Loris

Journal of the Wildlife and Nature Protection Society of Sri Lanka

June, 1999 Volume 22, Number 1

CHOOSE TO MAKE A DIFFERENCE

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Loris

THE JOURNAL OF THE
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June 1999

The Wildlife and Nature Protection Society of Sri Lanka

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The editor invites contributions not only from members of the Society but also from the general public, on matters relevant to biodiversity, natural history and nature conservation in Sri Lanka. Contributors should attempt to structure their articles in accordance with the *Guide to authors* on pages 62–64 of this issue. *Loris* is issued in volumes of six fascicles, the fascicles being issued in June and December each year.

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Editorial

It is with deep humility that I take over the editorship of *Loris*, thoughtful of the fact that those who have gone before me include giants of the ilk of W. C. O. Hill and R. L. Spittel. My first duty is to apologize to members for the delay in producing this issue. There was an interregnum of several months between Mrs. Sirancee Gunawardana retiring as Editor (having served in this capacity with distinction and sacrifice for more than a decade) and my taking over. Clearly, some changes in the journal's format and style were necessary, and it was only in early September that the Committee was able to consider these and happily, agree entirely with all the proposals I submitted.

Because of the urgency of producing the first number of the new volume, the present issue does not reflect all the changes we propose. Nevertheless, this gives me an opportunity of laying before the members the format we have in mind for future issues, inviting comment, and also beginning to steer *Loris* in a slightly new direction. Pages 62–64 of this issue contain a *Guide to Authors*, which I hope contributors will follow in preparing material for submission. While I welcome comment on and criticism of these, I hasten to add that this *Guide* is meant purely to help contributors structure their submissions: it is not intended to be in any way restrictive.

I should draw members' attention to the fact that *Loris* is a complicated journal, both in terms of content and style. It has a history of more than 60 years, during which time it has evolved continuously. Although early volumes were primarily literary in content, the journal has included original articles on important fields of research, winning it continuous representation in discerning international citation and abstracting services such as *Zoological Record*. The challenge before the Editor is to 'mix and match' these different types of contributions. For this reason, I intend compartmentalising the journal into several 'subheads', discussed in more detail in the *Guide to Authors*. The arrangement of articles within each issue however, will be entirely according to the dictates of the printer.

To remind ourselves of the journal's origins and antiquity, I have chosen to retain also in future issues the evocative drawing of a slender loris by Ian Cooke. This has graced the *Loris* cover from the journal's inception in 1936, and has come to be an important part of the journal's identity. However, I would like dearly to locate the original of this drawing (or at least a better copy) in order that we could do justice to it by reproducing it better.

Today's technology makes possible many things that were only dreamt of a decade ago. Future issues of *Loris* will include colour photographs without limit, so long as they are justified by the content. I also intend making *Loris* available on the internet, perhaps as early as end this year. The growing number of people who have access to e-mail leads me to request contributors to *Loris* (even of letters), if at all possible, kindly to e-mail their submissions to me (rohanp@slt.lk); please state the subject as "Loris" to enable easy identification. This also saves labour and generates better typography as articles do not need to be re-typed. Written contributions however, should *always* be sent direct to the Society's headquarters at Rajamalwatta Road, Battaramulla, where they are recorded and forwarded to me.

Mrs. Sirancee Gunawardana, Honorary Editor, *Loris*, 1988–98.

Because of the urgency of getting this issue out to members, many routine editorial duties have been exceptionally overlooked. Not all articles have been peer-reviewed; illustrations have not always been especially sourced to enrich articles that would be better served by them; and proofs have not been circulated to all authors. I apologize to members for these shortcomings.

The Committee has also agreed with my view that the additional cost of producing *Loris* to new standards of quality be defrayed as far as possible by generating more advertising revenue. There has been little time in which to solicit advertisers, but are grateful to the companies that so readily stepped in to help. Any members who could assist in obtaining advertisements for *Loris* are requested kindly to contact Mr. Ashley de Vos (President) or myself. Naturally, all advertisements should be consistent with the Society's aims and objectives.

We intend to publish the next issue of *Loris* on time, in December, which leaves us with only a short time to generate articles. Members wishing to submit material for publication in this are requested to do so before 15 November. I would welcome contributions from the broadest possible spectrum of both members and interested non-member conservationists to make this "millennium issue" one that will be valued and remembered.

Rohan Pethiyagoda,
Honorary Editor.

First record of an albino bat in Sri Lanka

W. B. Yapa, P. M. C. B. Digana and W. D. Ratnasooriya

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Something every nature enthusiast hopes for now and again is a rare or unexpected sighting. We were treated to such a rare observation one evening in a large natural cave in Wavulgalge— an albino bat. It was quite conspicuous in the dark cave, among hundreds of other bats. We spotted it first about five meters away from its roosting position, as we peered into the cave's dim light. Having sighted the bat, conspicuously white against the dark brown of the hundreds of others in the cave, we slowly approached it. When it was about 3 metres away from us, we took a photograph (see plate). However, the camera flash disturbed the bats and many of them — including the albino bat — flew away. It was a thrilling sight, this single white bat fluttering about among many hundreds of its typically brown brethren. Sadly, within a few seconds it disappeared from the cave, and we did not see it again.

We first sighted the albino bat at Wavulgalge in February 1996. It was seen again on 22nd October 1996, and seven more time in 1997 (23 and 27 February, 19 and 31 July, 2 August, 22 October and 19 December). On two occasions, one of us (P.M.C.B.D.) was able to observe it at close range (rather less than a metre), with a torch fitted with a red-light filter, and able to identify it as a *Hipposideros lankadiva*, the Large Ceylon Leaf-nosed Bat. *Hipposideros lankadiva* is the largest insect-eating bat in Sri Lanka. It possesses a characteristic nose leaf structure, allowing it easily to be distinguished from other smaller bats that occur with it. On all the occasions on which we sighted this specimen, it was observed roosting among other *H. lankadiva*. Although, *H. lankadiva* shares its roosts with several other species, within the roost they occupied a separate area of the cave. Its size, and the fact that there were no young bats in the cave on the days on which the albino was observed, suggest that this specimen was an adult. It was last seen in the cave on 19 December 1997.

Roosting Large Ceylon Leaf-nosed Bats *(Hipposideros lankadiva)* at Wavulgalge Cave, with the albino visible clearly in the middle of the photograph.

A normal *Hipposideros lankadiva*, the Large Ceylon Leaf-nosed Bat, the largest insectivorous bats recorded from Sri Lanka.

We have been visiting this cave regularly since 1986, when our research on Sri Lankan bats commenced. In the course of this work, we have observed over 400 roosts of bats which provided shelter, we estimate, for over 700,000 bats. Yet this was the only albino bat we noticed. It appears that this is the first time an albino bat has been reported in Sri Lanka. Albinism is a rare inherited condition that is caused by a recessive gene which inhibits the formation of pigments. In albinos, the pigment melanin, which is responsible for the colour of animals, is absent in skin, hair and eyes, so that the animal is strikingly white in appearance. Albinos are found among many mammalian species such as squirrels, guinea pigs, mice, rats, rabbits and humans, and also in other vertebrates. The deficiency of pigments in mammalian albinos frequently result in sight defects in addition to several other abnormalities. It is often a disastrous condition for animals as albino animals are conspicuous prey and are often quickly eliminated from a population. This holds especially true for nocturnal animals since they are very conspicuous to predators in dark nights.

Biodiversity conservation in Sri Lanka

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A major planning workshop on biodiversity conservation in Sri Lanka was held by the Department of Wildlife Conservation (DWLC) at Le Kandyan Hotel, Kandy, from 27–30 June 1998, as a part of the Asian Development Bank (ADB) Project Preparatory Technical Assistance (PPTA) to improve, *inter alia*, biodiversity conservation, protected area (PA) management and the livelihoods of people living around PAs. Three ADB consultants and more than 120 local participants attended this workshop to provide inputs for the preparation of a feasibility study for an investment project involving about US$ 35 million (Rs 2,500 million) for which the DWLC is the executing agency. A representative from the Ministry of Public Administration, Home Affairs and Plantation Industries and the Directors of both DWLC and the Forest Department also attended.

There is a Jewish proverb that says, *Beware what you want in life, for you may get it*. We ought to keep this proverb in mind as it is relevant to the nature of the proposed project. The ADB project envisages granting Sri Lanka a *loan* of $ 35 million, and hence the money will have to be repaid to the ADB— with interest. Thus, it is necessary from the very outset to plan this project sensibly so that we do not fritter away the loan on fancy and unproductive 'development activities'. Banks usually grant loans, in order to profit enormously from the interest they levy: the ADB is no exception. In this article, we point to some pitfalls which such a project should avoid—and to some home truths their executors would do well to bear in mind.

Two neologisms beginning with the letter 'B' that have crept into the general use recently are, *buckyballs* and *biodiversity* (Gee, 1992). Biodiversity is currently the buzz word in ecological thinking and it means different things to different people. It is the term used to describe the total variety of living organisms (plants, animals, fungi and microbes, together with their interrelationships, habitats and ecosystems), that exist on our planet. But biodiversity means much more than a mere measure of the number of species in an area. It defines a *working* system rather than a mere inventory of species and as such, in the final analysis, biodiversity conservation, if it is to be effective in Sri Lanka, must be aimed at enhancing the material well-being of the people. Any programme designed to support the conservation of biodiversity in Sri Lanka therefore, must emphasize the vital importance of protecting the 'life support systems' that are crucial to the welfare of the people. As Gee (1992) points out, it is the biodiversity interactions over millions of years, that have ensured that human beings have an atmosphere to breathe, a soil to till and freshwater to drink. It is precisely for this reason that biodiversity conservation in Sri Lanka deserves the highest priority. In the long run, loss of biodiversity will result in denudation of soil, diminution of freshwater, destruction of forests and the disappearance of species. The neglect of biodiversity conservation in Sri Lanka could easily exacerbate the current economic downturn and civil strife. This is the only strong argument that is likely to bring about a firm commitment from the planners and policy makers in support of biodiversity conservation in Sri Lanka.

A unified strategy

The biodiversity conservation strategy, as far as Sri Lanka is concerned, is likely to have a better chance of success if activities could be linked to a single, strong, supreme theme. The theme must be such that its conservation alone would have a knock-on effect on a multitude of other species and their habitats.

The elephant is one of a small group of ecologically significant, culturally important, and obviously charismatic large animals that can be used as a 'flagship' species to attract support for biodiversity conservation. Thus, the elephant in Sri Lanka is not only a flagship species, it is also an 'umbrella' species— i.e., a taxon for which the habitat required to sustain viable populations is sufficiently large to encompass appreciable parts of natural ecosystems (CBSG, 1991). It is also a 'keystone' species in that it plays a key role in the structuring of natural communities and thus the maintenance of biodiversity (Dublin *et al.*, 1997). At intermediate densities, elephants do enrich their habitats. The existing PAs amount to 8,220 km^2, of which about 6,817 km^2 (or 83%) represent actual or potential elephant habitats. Therefore any programme designed to conserve the elephant in Sri Lanka will protect a substantial part of the island's biodiversity, especially in the dry zone, to which elephants are today largely restricted. Of the 605

species of vertebrates recorded from Sri Lanka, 158 (26%) are endemic and also *sympatric* with (i.e. they occur together with) the elephant. The number of endemic and relict vertebrates species and subspecies in Sri Lanka is 309 (Crusz, 1986), whose ranges overlap that of the elephant. Such a correlation between the elephant distribution and those of endemic species means that conservation of the elephant in Sri Lanka will boost also the conservation of several other less charismatic but equally important species and their habitats.

Cynics may question the wisdom of focusing conservation efforts on a single species, but we choose to look at this issue differently. If the endemic species such as the Ashy-headed laughing thrush (*Garrulax cinereifrons*) were to disappear from the face of the earth, how many people in Sri Lanka will have their quality of life affected? The loss of most of the island's wildlife is of little concern to most Sri Lankans. However, if we lose large number of species we will be sorry, for as Norton (1988) points out, species loss is like playing Russian roulette: each species lost without serious consequences (such as the Ashy-headed laughing thrush) is a blank in the chamber. But when the trigger is pulled with the bullet (such as a keystone species) in the chamber, it will no longer be a laughing matter.

The elephant, with its large body size and intemperate appetite, needs huge areas to forage. However, given the small size of Sri Lanka and its dense human population, it will not be possible under the present circumstances, to set aside conservation areas of sufficient size and ecological diversity to accommodate them. Furthermore, none of the existing reserves is large enough to accommodate the entire annual home ranges of all the elephant herds. Conservation and survival of the elephant in the wild will also depend on how it fares outside the PAs (Petocz, 1988). A compromise can be achieved with the establishment of Managed Elephant Ranges (MERs) that are shared by both people and elephants, within which human activities such as sustained-yield forestry, slow rotation shifting cultivation and controlled livestock grazing, that are compatible with elephant conservation, could continue (Santiapillai & Jackson, 1991). Such an approach to elephant conservation would benefit biodiversity conservation in Sri Lanka, and it will also serve to link it to economic development, thereby ensuring the support of donor agencies such as the World Bank, ADB, USAID etc., who are coming under increasingly strict mandates to assure that loans or grants are provided to projects that have a solid biodiversity conservation basis (Petocz, 1988).

Photo: Vernon Tissera

Why did the elephant cross the road? "Much of our biodiversity is conserved with in a patchwork of parks and reserves surrounded by human settlements and agriculture." A wild elephant crosses a 'trunk' road, an event of little surprise to people living in the area.

Protected area management

The establishment and management of PAs is one of the most important ways of ensuring that a significant component of a country's biodiversity is conserved in order to meet the material and cultural needs of its people now and in the future (MacKinnon *et al.*, 1986). Despite is small size (65,610 km^2), and relatively high human population (18+ million), Sri Lanka has a fairly extensive system of PAs covering over 12% of its land area (IUCN, 1990). There are 70 existing PAs which include 1 Biosphere Reserve, 1 World Heritage Site, 1 Ramsar Wetland Area, 11 National Parks, 3 Strict Nature Reserves, 2 Nature Reserves, 1 National Heritage Wilderness Area, 1 Jungle Corridor and 49 Sanctuaries—not counting the vast areas under the Forest Department.

We need therefore, to proceed with great caution when implementing the proposed ADB project in Sri Lanka. There is sufficient local expertise of international reputation available among our universities, research institutions, and government and non-government agencies to prepare and implement a realistic programme for the conservation of biodiversity, and at a very modest cost, too. Before we set about a national programme for biodiversity conservation, we must realize that without political stability, there can be no stable protected areas. This is borne by the fact that some of the important conservation areas such as Wilpattu National Park (131,693 ha), Wilpattu North Sanctuary (624 ha), Giant's Tank Sanctuary (3,9421 ha), Madhu Road Sanctuary (26,677 ha), Vavunikulam Sanctuary (4,856 ha), Chundikulam Sanctuary (11,150 ha), Kokilai Sanctuary (2,995 ha), Padaviya Tank Sanctuary (6,475 ha), Somawathiya Chaithiya National Park (37,762 ha), Trikonamadu Sanctuary (25,019 ha), Lahugala-Kitulana National Park (1,554 ha) and Ruhuna National Park (126,782 ha) have already become inaccessible as a result of the on-going civil conflict. These areas together amount to 415,008 ha, or 52% of the existing PAs.

The remaining PAs are coming under increasing pressure to house more wildlife, entertain more visitors, absorb more pollutants and offer more resources for agriculture, forestry and mining. Such demands on PAs could adversely affect the behaviour of the human communities that live in and around them. We can recognize three distinct cultures in Sri Lanka: Sinhala or Buddhist, Tamil or Hindu and the indigenous Veddha. It is important to bear in mind that as Machlis & Tichnell (1985) argue, the relationship between man and nature varies from culture to culture and not from park to park. Many of our PAs are artificial biotic areas that are inextricably linked to natural and human activities outside their boundaries. This is why it is essential that we do not blindly copy to our situation western models of protected-area management.

Goal

Our goal in Biodiversity conservation should not concern merely the preservation of species. It should aim at promoting ecological processes. Much of our biodiversity is conserved with in a patchwork of parks and reserves surrounded by human settlements and agriculture. The activities of the people living along the periphery of PAs influence the threats that occur. We have very little factual data on the needs and wants of local people: what benefits do local people actually receive from PAs? National Parks and Nature Reserves are creations of a political process; the economic and environmental decisions necessary for their survival will ultimately depend on who wields political power. Development is essential for conservation, because without it conservation cannot be sustainable either (Allen, 1980). Against the combined threat of poverty and population growth, no PA is immune. Biodiversity conservation is unlikely to succeed if development fails to address the basic needs of the poor people who live adjacent to the PAs. If the PAs are to survive in Sri Lanka, they should be integrated into regional socio-economic systems. One can but hope that the ADB project, if it does come to implementation, will take these sobering facts into consideration.

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Tape lures– a new threat to our birds?

Rex I. De Silva*

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In recent years the availability of moderately-priced portable sound recording equipment has encouraged many birdwatchers to tape-record bird calls. A good collection of sound recordings can be a useful educational tool, as well as a source of satisfaction to the owner. Regrettably, like many other good things, this is also open to abuses. As is well known, recordings of bird calls when played back, can be used to attract some species towards the source of sound where they may more easily be observed. When used in this manner, sound recordings are referred to as 'tape lures'. In recent years many Sri Lankan bird tour guides have resorted to using tape lures as a relatively easy way of showing their clients some of our rare and endangered endemic species.

This raises the obvious question as to whether the practice could have an adverse effect on at least some of our already threatened avifauna. I therefore wrote (5 January 1998) to the Royal Society for the Protection of Birds (RSPB) requesting their views on the use of tape lures. Dr. Julian Hughes, the Species and Habitats Policy Officer of the RSPB replied (*in litt.*, 6 February 1998) giving the required information. I reproduce below relevant excerpts from his letter.

> "...repeated tape playing at the same sites on consecutive days during the breeding season may result in driving a male bird away from a territory. For extremely rare species, this could have a *critical effect* on the breeding success and so, ultimately, the population. In the UK (and throughout the European Union) it is an offence to disturb rare breeding birds... I have also contacted the American Birding Association (ABA) on your behalf. Their code of birding ethics includes: 'Limit the use of recordings and other methods of attracting birds, and *never use such methods* in heavily birded areas or for attracting any species that is *threatened, endangered or of special concern*, or is rare in your local area'. Greg Butcher, Director of ABA, also gave the advice that tape lures should not be used on 'known birds' or in places where *bird-finding guides regularly visit*" [Emphasis added by me—RIDeS.]

While there is admittedly no information on the effects that tape lures have on Sri Lankan birds, Hughes' comments are cause for concern, especially as tape lures are increasingly being used in Sri Lanka by bird tour guides, some of whom *guarantee* their clients sightings

Courtesy of Kishan Gunasekera

The Sri Lanka Arrenga—an unsuspecting victim?

of rare endemics. A particularly distressing example is that of the Sri Lanka Arrenga or Whistling Thrush, *Myophonus blighi*. This is a rare species seldom seen by the average birdwatcher. Nevertheless, bird tour guides operating in the Horton Plains National Park and elsewhere regularly use tape lures to attract it for the benefit of their clients. It is important to note that Hoffmann (1984) considers the Arrenga to be an endangered species. This opinion is shared by Collar, Crosby and Stattersfield (1994) who also consider it to be endangered. In an article on the species, Warakagoda (1997) comments as follows—

> "The Sri Lanka Whistling Thrush is undoubtedly the most restricted in range of the Sri Lankan hill birds... today it is being pushed step by step *towards extinction* by the continuous rapid destruction of its habitat in the hill forests of Sri Lanka." [Emphasis added by me—RIDeS.]

Although I have cited the Arrenga as an example, it is important to note that tape lures are used to attract a variety of other species as well, some of which are rare and threatened. This evokes the question: should the use of tape lures be allowed to continue uncontrolled in Sri Lanka's National Parks and other protected areas? Perhaps the Department of Wildlife Conservation could study the problem and, if necessary, take appropriate steps to control what may soon become a serious threat to our avifauna.

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The population explosion and the conservation of biodiversity

Melwin Herath*

Sri Lanka, within its 65,415 sq. km, carries a population of 18.5 million, which translates to a density of 283 persons per sq. km. This is very high in comparison with the land area and resources available. The population policy of the government in 1991 recognised that it was 'necessary to reach replacement levels of fertility an average of two children per woman in the reproductive ages at least by the year 2000, which would result in a stable population by the middle of the next century.'

In 1871, Sri Lanka's population was just 2.4 million. In 1946 it was 6.7 million. At the turn of the century there were wild elephants even around Negombo and Avissawella. Although the population was increasing only slowly at the time, the dramatic post-independence improvement in health care brought with it a corresponding increase in population.

In 1980, Sri Lanka's annual rate of increase was 1.8%, declining to 1.4% in 1992. This is claimed to have been partly due to emigration: in 1983 for example, the statistics show that about 107,000 persons emigrated. If there is a continual increase of 1.4% per annum, the population is likely to reach 70 million mark by 2100. Only when the birth rate equates to the death rate will the goal of population stability be reached.

The ideal will be to have on average two children per family. If this target can be reached by the year 2000, the population in 2050 could be limited to 35 million. To achieve the equilibrium of two children per family, the family planning programme should be extended from 65 percent to 72 percent (based on 1987 figures) within the next ten years.

The population projections (in millions) for the next twenty years are as follows–

Year	Total	Male	Female
1999	18.98	9.55	9.41
2000	19.17	9.65	9.52
2005	20.15	10.11	10.04
2010	21.02	10.52	10.50
2015	21.70	10.83	10.86
2020	22.19	11.05	11.14

Population distribution in the three districts where elephant habitats are situated, as an example, will show how the population increase are likely to affect wild life–

District	AGA Division	Popul'n	Land area (km^2)	Popul'n per km^2
Ampara	Uhana	82,446	673.1	123
	Dagama	27,498	384.0	72
	Padiyatalawa	12,523	850.0	16
	Kalmunai	65,803	27.7	2,376
	Lahugala	7,073	953.6	7
	Mahaoya	13,019	697.8	19
Matale	Ambanganga Korale	14,490	52.3	277
	Dambulla	39,472	456.3	87
	Laggala	12,153	389.0	31
	Wilgamuwa	22,122	263.0	84
	Matale	92,904	163.8	567
Puttalam	Anamaduwa	53,227	534.8	100
	Karuwalagaswewa	16,146	523.6	31
	Wanathavillu	11,691	710.4	16
	Chilaw	81,465	188.0	433

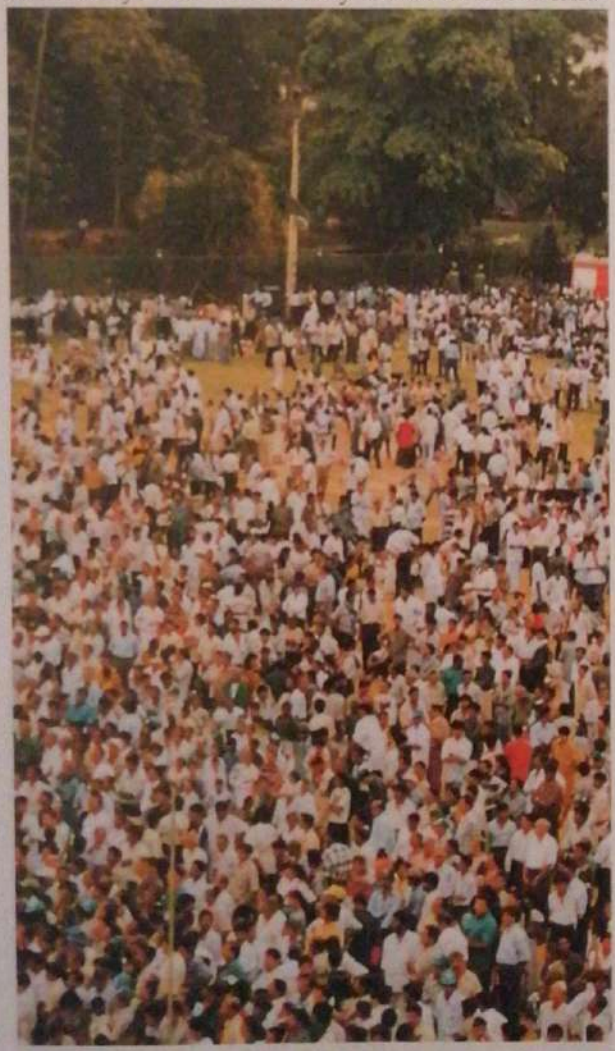
Population increase (per cent per annum) in some districts close to national parks are as follows (1991 figures) –

District	Population increase % p.a.
Hambantota	1.4
Mannar	1.7
Mullative	2.0
Kilinochchi	2.7
Ampara	1.8
Puttalam	1.7
Polonnaruwa	1.7
Badulla	2.0
Monaragala	1.8

The present increase in population we are seeing, from 17 million to 25 million in just two decades, means that nearly 270,000 persons will enter the job market every year. To ensure full employment in the same period, the economy should grow at 7 to 8 percent per annum. Paddy production in 1950 was 15 million bushels. By 1994 it has increased eight times, to 120

million bushels— within 40 years. The population has increased by 10 million during the same period, yet we are not self-sufficient in our staple food. In fact, even a growth rate of 1.4% per year, which is lower than that at present, means that the national population increases by 710 babies per day, necessitating the construction of a new school every day and a new hospital every 56 days!

When the population at the turn of the century was around 3 million, Sri Lanka's forest cover was 70% of the total land area. By 1994, when the population increased to 17 million (a factor of five), forest cover had declined to just 25% . Today, the forest cover is barely 12%, with a population of 19 million. Unless courageous measures are taken to control the population explosion, saving the environment and Sri Lanka's unique biodiversity in the next century will be an idle dream.



Seven hundred more people join our nation's population each day, competing for a steadily dwindling set of resources.

The Heart of Kandy

Viduranga Waisundara,
Kandy.

It is the eye of the morn in the mountains,
And the pleasant surprise of the day.
It's the life-giver to the Temple of the Tooth,
Which pulls your pain away.

Yet, how could we be so insolent,
To drive that spirit off the city?
The breath weakens if you breathe it,
And throbs in tears of insanity.

The crystal clear waters of the wonderful lake,
Upwells no more to greet the clear blue sky.
The 'splirting' fish and the flirting storks,
Will amuse you no more, as you walk by.

You'll need a cylinder of pure oxygen,
Or a wet handkerchief to hold onto your nose,
For the smell is unbearable to any living being,
It ain't no sweet-smelling rose!

The greenery around the banks of the lake,
Disappeared a long time ago.
Yet, maybe the water likes the colour of green,
That it's turning out to be so.

You want to see fish swimming with their bellies up?
This lake will turn out to fulfill your like!
Yet, don't expect the fish to be alive,
They'll all be dead—even the pike!

Rest your eyes upon the will-power of man,
Tthat your heart will one day despise.
The sun sets, but never like these days,
For Kandy has to pay the price.

It's by everybody's fault that the lake is being polluted.
We must get together to help Bogambara Lake survive
Many centuries to come,
For it's the only proof of a rich and solid culture that
evolved in the hill-capital.

U.S. convicts coral smuggler

Rohan Pethiyagoda

The United States is the world's largest consumer of ornamental aquarium fish and products. Entry into this lucrative market is every exporter's dream. Nevertheless, the U.S. has for long been criticised by conservationists for not doing enough to regulate the import of endangered animals into its territory. Conservationists' suspicions were further aroused when the U.S. President George Bush refused to sign the landmark Convention on Biological Diversity ("Rio Convention") in 1991. Surprise it was then, when Petros Leventis, the owner of a Florida-based company, Greek Island Imports Inc., was successfully prosecuted recently for smuggling large quantities of coral into the U.S.

At the end of a week-long trial, the federal jury in Tampa, Florida, unanimously found Leventis guilty on two counts relating to the smuggling of protected corals from the Philippines to the United States. The U.S. Lacey Act makes it an offence to import wildlife taken in violation of the law of the country of origin, including 'unwritten' law, such as tribal practice. In addition to being found guilty under the Lacey Act, Leventis was also convicted of smuggling, under U.S. customs law. Interestingly, he was prosecuted not by the U.S. Customs but by the Fish and Wildlife Service (the equivalent of Sri Lanka's Wildlife Department).

The Philippines is one of the world's largest exporters of marine ornamental fishes and invertebrates. However, the islands' reefs have suffered severe damage owing to decades of unrestrained harvesting for the lucrative export trade. This was recognised as long ago as 1977, when all exports of corals from the Philippines was banned by law. Reef fish populations too, have suffered drastic declines in the Philippines because of the use of sodium cyanide, a chemical highly toxic to fishes but not significantly toxic to humans.

In the case involving Leventis, U.S. Fish and Wildlife officials found that Greek Island Imports Inc. had imported from the Philippines, under false declarations, several species of coral including blue, organ-pipe, branch, brush, staghorn, finger, brown-stem, mushroom and feather corals, all of which have been listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) since 1985. These species may not be legally traded without export permits from the country of origin.

Leventis's and his company came under suspicion when Fish and Wildlife inspector intercepted a 40-foot shipping container packed with some 350 boxes and packages of coral and seashells. A major investigation was then launched by Fish and Wildlife Service special agents and U.S. Customs Service officers, who documented a series of transactions involving protected corals and seashells between Leventis and his alleged Philippine supplier, going as far back as 1991.

Leventis and his company were finally indicted in November 1998 on charges that he and an alleged accomplice smuggled protected corals and seashells into the United States from the Phillipines using false declarations, invoices and shipping documents to circumvent U.S. and Philippine laws in addition to international trade restrictions that protect corals and other marine species. He is due to be sentenced in November and faces up to five years in jail with fines of up to $250,000 (Rs 18 million) for each of his three criminal convictions. His company faces fines of up to $500,000.

Following the landmark judgement, U.S. Fish and Wildlife Service director John Rodgers was quoted in the media as stating, "Stopping the illegal commercial exploitation of coral species is a vital part of U.S. and international efforts to save these resources. Profiteering at the expense of coral reefs will not go unchecked. The United States is committed to the rigorous enforcement of the laws and treaties that protect coral species worldwide".

It is not yet known whether the Philippines has taken action against Leventis's Philippine supplier. Nevertheless, it is heartening to note that the United States is taking its obligations under CITES seriously. In many developing countries, the policing of exports is affected by the large amounts of money involved in this lucrative trade. It is therefore incumbent on affluent importing countries to help by prosecuting their citizens who break the law.

The allure of ready cash for the unsustainable harvesting of reef products is just too much for many unscrupulous businessmen.

A basic introduction to DNA and a proposal to study the short-nosed fruit bats of Sri Lanka

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Bats are an ancient order of mammals. More than one third of the mammalian species recorded in Sri Lanka consist of bats (30 species of bats, compared to 59 other mammalian species; Phillips, 1980). The diversity of bats in the island is second only to the Darjeeling district of India, and as such, Sri Lanka is identified as a "hot spot" in the diversity of bats in the south Asian region (Vane-Wright and Bates, in prep.).

Fruit and nectar feeding bats (megachiropterans) are good agents for pollen and seed dispersal of many economically important plant species. In many ecosystems, they have been identified as a 'keystone' species for forest regeneration (Fujita and Tuttle, 1991). On the other hand, some species of bats have become fruit pests and are known to cause severe problems in agriculture. In 1992, with the identification of their importance, the IUCN put forward an action plan for the conservation and management of fruit bats (Mickleburgh, Hutson and Racey, 1992). The genus *Cynopterus* (short-nosed fruit bats), presumed to exist as a species complex in Sri Lanka, has been identified as meriting conservation and management. For the purposes of this discussion, a species is defined as a reproductively isolated group, a definition that is often difficult to test directly in the field. A species complex refers to a situation where the usual, morphology-based, taxonomic keys cannot be used to distinguish between two or more species (as defined here) of a genus (Bates and Harrison, 1997).

According to the current classification, the *Cynopterus* species complex in Sri Lanka consists of two species: *C. sphinx* (the large morphotype) and *C. brachyotis* (the small morphotype) (Corbet and Hill, 1992). However, preliminary studies conducted by us, based on conventional morphology and morphometrics, suggest the presence of three different morphotypes (large, small and intermediate) within the *Cynopterus* species complex, suggesting the presence of three possible 'species'.

The large morphotype is widely distributed in many habitats including 'disturbed areas' of forest cover (Mapatuna, Ratnasooriya and Bates, 1998). It is also considered a major fruit pest. The small morphotype is restricted to forest habitats, and therefore potentially threatened through loss of forest habitats. The intermediate type is found in sympatry with the other two. It can pose a major threat to the other species of *Cynopterus*, since it can adapt to both forest cover and

Cynopterus sphinx: Wasgomuwa.

Cynopterus brachyotis: Mousakanda.

to disturbed areas. Therefore, the following issues need to be resolved prior to planning of any conservation and management programmes of *Cynopterus* species complex:

1. What is the taxonomic status of each morphotype of *Cynopterus* found in Sri Lanka?
2. Should the small morphotype be classified as an 'endangered' species?
3. Is the intermediate type a distinct species or a hybrid of the other two?
4. Is it necessary to protect all three morphotypes, and if so how and at what level?
5. What are the types that need to be managed and still conserved?
6. How can the interests of agriculture be accommodated within a framework of conservation of biodiversity?

To obtain answers to some of the questions posed above, molecular systematic analysis, based on the analysis of DNA, can be utilized.

DNA is the chemical that contains the 'blueprint' of life. Each molecule of DNA contains two strands that are made up of nucleotides. Each nucleotide comprises of a base, a sugar moiety, and a phosphate group. There are four types of nucleotide bases in DNA (A, G, T and C), and the two strands of the DNA are held together by hydrogen bonding between nucleotide base pairs situated on opposing strands. Hydrogen bonding between bases is specific such that A is H-bonded to T while G is bonded to C. The genetic information of an organism is encoded by the nucleotide base sequence of the DNA.

There are two types of DNA found in an animal; nuclear DNA, which is found in the chromosomes of cell nuclei, and mitochondrial DNA (mtDNA), found in a sub-cellular organelle termed mitochondria.

Mitochondrial DNA has several advantages in phylogenetic analysis, as compared to nuclear DNA. Mitochondrial DNA is inherited only from the mother (cytoplasmic inheritance) and is therefore found to be haploid. Further, changes in the mtDNA occur much faster than the changes in the nuclear DNA, which results in mtDNA evolving much faster than the nuclear DNA.

The genetic relatedness between species, subspecies and sibling species therefore can be analysed by comparing differences in the mitochondrial DNA sequences (the order of nucleotides in the DNA). Fortunately, it is not necessary to examine the complete mtDNA genome of organisms (the mammalian mitochondrion is approximately 17,000 nucleotide base pairs in size). This is because certain regions of the

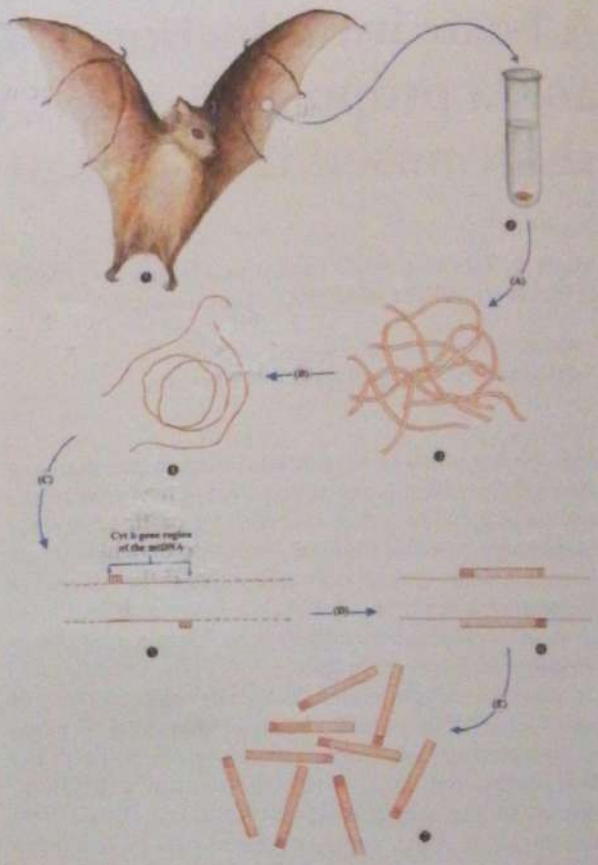

Figure 1. Schematic drawing showing the stages of extraction and amplification of mitochondrial DNA from tissues of the short- nosed fruit bat. (1) anesthetised bat; (2) a 0.1mm piece of tissue is excised from the wing membrane; (3) double-stranded molecules of nuclear and mitochondrial DNA; (4) single-stranded molecules of nuclear and mitochondrial (mt) DNA; (5) binding of primers specific to the cytochrome b gene, only with the cytochrome b gene region of the mtDNA; (6) copying of the cytochrome b gene region of the mtDNA and synthesis of a new DNA fragment; (7) a large number of copies of the cytochrome b gene. The processes shown are, (A) DNA extraction; (B) heat to separate the double-stranded DNA; (C) binding with primers; (D) Tag DNA polymerase; (E) PCR cycle repeated several times

mtDNA have been identified to contain more nucleotide sequence variation (between populations) than other regions of the mtDNA. These regions are therefore referred to as 'hypervariable' regions. One example of a hypervariable region is the cytochrome oxidase b (*cyt* b) gene. These hypervariable DNA regions can then be selectively copied and amplified from the rest of the mitochondrial and nuclear DNA in the sample, and subjected to sequence analysis.

Selective amplification is carried out by a technique known as Polymerase Chain Reaction (PCR), which acts

as a DNA photocopier, capable of making many thousand copies of a single DNA fragment. Because of the amplification power of PCR, a minute sample from any tissue is sufficient for mtDNA analysis. Furthermore, the technique does not require the separation or purification of mtDNA from nuclear DNA.

The procedure (Fig. 1) of mtDNA analysis by PCR, is as follows. Total cellular DNA is first extracted from any tissue and then heated to separate the two strands of the DNA. PCR employs an enzyme known as '*Taq* DNA Polymerase' to copy and amplify the DNA. However, to initiate copying of the DNA, the enzyme needs a short piece of DNA known as a 'primer'. The primer binds to one strand of the DNA by complementary base pairing and then the polymerase copies this DNA strand by adding in the complementary nucleotide bases to the primer, so that a new DNA chain is synthesized. Selective copying of a particular region of DNA is achieved by using a primer pair, which flanks this region of the DNA. For example, if the *cyt* b gene needs to be copied, a pair of primers, which bind only to the either side of this region, is used in the PCR reaction. The distance between the two primer binding sites defines the length of the DNA to be copied. Amplification is achieved by repeating the cycle of heating, primer binding and chain synthesis (generally 30-40 cycles). The PCR-amplified product is then examined for nucleotide sequence variation by DNA sequencing, to detect evolutionary relationships.

Under a National Science Foundation funded research project, we are now in the process of examining the PCR amplified products of the mitochondrial genes cytochrome b and NADH dehydrogenase of *Cynopterus*. Loss or addition of nucleotide bases is scored to determine phylogenetic relationships. The closely related types will have little variation in these regions compared to the types that are distantly related.

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AWARDS

STUDENT CONSERVATION RESEARCH

Student teams from around the world are invited to enter the 2000 BP Conservation Programme Awards to secure funding, training and support for the field research projects that they are planning, which tackle conservation issues of international importance.

Each year, the BP Conservation Programme present awards and training to fifteen teams - £5,000 to the four best projects; £3,000 to ten runner-up projects and the top 'Follow-Up' Award of £10,000 is presented to the best proposal for follow-up work submitted by a previous year's winner.

All projects applying to the Programme for an Award must meet the following criteria–

- the project must address a recognized conservation issue of international importance;
- it must involve local people and have clearance from the host government;
- the majority of team members should be under or post graduate students.

Since 1985, the Programme has helped 117 international student teams to carry out conservation field research in 46 countries. The Indonesian-British team, *Action Sampiri*, for example, won the Follow-Up Award in 1998 and is currently working on the islands of Sangihe and Talaud to conserve endangered parrots – press pictures are available.

Dr. Michael Rands, Director and Chief Executive, BirdLife International, said "Young people are the future of this planet. Their enthusiasm, and the time and energy they've got to explore and make discoveries about biodiversity, will be critical for the future".

Celebrating its 15th year in 2000, the BP Conservation Programme is the result of a long-term partnership between wildlife conservation organizations BirdLife International and Fauna & Flora International, and BP Amoco plc.

Mark Rose, Director, Fauna & Flora International said: "The importance of collaboration between people and organizations in developed and developing countries cannot be underestimated. Through the BP Conservation Programme we aim to establish partnerships across the world which will last into perpetuity".

The closing date for applications is 16 November 1999.

For an entry form call: Katharine Gotto, Programme Manager, Tel: +44(0)1223 277 318; or write to The BP Conservation Programme, BirdLife International, Wellbrook Court, Girton Road, Cambridge CB3 0NA, England; or email: katherine.gotto@birdlife.org.uk

Entry forms can also be submitted electronically via The BP Conservation Programme's web-site: http://www.bp.com/conservation/

Conserving the leopard in Sri Lanka

The need for a management strategy

Gaminie V. Samarakoon*

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Introduction

Among the world's most successful predators, the leopard *(Panthera pardus kotiya)* formerly occurred throughout much of Africa and Asia. It appears that leopards migrated into the Indian subcontinent well before the other two big cats— the lion and the tiger. Being adaptable to almost any environment (leopards inhabit almost every habitat from semi-desert to 5,000-metre mountains) has meant that this versatile predator has persisted almost everywhere in Sri Lanka where some forest cover is available, even close to human habitations.

In a comparative study in Bandipur Tiger Reserve, South India, Johnsing (1986) found that the leopard is more successful than two other large carnivores occurring in the same habitat, namely the tiger (*Panthera tigris*) and the dhole or wild dog (*Cuon alpinus*). He attributed this to the leopard's ability to climb, catch and cache food on trees, survive on small prey, hunt even in thin cover and survive with less water.

The leopard is a territorial animal, which occurs in varying densities depending on the availability of prey. No statistics are available in Sri Lanka, but several African studies suggest that in areas of low prey availability adult leopards may occur only as one per every 30 sq. km. When prey is abundant however, they could occupy ranges as small as 1 sq. km. (Nowak, 1999). As is common among members of the cat family, the leopard has a relatively short gestation period, and litters comprise two or occasionally three cubs (Phillips, 1934). This gives the leopard a capacity to breed rapidly and maintain stable populations even in adverse conditions, especially excessive human pressure. Leopards are able to feed on almost any prey up to their own size: they have been known to feed on mice and small aquatic crabs. Of Sri Lanka's mammal fauna, only elephants and fully-grown buffaloes are likely not to fall prey to leopards (Phillips, 1934). Cases of cattle-killing and dog-snatching by leopards are not uncommon in villages fringing leopard habitats, although in Sri Lanka leopards have seldom attacked people (by contrast, in India, Nowell and Jackson, 1996, reported that 170 people were killed by leopards between 1982 and 1989).

Unprecedented increase in the human population and poor land-use practices threaten the continued existence of large carnivores (Johnsing 1986). The leopard in Sri Lanka is no exception, and has been included in IUCN's (1999) List of Nationally Threatened Fauna. In Sri Lanka today, leopards are almost entirely confined to protected areas, which also are under severe pressure. Apart from the umbrella protection the leopard receives from the protected area system and the Fauna & Flora Protection Ordinance, there have been no other specific measures to conserve the leopard in Sri Lanka.

Almost the entire conservation effort in Sri Lanka revolves around the elephant, which is considered a more attractive flagship species. Few studies have been made in recent years to assess the status of the leopard in Sri Lanka. Santiapillai et al. (1982) estimated that as at that time, only 400–600 leopards survived in Sri Lanka. No estimates have been published since, and little information is available on the local abundance of this species. These factors have combined to make the preparation of a conservation strategy difficult.

A lack of genuine conservation effort to save the leopard will almost certainly lead to the total extinction from the wild of this important and charismatic member of the Sri Lankan fauna, now recognised to be a subspecies endemic to Sri Lanka. Under similar conditions, the cheetah disappeared from Indian jungles half a century ago, in 1948. The natural prey of the cheetah, black buck, chinkara (Indian gazelle) and spotted deer, were almost completely decimated in its natural habitat; additionally, the presence of a significant human population, with its cultivation and grazing, was too much for the cheetah to compete with.

Causes of decline

Clearly the greatest pressure on Sri Lanka's leopard populations comes from the shrinkage, destruction and fragmentation of forest—the leopard's natural habitat. This also has the effect of reducing the availability of the prey, especially grazers, on which leopard populations depend. The isolation of small populations through habitat fragmentation could severely restrict genetic diversity and become a cause of decline.

The commercial exploitation of leopards for their hides has also proved a major threat. In some areas, people hunting wild boar, sambar or deer using hunting dogs are known to kill leopards when they find them. The flesh, believed by some to have medicinal value, is consumed or sold at high prices. Despite the provisions of the Fauna & Flora Protection Ordinance and other laws and regulations such as the Convention on International Trade of Endangered Species (CITES), to

which the Sri Lanka is a signatory, there are indications that leopard poaching is going on freely in remote areas of Sri Lanka. A few years ago, in a detection made by wildlife officers in Tissamaharama (Hambantota District), four leopard skins were recovered in the possession of a foreigner. Poisoning and shooting are the most commonly used methods to kill leopards, although especially in the central mountains, villagers are known to hunt with spears.

The lack of basic data on the present status of the leopard in the wild is one of the major drawbacks in the formulation of strategies for its conservation. I list below some studies which should be carried out as a matter of priority:

- **Present distribution** – The present range of distribution of leopards in Sri Lanka needs to be established and mapped through an island-wide survey. This survey should cover all the accessible forest areas both within and outside the protected area network. Both direct sightings and indirect evidence of the presence of leopards, such as pugmarks, claw marks and scats should be recorded. As it was done in the elephant census in 1993, field staff of the Department of Wildlife Conservation (DWLC) and non-departmental volunteers could participate in this survey. Involvement of academic institutions such as universities should be obtained in designing these studies.

Photo: Chitral Jayatilake

Sri Lanka's top carnivore should not be allowed to vanish.

- **Population Estimates** – Appropriate methodologies should be developed to estimate local the populations of the leopard. Techniques such as pugmark censuses and water-hole counts should be tested to determine the best practical means of estimating the leopard populations and densities in the wild. Population estimates in representative habitats can be extrapolated to estimate the total population. Radio telemetry studies on big cats, carried out in other countries such as India, have proved that this is one of the most effective methods of estimating home range size. Estimated home range size can be used to determine the density and carrying capacity of the leopard, in its natural habitat.

- **Ecological studies** – Comprehensive studies on the ecology of the leopard will help us understand its specific biological needs and make recommendations for its management. Ecological aspects such as prey-predator relationships, diet composition, quality and the quantity of the prey base, should be studied in detail.

In-situ conservation

Knowledge of the distribution of leopards would help identify the areas significant for the conservation of this species. New areas to be included in the national network of protected areas could be identified by these studies. The possibility of establishing forest corridors between isolated forest 'islands' also should be explored. Dispersal of individuals would minimise inbreeding within small populations, ensure genetic exchange and viability of populations.

Institutional strengthening of DWLC will ensure the effective protection of the leopard, within and outside the protected areas. DWLC staff should be provided with necessary facilities to carry out protective activities effectively, in the relevant areas. Investigations should be carried out to identify the ways and means to effect this. Johnsing (1986) suggests that officers who are exceptionally dynamic, energetic and interested in wildlife and outdoor life should manage the wildlife reserves, and governments should ensure that they appoint the best of their officers to be in charge of wildlife reserves.

Only a scientifically managed protected area network can ensure the long-term protection of a threatened wild animal species such as the leopard. Habitat restoration in degraded protected areas, through an intensive habitat management programme, would help maintain a stable prey base for the leopard. It will also ensure a healthy population of leopards within the protected areas, and help prevent these big cats from straying into populated areas and falling prey to the poachers.

Ex-situ conservation

It appears that the rapid rate at which leopards have bred in the National Zoological Gardens has produced an unmanageable captive population. An attempt was made to introduce a few of these zoo-bred animals to Yala National Park in early 1980s. Unfortunately, no means were devised to monitor these leopards after release, and the outcome of this 'experiment' is not known. The possibility of a leopard re-introduction programme should be explored with the objective of re-stocking isolated wild populations. This could be done in collaboration with zoo, which has considerable experience of captive breeding and veterinary care of leopards. Of course, the re-introduction of captive-bred leopards into the wild should be planned and executed in strict accordance with the guidelines developed by IUCN for the re-introduction of wild animal species.

Conclusion

The leopard has already been identified as a threatened species in Sri Lanka. Timely intervention in the conservation of this largest of Sri Lanka's felid carnivores, which occupies the apex of the food pyramid, will save it from ultimate extinction. A comprehensive conservation strategy should be devised, based on a detailed study of its ecology, considering the leopard a flagship species. Such conservation projects implemented in other countries have proved to be extremely beneficial not just to leopards, but also to other species sharing the same habitat.

The conservation of the leopard should be a joint effort by DWLC and the other interested governmental and non-governmental organizations. It is DWLC however, that has the authority and the responsibility to initiate such an effort.

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Footprints on the sand

Cecil D. Dharmasena

The silence was deafening. In a moment, our collective reverie was suddenly shattered by the low call of a Yellow-legged Green Pigeon on a tall tree. The call was promptly answered by its mate, a few trees away. A rustle in the branches overhead revealed a couple of macaques, our constant companions at the camp. It was comforting to know they were keeping an eye on us and would probably warn us of any approaching danger. Just behind us in the bushes, a Raquet-tailed Drongo vented its bell-like garbling and rollicking mimicry— an energetic racket for such a small bird. Some White-browed Bulbuls chatted gaily in the low trees to our right. And all this sudden noise jolted us to attention. The late sultry afternoon found the four of us seated absolutely quiet and still on a fallen tree by the roadside, about two hundred yards from the camp. Our seat faced a busy junction, a veritable Lipton's Circus, while the sands revealed a lot of traffic. A family of elephants, including a small baby, had walked down the main track early that very morning and a few piles of dung and some pulled down branches pointed to a rather leisurely stroll. Two bears— a mother and her baby— had come from the direction of the large rock outcrop, hesitated at the junction, walked a short distance towards our camp and then veered off into the forest. Their human-like footprints were deceptive: the uninitiated would have sworn these were made by man. How we would have loved to see them, they being one of our targets— of our cameras, of course.

But the main attraction for our afternoon's vigil was the imprint of a big leopard, overlaid on the tyre tracks we had made in returning to the camp for lunch. This meant that the big cat had walked towards the camp while we were having our after-lunch siesta. They were the same tracks we had seen day after day—probably those of the resident male which resourcefully patrolled his territory day and night. How we longed it would come and allow us a glimpse. The cameras were switched on and ready, and so were we.

Just behind us, a barking deer barked loudly, announcing its presence. It had seen us and become alarmed. This stag was resident near the camp and we noticed him constantly— quite a friendly creature. Perhaps he found solace in our presence, knowing he was safe from the leopard as long as he kept close to us. It was only then that we remembered he had barked in agitation while we were resting after lunch, no doubt signalling the arrival of the leopard.

It was now around 6.30 p.m. and the jungle was settling down. A Shama whistled a last few melodious notes to its mate before retiring for the night, while an early Nightjar tuned up with a couple of preliminary *tunk - tunk - trrrrrr's*, a song he would sing in earnest as soon as dusk descended.

What was that slight rustle in the undergrowth? Our hearts beat a little faster, but it was only a grey mongoose rooting around the fallen carpet of dead leaves. It saw us, stared curiously for a while and trotted away, probably confused as to what four ape-like creatures where doing, sitting solemnly on a log. Though the trumping of my heart slowly subsided, I found my hand yet gripping the long handle of my axe. From the corner of my eye, I saw our guide slowly relaxing his grip on his *katty*, smiling in relief. It was getting a little too gloomy for any useful photography, so regretfully, the cameras were silently returned to their cases.

A mouse deer, whose hoof prints look rather like tiny holes imprinted with a pencil in the fine sand, hopped across the road on the far side of the junction. We were happy it did not notice us— an indication we were well camouflaged. The slightest movement, or even the sound of exhaled breath, would have given us away.

My thoughts went back to the previous day when we had visited a sambar kill, a short distance from camp. It was the awful smell that gave it away, but it took us sometime to locate it because the wind kept changing direction constantly. Such quick changes are confusing in thick jungle because one does not know from where an animal might emerge, and the animal itself becomes confused because your scent goes to it in sort of 'whiffs and starts'. Also, the circling breeze suddenly whips up dead leaves on the ground from different spots all around and the resultant 'rustling' from all around is positively startling. Finally, the buzzing of flies brought us to the carcass of a young sambar hind, lying on its back. The whole stomach had been devoured, with only the ribs left sticking up, cleaned of all flesh. The legs, hindquarters, head and neck were intact but covered with flies. The broken neck had twisted the hind's head at grisly angle.

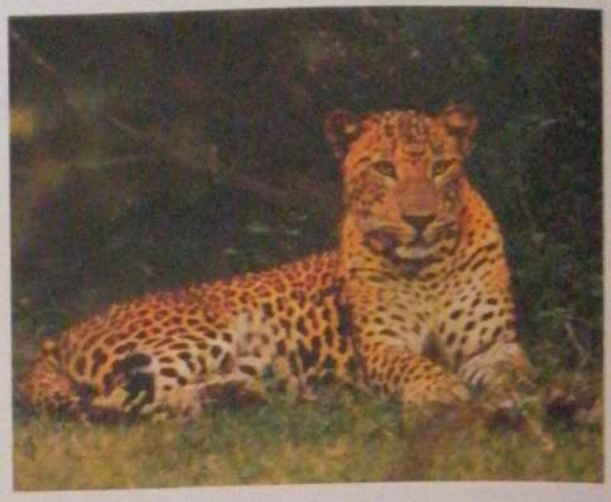
What a heroic fight the poor creature must have put up. The leopard had jumped down on it from a smallish tree some yards away, the area being a tangle of broken branches with extensive scrape marks on the ground. Patches of dried blood were noticeable all over. A large patch of skin with bloodstains was impaled on the sharp end of a broken branch. After killing the creature, the leopard had dragged the carcass only about five meters before starting to feed: the drag marks were still clearly visible.

Without much disturbance, we left the tragic scene, returning the following morning, only to find that the

kill was gone. The silence in that small space was ominous and our guide warned us to be careful while he took the lead in following the drag mark. In a few minutes we got to the nauseous smell and heard the buzzing of flies ahead. Just as we spied the kill a few yards ahead, a loud grating growl from behind a tree brought us to an immediate standstill. In a flash, the leopard was gone. We were in no position to confront the beast and we certainly had no intention of doing so. A quick glance at the kill showed us that the head, neck and one forelimb were gone, probably devoured last night. Quickly turning around, we beat a hasty retreat, as it was positively dangerous to hang around. It is never wise to disturb a hungry leopard at its kill. Walking back, we alarmed a large fishing cat which had also been attracted by the stench. It ran off through the undergrowth and we had but a fleeting glimpse of it. Was it the same animal that had left its small, leopard-like tracks on the sand at our junction? we wondered. We would never know.

Silence descended once more at the junction while we continued our vigil. Suddenly, the booming calls of a troupe of grey langurs came from the direction of the *pitiya* (glade) full of wood apple trees, rather less than a quarter-mile away. The calls approached us, the langurs following their enemy and warning the jungle of its approach. How annoying it must have been for the leopard. The two macaques above us became restless. They knew what was coming but had not seen it yet. Instead of hanging around as we wished they would, they high-tailed it down towards the river, making quite a din in the branches overhead. We sat there, absolutely frozen, our hearts beating hard against our ribs. My mouth had gone dry with excitement, and my hand grasping the axe was dripping with sweat. What a disappointment that the light had faded and photography was not possible—but then again, one cannot have it all in the jungle. Ten minutes later, the magnificent leopard stepped across the track to our right. It hardly paused as it looked up and down the road, not noticing our position, which was concealed by some branches. Its dappled coat in the fast-fading light was magnificent as it disdainfully crossed the road and walked through an open patch directly ahead of us. In a few seconds, it was gone, leaving us wondering whether it was the same creature that was responsible for the sambar kill just a kilometre away. What a thrill, even though we had missed that elusive photograph!

It was time to go. Reluctantly we gathered our belongings and walked back in the dim twilight. Conversation was restricted to a few breathless comments. A hundred yards ahead, the loud crack of a branch to the left of the track announced the presence of an elephant, perhaps the same one whose footprints we had seen early that morning on the sand-spit by the river, barely fifty yards from our camp. Our guide hesitated, hardly believing that an elephant could get between the campsite and us so silently and so swiftly. Should we, rather than continue down the path, detour through the jungle to our right? But is was almost completely dark now, even the track ahead being barely visible and the jungle on either side positively gloomy. The sound of cracking branches on the right side too, left us with no choice— it was either continue straight down the track or spend the night where we were on trees, a dim prospect indeed. Swiftly, we walked along trying hard not to step on twigs and dry leaves, our guide well ahead, with the three of us bunched together, bringing up the rear. The pungent whiff of elephant suddenly assailed our nostrils and the guide urged us to follow quickly.



Lurking in the shadows.

The elephant, sensing our presence, had stopped feeding. Although we could not see a thing inside the forest, we knew it was very close, listening to us and following our every move. With hearts in our mouths, we stumbled along, trying hard not to fall prey to a charge from which we would have no escape. The next fifty yards were touch-and-go, the muddy odour of the elephant being so strong that I imagined it was right on our heels. But good fortune prevailed and just around the next bend we spied our campfire and the welcome sight of our companions cooking dinner. They too, had heard the elephants and were somewhat alarmed. A few collective hoots and loud coughs from camp sent the intruders quickly away. What a relief it was!

Later that night, I lay on my camp-cot by the dancing flames of the campfire. It was chilly, and as the full moon arose over the river, the stars dimmed out one by one. The water gurgling over the rocks glistened a bright silver. What stories would the sands at the junction reveal next morning? I wondered. Turning over, I fell into a blissful sleep, dreaming of that graceful cat padding silently along through the dappled shade under a setting sun.

Nature on the Lake

Will the Kandy Lake retain its beauty?

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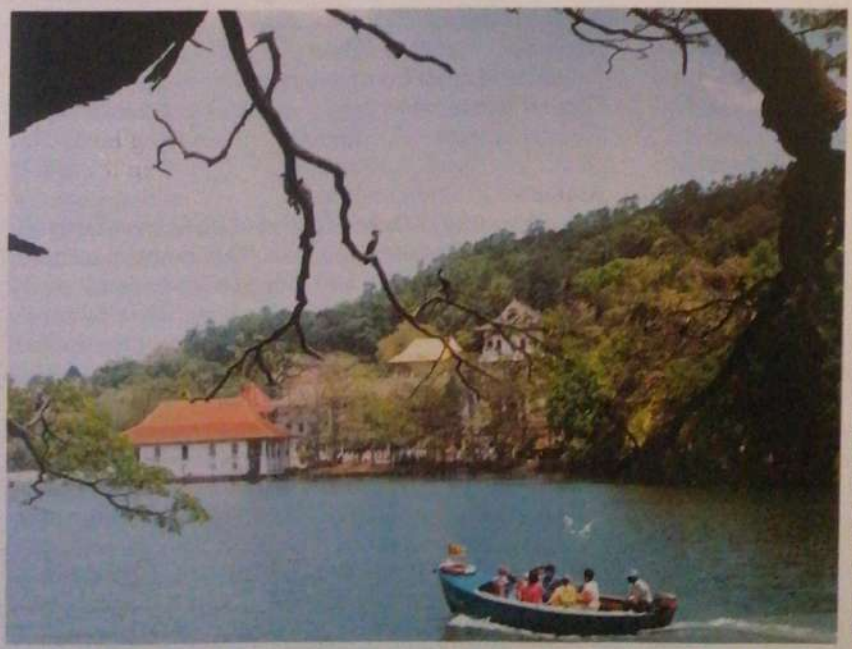
Kandy Lake is the best-known treasure of the historic dream city of Kandy, now classified as one of the key world heritage cities. This picturesque lake, flanked on one side by the lush greenery of Udawattekelle, with the imposing Sri Dalada Maligawa nestling between, has long fascinated visitors to Sri Lanka's ancient capital.

History

Kandy Lake is a creation of Sri Wickrama Rajasingha, the last monarch of the Kandyan kingdom. The origin of lake goes back to somewhere between 1810 and 1812. At this time, there was a vast paddy field known as Hingula-wela to the south of royal residence, separating it from the Malwatta monastery. The king wanted to construct a roadway across the paddy field, connecting the palace and the monastery, so his visits there would become easier. He discussed this idea with the royal architect, Devendra Mulachariya, and in the discussion the king also requested Mulachariya to think of a plan to transform Kandy into a 'heavenly' city. The King was greatly impressed with the plan his architect produced, and construction work on the present dam began in 1810. Initially, the king wanted the dam built across the paddy field, so that it could serve also as a roadway between the palace and the Malwatta temple. Later however, he decided to build the dam in its present position, and now Lake Drive runs along it. In constructing the lake, in 1812 Rajasingha created the small island in the lake's centre, Kundasalawa, as a washing place for his canoe.

Features

The Kandy Lake has a surface extent of about 18 ha (45 acres). The main sluice gate (*bisokotuwa*) is located close to the Wales Park junction, just opposite Laksala, the government handicraft shop. The silt trap (known in popular Sinhala parlance *vali-bokka*), well-like enclosures deep enough to trap the silt while allowing the water alone to flow over the well and into the lake, are most important in the maintenance and preservation of the lake. There are five silt traps located around the lake, helping to prevent the shallow basin from filling up with earth washed in from the surrounding hills. The first silt-trap is near the turn off to Hillwood College, between Hillwood Mawatha and the exit gate of the Malwatte temple. The second is at the turn-off of the Saranankara Mawatha, close to the official residence of the Mahanayake Thera. The third is opposite of the Lakeside hospital. The fourth, also the most important, popularly known as the Ratubokkuwa Trap, is at the end of *ratu-ela*, and has resulted in the creation of a playground on the accumulated silt of many decades: this trap was originally intended to contain silt washed in from Nuwara-wela. The fifth trap is near the gate to the



The Kandy Lake has for centuries soothed the nerves of kings, peasants and tourists alike.

Buddhist Publication Society.

Threats

All these traps are now fully silted over, in some cases with the entire area of the well being overgrown with scrub. This neglect has caused the lake to silt up, with islands of silt accumulating in several places. The lake's water is no longer clear. It is not uncommon to sight floating masses of garbage near main sluice gate and several other places. Among the garbage one often sees large dead fish floating on the water. The green colour of the water is a sign of eutrophication, indicating a high level of organic pollution. If the eutrophication process continues, it could further threaten the lives of aquatic organisms inhabiting the lake, and birds depends upon them as food.

Tree flora

Over 450 individual trees are present around the lake's perimeter. These belong to 58 species, the most common of which are *Tabebuia rosea, Acacia auriculiformis, Mangifera indica, Peltophorum pterocarum, Annona glabra, Roystonia regia* and *Swietenia macrophylla*. *Annona glabra*, a small tree, appears to be spreading along the margin of the lake.

Table 1. List of tree species found around the lake.

Botanical name	Common name	Family
Acacia auriculiformis	Acacia	Fabaceae
Acacia mangium	Acacia	Fabaceae
Annona glabra	Wel-atta	Annonaceae
Areca catechu	Puwak	Arecaceae
Bambusa vulgaris	Una	Bambusaceae
Bauhinia purpurea	Dam-koboleela	Fabaceae
Bauhinia variegata	Sudu-koboleela	Fabaceae
Caliandra calothyrsus	Calliandra	Fabaceae
Calophyllum inophyllum	Domba	Clusiaceae
Caryota urens	Kitul	Arecaceae
Cassia fistula	Ehela	Fabaceae
Cassia spectabilis	Cassia	Fabaceae
Chuckrasia tabularis	Hulan-hik	Meliaceae
Cocos nucifera	Pol	Arecaceae
Couroupita guianensis	Sal	Lecythidaceae
Delonix regia	Mai-mara	Fabaceae
Dipterocarpus hispidus	Bu-hora	Dipterocarpaceae
Dracaena fragrans var. *fragrans*	Draceana	Agavaceae
Eucalyptus toriliana	Eucalyptus	Myrtaceae
Ficus benghalensis	Nuga	Moraceae
Ficus religiosa	Bo	Moraceae
Filicium decipiens	Pihimbiya	Sapindaceae
Lagerstroemia speciosa	Mal-murutha	Lythraceae
Lagerstroemia sp.		Lythraceae
Leucaena leucocephala	Ipil-ipil	Fabaceae
Livistona chinensis	-	Arecaceae
Madhuca longifolia	Mee	Sapotaceae
Mangifera indica	Mango	Anacardiaceae
Mesua ferrea	Na	Clusiaceae
Muntingia calabura	Cherry	Tiliaceae
Myroxylon balsumum	Kattakumanchal	Fabaceae
Neolitsea cassia	Kuda-davula	Lauraceae
Pandanas tectorius var. *sanderi*	Wetakeiya	Pandanaceae
Parkia javanica	Toku-mara	Fabaceae
Peltophorum pterocarpum	Kaha-mara	Fabaceae
Pinus caribeae	Pines	Pinaceae
Pithecellobium dulce	Andara	Fabaceae
Pittosporum ceylanicum	Kaputu-gedi	Pittosporaceae
Plumeria obtusa	Sudu araliya	Apocynaceae
Plumeria rubra	Ratu araliya	Apocynaceae
Pterocarpus indicus	Gammalu	Fabaceae
Roystonea regia	Raja thal	Arecaceae
Saccharum arundinaceum	Rambuk	Poaceae
Samanea saman	Pare-mara	Fabaceae
Saraca asoca	Asoka	Fabaceae
Spathodea companulata	Kuda ella	Bignoniaceae
Sterculia balanghas	Nava	Sterculiaceae
Swietenia macrophylla	Large leaf mahogany	Meliaceae
Swietenia mahagani	Small leaf mahogany	Meliaceae
Syzygium cumini	Madan	Myrtaceae
Tabebuia rosea	Robarosia	Bignoniaceae
Terminalia arjuna	Kumbuk	Combretaceae
Terminalia bellirica	Bulu	Combretaceae
Terminalia catappa	Kottamba	Combretaceae
Thevetia peruviana		Apocynaceae
Toona sinensis	Toona	Meliaceae

Avifauna

More than fifty different species of birds have been observed in and around the lake. This number includes five migratory species and four species endemic to Sri Lanka (the Lorikeet, *Loriculus beryllinus*; Layard's Parakeet, *Psittacula calthropae*; Yellow-fronted Barbet, *Megalaima flavifrons* and the Small Barbet, *Megalaima rubricapilla*).

Of the migratory species, the graceful Whiskered Tern, *Chlidonias hybridus* can be seen doing it's aerobatics and fishing low over the water during the migratory season between October and April. Another eye-catching migrant is the Common Sandpiper, *Tringa hypoleucos*, bobbing its short tail and looking for food at the water's edge.

Three members of the colourful kingfisher family

can always be seen in the area. The very common White-breasted Kingfisher, *Halcyon smyrnensis* and the not so common but very attractive Common Kingfisher *Alcedo atthis*, are seen perched on vantage points of leafless branches, aiming at fishes below. The very large and spectacular Stork-billed Kingfisher, *Pelargopsis capensis*, with its huge bill, is the one that thrills everyone fortunate enough to see it.

Anyone walking around the lake is bound to see the pelicans *Pelecanus phillippensis* which were 'imported' from the dry zone to add beauty to the lake. Neither can anyone ignore the striking sight of the different species of egrets with their snowy white plumage standing out against the dark background along the shoreline. The small population of cormorants (the Little Cormorant, *Phalacrocorax niger* and the Indian Shag, *Phalacrocorax fuscicollis*) is another attraction always present in the lake. They are either seen diving and fishing in the water or sunning themselves, with outstretched wings, on branches overhanging the water. Another very interesting water bird is the Night Heron, *Nycticorax nycticorax*, that can be resting on branches in dark, heavily overgrown areas of the lake.

All in all the Kandy Lake and its environs provide a very pleasant birding walk—right in the heart of a bustling city.

List of birds of the Kandy Lake and its environs

(M, migratory species; E, endemic species; I, introduced species.)

Phalacrocorax niger	Little Cormorant
Phalacrocorax fuscicollis	Indian Shag
Pelecanus philippensis	Spot-billed Pelican (I)
Nycticora x nycticorax	Night Heron
Ardeola grayii Indian	Pond Heron
Bubulcus ibis	Cattle Egret
Egretta garzetta	Little Egret
Egretta intermedia	Median Egret
Egretta alba	Large Egret
Ardea cinerea	Grey Heron
Haliastur indus	Brahminy Kite
Haliaeetus leucogaster	White-bellied Sea Eagle
Ichthyophaga ichthyaetus	Grey-headed Fishing Eagle
Spilornis cheela	Crested Serpent Eagle
Accipiter badius	Shikra
Amaurornis phoenicurus	White-breasted Waterhen
Actitis hypoleucos	Common Sandpiper (M)
Chlidonias hybridus	Whiskered Tern (M)
Streptopelia chinensis	Spotted Dove
Loriculus beryllinus	Ceylon Lorikeet (E)
Psittacula eupatria	Alexandrine Parakeet
Psittacula krameri	Rose-ringed Parakeet
Psittacula cyanocephala	Blossom-headed Parakeet
Psittacula calthropae	Layard's Parakeet (E)
Eudynamys scolopacea	Indian Koel
Centropus sinensis	Common Coucal
Cypsiurus balasiensis	Palm Swift
Pelargopsis capensis	Stork-billed Kingfisher
Halcyon smyrnensis	White-breasted Kingfisher
Alcedo atthis	Common Kingfisher
Megalaima zeylanica	Brown-headed Barbet
Megalaima flavifrons	Yellow-fronted Barbet (E)
Megalaima rubricapilla	Ceylon Small Barbet (E)
Dinopium bengalense	Red-backed Woodpecker
Pericrocotus flammeus	Orange Minivet
Pericrocotus cinnamomeus	Little Minivet
Pycnonotus cafer	Red-vented Bulbul
hloropsis cochinchinensis	Jerdon's Chloropsis
Aegithinia tiphia	Common Iora
Copsychus saularis	Magpie-Robin
Orthotomus sutorius	Common Tailorbird
Phylloscopus nitidus	Green Leaf Warbler (M)
Phylloscopus magnirostris	Large-billed Leaf Warbler (M)
Muscicapa dauurica	Brown Flycatcher (M)
Rhipidura aureola	White-browed Fantail Flycatcher
Terpsiphone paradisi	Paradise Flycatcher
Turdoides affinis	Southern Common Babbler
Parus major	Grey Tit
Nectarinia zeylonica	Purple-rumped Sunbird
Nectarinia lotenia	Loten's Sunbird
Dicaeum erythrorhynchos	Tickell's Flowerpecker
Zosterops palpebrosa	Small White-eye
Oriolus xanthornus	Black-headed Oriole
Dicrurus caerulescens	White-bellied Drongo
Corvus splendens	House Crow
Corvus macrorhynchos	Black Crow or Jungle Crow
Acridotheres tristis	Common Mynah
Gracula religiosa	Common Hill-Mynah
Lonchura striata	White-backed Munia
Lonchura punctulata	Spotted Munia

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The life of the Red Ramanella (*Ramanella obscura*), a frog endemic to Sri Lanka

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In the very beginning, except for thunder, rain, wind and exploding volcanoes, the earth was silent. Much later, the first stuttering of the flies and the raucous chirping of the crickets, the first land invertebrates to make themselves heard, livened the terrestrial environment with their songs. Meanwhile some aquatic vertebrates dragged themselves on to land to feed on the plethora of invertebrates that were diversifying rapidly on land. These were the first amphibians, each having a voice unique to its species. This cacophony that evolved over 300 million years ago during the Devonian period has survived up to now, fluctuating in diversity through the eons to a massed choir of over four thousand different voices (species) at present. Most of these species live in the tropical rain forests of the world. Unfortunately, this medley of sounds will soon cease to be heard if human beings continue to deprive the earth of its precious forest resources.

Sri Lanka is blessed in having a very high diversity of amphibians, especially among the anurans (i.e. the tailless amphibians of the order Anura: Salientia) in which all toads and the frogs are included. There are four families of anurans found in Sri Lanka, namely Bufonidae (toads), Ranidae (aquatic frogs), Rhacophoridae (tree frogs), and Microhylidae (narrow mouthed frogs) (Figs. 1, 2, and 3).

In this article, we explore the inconspicuous but enigmatic life of an amphibian exemplified by *Ramanella obscura*. We will mainly consider its natural and human-modified habitats, ecology and reproductive behaviour. Briefly, we will also explore some aspects of the high labour, high-cost conservation-tool of captive breeding that may have to be used in the future if our children also act as indifferently as we ourselves do by passively allowing the destruction of Sri Lanka's rich natural habitats.

Figure 1. *Bufo melanostictus* (family Bufonidae).

Figure 2. *Rana temporalis* (family Ranidae).

Figure 3. *Polypedates cruciger* (family Rhacophoridae)

Ramanella

Among the frog families of the world, the family Microhylidae includes the highest number of genera (not necessarily species), totalling about 60. *Ramanella* is one of these. There are three described species of *Ramanella* from Sri Lanka, namely *Ramanella obscura*, *R. palmata* and *R. variegata*, of which the former two are endemic to the island.

Figure 4. A male *Ramanella obsucura*: note the small head and the narrow mouth.

Figure 5. The ventral surface of a male *Ramanella obscura*. The white mottles are larger in the female than in males.

Ramanella obscura is commonly known as the 'Red ramanella' or the 'Grey-brown pug-snouted frog'. This small frog, measuring around 2–3 cm (Fig. 4), can easily be distinguished from other species of *Ramanella* in having a black ventral surface mottled with irregular white spots (Fig. 5) — these spots are larger in females than in males. The females are also larger and lighter in colour than the males and hence the black/brown markings on the dorsal part of their bodies are more apparent.

Ramanella obscura cannot withstand desiccation as well as some toads (e.g. *Bufo melanostictus*, the common house toad) can. Hence these frogs are essentially confined to humid and cool parts of Sri Lanka's wet zone. The natural habitat of these frogs is the wet forests of the country (Fig. 6). However, with the depletion of forest cover over the decades, these frogs have invaded a productive human-modified habitat —home gardens. However, not all home gardens are conducive to a breeding colony of *R. obscura*. But any home-garden habitat (as we shall discuss later), especially in the wet zone, can be converted to a good amphibian habitat quite easily.

Like all adult amphibians, *R. obscura* adults are predatory. This frog feeds predominantly on ants and termites and also other invertebrates inhabiting leaf litter. So they have a very close affinities to the detritus food chains in forest ecosystems.

In the natural habitat, the commonest breeding sites of this species are the tree pans on large trees (Fig. 7). The water in these tree pans is usually clear, slightly acidic (pH 5.5–6.5), and has a strong amber colour, rather like tea. This is an indication of the presence of tannins, complex organic compounds produced by plants. These tree pans also contain an abundance of decaying leaves, and hence the bottom is covered with a thick layer of fine organic particles. Tree pans are visited by a plethora of forest-dwelling invertebrates that often fall into the water and contribute to the overall organic mass. They also serve as a food source for the adult *Ramanella*. These frogs also lay eggs in shallow ground pools with a lot of decaying vegetation. These pools are the commonest breeding habitats of Red ramanella in home gardens.

Amphibian migrations and their orientation capabilities have mystified scientists for a long time. In temperate regions, where there is distinct seasonality,

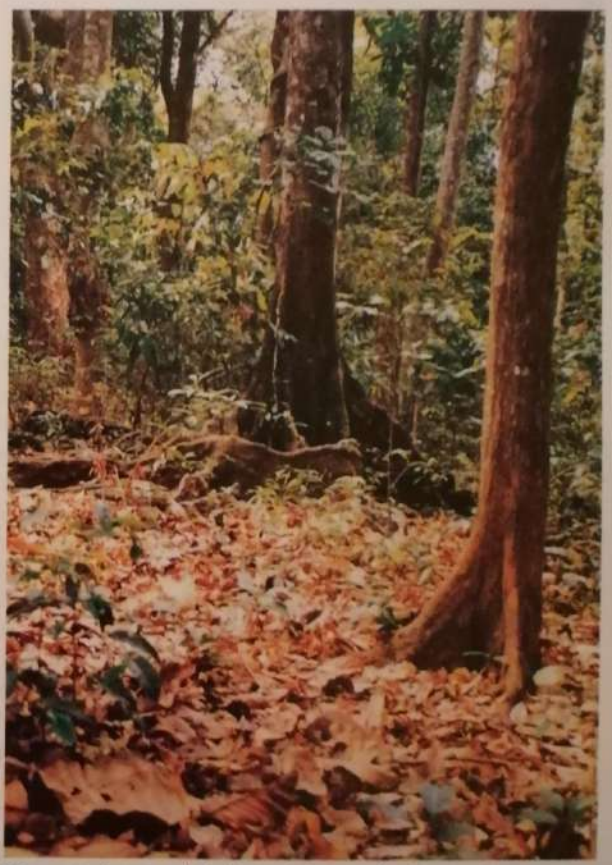


Figure 6. A natural habitat of *Ramanella obscura*: Gannoruwa Forest, Peradeniya.

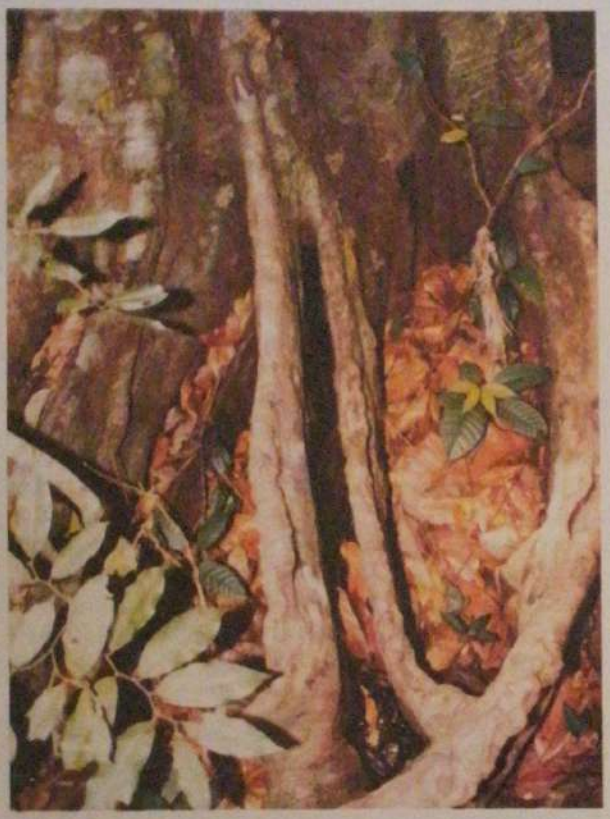


Figure 7. A breeding pool (tree pan) in the natural habitat.

amphibians undertake long migrations from their feeding habitats, sometimes over great distances, back to the pools of their 'childhood' to lay eggs. But the tropical *R. obscura* are not nearly as mobile. They tend to remain around a single breeding pool during the whole their lifetime, so long as the habitat is not excessively disturbed. Recent studies have shown that they would move about 20m from the pool in search of prey. This is because the leaf litter habitat is rich in termites, ants and litter-dwelling invertebrates — the food of *Ramanella obscura*. Unlike many species of amphibians, *R. obscura* is not very selective about its breeding habitat. It colonizes new breeding habitats quite effectively, given that the new breeding habitat is not cut-off by uncrossable barriers.

Breeding

These frogs breed essentially during the rainy season. The first rains are celebrated with loud cries that can be heard for over a hundred meters. Only the males call loudly. For calling (vocalization) the males have a sac on their throat (vocal sac) which can be filled with air. After air is inhaled, the nostrils are closed shut and the air pumped alternately between the sac and the lungs, creating sound as it passes over the vocal cords in the larynx. The air within the sac helps to enhance the quality and amplify sound. As the frogs can call without taking in new air, they can even call while under water.

The males come to the breeding pools first and the females visit these breeding pools periodically. Soon after egg deposition, females return to the riparian or litter habitat for feeding. So in a *Ramanella* breeding pool you will notice about four males and if you are lucky, a female or two.

In temporary pools in home gardens, it has also been noted that they do not breed on the first day of rain; up to two days of continuous rain often pass before breeding embraces are observed. Why do these amphibians behave this way? As mentioned before, these frogs lay their eggs in shallow-water habitats in home gardens. As these habitats are vulnerable to desiccation after a few days of rain, the water retention capability of the pools increase, giving the tadpoles a better chance of survival.

The males of *R. obscura* are mildly territorial towards each other but bouts of territorial combat are restricted to harmless pushing and chasing. Often, two vocalizing males can be seen pushing each other over short distances. The calling occurs in short phrases, usually sung as a duet between two males. However it should be noted that there are several distinct calls for *Ramanella* of which some are exclusively used *after* amplexus (the spawning embrace). Though males in shaded wet forests often call throughout the day, the males in more open breeding habitats hide and cease calling altogether as light intensity increases. So, in exposed home garden pools, the frogs call from dusk to dawn.

These amphibians are also very sensitive to vibrations and abruptly stop calling if approached by a human being. Like most ground-dwelling frogs, they are also stimulated primarily by Rayleigh waves, which are transmitted through the ground, and have a substantial vertical energy component. Hence observing *Ramanella* behaviour requires patience and calmness and one's movements need to be slow and controlled.

When studying amphibians, it is always important to study also the sympatric species (species that occur together competing for resources) to facilitate future conservation. In home gardens, several species have been observed to share the breeding pools of *Ramanella obscura*, predominantly to 'drink' water (many amphibians come into pools of water at night to absorb water through their skins). These species include *Limnonectus limnocharis, Bufo melanostictus, Polypedates cruciger, Philautus 'variabilis'*, and *Rana gracilis*. But litter-dwelling species like *Philautus nasutus* occur together with *Ramanella obscura* though they do not share the same breeding habitats. Sometimes amorous male *R. obscura* can react threateningly even to larger species like *Bufo melanostictus* by pushing them out of the breeding

Figure 8. A *Ramnella* male pushing a *Bufo melanostictus* out of the breeding pool.

Figure 9. A pair of *Ramanella* in amplexus (lateral view).

Figure 10. The pair in amplexus (dorsal view).

Figure 11. A pair of *Ramanella* floating in water prior to spawning.

pool (Fig. 8).

When a female moves into a breeding pool, a male quickly mounts her, holding her just behind her forelimbs (Figs. 9 and 10). This is thought to be a more advanced way of holding the females, termed as a pelvic or an inguinal hold. The other embraces that exist are the cephalic hold, where the male grasps the female in front of the forelimbs; and the pectoral or axillary embrace, where the female is held by her waist. In *Ramanella*, the unsuccessful males do not try to push-off the mounted male like in some other frog species. The male sometimes holds on to the female for over five hours before the eggs are deposited. During this period the couple float freely in the water (Fig. 11).

In the breeding pool, a female in amplexus dips her head into the water and raises her cloaca (a single vent for excretory products, faeces and reproductive products) to the level of the water surface. This is a cue for the male to be ready for the deposition of sperm. As soon as the eggs are emitted, the male ejaculates sperm to fertilize the eggs externally (Fig. 12). The female lays the eggs in one to three batches during a single spawning event. After all the eggs are laid, the female drags the male, still in the spawning embrace, out of the water. This usually results in the male releasing the female. In a rainy season, a single female is capable of laying 4–8 clutches of eggs, a feature that also has an adaptive value. Species like *B. melanostictus* lay thousands of eggs at a time during favourable periods (Fig. 13). But for species that breed in shallow pools, like Red Ramanella, desiccation is an acute problem. Hence they are capable of laying several clutches of eggs during a breeding season to compensate for eggs lost due to desiccation.

As the rainy season progresses, with clutches of eggs being regularly laid, the clutch size decreases. I counted as many as 338 eggs in initial clutches, though the number progressively decreased to as little as 38 eggs by the end of the rains. This strategy enables a longer

Figure 12. Spawning male and female (note the floating eggs).

Figure 13. A pair of *Bufo melanostictus*, who are explosive breeders, in amplexus.

Figure 14. A close-up of some newly laid eggs of *Rannella obscura*. Note the insects that are trapped by the gelatin.

growing time for the first batches of eggs—if the pool does not dry out completely. However, spawning does not seem to occur during heavy rains: this maybe an inherent strategy to prevent eggs being washed away.

The eggs of these frogs float on water like rafts: at the water surface, they are able to absorb atmospheric

Figure 15. The blastula (ball of cells) showing smaller pigmented cells on top and the yolky, larger cells at the bottom.

oxygen for the developing embryos within. The eggs, which are black, absorb radiation to raise the temperature and accelerate development. The eggs are covered in a gelatinous membrane that makes them very sticky to dry objects. Small insects that fall on the eggs are trapped by the gelatin (Fig. 14). As small water pools have comparatively less detritus in them, the trapped insects will serve as a valuable food source for the developing tadpoles. The gelatine layers that cover the eggs also give the eggs some protection against mechanical damage.

If the eggs are left undisturbed, they float on the surface of the water until the tadpoles emerge. As raindrops hit these eggs, they sink to the bottom quickly. If the eggs do not sink when disturbed, they may be swept to the extreme margins of the pool to be subjected to desiccation or may be swept out of the pool with rising water to an alien habitat lacking proper conditions for growth.

The life cycle of *R. obscura* is typical of most anurans. The single cell first divides into two cells and after several cleavages, forms the blastula (a ball of cells). But in amphibians, this cell mass contains two kinds of cells. The larger, heavy, yolk-containing cells on the bottom and the smaller, lighter cells on the top (Fig. 15). This cell mass later gives rise to the external-gill stage larva, which is brownish in colour. During this period, it adheres to underwater objects using its pair of adhesive organs. At this stage, if observed closely, you will be able to see two small projections on the sides of the head, which are the external gills (Fig. 16). Later, the external gills are covered by an operculum to form the internal

Figure 16. The external gill stage larvae of *Ramanella obscura*.

Figure 17. The internal gill stage larva, with the funnel-like mouth lacking horny teeth, the funnel shaped spiracle near the mid-ventral portion of the tadpole, the heart, the funnel shaped mouth and the intestines.

gills. In tadpoles of *R. obscura*, the opercular chamber (i.e. the chamber where the gills are held) opens to the outside near the anus through an opening called a spiracle. When the internal gill stage is reached the tadpole takes in water through its mouth and passes it through the spiracle, and on the way, gas exchange occurs via the internal gills.

Tadpoles

The free-swimming tadpoles become darker in colour due to the development of many chromatophores (colour-giving cells), but the edges of the tail still remain transparent. During this stage, the spiracle in the mid-ventral region is clearly visible as a colourless tube and the heart and the intestines are also clearly visible (Fig. 17).

If foraging in amphibian tadpoles are considered, there is a diversity of mechanisms such as scraping algae, surface-film feeding, and rarely, predation. These mechanisms require a strong mouth and often, horny teeth. However, *Ramanella* tadpoles and all other microhylid tadpoles lack horny teeth and hence the upper jaw is not supported by a cartilage. The lower lip has many folds and the mouth appears like a funnel. This construction is ideal to suck in tiny particles of

Figure 18. The two legged tadpole of *Ramanella obscura*.

Figure 19. The four legged tadpole of *Ramanella obscura*.

Figure 20. Ready for terrestrial life: a juvenile *Ramanella obscura*.

organic material and infusoria that are abundant in its habitat. Behind the mouth there are branchial food traps that secrete mucous to trap tiny particles and organisms. This habit of feeding on minute particles is termed microphagy and this system of feeding soon clears the water column of particles and infusorians. For a continuous supply of food, the tadpoles depend on the bacterial masses and detritus on the bottom of the pool.

About a month after the eggs are laid, the hind limbs appear as small buds near the tail junction of the tadpole (Fig. 18). About two weeks thereafter, the front legs also emerge behind the branchial chamber (Fig. 19). Two to

three months after the fertilisation of eggs, a juvenile *Ramanella* imago (the final stage of metamorphosis) crawls out to the periphery of the pool (Fig. 20).

Captive breeding of this frog is easy but even then, this is a high-cost, high-labor endeavour. As this frog is adaptable to a well-furnished home garden, captive breeding is perhaps not required in order to maintain its population at present. But semi-captive breeding, where you supply some of the ecological requirements, such as a breeding site and a feeding site for successful breeding, will be very welcome to this and many other species of frogs (remember, there are many other frogs that live in sympatry with *R. obscura*).

Enriching your garden

So how can you modify your home garden to promote *Ramanella* conservation? Consider all the factors that were discussed above. Briefly, a shady, cool breeding pool under a tree is essential. If you do not want large species like *Bufo melanostictus* and *Polypedates cruciger* to breed in this pool (it will definitely help if you have a larger pond for other, larger species to breed in), it has to be shallow (about 12 cm) and small (40cm × 40cm). To increase water retention, you could line the bottom of the pool using thick polythene, plastic or cement. Make sure that one of the walls of the pool is slanted to facilitate the metamorphosing tadpoles to leave the pool. As the pool is constructed under a tree, natural leaf litter fall is enough to supply organic material to the pool, but if you feel that it is not enough, you can always supplement the litter.

You have to be careful not to let flowing water (from watering plants etc.) enter the breeding pool. As I said before, rain hitting the eggs will induce them to sink to the bottom of the pool, but flowing water will carry the eggs out of the pool. You can also develop a riparian zone (near-water vegetation) around the breeding pool that will provide the *R. obscura* adults a daytime refuge.

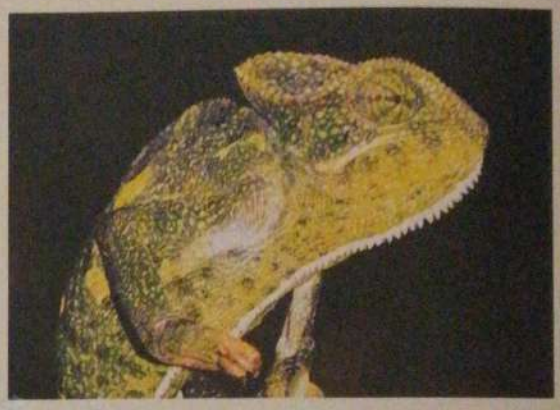
Finally a word of caution is essential. After the development of the home garden into an amphibian habitat, it is always good to observe for a while if natural recruitment takes place. If this does not happen, you should bring a few tadpoles of the desired species from a *nearby* water body. This will help to minimise unwanted hybridisation and homogenisation of genes.

I hope I have demonstrated that the conservation of amphibians need not be restricted to the protected areas alone. With a basic knowledge of their ecological requirements, conservation can be attempted right in your backyard. This will increase the areas available for our impoverished fauna and ensure that the cacophony of frogs, a nocturnal serenade that has prevailed through the 300 million years in which amphibians have inhabited our planet, will continue for a long time to come.

4th

World Congress of Herpetology to be held in Sri Lanka in August, 2001

UNVERSITY OF PERADENIYA



The 4th World Congress of Herpetology will be hosted by the University of Peradeniya in early August, 2001.

This prestigious event is expected to attract around 1,000 scientists from around the world to Sri Lanka. The previous world congresses were held in Kent, England (1989); Adelaide, Australia (1993); and Prague, Czeck Republic (1997).

The Congress has won formal government approval, and is expected to take place at about the same time as the Kandy Perahera, an added attraction for the visitors. The event will also serve to boost eco-tourism to Sri Lanka, now recognised as one of the most important herpetological hotspots in the world.

The Congress sessions will cover a wide variety of disciplines, including conservation biology, ecology and palaeontology. However, two areas of special focus will be the medical and toxicological applications of herpetology (e.g. snake venoms and skin secretions of amphibians, both the subjects of intensive research world-wide), and the declining amphibian populations (DAP) syndrome. The latter is an as yet unexplained phenomenon where many amphibian populations world-wide have declined catastrophically during the past decade, a phenomenon that has already resulted in the extinction of a number of species, especially those occurring in high-altitude habitats.

The Congress is being organised in Sri Lanka under the direction of Mr Anslem de Silva of the University of Peradeniya, who is also President of ARROS, the Amphibian and Reptile Research Organisation. Mr de Silva who will also serve as the President of the World Congress, currently heads the Declining Amphibian Populations Task Force for Sri Lanka.

Workshop on first aid for wildlife officers

Dr. Maithrie M. Rajapakse

General Hospital, Kandy

A workshop organized by the Kandy Society of Medicine was conducted at the General Hospital Kandy for wildlife officials on 18 February 1999. The idea of conducting a workshop of this nature was the result of an experience we had when we made a visit to Horton Plains. The trip to Horton Plains was organized by the Kandy Society of Medicine and the participants consisted mainly of the families of doctors from the teaching hospitals of Kandy and Peradeniya. The party included professors and consultants in several specialties ranging from surgery to medicine, paediatrics, oncology, parasitology and even anaesthesiology. Also included in our group were non-medical specialists, including entomologists and botanists. After an overnight stay at Nuwara Eliya, we proceeded to Horton Plains the next day. After a long trek to World's End, one of our colleagues, a middle aged and somewhat heavy female professor, sprained her ankle. She was in severe pain and was unable to walk at all.

There was no way of contacting the guard post or anyone at all to find transport to take the patient to the entrance, the nearest point accessible by vehicles. Even if there was a way to contact the guard post, it may not have been possible for a vehicle to be driven to the spot where our colleague lay. We had to find a way to transport the patient to the entrance and devoted all the collective brain-power available to designing a makeshift stretcher. Two small trees were cut with the only penknife available (under strong protest from the environmentalists present) and a stretcher was made with the help of all available jerkins, pullovers and ladies' raincoats. The stronger men in the party carried the patient on this stretcher, though it was difficult at times, the path being very narrow. When we reached half-way, we were pleasantly surprised to find that one of the more resourceful people in our party had gone ahead and summoned a double cab owned by the Wildlife Department. All praise to the driving skills of the wildlife officer: he drove the distance on reverse, negotiating large boulders on the road with much skill. An inexperienced driver would not have been able to manoeuvre a 4-wheel drive vehicle on that road— so large were the obstacles. Finally, we reached the gate with smiling faces all-round, deeply grateful to the wildlife officers who had come to our aid.

On inquiring, we found that the guard post did not have any facilities to cope with medical emergencies; neither had any of the staff been trained in first aid. This is a place visited by thousands of people of all ages, including foreigners, and the nearest hospital is about 30 km distant. It is therefore essential that some medical facilities be available at the guard post. A motorable road to World's End would also be useful to have, to be used in emergencies such as this (but not to be misused by politicians and 'VIPs'). Some mode of communication too, should be made available from various points in the Park, to the guard post.

This experience prompted the President of the Kandy Society of Medicine, Dr. Sarath Wattegama, to organize a donation of a first aid box and a stretcher to the guard post at Horton Plains. We also decided to offer first-aid training to wildlife officials from all parts of the island.

Accordingly, on an initiative by Dr. Wattegama, a workshop was organized in collaboration with the Director of the Wildlife Department, to coincide with the Annual Sessions of the Kandy Society of Medicine, and coordinated by me. There were 28 persons who attended the workshop, ranging from game rangers to park wardens drawn from all parts of Sri Lanka. There were also a few officials from the Wildlife Department's head office in Colombo.

After an introduction by the President, the following lectures were delivered. (1) *First aid on medical emergencies*, Dr. Maithrie Rajapakse (Consultant Anaesthetist); (2) *First aid on injuries*, Dr. Gamini Edirisinghe (Consultant Orthopaedic Surgeon); (3) *First aid on shock and other emergencies*, Dr. M. S. S. B. Etulgama.

The lectures were delivered with the help of slides and demonstrations. We felt that all the participants were most interested, and many expressed a desire to benefit from more sessions such as this. A senior official of the Wildlife Department agreed to inform the ministry and arranged for more workshops of this nature to be conducted also in the future, and we hope this will be followed up. At the end of the workshop, a certificate of attendance was awarded to all the participants. We hope these wildlife officers will now be able to cope with at least some of the medical emergencies they encounter in the field, until the patient is taken to hospital. I thank Dr. Sarath Wattegama, Dr. Gamini Edirisinghe, Dr. H. M. S. B. Etulgama, the participants of the workshop and the wildlife officers for their co-operation.

The trap gun

Dr. Jayaindra Fernando

The northeast monsoon, better known as the *maha* season among the locals, had commenced in Ampara. Folks were busy ploughing their fields. The chicks of the White-breasted Waterhen had frequented my garden during the preceding few weeks and attained adult plumage. A dozen Blue-tailed Bee-eaters, who are winter visitors, had arrived and completely ignored the Green Bee-eaters who had been there all year long. The arrival of another winter visitor, the Indian Paradise Flycatcher, confirmed the imminent change of season.

Amidst this seeming calm, a week would not pass without some unsuspecting villager becoming the victim of a trap gun. Sometimes (quite often, I suspect), the victim turns out to be the trapper. Between November 1997 and October 1998 there were 33 victims of trap-gun accidents admitted to Ampara Base Hospital. For every human victim many a times that number of wild beasts are killed. The islandwide tally would probably run into several hundreds.

Trap guns, known locally as *bandina thuwakku* (guns that are tied), are illegal. Nevertheless, they are commonly used in forested areas of Sri Lanka to kill wild boar, sambhur, spotted deer, hog deer and even hare. However, even domestic cattle, buffalo, jackal or leopard could set off the guns, with resulting injury or death.

With a deep interest in conservation of the wild and an occupation dealing in human victims, my curiosity of the trap guns grew. Soon my colleagues at work were equally interested. When Dr. Indika [illegible]wala found a grocery-store helper who knew of someone who in turn knew of someone who owned a gun, we [illegible]nini expedition on our hands.

Thus, on a sunny Sunday afternoon, we left our car on a narrow gravel track and set out on foot. The grocery store helper led the way through a maze of rural footpaths. Dr. Disala Fernando, a keen bird watcher, joined Indika and me. I trailed the party, recording the scenery on camera. After some initial confusion, our 'man of the moment' arrived with all his hardware.

The trap gun is basically a muzzle-loading gun which is tied to a tree (Fig. 1) with the trip wire (in Sinhala, *maru wela*, i.e. the line of death) (*a*) drawn across a well used animal tract. Our man sat on the ground and cut two 'sky rockets' (fireworks) in half and took out the powder. This was inserted into the gun barrel (*b*) though the muzzle (*c*) and rammed over with a paper wad (*d*). We were told that the explosives used in stone quarries and the powder from pilfered T-56 rounds are also used by some trap-gun users. Sometimes, when the latter is used unknowingly, the powder of the tracer and incendiary rounds can spark off forest fires.

Figure 1. See text for details.

The projectiles, which consist of lead pieces, nails or other metallic parts, are inserted next into the barrel (*e*). This step was omitted in our demonstration. The powder on the sides of a matchbox was scraped off and ground together with a few match heads. The mixture was wrapped in cigarette foil to make the cap (*f*) and placed on the nipple (*g*).

After securing the gun to a nearby tree, the firing mechanism was set. This consists of a hammer (*h*) powered by a spring (*i*) aligned to detonate the cap (*k*). The hammer is kept wound by a lever (*j*) which in turn is restrained by a guard to which the trip wire is attached. When the latter (*a*) is pulled by the victim, the lever (*j*) and thereafter the hammer are released to detonate the cap. The flame spreads to the charge (*c*) through the nipple (*g*).

By the time we were ready for the demo firing, it was quite dark. True to the trapper's promise, the gun went off without a hitch when the *maru wela* was tripped. We took leave and made our way back to the hospital. For me it was back to work as two patients who needed urgent surgery had been transferred from Kalmunai and Sammanthurai hospitals. It was late when I sat to dinner. The bright winter constellation of Orion was up in the eastern sky. Orion was a hunter, but not with trap guns.

Letters

FLAMINGO NESTS IN BUNDALA

Sir—

Our article on the nests of Greater Flamingoes in Bundala (*Loris*, 21(4)) has evoked the suggestion that these were "trial-nests". Greater Flamingoes are known to make trial-nests and this could possibly be the reason that eggs and chicks have not been observed. Nevertheless, we suggest a more prosaic and, in our opinion, more likely explanation.

Based on the condition of the nest mounds when we examined them in April, we suspect that they were probably constructed early in 1997, when the water level in the *lewaya* was quite high. As a consequence. most of the shoreline would have been inaccessible to vehicles as well as most domestic animals, thereby affording the nest-mounds a degree of protection. However, by mid-March the water level had dropped substantially causing the shoreline to recede by up to 100 m (and even more in some places). This, combined with the drying up and hardening of the ground, made the area accessible to vehicles and we often observed jeeps, carts and bicycles passing through the area in which the mounds were situated: a few mounds were damaged by vehicles. On one occasion small boys were seen playing cricket near the mounds. We also observed that stray dogs regularly foraged in the area.

As indicated in our article, flamingoes are apt to abandon their nests if disturbed' therefore, while not entirely rejecting the "trial-nest" hypothesis, we suggest that disturbance from human activities (and possibly stray dogs) was a more probable cause for desertion of the nests.

Rex I. de Silva
Aruna Kirtisinghe
Dushyantha Perera

AIR POLLUTION

Sir—

I live in Colombo. My house is situated on a block of land which has two road frontages. From 6 a.m. until about 10.00 p.m., there is an unending flow of traffic along this road, emitting a large volume of fumes, mostly from diesel vehicles, which cover the entire surroundings. I can *feel* the smoke. I breathe it. Small particles of dust and carbon settle on me and on all the objects in the house, including our clothes, our food and our garden plants.

Our cat, which has a white coat, is almost black now. If my furniture is not dusted daily, an ugly layer of a black oily substance can be seen covering the surface. At night, a cloud of dust can be seen in the sky, making the stars barely visible. I cannot drive without putting the shutters up and turning on the air conditioning, adding yet more dangerous gases into the air.

I know that this dust and smoke is bad for my health. It could cause asthma, lung cancer and complications in the brain, heart and blood circulation. But there is nothing I can do about it. There is no one in authority who is concerned about this.

I have heard that I have a right to breathe clean air. There are the ministries of environment and transport, the Central Environmental Authority, the Colombo Municipal Council and a host of other state agencies which should monitor and control air pollution.

If this is the cost of development, I would rather, do without it. Life is not worth living like this. It is better to live in a remote area close to nature, without vehicles and without dust, rather than living in an air conditioned room amidst industrial waste and pollution.

Quintus Fernando,
Colombo 6.

SUGGESTIONS

Sir—

I am a member of WNPS and enjoyed reading the last issue of *Loris*. However, even though I am a scientist, I often find that scientific names are used in the journal, in many cases without common names being provided. If authors make it a practice always to include the common names of the organisms referred to in their articles, we will enjoy reading these articles even more than we do at present. I suggest a less formal approach so as to widen the appeal of Loris and promote greater understanding of the subject matter by readers of all backgrounds.

You could also consider having a page for 'Letters to the Editor' and a section in which organizations such as WWF could advertise. This would present an opportunity for like-minded individuals to exchange ideas and for organizations to make their efforts known to relevant sections of the Society who are more likely to be interested in such matters.

Dushyantha Peter,
Colombo 8.

Sir—

I have an almost-complete set of *Loris*, dating back to the '30s, which is one of my most treasured possessions. I often leaf through these, and am always fascinated by the wonderful articles, full of information, beautifully written. What has happened now? Like everything else in Sri Lanka, standards have dropped terribly.

If our country is going to progress, we must set an example to the younger generation by setting exemplary standards. What hope is there fore wild life if we, the few who love nature, cannot articulate our thoughts clearly and take the trouble to communicate effectively with those who are yet to be converted to the cause?

SIDNEY P
Moratuwa.

Sir—

As Sri Lanka's oldest NGO it is sad to see what is going on in the Wildlife and Nature Protection Society. What a shame! I hope that the new President will be able to bring the warring factions together and motivate all the members to work towards conserving our wonderful natural resources and heritage without fighting among themselves. Let us set an example to politicians as to how people from different backgrounds, with different interests, can work together towards an important common cause.

There are many things a Society with 3,000 members could, and should, do. We should work towards getting the government to adopt a "Clean Air Policy", so as to legally prevent belching buses from polluting the air our children, and our wildlife, breathe. We could undertake *shramadana* activities to clean up national parks or undertake public awareness projects to reduce littering. We could address the problems of noise pollution by explaining to motorists that the brake is better than the horn. So let us stop bickering and get on with the job of making a difference. That is why, after all, we are members of the Wildlife and Nature Protection Society.

SHIRANEE MUTHUWAGAMA,
Colombo 3.

YOUNG PEOPLE

Sir—

I read the December 1998 issue of *Loris* and noted that some of the articles are excellent, not just for students of conservation biology but also for the general public and nature lovers.

Most scientific articles appearing in national newspapers contain misinformation, probably because their editors do not have scientific knowledge. But *Loris* is beyond that, because the content of articles appears to be scientifically accurate and of a high standard, with a writing style suitable for students as well as the general public.

I am interested in becoming a member of WNPS. It is our duty to live with nature. I would like to see the Society organising awareness programmes for young people. WNPS must organize good programmes to promote practical activities, which will encourage citizens to conserve fauna and flora and our environment. If we implement such programmes, the younger generation will learn to be responsible and love nature. Through such programmes, the Society could also capture the attention of adults through the younger generation, who will serve as good agents and ambassadors for promoting conservation in Sri Lanka.

MS SHAMRREN SHIBLEY
Kandy.

Sir—

I was happy to read in the recent WNPS Newsletter that the new Director of Wildlife Conservation had imposed severe penalties on criminals who had shot a sambar in Horton Plains. When everyone knows that this is a National Park, how could they go there and kill a wild animal? They deserve even more than the punishment they got.

From what we read in the newspapers however, people are killing elephants every day. Yet, no one has been punished. Why is this? Is it alright to kill a crop-raiding elephant but not a sambar? The Wildlife Director must take an interest in this matter if all our elephants are not to vanish within the new century.

C. B. RATNAYAKE,
Peradeniya.

Orientation in migrating birds– a mystery remains

By Lionel A. Samayawardhena*

* Department of Zoology, University of Ruhuna, Matara.

Temperature, a crucial factor in the character of life on the earth, kinetically controls each and every reaction occurring on this planet. Seasonal changes in climate depend mainly on the earth's rotation around the sun. Many organisms react to these climatic changes by migrating to more favourable habitats. Of course, because the need to migrate is strongest in areas that are subject to extreme winters, most 'climatic' migrations involve animals leaving the temperate parts of the world and heading towards tropical regions during winter.

Not all migrations however, are induced by the seasons. Many animals migrate in order to reproduce (e.g. amphibians, moths, monarch butterflies). These movements could be over ranges as small as a few metres or as large as several thousand kilometres. Many species of fish migrate between fresh and salt water in the course of their life cycle. Among mammals, the mass migrations of wildebeest in east Africa and caribou in Newfoundland are perhaps among the best known.

To us in Sri Lanka, the most familiar examples of migratory species are among the birds. Being endothermic, birds maintain a near-constant internal body temperature, which is higher than that of the surrounding environment. This enhanced body temperature facilitates an optimum rate of metabolic activity, permitting the controlled release energy according to the birds' needs. Their normal mode of locomotion — flight — itself needs higher levels of energy for powering their flight muscles. The seasonal migrations birds make however, are over enormous distances. The total distance travelled between breeding and non-breeding grounds by groups of Long-billed sandpipers (Scoloradriidae) and Short-billed sandpipers (Charadriidae) may exceed 12,000 km, probably among the longest migrations of any land birds.

It is known that both day-length and stored energy reserves jointly influence migration in shorebirds. In preparation for crossing major ecological barriers, migratory birds accumulate large stores of 'fuel' during the summer months, mainly in the form of fat. Immediately prior to migration therefore, their body mass could be as much as twice that at the end of a migration. So dramatic an increase in body mass, however, significantly impairs flight performance. This is also relevant because the maximum range and speed increases with total body mass and this enhances the birds' ability to fly 'economically' at a faster speed. Birds with heavy fuel burdens sometimes benefit from the favourable tailwinds at high latitudes. Hence, in order to save energy by flying with a tailwind, birds need to climb to a suitable air stream immediately after commencing their migratory flight. Because their capacity to climb is related to the stored fuel they carry, this is best accomplished at a time when birds have ample stocks of energy.

Throughout the ages, different populations of several species of birds have developed individual migratory routes. They 'home' towards breeding and resting grounds in various parts of the world. How exactly these sites have been selected, and how the birds find their way to the sites is still a mystery.

It is known that birds are equipped with the ability to orientate themselves effectively, thus facilitating long-distance migrations. Perhaps the best known example of homing is in pigeons, which have an innate and uncanny ability to locate their home area even after been displaced several hundred kilometres. Although the mechanism through which a pigeon successfully homes after displacement is not understood, pigeon keepers know their birds will return to their home aviaries after release from almost anywhere. In ancient times, pigeons were used as messengers even in Sri Lanka, the news carried by pigeons being known as *parevisandesaya*.

Birds' orientation during migration falls into two categories: compass orientation and goal orientation. In compass orientation, birds simply use the earth's magnetic field as a compass. In this case, the birds do not endeavour to reach a specific site, but maintain only a specific direction. In goal orientation however, the birds clearly have in mind a specific destination. Despite this, the route of approach may differ between different flocks and different years. The memory power of goal orientated migratory birds is astonishing.

While many migratory species clearly have pre-programmed goal directions, some (such as the Crossbill), appear not to posses such 'inherent' information and therefore show much irregularity in their migratory directions. Rigidly fixed innate migratory direction-finding species however, include European cuckoos, which migrate to resting areas in central Africa irrespective of the migratory habits of their diverse foster parents.

Amongst the different mechanisms birds use to orientate themselves, visual orientation using landmarks is probably the simplest. Migratory birds arriving in Sri Lanka usually arrive first in the forests of the northern part of the island. They then appear to follow prominent 'landmarks' such as mountain masses, water bodies, light sources from cities, lighthouses, stars and even cloud patterns. The specific landmarks used by birds also depend on whether they fly by day or night. Nocturnal migrants apparently navigate by the stars.

Sun is probably one of the compasses birds most commonly use for determining their migratory paths. This has been demonstrated experimentally altering the apparent direction of sunlight using mirrors. Not all species however, navigate by the sun: the earth's magnetic field is also used as a reference by migrating birds. In higher latitudes however, the direction of the earth's magnetic field becomes more difficult to determine accurately. Here, celestial clues may help birds to decide which end of the magnetic axis is the correct one in the crucial process of establishing the starting direction of migration. As long ago as the 1950s scientists observed that birds do not orientate themselves according to the polarity of the magnetic field *per se*. Thus, they travel 'pole-ward' or 'equator-ward' rather than 'north' or 'south'. This is probably how nocturnal migrants are able to navigate accurately even under a completely overcast skies: they seem to view the earth simply as a huge magnet with magnetic north and south poles. The ability of birds to use the stellar compass may not be innate—but most birds possess the ability to acquire it. In addition to magnetic and stellar beacons, the moon, the polarity of light, wind, infrasound and scent cues are known to be significant in bird migratory behaviour. Some scientists believe migratory patterns in birds to be very ancient, with species adapting to the drifting of Earth's continents over geological time. Others feel that global climate change over the same period has been so dramatic that the migratory patterns of individual species may not be that old.

It seems that young migratory birds are bestowed with innate information on the distance and direction of their first migratory flight. Experiments have shown that captive-raised birds orientate themselves just as effectively as wild ones. Pied flycatchers (*Ficeula hypoleuca*) for example, are long-distance nocturnal migrants. Pied flycatchers raised in different local geomagnetic fields however, have behaved differently in migratory behaviour from their wild relatives. These experiments suggest that stellar cues and celestial rotation play a crucial role in the process of translating innate information on migratory directions into actual orientation.

Successful orientation during migration requires that birds are bestowed also with other attributes. Their vision is usually well developed, with night vision particularly well developed in nocturnal migrants. The vision of many bird species extends also to ultraviolet light, and the ability to detect the plane of polarisation of polarised light. Birds also possess other 'receptors' such as a pineal organ. Their sense of smell, although poor, could help local migratory movements, especially in birds occupying urban habitats (such as crows). Hearing is well developed in almost all birds. Although much is known already, a great deal remains to be discovered with regard to the exact manner in which each individual species achieves such spectacular accuracy in the great migrations birds undertake annually.

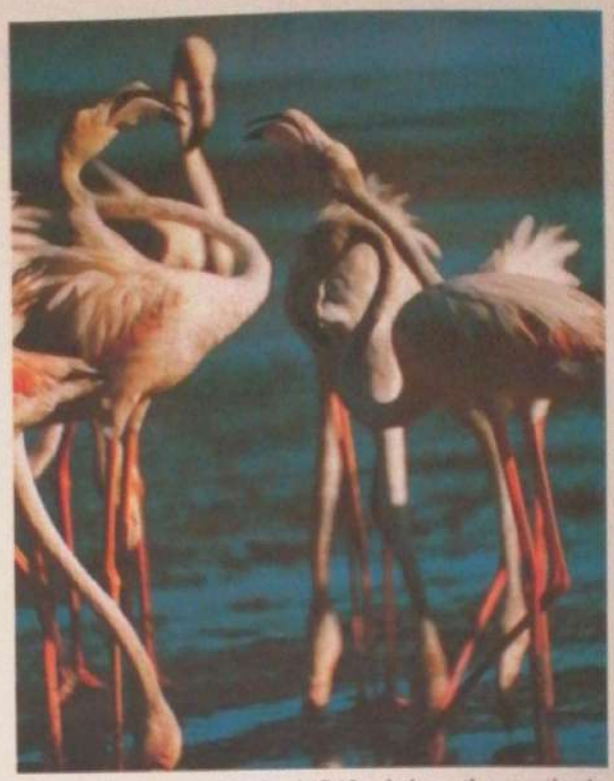


Photo: © Lal Anthonis

Greater Flamingoes wintering in Sri Lanka's southern wetlands.

From a conservation standpoint, bird migrations drive home also some other sobering facts. First, the difficulty of protecting species that move over vast areas of the earth's surface each year: protecting them in each country they visit is a gargantuan task. Second, each population of migratory birds has a unique 'genetic code' of migratory information which tells it where to be at each time of year. We tend to lump all these different populations, each with its own migratory code, into single 'species' simply for the sake of convenience. However, when a population is extirpated, so is the migratory information it carries in its genes: the species will never return to its original haunts, even though it may survive in populations elsewhere.

Karu: the gentle genius

Remembering P. B. Karunaratne

Kelum Manamendra-Arachchi*

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Great men, I often think, fall into two groups. First there are those easily-recognised intellects that rise above their fellows through superior cleverness and productivity. And then there are those silent giants who devote all their attention to making other men great. The late P. B. Karunaratne was among the latter class. Karu, as he was universally known, was one of those rare men of science who was more given to stimulating interest in others than in using his knowledge to further his own interests. A king who spent much of his life making emperors of others.

Despite knowing more about the natural world than almost anyone who came into contact with him, Karu was unforgivably diffident and self-effacing when it came to using his knowledge to further his own career; unforgivable because he knew so much and yet wrote so little. Sadly, his modest output of published work will result in history relegating him to a relatively minor slot amongst Sri Lanka's natural historians. Imagine if you will, how Emmerson Tennent or Frederic Kelaart would be remembered had they not written their *Natural History of Ceylon* and *Prodromus* respectively. It is fit therefore, that before the sands of time erase memories still alive, that we record for posterity, even if only briefly, the life of this unique man.

Galketiyagodagedera Mahantemudiyanselage Punchi Banda Karunaratne was born at Kahalla, near Katugastota, Kandy to G. M. Kiri Banda (of the Ceylon Police) and Samarakoon Mudiyanselage Ranmenike on 16 January 1930. One of thirteen children, Karu was educated at Dharmaraja College, Kandy, which he attended up to his senior school certificate (SSC). The wealth of nature-related stories set in those early days in Kandy he would recount in later years suggests that his interest in natural history was kindled at an early age. His childhood fascination seems to have centred around butterflies, which he collected avidly and in many cases bred through the entire life cycle, having first identified the relevant food plants. Why he never went to university is not clear. He would suggest in later life that he had little patience for academic work, and in any case could not have entered university, having been an year over-age when he passed his entrance examination.

In June 1953, the 23 year-old Karu secured employment in the institution in which he had always dreamed of working. The National Museum was then at the peak of its fame, under the direction of Paul E. P. Deraniyagala. Having become the Museum's first native director in 1939, Deraniyagala was always on the lookout for fresh talent that would help enhance the institution's collections and scientific reputation. Immediately after he was hired, Karu was sent off to Jaffna, as Assistant in Entomology at the Museum's branch there.

The peninsula offered Karu a glimpse of a natural world quite different from that he had known among the verdant hills of Kandy. Yet, Karu found much to interest him, not least among the reptiles. The highlight of his sojourn in Jaffna was to come in 1958, when he nearly lost his life after being bitten by a deadly saw-scaled viper *(Echis carinata)*. Ever the unemotional observer, Deraniyagala wrote up the episode in the museum's journal, *Spolia Zeylanica*, in 1960, quoting Dr. N. Walloopillai, the physician who attended on Karu. "Mr. G.P.B. Karunaratne was admitted to Ward 8 of the Jaffna Hospital at about 3 p.m. on 17.10.58, with a history of being bitten by a viper at about 2.30 p.m. on the same day..."

Deraniyagala went on to write:

> "Mr Karunaratne was bitten on the left index finger by an *Echis carinata sinhaleya* that had been caught at Ariyalai five days previously and kept without food since its capture. Two or three drops of blood oozed from the hand and the surrounding flesh turned blue immediately. He also experienced a burning sensation which spread upwards to

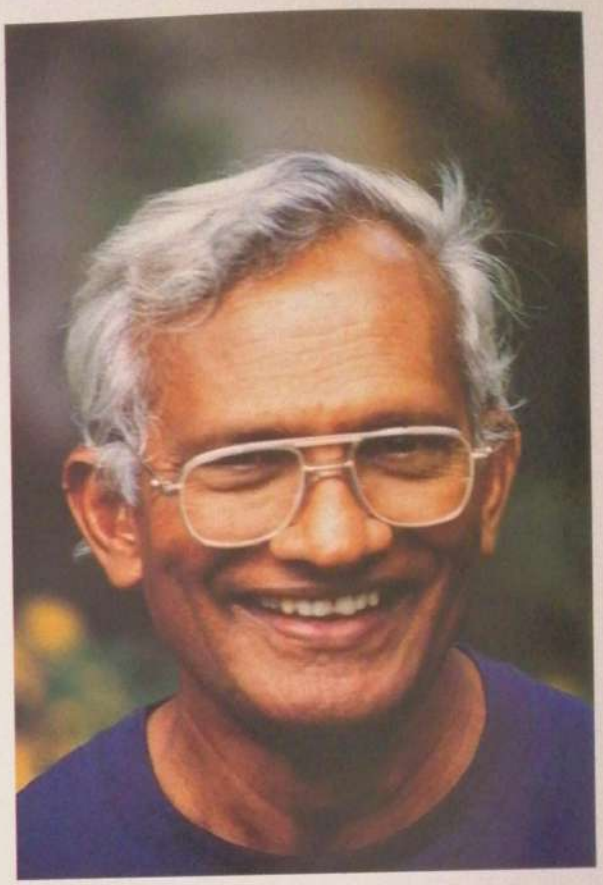
At work in the Colombo Museum.

the elbow. The finger commenced swelling and he sucked the wound to extract the poison. However, he found that the wound would not bleed, so after a few minutes he tied his finger above the wound with a cord and incised the site with a safety razor blade. The snake was preserved in formalin..."

Deraniyagala goes on to describe in dispassionate detail Karu's tryst with death, noting that he reported for duty two weeks later, on 3 November. Karu was transferred back to Colombo shortly thereafter and in 1963 became Curator in Entomology, a post G.M. Henry had aspired to in vain two decades previously. The museum would never recover from Deraniyagala's retirement in 1963, however. A giant among even great men, the diminutive Deraniyagala had dominated Sri Lankan natural history researches for nearly half a century. Like many dictators, he had cared little to groom a hierarchy of intellectual successors disciplined in his style of tireless research and prolific publication. Brimming with knowledge and ability but short of the paper qualifications that were becoming ever more important in Sri Lanka's fast-developing bureaucracy, by the late 1970s Karu decided he no longer had anything to offer the museum's increasingly apathetic management. Unhappy, disillusioned and too well-mannered to protest, he opted to retire.

Retirement, arguably, was to bring out the best in Karu. He was free to become involved in work he actually enjoyed doing, free from the senseless administrative routine and backbiting of the museum. Almost every young natural historian of any ability who had come into contact with Karu (Sarath Kotagama and Ranil Senanayake among them), were eager to engage him in their projects. Celebrated foreign workers too, engaged Karu to guide them in their fieldwork and exploration. The Smithsonian's world-renowned specialist in wasp taxonomy, Karl Krombein, worked extensively with Karu on his *Biosystematic studies of Ceylonese wasps* in the 1980s. Carl Gans, editor of the *Biology of reptilia* series and distinguished herpetologist, was another scientist who won Karu as a collaborator.

From 1980 to 1983, Karu led the field team conducting a faunal survey of the Sinharaja World Heritage Site under a project led by Sarath Kotagama. From 1983 to 1989, funded by a Ford Foundation fellowship, Karu served as zoo-archaeologist to the Department of Archaeology's survey of historic-period deposits at Mantota, near Mannar. He followed this with a two-year Archaeological and Ecological survey of the lands that were to be inundated by the Samanalawewa Project, conducting at the same time a survey of small mammals in the Udawalawe National Park (1989). From 1992 to 1996, he was contracted as National Consultant to the Forest Department's National Conservation Review (NCR), which for the first time sought to map the distribution of plants and animals in Sri Lanka. Karu's association with the NCR ended in early 1996, and he had two offers for other long-term exploratory projects in hand when he started feeling unwell.



Portrait: 1991.

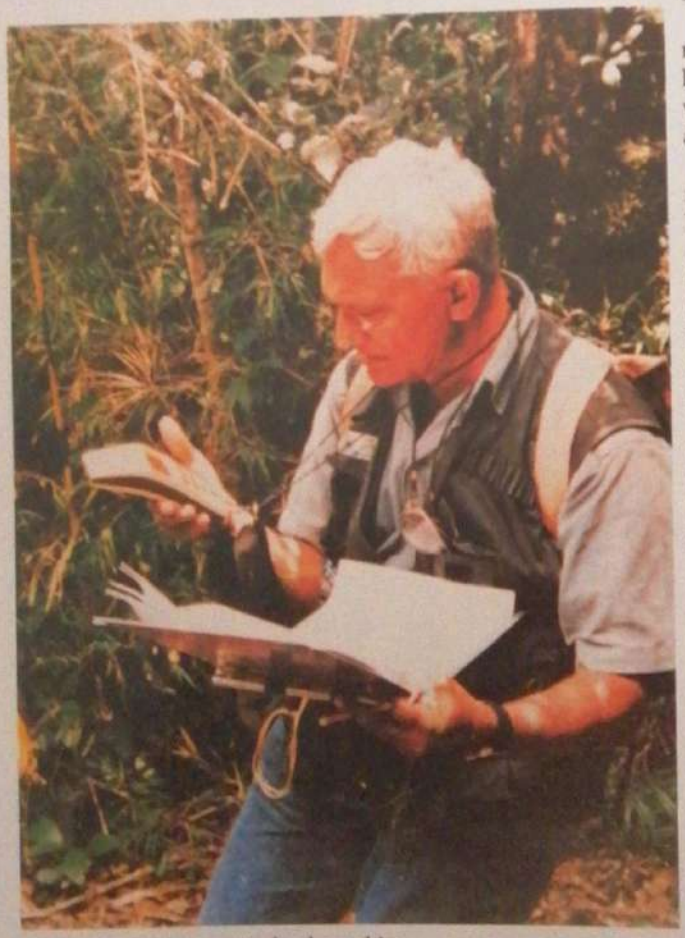
Opposite page: The dashing bridegroom on his wedding day—5 May 1968.

Dr. Karl Krombein would write, after Karu's death, that his knowledge of Sri Lanka's natural history was encyclopaedic. In Karu's case, this was actually true. From plants and trees, from insects to mammals, Karu seemed to know everything. A walk in the forest with him would be a treat, for he knew not just the names of almost everything but also the interrelationships that make natural science so fascinating. His knowledge of birds too, was profound (he wrote often in the Ceylon Bird Club Notes and was a founder member of the Field Ornithology Group). As a field worker, he was tireless, caring little for comfort, food or drink. Only once have I seen him lose patience, when a novice student working with him in on a survey in leech-infested Sinharaja stopped to remove a leech. Karu himself would work all day and remove leeches only after the day's work was

done!

At first, the pains he was suffering from were attributed to gastritis. As it happened, Karu's ability to endure pain might have been his undoing. He would suffer his agonies silently, not even confiding in close friends or even his doctors how serious his condition was. Finally he was diagnosed as having cancer, which had advanced to a stage in which it could not be treated. Karu was sent home to die, comforted by morphine and the loving attention of his family and countless young friends, almost all of them nature lovers of one kind or another. There, lying on his deathbed, he would keep his visitors spellbound with diverse insights he had of the natural world, and the exploits of his youth. Karu had grown up in an age when sport hunting was acceptable, and he had countless exciting hunting stories to tell. He remained a keen angler throughout, fishing both at the Colombo breakwater and, with even more interest, in numerous rivers, for mahseer (*Tor khudree*). The end came unexpectedly swiftly on 14 June 1996, at his home in Kohuwala, in the suburbs of Colombo.

Karu is remembered by more than a dozen insect species named in his honour, and a frog, *Microhyla karunaratnei*. In 1998 Rohan Pethiyagoda and I honoured him by naming after him a rare and endemic dwarf horned lizard, *Ceratophora karu*. Karu had known about it for years but, as was so often the case with him, did nothing about it. If he was privately pleased by these honours, he never showed it, and would always brush mention of them gently aside. In a 1969 paper in *Spolia Zeylanica*, Karu himself had described a new species of predatory hemipteran aquatic bug (*Hydrometra kahallensis*) and named it for his birthplace, Kahalla. In 1985 NARESA (now the National Science Foundation) bestowed on Karu its Award for Scientific Achievement, an action which touched him deeply: it was the first time he had been publicly honoured. In 1994 there was a move to offer Karu an honorary degree from the University of Peradeniya. Sadly, as is often the case in our country, this was obstructed by a group of people who neither knew Karu or cared to find out just how unique he was. Karu heard of the plan only after it failed, and was deeply hurt by the acrimony of his peers. This deeply gentle man never had a bad word even for his enemies.



Karu in the field, as most of us knew him.

Sadly, Karu's legacy is betrayed by his extreme modesty, which led to his reluctance to commit his knowledge to writing. Like many clever men, he was deeply conscious of what he did not know, and under

played the great wealth of knowledge he had. I met him first in 1980, when he came to the Dehiwala Zoo to deliver a lecture on butterflies to our association of young zoologists. Later, I was to have the pleasure of working with and learning from him both during the Sinharaja project and the archaeological survey which took us to many of Sri Lanka's most exciting cave deposits: Batadomba Lena, Alu Lena, Beli Lena, the Fahin Cave.

To his own mind, his greatest achievement was the spawning of a new generation of young people interested in natural history. He had much hope for them, and delighted in their ability, not least that of his son Laksiri, who Karu would often say, showed more ability and promise than himself. Karu left behind his wife Rita and daughter Lakmini, in addition to a great many people whose lives he enriched very greatly. Just how greatly, this most modest of modest men could never know.

Much of what Karu did publish appeared in *Loris* and the Ceylon Bird Club Notes. His articles in *Loris* include *Random notes on mammals and birds of the Kanneliya jungles* (1974); *The dung beetle* (1978); *Random notes on the amphibians of the Kanneliya jungles* (1986); and *Small mammal survey of Udawalawe National Park: preliminary report, March to May 1989* (1989). WNPS Special Scientific Publications include *Habitat preferences of small mammals in Udawalawe National Park* (1990) and *Fauna of the Samanalawewa area* (1992).

A prayer for Welanwita
(the old Welanmita)

By Lalith Seneviratne

A curious mind browsing through the inch-to-the-mile topographical map of Haputale would not fail to notice the seemingly totally isolated village of Welanwita nestling cosily among the southern foothills. Ever since this village caught my eye — reading about the general area in the *Ceylon Vagabond* by Lala Adithiya, that indefatigable trekker and story teller of the sixties— I would dream of getting to this tiny hamlet by passing more or less through the elephant corridor extending from Pokunutenna in the northeast corner of Udawalawe National Park to the hills of Haputale and Poonagala. This is one of the two approaches to the village, the other being through a turn-off on the Beragala-Koslanda road, until recently only a footpath, now developed into a fair-weather tractor track.

Finally, in February this year, I was able to find time—and two companions— for the trip. Michael Owen, an American diplomat, has a deep interest in Sri Lanka, and is someone who is just as much at home in the hinterland as in the city. Alan Pauling, a civil engineering consultant, is in addition an avid trekker. Our trio was joined by four guides from the sylvan village of Pokunutenna, our starting point. Tissa, a young and successful herdsman, knew the jungle tracks like the palm of his hand; what is more, he had an uncanny sense of direction in the jungle, an invaluable attribute for a long jungle trip of this nature. The enterprising Ariyaratne was *de facto* First Citizen of the village. Ajith, the first village lad to have obtained a university degree, was a teacher at a nearby school. And Mohottihamu, a senior citizen, lived a carefree life without a permanent abode—he had a reputation for roaming about the jungle for days on end without once having being harmed by any of the fearsome animals known to inhabit those forests: elephants, bears, leopards, snakes.

The sky was slightly overcast by midday, when we got our assorted paraphernalia assembled and gathered by the ancient Dewlane Wewa off the Kaltota-Tanamalwila road. Here our party was joined by P. M. Karunaratne and S. K. Godage, the principal and a teacher respectively of the school in which Ajith taught. The dam of the Dewlane Wewa was under restoration at the time, a couple of broken-down bulldozers gracing the site. The construction workers told us that they had been smitten by a string of bizarre equipment failures, which they superstitiously attributed to the unintentional unearthing of ancient treasures, known in Sinhala as *nidan vastu*. Our guides however, were of the view that the construction workers were actually hunting for treasure, and this was the cause of the mishaps. They said it was customary in days of old to hide treasure among important civil engineering works, to be used later to pay for maintenance and renovation. How far-thinking our forebears were! Any use of this treasure for personal gain, they assured us, would bring ill luck. Today however, it is common for treasure hunters to vandalise public works and temples in search of loot, oft times with success, in spite of laws which criminalize such activity.

Soon we were passing through pasture land and *chena* country, with numerous herds of cattle and buffaloes. The buffalo milk from this area fetches premium prices and is transported to far away places like Tanamalwila and Hambantota more than 70 km away, to make so-called Ruhuna curd, much in demand for its creamy (not sour) flavour. Being as they are on the forest border, the herdsmen have to protect their calves from being attacked by leopards. Once a leopard acquires a taste for calves and realises how easy it is to prey on cattle, it makes a habit of preying on calves and there is no end to the villagers' losses. Tissa told us that he himself had lost fifteen calves during the previous year.

The *talawa*

We had now left behind us all vestiges of civilization and entered the *talawa* country (savannah or parkland). These *talawas* consist of rolling hills of mana grassland interspersed with stands of trees which include medicinal treasures such as aralu, bulu, nelli and gammalu. The palm-like madu trees, reminiscent of the kind of vegetation one sees in movies like Jurassic Park, give the landscape a primeval feel. Kadumberiya plants, which provide leaves for the *beedi* mini-cigars, were also plentiful. Frequent fires prevent many less fire-resistant trees growing in this terrain.

Visibility in this open landscape is excellent. We noticed both old and recent elephant dung pats, signalling that we were within an elephant migration route. We were, in fact, walking along a path created by continuous trampling by elephants. It was evident from the freshness and the quantity of some of the dung (the temperature of the dung to the touch being an indication of freshness), that a small herd of elephants was moving ahead of us. Although we were ready for any eventuality, being armed with 'elephant flares', we knew that in this type of country, with lots of space and few people, elephants would avoid rather than confront humans. Nevertheless, we were all hoping for a glimpse

of the herd. Tissa told us we were passing through Karaditalawa.

As we proceeded along the narrow, long and winding valleys of the *talawa*, the vegetation changed quite abruptly to lush evergreen forest. The immediately perceptibe cool and damp were almost palpable—and refreshing. We could not help wondering at the ability of trees to retain moisture in the ground. It was almost as if that there had been recent rain, which we knew there had not. The jungle was now looking rather like a rainforest. Milla, mandoran, kaluwara (ebony), halmilla (Trincomalee-wood), damba, araththa and many other intermediate and wet-zone trees could be seen in plenty. Giant vines like puswal, kalawal and the parasitic baandura were snaking upwards into the trees. We noticed also the diminutive and endemic medicinal plant, bin kohomba. In earlier times villagers would harvest this plant, but it is now a protected species. We were surprised at the height and girth of many of the trees and wondered how it was that they survived the axe. So large were some of them that two people would have to hold hands to straddle the girth of some of the trees. The reason for them being spared then dawned on us: the lack of an access road for miles around. What a blessing, for these last remaining patches of virgin forest! The narrow valleys with the small copses of trees inevitably gives rise to ever-flowing streams. The beauty of these jungle streams, with their cool, crystal clear water, rounded large boulders strewn along their courses, and big, shady trees like kumbuk and damba lining the banks, are difficult to describe. We soon reached the Nelu Ara (stream), where we stopped for refreshments. Here we saw the distinct pug marks of a leopard, which we estimated (by the pug mark spacing) to be around 8 feet (2.44 m) from nose to tail-tip.

Elephants

We continued along the elephant path, up and down the rolling hills, and suddenly from a patch of forest in one of the valleys below, us a hundred metres or so to the left, we heard light trumpeting, accompanied by the sound of breaking of branches. This was a signal that the herd of elephants had sensed our advance. Clearly, it was wise to overtake them and leave them alone. This we did while trying to peer through our binoculars to get a glimpse of them hiding behind the trees. Having got passed them, we crossed another stream, the Garum Ara. As its name suggests, there were signs of gem prospectors having dug up the bank at several places. It seemed that a group of them had been there barely a day or two previously, so fresh did the charred logs in their makeshift fireplace appear. Here we stopped for a while and enjoyed a late lunch.

After our repast, it was back to the climb. This time we had to ascend the steepest stretch so far, compounded by the fact that we had just filled our stomachs with a hearty meal of rice and curry. We passed many rock caves, some almost as if they had been carved out of the rock: these, no doubt, were the lairs of the leopard and the sloth bear. Down again, on entering a forest patch, we saw the skeleton of an elephant, including the well-preserved skull. Perhaps it was an aged animal which died of exhaustion while climbing up the hill. In fact, the sheer incline of the hills and the narrow, boulder ridden crevices and ridges through which the path runs, made us realise how sure-footed and agile the elephants must be—quite contrary to what one might imagine. We noticed frequent Sambar droppings, indicating a healthy population of these magnificent deer.

After nearly five hours of travel we sensed that we were nearing human habitation, as indicated by the appearance of cattle and fenced-off land. Through a sugar cane plantation we saw the first village dwelling, a humble wattle and daub house. The family within welcomed us with smiles and offered us tea. In return we handed out biscuits and sweets to the children. We were, it became clear, close to a relatively recent settlement called Kumaratenna. One of the villagers led us to the centre of the hamlet and on to the track leading to Welanwita from the Beragala-Koslanda road.

Kumaratenna itself is a village totally dependent on sugarcane. The villagers grow it and manufacture crude sugar in the form of *juggery* which they sell to the traders from Haputale, who visit regularly. We were impressed by the fact that they traded not the cane itself but a 'value added' product, unlike is the case in many villages elsewhere in Sri Lanka. Some of the villagers owned rollers, driven by a pair of circling bulls, to extract the sugar cane juice; a few even had rollers that were pulley-driven by an engine.

Sugarcane

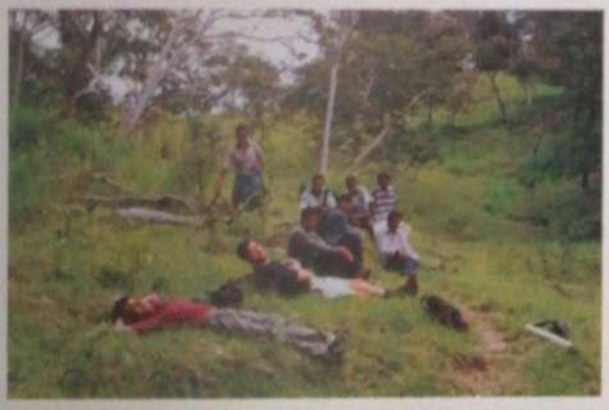
We chewed our fill of sugarcane and continued on the now well-defined track. After about two miles of walking through a peaceful forest patch, we reached our destination, Welanwita, encircled by small hills. We were greeted by a couple of children and their grandfather. Despite their evident surprise at seeing us, they willingly led us to the only 'decent' building in the village—the school. Luckily, the doors were open. Thanks to the teachers having left the village for the long weekend, this became our residence for the night. As the evening went on, curiosity got the better of the inhabitants, most of whom were clearly wondering who these strangers were. Soon, our credentials were established and the people relaxed. To our amazement we found out that my two fair-skinned companions were the first white people to have visited Welanwita in living memory—except, that is, for a wandering monk who had passed through without stopping.

Little by little, we began to learn about the village. Just before darkness fell, we had a dip in the refreshing village stream, which originates from an underground spring in the village. Completely refreshed, we soon recovered from the exhaustion of six hours of almost non-stop trekking. The spring (and another smaller one) are the lifeblood of the village, for without it there would be no water for agriculture. One family with seven children, the youngest being an infant aged just 25 days, volunteered to rustle up a meal for us. Such was the material wealth of this family that it did not possess a single cup or tumbler in which to serve tea. Darkness was not at all a problem, for it was the night before full moon. We had a long chat with our hosts over hot tea and then a wholesome meal. All of us went to sleep happy, awed by the isolation of the village and looking forward to the day ahead. Slowly the night chill settled in, and we had to cover ourselves snugly. We woke up with the first rays of the dawn sun to what appeared to be a beautiful, clear day.

Dutu Gemunu

The early morning was spent chatting with folks in the garden of the oldest inhabitant, Don Samel Seeya and his wife Ensohamy. Don Samel, it appeared, was 80 years old—but both he and his wife were clearly in excellent fettle. From him we discovered the origin of the name Welanwita. It seems that on an occasion when the great king Dutu Gemunu (161-137 B.C.) broke the hilt (*mita*) of his sword, a replacement was crafted from a welang *(Pterospermum suberifolium)* tree from this village. Welanmita was later corrupted to Welanwita, the present-day name of the village. The welang tree, which reaches a height of about 25 metres, is a native of Sri Lanka's monsoon and intermediate forests. Welanwita itself is in the intermediate climatic zone, between the plains of the dry zone and the moist central massif of Sri Lanka. Earlier, we had noticed leeches in small numbers along the stream— again suggesting that this is not strictly the dry zone. However, the villagers consider themselves to be dry-zone dwellers.

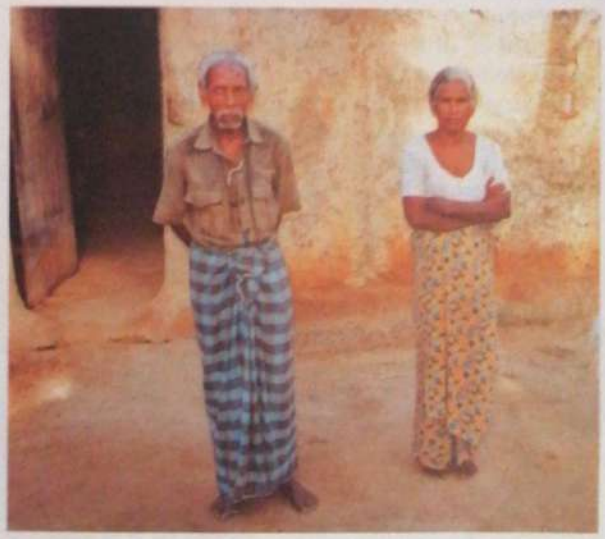
Thinking of the origin of the place name, we wondered as to what it was that attracted King Dutu Gemunu and his warriors to villages as remote as these. The answer probably is as relevant today as it was then. As far back as history records, the Sri Lankan people have been slow to think of themselves as a single nation— and thus respect each other. The king, with his vision of a united and great Lanka, probably realised that rallying the people together in the fulfilment of his vision was a priority if he was to ensure victory over the invaders that then threatened his kingdom. No doubt he and his warriors visited every nook and corner of the country for this purpose.



Above left: typical *talawa* country, grassland with scattered trees.

Below left: the *diyabubula*, a perennial spring yielding clear, cool water.

Below: Don Samel Seeya and Ensohamy, the senior citizens of Welanwita.



The villagers said they had no significant health problems except for occasional bouts of malaria. The nearest hospitals were at Haputale and Koslanda, a walk of 13 km followed by a bus ride of around 17 km. To the nearest post office and village headman was similarly a 13-km walk. Thus, the single most important development in the life of the village will be the conversion of the fairweather tractor track to at least an all-weather light truck track, a promise, according to them, made by all politicians visiting them in the run up to a poll, and quickly forgotten afterwards. Due to a lack of goods transportation facilities, the villagers are at the mercy of traders from Haputale who bring a tractor and purchase their produce of such as bananas, limes and oranges—all at rock bottom prices. The orange crop, we were told, has been failing in recent years, due to a disease affecting the trees. Apart from the tractor, the only other transport plying the track is a traditional bullock-cart or *thawalama*, which takes a day to get to town and another to return.

The school building, constructed in the 1960s, was in relatively good repair. Officially, the school has classes up to year ten, with a total student population of 50 (but average attendance, we heard, barely reaches 30). Four teachers have been allocated to the school but except for two dedicated ones, the others are absent most of the time. No student from the school has ever passed the G.C.E. (ordinary level) examination. Unless accessibility improves, it is unlikely that competent teachers will volunteer to be posted to so isolated a spot. We found however, that the school was be kept clean, with the garden relatively well maintained. Welanwita has no temple, but there is a very old and large huge bo tree that serves as an object of worship. So large is its trunk that it has completely encircled the granite Buddha statue at its foot.

Diyabubula

The outflow of the underground spring or *diyabubula* which feeds the village never reduces even at the height of the drought. According to legend, there emerged once upon a time from this spring objects such as the branches of a coconut palm, sea shells etc. The head of the spring had to be compacted with granite slabs positioned with the help of elephants to stop this. The stream which originates from this spring later becomes the Diyabetma Oya which joins up with Kuda Oya. The spring irrigates several patches of paddy in the village: these small rice fields are exceedingly picturesque, being encircled by thick forest. The villagers did not until recently use fertilizer or pesticides for paddy cultivation. Thanks to the tractor however, use of both is on the increase.

Appuhamy, one of the senior villagers, told us of the jungle shrine Kombuwa Kumbura Devalé, about 3 km south of the village. This shrine, which dates from time immemorial, is locally renowned for its mystic powers, especially in the location of stolen property and especially stolen cattle. In fact, in Welanwita that day were two people who had trekked the same path as we did from Kaltota, to pray for the recovery of a pair of bulls they had lost.

Devalé

At this point, instead of starting our return journey, we continued south with Appuhamy in search of the Kombuwa Kumbura Devalé. The first part of the journey was on a muddy track. After about 45 minutes' walk and crossing a stream, we reached the shrine. Unusually the shrine, which is in the open, consists only of a few granite slabs, a *lingam*- like piece of granite and a metal *trishula* (the weapon of the god Kataragama). The ritual consists of grinding a handful of pepper seeds on the granite slab and praying for the recovery of stolen property. The belief is that results will be seen within seven days, most often in the form of the thief admitting responsibility. Although the *trishula* was seen, Appuhamy mentioned that the shrine itself is dedicated to god Kalimaani.

With the morning wearing on, we decided to begin the return journey, retracing the path back through Welanwita. However, to add variation, we made a slight detour and walked parallel to Puwakgas Oya, which eventually joins up with the Weli Oya. As was the case in the onward journey, we thoroughly enjoyed the return, with camaraderie growing with every kilometre covered, and several stops by the streams to refresh ourselves. We returned to our starting point just before dusk, to a glorious sunset.

Reflecting on the trip, we fully sympathise with the Welanwita folks' plea for a motorable track. Sooner or later this will come, and so it should, for they deserve it. Going by the recent past however, the first casualty will be the forest, for with what would be equally a logging trail, the great trees will no doubt fall one by one. Then the forest will turn to shrub and the beautiful perennial streams that feed many rivers would be no more. So on and on. But this need not necessarily be the case. Sri Lanka has powerful protective legislation and committed and trained wildlife officials committed to conserving the country's biodiversity. Carrying the people, as did Dutu Gemunu two thousand years ago, does not need 'rocket-science' or long-drawn master plans costing millions of rupees. What we need are first, the political will arising from a conviction to do what is good for the country: this is entirely in the hands of a handful of people who manage our country. The rest will then follow, and we can then again be citizens of a proud, united and respected nation. This, to sum up, was the prayer of us all at the end of this most memorable excursion.

The Society's new headquarters

Ashley de Vos

Mr. Benny Abeyratne lights the ceremonial oil lamp observed by (from left to right) Mr. Hewage Jayasena, WNPS President Dr. Ranjen Fernando and past President Thilo Hoffmann (partly obscured) at the inauguration of the new WNPS Headquarters.

The declaration of Chaithiya Road as a high security zone brought the Society under immense pressure, with access to the building becoming progressively more difficult. Constant reminders from the Army requesting us to relocate prompted the Society to explore avenues with regard to shifting its headquarters to a more easily accessible location. As the UDA had agreed to allocate to the Society a block of land at 86, Rajamalwatta Road, Battaramulla, near the present Environment and Forestry Ministry, the committee decided to construct a new building, coincidentally also to celebrate its entry into its second century of existence.

Mr. Ranjith Jinasena, on behalf of the Society, requested Messrs Surath Wickremasinghe Associates to produce the original design. The land was marsh, posing a challenge to the architect and designer. Mrs. Jayasoma, a quantity surveyor attached to the State Engineering Corporation, was assigned the task of supervising the project and the necessary bills of quantities prepared. Subsequently, Mr. Ashley de Vos was requested to assist the Society by helping to implement the project.

Tenders were called by Newspaper Advertisement, but due to the difficulty in accessing Chaithiya Road, the response was poor. Two Tenderers submitted offers and the tender was signed with Messrs Duminda Builders for Rs.4,382,261.40. Due to a delay to mobilise the Contractor requested a 10% increase on the tender figure. The new figure of Rs.4,820,487.54 was approved by the committee in 1996.

The bad quality of the soil, nessicitated a contract for the reconstitution of the soil. This contract had been completed, as it was let prior to the commencement of the Building Works. Soon after the building work commenced, Mrs. Jayasoma left the country to take up an assignment abroad. The Society requested Mr. Ashley de Voz to take over the project and take measures and make necessary adjustments to ensure that the building was more cost effective. He was also requested to restudy the design and to make it more sympathetic to the Environment. The roof was changed and the design modified. This led to a reasonable reduction in cost.

The Chaithiya Road office was handed over to the Army on the 27th February 1999 and the Society officially started work in the new building on 2 March, 1999.

a. Original Building cost with 10% increase	4,820,488
b. Final Project Cost	
01 Duminda Builders (main building contract)	3,168,933
02 Aluminium doors & windows	510,525
03 Toilet fittings & tiles	122,352
04 Retention (2.5%), 12.5% GST less BTT	85,262
Final Building Cost	3,887,072
c. Extras outside main contract	
01 Soil Compaction	565,972
02 Water supply	24,700
Electricity Connections	5,414
Electric Fans	45,637
03 Boundary fence & gate	127,584
04 Mrs. Jayasoma (Consultant)	20,000
Mrs. Sarathchandra (QS, Final Bill)	10,000
Tender Notice	950
Total outside main contract	800,357
Final Building cost	3,887,072
Extras Outside Main Contract	800,257
Total Project Cost	4,687,330
Area of building	
Ground Floor	4,445 sq.ft
Upper Floor (excluding terrace)	1,118 sq.ft
Total	2,563 sq.ft
Cost per sq.ft. for building:	Rs.1,516.00 per sq.ft.
Cost per sq.ft. for project:	Rs.1,829.00 per sq.ft.

The New Headquarters Building of the Wildlife and Nature Protection Society of Sri Lanka

Photo Essay

SINHARAJA

By Rahula Perera

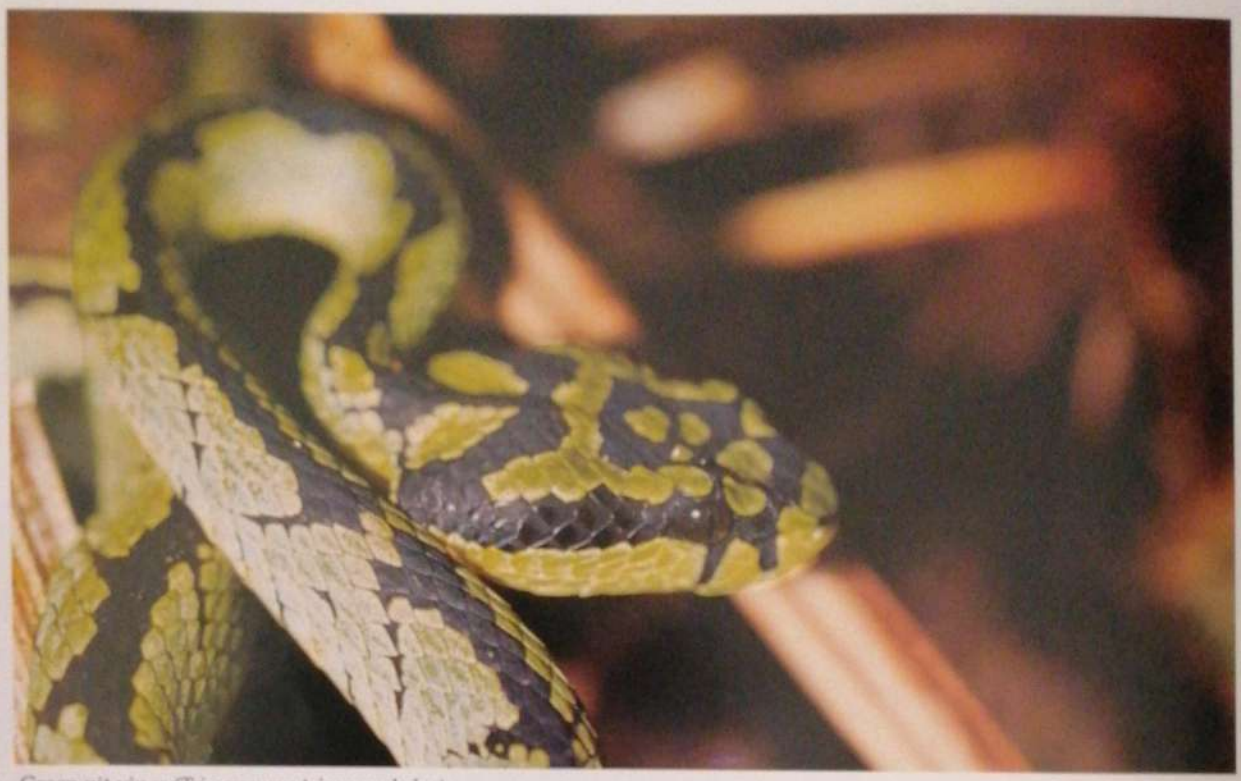
Stick insect.

Previous page spread: the 'closed canopy' of the largest surviving rain forest in Sri Lanka: the Sinharaja World Heritage Site. Inset: spores on the under-surface of a fern leaf (above), and the young leaves of a rainforest tree, red because it lacks chlorophyll (below).

One of a myriad rainforest spiders.

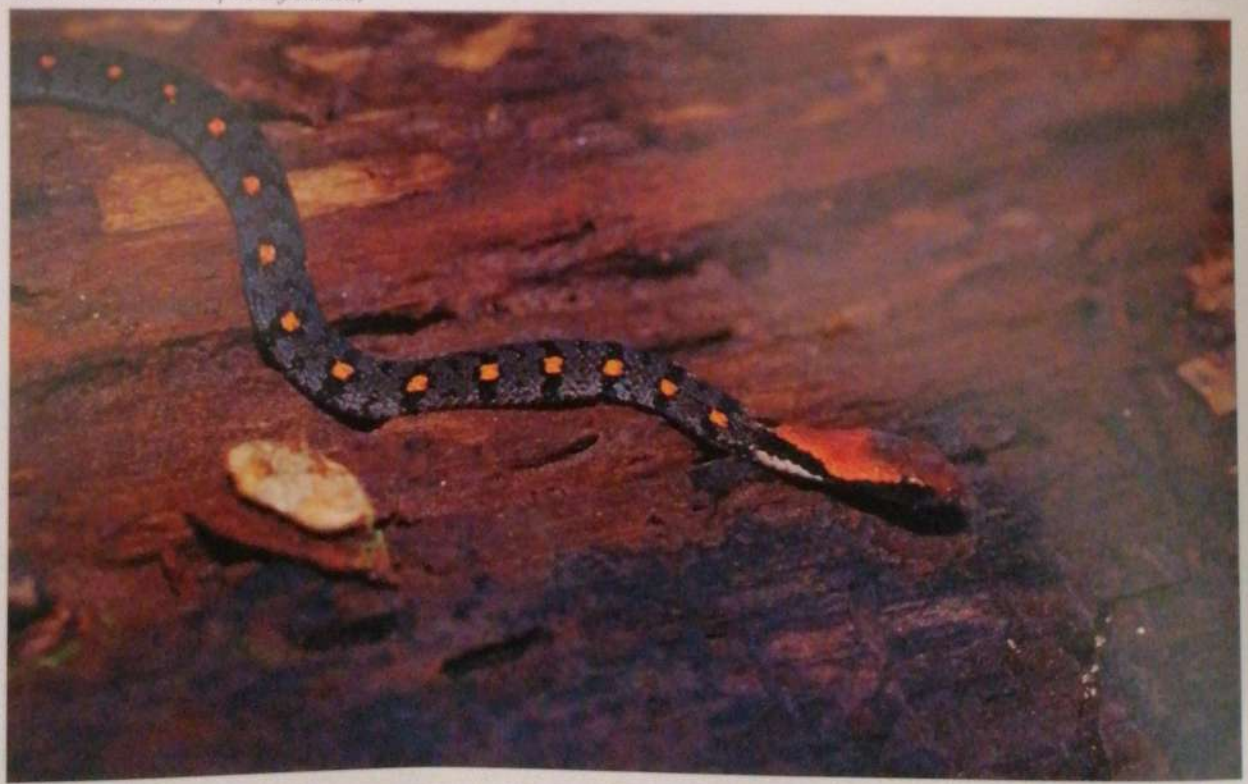
It is not only nectar that butterflies drink: they also 'puddle' in deposits of animal urine.

Damselfly.



Green pit viper *(Trimeresurus trigonocephalus)*

Blossom krait *(Balanophis ceylonensis)*



Otocryptis wiegmanni

Green graden lizard (Calotes calotes)

Left: a fallen tree decays and decomposes, its nutrients offering new hope to the thousands of saplings that will use the 'light gap' in the canopy to begin their rush to compete for a place in the sun.

Dainty agarics, the wild mushrooms of the forest.

Pitcher plant.

An undescribed species of tree frog, its toes pigmented in red, looking rather like they have been manicured with nail polish.

BirdLife
INTERNATIONAL

BIRDLIFE INTERNATIONAL ANNOUNCES A UNIQUE OPPORTUNITY TO HELP SAVE BIRDS FROM EXTINCTION

As part of its Globally Threatened Species Programme, BirdLife International will ensure that by next year there is widely available, up-to-date information on all bird species considered to be in danger of extinction. This information will be published in a book *Threatened Birds of the World*, which will discuss the status, threats and potential conservation measures for every species at risk. Each species will be illustrated and accompanied by a map depicting its range. *Threatened Birds of the World* will be a powerful tool to encourage governments, policy makers and communities to take the necessary steps to ensure the survival of over 1,200 species now facing extinction.

BirdLife International is looking for individuals, not-for-profit organisations and commercial companies to play a special role in the Globally Threatened Species Programme. Each species in the book can be sponsored and the funds raised will be used to ensure that the book is distributed as widely as possible. The BirdLife International Partnership can then put the conservation recommendations into action around the world.

Individuals can sponsor one species for US$165 (£95 sterling) not-for-profit organisations can be sponsors for US$430 (£250 sterling) and commercial companies for US$850 (£500 sterling). Species are allocated on a first-come, first-served basis. All sponsors will have their name printed as an acknowledgement alongside the species of their choice.

This is a unique chance for birders, ornithologists, bird clubs, expedition teams, researchers, conservationists and companies to choose a bird that matters to them and publicly support international conservation efforts to save it from extinction.

Choose your bird soon - before someone else does!

For further information and a sponsorship form please contact:
Naomi Hawkins, BirdLife International, Wellbrook Court, Girton Road, Cambridge, CB3 0NA, United Kingdom Tel: + 44 1223 277318 Fax: + 44 1223 277200
Email: naomi.hawkins@birdlife.org.uk

The Sri Lanka waterfowl census, 1997

By Thilo W. Hoffmann, National Coordinator

The 14th national count in January 1997 was subject to the same security restrictions as in recent years (see 1996 report); however, some very limited work was possible in the Jaffna Peninsula. Again we were short of volunteers for inland wetlands.

We thank the following participants: C. B. Bavinck, T. W. Hoffmann, Lester Perera, Elmo Alles, Lucky Abeywardena, Jagath Gunawardana, U. Sirivardana, S. C. Seneviratne, Hemantha Seneviratne, Sampath Seneviratne, Deepal Warakagoda, Niroshana Herath, Kithsiri Gunawardena, Uditha Hettige, Bennie Abeyratne, A. A. Munasinghe, Ismeth Raheem, Nanda Senanayake.

The total number of birds (120,215) was almost double that of last year, most of the increase coming from the south coast and the partial count in Jaffna. The transformation of wetlands into prawn farms in the coastal belt from Chilaw to Kalpitiya has further diminished the importance of that formerly valuable wetland area: ducks were practically absent from this part of the country. The results by area are shown in Table 1. Table 2 presents the area-wise figures over the last few years. The general trend towards fewer winter migrants is now confirmed. It would appear that at least some of the birds displaced from the north-western main sector are now increasingly using the south.

The number of species recorded during this census, 86, was also low, is 8 less than last year, the deficit being in respect of waders (minus 3) and gulls and terns (minus 5). The resident birds are quite stable, but ducks were again very low and waders about average. The fact that the northwest and north cannot be properly censussed is reflected in the relatively low figures for gulls and terns since 1993. Flamingoes in fair numbers were found in the Hambantota area throughout the year. A notable feature this winter was the large number of Black-tailed Godwits in the south; such numbers had

Table 1. Totals of waterbirds and distribution in main areas (1997).

Species	No. of species	Total	Jaffna area	Portugal Bay to Chilaw coastal	Puttalam Chilaw Freshwater	Chilaw Galle all Wetlands	Galle Yala Coastal	Inland Tanks North	South-east Fresh Water
Grebes	1	236	0	0	106	51	52	21	6
Pelicans	1	640	0	0	105	53	163	33	286
Cormorants and Darters	3	8,521	0	1,152	1,312	313	3,756	533	1,455
Herons	12	12,365	600	1,657	1,354	582	5,160	1,911	1,101
Storks	5	1,623	0	0	264	311	687	122	239
Ibises	3	1,341	0	0	116	253	563	369	40
Flamingoes	1	2,600	200	0	0	0	2,400	0	0
Ducks	6	24,697	9,840	302	2,857	478	11,080	140	0
Rails, Coots	6	1,650	0	12	336	284	882	128	8
Jacanas	1	1,214	0	0	343	58	698	100	15
Waders	33	54,707	300	9,189	346	242	44,130	289	211
Gulls, Terns	10	10,478	0	2,974	428	946	5,600	180	350
Raptors	4	143	0	37	10	42	26	16	12
Total	86	120,215	10,940	15,323	7,577	3,613	75,197	3,842	3,723
						Galle Ranna 1,641	Hambantota 55,687	Yala 17,868	

Table 2. Totals of main sectors compared with previous years (* signifies only part of the area was covered).

	1997	1996	1995	1994	1993	1992	1991	1990
Jaffna	*10,940	0	*16,218	*8,652	0	*20,913	*13,929	98,288
Mannar	0	0	0	0	0	*400	*1,213	48,730
Trincomalee	0	0	1,256	9,433	0	0	0	0
Portugal Bayto Chilaw Coast	15,323	17,065	28,006	13,745	14,499	59,847	64,841	10,609
Puttalam–Chilaw Freshwater	7,577	7,786	131,025	5,061	10,070	7,938	22,405	3,746
Chilaw–Galle (all wetlands)	3,613	1,625	5,942	6,772	9,521	16,357	14,867	5,711
Galle–Yala Coast	75,197	32,665	43,454	21,739	76,362	70,295	18,111	73,699
Inland Wetlands (tanks) N	3,842	5,027	8,581	9,323	19,658	14,697	34,340	7,948
Inland Wetlands (tanks) S-E	3,723	2,786	1,838	1,196	1,491	676	5,461	5,097
Total	120,215	66,954	236,320	75,921	131,601	191,123	175,167	253,828

Table 3. Totals of groups of waterbirds compared with previous years

	1997	1996	1995	1994	1993	1192	1991	1990
Grebes	236	1,114	433	139	413	561	177	150
Pelicans	640	340	570	756	722	908	3,010	1,323
Cormorants	8,521	7,260	11,372	8,461	10,399	15,543	20,897	7,849
Herons	12,365	11,080	14,415	13,532	13,551	26,263	18,912	12,405
Storks	1,623	1,837	2,019	576	1,035	1,337	1,510	2,127
Ibises	1,341	1,054	1,200	1,392	1,149	1,038	1,270	1,038
Flamingoes	2,600	1,177	188	138	250	1,397	7	2,250
Ducks	24,697	17,044	163,272	18,276	20,669	38,718	42,460	105,250
Rails, Coots	1,650	1,589	2,755	940	1,785	2,249	4,149	2,082
Jacanas	1,214	1,071	1,294	736	1,342	0	0	0
Waders	54,707	17,349	30,774	20,257	69,066	81,261	57,357	89,567
Gulls, Terns	10,478	5,915	7,919	10,561	11,112	21,700	25,299	29,787
Raptors	143	124	109	157	108	152	119	0
Total	120,215	66,954	236,320	75,921	131,601	191,127	175,167	253,828

earlier been recorded only in the Jaffna Peninsula. Noteworthy also (though not reflected in the count) is the large number, 80, of Broad-billed Sandpipers at Bundala in November 1996, and 40 at Palavi in February 1997. The Broad-billed Sandpiper is normally a scarce winter visitor to Sri Lanka.

Rare birds noted during the 1997 count: two Black-necked Storks; one each of Ruddy Crake and Slaty-breasted (Blue-breasted Banded) Rail; two Spotted Redshank; two Green Sandpipers; one Red-necked Phalarope (at other times during the season there were 4 to 7 at Bundala); one Ringed Plover; one Caspian Plover.

Habitats. Natural wetlands continue to be converted to human uses on a major scale and this trend cannot be arrested in the foreseeable future. It now also affects the south, the last remaining area of importance for wintering waterbirds, apart from the now inaccessible major wetlands in the north, northwest and east. The latter are 'protected' by the on-going conflict in the country, but once it is resolved, will probably suffer the same fate as those in the south. Despite the CEA and the Wetland Conservation Project, there does not appear to be a prospect of meaningful wetland conservation in Sri Lanka. There can be no hope as long as human uses of natural resources are regarded *per se* and *a priori* to be vastly more important than their conservation.

Acknowledgements
We thank NORAD for financial support and Mr. Gunther Lamsfuss for his donation.

Ceylon Bird Club Notes, 1997

Thilo W. Hoffmann

As in the previous year, some talks on bird subjects were held and a few field excursions were organized. One of the guest speakers was Dr. Robert L. Fleming, Jr. The Club has considerable correspondence, mainly with overseas contacts, as part of its service to bird-watchers and ornithologists.

New records and rare species

For various reasons, including a lull in new and rare sightings, the Rarities Committee did not meet during the year. Rare species observed in 1997 include: a Rufous-necked Stint at Kirinda Kalapuwa in December by Deepal Warakagoda (the second record, first being by Rex de Silva in February 1996); a Large White-rumped Swift or Pacific Swift (*Apus pacificus*), the second record, by M. J. Pointon from the U.K. at Bentota, in December; and a Jouanin's Petrel off Colombo in November, by Himal Warakagoda (fourth record).

Habitats

There was no change in the general trend, with continuing degradation of most natural habitats in Sri Lanka. Official indifference with regard to these irreplaceable resources is near total. 'Economic progress' is the key-phrase to which all other interests are subjugated. Once the armed conflict is over, the remaining natural areas in the east and north, which have so far escaped (especially wetlands), will also probably be engulfed in the war of 'development' and be destroyed in the process.

Following the avifaunal survey (1992–94) by members of the Club, and subsequent persistent lobbying, the Annaivilundawa cluster of tanks was declared a sanctuary under the 'Fauna and Flora Protection Ordinance' in June 1997. With the systematic destruction of wetlands in the Chilaw-Kalpitiya coastal belt, this sanctuary is now of particular importance and we expect that the Department of Wildlife Conservation

will continue to watch over it and enforce the law and regulations, especially in relation to visiting hunters. The Club recommends that the Annaivilundawa Sanctuary be designated a site of international importance for waterfowl under the Ramsar Convention.

Waterfowl count

The total number of birds counted in 1996 was incorrectly printed in last year's report (*Loris*, 21(3): 112–113) as "just over 120,000" when the actual figure was in fact around 67,000 birds, the lowest number since censusing commenced in 1983. The 14th annual census in January 1997 yielded just over 120,000 birds, compared with typically 200,000–300,000 in earlier years. Once again, due to the adverse security situation, the census was confined to the western and southern parts of the country.

Raptors

In 1996, raptors were reported in numbers similar to those of previous years, there being no apparent shifts in either distribution or status. Most numerous continue to be the Crested Serpent Eagle and the Crested Hawk-Eagle. The Black Eagle is increasingly reported (25 sightings). Also reported in good numbers were the Grey-headed Fishing Eagle, White-bellied Sea Eagle, Black-winged Kite, Crested Honey-Buzzard, Brahminy Kite and Shikra. The Common Buzzard was noted ten times. Rare sightings include one each of the Black Baza, Brown Baza, Besra Sparrow-Hawk, Long-legged Buzzard, Osprey and Peregrine. The scarcity of Harriers continues, with only one report of a Pallid Harrier and two of Marsh Harriers; it is expected that these sightings will increase when the north and east become accessible again to birdwatchers. Hermann Dottlinger's Shahin study was continued. Few Owls were reported, the most numerous being the Chestnut-backed Owlet.

Digest

Since its founding in 1943, the Club has regularly published its monthly notes. The more interesting sightings are listed below.

January. Flamingoes were quite numerous in the Hambantota area throughout the winter (up to 3,000), with smaller numbers in the north. A large concentration of Black-tailed Godwits (over 6,000) at Kalametiya. Four Sand Martins, two and seven Red-necked Phalaropes, and a Caspian Plover at Bundala.

February. A Great Knot at Vallai Bridge in Vadamarachchi. A White Wagtail at Uda Walawe, also ten Blyth's Pipits, a Grey Drongo, and the annually returning Black-capped Kingfisher. A Red-necked Phalarope at Karagan Lewaya, and over 1,000 Black-winged Stilts at Bundala. Two Grey Drongos at Yala. A Green Sandpiper at Nuwara Eliya. Ten Alpine Swifts in the Horton Plains, five Glossy Ibis at Bellanwila. A Malay Bittern in Sinharaja and another at Gilimale. Forty Broad-billed Sandpipers at Palavi, and an Orange-headed Ground Thrush at Kaduwela.

March. The nest of a Spotted-winged Thrush at Kottawa FR; Broad-billed Rollers at Kitulgala and Sinharaja; also a Scaly Thrush and a Banded Crake. Ruddy Crake at Kalawana. Scaly Thrush at Sita Eliya.

April. Two Great Cormorants at Pothana Wewa. Orange-headed Ground Thrush at Uda Walawe. Hume's Whitethroat at Kalametiya. Breeding of variant Black-winged Stilts at Bundala. Three Short-tailed Shearwaters at Colombo.

May. A nesting colony of Spot-billed Pelicans at Kalametiya. Five Red-billed Tropicbirds in the Hikkaduwa area. Barn Owl at Bundala. Black-backed Yellow Woodpeckers at Dodangaslanda.

June. An Avocet at Bundala. Lesser Frigatebird caught at Ratmalana, and another over Colombo. Many reports of breeding of resident species.

July: Three Great Cormorants and one Glossy Ibis at Habarana. Fifty Great Cormorants at Polonnaruwa. A Brown Skua captured at Kelaniya.

August. A Swinhoe's Storm Petrel off Colombo, and a Lesser Frigatebird. Three Spotted-winged Thrushes at Tangamalai Sanctuary.

September. Black Baza at China Bay. Nest with a single fledgling of the Green-billed Coucal at Sinharaja.

October. Sixteen Avocet at Bundala. Flamingoes have increased to over 1,000.

November. Grey Drongo at Colombo; this species is now increasingly noted. A Spotted-winged Thrush with three chicks at Sinharaja. Jouanin's Petrel off Colombo (fourth record). Two Orange-headed Ground Thrushes at Sigiriya. Long-legged Buzzard at Horton Plains.

December. Large White-rumped Swift, *Apus pacificus*, at Bentota (second record). Rosy Starlings at Vallai. Pallas's Grasshopper Warbler at Bellanwila. Black-capped Kingfisher at Uda Walawe. One Rufous-necked Stint (second record) at Kirinda Kalapuwa.

List of special papers in the *Ceylon Bird Club News*, 1997:

Hoffmann, T.W. (April). Sunbirds on our verandah.
Hoffmann, T.W. (May-June). The roosting rocks for seabirds on the shore off Colombo Fort.
Hoffmann, T.W. (September). Notes on the distribution of some Sri Lankan birds.
Perera, L. & Perera, U. (October). Nest building of Flamingoes in Sri Lanka.

Book reviews

The Birds of the Indian Subcontinent
Richard Grimmett, Carol Inskipp and Tim Inskipp. Oxford University press, India. ISBN 0-19-564907-9. Rs 4,500/-

By Gehan de Silva Wijeyeratne

[Editor's note: Mr de Silva Wijeeratne bases this review on the edition of this book published by Christopher Helm, an imprint of A&C Black, London: ISBN 0-7136-4004-9, £ 55. The edition presently sold in Sri Lanka however, is that by OUP.]

The publication of Birds of the Indian Subcontinent sets a new standard for ornithological publications for the Indian region. This is not say that the literature or the illustrations have not been available before. Ali & Ripley's 10 volume handbook series published between 1968 and 1975, subsequently issued as a compact edition have been the standard reference for many years. The Pictorial Guide with plates by John Henry Dick has been around since 1983.

What set this book apart, is that for the first time we have concise, but nevertheless good species descriptions with first class illustrations of virtually all the birds of the Indian subcontinent. The quality of the illustrations alone set it apart from anything else available before. The twelve artists who have contributed to this landmark publication are among the best contemporary bird illustrators. The plates by Clive Byers and Alan Harris are exquisite. One wonders whether bird illustration can get any better.

The book is structured with the first 37 pages on relatively brief preliminary sections covering climate, habitats, migration, conservation and organisations. This is followed by the 153 plates in field guide format. 513 pages of text follow making the meat of the book finished off by 30 pages of references and indices. The references have been restricted to key papers as a full list is to be published as a separate bibliography.

Despite the concise text covering 2-3 species on a page, the book still runs to 888 pages given the need to cover 1,295 species. Weighing-in close to two kilograms, it has the shape and weight of a *handbook* and makes it an unlikely candidate for use in the field. In true handbook fashion, there is a wealth of up- to-date information. However, a short account for each species, necessary to achieve a single volume, means it will not be a substitute for Ali & Ripley nor an alternative to a country-specific guide such as Henry's *Guide to the Birds of Ceylon* (1998). For detailed information at species level, such other sources of reference will remain indispensable.

A key feature of the book are the distribution maps for each species. The maps alone would have been worthy of a separate publication. Unfortunately they have suffered from being reproduced small, a pity as it is clear that much work has gone into them to mark recent records and range extensions. It would have been useful if the distribution maps marked out distinct races with disjunct distributions. This would have added a useful visual clue to the taxonomic work that needs to be done to identify some of the 'cryptic' species in the region.

The case for reviewing the *Pycnonotus melanicterus* complex of the Black-crested Bulbul is to cite one example of interest to Sri Lankan ornithologists. Another example is Wijesinghe's (1994) re-elevation of the nominate 'race' *rubricapilla* of the Crimson-fronted Barbet into a distinct species, the Ceylon Small Barbet, by splitting it away from the 'race' *malabarica* in the Western Ghats. Although the authors note that it is 'a small colourful Barbet, occurring as two distinctive races in the Western Ghats and Sri Lanka', there is no discussion of Wijesinghe's contentious re-elevation. This may disappoint serious regional birders who take their taxonomic debates keenly. However, if the book is used in conjunction with Inskipp *et al.*'s *An annotated checklist of the birds of the Oriental Region*, the relevant references for any taxonomic debate can be found easily.

Admittedly, it may be too onerous a task to map the distribution of each race. But one hopes that a future edition will at least mark out on the maps those species that might potentially split. However, it would be misleading to give the impression that the subspecies level has been ignored. This is certainly not the case. Although in some cases the text merely records the number of subspecies recognized, where distinct forms are concerned, the authors and artists have sought to describe and illustrate them. This is highly desirable, if not essential, as some of these distinct forms may with time be elevated to species. Raising awareness of them is important not only for birdwatchers but for conservationists as well. There are too many examples to cite, but birders resident or visiting Sri Lanka will be pleased to see many Sri Lankan races illustrated and discussed in the text.

To conclude, what we have is neither a full blown treatise to rival Ali & Ripley nor a field guide. What is on offer is a handbook that provides something between

the two ends of the spectrum, subject to the inherent limitations of a single-volume work. The casual birdwatcher, envisaging a one-off visit, should be excused for preferring the stripped down, lighter, portable 'field guide' version. The serious regional enthusiast would however find it difficult to leave a gap in his or her collection, by not acquiring this book.

Overall, it is a superb book and is undoubtedly a splendid addition to the collection of the book collector or the serious birdwatcher. But quality comes at a price. £55 for the Christopher Helm imprint of A&C Black, makes it expensive for residents of the subcontinent. The OUP edition is more affordable.

Literature cited

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*Gehan de Silva Wijeyeratne is lead author of **A birdwatcher's guide to Sri Lanka** published by the Oriental Bird Club. He is currently working on the **Pica Traveller Sri Lanka**, a new-genre travel guide for wildlife and culture* [ISBN 1-873403-87-9].

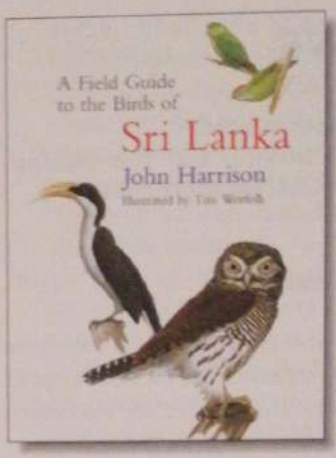
A Field Guide to the Birds of Sri Lanka
John Harrison with illustrations by Tim Worfolk.
Oxford University Press, India. ISBN 0-19-854961-X.
Rs. 2,650/-

By Rex I. de Silva

The long-awaited field guide to Sri Lankan birds has finally arrived. Does it live up to the pre-publication expectations? The answer is a qualified "yes".

The introduction gives brief information on climate, geography and vegetation. A map shows the large-scale topography, climatic zones and national parks. This is followed by brief descriptions of areas of wildlife interest and lists of some of the birds likely to be encountered in them. The listing of useful addresses which follows inexplicably omits the *Field Ornithology Group of Sri Lanka* (FOGSL), the largest ornithological organisation in the country and the official *Birdlife International* partner for Sri Lanka.

The guide follows the arrangement of orders, species and scientific names of Howard and Moore's *Complete Checklist of the Birds of the World*. These are modified in some instances by those of OBC's *Annotated checklist of the birds of the Oriental Region*. The author has chosen to simplify some technical terms and thus prefers "nape" and "eyebrow" to "nuchal" and "supercilium". Nevertheless, I am uncomfortable with his use of "armpit" for "axillary". A useful glossary of ornithological terms is included.



The author states that all 426 species in the official checklist are included in the guide. (There is in fact no nationally accepted "official" checklist for Sri Lanka, and the actual number of species recorded to date is around 445.) Species accounts are prefaced by general pointers to identification for each family. The species descriptions are in the now familiar "field guide" format and list alternative scientific and common names. This is a useful feature considering the numerous recent changes in taxonomy and nomenclature. It is encouraging to note the author's use of "Sri Lanka" in bird names (e.g. "Sri Lankan Blue Magpie"). The species descriptions are accurate and fairly comprehensive and, when used in conjunction with the plates, should enable even beginners to identify most species. I "field tested" several of the descriptions and could find no errors. The descriptions of calls (vocalisations) are adequate. The status, distribution and habitat descriptions were accurate for all the species I tested. A welcome inclusion is the concise description of nests (but not eggs) and nesting seasons. This is a feature that more field guides could follow, especially as this information can usually be included in a single sentence. Each species description ends with an account of its range outside Sri Lanka.

The separation of plates from text is inconvenient in a field guide, but is probably made necessary by the number of species in each plate. Short identification summaries opposite each plate alleviate this problem to some extent. However, as these are often very brief, the reader may need to refer to the main text for more information. This is expedited by cross referencing. Small colour-coded distribution maps are provided alongside the identification summaries for all species other than vagrants.

The 48 plates by Tim Worfolk vary from good to outstanding. They show sex- and age-related variations and also depict many species in flight. The birds in a single plate all face in the same direction, making comparisons easy. A few plates are overcrowded (e.g. Plate 8, ducks; and Plate 11, harriers); however, even

here the illustrations of individual birds are clear. The grey background to Plate 25 (skuas and gulls) detracts from the figures— another colour would have been advantageous. However, these are minor criticisms and do not detract from the overall excellence of the plates.

Situated between the text and plates is a comprehensive index to both the English and scientific names. Several entries "tested" by me had no errors. A single-page bibliography is included. Surprisingly, this does not include the earlier *Field Guide to the Birds of Sri Lanka* by Kotagama and Fernando (1994).

The book comes with sturdy weather-resistant covers which should withstand the rough usage to which field guides are often subjected.

Despite some minor criticisms, this is a comprehensive and reliable work which fills a long-felt void in Sri Lanka's ornithological literature. The book will be of value to both neophyte and experienced ornithologists alike: my copy will certainly have a permanent place alongside my binoculars. A drawback is the high price, which may place the book out of reach of many. A paperback edition is listed and it is hoped that this will be more affordable.

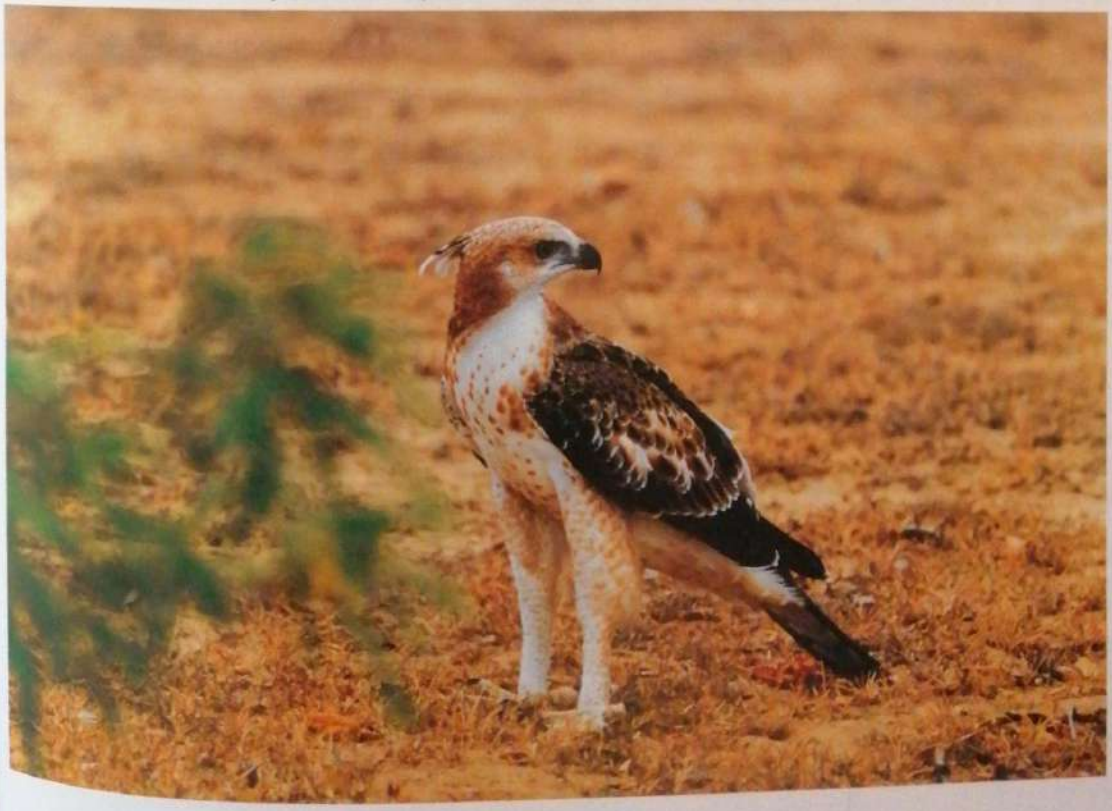
NEWS

TREE PLANTING CAMPAIGN IN COLOMBO

The Wildlife and Nature Protection Society also took part in this ceremony, which was organized by the Environment Sub-committee of the Colombo Municipal Council under the Chairmanship of Mr. Wimal Gamini Rodrigo, MMC. The members of the Nature Club at St. Bridget's Convent will look after the plants.

Colombo Mayor Omar Kamil planting a mee *sapling at a tree-planting ceremony held on 22nd May 1999, opposite St. Bridget's Convent, Colombo 7 (photo: M.T.Q. Fernando, Colombo District Representative).*

The Changeable Hawk Eagle (*Spizaetus cirrhatus*): a photograph contributed by Palitha Antony (Life Member).



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Count the elephants! It is unusual today to see herds of this size. This photograph was taken on 14 May, 1999, at Minneriya, by Dr. H. I. E. Katugaha.

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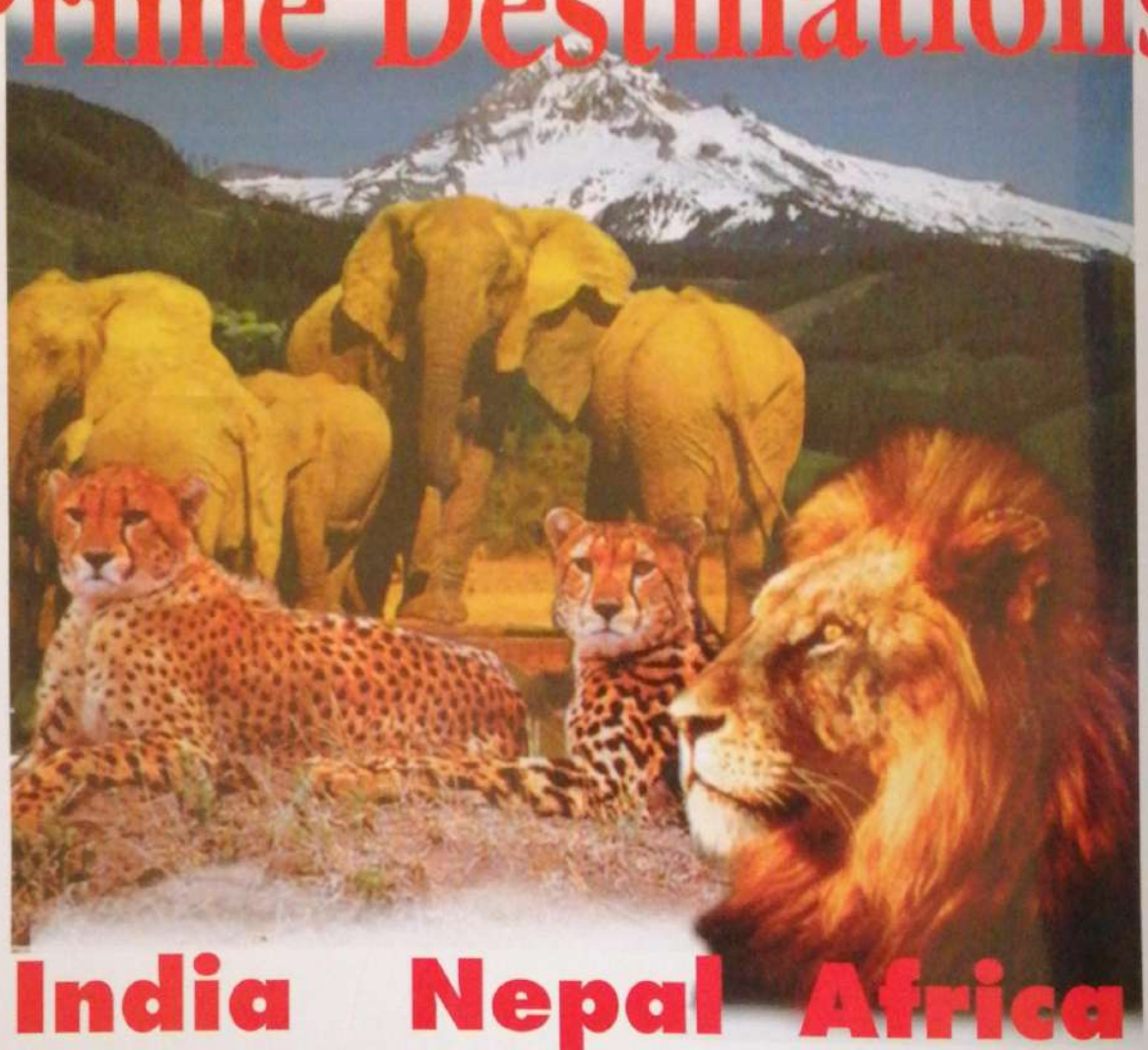

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December, 1999

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Loris

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Volume 22, Number 2
December 1999

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Cover photograph: *Featherstars on Negombo reef. Courtesy Dr. Charles Anderson.*

Edible crabs of Sri Lanka

Mohomed Bahir

Wildlife Heritage Trust of Sri Lanka

Of all the animals we commonly eat, I regard crabs and mollusks as being the most bizarre. Faced with the prospect of eating a spider or a snail, most people are ready to throw up. But crabs are quite closely related to spiders (just as squid are to snails). What is more, both crabs and squid are commonly eaten in Sri Lanka, especially along the coast. Crabs are commonly sold in almost every fish market, though the price restricts the delicacy to the affluent middle classes. Today, thanks to a lucrative export trade, crabs (especially mud crabs) are beyond the purses of most Sri Lankans (I was amazed on a visit to Singapore recently to discover that Sri Lankan mud crabs were advertised at several speciality restaurants). Export-quality mud crabs are usually larger than average, often in excess of 1 kg apiece. Visits to a few fishmongers who do specialise in crabs soon demonstrated that if you like your crabs large and fleshy, you could be asked to pay anything up to Rs 400 per kilo.

Although I have for several years been working on the taxonomy of Sri Lankan freshwater crabs, I paid scant attention to the larger, edible crabs because I assumed they were well known and well studied. However, my very first visit to the market, in search of crabs, proved me wrong. According to the fisheries literature, there is only one species of mud crab (*Scylla serrata*, the Giant Mud Crab) in Sri Lanka. Distributed widely over much of the western Indian Ocean, *S. serrata* is a large species of crab, in Sri Lanka sometimes reaching 3 kg in weight, with a carapace width of as much as 28 cm (11"—the carapace being the upper part of the crab's body shell). There is a record of a specimen from the Chilka Lake on India's east coast however, of a *S. serrata* with a carapace measuring almost 45 cm (18") across.

While the larger crabs I saw certainly matched the description of *S. serrata*, there were smaller individuals that were clearly a different species. I purchased a few specimens and took them back to the WHT lab, where I was soon able to identify them as *Scylla olivacea*, the Orange Mud Crab (so called because of the orange hue of its claws). Since then, I have taken a rough census of the *Scylla* species in every fish market I have visited, and found that around 30% of the crabs are *S. olivacea*, the balance being *S. serrata*. Not having eaten either, I have no idea whether they taste different, though *S. olivacea* are generally smaller than *S. serrata*, seldom exceeding 1.0 kg each. As far as I am aware, this is the first record of *S. olivacea* from Sri Lanka, a matter of some interest because the species is heavily exploited by the export trade. Until now, fisheries biologists have always considered that all the mud crabs exported from Sri Lanka were the widely-distributed *S. serrata*. I have also been on the lookout for specimens of another mud crab described originally from southern India, *Scylla tranquebarica*, but have not yet found one (it is possible that they occur on the east coast of Sri Lanka, where I have not yet had an opportunity to look).

In this article, I introduce the brackish-water and marine crabs generally eaten in Sri Lanka. I hope this will enable readers to identify crabs they encounter in markets, and also lead to better awareness of the need to conserve and manage sustainably the lucrative fishery that exists for these fascinating animals.

Scylla serrata and *Scylla olivacea*

The Giant Mud Crab. These crabs occur in mangroves throughout the western Indian Ocean, the ones from Sri Lanka being exported in quantity to Southeast Asian countries. The crabs are collected through baited traps (Figure 4*b*): crabs are ready scavengers and readily congregate wherever there is rotting flesh. If the supply of bait runs out, however, they readily turn cannibal and feed on one another.

Scylla serrata superficially resemble *S. olivacea* in many respects, but may be diagnosed from that species quite easily by the pairs of pronounced teeth (spines) on the distal half of the outer margin of the chelipedal carpus and also the palm of the cheliped (Fig. 19, 29). These are lacking, or greatly reduced, in *S. olivacea* (Figs. 1*b*, 2b). Males of the two species may also be distinguished by their differently-shaped gonopods (male sexual organs; see Fig. 1*c*,*d*).

Scylla serrata acieves a much greater size and weight than *S. olivacea*: large specimens of the former species commonly reach 1 kg each (not unusually up to 3 kg), with a carapace width of 25 to 28 cm. *Scylla olivacea* adults commonly reach a weight of around 500 g, exceptionally up to around 1 kg.

While both these species are dark green overall, they can also be told apart from their colour in life: the chelipeds (claws) of *S. olivacea* (Fig. 6*b*) are orangish brown over at least half their length, whereas those of *S. serrata* (Fig. 5*b*) are orange only at their tips.

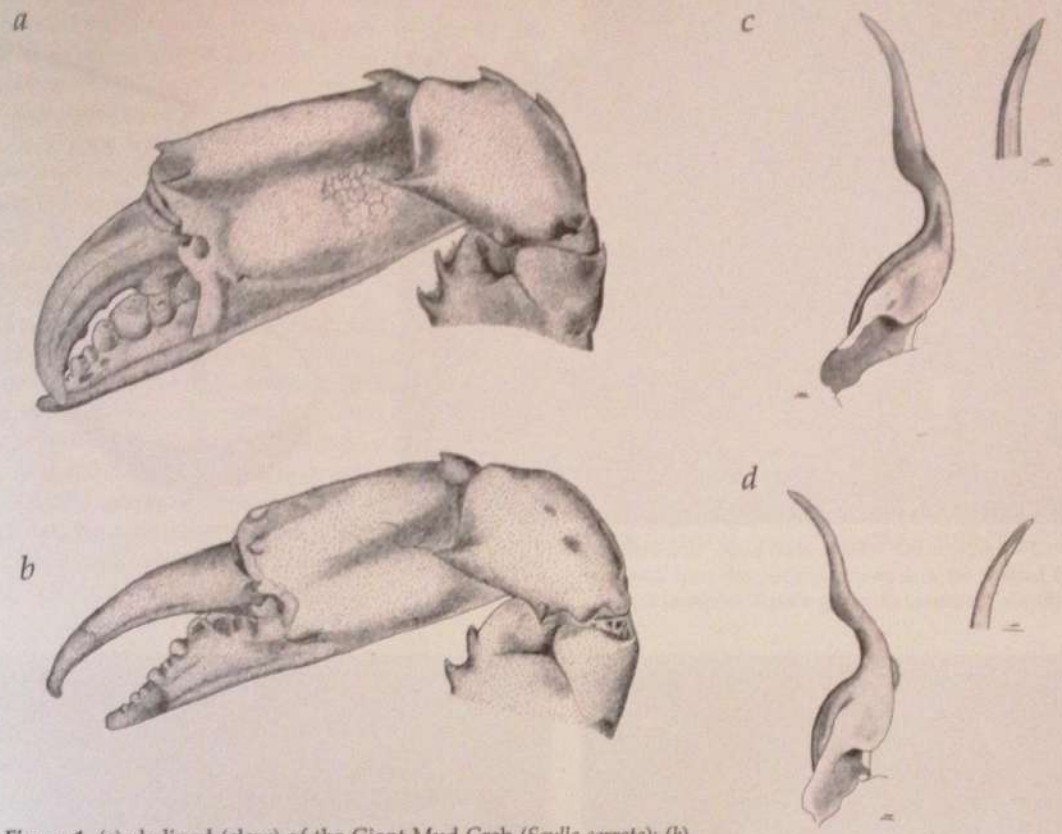

Figure 1. (*a*) cheliped (claw) of the Giant Mud Crab (*Scylla serrata*); (*b*) cheliped of the Lesser Mud Crab (*Scylla olivacea*); (*c*) gonopods of the Giant Mud Crab (*Scylla serrata*); (*d*) gonopods of the Lesser Mud Crab (*Scylla olivacea*).

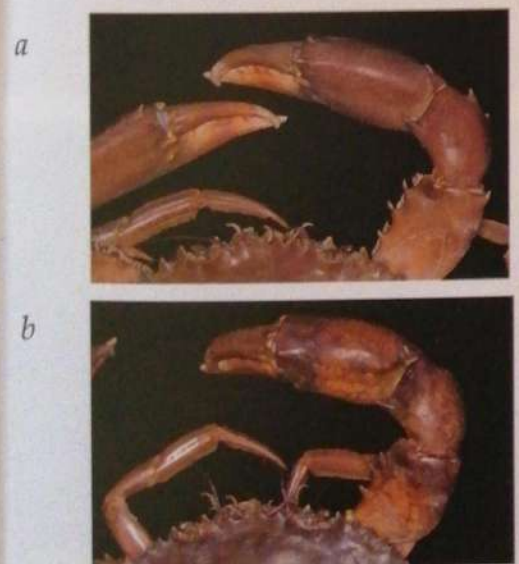

Figure 2. (*a*) cheliped (claw) of the Giant Mud Crab (*Scylla serrata*); (*b*) cheliped of the Lesser Mud Crab (*Scylla olivacea*).

Figure 3. A preserved specimen of the Giant Mud Crab (*Scylla serrata*).

b

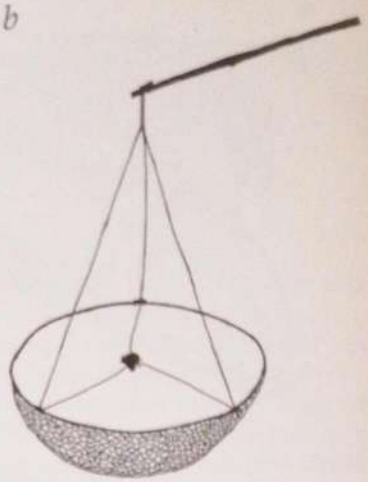

Figure 4. (*a*) Fisherman retrieving crab trap: Unawatuna, southern Sri Lanka; (*b*) a drawing of the crab trap used for mud crabs (*Scylla* species), showing simple construction.

Figure 5 (*a, b*). The Giant Mud Crab (*Scylla serrata*), in defensive posture: note that only the cheliped (claw) tips are orange.

Figure 6 (*a, b*). The Lesser Mud Crab (*Scylla olivacea*): note that much of the chelipeds (claws) are orange.

Portunus pelagicus* and *Portunus sanguinolentus

Known in English as the Flower Crab, thanks to the beautiful, mottled 'floral' pattern on the carapace (Fig. 8), *Portunus pelagicus* is probably the most commonly eaten crab species in Sri Lanka. Unlike in the case of *Scylla*, they keep fresh with refrigeration, and are much cheaper than mud crabs. These crabs are harvested (by trapping) from the open ocean, where they inhabit the sea floor. As in the case of mud crabs, they are adapted for swimming, their last pair of legs being flattened and paddle-like.

Portunus pelagicus is easily distinguished from another species of the same genus, *P. sanguinolentus*, that sometimes appears in fish markets, by the three white-edged, dark-maroon 'eye-spots' of the latter. The shell of *Portunus* is rather thinner than that of *Scylla*, and the limbs of these crabs are sometime eaten together with the shell, after softening through deep frying. Individuals of both species rarely exceed a carapace width of 20 cm. Males have somewhat longer claws than females.

Figure 7. Piled high on the fishmonger's slab, Flower Crabs are a favourite Sunday dish in most seaside towns. Hardly eaten at all (except in Sri Lanka's north) until a few decades ago, the dearth of mud crabs has resulted in this species being harvested —and consumed— with increasing intensity.

Figure 8. The flower crab, *Portunus pelagicus*; (*a*) dorsal view of female; (*b*) ventral view of female.

Figure 9. The flower crab, *Portunus sanguinolentus*; (*a*) dorsal view of male; (*b*) ventral view of male.

Cardisoma **sp.**

In addition to *Scylla* and *Portunus*, few Sri Lankan crabs are harvested commercially (species of swimming crabs— genus *Charybdis*— however, sometime appear in markets). In some maritime parts of Sri Lanka, a species of large land crab of the genus *Cardisoma* (Fig. 10) are eaten by the local inhabitants, though as far as I am aware, these are not exploited commercially. In Sri Lanka, *Cardisoma* do not grow as large as mud crabs or flower crabs, and it appears that they are nowhere near as fleshy. *Cardisoma* occur near the sea and around mangroves: although they are terrestrial (they lack legs adapted for swimming), their young are initially deposited in the water, for which reason they seldom venture far inland. *Cardisoma* live by day under boulders or in deep burrows, often more than 1 m below the ground, emerging at night to feed in the open. They have an interesting defence mechanism: they spray urine onto intruders, sometimes reaching a range of almost 1 m.

Figure 10. *Cardiosoma* sp. (*a*) anterior view of a specimen in defensive posture, from Galle; (*b*) posterior view; (*c*) anterior view of specimen from Nilaveli, north of Trincomalee (courtesy Jane Dixon-Clarke).

Crab facts and fallacies

- There is a common notion that mud crabs have less flesh during the full moon. I have not tested this objectively, but have been unable to find any scientific evidence to support this belief. It could be that increased ambient light at night (mud crabs are active mainly at night) results in the animals moving about less and therefore feeding less. On the other hand, people who regularly have a 'crab feed' on *poya* days have told me that they have not observed any weight loss in their victims during this time.

- Like all crustaceans (a group that includes also the shrimps, lobsters, barnacles and wood lice), and unlike most vertebrates (except the turtles), crabs wear their skeleton on the outside. Their rigid exoskeleton (made up of lime, which occurs naturally in seawater) serves as an excellent suit of armour and protects them from attack by many types of predators, but this also has some disadvantages. The main disadvantage is that crabs cannot grow continuously. They therefore absorb almost all the lime from their shells from time to time, and shed the loose skin that remains (a process known as moulting). They then absorb water, expand their bodies, and grow a new shell. During this time, the armour-less crab is very vulnerable to predators, and therefore does not move around much.

- As a group, crabs are known scientifically as the Brachyura, meaning 'short-tail' (unlike, for example, shrimps and lobsters, which have long tails). In crabs, the tail is folded under the body.

- Crabs breathe by means of gills, which they use to extract oxygen from water. In land crabs, the gill chambers are enlarged, enabling them to serve as lungs, allowing the animal to breathe atmospheric air. Regardless of this, even land crabs are restricted to relatively moist habitats.

- In order to operate their limbs in the absence of a skeleton like ours, crabs have had to develop a different scheme of flexor and extensor muscles that work from *within* the skeleton, rather than outside it (see Figure 11).

- Crabs occupy an amazing variety of niches, and come in an enormous variety of sizes. Minute crabs live inside some species of corals, mussels, starfishes and sea cucumbers (Fig. 12); on the other hand, the limbs of the Japanese giant crab, *Macrocheira kaempferi*, when fully flexed, can measure upwards of 3.5 m (12 feet) across. The weight record in crabs however, is held by the New Zealand giant crab, *Pseudocarcinus gigas*,

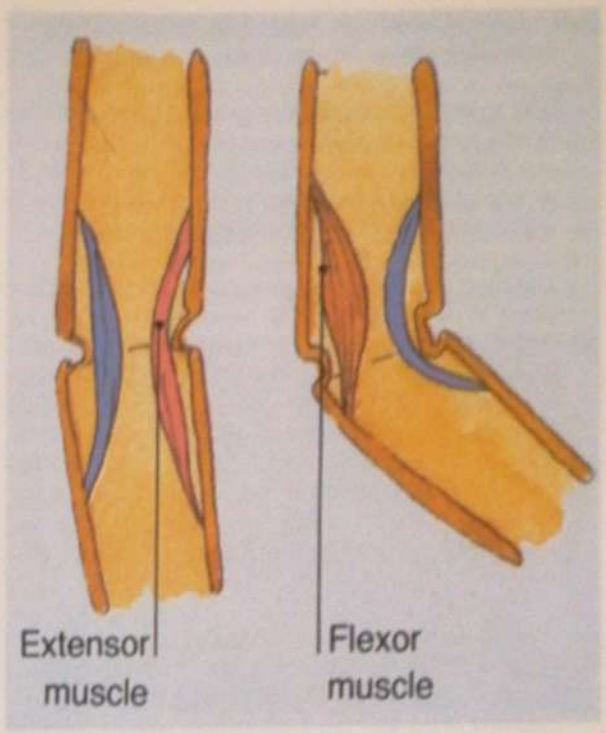

Figure 11. Because they lack in internal skeleton, the musculature of crabs is somewhat different from that of vertebrates.

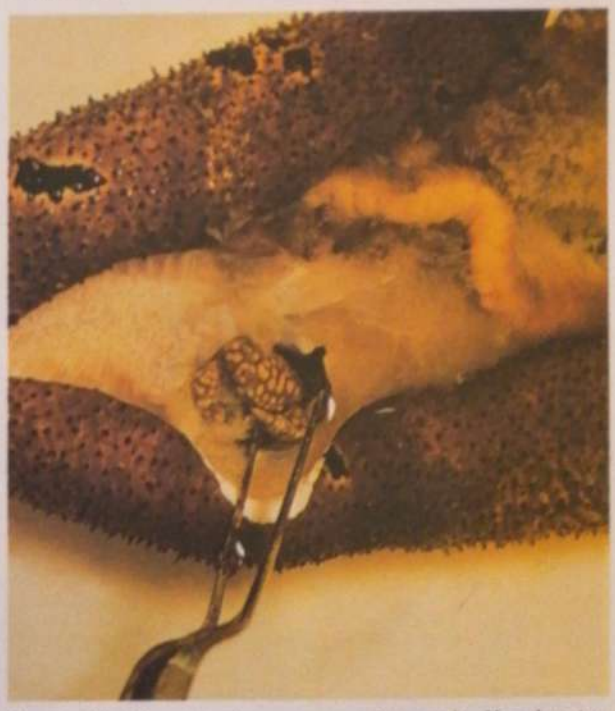

Figure 12. The minute sea-cucumber crab, *Hapalonotus reticulatus*, measuring less than 2.5 cm (1") across, lives in sea cucumbers (photograph: D. Vandenspiegel, © 1999, *Journal of South Asian Natural History*.

individuals of which can reach 9 kg each, the carapace measuring almost 50 cm across.

- Like many arthropods (the group of invertebrates to which crabs, and all insects, belong), crabs are able to autotomose— i.e. sacrifice their limbs voluntarily to a predator, enabling the crab to escape. This is why many market specimens lack limbs.

- The flesh of many crab species— including *Scylla*— turns toxic soon after the animal dies. They are therefore kept alive until just before cooking. In many Sri Lankan homes, crabs are killed by being boiled alive; however, a more 'humane' way to kill then is probably by tearing the carapace apart from the abdomen. In commercial crab fisheries in Europe and North America, crabs are usually electrocuted and then boiled. The un-boiled flesh of sea crabs (*Portunus* species) keeps fresh under refrigeration just as fish does.

- In some parts of India, even the tiny, stalk-eyed burrowing beach crabs (genus *Ocypode*) are collected in numbers and eaten after being cooked whole. Anyone who has tried capturing one in daytime knows how challenging this is: however, they can easily be collected at night by setting a pitfall trap by way of a plastic bucket buried up to its neck in the sand, baited with a small piece of rotting meat (or, for reall effect, prawn).

How to tell males from females

Once you have a crab in your hand, its sex can easily be determined. In crabs, the last four segments of the tail fold under the abdomen as a flap covering the sexual organs. In females, this flap is rounded, conical and wide, whereas in males it is narrow and pointed. Lift the flap gently in a male, and you will see the gonopods— long, penis-like structures with which the male guides sperm on to the females eggs (see Fig. 13).

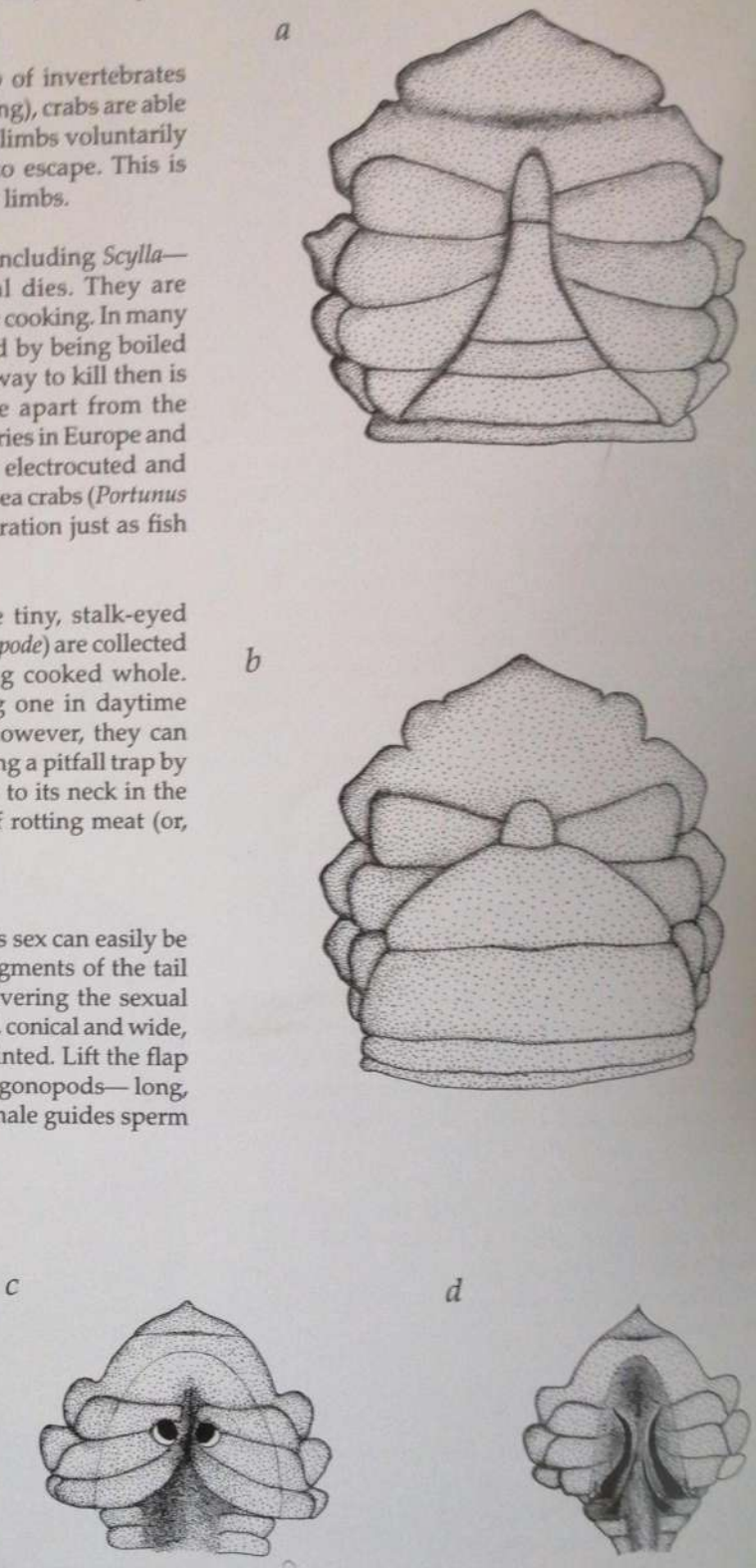

Figure 13. The underside of a crab, showing the difference between (*a*) males and (*b*) females. The sexual organs lie under the segmented flap. When the flap is lifted, the ova in females (*c*) and the gonopods in males (*d*) can be seen.

How to catch and handle crabs great and small

Anyone who has tried to handle a crab knows that all crabs with a carapace width of more than about 3 cm are capable of delivering a nasty 'bite'— the larger, the more severe. While flower crabs are usually dead by the time they reach market, mud crabs are necessarily alive, and therefore capable of inflicting a painful wound in anyone intending to eat them. Although I have not seen it happen, I am willing to believe that a large *Scylla serrata* is powerful enough to take off someone's finger. Handling crabs safely is therefore a matter of some importance to anyone interested in studying their natural history.

Small crabs can easily be immobilised on the ground by pressing their limbs down (Fig. 14*a*), and then picking them up either from the sides (Fig. 14*b*) or rear (Fig. 14*c*) of the carapace, where their claws cannot reach. Until one is experienced in this, it is easier to immobilise larger crabs by pressing them down gently but firmly with a rubber slipper or other rugged footwear placed at the centre of the carapace. Large land crabs (e.g. *Cardisoma*) are very quick on their feet, and the easiest way to catch them is to throw a hat or similar object over them: here, in the dark, they feel safe, and will wait patiently for their intended captor to approach with a rubber slipper.

Large crabs could safely be handled as shown in Fig. 14*d*.

If it is necessary to keep captured crabs for some time for study before release, it is best to keep them in a dark container with nothing which they can grasp in their claws (plastic buckets are good; cloth bags are not). Remember also that all crabs breathe through gills, and so need some moisture, though land crabs should never be fully immersed in water or left out in the sun. If it is necessary to tranquilise a crab in order to examine it, the best way is perhaps to put it in a refrigerator (not a freezer) for some hours, where it will become torpid.

Figure 14. How to safely capture and handle a crab. First, immobilise the crab by pressing it on to the ground with your hand (for small crabs, (*a*)) or a piece of footwear (for large crabs). Then grasp the animal gently but firmly by the sides (*b*) or the rear (*c*). In the case of large crabs, it is best to grasp the animal as shown in (*d*).

Range extension of the red-throat litter skink, *Sphenomorphus rufogulus*

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Little work has been reported on taxonomy, ecology and distribution of Sri Lankan skinks. Currently, 29 species of Scincidae, in seven genera, are recognised from Sri Lanka. Of these, 22 species are endemic to the island (Deraniyagala, 1953; Welch, *et al.* 1990; Greer, 1991; De Silva, 1996; Das, 1996). Many of these species are similar in overall colour (yellowish brown) and show complex pholidosis, resulting in field identification often being confused. De Silva (1996) suggests that more species of Sri Lankan skinks remain to be described.

The endemic skink *Sphenomorphus rufogulus* was first described from the type locality, 19 km north of Trincomalee (Eastern Province) in Sri Lanka's dry zone, by Taylor in 1950. This species has been categorized as 'data deficient' by IUCN (2000) (if distribution data for a particular species has not become available during the last fifty years or more, it is categorized as data deficient). Taylor's description was restricted to colour and head scale pattern, and lacks detailed morphometric measurements and habitat data.

During the course of a faunal survey for the proposed Zoological Garden Stage I, at Pinnawala (Kegalle District) in the wet zone in October, 1999, an adult male red-throat skink was found in a pit fall trap set at the boundary of a manihot (*Manihot* sp.) plantation and a māna (*Pennesetum* sp.) grassland. This specimen was tentatively identified as *S. rufogulus* (Fig. 1) using the key provided by Taylor, 1953. *Sphenomorphus rufogulus* is immediately distinguished from all Sri Lankan skinks except *Lankascincus fallax* (Peters, 1860) by having a fused frontopariatal scale; and lacking supranasal scales. It differs superficially from *Lankascincus fallax* by throat colour difference in living males. In *S. rufogulus* throat colour bright rosy red (Fig. 2), where as in *L. fallax* the scales on head and throat are dark blue-black, with whitish spots. Measurements and scale counts of this collected specimen are given below.

Measurements of captured specimen (in mm): axilla to groin, 22.1; eye diameter, 1.4; eye to nostril, 1.1; eye to snout, 3.7; head depth, 4.0; head width, 5.5; snout to axilla, 14.9; snout to vent, 37.6; tail length, 39.5. Scalation: supralabials, 7; infralabials, 5; supraocular, 5; scales around mid-body, 23; subdigital lamellae on 4th toe, 17.

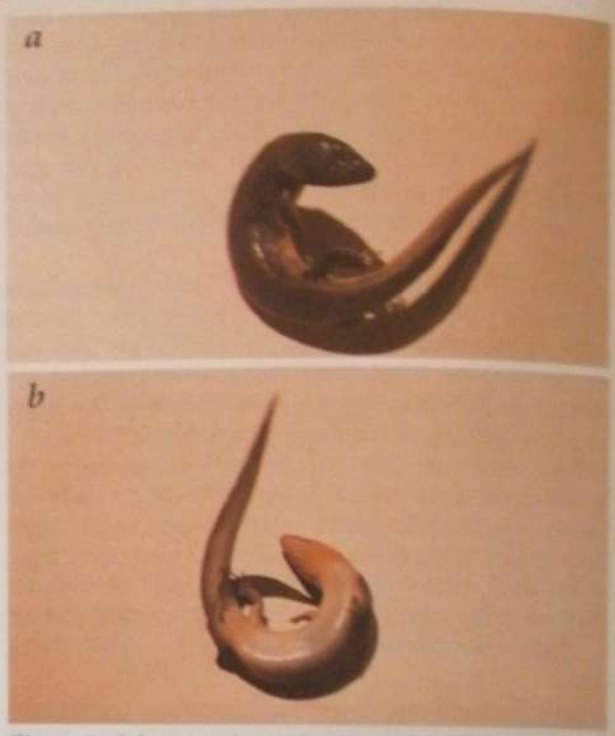

Figure 1. *Sphenomorphus rufogulus*, male, 37.6mm SVL, (a) dorsal aspect; (b) ventral aspect, showing the reddish throat.

This is the first record of *S. rufogulus*, since its original description in 1950. Furthermore, this is the first record of this species in the wet zone of Sri Lanka.

Acknowledgements

We thank Mr. S. Gunasena, Director, National Zoological Gardens, for permitting this work at the study site; we also thank Mr. P.M.C. Digana, Miss. D. Fernando and Miss. M.R.M.P. Nandasena, who assisted with field work.

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Magilus lankae: one of Sri Lanka's rarest seashells

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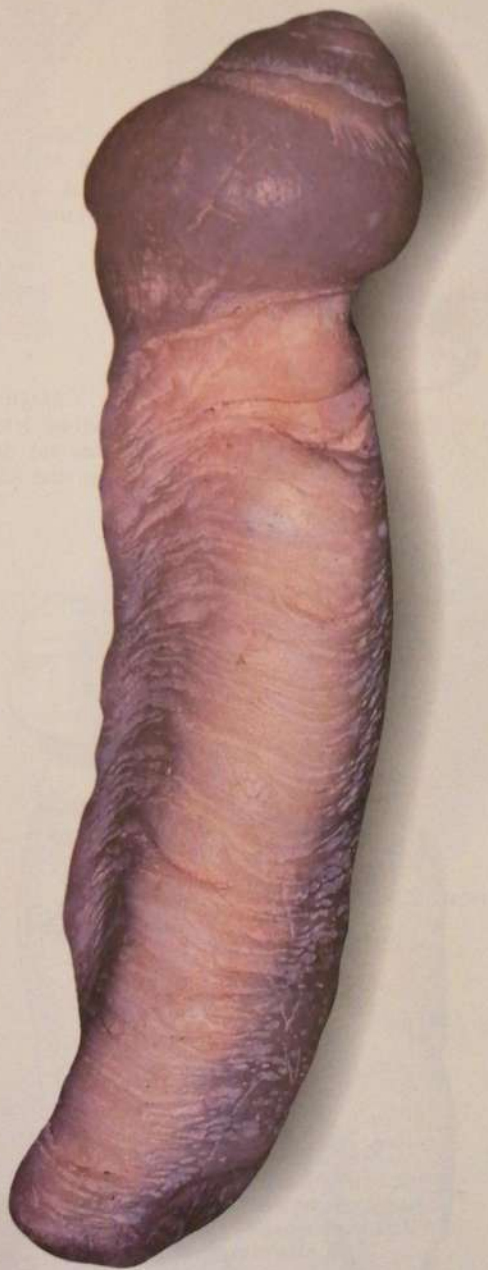
Seashells, everyone knows, are the armoured housing of snails that live in the sea—marine molluscs. Because they are attractive and durable, shells are collected by a large number of hobbyists, many of whom are lured into the pastime by picking up these marine marvels on childhood beach excursions. While the practice of collecting seashells washed ashore on beaches is harmless, there is increasing pressure on snail species living in near-shore habitats, thanks to the growing practice of collecting these for the marine aquarium hobby and to swell the collections of professional conchologists. What is more, Sri Lanka's reef habitats are increasingly under pressure as a result of siltation, uncontrolled tourism, and coral extraction. Many species of marine molluscs are now considered endangered.

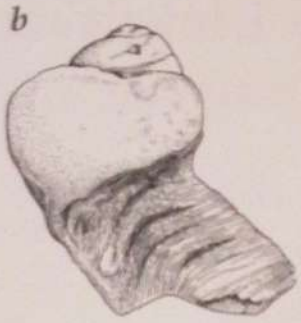
The great Sri Lankan naturalist P. E. P. Deraniyagala reported the discovery in 1968 of a new species of seashell at Mihiripanna, eight miles south of Galle. It had been dredged from between the shore and the reef by a coral gatherer, and come into the possession of Cedric Martenstyn, who sent it to Deraniyagala for identification. The naturalist determined that the specimen belonged to the little-known genus *Magilus*, and described it as *Magilus lankae*, a new species, in the *Proceedings of the 24th Annual Sessions of the Ceylon Association for the Advancement of Science* (November, 1968). Sadly, it seems that this specimen is now lost. Since the species' discovery in 1968, only two further specimens have, as far as I am aware, come to light. One of these was gifted to me by the late P. B. Karunaratne in 1985, and the other is in the collection of my friend, the marine ecologist Prasanna Weerakkody. In view of the rarity of the species, I describe and illustrate the only two specimens presently known.

Magilus are thin-shelled mollucs possessing a cover to the opening. these molluscs begin life as free-swimming larvae, but at the end of this stage attach themselves to a stand of coral. As the coral grows upward, the mollusc keeps pace by constructing a shell tube, which also grows with the host coral, zig-zagging through it until it is about ten times as long as the original, spirally-coiled shell. The entire snail's shell and most of the tube become filled with white, solid, shell material, and the living animal occupies only the upper end of the tube. The surface of the shell is finely sculpted and traversed by fifteen longitudinal lines; the right and the left margins of the tube are depressed into two lateral ridges.

Two other species of *Magilus*, *M. antiquus* and *M. japonicus*, are known from the western and eastern Indian Ocean, respectively. Unfortunately, no Sri Lankan specimens have as yet been subjected to examination by a conchologist specialised in this group of snails, and so it is not possible to say whether *M. lankae* is in fact a distinct, valid species. If so, it would be fascinating to discover a living example and learn more of its biology.

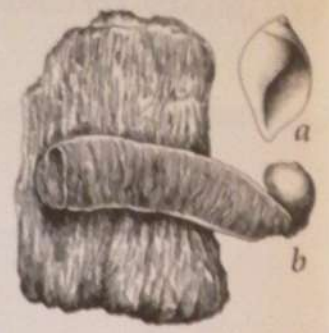


Magilus lankae, dorsolateral aspect of specimen No. 2 (length of shell 91.2 mm).



Magilus lankae, specimen no. 1: length of shell 39.6 mm, *(a)* dorsal aspect; *(b)* inner side; *(c)* outer side.

Below: Magilus lankae, specimen no. 2: length of shell 91.2 mm, (a) dorsal aspect; (b) inner side; (c) outer side.



Right: a stand of coral with an attached *Magilus* coral-shell (after Hornell, 1951), *(a)*, larval form; *(b)* adult.

Description of specimens

No. 1: retrieved from a lime kiln at Aluthgama, southern Sri Lanka, and gifted to me by P. B. Karunaratne in 1985. No. 2: no locality data or date; in the collection of Mr. Prasanna Weerakkody.

Shell white or ashy-white in colour, thick and solid. Distal end of tube broken off. Opening horizontally oval. Body whorl and spire almost smooth. Dorsal surface of tube with fine transverse ridges. Inner side of tube depressed into a lateral ridge. outer side of tube rounded.

Measurements of specimens (in mm)

Specimen No.	1	2
Length of shell	39.6	91.2
Body whorl	23.5	24.5
Width	27.5	25.4
Height	26.6	24.2
Bi-lateral width of tube	20.9	24.2
Bi-lateral width of opening	12.6	9.2
Length of tube	17.6	73.4
Maximum thickness of tube	5.7	9.4
Minimum thickness of tube	1.0	1.7
Length of body cavity	35.4 (+)	25.0

Acknowledgements

I am grateful to the late P. B. Karunaratne for the specimen gifted to me, and to Prasanna Weerakkody for permitting me to examine and report on the specimen in his collection.

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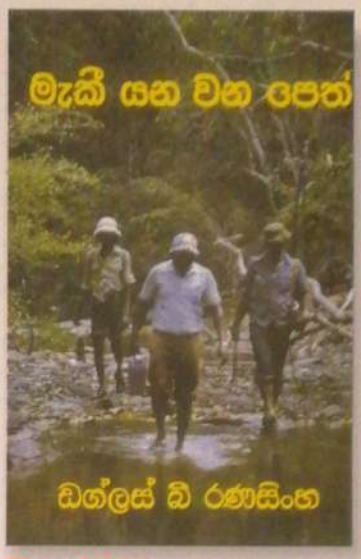

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The loris in lore and literature

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Introduction

Of the very nearly one hundred species of mammals recorded from Sri Lanka, the slender loris (*Loris tardigradus*) is among the least well known— at least to the public. Yet, it is part of the public's imagination of the essence of Sri Lanka's wild life. In this article, I summarise references to the loris (sometimes called the Ceylon Sloth) in Sri Lanka in not only the early scientific literature, but drawing also on folklore and poetry.

Sixty-three years ago, in December 1936, the first number of the *Loris* magazine was launched by what is now the Wildlife and Nature Protection Society of Sri Lanka. Dr. R.L. Spittel, in explaining why the name *Loris* was chosen, explained, "The title was given because it is symbolic of our jungles and the mysteries they enshroud, ever calling adventurers to solve them".

The first editorial was written by Prof. W.C. Osman Hill. He explained the objectives of the new journal and its name, thus—

> "The name *Loris* is redolent of the mystic aspect of the jungle, and especially of the Ceylon jungle... The loris is a small, comparatively insignificant denizen of our wilds, and is about the last creature that the game hunter would search after. To the seeker after the really interesting dwellers of the forests, however, the *Loris* to one of the first attractions. Its zoological position at the foot of the great Primate order, in which man himself belongs, is one of its important claims for remark. But besides this, its limited geographical range, suggesting that it is a relic of some past age, calls forth further enthusiasm in the heart of the true nature lover. Add to these attributes its shy, retiring nature, nocturnal habits and difficulty of this creature's name has become synonymised with the eerie and spectral, and why also it has become the object of a vast amount folk-lore among its human neighbours in, or bordering its forest home", (Hill, 1936).

The natural-history literature

References to the loris abound in the early natural-history literature on Sri Lanka. I list below some examples.

Somanader (1969): "Their very name, which is derived from the Dutch word 'loeris' meaning a 'clown', is suggestive of all that is fantastic, eerie and spectral" [The Dutch word *loris* also means 'simpleton' or 'booby'.]

Goldsmith (1774): "A little four-handed animal of the island of Ceylon, which Mr. Buffon calls the Lori".

Pennant (1781): "*Loris*... monkey with a produced dog-like visage".

Bingley (1803): "This *Loris*... about the size of small cat".

Still (1930): "Their figures resemble ours even more than monkey's do for they have no tail and on all but one of their fingers have delicate little nails like baby's, the other has a claw. The Sinhalese of the forest recognize the likeliness and a not uncommon nickname for a very thin person is *unahapuluwa* or loris."

Tennent (1859): "The loris is known in Tamil as *theivangu* or "the slender-bodied one"— hence a deformed child or an emaciated person is even today in Tamil accorded the same epithet. Some lorises are said to have a spot on their forehead, resembling the *nammam*, or mark, worn by the worshippers of the Hindu god Vishnu: through this peculiarity, it is the separate name *nama-theivangu*... During the day the [loris] which I kept was usually asleep in the strange position represented below; its perch firmly grasped with all hands, its back curved into a ball of soft fur, and its head hidden deep between its legs".

Walters (1892): "I have seen these creatures coiled up fast asleep sitting upon their heads, which were hidden away between the legs".

Blanford (1888-91): "it sleeps rolled up in a ball with its head between its legs, grasping its perch with its arms".

Phillips (1981): "It curls itself into the semblance of a ball, holding on to several twigs or notches with hands and feet while tucking is head between its arms."

Still (1905): "If moral characteristics be added to physical, the loris is very high in the scale; for his manners are excellent, rather like those of an old-fashioned child who does not play, but takes his pleasure in some more dignified manner. For the loris never plays; life is for him a very serious matter. Except the Pangolin, all other animals I have kept or known, play, all but the loris. If one comes to think of it, any loris who in his natural hunts attracted attention by frisking about and playing, would very soon be snapped up by an owl or other enemy, for he is very weak, and very slow, and his safety, like that of a new boy in a public school, must depend

almost entirely on unostentatious self-effacement. Hence his good manners."

"Ceylon Sloth"

The apparent lethargy of the loris—evident from its slow and deliberate movements— led to its being called the Ceylon sloth, a name no longer in use.

Goldsmith (1774): "...slow-paced lemur is an animal of small size scarcely equal to that of a cat".

Kirby (1835): "The Lory or sloth ape, so called from the excessive slowness of its movements...".

Sterndale (1884): " This, like the [slow loris], is nocturnal in its habits, and from the extreme slowness of its movements is called in Ceylon 'Sloth'".

The loris's eyes

The first thing that strikes someone seeing a loris for the first time are the creature's large, watery eyes. "At night the eyes of the loris shine like phosphorescent fire", noted Walters (1892). Yet, these very eyes have spelled doom to the loris. Tennent (1859) explains why: "The singularly large and intense eyes of the loris have attracted the attention of the Sinhalese, who capture the creature for the purpose of extracting them as charms and love-portions, and this they are said to effect by holding the little animal to the fire till its eyeballs burst".

Jerdon (1874) confirms that the loris's eyes were also valued in India: "Large numbers are brought alive at times to the Madras market, their eyes being a highly esteemed remedy among the Tamul doctors." Sterndale (1884) added the first humanistic touch: "The eyes medicine or charm by natives and procured by a method too distinguishably cruel to write about, so the sale alive of these little creature should be looked into and regulated".

This cruel practice seems to have been widespread enough to have attracted the attention of almost every early writer dealing with the loris. Gordon-Cumming (1893) elaborates: "The villagers believe their tears to have power as love portions, a fact which give rise to a revolting practice. The little beasts have singularly beautiful eyes, very large for their skinny little bodies, and the seekers after love portions hold their eyes close to a scorching flame, making them weep copiously. These with, presumably a mantra, or two from the *Copular*, form the philter which makes the course of true love run smoothly,"

Still (1930) left no doubt as to which side of the debate he was on: "Like most nocturnal creatures, the loris has wonderfully large and beautiful eyes, and fiends who make quack medicines sometimes tie the poor little things close to a hot fire so that those eyes may weep, and their tears be bottled and applied to the cure of an aliment which only people would practice such an abominable act deserve to suffer from".

Loris folklore

The loris had by the 19th century become the subject of a rich folklore. The naturalist John Still (1905) recounts—

> But besides modesty [the loris] has one other means of defence, and a very curious one indeed it is. For he imitates a cobra. Before relating the instance in which I saw this done, I must support my testimony by the only reference to this habit that I know of. Sinhalese of the North Central Province have several times told me little stories about *Unahapuluwa*, and I have thought them far-fetched and absurd. And among the stories of its habits told me by jungle men has been this; "That the loris copies the sound of the cobra as means of self-defence".
>
> Now that I have had an opportunity of testing this story and of finding it true, the other yarns do not seem so absurd. It happened this way.
>
> I was sitting in the verandah spoiling my eyes by reading by the last flicker of afterglow, when I heard the regular breathing sound made by a cobra when he inflates and deflates his body. A cobra moving ordinarily, or hunting anything much weaker than himself, does not make this sound, but only when with expanded hood he sits up to fight.
>
> With the breathing sound came occasional quick hiss of a strike. So I got up and took a stick, for I thought that Cobra might be attacking my loris, who has not in his cage, but only tethered to the top of it".

Spittel (1957) wrote of lore on the loris's stealth: "The loris (Unahapuluwa) is so gentle in its movements that it can climb the back of a roosting cock or peafowl without awakening it and bite off its neck. And should a [twig] snap as it ascends to the peacock's high perch, it carries it all way down, deposits it on the ground, and steals up stealthily again". Spittel himself would use the simile, "as noiseless as a loris".

Dissanayake Adikarige Edmund of Pilimatalawa told me a, interesting folk 'tradition' he learned from his late mother, Madawala Dissawage Kumarihamy. It is a recipe for those in search of wealth, prosperity and success.

The aspirant is required to select a cattle shed in which milk is churned, far away from human habitation, with a brook running nearby (these prerequisites are essential for the arrival of *gopalla*— an apparition representing the benevolent deity). The story goes that the *gopalla* is only very rarely sighted. He arrives with a *yashti* (walking stick) and *sembhu* (a small pot) in his arms.

The aspirant is required to bathe and cleanse himself. Then, bearing a loris in one hand, he enters the cattle shed. If all is well, the *gopalla* will appear when the grey streaks of dawn appear in the sky. His arrival is not visible to the human eye. The eye of loris, however, have no trouble in perceiving with ease the arrival of the *gopalla*. Terrified, the loris begins to tremble and tear. This is moment for which the aspirant has been waiting. Has places a *gahala* leaf beneath the loris and collects the

precious tears with a piece of cotton wool. Applying these tears to his own eyes, he is able to see the *gopalla*. The *gopalla* however, should not see the aspirant, who conceals himself suitably before applyig the loris tears to his own eyes.

Thus empowered, the aspirant watches the *gopalla*, who at some point starts churning the milk, keeping his magic *yashti* by his side. Choosing his moment, the aspirant is required to purloin the *yashti* and flee. When the *gopalla* senses that his *yashti* is missing, he is apt to give pursuit. The aspirant then takes refuge in the brook, where he immerses himself up to the nape of the neck. There, the *gopalla* cannot touch him.

Desperate to recover his magic *yashti*, the *gopalla* offers the aspirant anything he wants in return for the stick. This is the moment the aspirant has been waiting for: he recites a long list of desiderata he has taken trouble to memorise in advance. Having obtained the *gopalla*'s solemn promise, he returns the *yashti* to its owner and waits for his wishes to come true.

Proverbs

The loris finds mention in at least two Sinhala proverbs: "The loris's young one is a gem to her" *(unahapuluwa ge daruwa oota menika lu)*— i.e. one's own child is *the* gem.

Another proverb has it that "You can't draw tears from the eyes of the loris" (*unahapuluwa ge ahen kandulu gannata beri lu*). This may be liked to the English simile, "Like drawing water from a stone," but lends itself also the alternative interpretation meaning "something that happens but rarely".

Seneviratne (1936) evinces a record of considerable interest amongst the natives – Sinhalese – of this arboreal indigenous mammal.

The Sinhala name of the loris is now generally accepted as being *unahapuluwa*, although earlier texts (in the Latin script) record several variations: *unahapuluwa* (Carter, 1965; de Zoysa, 1964); *unahaputuwa* (Ratnasuriya & Wijeratne, 1949); *udahapuluwa* (Still, 1905); *hunu pupuluwa* (Hettiarachchi, 1981); *kalu-unhapuluwa* (Phillips, 1981).

John Still's immortal poem, 'The Loris' in his *Poems in captivity* (1919), to me, says it all—

In the forest, in the moonlight,
When the boughs are lacing black against the sky,
And all the stirrings of a tropic night
Encompass me with magic out of sight,
I hear you thin weird cry:
I sense you passing by.
Softly and silently your tiny palms
Cleave to the bosses of your secret way,
On where the bearded moss hangs thick and grey,
Up where the silver, moonlight glints and charms,
You slowly creep,
while the geckos cheep,
And your enemy, the owl, on silent wing,
Sweeps through the dusky passes of the trees;
Sweeps and is gone, while the cicadas sing.
And still your fretful wailing haunts the breeze
That soughs among the tree-tops where you weep
Good-night, my little Kinsman, I must sleep.

Natural history notes

The genus *Loris* contains only a single species, *L. tardigradus*, which is endemic to Sri Lanka and southern India. Lorises are primates (i.e. they belong to the same zoological order as humans), and belong to the family Loridae. The family itself occurs in both Africa and Asia; it is represented in Southeast Asia by the genus *Nycticebus*, in which four species are presently recognised.

In Sri Lanka, lorises are more common than they seem: being nocturnal and arboreal, they rarely come into contact with man.

The slender loris (*L. tardigradus*) is a small creature, with large males reaching just 350 g (females rarely reach even 300 g). Phillips (1981) recognised several subspecies from Sri Lanka, and remarked that the one recorded from Horton Plains (*L. t. nycticeboides* Hill, 1942) was probably Sri Lanka's rarest mammal: it is known only from the two individuals from which Hill described the species (now preserved in the Natural History Museum, London). The systematic status of these subspecies is yet to be tested using modern, molecular techniques.

Hardly anything is known of the behaviour and ecology of lorises in the wild. Most natural history information has been obtained from captive animals. In Sri Lanka, lorises are known from almost every kind of natural forest, ranging from mangroves and dry-zone scrub to montane cloud forest.

According to most reports, lorises are primarily insectivores, though they are also known to feed on leaves, fruits (especially those with a hard rind), birds, birds eggs, mice and lizards. When eating an animal, every part is consumed (skin, scales, feathers, bones etc); the Sri Lankan belief that lorises are given to strangling peafowl and eating their brains however, is fanciful.

Lorises have been observed to drink by dipping one hand in water and then licking the liquid off it; or scraping water off wet leaves, and then licking it off the hand.

Lorises move very slowly and deliberately through vegetation, seldom hastening their movements. They run clumsily on dry land and are unusual among mammals for their inability to swim. Lorises live solitary lives for the most part, pairs being not uncommon (males however, are territorial, and scent-mark their boundaries). Female lorises come into estrus once or twice a year. A single (rarely, two) young is born after a gestation of 160–174 days. Lactation lasts around one year.

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Can wildlife pay for its conservation?

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Abstract

Given the relatively small size of Sri Lanka, setting aside over 12% of the land area for wildlife conservation is indeed a great achievement. But given the importance of agriculture and the limited area of arable land left in the island, it is unlikely that the protected area system will be substantially increased in the future. If wildlife conservation is to succeed in Sri Lanka, it must justify itself as an economically viable form of land use, beneficial to the people. Protecting highly mobile species such as the elephant within protected areas has proved difficult. People whose lands border elephant reserves have had a raw deal for some time in Sri Lanka. Elephants have destroyed crops and in turn have been killed by irate farmers. Since 1950, a minimum of 1,425 wild elephants have been killed by farmers in defence of their crops. The human-elephant conflict seems to have replaced poaching in Sri Lanka. For wildlife and protected areas to survive on a significant scale, in Sri Lanka, they must be both ecologically and economically viable. At least some non-endangered wildlife species can pay their way, and thereby ensure their survival even outside the designated conservation areas.

Key words: wildlife, Sri Lanka, elephant, conservation, sustainable use.

Introduction

Sri Lanka is a small island of 65,610 km^2, but supports a relatively high human population of more than 19 million at a density of about 290 people per km^2, whose principal economic activity is agriculture. Therefore, land is scarce. Nevertheless, Sri Lanka has already set aside over 12% of its land area for wildlife conservation. But arable land being at a premium, it is likely that no Government hereafter would allocate substantial extent of land for wildlife conservation. Therefore, if wildlife conservation is to succeed, it must justify itself as an economically viable form of land use, from which people can benefit. Unless this happens, people will continue to call for the conversion of such lands to agriculture, replacing deer and elephants with cattle and goats.

Although conservation of wildlife grew out of the innate concern of the Buddhists and Hindus in Sri Lanka for the welfare of animals, the need to set up special reserves for protection of wildlife arose from a concern by the very people who exploited wildlife— namely, the British colonial hunters— who feared that given the rate at which wild animals were being over-exploited in Sri Lanka, that there would be no game left for them to continue hunting. While game sanctuaries gave total protection to wildlife, the Resident Sportsmen's Reserves were declared for the sole purpose of hunting game on licence. According to Emerson Tennent[1], during the early British period (1831–1900), in addition to some 9,500 elephants that were captured and exported from the Mannar District between 1853 and 1872, more than 10,000 elephants were slaughtered by shooting for sport and monetary rewards. At that time, the development of the island's economy by the British was not motivated by purely philanthropic considerations, but rather by the need to enhance their own imperial economy. Judging from the past records of the British, had they seriously considered rice as an economic exportable crop, as they did coffee, tea and rubber, and if they were willing to import the labour from South India to work the fields in the dry zone following the restoration of the tanks (man-made reservoirs), we would not be far wrong in stating that there would not have been a single wild elephant alive in Sri Lanka outside the Resident Sportsmen's Reserves, two of which ultimately became premier conservation areas namely, Ruhuna and Wilpattu National Parks in 1938. Sadly, since colonial times, our economic development has been patterned to suit the Ruler and not the ruled, in the process of which, most of us have forgotten one vital factor - that independence, if it is to be of any value, should be for the greater good of our rural masses who form the majority, and not for the urban elite who represent a minute fraction of our population.

The original concept of a national park by IUCN is that of a relatively large and inviolable area where wildlife is given absolute protection, and "visitors are allowed to enter, under special conditions, for inspirational, educative, cultural and recreative purposes"[2]. This essentially western concept of ensuring the protection of species is no longer popular among many wildlife ecologists in Asia, since it can work only through the use of guns and guards. Some die-hard purists strongly believe that our wildlife resources must be cherished and protected and not utilised, except for some non-invasive tourism. The slogan, *"Take nothing but photographs,*

leave nothing but footprints" is attractive especially to someone living in the highly affluent and industrialised west, where the remaining wilderness areas are looked after with great care for the enjoyment of both the present as well as future generations. This is relevant in the west where much of the wildlife had been decimated through over-exploitation in the 19th century. But lately, there has been an awareness among many progressive and more thoughtful conservationists of the fact that a number of non-endangered species of wild fauna and flora can be exploited by the rural poor who live in and around areas frequented by wildlife, and thereby derive some economic benefit from them[3, 4, 5, 6]. This benefit should not be restricted only to the revenue earned from eco-tourism but should include the use of the meat and hide of the wild animals as well.

In countries where the people in general enjoy a very high standard of living, and are not in want of proteins and other basic amenities, the aims of management are straightforward conservation, or embrace some form of utilization, such as tourism or harvesting. Even in the tropics, there are instances when total protection of some wildlife populations is justified given their rarity, status or ecological significance. This is especially the case with some of the endemic species, with restricted range and reduced population size. Endemic flora and fauna are at a far greater risk of extinction than more widely distributed species. On the other side of the coin is the situation, where rural people compete with wildlife, often dangerous and potentially destructive animals, in their struggle to till the land. It is in such situations, that wildlife comes into conflict with people. Thus, protectionism of the developed countries must be balanced by a controlled, prudent, and sustainable utilization of wildlife resources in the developing countries. The World Conservation Strategy[7], supports all forms of wildlife exploitation, provided they are carried out in a sustainable manner, on the grounds that the income so generated will enhance conservation itself. Although wildlife conservation is mainly about species, habitat and ecosystem dynamics, yet it is a socio-economic process that affects and in turn is affected by human welfare[5].

Incompatibility of wildlife and agriculture

Protecting highly mobile species such as the elephant within a patchwork of protected areas in Sri Lanka has proved difficult. Elephants spill over and range frequently outside the borders of even the largest protected area. Their extensive migrations ensure that the grazing has a periodic rest and can recover[3]. Given this fact, it would be almost impossible provide effective protection of such wildlife in areas that come under agricultural development. Year by year these areas are being opened up and wilderness areas will therefore become smaller and smaller and ultimately the animals will have to feed on the crops that have been planted for the use of man. The survival of elephants in such areas is possible only if the people are prepared to tolerate the animals on their land. The cumulative cost in crop protection and crop insurance will be too costly for a poor country like Sri Lanka to underwrite. During the last four years, the Government of Sri Lanka has spent much of the US$ 4,000,000 it received from the UN's Global Environment Fund (GEF). In addition, the Government allocated a matching fund of its equivalent in local currency for the conservation of elephant and other wildlife. In carrying out just one largely unsuccessful elephant drive, from Handapanagala to Ruhuna National Park, the Department of Wildlife Conservation spent US$ 1,200,000 (Ms Amara Paranagama, per. comm.). Furthermore, there is no point in maintaining staff in such areas, if at the end of say 5 years or so, there is no wildlife remaining that would justify this expenditure. A population of 100 elephants in a particular area today is of little significance, if the habitat is to be turned into sugar-cane plantation in a few years' time. The problem with wildlife is that the people who wish to preserve it, are rarely those who have to pay the cost[4]. While the peasant farmer becomes destitute over night as a result of elephant depredation, the well off animal lover or animal-rights activist enjoys wildlife spectacle at a minimal cost. Under such circumstances, it would be unrealistic to expect the farmer to support the conservation of wildlife. Wildlife will survive in agricultural areas, only if the people who share their land with wildlife are prepared to tolerate it. According to the former Director of the Department of National Parks and Wild Life Management of Zimbabwe, Dr Graham Child, "if wildlife is permitted to contribute to the welfare of people, they will not be able to afford to lose it in their battle for survival. If wildlife does not contribute significantly to their well-being, people will not be able to afford to preserve it, except as a tourist curiosity in a few protected areas"[3].

The central theme of our argument is that for wildlife and protected areas to survive on a significant scale in Sri Lanka in the years to come, they must be both ecologically and economically viable. Wildlife conservation must be looked upon as an alternative form of land use that can compete economically with agriculture and forestry. As the well-known American biologist, Aldo Leopold[8] once pointed out, wildlife is a resource comparable with forests and should be used to generate financial benefits. This is especially relevant in Sri Lanka where declining soil fertility and high human population growth has resulted in increased encroachment and degradation of the protected areas and the forests inhabited by wildlife. If such trends go unchecked, even the quality of our lives will be adversely affected by the depletion of our natural resources and environmental degradation.

Loss of elephants in Sri Lanka and its implications

People whose lands border elephant reserves have had a raw deal for some time in Sri Lanka. Elephants destroy crops and at times even kill people. The danger to elephants in the present situation is that because they have no commercial value, and are a potential threat to human life and property, they are likely to be eliminated from agricultural communities by the local people. Since 1950, a minimum of 1,425 wild elephants had been killed in the escalating conflict between man and elephant in Sri Lanka, were the number of elephants has declined from about 12,000 at the turn of the 19th century to about 4,000 today. In 1998 alone, at least 138 elephants were killed by farmers in defence of their crops[6]. Many of the hapless elephants that fell victim to the farmers were tuskless bulls or *maknahs*[9]. These were killed neither for the ivory (which they lack) nor for the meat (which no one eats in Sri Lanka) nor hide (for which there is no local market). Therefore, the slaughter of elephants is not the result of an increased demand for ivory, meat or hide. Instead, the real cause may lie in how farmers perceive the value of elephants[5]. The recent increase in the wanton slaughter of elephants in Sri Lanka points to the fact that where there is intense competition between wildlife and people, with whom they share the land, human interests inevitably prevail. In Sri Lanka, there seems to be no advantage to the ordinary man of having elephants around. For those people who live next to an elephant reserve, the presence of elephants is both a bloody curse and a liability. The killing of an elephant therefore removes a serious pest. Thus many farmers, despite their Buddhist faith, do not really regret the disappearance of the elephant from their neighbourhood. For the rural poor who suffer so many problems such as inadequate food, insufficient health care, fluctuating rainfall, increasing oil prices, the IMF and the World Bank, elephants must surely be a luxury - a luxury that they cannot afford. Given this situation, it is now quite obvious that both elephants and other wildlife will decline in number and eventually disappear altogether from agricultural areas in Sri Lanka, unless the damage they cause can be adequately and promptly compensated. If wildlife is given a value, then it could be transformed from a liability into an asset[5]. But the amount paid to families to compensate their losses is woefully inadequate. Between 1992 and 1994, about 400 cases were investigated by the Department of Wildlife Conservation, and a sum equivalent to about US$ 6,000 was paid as compensation. It is estimated that in the conflict areas, up to 73% of the families earn less than Rs. 30,000 (= US$ 440) per annum, well below the poverty line, and hence, it is estimated that the funds available through GEF could feed and clothe 1,800 families for 10 years[23].

Capture and use of problem elephants

In the words of the one time Warden of Department of Wild Life, in Sri Lanka, Dr. C.W.Nicholas, "The ancestors of the Sinhalese, brought with them to a new and undeveloped land in which the wild elephant was found, their inherited skill in the domestication of the animal. And it may be surmised that they began from the earliest days of their advent to capture and tame the Ceylon elephant and employ it in the service of man".

Capture and use of elephants in the service of man is far more sensible than doing nothing and seeing them decimated by angry farmers and poachers. The human-elephant conflict in Sri Lanka is real and it seems to lead in just one direction: the destruction and eventual elimination of elephants, unless innovative measures are taken now, to address the concerns of farmers, and mitigate the problems faced by the rural poor. The capture of elephants from areas that were to be developed for agriculture was suggested by the Senior author in 1964 and 1965. The Ex-President of the Wildlife and Nature Protection Society in Sri Lanka, Mr Thilo. Hoffmann[10], recognized the need to capture, over a few decades, as many as 1,000 elephants or more from areas outside the protected reserves, and highlighted the fact that every elephant that was killed represented a great financial loss to the country, both in terms of local revenue as well as foreign exchange.

The last elephant kraal by the Dutch was in 1795, at Hanwella just 18 miles east of Colombo. The first elephant kraal by the British was in 1802 in Negombo, only 23 miles north of Colombo. No one but a rank idealist will mourn the disappearance of the elephant from Colombo, Negombo or even Hanwella.

We suggest that some of the elephants that raid crops in agricultural areas be captured annually and domesticated and used in forestry, eco-tourism, agriculture, irrigation, construction, or sold to Buddhist temples or private individuals capable of looking after these animals. The revenue accruing from such operations must then be used to improve the livelihood of the poor. Only in this way can we change the attitude of local communities from intolerance to accommodation. During the past five years, on average about 100 elephants were lost in conflict areas. Given that domesticated elephants are worth between Rs. 75,000 and Rs. 1,500,000 (= US$ 1,200 to 24,200), depending on age, size and sex, the animals that are killed by farmers in defence of their crops, represent a substantial loss indeed. The revenue from the sale of these captured elephants can then be used in poor rural areas to build dispensaries, grinding mills, supply clean water, or even manufacture paper out of elephant dung!

The elephant is the jungle's perfect cross-country vehicle. Domesticated elephants have been used

extensively in Asia, in war and peace. In Assam, in north India, elephants were put to work ploughing farmland and pounding rice. In Myanmar (Burma), they are the backbone of the timber industry. The elephant's advantages in forestry operations - both economic and environmental - are many and well proven[11]. A fully trained elephant is an investment for life. Unlike machinery, elephants do not rust, corrode or pollute the environment. They do not need expensive spare parts, and their dung acts as fertilizer as well as an agent of seed dispersal in the forest, automatically reforesting even as they remove trees[11]. Trained elephants are therefore an economic asset that can be used in production forestry to haul timber and in wildlife to haul tourists, or patrol reserves.

Game Ranching

Game ranching is a form of farming wildlife, and it promotes the commercial use of wild populations. In Zimbabwe, the abandoning of a protectionist philosophy and recognizing the economic properties of wildlife, has encouraged economic forces to reinforce wildlife conservation[5]. Many species of wildlife such as red and fallow deer, wild pigs, crocodiles, turtles, can be ranched successfully. In New Zealand, deer antler velvet is harvested for use in Chinese pharmaceutical industry[4]. Wildlife ranching is a relatively new form of agriculture, and from a conservation point of view, ranching is by far the most desirable form of farming wildlife, as it depends on the supply of animals from the wild being maintained[12].

Crocodiles have been successfully ranched in Africa, South America and Australasia, often with eggs taken from the wild. This is not a drain on the populations since a certain number of hatchlings are released back into the wild, once they reach a size that would give them immunity from their predators. In Venezuela, hunting crocodilians on the floodplains of the Orinoco Basin is a big business. In 1982, the Government lifted a 10-year ban on hunting of the common caiman (*Caiman crocodilus*) with the view to promoting the sustainable utilization of the caiman by local people. Today, as many as 15,000 caimans are harvested annually for their hide and meat[13]. In Western Queensland of Australia, kangaroos were shot as pests by rural Australians, since they competed with sheep for grazing lands. As it was illegal to sell kangaroo meat for human consumption, more than one million kilograms of kangaroo meat was left to rot in 1992. Today by creating a legal market for kangaroo meat, it is hoped that kangaroos will be seen as a source of income by farmers, encouraging them to reduce sheep numbers rather than kill kangaroos illegally[14]. Turtles lay thousands of eggs during a nesting season. A substantial portion of these eggs is lost to predation and flooding. Therefore, if losses due to predation and flooding can be minimised, some of the eggs could be utilized by people, without jeopardising the survival of the turtles. The turtles, with their huge output of eggs, have all the ingredients for striking a balance between conservation and sustainable utilization[15].

Harvesting wildlife

Wildlife conservation is a complex issue which can evoke powerful emotions among people. In the final analysis, conservation is management - maintaining sustainable populations in healthy habitats[8]. Sustainable utilization of wildlife has been recognized by both IUCN (The World Conservation Union) and WWF (World Wide Fund for Nature), and also by a number of responsible NGOs as one of the best ways of preserving wild species. But as Milner-Gulland[16] points out, in order to institute a sustainable harvesting programme, the game species must first be protected from unregulated hunting. Robinson & Redford[17] provide indices and models for the measurement of hunting sustainability in tropical forest systems. The trick is to harvest a population at the same rate as it seeks to increase. In the Dry Zone of Sri Lanka, there are many rocky areas characterised by thorn-scrub vegetation which have very poor agricultural potential, even with the use of fertilizers. These areas are ideal habitats for deer, sambar and pig. Under proper management such areas could be made into economically productive land and could also supply the protein needs of both the rural as well as the urban people. If shooting *non-endangered game* on permit is allowed *within these areas*, then it will generate additional revenue. Hunting of game animals is sustainable in the long term only if the harvest is both biologically and socioeconomically sustainable[18]. In one village in Zimbabwe, poaching on game animals has also been much reduced, because about 150-odd impala are culled officially every year, and the meat is sold at cost price to the villagers[19]. Furthermore, placing an economic value on wildlife will promote its conservation. In the absence of economic incentives, no amount of legislation will ensure the survival of wildlife outside protected areas.

Conclusion

The idea of farming or ranching wildlife is a controversial issue in Sri Lanka. Many nature lovers who see only the aesthetic value of game, and animal rights activists oppose the idea of ranching. We are aware of their criticisms and recognize the fact that debates on this issue could be fractious. It is however easy for people in towns and cities who have their protein needs satisfied through beef, pork, mutton, chicken and fish to decry the utilization of game by villagers. But the future of Sri Lanka depends on a healthy peasantry and we feel that it is important that the protein needs of the Dry Zone

villager be addressed. According to a recent UNICEF report, the highest degree of malnutrition among children under 5 years of age, prevails in the Dry Zone where people have been settled. One of the chief causes of heart diseases in the village areas is malnutrition and lack of animal protein in the diet. Wild game is known to be an important source of protein for rural people, and its sale can provide tangible financial assistance to the poor people[20,21]. Some of the rural poor live from hand to mouth, but the hand is at times empty and rarely well filled. It is scandalous that the poor are unable to consume enough food to meet even their basic needs. In any developing country, extreme inequalities in the distribution of income and assets are both a cause and a consequence of biodiversity loss[22]. In 1984, the Department of National Parks and Wild Life Management in Zimbabwe started the Communal Areas Management Programme For Indigenous Resources (CAMPFIRE), whose aim was to help people in the communal areas to get the most out of natural resources, including trees, grazing, water and wildlife. Today, it is an outstanding success. Although wildlife does cause problems, the benefits to the community from wildlife far outweigh the problems for most people in Zimbabwe[19].

Total preservation of wildlife resources is a luxury many poor countries, including Sri Lanka cannot afford in the face of the legitimate aspirations of the poor for a better standard of living. Harvesting wild populations, whether on land or in sea, represents the only sustainable resource-use of consequence[5]. But the acceptance and adoption of such a policy in Sri Lanka would require a change of attitude from large sections of the population. Development must be a process that ensures that people have access to basic needs. Their prosperity must therefore depend on the *prudent exploitation* of their forests, wildlife, fisheries and the limited areas of good agricultural soils. In the years to come. in many parts of Sri Lanka, where the human footprint is already being felt in and around wilderness areas, promoting the aesthetic value of wildlife alone will not guarantee its conservation. At least some wildlife species can pay for their conservation, and thus ensure their survival even outside the few designated conservation areas.

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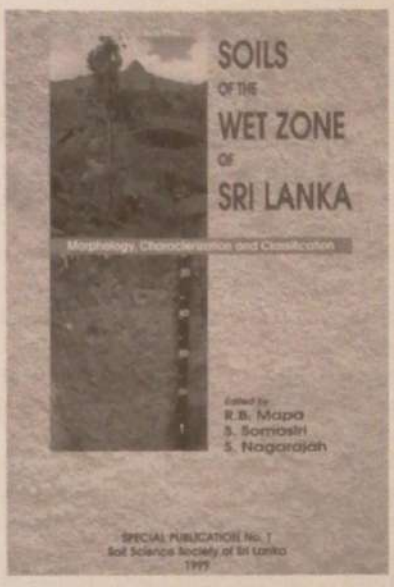
Book reviews

The soils of the wet zone of Sri Lanka: morphology, characterization and classification

R. B. Mapa, S. Somasiri, S. Nagarajah (Eds.). Soil Science Society of Sri Lanka. ISBN 955-8124-001.

Rs 200/- + Rs 20/- postage. Order from: Prof. R. B. Mapa, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka. Email: mapa@agri.pdn.ac.lk

Reviewed by Hemantha Wijewardana
President, Soil Science Society of Sri Lanka.



The Soil Science Society released its first special publication titled *Soils of the wet zone of Sri Lanka: morphology, characterization and classification* on 22 October, 1999 at the Society's 30th Annual Sessions. This publication expands present knowledge on the wet-zone soils of Sri Lanka, and contains detailed information on 28 benchmark soil series identified in the low, mid- and up-country wet zone. It includes colour plates of soil profiles and landscapes supported by summarized information on physical and chemical soil data. The soils are classified according to *Soil Taxonomy* (USA) and FAO/UNESCO systems to facilitate agro-technology transfer. In addition, chapters on climate and landform, history of soil classification, the risks and limitations and management of wet zone soils, are included. The authors of this publication are all eminent soil scientist working in different institutions of Sri Lanka.

Soil is one of the most important natural resources available to the people of Sri Lanka. A large proportion of the labour force is dependent for a living on soil and/or land. Until recently, agricultural products accounted for the largest slice of Sri Lanka's export income. The island's wet zone of in particular supports the export crops, tea, rubber, coconut and spices, which are together responsible for about one-third of the country's foreign exchange earnings. Nearly 50% of the labour force finds employment in the agricultural sector. Agriculture is the principal means of sustenance of the rural population, and soil utilization plays a major role in its socioeconomic development.

The total land area of the country is only about 6.5 million hectares. Of the total land area, about 65% is not available for agricultural purposes due to unsuitable terrain, rockiness, water bodies, national reserves, protected areas or allocation for non-agricultural uses. Further, the adverse climatic conditions encountered in the dry zone limit the full utilization of the available fertile soils for agricultural production. Due to inappropriate soil management practices, the effective extent of productive soil has been diminishing over the years. On the other hand, the population dependent on land-based livelihoods has been rising. The total population has increased from 5 million in 1948 to about 19 million by 1998. The per capita land area has reduced to such a low level that it is nearly impossible to sustain the entire population through agriculture alone. It is therefore essential that the limited land area available is used and managed properly to enhance and sustain optimal soil productivity.

Sri Lanka is divided into three main rainfall zones: wet, intermediate and dry. These zones are in turn subdivided into seven major agroecological zones based on altitude. Both wet and intermediate zones consist of low country (0–300 m above mean sea level), mid-country (300–900 m above msl) and up country (>900 m above msl). The dry zone is entirely part of the low country. Thus, the seven agroecological zones are low country wet zone; low country intermediate zone; low country dry zone; mid-country wet zone; mid-country intermediate zone; up country wet zone; and up country intermediate zone. These seven zones are further subdivided into 24 well defined agroecological regions, each with its unique combination of rainfall pattern, elevation, landform, temperature range and type of soil.

The book consists of nine chapters. The first chapter deals with the scope of the publication and a provides a general outline of each chapter. Chapter 2 deals with the climatic environment of the area under study. The climatic conditions of the wet zone are discussed in sufficient detail to provide the reader with a clear understanding of the climatic environment under which each major soil group described in this publication has developed. In this region, climate is the most important soil-forming factor, because of the intense weathering conditions resulting from very high temperature and rainfall. Important weather data for representative sites are included to illustrate the minor climatic variations encountered even within the wet zone and also to

facilitate soil management decisions appropriate for different locations in the wet zone.

In Chapter 3, the physiography, land systems and landforms are discussed in sufficient detail to enable them to be related to the different soil morphologies of different landscapes. At first, to place the physiography of the wet zone in perspective, an outline of the general physiography of the whole country is presented for the benefit of the reader who is not familiar with the geomorphic setting of the country. The distinctive land systems occurring in the wet zone and the major landforms that constitute each land system are described in some detail to help the reader visualize the physical environment in which a particular soil is found.

Chapter 4 presents a review of the earlier soil investigations and efforts at soil classification in Sri Lanka. Further, the relationships of earlier soil classifications with the international classification systems now in use are discussed.

In Chapters 5, 6 and 7, representative soil profiles of major soil series of the wet zone are described. These soil profiles are grouped and described according to elevation. In Chapter 5, soils of the low country wet zone and their local classification as well as that according to *Soil Taxonomy* and the FAO/UNESCO system are discussed. This chapter also describes the methods used for selecting, naming and mapping of benchmark soils. Similarly, the soils of the mid-country wet zone and up-country wet zone are described in Chapters 6 and 7 respectively.

For each of the soil series a colour plate showing the landscape and soil profile is provided with a summary of morphological characters and a description of physical and chemical properties. The local classification and those according to *Soil Taxonomy* and the FAO/UNESCO system are also given. The soils are classified only at the subgroup level according to Soil Taxonomy due to the difficulty of defining the soil moisture control section for determining the soil moisture regime, and unavailability of long-term soil temperature records as well as soil mineralogical data.

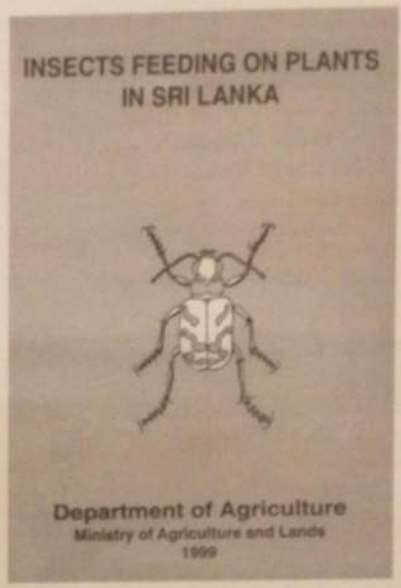
In Chapter 8, the possible risks and limitations in the use of the wet zone soils are discussed. These are discussed according to the groupings followed in Chapters 5, 6 and 7. In the final chapter (Chapter 9) the current use and management problems of the wet zone soils are discussed.

A glossary of selected technical terms is included in Appendix I. This should help students and non soil scientists in understanding the material covered in the text. The methods used for the physical and chemical analysis of soils in this study are given in Appendix II. The distribution of the benchmark soils of the wet zone of Sri Lanka is shown in the map given in the rear folder.

Insects feeding on plants in Sri Lanka

P. M. Wijeratne (compiler). Department of Agriculture, Ministry of Agriculture and Lands. 1999. 171+ pages. ISBN 955-8306-00-2.

Reviewed by Jayanthi Edirisinghe
University of Peradeniya.



I was pleasantly surprised and very pleased to see a long-felt need fulfilled by the book listing insects and mites on crops and related plants recorded during the past 100 years. In this book the compiler brings together insects that feed on 438 crops and related plants. As stated by him a greater part of the volume has been drawn from the "preliminary list of insect pests of cultivated plants in Ceylon" published in 1923 and the unedited (unpublished) pest list compiled by the entomologists of the Department of Agriculture in 1960.

The commendable task of putting this information together fills a very big void in the study of entomology in Sri Lanka. The book is intended as a comprehensive and a convenient reference for students and researchers in the field of Entomology; for those pursuing courses in Agriculture, Forestry, Zoology and Biology and for the Field Botanists. The book lists 438 crops and plants of Sri Lanka in its content pages, under their scientific name, arranged alphabetically, thus making it a ready reference. Thereafter, the entire book is devoted to listing of insects feeding on each plant species (listed with the Sinhala and Tamil names and the plant family) under different feeding strategies and taxonomic groups. Thus, the headings go as "Leaf eating caterpillars, leaf eating beetles, leaf hoppers and plant hoppers, aphids, bugs, scale insects and mealy bugs, ... stem boring beetles, pod boring caterpillars..." giving a complete picture of all categories of insects feeding on a specific plant. Written against the scientific name of each insect is its authority followed by the classification (order and family). The revision of insect names has been aptly carried out by taxonomists of the

Natural History Museum and CABI BIOSCIENCE. Similarly, the plant names have been ably revised by Prof. M. D. Dassanayake. These revisions make the book an accurate, invaluable, current compilation.

As the title says, the focus of this book is plant feeding insects and it certainly compresses the essentials into an easily referred account that can be used for a multitude of purposes; whether it is to know the insect species, type of damage, part of the plant damaged, type of pest control method that can be applied, diversity of the insect fauna on a particular crop and the gamut of pests that have to be considered when planning IPM strategies for crop pest control. These are some of the extensions of the usage of this book that comes into my mind.

As someone who has been waiting to see a local publication of this nature, for both teaching and research purposes, I find this book outlined very practically for easy and ready reference and is an asset to students and teachers of entomology. No sooner a copy of this book was given to me, I made it a point to meet the compiler Dr. Wijeratne and personally congratulate him for the service he has rendered to the study of entomology in Sri Lanka. I have no doubt that this compilation will be counted as a mile stone in the entomological history of Sri Lanka that dates back to the British period.

On settling down to go through this book, I could not help but jump from one known plant name (starting with Mahogany) to another of my interest, to check on the types of insects and names of insects. At this point, I felt that, had an index been included tying common English names of plants with their scientific name, my task would have been much easier. I see this as one of the minor omissions in this book preventing any user from hurriedly checking on a plant known by its common name. Another improvement that I would like to suggest is that to have a pest rating for the insects that have been listed under each crop. This would enable the identification of the most important and damaging insects from less important once at a glance. Also, this information would help scientists to formulate research projects and help funding agencies to make their decisions. Perhaps a second edition of this valuable book could incorporate these ideas.

The printing of "Insects feeding on plants" had been funded by the Japanese International Corporation Agency (JICA), helping a worthy cause. Copies of the book have been distributed to relevant persons and authorities connected with the subject. A limited number of copies are available with the compiler, Dr. P. M. Wijeratne, PGRC, Gannoruwa, Peradeniya for free distribution to interested persons.

Correspondence

Letters

Sir—

As Melwin Herath (*Loris*, 22(1): 8) correctly points out, the real victim of the human population will be not just biodiversity, but humanity itself. It is sad that successive governments have neglected family planning awareness because of pressure from racist extremists. I recall the family planning programme started by J. R. Jayewardene in the early 1980s coming under fire from Sinhalaese extremists because it was claimed that Tamils and Moslems will never practice birth control and that they will drive the Sinhalese into a minority in this country. This kind of bigotry has led to the almost complete abandonment of family planning awareness programmes in Sri Lanka.

No one could seriously doubt that today's young fathers and mothers do not understand the advantage of small families. In most cases, parents would like to have just two children: however, the problem seems to be that most parents think of family planning only when the third pregnancy occurs. The challenge before government is to offer *timely* family-planning assistance and awareness in the course of the second pregnancy.

There are only 65,000 sq. km. of land in Sri Lanka, and eventually we shall probably be standing on one another's shoulders. Now is the time to act, in which case we could probably restrict the national population to about 25 million, instead of the 40 million being predicted by 2050.

Some countries such as Mexico have been able to halve their birth rates in just 15 years thanks to effective awareness programmes. Family planning is something about which politicians and leaders should not be coy if they really care for the future. We should face the issue squarely and plan our population. After all, as Mr Herath points out, if 700 people continue to be added to our population each day, who is planning for the schools, hospitals, homes and jobs they will need?

Humans are supposed to be intelligent beings: let us therefore breed like humans and not like rats.

SRIMAL RAJAPAKSE,
HOMAGAMA.

Thank You

We wish to record our grateful thanks to the large number of readers who took time to write, e-mail and call us to express their satisfaction with the revised format of Loris. *This encouraging correspondence is not being published for lack of space. Nevertheless, thank you all!*

Editorial Committee.

The encounter...

Gamini G. Punchihewa

42, Hospital Road, New Town, Embilipitiya

Darkness was fast falling over the vast sylvan solitude of the Wasgamuwa Park tha evening in mid-1997. We were travelling in a vehicle in the company of some members of the park staff. They were a seasoned lot. They knew every jungle trail, whether the trails of the elephant, the bear or the leopard. They also knew where the birds, both native and migrant, took refuge in those tanks that dot the parkland and on the forest canopy as well.

As our vehicle took a bend on this park road lined with overhanging trees, there was the gay walker, ambling away, quite undisturbed. He did not care for the intruders into his habitat as he was truly the lord of this jungle: none shall dispute his rights. This massive creature, about 9–10 feet in height, was a typical march elephant, the race said to dominate the Mahaweli plains and the Polonnaruwa area.

As the beam of our headlights fell on its bulky body, this mildly alarmed Goliath, enjoying a lonely walk on its private turf, hastened its steps. On the instructions of the wildlife officials, the driver slowed down: no one wanted a confrontation at this hour, with night falling fast. Although the beast ahead of us did not appear unduly disturbed, we noticed it quicken its gigantic steps. The wildlife staff did not want the driver to stop, or to approach the elephant too closely. It was, after all, minding its own business.

Any sudden move, the game guards told us, could excite the animal, causing him to turn around and confront us. So on and on we went, chilled with fear. The huge giant of the forest going ahead of us, as if to say 'follow me or face disaster', and we in nervous pursuit.

Nearing the Kelahandiya (jungle junction), the elephant took vanished into the jungle without so much as a trumpet. As the elephant edged away, our wildlife companions stopped the vehicle and climbed onto the footboard, shouting "Daha aliya, daha aliya". The words succeeded in hastening the elephant's departure into the forest.

The favourite haunts of the elephant in Wasgamuwa Park are around tanks such as Vilumitiya and Kadurupitiya, Meewathpura Villu and Yudaganawa plains. The wildlife staff told us that there were 200–250 elephants in this forest, moving around in groups of between three and 25 individuals. The herd we sighted at Vilumitiya Tank comprised of about 25–30 animals, including some babies. It was a wonderful sight to see the offspring mingling with adults.

Randenigala

T. Quintus Fernando

Last August, I took my family to the Tree Centre at Randenigala, managed by the Wildlife Trust. From the Tennekumbura bridge on, the scenery to Mahiyangana through Raja Mawatha became more and more fascinating— Mailapitiya, Adikarigama, Keerti Bandarapura.

Nearing Randenigala, it was a treat to the eye to see the mighty reservoir bounded by the huge mountains of the Dumbara Valley: the Victoria- Randenigala-Rantambe Sanctuary. The reservoirs are at the foot of seemingly enless jungle slopes. It is really a breathtaking view. The elephant dung we saw bore witness to the fact that wild elephants were around. Though this is a sanctuary, villages can still be seen by the road: several small shops sell fruits, vegetables and daily needs. Heaps of red bricks suggested that the brick industry is flourishing here.

Any human settlement can pose a threat to wildlife and nature, as villagers set fire to the forest, extract timber and firewood and engage in cultivation, fishing and poaching. Eco-tourist accommodation, which is lacking now, will certainly help improve the conditions inthe sanctuary, as wildlife enthusiasts often report problems they see. The Tree Centre offers some ten small, air-conditioned cottages, built along the slope of a small hill, which are let out, inclusive of meals. After evening tea, we climbed up a short distance of Bambikanda Hill, just behind our cottage.

Early next day, we left for Dambana. The drive to Mahiyangana, within the sanctuary, was spectacular: first the thick forest and later the irrigation canals of the Minipe project. On the Manampitiya Road we saw large expanses of burnt forest. As we neared Dambana Vedda Village, we again saw that acres and acres of forest inside the Maduru-Oya National Park had been set on fire.

We met the Vedda Chief, Uruwarige Vanniyalage Eththo, who greeted us in true Vedda fashion. Having exchanged greetings, we visited the house occupied by the late Vedda chief, Tissahamy. It is unfortunate that Veddas have been reduced very nearly to beggars today. The Wildlife Department should employ them to look after the forest. They have a rich culture, which the Ministry of Cultural Affairs must help them preserve.

On our return, we had a swim in the Ulhitiya reservoir. That evening we visited the beautiful Loggoloya Reservoir, mesmerized by the colours, rhythm and the patterns of the waters, which take one to a different world. There is much bird life, too. The next day we returned home. This trip was well worth repeating.

Science Digest

The Editor's review of new developments in biodiversity and environment-related research

Rhino horn, tiger bones and seal penises: traditional medicine ain't all good

Despite the proliferation of modern 'western' pharmaceuticals, around 80% of the world's 6 billion population is still estimated to rely primarily on traditional medicine of one kind or another. In Sri Lanka, the *ayurveda* system uses only plant-based materials in the manufacture of its pharmacopoeia (even though animal products ranging from leopard meat to loris tears have been used by off-beat practitioners at various times in the past). In many other countries however, especially the 'Chinese World'— including China, Taiwan and Hong Kong— animal parts are widely used in traditional medicine. This trade has led directly to declines in the populations of many charismatic species, including the tiger and several species of rhinoceros. Although pressure has been mounting on the governments concerned to regulate the trade, the amounts of money involved are so enormous that effective enforcement is almost impossible. This is especially true in prosperous Hong Kong, where money can buy just about anything. The Chinese traditional medicine market is worth around US$ 1 billion at present, but is expected to expand at least ten-fold in the next decade.

It was heartening therefore that Chinese officials agreed at a World Wildlife Fund-sponsored conference last October to control the trade in products derived from endangered species and also seek alternatives from farmed animals or other sustainable sources. While this is yet to be translated into official policy, conservationists are relieved that the Chinese government has at least acknowledged that a problem exists. It now remains for Taiwan and Hong Kong to follow suit.

Also encouraging is the fact that while many of the most harmful 'remedies' address the problem of impotence, new developments in western medicine, such as the 'miracle' anti-impotence drug Viagra and several other products now in development, will replace traditional cures in the next few years. This is timely indeed, given that Chinese herbalists are now looking to new species for medicinal derivatives, given the decline in traditionally exploited animals such as tiger and rhinoceros. Seal penises are now widely used as aphrodisiacs in Chinese medicine, with top-dollar being paid for several species of seals and sea lions, many of them endangered. Chinese traditional medicine companies have been known to order enormous quantities of seal penises each year, reportedly 250,000 from Labrador and Newfoundland in 1993 alone. In a bizarre twist of events, the Japanese have not taken to eating Sea Lion penises, including those from endangered Galapagos sea lions.

Who will bell the CPC?

The recent appeal court ruling that the Central Environmental Authority introduce curbs on vehicle emissions has been welcomed by all. Let us hope the CEA will make meaningful regulations and also insist on an effective system of monitoring and controlling vehicle exhausts. However, the problem does not lie with the CEA alone. The Ceylon Petroleum Corporation, which has a monopoly on the production and sale of petrol and diesel in Sri Lanka, is in fact the main culprit. Thanks to it being a monopoly, it has seen no need to improve the quality of fuel it produces. Sri Lanka is now one of the last countries in the world not to use unleaded petrol. In fact, even the four-star petrol now available is not unleaded. The three-star petrol in fact has 30 mg of highly toxic lead per litre. The problem with lead is that once it enters the food chain, it remains there for decades.

In the case of diesel too, the quality of diesel produced by the CPC is so poor that even new cars belch smoke laden with particulate matter. In this regard, analysis of data accumulated by the State of California, published recently, is chilling: the risk of cancer in people exposed to diesel smoke is 7–14 times higher than that for other high-risk carcinogens such as formalin.

No one, including the moribund Ceylon Petroleum Corporation, has a right to poison the environment day in and day out without being held accountable. It is time for the CPC to mend its ways, something that could best be done by ending its monopoly over this lucrative market. That way, Sri Lankans will not only have access to cleaner air, but also cheaper fuel.

Proto-fishes

Read any book on the evolution of vertebrate animals, and you will be informed that the earliest vertebrates appeared in the Ordovician period, around 480 million years ago, although they are well represented (by fish-like creatures) only in fossils of the early Silurian period, around 430 million years before present. A recent announcement by Professor D.-G. Shu of the Early Life Institute at Northwest University, Xi'an Province, People's Republic of China and his colleagues in the prestigious science journal *Nature* (vol. 402, no. 6757, 4 Nov., 1999), changes all that. The scientists have dated two fish-like fossils they discovered in China's Yunnan Province back to the Early Cambrian period, pushing the origin of possible vertebrate ancestors a full 50 million years. The relationships of the fossils are still being worked out, but both specimens appear to have paired fins, something that appears bizarre given that this feature was until now thought to have evolved much later in fishes (primitive fish-like vertebrates such as lampreys lack paired fins).

Inbreeding *is* reversible

One of the great dilemmas facing conservation biology is the problem of fragmented populations. All of Sri Lanka's protected areas, for example, are now relatively small 'islands', it being impossible for animals to move from one to another. The trouble with such small populations is that they run a high risk of inbreeding, which results in a high proportion of deformed or sterile progeny, leading inevitably to the demise of the population. Although this problem has been known and understood for decades, especially when it comes to maintaining viable captive populations of endangered species in zoos, it has rarely been possible to gauge whether a seriously inbred population can once again be made viable through the introduction of unrelated animals from other populations of the same species.

A recent study by Thomas Madsen of the University of Sydney and colleagues (*Nature*, vol. 402, no. 6757, 4 Nov., 1999), suggests it is. Working with the last remaining individuals of a population of vipers, *Vipera berus*, at Smygehuk near Lund, Sweden, Madsen's team introduced 20 male adders from another population, having first marked all four remaining males in the indigenous Smygehuk population. After four breeding seasons, the surviving introduced males were all recaptured and returned to their original habitat. It seems however, that they had done their work. Today, seven years after the introduction, the Smygehuk population appears once again to be viable, having increased almost ten fold in the period.

The success of this experiment suggests that in Sri Lanka too, small, 'trapped' populations of animals, especially large mammals such as the elephant and leopard, should be periodically translocated so as to minimise inbreeding depression and the extinctions that would inevitably follow.

New muntjac

A team from New York's Bronx Zoo working in northern Myanmar have discovered a new species of muntjac, named *Muntiacus putaoensis* after the town of Putao, from nearby which the deer was discovered (*Journal of Zoology*, 249: 427). The local people refer to this species as the 'leaf deer' because the entire carcass of this diminutive species can be wrapped in a single leaf of the plant *Phrynium capitatum*. Hardly anything is known of the ecology of the deer, which inhabits areas of dense rain forest south of Myanmar's Hkabo-Razi National Park, on the Myanmar-India-China border. *Muntiacus putaoensis* is the second species in this genus to be discovered during the past decade, and follows a series of new large mammal finds in the south-east Asian region, including Laos and Vietnam. A single species muntjac, the barking deer *Muntiacus muntjak*, is known from Sri Lanka.

Bt corn makes moths flake

Biotechnology, fast coming to be known as BT, has inspired furious debate among scientists and lay people alike, especially regarding the use of the developing world. Multinational BT companies such as Monsanto, are veritable four-letter words, for example, in many parts of India. What biotechnology does is modify the genes of plants (and to a lesser extent, animals) to make them more productive, faster growing and pest-resistant. Such genetically-modified (GM) crops result in higher profits both for farmers and seed producers such as Monsanto, alike.

Some 20% of the corn grown in the USA (on an areas about the size of Sri Lanka) is a variety known as *Bt* corn, which has been genetically modified to exude an insecticidal toxin derived from the bacterium *Bacillus thuringiensis* (hence, *Bt*). When insect 'pests' including butterfly and moth caterpillars feed on the corn, they ingest the toxin and are killed. While this is all very well for protecting crops, a study headed by Deepak Saxena of the Laboratory of Microbial Ecology at New York University has come up with several disturbing discoveries (*Nature*, 402: 6761). They found that monarch butterfly caterpillars that fed on milkweed that had been contaminated with pollen from *Bt* corn died, demonstrating that the genetically-modified crops could give rise to significant secondary impacts. They also found that corn borers (*Ostrinia nubilalis*) that fed on *Bt* corn were not themselves affected by the toxin, but that lacewings (a group of insectivorous insects) that fed on the borers died. Worst of all, *Bt* corn was found to exude the toxin from its roots directly into the soil, rendering the soil toxic for as long as 234 days (the length of the study). Ammunition indeed, for opponents of BT in general and GM crops in particular.

Next: bio-terrorism

As if the travails of BT (see '*Bt* corn makes moths flake', above) were not enough, there is now increasing apprehension that terrorists could adopt biotechnology for their own evil ends. The problem lies in the fact that seed companies are today producing near-ideal seed for high-yielding, disease and pest resistant crops with 100 percent genetic uniformity. This leaves open an inviting niche for bio-terrorists to develop a fungus or infectious microbe that could produce crop-killing toxins, just as *Bt* corn develops insect-killing toxins. Because the genetic make up of the crops themselves is so uniform, a pathogen that affects one will affect all. In conventional farming however, there is considerable genetic variation in seed material, resulting in crops that might not be as good as we like, but at least part of which might be resistant to some diseases. No such luck with the giant, single-crop farms that are taking over agriculture in developed countries these days.

Nevertheless, 'bioterrorism' also has the potential to be put to good use in fighting crime, especially against drug lords. For example, Florida drug enforcement authorities recently announced that they were considering the use a strain of the fungus *Fusarium oxysporum*, developed by a Montana biotechnology firm, to target illegally-cultivated cannabis. *Fusarium oxysporum* infects the plant with a deadly root-eating canker, literally choking the life out of it. However, some scientists fear that the organism may mutate and affect other commerically valuable crops.

The issue of bio-terrorism has been taken seriously enough in the United States for the White House to order the Department of Agriculture and the FBI to make plans to cope with a crisis (*Discover*, 20: 1). Who knows, Saddam Hussain might, even as you are reading this, be developing a genetically-modified potato that could put the famous Irish potato famine to shame.

A whale of a hippo

Biologists have long wondered which group of land mammals it was that first gave rise to the cetaceans, the group of animals which includes the whales. Two recent separate studies by John Gatesy of the University of Arizona (1997, *Molecular Biology and Evolution*, 14: 537–543) and Bjorn Ursing & Ulfur Arnason of Lund University, Sweden (1998, *Proceedings of the Royal Society*, Series B, 265: 2251–2255) analysing DNA from a large number of cetacean and land-mammal species has shown however, that the land mammal most closely related to the whales is the hippopotamus. Now that the molecular data is in place, the conclusion seems almost obvious: hippos, like whales, lack dense body hair and sebaceous (oil) glands. They also have much else in common: males have their testicles positioned inside the body, they use sound to communicate under water, and also mate and suckle their young under water. This is not to say that whales are directly descended from hippos— merely that they share a common evolutionary ancestor.

And now, a panda clone

Coming hot on the heels of Dolly, the world's first cloned mammal, scientists at the Chinese Academy of Science have succeeded in cloning a giant panda. Cells from a dead female panda were implanted in egg cells of a common female white rabbit and the resulting 'panda' embryo nurtured for 10 months. According to the Chinese news agency Xinhua, DNA tests on cells extracted from the embryo confirm that it is one hundred percent panda. The challenge facing the scientists now is to successfully implant the embryo in the uterus of a female panda, in the hope that it will develop normally and, in the fullness of time, give birth to a normal baby.

Less than 1,000 giant pandas now survive in the wild, and the animals have been notoriously difficult to breed in captivity. The species is threatened largely by habitat loss, but cloning might offer a temporary respite to the 'gene pool' being eroded beyond recovery.

... what next, a Lakspray clone?

And news from Japan that the Snow Brand milk-food company has extracted cells from colostrum (the milk produced in the first week after a cow has delivered) and successfully used these to clone two calves. The clones were produced by combining the nucleus of a mammary cell with an unfertilised egg and inserting the resulting embryo into the uterus of a surrogate cow (the same method was used to produce the sheep Dolly, the first cloned mammal, three years ago). (1999; *DTE*, 8: 1).

Old Four Legs

Evolution dictates that organisms continually adapt to their environment, natural selection deciding which ones will survive. Given that the world's environment is constantly changing, the 'turnover' of species, through the extinction of some and the evolution of others, is a continuous—and sometimes remarkably rapid—process. The ability of a species to endure without changing significantly for 380 million years, i.e. from before the time the dinosaurs *arrived*, is surely remarkable. Such a species is the coelacanth.

Known only from fossils dating back more than 80 million years, the coelacanth was thought to have become extinct long before the dinosaurs themselves disappeared, 65 million years ago. Palaeontologists had long been intrigued by it because, though clearly a fish, the fossils showed it had legs. Could this be the evolutionary 'missing link' between fish and amphibians?

On 22 December 1938 however, an unusually ugly fish with blue-gray flesh and scales, with curious white spots and speckles, its fins more like legs, was caught in the Bay of Chalumna off south-eastern South Africa. The captain of the vessel had never seen the fish before, and called Marjorie Courtenay Latimer, curator of the East London Museum in South Africa. Upon arriving at the docks, Latimer witnessed a creature that she had previously seen only in textbooks. She hurriedly stuffed the five-foot fish into the boot of her taxi and rushed back to the museum, to preserve it. Within hours, she looked up the textbooks and was able to conclude that here was a true 'living fossil' seen alive for the first time. It was almost as if she had visited Jurassic Park and come away with a freshly dead T. Rex.

The coelacanth was eventually named *Latimeria chalumnae* honouring both Latimer and the place in which it was caught. This was the first time a species hitherto known only from fossils had been collected fresh, and scientists were fascinated to discover how wrong they had been in reconstructing from the fossils alone the details of the actual creature. Soon rewards were offered throughout the fishing ports of South Africa for another specimen, but, without luck. Finally, in 1952, French

researchers caught another specimen from the deep sea off the Comoro Islands, a small volcanic group of islands, until 1975 a French colony, on the northwest corner of Madagascar. Subsequently, they acquired about a hundred more specimens there, and the coelacanth became one of the world's best-studied fishes. By the 1980s, specimens had even been filmed under water using remote cameras. Being restricted to a small area around the Comoros, the species was considered to be endangered and its conservation became a matter of international concern.

Surprise it was then in September 1997, when Mark Erdmann, a biologist from the University of California at Berkeley, and his wife, Arnaz, a naturalist, were on their honeymoon in Indonesia. As they wandered through the Manado fish market Arnaz asked, "Isn't that one of those fossil fishes?" Mark turned to look and was amazed to find it was a coelacanth. Erdmann took a photo of the fish and later posted it on his wedding web site. Almost immediately, the scientific world went crazy once more. Coelacanths off Indonesia? Amazing! After the honeymoon, Erdmann went back to Indonesia and spent the next six months searching for another coelacanth, and eventually found a living specimen.

The Indonesian coelacanth population is 6,000 kilometres from the Comoros, suggesting that the species is more widespread than previously thought. In fact, Sri Lanka lies almost mid-way between the two sites, though further to the north. DNA studies of the two populations have shown that they have been reproductively isolated for between two and nine million years; whether or not the two are considered distinct species depends largely on how one defines a species. The Indonesian discovery shows that coelacanths are not as rare as once believed—just hard to find. Evolutionary biologists are now convinced that the coelacanth is not in fact the 'missing link' between fishes and amphibians, but it does represent the tenacity with which a species can survive the turmoil the Earth has endured these past 380 million years.

Life on the deep side

The ability of life to survive in hostile environments is something that never fails to arouse wonder. Could other planets of our solar system, such as Mars, contain (or in the past, have contained) life? A place that scientists have long wanted to explore has been Lake Vostock, perhaps the lowest freshwater lake on the planet: the lake is buried more than 12,000 feet (3,600 m) under the Antarctic ice pack—and you cant find a more hostile place than that! Vostok is deeper than California's Lake Tahoe, with a maximum depth of about 1,640 feet and has a surface area similar to Lake Ontario, one of North America's Great Lakes. The conditions in the lake have been compared by scientists to those that exist on Jupiter's moon Europa: if Vostock can sustain life, then so, many believe, could Europa.

Three separate papers published in the prestigious American journal *Science* (10 December, 1999) describe the discovery of bacteria in the ice just 500 ft above the lake. John Priscu, a biologist at Montana State University and lead author of one of the studies concludes: "The ice we found the microbes in is refrozen water from Lake Vostok. Hence, our data strongly imply that there is life in the lake-water itself." The researchers based their studies on an ice core, 18 inches long and four inches wide, that was taken from about 11,800 feet below the surface of the ice sheet and about 495 feet above Lake Vostok. Jean Jouzel, a scientist at the Centre Nacional de la Recherche Scientifique in France demonstrated through telling evidence that the ice core sampled by the researchers did indeed come from Lake Vostok water that refroze to the glacier.

The scientists decided to drill only within 500 feet of the lake and not into the lake itself for fear of contaminating it. The direct exploration of the treasures that Vostock might hold has, therefore, been put off indefinitely, until a completely safe method is found.

Salman Khan't kill

Its not all roses being Salman Khan. On 1 October 1998, the dashing Bollywood screen idol set out from the dusty village of Kankani, some 30 km from Jodhpur, with an all-star cast of game poachers anxious to pot blackbuck (*Antilope cervicapra*) and chinkara (the Indian gazelle, *Gazella bennettii*). They had just shot two endangered and strictly protected blackbuck , and were searching for more, when they were discovered by members of the local Bishnoi community, who reported them to the authorities.

Khan and his party had not reckoned with the Bishnoi, a Vaishnavite sect, who for centuries have militantly conserved their flora and fauna and for whom protecting wildlife is an integral part of their sacred tradition", reports Jitendra Ram (1998; *DTE*, 1: 12). The Bishnoi are in fact fanatical and militant conservationists, on one occasion having even prevented an Indian Air Force helicopter from taking off with the carcases of animals that had been poached from the air. On another occasion, an army officer caught poaching game was badly beaten up.

The common desert tree *Prosopis cineraria* and blackbuck are especially sacred to the Bishnoi, whose tradition dates back to1472. The sect's conservationist militancy dates to 1730, when 363 members of the sect from 84 neighbouring villages died fighting their king, who was felling the forest. There is today a conservation award named after Amrita Devi, a Bishnoi woman who died in that struggle.

The citizens' arrest of Salman Khan was big news, because in much of India, film stars of his fame are worshipped as deities. In fact, even after he was apprehended by the Bishnoi, Khan almost got away. The government veterinarian who was called upon to autopsy the two blackbuck reported that one had died of overeating and the other of "jumping too high". Ironically, the Indian office of WWF had featured Salman Khan on their 1999 calendar—replaced by another star when the news of the arrest broke shortly before the calendar was released.

Time to call it a day?

Scientists at the European Union's Joint Research Centre (JRC) at Ispra, Italy recently issued a depressing forecast: they concluded that attempts to save most of the world's remaining tropical rainforest biodiversity hotspots are doomed to failure and should probably be abandoned (1999; *DTE*, 7:18). This is not to say that they recommend destruction of these forests—merely that it is probably futile for the EU to continue to pump money into rainforest conservation. "The pressures to remove the forests are too great... there is very little we can do to change the politics of these countries", notes Frederic Achard, JRC's co-ordinator. Achard recommends instead, that the focus should move to 'cool spots', less rich in biodiversity but with a better chance of survival.

I have often wondered aloud whether the *ca.* 140 fragments of rain forest remaining in Sri Lanka, totalling just 750 sq. km., have a viable future. Given the lack of vision and dedication of Sri Lanka's official conservation establishment, I doubt it. But then again, if the JRC team is correct, we are merely prolonging the agony— not curing the disease.

Acid Rain?

Situated 2,100 metres above sea level, the mist-driven Horton Plains have long been considered the 'roof' of Sri Lanka. Two of Sri Lanka's major rivers—the Mahaweli and the Walawe—begin there, and the habitat supports dozens of endemic plants and animals. A study of the acidity of cloud water in the plains, lead by E.R.N. Gunawardena of Peradeniya University's Department of Agricultural Engineering however, makes one pause to think (pp. 37-63 in, *Proceedings of the final workshop, University of Peradeniya–Oxford Forestry Institute Link Project*, 1998). Gunawardena and his team measured cloud-water acidity in the period February to May 1996 and found that it ranged between pH values of 3.88 and 5.59. This startling result suggests that it is time we sat up and thought about the quality of the air over Sri Lanka. The pH value of 3.88 in particular, represents a very high level of acidity, too high in fact for most organisms to survive, especially give that many cloud-forest plants depend on cloud-water for their survival.

Hot on the heels of this study comes a revelation (*Down to Earth*, 8: 4), that an enormous haze of pollutant aerosols discovered about 3,000 m above the northern Indian Ocean, which includes Sri Lanka, by the multi-nation Indian Ocean Experiment (INDOEX). The size of the cloud is, according to the scientists, comparable to the area of the continental United States of America! The scientists say the haze consists of soot, sulphates, nitrates, carbon monoxide and sulphur dioxide. The main contributor to the haze is thought to be vehicle emissions (especially from diesel vehicles), augmented by smoke from the 1988 Indonesian forest fires.

Not just skin deep

I have often wondered why it is that many conservationists seem to be inclined more towards the protection of 'cute and cuddley' animals than, for example, critters like spiders, lizards and frogs. In a discussion with Peter Ng, a research biologist at Singapore's National University some years ago, I described this as the Bambi Syndrome in conservation biology. Peter later discussed this idea in an article he wrote on the subject (1993; *Malayan Naturalist*, 46: 23). We also wondered aloud, over cups of coffee in his lab, what could possibly attract ordinary, run-of-the-mill guys like us, to women (well, at least *one* woman each, seeing as we were both safely married by then).

I was intrigued recently to find that other scientists had not just wondered along similar lines, but actually subjected the matter to experiment. In a study published in the British journal *Nature* (1999; 399: 6738), a team led by Ian Penton-Voak of the University of St Andrew in Fife, Scotland, reported that they showed a sample set of British and Japanese women computer-generated images of a variety of men, and asked them to indicate their preferences. They were amazed to find out that the women tended to prefer different types of men depending on the point they were then at in their menstrual cycles.

When in the middle of their cycles, women indicated preferences for hunky, Clint Eastwood-type men. In the few days just before and after menstruation however, they were more inclined toward men with more 'feminine' faces, like Leonardo di Caprio. What is more, most women indicated that they preferred the Eastwood type for a short-term 'fling', even though they thought such men are dishonest, 'cold' and less dependable. On the other hand, the di Caprio type was definitely their choice for Mr Long Term: they said they associated such faces with better parenting and fidelity. Interestingly, women taking contraceptive pills consistently preferred men with 'feminised' faces.

So, if your boss happens to be a lady, and you want to ask for that overdue increment, remember to choose the right time of month for it.

The 1998 El Niño Revisited

The recent El Niño serves to remind us that things are hotting up on Planet Earth and may spell doom for biodiversity as we know it.

Whenever the weather or the climate comes up for discussion, there's sure to be a grandpa who will chip in with 'When I was a boy, you could be as sure as anything that the monsoon would start on the 15th of June' or 'It never used to rain in February.' Whatever the specific issue might be, the conclusion of the discussion is invariably something like, 'Things were predictable back then. Now they've gone and cut all the trees down, and the weather pattern has gone all wrong!' As sceptical as many of us might be, grandpa could be right. Of course, contrary to old people's claims, meteorological records kept over the past century show that the weather has never been as predictable as we could have liked. There have always been wet years and dry years, warm years and cool ones. But of one thing we can be sure: the world is right now undergoing something of a climatic spasm, and it certainly spells catastrophe for some things we cherish, including biodiversity.

No one is quite sure whether the dramatic changes we are presently seeing in the world's climates have anything to do with us humans. Scientists have been concerned that some things mankind has been doing over the past century could be responsible for the problem. Burning fossil fuels such as petrol, diesel and coal in increasing quantities this past century has been cited as a possible cause. The carbon dioxide given off by this continuous combustion process is suspected of turning Earth into a greenhouse, preventing the sun's radiation from being reflected back into space.

Yet, episodes such as the El Niño we witnessed recently, clearly have little to do with the so-called greenhouse gases: the El Niño phenomenon is at least a century — most likely several centuries — old. Yet, it resulted in the warmest year the earth has known in 1,200 years. What made 1998 globally the warmest year on record? Scientists are yet to find a credible reason.

World-wide, August 1998 was the warmest month on record: the average global temperature for the month was 61.4° F, which is 1.3° above the long-term mean temperature of 60.1°. The previous record for August was 61.1°, set in 1997, most closely approached by August 1995 and 1990. All in all, a steaming-hot decade. The average global temperature rose 1.1° F over the past century and is projected to rise another 2 to 6° by 2100. This is a faster rate of change than any that has occurred on the planet in the last 10,000 years.

The 1998 El Niño also resulted in a global sea level rise of as much as 2 cm, although levels have now returned to normal. The measurements were made possible by the TOPEX/ Poseidon satellite system, operated by the Center for Space Research at the University of Texas at Austin. The satellite measures global sea level at 10-day intervals with a precision of 0.4 centimetres (0.16 inches), making the 2 centimetre (0.8 inch) change relatively easy to detect. Global mean sea level changes seasonally between years, and is a measure of the changing heat content of the ocean.

Perhaps some of the most dramatic evidence of global warming is to be found in the world's glaciers, which are melting down at an alarming rate. The change is not so noticeable for high-latitude glaciers, but glaciers closer to the equator have shrunk dramatically. The largest glacier on Africa's Mount Kenya lost 92 per cent of its mass in the last century, during which period the Mount Kilimanjaro glaciers have shrunk by 73 percent. While there were 27 glaciers in Spain in 1980, that number has since dropped to 13. New Zealand glaciers have shrunk about 26 percent since 1890.

Much remains to be discovered: researchers have collected detailed data on only a few hundred of the roughly 200,000 glaciers around the world. Melting ice is predicted to be a leading contributor to global sea level rise, threatening flat, low elevation countries such as the Maldives and Bangladesh. Even though the world's glaciers, excluding Antarctica and Greenland, make up only about 6 percent of the world's total ice mass, the water is recycled more quickly and contributes more to sea level rise than do the polar ice sheets. The International Panel on Climate Change projected in 1996 that the world's oceans will rise by more than 18 inches by the year 2100, with a third of that contributed by glaciers and ice caps and more than half by the thermal expansion of warming waters.

What impact will these changes have on biodiversity in the short term? It is impossible to predict with any degree of certainty exactly which species and ecosystems will be most at risk, but we can be sure that the changes will be dramatic. In evolutionary terms a century is a mere twinkling of an eye, and many of the world's organisms will perish rather than adapt to the planet's new hothouse conditions. Some scientists predict that the tropics will become wetter, while others think they will become increasingly dry. Both scenarios could cause vegetation patterns to change, with major repercussions in the food chain. Climate-sensitive species (e.g. most amphibians) will probably be among the first to succumb. Among the more resilient groups will probably be the mammals, many of which (like humans) have already adapted to a wide variety of habitats.

Ceylon Bird Club Notes, 1998

By Deepal Warakagoda, Secretary

Thilo W Hoffmann retired as Chairman / Secretary. He tended the Club practically alone for 28 years, and managed all its affairs, bringing it to its present standard and position. He was Sri Lanka's foremost worker for nature conservation, with an unmatched knowledge of the island's geography, habitats and wildlife. To mark the Club's deep gratitude to him, he was invited to be Chairman Emeritus. A committee of members took over the duties of the Club at the Annual General Meeting in June.

Among the regular activities during the year were a few special talks, mainly on identification of rare and difficult species groups, and field trips. Membership cards were introduced. It was decided that membership in the former "Beginners' Section" is henceforth to be termed "Associate Membership".

Threatened birds of Sri Lanka: National Red List by T.W. Hoffmann was published by the Club. The 3rd edition of *A Guide to the Birds of Sri Lanka* (formerly *Ceylon*) by G.M. Henry— revised and enlarged by three Club members, T.W. Hoffmann, Deepal Warakagoda and Upali Ekanayake— was published. It describes all 426 species (representing 465 forms) accepted by the Rarities Committee of the Club as authentically recorded in the country at the time of the revision.

New records and rare species

The scope of the Rarities Committee of the Club was enlarged, and its name changed to the Records Committee. It now includes foreign field experts on the avifauna of the Asian region who have regularly visited Sri Lanka. During the year it accepted the following records: Pacific Swift *Apus pacificus* and Desert Lesser Whitethroat *Sylvia curruca minula*, both first records, both at Bundala in November 1996 by Deepal Warakagoda; Citrine Wagtail *Motacilla citreola*— probably the first definite record— at Udawalawe NP in March 1996 by Deepal Warakagoda; and Blyth's Pipit *Anthus godlewskii*, at Udawalawe NP in February, 1995 by Simon Harrap and Deepal Warakagoda. It decided to remove from the Sri Lanka List Wryneck *Jynx torquilla* and Nordmann's Greenshank *Tringa guttifer*, as having been accepted on misleading data.

Habitats (by Jagath Gunawardana)

Degradation of habitats continued throughout this year. A causative factor now becoming prominent is disturbance by visitors; this was particularly evident in the national parks of Bundala, Horton Plains, Ruhuna and Udawalawe. In the Bundala NP (Sri Lanka's only Ramsar site) the influx of freshwater has diminished the salinity of the Malala and Embilikala lagoons. The Bellanwila-Attidiya Sanctuary continued to be degraded by industrial pollution and the large open garbage dump.

Another distressing activity was the raiding of heronries in the North Western and North Central Provinces from March to June when people butchered the young birds for meat. This was controlled to some extent by the officials of the Department of Wildlife Conservation and the police, who conducted several raids and apprehended some offenders.

A part of the Minneriya-Giritale Sanctuary was upgraded to a National Park in May. (This was done primarily to curb the activities of visitors, which were causing much disturbance to the animals, particularly to Elephants.)

The proposal to have the Lunama-Kalametiya Sanctuary declared a Ramsar site has not yet been ratified, and the problem of a proposed tannery still looms as a serious threat.

Waterfowl count

The 15th annual waterfowl census by the the Club was done in January 1998. *Ca.* 151,000 birds, of 97 species, were counted, more than in the last two years but much less than in several previous years. Again areas affected by the military conflict could not be visited except certain sites in the Jaffna peninsula.

Endemic species

All 26 endemic species have been recorded in their usual numbers from their usual sites, mainly Sinharaja and Horton Plains. Unusual this year were several reports from the Peak Wilderness. A study of the range and distribution of the Green-billed Coucal is being carried out by three Club members.

Birds of prey

Twenty-one species reported. Black Eagle now among species regularly observed with many sightings. Black-winged Kite now common only in some areas. Only few records of Mountain Hawk-Eagle, Rufous-bellied Hawk-Eagle, Common Buzzard, Kestrel, Marsh Harrier and Crested Goshawk. Uncommon raptors, further under-represented in reporting, were Shahin Falcon, Besra Sparrowhawk, Booted Eagle, Black Kite and Montague's Harrier. One sighting of rare Amur Red-footed Falcon. Nesting pair of Mountain Hawk-Eagles at Kitulgala, *ca.*

160 m, first record of breeding at this altitude; the pair had been regularly seen here earlier, away from the species' usual range. Nest of Crested Goshawk at Salgala Hermitage. Shahin Falcon studies continued by Hermann Doettlinger.

Owls: nine species reported. Most records are of Brown Fish Owl. Other common species, such as Brown Hawk Owl and Collared Scops Owl, and the less common owls were all under-represented.

Digest

The Club has published its monthly notes regularly since it was founded in 1943. The more notable sightings of 1998 are given below.

January. *Ca.* 50 Rosy Starlings, an Indian Reef Heron and one Montagu's Harrier at Puttur; two Indian Coursers at Averangkal (both sites in Jaffna peninsula). *Ca.* 400 Greater Flamingos at Puttur and *ca.* 400 at Yala NP. Two Temminck's Stints and 2 Large Sand Plovers near Kalpitiya. Two Ringed Plovers at Palavi. One Orange-headed Ground Thrush at Sigiriya and one at Udawalawe NP. Two Black-capped Kingfishers and two White Wagtails at Udawalawe NP. Small Cuckoo at Usangoda (near Ambalantota). *Ca.* 30,000 Garganey, 5,000 Pintail, and 7,000 Black-tailed Godwits, 7 Collared Pratincoles and 15 Oriental Pratincoles, at Kalametiya. 14 European Bee-eaters at Yala NP.

February. Black-backed Yellow Woodpecker west of Kurunegala. Shahin Falcon at Sinharaja. Four Blyth's Pipit at Udawalawe NP. Barn Owl by main road at Kiri-ibbanara (near Embilipitiya). Second record of nest of Sirkeer, by Buttala-Kataragama road. Two Sand Martins, a Yellow-headed Yellow Wagtail *Motacilla flava lutea*, 20 Common Snipes and 5 Temminck's Stints at Kalametiya. *Ca.* 1,500 Greater Flamingos in Hambantota-Bundala area. Caspian Plover and 2 Red-necked Phalaropes at Bundala. 200 Rosy Starlings and 5 Black-necked Storks at Yala NP.

March. Brown Baza at Horton Plains. Two Scaly Thrushes, a Kashmir Red-breasted Flycatcher and a Banded Crake at Suriyakanda.

April. *Ca.* 2,250 Greater Flamingos at Puttur, after gradual increase since January.

May. Immature Malay Bittern at Sinharaja.

June. Forty-eight Greater Flamingos at Puttur, and *ca.* 800 at Bundala.

July. *Ca.* 800 Greater Flamingos at Bundala.

August. Six Black Kites at Jaffna. Three Greater Flamingos at Puttur. Indian Reef Heron at Mundel. Ceylon Trogon near Kuliyapitiya. 60 Ceylon Hill Munias near Sinharaja.

September. Eight White-headed Starlings at Peak Wilderness above Maliboda. 83 Greater Flamingos at Karagan Lewaya.

October. *Ca.* 4,500 Greater Flamingos at Karagan Lewaya.

November. Two White-headed Starlings, a Green-billed Coucal and a Ceylon Blue Magpie at Peak Wilderness above Hapugastenna. A Tytler's Swallow *Hirundo rustica tytleri* and a Red-rumped Swallow *H. daurica nipalensis* at Bundala.

December. Besra Sparrowhawk at Avukana. Several Pallas's Grasshopper Warblers at Attidiya. Two pairs of Green-billed Coucal at Morningside (Sinharaja) at 1,000 m. Amur Red-footed Falcon at Udawalawe NP. One Sharp-tailed Sandpiper at Karagan Lewaya and one at Kirinda. A Red-necked Phalarope and a few Large Sand Plovers at Karagan Lewaya.

List of special papers in *Ceylon Bird Club Notes*, 1998

Van Twest, R. (January). An unusual nesting site of the Red-vented Bulbul.

Gunawardana, J. (March). Checklist of the birds of the Sri Jayawardenepura (Kotte) Sanctuary.

Warakagoda, D. et al. (June). Possible occurrence of a new race of the Large Sand Plover.

Wijesinghe, D. P. (June). Review of *An annotated checklist of the birds of the oriental region* by Inskipp, T. et al. Oriental Bird Club, U. K.

Lamsfuss, G. (December). Some remarks on Nordmann's Greenshank *Tringa guttifer*.

Impression (not from life) of a Shahin Falcon screaming, by G. M. Henry, 31.07.1935.

The 1999 Waterfowl Census in Sri Lanka

By Kithsiri Gunawardena, Co-ordinator

The 16th annual waterfowl census by the Ceylon Bird Club was conducted in January 1999. The following members participated: Lucky Abeyawardena, Bennie Abeyratne, C.B. Bavinck, N.M.R. Caldera, Uditha Hettige, Jagath Gunawardana, Kithsiri Gunawardena, Chandima Kahandawala, Kiran Kumaranayagam, A.A. Munasinghe, Lester Perera, Willie Perera, Ismeth Raheem, P. Samaraweera, Hemantha Seneviratne, Sarath Seneviratne, U. Sirivardana and Deepal Warakagoda.

Coverage was largely as in 1998. Areas in Mannar, Trincomalee and north of Kalpitiya were again excluded by the military conflict. However, visits were permitted to a few extra sites in the Jaffna area.

The total number of birds counted was approximately 72,000. This is less than half the total for 1998, and is rather low also compared with previous years. Heavy rains experienced in January 1999 may have been the main reason. The largest reduction is seen in ducks— from 72,000 to 18,000— and waders— from 39,000 to 23,000— in comparison with 1998.

The number of species at 89 is satisfactory considering the low number of birds recorded. The following rare or interesting species were noted: 4 Lesser Adjutants, 20 Common Teal, 1 Osprey, 27 Crab Plovers, 8 Ruff, 2 Green Sandpipers, 1 Bar-tailed Godwit, 8 Red-necked Phalaropes and 1300 Lesser Black-backed Gulls. Much fewer than in 1998 were Pintail, Garganey, Asiatic Golden Plover, Black-tailed Godwit, Whimbrel, and Eurasian Curlew. On the other hand, the number of gulls and terns is the highest since 1993; the 11 species noted island-wide this year were all recorded also in the Jaffna peninsula. Surprising is the very low count of wetland raptors compared with previous years.

Habitats

As mentioned above, during the period of the census the country experienced heavy rains, and many water bodies were brimful. (When this happens nearly all the waterfowl disappear from them. It is not known where they go; counters who have visited smaller or shallower bodies of water in pursuit have drawn blanks.)

Attention is invited, of all who care about the environment, to the degradation of the wetlands everywhere in the country. The wetlands between Chilaw and Kalpitiya which offered rich habitat for migratory waders and ducks have been ruined by the un-regulated expansion of prawn farms, as has been stressed in our earlier reports. This once vibrant bird habitat lies desolate, with chemical-filled ponds that offer brief sanctuary only to the prawns, bred in the millions for heavy commercial gains.

The southern wetland Kalametiya, which was becoming more and more important with the recording of an increasing number of species of water birds, is in imminent danger of destruction by a proposed tannery. The chemical-laden effluents from it are to drain into the

Table 1. Totals of waterbirds and distribution in main areas — 1999.

Species	No. of species	Total	Jaffna area	Puttalam to Chilaw coastal	Puttalam to Chilaw inland	Chilaw to Galle	Galle to Yala coastal	South-east inland	Rest of island inland
Grebes	1	229	2	-	167	5	35	-	20
Pelicans	1	298	2	-	-	14	104	39	139
Cormorants, Darters	4	4,764	751	458	667	177	879	795	1,037
Herons	12	9,368	1,402	235	590	750	2,079	932	3,380
Storks	4	1,351	270	-	447	67	345	106	116
Ibises, Spoonbills	3	533	116	-	155	50	120	45	47
Flamingos	1	1,357	200	-	-	-	1,157	-	-
Ducks	7	18,495	14,934	650	535	387	1,801	90	98
Rails, Coots	5	1,123	2	10	185	192	306	374	54
Jacanas	1	1,032	3	-	157	22	66	625	159
Waders	34	22,583	3,856	12,412	40	91	4,963	945	276
Gulls, Terns	11	10,893	5,054	1,175	355	122	2,447	85	1,655
Raptors	5	62	28	-	-	3	24	-	7
TOTAL	89	72,088	26,620	14,940	3,298	1,880	14,326	4,036	6,988

wetland. It is heartbreaking that a habitat so important that it has been proposed the status of Sri Lanka's second Ramsar site is to be sacrificed to an industrial plant for which a suitable location can easily be found elsewhere with minimal damage to the environment.

It is time for those who are genuinely concerned about the continued existence of our wetlands to unite and take some meaningful action to arrest their on-going destruction. If we do not, these habitats, the birds and the beauty of both will be lost to future generations.

We thank all the participants for the work done, and solicit their continued support for the future counts. We also thank CBC member Guenter Lamsfuss for his donation.

Impression (not from life) of a Yellow-wattled Lapwing, by G. M. Henry, 02.06.1945.

Table 2. Totals of main sectors compared with previous years.

	1999	1998	1997	1996	1995	1994	1993	1992
Jaffna area	26,620	29,091	* 10,940	–	* 16,218	* 8,652	–	* 20,913
Mannar area	–	–	–	–	–	–	–	* 400
Trincomalee area	–	–	–	–	1,256	9,433	–	–
Puttalam to Chilaw – coastal	14,940	23,860	15,323	17,065	28,006	13,745	14,499	59,847
Puttalam to Chilaw – inland	3,298	6,008	7,577	7,786	131,025	5,061	10,070	7,938
Chilaw to Galle	1,880	1,471	3,613	1,625	5,942	6,772	9,521	16,357
Galle to Yala – coastal	14,326	77,694	75,197	32,665	43,454	21,739	76,362	70,295
South-east – inland	4,036	2,470	3,723	2,786	1,838	1,196	1,491	676
Rest of island	6,988	10,821	3,842	5,027	8,581	9,323	19,658	14,697
* – part only	72,088	151,415	120,215	66,954	236,320	75,921	131,601	191,123

Table 3. Totals of groups of waterbirds compared with previous years.

	1999	1998	1997	1996	1995	1994	1993	1992
Grebes	229	232	236	1,114	433	139	413	561
Pelicans	298	494	640	340	570	756	722	908
Cormorants, Darters	4,764	7,847	8,521	7,260	11,372	8,461	10,399	15,543
Herons	9,368	16,131	12,365	11,080	14,415	13,532	13,551	26,263
Storks	1,351	1,585	1,623	1,837	2,019	576	1,035	1,337
Ibises, Spoonbills	533	1,178	1,341	1,054	1,200	1,392	1,149	1,038
Flamingos	1,357	964	2,600	1,177	188	138	250	1,397
Ducks	18,495	72,216	24,697	17,044	163,272	18,276	20,669	38,718
Rails, Coots	1,123	1,716	1,650	1,589	2,755	940	1,785	2,249
Jacanas	1,032	1,443	1,214	1,071	1,294	736	1,342	-
Waders	22,583	38,538	54,707	17,349	30,774	20,257	69,066	81,261
Gulls, Terns	10,893	8,896	10,478	5,915	7,919	10,561	11,112	21,700
Raptors	62	185	143	124	109	157	108	152
	72,088	151,425	120,215	66,954	236,320	75,921	131,601	191,127

Earlier totals
1991 – 175,167
1990 – 253,828
1989 – 303,610
1988 – 109,759
1987 – 50,736 (Hambantota area only)
1986 – 243,930

Sri Lanka wins first ever *Conservation Achievement Award*

A news release by the
Field Ornithology Group of Sri Lanka

BirdLife International, the world's largest and best known bird-conservation organisation has awarded the first-ever *Conservation Achievement Award* to the Field Ornithology Group of Sri Lanka (FOG), an NGO dedicated to awareness-building on, and conservation of, Sri Lanka's avifauna.

The award was presented to FOG's president, Professor Sarath W. Kotagama by Her Majesty Queen Noor of Jordan, Honorary President of BirdLife International, at a special ceremony held during the 22nd BirdLife International World Conference held in Malaysia from 13–17 October, 1999.

Established in 1976, FOG was initially affiliated to the Department of Zoology of the University of Colombo. The primary objectives of the organisation were to generate awareness for bird conservation and encourage the study of birds through the bird watching hobby. The organisation has operated for the past 24 years, staffed entirely by volunteers. Despite its small beginnings (having started with just seven members), FOG today has a membership of more than 900, and regional branches in Galle and Gampaha. Membership is open to anyone over seven years of age. Since 1996, FOG has been recognised as the official representative of Sri Lanka by BirdLife International.

FOG's regular activities include general meetings on the last Saturday of every month, usually including special lectures and slide or video shows. The organisation also arranges 1–3 day field trips for bird watchers; 3–5 day field workshops on waders and wetland studies in Bundala; and a field techniques course for bird studies at Buttala; bird flock studies in Sinharaja. The Sinhala lecture series *Kurulu lowata kawulu dorak* has proved to be especially popular. Many other awareness programmes and residential workshops have been held, targeting particular audiences (e.g. schoolchildren, university students, government authorities, professionals, disabled armed forces personnel etc.

FOG members have been encouraged to participate in numerous international conservation conferences and programmes including the *Asian Red Data Book on Threatened Birds*, World Bird Watch and World Bird Count. The organisation has now set out on an ambitious programme to establish 2,000 school bird organisations by the end of year 2000. It also encourages bird-friendly hotels. FOG also organises a an annual poster and photographic exhibition on bird themes, commemorating its founder-president, the late G.P.B. Karunaratne.

FOG's publications include *Flyway* (a bimonthly newsletter in English); *Malkoha* (a quarterly news bulletin); *Blue Magpie* (a research journal); *Trailing Edge* (an educational bulletin); and *Ulalena* (a quarterly Sinhala leaflet). Books published by FOG members include *A field guide to the birds of Sri Lanka;* the first complete bird reference in Sinhala, *Sirilaka Kurullo*; and two other Sinhala titles, *Sri Lankawe Kurullan Handunaganimu* and *Kurulu Lowata Pivisuma*.

In February 2000, FOG will be launching its Important Bird Areas (IBA) programme. In October, it will host the 2nd Pan-Asian Ornithological Congress (PASOC 2000) in Sri Lanka.

Elephants in Sri Lanka: past present and future

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Introduction

The Asian elephant (*Elephas maximus*) is considered an 'endangered species'. Historically, the range of the Asian elephant extended from the Euphrates and Tigris Rivers in west Asia to the Yangtze-Kiang River in China (Olivier, 1978). Exponential growth of human populations and attendant land use changes over the past few decades have extirpated Asian elephants from approximately 85% of their former range. As a 'free ranging' or 'wild' species, the Asian elephant (hereafter, 'the elephant') is now limited to a number of isolated and fragmented populations in thirteen south and southeast Asian states with a total estimated population of 35,000–50,000 (Sukumar, 1989; Santiapillai and Jackson, 1990).

In Sri Lanka, as in the rest of Asia, the elephant has been closely associated with man and has played a central role in the country's economy, conflicts, religion, and culture for many millennia (Jayewardene, 1994). It continues to hold an important position in the religious and cultural traditions of the country and plays a significant and high profile role in the country's conservation efforts.

Elephant population history

The current Sri Lankan population of free ranging elephants has been estimated at approximately 2,000–4,000 (McKay, 1973; Santiapillai and Jackson, 1990; Jayewardene, 1994). Over the recent past, much apprehension has been expressed over the precipitous decline of the elephant in Sri Lanka, based on the premise that the 'historical population' in the island was in the range of 12,000 (McKay, 1973) to 20,000 (Jayewardene, 1994). McKay's estimate was based on the density of elephants in his study area in southern Sri Lanka and extrapolation of it to the total land area of the island. The higher number of 20,000, was based on reported annual losses of approximately 195 elephants in the 19th century (Jayewardene, 1994), and does not take into account the reproductive potential of elephant populations. An annual loss of 195 animals can probably be sustained indefinitely (without any decrease in numbers) by a population of around 4,000–5,000 elephants with a rate of increase of 4–5%, which is well within the rate of increase observed in elephant populations

Thus, a more realistic evaluation of the possible history of elephant populations in Sri Lanka is in order. Undoubtedly, the chronicle of elephant populations in Sri Lanka is intricately linked with that of human presence in the island, and could be divided into four distinct periods: prehistoric, ancient civilization, colonial, and post-independence.

The prehistoric period. During this period the island was sparsely populated by hunter-gatherers. There is no evidence of hunting of elephants by these people, who were also unlikely to have had a major impact on landuse patterns. Thus, elephants would have inhabited the entire island during this period and have had a stable population. The elephant under 'natural' conditions is a low-density species (Rudi van Aarde, pers. com), and ecologically it is an 'edge species' and a 'pioneer species'. Thus, the wet and dry zone climax forests that would have clothed the island in the prehistoric era would not have supported high elephant densities. Given the extremely low densities of elephants reported from primary forest areas (McKay, 1973; Eisenberg, 1981) the total number of elephants is likely to have been comparatively low. The density of elephants in Wilpattu, which has a large extent of mature forest, has been estimated as 0.12 elephants per sq. km. (Eisenberg and Lokhart, 1972). As the entire island was likely to have been under primary forest cover, the average density of elephants in Sri Lanka during the pre-historic period can be assumed to have been around 0.1 per sq. km. Thus, if elephants inhabited 90% of the island, the total elephant population would have been around 5,000.

The ancient-civilization period. In 5th century BC, people from the ancient civilization in India colonized Sri Lanka and founded an agro-based civilization in the dry zone of the country. Over the years, they constructed countless numbers of freshwater reservoirs by damming rivers and tributaries, and converted large extents of land in the dry zone to irrigated agriculture. The 'hydraulic civilization' that prospered as a result, used elephants extensively in cultural events, wars, pageants, and as work animals (Jayewardene, 1994). Thus, while the agricultural land-use patterns no doubt excluded elephants from the centers of civilization, their capture for domestication would have depleted elephant populations in surrounding areas.

During this period Sri Lanka was also famed as a center of elephant commerce, both exporting and importing elephants to and from the mainland (Jayewardene, 1994). The export of elephants to the

mainland could be explained in terms of the higher value placed on Sri Lankan elephants for use in work and war (Jayewardene, 1994). The need for importing elephants into the country is more difficult to understand, especially given the effort that must have been entailed in transporting elephants between the mainland and Sri Lanka in that period. The only logical reason to import elephants from the mainland would have been that they were different to those in Sri Lanka in some manner, the most obvious possibility being that they were tuskers. At present less than 7% of Sri Lankan males have tusks, whereas the incidence of tuskers varies between 45% in north India to almost 95% in south India (Sukumar, 1989). Culturally, tuskers are highly prized and held in high esteem and even today, they are imported from the mainland by prominent Sri Lankan temples. While it has been suggested that the paucity of tuskers in Sri Lanka is human induced (Kurt et al., 1995), it could also have been a genetic cause such as a 'founder effect' or the greater impact of genetic drift in a smaller Sri Lankan population. A cause pre-dating the ancient civilization, therefore of genetic origin, is supported by the historical import of elephants, even during the early periods of the ancient civilization.

While the landuse changes and capture for domestication by people of the ancient civilization is likely to have depleted elephant populations in the dry zone during this period, the sparsely settled wet zone and the central hills would have served as a refugia for elephants. Thus, the total elephant population is likely to have reached a low level as elephants would have been largely limited to the low carrying capacity wet-zone forests. Assuming a density of around 0.1 per sq. km. and that elephants inhabited one-third of the island, the total population at this time could have been around 2,000.

The colonial period. Around 15th century AD the civilization in the dry zone of the country declined, and the center of civilization shifted to the wet zone. Shortly thereafter, the country came under colonial rule, during which period the wet zone became densely populated and settled. Large-scale land-use changes through growing of cash crops and the systematic killing of elephants by shooting, practically eliminated elephants from the wet zone during this period. However, the secondary forests in the abandoned dry zone of the country, together with the countless artificial freshwater reservoirs that were constructed during the height of the ancient civilization, now presented ideal elephant habitat, and would have offered important refugia for elephants. The low-intensity slash and burn agriculture practiced by remaining inhabitants of the dry zone would have maintained the habitat in an ideal condition for elephants and helped to support high elephant densities. Thus, during this period, while the wet-zone elephant populations were exterminated, the populations in the dry zone are likely to have undergone a resurgence and the total elephant population would have risen to unprecedented heights. Assuming elephants inhabited two-thirds of the land area at a density similar to that observed by McKay (1973) in his study area, of 0.19 elephants per sq. km., the total elephant population in this period could have been as high as 8,000.

Post-independence period. The period following independence from colonial rule represents the fourth (current) phase of the saga of elephants in Sri Lanka. With exponential human population growth aided by the introduction of western medicine and modern technology, subsequent governments in Sri Lanka turned to re-developing the dry zone for agriculture as the answer to feeding the burgeoning human population. Fueled by large-scale irrigation projects that dammed major rivers and diverted the flow to rehabilitated and newly-constructed reservoirs, extensive areas of the dry zone were once again brought under irrigated agriculture. Large-scale trans-migration programs re-settled people from the crowded wet zone of the country in the newly-opened dry zone.

However, this time there was an important difference in how people perceived the elephant. Previously, when extensive areas were converted to agriculture, elephants in those areas were eliminated, possibly by capture during the ancient civilization period, and by shooting in the colonial period. In contrast, during this fourth phase, modern environmental attitudes and the growing awareness of the endangered status of elephants led to attempts at preserving the elephants that inhabited areas cleared for agriculture, resulting in a dichotomy of attempting to conserve elephants while drastically decreasing their habitat. The origin of the present high level of human-elephant conflict (HEC) in Sri Lanka can be attributed to the attempt at pursuing these two fundamentally incompatible objectives.

In the post-independence era, a number of protected areas (PAs) were designated, where elephants that inhabited land cleared for agriculture were to be accommodated. Elephants were translocated to these PAs by elephant drives and chemical immobilization and transport. However, in most instances, translocations failed to eliminate elephants from developed areas, which was attributed to translocated elephants returning to their homelands (Jayewardene, 1994). In order to prevent 'backtracking' by translocated elephants, and to prevent elephants in PAs from venturing out, barriers were set up on the boundaries of PAs.

Challenges for conservation and managenment

One of the main impediments to the conservation and management of Asian elephants is the paucity of scientific

data on free-ranging or 'wild' elephants, which applies to Sri Lanka as well as the rest of Asian elephant range. Much of the available 'knowledge' of Asian elephants is based on extrapolation from studies of domesticated elephants and studies on African elephants. However, current research indicates that behavior, genetics, and ecology of free ranging Asian elephants is very different from African elephants: clearly, Sri Lanka needs data based on Sri Lankan elephant populations, in order to conserve them.

With the rapid expansion of human populations over many parts of Asian elephant range, conflict between farmers and crop-raiding elephants has become an important socio-economic and political issue. Consequently, the driving logic behind elephant management has been the mitigation of human elephant conflict, tempered with the 'need' to conserve elephants. Thus even in the absence of a sound understanding of the ecology, behavior, or genetics of elephant populations, it has become necessary to undertake interventional management of elephants. Unfortunately, these management actions are rarely monitored and the effectiveness of actions such as translocations, elephant drives, and elephant barriers in mitigating the HEC and their effects on elephant populations remain largely unknown (Fernando, 1997). Asian elephants are forest animals and usually occupy poor-visibility habitat. Frequent conflict with humans causes behavioral adaptations in many elephants, including changing of activity patterns to be largely nocturnal in their wanderings, remaining under dense cover during day, and the avoidance of humans or the development of aggressive responses towards them. Thus, free-ranging elephants are difficult to study by direct methods, which may partly explain the dearth of information on them.

Current research. In order to promote the conservation and management of elephants, we (see Acknowledgements, below) initiated a research project for the study of their ecology and ranging patterns based on radio telemetry in southern Sri Lanka. The project was launched in 1995, through placement of radio collars on five elephants in and around the Yala National Park (YNP) by the Department of Wildlife Conservation (Desai, 1995). Subsequently, two more animals were collared in YNP and another three in and around Lunugamvehera National Park. In addition to tracking the collared animals through radio telemetry, the project involved the collection of ecological data, application of dung counts to estimate elephant density, and the collection of data on HEC. Photographic cataloging of individually identified animals, initiated prior to the project, was continued to provide information on the population structure and social organization of elephants in RNP. In addition, studies on the genetics of Asian elephants were conducted to determine the extent and distribution of genetic variability of elephants in Sri Lanka, and the genetic distinctness of Sri Lankan and mainland populations. A parallel project was initiated in the northwest region in 1997, with the radio collaring of a further 8 elephants. The findings of the project were presented to the Department of Wildlife Conservation at a recent workshop; a summary of our findings is presented below.

Ranging patterns. In contrast to previously held views, we found that elephants in Sri Lanka do not have separate wet- and dry-season ranges, and that they do not undertake seasonal long-distance migrations. This pattern of ranging has since been confirmed by the northwestern study (Devaka Weerakoon, pers. comm.). Female groups were found to have small, well-defined home ranges of 30–140 sq. km. in extent, to which they showed a high degree of fidelity (they keep to the same area year after year). Thus, unlike in southern India where female groups may have ranges in excess of 500 km^2 (Baskaran et. al., 1983), elephant management in a fragmented landscape is likely to be feasible in Sri Lanka.

Males were found to occupy small ranges, less than 100 sq. km. over most of the year; but they dramatically increased their ranging during the *musth* period of about two months, ranging over an area almost four times their range for the rest of the year. Such widespread ranging during musth is likely to be related to reproductive activity and important for preventing inbreeding (Fernando, 1998). Therefore, management of males needs to leave provision for such dispersal.

In addition to the differences in ranging patterns of females and males, we also observed that the ranging of females seemed to be much more restricted by management measures such as electric fences. Most instances of crop raiding and conflict with humans in the southern area were attributable to males, which often circumvented and breached fences. Thus, managers need to consider the differences in ranging and impacts of management measures on males and females.

Relation to land-use patterns. It was observed that elephants were not restricted to protected areas (PAs) and that the administrative boundaries of PAs in many cases did not coincide with the ecological boundaries of the elephants. Patterns of habitat use by elephants, suggested that traditional *chena* or slash and burn cultivation in unofficial buffer zones of PAs created good habitat for elephants. In Yala, we observed the movement of elephants into buffer-zone cultivation areas in the dry season once harvesting was complete, and their return to the safety of the PA in the wet season when cultivation commenced again. Elephants heavily utilized the pioneer vegetation that came up between

annual cultivation cycles in areas outside the PA and these areas are likely to be critical for the survival of the elephant population in YNP through the dry season. In contrast, irrigated agriculture created an environment incompatible with the presence of elephants in non-conservation areas, and the 'non-intervention' management of habitat within PAs encouraged a secondary climax of mature scrub (which is sub-optimal for elephants) within conservation areas.

Social organization. Previously, Asian elephants and African elephants (*Loxodonta africana*) were thought to have an identical or largely similar social organization, with a multi-tiered hierarchy of social groupings consisting of families, kinship groups, clans and subpopulations among females, and the permanent dispersal of males. Our studies combining genetic data, behavioral observations, and telemetry data suggested that Asian elephants may have a social organization very different to that of African savanna elephants, with smaller groupings and a lesser degree of association among group members (Fernando, 1998). In addition, our studies suggest that males may disperse from their social groups but remain in their natal area and undertake periodic dispersal during musth as a method of preventing inbreeding (Fernando, 1998).

Genetics. In a study sampling 118 elephants from the mainland and Sri Lanka, we found that genetic diversity in Asian elephants was lower than in many large ungulate species. In common with a previous study on the mitochondrial DNA of Asian elephants (Hartl et al., 1996) our study did not support the putative subspecies distinction between Sri Lankan elephants (*E. maximus maximus*) and mainland elephants (*E. maximus indicus*). However, in contrast to Hartl et al. (1996) we did find significant genetic differences between the two populations (Fernando et al., in press). In view of previous electrophoretic studies (Nozawa and Shotake, 1990; Hartl et al., 1995), observed morphological differences (Deraniyagala, 1955), and our own data, we suggest that further studies need to be conducted before concluding that the current subspecific distinction is invalid (Fernando et al., in press).

Surprisingly, we also found that the northern, mid-latitude and southern populations in Sri Lanka were genetically different from each-other to a significant extent (Fernando et al., in press). In this connection, it is interesting to note that morphological differences have been previously observed between elephants from different geographic locations in the country. The small-stature southern elephants being called *ruhunu gataw* and the exceptionally large and bulky elephants from the mid-latitude region being termed *vil aliya*— which were in fact described as a separate subspecies previously (Deraniyagala, 1955). Thus, our findings suggest that the northern, mid latitude and southern populations should be managed as distinct populations and that elephants should no longer be translocated between these regions.

Our analysis of mitochondrial DNA also found that there were two genetically divergent lineages within Asian elephants, but that they were not geographically separated, both groups occurring in Sri Lanka and the mainland (Fernando et al., in press). Thus, our study suggests the colonization of Sri Lanka by elephants from the mainland through a land bridge many millions of years ago in the Pliocene, subsequent submergence of the land bridge isolating the two populations, and their independent evolution for a considerable time. More recent re-emergence of the land bridge during the glacial (Pleistocene) periods again caused mixing of the two populations, giving rise to the present populations (Fernando et al., in press).

Management

Previous and current management of elephants in Sri Lanka was and continues to be based on the premise that all elephants should be living within PAs. Consequently, elephants in non-conservation areas are regularly translocated to PAs and elephant barriers erected on administrative boundaries of PAs to ensure that they remain there. However, for the past few centuries, elephants have continuously occupied areas designated as PAs in Sri Lanka. Consequently, even at the time they were declared as PAs, elephants in such areas would have been at the long-term carrying capacity of those areas: i.e., , such areas were already carrying the number of elephants they could support over the long term. The long term carrying capacity of an area, especially for a long lived species such as elephants is determined by random events such as severe droughts, insect outbreaks, and severe floods that occur very infrequently, perhaps once every few decades. If a population greatly exceeds the carrying capacity of an area, when such a limiting event occurs, the results can be catastrophic and may result in the extinction of the entire population.

In addition, a segment of the elephant population ranges entirely within PAs and hence have an excellent conservation future since they do not come into conflict with humans. Translocation of additional elephants into PAs and incarcerating them there will cause intense competition for limited resources between the elephants that were previously ranging entirely within PAs and those that are translocated, thus jeopardizing the future of animals which otherwise would have had a good future (Fernando, 1997).

Thus, attempting to push elephants that are in non-conservation areas into PAs and incarcerating them there by erecting barriers is unlikely to succeed, and if it does,

is likely to cause exceeding of the carrying capacity of PAs, leading to dire consequences for the entire population of elephants, the habitat, and other species that inhabit PAs.

Elephants are a long lived species and populations that appear to be viable in the short term may actually be in danger of certain extinction in the long term (Armbruster, Fernando, & Lande, 1999). In elephants, the first effects of overcrowding and increased competition are likely to be the activation of density dependent population control mechanisms such as increase in the age of first reproduction and birth intervals, which are not apparent in the short term. Other more evident effects such as increased intra-species aggression and high infant mortality may also occur. Thus, although a larger elephant population maybe accommodated in PAs over the short-term by translocating elephants from non-conservation areas and confining them, the long term effects will be largely detrimental, ranging from catastrophic population crashes to decrease in recruitment and increase in mortality. At best, the end result of such actions will be a population with an unhealthy population structure, composed largely of non-breeding adults and very few young.

Over much of non-conservation area elephant range, developmental activities are taking place with opening up of land for irrigated agriculture and settlements. In the absence of land use zoning, both governmental and non-governmental agencies commonly initiate developmental activities based on political and immediate socio-economic needs, without consideration of ecological and conservation consequences. The resulting escalation of HEC in non-conservation areas frequently causes the death of elephants and extols a high cost of suffering from both humans and elephants, leading to the elimination of elephants from non-conservation areas. Although the activities that result in the death of elephants in non-conservation areas are not generally viewed as part of 'elephant management', by default, they are an integral part of current management.

The end result of 'managing' elephants by 'development of non-conservation area elephant range, translocation of elephants to PAs, and confining them there by barriers, will be the elimination of elephants from non-conservation areas, and the possible overcrowding of PAs, which holds little hope for the future of elephants in Sri Lanka.

Options for the future

Given that a large segment of the elephant population in Sri Lanka depends entirely or partly upon non-conservation areas for their survival, the best option for maintaining our elephant population at the current level is to *ensure that elephants will be able to continue use of non-conservation areas as part of their range*. If this is not possible, the next option is to *alter the habitat in the PAs so that they can carry more elephants*. If neither alternative is feasible, elephants in non-conservation areas will need to be removed through *capture and domestication*. Such a management action will mean the *limiting the number of elephants to what the PAs can carry in their present state*.

Keeping elephants in non-conservation areas. Currently, management activities such as erecting electric fences that limit elephants to PAs and translocation of elephants are mainly conducted in order to alleviate the suffering of farmers who have to bear the hardships imposed by HEC. One way of achieving the objective of continuing to keep elephants in non-conservation areas but reducing the economic burden on farmers is to develop activities such as community-based eco-tourism. Activities such as elephant viewing and elephant-back photo safaris can bring in significant monetary benefits to communities in elephant range areas, so that they can obtain a tangible benefit from elephant presence rather than being called upon merely to bear the cost of the HEC. If converting elephants into a source of income for communities in elephant range areas can be made into a reality, the need to remove elephants from non-conservation areas will decrease.

Our studies indicate that traditional slash and burn agriculture creates optimal habitat for elephants by creating a mosaic of successional-stage vegetation. Currently, land under slash and burn agriculture constitutes the major portion of non-conservation area elephant range. Regularization and rotation of cultivation cycles in such areas to achieve the maximum diversity of habitat types and to provide refugia for elephants will offer the maximum benefit for elephant conservation. When combined with activities like eco-tourism such land-use management can benefit both elephants and farmers.

The down-side of such an approach is that large non-conservation areas will need to be set aside as elephant ranges, necessarily excluding 'development' activities. Therefore, the demarcation of such areas has to be done with the cooperation of all government and non-governmental agencies that are involved in developmental activities; it cannot be done by conservationists in isolation. Thus, land-use zoning of such areas, taking into consideration projected activities over the next few decades, will necessarily be crucial to such an approach.

Habitat alteration within PAs. The ecological situation of YNP in relation to elephants provides a good illustration of factors relevant to habitat management. Our studies indicated that much of habitat within YNP consisted of a secondary climax of mature scrub forest. In common with tall forest such as dry evergreen

monsoon forests in parts of the PA, such areas offer sub-optimal habitat for elephants. The tall forest areas in Block III and IV of YNP represent a unique habitat with its own fauna and flora and it is advisable to manage it in that state. However, the secondary scrub forest areas represent land that was under slash and burn agriculture previously and could be managed to provide better habitat for elephants. Our observations of traditional slash and burn agriculture in the unofficial buffer zone area around the western boundary of YNP suggest that improved habitat management strategies could provide better habitat for elephants and thus increase the carrying capacity for elephants.

However, habitat management is a complex intervention and could have unforeseen repercussions for both target and non-target species. Therefore, it first needs to be done on a trial basis with close, long-term monitoring to assess its feasibility before adoption as a management alternative. Although habitat management can increase the carrying capacity of elephants in a PA—and hence potentially accommodate elephants that are currently in non-conservation areas— translocation of elephants from non-conservation areas into PAs with increased carrying capacity nevertheless risks creating an elephant population with an unhealthy population structure. Thus, even if the carrying capacity of PAs can be increased, it may yet be best to let natural reproduction increase the elephant population gradually to the new carrying capacity.

If management of elephants within the PA system alone is opted for, elephant populations in such areas will need to be monitored very closely and regulated so that they do not exceed the carrying capacity of such areas. In order to ensure the long term conservation of elephants and preserve genetic diversity, the genetic make up of such populations will need to be studied in detail and they will need to be managed as a meta-population with movement of individuals to mimic and preserve historical patterns of gene flow and prevention of inbreeding.

Limiting elephants to PAs without habitat alteration. The PA system in Sri Lanka consisting of National Parks and Reserves (excluding the Horton Plains and Peak Wilderness areas) inhabited by elephants is approximately 5,880 sq, km in extent (Jayewardene, 1994). Thus if we are to limit elephants to the present PA system, assuming a density range of 0.12 [as estimated for Wilpattu by Eisenberg and Lockhart (1972)] to 0.19 [as estimated for Gal Oya and Yala by McKay (1973)], and 90% occupancy of PAs, the total population that could be supported will be between 635-1,000 elephants. Such a population, which will necessarily be divided into a number of small, fragmented, and isolated subpopulations will be very detrimental to the long term survival of elephants in Sri Lanka. In addition to the danger of extinction due to demographic stochasticity, in the case of elephants, populations inhabiting small habitat fragments are much more liable to come into conflict with humans, hence run a disproportionately high risk of being exterminated. Over the long term, such fragmented populations also run a high risk of detrimental genetic consequences of small population size (Fernando, 1983). However, the conservation future of a elephant population limited to what the PA system can support will be better than that of a population limited to PAs and is also exceeding the carrying capacity of PAs.

Capture and domestication. If elephants cannot be allowed to continue use of non-conservation areas, the only way to remove them from such areas that is compatible with elephant conservation is to remove them by capture and domestication. As discussed above, the more intuitively 'obvious' solution of translocation into PAs is not really a conservation option.

Capture and domestication of elephants takes them out of the wild gene pool effectively and permanently. Reintroduction of elephants that have been in captivity into the wild, as in the case of 'orphaned' calves, is unrealistic and is not a viable conservation option. The biggest direct problem in conserving elephants in Sri Lanka is conflict with humans. Elephants brought up in close association with humans will lose their fear of people and, if sent back into the wild, are very likely to turn into 'problem animals'. In addition, irresponsible re-introductions or translocation of animals without due consideration of their geographic origins and genetic makeup can cause introduction of diseases to wild populations, disruption of natural patterns of genetic distribution, and loss of local adaptation of populations. If re-introductions and translocations are carried out, in view of the possible detrimental effects on the subject animals and those in the receiving areas, they should only be conducted with close long term monitoring.

Sri Lanka has had a long history of close human elephant association and elephants are an important and integral part of its culture, society and religion. The continued existence of captive elephants and their use in religious and cultural festivities is important in preserving traditional ties to elephants and provides an important background for their conservation. Thus, if elephants cannot be allowed to range in non-conservation areas, their capture and domestication is a viable alternative which can also provide a useful if indirect contribution to their conservation through keeping alive the close ties between man and elephant. The semi-captive form of management as in the elephant orphanage at Pinnawela is yet another option in the captive management of elephants and also a major attraction for both local and foreign tourists. The ability to

successfully breed elephants, demonstrated at Pinnawela, could also provide elephants for captive management and use in religious and cultural activities.

Conclusion

We may yet be able to ensure the survival of the elephant in Sri Lanka for posterity, if we are willing to address the outstanding issues that confront the conservation of elephants. In order to conserve elephants, rather than seeking to mitigate problems after they have arisen, we need to look ahead and plan for the future, taking into consideration the ecology, genetics, and behavior of elephants as well as projections of human population expansion and development.

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I wish to thank Manori Gunawardene, P. D. Kulatunga, L. K. A. Jayasinghe, and H. K. Janaka who were part of the team that conducted fieldwork for the radiotelemetry study, and Nimal Kaluarachchi and G. V. Gunawardene who provided counterpart support from the DWLC. The untimely and tragic death of G. V. Gunawardene by an elephant he was attempting to save in the line of duty as a game guard in the DWLC is sadly remembered. Thanks are also due to Rahula Perera and Vimukthi Weeratunga who assisted in photographic cataloging of elephants, and to Mahendra Siriwardene, Harin Corea, Chandana Gunasekara, Nisha Fernando and Lalith Seneviratne for assistance with field work. I also wish to thank S.W. Kotagama, Eric Wickramanayake, Ajay Desai, Russ Lande, and R. Rudran for their contributions to the project through discussions and advice. The collaring of elephants was done by officers of the Dept. of veterinary science, Peradeniya University, and DWLC officials. The radiotelemetry project was funded by the Global environmental Facility through the Dept. of Wildlife Conservation, and administered through the Open University Sri Lanka. H.S. Panwar and Nalani Amerasekara provided valuable support in administering the project. Since the end of the project in March 1999, MOTOROLA Sri Lanka funded the project for a further three months through the Biodiversity and Elephant Conservation Trust.

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Waterbird study in Malala Lewaya (Sri Lanka)

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Abstract

Malala Lewaya, a large brackish-water lagoon ('lewaya') in the Bundala National Park (a Ramsar Site) in south-east Sri Lanka, is effectively at the southernmost end-point of the Central Asian Migratory Flyway. This study was conducted from January to December, 1997, to monitor the migratory and resident waterbird populations utilizing the lewaya and its environs. Spot counts, using binoculars and telescope, were carried out at five selected study sites. Malala Lewaya, as a whole, is an important feeding and resting habitat to large numbers of migratory ducks, waders (shorebirds) and Greater Flamingoes, which utilize the area during the (northern-hemisphere) winter months. The population data show that migratory waterbirds outnumber resident populations in the ratio 1.6 : 1. Small numbers of migratory species loitered on during the non-migratory season. Several species of resident waterbirds were also present in considerable numbers. Some of these species nest within the lewaya and its environs. High population densities of waterbirds occurred in three of the study sites. A single threatened species, the Spot-billed Pelican, was present in moderate numbers in the lewaya. The waterbirds were subject to several threats and disturbances from human activities. Regrettably, almost no patrolling or evidence of law-enforcement were observed during the study. As Malala Lewaya is an important habitat to waterbirds, I recommend that further studies be carried out, especially aimed at developing a pragmatic management plan for the lewaya.

Introduction

The great Central Asian Flyway (also known as the Central Asian-Indian Flyway) is an important flight path for migrating waterbirds. The flyway starts in northern Russia and Siberia, continues southwards through Central Asia, on through the Indian sub-continent and thence to Sri Lanka— which is at the southernmost end of the flyway. This means that birds migrating south in the northern winter season have (if they do not find suitable winter quarters elsewhere), to stop at a wintering site in south Sri Lanka as there is no land (only ocean) for the next 8,000 km until Antarctica is reached. Bundala National Park in S.E. Sri Lanka, which has long been recognized as the most important habitat in the island for migratory waterbirds, is therefore effectively the very end point of this great migratory flyway. This is one of the reasons that it was, in 1990, declared a "Ramsar Site" i.e. a site internationally important to (migratory) waterfowl. Bundala remains the only "Ramsar" site in Sri Lanka to date. Malala Lewaya (650 ha) is one of five large lagoons in Bundala National Park. In this report I present data that I accumulated in the course of a NARA / SAREC-sponsored project to study the waterbirds of the lagoon. (Note that insofar as this study and report are concerned the term "waterbirds" is broadly defined as birds ecologically dependent on wetlands.) The aims of the study were —

1. To identify the resident and migratory waterbird species which utilize Malala Lewaya and to carry out censuses in selected study sites.
2. To identify those parts of the lewaya which are of importance to waterbirds and may therefore need increased protection.
3. To identify rare or threatened species of waterbirds which may be present.

Methods

Five study sites, which from previous experience were believed to be important waterbird habitats, were identified for intensive study during the period January to December 1997. These sites are briefly described below.

Malala South: This is a site near the outlet channel of the lewaya. An exposed shallow bank is present some metres offshore. This, together with the shoreline, is a feeding and resting-place for waterbirds.

Uda Malala: This site has extensive shallow banks and an islet which are favoured as feeding and resting habitat by waterbirds. A hillock gives a good overall view of the entire site. Most of the site is bordered by jungle.

Palle Malala: Situated in the northern part of Malala Lewaya, this wetland has a grass covered cape at the southern end and is bordered by scrub jungle elsewhere. It is separated from Palle Malala tank by a narrow strip of dry land. The grassy margins turn into marsh during

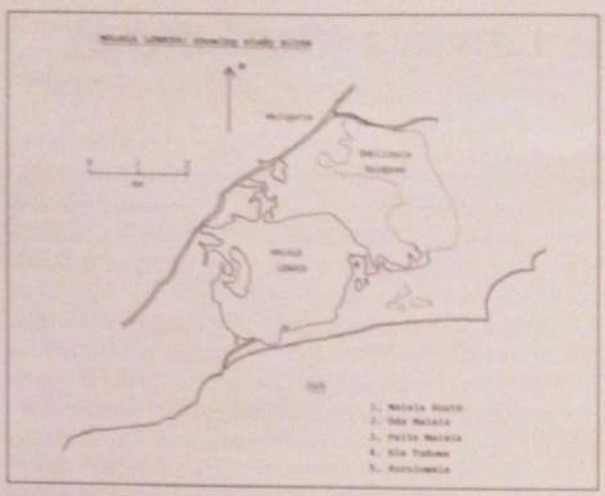


Figure 1. Malala Lewaya, showing study sites. (1) Malala South; (2) Uda Malala; (3) Palle Malala; (4) Ela Tudawa; (5) Kuruluwala.

the rains, thereby becoming suitable habitat to many small and medium sized waterbirds.

Ela Tuduwa: This is a small bay with a flat promontory on the western side and a jungle-girt eastern margin. This site is near the western end of the natural channel connecting Embilikala Kalapuwa with Malala Lewaya.

Kuruluwala: This is a large waterhole surrounded by scrub-jungle and forest, which during rains expands greatly and becomes confluent with the main lagoon, whereas it dries up completely during times of drought.

In four of the above locations, *viz.*, Malala South, Uda Malala, Palle Malala and Ela Tuduwa, areas of 50 ha each were selected as study sites. In the fifth site, Kuruluwala—on account of its small size—a study area of 6 ha was selected (but see below). The sites were visited on the following dates: 25–26 January 1997; 8–9 and 22–23 February; 8–9 and 29–20 March; 10–11 and 26–27 April; 24–25 May; 14–15 June; 12–13 July; 9–10 August; 6–7 and 20–21 September; 4–5 and 18–19 October; 15–16 and 29–30 November (note: on account of floods, Ela Tuduwa could not be visited on 15–16 November); 13–14 and 27–28 December.

One or more spot counts were carried out at each site on every visit. A tripod-mounted telescope (Kowa 77mm with 20× and 30× eyepieces), binoculars (Swift Audubon 8.5 × 44 and Yashica 8 × 40) were used for observation, and hand tally-counters were used for counting the individuals of each species. Except for Saunders and Little Terns, all species were counted separately (refer to checklist of observed species). Although it was possible to separate the Saunders and Little Terns, this sometimes proved impractical when large fast-flying mixed flocks were encountered; hence they were "lumped" together in a single category. As identification guides "Shorebirds" (Hayman *et. al.* 1986) and "Waterbirds" (Bushan *et. al.* 1993) were used. Sri Lanka Survey Department maps (Survey Department 1988 and 1997) were used for site data together with the Wetland Site Report and Conservation Management Plan – Bundala National Park (Bentham *et. al.* 1993).

Abbreviations

NARA, National Aquatic Resources Research and Development Agency; SAREC, Swedish Agency for Research Co-operation with Developing Countries.

Table 1. Mean (or actual) numbers of birds observed at the various study sites in Malala Lewaya, January–December, 1997. The figures within brackets indicate the number of counts carried out during each month. Where two counts were carried out, both figues are given.

Site	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Malala South	54 (1)	93 (2:64; 121)	50 (2:35; 65)	130 (2:53; 207)	13 (1)	77 (1)	42 (1)	33 (1)	66 (2:55; 76)	37 (2:33; 41)	32 (2:26; 38)	348 (2:21; 674)
Uda Malala	1,727 (1)	687 (2:540; 834)	1,227 (2:959; 1,494)	648 (2:466; 829)	612 (1)	212 (1)	1,077 (1)	943 (1)	718 (2:653; 783)	1,487 (2:1431; 1,543)	2,686 (2:867; 4,505)	681 (2:224; 1,137)
Palle Malala	332 (1)	463 (2:325; 600)	482 (2:270; 693)	553 (2:499; 606)	256 (1)	229 (1)	1,546 (1)	545 (1)	745 (2:558; 932)	454 (2:425; 482)	446 2:303; 588)	202 (2:188; 215)
Ela Tuduwa	324 (1)	183 (2:172; 194)	378 (2:163; 592)	300 (2:250; 349)	201 (1)	138 (1)	284 (1)	1,179 (1)	851 (2:504; 1,198)	403 (2:358; 447)	942 (1)	224 (2:110; 338)
Kuruluwala	49 (1)	128 (2:77; 179)	142 (2:114; 170)	55 (2:30; 80)	15 (1)	16 (1)	14 (1)	5 (1)	63 (2:1; 125)	46 (2:41; 50)	22 (2:19; 24)	45 (2:36; 53)

Results and discussion

Results of surveys at five selected sites and discussions are presented here (together with brief observations from neighbouring wetlands).

There was considerable fluctuation in the numbers of waterbirds between visits, but some of the study sites consistently held larger populations (Table 1). Based on average or real values each site was assigned to rank value of between 1 and 5 for the entire study period. (This rank value was arrived at by totaling the rank values of a particular site for all visits and dividing the result by the number of visits.) This simplified ranking showed that Uda Malala had the highest rank and Kuruluwala the lowest (Table 2). Table 2 also shows the ranges and as can be seen, there is little overlap between high and low ranking sites.

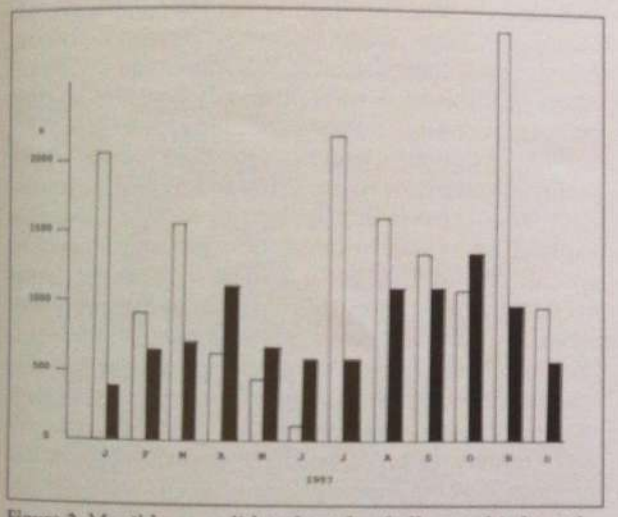


Figure 2. Monthly consolidated totals of all waterbirds at the five study sites, January–December, 1997.

Table 2. The different study sites are shown in ranking order. A low value indicates that the site held a large population of waterbirds, whereas a high value indicates a smaller population. Ranking is obtained from real or mean values obtained from Table I. The total number of counts and ranges of the numbers of waterbirds observed at each study site during 1997 are also given.

Site	Rank value	No. of counts	Range
Uda Malala	1.42	19	212 – 4,505
Palle Malala	2.17	19	188 – 1,546
Ela Tuduwa	2.5	18	110 – 1,198
Malala South	4.25	19	13 – 674
Kuruluwala	4.67	19	1 – 179

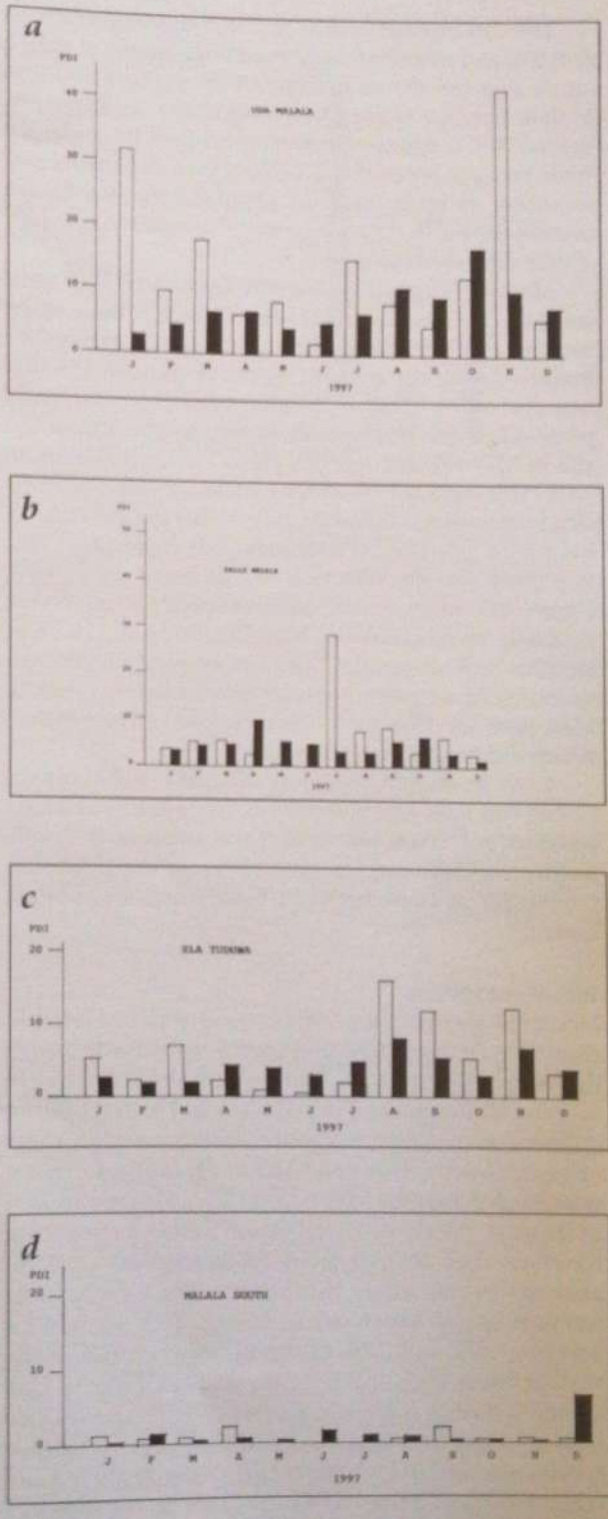


Figure 3. Population Density Indices (PDI— average numbers of birds per ha) for (*a*) Uda Malala, (*b*) Palle Malala, (*c*) Ela Tuduwa and (*d*) Malala South sites respectively. Solid black bars: resident species; unshaded bars: migratory species.

The consolidated totals, on a monthly basis, of both resident and migratory waterbird populations at all five study sites are shown in Figure 2. It will be noted that Malala Lewaya is especially favourable to migratory species, the overall proportion of resident to migratory birds being in order of 1 : 1.6. The figure also shows that moderate to large numbers of migratory species are present during the "non-migratory" months May to July (this is discussed below).

Monthly Population Density Indices (PDI's) were computed for the four larger sites. These give the average number of resident and migrant waterbirds present per hectare during the relevant month (Figure 3). The PDI was derived by dividing the total number of waterbirds present in a site during each month by the area of the site in hectares. For reasons given earlier (variation in size) PDI's were not calculated for Kuruluwala. The PDI's clearly show that Uda Malala, Palle Malala and Ela Tuduwa hold high population densities of both resident and migratory species, with Uda Malala being the highest. Figure 3(*d*) shows that no migrant species were present in Malala South site during May, June and July. (This was also true for Kuruluwala). The other sites supported small to moderate or large populations of migrants during May, June and July (with the exception of Palle Malala which did not have any in June).

Visits to nearby wetlands (Bundala, Koholankala, Maha, Karagan and Kalametiya Lewayas; Embilikala Kalapuwa, Debara Wewa and the adjacent Wirawila paddy fields) suggest that there is considerable movement of birds between these areas and Malala Lewaya.

Waterbird species

In total 64 species of waterbirds were observed (refer to checklist). Of these 29 were waders or shorebirds, 5 were ducks, 8 larids (gulls and terns), 1 species of flamingo (Greater Flamingo) and the rest resident waterbirds not included in the other categories. Additionally 6 species of raptor were observed. Although raptors are not waterbirds *per se* they have been included in the checklist as they are closely involved in the wetland ecosystem; however, they are not included in the data or data-analyses presented in this report. The twelve most common species are shown in Table 3. They account for between 46% and 76% of the birds observed in the various study sites. Interestingly a lower value in Uda Malala indicates a greater diversity, as 32 species (the highest of any site) were recorded there. The number of species recorded at each site is also shown in Table 3 and range from 19 species at Kuruluwala to the (already referred) 32 species at Uda Malala. The twelve most abundant species are ranked (resident and migrants separately) in table IV, where it is shown that the Black-winged Stilt is the most plentiful resident species and Garganey the most abundant migrant. Overall the most numerous species were, in order of abundance: (1) Garganey; (2) Greater Flamingo; and (3) Black-winged Stilt.

Notable sightings during the study included 3,064 Garganey at Uda Malala on 29th November and 1,286 Greater Flamingo at Palle Malala on 13th July.

Figures 4 and 5 show, respectively, the consolidated totals of waders, ducks, gulls and terns, Greater Flamingo and resident waterbirds present in the five sites. It is seen that waders were present in considerable numbers throughout the year. This is an important finding as Bushan *et. al.* (1993) shows that shorebirds (waders) are among the best indicators of the current status of wetland habitats.

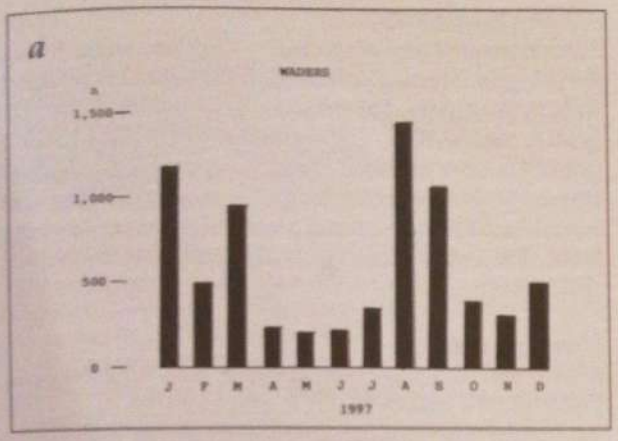
As already indicated numbers of migrant birds were present during the non-migratory months; these included Greater Flamingo, Lesser Sandplover, Curlew Sandpiper, Black-tailed Godwit, Common Redshank, Marsh Sandpiper, Common Sandpiper and Turnstone. Many of these birds were obviously juveniles loitering on but several adults, some in breeding plumage (Curlew Sandpiper, Common Redshank and Black-tailed Godwit), were observed in May, June, July and August. This is not easy to account for although several possible explanations come to mind. (For instance it could be speculated that some of the waders were possibly early-breeding strays from the East Asian Flyway which arrived in Malala Lewaya after completing breeding in their northern homes. It is also important to note that there is no evidence to suggest that any of these birds may have bred in Sri Lanka). Many of the flamingoes were immature birds but here again, a considerable proportion of the loiterers were adults. This is a problem which, it is hoped, further studies will clarify.

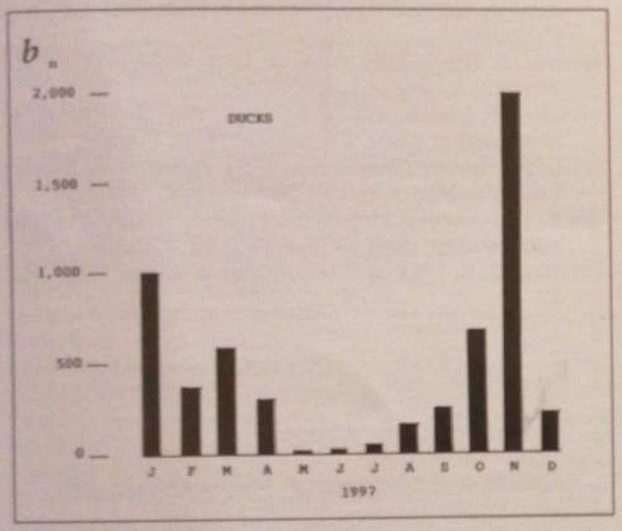
Evidence of breeding was observed in June and July. The breeding species included Little Cormorant, Indian Shag and Painted Stork in Palle Malala; Little Grebe, Black-winged Stilt and Pheasant-tailed Jacana at Uda Malala; Little Tern at Ela Tuduwa and Uda Malala. Although actual evidence of breeding was not observed, several juvenile Caspian Terns were also seen.

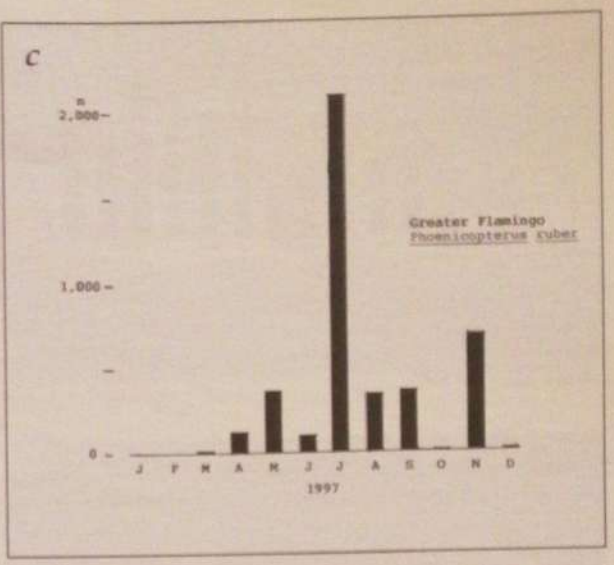
A single threatened species, the Spot-billed Pelican was moderately plentiful in Malala Lewaya. This species is considered to be threatened (Anon. 1989) as the total world population is estimated at only 11,500 (Taldukar, 1995).

Conservation issues

During the study it was observed that the waterbirds in the various study sites were subjected to several disturbances and threats. In Malala South the presence of throw-net fishermen and, on weekends, parties of picnickers created a disturbance to the birds. The birds at Uda Malala were also disturbed by throw-net and







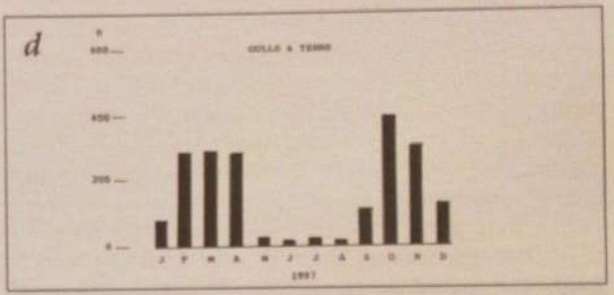


Figure 4. Monthly totals of (*a*) waders; (*b*) ducks; (*c*) flamingoes and (*d*) larids (gulls and terns), present in all study sites in 1997.

Table 3. The twelve most abundant species during January–December, 1997. Each species is indicated as a percentage of the total number of waterbirds observed at each site (refer to appendix for scientific names).

Species	Malala South	Uda Malala	Palle Malala	Ela Tuduwa	Kuruluwala
Little Cormorant	1	3	10	4	2
Spot-billed Pelican	7	2	4	1	7
Painted Stork	24	2	2	4	3
Spoonbill	5	3	11	4	0
Greater Flamingo	10	10	21	7	0
Pintail (duck)	0	6	0	0	0
Garganey (duck)	4	23	6	15	12
Black-winged stilt	4	4	6	9	13
Lesser Sandplover	4	1	1	5	2
Curlew Sandpiper	2	3	7	6	4
Black-tailed Godwit	3	2	6	18	3
Little/Saunder's Terns	7	7	0	3	0
Total %	71	66	74	76	46
No. of different species observed	22	32	27	29	19

Table 4. The twelve most abundant species from January–December, 1997 (Table 3) are ranked with reference to their status as either migrant or resident species.

Taxon	Rank
Residents	
Black-winged Stilt	1
Painted Stork	2
Spoonbill	3
Spot-billed Pelican	4
Little Cormorant	5
Little Tern	6
Migrants	
Garganey	1
Greater Flamingo	2
Black-tailed Godwit	3
Curlew Sandpiper	4
Lesser Sandplover	5
Pintail	6

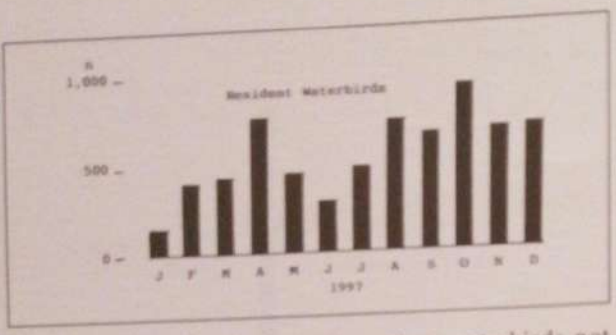


Figure 5. Monthly totals of all resident waterbirds not included in any of the other categories, present in all five study sites in 1997.

other fishermen in addition to which signs of poaching, usually of egrets and occasionally pelicans, were in evidence. Palle Malala is the base for several fishing canoes and throw-net fishermen. Here too some evidence of poaching was found, flamingoes were among the victims. The waterbirds at Ela Tuduwa were also disturbed by fishermen, although here the primary disturbance was from several tourist jeeps which frequently drove along the water's edge, disturbing large numbers of birds causing them to take to flight. Kuruluwala was relatively undisturbed probably as it is (despite its name) a poor site insofar as birds are concerned. It is an established fact that frequent disturbances causing them to take to flight, can be expensive to birds in terms of energy expenditure and, frequent or regular disturbances can therefore have an impact on the survival of individual birds and flocks.

All the study sites are within the Bundala National Park hence, permits are required to enter them. It is nevertheless disturbing to note that considerable numbers of humans appear to have unrestricted access (especially to the first three sites) without permits. The data have shown that Uda Malala, Palle Malala and Ela Tuduwa are particularly important sites for waterbirds, hence they should be afforded effective protection. Regrettably no patrolling or law enforcement was observed at these sites (or anywhere else in Malala Lewaya for that matter).

Future studies

It has been shown that Malala Lewaya as a whole is an important site for both resident and migratory waterbirds, hence the Lewaya merits further study. For example detailed investigations could be conducted to determine turnover, macrobenthic biomass in feeding areas, identification of prey items and availability of benthic and other prey (for waterbirds) etc. Concurrent with this a pragmatic management strategy, with the requirements of waterbirds receiving priority, should be formulated for Malala Lewaya.

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Appendix

Checklist of birds seen at Malala Lewaya, 1997

WV: Winter Visitor (migrant)
R: Resident
WV, R (or R, WV): both resident and migratory populations may be present.

Taxon	Status
Waders (shorebirds)	
Pheasant-tailed Jacana *Hydrophasianus chirurgus*	R
Black-winged Stilt *Himantopus himantopus*	R
Australasian Stilt *Himantopus leucocephalus*	R
Stone Curlew *Burhinus oedicnemus*	R
Great Stone Plover *Esacus recurvirostris*	WV, R
Little Ringed Plover *Charadrius dubius*	WV, R
Kentish Plover *Charadrius alexandrinus*	WV
Lesser Sand Plover *Charadrius mongolus*	WV
Large Sand Plover *Charadrius mongolus*	WV
Asiatic Golden Plover *Pluvalis fulva*	WV
Grey Plover *Pluvialis squatorala*	R
Yellow-wattled Lapwing *Hoplopterus malabaricus*	R
Red-wattlled Lapwing *Hoplopterus indicus*	WV
Little Stint *Calidris minuta*	

Taxon	Status
Curlew Sandpiper *Calidris ferruginea*	WV
Ruff *Philomachus pugnax*	WV
Pintail Snipe *Gallinago stenura*	WV
Black-tailed Godwit *Limosa limosa*	WV
Bar-tailed Godwit *Limosa lapponica*	WV
Whimbrel *Numenius phaepous*	WV
Eurasian Curlew *Numenius arquata*	WV
Common Redshank *Tringa totanus*	WV
Marsh Sandpiper *Tringa stagnatilis*	WV
Common Greenshank *Tringa nebularia*	WV
Green Sandpiper *Tringa ochropus*	WV
Wood Sandpiper *Tringa glareola*	WV
Common Sandpiper *Actitis hypoleucos*	WV
Turnstone *Arenaria interpres*	WV
Red-necked Phalarope *Phalaropus lobatus*	WV
Other waterbirds	
Little Grebe *Tachybaptus ruficollis*	R
Little Cormorant *Phalacrocorax niger*	R
Indian Shag *Phalacrocorax fuscicollis*	R
Spot-billed Pelican *Pelecanus philippensis*	R
Black Bittern *Dupetor flavicollis*	R, WV?
Night Heron *Nycticorax nycticorax*	R
Indian Pond Heron *Ardeola grayii*	R
Cattle Egret *Bubulcus ibis*	R
Little Egret *Egretta garzetta*	R
Median Egret *Egretta intermedia*	R
Grey Heron *Andea cinera*	R
Purple Heron *Andea purpurea*	R
Painted Stork *Mycteria leucocephala*	R
Openbill *Anastomus oscitans*	R
White Ibis *Treshkiornis melenocephalus*	R
Spoonbill *Platalea leucocorodia*	R
Greater Flamingo *Phoenicopterus ruber*	WV
Lesser Whistling Teal *Dendrocygna javanica*	R
Cotton Teal *Nettapus coromandelianus*	R
Pintail *Anas acuta*	WV
Garganey *Anas querquedula*	WV
Shoveller *Anas clypaeta*	WV
White-breasted Waterhen *Amaurornis phoenicurus*	R
Moorhen *Gallinula chloropus*	R
Purple Coot *Porphyrio porphyrio*	R
Watercock *Gallicrex cinerea*	R
Brown-headed Gull *Larus brunnicephalus*	WV
Gull-billed Tern *Gelochelidon nilotica*	WV
Caspian Tern *Sterna caspia*	WV, R
Large-crested Tern *Sterna bergii*	R
Little Tern *Sterna albifrons*	R
Saunder's Tern *Sterna saundersi*	R
Whiskered Tern *Chlidonias hybridus*	WV
White-winged Black Tern *Chlidonias leucopterus*	WV
Raptors (refer to text)	
Brahminy Kite *Haliastur indus*	R
White-bellied Sea Eagle *Haliaeetus leucogaster*	R
Grey-headed Fishing Eagle *Ichthyophage ichthyaetus*	R
Crested Serpent Eagle *Spilornis cheela*	R
Shikra *Accipiter badius*	R
Crested Hawk Eagle *Spizaetus cirrhatus*	R

Greater Flamingo (*Phoenicopterus ruber*).

Black-tailed Godwit (*Limosa limosa*).

Whistling Teal (*Dendrocygna javanica*).

Yellow-wattled Lapwing (*Vanellus malabaricus*).

Breeding the Common Grass Yellow butterfly

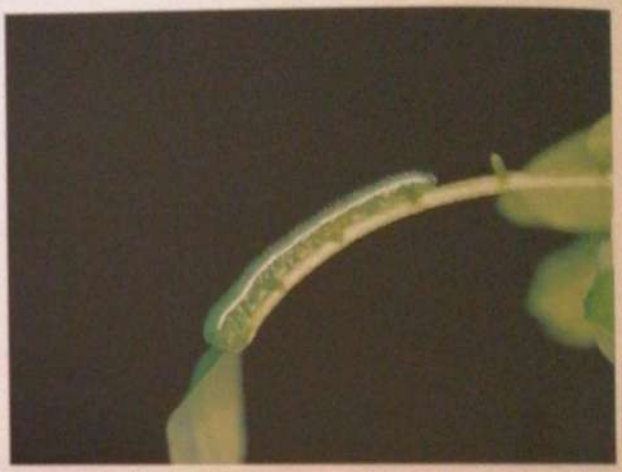
Sudath Nanayakkara

Wildlife Heritage Trust of Sri Lanka.

The Common Grass Yellow (*Eurema hecabe*), a member of the family Pieridae, was described first by Linnaeus in 1764. The Pieridae are represented in Sri Lanka by twelve genera containing a total of 27 species, five of which are in the genus *Eurema*. This is one of the most common butterflies in Sri Lanka, and occurs almost everywhere. L.G.O. Woodhouse, author of *The butterfly fauna of Ceylon* (1942), mentioned that it is particularly common in the Haldumulla area. The butterfly is usually seen on grass or small shrubs up to about 50 cm high, rarely flying more than about 1.5 m above the ground; as a result, they are easy to spot. Its beautiful bright colour renders it an extremely attractive insect. The species itself has a range that extends from Sri Lanka and India all the way to China.

Common Grass Yellows breed throughout the year. The caterpillars feed on the shoots and leaves of various species of leguminous plants. I first observed these butterflies laying their eggs in the small garden outside the WHT lab in Colombo on a clear afternoon early last June. There were three of them flying about the garden, around a *Sesbania grandiflora* tree (Sinhala: katuru murunga; an introduced species). One of them rested briefly on each of several young leaves of this tree, and then flew away. A cursory glance showed that she had in fact been depositing tiny eggs, each shaped rather like a tiny grain of rice. One shoot had three eggs on the upper surface, and a further two on the underside. Observing the egg over a quarter-hour, I was fascinated to notice that having started out white, it soon took on a yellow hue.

Common Grass Yellow egg, 2×1 mm (L×W).



Common Grass Yellow caterpillar, 8 days after hatching, 22.4 mm long.

Common Grass Yellow chrysalis (pupa), 11 days after hatching, attached to the leaf of its host plant (18.1×3.5 mm).

I decided to record the development of the eggs, and so broke off the stem on which their host leaf was and placed it in a vase in the lab. I measured the eggs immediately with a pair of vernier calipers: 2 mm long by 1 mm wide. Looking at the eggs under a microscope, I noticed they had fine ridges running longitudinally. For the first two days, the eggs showed now change. On the morning of the third day, they had turned from pale yellow to a leafy green. That same evening, tiny green caterpillars, with no markings whatever on them, and about 4 mm long, hatched from four of the five eggs.

On the first day, the caterpillars did not feed, but on the second day they were all busy feeding, focussing their attention on the tender leaf margins. I experimented with them by putting them on the leaves of another leguminous tree, *Cassia auriculata*: they were just as happy to feed off the shoots of these, too. (The ability of utilise a variety of food plants probably explains the abundance of this species in Sri Lanka.) By the eighth day, the larvae were about 22.4 mm long and around 3 mm wide at the centre. By this stage the caterpillar was light green, covered in tiny hairs, each of which carried a tiny droplet of liquid on its tip. A white stripe ran along each side of the body. They still fed only on the leaf margins, avoiding the centre. Most of the feeding was done on the underside of the leaf, probably for the reason that this way the caterpillar was less visible to predators. It appeared that they fed only in daytime.

On the tenth day the caterpillars all stopped feeding, having shrunk slightly in size to 21.2 mm in length. By the morning of the 11th day, the caterpillar had metamorphosed into a beautifully camouflaged, light green chrysalis, 18.1 x 3.5 wide. The head of the chrysalis, much wider than the tail, was secured to the leaf by a fine thread of silk; the tail itself was anchored to the leaf. Being on the under-side of the leaf, the chrysalis would be sheltered from the elements and also safe from predators. On the third day after metamorphosis, I noticed that the chrysalis had turned yellow, with the wings and markings being clearly visible under its protective membrane the next day. That same evening, the butterfly imago emerged from the chrysalis, unfurled its wings (which were clearly wet) and rested for about an hour, upside down, hanging on to the remains of its former home. It had taken 18 days in all from the laying of the egg to the emergence of the imago.

The newly-hatched Common Grass Yellow butterfly, 18 days after the egg was laid; *inset:* the chrysalis just before the imago emerged.

Minneriya— where the elephants gather

H. I. E. Katugaha

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One hot July afternoon our jeep took us along a gravel road. Certainly not the best of roads. The going was slow. A muntjack scampered across to vanish into the jungle. Driving through the forest was rewarding. It was cool but dusty. Jungle fowl took off as we approached. A Serpent Eagle surveyed the surroundings from his high vantage point. Suddenly, we found ourselves beside a vast sheet of water. The Minneriya Tank. Spoonbills were moving about in the shallows searching for food. A flight of egrets had our attention. And there, to our left, beside an old gnarled tree, were the elephants spread out in all their glory.

It was the largest gathering of pachyderms I had seen in years— not since I had the luck to see such gatherings at Lahugala in less troubled times. There were over ninety elephants of all sizes spread out in front of us. What more could a nature lover ask for? As we were the first to reach them, we stopped at a respectable distance, so as not to disturb them in any way, and observed this great gathering of the clans. Few places exist in Sri Lanka today where one could observe such gatherings.

Minneriya Wewa was the creation of King Mahasen (276–303 AD). He is reputed to have created sixteen such

wewas to provide water for the rice fields in years gone by, when the land was fertile and populated. It is said that the land belonged to the Veddahs who were cultivating *meneri*. The king is said to have amply compensated them and obtained their help in building the dam.

This dam is said to have breached several times and a human sacrifice was called for. The queen had refused to part with a prince and the king had therefore obtained a prince from his sister. Luckily for this prince, the *Adigar* was fond of him and contrived to sacrifice a bear, having concealed the prince. Later the king regretted his act but was overjoyed when his *Adigar* informed him that the prince was alive. The young prince was then brought back with full royal honours.

The king was loved by his people and after his death he was deified. Referred to as Mahasen Deviyo, he is worshipped even to this day in this land. A shrine dedicated to him was originally found on the dam, but this has now been shifted to another site. Annual rituals are conducted to obtain his blessings even today.

With the collapse of the Rajarata civilization, the jungle tide rolled over this once fertile land. It is believed that the Minneriya tank never breached, even though most others did. Only a few villages remained, consisting of a few huts.

Rediscovered during British Rule, it remained a sportsman's paradise till after Independence. Sri Lanka's first prime minister, D. S. Senanayake, then set about colonizing this land once again. Many early British writers make mention of Minneriya and its surroundings: Pybuss, John Davy, Emmerson Tennent and of course, Samuel Baker, the celebrated sportsman-explorer.

Minneriya-Giritale National Park was declared only in May, 1998. This, our newest park, is still in its infancy. A fifteen- minute drive from Habarana along the Polonnaruwa road will bring you to its humble gate. The roads are now being made and one should travel in a four-wheel drive vehicle to best survey all the park has to offer. No bungalows have yet been constructed, but I was informed that camp sites will soon be available. Grossly understaffed, sometimes four vehicles to a single guide. I hope that as the park gets more popular, more guides will be available to take the visitors into the park. A lot of work remains to be done.

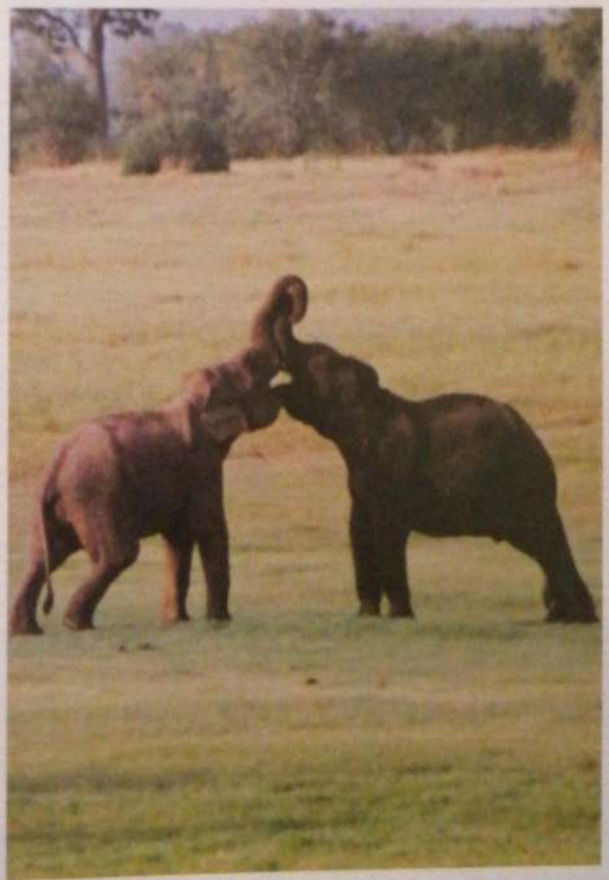
To get back to our elephants, they were feeding peacefully. Six adult bull elephants were going around testing the females for receptivity. Two young bulls on the far side were having a trial of strength. They pushed, entwined their trunks and trumpeted. The other elephants close by paid no attention at all.

More vehicles arrived, full of tourists and other natures lovers. They all parked at a respectable distance and did not disturb the animals. I hope this will always be the case. Quite a contrast to what happens at Kaudulla Tank. There, tourists are seen walking all over the place and the jeeps are quite a disturbance as they get far too close to the elephants. If not checked soon, there will be tragedy in the near future.

One bull elephant walked towards us but did not threaten us in any way. We watched silently. Soon, he was joined by two females who moved away from the parent herd to join him. Their behaviour left us in no doubt that they had a date for the evening. One female had a problem with her left leg. Her knee was swollen and she was in obvious pain. She did her best not to put weight on the leg and when resting kept her leg bent so as not to put weight on it. There were no external injuries visible. There were four baby tuskers in the gathering but sadly, no adult tusker, even though the gathering comprised nearly a hundred elephants.

As it was now getting dark, we had to leave. More elephants were emerging from the jungle and I am sure there would have been a gathering of well over hundred elephants by late evening.

Yes, Minneriya is well worth a visit. The best time is between June and October. Our newest national park is sure to grow in popularity. I hope the Department of Wildlife Conservation realizes this and makes sure it is better staffed in the year 2000.



Fishes in trouble

The decline and fall of Sri Lanka's freshwater fish fauna

Rohan Pethiyagoda

Background

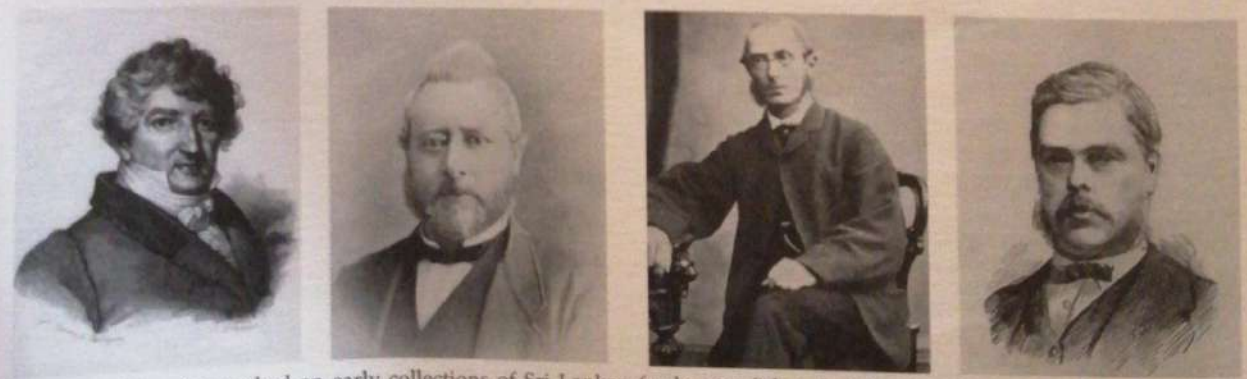
All things considered, Sri Lanka's freshwater fishes are probably better studied than any other group of animals. As long ago as the 1830s, the great French systematists, Baron Georges Cuvier (1769–1832) and Achille Valenciennes (1794–1865) reported on several small collections of freshwater fish from Sri Lanka in their 22-volume *Histoire naturelledes Poissons* (1828–49). The Dutch ichthyologist Pieter Bleeker (1819–78) broke journey in Galle en route from Java to Holland in 1860, and took time off to collect some fish. He described several new species from the island shortly thereafter, and illustrated them with beautiful colour figures. Working on the collection of the British Museum, Albert Günther (1830–1914) would also describe several fish species endemic to Sri Lanka. Francis Day (1829-89), working in India, included several Sri Lankan fishes in has magnificent *Fishes of* India (1875–78). In the first decade of the 20th century Georg Duncker (1870–1953) made the most exhaustive collection of fish accumulated up to that time and reported the first near-complete list of fishes in a brief paper in 1912. It was only with the advent of Paul E. P. Deraniyagala however, that an attempt to provide a synthetic treatment of the fauna was made.

This Deraniyagala did in 1952, with the publication of his *Coloured Atlas*, which brought together information published in several earlier papers, providing also for the first time colour drawings of many species. Deraniyagala had clearly stimulated the interest of several others, for three books on Sri Lanka's fishes followed thick and fast: A. S. Mendis's *Fishes of Ceylon* (1954); I. S. R. Munro's *The marine and freshwater fishes of Ceylon* (1955); and A.S. Mendis and C. H. Fernando's *A guide to the freshwater fauna of Ceylon* (1962). These books were all taxonomic in character, with little information on the ecology or geographical distribution of Sri Lanka's freshwater fishes. This void was finally filled by Ranil Senanayake, who after several years of field research in the late 1970s, wrote a comprehensive thesis (*The ecology and biogeography of the inland fishes of Sri Lanka*, 1980), addressing especially these issues. Sadly, despite the wealth of information it contains, this work was never published. In my own book, *Freshwater fishes of Sri Lanka* (1991) I attempted to illustrate with colour photographs almost all the species, provide distribution maps for each, and publish as much information as was available regarding their ecology and husbandry.

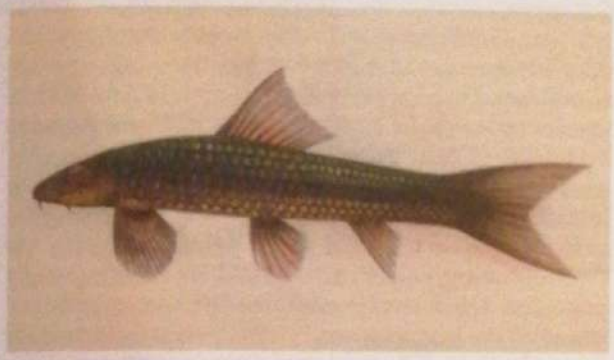
We have a right then, to assume that the freshwater fishes of Sri Lanka are well known. This is far, however, from the truth. Although they have been subjected to more synthetic treatments than almost any other group of vertebrates, much remains to be learned.

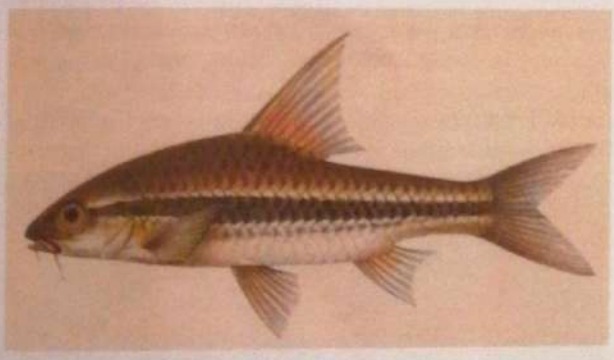
In my 1991 book, I drew attention to the fact that the degree of endemicity of the Sri Lankan fishes was much higher than previously supposed. At least 26 freshwater dispersants (42% of a total of 62 species) and three gobies known to migrate between saltwater and freshwater were then thought to be restricted to the island. Sri Lanka's endemic fishes are, by and large, restricted to the wet zone (here defined as the land area where annual precipitation exceeds 2500 mm). I suspect this endemism more because the south-western wet zone is a distinct 'land-island' biotope than because Sri Lanka itself is an island long separated from India.

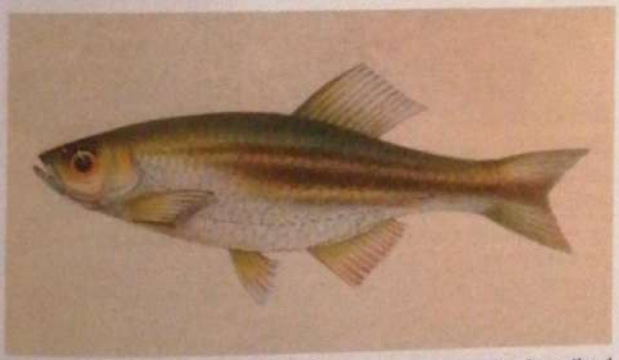
Because freshwater fishes are the target of both the food and ornamental fishery, and also because of their



Ichthyologists who worked on early collections of Sri Lankan freshwater fishes. Left to right, Baron Georges Cuvier (1769–1832); Pieter Bleeker (1819–78); Albert Günther (1830–1914); and Francis Day (1829-89).



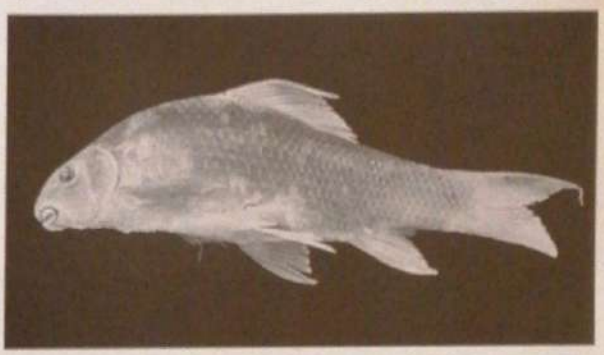


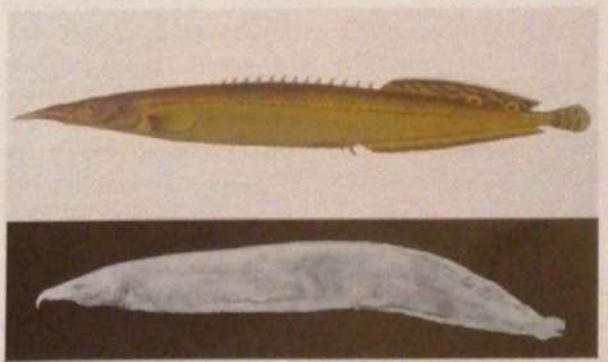


Four endemic Sri Lankan freshwater fishes newly described and illustrated by Pieter Bleeker in 1864. Top to bottom, *Schistura notostigma, Garra ceylonensis, Puntius pleutotaenia* and *Danio micronema*.

interest to the aquarium fish export industry, there has been growing concern regarding the sustainability of exploitation. In *Freshwater fishes of Sri Lanka*, I drew attention to the fact that populations of several species of freshwater fishes appeared to be in decline. There, and in a subsequent paper in 1994, I pointed out that two species which were as at 1980 known to be widespread and abundant (the Red-fin Labeo *Labeo lankae* and the Spiny Eel *Macrognathus aral*), had virtually disappeared. Neither species was known to be the target of a fishery, although both did appear incidentally in fisheries statistics. The reasons for their disappearance were thus a mystery. This prompted me to begin a fresh survey (1996–98) of the island's freshwater fishes. Neither of these species turned up in this survey, but more than a dozen other fishes never before recorded from Sri Lanka, did!

It is now clear that the status of several freshwater fish species is critical, and that unless early remedial action is taken, extinctions may follow. In order formally to declare a species extinct, we must be satisfied beyond reasonable doubt that no individuals remain alive. I would not readily say this of any fish, because some species are known from exceedingly small populations,





Extinct? The Red-fin Labeo *(Labeo porcellus)* above; the Spiny Eel *(Macrognathus aral)* below. Both were common and widespread until the late 1970s. We learn an important lesson from this: species extinctions do not always occur where you expect them, and they are not always gradual. Extinctions often occur suddenly and catastrophically, striking down species that appear abundant and show no signs of distress.

and it is possible that *Labeo lankae* and *Macrognathus aral* are lurking somewhere—let us hope so. But the sad fact is that these were species that Ranil Senanayake found to be common and widespread in the late 1970s, just a decade before my own abortive search for these species in the late 1980s and until now. Even if they are not actually extinct, their populations have certainly crashed. Cause then, for alarm.

Threats to the fauna

Exotics

Around 30 species of fish introduced to Sri Lanka, probably more, are now known from wild populations which are self-sustaining or growing. Apart from species deliberately introduced for the food fishery (mainly several species of tilapia and large carps such as rohu), several species exist in localised populations around Colombo. The latter are escapees from the tanks and ponds of hobbyists and aquarium fish breeders which have now entered the waterways of the coastal floodplain. By a network of canals and waterways (e.g. Bolgoda Lake and hamilton Canal), this joins up the Kalu Ganga basin in the south, the Kelani basin at Colombo, and the Attanagalu Oya basin in the north. There is no impediment therefore, to species slightly tolerant of saline water, moving freely into almost the whole of the western floodplain. In the long term, these exotic species will inevitably disperse to occupy at least the lowland floodplain of the western and south-western wet zone. We can but hope that they will not move into rainforest habitats, where they could wreak havoc on an enormous variety of native species.

What a tragedy this is for Sri Lanka's indigenous fishes! Several endemics are almost completely restricted to this area (e.g. *Aplocheilus dayi* and *Amblypharyngodon grandisquamis*). Now, the wet zone coastal floodplain is inhabited by more exotic species than indigenous species. It is clear that almost all these 'Colombo' species originate from the aquarium hobby and industry, probably the result of poor water disposal management or escapes during times of flooding. The three most notable groups among these are species of *Chitala*, *Osphronemus* and *Hypostomus*, all of which are attractive to the ornamental fish industry and continue to be captured for sale. While the latter two are herbivorous as adults, *Chitala* are notorious predators that grow to be as big as any indigenous freshwater fish Sri Lanka has. It is imperative that restrictions be placed on the import and possession of ornamental fishes to ensure that no further species are added to this potentially troublesome exotic fauna.

Of the several species of carps that have been introduced for the food fishery, only the common carp *(Cyprinus carpio)* and rohu *(Labeo rohita)* appear to have large, self-sustaining populations. The former is the only species now occurring in many headwater streams above 1500 m. a.s.l. elevation, while *L. rohita* is now the dominant cyprinid almost everywhere in the dry zone. Despite doubt about its ability to breed in Sri Lanka following the suspension of stocking in 1990, it is now clear that the species not only breeds but actually dominates fish biomass in flowing-water habitats throughout the dry zone, especially in the north-central and north-western provinces. The other cyprinid species, *Catla catla, Cirrhinus mrigala, Hypophthalmichthys nobilis, H. molitrix* and *Ctenopharyngodon idella* evidently do not commonly breed in Sri Lanka's flowing waters.

Two 'air breathing' species introduced from the Indonesian islands several decades ago, the snakeskin gourami (*Trichogaster pectoralis*) and the giant gourami (*Osphronemus goramy*), have populations high enough to warrant a fishery. Nevertheless, populations of these species appear to be highly localised and were found to occur only in the western coastal floodplain.

The rainbow trout (*Oncorhynchus mykiss*), originally introduced from California as a sport fish in 1882, is the only fish species recorded from Horton Plains National Park (elevation *ca.* 2100 m. a.s.l.)., where it is now strictly protected. The destructive nature of this fish, which may already have been responsible for species extinctions in Sri Lanka, is well documented. It is important that this species be eradicated from Sri Lanka, perhaps through the mechanism of a controlled short-term and potentially lucrative licensing scheme for sport fishing in this national park.

At least five species of tilapia have been introduced to Sri Lanka since 1952, together with a number of

Originally from the Zambesi River of east Africa, tilapia (above) is now Sri Lanka's most abundant fish, having invaded almost all aquatic ecosystems. Around 20 million kg of tilapia are harvested from Sri Lanka's freshwater bodies annually, helping to supplement the nutritional status of poorer rural communities. But is it worth the ecological cost? Come the end of the 21st century, Sri Lanka's indigenous freshwater fishes may all have disappeared, leaving exotic species such as tilapia to inherit—and dominate—their ecosystems. With good intentions, politicians ignorant of the danger to the country's indigenous fauna continue to release more alien species into the aquatic ecosystem.

hybrids. Of Sri Lanka's annual freshwater fish catch of ca. 20 million kg, tilapia accounts for 56-99%, depending on the location, but accounts for more than 90% by weight of fish harvested in dry zone tanks. However, in the 47 years since its introduction to Sri Lanka's inland waters, no critical assessment has yet been made of its impact on the indigenous fishes. Instead, the uncontrolled dispersion of tilapia in Sri Lanka has probably been viewed with complacence by fisheries personnel as it is commonly though of as being herbivore, and therefore not a threat by predation to the indigenous fishes. The validity of this assumption is questionable: both fish and fishery may pose a threat to the aquatic fauna and flora of Sri Lanka. It seems extremely probable that the decline of the Red-fin Labeo *Labeo lankae* and the Spiny Eel *Macrognathus aral* have been due to competition with tilapia, which now, together with rohu, dominate the former habitats of these species.

The success of tilapia in the fishery has been attributed to many factors. It is a resilient species that also breeds rapidly and profusely throughout the year. It is able to withstand a high degree of pollution; tolerate, breed in and even disperse via sea water; and utilize almost all available sources of food. The present distribution of tilapia includes the entire dry zone (where it is by far the most abundant species), most estuaries and lagoons in both the dry and wet zones, and the larger streams, reservoirs and rivers of the wet zone lowlands up to 600 m elevation.

Tilapia is however, appears to be absent from rapids and streams where the substrate does not consist of sand, mud or silt. However, increasing siltation of lowland streams caused by poor sloping-land use practices could result in this species invading also wet-zone forest habitats. Today, tilapia populations are established in the 'heartland' of Sri Lanka's invaluable 'endemic country', in places such as Akuressa and Rakwana. In principle there is nothing to restrict the dispersion of tilapia into the central hills, where it has already established itself in pockets. Inn Sulawesi, tilapia has now invaded high-gradient headwater torrents with rocky substrates. In Sri Lanka, I have found tilapia occurring together with the endengered Martenstyn Barb (*Puntius martenstyni*) in the Knuckles.

Tilapia breeds throughout the year, but more frequently during rains, thereby coinciding with the breeding 'season' of most of our indigenous fishes. The population of tilapia in Sri Lankan standing waters also outnumbers and outweighs that of all the other species combined. While 58-78% of the diet of small (25 mm long) tilapia comprises zooplankton, these fish are also known to predators of small fish. When food is scarce, it is known to prey even on its own young. These aspects of tilapia biology are usually ignored by most literature dealing with its fishery 'success'.

The excuse usually trotted out for introducing tilapia to reservoirs in Sri Lanka is the lack of 'specialized' indigenous lake-dwelling species. While this may strictly be correct (there being no natural lakes in Sri Lanka), it does not mean there are no specialized *stillwater* species—e.g. the species that inhabit our wet zone swamps. At least 25 indigenous fish species occur in reservoirs, 13 of them being common and widespread. What is more, another direct consequence of the introduction of highly-productive tilapia has been the introduction of new, highly intensive fishery technologies. Almost all Sri Lankan reservoirs are now intensively fished, often with gill nets of small mesh size (3-5 cm). And none of these nets come marked with a warning: "No Entry to Indigenous and Endemic species".

Above: rainbow trout, introduced to Sri Lanka almost 120 years ago as a sport fish by British settlers. The only known self-sustaining population of this monster species, known to have caused fish extinctions world-wide, is in Horton Plains National Park, where ironically, it is strictly protected. Below: the author as a young boy, showing off a near-record 3 lb trout caught in Elgin Gorge, Agrapatana. Trout no longer survive in the area, having been fished to extinction (by poisoning) by estate workers.

What is not generally made known is that tilapia (*O. mossambicus*) is not originally a lake-dwelling species. Its natural habitat is the Zambezi River in East Africa. Here, tilapia breed in pools, but the fish can also withstand fast-flowing water. It is not a menace in the Zambesi however, because other species in the river are adapted to compete with it. In Sri Lanka, the arrival of tilapia has been by way of a *blitzkrieg* on the local fish fauna.

In the longer term, extensive invasion of the lowland wet zone and the Knuckles hills by exotics, most notably tilapia, would almost certainly result in extinctions. Environmental disturbance caused by on-going colonization is resulting in these areas increasingly developing the characteristics of invadable ecosystems.

The casual approach to introductions and the citing of a 'lack of evidence' of pressure to indigenous Asian fishes by exotics such as tilapia is in part because few Asian countries have made systematic assessments of their native fish resources (or faunal diversity in general). Even recent publications of faunas in many Asian countries are based more on out-dated literature or old museum collections than on recent surveys. In these circumstances, it is unlikely that extinctions will become known until long after they have occurred, as has possibly been the case in Sri Lanka, with the Red-fin Labeo *Labeo lankae* and the Spiny Eel *Macrognathus aral*.

The only assessment of the effects of exotic species in the less developed countries of Asia have appeared in fisheries literature, and it is not surprising that these generally favour the exotics, which have undoubtedly contributed to an increase in production. The deleterious effects of exotics have not been examined on the basis of comprehensive surveys but have usually been based mainly on fisheries catch data. Such surveys often mention only those species previously present but now not captured or rarely recorded. A recent (1989) regional fisheries assessment concluded not only that that tilapia has not endangered any indigenous fish species, but has also not had any detrimental / deleterious effects on any waters in India, Malaysia, the Philippines, Sri Lanka, Taiwan or Thailand!

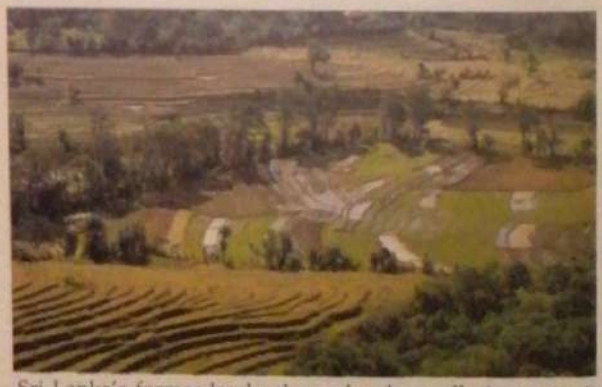
There is little doubt that almost all exotics do exert pressure on the host fauna. Such pressures need not necessarily be the result of direct influences such as predation or competition, but could be the result of indirect influences such as increased fishery pressure or potentially harmful fishery technologies (e.g. small-meshed gill nets). Moreover, the species under greatest pressure need not be (and seldom are) the *target species* of the fishery. For example, Sri Lanka's freshwater turtles *Lissemys punctata* and *Melanochelys trijuga* have almost disappeared from dry zone reservoirs, in which they were previously abundant, evidently as a result of the gill net fishery. Assessment of the effects of individual pressure factors on fish populations is not always simple, especially when several factors exist. The presence of exotics is usually only one of a number of pressure factors on native fishes and population declines could be the result also of other factors, the effects of which are not easily evaluated separately.

Problems arise primarily from fisheries managers attempting to fill what they perceive as 'vacant' ecological niches with allegedly 'benign' exotics. Many of the dietary, ecological and behavioural labels in use by such people are oversimplified, the 'niches' being artificial. There clearly are dangers in using these blasé labels to justify introductions. Many species are also capable of utilizing different niches in different localities.

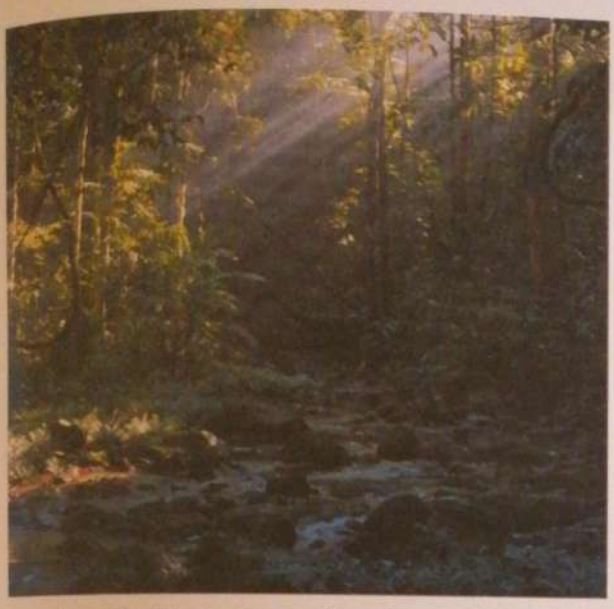
Habitat deterioration

Today, rather less than 750 km² of Sri Lanka's former 16,000 km² of rain forest remains. This accounts for just 1.2% of the island's land area. In this highly-fragmented 750 km² the last remains of our country's endemic biodiversity persist, fighting a grim battle for survival. Much of the central and south-western hills are planted with tea, this crop now accounting for more than 200, 000 ha. It is estimated that as much as 30 cm of top soil has been lost from upland areas during the past century since tea was introduced. The consequent loss of soil fertility has resulted in this agriculture becoming largely dependent of fertilizers. Some 40,000 MT of fertilizer (NPK) are utilized by the tea industry each year. It is hardly surprising then at Sri Lanka's up-country streams and rivers contain barely any fish. It could well be that extinctions occurred in this fauna in the 19th century, before records were maintained, as a result of habitat alteration and the introduction of rainbow trout (the first systematic survey of these habitats, after all, were Senanayake's in the 1970s, long after the trouble started).

Deforestation has also resulted in reduced ground water retention and therefore the periodic desiccation of headwater streams. Steadily declining rainfall in the headwater catchments will also worsen this situation.



Sri Lanka's former lowland marshes have all given way to paddy cultivation. The fauna and flora they contained have mostly disappeared and can only be guessed at.



Most forest-dwelling freshwater fishes show a clear preference for shaded, slightly acidic, soft, clear-water streams.

While tea plantations occupy much of the central highlands and southern wet zone, much (*ca* 200 000 ha) of the western and south-western wet zone is planted with rubber. Despite the pollution resulting from the processing of latex, rubber is tolerant of ground cover (obviating the need for herbicides) and appears to have been a more benign crop insofar as the fishes are concerned (the only surviving population of the highly endangered Bandula Barb, *Puntius bandula*, occurs within a rubber plantation). The presence of ground cover also contributes to reducing erosion, and the relatively tall (10 m) trees confer a high degree of shade to waterways in rubber plantations.

Of the 73 Sri Lankan freshwater species recorded by me, 33 have a strong preference for shade, 18 being found only in shaded habitats. In addition to the advantages shade confers on fishes, detritus-feeding and invertebrate-feeding fishes have obvious advantages in forest streams, and deforestation would pose an immediate threat to these species, especially those inhabiting headwaters.

Although Sri Lanka has no natural lakes (and therefore no specialized lake fishes), a few endemic fishes have a strong association with still-water habitats. It is regrettable, therefore, that the lowland wet-zone marshes have almost completely given way to paddy cultivation. The compulsory seasonal drying out of paddy fields and their high agrochemical usage result in this habitat now being of little value to fishes, especially in times of drought.

The surface water draining from the granitic central hills of Sri Lanka is normally clear, soft (2–5 DH, conductivity 18–3 μS at *ca* 22°C) and more or less neutral (5.8–7.0 pH). Lowland standing-water bodies have more dissolved solids (conductivity 400–1100 μS at *ca.* 27° C) and are generally alkaline (7.4–8.4 pH). While no recent comparative analysis has been made, there is little doubt that continuing deforestation and poor slope agriculture practices are causing increasing siltage of rivers. We made comparative assessments of fish assemblages at two locations (Avissawela and Rattota) upstream and downstream of tributaries that introduced silt-rich turbid water into river courses. In the former case, no difference in the assemblage was observed, whereas in the latter case, Martenstyn's Barb occurred immediately upstream of the disturbance but not for 350m downstream of it. In Akuressa, we found that when the water in a rivulet we were sampling was made turbid as a result of our sampling activity, both Rasbora *vaterifloris and Malpulutta kretseri* tended to 'take cover' under roots or leaves or move further downstream. Water turbidity clearly does affect fish assemblages, and this needs to be considered in conservation planning.

The following factors probably affect indigenous fish populations negatively: loss of shade (and therefore exogenous food sources by way of insects and larvae); increased erosion; substrate alteration (including the reduction of leaf debris caused by shade loss); changes in water quality and temperature; and desiccation due to reduced ground water retention. Because distribution and microhabitats suggest that many species, particularly the endemic ones, are habitat specialists, significant habitat degradation can lead to changes in community structure and decreased diversity. Such altered habitats tend to be better suited to habitat generalists and introduced exotic species, which, surely enough, are now progressively invading these habitats.

Pesticides

Although the import of pesticides is regulated by the *Control of Pesticides Act* (No. 33 of 1980), no pesticides have been tested in Sri Lanka for toxicity to non-terget species (i.e. species that are not pests). We therefore have no idea on the impact these pesticides could have on our indigenous fauna and flora. There is also no regulation of pesticide use, especially near waterways (although deliberate poisoning is, of course. illegal). Upwards of 1.5 million kg of insecticides, 2 million kg of herbicides and 800,000 kg of fungicides are used annually in Sri Lanka. Eventually, almost all of this washes into waterways and pose a threat to aquatic organisms. The Anti-malaria Campaign is also a major user of insecticides, mainly malathion. The tea industry, which is located largely in headwater catchments, utilizes some hundreds of thousands of litres of Paraquat, a highly toxic herbicide annually. Although toxicity of pesticides in use in Sri Lanka to aquatic fauna has not been assessed, damage to aquatic organisms should be expected. The now-com-

mon 'ulceration syndrome' in freshwater fishes also appears to be related to agrochemical use.

Exploitation

The only significant fishery for the rain forest fishes in Sri Lanka is by aquarium fish exporters. The sustainability of unregulated harvesting is highly questionable, and it is imperative that this industry be shifted from gathering to culture. Culture techniques exist for almost all the species that may legally be exported, and more indigenous species could be permitted to enter the trade if they are specifically cultured and a regime of effective supervision and monitoring. The present system of permitting certain wild species to be harvested for export is clearly imprudent. Almost all fishery methods are necessarily indiscriminate. Sweeping his net through the water, a freshwater fish collector cannot hope to catch only a specific species of fish. The 'non-target' fishes (usually the endangered ones prohibited from export) are then discarded. What incentive is there for the fisherman to discard these specimens thoughtfully? None. The practice of harvesting fish from the wild could have other negative impacts too: e.g. the possibility of indigenous fish species being accidentally translocated between freshwater catchments.

Sri Lanka therefore needs to offer a set of incentives, both legal and financial, to fish exporters to breed all the freshwater fishes they deal in, with wild collection being allowed only for the capture of brood stock under a regime of strict monitoring.

Conservation

A curious situation exists in Sri Lanka where 96.4% of the protected areas are in the dry zone, only 3.6% being in the wet zone. A much-quoted statistic is that 12.2% of the land area of Sri Lanka receives some measure of protection (i.e. it is not used for agriculture, a happy figure compared with the global average of 3.7% estimated by IUCN). Our 12.2% exceeds, by proportion, the extent of protected areas in neighbouring countries, but it is ironic that very few endemic species benefit from this. The lowland rain forests of Sri Lanka have the highest incidence of endemic vertebrates, and the dry zone the lowest incidence. Further, no endemic vertebrates are restricted to the dry zone. It is relevant that only 74 940 ha. (3.3% of the wet zone's 22 500 km²) is now forested, less than half of this being primary forest.

This being the case, it is unfortunate that *not one* of Sri Lanka's endemic fish species occurs in a national park. Further, none of the species with extremely small distributions (e.g. *Puntius bandula, P. asoka, P. srilankensis*) occurs in a protected area. It is important therefore that a new concept of protected habitats be developed for 'point endemics' such as these, possibly involving also

Four species of freshwater fish endemic to the Knuckles Hills. Top to bottom: *Labeo fisheri, Puntius srilankensis, Puntius martenstyni* and *Danio* sp.

the local peasand and farming communities, who may be able to participate in conservation activity through being permitted sustainable exploitation of the resource, for example through eco-tourist attractions.

The Knuckles Range of hills is clearly a region of special interest. Four species of fish are restricted to it (*Labeo fisheri, Puntius martenstyni, P. srilankensis*, and *Danio* sp.). Vast tracts of this forest have been leased out for the cultivation of cardamom, resulting in severe stresses on habitats. A general conservation plan for this unique habitat is urgently necessary.

Despite being committed officially to a progressive biodiversity conservation action plan, Sri Lanka's present conservation programme is orientated towards awarding protection to a list of species which are themselves resident largely in unprotected habitats. Meaningful conservation can take place only by eliminating this 'Bambi syndrome' from the conservation strategy and moving away from the concept of protected species lists toward a system of conserving ecosystems, habitats and communities rather than individual taxa. It is important that the remaining wet zone forests and associated biotopes be strictly protected.

Ex-situ conservation

Given the threats to the freshwater fishes, it is imperative that a sufficiently large number of captive populations are maintained with a view to reintroduction once the pressures on wild populations have been controlled or their survival assured. While this is not an ideal solution, it represents a means of securing the survival of at least part of the genetic material now at risk. In the case of many endangered species, the present populations are so small that genetic erosion may already have commenced. Even abundant species have been known to undergo sudden crashes in their populations over short periods, as has been seen in Sri Lanka in the cases of *L. porcellus* and *M. aral*. The degree of monitoring in countries such as Sri Lanka is so cursory that such crashes could easily go undetected; this is also probably the reason for the very small number of extinctions reported from developing countries: extinctions, no doubt, have happened, but no one knows and few care.

A further possibility is the translocation of threatened fishes, particularly those with localized distribution, into less stressed habitats. This has already been attempted successfully in the case of four endemic Sri Lankan cyprinids introduced into the Mahaweli basin at Ginigathena in the late 1970s. Several dangers, however, are contingent on such translocations, which should be undertaken only with a good knowledge of the host biotope, and the likely impact and range of dispersion of the translocated species.

Recommendations

Exotics. It is imperative that Sri Lanka engages in urgent action to eradicate the exotic fish species that today dominate its inland waters. The diversity of the species involved is so great however, that this may well be an impossible task. The most destructive of the exotics are undoubtedly the tilapia species, their *ca*. 20,000 MT annual catch being an important nutritional benefit to the rural societies involved in the fishery. The solution to this problem therefore has to be addressed socio-economically, and not simply as an 'invasive species issue'. Sri Lanka is not alone in encountering a problem with tilapia. Most Asian countries, from Pakistan to the Philippines are seriously affected. This has the benefit of making possible a multi-lateral approach to the development of management mechanisms and therefore shared investment. As it is likely that the only possible controls will be biological, the investment in research is likely to run into millions of dollars. Nevertheless, if this problem is not addressed and solved in the medium term, it is likely that widespread fish extinctions of aquatic organisms will follow.

Riparian shade is possibly the most important habitat characteristic for the endemic fish species of Sri Lanka's wet zone, most of which occur in the small streams (1–2 m wide) and rivulets of the remaining forests. There should be an urgent 'public-action' programme to plant naturally-occurring riparian tree species along stream banks. This activity is suited for action by NGOs and local government, and funding lines are available through the Ministry of Forestry and Environment.

Ornamentals industry. Because the methods of harvesting are indiscriminate ('everything comes into the net'), the principle of allowing the wild-collection of fishes for the ornamental trade and permitting the export of some of these probably results in little or no reduction of the pressure on threatened fish species and communities, and therefore little conservation benefit. Sustainability of the trade can be assured through the breeding of commercially-important fish species, and incentives should be given to this industry to engage in culture (as opposed to capture). This has the added conservation benefit that techniques for culture will be developed, and a captive 'gene pool' maintained, permitting restocking in the event of sudden population crashes.

Conservation breeding. At present, with the exception of elephants, there is no 'captive' conservation breeding for any group of animals in Sri Lanka. Because of the difficulty of monitoring the populations of aquatic organisms, and because sudden and unexpected crashes

"Point endemics"—*top:* the Asoka Barb (*Puntius asoka*); *centre:* Pathirana's Danio (*Danio pathirana*); *bottom:* the Bandula Barb (*Puntius bandula*), species known only from highly restricted populations which, if locally extirpated, will become extinct. None of these occurs in a protected area. Management plans for them must involve local communities.

have been known to occur (e.g. *Macrognathus aral* and *Labeo lankae*), it is important that as many species as possible be maintained in the form of captive populations. This is both sustainable and viable through public aquariums such as that at the Dehiwala Zoo (though ideally, several independent stocks must be maintained).

Point endemics. Several species occur as 'point endemics' and are mostly restricted to small, localised 'pocket populations'. None of them at present occurs within a protected area. Because most of these areas are human inhabited, the declaration of protected status for their habitats is impractical. This is an area in which local communities could be engaged in conservation activity through explaining to them the uniqueness of a species that occurs only in their river or stream. This is turn could lead to sustainable eco-tourism and perhaps even 'natural' aquarium exhibits. As these habitats are usually 'worked' by ornamentals collectors even now, the local communities involved realise that there is economic value in their resource. However, the *uniqueness* and *vulnerability* of the resource have to be made clear to them. Species that could be considered for treatment by these means include *Puntius asoka* (Kitulgala, Deraniyagala); *P. srilankensis* and *Danio sp.* (Laggala-Pallegama); *P. bandula* (Galapitamada); *Danio pathirana* (Opatha); *Schismatogobius deraniyagalai* (Yatiyantota); *Sicyopus jonklaasi* and *Stiphodon martenstyni* (Atweltota); and *Sicyopterus griseus* (Yogama).

Pesticides. Finally, we must adopt the principle that all pesticides used in Sri Lanka should be tested 'in-country' for toxicity on non-target organisms. As aquatic ecosystems are the most vulnerable and sensitive of all habitats, the focus should be primarily on key indigenous aquatic organisms.

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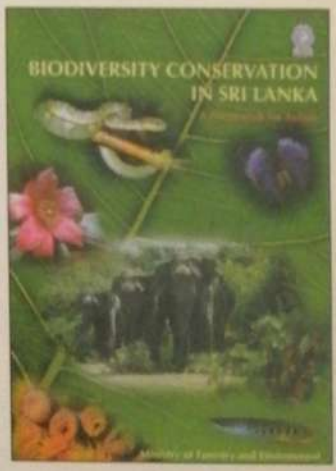

The Ministry of Forestry & Environment released policy document, *Biodiversity conservation in Sri Lanka: a framework for action* in December, 1999. The 126-page book spells out the Ministry's vision for the wise use and conservation of the nation's biological resources, in keeping with the Convention on Biological Diversity, to which Sri Lanka is a signatory. Approved by Cabinet in August, 1998, the *Framework* spells out a broad policy landscape for implementation by different government departments and institutions, through both existing and new legislation.

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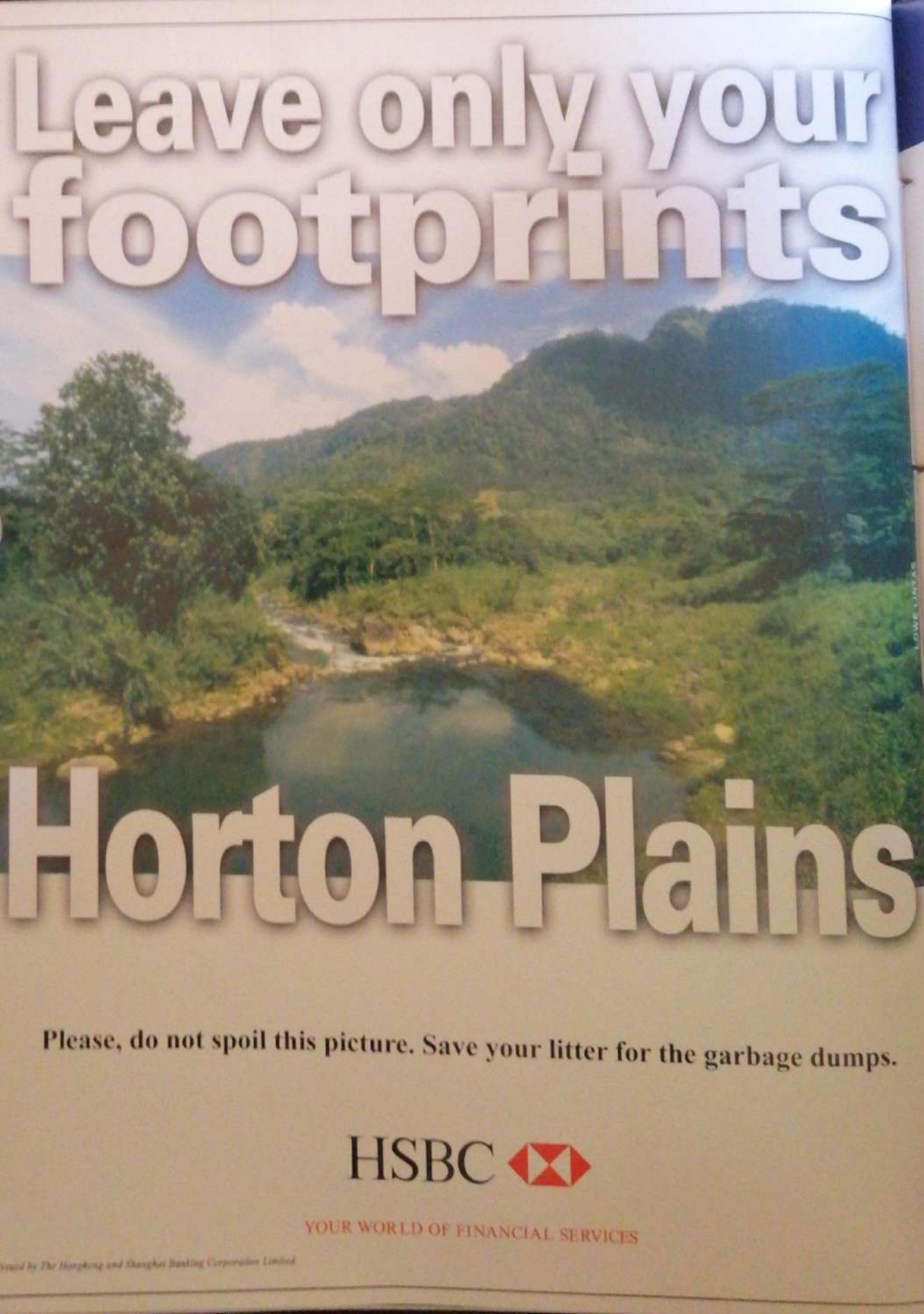

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Loris

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Editorial

Science in Crisis

For reasons I do not care to go into here, I belong to that small minority of people that did not see anything to celebrate in the advent of the new millennium. While I marvel at the fact that our race has had it in its power to self-destruct for upwards of half a century— and hasn't— human folly has continued to express itself in so great a diversity of ways that those of us who do take time to reflect shake our heads in despair. Contemporary prophets have ventured to predict the flavour of the century to come, but if the last century was anything to go by, their divinations will be no better than Nostradamus's.

End last year, newspapers and magazines the world over raced each to 'elect' their Man of the Century (the millennium itself being rather a tall order). We in Sri Lanka had only politicians from among whom to pick— a symptom of the intellectual bankruptcy that plagues our nation. But look back on the centuries past and it is easy to spot giants who enriched the human heritage almost beyond measure. Leonardo da Vinci in the 15th century; Galileo Galilei in the 16th; Isaac Newton in the 17th; Carl Linné in the 18th; Charles Darwin in the 19th; and Albert Einstein in the 20th. So great was their intellectual facility and insight into nature that they will be remembered so long as our species persists.

What then of these times in which we live? What developments can we expect that are likely to change our lives? Some *trends*, of course, are easy to see: in the coming years the marvels of medical science and genetic engineering will surely improve our lives; nanno-technology will present us with a new industrial revolution; and computers and the internet will revolutionise the way we handle information. But if you need proof that there is no such thing as 'the foreseeable future', look back on the first two decades of the 19th century.

The year 1900: Gregor Mendel discovers the laws of heredity and Max Planck the quantisation of atomic (in fact, all) energy. 1901: Karl Landsteiner discovers human blood groups. 1903: Orville and Wilber Wright invent the airplane. 1905: Albert Einstein publishes his theory of special relativity and its awful consequence, $E=mc^2$. 1909: Robert Millikan measures the charge of the electron. 1910: Pierre and Marie Curie isolate radium. 1912: Alfred Wegener announces continental drift. 1913: Niels Bohr models the atom. 1915: Manson Benedicks discovers the principle of the semiconductor diode. 1916: Einstein publishes his general theory of relativity, winning himself a place alongside Newton and Archimedes. 1919: Gugliemo Marconi invents radio communication.

Who, in 1899, could have predicted any of this? Science leads us not just into the unknown, but into the unexpected and the bizarre, like Einstein's assertion that gravity is nothing more than a curvature of space-time or Heisenberg's contention that all atomic events are based on probability and are not therefore deterministic.

It is no great shame that while all this frenetic activity went on in Europe and North America, we in Asia languished. It is all very well to blame our colonial oppressors, but let's face it, the chances are that colonialism stimulated rather than stifled scientific investigation in South Asia. The Boses and Ramanujan in India, and de Alwis, Kelaart and Deraniyagala in Sri Lanka, were all *products* of colonialism, not its victims. And as if to prove my contention, the post-colonial era has seen the virtual collapse of science in our country. Although we scientists are quick to trot out lame excuses about the 'lack of facilities' or 'shortage of funds', this is in fact utter bunkum. The sad fact is that we Sri Lankans lack a spirit of inquiry— the *subversive* mentality that good science demands. Send us abroad, and we excel. Stay home, and we seem content merely to eat lotuses.

As if this were not enough, in 1956 we dealt scientific education a death-blow by striking English from the schools curriculum in the belief that it would level the playing field for the masses. Now, four decades later, we know it did nothing of the kind: it only served to disenfranchise two whole generations of youth, leading to two bloody revolts. In the mean time, we English-speakers have held grimly onto our bastion of power and affluence— the private sector— from the higher ranks of which the cream of our country's youth are, by a cruel caprice of political folly, excluded. Thanks to English, my sons will vie for jobs in Colombo's blue chip companies against only 1% of their potential rivals: the balance 99% they would otherwise have had to compete with, many of whom are no doubt far more able, were crippled in childhood by being denied access to English.

What hope then, for Science? Cut off from the world's scientific literature and the internet, and unable to communicate with peers overseas, our future scientists are being born into the Information Age sans the one prerequisite that Age demands— an international language. What a tragedy! And without good science, what hope is there for biodiversity conservation?

In Sri Lanka, research biology is barely breathing. Only a handful of papers make it into the better international peer-reviewed journals each year, despite many of these journals visibly lowering the bar for 'Third World' scientists in a condescending endeavour to appear fair. Even at a lower level, demand for quality research far exceeds supply. We still do not know to the nearest ±50%

of error how many endemic bird species there are in this island, or how many frog species have become extinct in the recent past, or how many elephants there are. To me, this last lacuna says it all: here is the second-largest land-mammal on the planet and we do not know its numbers *even to the nearest thousand* in this tiny island of ours!

Sadly, our culture resists science. As a research scientist myself, I know from experience the suspicion and sheer animus that scientific inquiry generates not only among otherwise civil members of the public, but in the very government institutions whose job it is to stimulate science. At a time when only 4% of our rain forests remain, and we know that species— *vertebrate* species— are becoming extinct all around us, it seems bizarre that even many conservationists do not recognise the urgent need for research. Quite apart from better knowledge of our fauna and flora (let's face it, almost all our present knowledge was the work of the British and not ourselves), we need to monitor endangered species and undertake active conservation programmes. The schedules of the *Fauna & Flora Protection Ordinance* name upwards of 600 threatened species: yet there isn't a monitoring or conservation programme in place for even one of them. For the most part, recent research in this field has consisted merely of picking up old books left us by our colonial masters and re-hashing their contents. The spirit of exploration, it seems, is dead. The pioneers worked indefatigably without computers or, for the most part, even electricity: Hermann, Loten, Kelaart, Layard, Legge, Trimen, Thwaites, Green, Duncker, the Sarasins, Wall, Woodhouse, Deraniyagala and Kirtisinghe. Then, in the 1950s, with their demise, and their work barely half complete, everything stopped. *The spirit of exploration died.*

Now, sadly, species are disappearing before they can be described or even photographed, so future generations could at least know what *used* to live on this island before we destroyed its natural heritage. As at the time I write, there is not a single *ex situ* conservation programme for any species in Sri Lanka. Nor do we have a management programme for the hundreds of alien plant and animal species that are invading our ecosystems. Nor do we know, to the nearest ±1,000, how many species of moths and beetles inhabit this island. Many of us, members of the Wildlife and Nature Protection Society, have good intentions. But good intentions alone will not save biodiversity. We need active research and *scientific* conservation programmes.

Sadly, nothing we say or do now is likely to change anything. For many species—indeed, for many habitats—it is already too late. Even for those that could otherwise have a fighting chance, the combined weight of human folly is perhaps too great to permit the few scientists who have the will, the vision and the wit to affect events (and they do exist), to do anything about it. As for myself, I am not sanguine. I have long since despaired of Sri Lanka finding the strength of character to rise above mediocrity and soar to the wonderful heights the human spirit is capable of reaching. Sadly, it is not for want of intellect that we will fail, for we are as clever as they come. It seems our divisive and inward-looking society lacks the will to reach for excellence, not just in this, but in any field. A sad indictment, I know. In the field of biodiversity conservation, we have not just missed the bus— we have, for good measure, removed the steering wheel, wrecked the engine and deflated the tyres.

There is little point in pinning the blame on politicians, for they are but a reflection of ourselves and the society we have created. The need of the hour is to stop fooling ourselves that there is hope. There isn't. Not unless we pull ourselves up by our bootstraps, and come to terms with the fact that no one owes us a living and that only we can help ourselves. We have to take painful decisions to ensure a better tomorrow for those coming after us. Otherwise, the 40 million Sri Lankans who will inhabit this island mid-century (if we keep breeding at the reckless pace we are) will curse us for it.

No one will be happier than I should the future prove me wrong—but you won't find me holding my breath, waiting for that New Tomorrow to dawn.

ANNOUCEMENT

The Paul Hermann Database
The Natural History Museum, London

Paul Hermann (1646–95), a Dutch physician, made the first scientific collection of Sri Lankan plants, mainly from around Colombo, while in the island between 1672 and 1677. Hermann's herbarium became the basis for his own *Musaeun Zeylanicum* (1717) and Johannes Burman's *Thesaurus Zeylanicus* (1737), which works are the foundation on which Sri Lankan taxonomic botany rests.

The herbarium was lost in 1711, only to reappear almost miraculously in 1744, when August Günther, Denmark's Apothecary Royal, sent Carolus Linnaeus the four-volumes of pressed specimens and *ca.* 400 drawings, which became the basis for his *Flora Zeylanica* (1747). The greater part of the herbarium is now in the library of the Natural History Museum, London.

The herbarium, and details of Hermann's life and work may now be viewed and downloaded free of charge on the internet, from **http://www.nhm.ac.uk/botany/databases/hermann/**

Nudibranchs: Snails without Homes

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Many colourful and oddly shaped animals are seen on the reefs and sand when diving. As there are so few illustrated guides available that describe marine animals and plants, we are very often unable to identify what we have seen. A further difficulty is that those guides that are available are likely to cover areas other than the Indian Ocean. I had always found the group known commonly as sea slugs or nudibranchs fascinating, because of their striking colours and the variety of form. I therefore, decided to observe, photograph and learn more about them during the west-coast diving season in the year 2000.

Nudibranchs are molluscs, a phylum that includes the shelled gastropod snails, the bivalved clams, oysters and mussels, and—believe it or not—squid and octopus (see the box for a simplified classification.) An obvious feature of the animals that we call 'snails' is the shell that they carry about with them and into which they retreat when danger threatens. Some even have a 'front door' (operculum) that can be shut to keep out marauders, for instance crabs. The bivalves have paired shells. Many of these animals live permanently attached to solid substrates while others move about and may even burrow into sand and mud; some even bore their way into wood and limestone. Nudibranchs are molluscs without shells, rivalling reef fishes in their beautiful and striking patterns and colours.

These animals are grouped into the subclass Opisthobranchia together with related forms that share a common anatomical arrangement of the gut and mantle cavity that differs from that possessed by the gastropods in the subclass Prosobranchia. The shell is often reduced: in the bubble shells, it is thin and fragile with a large aperture, into which the animal is unable to retreat fully. The shells of *Bulla ampulla* (Fig. 1) can be found washed up on beaches. The shell of the Paper Bubble *Hydatina physis* (Fig. 2) is too fragile to withstand waves. The shell of the Little Bubble *Haminoea* sp. (Fig. 3) is covered in life by its beautiful light green mantle with pink markings. In the most advanced opisthobranchs, like *Philinopsis cyanea* (Fig. 4), the shell is lacking. It can easily be mistaken for a nudibranch. It is a voracious carnivore that preys on nudibranchs, swallowing them whole in a matter of seconds. There are other animals that may be mistaken for nudibranchs, like the flatworms (Fig. 5). Flatworms are very flattened, like oval carpets, with two folds that stick up like tentacles at the head end. The animal in the photograph is bunched up over an irregularity on the rock.

Nudibranchs are placed in an order different from that of the animals described above. As their name suggests, internal gills are absent, but external (naked) respiratory structures are present in many. They are found on the seabed in rocky areas and sometimes on sand near rocks or amongst seaweeds. They feed on a variety of invertebrates including worms, bryozoans, sponges, coelenterates, crustaceans and molluscs. They are soft-bodied animals and, unlike their relatives the snails, have no obvious form of defence. However, like other animals that are sedentary (e.g. sponges and sea squirts) they produce a range of chemical substances to protect themselves from predators and, in addition to the chemicals they produce themselves, substances extracted from their prey are stored in their bodies and used for the nudibranchs' own defence. This form of "chemical warfare" practiced by nudibranchs has drawn the attention of chemists looking for new substances with which to fight cancer, infections, pain and a host of other diseases. Sri Lanka's nudibranchs are being investigated as well, in Sri Lanka. Tubercular nudibranchs go a step further: they hijack solid weapons, not just chemicals (see below).

Nudibranchs show bilateral symmetry externally, being elongated animals with a resemblance to garden slugs. The order nudibranchia is divided into four suborders on the basis of general appearance. The Harlequin nudibranchs (suborder Doridacea, Figs. 6–26) are the most commonly encountered in our waters. The 'body' of the animal and its head is hidden to varying degrees by an expanded lobe on top called the mantle. The animal walks by means of an elongated foot, like all snails, and the mouth is surrounded by one or more pairs of oral tentacles. What makes them special however, is the tuft of feathery gills on the rear part of the back surrounding the anus and the pair of specialised tentacles called rhinophores in front. One group of doridaceans however, (the phyllidiids, see Figs. 17–26) does not possess gills on the back, but instead they are present in two rows on either side of the body below the mantle, which is itself characteristically lumpy (tuberculated).

Tubercular nudibranchs (suborder Aolidacea, Fig. 27) feed mostly on coelenterates: animals that use stinging cells called nematocysts to capture prey. (Jellyfish, sea anemones and corals are all coelenterates.) They are able

A simplified classification of the phylum MOLLUSCA

Class:	GASTROPODA		Snails
Subclass:	PROSOBRANCHIA		Three (or four) orders containing all the familiar marine snails.
	OPISTHOBRANCHIA		There are nine orders. The more familiar ones are listed below.
Order:		CEPHALASPIDEA	A primitive order, with and without shells. Most are predators.
Family:			Hydatinidae — Paper bubble shells Bullidae — Bubble shells Atyidae — Little bubble shells Aglajidae — (lack shell)
		ANASPIDEA	Sea hares. Sea slugs with small internal shells. Herbivores. Some weigh more than 2kg and exceed 60cm in length.
		NOTASPIDEA	Side-gilled sea slugs. Feed on sponges.
		SACCOGLOSSA	Highly specialised herbivores, with or without external or internal shells
		NUDIBRANCHIA	Nudibranchs and sea slugs. Lack shells. Feed on various attached invertebrates. Four suborders.
Subclass:	PULMONATA		Air breathing forms. Mostly terrestrial. Coffee bean shells and False limpets are mangrove and seashore forms.
Class	BIVALVIA		Clams, mussels, oysters and other molluscs with paired shells
	CEPHALOPODA		Squid, cuttlefish and octopuses.

to ingest the nematocysts without firing them, transport them to the numerous finger-like appendages (cerata) that cover their bodies and use them for defence against predators. Tubercular nudibranchs usually have one pair of tentacles greatly enlarged.

Nudibranchs are colourful and hardy and are collected for the ornamental marine fish trade. Some nudibranchs belonging to the two suborders described above collected on the west-coast reefs, are illustrated in the accompanying photographs. The animals were either collected personally by the author or obtained from other divers. Wherever possible underwater colour, when it differs from that at the surface, is noted. Some of the animals were observed in an aquarium and it was seen that particular species had characteristic movements, for example, of the mantle and gills; these are described, but it must be remembered that these observations are based on single specimens.

The photographs are all of live animals taken in an artificial environment. Identification was done by reference to published colour guides that are listed under references. Where an unequivocal match was not found, a genus is suggested based on resemblance to identified specimens. The common names provided are those taken from the literature (usually based on the Latin specific name), names used by divers in Sri Lanka or coined by the author based on some obvious physical feature. Names have been coined for all the unidentified animals to aid reference. Habitat, location and size information relates to the subjects photographed and/or examined.

Little is known about the distribution and abundance of Sri Lanka's marine invertebrates. Study in this field is hampered by a lack of literature with which to identify animals. It is hoped that this collection of photographs

will be a step in filling a void and that it will be of use to underwater naturalists as a field guide. It is also hoped that this collection of photographs and names will encourage those involved in the trade in these animals to keep detailed records of the species collected, exported etc., as an input towards sustainable management of the harvesting of these species.

Acknowledgements

I wish to thank Darrel Fryer for specimens; Arjan Rajasuriya for specimens and literature; and Rohan Pethiyagoda for giving me access to his collection of Fredric Kelaart material, from which *Ch. fidelis* was identified. A great many years ago Nileendra Senanayake first drew my attention to the variety of nudibranchs on the shallow Colombo reefs: I thank him for kindling an interest in them.

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Figure 1. *Bulla ampulla* 'Bubble shell': CEPHALASPIDEA, BULLIDAE; Pasekudah, Colombo. Sand bottoms.

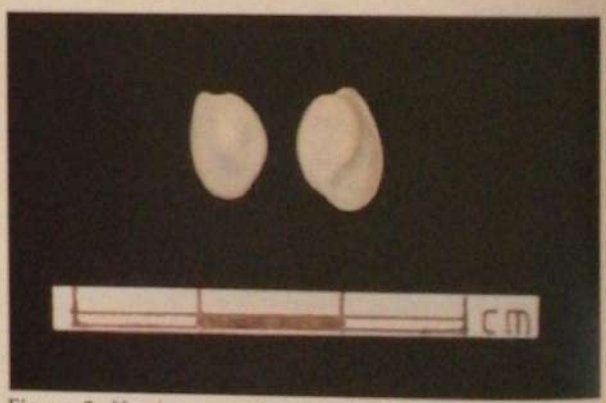

Figure 3. *Haminoea* sp. 'Little bubble shell': CEPHALASPIDEA, ATYIDAE; Pigeon Islands, Nilaveli. Tide pool.

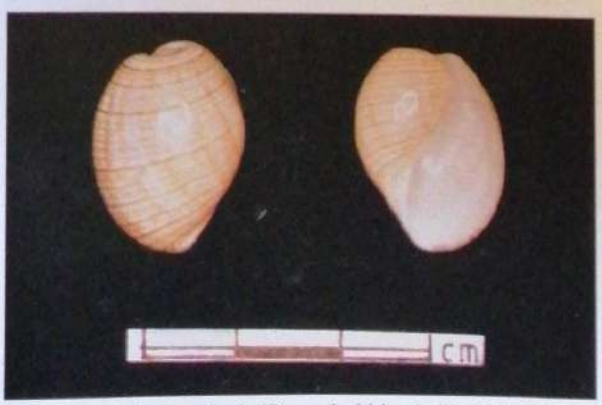

Figure 2. *Hydatina physis* 'Paper bubble shell': CEPHALASPIDEA, HYDATINIDAE; Barberyn reef, Beruwela. Tide pool.

Figure 4. *Philinopsis cyanea*: CEPHALASPIDEA, AGLAJIDAE; Moratuwa, Itipandama reef. Sand bottom, 10m.

Figure 5. Unidentified flatworm, phylum Platyhelminthes. ? *Pseudoceros* sp.: POLYCLADIDA, PSEUDOCEROTIDAE; Moratuwa, Itipandama reef. On rocks, 10m.

Figure 6. *Chromodoris tennentana* 'Tennent chromodoris': CHROMODORIDIDAE; Wellawatte, Degal Meda reef; 22m, on rocks. 50mm.

The colour underwater is cream with black spots and a dark mantle edge.

Figure 7. *Chromodoris decora* 'Decorated chromodoris': CHROMODORIDIDAE; Ratmalana Deep reef (Bamba Dahaya); 20m, on rocks. 20mm.

Feeds on sponges.

Nudibranchs of the family chromodoridiidae are very soft and jelly-like, collapsing out of water. All have a pair of rhinophores at the head end and a branching Christmas tree-like set of gills behind. The mouth and its oral tentacles are hidden by the mantle; the rearmost portion of the foot shows behind the mantle in some species.

Figure 8. *Chromodoris fidelis* 'Girdled nudibranch': CHROMODORIDIDAE; Moratuwa, Itipandama reef; 10m, on sandy, rock strewn bottom. 25mm.

Figure 9. *Chromodoris* sp. 1 'Three-lined chromodoris': CHROMODORIDIDAE; Lunawa, Bodhigala; 21m, on rock. 40mm.

This unidentified chromodoris has a yellow-blue-white mantle border clearly seen underwater, the spots showing up pale blue on a pale honey background.

The underside of the mantle and the upper side of the foot are covered with small purple spots with white edges; the mantle edge underneath is lilac. The sole of the foot is an unmarked cream.

When resting, the animal flattens itself and spreads the mantle out in a wide oval. When moving, the whole mantle is periodically flipped up and down.

Figure 10. *Glossodoris atromarginata* 'Common nudibranch': CHROMODORIDIDAE; Colombo reefs. Collection data not available. 60mm.

This nudibranch is the one seen most often on Colombo's shallow in-shore reefs. The deeply ruffled narrow mantle with a dark edge is distinctive. Described in older books as *Casella atromarginata*.

Feeds on sponges.

Figure 11. *Risbecia pulchella* 'Beautiful risbecia': CHROMODORIDIDAE; Colombo reefs. Collection data not available. 60mm.

This animal has a mantle that is narrow behind showing the yellow-spotted foot below, with a characteristic expanded head-lobe.

Figures 12, 13. ? *Risbecia* sp. 1, 'Red-lipped nudibranch': CHROMODORIDIDAE; Moratuwa, Itipandama reef; 10m, on sandy, rock strewn bottom. 20mm.

The underside of the mantle is the same orange-red as the rhinophores and gills. The mantle is expanded into a head-lobe that it periodically flips up and down flashing the red underside, as seen in Fig. 13. The gills are in constant rapid quivering movement; a characteristic displayed only by this nudibranch.

Figure 14. *Hypselodoris kanga* 'Chequered nudibranch': CHROMODORIDIDAE; Moratuwa, Itipandama reef; 10m, on sandy, rock strewn bottom. 30mm.

The gills are held stiffly erect in a tulip shape; the yellow spots on their outer faces are characteristic of this species.

The animals illustrated in Figures 15 and 16 belong to two different families. They resemble the chromodorids in possessing rhinophores and branchiae (gills) around the anal opening.

Figure 15. *Jorunna funebris* 'Peppermint slug, Funeral jorunna': DORIDIDAE; Colombo reefs; 1m to 10m. 50mm.

These are thick and rather cylindrical animals with mantles that cover the foot completely. They are usually found in the vicinity of a blue encrusting sponge (*Xestospongia* sp.) common on the Colombo reefs, that they feed on.

Figure 16. *Tambyja affinis* 'Bordered tambyja': POLYCERIDAE; Ratgama, Godagala; 15m, on rock. 55mm.

This nudibranch was found on a rocky cliff exposed to strong currents from the open sea a few kilometres off the coast. It has a rounded body with a distinct hump in the middle and no mantle expansion. There is a pair of thick black oral tentacles that are very prominent. These nudibranchs feed on bryozoans (moss animals).

Nudibranchs of the family phyllidiidae have thick, warty mantles that are oval in shape, firm and rubbery to touch and which cover the foot all round. There is a pair of rhinophores at the anterior (head) end. The gills are hidden under the mantle on either side of the foot. When picked up and taken out of water they tend to curl up slightly, but otherwise hold their shape, unlike the soft and jelly-like chromodorids that collapse out of water.

Figure 17. *Phyllidia varicosa* 'Varicose phyllidia': PHYLLIDIIDAE; Colombo reefs; collection data not recorded. 70mm.

The animals seen most often on the Colombo reefs have white ridges with yellow spots on a black background. Those illustrated in the reference books under the name *varicosa* have blue ridges with yellow spots – like the animal in figure 18. (Viewed from the right side.)

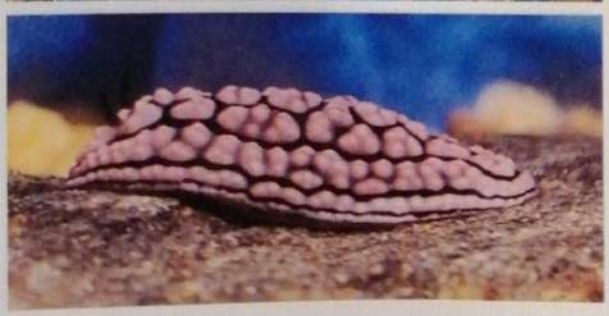

Figure 19 (above) (viewed from above, the head to the right) and **Figure 20** (below) (viewed from the left side), *Phyllidia* cf. *nobilis* 'Noble phyllidia': Wellawatte, Kinross first reef; 2–3m, on rock. 40mm.

Figure 18. *Phyllidia varicosa* 'Varicose phyllidia': PHYLLIDIIDAE; Blue form: Moratuwa, Itipandama rocks; 10m, on sandy rocky bottom. 40mm.

The only blue coloured *varicosa* seen by the author. The colour is a deeper blue underwater. (Viewed from above; the head is to the left.)

Figure 21. *Phyllidia* sp. 1 'Fin-back phyllidia': PHYLLIDIIDAE; Ratmalana Deep reef (Bamba dahaya); 20m, on rock. 25mm.

The dorsal surface of this phyllid is covered in rows of tuberculated ridges that are thin and fin-like. White on black underwater. May be the same animal as Fig. 26.

Black phyllidias with groups of white nodules (tubercles) arranged in various patterns, as seen underwater, are commonly found on reefs off Colombo. At the surface, the white tubercles are seen to be pink (like the animal in Figures 19 and 20), grey or white.

The reference books are full of phyllidias, many unidentified to species level, differing in details of tubercle arrangement and colour. This was the only specimen for which a reasonable match was found, but not convincing enough for definite identification. The tubercles appear fuzzy in the photo because the groups of pigmented lumps are covered by a layer of translucent tissue. A 'keyhole' shaped grouping of tubercles extends forwards from the rhinophores (to the right in Fig. 19)— an arrangement seen in many of the photos that follow.

Figure 22. ? *Phyllidia* sp. 2 'Sargent phyllidia': PHYLLIDIIDAE; Ratmalana Deep reef (Bamba Dahaya); 20m, on rock. 25mm.

The common name is derived from the three black stripes on the white background. This animal does not possess lumpy tubercles but only small papillae arranged in two rows down the back and scattered around the mantle periphery. It may not even be a *Phyllidia* but is named so as nothing resembling it has been located in the reference books. The rhinophores are white and can be seen on the left.

Figure 23. *Phyllidia* sp. 3 'Gold-spotted phyllidia': PHYLLIDIIDAE; Moratuwa, Itipandama rocks; depth 10m, on sandy rock strewn bottom. 45mm.

This striking animal was surprisingly not located in any of the reference books. At rest it flattens itself and spreads the mantle into the shape of a wide oval, as seen in the photo. It is more a lemon yellow underwater.

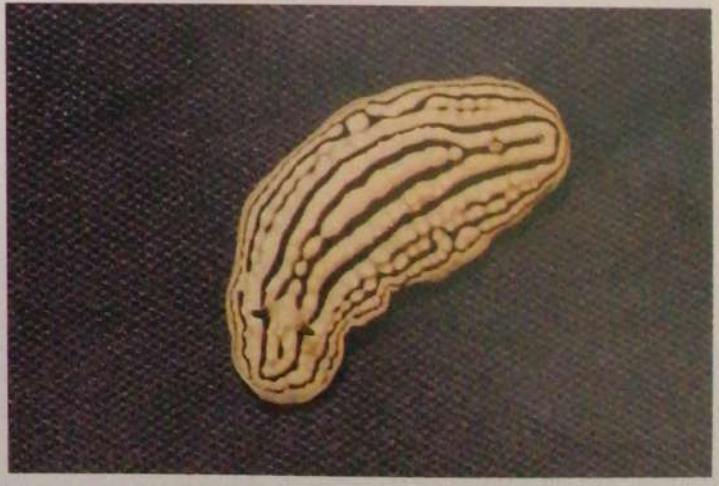

Figure 24. *Phyllidia* sp. 4 'Concentric phyllidia': PHYLLIDIIDAE; Wellawatte, Degal Meda reef; 20m, on rocks. 30mm.

Very striking concentric white tuberculated ridges that are rather low and rounded.

Figure 25. *Phyllidia* sp. 5 'Radial phyllidia': PHYLLIDIIDAE; Wellawatte, Degal Meda reef; 20m, on rocks. 40mm.

The clusters of tubercles are white underwater and grey at the surface. They are pointed and grouped in short radially aligned ridges and clusters.

Figure 26. *Phyllidia* sp. 6 'Fin-back phyllidia': PHYLLIDIIDAE; Moratuwa, Itipandama reef; depth 10m, on sandy, rock strewn bottom. 30mm.

Similar to *Phyllidia* sp. 1 (Fig. 21) but differs in the lower and wider ridges where only the midline one is discontinuous, the differently shaped 'keyhole' and the three-spot pattern posterior to the anus. The significance of these variations is not known and these animals may turn out to be the same species.

Figure 27. *Pteraeolidia ianthina* 'Railroad nudibranch, Violet pteraeolidia': GLAUCIDAE; Wellawatte, sand inshore of the Palagala reef; 13m. 80mm.

This is a tuberculate nudibranch of the sub-order Aolidacea. Situated along the back of the worm-like body are 17 pairs of fan-like structures, the cerata which are characteristic of this sub-order. The cerata communicate with the digestive system of the animal and at their summits are special structures (cnidosacs) to store the nematocysts obtained from their hydroid prey. These are used for the animal's defence. Never handle these animals with bare hands, as they are capable of causing irritating stings on account of these (borrowed) nematocysts.

The colour underwater was brown with a few spots of green-blue iridescence, as it was an overcast day. In bright sunlight, the animals glow with a brilliant mauve iridescence with bluish green highlights. The colour is said to vary from pale to dark purple with brown and green not being uncommon. All the animals seen in Sri Lanka have been brown.

Lizards of Mount Gannoruwa

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Gannoruwa Forest, located in Kandy District, lies approximately within 07°15'–07°17' N and 80°35'–80°36' E. The highest elevation is 755 m (see also Fig.1). The mountain is located *ca.* 2 km north of Peradeniya University, on the north side of a sharp bend in the Mahaweli River. The mountain forms a ridge 5.6 km long, bearing 320°–140° (NW–SE). Vegetation on the mountain comprises lowland evergreen mixed forest, forest plantations and grasslands. Mean daily temperature vary between 23.1°C (January) and 26.0°C (April), annual rainfall being *ca.* 2,130 mm, evenly distributed throughout the year.

I made frequent visits to the study site since 1996, identifying the species observed from the available literature (Deraniyagala, 1953; Greer, 1991; Smith, 1935; Taylor, 1953). The names used here follow Das (1994), for garden lizards and skinks; and Manamendra - Arachchi (1997) for geckoes. *Cnemaspis* specimens were identified alive using a stereomicroscope, and released to the same locality.

This study was designed to evaluate the lizard diversity of this small forest reserve with the intention of providing base-line information for conservation purposes.

Cnemaspis scalpensis.

Cnemaspis kandianus.

Checklist of Species observed in Gannoruwa
(*N.b.*– * endemic species)

Garden Lizards (Agamidae)

Calotes calotes (Linnaeus, 1758), usually found on trees on the forest margin, not far above the ground. Common.

Calotes versicolor (Daudin, 1802), a ground-dwelling synanthropic species. Common.

**Calotes liolepis* Boulenger, 1885. An arboreal lizard, rarely found on ground. Compared to *C. calotes* and *C. versicolor* it is a slow moving species, inhabiting dense forested areas including mahogany (*Sweitania macrophylla*) plantation forest. It was also observed on *Gliricidia sepium* trees in small scale pepper (*Piper* sp.) plantations close to the forest. Common.

**Lyriocephalus scutatus* (Linnaeus, 1758), a slow-moving, sub-arboreal species was observed mainly on tree trunks (16–200 cm gbh), juveniles being restricted to the forest floor. Although largely restricted to shaded habitats within less-disturbed forest, this species was also observed found to occur in a cocoa (*Theobroma cacao*) plantation. Common.

**Otocrytptis weigmanni* Wagler, 1830. A ground-dwelling lizard sometimes found on trees up to about 1 m above ground level. It is commonly found throughout the forest in shady habitats including home gardens. Common.

Geckoes (Gekkonidae)

Cnemaspis kandianus (Kelaart, 1852). This diurnal and crepuscular gecko was observed on rock faces, tree trunks and occasionally under stones and decaying logs. It occurs throughout the forest and also in home gardens. Common.

**Cnemaspis scalpensis* (Ferguson, 1877). A diurnal and crepuscular species, found mainly on tree trunks, usually seen in pairs. Common.

Cnemaspis tropidogaster (Boulenger, 1885). Diurnal and crepuscular, a comparatively small gecko, which inhabits tree trunks. Rare.

**Geckollea triedrus* (Gunther, 1864). A terrestrial, nocturnal species that spends the daytime hiding under

rocks or in rock crevices (a female with two eggs was observed 1 m above the ground in a rock crevice; another mature female observed in daytime, hiding in a hole in the ground). It seems most active between 1900–200 h, when it is seen on leaf litter and sometimes on rock faces and tree buttresses. Uncommon.

**Cyrtodactylus frenatus* Gunther, 1864. Nocturnal and arboreal, this comparatively large gecko is usually encountered both on rock faces and tree trunks (100–300 cm gbh). Though more often seen on rocks, these lizards were observed on trees up to 10 m high. It was more frequently met with at higher elevations within the site.

**Hemidactylus brooki pavimaculatus* Deraniyagala, 1953. A very common species, found around human settlements and rarely in the forest. Common.

** Hemidactylus depresus* Gray, 1842. A nocturnal gecko, hiding in daytime in rock crevices or tree barks. Common.

Hemidactylus frenatus Schlegel, 1836. This lizard inhabits trees and is abundant also in human settlements. Common.

Gehyra mutilata (Weigmann, 1835). Encountered in human settlements; rarely seen in the forest. Common.

Hemiphyllodactylus typus Bleeker,1860. A slow-moving and slender gecko, mainly found around human settlements, especially in crevices in ceilings. Rare.

Skinks (Scincidae)

**Lankascincus taylori* Greer, 1991. A small terrestrial skink found under decaying logs and rocks, and on leaf litter. Common.

**Mabuya carinata lankae* Deraniyagala, 1953. A fast-moving, large skink frequently found both on rock faces and on leaf litter; it is mostly abundant in synanthropic habitats. Common.

Mabuya macularius macularius (Blyth, 1853) Seen mainly on rock faces and in grass in the open areas within the forest. Uncommon.

**Nessia monodactylus* (Gray, 1839). A fossorial species found in shady, densely forested areas. It was found under moist rocks, decaying logs and leaves within lose soil. Found also in synanthropic habitats. Uncommon.

Discussion

Nineteen of 67 lizard species recorded from Sri Lanka (Das, 1994; Manamendra-Arachchi, 1997; Pethiyagoda & Manamendra-Arachchi, 1998) occur in Gannoruwa, nine of them endemic to Sri Lanka.

Of twenty species of geckoes recoded from the island (Deraniyagala, 1953; Manamendra- Arachchi, 1997; Taylor, 1953), ten were recorded from the study area, five of them being endemic to Sri Lanka. All the geckoes recorded from the wet zone, except the *Lepidodactylus lugubris*, occur here.

Lankascincus taylori is a widely distributed endemic skink. Greer (1991) quotes Taylor (1950:497) as stating that the holotype of *Lankascincus deignani* was collected from Mount Gannoruwa, but casts doubt to the locality "Gangoruwa." However, the record is cited as "Peradeniya, Kandy District, Ceylon." I have examined 22 mature specimens of *Lankascincus* from Gannoruwa and did not find any examples of *L. deignani*.

Deforestation and recent fires have resulted in significant soil erosion that would have impacted on the habitats of both terrestrial and fossorial species. Diminishing undergrowth has also contributed to soil erosion and further degradation of habitat. The future of the reptile fauna of Gannoruwa is in doubt, especially given that "geographic distribution patterns have changed rather drastically because of man's influence. These damages have been extremely rapid when compared with evolutionary process." (Erdlen, 1984).

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Nessia monodactylus.

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An Australian Wader, *Himantopus himantopus leucocephalus*, in Sri Lanka

Rex I. De Silva*

* 31, Dampe, Madapatha, Piliyandala.

The Australian Stilt, *Himantopus himantopus leucocephalus*, is a wader (shorebird) with breeding populations in Australia, New Zealand and Papua New Guinea. It migrates to the Philippines, Borneo, Indonesia and also occurs as a vagrant in Japan and elsewhere. It is considered by some authors to be a species in its own right, whereas others treat it as a sub-species of *Himantopus h. himantopus*, the race commonly encountered in Sri Lanka. The two subspecies are similar in general appearance, except that *H. h. leucocephalus* has on its hindneck black feathers which form a prominent, elongated, roughly-triangular marking, starting at (or near) the nape and extending downwards to the base of the neck (Fig. 1). The black feathers form a vertical median ridge which is usually visible at close range under field conditions (De Silva 1996a; 1996b; 1999a). The head of adult *H. h. leucocephalus* is always pure white. It should be noted that a few individuals of the nominate subspecies may exhibit dark neck markings but, when present, these are easily distinguishable from *H. h. leucocephalus* (see below).

Australian Stilts were first recorded from Sri Lanka by the writer (De Silva, 1996a): this is the first record of any Australian land-bird from the island. The ornithological literature however, records that an Australian Wader, the Black-fronted Dotterel, *Elseyornis melanops*, was collected in India in the nineteenth century (Ali & Ripley 1983; Hayman *et al.*, 1987; Inskipp *et al.*, 1996; Ripley 1982).

It is also now known that *H. h. leucocephalus* had previously been collected in the subcontinent, although this fact was not recorded in the literature (see below).

Photographs of a stilt with black hindneck markings were taken at Palatupana in February 1999 by Dr. H. I. E.

Katugaha (Figure 1). Based on studies made by me in Australia (in museums, captive collections and the field: De Silva, 1999a), I identified the bird as *H. h. leucocephalus*. Nevertheless, it seems necessary to eliminate the possibility that the bird in the photographs was possibly an aberrant *H. h. himantopus* or a hybrid. Hayman *et al.* (1987) state that "Head and neck pattern of [the] nominate race is variable, but never resembles that of other races". Steinheimer (*in litt.*) also concurs with this insofar as the nominate and Australian forms are concerned (see below). The bird photographed by Dr. Katugaha (Fig. 1) has a nlackish-brown back, which character is consistent with females of *H. h. leucocephalus* (Hayman *et al.*, 1987; Sonobe and Usui, 1993); I referred the photographs to Danny Rogers and David W. Eades of the Royal Australian Ornithologists' Union (RAOU) for an opinion, and Rogers (*in litt.*), in consultation with Eades, commented as follows—

> "... In Australia, the upperparts of *leucocephalus* look slightly browner in adult females than in adult males, and in both sexes the upperparts develop a slightly browner tinge with wear. By December most of our adults are slightly worn and brownish".

In order to further verify identification of the bird, I forwarded copies of Dr. Katugaha's photographs to The Natural History Museum (NHM) at Tring (U.K.), a leading repository of avian information. Frank Steinheimer, Curator of the Ornithology Department,

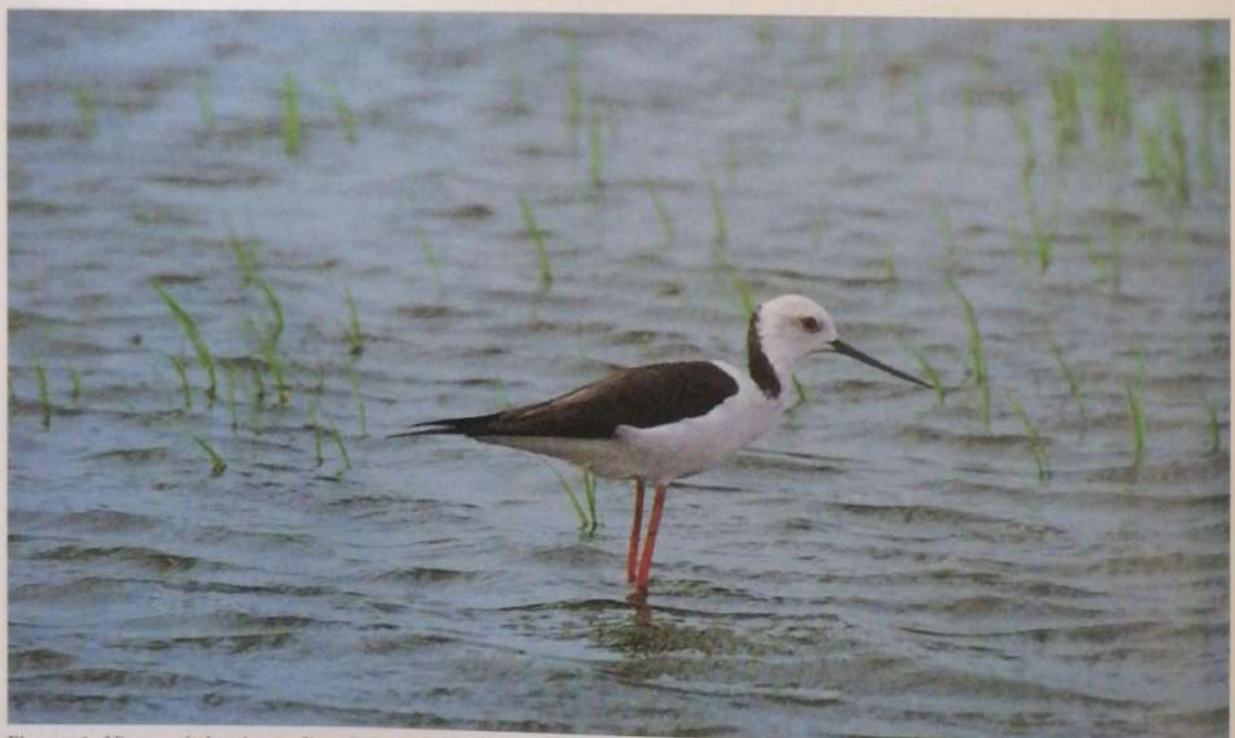

Figure 1. Views of the Australian Stilt, *Himantopus himantopus leucocephalus*, at Palatupana: February, 1999 [courtesy Dr. H. I. E. Katugaha].

after comparing them with specimens of both the nominate and Australian forms, identified the bird as an Australian Stilt, *H. h. leucocephalus*. Steinheimer (*in litt.*) pointed out that when *H. h. himantopus* has black on the head or neck, the black extends up to or above the eyes. He further noted that even when the black area thins out in moult, it never takes the appearance of a well-defined black hindneck and pure white head. Steinheimer adds that the NHM has in its collection a specimen of *H. h. leucocephalus* from an unspecified location in the Indian sub-continent (De Silva, 1999b).

Copies of Dr. Katugaha's photographs were also sent to Peter Dann, Head of Research, Phillip Island Nature Park (Australia). Dann identified the bird as an "Australian Pied Stilt" (i.e., *H. h. leucocephalus*).

(It is perhaps relevant to point out that Rogers, *in litt.*, suggests the possibility that *H. h. leucocephalus* could arrive in Sri Lanka from Indonesia).

The occurrence of *H. h. leucocephalus* in Sri Lanka is of interest as it is the only Australian land bird to be recorded in this island, and one of very few Australian birds to be recorded from the sub-continent.

Acknowledgements

Dr. H. I. E. Katugaha sent details of his observations, provided several sets of his excellent photographs and offered much encouragement. Dr. Frank Steinheimer confirmed identification of the bird. Drs. Danny Rogers and David. W. Eades supplied much useful information. Dr. Peter Dann gave his opinion on the bird's identity. Richard Grimmett drew my attention to the record of *Elseyornis melanops* from India. I thank all these colleagues for their assistance and encouragement.

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The Captive Bird

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The tree is bathed in a golden light,
Its leaves sway away gently morn and night
I dream, I sigh, I yearn to be
Resting upon that lovely tree.

I see my kindred rise up high,
I see them guide their young to fly,
They flit, they glide, flying as they will,
Not still like me bend this grille.

I see them build their nest, each pair,
I see them tend their babes with care,
Bleeds then my heart with a glow at stuns,
Unshed tears for my unborn sons.

At dawn as life resumes its crawl,
The will to live within my palls,
I sit and ponder on my plight,
'Tis living death, this blighted life.

For cramped, confined, condemned I be
To a desolate life destined for me,
A master's love, his speech so soft
Is dross beside my freedom lost.

My heart it thrills to sight my clan,
To spread my wings to widest span,
To soar up high in a clear blue sky,
For just a while before I die.

A joyous song I shall then sing
Of bounteous nature's wondrous things
Mourn I shan't for my crippled wings,
For thoughtless humans and their sins.

Marine Turtles: Imperilled Ancient Ocean Wanderers

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Historical Background to Present-day Species

Marine turtles are ancient denizens of the world's oceans, boasting a proud ancestry dating back some 240 million years. Ancestors of these reptilian living fossils lived way back in the period referred to as the 'great age of reptiles', when dinosaurs ruled the earth. Today's marine turtles have remained virtually unchanged for about 140 million years since the geological epoch known as the Cretaceous. Supremely adapted to life in the ocean since ancient times, they have not only survived but have thrived through successive periods of climatic change, sea level fluctuation and natural disasters which sent many other species extinct, with no need to evolve any further. As descendants of this ancient lineage, seven species of marine turtles are found to inhabit the oceans of the world today. They are the Loggerhead turtle (*Caretta caretta*), Olive Ridley turtle (*Lepidochelys olivacea*), Kemp's Ridley turtle (*Lepidochelys kempi*), Hawksbill turtle (*Eretmochelys imbricata*), Leatherback turtle (*Dermochelys coriacea*), Flatback turtle (*Natator depressus*) and Green turtle (*Chelonia mydas*). A subspecies of the Green turtle known as the Black turtle due to its overall gray to black carapace, which is steeper than that of the Green turtle, has been the topic of debate and taxonomic controversy of recent times. Some researchers believe it to be a distinct species and have even classified it as *Chelonia agassizi*, while on the other hand, recent mitochondrial DNA analysis suggests that regardless of appearances, there is little genetic difference between the two forms.

Reproduction and Predation

Marine turtles spend more than 90% of their lives at sea, and undertake lengthy migrations but are still tied to land for purposes of reproduction. Being reptiles, they procreate by laying eggs that are temperature-dependent for successful hatching. As a result, every breeding female turtle must return ashore, to crawl laboriously up a sandy tropical beach at night, find a suitable nest site, dig a nest chamber to deposit her clutch of soft shelled eggs and cover them up again before returning to her familiar ocean habitat. She will go through this arduous procedure periodically throughout her reproductive years and amazingly every time she will return to the very same beach where she herself hatched out, due to a phenomenon known as imprinting. The eggs thus buried and left untended in the egg chamber, will hatch in 45–70 days (depending on the species) after being laid. The emerging hatchlings must then find their way down to the ocean with no parental assistance and begin their potentially long aquatic lives. It is during this journey between nest and ocean that the process of imprinting takes place.

Adult sea turtles with their strong protective armour in the form of a carapace above and a plastron below, have few natural predators besides man. However, turtle eggs and hatchlings are highly vulnerable to natural predation at all stages of their development. Turtle eggs are eaten by a range of natural predators including wild boar, foxes and jackals, members of the mongoose family, lizards and burrowing crabs. In addition to these natural predators, when turtles nest in populated areas man and his domesticated animals such as dogs and pigs will extract and eat all the eggs from any nest that is discovered. Nests that remain undisturbed through the incubation period will hatch and the emerging hatchlings must evade a host of predators on their crucial first journey between the nest and the sea. Birds of prey, sea and shore birds and crabs will be waiting to catch and eat these tiny turtles, as they scurry down the beach as fast as their little flippers will carry them, in a mad rush to reach the relative safety of the ocean. For this reason, turtle hatchlings usually emerge from the nest at night, when fewer predators are around and immediately scramble down to the water. Once they reach the surf-line, they begin to swim frantically towards the open ocean, while having to deal with a further set of predators such as large carnivorous fishes and sea birds. Being highly susceptible to predation in the early stages of life, it is not surprising that only an estimated 0.01% of eggs laid, result in hatchlings that survive the

Figure 1. Literally 'turned turtle' and awaiting slaughter, three Olive Ridley turtles at Negombo.

Figure 2. Olive Ridley turtles being killed at Kandakkuliya on the north-western coast.

vulnerable juvenile years to become reproductive adults.

Turtles and Man

These ancient ocean dwellers that evolution made perfect, are however threatened with extinction today, due to the destructive actions of man, the late arrival on planet Earth and destroyer of all creatures! Marine turtle populations throughout the oceans of the world are presently being decimated by direct exploitation by people as well as indirect man induced means. Indirect threats include the loss of nesting sites due to beach-front development, harmful fishing methods and destructive fishing gear such as nylon gillnets which lead to heavy unintentional by-catch in the fisheries industry, as well as marine pollution and ingestion of indigestible marine debris which have the adverse effects of making turtles susceptible to decease and death. Humans the world over, have been exploiting sea turtles and utilizing many turtle products for centuries. In the process of this unregulated utilization, they have driven turtle populations to dangerously low levels world-wide.

Since the advent of ocean navigation in human history, seafarers in all oceans have considered turtles a useful source of protein on their long voyages. Likewise, coastal populations have used turtle eggs and flesh as a source of food for centuries, on a subsistence level. Even today with the knowledge that marine turtles are endangered species in need of protection, they are the victims of direct hunting in many countries in whose waters they occur. Adult turtles are killed by people for their flesh, which is even canned and used for the very popular turtle soup, while the eggs are dug out of the nest chambers for human consumption as a source of protein and due to the belief among some people that they have aphrodisiac properties. The scutes of the carapace of some species such as the Hawksbill and Green turtles are used for making 'tortoiseshell' jewellery, ornaments and curios, in some countries. Likewise, in some parts of the world, adult and baby turtles are killed to be sold as stuffed animals with a polished carapace, for use as wall ornaments and paperweights. The skin off the flippers of Olive Ridley and Green turtles is tanned and used to make leather for shoes, belts, handbags, wallets and watch-bands. As a result of such relentless exploitation over the years, marine turtles are now rapidly moving towards extinction. The problems caused by direct exploitation are further exacerbated by the indirect threats, which also take an increasing toll off turtle populations in all oceans.

Turtles in Sri Lanka

Five of the seven extant species of marine turtles found in the world today, not only inhabit the ocean around Sri Lanka, but also nest on the beaches around the island. While the Olive Ridley seems to be the most abundant species in our waters, the Green, Hawksbill, Leatherback and Loggerhead also nest in Sri Lanka. As in other parts of the world however, they are indiscriminately exploited in Sri Lanka too, with the fisheries industry accounting for both direct catches and accidental entanglement of turtles in nylon gillnets. Likewise, female turtles that come ashore to nest are sometimes slaughtered for their flesh while most nests in unprotected areas are plundered and the eggs removed for human use. This kind of exploitation continues to take place, despite all species of marine turtles being protected by law under the amended *Fauna and Flora Protection Ordinance*, since 1972. Legislation to protect marine turtles has been a part of Sri Lanka's law since 1938, when only the Leatherback was afforded initial protection. However, by subsequent regulations gazetted on 28 July 1972, Schedule III (where protected reptiles are listed) of the *Fauna and Flora Protection Ordinance* was amended to include all five species of sea turtles that inhabit Sri Lanka's waters. Therefore, it is presently a punishable offence under this ordinance to kill, wound or catch any marine turtle or have in ones possession the eggs or any other part of a marine turtle in Sri Lanka. Regardless of the existence of

Figure 3. A sub-adult Hawksbill turtle held captive in a hatchery at Kosgoda.

Figure 4. Three-day old Green turtle hatchlings about to be released at midday for the benefit of tourists at a hatchery in Kosgoda.

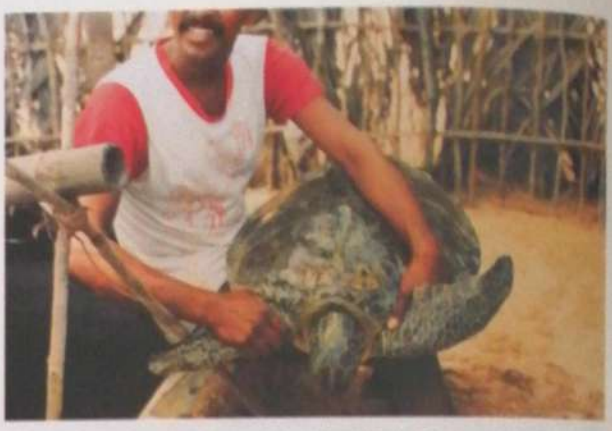

Figure 5. Adult Green turtle illegally held in a hatchery at Kosgoda.

such strong protective legislation, the law has never been implemented effectively to protect marine turtles in Sri Lanka from relentless exploitation by man.

Within the last two decades, a new threat has been added to direct exploitation of adults and eggs, in the form of a proliferation of so-called turtle hatcheries along the south-western coastline of the country. Though operated in the name of conservation, they are often in fact an illegal source of income for hatchery owners who exploit both the turtles that nest here and the flourishing tourist industry on this coastal belt. These hatcheries buy turtle eggs from the coastal community who patrol the beaches at night and remove as many eggs as they can find from newly-laid turtle nests. Some go to the extent of removing the eggs even as a female turtle lays them. The hatchery operators buy these eggs and re-bury them within an enclosure at the hatchery. Here, some clutches of eggs are left undisturbed to hatch, while others are often re-opened to show the eggs to visiting tourists and such eggs are doomed never to hatch successfully. The hatchery enclosures themselves are sometimes unsuitable, as they are located on the beach and are sometimes inundated by the rising tide, so that all the eggs buried at such times will not hatch. In most such hatchery enclosures, the clutches of eggs are buried too close to each other, so that if one clutch hatches the others around it will be disturbed when the hatchlings dig collectively out of the chamber. Once a nest hatches and the hatchlings emerge, the hatchery owners hold these unfortunate baby turtles in overcrowded cement tanks, for tourists to see, touch, hold and photograph. The water in the tanks is rarely changed and the conditions in them are generally unhygienic. Therefore, the hatchlings kept in these tanks for anything between three days and a week, often suffer from fungal and bacterial infections. Being over-crowded in these small tanks, they often begin to bite each other, causing ulcerating wounds and lacerations on the flippers and neck.

It is a well-known fact that turtles are born with a yolk sac, which provides them with the necessary energy to swim out to the open ocean in the first three days of life, when they do not feed at all. Once this yolk sac is fully absorbed, approximately three days after hatching, young turtles no longer have this energy source to carry them out to the relative safety of the open ocean and if released, are bound to fall prey to predation, or die of starvation in their weakened state. Hatchery owners who hold hatchlings in tanks for several days before releasing them are therefore making sure that none will survive once released. Some hatcheries even allow visiting tourists to release a few hatchlings for an extra fee and this is done even during the day when they are sure to be eaten by predators. Most hatcheries also hold a few adult turtles in captivity, to make the hatchery more attractive to visitors. These adults are kept in such small tanks, that they can hardly move around and the water in them is not deep enough for them to swim without injuring their flippers by repeatedly being dragged against the bottom and sides of the tank. These pathetic captives often have eye infections and some have even gone completely blind, while injuries to the soft parts of the body are numerous.

The hatcheries that have thus mushroomed along the south-western coastal belt, where many of Sri Lanka's turtle nesting sites are located, ensure that hardly any nests are left undisturbed to hatch in their natural state. The often poor, coastal communities find that selling turtle eggs to hatcheries, although illegal, is a new and easy source of supplementary income, and they make sure that all nests in these areas are plundered. This will go on unabated as long as the demand for eggs from hatcheries is present, but turtle egg collection is not the only livelihood of these people since it is only an additional source of income. Operating these hatcheries itself is an illegal activity, as it is an offence to have in ones possession any turtle or its eggs. Therefore, if the available laws are enforced by the relevant authorities, these hatcheries would not be in operation today. As it is however, this is

a thriving commercial venture, which is detrimental to the long-term survival of these endangered species in Sri Lanka's waters. There is provision under the prevailing law that exceptions can be made and hatcheries that are maintained purely for the purpose of conservation and scientific research can be licensed to operate under strict supervision and careful guidelines. However, no such guidelines have been designed or enacted as yet, and hatcheries operate illegally, with no scientific basis or monitoring of practices used. Therefore, the conservation purpose of hatcheries is defeated completely and the present hatcheries are possibly the biggest threat to the survival prospects of turtle populations that nest along this coastline.

Regular turtle nesting beaches located further south include the coastal areas within the national parks of Bundala and Yala. In these nesting grounds, nests are better protected from human exploitation, but are subject to heavy natural predation by wild animals such as wild boars, jackals, monitor lizards and crabs. However, any nest that escapes such natural hazards in these areas has the chance of hatching successfully. While the five species of sea turtles occurring in Sri Lanka are all globally endangered and their plight is recognised by national legislation, the amount of protection offered to them in practical terms is wholly inadequate. If some meaningful action is not taken to mitigate the threats they face both in our waters and on their nesting grounds on our shores, soon the populations around Sri Lanka could disappear altogether, as they already have from several other such areas in the world. At least now the imminent threat to their survival must be recognised and taken seriously enough, to attempt some urgent action to arrest the situation created by our own consumptive attitudes towards the environment in general and specifically towards threatened species such as marine turtles. If not, soon it will be too late to save these amazing, ancient, marine reptiles that inhabited our planet long before us, due to human greed and negligence.

The Na-ketiya earth slip

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While on holiday in Haputale in April last year, a friend suggested that I visit Na-ketiya Village and see the largest earth slip in Sri Lanka. Earth slips, being disasters like floods and fires, serve to remind us how small man is before the might of Nature.

In Sri Lanka, earth slips usually occur on steep slopes where there is a fracture in the bed rock. When the soil on the bed rock becomes saturated with water during heavy rain, the clay on the rock surface acts as a lubricant, sending everything on it—soil, boulders, trees and man-made structures—hurtling down with a terrific force.

Na-Ketiya is a small village nestled among the mountains of Uva. To reach it, turn off at Beragala junction towards Wellawaya on the Colombo–Ratnapura– Badulla Road. The sparsely-populated countryside is of breathtaking beauty. To your left are the majestic hills of Haldummulla and Haputale, covered with jungle and scattered with small waterfalls. Occasionally, one encounters a family of monkeys. On the right is the precipitous drop to the southern plains, hundreds of metres below deep. On the mountain slopes are trees more than 30 m high, hitherto spared by the woodcutter. Several ancient but lovely bridges later, one arrives at the 198 km post, and the Na Ketiya earth slip.

To believe the extent of damage caused by this massive slip, it has to be seen. There are acres and acres of loose red and yellow earth everywhere. A muddy stream now flows through thestretch of 100 metres that used once to be a main road. The area affected by the slip, according to H. L. S. Wijesinghe, Divisional Secretary, Haldummulla, is approximately 100 hectares. A local resident told me that there have been several earth slips prior to the most recent disaster that struck this sleepy village on 20 November 1997. The first slip in memory had taken place around 1930.

About 15 years ago, a crack had appeared in one of the plantation housing units (line-rooms) that then stood here. A few weeks before the present earth slip, it had rained incessantly both day and night. The local residents, warned of the possibility of a slide, were evacuated to safety as the threat of an avalanche appeared ever greater. At about 2 a.m. on the fateful day, a fearful noise reminiscent of continuous thunder announced the onset of trouble. The entire slope, together with rocks, boulders, houses and a portion of the Beragala–Wellawa road, complete with the huge *mara* trees that had stood there for years, went crashing down into the valley and were buried in mud.

Thanks to the timely warning and evacuation, no one was hurt. Even today, more than two years later, the road remains closed, for there have been several more slips since. Every day, visitors from all parts of the country visit to see the earth slip. My two children, who knew of such disasters only from books, were awestruck.

It is necessary for the government to identify the areas susceptible to earth slips and take precautionary measures, such as preventing the clearing of jungles on mountain slopes.

Temporal-gland Secretion in the Female Elephant

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On 21 January, 2000, while in the Ruhuna National Park, we encountered four elephants standing quietly on the far side of Buttuwa Lagoon. The two adult females and two babies were soon joined by another female and her baby. We stopped our vehicle and waited, certain they would cross the lagoon and come towards us.

They crossed the lagoon at 9.30 a.m. and came by a vehicle parked in front of us. The leading female, obviously the matriarch, looked agitated tough we did not disturb her in any way. She circled the vehicle in front of us and then came to us, the baby running behind her.

When she was going around our vehicle, we noticed a secretion from her temporal glands. She was no more than five feet from our vehicle and kept circling us, making a peculiar sound rather like, "Kek, Kek, Kek, Kek". She was clearly agitated, though she did not show any aggression. When another vehicle came up behind us, she went over to it and repeated her performance. Another mother and baby came across the lagoon and joined the herd. They milled around our vehicles for about half an hour before they moved off into the jungle.

Our tracker was astonished. He had never seen a temporal-gland secretion before in a female elephant: this is a phenomenon associated almost entirely with *musth* in adult males. The last time I saw a female having temporal gland secretions was nearly fifty years ago, again in the Ruhuna National Park.

One was permitted to tour the park on foot in those times, there being no road network like there is today. Our party consisted of the late Sam Elapata Dissawe, the late A. H. E. Molamure, our camp cook David, tracker Pinoris and myself, then a schoolboy. A herd of seven elephants was seen along the Jamburagala road with the matriarch showing a copious secretion issuing from her temporal glands. While we were observing the herd, a large male came along. He was not in *musth*. He approached the female and began stroking her temples and then tasting the secretions. Each time he did this he gave a shrill trumpet. This was repeated more than fifteen times and the herd, along with the male, moved off into the jungle. Pinoris predicted that the male would certainly come to musth in a day or two. We tried unsuccessfully to locate the herd for two days to test our tracker's prediction. He said he had seen females with temporal-gland secretions on two previous occasions.

Both Cynthia Moss and Joyce Poole have observed that in the African elephant, both male and female show copious temporal-gland secretions when excited, especially when two herds meet up after a separation. The secretions occur during the "greeting ceremony" in which the animals engage.

This phenomenon is rare however, in the female Asian elephant. So far, the reason for this is not known. Dr. R. Sukumar observed that "female Asiatic elephants occasionally secrete from their temporal glands, although the precise significance of this is not clear. I have seen cows secreting in an advanced state of pregnancy or after calving" — *Elephant Days and Nights*. There is also a picture of a female showing temporal gland secretion opposite page 112 of this book.

Though the condition of *musth* has been known in the Asian elephant for centuries, it was recognized in Africa only recently, in the course of the work done on male elephants in Amboseli by Joyce Poole and Cynthia Moss.

Elephant owners have told me that some female elephants in captivity too, have shown periodic temporal gland secretions, though not as copious as in the males.

SAARC News

Bhutan Bans Plastic Bags

Becoming increasingly aware of the threat they pose to the environment, Bhutan's ministry of trade has banned the use and sale of plastic bags and wrappers. Traders found selling or using plastic bags are liable to a fine of Rs 500/- for the first offence, and Rs 10,000/- and cancellation of trade license for subsequent offences. The move has led to a drastic reduction in plastic pollution in Bhutan, especially in its capital, Thimpu.

— *Down to Earth, 09(09)*

Loudspeaker Religion

India's Supreme Court has made a landmark judgement that numbers the days of "loudspeaker religion", where places of religious worship cause noise pollution by broadcasting religious chanting and sermons on public address systems. "A [noise] pullution-free environment is a natural right for everyone, noted Justices M. B. Shah and S. N. Phukhan in their order against the Church of God, whose broadcasts were disturbing neighbours in Chennai's Majestic Colony.

How many Endemic Birds?

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The number of endemic bird species (i.e. species occurring only in Sri Lanka and nowhere else) has been a rather perplexing issue to Sri Lankan ornithologists. It is therefore helpful to review the numbers of species accepted as being endemic by various authorities.

Holdsworth (1872)	37 species
Legge (1880)	47 species
Wait (1931)	25 species
Whistler (1944)	22 species
Fleming (1977)	21 species
Phillips (1978)	21 species
Wijesinghe (1994)	26 species
Inskipp *et. al.* (1996)	23 species

The apparent uncertainty regarding the actual number of endemics continues to exasperate ornithologists. In attempting to study the problem, it is useful to decide first what constitutes a species. A broad definition would be "a category in the system of classification of living organisms consisting of similar individuals capable of exchanging genes or interbreeding," (Allen, 1990). There are, of course, several other more specific definitions. However, for the purpose of this article, we need consider only two 'species concepts', they are—

- The Biological Species Concept (defined above).
- The Phylogenetic Species Concept. This considers as separate species, two or more geographically isolated populations of, what is considered to be, a single species under the Biological Species Concept.

The majority of biologists, at present, accept the Biological Species Concept when (for instance) defining endemics. On the other hand, the Phylogenetic Species Concept has not gained widespread acceptance.

This brings us to the question regarding the actual number of endemic bird species in Sri Lanka. Apart from historical works, most recent authorities have accepted from 21 to 23 endemic species, the single exception being Wijesinghe (1994) who listed 26 endemics. He selectively elevated three (endemic) subspecies to full species status, without giving reasons for doing so. The subspecies so elevated were the Sri Lanka Small Barbet (*Megalaima r. rubricapilla*), the Black-capped Bulbul (*Pycnonotus m. melanicterus*) and the Sri Lanka Hill Munia (*Lonchura k. kelaarti*), which, by virtue of their new status as full species, were declared endemic. In doing so, Wijesinghe obviously adopted the Phylogenetic Species Concept, but only for these three (sub) species. Paradoxically, he appears to have accepted the Biological Species Concept for the other 423 species in his checklist (had Wijesinghe consistently adopted the Phylogenetic Species Concept throughout his Checklist, Sri Lanka would have ended up with approximately 60 endemic species). Significantly, the standard work for the region, the *Checklist of the Birds of the Oriental Region*, does not validate Wijesinghe's new endemics; the authors conclude that the elevation to species status had been "without discussion" and "without giving reasons" (Inskipp, Lindsey and Duckworth, 1996). A basic taxonomic principle was also violated, which is that when a (nominate) race is elevated to species level, it cannot be done in isolation: the entire group should be revised as well. Wijesinghe failed to do this.

I suggest therefore, that given the present state of ornithological knowledge, only 23 species should be regarded as being endemic to Sri Lanka. These are listed below.

1. Sri Lanka Spurfowl *Galloperdix bicalcaratus*
2. Sri Lanka Junglefowl *Gallus lafayetti*
3. Sri Lanka Wood Pigeon *Columba torringtoni*
4. Sri Lanka Lorikeet *Loriculus beryllinus*
5. Layard's Parakeet *Psittacula calthropae*
6. Red-faced Malkoha *Phaenicophaeus pyrrhocephalus*
7. Green-billed Coucal *Centropus chlororhynchos*
8. Chestnut-backed Owlet *Glaucidium castanonotum*
9. Sri Lanka Grey Hornbill *Ocyceros gingalensis*
10. Yellow-fronted Barbet *Magalaima flavifrons*
11. Yellow-eared Bulbul *Pycnonotus penicillatus*
12. Sri Lanka Whistling Thrush *Myiophoneus blighi*
13. Spotted-winged Thrush *Zoothera spiloptera*
14. Sri Lanka Warbler *Bradypterus palliseri*
15. Dusky-blue Flycatcher *Eumyias sordida*
16. Brown-capped Babbler *Pellorneum fuscocapillum*
17. Sri Lanka Rufous Babbler *Turdoides rufescens*
18. Ashy-headed Laughing-Thrush *Garrulax cinereifrons*
19. Legge's Flowerpecker *Dicaeum vincens*
20. Sri Lanka Hill White-eye *Zosterops ceylonensis*
21. Sri Lanka Blue Magpie *Cissa Ornata*
22. Sri Lanka White-headed Starling *Sturnus albofrontatus**
23. Sri Lanka Hill Mynah *Gracula ptilogenys*

Future workers will doubtless revise this list: when this is done it is hoped that revisions will be carried out in accordance with the *International Code of Zoological Nomenclature* (ICZN).

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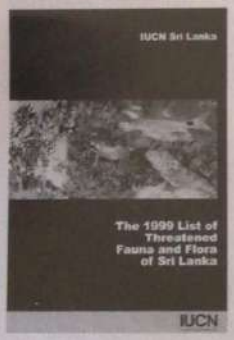
* Formerly *Sturnus senex*.

New books



The 1999 list of threatened fauna and flora of Sri Lanka

2000. IUCN, Sri Lanka. viii+113 pp. ISBN 955-8177-01-6.

For the first time, the entire fauna and flora of Sri Lanka for which published data are available has been assessed according to objective criteria, and the threats they face assessed. The book is the work of a large team of authors led by D. K. Weerakoon and R. N. de Fonseka, in consultation with a panel of national experts.

Traditions of Sri Lanka

By C. G. Uragoda.

2000. Published by the author, Colombo. 319 pp. ISBN 955-96843-0-2

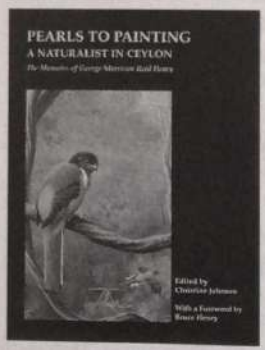
Scientist-historian Chris Uragoda presents a lifetime collection of traditions and lore gathered from all over Sri Lanka. The hotchpotch ranges from traditional methods of weed control and water purification, to the medicinal uses of a variety of plants. Six pages are devoted, for example, to the betel leaf— not just as a good chew, but as a traditional gift.

Land snail diversity in Sri Lanka

By Fred Naggs and Dinarzarde Raheem.

2000. The Natural History Museum, London. CD ROM. ISBN 0565091565 [in printed form as ISBN 0565091514].

A fascinating 'first glance' at the diversity of Sri Lanka's land snails, based on the collections of the British Museum (Natural History) (BMNH), now The Natural History Museum. The work serves as a starting point for a large-scale survey of this fauna now in progress, in collaboration with the BMNH.



Pearls to Painting: the memoirs of George Morrison Reid Henry

Edited by Christine Johnson, with a foreword by Bruce Henry.

2000. WHT Publications, Colombo. 140 pp. ISBN 955-9114-14-X

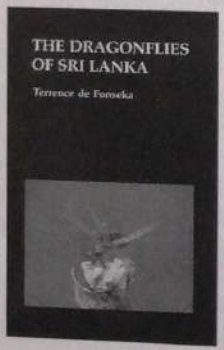
The 'Ceylon years' of the memoirs of the famous entomologist-ornithologist, weaving a richly atmospheric tapestry of colonial life in Sri Lanka in the early 20th century, spiced with delightful natural-history observations. Richly illustrated in colour with Henry's own paintings.

A field guide to the birds of the Indian subcontinent

By Krys Kazmierczak, with illustrations by Ber van Perlo.

2000. Pica Press, Sussex. 352 pp. incl. 96 plates. ISBN 1-873403-79-8

A handy handbook to the birds of the region, including colour illustrations of all 1,330 species and their distinct subspecies (often with female and juvenile plumage), accompanied by 1,300 useful distribution maps (in colour). Text, maps and plates are together.



The dragonflies of Sri Lanka

By Terence de Fonseka

2000. WHT Publications, Colombo. 303 pp, 20 plates. ISBN 955-9114-19-0

The first account of the damselflies and dragonflies of Sri Lanka, including keys to all 117 species presently known from the island. Though the text is technical, the hundreds of black and white drawings serve to guide even the novice through to the identification of any species. The text includes data on distribution.

BOOK REVIEW

The Great Indian Elephant Book: an anthology of writings on elephants in the Raj

Dhriti K. Lahiri-Choudhury (Editor). 1999. Oxford University Press, New Delhi. 459 pp.
Price: 595 Indian Rupees (US$ 14.00).

It is said that being published by the Oxford University Press (OUP) is like being married to a Duchess: the honour is greater than the pleasure. But on reading Prof. Lahiri-Choudhury's book, it appears that the former Professor of English at Calcutta's Rabindra Bharati University and one of the founder members of the IUCN's Asian Elephant Specialist Group, must have derived great pleasure too in compiling the collection of excerpts on the changing perception of the Indian elephant and the sportsman's ways with it under the British Raj. In his introduction, which is the best item in the book, Prof. Lahiri-Choudhury provides an extremely interesting analysis of the use and abuse of the elephant in war and peace in the nineteenth century by the British colonial rulers even as they were hunting it across its range in the Indian subcontinent. He is well placed to comment on both the hunter and the hunted as he too, had brought down a couple of magnificent rogues with his rifle (although not for sport but in response to growing conflict between man and beast in north-eastern India).

Lahiri-Choudhury's book deals with the period that began in 1773 when British rule was imposed in India, and where the elephant itself subsequently became the emblem of imperial power. The book also covers Sri Lanka, given its geo-cultural and historical links with India. In his book, Lahiri-Choudhury attempts to discuss two aspects of the elephant: the changing perception of the elephant; and the sportsman's ways with it. When the British took control of the Indian subcontinent, elephant and other wildlife were so numerous that people were encouraged to hunt and eliminate them in vast numbers. Sport was an abiding passion with the British, hunting and polo for the upper classes, a bit of football for the lower orders. As Ann Morrow points out in her book, *The Maharajas of India*, sport was thought an important way of 'sweating the sex' out of the other ranks. The British upper classes loved big-game hunting wherever they went, blood sports being the closely guarded privilege of the top drawers. But not everyone who was sent to rule India during the British Raj, came from the ruling class. Hunting was not just a sport, but a symbol of status as well, the criterion being the number of animals one shot. The size of the hunted increased the status of the hunter so much that some measuring tapes that were used had 11 inches to a foot! Thus, big-game hunting, as Lahiri-Choudhury argues, became a short-cut to the status of 'gentleman'. That was their way of proving their credentials to their peers. Nevertheless, hardly any colonial sportsman who shot elephants recognized the courage of the native trackers and *shikaris*, who often went ahead of the well armed white sahib! Even G.P. Sanderson sent two of his unarmed trackers ahead of him after wounding an elephant. Shooting elephants was far more thrilling than hunting foxes back home. No wonder then, that Lord Curzon once implored a friend of his to "come and stay with us and we will arrange for you to shoot tigers from the back of elephants or elephants from the back of tigers". Both the Indian princes and their British guests were inveterate hunters. In some princely states of the Maharajas, hunting was a major form of recreation and dead elephants' feet were used as umbrella stands; tusks were used for gongs, and the penis made a stalwart golf bag. For the Hindus however, the elephant being a symbol of Lord Ganesha, its killing is and has always been taboo. While the upper-class Englishmen loved the sport of elephant hunting, the upper class Hindus loathed it. Even in predominantly Buddhist Ceylon, elephant hunting was never popular among the people, although capturing and training elephants for use in war and peace was an established art. Elephants were protected by kings in Ceylon, and it was in 1826 that their hunting became an accepted form of sport. At least 40,000 Asian elephants were killed or captured during the past century in India alone.

The book is divided into four sections: the first deals with the changing perceptions of the people who hunted elephants; the second deals with the dangers associated with the game of shooting elephants in India; the third deals with encounters of elephants in Burma, and the fourth is confined to Ceylon. These carefully selected excerpts from 23 contributors, provide us a historical perspective of the changing attitude of the colonial hunter to the elephant and his role in its endangerment. Lahiri-Choudhury begins his anthology with W.W. Hunter's account of William Makepeace Thackeray, grandfather of the novelist, who at the age of 17 joined the East India Company in East Bengal (Bangladesh today) at an annual salary of Rs. 495 (£ 62). Thackeray augmented his meagre salary by private trade of supplying elephants for the Company's troops. He became a mighty hunter of elephants. His main sources of income were the destruction of tigers and the capture of wild elephants. The attitude of the colonials changes from regarding the elephant as an instrument of short-term profit to valuing it subsequently for pleasure, when it became an object of sport hunting. The Government of the day in fact promoted the slaughter by offering a bounty for each animal that was killed. The impact of this policy was seriously felt in south India and Ceylon where elephants declined substantially in both range and

Capture of a wild elephant, from Emerson Tennent's *Natural History of Ceylon* (1861).

number. In Sri Lanka, Samuel Baker and his colleagues were responsible for wiping out entire herds of elephants, collecting only their tails as trophies from the largely tuskless individuals. Baker even explains the difference between killing and shooting an elephant. Furthermore, since elephants were so numerous and widely distributed, there was hardly any recognition of the need to conserve the species. It was F.W. Champion who first became appalled by the mindless slaughter of these magnificent animals, which he referred to as "perhaps the finest of God's wild creatures".

The real study of wild elephants, according to Lahiri-Choudhury, began with Capt. Thomas Williamson in 1807, and continued with the publications by Sir Emerson Tennent in 1867 and G.P. Sanderson in 1878. Tennent's authority lost out to Sanderson's in due course. A few of Tennent's contemporaries did not take his writings seriously. Captain John Macdonald Henderson used an old quip to describe it— "all that is true in it is not new and what is new in it is not true". Sanderson rubbished Tennent's work, *The Wild Elephant*, as being "full of the errors which are unavoidable when a man writes on a subject with which he has no practical acquaintance...". Tennent was nicknamed "Sir Timorsome Emmet" by his colleagues in Ceylon, on account of his exploit in running away from a crowd! Elephants in the wild were studied over the barrels of rifles first, before binoculars and notebooks replaced them. G.P. Sanderson's *Thirteen Years Among the Wild Beasts of India*, published in 1878, still remains a classic. Col. F.T. Pollock on the other hand, was spot on when he compared the temperament of an elephant under stress, to that of women— "uncertain, coy and difficult to please". He also correctly measured the approximate shoulder height of an elephant by multiplying the circumference of its forefoot by two— a fact well known to the elephant catchers in Ceylon long before Pollock's time.

Reading Lahiri-Choudhury's carefully selected excerpts makes it clear that the a number of hunters contradict each other on the basis of their own experiences and ignorance. There is considerable confusion over the longevity of the species in the wild. While Tennent, on the information he received from knowledgeable natives estimated it as 70 years, he also quotes one Col. Robertson who, based on knowledge of a domesticated elephant in Ceylon, records that it might have lived to more than 140 years! Sanderson betrayed his ignorance of the average life span of an elephant in the wild by putting it around 150 years. One of the most renowned travellers of the seventeenth century, Jean-Baptiste Tavernier too, mentions in his classic, *Travels in India* that "an elephant's age sometimes amounts to 120 or 130 years". Furthermore, the exploits of the British hunters were published largely for the consumption of the British audience both in the colonies and in the mother country. Such publications appeared in *Country Life* and *Field* in England. The natives did not exist in the subconscious of the colonials. An exception is Sanderson, who acknowledges the fact that "the elephant is essentially a native's animal. Natives alone have fully studied his peculiarities and classified him into castes; his capture, training and keeping, are in native hands, as well as the trade; and the native standard of merit regulates the market..." The exploits of the colonial hunters do not advance the cause of elephant conservation today. Elephant and wildlife conservation in the Indian subcontinent grew out of the innate concern of the Buddhists and Hindus for the welfare of the animals. However, the need to set up special reserves for protecting wildlife, including the elephant, arose from a concern by the very people who exploited wildlife: namely the British colonial hunters, who feared that at the rate they were exterminating wildlife, there would be no game left for hunting.

The Great Indian Elephant Book provides interesting reading for the wealth of first hand information it contains on the elephant both in the wild and in captivity. As many of the primary sources Lahiri-Choudhury has consulted are no longer readily available to those of us working outside India, the book becomes a valuable adjunct. It also helps us understand the time, culture and mind-set of the colonials who took to the sport of big-game hunting. If there is a message in the book, it is that an understanding of the past could be the beginning of wisdom.

CHARLES SANTIAPILLAI
DEPUTY CHAIRMAN,
IUCN/SSC ASIAN ELEPHANT SPECIALIST GROUP

FAUNA AND FLORA PROTECTION ORDINANCE

(An unofficial text incorporating all amendments up to Act No. 49 of 1993)

Editor's note— The Fauna and Flora Protection Ordinance, the law that governs the conservation and use of biodiversity in Sri Lanka, has evolved over a period of some 60 years, during which time it has been revised several times. Here, for the first time, is the Ordinance as it now stands, incorporating all the amendments made to date. One drawback of this continuous revision is that some sections and sub-sections are 'missing'; nevertheless, subject to any editorial errors introduced in this version, this is the law as it now stands. I am grateful to Jagath Gunawardana for checking the text against the various enactments. Any errors that remain, however, are entirely my own. — Rohan Pethiyagoda.

1. AN ORDINANCE TO PROVIDE FOR THE PROTECTION, CONSERVATION AND PRESERVATION OF THE FAUNA AND FLORA OF SRI LANKA; FOR THE PREVENTION OF THE COMMERCIAL EXPLOITATION OF SUCH FAUNA AND FLORA; AND TO PROVIDE FOR MATTERS CONNECTED THEREWITH OR INCIDENTAL THERETO.

PART I

NATIONAL RESERVES AND SANCTUARIES

2. (1) The Minister may by Order published in the Gazette declare that any specified area of State land shall for the purposes of this Ordinance be a National Reserve and may by that Order or by any Order subsequently published in the Gazette declare that the whole or any specified part of any such National Reserve shall be—

(a) a Strict Natural Reserve; or

(b) a National Park; or

(c) a Nature Reserve; or

(d) a Jungle Corridor; or

(e) a Refuge; or

(f) a Marine Reserve; or

(g) a Buffer Zone.

(2) The Minister may by Order published in the Gazette declare that any specified area of land within Sri Lanka (other than land declared to be a National Reserve) shall be a Sanctuary for the purposes of this Ordinance.

(3) An area declared to be a Sanctuary may include both State land and land other than State land.

(4) The Minister may by Order published in the Gazette declare that from a specified date—

(a) the limits of any Strict Natural Reserve, National Park, Nature Reserve, Jungle Corridor Refuge, Marine Reserve or Buffer Zone, shall be altered or varied;

(b) any National Reserve or part thereof shall cease to be a National Reserve;

(c) any Sanctuary or part thereof shall cease to be a Sanctuary;

(d) that a National Reserve of one class shall be a National Reserve of another class.

(5) (a) The Minister may, by Order, declare that the limits of any National Reserve or Sanctuary shall be altered or varied.

(b) Any Order made by the Minister under this subsection shall have no effect unless it has been approved by Parliament and notification of such approval is published in the Gazette.

2A. The Director shall administer, control and manage the facilities or services which are to be provided within any National Reserve.

3. (1) Save as hereinafter provided—

(a) no person shall be entitled to enter any Strict Natural Reserve or Nature Reserve, or in any way to disturb the fauna and flora therein;

(b) no person shall be entitled to enter any National Park except for the purpose of observing the fauna and flora therein;

(c) no animal shall be hunted, killed or taken, and no plant shall be damaged, collected or destroyed in a Strict Natural Reserve, destroyed, in a Strict Natural Reserve;

(d) no person shall hunt, shoot, kill or take any wild animal, or take or destroy any egg of any bird or reptile or any nest of any bird, in any Sanctuary.

(1A) No person shall, on any State land or any part thereof within any Sanctuary, carry, or have in his possession or under his control, a gun, or a cartridge or other explosive of any description except under the authority, and in accordance with the terms or conditions, of a permit issued by the prescribed officer upon the payment of the prescribed fee. The preceding provisions of this subsection shall be in addition to, and not in derogation of, the provisions of the Firearms Ordinance.

(3) Nothing in the preceding provisions of this section shall be deemed or construed to prohibit or restrict the exercise by any person of any right acquired by him, whether by law or custom or usage, in or over any land situated within the limits of any Nature Reserve, or in or over any State land in any Sanctuary, being a right which was so acquired by such person prior to the date of the establishment of such Nature Reserve or Sanctuary.

(4) Any right referred to in subsection (3) which has not been, or is not, exercised by the person entitled thereto for a continuous period of two years shall be deemed to have lapsed, or to lapse, and to have been, or to be, ceded to the State.

3A. No person shall, within one mile of the boundary of a National Reserve, construct a tourist hotel or provide any services or facilities provided by a tourist hotel.

4. (1) No person other than the Director shall enter or remain within any Strict Natural Reserve except—

(a) for the purpose of discharging any official duty on the instructions or with the written permission of the Director; or

(b) under the authority and in accordance with the conditions of a written permit from the Director.

(2) A permit under subsection (1) (b) shall be issued only for the purpose of authorizing scientific research.

5. (1) No person shall enter or remain within any National park except under the authority and in accordance with the conditions of a permit issued by the prescribed officer on payment of the prescribed fee.

(2) A permit under subsection (1) shall be issued only for the purpose of enabling the permit—holder to study or observe the fauna and flora in a National Park.

(3) If no fee is prescribed for the issue of a permit under subsection (1), such permit shall be issued free of charge.

5A(1) No person shall enter or remain within any Nature Reserve except under the authority and in accordance with the conditions of a permit issued by the prescribed officer on payment of the prescribed fee.

(2) If no fee is prescribed for the issue of a permit under subsection (1), such permit shall be issued free of charge.

6. (1) No person shall in a Strict Natural Reserve, National Park, Nature Reserve, Jungle Corridor, Refuge, Marine Reserve or Buffer Zone —

(a) hunt, shoot, kill, wound or take any wild animal or have in his possession or under his control any wild animal, whether dead or alive, or any part of such animal; or

(b) take or destroy any egg of any bird or reptile, or any nest of any bird; or

(c) fire any gun or do any other act which disturbs or is likely to disturb any wild animal or do any act which interferes or is likely to interfere with the breeding place of any such animal; or

(d) fell, girdle, lop, tap, burn or in any way damage or destroy any plant, or take, collect, or remove any plant therefrom; or

(e) clear or break up any land for cultivation, mining or for any other purpose; or

(f) kindle or carry any fire; or

(g) possess or use any trap or any explosive or gun or other weapon or poisonous substance capable or injuring or destroying any animal or plant; or

(h) make any fresh clearing; or

(i) except under the authority of a permit issued in that behalf by the prescribed officer, erect any building, whether permanent or temporary, or occupy any building so erected; or

(j) construct or use any road or path so constructed by him; or

(k) construct or manage any tourist hotel or provide any services or facilities similar to the services or facilities provided by a tourist hotel.

(2) No person shall introduce any animal into any Strict Natural Reserve, National Park, Nature Reserve, Jungle Corridor, Refuge, Marine Reserve or Buffer Zone, or tether, liberate or release any animal therein.

(3) No person shall lead, or allow to stray any domestic animal into any national Reserve. It shall be lawful for the Director or any officer authorized by the Director to seize any domestic animal within any National Reserve and to release it to the owner thereof on the payment of a prescribed fine if such animal is claimed within twenty—eight days of such seizure. Any animal not so claimed may be disposed of by the Director in such manner as he may deem fit.

(4) Any person who acts in contravention of the provisions of this section shall be guilty of an offence and shall on conviction be liable to imprisonment of either description for a term not less than one year and not exceeding five years.

6A. (1) No person shall fish or take any aquatic animal or plant from any waters within a National Reserve, or Sanctuary which is on State land, except under the authority, and in accordance with the conditions, of a permit issued by a prescribed officer on payment of the prescribed fee.

(2) No person shall remove any object of archaeological, pre-historic, historical, geological or other scientific interest, or any other object of mineral value, from any National Reserve or Sanctuary except under the authority, and in accordance with the conditions, of a permit issued by the prescribed officer on payment of the prescribed fee.

(3) If no fee is prescribed for the issue of a permit under subsection (1) or subsection (2), such permit shall be issued free of charge.

(4) Where the prescribed officer is satisfied that any application for the issue of a permit under subsection (1) is for the purpose of enabling the applicant to catch fish in any waters referred to in that subsection for the local consumption of the inhabitants of any village who have, by custom, or usage, fished in such waters for that purpose, then, notwithstanding the provisions of that subsection, such officer shall issue such permit free of charge.

7. (1) No person shall, except in accordance with regulations—

(b) in any on any Sanctuary—

(i) fire any gun, or do any other act which disturbs or is likely to disturb any wild animal or do any act which interferes or is likely to interfere with the breeding place of any such animal; or

(ii) hunt, shoot, kill, or take any wild animal, or have in his possession or under his control any wild animal, whether dead or alive, or any part of any such animal; or

(iii) take or destroy any egg of any bird or reptile or any nest of any bird; or

(iv) construct or use any hide or ambush on the ground or on any tree for hunting, shooting, injuring or wounding any wild animal, bird or reptile; or

(v) set, lay or spread any pitfall, trap, snare or other instrument for the purpose of killing or capturing any wild animal, bird or reptile; or

(c) in any State land within any Sanctuary—

(i) fell, girdle, lop, tap, burn or in any way damage or destroy any plant, or take, collect, or remove any plant therefrom; or

(ii) clear or break up any land for cultivation, mining or for any other purpose; or

(iii) kindle or carry any fire; or

(iv) possess or use any trap or any explosive or poisonous substance capable of being used for the purpose of injuring or destroying any animal or plant; or

(v) make any fresh clearing; or

(vi) erect any building whether permanent or temporary or occupy any building so erected unless such person is the holder of a permit issued in that behalf by the prescribed officer; or

(vii) construct or use any road or path so constructed by him.

8. No person shall from any road or land outside a Strict Natural Reserve, National Park, Nature Reserve, Jungle Corridor, Refuge, Marine Reserve or Buffer Zone, hunt, shoot, kill or take any wild animal in such Strict Natural Reserve, National Park, Nature Reserve, Jungle Corridor, Refuge, Marine Reserve or Buffer Zone.

8A. (1) The Director may provide roads and tracks within a National Reserve to be nature trails for the use of any person who desires to travel on foot to study or observe the fauna and flora therein:

Provided that the State shall not be liable for any injury or damage sustained or incurred by any person using such trail.

(2) No person shall use any such nature trail unless he has obtained a permit issued by the Director upon the payment of the prescribed fee.

(3) Regulations may be made specifying the manner in which any person may use such nature trail.

9. Regulations may be made—

(b) prescribing the circumstances and cases in which and the conditions and restrictions subject to which wild animals may be hunted, shot, killed or taken in a Sanctuary;

(c) prescribing the conditions to be attached to any permit issued for the purposes of this Part of this Ordinance and the fees to be paid for the issue of such permits;

(d) for the purpose of extending, with such modification as may be necessary, all or any of the provisions of Part II or of Part III of this Ordinance to any Sanctuary;

(e) for the purpose of extending, with such modification as may be necessary, all or any of the provisions of this Part of this Ordinance to any specified insect;

(f) declaring that all or any of the provisions of this Part of this Ordinance shall not apply to any specified species of animal in any specified area.

9A. (1) No person or organisation, whether private of State shall within a distance of one mile of the boundary of any National Reserve declared by Order made under section 2, carry out any development activity of any description whatsoever, without obtaining the prior written approval of the Director".

(2) Every application for approval, under subsection (1) to commence a development activity shall be accompanied by an Initial Environmental Examination or Environmental Impact Assessment, as the case may be, in terms of the National Environmental Act, No. 47 of 1980, relating to such development activity. The Director shall have regard to such environmental impact assessment in deciding whether or not to grant approval

for the commencement of the development activity to which that assessment relates.

10. Any person who acts in contravention of—

(a) any provision of this Part of this Ordinance other than the provisions of section 6; or

(b) any regulation made under section 9 for any purpose set out in that section; or

(c) any provision of Part II or Part III of this Ordinance which has by regulation been extended, with or without modification, to any Sanctuary; or

(d) any provision of this Part of this Ordinance which has by regulation been extended, with or without modification, to any specified insect,

shall be guilty of an offence and shall on conviction be liable to a fine not less than ten thousand rupees and not more than twenty thousand rupees or to imprisonment of either description for a term not less than two years and not more than five years or to both such fine and imprisonment.

11. In this Part of this Ordinance, unless the context otherwise requires—

"animal" means any vertebrate or invertebrate;

"domestic animal" means—

(a) any head of cattle, or any sheep, goat, horse, ass, mule, dog, or cat;

(b) any domestic fowl reared by man as poultry; and

(c) when domesticated by man, any pig;

"plant" means a member of the plant kingdom;

"wild animal" means any animal which is not a domestic animal.'.

PART II

ELEPHANTS AND BUFFALOES

12.(1) Save as in hereinafter provided, no person shall in any area outside a National Reserve or Sanctuary—

(a) hunt, shoot, kill, injure or take any elephant; or

(b) without a licence, in that behalf from the Director, capture any buffalo.

(2) Every licence under subsection (1) shall be issued in the prescribed form on payment of the prescribed fee and shall continue in force for such period and within such limits and may be subject to such conditions as the Director may consider necessary or expedient to insert therein for the protection and preservation of buffaloes.

(3) The holder of a licence under subsection (1) (b), shall not later than fifteen days after the expiry of the licence, return the expired licence to the Director or the prescribed officer, and intimate to him the particulars of any buffalo captured by him

13.(1)(a) Whenever it appears to the Director that in any area outside a National Reserve damage to any person or to any house, crop, plantation or other property is likely to be caused by any elephant or buffalo, he may by notices affixed in conspicuous places within that area declare that area to be one within which damage by elephant or buffalo is apprehended and he may take such steps as may be necessary or expedient to have the elephant or buffalo driven off or captured and may issue licences subject to such conditions as he may deem necessary on payment of the prescribed fee, or such fee not exceeding the prescribed fee, if any, as he may consider adequate, authorizing the licensee to capture such elephant or buffalo within that area while the declaration is in force.

(b) Whenever it appears to the Director that there is serious danger to life or property in the area referred to in subsection (1) (a), he may issue licences subject to such conditions as he may deem necessary or expedient either free or on payment of the prescribed fee or of such fee not exceeding the prescribed fee, if any, as he may consider adequate, authorizing the licensee to shoot, kill or take the elephant or buffalo, as the case may be, within that area while the declaration is in force.

(2) Every declaration under subsection (1) shall be forthwith reported by the Director to the Minister and shall continue in force for a period of two months from the date of such declaration.

(3) The Minister may by notification in the Gazette extend or restrict the period for which such declaration shall continue in force, or may otherwise vary or revoke such declaration, but without prejudice to anything done or suffered thereunder prior to the publication of such notification.

14. Where the Director is satisfied that any elephant is found trespassing repeatedly in or upon any plantation or cultivated land and is causing serious damage to the owner of the plantation or cultivated land or likely to cause damage to life or property of those living therein, he may issue to any person a special licence, subject to such conditions as he may deem necessary or expedient, either free or on the payment of the prescribed fee or such fee not exceeding the prescribed fee or such fee not exceeding the prescribed fee, if any, as he may consider adequate, authorizing that person to follow or pursue such tusker or elephant to any place (not being place within a National Reserve) and to shoot, kill or take such elephant.

16. Any person who in the exercise of any right conferred by or under section 13 or section 14, kills or takes any elephant or buffalo, shall forthwith report such killing or taking to any police officer entitled to officiate in the area within which such killing or capture took place or to any prescribed officer and to the Director".

17.(1) Any elephant duly killed or taken by any person under the authority of any licence issued under this Part of this Ordinance, shall be the property of that person, unless otherwise provided in the conditions attached to the licence;

(2) Subject to the provisions of subsection (1), every elephant which is killed or captured shall be the property of the State.

(3) Any buffalo duly killed or taken by any person in accordance with the provisions of this Part of this Ordinance shall be the property of that person, unless otherwise provided in the conditions attached to the licence, where any such buffalo was killed or taken under the authority of a licence.

18. Subject to such restrictions or conditions as may be prescribed, the Director may, by sale or otherwise, dispose of the tusks or the carcase, or any part of the carcase, of any dead elephant which is the property of the State.

19.(1) A royalty according to such rates as may, from time to time, be prescribed shall be levied as export duty by the officers of customs at the port of shipment in respect of every elephant, whether wild or tame, exported from Sri Lanka to any place outside Sri Lanka.

(2) No elephant, whether wild or tame, shall be exported from Sri Lanka to any place outside Sri Lanka except under the authority of a special permit issued by the Director.

(3) This section shall have effect as if it formed part of the Customs Ordinance and the provisions of that Ordinance shall apply accordingly.

19A. (1) Notwithstanding the provisions of section 40, no person shall export from Sri Lanka—

(a) any tusk or tush, or any part of a tusk or tush, or any article made out of a tusk or tush or part of a tusk or tush or any article containing ivory from a tush or tush; or

(b) any other part of an elephant, or any article made out of or containing any part of an elephant.

(2) Any person who contravenes the provisions of subsection (1) shall be guilty of an offence and shall on conviction be liable to a fine not less than thirty thousand rupees and not more than fifty thousand rupees or to imprisonment of either description for a term not less than two years and not exceeding five years or to both such fine and imprisonment.

(3) This section shall have effect as if it formed part of the Customs Ordinance and the provisions of that Ordinance shall apply accordingly".

20. Any person who—

(a) in contravention of this Part of this Ordinance or contrary to the tenor of any licence issued to him thereunder, hunts, shoots, kills, injures, takes, follows, or pursues any elephant; or

(b) exports any elephant, whether wild or tame, from Sri Lanka except under the authority of a special permit issued under section 19, or in any way evades payment of the royalty payable on such export,

shall be guilty of an offence and shall on conviction be liable to a fine not less than one hundred thousand rupees and not more than two hundred and fifty thousand rupees or to imprisonment of either description for a term not less than two years and not exceeding five years or to both such fine and imprisonment, and where any person who is convicted of an offence mentioned in paragraph (a) of this section in respect of the killing or taking of any elephant is found by the court to be in possession of that elephant or its carcase or tusks or tushes, the court may make order directing such elephant, carcase, tusks, or tushes to be delivered to the possession or custody of any officer of Government to be held by that officer for and on behalf of the State.

21.(1) Subject to the provisions of subsection (2), any person who takes, dismembers, removes, sells or purchases the carcase, or any part of the carcase, of any dead elephant which is the property of the State shall be guilty of an offence and shall on conviction be liable to a fine not less than one hundred thousand rupees or to imprisonment of either description for a term not less than two years and not exceeding five years or to both such fine and imprisonment.

(2) Nothing in subsection (1) shall apply to the carcase or any part of the carcase of any dead elephant which is the property of the State if such carcase of or such part of the carcase has been disposed of by the Director under section 18.

22. Any person who in contravention of this Part of this Ordinance or contrary to the terms of any licence issued to him thereunder, hunts, shoots, kills or takes any buffalo, shall be guilty of an offence and shall on conviction be liable to a fine not less than five thousand rupees and not more than ten thousand rupees or to imprisonment of either description for a term not less than one year and not exceeding two years or to both such fine and imprisonment".

22A.(1) No person shall own, have in his custody or make use of an elephant unless it is registered and unless a licence in respect of the elephant has been obtained in accordance with the provisions of this section.

(2) Every person who owns or has in his custody an elephant shall register such elephant with the prescribed officer.

(3) Every person who owns or has in his custody an elephant shall, prior to registration, pay such registration fee as may be prescribed.

(4) The Director shall maintain a register of elephants in such form as may be prescribed.

(5) Every person who owns or has in his custody an elephant shall, upon payment of the prescribed licence fee, obtain from the prescribed officer an annual licence in respect of such elephant.

(6) Where a person becomes the owner, or obtains the custody, of an elephant by virtue of sale, gift, the death of the previous owner or in any other manner whatsoever, such person shall immediately inform the Director or prescribed officer and, if the elephant is registered or licensed, take such steps as may be prescribed to have the previous registration and licence cancelled and to have a fresh registration made and a fresh licence obtained.

(7) Any person who owns, has in his custody or makes use of an elephant which is not registered, and in respect of which a licence has not been obtained in accordance with the provisions of this section, shall be guilty of an offence and shall on conviction be liable to a fine not less than one hundred thousand rupees and not more than two hundred thousand rupees or to imprisonment of either description for a term not less than two years and not exceeding five years or to both such fine and imprisonment.

(8) The Director or any officer authorised by him may at any time enter any premises where he has reason to believe that an elephant is being kept and to make such inquiries and investigations thereon as may be necessary to ascertain whether the provisions of this section are being complied with.

(9) Regulations may be made—

(a) specifying the officers to whom applications for registration of, and licences in respect of, elephants shall be made, and who shall have power to register and issue licences in respect of elephants;

(b) specifying the particulars to be set out in any such application, in the document certifying such registration and in such licence, including reference to identification marks and other details of the elephant to which the application, document certifying registration or licence relates;

(c) specifying the conditions subject to which such registration shall be made and licence issued and the fees payable for such registration and licence;

(d) specifying the form in which prescribed officers shall maintain registers under this section; and

(e) specifying the manner in which any such registration or licence shall be cancelled and a fresh registration made and a fresh licence issued.

23.(1) Any person who is in unlawful possession of any elephant shall be guilty of an offence and shall on conviction be liable to a fine not less than one hundred thousand rupees and not more than two hundred thousand rupees or to imprisonment of either description for a term not less than ten years and not exceeding twenty years or to both such fine and imprisonment; and the court may on the conviction of any such person make order for the disposal of the elephant in respect of which the offence was committed, having regard to the rights of any other person who may appear to the court to be lawfully entitled to the possession of such elephant.

(2) A person who is found in possession of an elephant shall be deemed to be in unlawful possession of that elephant unless—

(a) he is the captor of that elephant under the authority of a licence issued under this Ordinance or under any written law repealed by Ordinance No. 2 of 1937; or

(b) he is the successor in title to such captor; or

(c) he is in possession on behalf of such captor or his successor in title.

24.(1) No person shall have in his possession a tusk or tush unless such tusk or tush has been registered with a prescribed officer.

(2) Every prescribed officer shall keep a register for the registration of tusks and tushes in such form as may be prescribed.

(3) Any person who has in his possession a tusk or tush which has not been registered shall be guilty of an offence and shall on conviction be liable to a fine not less than thirty thousand rupees and not exceeding one hundred thousand rupees or to imprisonment of either description for a term not less than two years and not exceeding five years or to both such fine and imprisonment.

(4) The court may, on the conviction of any person of an offence under subsection (3), make order for the disposal of the tusk or tush in respect of which the offence was committed, having regard to the rights of any other person who may appear to the court to be lawfully entitled to the possession of such tusk or tush.

(5) Regulations may be made—

(a) specifying the officer who shall have power to register tusks and tushes, and

(b) specifying the form in which prescribed officers shall maintain registers under this section.

24A. (1) Upon registration of a tusk or tush in accordance with section 24, every person who has in his possession a tusk of tush shall obtain a licence in respect of such tusk or tush.

(2) The licence shall be obtained on

application made to the prescribed officer, in the prescribed form, on payment of the prescribed fee.

(3) Every prescribed officer shall maintain a register in respect of the licensing of tusks and tushes.

(4) Any person who has in his possession a tusk or tush without obtaining a licence in respect of the same, shall be guilty of an offence and shall on conviction be liable to a fine of not less than thirty thousand rupees and not exceeding one hundred thousand rupees or to imprisonment of either description for a term not less than two years and not exceeding five years, or to both such fine and imprisonment.

24B. The Director or any officer authorised by him may at any time enter any premises where he has reason to believe that tusks or tushes are being kept, and to make such inquiries and investigation thereon as may be necessary to ascertain whether the provisions of this section are being complied with".

25.(1) Where it appears to the Director or to any police officer or other prescribed officer that any person is in unlawful possession of any elephant, tusk or tush, it shall be lawful for the Director or such police or other prescribed officer to seize such elephant, tusk or tush and detain such elephant and to apply to the Magistrate having jurisdiction over the place where the elephant, tusk or tush was seized to make order for the disposal of such elephant, tusk or tush and the Magistrate to whom such application is made may, after such inquiry as he may deem necessary, make such order for the disposal of the elephant, tusk or tush as the justice of the case may require.

(2) An order made under this section shall not affect the liability of any person to be prosecuted for any offence committed in respect of the elephant, tusk or tush to which the order relates.

27. Regulations may be made prescribing the circumstances in which and the conditions subject to which the Director may waive or reduce the fee prescribed for the issue of any licence under this Part of this Ordinance.

28. In this Part of this Ordinance, unless otherwise expressly provided or unless the context otherwise requires—

"buffalo" means a wild buffalo;

"elephant" means a wild elephant, and includes a tusker, and for the purposes of section 22A, includes a tame or domestic elephant or tusker;

"tusk" means the tusk of a tusker;

"tush" means the tush of a tusker;

"tusker" means a wild elephant with a pair of incisors (teeth) or a single incisor.

29. There shall be established and maintained, within or outside any National Reserve or Sanctuary such number of elephant orphanages or similar establishments providing for the care and attention of orphaned elephants as the Director may deem necessary, for the protection and preservation of elephants".

PART III

VERTEBRATES AND INVERTEBRATES

30. Any person who in any area outside a National Reserve or a Sanctuary—

(a) kills, wounds, injures or takes any mammal or reptile not included in Schedule I; or

(b) takes or destroys the eggs or nest of any such reptile; or

(c) uses any boat or any lime, snare, net, spear, trap, gun, rod, line or hook with any accessory or bait, or explosives of any description or other instrument for the purpose of killing, wounding, injuring or taking any such mammal or reptile; or

(d) has in his possession or under his control, any such mammal or reptile killed or taken or any part of such mammal or reptile killed or taken, or the meat or flesh of any such mammal or reptile killed or taken or the eggs of any such reptile; or

(e) has in his possession or under his control, the hide or skin of any such mammal or reptile killed or taken, or the horns or antlers of such mammal; or

(f) exposes for sale, any such mammal or reptile or any part of such mammal or reptile; or

(g) purchase the hide or skin of any such mammal or reptile for the purpose of tanning or preparing such hide of skin for use,

shall be guilty of an offence and shall on conviction be liable to a fine not less than ten thousand rupees and not exceeding thirty thousand rupees or to imprisonment of either description for a term not less than two years and not exceeding five years, or to both such fine and imprisonment.

The provisions of this section shall not apply to any domestic animal as defined in section 11.

31. Any person who in any area outside a National Reserve or a Sanctuary—

(a) kills, wounds, injures or takes any bird; or

(b) takes or destroys the eggs or nest of any bird; or

(c) uses any boar, or any lime, snare, net, spear, trap, gun, rod, line or hooks with any accessory or bait or explosives of any description or other instrument for the purpose of killing, wounding, injuring or taking any bird; or

(d) has in his possession or under his control, any bird killed or taken, or the skin of any bird killed or taken, or the feather or any other part of any bird killed or taken, or the eggs of any bird; or

(e) exposes or offers for sale, any bird or any part of any bird,

shall be guilty of an offence and shall on conviction be liable to a fine not less than five thousand rupees and not exceeding ten thousand rupees, or to imprisonment of either description for a term not less than two years and not exceeding five years or to both such fine and imprisonment:

Provided that a person shall be deemed not to have committed an offence under this section in relation to any bird specified in Schedule II.

The provisions of this section shall not apply to any domestic animal as defined in section 11.

31A. Any person who in any area outside a National Reserve or a Sanctuary—

(a) knowingly kills, wounds, injures, takes or collects any amphibian or fish included in Schedules III and IV respectively; or

(b) takes or destroys the eggs, spawn, or nest of any such amphibian or fish; or

(c) uses any boat, lime, snare, net, spear, trap, gun, rod, line or hook with any accessories or bait or explosives of any description or any other instrument for the purpose of killing, wounding, injuring or taking any such amphibian or fish; or

(d) has in his possession or under his control, any such amphibian or fish killed or taken or any part of any such amphibian or fish; or

(e) exposes of offers for sale or transports, any such amphibian or fish or part of any such amphibian or fish; or

(f) purchases such amphibian or fish for the purposes of drying, curing or any other purpose,

shall be guilty of an offence and shall on conviction be liable to a fine not less than ten thousand rupees and not more than twenty thousand rupees or to imprisonment of either description for a term not less than two years and not exceeding five years or to both such fine and imprisonment.

31B. Any person who in any area outside a National Reserve or Sanctuary—

(a) knowingly kills, wounds, injures, takes or collects any invertebrate included for the time being in Schedule IVA; or

(b) takes or destroys the eggs, spawn, larva or nest of such invertebrate; or

(c) uses any boat, lime, net spear, trap, gun, rod, line or hook with any accessories or bait, or explosives of any description or any other instrument used for the purpose of killing, wounding, injuring, taking or collecting any such invertebrate; or

(d) has in his possession, or under his

control and such invertebrate killed or taken or any part of such invertebrate egg, spawn or larva; or

(e) exposes of offers for sale, or transports any such invertebrate or part of such invertebrate; or

(f) purchases such invertebrate for the purpose of drying, curing or for any other purpose,

shall be guilty of an offence and shall on conviction be liable to a fine not less than ten thousand rupees and not more than twenty thousand rupees or to imprisonment of either description for a term not less than two years and not exceeding five years or to both such fine and imprisonment.

34. The Minister may by regulation add to, rescind, vary, or amend any of the provisions of Schedules I, II, III and IV.

35.(1) A certificate purporting to be signed by any competent authority to the effect that any mammal, bird, reptile, amphibian, fish or invertebrate or a part of any mammal, bird, reptile, amphibian, fish or invertebrate forwarded to such authority for examination and report is a mammal, bird, reptile, amphibian, fish or invertebrate of a species included in Schedule I, Schedule II, Schedule III, Schedule IV or Schedule IVA, as the case may be, shall, on production in any court of law, be sufficient evidence of the facts stated in such certificate until the contrary is proved.

(2) For the purposes of subsection (1) the expression, "competent authority" means—

(a) the Director of National Museums;

(b) the Director of National Zoological Gardens.

36. The Minister may by notification in the Gazette declare that for a specified period no person shall shoot, kill, or take any bird of any species or take the eggs or nest or any such birds in any area outside a National Reserve or a Sanctuary mentioned in the notification, and any person who in any such area and during such specified period shoots, kills or takes any bird or the eggs or nest of any such bird, shall be guilty of an offence and shall on conviction be liable to a fine not less than five thousand rupees and not more than ten thousand rupees or to imprisonment of either description for a term not less than one year and not exceeding two years or to both such fine and imprisonment.

37.(1) No person shall import into Sri Lanka any mammal, bird, reptile, amphibian, fish, or invertebrate whether dead or alive, or any part of any such mammal, bird, reptile, amphibian, fish or invertebrate or the eggs, spawn or larva of any such mammal, bird, reptile, amphibian, fish or invertebrate except under the authority of a permit issued in the prescribed form obtained from the prescribed officer on payment of the prescribed fee.

(2) This section shall have effect as if it formed part of the Customs Ordinance and the provisions of that Ordinance shall apply accordingly.

(3) The provisions of this section shall not apply to any domestic animal as defined in section 11, or to any tropical aquarium fishes.

"Tropical aquarium fish" means any species of fresh water fish specified in Schedule IV.

(4) In case of doubt or dispute, a certificate purporting to be signed by the Director to the effect that any fish belongs to a species of tropical aquarium fish or that any species of fish is a species of tropical aquarium fish shall be admissible in evidence and shall be *prima facie* proof of the facts stated therein.

38. Regulations may be made—

(a) requiring any person who imports any mammal, bird, reptile, amphibian, fish or invertebrate on a permit issued under section 37, to provide a certificate from an approved authority that such mammal, bird, reptile, amphibian, fish on invertebrate is free from disease or infection;

(b) prohibiting any mammal, bird, reptile, amphibian, fish or invertebrate imported under the authority of a permit issued under section 37, from being liberated or released in any part of Sri Lanka or prescribing any area or areas within which any such mammal, bird, reptile, amphibian, fish, or invertebrate may be liberated or released.

39.(1) Any person who—

(a) imports into Sri Lanka any mammal, bird, reptile, amphibian, fish or invertebrate in contravention of the provisions of section 37, or any regulation made under section 38; or

(b) contravenes any regulation made under section 38,

shall be guilty of an offence and shall on conviction be liable to a fine not less than five thousand rupees and not more than ten thousand rupees or to imprisonment of either description for a term not less than two years and not exceeding five years of to both such fine and imprisonment.

(2) Any person who liberates or releases any mammal, bird, reptile, amphibian, fish or invertebrate which has been imported into Sri Lanka in contravention of the provisions of section 37 shall be guilty of an offence and shall, in addition to any punishment to which he may be liable under subsection (1), be liable on conviction to a fine of two thousand rupees in respect of each mammal, bird, reptile, amphibian, fish or invertebrate so liberated or released.

40.(1) No person shall export from Sri Lanka—

(a) any mammal, bird, reptile, amphibian, fish, coral or invertebrate whether dead or alive; or

(b) the eggs, feathers, or plumage of any bird, the horns, antlers, skin or hide of any mammal or reptile, or any part of any mammal, bird, reptile, amphibian, fish, coral or invertebrate,

except under the authority of a permit issued in the prescribed form obtained from the prescribed officer on payment of the prescribed fee.

(2) Such permit shall not be issued except for the promotion of scientific knowledge including supplies to foreign museums, foreign zoological gardens in exchange for supplies to local museums or local zoological gardens.

(3) This section shall have effect as if it formed part of the Customs Ordinance, and the provisions of that Ordinance shall apply accordingly.

(4) The preceding provisions of this section shall not apply to—

(a) any domestic animal as defined in section 11; or

(b) any mammal, bird, reptile, amphibian, fish, coral or invertebrate of a species which is not indigenous to Sri Lanka.

(5) In case of doubt or dispute a certificate purporting to be signed by the Director of Museums, Director of the National Zoological Gardens or Director of the National Aquatic Resources Authority to the effect that any mammal, bird, reptile, fish, amphibian, coral or invertebrate belongs to a species which is not indigenous to Sri Lanka, or that any species of any mammal, bird, reptile, fish, amphibian, coral or invertebrate is a species not indigenous to Sri Lanka, or that any part of any mammal, bird, reptile, fish, amphibian, coral or invertebrate is a part of a mammal, bird, reptile, fish, amphibian, coral, or invertebrate of a species which is not indigenous to Sri Lanka, or that any egg of any reptile, or bird, is the egg of a reptile or bird of a species which is not indigenous to Sri Lanka be admissible in evidence and shall be *prima facie* proof of the facts stated therein.

(6) Regulations may be made—

(a) prescribing the officer who shall have power to inspect prior to its export any item referred to in this section;

(b) prescribing the officer who shall have power to seal any such item after such inspection;

(c) prescribing the documents to be furnished by the exporter of any such item, in proof of the circumstances under which such exporter obtained possession of such item.

41. Any person who exports from Sri Lanka any mammal, bird, reptile, amphibian, fish or invertebrate whether dead or alive or any part of any mammal, bird, reptile, amphibian,

fish or invertebrate, or any eggs, feathers, plumage, horns, antlers, skins or hide of any such mammal, bird, reptile, amphibian, fish or invertebrate in contravention of the provisions of section 40, shall be guilty of an offence and shall on conviction be liable to a fine not less than twenty thousand rupees and not more than fifty thousand rupees or to imprisonment of either description for a term not less than five years and not exceeding ten years or to both such fine and imprisonment.

42. No person shall in any area—

(a) remove, uproot or destroy or cause any damage or injury to, any plant which is for the time being included in Schedule V and—

(i) is growing on the property of any other person; or

(ii) is growing in any public place; or

(b) destroy any plant which is for the time being included in Schedule V, and growing on his own property; or

(c) sell or expose for sale any plant for the time being included in Schedule V; or

(d) remove, uproot or destroy, or cause any damage or injury to any tree upon which any orchid or any other epiphytic plant is growing.

43. No person shall uproot or destroy or cause any damage or injury to any tree (hereinafter called a "protected tree") growing in any public place and included for the time being in Schedule VI:

Provided that nothing herein contained shall be deemed to prohibit or to penalize any act done by or on the orders of any person entrusted by the State or by any local authority with the charge or care of any protected tree if such act is done in order to stimulate the growth or to improve the condition or appearance or to secure the safety or to preserve the existence of any such tree.

44. The Minister may be regulation add to, rescind, vary or amend any of the provisions of Schedule V or Schedule VI:

Provided that no tree shall be so added to the list of trees in Schedule VI unless that tree is growing in a public place and unless in the opinion of the Minister the preservation or protection of that tree is necessary or desirable for scientific or aesthetic purposes or on religious or historical grounds.

45. Regulations may be made—

(a) prohibiting or regulating the exportation from Sri Lanka of any specified plant, whether or not such plant is included for the time being in Schedule V;

(b) prohibiting or regulating the cultivation of any specified plant;

(d) generally, for the protection and conservation of the wild vegetation, plant life and flora of Sri Lanka.

46. Any person who acts in contravention—

(a) of the provisions of section 42; or

(b) of the provisions of section 43; or

(c) of any regulation made under section 45,

shall be guilty of an offence and shall on conviction be liable to a fine not less than three thousand rupees and not more than ten thousand rupees or to imprisonment of either description for a term not less than two years and not exceeding five years or to both such fine and imprisonment.

47. Nothing in this Part of this Ordinance shall affect the provisions of—

(a) the Forest Ordinance, or any rules or regulations made thereunder;

(b) the Water Hyacinth Ordinance;

(c) the Plant Protection Ordinance, or of any regulation made thereunder;

(d) the Tea Control Act, or of any regulation made thereunder;

(e) the Rubber Control Act, or of any regulation made thereunder;

(f) any other written law relating to the cultivation or to the regulation or the prohibition of the cultivation of any plant.

48. In this Part IV of this Ordinance unless the context otherwise requires—

"plant" means a member of the plant kingdom;

"public place" means any State land or land at the disposal of the State or land belonging to, or vested in, a local authority or public corporation and includes any land which is not private property.'.

PART V

MISCELLANEOUS PROVISIONS

49.(1) No person shall carry on or exercise the business or trade of a taxidermist, tanner, curer or trophy dealer, or any other business or trade involving the purchase, sale or exposure for sale or transport of any animal, whether dead or alive, or of any part of any dead animal, ether dead or alive, or of any part of any dead animal, except upon a licence in respect of each such business or trade, issued in the prescribed form obtained from the prescribed officer on payment of the prescribed fee.

(2) Every licence issued under subsection (1) shall be subject to the prescribed conditions and if no fee is prescribed for the issue of such a licence, it shall be issued free of charge.

(3) In this section "animal" means an animal as defined in section 11, but does not include a domestic animal as defined in that section.

49A.(1) No person shall after the date of the coming into force of this section, have in his possession or custody or under his control, any animal in excess of the prescribed number, except under the authority and in accordance with the conditions of a permit issued in the prescribed form, by the Director on payment of the prescribed fee:

Provided that where any person has in his possession, or custody or under his control any animal, in excess of the prescribed number, prior to the date of the coming into force of this section, such person shall within a period of three months from the date of the coming into force of this section obtain a permit under subsection (1).

(2) The Director or any prescribed officer shall have the power to—

(a) enter, inspect and search any premises on which any animal is being kept under the authority of a permit issued under subsection (1) and satisfy himself that the conditions of the permit are being complied with;

(b) seize any animal found in such premises, in contravention of the provisions of the permit issued under subsection (1).

(3) The Director may order the confiscation of any animal seized under subsection (2) after such inquiry as he may deem necessary. Any person aggrieved the order of the Director may within fourteen days of the confiscation, give notice in writing to the Director that he intends to institute action in the appropriate court against such confiscation.

(4) No order of confiscation made under subsection (3) shall take effect until the expiry of a period of fourteen days from the date of such order, or where an action has been instituted in respect of such order until the final determination of such article by court".

50.(1) The Minister may by notification in the Gazette declare any road in any area outside a National Reserve or a Sanctuary to be a prohibited road for the purposes of this Ordinance.

(2) Any person who discharges any gun on any prohibited road or on any land adjoining any such road and reserved for its extension, protection or benefit, shall be guilty of an offence and shall on conviction be liable to a fine not less than five thousand rupees and not more than ten thousand rupees or to imprisonment of either description for a term not less than two years and not exceeding five years or to both such fine and imprisonment.

(3) Regulations may be made prescribing the means by which and the manner in which the fact that any road is a prohibited road for the purposes of this Ordinance may be brought to the notice of members of the public who have occasion to use that road

or to travel thereon.

51. No person shall shoot at any animal from any position in or on any moving or stationary vehicle of any kind.

52. No person shall use any artificial light, for the purpose of enabling or facilitating the destruction or the capture of any animal whether by dazzling the vision of any such animal, or by attracting any such animal to such artificial light or otherwise.

52A. No person shall shoot at, injure or kill any animal within a distance of one hundred yards from a water— hole or place where such animal usually goes to drink water.

53. Except in accordance with regulations, no person shall, on any State land or any public thoroughfare outside a National Reserve—

(a) hunt, shoot, kill or take any animal between sunset and sunrise;

(b) set, lay or spread any net, pitfall, trap, snare or other instrument for the purpose of killing or taking any animal; or

(c) construct or use any ambush, or hid on the ground or on a tree for the purpose of shooting or injuring any animal.

53A. No person shall use any poison, explosive or stupefying substance for the purpose of poisoning, killing or stupefying any animal.

53B. No person shall have in his possession, sell, expose for sale or transport the flesh of any animal which has been killed or taken by the use of any poison, explosive or stupefying substance.

Provided that no person is to be convicted under this section if he proves that he did not know and had no reasonable cause to believe that the animal whose flesh he is charged with having in his possession, selling, exposing for sale or transporting had been killed or taken by the use of any poison, explosive or stupefying substance.

53C. (1) In case of doubt or dispute, in a prosecution for an offence under Section 53B, as to whether any flesh is the flesh of an animal taken or killed by the use of any poison, explosive or stupefying substance a certificate purporting to be signed by a competent authority to the effect that the flesh in question is the flesh of an animal, which had been killed or taken by the use of any poison, explosive or stupefying substance, shall on production in any court of law be sufficient evidence as to the facts stated in such certificate, until the contrary is proved.

(2) In this section "competent authority" means—

(a) a Government Medical Officer; or

(b) a Government Veterinary Surgeon.

54. (1) No person shall at any restaurant, hotel, rest house or eating house, serve or authorize the serving of any food which constitutes or contains the flesh of any animal, the killing of which is at that time prohibited under this Ordinance.

(2) Any person who contravenes the provisions of subsection (1) shall be guilty of an offence and shall on conviction be liable to a fine not less than ten thousand rupees and not more than twenty thousand rupees or to imprisonment of either description for a term not less than two years and not exceeding five years or to both such fine and imprisonment.

55. (1) The Director may by a writing under his hand authorize any person to do any act otherwise prohibited or penalized under this Ordinance or any regulation made thereunder, if in the opinion of the Director such act should be authorized for the protection, preservation or propagation, or for the scientific study or investigation, or for the collection of specimens for a national zoo or national museum or for any university established or deemed to be established under the Universities Act, No. 16 of 1978, of the fauna and flora of Sri Lanka.

55A. In this Part of this Ordinance—

"animal" means any mammal, bird, reptile, amphibian, fish, coral or invertebrate and does not include a domestic animal as defined in section 11, or any tropical aquarium fish as defined in section 37".

(2) No person authorized under subsection (1) to do any act shall, by reason only of the commission of that act, be guilty of an offence under this Ordinance or any regulation made thereunder.

PART VI

GENERAL

LICENCES AND PERMITS

56. (1) The Director or any officer empowered to issue a licence or permit under this Ordinance or any regulation made thereunder may in his discretion—

(a) insert in any such licence or permit any condition which he may consider necessary or expedient;

(b) refuse to issue any such licence or permit;

(c) revoke any such licence or permit, by notice in writing to the person to whom such licence or permit was issued.

(2) Any person aggrieved by the refusal or revocation of any permit or licence (other than a licence under section 49) may appeal against such refusal or revocation to the Minister.

(3) Any person aggrieved by the refusal to issue a licence under section 49 or by the revocation of any licence issued under that section may appeal against such refusal or revocation to the Minister.

(4) The decision of the Minister on any appeal preferred under subsection (2) or subsection (3), as the case may be, shall be final and conclusive.

(5) Regulations may be made prescribing the time within which appeals shall be preferred and generally in respect of all matters incidental to or connected with the hearing or disposal of such appeals.

57. (1) No person other than the person named in any licence or permit issued under this Ordinance or any regulation made thereunder shall be entitled under cover of that licence or permit to do any act to authorize which that licence or permit was issued.

(2) Any person who transfers to any other person any licence or permit issued to him under this Ordinance or any regulation made thereunder shall be guilty of an offence and shall on conviction be liable to a fine not less than one thousand rupees and not exceeding two thousand rupees or to imprisonment of either description for a term not less than one year and not exceeding two years or to both such fine and imprisonment.

OFFENCES AND PENALTIES

58. Any person who does any act in contravention of any of the provisions of this Ordinance, or of any regulation, or of any condition inserted in any licence or permit issued under this Ordinance or any regulation, shall be guilty of an offence punishable, where no other penalty is expressly provided by this Ordinance, with a fine not less than two thousand rupees and not more than five thousand rupees or with imprisonment of either description for a term not less than one year and not exceeding two years or to both such fine and imprisonment.

58A. Notwithstanding anything in any other provisions of this Ordinance, where any person is convicted of the offence of killing, hunting, shooting, injuring or taking, or having in his possession or under his control, any wild elephant within a Nature Reserve or Sanctuary, he shall be liable to be punished with a fine not less than one hundred thousand rupees or to imprisonment of either description for a term not less than five years and not exceeding ten years or to both such fine and imprisonment".

59. Any person who attempts to commit or abets the commission of any offence under this Ordinance or any regulation made thereunder shall himself be guilty of the same offence.

60. (1) An act otherwise prohibited or penalised under this Ordinance or any regulation made thereunder, shall not be an offence, if it is done for the purpose of protecting any human being from any immediate danger or from injury by any wild animal.

(2) In this section "wild animal" means any wild animal as defined in section 11.

(3) The following provisions shall apply in any case where any wild animal is killed or

taken by any person in such circumstances that such killing or taking is not an offence by virtue of the operation of subsection (1):—

(a) such person shall forthwith report such killing or taking to any police officer or grama seva niladhari entitled to officiate in the area within which such killing of taking took place, or to any prescribed officer;

(b) such police officer or grama seva niladhari or prescribed officer, as the case may be, shall, upon the receipt of such report, investigate the circumstances in which such killing or taking took place and report the result of the investigation to the Director;

(c) such wild animal shall be the property of the State and accordingly such police officer or grama seva niladhari or prescribed officer, as the case may be—

(i) shall, if such wild animal was so taken, take over such wild animal for and on behalf of the State; or

(ii) shall, if such wild animal was so killed, take over the carcase of such wild animal for and on behalf of the State, and shall thereafter sell such carcase by public auction, issue a receipt in respect of such sale to the purchaser, and credit the proceeds of such sale to the Wild Life Preservation Fund.

(4) Any person who fails to report the killing or taking of any wild animal to any police officer or Grama Niladhari or prescribed officer as required by paragraph (a) of subsection (3) shall be guilty of an offence and shall on conviction be liable to a fine not less than one hundred thousand rupees and not more than two hundred thousand rupees or to imprisonment of either description for a term not less than two years and not exceeding five years or to both such fine and imprisonment.

63. It shall be lawful for a Magistrate summarily to try any offence under this Ordinance or under any regulation made thereunder, notwithstanding that the punishment specified for such offence is in excess of the ordinary jurisdiction of such Magistrate.,

64. (1) Except as herein before expressly provided in regard to the disposal of any elephant or of the carcase of any elephant or the tusks or tushes of any elephant, on the conviction of any person for an offence relating to an elephant, any animal or any part of any animal in respect of which any offence has been committed and any gun, vehicle, boat, artificial light, snare, net, trap, or other instrument, contrivance, appliance or thing used in, or for the commission of any offence, shall by reason of that conviction be forfeited to the State.

(2) Any property forfeited to the State under subsection (1) shall—

(a) if no appeal has been preferred to the Court of Appeal against the relevant conviction, vest in the State with effect from the date on which the period prescribed for preferring an appeal against such conviction expires;

(b) if an appeal has been preferred to the Court of Appeal against the relevant conviction, vest in the State with effect from the date on which such conviction is affirmed on appeal.

In this subsection, "relevant conviction" means the conviction consequent to which any property is forfeited under subsection (1). The Director shall take possession, on behalf of the State, of any property vested in the State under this section.

(3) In this section "animal" means any mammal, bird, reptile, amphibian, fish or invertebrate but does not include a domestic animal as defined in section 11.'.

65. Where a prosecution under this Ordinance or any other written law is instituted by an officer of the Department of Wild Life Conservation, the court may direct that one—half of any fine recovered in the case shall be paid into the Wild Life Preservation Fund which shall be maintained and operated on by the Director in the prescribed manner.

66. (1) Where a police officer or prescribed officer has reasonable grounds for believing that any person has committed an offence he may, subject to such restrictions as may be prescribed—

(a) require such person to produce for his inspection any animal or the carcase or part of the carcase of any animal in his possession, or any licence, permit or other document issued to him or required to be kept by him under the provisions of this Ordinance;

(b) stop and search any person or any boat, vessel or vehicle and open any package or container found on such person or carried in such boat, vessel or vehicle;

(bb) enter and search without warrant any hut, house, wadi or premises of any person, and question any person found in such hut, house, wadi or premises;

(c) seize any animal or the carcase or part of the carcase of any animal in the possession of any person and appearing to such officer to be the property of the State under the provisions of this Ordinance;

(cc) seize and take possession of any animal or the carcase or part of the carcase of any animal which may be produced in evidence of the offence;

(d) unless he is satisfied that such person will appear and answer any charge preferred against him, arrest and detain such person without warrant and seize anything in his possession which may be produced in evidence of his offence;

(e) seize any boat, vessel, vehicle, gun, cartridge, knife, torch, battery, or any other article or equipment which appears to such officer to have been used in the commission of the offence, or which may be produced in evidence of the offence.

(2) Any person who without reasonable cause fails to produce and hand over anything which a police officer or prescribed officer acting under the provisions of this section may require him to produce or hand over, shall be guilty of an offence.

(3) Any person who—

(a) fails or refuses to stop any boat, vessel, or vehicle when called upon to do so by a police officer or prescribed officer, or

(b) does not allow the search of any boat, vessel or vehicle by a police officer or prescribed officer, or

(c) refuses to be searched by, or obstructs or resists, or escapes or attempts to escape from the custody of, a police officer or prescribed officer acting under the provisions of the Ordinance; or

(d) does not allow entry into, or the search of, any hut, house, wadi or premises by a police officer or prescribed officer in the exercise of the powers conferred on such police officer or prescribed officer by subsection (1),

shall be guilty of an offence and shall on conviction be liable to a fine not less than five thousand rupees and not more than ten thousand rupees or to imprisonment of either description for a term not less than five years and not exceeding ten years or to both such fine and imprisonment.

(4) In this section "animal" means any mammal, bird, reptile, amphibian, fish, or invertebrate but does not include any domestic animal as defined in section 11.

66A. Any officer appointed for the purposes of this Ordinance under section 68—

(a) who is guilty or prevarication in any judicial trial for an offence under this Ordinance; or

(b) who wilfully fails in his duty to report any offence under this Ordinance,

shall be guilty of an offence and shall on conviction be liable to a fine of not less than ten thousand rupees and not more than twenty thousand rupees or to imprisonment of either description for a term not less than one year and not exceeding two years or to both such fine and imprisonment.

66B. Where any person is found offending against any part of this Ordinance, it shall be lawful for any prescribed officer to require the person offending to state his name and place of abode, and in case a person so offending

after being so required refuses to state his correct name or place of abode or states a name or place of abode which is incorrect, he shall be guilty of an offence and shall, on conviction, be liable to a fine not less than five hundred rupees and not more than one thousand rupees.

66C. (1) It shall be lawful for an officer of the Department of Wild Life Conservation or police officer or prescribed officer

(a) to require any person possessing, carrying or using a gun to produce the licence issued in respect of such gun under any written law;

(b) to enter and search any premises in which he has reasonable grounds for believing, that any person is manufacturing, selling, repairing or has in his possession any unlicensed gun;

(c) to stop and search any boat, vessel or conveyance in which he suspects that any unlicensed gun is being carried;

(d) to take into custody any unlicensed gun and produce such gun at the nearest police station or divisional secretariat.

(2) Any person who—

(a) fails to produce a licence in respect of any gun in his possession; or

(b) refuses to allow the search of any premises; or

(c) fails or refuses to stop any boat, vessel or conveyance when called upon to do so by an officer referred to in subsection (1), in contravention of the provisions of subsection (1),

shall be guilty of an offence and shall on conviction be liable to a fine not less than five thousand rupees and not more than ten thousand rupees or to imprisonment of either description for a term not less than two years and not exceeding five years or to both such fine and imprisonment.

66D.(1) Where any road is constructed within the boundaries of any National Reserve by any other agency, it shall be lawful for the Director or any officer of the Department of Wild Life Conservation to—

(a) erect barriers on any such road or any part of such road at any point within such National Reserve, in order to exercise control over access to the Reserve;

(b) make such arrangements as may be necessary for the opening and closing of such barriers, to facilitate access to, and from, such Reserve;

(c) stop and search, at such barriers, or on any road or part thereof any vehicle suspected to be connected with the commission of any offence under this Ordinance.

(2) No person shall, at any barrier erected under subsection (1) or on any road or part thereof within a National Reserve, fail to stop any vehicle when called upon to do so or fail to obey any direction lawfully given by the Director or other officer under subsection (1), and any person who fails to stop when so called upon or to obey any direction so given shall be guilty of an offence and shall on conviction be liable to a fine not less than five thousand rupees and not exceeding ten thousand rupees or to imprisonment of either description for a term not less than two years and not exceeding five years or to both such fine and imprisonment.

67.(1) For the purpose of preventing the commission of offences against section 8 of this Ordinance on any portion of any road running alongside a Strict Natural Reserve, National Park or Nature Reserve, Jungle Corridor, Refuge, Marine Reserve, Buffer Zone or Sanctuary—

(a) it shall be lawful for the Director to cause barriers to be placed across each end of that portion of the road, so as to enable vehicles to be stopped and searched thereat as hereinafter provided; and

(b) it shall be lawful for a prescribed officer to stop at such barrier any vehicle which is about to enter that portion of the road, and to search the vehicle and any person in the vehicle, for the purpose of ascertaining whether any gun is being carried therein, and in any case where any gun is so found therein, to require the person for the time being in charge of the vehicle to permit such officer or any other person specified by such officer to travel in that vehicle during the whole or any part of the journey to be performed on that portion of the road.

(2) Where the person for the time being in charge of any vehicle which is stopped at any barrier under subsection (1) refuses, upon being required so to do under that subsection, to permit a prescribed officer of any person specified by such officer to travel in the vehicle, it shall be lawful for the prescribed officer to take such steps as may be necessary to prevent the vehicle from proceeding beyond the barrier.

67A. Where any offence under this Ordinance is committed by any person in any part of the territorial sea, the Magistrate's Court having jurisdiction—

(a) over the part of the coast nearest to which the offence was committed; or

(b) over the place at which the person came ashore after the commission of the offence,

shall have jurisdiction to try the offence.

67B.(1) Notwithstanding anything to the contrary in the First Schedule to the Code of Criminal Procedure Act, every offence under this Ordinance shall be a cognizable offence and a bailable offence within the meaning of that Act.

(2) The Director and every prescribed officer shall have the power to release any person arrested under this Ordinance on bail or on such person executing a bond with or without sureties.

67C. The Director and every prescribed officer shall be deemed to be a peace officer within the meaning of the Code of Criminal Procedure Act for exercising, for the purposes of this Ordinance, any power conferred on peace officers by that Act.

67D. (1) The Director and, subject to the provisions of subsection (2), every prescribed officer shall exercise the powers that may be exercised in respect of cognizable offences by an inquirer, or by an officer in charge of a police station, under the provisions of Chapter XI of the Code of Criminal Procedure Act.

(2) The powers referred to in subsection (1) shall not be exercised by a prescribed officer in any place which is outside the limits of the area to which he is appointed.

(3) An inquiry under this section shall be held at or in the neighbourhood of the place in which the offence is alleged to have been committed.

67E. The provisions of the Code of Criminal Procedure Act relating to arrests, searches, search warrants, the release of persons arrested on bail or on the execution of bonds, the production of persons arrested, and the investigation of offences shall be held to be applicable to all action taken in these respects under this Ordinance.

67F. Where any person convicted of any offence under section 6 or section 7 in respect of any State land continues to be in unlawful or unauthorized possession or occupation of such State land or any portion thereof, the the district director of the district or area, or the officer of the Department of Wild Life Conservation in charge of the range in which such State land is situated may issue a notice on such person forthwith to vacate the land of which he is in unlawful or unauthorized possession or occupation and if he fails to do so he may be ejected from the land under the procedure prescribed by sections 120 to 127 (both inclusive) of the Land Development Ordinance as if—

(a) that land were a holding under that Ordinance,

(b) the notice issued under this section were a notice under section 119 of that Ordinance,

(c) the reference in section 124 of that Ordinance to the person whose grant has been cancelled were a reference to the person to whom a notice under this section has been issued, and

(d) the district director of the district or area in which that land is situate were the Government Agent exercising, discharging or performing in respect of a holding any power, duty or

function imposed upon or assigned to the Government Agent under that Ordinance.

APPOINTMENT OF OFFICERS AND ADVISORY COMMITTEE

68.(1) For the purposes of this Ordinance, there may be appointed—

(a) a person by name or by office to be or to act as Director, or as Deputy Director, Wildlife Conservation,

(a) a person by name or by office to be or to act as district director, Wildlife Conservation, for any specified district or area;

(c) a person to act as an honorary district director, Wildlife Conservation, for any specified district or area;

(d) such other officers and servants as may, from time to time, be required.

(2) In the exercise of their powers and in the discharge of their duties under this Ordinance all persons, officers and servants appointed under this section shall be subject to the general direction and control of the Minister.

(3) All persons, officers and servants appointed under this section shall be deemed to be public servants within the meaning of the Penal Code.

69. The Director may with the approval of the Minister delegate to any district director or to any honorary district director in respect of his district or area any power or duty conferred or imposed on the Director by this Ordinance or by any regulation made thereunder.

70.(1) The Minister may appoint an Advisory Committee which shall consist of the Secretary to the Ministry in charge of the subject of Wild Life Conservation as Chairman, the Director and ten other persons for the purpose of advising the Director and making recommendations to the Minister on all matters and questions relating to the fauna and flora of Sri Lanka.

(2) Meetings of the advisory committee shall be held at least four times in every year.

(3) The advisory committee shall be entitled to determine its own procedure in any matter of procedure for which no provision is prescribed.

GENERAL REGULATIONS

71.(1) The Minister may make regulations for the purpose of carrying out or giving effect to the principles and provisions of this Ordinance.

(2) In particular and without prejudice to the generality of the powers conferred by subsection (1), the Minister may make regulations for or in respect of all or any of the following matters:—

(a) the circumstances in which and the conditions subject to which the Director may exercise the powers conferred on him by section 55;

(b) the circumstances in which and the conditions subject to which any licence or permit may be issued free of charge;

(c) the fee to be paid for any licence or permit issued under this Ordinance or under any regulation, and the mode and manner of payment of recovery of any such fee;

(d) the prohibition or regulation of the import, manufacture, sale, possession or the use of any speargun or of any head-gear so constructed as to be capable of being fitted with any lamp or artificial light or of any lamp constructed so as to be capable of being fitted into any head—gear;

(e) the period of office of the members of the advisory committee appointed under section 70, the manner in which meetings of that committee shall be convened, the procedure to be followed at such meetings, and the manner in which the recommendations of that committee shall be made;

(g) the establishment and administration of the "Wildlife Preservation Fund" and the purposes for which that Fund may be employed; and

(h) all matters for which regulations are required or authorized to be made under this Ordinance, all matters stated or required by this Ordinance to be prescribed, and all other matters incidental to or connected with such matters.

(3) Every regulation made by the Minister shall be published in the *Gazette* and shall come into operation on the date of such publication or on such later date as may be specified in such regulation.

(4) Every regulation made by the Minister shall, as soon as convenient after its publication, be brought before Parliament for approval. Any regulation which is not so approved shall be deemed to be rescinded as from the date of disapproval but without prejudice to anything previously done thereunder. Notification of the date on which a regulation is deemed to be rescinded shall be published in the *Gazette*.

INTERPRETATION AND SAVINGS

72.(1) In this Ordinance, unless the context otherwise requires—

"Buffer Zone" means a Buffer Zone constituted by Order under section 2 (1);

"coast" means the border of land which is adjacent, to the sea and not covered by sea water;

"cultivated land" includes land used for chena cultivation when a crop is growing on such land;

"Director" means the person appointed to be or to act as the Director, Wildlife Conservation, for the purposes of this Ordinance, and includes the Deputy Director, Wildlife Conservation, appointed for such purposes;

"district director" means a district director, Wildlife Conservation, appointed for the purposes of this Ordinance;

"Invertebrate" means a member of the phyla, protozoa, porifera (Sponges), coelentreata, arthropoda, mollusca, annelida;

"gun" has the same meaning as in the Firearms Ordinance and includes a speargun or a "cap-chur" gun;

"honorary district director" means an honorary district director, Wildlife Conservation, appointed for the purposes of this Ordinance;

"Jungle Corridor" means a Jungle Corridor for elephants constituted by Order under section 2 (1);

"local authority" means Municipal Council, Urban Council or Pradeshiya Sabha and includes any authority created and established by, or under, any law to exercise, perform or discharge powers, duties and functions corresponding to, or similar to powers, duties and functions exercised, performed and discharged by any such Council or Sabha;

"Marine Reserve" means a Marine Reserve constituted by Order under section 2 (1);

"National Park" means a National Park constituted by Order under section 2 (1);

"National Reserve" means a National Reserve constituted by Order under section 2 (1);

"Nature Reserve" means a Nature Reserve constituted by Order under section 2 (1);

"offence" means an offence under this Ordinance or under any regulation;

"police officer" means a member of an established police force and includes a police reservist;

"prescribed" means prescribed by this Ordinance or by regulation;

"Refuge" means a Refuge, constituted by Order under section 2 (1);

"public corporation" means any corporation, board or other body which was, or is established, by or under any written law other than the Companies Act, with funds or capital wholly or partly provided by the Government by way of grant, loan or otherwise;

"regulation" means a regulation made by the Minister under this Ordinance;

"Sanctuary" means a Sanctuary constituted by order under section 2 (2);

"Sri Lanka" includes the territorial sea of Sri Lanka;

"State land" means land to which the State is lawfully entitled or which may be disposed of by the State together with any building standing therein, and with all rights, interests and privileges attached or appertaining thereto, and shall be deemed to include land vested in, or under the control of the River

Valley Development Board and the Mahaweli Development Board or any other authority charged with the function of developing State land, or in any local authority;

"Strict Natural Reserve" means a Strict Natural Reserve constituted by Order under section 2 (1);

"territorial sea" means the area declared as the territorial sea of Sri Lanka by Proclamation, made under the Maritime Zones Law, No. 22 of 1976;

"tourist" means any local or foreign visitor who enters any national park;

"tourist hotel" means an organisation, institution or an enterprise which provides not less than ten rooms for accommodation;

"vertebrate", means a member of the class of pisces, amphibia, reptilia, aves or mammalia; and

"wild life" means, plants and animals which owe their existence to natural phenomena or processes that occur autonomously.

(2) Any reference in this Ordinance or in any regulation or in any other written law to a Schedule of this Ordinance shall be deemed to be a reference to the Schedule for the time being in force.

73. Every licence issued by any authority under any written law repealed by Ordinance No. 2 of 1937 for the doing of any act for which a licence is required by this Ordinance shall be valid and continue in force until the expiration of the period for which it was granted.

74. All such proclamations, notifications and orders issued, and all such regulations and rules made, and all such concessions, permissions and authorizations given, and all such royalties fixed under any written law repealed by Ordinance No. 2 of 1937 as are in force at the date on which this Ordinance comes into operation shall so far as they relate to matters for which provision may in any manner be made under this Ordinance and so far as they are not inconsistent with the provisions of this Ordinance, continue in force unless or until provision in regard to such matters is made in accordance with the provisions of this Ordinance.

75. The provision of the Fisheries Ordinance shall cease to be in operation in any National Reserve or Sanctuary as from the date on which such National Reserve or Sanctuary is duly constituted under section 2; but, subject as aforesaid, the provisions of that Ordinance shall continue to be in operation in any area outside a National Reserve or Sanctuary.

[Editor's note— Provisions of Act No. 49 of 1993 which remain uncorrelated to the principal enactment—]

69. The Minister or any person authorised by the President by instrument under his hand may sign, on behalf of the Government of Sri Lanka, any international agreement or convention relating to wild life.

70. In the event of any inconsistency between the Sinhala and Tamil texts of this Act, the Sinhala text shall prevail.

71. Schedules I, II, III, and IV to the principal enactment are hereby repealed, and the following Schedules substituted therefor—

[Editor's note— A summary of the Schedules (with emended spellings) for vertebrates is given below; the schedules for invertebrates, plants and trees are not reproduced.]

Schedule I
List of mammals and reptiles that are not protected

Wild Boar	*Sus cristatus*
Black-naped Hare	*Lepus nigricollis*
Indian Crested Porcupine	*Hystrix indica*
Rats and mice (except the endemic species)	*Rattus rattus*
	Rattus norvegicus
Torque Monkey or monkey (other than Hill Monkey)	*Macaca sinica sinica*
Grey Langur	*Semnopithecus entellus*
Cobra	*Naja naja*
Indian Krait	*Bungarus caereleus*
Sri Lanka Krait	*Bungarus ceylonicus*
Russel's Viper	*Vipera russelii*
Saw-scaled Viper	*Echis carinata*

Schedule II
List of birds that are not protected

Black Crow	*Corvus macrorhynchos culminatus*
House Crow	*Corvus splendens protegatus*
House Sparrow	*Passer domesticus ora*
Spotted Munia	*Uroloncha punctulata lineoventor*
White-backed Munia	*Uroloncha striata striata*
Striated Weaver	*Ploceus manyar flaviceps*
Rose-ringed Parakeet	*Psittacula krameri manilensis*

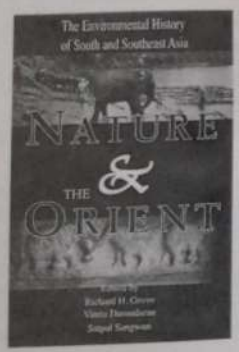
Schedule III
List if amphibians that are protected

Bufo Atukoralai
Adenomus kelaartii
Limnonectes corrugatus
Rana gracilis
Limnonectes greenii
Nannophrys ceylonensis
Nannophrys guentheri
Nannophrys marmorata
Polypedates cruciger
Polypedates eques
Rhacophorus microtympanum
Philautus nasutus
Theloderma schmarda
Ramanella palmata
Ramanella obscura
Microhyla zeylanica
Ichthyophis glutinosus
Ichthyophis pseudangularis
Ichthyophis orthoplicatus

Schedule IV
List of fish that are protected

Two-spined Angelfish	*Centropyge bispinosus*
Regal Angelfish	*Pygoplites diacanthus*
Clown Coris	*Coris aygula*
Bicolour Wrasse	*Labroides bicolor*
Lionfish	*Pterois radiata*
Batfish	*Platax pinnatus*
Green Labeo	*Labeo fisheri*
Orange-fin Labeo	*Labeo porcellus*
Asoka Barb	*Puntius asoka*
Martenstyn's Barb	*Puntius martenstyni*
Blotched Filamented Barb	*Puntius srilankensis*
Bandula Barb	*Puntius bandula*
Wilpita Rasbora	*Rasbora wilpita*
Redneck Goby	*Schismatogobius deraniyagalai*
Red tailed goby	*Sicyopterus halei*
Lipstick Goby	*Sicyopus jonklaasi*
Smooth-breasted Snakehead	*Channa orientalis*
Jonklaas's Louch	*Lepidocephalichthys jonklaasi*
Golden Butterflyfish	*Chaetodon semeion*

New Books

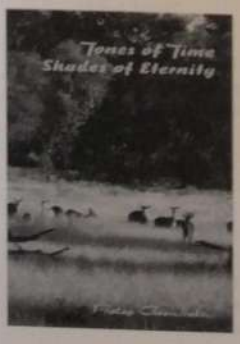


Nature & the Orient: the environmental history of South and Southeast Asia

R. H. Grove, V. Damodaran & S. Sangwan (Editors).

1998. Oxford University Press, Delhi. 1036 pp. ISBN 019563896-4

A magnificent account of how our lands were shaped by the historical past; includes a chapter on environmental issues in Sri Lanka in the period 1840–1940 (pp. 793–827), by Eric Meyer.



Tones of Time, Shades of Eternity

By Pratap Gooneratne.

2000. WHT Publications, Colombo. 312 pp. ISBN 955-9114-23-9

Pratap Gooneratne presents the product of a lifetime of nature photography, including dozens of pictures from now-inaccessible national parks such as Wilpattu and Kumana. None of the *ca.* 600 spectacuar photos in this book have previously been published. This large-format (3 kg) book is designed for every nature-lover's coffee table.

Haematological Parameters of four Sri Lankan Terrestrial Small-mammal Species

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Abstract

Baseline haematological data from terrestrial small mammals are lacking in Sri Lanka. However, such data are extremely useful in evaluating toxic effects on animals. Aim of this study was to obtain such data from four species of terrestrial small mammals, viz. *Rattus norvigicus* (N=30), *R. rattus* (N=23), *Suncus suncus* (N=13) and *Mus musculus* (N=8) inhabiting Pilikuththuuwa, a relatively undisturbed and unpolluted forest patch situated in the Gampaha District. Blood samples were collected using aseptic precautions over a period of one year and were subjected to haematological analysis using standard techniques (Total White Blood Cell (WBC) counts, Red Blood Cell (RBC) count, Packed Cell Volume (PCV), Bleeding Time, Hemoglobin Concentration (Hb), Mean Corpuscular Volume (MCV) and Mean Corpuscular Haemoglobin Concentration (MCHC). The results show significant interspecific differences in all parameters except WBC count. Further, all parameters were significantly different between *Suncus suncus* and *Mus musculus*. These results provide baseline haematological data for these four species of wild, terrestrial small mammals in Sri Lanka.

Introduction

Sri Lanka has a rich diversity of wild mammals of which 30% are terrestrial small mammals (Phillips, 1984). Baseline data of hematological parameters of Sri Lankan terrestrial small mammals are almost absent . Haematological data are, however, available for small laboratory mammals, but they are not absolutely valid for outdoor conditions in the wild. Further, such data is extremely useful in evaluating toxic effects of environmental chemicals, in estimating nutrient status and in diagnosis of various disease conditions. Recently, in the course of another study, we had the opportunity of capturing four species of terrestrial small mammals, viz. the rodents *Rattus norvigicus, Rattus rattus, Mus musculus* and the shrew *Suncus suncus* from Pilikuththuwa, an undisturbed and unpolluted large forest patch (*ca.* 1,000 ha.) in the Gampaha District in Sri Lanka's wet zone (rainfall > 2,500 mm/yr). Pillikuththuwa (80°03'E 7°03'N) is situated 25 m above the surrounding terrain. We report data of some haemetological parameters of the four species of terrestrial small mammals recorded over a period of one year.

Materials and methods

The study was carried out between August, 1997 and August, 1998. Sherman (10–15) and wire-mesh (10–15) traps baited with charred coconut and/or dry fish were set at the pre-determined trap-line at 10 m intervals at 1600–1800 h at least 4 times a month. Traps were checked following morning (0600–0800 h). Using mild anaesthesia, the trapped animals were weighed and the following parameters were recorded for identification purposes: colour of pelage; body weight; head length; inter-orbital width; ear length; inter ear length; body length; tail length; hind foot length; and sex .

Blood samples were collected under aseptic precautions and the animals released. Total White Blood Cell (WBC) counts, Red Blood Cell (RBC) count, Packed Cell Volume (PCV), Bleeding time, Hemoglobin Concentration (Hb), Mean Corpuscular Volume (MCV) and Mean Corpuscular Haemoglobin Concentration (MCHC) were estimated as described by Cheesbrough *et al.* (1976). Statistical comparisons were made using Kruscal and Wallis tests and Mann-Whitney U-tests, the significance level set at $p<0.05$.

Results

The results are summarised in Table 1. For the four species investigated, significant interspecific differences were seen in all parameters except WBC count. Among the rodent species, RBC count, WBC count, PCV, MCV and Hb values were significantly higher ($P<0.05$) in *R. rattus*. Further, in *R. norvigicus*, RBC count and MCV values were significantly higher in males than in females. In addition to the above-mentioned parameters, in *R. rattus*, WBC count and Hb values were significantly higher ($P<0.05$.) in males in comparison with females. In contrast, all the investigated blood physiological parameters between *S. suncus* and *M. musculus* were significantly different.

Discussion

This is the first study to report haematological parameters of wild terrestrial small mammals in Sri Lanka. This study provides both reference and baseline data for evaluating haematological effects of environmental pollutants and chemicals in future studies.

Pollution of the environment by various human

Table 1. Some hematological values of *Rattus norvigicus, Rattus rattus, Suncus suncus* and *Mus musculus*. (Mean ±SD; ranges are in parantheses). Rn: *Rattus norvigicus*, Rr: *Rattus rattus*, Ss: *Suncus suncus*, Mm: *Mus musculus;* RBC: Red Blood Cell Count, WBC: White Blood Cell Count, PCV: Packed Cell Volume, BLTIM: Bleeding Time; Hb: Haemoglobin Concentration, MCHC: Mean Corpuscular Haemoglobin Concentration, MCV: Mean Corpuscular Volume; M: male, f: female, p: pooled; a: significantly different from Rn, b: significantly different from Rr, c: significantly different from Ss, d: significantly different from Mm.

Species	RBC x10*1	WBC 1^{-1}	PCV %	BLTIM min	Hb dl^{-1}	MCHC gdl^{-1}	MCV mm
Rn(m)	7.9±1.1 (6.3-8.2)	19475±771 (18270-20030)	32.2±2.2 (28.9-34.5)	60.0±1.0 (58.1-62.0)	11.25±0.8 (11.0-12.9)	35.7±3.7 (32.2-36.3)	40.2±2.1 (39.2-43.1)
Rn(f)	5.8±0.42 (5.5-6.5)	18820±735 (17200-18970)	31.5±0.7 (29.9-31.9)	59.0±1.4 (57.5-59.9)	11.1±1.4 (11-11.9)	35.2±3.2 (31.4-35.9)	54.1±1.7 (53.9-55.6)
Rn(p)	6.9±0.92 Bd	19148±752 d	31.9±1.6 bc	59.5±1.2 dc	11.15±0.11 bd	35.5±3.45 bc	47±1.9 bc
Rr(m)	8.0±0.4 (7.3-8.2)	20778±445 (19220-21000)	41.5±1.1 (40.2-42.1)	60.1±0.3 (59.9-60.5)	13.1±0.65 (12.5-13.7)	33.4±.4 (31.2-34.5)	57.1±.9 (56.1-57.3)
Rr(f)	6.2±0.63 (5.9-6.9)	18056±654 (17720-19200)	39.5±0.3 (39.1-40.5)	58.3±0.45 (52.3-59.6)	11.9±0.32 (11.5-12.1)	29.5±.3 (28.1-31.9)	55.9±.9 (54.1-57.1)
Rr(p)	7.1±0.8 a	19417±447 d	40.0±2.6 acd	59.2±1.5 cd	12.5±0.8 ad	31.2±2.9 acd	56.2±1.1 acd
Ss(m)	7.8±1.8 (7.2-8.9)	20711±543 (19200-21300)	44.1±3.8 (39.1-45.5)	54.0±3.2 (52.3-55.6)	12.1±0.4 (11.9-13.6)	27.2±0.3 (25.9-28.1)	59.3±1.6 (57.1-59.9)
Ss(f)	6.4±07 (5.9-7.2)	18225±435 (17200-19340)	42.5±2.3 40.9-44.4)	52.17±0.5 (50.5-56.1)	11.0±0.4 (10.8-12.1)	26.0±0.5 (25.5-28.1)	55.3±1.3 (54-56.5)
Ss(p)	7.1±2.1 d	18050±626 d	43.1±45.6 abd	53.0±2.8 abd	11.5±0.7 d	26±0.64 abd	57±59 abd
Mm(p)	7.0±2.1 6.1-7.9 ac	12333±1026 12000±13200 ac	33.01.7 (31-33.2) bc	52.6±3.7 (50.0-54.1) ab	11.3±0.75 (10.9-12.1) abc	34.24±1.1 (32.5-43.6) abc	47±1.3 (46-47.3) cb

activities such as industry, agriculture and motor traffic is increasingly evident in Sri Lanka (Anon., 1991). Blood chemistry is sensitive to, and may affected by, environmental pollutants (Dmowski *et al.* , 1998). A number of pollutants are known to cause haematological changes in mammals. These include toxic trace elements (Corpas and Antonio, 1998; Martin and Black, 1998) and pesticide residues (Safer *et al.*, 1999; Sharma and Sharma, 1999). Further, Hb and PCV levels are known to reflect nutritional deficiencies of some minerals and proteins (Wolkers *et al.*, 1993). The high values seen in these two parameters in this study suggest that these four species of small mammals in the Pilikuththuwa forest are in good nutritional status. In addition, heavy metals such as lead, cadmium , mercury and some pesticides have been reported to cause anaemia in animals including mammals (Heath, 1995). Since the data obtained for four species of small mammals do not show a low RBC count, PCV, Hb and MCV, it seems that the mammals recorded have not so far been exposed to significant amounts of these

pollutants. Further, in this study, the haematological parameters of the male *Rattus* and *Suncus* species were higher than their respective females, as reported also with laboratory species of rodents (Schermer, 1958).

In conclusion, it is vital to record baseline data where ever possible on blood parameters as recorded in this study, since they are of immense value not only to study the biological impacts of pollutants on wild animals but also in diagnosis, prognosis and therapy of wild animals maintained in zoos.

Acknowledgements

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Destroy them not!

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Under the star lit skies, serene in the Yala park
Animals roam at random, a haven in the dark
The trumpet of the elephant, chose at hand
The call from the Samburs, from there it stands

In between you hear, the leopard growl
Cooing in fear, trembles the jungle fowl
All these under the canopy of a star lit sky
Out of this world, comes a terrible cry

For man has intruded this kingdom for fun
And aimed at an animal, blast goes the gun
Animal and bird all species on earth
Has a right to live, as man from his birth

Man is far from an animal, yet they fear his same
The gaggle the rabbit, they are killed in his game
These dumb friends, against man they cannot appeal
Destroy them not to suit your meal!

Kombi

N. T. Ariyaratna

Kombi, the last of the children of Tissahamy made famous by Dr. R. L. Spittel in *Savage Sanctuary*, is spending her twilight years at Mahakandiya, Ampara, far away from the jungles she was born and grew up. I met her last June, collecting firewood about a kilometre from her home. A mother of seven children and locally known as Vedi Aachchi, she is accustomed to a lonely life: as a child, on several occasions, she was hidden for days by her father, playing hide and seek with the police.

Well-wishers have constructed a brick-walled all-purpose room for her with a thatched roof, now badly in need of repair. Though visitors come, she is bitter that no one has offered to repair the roof.

At an estimated 86 years of age, her eyesight is almost gone and her memory is clearly failing. However, she is physically active and prefers to cook her own meals. On the day of our visit, her lunch consisted of rice and a *mallum*, which she offered to share with us. She says she used to sleep on a *messa*, but with her eyesight failing, she now prefers to sleep on the floor.

Kombi is the last of a generation that witnessed the transformation of the sprawling landscape of lower Uva, almost entirely forested and teeming with wildlife fifty years ago. She remembers her adventurous childhood and has proud memories of Tissahamy, her father.

The New National Wildlife Policy

The full text of the government's proposed National Wildlife Policy is given below. The policy was developed by a task force appointed for this purpose by the Minister of Public Administration and Home Affairs. The Society was represented on the task force by the president, Ravi Deraniyagala. Future foreign aid to the wildlife sector, and legal reform, are expected to be based on the principles outlined in this policy statement. Significant deviations from existing practice include the principle of 'wise use', private-sector participation and the encouragement of scientific research in management and conservation systems.

Preamble

The idea of **conservation** has evolved over time to its present-day meaning of managing the Earth's living resources for the benefit of people and others alive today, without threatening the interests of those who will be alive tomorrow. This is linked to the idea of **sustainable development**, which can be described as seeking happiness and prosperity for all in ways that show we intend to stay on Earth, rather than to loot it and move on. Thus, the key to conservation is to have **compassion** for people living in the future or far away, and for the other forms of life that share our world, while also showing an enlightened self-interest towards ourselves and our immediate society.

Conservation is important because the Earth's living resources are valuable. Natural ecosystems, for example, help maintain supplies of fresh water, and protect people from floods, land-slides, soil erosion, siltation and the effects of climate change. Wild species depend on such ecosystems and can be used as important sources of foods, medicines and other subsistence and trade goods, while providing opportunities for recreation, tourism, science and education. Genetic resources are contained within wild species and can be used to improve crop plants and livestock breeds, for instance by making them resistant to pests and diseases. For these reasons, a comprehensive and effective approach to the sustainable management of protected areas and wildlife resources is needed.

The first *National Policy on Wildlife Conservation 1990* was approved by Cabinet in June 1990. The present *National Wildlife Policy* addresses many of the same issues in updated form, while also adding some points that respond to the evolving needs of Sri Lankan society and the additional mandates of the Convention on Biological Diversity, which Sri Lanka ratified in 1994. The Convention is important because it provides a new context for managing wildlife resources, by emphasizing the three themes of **conservation**, **sustainable use** and **benefit sharing**, and by recognizing that these must be balanced and linked if sustainable development is to be achieved.

The *National Wildlife Policy* renews the commitment of Government to conserve wildlife resources for the benefit of present and future generations, while assuring the sustainable use of this resource for education, recreation and research in a transparent and equitable manner. It does so by linking together the activities, interests and perspectives of the people who use and benefit from wildlife resources with those of professional wildlife managers and scientists*. It is the intention of Government to define a strategy to implement this Policy as soon as possible through a *Biodiversity Conservation Action Plan*, supported by such legislative measures as may be necessary to achieve harmony and success among all those who seek to promote conservation and sustainable development in Sri Lanka.

NATIONAL WILDLIFE POLICY FOR SRI LANKA

1. Objectives of the National Wildlife Policy

The Objectives of this National Policy are:

1.1 **To conserve wildlife resources**, through protection, research, education, sustainable use and benefit sharing, for the benefit of present and future generations.

1.2 **To maintain ecological processes and life-sustaining systems**, with particular regard to primary production, hydrological balance, nutrient cycles, and prevention of erosion, siltation, drought and flood.

1.3 **To manage all components of genetic diversity**, as resources to improve crop plants and farm animals, and to develop in a fair and equitable manner new products and processes through bioprospecting.

1.4 **To ensure sustainable use and equitable sharing of benefits** arising from the direct and indirect use of wildlife resources and ecosystems.

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* In articulating these commitments, technical terms are used that are explained in Annex 1.

1.5 **To conserve native and endemic species and their habitats**, so as to maintain the overall species richness and ecological integrity of the country.

1.6 **To encourage the development of biological repositories**, for the purposes of conservation, education and science.

1.7 **To encourage the private sector and communities to join as a full partners** in all aspects of the wildlife-conservation process.

2. Policy on Protected Area Management and Wildlife Conservation

National Policy in this area is:

2.1 **To develop national strategies, plans and programmes for wildlife conservation**, in line with appropriate national and international standards.

2.2 **To protect viable and representative samples of all ecosystems**, including sites of special scientific interest, and wherever necessary to enlarge and connect protected areas to create viable conservation units.

2.3 **To take urgent steps to conserve all remaining natural wet zone forests**, which are under-represented in the national system of protected areas.

2.4 **To identify, classify, manage and monitor all protected areas**, on the basis of appropriate scientific studies and agreed criteria.

2.5 **To manage all protected areas according to approved management plans**, which will be reviewed and revised regularly, and implemented by staff at the field level who will be afforded such authority and resources as they need to do so effectively.

2.6 **To ensure that protected areas are internally zoned according to accepted criteria**, to reflect the different resources within each zone and the most appropriate sustainable use of those resources.

2.7 **To manage all protected areas in the context of their surrounding landscapes**, taking into account the ecological, social and economic links between natural and human systems.

2.8 **To promote active, ecosystem-based management of all protected areas**, including the eradication wherever possible of alien and invasive species, subject to thorough consideration of the environmental impacts of these interventions.

2.9 **To regulate the importation of alien organisms**, including genetically-modified organisms, so as to minimize risks to the integrity of Sri Lanka's biodiversity.

2.10 **To prepare and implement species recovery plans for all endangered species**, using objective criteria for their identification developed by a national task force or other expert consultative mechanism.

2.11 **To encourage and enable the sustainable development of communities living around protected areas**, by ensuring that local people are consulted in the process of decision making, actively participate in implementation, and receive direct benefits from the management of protected areas.

2.12 **To facilitate ecotourism in protected areas**, to the extent that it provides benefits to local people and does not damage the ecosystems concerned.

3. Policy on Institutional Support for Wildlife Conservation

National Policy in this area is:

3.1 **To provide adequate support to wildlife resource managers**, and to reorient, strengthen and decentralize their institutions as necessary to enable them to accomplish their tasks effectively.

3.2 **To amend or revise legislation** as necessary to support the implementation of this policy.

3.3 **To promote research and education** as valuable contributors to the national effort on wildlife conservation.

3.4 **To value the traditional knowledge of sustainable ecosystem use possessed by the people of Sri Lanka**, and incorporate this as appropriate within wildlife-management systems.

3.5 **To encourage *ex-situ* conservation measures**, where they can be shown to contribute to wildlife conservation, environmental education and the scientific understanding of how to use biodiversity sustainably.

4. Policy on Inter-sectoral Linkages

National Policy in this area is:

4.1 **To monitor events and take actions needed to maintain consistency** between the *National Wildlife Policy* and other sectoral and inter-sectoral policies.

4.2 **To promote co-operation among stakeholders** through particpatory decision making at all levels.

ANNEX 1: DEFINITIONS OF KEY CONCEPTS

Biological diversity: The total variety of living things at the genetic, species and ecosystem level.

Biological repository: A collection of organisms or other living material, such as a botanical or zoological garden, an aquarium, butterfly farm, insect house, bird park, aviary, or a germ-plasm collection; or a collection of preserved specimens established for scientific research, such as a museum.

Bioprospecting: The search for commercial products and processes using biodiversity as a source of information and as a stimulant for new ideas.

Ecosystem: All the organisms in a particular place and time, including all the relationships amongst them, together with all the physical features of light, heat, moisture, wind and chemistry that affect them.

Ecotourism: Nature-based tourism that is sustainable, includes environmental education and supports conservation.

Endemic: An organism that occurs naturally only in a named place.

Environment: Everything that surrounds an organism and affects it.

Protected area: An area set aside primarily to preserve natural ecosystems, to maintain ecological processes and to manage populations of native wildlife.

Species: A group of organisms capable of interbreeding freely with each other but not with members of other species, usually identified using distinguishing physical characteristics.

Stakeholder: Someone with an interest in what happens to a resource, usually because there is something to be gained or lost in a dispute over it.

Sustainable development: A process by which the needs of current or local people are met in ways that preserve or enhance the ability of future or distant people to do the same.

Wildlife: Plants and animals that owe their existence to natural phenomena or to processes that occur autonomously.

Society News

President's Profile

Mr. Ravi Deraniyagala is the Society's President for the Year 2000/2001. He has been a member of the Society for over 30 years and has served the Society, as its Honorary General Secretary for six consecutive years, including the Centenary Year in 1994 and thereafter, as its Vice President.

Mr. Deraniyagala an old boy of St. Thomas' College, Mt. Lavinia, was a School Prefect and excelled in his academic studies and sports career, representing the College in 4 sports. He hails from a distinguished family, that has served the cause of conservation for decades. His Uncle, Dr. Paul E. P. Deraniyagala, author of many publications was the former Director of National Museums (1936–1963) and was considered an authority on the Asian Elephant. His cousin, Dr. Siran U. Deraniyagala is the present Director General of Archaeology.

Mr. Deraniyagala was appointed in 1996 and continues to serve as a Member of the Fauna & Flora Protection Advisory Committee, an appointment under the Fauna & Flora Protection Act of Parliament. He also serves as a Member of the Presidential Task Force formulating the National Policy for Wildlife Conservation for Sri Lanka and served as a member of the Select Committee appointed to draw up the Elephant Conservation Policy for Sri Lanka. He is a Life Member of the Natural History Society of Sri Lanka and is actively associated with the Field Ornithology Group of the University of Colombo. He is also a Life Member of the Royal Asiatic Society and is a Fellow of the Royal Commonwealth Society, and serves the Sri Lanka branch, as its Honorary General Secretary.

A Chartered Banker, Mr. Deraniyagala has successfully completed his advance studies at the University of Pittsburg, USA and the Cranfield School of Management, U.K. A Fellow of the Association of Business Executives (London) he won prizes for Finance and Strategic Management and was awarded the coveted ABE Challenge Shield for the best results in the final examination. A widely travelled banker his work has taken him to many parts of the world and and he was selected to lead the banking delegation to the Republic of China.

Mr. Deraniyagala has traveled intensively in the National Parks of Sri Lanka. He has also visited the National Parks of India, East Africa, South Africa, including the Kruger National Park and the game reserves of the Table Mountains in Cape Town. This year he attended the IUCN second World Conersation Congress in Jordan.

Mr. Deraniyagala carries a new vision for the Society to face the challenges of the millennium, ever mindful of the Society's objectives and the need to conserve for the future, Sri Lanka 's wildlife, nature and the environment.

We wish him well.

Letters to the Editor

Erratum

Sir—

"Fishes in trouble: the decline of Sri Lanka's freshwater fauna" (*Loris*, 22(2): 64) carried pictures of three 'point-endemics', the lowest of which is captioned 'Babdula Barb (*Puntius bandula*)'. However, this picture looks to me like a goby. Please clarify the identify of this species.

K. B. Ranawana
Senior Lecturer in Zoology

Editor's note. As several sharp-eyed readers pointed out, this fish is in fact a goby, *Schismatogobius deraniyagalai*, which, because it occurs also in India, is not in fact a point endemic. The Bandula Barb, which *is* a point endemic, was meant to have been figured here. [*N.b.* The Editor was also the author of the article in question].

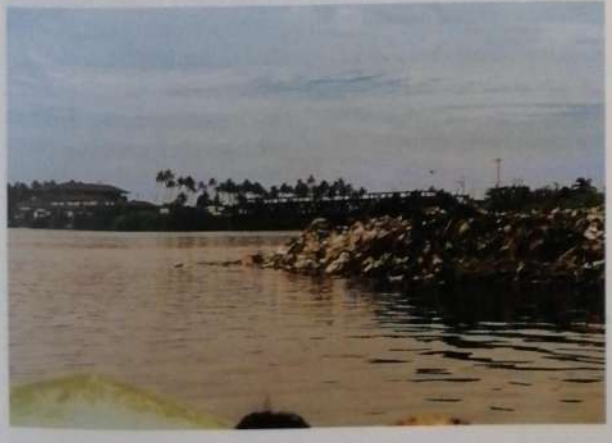
Garbage in the Bentota Mangrove

Sir—

I spent the Sinhala New Year holidays at the Bentota Spit in a private bungalow. Taking a boat ride to view the mangroves, having gone under both bridges and travelled 400–500 yards upstream, we came upon a most unfriendly sight: the town waste was being dumped into the lagoon. The heap of garbage has over the years built up to a mound some 50×100–150 feet long and 20 feet high, entirely in what used to be the lagoon. A sight I have never seen before was egrets feeding on the rubbish. I took this photograph showing the town's dump (the bridges and Bentota Beach Hotel are in the background).

One wonders what the local authorities and the CEA are doing about this disgusting sight—one the tourists visiting the mangroves will no doubt look at in horror. Are the authorities aware of this health hazard?

Vernon Tissera,
Helbodde, Katukitula.



The vanishing cry of the cuckoo

Sir—

The incessant cries of the koha (a.k.a. koel or cuckoo), herald the approach of the Sinhala–Hindu New Year each April, and may be heard even after this festive season.

Having lived in the Walawe region for well-nigh 30 years, having worked with the precursors of the present-day Mahaweli Authority, I have noted with concern that during the last three or four years, the koha's seasonal cries, formerly building to a great crescendo during this period, were barely heard: its call appears to be waning.

In the recent past, some observers living in the Colombo suburbs like Homagama, Battaramulla, Kosgama had reported in the newspapers that the cuckoo's loud renderings had not been heard as much as before during April new-year season. Their customary new-year calls are now barely heard.

Some cuckoo species, like the Red-faced Malkoha and the Blue-faced Malakoha, which lay eggs in their own nests which they build themselves, are non-parasitic. Others, like the koel, the Pied Crested Cuckoo, Bay Banded Cuckoo and the Ceylon Hawk Cuckoo (the largest of our cukoos), lay their eggs in other birds' nests.

This species of the koha-koel has the female speckled *gomara*— an idyllic poetic term used in Sinhala prose and verse to describe the spotted complexion of the female of this species. It is this particular koha-koel that renders its sonourous cheers around the time of the new year season in April. When the chicks of the koel-koha hatch out in the crow's nest, they adopt a ruse. They wriggle among the crow chicks and, in the ensuing duel for survival, the koel chicks turn victorious. The koel chicks oust one or two crow chicks; having thus made themselves comfortable, they get along with such crow chicks as remain in the nest.

Despite their increasing rarity, a pair or two kohas alight on our shade and fruit trees, transforming our home garden with their cries of *koha, koha-kohe*. The presence of the koha and its crescendo of cries are more frequent where crows are numerous. There is a population explosion of crowns within Colombo; however, in suburbs like Battaramulla, Homagama, Pitipana, Kosgama, why are its cries not heard often during the April season? In the dry zone, wilderness areas like Gal Oya-Walawe (where I had worked and lived for nearly 25 years) and the like, the crow population is remarkably less than in the cities and urban areas. Where the crow population is low, koels too, are proportionately rarer.

I would be interested to learn from more knowledgeable members whether in fact koels are on the decline.

Gamini G. Punchihewa
42, Hospital Road, New Town, Embilipitiya.

Atu: the Man Behind the Legend

Hemantha Situge*

* 50, Leyn Baan Street, Fort, Galle.

A sketch of the life and times of Vickie Atukorala, introducing a series of reminiscences written by the naturalist shortly before he was hospitalized with terminal cancer.

Natural historians fall broadly into two categories: bookish academics who work mostly in laboratories and libraries; and gung-ho enthusiasts who live only to savour Nature in all her glory. The mid-twentieth century saw in Sri Lanka a fine selection of both varieties, among the latter class several of whom are still fondly remembered by nature-lovers and celebrated by the animals that bear their names. Three of these celebrities were in fact great friends and shared much in common: Rodney Jonklaas, Eric Conway and Vickie Atukorala. All were avid divers and fishermen, never happier than when in the sea; none of them ever married. All took an avid interest in sharing their enthusiasm with young people, spawning a new generation of naturalists in Sri Lanka.

Of the troika, Jonklaas was the most 'domesticated', and arguably the best known. An aquarist, horticulturist, explorer, diver and raconteur *par excellence*, he was readily absorbed into Colombo society, though his sometimes risqué humour did not always amuse the faint-hearted. The reclusive Conway was liked by all, his frail frame cutting a strange figure as he wandered among the fringe of Colombo society, eccentrically clad in a sarong, an attire at which many of his Burgher brethren would frown disapprovingly.

'Atu' was arguably the most precocious of the three, uncompromisingly set in his ways, his latent genius being freely shared with all who would listen or accompany him on jaunts into the wilderness. His encyclopaedic familiarity with Nature belongs to another age, which has no parallels in our own. Perhaps the only recent equivalent was P. B. Karunaratne, the gentle and benevolent sage who until recently made it his duty to share the wealth of knowledge he had not just with the youngsters who flocked to him as moths to a flame, but with the scientific high and mighty from around the world.

The two decades that have passed since Atu's death have served almost to erase completely his memory from amongst all except those who knew him well. And of that latter class, there are but a precious few still alive today. Some random 'memoirs' written by him in the latter part of 1978 were traced by me in the possession of his octogenarian brother, Dhanawanthari, better known as 'Danvie'. Atu's friend, Dr. P. H. (Chandra) Amerasinghe, had prevailed upon Atu to commit some of his insights and experiences to writing, something Atu was evidently none too happy to do. Sadly, as incomplete as they were, these autobiographical notes were never published due to Chandra's untimely death in a motorcycle accident on 6 January, 1979. Atu himself had a near tryst with death, being his pillion rider.

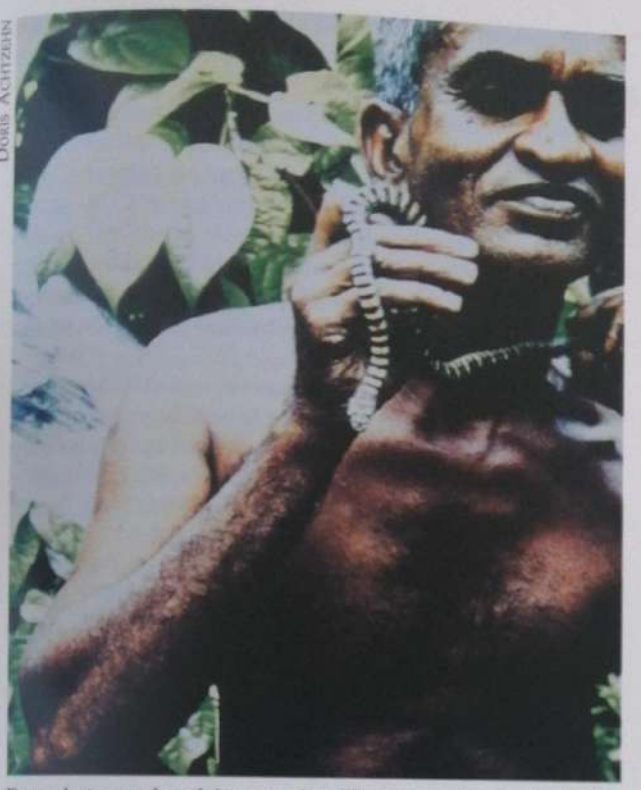
Atu (right) aged 3, with his younger brother Danvie, at Hatton.

Vickremadhira Gunawardena Wijetillake Atukorala was born in Hatton to Caronolis Wijetillake Yasapala Atukorala and Agnes Gunewardene Atukorala on 4th September 1915. 'Vickie', as he was known throughout his life, was the fourth of seven children. Nature was very much a part of Atu's life, but his passionate first love was water. He spent most of his childhood in Nuwara Eliya, where he first learned to swim in the chilly waters of a now-forgotten swimming pool.

Atu's father was in the postal service, holding a transferable post from which he retired as a postmaster. In recognition of his distinguished service to the state, he was invested a Muhandiram in 1931.

The family later moved to Colombo when Atu was eight, and his flirtations with water grew into a whirlwind romance when he was introduced to the sea. To top it all, his parents took a home by the Wellawatte Canal which, he recalled later in life, then "was a crystal clear waterway teeming with aquatic life, fishermen and naughty little boys!"

It was the Chairman of the Colombo Municipal Council, Layard, who had commissioned the building of this once-beautiful waterway. Layard's Folly, it quickly came to be known as, in view of the mouth of the canal being blocked by a sand bar for most of the year, rendering the waterway unnavigable. "It served well especially for the fishermen and people like us," Atu recalled years later, "It was absolutely a haven. We would



Few photographs of Atu survive. This one, taken in the 1960s, shows him with a flying snake, *Chrysopelia*.

return from school, dump our books, gobble our food and Eric and I would go out with our nets and fishing rods and fish until it was dark. The Buddhist upbringing that shrouded my family did not permit us to cook the fish we caught, but the servant boy who was with us at the time made sure that we did the needful to it. I am sure he had something to do with the cultivation of the cultured savage in me."

Atu was educated at Royal College, Colombo. Amongst his classmates were James Obeysekara, A. W. Henricus (the celebrated Empire-Medal boxer), Henry Carthenis (Chief Officer in charge of Governor's House) and Dr. A. T. S. Paul, who vividly recalls his schooldays with Atu. Dr. Paul's earliest memory of Atu is when he was about twelve or thirteen. As a schoolboy, Atu was already a collector of specimens, and used to bring insects and snakes to school in his pocket. Dr. Paul recalls that Atu excelled in zoology and botany while in school, his interest being fuelled by his burgeoning familiarity with the natural world.

Atu's own recollections in his *Early visits to Kinross Reef* reveals a precocious youngster with a yen for taxonomy. Atu's earliest employment was at the Zoological Gardens, Dehiwala, under the able management of Major Aubrey N. Weinman. His notes on birds collected for the zoo at Kumana Sanctuary on 17th May, 1949 were published in *Loris* in June, 1949. As far as I am aware, this is the only article he ever published, at least under his own name.

Danvie Atukorala recalls the incident of Atu and the King Cobra in Dehiwala Zoo. The hapless cobra had got some debris in its eye and was desperately attempting to brush it off by hitting and rubbing its head against the sides of its enclosure. The reptile keeper, aptly named *Nai* James, while happy to handle all the other snakes, was unwilling to grasp the angry reptile in his hand and remove the speck in its eye. Summoned to help, Atu deftly captured the snake and, with a pair of forceps, removed the offending insect from its eye. As Atu released the animal however, it turned on him and bit him on the wrist. The incident was witnessed by the large crowd who, on hearing the commotion earlier, had gathered around the cage. The zoo staff knew, of course, that the king cobra's venom is fatal: as its name (*Ophiophagus*) suggests, this is a snake that feeds *only* on other snakes, including the most venomous. The potency of its venom is legendary. Reacting instantly, Atu whipped out his penknife with his other hand and incised a deep cut across the fang marks left by the snake, furiously sucking out as much blood as he could. Colleagues bundled him into a car and rushed him to Colombo's general hospital. His left arm had swelled to more than twice its size, the swelling extending above the elbow. An anti-venom injection was administered, but, having never before used in Sri Lanka, its efficacy was in doubt. As Atu lay in bed, surrounded by doctors and medical students, he calmly informed them that he had read somewhere that should the swelling reach his shoulder, he would die. Thankfully, it did not.

Stories abound of Atu's handling of dangerous animals. During his time at the zoo in the 1950s, the German Circus Busch happened to visit Colombo. Its star performer was a Bengal tiger, which, however, suffered from an infected paw. None of the veterinarians was willing to approach the bad-tempered animal, and, as was often the case in such instances, Atu was requested to help. This he did, enabling the tiger's recovery, the down-side being that the same animal is said to have mauled its keeper to death when the circus reached Bangkok.

Despite being a hunter, Atu was actively conscious of the need to treat zoo animals well, so that they could lead a life that paralleled as closely as possible their existence in the wild. Not surprisingly then, his career at the zoo ended when he discovered that top officials were on the take, resulting in animals being neglected, especially by being given substandard food. Following his departure from the zoo, Atu was appointed Marine Supervisor from June, 1958 to March, 1960. He was assigned to a project aiming to grow corals at Pathiraja Point in Bundala. A Japanese Professor Kawaguti had been invited by the government to identify the corals

Atu, showing off his coral laboratory at Bundala to Leonard Woolf.

and devise methods of monitoring their growth.

But Atu was restless and clearly unable to hold a job. After his departure from the corals project, he was associated with several projects to farm snakes for research, at Peterson Lane, Hendala and finally, what was known as "Lanka Snake Farm" at Kapuhena Estate, Indigolla, Gampaha in the 1970s. The Gampaha snake farm was managed by B. Schulz and G. Czaja, with Dr. Ranil Senanayake serving as Scientific Director.

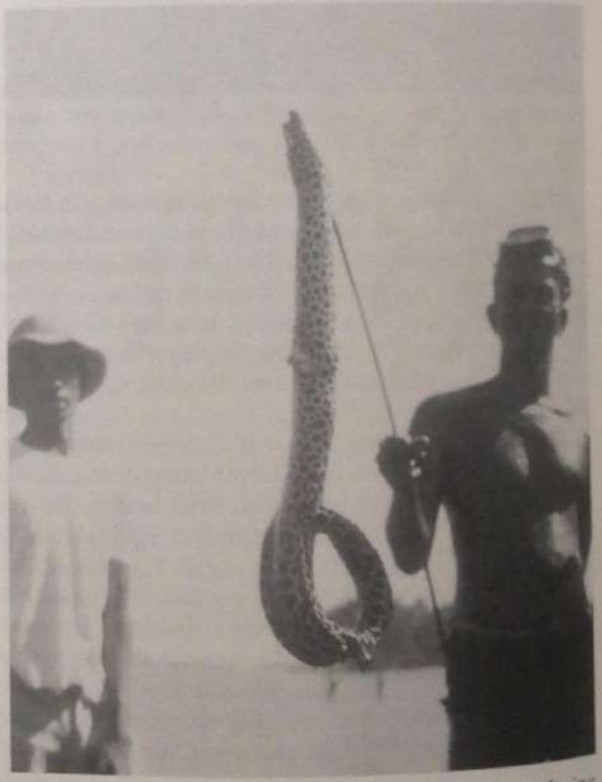
Among the first Sri Lankans to don a diving mask, Atu had the pleasure of being the first to explore the reefs that surround Sri Lanka, at a time when tourist hotels were unknown. He knew the reefs of Barberyn, Passekudah, Kalkudah, Nilaweli, Kuchchaveli, Great and South Basses, Polhena, Hikkaduwa and Unawatuna intimately. Much of his reef-craft was learned from Samoan friends living in Sri Lanka at the time: these Pacific islanders were as much at home in the sea as on land.

Atu's friend, the novelist James Goonewardena, writing of Atu in the *Daily News*, recounted how Atu seemed to know 'something about everything' in the natural world. "Atukorala had the habit, of making you the recipient of bits of his vast knowledge. When we came around to talking of the frigate bird once, 'Ah,' he said, 'the frigate bird. They're not often seen over here—in the Maldives, yes. Marvellous birds, with that long wing span, and that tremendous speed they can get when they're on the wing. You could only see them when there's a squall—they love a fight with the winds, because they're powerful birds.' You could see the reservoir from which the little bit of information started to spring forth."

In days when divers were few and far between, both Atu and Jonklaas were avid spear-fishermen. This mode of fishing soon turned controversial however, and in 1979 the Minister of Fisheries imposed a ban on the import of spear guns (see *Loris* vol. 15(1): 48 1979 (editorial), and vol. 15(2): 64 1979, "Spear fishing: the other side of the coin", by Rodney Jonklass.

Atu was an indefatigable, fearless and dedicated field naturalist. His excursions are legendary. He sowed undaunted where others later reaped. Among those who were acquainted by him with the local wild and marine life were Sir Arthur Clarke, Dr. George H. P. de Bruin, Rodney Jonklaas and Dr. Ranil Senanayake. Sir Arthur reminisces of him as, "An unique character who had unmatched knowledge of the island's flora and fauna".

"Atu was a remarkable character," says Dr. Ranil



Dr. H.I.E. Katugaha recounts a memorable incident during schooldays, on 22 February 1955. "I first met the late Mr. Atukorala when he joined us on a zoological expedition to Duwa (Negombo) with our class, along with our class master, the late Brookie de Silva. I well remember him spearing a large moray eel, which I believe is still preserved in a glass jar in the zoology laboratory at St. Thomas' College, Mt. Lavinia. Atu did not use a spear gun, but instead a long spear."

A Week in the Maldives

Rodney Jonklaas recalls his third visit to the Maldives in early 1961, accompanied by Atu, who had taught him the art of skin diving.

"Atu and I dived into the breathtakingly clear water on the side of the *Maldive Star*. The fresh, cool sea made our blood tingle. I was fulfilling a long-felt ambition and owed Atu my initiation into the beauties and mysteries of the undersea world, for he is without doubt *the* pioneer skin-diver of Ceylon. After several months of planning and waiting, I was to show him a real coral island, a real atoll and fishes that he had never dreamed of. Atu scorns fins, gloves or a spear gun. Since the days of his initiation [to skin-diving], he operates in the water equipped solely with a facemask and a simple hand spear.

"As we reached the reef-wall of Male harbour, the white coral sand bottom sprang into view a hundred feet down; then came hordes of pelagic fishes, and then the blazing jungles of coral, alive and glitter with fantastic fishes. To me, it was still a moment of ecstasy even if it was my third trip, but to Atu it was a sight to remember.

"We had come to the Maldives to spearfish, collect live fishes for our aquarium, hunt for seashells and lobsters-mainly to enjoy ourselves. Before us was a glorious vista of at least a week of sustained underwater exploration in the world's most glorious coral reefs.

"Perhaps it was fitting that just as I caught by hand, some two years ago, the first *Pygoplites*, this time Atu acquitted himself nobly by doing the same with a beautiful Conspicuous Triggerfish at the mouth of Male harbour. To you poor terrestrials who have never seen *Pygoplites diacanthus*, it is the most gorgeous coral fish in the world. The Conspicuous Trigger on the other hand, is less gaudy but even more striking, and a very rare fish off Ceylon, yet the commonplace "Rondu" of the Maldives. Of course, it is an aquarist's prize.

"Although the first thing I carried with me was my powerful spear gun, killing fish was the least of my aims when visiting Maldives. But we needed fresh fish for ourselves, our friends ashore and ship's crew, so we made for the edge of the reef once more where I knew swam legions of fine Blue Parau, Dogtooth, Tuna and other toothsome denizens of the deep. Within the first hour, after I had taken two fine Blues, a six-foot gray shark began to give trouble. Time and again it circled us warily, yet relentlessly, trying to sneak in and grab the fish unawares. But each time I was ready for it with a menacing gun, or Atu's slender spear kept it away from very close proximity. Subsequently we saw dozens of sharks but none as persistent as this brute, which kept us uneasy for over an hour and gave Atu his baptism of Maldivian menace in the water.

"Hunting for lobsters off Male was an unusual adventure. By day, the colourful Red, and Green lobsters of the coral fastnesses of the Maldives are completely invisible. We saw (and took) only one by day in eight days of intensive diving. But by night we found them walking warily about in the open just outside the harbour. We had an assignment to identify and photograph these lobsters (in reality crayfish) and we plunged into the job with great enthusiasm.

"Night diving in the Maldives is not recommended for novices. Even within Male's harbour, which is seldom deeper that two fathoms, there are hidden dangers for the uninitiated. Scores of vicious, hungry moray-eels, accustomed to eating the offal thrown out of bonito boats, are there in writhing masses. A careless hand or foot anywhere near them in the dark can lead to painful injury. We had first-hand information from several terrified Maldivians who alleged that their hands were often seized by these morays as they washed bonito in the shallow water.

"Out of the harbour entrance and to the edge of the reef-wall we swam one moon night. The scene, in spite of the chill of the clear open water, was one of sheer magnificence. We found that our underwater world, with moonbeams dancing on the corals where sunbeams spangled them by day. All the gaudy daytime fishes were asleep and in visible, snug in coral fastnesses and impenetrable catacombs. But in their place swam scores of Red Squirrel fishes, snapper and other nocturnal species. There were also the brilliant crayfish, the Reds with blue specks, and the white-feelered Greens, which we were familiar with in Trincomalee. Capturing them by hand was not easy, and unlike their drab and numerous cousins on the west coast of Ceylon, these flaunted long spines and injured our hands severely.

"Many times we dared to swim away from the narrow shelf and gaze awestruck at the inky deeps over the 100 feet reef-wall. There we knew swam giant fishes: sharks, groupers, great wrasses— who knows what else? Once I saw the gigantic outline of a Great Parrot-Wrasse swim up and into the feeble ray of Atu's flashlight. It was an eerie sight and anyone less experienced than he was might easily have panicked and rushed out, never to re-enter the water off Male by night.

"We also hunted rare seashells by night. I am an avid conchologist, and in this hobby there appears to be no limit to the time and trouble one goes to, to discover the hiding places of the various multi-coloured and many-shaped homes of calcium carbonate which are referred to simply as "shells". We found the sheltered waters off the

islands by night ideal for a novel form of detective work. Many of the rarer shells are nocturnal and spend the daylight hours in slumber and concealment deep under the sand. But by night (goodness knows how they can tell) they climb upwards and travel on or just underneath the surface of the sand, creating patterns and trails, which increase in complexity as the night hours wear on. Then, as it dawns, they burrow once more into the depths of the sand and the gentle ripples and waves obliterate their trails.

"We discovered that in some spots, where soft sand of coral dust made flat deserts within the lagoons, there were many rare shells to be hunted after dark. So, as soon as dusk fell, we sallied forth, despite the chill breeze, to hunt shells carrying our flashlights and diving gear and a bag of our captures. It was, altogether, an exhilarating and novel experience and I shall never forget the *sheer magic of those shell-diving nights* on the Maldives. By 6.30 p.m. the first trails had started and we frenziedly followed them with our fingers until we saw or felt, a live, rate mollusc at one end. Many times we backtracked them and had to retrace our paths. We often crossed each other's paths in following two shells, which had gone in opposite directions.

"As the night wore on, the trail became longer and more complicated, adding greatly to our fun. We found also that we had competition. At least two large Stingrays were out shell hunting too and we met them often, gazing incredulously at us in the glare of our torches. One was a monster of over 150 lbs., with a long, slender tail armed with a 6-inch sting. We left *him* well alone! We had seen some of his after-dinner remains— the shell of a tough Scorpion-shell or *Lambis*, bitten clean in half. We gave up night shelling only when our burdens became too heavy, and hunger, chill and exhaustion sent us home for a shower, dinner and bed.

"A great deal of our time, energy and patience was taken up by the efforts we made to *capture living coral fishes*. Underwater netting in Ceylon is difficult enough in the Maldives it is infuriatingly impossible to capture most fishes you are after. The tortuous labyrinths of coral provided perfect avenues of escape for the beautiful fishes we hunted with small hand nets and our own. However, by dint of hard effort and no little strategy we somehow contrived to net a few of the perky little demons we wanted to so badly. For the miserable few we netted, countless hundreds cavorted mockingly before our eyes on the teeming reefs of Male.

"Storing the fishes was another problem. The only aquarium in Male, owned and built by a good friend of ours, had suffered a dread malady in that its glass front had broken. We could not have brought any with us on the "Maldives Star". We had to resort to Polythene bags (most of which developed annoying leaks) and cold cardboard boxes. The latter we transported with immense difficulty on the deck of the ship from Colombo. They were the object of a great deal of curiosity on the part of every passenger and crewman.

"We assembled our little aerator and watched gleefully as the life-giving air bubbled enthusiastically into our precious containers with their still more precious inmates. But the vagaries of the electric current supply of Male speedily reduced our captives to half their number.

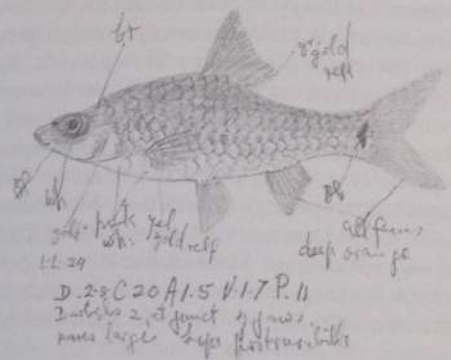
"We confined two special pets in aluminium cans underwater with salt-water circulating. One night they received a terrific bashing when the tide dripped so low as to place the cans against the coral breakwater, and a slight squall sprang up. Then we borrowed a professional fish-trap and transferred our captives there, much to their relief and ours.

"Packing the fishes and sending them on board the day we left was a nightmare. All our fishes were kept in the Customs one night and when we went the next morning we found they had been already sent on board ship. We knew what that meant! We rushed on board and our worst suspicions were confirmed. Nearly all the boxes had been dumped on deck with scant regard for their precious inmates. Nearly all the bags were leaking and the oxygen let out. Our best two fishes never recovered. To those of you, Ceylonese and Maldivians alike, who read this, I say that if you imagine anyone can go to the Maldives and bring back fishes alive, which you think, are worth a fortune... forget it!

"In between fish-netting outings and their attendant frustrations, we had several trips off Male as well as to Hulule Island close by for spear fishing and daytime shell collecting. We sailed one afternoon in a graceful little yawl to the glorious shallows of Hulule. Here there are stretches, miles along, of water less than three feet deep, over a pure white coral-dust bottom. You are dazzled as you swim with a mask over this bottom. We preferred to walk and plunge over the reef-wall in deep water where the big fishes swam and where rare shells nestled in corals.

Ah, well, all good things end. All too soon we found ourselves back on the decks of the *Maldives Star*, waving goodbye to the gallant launch *Sea King* which circled us and sped back to Male with our friends. We raised anchor and steamed out in the direction of Colombo, 425 miles away.

"But a short while later, a carelessly laid steel cable fouled our propeller and the shipper brought the ship to a halt. As we drifted in the strong current and carried us southwards, two sturdy seamen went over the side to free the fouled blades and shaft. After they went in, I noticed the cook skinning and plucking some chicken and throwing the offal overboard. So I hastily went in myself, with fins and mask. I was just in time to see them finish the job and climb up the rope ladder to safety. It is as well they did not know it at the time, but deep, deep down, in the fathomless blue of the Indian Ocean, swam the vague outline of a shark which was sniffing the scent of fresh blood and seizing the offal as *hors d'oeuvres* before he came up for the *pièce de resistance*. Can you blame them for shining up that ladder, fins mask and all, in record time?"



Field notes: a cyprinid fish, figured in detail.

Senanayake, befriended by Atu, a family friend, in his childhood. "What I have learnt on natural history— I owe him the whole lot. He had an enormous memory for essential details. Field studies were indispensable to my research. I used to go on all my field trips with Atu. He was my constant companion."

"We were at our house at Kankesanthurai," recalls Dr. Paul. I remember Atu roaming around, collecting little wild flowers. He kept them and drew them typically at the same. Most of them were small grass flowers. Eventually, I remember him having large collection of drawings of these flowers."

Atu used proudly to refer to himself as a "cultured savage". Says Senanayake, "He believed that he was part of the old Polynesian race. Atu possessed a highly anti-colonial Sinhalese mentality."

"What makes Atukorala even more distinctive," observes James Goonewardena, "is his deep and curiously triumphant humanity."

Atu's life was a carefree spree of wild living. He drank too much, and being unmarried, never felt the need to save, or, for that matter, earn. One day in October 1981, in Negombo, he discovered that his legs were becoming paralysed. Thinking he had unknowingly been bitten by a snake, he telephoned Dr. Paul. Later that day, at his residence at Kensington Gardens, the physician found that Atu had a cancer of the prostate, with a secondary cancer in his spine (which was why his legs were lifeless). Says Paul, "Atu never believed this. He rejected my diagnosis."

Paralysed and confined to a bed, Atu did not despair. Lying on his back, he engaged in his hobby of sketching in the course of the eight long month it took the cancer to do its work. Each morning, he woke up with a firm conviction that he had to make the best of the day. His faithful friend since childhood, Eric Conway, played a key role in this story of courage. Eric would bring with him each day a few sprigs with flowers for Atu to draw, leading eventually to several hundred sketches, each of which was properly labelled with the botanical common names. When flowers were few, Atu drew anything that came to hand, including insects caught in the hospital yard.

In April 1982 Irma Patternot, sister of his childhood friend Neville (Kadalay) Jansz travelled from England to see Atu in hospital, and made him promise to record his memoirs. Having returned to England, she wrote—

> Dear Atu,
> I am keeping my promise. Herewith a dictating machine and several tapes for recording the precious material which you will impart to the world. This is no mean flattery, but knowledge of such rare quality and content can only be from a naturalist so gifted as you.
>
> Should you find the tapes insufficient, let someone know, and I will send you more. As for transcribing them, I will personally do it here in England. I will type the manuscripts and god willing, you will be able to read it. I am also sending you a few adhesive labels to mark the tapes for your own benefit.
>
> It was wonderful seeing you again. It was Atu as I always knew him. Even your illness did not seem to deter your cheerful disposition. How remarkable! No doubt your good and faithful friend, watching over you, day and night, must be comforting. Dear Conway. I'm sure Neville too must be near you. He never wanted to be too far away from you.
>
> I have to smile, when I think of the three villains of Peterson Lane... Carefree as the wind! A Bohemian life, so full of colourful events. What a memoir to read. I don't think Peterson Lane will ever see anything like it again!
>
> May I reiterate that it was wonderful seeing you and in such good spirits, that it makes you an example to those around you.
>
> Till I see you again. Warm wishes to both of you.
> Love,
> Irma.

Irma's wish did not come true. The bad spell was clearly passing, and life seemed to be ebbing away from him. On 29 June 1982, in Atu's own words, the "Dragon of death came to annihilate" him "like the hapless Guppy in the tank". "[I have] no regrets because I played my earthly innings in my own style – simply, slowly, satisfyingly". Atu's body was cremated and his ashes were strewn in the sea at Kinross, which he loved.

Drawn in Maharagama Cancer Hospital, 11 October, 1981: "*Episcia* (Gesneraceae)".

Atu: a pen-portrait

by Dr. P. H. (Chandra) Amarasinghe
(written on 27 July 1978)

My friend Atu is a cultured savage. He slipped from the confines of the classroom at an early age, and escaped to the jungle and the sea— places in which he had always longed to roam and yearned to linger. His completely unsophisticated life and his unusual behaviour made him look mere savage in the eyes of those who wore only a veneer of culture.

Atu never could study merely to pass examinations; yet he had a thirst for knowledge for its own reward. Even as a schoolboy at Royal College, Colombo, he had the yearnings of a born naturalist. While still in his teens, he became deeply interested in fish. It was not the usual interest boys have in collecting fish for display. He actually studied any fish or animal he caught, using freely the libraries of the Colombo Museum and the Royal Asiatic Society. He is one of the few people in Sri Lanka who, without having some paid research job, has a fish and a frog named after him, by discovering new species. How these were named is another story. Suffice it to say that the fish was initially dismissed locally with bored contempt, then eventually submitted to the British Museum, whose experts recognised its uniqueness and proposed it be named after Atu. If you refer to page 91 of the Government Publication *Fishes of Ceylon* by A. S. Mendis, you can read about *Horadandia atukorali*.

I once told this self-taught naturalist that he reminded me of a gnarled old jungle tree with saltwater in his veins. He accepted this with his shy, appealing smile, obviously pleased at the comment. Turning sixty, with crew-cut metal-grey hair, he looks ageless. Five feet six inches in height, he still has a wiry, lean body, with a hint of bowing about his slim, strong legs. His weather-beaten face, dark browned by the tropical sun, has a flattened nose, which lends it both charm and character. He likes to tell you that his is a Papuan face, accidentally born in Ceylon. His teeth, though stained brown with nicotine, are perfect. Toothbrushes play no part in his life. A little bit of salt, a piece of charcoal (preferably from a campfire) or a twig with a chewed-up end serve him so admirably that he has still to lose a single permanent tooth, while many of his erstwhile classmates, some of whom are doctors, lawyers and ministers of state— all of the toothpaste and toothbrush brigade— have not a tooth to call their own. His eyes have lost their old glory. In their younger days, they had a bright piercing look, intensified by those long and bushy eyebrows, once jet black and now quite grey. Telltale, thin white lines circle the edges of his brown eyes merely signifying unrelenting old age. But the hazy white mist that one can see in the front part of his eyes forewarns that the lenses inside will eventually lose their transparency. Ordinary spectacles are of no benefit to him, so he has made his own, using a magnifying glass to replace the plain glass of a diving mask. Yet, this dauntless old man of our seas can still take a hand spear: his is a short-pointed rod of iron, without even a barb out of our coral reefs and be certain to return with a fish for lunch. Few divers can do that today. This is the age of aqualungs, spear guns and fins. Atu scorns these devices. He started the game of spear-fishing forty years ago and will not change. Most of our divers— even the well-known Rodney Jonklaas— learnt much of their reef-craft from Atu. He wishes to be the "Old Master". He is.

All his life he wanted to live as *naturally* as possible. As a young adult, he had a small house with a fair-sized garden given to him by his father. Though in the heart of Colombo City, the artist in him had transformed this spot into an enchanting jungle. On two magnificent trees, Atu had grown varieties of climbing plants that he had collected in his wanderings in the wilderness. Bushes and jungle ferns grew in wild profusion. There was hardly any room to walk about because of the numerous cement tanks on the ground, in which he bred his exotic tropical fish for sale, locally and abroad. Inside the house, young cobras, kraits and vipers slumbered in ventilated boxes, awaiting shipment to foreign countries. His desk was always littered with notes, drawings, soot impressions of leaves, and often with some unfinished woodcarving. It is a pity that he did not publish any of the numerous essays he had written on a variety of subjects to pass on his knowledge to posterity; but lucky is the man whose means of livelihood are the same as his hobbies.

Atu's needs are meagre. He has no desire to expand his business to get rich. "I don't need money," he once told me. "Money does not seem to like me, judging by the speed it leaves me whenever I get hold of some." Whatever he has, he gives generously to his friends— and these range from ambassadors to convicted criminals. One ambassador, a keen collector of seashells, was positively thrilled to get a perfect specimen of a *Palma rosa* that Atu had found on the seabed.

The love of a simple, primitive life, untouched by the daily pressures of civilized living, is strong in Atu. On a jungle trail or on the main roads of the city, his dress is the same— a sarong, often worn without a shirt. One difference is that he is more often without shoes in town than in the jungle. His entire wardrobe consists of a spare sarong and shirt, a pair of shorts and his special suit— a maroon bush-shirt and black slacks, for very special occasions, when he feels a sarong might embarrass his host. He sleeps on a mat on the floor with some folded clothes for a pillow. Most of our villagers do this, but not public school boys. When we have camped on a beach, we slept under a tent, on camp beds. Atu dug a hole in the sand under the stars and covered himself with his sarong. "It's warm and

comfortable," declared Atu. A shave in the morning is one ritual he never misses. He uses neither soap nor mirror, but constantly probes his face with his fingers.

Atu is a born bachelor but he has no liking for solitude. Like Socrates, he has a host of friends who visit him frequently, come to him for personal advice or merely listen to his tales of the jungle or his experiences in the sea. Many were the Sundays when we took some uncooked food and the liquor essential for making Atu eloquent, and listened while he reminisced. Later, he would cook a delicious meal for all of us. While cutting the fresh meat or fish, he shows off by eating a few pieces raw. He had learnt this from the Samoans who had taught him skin-diving, using a bamboo mask, in the nineteen thirties. "Raw sea urchin eggs taste like mixture or cod roe and oyster," Atu once said, smacking his lips for effect. The one thing he could not eat raw was snake. The time he tried barbecued Russell's Viper, he needed much fortification of the spirit with spirits.

On any aspect of Nature, Atu can make the most interesting contribution. I remember taking Atu on a weekend visit to a coconut estate. We were lucky to be in the dry zone the day the northeast monsoon broke. About 5.30 p.m. torrents of rain came cascading from the clouds. Atu was agog with excitement. "Wait until dusk," he said, "and you will hear the mating calls of countless of frogs." As darkness fell, there was a strange, quiet spell, after the last flight of parakeets had chirped and gone to roost on the coconut trees. Presently, there was a croak here and a croak there, reminiscent of an orchestra tuning up. A bassoon joined in giving a deep long note every few seconds. Then another species of frog gave its cyclical mating call. Suddenly, as if one cue, the whole orchestra started up— a crescendo of mating calls that must have stirred the loins of the most indifferent lady frog in Frogland. Atu listed the names of the species, which he could recognise merely by their mating calls. "Listen to that one," he urged, pointing to a spot in the absolute darkness outside. "Can you hear the one that goes...? (he imitates the call)— it's called... (he gives the scientific name). He's a tiny fellow about an inch long, with green and brown stripes on his back."

The rain drummed on the zinc roof of the estate bungalow for two hours. Abruptly it stopped, as if turned off by an unseen hand. The frogs continued croaking, regardless. Atu led us out to the rain-soaked garden to catch the various species of frogs by torchlight. We followed each different croak and caught a number of species. Amazingly, the frogs were exactly the size and colour that he had described minutes before reaching each one. They were almost all in pairs, one on top of another. Naturally, this was the moment they had waited for during the long months of drought in the dry zone. Millions of fertilized eggs would be laid to ensure the continuation of each species. Few would survive. There are so many hazards during the development of a frog's egg, and almost as many after the tadpole is transformed into a frog. A frog's eyes shine red in the torchlight. Red eyes glowed at us on all sides, wherever the torchlight fell. One pair of red eyes looked unblinkingly at us from the shallow drain beside which we were walking, but the experienced naturalist knew the difference. "Snake," he said softly, and stood still while he displayed the creature by the light of his torch, from tongue to tail. The prominent bulge in its neck, obviously caused by a recent dinner, was undoubtedly a late member of the orchestra. Next morning, we saw thousands of eggs floating in numerous pools of rainwater all over the estate. Many of them in the shallow hoof marks of cattle, destined to dry up before the eggs were hatched. But we saw no frogs on that morning's walk.

Atu's one failing is his fondness for "Alcoholidays". These are periods when he drinks for days at a stretch, thereafter remaining as sober as a Trappist monk for months on end. Perhaps these bouts of drinking are impelled by a subconscious fear of settling down to a permanent job and thereby losing his freedom. Jobs he had had from time to time— collector of specimens for the Dehiwela zoo, assistant at the salterns at Bundala, and keeper of a snake farm which exported snake venom. But the urge to be free, unhampered by office hours, lured him away from every job he tried.

Early one morning, a senior diplomat from an European country found Atu, sitting on the beach opposite the Kinross Life Saving Club, sipping his favourite brew. It must have been during one of Atu's "Alcoholidays". He knew all about Atu as he had taken him on his holiday to the Maldive Islands. He advised Atu to use his talents and earn some money, instead of wasting his time. Atu replied "Sir, you have studied well and done good work for your country for nearly forty years. When you have a couple of hours to spare, you like nothing better than having a swim in the sea and then drinking a beer under the shade of a coconut tree. But, that Sir, is what I have done all my life".

Atu is appreciated more by foreign experts than by local ones. Professors, collectors from foreign zoos and biologists, all cultivate Atu's acquaintance. He keeps them entertained and informed about Sri Lanka's natural history, as no one else can.

I never fail to take Atu whenever I have the chance to show foreign friends around our island. They are spellbound by his stories and follow him confidently into the jungle, or, if their tastes were different, swim after him to see the exquisite fish among the coral reefs. They are struck by his simplicity, nourished by his knowledge, and pleased by his patent honesty. When, weeks later, these foreign friends write to me from their own countries, not one of them (whether tycoon or teenager, grandmother or glamour girl) fails to make affectionate enquiries about this gnarled old jungle tree with seawater in his veins, this cultured savage, my friend Atu.

Two Hawkfishes (Cirrhitidae) new to Sri Lankan Waters

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Hawkfishes are inhabitants of well-defined habitats and some, like the species described here, live in the uppermost zone (surf zone) of the sea, for which reason they are often missed by divers who avoid these dangerous shallows.

I observed the first species when snorkeling off Coral Garden Hotel, Hikkaduwa. In the shallow reefs 1–3 m deep, I found some specimens of *Cirrhitus pinnulatus*, clinging to the corals by their pectoral and pelvic fins. This species is easily identified by its large white spots (that may appear yellowish under water) running in lines along the body. This colouration is cryptic in the reef and it is not easy to detect the fish in the sea. It is also not easily recognized on photographs, but I hope the reader will be able to detect it on the illustration (Fig.1). *Cirrhitus pinnulatus* is a wide-ranging Indo-west-Pacific fish and so it is no surprise to find it around Sri Lanka.

The second species too, seems to have been overlooked by researchers. I found one specimen at a depth of about 1 m in the bay west of the Club Hotel, Dickwella Village, in southern Sri Lanka. There the waves pumped masses of water over the reef terrace into a very shallow lagoon. From there, the water runs back to the sea within narrow channels as strong currents. At the inner entrance of the channels next to the hotel, I detected a hawkfish. It sat at the rocky bottom that was overgrown by a short layer of algae.

I was at first unable to determine the species, as it was not included in any of the Indian-Ocean fish guides. I first mistook it for *Cirrhitichthys calliurus*, but this was a mistake. *Cirrhitichthys calliurus* was described (by Regan, 1905) from Muskat, Gulf of Oman. It has a clear caudal fin with a few spots and a broad, blackish posterior border; and it is restricted to the seas of the Arabian Peninsula. A similar species, *Cirrhitichthys aureus*, is of overall yellow or orange and confined to eastern Asia, from Indonesia and the Philippines to China and Japan. Munroe used this name in his book on the fishes of Ceylon for a specimen found in the Gulf of Mannar, but it could not be this species. He used the description given by Day (1873), for a new species from Madras, India, called *Cirrhitichthys bleekeri*. The species from Dickwella fits quite well into this description. Randall also referred in his review of the hawkfishes (1963) to Day's descriptions, as no types or other specimens were located in the museums.

As I found some differences between the original descriptions, especially in colouration, I repeat them here. After Randall and Munroe (who both reproduced Day's description), the colour is:

Figure 1. *Cirrhitus pinnulatus* clinging to the corals.

Figure 2. *Cirrhitichthys bleekeri.*

"rosy with light longitudinal lines and a large ill-defined blotch below the soft portion of the dorsal fin extending half way down the side; in some specimens 2 more descend from spinous portion of dorsal fin; a small dark spot behind upper edge of preopercle; dorsal and caudal fins more or less banded, the caudal with red spots; soft portion of dorsal darker spinous portion and having a light outer edge."

Figure 2 shows a quite different coloration: the body is yellowish, the light longitudinal lines are almost invisible; the dark blotch extends from the soft dorsal fin partly down the sides, interrupted by ill-defined spots of the yellowish ground-colour. Under the spinous portion of the dorsal fin, there are 2 rows of scales with brownish centres. Instead of a small dark spot behind preopercle, there are some reddish spots on opercle and pectoral-fin base, and there is a narrow line of the same colour from the eye to the corner of the mouth. The caudal fin is densely spotted with reddish-brown spots of different sizes. Typical for all Cirrhitidae are 1 or more cirri projecting posteriorly from the interspinous membranes near the tips of the dorsal spines. This species has 5 to 7 fine cirri on each membrane, not mentioned nor shown by Day, and also not seen in Munroe or Randall because both used the figure of Day.

As colouration within species is variable, the Sri Lankan specimen cannot be announced as a new species or subspecies. There could be differences in colour between these and specimens from India, but it is too possible that the descriptions were made from dead fishes in which the colouration had changed. Underwater investigations around India could clarify this problem. It seems that the specimen described here from southern Sri Lanka is the southernmost record of this species; it has not been recorded from the Laccadives, Maldives, Chagos and other islands.

The reason some authors use different names for the three species of *Cirrhitichthys* included here is that some think all are only local races of a single species, the most senior available name being *C. aureus* (Temminck & Schlegel, 1843). It is also possible (as indicated by Randall), that a future revision will demonstrate that they are only subspecies (*Cirrhitichthys aureus calliurus, C. a. bleekeri* and *C. a. aureus*) with a continuous distribution from the Red Sea to Japan. However, so long as three geographically-separate population of different colouration and with other differences are known, it is safest to give them species status pending further collections.

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Science Digest

The Editor's review of new developments in biodiversity and environment-related research

Hotspot in Trouble

Together with south-India's Western Ghats mountains, Sri Lanka is considered to be one of the world's 25 biodiversity hotspots. An analysis of human population densities in the global hotspots however, contains some dismal news: ours, Hotspot 21, is the most populous hotspot of them all (*Nature*, 404: 990–992; 403: 853–858). Human population density in Hotspot 21 now stands at around 350 per km^2, rising at around 1.3 percent per year. The nearest rival we have is the Philippines, with a population density of around 200 per km^2, some 43% lower than our own. By comparison, the Mesoamerican Hotspot which includes Costa Rica, considered by some to be one of the better-managed 'developing-country' hotspots, has a human population density of just 50 per km^2. Given that Sri Lanka's population will double by 2050 given the present rate of growth, many analysts fear that there is really little hope for the long-term preservation of the island's biodiversity. Under five percent of Sri Lanka's former 16,000 km^2 of rain forest now survives, and given present-day trends, this is likely to halve in the next fifty years.

Elephant Genetics

It has long been known that different populations of the Asian elephant exhibit differences in several respects including size, shape of the head and the presence of tusks in males. For example, only some five percent of Sri Lankan males have tusks, compared with almost all males in the mainland population. Even within Sri Lanka, biologists have recognised differences between populations, the taxonomist P.E.P. Deraniyagala going so far in 1939, as to name the Mahaweli floodplains population around Manampitiya, *Elephas maximus vilaliya*.

Now, a recent study led by Sri Lankan-born Prithiviraj Fernando of the University of Oregon suggests that traditional wisdom might have been right. Fernando and his team analysed DNA from 118 animals spread across the range of the Asian elephant and found the mainland population to be remarkably homogeneous, genetically speaking. A surprise in their results was that the Sri Lankan elephants were not only remarkably distinct from their Indian cousins, but also segregated into three distinct populations: northern, mid-latitude and southern. They do not, however, recommend recognition of the subspecies *E. m. vilaliya* (the study does not correlate the morphology of the animals studied with their genetic make-up).

A lesson from this study is that contrary to popular belief, elephants in Sri Lanka do not migrate over long distances, especially not on an 'island-wide' basis. For conservation managers, this has an important lesson: we should not force hybridisation between these genetically distinct (in fact, unique) populations by engaging in long-distance elephant drives or translocations under any circumstances.

Fernando is also associated with another study (*Animal Conservation*, 2: 69–73) that the long-term viability of elephant populations cannot be estimated through population trends in even a 100-year time frame. Because there is a lag of around 200 years before extinction events begin occurring in slowly declining elephant populations, examining the persistence of populations merely in the time-frame of a century in effect underestimates the risk of extinction in the long (1,000-year) term.

Wildlife Trade

Unknown to most of us, the illegal wildlife trade is flourishing. Earlier this year, four well-planned raids by wildlife officials in India succeeded in netting an amazing quantity of endangered-wildlife related contraband, including—

- 12 tiger skins
- 132 claws belonging to a further 8 tigers
- 175 kg of bones (for use in Chinese medicine)
- 124 leopard skins
- 18,080 leopards belonging to more than 1,000 leopards

The sheer size of the haul is indicative of the volume of trade that exists for these items (*National Geographic*, 198(1): xii) and raises questions about the situation in Sri Lanka.

Dying planet

The *Living Planet Report* of the World Wildlife Fund (WWF) estimated last year that one third of the world's natural resources have been destroyed in the last 25 years of the 20th century: 32 percent of the species that existed as at 1970 have now disappeared, across all habitat types. This has been the greatest extinction since a meteor crashed into Mexico 65 million years ago, causing world-wise chaos and the extinction of the dinosaurs. The report, compiled jointly by IUCN's Conservation Monitoring Centre in Cambridge, England, and the New Economics Foundation, shows that human consumption of natural resources has increased by a staggering 63 percent between 1970 and 1998.

Effluents: benzine

The levels of atmospheric pollutants in urban air, especially in Colombo, is still to be assessed. Such studies have been carried out in some Indian cities in recent years, with horrifying results. A study in Calcutta in 1998 showed that levels of some highly-carcinogenic polyaromatic hydrocarbons such as benzene, toluene and xylene are alarmingly high. According to the World Health Organisation, there are no safe limits for these cancer-causing gases, which result both from vehicle exhausts and fossil-fuel fired stoves. Benzine in particular is considered a definite human carcinogen by the International Agency for Cancer research (IACR) (*DTE*).

The European Union insists that petrol should contain no more than 1% benzine, and that atmospheric concentrations in excess of 10 ppm are dangerous.

Effluents: Particles

A study published in 1999 (*American Journal of Critical Care Medicine*, 159: 2) says that long-term exposure to atmospheric particles less than 10 microns can increase the chances of lung cancer in men. Such particles occur in greater densities in urban areas, as a result of vehicular and industrial emissions. A team led by David Abbey from Loma Lind University, California, monitored more than six thousand non-smokers between the ages of 27 and 95 years of age. Abbey found that men were significantly more at risk than women because they spent more time outdoors.

The US Environment Protection Agency has set limits on airborne particulates— for particles smaller than 2.5 microns in diameter, the limit is 15 microgrammes per cubic metre of air.

Fuel-cleaner

A new fuel additive developed in Japan, has now been successfully tested at the Environmental testing Corporation in Orange County, California. The culmination of an 18-year research and development project, the additive, called Soltron uses enzymes to increase the fuel's capacity to absorb oxygen. The net effect is more complete combustion of the fuel, resulting in hydrocarbon emissions being reduced by as much as 55 percent, and carbon monoxide reduced by 37 percent. The quantity of Soltron needed for an effective mix is just 0.025 percent of the volume of fuel. The product, which works equally well with both petrol and diesel, is not yet commercially available. (*DTE*, 7: 13).

Bleached Corals

The 1997–98 El Niño warmed much of the tropical Indo-Pacific and caused widespread bleaching of coral reefs. Corals are made up of vast colonies of minute animals, which harvest nutrients from algae inhabiting their cells, known as zooxanthellae. It is these algae that serve to give corals their beautiful colours. When seawater warms beyond certain limits (as it did in this El Niño event), these algal colonies die off, in effect 'killing' coral and making it appear bleached. This is why the reefs around Sri Lanka have been reduced to ghostly skeletons of their former glory. Sri Lanka is not alone, however: El Niño affected an estimated 70 percent of the world's coral reefs, completely bleaching 10 percent of them.

Now, a new study led by Terry Done of the Australian Institute of Marine Sciences at Cape Ferguson, Australia, (*Science*, 288: 941; *DTE*, 9: 50) suggests that the recovery of corals may be faster than expected. It seems that although El Niño wiped out large masses of colourful adult corals, juveniles were not so seriously affected. Many reefs are therefore springing back to life. Of course, the downside is that another El Niño will be upon us around 2007, and this may just about deliver the *coup de grace* to the fledgling corals that are now helping these reefs to recover.

No longer endemic

Sri Lanka prides itself on having some 830 species of flowering plants endemic to its forests. This endemism however, is largely dependent on how well the Indian flora is known. As exploration in India continues, it is likely that the number of Indian endemics will rise, and that of Sri Lankan endemics will decline. This is precisely what has come out of a study carried out by the Kerala

Forest Department. C. R. Suresh, in an article titled "Occurrence of Sri Lankan endemic plants in Silent Valley", published in the book *Silent Valley: Whispers of Reason* (1999, ed. Manoharan, T.M., Biju, S.D., Nayar, T.S. & P.S. Easa, publ. by Kerala Forest Department; 421 pp; ISBN 61-900979-14), announced the discovery in this reserve of seven plants hitherto considered endemic to Sri Lanka. *Syzygium makul, S. neesianum, Coleus barbatus, C. inflatus, Scutellaria oblonga, Dendrobium panduratum* and *Oberonia forcipata* have all been recorded from Silent Valley. The list of 'Sri Lankan endemics' found also in Kerala is expected to increase with the on-going exploration of the biodiversity-rich south Indian state's on-going exploration of hitherto neglected habitats.

...and not just plants

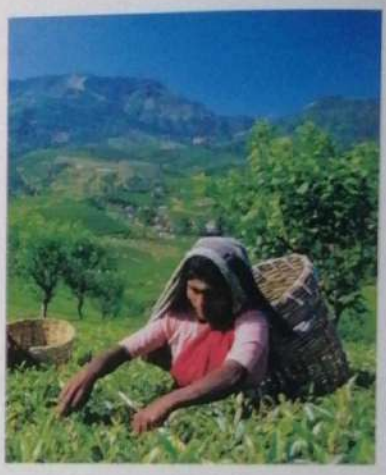
The shrew genus *Feroculus* has in the 150 years since its

discovery, been considered endemic to upper reaches of the Sri Lankan highlands, Horton Plains being a habitat in which these small animals are known to occur. Together with the mouse *Srilankamys* and the shrew *Solisorex*, it is one of three genera thought to be endemic to Sri Lanka (only a single species is known from each genus). Interestingly, all three groups are known only from montane habitats.

Surprise then, when M. S. Pradhan of the Zoological Survey of India and colleagues announced their discovery of *Feroculus* in Eravikulam National Park and the upper Bhavani Forest Reserve in the mountains of south India (*Mammalia*, 61: 448–450). Interestingly, the Indian specimens were collected from *shola* habitats at altitudes of 2,200–2,400 m, almost identical to that of the Horton Plains. Sadly, the publication does not state whether the specimens collected were preserved, and if so where they are now. This is all the more relevant because the researchers base their record purely on information on *Feroculus* gleaned from W. T. Blandford's monograph of the mammals of British India published in 1888, and not on the study of actual Sri Lankan specimens.

Caffeine-free Tea

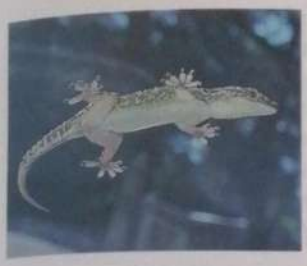
In a nation of tea drinkers, it may come as a surprise to some that like coffee, tea too, contains the stimulant-alkaloid caffeine. As a result, many people find it difficult to sleep for some time after consuming coffee and sometimes even tea. While 'decaf' instant coffee in commercially available, conventionally-brewed caffeine-free beverages have been but a dream.



Caffeine synthase is an enzyme that enables the synthesis of caffeine in plants containing this alkaloid. Now, a team led by Misako Kato of Ochanomizu University, Tokyo (*Nature*, 406: 956), has succeeded in cloning the gene responsible for encoding caffeine synthase in tea (*Camellia sinensis*), opening up the possibility of developing tea and coffee plants naturally deficient in caffeine. Given that tea remains Sri Lanka's primary value-added export, it is probably time the moribund industry turned from traditional practices to the benefits that biotechnology could offer. It is heartening that almost simultaneously with Kato's announcement, Sri Lanka's National Research Council announced a new scheme of funding for research in biotechnology: sadly, the scheme is restricted to government-affiliated institutions, notorious for their low research output.

Sticking to the Ceiling

There can't be a child in Sri Lanka who has not wondered how it is that geckoes are able to walk 'up-side down' on the ceiling. I recall myself as a ten-year old, experimenting with a pet house gecko by wetting its feet with tiny drops of water and then releasing it on to a wall. Of course, it would speed away effortlessly. It has long been known that gecko feet adhere to rough surfaces by means of thousands of minute hairs they contain. The hairs enter microscopic crevices in the wall (or other surface), anchoring the gecko to it not by friction but by van der Waals forces. But how much force is available to the gecko for this purpose? After all, gecko feet are small, and remember that as it runs along the wall or ceiling, only two feet serve to hold it up. Now, the question that has been on my mind for well nigh 35 years has finally been answered. Through intricate measurements, a team led by Kellar Autumn of Lewis Clark College, Oregon (*Nature*, 405: 681), has measured the actual force of a



single gecko-foot hair.

Typically, a gecko foot contains some 500,000 hairs known as *setae*. Each hair is just 30–130 millionths of a metre (mm) long and terminates in minute branches just 0.2–0.5 mm in diameter. The force of a single seta amounts to 194 millionths of a Newton (mN), with a measurement error of ±25 mN. This suggests that in theory, the gecko's four feet can support a weight of some 40 kg, more than enough to hold a 10 g gecko to the ceiling. How then, you might wonder, does the gecko manage to *lift* each foot off the surface, in order to walk? The answer is that rather as we do, geckoes *peel* their feet off the surface, at the same time uncurling their toes, thus releasing the setae's grip.

Acavus tumbles

The land snails of the genus *Acavus* are among the best-known molluscs in Sri Lanka. Being a genus endemic to this island, the six species (and four subspecies) hitherto recognised have traditionally been viewed as belonging to a relict lineage deriving from Sri Lanka's ancient connection with Africa. Now, study by Bernhard Hausdorf of the Museum der Universität Hamburg and Sri Lankan-born malacologist Kalika Perera have in effect stood *Acavus* on its head. According to Hausdorf and Perera (*Journal of Molluscan Studies*, 66: 217–231), the ten taxa hitherto recognised from Sri Lanka in fact belong to only three species: *A. haemastoma*, *A. superbus* and *A. phoenix*. They go on to describe a new subspecies, *A. pheonix castaneus*, while pointing out that contrary to previous opinion, *Acavus* is not an isolated group of ancient relicts, "but that speciation is in progress and that the radiation in *Acavus* species is probably much younger than the radiation of the [other] acavid genera." They conclude that in view of all the known species of *Acavus* occurring commonly in man-modified habitats, none of the species is at present endangered. It seems that the larger number of species previously recognised was a result of scientists being unable to tell true species apart from hybrids, which seem to be common in this group of snails.

Adam Walked

For the purposes of 'broad-brush' biogeography, Sri Lanka is in effect part of the Indian peninsula. We share close to 70% of our fauna with India, and hardly any higher levels of plant and animal classification (e.g. families) are endemic to Sri Lanka. The fauna and flora we share came here, of course, by a land route. Whenever sea levels have been sufficiently low, the shallow waters of the Palk Strait give way and Adam's Bridge serves, as its name suggests, as a true land-bridge between Sri Lanka and the subcontinent. During the past few million years, sea-level fluctuations have been caused mainly by Ice Ages, where glaciers and enlarged polar regions hoard water in the form of ice. Migration between India and Sri Lanka by land would thus have been possible only during these 'glacial maxima', which in turn give rise to 'sea-level minima'. A sound understanding of when exactly land bridges existed between the mainland and Sri Lanka is a prerequisite then, to understanding the way in which Sri Lanka's fauna and flora are shared with India (remember that migration is a two-way affair).

Two independent recent studies show that sea levels were at their lowest (121–130 metres or 397–427 feet below the present level) 22,000–19,000 years ago. The resulting land bridge would have been more than 100 km wide, and existed possibly until as recently as 8,000 years ago, in the final stages in the form of mangrove marshes. A team led by Yusuke Yokoyama of the Australian National University at Canberra analysed core samples from the seafloor of the Bonaparte Gulf (*Nature*, 406: 713–716); and British marine biologist Charles Anderson examined submarine coral formations (*Coral Reefs*, 17: 339–341), both reaching almost the same conclusions.

The first humans had arrived in Sri Lanka at least 10,000 years before the glacial maximum, and they too, probably walked.

The Bold and the Beautiful

The males of many species of birds and reef fishes are brightly coloured, and biologists have long known that females select males with the brightest colour. However, how do females *benefit* from their choice of the gaudiest males? A study led by Jean-Guy Godin of Mt. Allison University, Canada (*Proc. Natl. Acad. Sci. USA*, 93: 10262–10267) on the common guppy (*Poecilia reticulata*) suggests that the more colourful males are also more courageous. Brightly-coloured male guppies are more likely to approach predators closely, without being killed. Given

that male-male combat is unknown in guppies, it seems that only the 'fittest' males are thus selected for mating with the best females.

Lovemaking in the Dark

The sexes of many species of tropical fishes, both in freshwater and, of course, in reefs, identify each other by their colouration. Poor land-use practices however, often render freshwaters more turbid with silt, especially during the rainy season, when most species breed. It is well known that increased turbidity results in fewer individuals finding partners with which to mate, thus stressing populations. However, a study of an assemblage of closely-related fish species in Lake Victoria by a team led by Ole Seehausen of the University of Leiden (*Science*, 277: 1808) has shown that individuals of different species are more likely to mate in turbid water, leading to hybridisation which, in the long term, could lead to the disappearance of some species. The diversity of freshwater fish communities thus depends directly on the clarity of the water in which the fish live, something that we need to be conscious of when planning the conservation of our unique fish fauna.

Dog Days

A recent genetic study suggests that man's best friend could also be his oldest. Archaeological evidence suggests that dogs have been associated with man for as long as 14,000 years. Although dogs have been widely supposed to derive from wolves domesticated by early humans, it has not been known whether such domestication tool place just once in an early human population somewhere, or in several instances, at different places and times. Now, a study led by Charles Vilà of the University of California at Los Angeles (*Science*, 276: 1687) has provided the answers to some of these question through a study of DNA in 27 wolf populations world-wide, and 67 breeds of dogs.

It turns out that most dogs belong to a single lineage extending some 140,000 years back, suggesting their very early association with humans. It appears that early dogs were German-shepherd-like, resembling wolves in appearance; what is more, there is evidence of repeated hybridisation between dogs and wolves. Vilà's team concludes that the plethora of breeds we see today is the result of selective breeding that took place in the last 10,000–15,000 years, after humans ceased to be hunter-gatherers and adopted a more sedentary lifestyle. The availability of the wild wolf population for back-crossing, the authors conclude, may have been a major factor enabling the incredible diversity of breeds that are available today.

Green-billed Coucal Nest

The Green-billed Coucal (*Centropus chlororhynchos*) is not only endemic to Sri Lanka, but also among the island's rarest birds. No surprise then, that neither Vincent Legge nor G. M. Henry, the island's greatest ornithologists, were able to see a nesting pair of these elusive birds. In late 1997 by Martin Wijesinghe, the renowned eco-tourist guide of Sinharaja, had the fortune of seeing a pair of Coucals build a nest and raise a single chick (*Forktail*, 15: 43–45). Among the many fascinating observations made by Wijesinghe is that the bird's bill colour changes from ivory during breeding, to pale green during the post-breeding state.

Trees do help

A three year study by the European Union's Euroflux Project has shown that the EU's forests absorb as much as 30% of the carbon dioxide emitted by the Union's member states. The Kyoto Protocol on green house gases (GHGs), which result in global warming, requires signatory states to devise CO_2 sinks, in addition to cutting down on emissions. Forests are among the most effective sinks, and the Euroflux study demonstrates that they can contribute significantly to curbing GHGs. In the process of photosynthesis, trees absorb CO_2 and release O_2. Euroflux uses tower-mounted ultrasensitive gas data logging systems to measure the quality of air passing through forests, a technique known as eddy covariance. Europe's forest cover is increasing steadily owing to commercial reforestation. (*DTE*, 7: 13).

Elephant contraception

Wildlife managers in some parts of Africa are lucky: they have *too many* elephants, and need to keep numbers down by culling whole herds so as to conserve the available habitat. Culling however, is seen as inhumane by many conservationists. Now, 'immunocontraceptives' (vaccines that causes the immune system to produce antibodies that prevent fertilization) tested in South Africa's Kruger National Park, seem to offer new hope (*Nature*, 407: 149). About half the elephants immunized and monitored failed to become pregnant over the twelve-month study period. Immunocontraceptives are reversible and lack many of the side effects caused by hormonal oral contraceptives commonly used by humans.

Adventure on Horton Plains

Kavinda Amarasinghe*

*General Hospital (Teaching), Kandy.

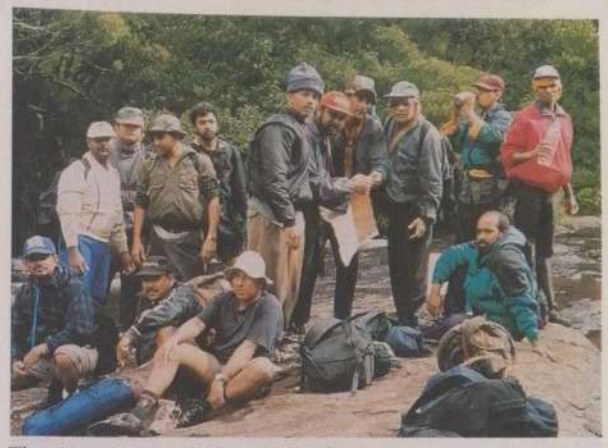
On the morning of 2 September, 1999, our fourteen-member team (all members of the Association of Nature Explorers) began a trek from Marathanne to Horton Plains through the Balangoda forest reserve. Our team leader, Lalith Gamage of the Forest Department, guided us using a one–inch topographic map and a compass. On our left was Dethanagala, so named because its twin peaks resemble a woman's breasts. We hoped by the end of the day to reach Galagama Elle, the highest but one waterfall on Belihul Oya, a tributary of Walaweganga. Here we would camp overnight and go on to Horton Plains next day.

The initial part of the journey was difficult because the thick undergrowth was wet. We moved through it carefully, trying not to damage the lush foliage. On several occasions we mistook animal trails for footpaths and had to change direction. Travelling ahead of us, Prasad, a doctor, kept probing for trap gun trip-wires with a long stick. It soon became clear that removing plentiful leeches that clung to our legs was a waste of time; so, ignoring them, we walked on.

We were far behind schedule. The time was By 4 p.m. it became clear that we were far behind schedule. We had reached the rock cliff from where we had to bear 40° south to reach our planned overnight stop. Tents had to be put up before dark, and as we did not hear the sound of the cascading waters that would indicate the Belihul Oya nearby, we descended some three kilometres along a slippery drain and reached a stream, which we identified on the map, much later, as a tributary of Bogawantalawa Oya.

Here we split into small groups: some collected firewood, some lit the campfire and others put up the tents. My doctor friends Sunil and Quintus had already started preparing the dinner. In next to no time the tents came up, the fire was lit and a ration of *arro* was served to warm ourselves. Dr Ananda Gunasekera, the popular vocalist, entertained us with our favourite songs and everybody joined in. It was past midnight when we had dinner. Ignoring the cold, the drizzle, damp clothes and itching leech bites, we crawled into the tents and tried to get some sleep.

Throughout the night, however, small streams of rainwater seeped into the tents, soaking our clothes and sleeping bags. Sleeping five to a tent, there was little chance of repositioning oneself to avoid the water. When



The Association of Natural Explorers team.

I finally emerged from my tent at 6 a.m. next morning, it was still drizzling. My assignment: to brew tea for the troupe. I lit the gas stove, kept a saucepan of water to boil, and walked barefoot in the icy-cold stream. There, alone, surrounded by trees shrouded in mist, the sunlight filtering through the branches and the birds warming up to their early-morning songs created an atmosphere I shall never forget.

We prepared *kiribath* for breakfast and packed our lunch in shopping bags. Making an early start, we travelled along several footpaths wet with the morning dew, and finally arrived at the boundary of a tea estate. Here we rested briefly, refreshing ourselves and once more began our ascent on a footpath that took us close to the cabañas Loinorn Estate. From here, we still had 8 km to reach our destination.

The climb was steep and the undergrowth grassy. Rhododendron trees, their trunks and branches laden with lichens and mosses were all, as were mountains similar to those in vicinity of Horton Plains— so we knew we were on the right track.

Just then an unexpected incident changed the course of our journey. Descending to the plains, we heard the chattering of a large crowd. As we came into sight of the commotion, we saw more than a hundred men, some of then carrying hoes and pans. As soon as they saw us, they took to their heels. These people were illegally engaged in gem mining along the Bogawantalawa Oya. As we walked along the riverbank, we were shocked to see the large-scale destruction wrought on this beautiful landscape. There were pits dug all over, uprooted and fallen trees, and the remains of crude *cadjan* huts along the bank. Not quite knowing what to do, we moved on along the bank, unaware that we had lost our way in the fading light. Although we sighted several more people

as we went along, we were unable to get directions from them because they fled as soon as they saw us.

Night was falling fast. Initially, we had decided to walk along the footpath. It soon became clear that this was risky because both sides were dug up and the blackish mud slippery. The pits were deep, most of them filled with water. One missed step could mean a twisted ankle or fracture. We had no option but to put up our tents on the muddy soil in the *patana* grassland. The wind was so strong that the tents blew off twice. Finally, we weighted the tents with our luggage. Despite the damp, we got a campfire started a rock surface (so as to avoid a forest fire). In the extreme cold, our hands and feet were numb, beset with 'pins and needles'. Intermittently shrouded in thick fog, we could hardly see the tents. Nevertheless, strengthened by a dinner of noodles and chicken, we engaged in a sing–song until after midnight. While I sat beside the fire, chatting to my friends, Tilak, Shantha and Dr Ratnayake—the most senior member of our group— our discussions centred around on how gem mining in this spectacular place could be brought to an end.

Top: the mindless destruction caused to Horton Plains' pristine landscape as a result of illegal gem mining.

Centre: Vast areas of the riverbank have been excavated, causing lasting damage to this habitat.

Bottom: the gem pits are a harard not only to nature-lovers touring the park, but also to wild animals.

At an altitude of over 2,000 m, with temperatures ranging around 15°C, camping in the wind-swept *patana* grass was a unique experience. I closed my eyes and drifted off to sleep listening to the wind and the falling rain. The following morning, though still exhausted, we started off early, determined to find our way out. This part of the journey was beautiful: looking down on the mountains bordering Balangoda was an impressive sight. Soon we heard water. Here, at last, was Belihul Oya. We crossed the river by a rock ridge, which had created a natural pool. The trees along the riverbank, with branches hanging low, their reflection falling on the crystal-clear water, was enchanting. It was noon when we stopped for breakfast—a few packets of noodles, all that was left of our meagre rations. Feeding on bits of noodles that fell into the water were a bright red crab and a single fish, perhaps a trout.

We followed the stream, confident it would lead us to Baker's Fall. It soon became clear that the damage done to this section was even worse than that we had seen the previous day. In the course of the morning, we encountered more illicit gem miners, now actually within the national park. Isolating two of them complete with shafts and cane baskets, we performed a 'citizen's arrest'. A few kilometres on, we reached the footpath connecting Baker's Fall with Worldsend. Seen from a distance, the fall is a magnificent sight. When we reached the Wildlife Department office, we briefed the park warden on the destruction caused by the gem miners and reiterated our deep concern for the conservation and protection of this beautiful wilderness area.

We are greatly indebted to Lalith Gamage (RFO), Bulitha Pradeep Kumara (journalist) and Sanka Gallege (photographer) for joining us on this hike and subsequently publishing several articles highlighting the destruction we observed. Rupavahini's *9.05* programme telecast a discussion on this issue, and we learned much later that several raids had been carried out on the gem miners. I hope permanent steps will be taken to preserve this priceless heritage.

Captive Life History and Siblicide in the Field Mouse, *Mus booduga*

Mohomed Bahir* and Sudath Nanayakkara*

* Wildlife Heritage Trust of Sri Lanka, 95 Cotta Road, Colombo 8.

The field mouse, *Mus booduga*, is one of four species of mouse known from Sri Lanka. It is most easily distinguished from the only other member of its subgenus, *M. (mus) musculus* by its white (rather than grey), underparts. *Mus booduga* occurs throughout Sri Lanka and peninsular India, from sea level to altitudes of almost 3,700 m (Mandal, 1984).

A pair of field mice were captured in a pitfall trap at the WHT Arboretum, Agrapatana (alt. 1,675 m), on 30 April, 2000, and introduced to a 60×45×45 cm (W×D×H) glass terrarium. The male weighed 14.0 g and the female 15.0 g, sex being determined by the presence of testes and mammae. The mammae were well-developed, suggestive that the female was pregnant.

The terrarium was furnished with the dried (hollow) stem of a *Cyathea* tree fern, dry grass, leaves, pieces of newspaper, a branch, and a shallow water-dish. The mice were fed on a diet of Prima® chicken feed, supplemented with lentils (*Lens culinaris*), green gram (*Phaseolus mungo*), chick-pea (*Cicer arietinum*) and unhusked rice grain, renewed daily.

On the third day after introduction to the terrarium, the mice commenced nest construction within the fern stem, using mainly dry grass and bits of newspaper. The cup-shaped nest had an internal diameter of 6 cm and depth of 3 cm. Apart from the nest proper, the inside of the stem was not lined with nesting material in the form of a tunnel, as is sometimes seen leading to mouse nests. The mice remained in the stem all day, becoming active after dusk.

On the night of 8 May, three young (1.5–2.0 g) were born. Pink at birth, they began turning black on 12 May, the eyes opening on 17 May, by when they weighed 4.0 g each. They began emerging briefly from the nest and began exploring the terrarium on 22 May, and on 24 May began feeding on the diet provided for the adults. As it was clear that the female was pregnant once more, the young were moved to a similarly-furnished terrarium of their own on the same day, and immediately began constructing a crude nest within the fern stem provided; they weighed 4.0, 5.0 and 6.0 g at this stage.

The young were weighed and photographed at 0930 on 16 June (8.0, 7.5, 7.0 g). While cleaning the terrarium at 1300 the same day, we found two of the mice mutilated

Newborn young of *Mus booduga*: 8 May, 2000.

Female *Mus booduga* nursing young: 8 May, 2000.

Four-day-old young of *Mus booduga*: 12 May, 2000.

Victims of siblicide— *Mus booduga* young killed by a sibling: 16 June, 2000.

and dead, the third (largest) sibling uninjured and apparently healthy (it is alive at the time of writing, on 20 September). It was not possible for an external predator to have entered the terrarium, the lid of which was secure. Between-litter siblicide is rare mammals (Leippert *et al.*, 2000), and we have been unable to find a previous record of this behaviour in *Mus*.

On 7 June, four young were born to the original 'parent' pair (suggestive of a gestation period of 14 days). Both parents however, died quite suddenly on 28 June, having shown no sign of illness. The young, not yet weaned, died later the same day.

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Nest and Eggs of the Black Robin

Sudath Nanayakkara*

* Wildlife Heritage Trust of Sri Lanka, 95 Cotta Road, Colombo 8.

The nest and eggs of the Black-backed Robin, *Saxicoloides fulicata leucoptera*, have been described by Henry (1998), who also gives the higher limit of this bird's range as 5,000 ft on the north-eastern slopes of the central hills, "less high in damper districts." Here I report a nest from the WHT Arboretum, Agrapatana, at an elevation of 5,500 ft (1,675 m).

The nest, set into a hollow in an embankment, was a crude cup (46 mm dia. × 67 mm cup-height) constructed of dried grass, reeds and roots. In it were deposited the slough of a ratsnake (presumably to deter rats from raiding it), and two eggs 19.6×14.9 mm and 18.8×14.6 mm. The eggs were incubated by the female alone, who remained with it throughout, even after the young hatched, except for 3–4 brief (*ca.* 2 hr) excursions in the daytime, when the male would remain nearby and guard the nest. Food for the young was brought only by the male. The young opened their eyes four days after they hatched.

Left: male Black-backed Robin; *top:* eggs deposited in nest; *above:* young, a day after hatching.

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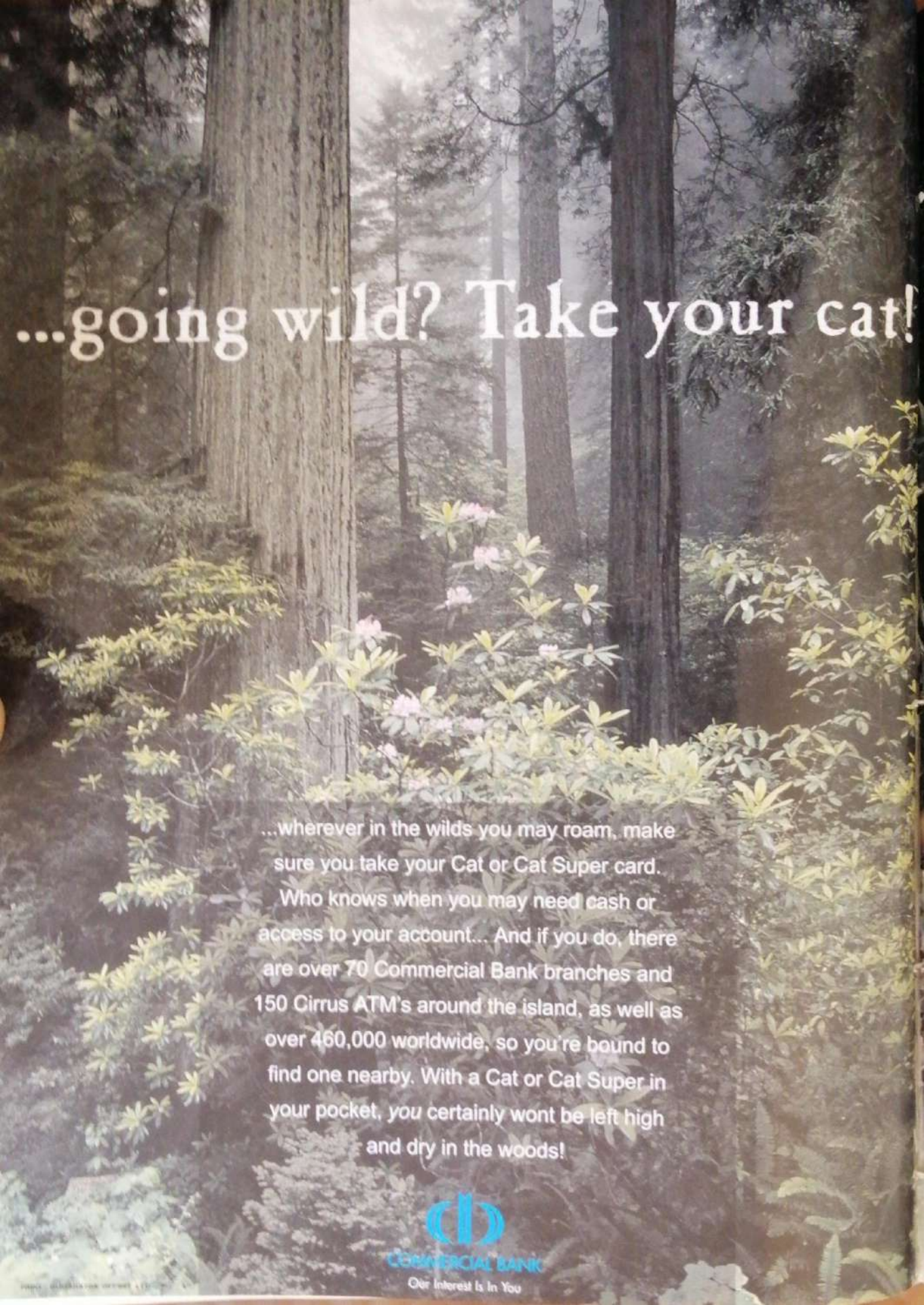
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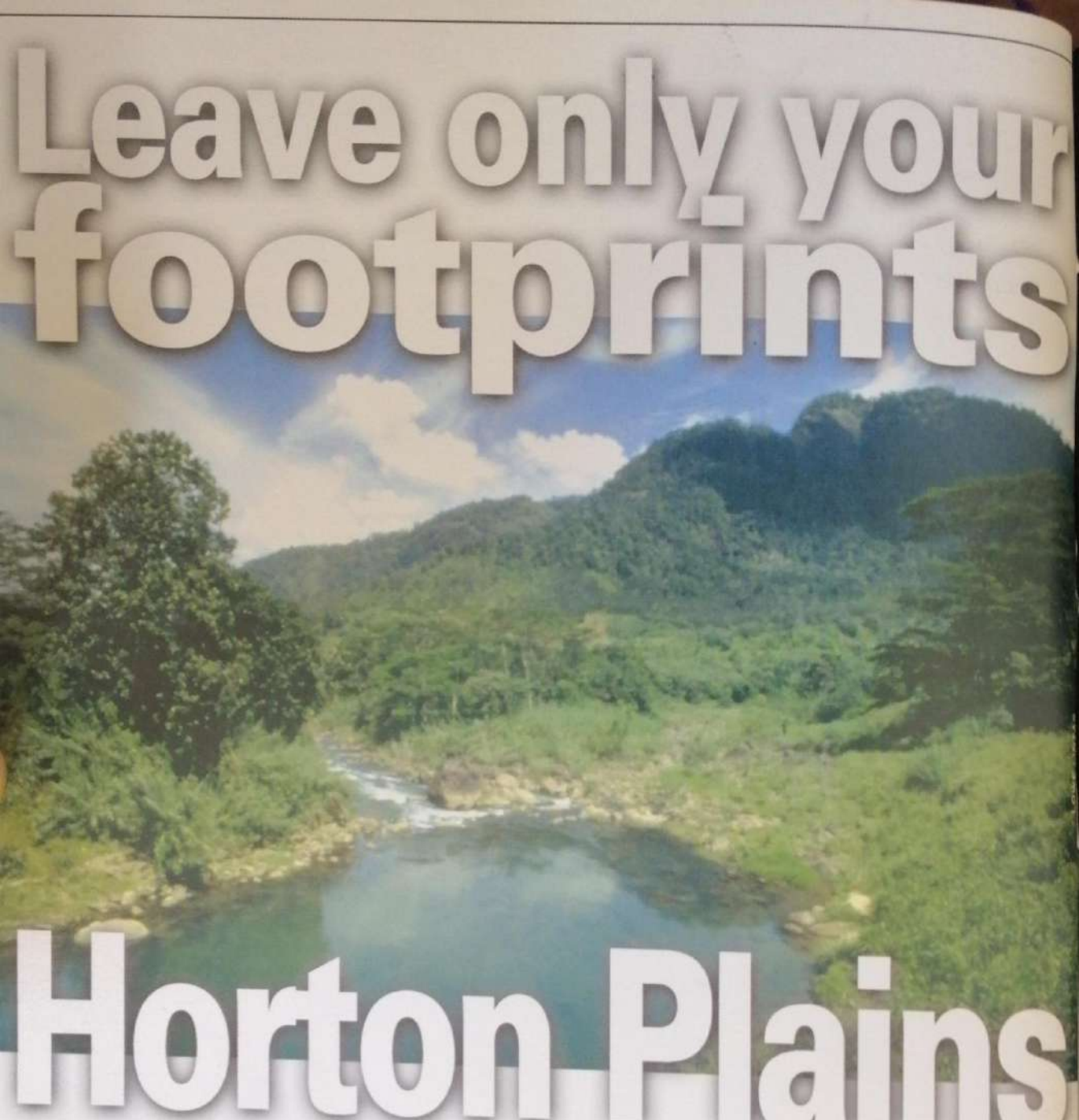

Horton Plains

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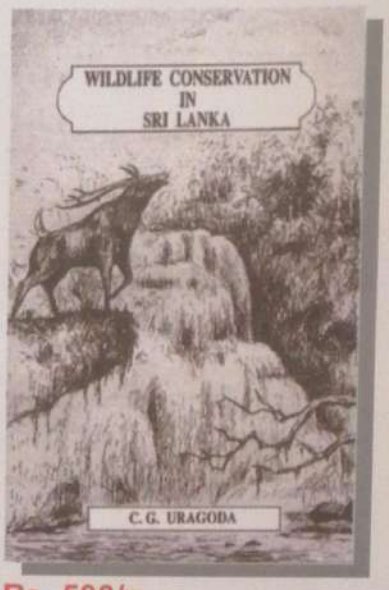

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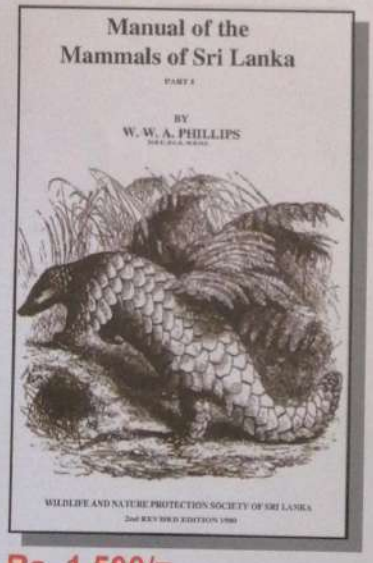

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Editorial

Alien Invasive Species: an Emerging Menace

Invasion by alien species is considered today, as one of the greatest threats to the global biodiversity, even more so than habitat loss and degradation. For millions of years, natural barriers such as oceans, rivers, mountains and deserts have provided the isolation necessary for the natural evolution of unique species and ecosystems. However, with the increase in travel and trade together with intentional and unintentional introductions have effectively breached these barriers, ending in some cases millions of years of natural isolation. Some of the species introduced in this manner have undergone a massive explosion in their population in the absence of natural enemies and competing species and consequently have become invasive species.

Most of the invasive species identified to date are macroscopic organisms that are visible to the naked eye. Hence, their rate of spreading can be easily monitored. However, in recent times there has been a marked increase in the use of microbial formulations such as biopesticides, garbage degradation enhancement agents and growth additives for agriculture and aquaculture. These formulations carry number of microorganisms, of which some are not indigenous to the country. These microorganisms can multiply and spread rapidly without being detected as they have a short generation time and invisible to the naked eye. Thus, the impact of these microorganisms on the environment will not be fully realized until it is too late to take corrective action.

Alien invasive species should not be treated lightly, as examples from other countries have shown that this is going to be an enormous problem in both ecological and economic terms. In the feature article of this issue of *Loris* Dr. Bambaradeniya has very lucidly presented the conceptual framework regarding invasive species with a special emphasis on Sri Lanka. Through the editorial I wish to draw the attention of our readers to some pressing issues, as I see it, which needs to be resolved soon if we are to successfully combat this emerging menace.

One of the main shortcomings in dealing with alien invasive species is the lack of a clear set of criteria to identify invasive species. As a result of which identification and prioritization of species for management is done mainly on an ad hoc basis at present. Although IUCN have laid out some broad guidelines regarding invasive species, to my knowledge they have failed to give a definite set of criteria that can be used for detection. Therefore, as a first step we must attempt to develop a set of criteria that can be used at a national level for identification of invasive species, so that a list of species that require management action can be compiled.

The next biggest obstacle in dealing with alien invasive species is the lack of a proper institutional and legal framework to deal with them. Thus people have no place to turn to when they have a question. Furthermore, there is no coordination among various government institutions that are directly or indirectly involved in dealing with alien invasive species. Thus the actions of these departments can sometimes be contradictory to each other, creating confusion among people. Therefore, there is a strong need to establish a institution anew or under an existing government department, that is directly responsible for dealing with issues pertaining to alien invasive species.

Another obstacle faced in dealing with alien invasive species is the lack of awareness among the general public about invasive species and the threat posed by invasive species to the indigenous biodiversity of the island. In many occasions I have observed people engaging in activities that would aid the spreading of invasive species unknowingly. It is my belief that mitigating and managing invasive species will not be possible until we get the full support of general public. Thus, an aggressive education campaign must be launched to achieve this feat and non governmental organizations (NGO's) like WNPS can play a major role here.

Currently, there is no concerted effort to manage the invasive alien species in Sri Lanka except several isolated attempts to control species such as *Salvinia molesta*, *Ulex europaeus* (in Horton plains NP), *Prosopis juliflora* (in Bundala NP), and *Lantana camara* (in Udawalawe NP). Even these actions are carried out on an ad hoc manner with little post management monitoring. Therefore, the effectiveness of these control measures is not fully realized. In addition, two national committees, one under the Ministry of Forestry and Environment and the second under the National Science Foundation have been established recently to look in to this matter and make necessary recommendations to the government.

Whilst it is impossible to eradicate all the invasive alien species in Sri Lanka, we must take necessary steps to, first, prevent further introduction of alien invasive species and second, to manage those alien invasive species that are currently posing a major threat to the indigenous biodiversity.

Alien Invasive Species in Sri Lanka

Channa N. B. Bambaradeniya

IUCN – The World Conservation Union, 53 Horton place, Colombo 7

Alien invasive species

An alien species refers to an organism, which occurs outside of its natural range or dispersal potential. They are commonly referred to as non-native, foreign or exotic species. An alien invasive species (AIS) is an organism that becomes established in natural or semi-natural ecosystems or habitats, is an agent of change, and threatens native biological diversity (IUCN, 2000).

Significance of alien invasive species

AIS are now recognized as one of the greatest biological threats to our planet's ecological and economic well-being. The impacts of AIS are immense, insidious, and often irreversible. It has been well documented that AIS have resulted in massive and rapid losses of biodiversity, especially in island ecosystems (Clout, 1995). Hundreds of species extinctions have been caused by AIS. Therefore, the direct ecological cost of AIS is the irretrievable loss of native species and habitats. In addition, the direct economic costs of AIS run into many billions of dollars annually. For instance, most alien invasive plants function as arable weeds that reduce crop yields and also increase costs of control; some invasive plants contribute to degradation of catchment areas and irrigation systems, resulting in huge costs to clear them; and control costs related to some invasive species which function as pests and pathogens of crops, livestock and forest plantations.

Some factors, which make threats posed by AIS very important in relation to the biodiversity of Sri Lanka are: geographically separated small size of the country; its island nature and developing status; greater diversity of habitats; evolutionary history which has resulted in high levels of species endemism in the southwestern part of the country; increased degradation and fragmentation of natural habitats due to development activities; and the current highly threatened status of many endemic species and their habitats (IUCN Sri Lanka, 2000).

Introduction of alien species

The introduction of plant and animal species beyond their natural range is closely linked to the history of civilization. Colonization in particular led to massive transoceanic movements and exposed ecological systems and native species to new stresses and threats. In the modern era of globalization, Trade, Transport, Travel and Tourism have sharply accelerated the rate of species movements. Establishment of an alien species that may become invasive is generated by two major categories of activities:

1. Intentional Introductions:
   a. Deliberate introductions for use in biological production systems (agriculture, forestry and fisheries), landscaping and for recreational and ornamental purposes.
   b. Introduction for use in containment or captivity (Zoos, Aquaculture, Aquaria, Horticulture, Pet trade), from which there is a known risk of escape or release to the wild due to negligence.
2. Unintentional Introductions:
   Accidental introduction of species through pathways involving transport, trade, travel or tourism ('hitchhikers' or 'stowaways').

The taxa that invade

AIS are found in all taxonomic groups; they include introduced viruses, fungi, algae, mosses, ferns, higher plants, invertebrates and vertebrates. In general, AIS are those that can take advantage of disturbances to colonize or expand their populations. About 1-2% of all introduced species is likely to become invasive.

Ecosystems that are likely to be invaded

While all ecosystems can be invaded, some are more vulnerable than others. Ecosystems particularly vulnerable to AIS include:

1. Ecosystems that are geographically or evolutionarily isolated (islands, lakes, mountains etc.). Availability of vacant, under – or unutilized niches facilitates the establishment of AIS in these ecosystems.
2. Degraded and stressed ecosystems.
3. Inland water systems.
4. Enclosed marine systems, such as bays and estuaries.
5. Agricultural systems.

Figure1. The slug *Laevicaulis alte*.

Conditions that favor establishment and spread of AIS

In general, the conditions that favor the establishment and spread of AIS can be summarized as follows:

1. Availability of empty or unutilized niches that occur naturally or created by habitat destruction/degradation.
2. Absence of natural enemies and diseases.
3. Intrinsic factors of AIS such as high rate of reproduction and the ability to disperse rapidly.
4. Ability of AIS to tolerate sub-optimal levels of resources.
5. Ability of AIS to exploit chemical changes such as pollution/eutrophication.
6. Synergistic interactions with global climate change.

Alien invasive species in Sri Lanka

Observations made during the past five years have led to the documentation of 43 species of exotic invasive biota (consisting of 12 species of fauna and 30 species of flora), spreading in natural and seminatural ecosystems in the different bioclimatic zones of Sri Lanka. The alien invasive fauna includes 8 species of vertebrates (freshwater fish – 6spp., mammals – 2 spp.) and four species of invertebrates (molluscs – 4 spp.) (Table 1). Besides these, three species of alien domestic (feral) animals; cattle, dogs and cats, behave in an invasive manner in certain locations of the island. The alien invasive flora includes one pteridophyte, two monocots and 27 dicots (Table 2). The total number of species includes 13 aquatic invaders (fauna–7 spp., flora–6 spp.) and 30 species which are terrestrial invaders (fauna – 6 spp., flora – 24 spp.).

Figure 2. Giant African snail *Achatina fulica.*

Table 1. Alien invasive fauna in natural ecosystems of the different bioclimatic zones of Sri Lanka.

Species	Mode;Source; Purpose	Distribution	Affected Habitats/Ecosystems
1. Rainbow trout *Oncorhynchus mykiss*	Deliberate; British planters; Sport fishery	Montane Zone	Streams
2. Clown knife fish *Chitala chitala*	Negligence; Aquarists; Ornamental fish trade	Lowland Wet Zone	Tanks, ponds, slow-flowing rivers, marshes
3. Plectosomus catfish *Hypostomus plecostomus*	Negligence; Aquarists; Ornamental fish trade	Lowland Wet Zone	Tanks, ponds, slow-flowing rivers, marshes
4. Guppy *Poecilia reticulata*	Deliberate; State; Mosquito control	Island wide	Tanks, ponds, slow-flowing rivers, marshes, streams
5. Tilapia *Sarotherodon mossambicus*	Deliberate; State; Commercial fishery	Island wide	Tanks, reservoirs, slow-flowing rivers, marshes
6. Snake-skin gouramy *Trichogaster pectoralis*	Deliberate; State; Commercial fishery	Dry & Intermediate Zones	Tanks, reservoirs, marshes, streams
7. Golden apple snail *Pomacea* spp.	Negligence; Aquarists; Ornamental fish trade	Lowland & Upland Wet Zone	Tanks, ponds, marshes
8. Giant african snail *Achatina fulica*	Negligence; British planter; Research/Hobby	Island wide	Natural and managed terrestrial habitats
Slugs 9. *Laevicaulis alte* 10. *Deroceras* spp.	Accidental; Horticulturists	Island wide	Natural and managed terrestrial habitats
11. House rat *Rattus rattus*	Accidental; Ships	Island wide	Natural and managed terrestrial habitats
12. Domestic/feral buffalo *Bubalus bubalis*	Deliberate; State & Farmers; Animal husbandry	Island wide	Forests

Table 2. Alien Invasive Flora in Natural Ecosystems of the different bioclimatic zones of Sri Lanka.

Species & Life-form	Mode;Source; Purpose	Distribution	Affected Habitats / Ecosystems
1. *Annona glabra* – Small tree / shrub ('Wel atha')	Unknown	Lowland Wet Zone	Coastal lagoons,marshes
2. *Salvinia molesta* – Floating (Salvinia)	Negligence; Deliberate; Ornamental plant	Island wide	Tanks, ponds, marshes, streams
3. *Eichhornia crassipes* – Floating (Water hyacinth)	Negligence; Deliberate; Ornamental plant	Island wide	Tanks, ponds, marshes, streams
4. *Lantana camara* – Shrub (Prickly Lantana)	Negligence; Horticulturists; Ornamental plant	Island wide	Scrubland, degraded open forests
5. *Ulex europaeus* – Shrub (Gorse)	Negligence; Horticulturists; Ornamental plant	Montane Zone	Montane forests, wet pathana grasslands
6. *Eupatorium riparium* – Shrub (Mistflower??)	Negligence; Horticulturists; Ornamental plant	Montane Zone	Montane forests.
7. *Eupatorium odoratum* – Shrub (*Chromolaena odorata* / 'Podisinghomarang')	Negligence; Horticulturists; Ornamental plant	Lowland Dry & Wet Zones	Forest edge & pathways
8. *Cestrum aurantium* – Shrub	Negligence; Horticulturists; Ornamental plant	Montane Zone	Montane forests
9. *Prosopis juliflora* – Small tree (Mesquite)	Deliberate; State; Aforestation	Arid Zone	Thorn scrublands
10. *Opuntia stricta* – Shrub (Cactus)	Negligence; Horticulturists; Ornamental plant	Arid Zone	Thorn scrublands
11. *Clidemia hirta* – Shrub (Hairy Clidemia)	Unknown	Lowland Wet Zone	Rainforests
12. *Swietenia macrophylla* – Large tree (Mahogany)	Deliberate; State; Forestry / Timber	Lowland Wet Zone	Disturbed Forests
13. *Mimosa invisa* – Creeper	Unknown	Lowland Wet Zone	Disturbed Forests
14. *Dillenia suffruticosa* - Small tree . ('Diyapara') Ornamental plant	Negligence; Horticulturists;	Lowland Wet Zone riparian areas.	Marshes
15. *Mimosa pigra* – Small tree / Shrub (Giant Sensitive Plant)	Accidental; Soil –moving machinary	Intermediate Zone	Riparian areas
16. *Leucaena leucocephala* Shrub (Ipil-ipil)	Deliberate; State; Fodder plant / Soil rehabilitation	Intermediate Zone	Dry-mixed evergreen forests
17. *Clusia rosea* – Shrub ('Gal goraka')	Negligence; Horticulturists; Ornamental plant	Sub-montane Zone	Rock outcrop forests
18. *Parthenium hysterophorus* Shrub . (Congress weed)	Accidental; Imported Goats	Dry and intermediate	Fallow fields, marshy areas
19. *Wedelia trilobata* – Runner (Morning glory?)	Negligence; Horticulturists; Ornamental plant	Wet and intermediate	Forest edge
20. *Myroxylon balsamum* – Tree ('Kattakumanjal')	Deliberate; State; Forestry	Wet and intermediate	Dry-mixed evergreen forests
21. *Alternanthera philoxeroides* – Runner (Alligator weed)	Deliberate; Horticulturists; Food	Island wide	Fallow fields, marshy / riparian areas
22. *Hydrilla verticillata* – Submerged plant (Hydrilla)	Negligence; Aquarists; Ornamental fish trade	Islandwide	Tanks, ponds, streams, canals
23. *Mikonia calvescens* – Shrub (Velvet plant)	Negligence; Horticulturists; Ornamental plant	Sub-montane Zone	Disturbed forests
24. *Tithonia diversifolia* – Shrub ('Naththasooriya')	Negligence; Horticulturists; Ornamental plant	Islandwide	Secondary Forests
25. *Mikania micrantha* – Wine (Mile-a-minute?)	Negligence; Horticulturists; Ornamental plant	Islandwide	Disturbed forests & scrubland
26. *Psidium littorale* – Treelet (Wild guava)	Negligence; Horticulturists; Ornamental plant	Montane Zone	Montane forests
27. *Alstonia macrophylla* – Tree ('Hawarinuga')	Deliberate; State; Forestry / Timber	Islandwide	Secondary forests
28. *Millingtonia hortensis* – Shrub	Negligence; Horticulturists; Ornamental plant	Southern Dry & Intermediate Zone	Disturbed forests & scrubland
29. *Imperata cylindrica* – Grass ('Illuk')	Unknown	Islandwide	Disturbed forests & scrubland
30. *Najas marina* – Submerged plant (Pond weed)	Unknown	Coastal areas	Coastal aquatic habitats

The impacts of AIS

The major impacts of alien invasive fauna can be summerized under the following categories: Direct exploitation or destruction of native biota; superior competitors for resources; hybridization with native biota; agricultural pests.

Direct exploitation or destruction of native biota:

This is the biggest threat of AIS. Most AIS destroy or deplete native biota by being active predators or herbivores. In addition, alien invasive fauna can also function as vectors which transmit diseases to vulnerable native biota. Among the alien invasive fish in Sri Lanka, three species (*O. mykiss, C. chitala* and *P. reticulata*) are active predators of native aquatic fauna. The Rainbow trout (*O. mykiss*) occurs in cold streams of the montane zone, mainly in the Horton Plains National Park, which is also known to be the sole locality of the endemic shrimp *Caridina sinhalensis* (Pethiyagoda, 1991). As the trout is known to feed on aquatic organisms such as crabs, shrimps, insects and other fish, it is possible that it has effected the populations of the above endemic shrimp as well as other endemic crabs (*Perbrinckia punctata* and *P. glabra*) in the montane zone streams. The Clown-knife fish (*C. chitala*) is a large voraceous carnivore which feeds on slow moving native fish. As it is spreading rapidly in the streams, rivers, ponds and marshes of the wet zone, it may have already effected the populations of the endemic fish which are mainly distributed in this zone. The guppy (*P. reticulata*), which is a prolific breeder distributed in aquatic habitats throughout Sri Lanka, has been observed to feed on the eggs of native amphibians (De Silva, 1996).

Superior competitors for resources:

All alien invasive fauna act as superior competitors of resources and thereby displace native biota. For instance, among the alien freshwater fish species, Tilapia (*S. mossambicus*) is non-selective in its diet and breeds prolifically, enabling it to colonize tanks, reservoirs and slow-flowing rivers, while displacing some of the native inhabitants such as *Labeo porcellus* and *L. dussumieri* (Pethiyagoda, 2000). The feral buffalo and cattle pose a threat to native large herbivores such as deer, sambhur and elephant by competing for limited food resources, especially in the dry zone habitats (Bopitiya *et al.*, 2000). The wallowing habit of buffaloes in water makes the aquatic habitats muddy, thereby deterring other animals such as elephants from using water holes to drink water. The feral buffaloes have also contributed to changes in vegetation communities in natural ecosystems.

Hybridization with native biota:

The two species of exotic mammals (*R. rattus* and *B. bubalis*) have become agents of hybridization, where they have interbred with indigenous sub-species. Three sub-species of the house rat (*R. r. rattus, R. r. alexandrianus,* and *R. r. rufescens*) have been accidentally introduced to Sri Lanka by ships. These have now interbred with the two local sub-species (*R. r. kandianus* and *R. r. kelaarti*) to form mixed populations (Phillips, 1980). Similarly, the domestic buffalo has interbred with the native wild water buffalo (*B. bubalis*), to form feral populations.

Agricultural pests:

Several species of alien invasive fauna function as agricultural pests throughout the island. The house rat (*R. rattus*) is a major grain feeding pest of rice, while the giant african snail (*A. fulica*) is a pest of agricultural/horticultural crops. The feral buffalo (*B. bubalis*) also cause damage to various agricultural crops, mainly in the dry zone of Sri Lanka. The Giant African snail (*A. fulica*) and the other alien slugs (*L. alte, Derocerus spp.*) are pests of horticultural plants. The introduced aquatic snail belonging to the Genus *Pomacea*, commonly called the Golden apple snail (GAS), was imported to Sri Lanka during the early 1980's by the ornamental fish traders. Today, it is rapidly spreading in aquatic ecosystems throughout Sri Lanka, as it is a prolific breeder. The exact species of the GAS occurring in Sri Lanka has not been confirmed yet, but taxonomic work is in progress now. Based on external morphological features, there seems to be two species that are currently spreading in Sri Lanka. It would be interesting to know whether the GAS spreading in Sri Lanka is *Pomacea cannaliculata*, as this species is considered as a serious pest of rice, causing severe economic damage especially in the Southeast Asian region (Naylor, 1996).

Figure 3. Golden apple snail *Pomacea* spp.

Other impacts of AIS:

Some AIS contribute to facilitation and mutualism. For instance, the feral buffalo and cattle feed on the pods of Mesquite (*P. juliflora*) and hence facilitate the spread of the latter alien invasive plant in the arid zone of Sri Lanka. Furthermore, the disturbances to natural habitats caused

by feral buffalo, cattle and unmanaged domestic pigs facilitate the establishement of alien invasive plants. Some Alien invasive plants such as *Lantana camara* and *Eupatorium odoratum* facilitate the spread of forest fires as well, causing severe damage to native ecosystems and species.

Beneficial attributes of AIS to native biodiversity

Some alien invasive plants provide food and cover for native fauna. For instance, the thick Gorse (*Ulex europaeus*) stands in the Horton Plains area serve as a good habitat of the endemic Black-lipped lizard (*Calotes nigrilabris*) and several amphibians, providing them with food (ie. insects attracted to flowers) and cover. It is also a nesting habitat of birds. The alien invasive shrub *Eupatorium riparium* in the montane region serves as a browsing plant of the sambar. The berries of *Lantana camara* is fed upon by several species of birds. The fruits of Wild Guava (*Psidium littorale*) and the Cactus (*Opuntia stricta*) are eaten by langhurs and macaques. Therefore, when considering management options for AIS, land management should be given a high priority in order to encompass these beneficial attributes of some AIS.

Management options for AIS in Sri Lanka

The basic options for consideration are prevention, eradication and control. Prevention of entry of AIS is the best option, followed by eradication, and then control. The following actions are proposed to address the various issues pertaining to AIS in Sri Lanka.

1. Coordination, policy and legislative initiatives:
   a) Set up a co-ordinating body, which could oversee all aspects and issues pertaining to AIS.
   b) Address the gaps and conflicts in policies and legislation.
   b) Set up new policies pertaining to the proper management of domestic animals.
2. Action to prevent future detrimental introductions:
   a) Gather information on the alien invasive fauna in other parts of the world.
   b) Training of personnel to detect alien biota.
   c) Adoption of a strict quarantine procedures.
   d) Strengthening of the current legislation.
   e) Conduct awareness programmes
3. Action to control the spread and / or eradication of the already established alien invaders:
   a) Initiate active scientific research on the alien invasive fauna.
   b) Adoption of a multitude of control measures, supported with scientific research.
   c) Regular monitoring of the already affected natural ecosystems to determine the status of alien invaders.

Figure 4. Congress weed *Parthenium hysterophorus*.

Figure 5. Water hyacinth *Eichhornia crassipes*.

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Figure 4. *Melanitis leda* Linnaeus, 1763. Common Evening Brown (Photo: T.N. Peries)

Figure 5. *Catalius rosimon* Fabricius, 1775.Common Pierrot (Photo: T.N. Peries)

A total of 38 butterfly species belonging to six families was observed during the study period. This included one endemic species. Among the butterfly species recorded *Troides darsius* (Ceylon Bird Wing) is listed as a nationally threatened faunal species by IUCN Sri Lanka (2000). Most of the species are less abundant and observed only once or twice. Most of the abundant butterflies were observed within the open areas such as forest edges and home gardens. These habitats were rich with variety of flowers and feeding plants. The most abundant species were *Neptis hylas* (E): Common Sailor; *Junonia atlites* (E): Grey pansy and *Delias eucharis* (E): Common Jezebel. These species were observed both within the forest and open areas. The least abundant species were *Troides darsius*, (E): Ceylon Bird Wing and *Cethosia nietneri* (E): Ceylon Lacewing. Most of the species were observed when the sun has warmed the air. During the hottest part of the day butterflies tend to rest.

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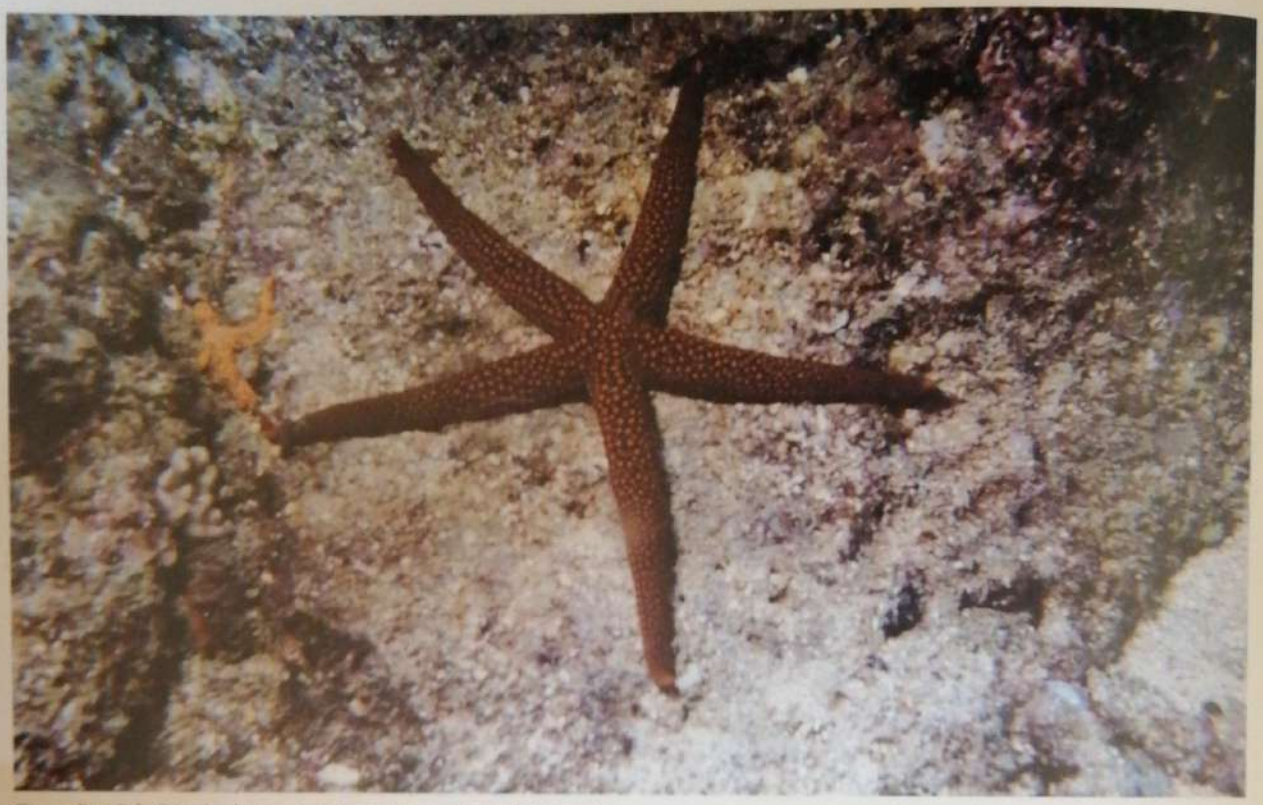
Checklist of butterfly species observed at Handurumulla-Pohonaruwa Forest
Order: Lepidoptera
Family: Papilionidae

1. *Troides darsius* Gray, 1852
   Ceylon Bird Wing or Common Bird Wing (E); Endemic; TR.
   Observed feeding on *Humboltia laurifolia* flowers in the forest areas. Largest species recorded from Sri Lanka, male smaller than female.
2. *Pachliopta hector* Linnaeus, 1758
   Crimson Rose (E); Fig. 1
   Common within the area and distributed in open areas and areas rich with *Lantana* vegetation. Male and female are similar in size.
3. *Pachliopta aristolochiae* Fabricius, 1775
   Common Rose (E); Fig. 2
   Common species found within the area. Hind wing of female is broader than the hind wing of male.
4. *Papilio polymnestor* Cramer, 1775
   Blue Mormon (E)
   One of the uncommon species in the area. Can be seen in forest areas and home gardens. Female is larger than the male.
5. *Papilio polytes* Linnaeus, 1758
   Common Mormon (E)
   One of the common species found within the area. Females are polymorphic.
6. *Papilio demoleus* Linnaeus, 1758
   Lime Butterfly (E)
   Can be seen in open areas. Male and female are similar in size.
7. *Graphium agamemon* Linnaeus, 1758
   Green Jay or Tailed Jay (E)
   One of the common species found within the open areas.
8. *Graphium doson* Felder, 1864
   Common Jay (E)
   Not as common as the Tailed jay.

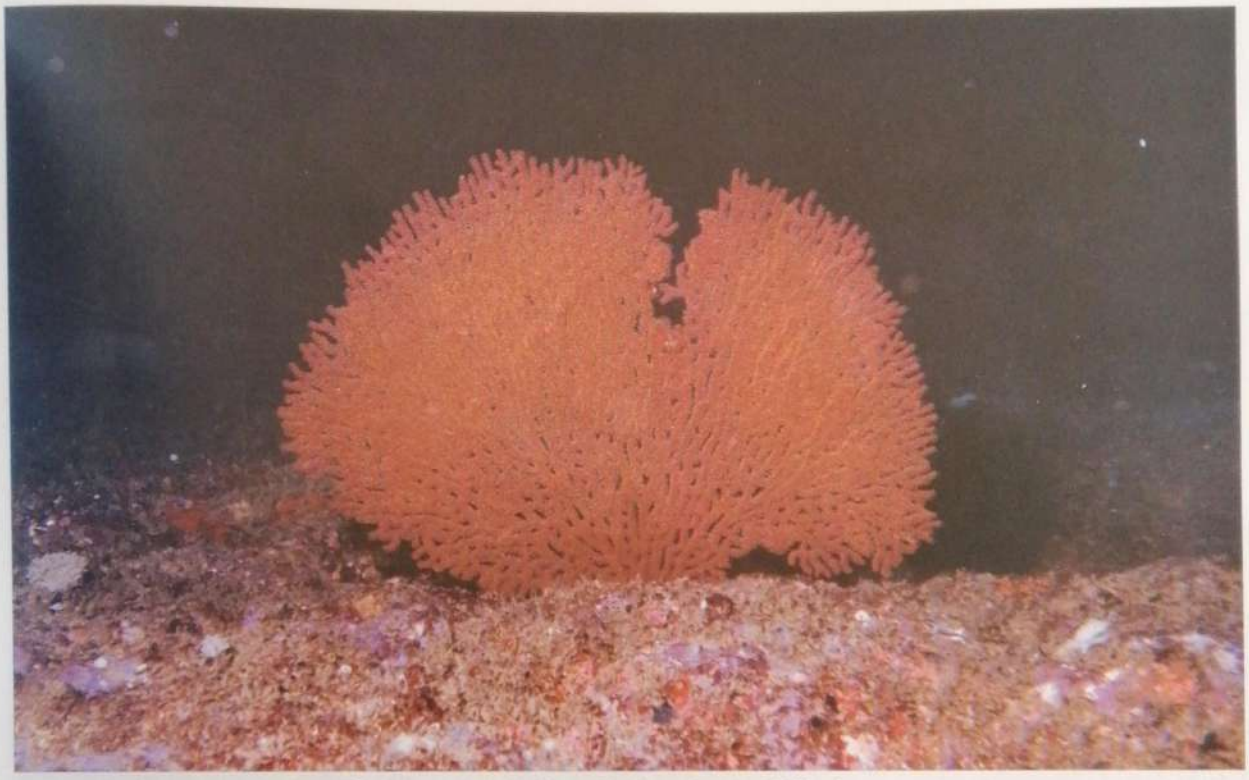
Family: Pieridae

9. *Leptosia nina* Fabricius, 1793
   Psyche or Flutter-By (E)
   Abundant within the home gardens.
10. *Delias eucharis* Drury, 1773
    Common Jezebel (E)
    Abundant species can be seen throughout the area.
11. *Catopsilia pomona* Fabricus, 1775
    Lemmon Migrant (E)
    Several colour morphs can be seen in the area
12. *Eurema brigitta* Stoll, 1780

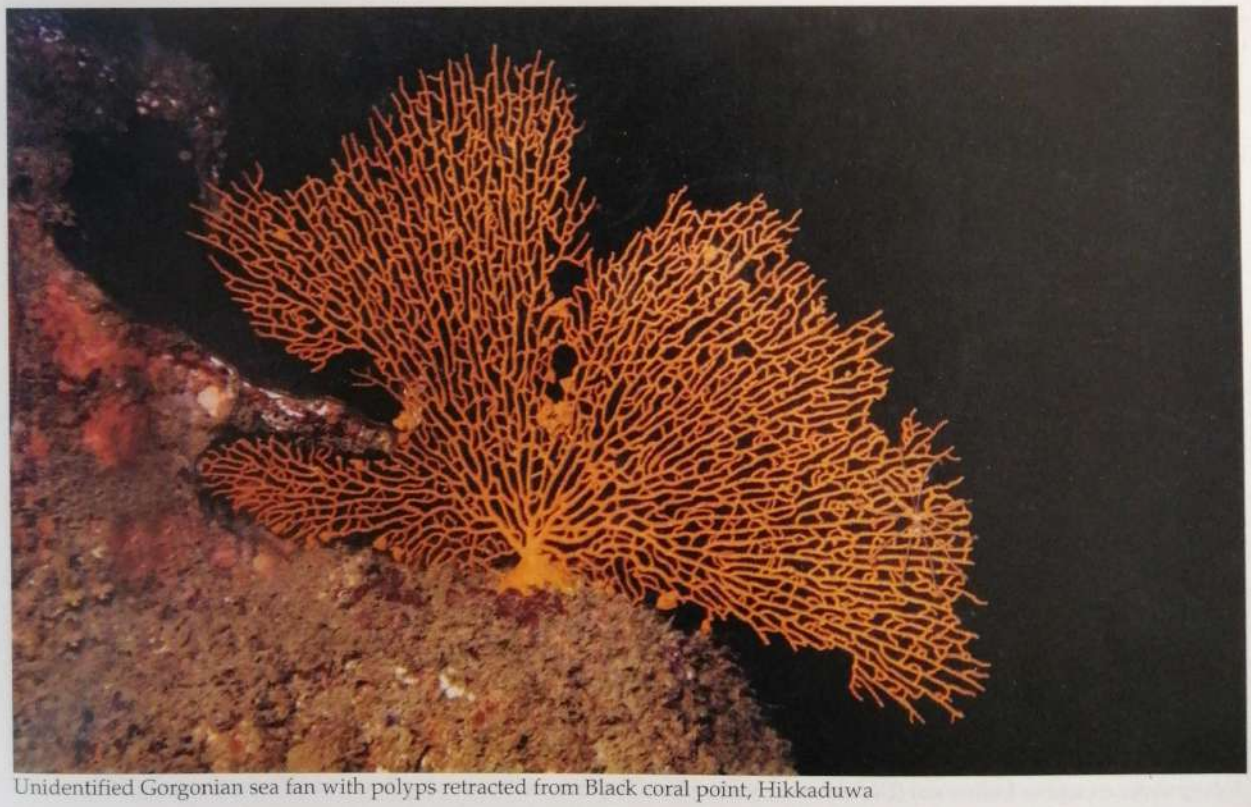


Green Starfish (*Nardoa lemonnieri*) from Pigeon Island, Nilaveli

Five lined snapper (*Lutjanus quinquilineatus*) from Godagala, Habaraduwa

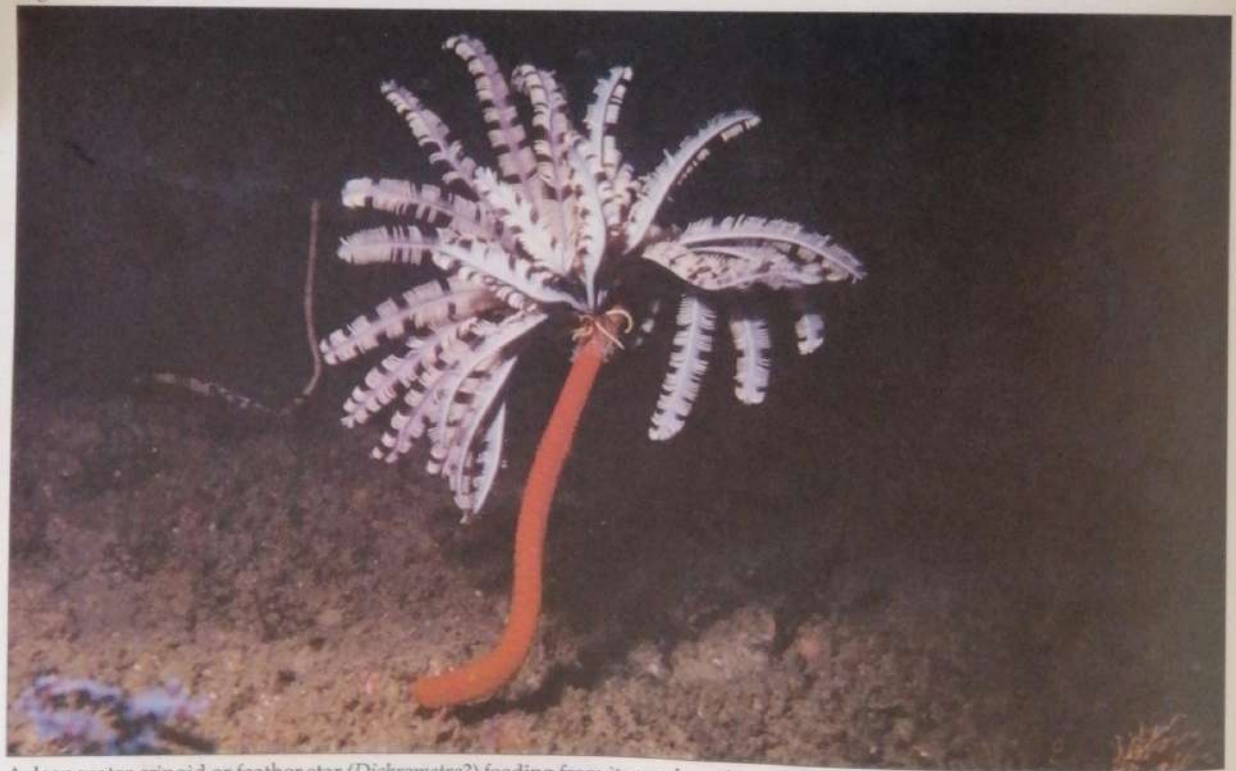


Unidentified Gorgonian sea fan with polyps expanded from Black coral point, Hikkaduwa



Unidentified Gorgonian sea fan with polyps retracted from Black coral point, Hikkaduwa

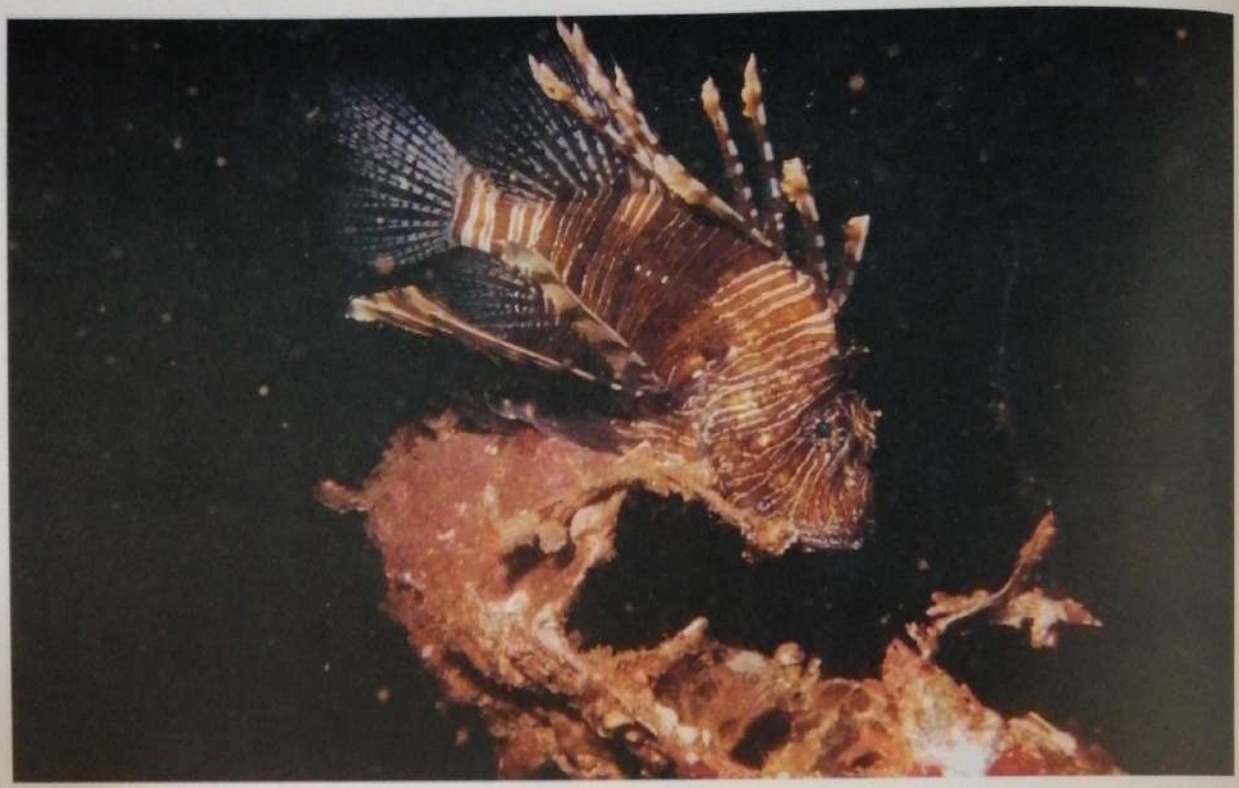
Similar damsel (*Pomacentrus similis*) above a rock covered by a brown carpet of corallimorpharian (colonial sea anemone) from Pigeon Island, Nilaveli



A deep water crinoid or feather star (*Dichrometra*?) feeding from its perch on the sea whip *Junceela* at Black coral point, Hikkaduwa

Oriental sweetlips *Plectorhinchus vittatus*

Bat fish (sub adult) *Platax orbicularis*



Lion fish *Pteroi volitans*

Dascyllus reticulatus on a table *Acropra*

Sharks: The Vulnerable 'Villains'

Anouk Ilangakoon

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Overview:

The Chondrichthyan fishes, including sharks, rays and chimaeras are a highly diverse group of fishes with a body frame composed primarily of cartilage. The evolutionary history of these cartilaginous fishes dates back to around 400 million years ago. Denizens of today's oceans, Class Chondrichthys, include approximately 1000 species of fishes, of which over 360 species are sharks. Despite this large variety of species, sharks comprise only about 2% of all living fishes.

Sharks are supremely adapted to life as top predators in the sea, with their hydrodynamic shape and highly developed sensory systems, which have evolved over millennia. They fill an ecological niche, at the apex of the marine food chain, in all oceans of the world today. As such, they play a crucial role in maintaining the ecological balance in their marine habitat and affect all other living organisms in the oceans.

However, the continued long-term survival of these dynamic ocean predators, is threatened today by a range of human activities. These vulnerable ocean creatures are subjected to both direct and indirect threats and unless urgent measures are put in place to ensure their survival, at least some species of sharks, could soon be critically endangered, throughout the oceans of the world.

Threats and Vulnerability:

Unfortunately, these highly evolved ocean predators, have a bad reputation and a villainous image in the minds of people the world-over. Even in historical times, sharks have been portrayed as wicked creatures in the culture, myth and legends of oceanic people in different parts of the world. This popular notion, that they are cold-blooded killing machines, that attack humans on site, has also found its place in modern day culture and even been exacerbated through literature and popular films such as '*Jaws*'.

Added to this negative public image, the rapid development of the fisheries industry throughout the world has resulted in sharks being targeted as a potential fishery resource, awaiting unlimited exploitation. A large variety of shark products are used by people all over the world today, including flesh and fins as food, liver oil as vitamins and pharmaceutical products, skin as leather and for surgical implants, blood and cartilage as supplementary health-food and even the teeth for making jewelry. In recent times, the medicinal uses of shark products have been tested and many new curative properties have been discovered using different parts of sharks. For instance, in the United States, shark corneas have been successfully transplanted to humans. Some scientists also believe that extracts from shark cartilage can be used to suppress the growth of tumors and it is therefore a potential treatment for cancer. As the use of shark products by people around the world increases the demand has been growing rapidly. Even the demand for shark, as a source of food for humans, has grown rapidly since the 1980's, resulting in the development of targeted industrial shark fisheries in many parts of the world. Some traditional and artisanal fisheries also harvest sharks. Likewise, industrial trawl and tuna fisheries operating in most oceans are taking significant numbers of sharks as by catch. Most of this by catch, goes unrecorded, as statistics are generally not maintained for species other than the target species. Therefore, neither the quantity of sharks in the by catch, nor the species composition is definitively known. Even without the by catch, reported worldwide landings of cartilaginous fishes exceed 700,000 tons an year. It is estimated that the by catch on the high seas alone may account for a

Figure 1. The indiscriminate catch takes sharks of all sizes from the smallest to the largest.

Figure 2. Silky Sharks *(Carcharhinus falciformis)* - the predominant species in the targeted fishery in Sri Lanka.

Figure 3. Fins being removed and piled up separately for the export market.

However, sharks are long-lived species with a low rate of reproduction. This is a result of their life history traits, which include a long gestation period, small litter size (compared to the majority of bony fishes), slow growth rate, late sexual maturity and low fecundity. Therefore, despite being well adapted to life in the oceans under natural conditions, sharks are extremely vulnerable to population collapse through adverse anthropogenic factors. In today's context, these factors include over-exploitation both as a directed fishery and as indirect by catch in non-target fisheries, as well as habitat modification and/or destruction through development of important coastal and estuarine habitats and all forms of land-based and marine pollution.

Therefore, scientists and conservationists warn that unlimited exploitation of sharks is not sustainable and many targeted species are already believed to be over-exploited. Some shark fishery practices such as 'finning' (removing the fins off a shark while it is still alive and throwing the severely maimed animal back in the ocean to die) are also extremely cruel and wasteful, raising not only conservation issues but ethical issues as well. Harvesting populations of any long-lived species that produces small numbers of young has to be done very carefully unlike when harvesting short-lived species that produce large numbers of young. Wherever there has been a targeted fishery of a particular species of shark, studies have shown that the catch rate will peak within a few decades and be followed immediately by a drastic decline, indicating an overall decline in the species. This is possibly a result of a collapse in the stock caused by low levels of recruitment. Documented examples of such stock declines include the Norwegian porbeagle shark (*Lamna nasus*) fishery in the North Atlantic and the soupfin shark (*Galeorhinus galeus*) fishery in California. Experts are of the opinion that a shark fishery can be sustainable only if harvesting is limited to less than 10% of the biomass.

Habitat alteration in coastal areas is another major threat to shark populations worldwide. Many species of sharks are dependent on inshore nursery grounds and pupping areas. Adult sharks will visit these areas seasonally, for the purpose of reproduction, while the juveniles of many species may inhabit areas such as estuaries, and sheltered mangrove ecosystems, year round during this vulnerable period of their lives. Therefore, all forms of human development in such sensitive coastal areas, becomes a threat to the survival of some species of sharks. Development not only alters their habitat but also leads to increased levels of nutrient and chemical pollution. Intensive fisheries activity in estuaries and inshore areas also degrades and destroys these important habitats. Marine debris may also be harmful to sharks, especially material such as plastic and nylon including destroyed and discarded fishing nets. As apex predators at the top of the ocean food chain, sharks are prime candidates for bioaccumulation of high concentrations of pollutants. The effect this has on their health and productivity is not known as yet, but as has been confirmed in terrestrial apex predators, it could be detrimental.

Figure 4. Other species caught-Scalloped Hammerhead Shark *(Sphyrna lewini).*

Sharks in the Indian Ocean:

The Indian Ocean, including the seas around Sri Lanka is inhabited by approximately 30% of all known shark species in the world, with at least 125 species being recorded thus far. These are distributed among eight

Figure 5. Other species caught - Oceanic White-tip Shark *(Carcharhinus longimanus).*

Orders and are divided between twenty-two Families (see annexed list of species). Some of these species are widely distributed throughout the Indian Ocean while others have a limited distribution, according to the present status of knowledge on the subject. It is also noteworthy that while most species occur in other oceans around the world, 28 species have a distribution that is limited to parts of the Indian Ocean (see annexed list).

The shark fishery in the Indian Ocean is not well documented and catch statistics are scarce. Although sharks have been caught in the artisanal fishery of many coastal states (including Sri Lanka) since ancient times, this was limited to subsistence levels. However, since the 1950's the commercial fishery in the Indian Ocean has been expanding, and presently there is both some targeted catch of sharks as well as a noteworthy extent of by catch in other non-target fisheries. The increased worldwide demand for shark products and specially the growing export market for shark fins has lead to the recent expansion of the shark fishery in the Indian Ocean, as in other parts of the world. Fishermen in Sri Lanka and many of the coastal states of the Indian Ocean, practice a fishing method known as the long-line, primarily for catching tuna but the same method is also used in the targeted shark fishery. In many of these countries, sharks now account for a substantial proportion of the long-line catch, as can be seen in Sri Lanka. The gillnet fishery in the Indian Ocean, which targets oceanic fish, also catches large quantities of oceanic shark species such as the Mackerel sharks. In the Western Indian Ocean, there is a purse seine fishery operating under a licensing scheme and practicing the extensive use of Fish Aggregating Devises (FADs), which often attract non-target species including sharks. The bycatch from this purse seine fishery is generally discarded, but in the case of sharks the wasteful practice of finning takes place. However, no records are maintained on the by catch of sharks in this fishery and the extent of resultant shark mortality in the Indian Ocean goes unrecorded. The harmless but huge plankton feeding whale shark (*Rhinodon typus*), the largest fish in the worlds oceans, inhabits the inter-tropical waters of the Indian Ocean and is taken in nets or harpooned in some areas such as Senegal, Pakistan, India and Taiwan.

The primary target species, of most commercial fisheries operations in the Indian Ocean is tuna. The by catch of associated species including sharks inevitably takes place, but goes largely unrecorded. Therefore, except for the statistics maintained on targeted shark fisheries, no information is available to assess the extent of shark catches in the Indian Ocean at present. Therefore, it is important to monitor the by catch, in order to estimate the extent and species composition of the shark fishery and assess its possible impact on Indian Ocean shark populations. Meanwhile, it is now illegal to fish for sharks in the British Indian Ocean Territories.

Conclusion:

The interaction between sharks and humans - both occupying the place of top predator in their respective environments - has been antagonistic from time immemorial. However, the time is fast approaching, for man in his wisdom (?), to cast aside these age-old prejudices and focus instead on the immensely important role the shark plays, in maintaining the health of our oceans, as an apex predator. Sharks, unlike most other endangered large carnivores, are not charismatic or cuddly and therefore do not automatically evoke a sympathetic response from people. The negative public image it has earned over the years exacerbates this and people rarely look beyond the ugly first impressions created by the rows of sharp, deadly teeth. However, sharks if seen alive in the sea, are beautifully adapted to their environment, graceful in their movements and efficient hunters. Like all predators they kill to eat and thus survive. Some species like the enormous whale shark and the basking shark (*Cetorhinus maximus*), are totally harmless plankton feeders, but even they are persecuted due to the negative image people have of sharks in general. All this negativity is due to a few species such as the great white (*Carcharodon carcharias*) and tiger sharks (*Galeocerdo cuvier*), which are known to occasionally mistake humans for their natural sources of food.

It is important however, that people the world-over realize that sharks cannot withstand unlimited exploitation, are highly vulnerable to population crashes and stock depletion and should therefore be carefully monitored, before they are exploited to extinction. At present there are few fishery management plans that take sharks into account, because they were not regarded as economically important till recent times. However, as target fisheries around the world expand more and more species of sharks and targeted stocks are likely to crash, if limits are not set for exploitation. Therefore, a concerted effort is urgently needed to limit exploitation through regulating the shark fishery to attain sustainable levels, discontinuing wasteful practices such as finning and protecting coastal habitats that are important as pupping areas and nursery grounds. Scientists are already warning of the impending danger to some species of sharks and some countries have responded by protecting certain species in their territorial waters. For example the notoriously ferocious great white shark is now protected in the waters around South Africa, Australia and certain states of the USA, because its numbers are known to be severely depleted throughout its range.

A recent development that is positive for shark conservation is that in many parts of the world, shark watching is developing as part of the ecotourism

industry. Even in the Indian Ocean, a few sites are now becoming known for the ecotourism potential of sharks. For instance, dive operators at Ras Muhammad in the Red Sea off the Sinai Peninsula of Egypt have discovered that certain areas off the reef wall there are excellent sites for divers keen on shark viewing. Likewise, live-aboard dive boats operating from Phuket, Thailand are exploiting the potential of shark watching off the Similan and Surin Islands in the Andaman Sea. Some commercial sport dive operators now operate specific shark watching tours at locations where shark sightings can be guaranteed. Some use bait to attract sharks at these locations and even hand feed them as an added attraction to enhance the photographic opportunities for their clients. However, the merits of such practices need to be carefully evaluated. Nevertheless, this kind of development is bringing a new dimension to the economic potential of sharks as a non-consumptive resource where sharks are more valuable alive than dead. This is also helping to change human attitudes and perceptions about these elegant predators of the deep.

However, while perceptions change slowly, exploitation takes place at an ever-increasing pace, as a result of growing human populations around the world and the corresponding growth in demand for shark products. If we are to conserve and protect sharks in their natural habitat, it is also of the utmost importance to know more about the ecological needs of the different species. In the past, much of what was known about sharks was based either on myths and legends, or at best on studies using dead specimens. In contrast, today scientists are carrying out research on living sharks, both in aquariums and in their natural habitat. Therefore, conservation plans and practical measures to ensure the long-term survival of sharks in the world's oceans can now be put in place, based on scientific fact, rather than on popular fiction as in the past. Such measures are urgently needed, to prevent the insatiable appetite of man the terrestrial predator from bringing the shark (the marine predator) to the brink of extinction in this century, as he did the whale in the last century.

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List of shark species known to inhabit the Indian Ocean
(Species marked with * have a distribution limited to the Indian Ocean)

ORDER HEXANDRIFORMES
Family Hexanchidae
Heptranchias perlo
Hexanchus griseus
Hexanchus vitulus
Notorynchus cepedianus

ORDER SQUALIFORMES
Family Echinorhinidae
Echinorhinus brucus

Family Squalidae
Centrophorus granulosus
Centrophorus lusitanicus
Centrophorus moluccensis
Centrophorus squamosus
Centrophorus uyato
*Centroscyllium ornatum**
Centroscymnus crepidater
Delatias licha
Deania calcea
Deania profundorum
Deania quadrispinosum
Etmopterus Lucifer
Etmopterus pusillus
Etmopterus sentosus
Euprotomicrus bispinatus
Heteroscymnoides marleyi
Isistius brasiliensis
Scymnodon obscurus
Squaliolus laticaudus
Squalus asper
Squalus megalops
Squalus mitsukurii

ORDER PRISTIOPHORIFORMES
Family Pristiophoridae
*Pliotrema warreni**

ORDER SQUANTINIFORMES
Family Squantinidae
*Squantina africana**

ORDER HETERODONTIFORMES
Family Heterodontidae
*Heterodontus ramalheira**

ORDER ORECTOLOBIFORMES
Family Hemiscylliidae
*Chiloscyllium arabicum**
*Chiloscyllium caerulopunctatum**

Chiloscyllium griseum
Chiloscyllium indicum
Chiloscyllium plagiosum
Chiloscyllium punctatum

Family Stegostomatidae
Stegostoma fasciatum

Family Ginglymostomatidae
*Ginglymostoma brevicaudatum**
Nebrius ferrugineus

Family Rhiniodontidae
Rhinodon typus

ORDER LAMNIFORMES
Family Odontaspididae
Eugomphodus Taurus
*Eugomphodus tricuspidatus**
Odontaspis ferox
Odontaspis noronhai

Family Mitsukurinidae
Mitsukurina owstoni

Family Pseudocarchariidae
Pseudocarcharias kamoharai

Family Alopiidae
Alopias pelagicus
Alopias superciliosus
Alopias vulpinus

Family Lamnidae
Carcharodon carcharias
Isurus oxyrinchus
Isurus paucus
Lamna nasus

ORDER CARCHARHINIFORMES
Family Scyliorhinidae
Apristurus indicus
*Apristurus investigatoris**
Atelomycterus marmoratus
Aulohalaelurus labiosus
*Cephaloscyllium silasi**
*Cephaloscyllium sufflans**
*Halaelurus alcocki**
Halaelurus boesemani
*Halaelurus hispidus**
*Halaelurus lineatus**
*Halaelurus lutarius**
*Halaelurus natalensis**
*Halaelurus quagga**
*Haploblepharus edwardsii**
*Haploblepharus fuscus**
*Holohalaelurus punctatus**
Holohalaelurus regani
Poroderma africanum
*Poroderma marleyi**
Poroderma pantherinum
Scyliorhinus capensis
Scyliorhinus garmani

Family Proscylliidae
*Ctenacis fehlmanni**
Eridacnis radcliffei
*Eridacnis sinuans**

Family Pseudotriakidae
Pseudotriakis microdon

Family Triakidae
Hypogaleus hyugaensis
*Iago omanensis**
Mustelus manazo
*Mustelus mosis**
Mustelus palumbes
*Scylliogaleus quecketti**
Triakis megalopterus

Family Hemigaleidae
Chaenogaleus macrostoma
Hemigaleus microstoma
Hemipristis elongatus

Family Carcharhinidae
Carcharhinus albimarginatus
Carcharhinus altimus
Carcharhinus amblyrhynchoides
Carcharhinus amblyrhynchos
Carcharhinus amboinensis
Carcharhinus brachyurus
Carcharhinus brevipinna
Carcharhinus cautus
Carcharhinus dussumieri
Carcharhinus falciformis
Carcharhinus galapagensis
Carcharhinus hemiodon
Carcharhinus leucas
Carcharhinus limbatus
Carcharhinus longimanus
Carcharhinus macloti
Carcharhinus melanopterus
Carcharhinus obscurus
Carcharhinus plumbeus
Carcharhinus sealei
Carcharhinus sorrah
*Carcharhinus wheeleri**
Galeocerdo cvier
*Glyphis gangeticus**
Lamiopsis temmincki
Loxodon macrorhinus
Negaprion acutidens
Prionace glauca
Rhizoprionodon acutus
Rhizoprionodon oligolinx
Scoliodon laticaudus
Triaenodon obesus

Family Sphyrnidae
Eusphyra blochii
Sphyrna lewini
Sphyrna mokarran
Sphyrna zygaena

Elephant Migration, Habitat Fragmentation and Conservation Actions?

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"Migration means so many different things to different people that the basic principles must be clearly stated before proceeding any further" is a statement made by Dr Robin Baker in his book titled the Mystery of Migration. This is a very appropriate statement to initiate the analysis of the question posed in this article. Let us consider some of the well-studied migrations:

The Atlantic Salmon - *Salmo salar*, breeds in freshwater rivers and the fry drift down the river to the sea as they develop. They spend the rest of their adult life in the sea and move up the same river to breed in the very same tributary where they were born many years later.

The monarch butterfly - *Danaus plexippus*, which is found in North America, heads south each year to winter in the south. In the following spring they move back north mating and laying eggs. Few, if any, make it back to where their journey started.

The barn swallow – *Hirundo rustica*, breeds in the north and winters in the south, and return back to the north to breed. They generally carry out this migration on an annual basis.

Each of the above examples have only "movement" as the common factor, while the purpose for movement such as to breed, to avoid the winter etc will differ. Furthermore, the frequency and regularity of movement is staggered in the different examples. Thus it will be clear that the only definition that we can use confidently is the general one given in most dictionaries that **"migration is simply the act of moving from one place to another"**. However, this will not be adequate for conservation actions.

The understanding of the real nature of migration for a given species will thus require the study of the individuals full path of movement during its lifetime, through time and space. This aspect is today referred to as "**lifetime track studies**". Thus a good understanding of the "**lifetime track**" will enable better conservation actions to conserve the animal.

Lifetime track of an organism takes place largely in familiar surroundings and between places that have been visited before. Taken together these places form a **"familiar area"**. The "familiar area" is the asset of the organism, it knows where to get what it wants in this area. Thus, it spends time learning their surroundings from very early in life. It is this area that we often refer to as the **"Home Range"** also.

Do elephants migrate?

Elephants do migrate as any other animal, but not like migrant birds. The migration is more a movement between locations which contains the needs of the elephant. This need could be determined by seasonal changes thus making the movement seasonal. What we often interpret as "elephant migration" is this movement between locations containing for instance a valuable resource such as food or water whose availability may change seasonally. Available past literature indicates that elephants show such movements.

However, studies on the movement of elephants in the Mahaweli Development area indicated that this was not always the case. A special study done to find out as to whether elephants in Wasgomuwa were migrating to Madura oya along the Kuda Oya showed that such a movement does not take place. This was a major blow to the proponents of the Wasgomuwa – Madura Oya elephant corridor. What was evident was that different herds were using the area, and the home ranges of these herds had extensive overlap giving an erroneous indication that they are actually migrating from Wasgomuwa to Madura Oya. The herds were not migrating but using the area, and populations were probably mixing.

Recent studies with Radio-collared elephants in the North Western and Southern Province has also shown very conclusively that in these areas too there is no such long distance migration. The female herds had "home ranges" or a "life time tracks" which expanded and contracted, primarily in response to availability of food and water. The males had larger "life time tracks", which changed according to the reproductive condition of the animal (musth response).

These observation are consistent with the new "Landscape Ecology" findings of Diffendorfer, Gaines and Holt (1995), with respect to mammal movement and fragmentation of habitats, which is "the proportion of animals moving would decrease with habitat fragmentation".

Accordingly, it will be prudent to question the issue of "elephant migration" and the concept of "elephant corridors" to permit such "migrations" as a means to conserve the wild elephants. Establishment of such "jungle corridors" would be an expensive and wasteful action that would only increase the Human–elephant-conflict (HEC) further. Furthermore, in most instances it is not practically possible to establish jungle corridors due to the absence of contiguous forests. It will therefore be important to study elephant movements on the basis of "life time track" studies and "Landscape Ecology", so as to formulate more precise conservation strategies.

Report from the Ceylon Bird Club for 1999

Deepal Warakagoda

Joint Secretary, Ceylon Bird Club, 39 Chatham Street, Colombo 1

The post of Joint Secretary was introduced, and former Secretary Deepal Warakagoda was supplemented by Kithsiri Gunawardena. The activities of the club during the year were directed by them.

A General Meeting was held in November. Events this year included a well-attended talk on bird taxonomy by Dr D P Wijesinghe, author of the *Checklist of the birds of Sri Lanka* 1994, published by the CBC.

Unusual records

Yellow-rumped Flycatcher *Ficedula zanthopygia* and Dusky Warbler *Phylloscopus fuscatus* were reported for the first time in Sri Lanka, the former at Yala Block IV by Deepal Warakagoda and Steve Rooke, the latter near Pugoda by Deepal Warakagoda, U Sirivardana and Kithsiri Gunawardena. The record of the former, if ratified, may be only the second in the Indian subcontinent.

Rarities: Amur Red-footed Falcon at Udawalawe by Deepal Warakagoda, and Lesser Whitethroat race *blythi* near Hambantota by Jagath Gunawardana.

The above four reports have yet to be ratified by the Records Committee.

Blyth's Pipits were present at Udawalawe in both migrant seasons, i.e. at the beginning and end of the year. Flocks of Rosy Starlings were noted at several sites at the end of the year.

A Ceylon Frogmouth nest was discovered in Sinharaja by Deepal Warakagoda, the fourth record in Sri Lanka. A party of members visited the bird and nest. A nest of our endemic form of Painted Partridge was found for only the second time, by Uditha Hettige, Kithsiri Gunawardena and Mahesh Priyadarshana, at Gal Oya National Park.

Habitats

Habitats for birds and other fauna continue to be degraded indiscremenately. Among popular sites visited by birders the condition of Bodhinagala, the Chilaw-Kalpitiya wetlands and the Bellanwila-Attidiya Sanctuary is most often noticed. There is still no evidence of adequate interest by the government or the authorities in planning for the needs of conservation of wildlife and its environment and the needs of a growing population together. The resources to tend the former are often not available, and the existing laws to protect them are not always applied as they should be. The many dedicated people in the Department of Wildlife Conservation, Forest Department and relevant environment bodies continue to face great difficulties in these regards.

Waterfowl count

In January 1999 the club carried out its 16th annual waterfowl census. With the same coverage as recent years *ca.*72,000 birds, belonging to 89 species, were counted. This total is very low. Heavy rain was one reason, with waterbirds shunning high water levels. The armed conflict again excluded the North and the East from the census, except, fortunately, for some sites in the Jaffna peninsula.

Endemic species

The 26 endemic species are being recorded as usual. Their populations, at the usual sites, appear to be stable over the last decade. The Green-billed Coucal distribution study by three members is continuing.

Birds of prey

22 species of raptors were recorded. Often reported were Crested Serpent Eagle, Crested Hawk-Eagle, Brahminy Kite, Shikra, Crested Honey-Buzzard, all common, while White-bellied Sea Eagle and Grey-headed Fishing Eagle were less common but conspicuous. Satisfactory numbers of sightings of Common Buzzard, Black Eagle, Mountain Hawk-Eagle, Black-winged Kite, Kestrel, Shahin Falcon were reported. Under-represented in reporting were Rufous-bellied Hawk-Eagle, Booted Eagle and Marsh and Pallid Harriers (the only harriers reported). There were a few sightings of the uncommon Crested Goshawk and Besra Sparrowhawk, 3 sightings each of Osprey and Amur Red-footed Falcon, and 2 sightings of Peregrine Falcon.

9 species of owls were recorded. The three commoner ones Collared Scops Owl, Brown Hawk Owl, and Brown Fish Owl were reported often. The endemic Chestnut-backed Owlet was reported only a few times although it is not so uncommon in its wet-zone haunts; likewise its dry-zone counterpart, Jungle Owlet. Few reports of Barn Owl, Forest Eagle Owl, and Little Scops Owl were received. A rare migrant, Short-eared Owl was recorded in the Jaffna peninsula. The CBCN carried a detailed report of the rearing of two Collared Scops Owls in captivity for several months.

Digest

The *Ceylon Bird Club Notes* have been published for every month since the club was founded in 1943. The more notable records of 1999 are as follows.

January. 27 Crab Plovers in the Jaffna peninsula. 4 Indian Coursers on Delft. Osprey at Jaffna and Nuwara Eliya.

Bar-tailed Godwit at Jaffna, Bundala, Karagan Lewaya. 3 Great Cormorants at Gal Oya in the NCP. A Barn Owl in Colombo Fort. 7 Stone-Curlews at Narahenpita. 200 Cotton Teal at Bolgoda Lake South. Scaly Thrush at Horton Plains. Black-capped Kingfisher at Udawalawe. 5 Glossy Ibises at Mirijjawila, 5 at Lunama. 5 Red-necked Phalaropes at Bundala, 8 at Hambantota. 2 Ringed Plovers, Large Sand Plover at Bundala. Grey-headed Fishing Eagle nesting at Yala.

February. A Peregrine Falcon in the Jaffna peninsula. Swinhoe's Storm Petrel off Negombo. 10 pairs of Great Cormorants nesting, Osprey, 3 Brown-throated Spinetail Swifts at Udawalawe. Pair of Painted Snipe off Tissa. *Ca.*1,000 Greater Flamingos at Hambantota. Rufous-necked Stint, 10 Temminck's Stints, Long-toed Stint at Bundala. 3 Black-necked Storks, 2 Grey Drongos at Yala.

March. 2 Indian Coursers, 500 Wigeon, 100 Spot-billed Pelicans, 1,500 Greater Flamingos, and a Short-eared Owl in the Puttur area. *Ca.*145 Broad-billed Sandpipers, 24 Terek Sandpipers between Palavi and Kalpitiya. A Barn Owl at Cinnamon Gardens. 4 Yellow-billed Tropicbirds near Ambalangoda. Dusky Warbler near Pugoda. Red-faced Malkoha, Green-billed Coucal, Mountain Hawk-Eagle, Besra Sparrowhawk at Kitulgala. Crested Goshawk, Rufous Woodpecker at Sinharaja. Kashmir Red-breasted Flycatcher near Ragala. Yellow-rumped Flycatcher at Yala Block IV. Pair of Black-necked Storks at Ruhunu NP. 2 Temminck's Stints at Kalametiya, 3 at Bundala. A Long-toed Stint at Bundala.

April. *Ca.* 1,200 Greater Flamingos at Puttur. Nesting Ceylon Frogmouth at Sinharaja. Peregrine Falcon near Ragala. Large flocks of Rosy Starling at Kalametiya.

May. Golden-backed Woodpecker, Collared Dove at Madhu. 2 Alpine Swifts at Thenadi Bay. Chestnut-backed Owlet near Lewella. Mountain Hawk-Eagle at Kandy. Painted Partridge, Small Scaly-bellied Woodpecker, Sirkeer, Shahin Falcon at Gal Oya NP. Hill Swallow, Highland Nightjar between Beragala and Koslanda.

June. 2 pairs of Painted Snipes at Minneriya NP. 3 Ceylon Spurfowl and 100+ Spoonbills at Wasgamuwa NP. Many Painted Partridges, a nest of that species, Jungle Bush Quail, Black Drongo, Small Scaly-bellied Woodpecker, 24 Great Cormorants at Gal Oya NP. Racket-tailed Drongo at Senanayaka Samudraya and Udawalawe NP. Highland Nightjars at Gal Oya NP, a pair at Lower Ohiya. Shahin Falcon at Horton Plains and Udawalawe. Pair of Little Scops Owls, 3 Brown-throated Spinetail Swifts, 2 Alpine Swifts, Rufous Woodpecker, nesting Malabar Pied Hornbill, and a Paradise Flycatcher nest at Udawalawe NP. Alexandrine Parakeet, 2 Broad-billed Rollers at Sinharaja. 3 Red-billed Tropicbirds near Hikkaduwa. 200-300 Greater Flamingos at Palatupana. Immature Black-necked Stork at Ruhunu NP.

July. Stone-Curlew in Sigiriya area. Mountain Hawk-Eagle at Pitawala Patana. Pair of Chestnut-backed Owlets at Aluwihare. Female Black Robin at Colombo Fort. Ceylon Wood Pigeon near Badureliya. Alexandrine Parakeet, Broad-billed Roller at Sinharaja. Highland Nightjar, Rufous-bellied Hawk-Eagle above Diyaluma.

August. 2 Great Cormorants at Kandalama. Rufous-bellied Hawk-Eagle at Bowatenna. Male Black Robin at Colombo Fort. Ceylon Hill-Mynahs, 6 Black Bulbuls at Horton Plains. Ceylon Blue Magpie above Diyaluma. 700 Black-tailed Godwits at Hungama. Large Sand Plover at Karagan Lewaya. 10 Indian Skylarks, 4 White-throated Munias at Bundala.

September. Grey-headed Fishing Eagle at Udawattakele. 12 Great Cormorants, Blue-faced Malkoha at Teldeniya. Barn Owl at Dehiwala beach. Crested Goshawk, Brown Fish Owl at Sinharaja. Long-tailed and Highland Nightjars near Beragala. Ceylon Frogmouth below Koslanda-Beragala. Ceylon Lorikeet near Tangalle.

October. 5 Whimbrels between Udappu and Mundel. Indian Reef Heron, pair of Great Stone-Plovers, 19 Sanderlings, 2 Broad-billed Sandpipers at Chilaw sandpits. Booted Eagle over Udahamulla. White-necked Stork near Bandaragama. Philippine Shrike at Ampitiya. 2 Common Buzzards at Horton Plains. Red-billed Tropicbird at Nandugala, Matara. 2 sightings of Black Eagle, 2 Red-winged Crested Cuckoos at Ruhuna NP.

November. Philippine Shrike at Kurunegala. Grey Drongo, Common Cuckoo, Banded Crake at Kollupitiya. Orange-headed Ground Thrush at Nawala. Philippine Shrike, Green-billed Coucal at Morningside, Sinharaja. Small Cuckoo, 3 Blyth's Pipits, 4 Orange-headed Ground Thrushes, female Amur Red-footed Falcon and Shahin Falcon at Udawalawe NP. Blue-faced Malkoha at Matara university campus. 3 Lesser Whitethroats of race *blythi* at Mirijjawila. Over 1,000 Greater Flamingos, 5 Red-necked Phalaropes, Indian Reef Heron, Crab Plover, 2 Great Knots at Bundala. Blossom-headed Parakeets, Brown-throated Spinetail Swifts, 2 Alpine Swifts at Yala NP.

December. Golden-backed Woodpecker at Anuradhapura. 3 Temminck's Stints at Puttalam. 3 Large Sand Plovers, 40 Sanderlings at Chilaw. Common Hawk-Cuckoo near Lewella. Banded Crake at Nuwara Eliya. Scaly Thrush at Nuwara Eliya, and a pair at Sinharaja. Indian Skylark, Common Buzzard at Horton Plains.

Great Cormorant, White-throated Munia, Small Cuckoo, several thousand Rosy Starling at Udawalawe. 1,000 Greater Flamingos at Bundala. 2 Red-necked Phalaropes, Booted Eagle in the Bundala area. Indian Reef Heron, Grey Drongo in the Yala-Bundala area.

List of special papers in *Ceylon Bird Club Notes*, 1999

Hoffmann T. (Feb). The House Sparrow

Hoffmann T. (March). Horton Plains - the vanished forest

Gunawardana J. (March). The decline in House Sparrows *Passer domesticus*

Gunawardana J. (March). Observations of the Openbill *Anastomus oscitans* feeding on Golden Apple Snails *Pomacea* spp.

Hoffmann T. (May). Further comments on the House Sparrow

De Silva R.I. (June). Australian Stilts *Himantopus himantopus leucocephalus* in Australia and Sri Lanka

Hoffmann T. (July). The Brown-capped Pygmy Woodpecker *Dendrocopos nanus gymnopthalmos*

Lamsfuss G. (July). A comment on the reports of the Australian Black-winged Stilt *Himantopus himantopus leucocephalus* in Sri Lanka

Hoffmann T. (March). Horton Plains - the vanished forest. Addendum

De Silva R .I. (Nov). The Australian Stilt *Himantopus (himantopus) leucocephalus* in Sri Lanka: a supplement.

The 2000 Waterfowl Census in Sri Lanka

Kithsiri Gunawardena

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For the 17th successive year the Ceylon Bird Club conducted the annual waterfowl census in Sri Lanka, from the first week of January to the first week of February 2000. Members participating were: Lucky Abeyawardena, Bennie L Abeyratne, Elmo Alles, C B Bavinck, Niran Caldera, Jagath Gunawardana, Kithsiri Gunawardena, Uditha Hettige, Chandima Kahandawala, Lester Perera, W I Perera, Mahesh Priyadarshana, Ravi Samarasinha, Hemantha Seneviratne, Sampath S Seneviratne, Sarath C Seneviratne, U Sirivardana and Deepal Warakagoda. The club thanks the following non-members for their valuable help: John Brown, K A J Dananjaya, Monique Goudreau, K A N D Kuruppu, C I Paranavitana, Dilup Perera, Kushan Perera, Kulasiri Ranaweera and W S V M Taraka Sandamal.

Coverage was expanded beyond the regions surveyed in recent years to the Batticaloa area and the Manampitiya - Kandakadu area. There had been no ornithological data from these areas for many years because of the ongoing armed conflict. The co-operation given to our counters by members of the armed forces and police to carry out the census in these areas and in the Jaffna peninsula has been crucial and the club records its thanks to them. Many new minor sites were covered islandwide, yielding a fair number of waterfowl.

Areas in Mannar, north from Kalpitiya, Trincomalee and north of the North Central Province were again excluded because of the armed conflict. The number of birds recorded in the Jaffna peninsula was lower this year owing to consequences of the conflict, such as the presence of only one counter there, and artillery shelling in certain areas.

As in many previous years, most of the sites had high water levels, and were hence generally shunned by waterbirds during the period of the count, especially its earlier weeks. We therefore, propose to extend the period next year into the second week of February, when water levels are usually low.

The total number of birds counted was (approximately) 104,000, an increase of 30,000 from the

Table 1. Totals of waterbirds and distribution in main areas - 2000

SPECIES	NO. OF SPECIES	TOTAL	JAFFNA AREA	PUTTALAM TO CHILAW - COASTAL	PUTTALAM TO CHILAW - INLAND	SOUTH OF CHILAW, TO GALLE	S. OF GALLE TO YALA - COASTAL	SOUTH EAST - INLAND	BATTICALOA AREA	REST OF ISLAND - INLAND
Grebes	1	632	18	-	419	41	95	8	-	51
Pelicans	1	384	-	-	-	6	134	94	-	150
Cormorants, Darters	4	8,494	828	325	816	256	1,662	2,941	-	1,666
Herons	13	21,684	1,259	331	163	2,147	6,271	2,109	4,680	4,724
Storks	4	2,862	782	-	380	69	1,142	405	-	84
Ibises, Spoonbills	3	1,248	101	-	140	117	494	103	225	68
Flamingos	1	2,620	1,020	-	-	-	1,600	-	-	-
Ducks	6	25,033	16,889	-	2,396	288	4,179	445	750	86
Rails, Coots	5	1,612	2	-	-	358	717	170	280	85
Jacanas	1	1,306	18	-	12	53	567	550	-	106
Waders	35	33,047	3,217	9,991	1	498	16,471	1,412	810	647
Gulls, Terns	11	4,940	898	-	162	201	1,909	492	-	1,278
Raptors	5	114	-	-	-	12	24	2	-	76
TOTAL	**90**	**103,976**	**25,032**	**10,647**	**4,489**	**4,046**	**35,265**	**8,731**	**6,745**	**9,021**

previous year, but much lower than in some earlier years (please see tables for comparisons). A marked proportional increase from last year's figures is seen in grebes, ibises, spoonbills, herons, and storks. The figures for herons, storks and flamingos are the highest for many years. The number of ducks counted is up from 18,500 to 25,000 and waders from 23,000 to 33,000. A marked decrease is seen in the figure for gulls and terns, which in this year is the lowest since 1992. The total number of species at 90 is satisfactory considering the number of birds counted.

The following rare or interesting species were among those counted: two Lesser Adjutants, two Glossy Ibises, 4,780 Wigeons, 105 Shovellers, one Ruddy Crake, one Crab Plover, 31 Large Sand Plovers, four Green Sandpipers, three Terek Sandpipers, three Ringed Plovers, 10 Great Knots, 20 Sanderlings, six Temminck's Stints, three Long-toed Stints, 50 Broad-billed Sandpipers, 15 Lesser Black-backed Gulls and 241 Great Black-backed Gulls.

Habitats

Regrettably, there is still no evidence of adequate interest by the government or the authorities in conserving wildlife or their environment. We give three unfortunate examples, which particularly affect waterbirds.

Very little action has been taken to remedy the continued destruction of wetlands between Chilaw and Kalpitiya area, by the prawn farm industry.

The threat posed by the proposed tannery at Kalametiya still exists. The CBC reiterates its concern (expressed in last year's report) and urges the unheeding authorities to spare this proposed Ramsar site and choose an easily available alternative.

The club is deeply distressed by what is happening to the Bellanwila-Attidiya sanctuary, seriously affecting its avian and other fauna. Apart from the regular problems which have taken place, such as the influx of industrial and domestic effluents and dumping of urban waste in the sanctuary (the latter by local government as well), private parties are now being permitted by the authorities to acquire and fill up parts of the sanctuary. All this is happening to a Sanctuary declared by and protected by the government!

Bellanwila-Attidiya ia a valuable sanctuary for avifauna, in terms of both species and numbers of birds present. It is a major nesting and roosting site for the Colombo area's water- and marsh-dwelling birds. Many annual foreign migrants too rest here on passage, or use it as a final destination. For example, ornithologists have recorded here several very rare species of warblers.

This is a rare site where Colombo's students and birdwatchers without the means or the time to go "on safari" can afford to view or study waterbirds, and other fauna as well. It is also an important revenue-earning tourist site, visited by nearly every foreign bird tour group. It is hoped that selfish and illegal interests will not prevail to destroy this wetland of great aesthetic, ecological and economic value, and that the government will even at this late stage show an enlightened attitude towards preserving it.

Table 2. Totals of main sectors compared with previous years

Year	2000	1999	1998	1997	1996	1995	1994	1993
Jaffna area	25,032	26,620	29,091	* 10,940	-	* 16,218	* 8,652	-
Puttalam to Chilaw - coastal	10,647	14,940	23,860	15,323	17,065	28,006	13,745	14,499
Puttalam to Chilaw - Inland	4,489	3,298	6,008	7,577	7,786	131,025	5,061	10,070
South of Chilaw, to Galle	4,046	1,880	1,471	3,613	1,625	5,942	6,772	9,521
S. of Galle, to Yala - coastal	35,265	14,326	77,694	75,197	32,665	43,454	21,739	76,362
South-East - Inland	8,731	4,036	2,470	3,723	2,786	1,838	1,196	1,491
Batticaloa area	6,745	-	-	-	-	-	-	-
Trincomalee area	-	-	-	-	-	1,256	9,433	-
Rest of island - Inland	9,021	6,988	10,821	3,842	5,027	8,581	9,323	19,658
Total	103,976	72,088	151,415	120,215	66,954	236,320	75,921	131,601

* - Small part only

Table 3. Totals of groups of waterbirds compared with previous years

Species	2000	1999	1998	1997	1996	1995	1994	1993
Grebes	632	229	232	236	1,114	433	139	413
Pelicans	384	298	494	640	340	570	756	722
Cormorants, Darters	8,494	4,764	7,847	8,521	7,260	11,372	8,461	10,399
Herons	21,684	9,368	16,131	12,365	11,080	14,415	13,532	13,551
Storks	2,862	1,351	1,585	1,623	1,837	2,019	576	1,035
Ibises, Spoonbills	1,248	533	1,178	1,341	1,054	1,200	1,392	1,149
Flamingos	2,620	1,357	964	2,600	1,177	188	138	250
Ducks	25,033	18,495	72,216	24,697	17,044	163,272	18,276	20,669
Rails, Coots	1,612	1,123	1,716	1,650	1,589	2,755	940	1,785
Jacanas	1,306	1,032	1,443	1,214	1,071	1,294	736	1,342
Waders	33,047	22,583	38,538	54,707	17,349	30,774	20,257	69,066
Gulls, Terns	4,940	10,893	8,896	10,478	5,915	7,919	10,561	11,112
Raptors	114	62	185	143	124	109	157	108
Total	103,976	72,088	151,425	120,215	66,954	236,320	75,921	131,601

A Further Note on the Australian Stilt *Himantopus leucocephalus* in Sri Lanka

Rex I. De Silva

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My article on Australian Stilt *Himantopus himantopus leucocephalus* (*Loris* 22:3) has resulted in a number of requests for more information on the subject. I therefore, quote excerpts from the comments and observations I received from three acknowledged authorities on stilts, all of whom have examined Dr. Katugaha's photographs.

Dr. Tony Prater (RSPB), co-author of *Shorebirds: an identification guide to the waders of the world* and *A guide to the identification and ageing of Holarctic waders* etc. States:
"I agree with your conclusions that these are photographs of the Australian Stilt *Himantopus (h.) leucocephalus*. The black hindneck is so clear and sharp and together with the characteristic impression of an almost ridged nape comes through on the photographs. The black on the hindneck of the nominate race never appears so clear and extensive as it does on this bird. I am not entirely sure about the age/sex but the brownish cast on the mantle is distinctive enough to indicate that it is either a first year male or an adult female. The wings are jet black so, in February, it is perhaps more likely to be an adult female. *H. (h.)leucocephalus* appears to be increasing its frequency in or just beyond its normal northern range in Indonesia and I would also agree that the birds are most likely to have originated from either Sumatra or Java although with regular numbers in the Philippines, even some times to Japan, it would appear that there is quite a wide dispersal from somewhere in the breeding range. Incidentally, we will shortly be publishing a revised edition of *Shorebirds* and will follow Monroe & Sibley (1993) in raising it to specific status - *Himantopus leucocephalus*".

Dr. C.S. Roselaar (Zoology Museum, University of Amsterdam) researched and wrote the sections on plumage and taxonomy of Black-winged Stilts in the *Handbook to the Birds of the Western Palaearctic*. He comments:
"This is certainly an Australian *leucocephalus*. The fact that the patch is solid and looks somewhat thickened when seen from aside is highly characteristic. Eurasian Stilts *Himantopus (h.) himantopus* [the race common in the Indian sub-continent] may occasionally show a black patch on the hindneck, but this patch is never as solidly defined as in this bird, and is formed of feathers equal in length to the remainder of the white neck-feathers, not forming a thickened 'plush'-like patch, giving it a different more slender-necked appearance. Judging from the number of skins available in the Netherlands, it must be common on Java and rare on Sumatra, but whether it occurs there as a breeder or migrant from Australia I did not investigate. The distance from N. Sumatra to Sri Lanka does not look too long for a wader to me, especially when aided by trade winds". Far more interesting will be the question what will the bird do when it meets an Eurasian Stilt: will they hybridize or not?

Dr. Ray Pierece the acknowledged Australasian authority on stilts and author of several scientific papers on waders, states:
"I have examined Dr. Katugaha's (very fine) photographs of the stilt at Palatupana Lewaya in February 1999 and have no doubt that it is an adult *Himantopus himantopus leucocephalus*. The plumage of the bird is classified as Node A in New Zealand, on a scale of A-J, with J being the totally black *H. h. novaezelandiae* (see Notornis 31:106-130). Node A birds are rare in New Zealand. So almost certainly your birds may have arrived from Australia or Indonesia".

Drs. Prater, Roselaar and Pierce all agree that the stilt photographed by Dr. Katugaha is an Australian *leucocephalus*. More, important, Drs. Prater and Roselaar explain why the bird is not a nominate Black-winged Stilt. Their comments show that although nominate birds may occasionally have black hind neck patches, dissimilarities exist by which *himantopus* and *leucocephalus* can be differentiated.

Ornithologists would now do well to direct their attention to learning more about the species. For example Dr. Roselaar has raised the question as to what *lecocephalus* does after it reaches Sri Lanka. This is something that naturalists should attempt to answer.

Acknowledgments

Once again I record my gratitude to Dr. H.I.E. Katugaha for his excellent photographs. I am grateful to Drs. Tony Parter, C.S. Roselaar, and Ray Pierce for their observations, comments and permission to quote their views. Lastly, I am grateful to Professor S.W. Kotagama for his continued guidance.

Further Reading

De Silva, R.I. Neck feathering in nominate Black-winged Stilts *Himantopus h. himantopus* in Sri Lanka (submitted).

Reminiscence of Kombi

Gamini G. Punchihewa

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The delightful short letter about Kombi written by Mr. A.T. Ariyaratne that appeared in the 'Loris' issue of June 2000 has evoked a considerable stream of nostalgic memories of Kombi, in me as well.

The reasons thereto are manifold. Having lived in the lush green Gal Oya Valley from 1955-70, while serving in the Gal Oya Development Board/River Valleys Development Board in such field capacity like a village officer and lands officer I came to be intrinsically interested in the study of the Veddas and those living Vedda characters and the vanished trails so fantastically described in Dr. R.L. Spittel's alluring books, like "*Savage Sanctuary*" and "*Vanished Trails*".

I was also one of those fortunates who accompanied our famed 'Surgeon of the wilderness', namely the late Dr. R.L. Spittel, in his dire quest to see his handful of Vedda characters like Tikiri Wanniya and Kombi (son and daughter of Vedda outlaw Tissahamy described in Dr. Spittels book '*Savage Sanctuary*') and of their families.

When I was working in Uhana (about 7 miles from Ampara) from 1955-61, I came into intimate contact with Tikiri Wanniya. He was living then in Badaraduwa in a jungle encampment, which stood about 6 miles from Uhana. Tikiri was the stepbrother of Kombi.

During these memorable visits, I still could recall how he regaled his time in narrating these thrilling but adventurous episodes of his father Wannaku Tissahamy. Then in 1963, came the memorable but momentous day for me, when I had that golden opportunity of taking Dr. Spittel to see his beloved Vedda friends like Tikiri Vanniya and Kombi. At that time I was staying in Uhana. I still could recount with joy how Dr. Spittel was in the heights of ecstasy in speaking to them and showering them with cash donations.

Writer with Kombi and her family in their dwelling in Binabaliaya in 1963. Left to right: Kombi's daughter, Kombi (child in arms), her son and the writer at the extreme right. (Photo taken in 1963 by H.J. Martinesz)

Now coming to Kombi, I came into frequent contact with her as in the case of Tikiri Wanniya. That was the opportune time when I was living and working in the serene wilderness – the verdant land of the Veddas, elephants and the birds, namely Namal Oya. It's close to Inginiyagala along the jungle road from Galgamuwa (via Namal Oya) through Rathugala, Mahakade, Nilgala Talawa and finally on to Bulupitiya close to Bibile.

From 1962-69, I was in charge of the newly carved out settlements for the few Vedda offshoots, purana villagers and people settled from Galle and Colombo districts. Kombi was living then at a jungle outpost named Binabaliya surrounded by the rolling mountain frontiers where Friar's Hood (Valimba kanda), the legendary hideout of Vedda outlaw Tissahamy described in Dr. Spittels '*Savage Sanctuary*' rises loftily. From Namal Oya to Kombi's place of settlement in Binabaliya was about 2-3 miles along the trail trod by Dr. Spittel in his search for his '*Vanished Trails*'.

Till 1970, I was in close contact with Kombi and her family and they were frequent visitors to my official quarters in Namal Oya where they had meals with us. She was then about 50-55 years old. During her visits and my visits there, she used to relate memoirs of the exploits of her fater and two brothers Sudu Banda and Bala Vanniya.

Vedda outlaw Tissahamy of Dr. Spittel's '*Savage Sanctuary*' had two wives, namely Hudu Bandi and Valli. Kombi was born to Tissahamy's first wife Hudu Bandi with her two brothers Sudu Banda and Kapuru. Valli had borne Tikiri and Bala Vanniya. Kombi got married to a villager of Bokkebedda called Herath Mudiyanselage Sudu Banda. She with her family originally lived in Bokkebedda and later shifted to Binabaliya their present dwelling in Mahakandia. At the time when I saw her in 1963, she had a brood of seven children. The eldest was a son called Wijesinghe. Among her daughters, the most raving beauty Ran Menike, at the time I saw her was about sweet sixteen where she bloomed in full blossom like the old Sinhala dictum of Kelehanda (jungle moon) My first book published in 1990, titled '*Souvenirs of a Forgotten Heritage*' was segmented into four sections. They were, I – A peep into the sands of time, II – The last tribe of jungle inheritors (The Veddas) III – Aftermath of the Uva Rebellion 1817-18, and IV- The vanishing fauna and flora of Gal Oya. In part II of this book there is a vivid but a first hand account of the Vedda characters like Tikiri, Kombi and their families in Chapter 19 – titled

'In search of Dr. Spittel's Vedda Characters' (pages 183-200). In them, there is a photograph of Kombi, and her children taken with me in 1963. This photograph I still relish as an everlasting memento of Kombi and her children.

Back in 1968 I had another mission entrusted to me by Dr. Spittel when he sent me a copy of "*Vanasarana*", a sinhala translation of his book '*Savage Sanctuary*' together with an autographed photo of Dr. Spittel, which he had requested me to present to Kombi with his complements. I happily obliged Dr. Spittel's earnest request in meeting Kombi and presenting them to her. In this instance, please permit me to quote this particular incident of meeting Kombi and presenting these souvenirs sent by Dr. Spittel, from my above quoted book. "I had taken with me Dr. Spittel's photograph (an autographed one by him), which was given to me, and asked her showing the photograph, whether she could tell me whose photo it was. She looked instantly and with a smile said, "Me dostara Spittel mahatmayage ne" (This is Dr. Spittel's photograph). She pronounced his name as Dr. Spittel very well. I told her that the Doctor was living in Colombo and wanted me to give her the two books, as I was living close to her place".

When I dug her memory into the past about her father's adventurous episodes, she fell into a reverie of thoughts. Here are few extracts of her story as culled from my above mentioned book: "I can remember one thrilling event when as a child he left me with my brother Sudu Banda in a cave known as Patharana Gal Ge. I was then about eight years old. My father wanted me to check his movements, as he was a very vindictive boy like my own father. Sudu Banda took his gun and was setting out to some place when I asked him where he was going and implored him not to go. He gave me a thorough beating and ran away. Later my father told me that his enemies had murdered him".

Editors note: Mr. Punchihewa is the author of three books, '*Souvenirs of a Forgotten Heritage*', '*Vignettes of far off things*', and '*Animals far and near*'. He is currently working on a fourth publication based on the Mahaveli basin '*The history & legend of the great sandy river*', which should be released soon.

Of Elephants and Frogs

Merlin Peris

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During the last few weeks my literary interest has been swinging between elephant and frog – whether I should write a critical review on Aristotle's observations on the elephant or a lighter piece on my own quaint experience with a frog. Two things happened at once which decided me on the latter – I found that I had been anticipated on the elephant, and with greater scholarship than I could have mustered myself, by H. H. Scullard in his comprehensive work on *The Elephant in the Greek and Roman World*, London (1974) while at the same time a copy of the June 1999 issue of the *Loris* reached me full of pictures of frogs. So frog it had to be – and frog it is.

Readers may wonder what Classicists like me have to do with frogs. Not much, except for those in Aristophanes' splendid comedy *Batrakoi* (" Frog") which is in the reading for the Classics in the University of Peradeniya, the frogs in Aesop's famous fables and Aristotle's sporadic observations on the creature in his *History of Animals*, from which, along with his *Parts of Animals*, *On the Generation of Animals*, and *On the Movement and Gait of Animals*, I had originally intended to cull my evidence on the great biologist's knowledge of elephants.

What clinched me to taking up the frog when dropping the elephant is however something also more than this- for the creatures studied by Aristotle, needless to say, far exceed elephant and frog. This is the fact that Prof. David M. Balme, one time of Queen Mary College of the University of London, under whom I researched on Greek Reincarnation teachings (- which themselves brought all creatures into kinship with man, though on a metaphysical than a physical dimension-) was, after A. L. Peck and till his own death in 1989 the leading expert on Aristotle's most extensive biological study, the *History of Animals*, completing the Loeb edition with a third volume which covered books 7-10.

Once again however I shall veer from the serious to the trivial, from Balme's learned researches on Aristotle's classification of animals and their parts to a personal anecdote of the professor which concerned frogs – and with that, get on to my own. This happened when he had shifted residence from Kent (where I and my family shared a portion of his lofty old house) to Leicestershire, which gave him opportunity to indulge his interest in horses and foxes. When her father was involved here in his Aristotle, it appears his youngest child, Mary (who had been my son's playmate) had acquired a snake and Balme was wondering what to feed it. "Frogs" said Prof. Tony Long, then a colleague at Queen Mary, and offered to bring one or two in a bag to a meeting at which they

were both about to participate. Balme, though not one to dress stylishly, was however, as Prof. Long reports, known for the many and various hats he owned and wore. Among these was a bowler which I have myself seen him don on important occasions. It was this that the professor wore to the meeting that day and it was under this then that, unbeknown to all his colleagues, he hid the bag of frogs which Long had hand him. All went well until a crucial moment in the meeting with all intent on the discussion, when the bowler suddenly leaped up and clean off the table, much to the amazement of all the poker-faced dons!

Which brings me to my own bizarre experience with another Classics-minded frog – and this only last December. The ambassador for Greece in India, in recognition of my popularization of Greek studies in Sri Lanka had secured me an invitation to Athens for a period of a month, two if I liked it - during which I would see the Millenium in there. So I packed my bag and took the British Airways flight Colombo-Dubai-Athens, landing at Athens at mid-day, caught a bus to the city center and lugged my bag to my hotel, Hotel Nikis in Nikis Street, cold, tired and disoriented by jet-lag. By then I had two bad experiences - a rip-off commission charged by the airport bank for changing my dollars and an attempt to pull a fast one on me by a young tout. Hotel Nikis, like nearly all the other hotels in Greece at this time of the year, was deserted. Even so I had difficulty selecting a room for myself - all were so small and cramped with the few pieces of furniture - and went to sleep, having first unpacked my bag and bathed.

It must have been some time past midnight when my body clock and a distinct rustling sound woke me up. I tried to sleep again, but Sri Lankan time was still with me - and so was that sporadic "siri-siri" sound, as of a polythene bag. Nothing to do but to get out of bed and investigate, cursing the possibility of a rat in the room to add to my initial annoyances and from which I would have to protect the food items I had lodged in the cupboard.

Following the intermittent sounds I found myself looking behind the bedroom door at a pink polythene bag in which was lightly wrapped my pair of shoes. While not positively leaping about, this bag was certainly throbbing with punches from within, as though by a Lilliputian boxer. Here then was a suspected rat. But when I gingerly untied the bag, what should leap out, and before my very eyes hop his way under the low-slung bed was no rat. It was a frog!

I certainly wasn't amused; I was angry - tired, sleepy and now angry. This fellow had been all around home the few days before I left for Athens, entertaining my grandchildren. Now it appears he had crept into one of my shoes, which lay packed and sneaked a flight Colombo-Dubai-Athens, all for free! The problem remained how to catch him, and then, what to do with him. For the moment, there was nothing I could do but go back to sleep.

Sleep would not come, or perhaps I slept fitfully, only to be roused, I don't know how long after, by that rustling again! No, not another frog! Back I went, putting on the light, and peeped behind the door. There sure enough was froggie, this time trying to get into the polythene bag. I obliged - he could not have done me a better favour. I swiftly emptied the shoes and offered the bag's mouth to him. Whereupon in he jumped in - and thank you very much!

Just then I heard voices from the ground-floor lounge. With my watch still registering Sri Lankan time, I thought morning had come and that the lounge was open for breakfast. So frog-bag in hand I went downstairs. The bar-keeper looked at me in surprise and said, "Breakfast is from 6.30, please". What time is it? I inquired. It was still 2.30 in the morning - and that, for the Greeks, is not the time to get *up* from bed - it's the time to go *to* bed! It was however not breakfast I wanted so much as to get rid of the impudent frog who had stolen a flight with me, ruined my sleep and now was a problem in my hand of making him get lost.

However, when the barkeeper's back was turned, I tried the front door. It opened to my push and I soon stepped into Nikis Street, cold bleak and silent. Then, unseen by the man I opened the bag. Out jumped the frog facing the Acropolis of Athens and the Theatre of Dionysus and with nary a good-bye look at me, hop-flopped swiftly along the pavement and out of sight. Everything around was concrete, marble, tar and darkness - so as I got back to sleep, despite my relief I was rather sorry for the poor beggar, thinking where would he find a patch of grass to jump about, a pot to crawl under, a marsh to croak from - and indeed some grub to eat.

There is a tail-piece to this anecdote. Popular belief in Sri Lanka has it that if you throw a frog, he falls where he falls facing his habitat. I have not checked with compass or otherwise whether the Acropolis is in alignment with my home in Kandy - which in this case my frog had also made his home. There is however another belief - which is that however far you throw a frog, he finds his way back to his former residence. Put these two together and what would you expect? Right! This it seems is just what happened - for not much later than my writing to my grandchildren at home about this frog who made his way to Athens with me, they stun me with the reply, he is back with them!

Now this is too much to believe - that he had made a return trip to Sri Lanka one way or another! Perhaps this is a new frog - a sibling of the other and from the same source - a water tank in the adjoining guest house - and my own frog is still in Athens.

This is what I think of the matter. And if I am right, among the chorus of the next performance of Aristophanes' *Frogs* there (- not in the Theatre of Dionysus, for it is still in ruins-) one of the members could well be a *real* frog, a Sri Lankan frog now in Athens that will be joining in the dramatist's lilting frog-song:

Brekeke-kex, ko-ax, ko-ax,
Ko-ax, ko-ax, ko-ax!
Oh we are the musical Frogs!
We live in the marshes and bogs
Sweet, sweet is the hymn
That we sing as we swim,
And our voices are known
For their beautiful tone
When on festival days
We sing to the praise

Of the genial god-
And we don't think it odd
When the worshipping throng,
To the sound of our song,
Rolls home through the marshes and bogs,
Brekekex!
Rolls home through the marshes and bogs.

(*Transl.* David Barrett)

Nature....Our Invisible and Invincible Friend

Cecil M. Rodrigo

The small pearl of the Indian Ocean of ours is still able to maintain its beauty to show gratitude to our ancestors who lived not only humanity but the environment also. Unselfish Sri Lankan pioneers benignly planted trees with the mere hope than even an animal will get its least benefit. Too, they believed planting of trees would be a meritorious act (Pina). Today as monies are being treated to be of paramount significance, progressive destruction of our resources today has become a matter of grave concern.

Beautiful environment creates benevolent thoughts and tranquility of mind. A country can entertain an offspring of stabilized morality by means of providing favorable and delightful environs. Kingdom of our thoughts will enhance its rating of happiness, if our home-land-village-city-country and even world possesses its natural existence. The person who lives in an unclean home actually lives with the thoughts of distortion and adversity. The compound in front of a home depicts the mentality of its dwellers. Attractive surroundings results mental relief for residents and outsiders too. Even a cruel person entering an alluring environment automatically begins to emanate pious emotions within him. Salubrious atmosphere builds a person comprising novelty.

We prefer to keep our own land and home very clean but hand over the responsibility of cleanliness of our bordering road side to the Government. Do the cleaning of our adjacent road side brings an inferior feeling for us? A revolution in our attitudes is of great importance nowadays.

Schools-temples-churches and hospitals must be main examples for model institutions on environment conservation. I suggest that "Environment Conservation" should compulsorily enter the curriculum as a subject in our school education.

Some believe that flower gardening is not of so significant. Do you know the biological secret that the sign of beautiful blooming flowers invisibly adds something to the prevailing beauty of the onlooker? Watching of flowers exhilarates the blood flow while enhancing the mental tranquility thus resulting, physical fitness.

Top level countries take a big toil to conserve its surroundings. One could pay a fine of 50 Dollars for dropping a waste paper around "Niagara Falls" in Canada. Though the legislation is such, breaching is entirely non-phenomenal. How about us?

How about our country? See to the areas ending a meeting-celebration or gathering. Hanging of flag pieces over several weeks or even months on street lamps or on telephone pillars remind us the activities and negligence of our own politicians and administrators.

Legal conditions should be stipulated for the compulsory removal of decorations of ended functions. Our pearl of Indian Ocean has so far won a long term international affection mainly due to its exciting beauty. So please let us love our environment and make our commitment to conserve it from today itself.

Sri Lanka's Medicinal Plants

Ranjith Mahindapala

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For nearly three millennia, plant and plant products, have been systematically used by mankind for treating illnesses. In Sri Lanka, this traditional form of medicine has been in existence for a long time, and over the centuries it has developed to such a level that it is now an established system of medicine. When last listed, 1,414 plant species have been used in traditional medicine. These species include several endemic species which are becoming increasingly rare and under threat of extinction. Nearly 80 medicinal plant species are now considered threatened. Approximately 200 species of medicinal plants are in common use, and of these 50 are heavily used in *ayurvedic* and traditional health care systems. In addition to recognizing their curative and therapeutic value, Sri Lankans use medicinal plants in rituals, cultural activities and in religious functions. Thus medicinal plants play an important part in the day-to-day life of the Sri Lankan people.

About 35% of the population in the country are primarily dependent on *ayurvedic* and traditional systems of health care, and there is a long history of traditional knowledge associated with plant use. In particular, rural populations depend heavily on these systems. In the villages, *ayurvedic* physicians and traditional practitioners of medicine are a part of the society, and there is an interwoven relationship between the communities and such practitioners. On most occasions, illnesses are treated free of charge, with the practitioners often providing the medicinal plant preparations as well. In the rural areas, people collect their requirements of medicinal plants from forests, which are their natural habitats. People would collect only their requirements of medicinal plants for treating illnesses, or the healers would collect the minimum amounts required for the preparation of medicine for the community in which they live. In this manner, communities practiced sustainable use concepts, with minimal damage to the habitats in which these precious plants are found. Herbal medicine is fast becoming popular in the developed world, and in the recent past, the world demand for medicinal plants has increased significantly. The increased demand both for local medicinal use as well as for export has placed a great strain on the natural populations of plants in Sri Lanka. Collectors of medicinal plants are now resorting to unsustainable exploitation causing a serious threat to the survival of some species. Dwindling supplies are exacerbated by the rapid depletion of natural habitats. Indeed, habitats too are threatened. Perhaps there is no other country where the threat to medicinal plants is more evident and more acute than Sri Lanka.

The local supply of medicinal plants for Ayurveda cannot meet the demand. Currently, about 60% of the requirements of medicinal plants are imported. The situation is compounded by the depletion of local resources due to habitat degradation, unsustainable harvesting levels and methods, post-harvest losses and failure to use the products in an optimal way. About 80% of the locally supplied medicinal plants are collected from the wild. Of the 50 species most heavily used, 30 are collected primarily from the forest.

Equally threatened is the knowledge base on which the traditional medicinal systems is based, as only a small proportion of the traditional knowledge and the ethnobotanical information is documented, the majority remains recorded in ancient, obscure *ola* (palm leaf) manuscripts scattered around the country or in the memory of elderly practitioners. These practitioners would normally not pass on such information, except to those trusted acolytes, preferably from the family. This *guru-kula* system of ancient teaching of traditional knowledge is fast disappearing. This knowledge not only addresses health care of individuals; it also addresses the traditional care and management of the natural resources surrounding the rural communities. In the light of these developments, it is necessary to preserve the traditional knowledge, particularly as it relates to the use of medicinal plants in order to reap benefits of their use.

Western medicine too makes extensive use of plant materials. The World Health Organization has estimated about 21,000 plants species as having medicinal properties. Of these, about 5,000 species have been subjected to extensive chemical investigations to ascertain their medicinal properties. Some of the recent studies have shown that about 25% of all prescriptions are plant-based. Of the 150 most commonly prescribed drugs in the USA, it is estimated that nearly 50% have been derived from wild plants. In the developed world, there is a growing interest in ethnobotanical studies to identify new uses of plants for treating diseases. In the recent times, such studies have identified plants used in the treatment of malaria in South America. In effect, the interest of the pharmaceutical sector on medicinal plants has been growing, and multi-national drug companies are searching new plants which can offer drugs for common diseases, as well as for difficult-to-treat diseases

such as AIDS. The potential of developing new drugs from plants is very promising.

From the foregoing, it is obvious that medicinal plants is a global treasure, to be preserved for the benefit of mankind. It is a precious repository of yet unknown galaxy of new drugs, waiting to be discovered and providing hope for the people who are sick with obscure diseases. Similarly, traditional knowledge too is very important. The need to conserve medicinal plants, and use them sustainably, is facilitated by the Convention on Biological Diversity (CBD), ratified by over 175 countries. CBD provides the background for sustainable use and for equitable sharing of benefits arising from the exploitation of medicinal plants.

The Project on Conservation and Sustainable Use of Medicinal Plants

In order to arrest the rapidly declining medicinal plant populations in Sri Lanka, a project has been launched with the support of the Global Environment Facility, for the conservation of medicinal plants and for promoting their sustainable use. This project seeks to secure conservation of globally and nationally significant medicinal plant species, and their habitats. The project will achieve these objectives through (a) *in situ* conservation by establishing five medicinal plant conservation areas (MPCAs) in different ecological zones of Sri Lanka, or adjacent to existing natural forests which are the home for some of the threatened species of medicinal plants, (b) *ex-situ* cultivation by promoting nurseries, home garden and plantation cultivation and supporting propagation and agronomic research on medicinal plants, and (c) by providing information and institutional support including promotion of appropriate legal and policy environment.

An important element of the strategic approach adopted is to define and demarcate medicinal plant reserves in biogeographically representative areas and use these as centers for a wide range of activities covering conservation, propagation, basic processing, ethnobotanical and ecological studies, and awareness promotion. From these centers activities will spread to other areas through extension and outreach programmes.

For this purpose, five Medicinal Plant Conservation Areas (MPCAs) have been established in Bibile and Ritigala (dry zone), Rajawake and Naula (intermediate zone) and Kanneliya (wet zone) adjacent to natural forests which harbour medicinal plant species.

Each MPCAs consists of about 10 *Grama Niladhari* Divisions (GND) abutting the core conservation forest. The project strives to actively involve the communities living in the MPCAs for promoting conservation and sustainable use of medicinal plants. Each MPCA is developing a site consisting of a medicinal plant garden, which will serve as a demonstration site, a medicinal plant-processing center for the use of communities, an ayurvedic dispensary, which is expected to mainly depend on preparations made by the communities, and an information center.

Some activities undertaken by the Project

A. *In situ* Conservation

Identification of *Grama Niladhari* Divisions in MPCAs and Social Mobilization

The *Grama Niladhari* Divisions for the MPCAs were identified after extensive discussions with communities, their organizations and other stakeholders at village level. The identification of *Grama Niladhari Divisions* (GNDs) was based on close proximity, levels of dependency on the forest resources, in particular medicinal plants, and the readiness of community members to accept participatory approaches to ensure conservation and sustainable use of medicinal plants.

In order to facilitate efficient participation of communities in the conservation efforts, community management structures have been established at the GND level. These are the Village Project Management Committees (VPMCs) consisting of only the community members with some of the village-level state officials assisting the VPMCs as observer members.

Baseline data collection

An important element for planning project activities is the collection of baseline data consist from three separate yet inter-related areas, viz.,

(a) Socio-economic survey
(b) Ethnobotanical Survey, and
(c) Resource inventory

The survey teams made up of members from communities collected the baseline data. These data are needed for decision-making and monitoring. Use of community members ensured a participatory survey and the ownership of data by them.

(a) *Socio-economic survey*

The Socio Economic Survey provided a benchmark of socio-economic status of communities living around the medicinal plants conservation areas. The data required to plan conservation strategies and related development activities were also collected under the survey. These data will also be used to develop a common monitoring system of project initiatives. The design of this survey has been documented by Worah (1998, 1999).

The socio-economic survey, completed in the latter part of 1999 in above MPCAs has revealed that more than 68% of the population in the GNDs surveyed belong to low income groups (monthly income below Rs 1500/-) (Kumarasiri, *pers.com*). The majority of the people are engaged in farming and agriculture related activities.

Furthermore, there has been a gradual environmental degradation in the MPCAs due to adverse human activities. The major threats to forests include illegal encroachments, forest fire and uncontrolled extraction of non-timber forest products including medicinal plants. Over the years farming practices of people have been converted from subsistence agriculture to cultivation of commercial crops. For example, bean cultivation for outside market has expanded in Naula and Rajawaka MPCAs resulting in heavy extraction of poles from natural forests and encroachment of fertile forestland.

The socio-economic survey has also proved the need for introducing joint forest management with people living around MPCAs. Data collected around conservation issues have also revealed positive conservation practices adopted by local community organizations and the need to improve on them.

(b) *Ethnobotanical survey*

The ethnobotanical survey was designed to be carried out in two phases. The preliminary phase is to develop a clear picture of the roles of medicinal plants and other forest products in the livelihoods and economies of all stakeholder groups in each target community. It is also expected to provide a preliminary focus on plants of particular importance to those communities (Milliken, 1999).

This preliminary phase of the ethnobotanical survey has been completed in all MPCAs. Collected data have been crosschecked through personal interviews with medicinal plant collectors, traditional practitioners and other knowledgeable people in the village. These data, once analysed, will provide listings of households and livelihoods, important medicinal plant species, forest areas in the village, common health problems, indigenous practitioners, and commercially collected medicinal plant species. In addition, information on abundant species and the use of forest products is available. Other information elicited includes instances of high prices fetched for specific species, market demands and felling of trees of medicinal value.

Phase II of the ethnobotanical survey is currently ongoing, and involves collection of information on the use of medicinal plants and the collection of voucher specimens. This component was undertaken only after a community agreement was set in place to safeguard intellectual property rights of the holders of ethnobotanical information.

(c) *Resource Inventory*

MPCA base maps at the scale of 1:20000 were prepared using aerial photographs and survey maps, and were digitized. The major forest types / natural vegetation structural types [dense (>75% canopy cover); sparse (50–75% canopy cover); scrub / grassland (< 50% canopy cover)] were interpreted to the maps from aerial photographs. Resource verification in these maps was carried out using GPS. The maps also include roads, village boundaries including names, creeks / drainage system, 20 m contours, administrative boundaries, 1 km grid, latitude and longitude / eastings and northings, and village land use types.

The resource inventory methodology was developed based on the methodology used in the National Conservation Review (IUCN, 1997) and other studies (Russell-Smith, 1994). The design of the survey is found in Russell-Smith (1999).

The main objectives of the resource inventory are (a) to provide baseline assessment of the distribution, associated population structures and densities, and ecological requirements of medicinal plant species in MPCAs, and (b) to provide an informed basis for ongoing *in situ* conservation of medicinal plant species and *ex situ* cultivation in home gardens and nurseries.

Considering the time constraints, and for undertaking the resource inventory as efficiently as possible, stratified sampling was used, with four principal levels of stratification, viz., (a) administrative unit, (b) natural vegetation structural type, (c) catenary position / position on slope, and (d) perceived resource density. Inventorying was undertaken on plots of 50 m x 20 m size, established at pre-determined stratified situations along gradsects which sample for maximum environmental heterogeneity (Gillison & Brewer, 1985). In each MPCA, a minimum of 160 plots was sampled. In some important forest areas, the number of samples was increased to have better representation.

Analysis of data is in progress. The information that would be generated would include the following (Karunaratne, *pers.com*).

- A detailed assessment of the distribution and abundance of individual species (e.g. priority medicinal plant species) based on plot information [viz. location, Eastings and Northings, position on slope, surface water availability, altitude, aspect, rock cover, soil depth / pH / texture, canopy cover / height / disturbance, wind exposure, grass and bamboo cover and harvest intensity].
- A basis for predicting the likely distribution and abundance of individual species (including priority species) elsewhere in the MPCA.
- A basis for future sustainability and resource assessment studies and conservation planning
- Solid criteria for zoning of habitat for various user categories

Preparation of Village Plans (Micro plans)

The baseline data, ethnobotanical and resource inventory data collected during the first two years of the project

are being used in preparing village plans with emphasis on *in situ* conservation. Village planning has been undertaken in GNDs using the PRA/PID techniques with the active participation of the community members and the office bearers of the VPMCs. As VPMCs have a legal status, they are now able to hold and disburse funds.

B. Ex situ Conservation

Several approaches are in place for *ex situ* conservation of medicinal plants, and these activities will complement the *in situ* conservation efforts described earlier. In this instance too, baseline data will be used to determine the directions in which *ex situ* conservation strategies are to be developed. For instance, species which are under threat in the natural habitat, or which are commercially important can be cultivated in the MPCA.

As a major activity in this component, cultivation of medicinal plants in homesteads in the MPCA is being encouraged and supported. Additionally, agriculturally oriented members of the communities have been trained in nursery practices, simple agronomic practices and in related areas. Also, medicinal plant nurseries have been established mainly for holding collections of germplasm of important medicinal plant species and for providing mother plants to prospective nurserymen.

Concomitant with the expansion of homestead cultivation and commercial cultivation, arrangements have been made for providing marketing information and marketing outlets to enable the communities to obtain the best prices for their produce. VPMCs are a vehicle for these activities, and it is expected that at the end of the project, the communities could be sufficiently empowered to arrange marketing of produce on their own. Another important feature is the packaging of medicinal plant products and the production of ayurvedic medicines from ingredients available in the respective MPCAs.

As a complementary activity, research on propagation and cultivation of selected medicinal plant species are being supported. As outcomes of this component, simple propagation techniques on a number of species have been developed, and these results, suitably packaged, will be provided to the communities.

C. Institutional and Capacity Building

The project lays special emphasis on capacity building of the communities particularly in the areas required for project activities and management of community organizations.

There is special emphasis on safeguarding intellectual property rights relating to project activities. In particular, ethnobotanical survey collects IPR-sensitive information relating to traditional knowledge on the use of medicinal plants. In order to safeguard traditional knowledge, the project initially developed a set of guidelines for the conduct of project activities, in addition to the confidentiality agreement for project staff and others involved in the project. Subsequently, a legal regime to safeguard traditional knowledge associated with the use of medicinal plants has been prepared. This is awaiting approval of the Cabinet of Ministers.

In regard to traditional knowledge, the Project has taken several noteworthy initiatives. These include the transcription of ancient palm leaf writings (*Ola* leaves) into Sinhalese. The old palm leaves contain information on diseases and their diagnosis, as well as prescriptions. Many of these are hundreds of years old, and have been preserved in archives. The project provides an opportunity to use this knowledge with due regard to the original holders of that information.

The Project has also launched a programme in the MPCA areas to preserve traditional knowledge available with the elderly traditional practitioners. In this programme, traditional practitioners with specialized knowledge on certain diseases (and on the use of medicinal plants) have been selected, and acolytes have been attached to them for learning. This system of apprenticeship is as old as the traditional healing systems, and the acolytes will remain attached to the physicians for a period of nearly two years. During this period, the acolytes will learn the skills and will also acquire practical experience. In addition, they will be provided with formal training intermittently so that the acolytes will have the benefit of both traditional systems as well as the formal systems of ayurveda. At the end of the apprenticeship, there is an opportunity for the acolytes to register in the government's ayurvedic medical system.

Conclusion

The Medicinal Plant Conservation and Sustainable Use Project provides a unique opportunity to demonstrate community participation in natural resources conservation, and the establishment of community management structures for this purpose. The empowerment of communities is an important element in the sustainability of the project-initiated activities. The emphasis given for safeguarding traditional knowledge, and the efforts for promoting the use of such knowledge is also noteworthy.

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My First Visit to Yala

Prasad S. Gunaratne

1961 was the year and the month was April – school holidays. The trip was organised by my uncle, Kingsley Ratnapala. The group consisted of eight adults and four children including the writer. We travelled in two Volkswagen cars and my Father's Morris 1000 car. Leaving Colombo around 5:00 a.m. we arrived at Tissamaharama, Rest House for lunch. During that period, the Rest House was owned by the Tourist Bureau and run by a Rest House Keeper (Ralahamy). If I remember correctly it had less than ten rooms.

In the evening, we went to Kataragama Devale and took part in the Pooja (rituals). It was my grandmother who took the lead in activities connected to the Pooja. She told the children stories about God Kataragama and Goddess Valli and certain miracles that had taken place at the Holy City in the past. These stories instilled a kind of fear in us.

During those days, the stretch of road between Kataragama town and Akurugoda was deserted in the nights. There were no houses or boutiques on the wayside. Only a few private cars and old wartime trucks converted to lorries carrying passengers and their goods between Kataragama and Tissamaharama were on the road. If I am right, their Registration plates carried MW letters. If one was lucky, one could observe an elephant or two crossing the road in the nights on that stretch.

The following day, after breakfast at Tissa Rest House we left to Yala. Our vehicles were loaded with dry rations, cans of fresh water, fruits, vegetables, extra fuel for vehicles and our baggage.

The road from Yoda Kandiya to Kirinda was narrow and both sides were covered with shrub jungle. Here and there, a few mud huts occupied by the Chena cultivators could be seen. No electricity, no tiled houses or boutiques on the wayside like today. The approach road from the turn-off at Yala junction was not tarred like today. It took us over an hour to reach Palatupana Wildlife Office.

After obtaining the bungalow permits and the tracker we proceeded to our destination – Buthuwa bungalow. After a late lunch, we set off on a tour of the park. Unlike today, there were very few vehicles and one had the opportunity to park the vehicle and watch animals without being disturbed by fleets of vehicles. Having done a round and seeing a few elephants and other common animals, we proceeded back to the bungalow. When we were nearing the bungalow, we came across a huge tusker standing in the middle of the road. He was a huge animal and had long tusks almost crossing at the end. He waited for some time in that position, turn to his left and started feeding on some leaves, leaving three quarter of his body to the road. We were compelled to wait patiently for about half an hour till the tusker decided to creep to the jungle. Our tracker told us that there are two cross tuskers (dala puttuwas) roaming around the area and some times they came very close to the bungalow. To his words, around 7:00 p.m. the same tusker came very close to the bungalow from the rear side and stayed for a few minutes before retreating to the jungle.

During the night, my father – who had been attached to the Hambantota Kachcheri as a Lands officer in 1950 – related to us some encounters with elephants he had faced during his visits to the Yala sanctuary. He also told us some stories about marauding elephants attacking people and breaking houses in adjacent villages and how young cattle of farmers are being killed by leopards. These stories and experience I gained during my first trip to Yala inspired me to develop a liking towards jungles and wildlife at a very young age. I owe a lot to my father who after observing my interest in wildlife and nature encouraged me to read books like *Village in the Jungle, Jungles of Ruhuna, Seeing Ceylon, Ceylon Vagabond,* and the *Loris* magazine, to mention a few.

The following day we left the bungalow after breakfast with lots of unforgettable memories and proceeded to Colombo. Since my first visit to Yala I have visited Yala unaccountable number of times. I have also made many visits to other national parks such as Wilpattuwa, Lahugala, Uda walawa, Wasgomuwa, and Bundala. I hope to pen a few experiences, which might be of interest to readers in future when, time permits.

Letters to the Editor

ATU: The man behind the legend

Sir -

I have been a member of the society and a subscriber to the "Loris" magazine for well-nigh three decades. On reading the above titled research article by Hemantha Situge in the last issue of the "Loris" my mind traced a path along the several years during which I enjoyed Atu's company and treasured his friendship.

I came to know Vickie Atukorale and Eric Conway in the early forties through Atu's childhood friend Neville (Kadalay) Jansz who lived in Fredrica Road, Wellawatte. We patronized the same pubs and also had common interests and our friendship grew with the years.

A few of my reminiscence may be of interest to your readers. I could recollect Atu telling me that had he learnt from anyone on natural history it was from the late Bertie Jayasekera, an elder brother of his classmate, the late Alick Jayasekera D.R.O. In his early days Atu had often been to the jungles and on fishing trips with Bertie and his brothers.

I was a regular visitor to Atu's place. Atu had twenty perches of land in Peterson Lane, Wallewatte that he inherited from his father. In this plot of land he pioneered breeding tropical fish and cultivating rare orchids and other plants. In this little plot of land he had created a veritable jungle. We often sat on a log placed on the pathway to his 'jungle'. I well remember Arthur C. Clarke and Mike Wilson soon after they arrived from Australia's Great Barrier Reef joining us on that log and regaling us with stories of their adventures.

Sam Elapatha Snr. Dissawe too was a regular visitor to Atu's place. Sam, E.D.W. Jayawardene and a few of us became founder members of the Cactus Society. Atu was our advisor. Sam Elapatha had an excellent Cactus garden at Godakawela under Atu's guidance. Much later Dhanapala Weerasekera better known as "Crimo" imbibed knowledge on Orchids and Cacti from Atu and became an authority on the subjects.

One remarkable characteristic, which I observed in Atu, was that he readily imparted his knowledge even to a little child who wanted to learn from him.

The story of Atu's pet mongoose is still embedded in my memory. A wild mongoose strayed into his place. Atu christened this animal Scrimbo. After sometime Scrimbo became very friendly with a few of us who had the entrée to Atu's Holy of Holies. All of a sudden Scrimbo disappeared and after quite a period of time it re-appeared, but had turned ferocious. It would gobble the food dished out, snarl at us and disappear. We were all mystified by this strange behavior. The mystery was solved when one-day scrimbo arrived with two babies. They too for sometime made it their habit to have the food offered. Although in course of time scrimbo again became tame, her offering always remained wild. After sometime they all disappeared.

The German circus Busch in 1950's was truly convinced that Atu had an uncanny prowess in handing Bengal tigers after he treated a particularly vicious animal. They invited Atu to join them but Welinman declined to release him. Later on this particular tiger killed its trainer.

In the late 1950's Atu and his two friends Eric Conway and Kadalay Jansz had quite a traumatic experience. Atu had just returned from Bundala and in his kit bag were a few sticks of dynamite. After quite a convivial session he decided to give his friends a lecture on dynamite. He told them that dynamite was harmless unless a detonator was used to set off the explosion. He told them that a stick of dynamite could be lit like a candle. To illustrate his point he took out a stick of dynamite affixed a detonator cap and a fuse wire lighted the fuse with his cigarette and threw the lot into a vacant plot of land outside his window. There was a tremendous explosion and the three of them continued their unfinished business with the bottle. Unfortunately emergency had been declared that day and the three of them were placed in remand custody and thereafter faced a protracted trial.

In the mid 1970's Atu was bestowed Honorary life membership of the Kinross Swimming and Life Saving Club, Wellawatta for the services rendered by him. In 1990 Atu's friend James Goonewardene launched his novel entitled "*One mad bid for freedom*" published by the Penguins at the Kinross which was followed by an exhibition of Atu's paintings. Arthur C. Clarke informed us that he was unable to attend due to ill health and with our permission visited the club the following day to view the exhibits. Some of Atu's friends and admirers made a collection and donated funds to St. Peter's College for a scholarship to a needy student in biology known as the Vickremadhira Atukorala Scholarship.

To me Atu may be dead but his legend lives on. The above titled well-researched article revives our interest on this remarkable man whose interest and knowledge of flora and fauna was unique. Indeed, he bestrode his particular world like a silent colossus. Above all he was a true friend.

J.W.D.Perera
14, Sinsapa Road, Colombo 6.

Sir –

I read with a sense of nostalgia the biographical account on my late friend Vickie Atukorala, written by Hemantha

Situge in the last issue of "Loris". To me it was indeed a privilege to meet him through Mike Wilson in the early 1960's, when I was working on the first Sinhala color film "Ranmuthuduwa". Mike introduced me to this remarkable man who was truly an unassuming character. His encyclopedic knowledge especially on flora and fauna added life to our discussions.

Atu always accompanied us on location hunts for movies. He kept us stimulated with his narratives on wildlife and traditional folklore. I could also remember the Polmalkarawala' – flying snake around his neck in most of the journeys reminding me of the Cobra around Lord Shiva's neck.

British ornithologist Iris Darnton in her *"Journeys in Ceylon Jungles"* published in London refers to Atu as Atikiralli a knowledgeable Sinhalese who accompanied her and her husband in their jaunts.

The nuances of Atu's character is somewhat portrayed by Korala as the guru of his generation of naturalists in James Goonawardene's, *"One mad bid for freedom"* published by the Penguins in 1990.

It appears to me that the account on Atu is a well-researched article. The writer has said that he has introduced a series of reminisces. I eagerly wait to read his unpublished 'memoirs' in following the series on Atu.

SHESHA PALIHAKKARA
UDUGODA, WATTEGAMA.

Sir -

I read in the above article of the Loris 2000 June issue that there had been snake farms, which extracted snake venom and exported in Sri Lanka. I would be grateful to any reader who can provide me information on whether this reference is the only instance found in the past.

A.E. DISSANAYAKE
225 GONAGAMPOLA KELANIYA

Putting the record straight

Sir –

In a book recently published in England, the Sri Lankan author has made reference to Iris Darnton and her version of the Broad-Billed Roller story, quoting her claim that "The Irisi" was named after her. As this occurred 50 years ago it seems a great pity that it should be resurrected. I am perhaps the only person left who knows the truth of the matter and I would like to put the record straight once and for all.

This unfortunate incident in Sri Lankan ornithological history was fully explained by my fatter, W.W.A Phillips, in Loris Vol VI and again in the centenary issue in 1984. I happened to arrive to stay with my parents shortly after Mr. and Mrs. Darnton had left on 3rd February 1950. The bird books were still spread out on the table opened at the page on Rollers and my father told me that, though Iris Darnton was convinced she had found a species new to science, he himself believed the bird to be *Eurystomus orientalis* The Dollar bird or Broad-Billed Roller.

Two days later Bill Phillyes visited Maha Oya and was able to make a positive identification of the birds, which he had been delighted to watch at their nesting hole, and a week later he set out with his camera equipment to photograph the birds. I have seldom seen my father so upset as when he returned home after finding these rare birds had been shot.

Iris Darnton, who had told my mother that she was going back to Maha Oya to observe "these birds further" had in fact, obtained a permit from P.E.P. Deraniyagala and was accompanied by the Colombo Museum taxidermist, who shot and collected the birds. The female was found to contain eggs.

If it was really necessary to collect these birds, for scientific reasons, this could have been delayed until after the breeding cycle was completed. Iris Darnton published a distorted version of this episode in Spolia Zeylanica Vol 26, and again in a book she wrote in 1975 entitled *"Journeys in Ceylon Jungles"*. As the birds were very slightly smaller than the Indian variety, they were given the name *Eurystomus orientalis irisi*, to distinguish them as a subspecies.

I am very thankful to know that the Dollar bird or Broad Billed Roller is now regularly seen in Sinharaja Rainforest and has been photographed by Dr. T.S.U. de Zylva and others. I do hope that now the true facts of this incident are known it can now rest where it belongs – in the past.

MRS. E. WYNELL MAYOW
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Nature Photographer of the Year

Nature Photographer of the Year contest is organised with the view of promoting nature photography in Sri Lanka. Application forms are available in the Daily News (Thursdays) and Dinamina (Saturdays) during the period August 19 to September 30, 2001 and also on www.jetwingeco.com

Notes on a Possible Mass-migration of Marine Species off the West Cost of Sri Lanka

Rex I. De Silva

31, Dampe, Madapatha, Piliyandala, Sri Lanka.

A chance observation and two studies carried out by the author evokes the question as to whether there is an annual southward mass-migration of several marine species during the south-west monsoon period (i.e. from approximately May to November, Anon. 1966).

In July 1976 while at sea about 15 km off the West Coast at an estimated latitude of 7° 45' N I observed around half-dozen whales in the distance. The crew of the fishing craft in which I was travelling informed me that they had observed similar whales before and added that the whales would usually move inshore to within 4 or 5 km off the coast towards dusk. The whales would remain at this distance until daybreak, when they would move offshore again (A. van Cuylenberg, *et. al. pers. com*). I considered it significant that all the whales observed were swimming southwards. Our boat passed fairly close to one animal, which I noted was a baleen whale with long, rather pale, pectoral fins. The other whales also appeared to belong to the same species. On returning to Colombo I referred to the literature and identified them as Humpback whales (*Megaptera novaeangliae*). Referring to his observations in the Bay of Bengal, my observations (above) and those of Ross from Oman, Whitehead (1983) commented that the songs of the Humpbacks from Oman and Sri Lanka were the same. He suggested therefore that these whales were from a single non-migratory stock. However as the whales seen by me were moving southwards, I speculate that they could possibly have been migrating towards rich feeding-grounds in the Southern Hemisphere.

In the mid 1970's I noted that in July and August fishermen on the west coast caught considerable numbers of Scalloped Hammerhead Sharks *Sphyrna lewini* (De Silva, 1986, 1995a). The sharks, which were possibly sub-adults, varied in length from approximately 120-150 cm. I was informed that they usually stayed several kilometers out at sea (possibly on the mud-banks) during day and only came closer to shore around dusk ("Kalu" *pers. com*). On account of the prevailing monsoon conditions I had to select relatively calm days in which to observe the sharks. Nevertheless even on such days disturbed seas and murky waters were the norm. I selected the reef know as *Palagala* for my study. This lies about a kilometer offshore in the Colombo region, where depths vary from approximately 15-20 m. I usually started diving late evening and continued after sunset until light became too weak for useful observations. (Divers will be familiar with the phenomenon by which sufficient light remains underwater for a considerable period after sunset). My initial attempts to observe the sharks were unsuccessful as the few I glimpsed almost immediately disap-peared into the murk. I guessed that they were probably frightened off by the sound of my SCUBA equipment. On subsequent dives therefore, I had no alternative but to dispense with the breathing apparatus and observe the sharks by free diving (i.e. holding my breath)." Down-time" was thereby restricted to less than one minute per dive; the extent of my breath- holding

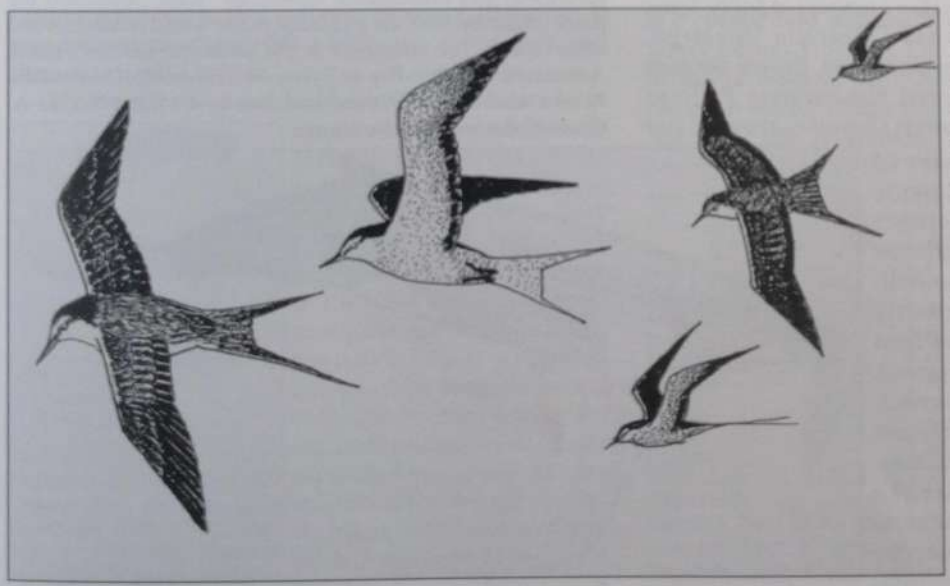

Figure 1. Bridled Terns *Sterna anaethetus* in migration.

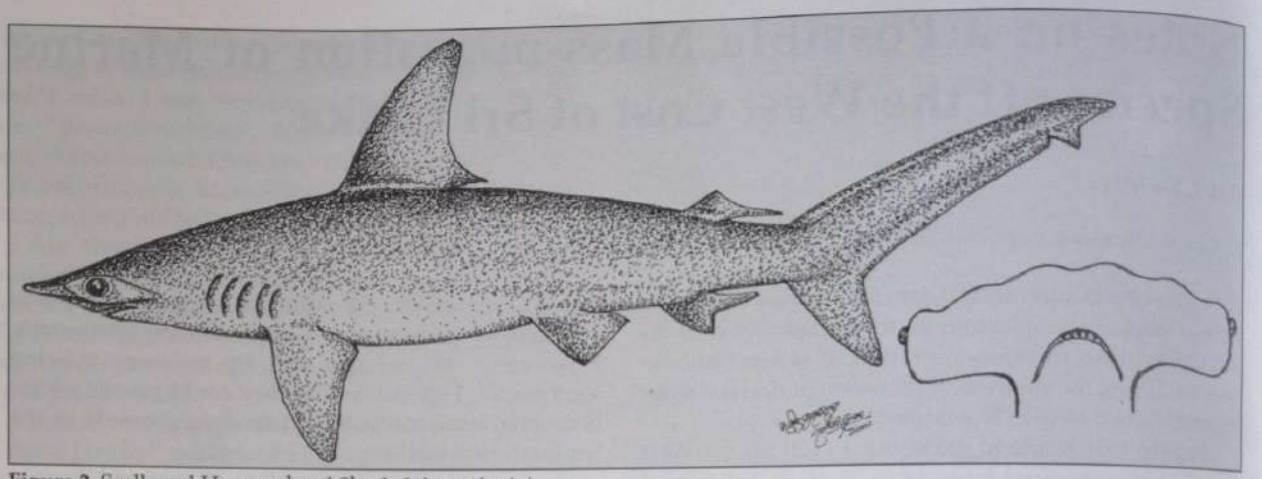

Figure 2. Scalloped Hammerhead Shark *Sphyrna lewini*

capacity at those depths. I was able to execute 20-30 such dives per evening before light became too faint. I noted that the bottom 3-5 m of water was extremely turbid (almost opaque) and therefore employed a strategy some used by spearfisherman for closing in on their prey. This involved diving into the turbid layer, swimming horizontally for some distance and then slowly ascending: in this manner I could often swim into the schools of sharks from below. Disappointingly the murky water precluded underwater photography. I observed that apart from random movements of a few sharks, the majority of hammerheads appeared to be swimming slowly southwards.

During the period 1981-1994 I made an intensive study of seabird migration off the west and south-west coasts of Sri Lanka (De Silva, 1986, 1995b, & De Silva & Perera, 1994). Large numbers of Bridled Terns *Sterna anaethetus*, together with smaller numbers of Sooty Terns *Sterna fuscata*, Brown Skuas *Catharacta lonnbergii*, Pomarine Skuas *Stercorarius pomarinus*, Brown Boobies *Sula leucogaster*, Flesh-footed Shearwaters *Puffinus carneipes*, Wilson's Storm Petrels *Oceanites oceanicus* and other seabirds were observed flying southwards from June to October (and sometimes November) each year. I estimate that in peak years close to half-million migrating seabirds fly southwards within sight of land during daytime (De Silva, *in press*). As this study is well documented, readers are directed to the relevant literature (listed below) for details.

It is not clear whether the (apparent?) mass movement of diverse marine species observed by me was the result of purely fortuitous and coincidental circumstances, or whether an actual mass-migration, possibly brought on by meteorological, hydrographic, biological factors or a combination of these occurs each year. It is significant to note that Brown Skuas (De Silva, 1994), Flesh-footed Shearwaters (De Silva & Perera, 1994) Wilson's Storm Petrels and Humpback Whales (in the Indian Ocean) are all mainly creatures of the southern hemisphere.

In documenting this migration it is my hope that a competent naturalist (or naturalists) will be inspired to carry out a comprehensive biological investigation into, what may be, an interesting and significant phenomenon.

Acknowledgements

For assistance in the marine and diving aspects I am grateful to Howard Dias, Trevor Ferdinands, Joe Rajapakse, Thava Ratnasingham and Arthur van Cuylenberg. Rodney Jonklaas (deceased) and professional fisherman "Kalu" discussed the shark migration with me and made many useful comments and observations. For assistance in the avifaunal studies I thank Annemarie Bell, Brindley de Zylva, Carl Fernando, Dushyantha Perera and Lester Perera and finally W.L.D.P.T.S.de A. Goonatilake for his illustrations.

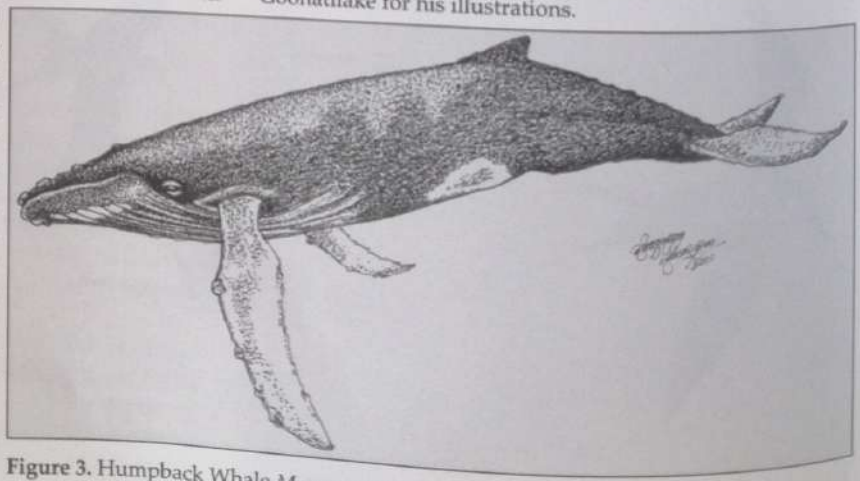

Figure 3. Humpback Whale *Megaptera novaeangliae*

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The Caspian Tern: *Sterna caspia* Pallas; A Sight Record from an Inland Tank

Sujan Maduranga Henkanaththegedara

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The Caspian Tern, *Sterna caspia* Pallas; is the largest tern species recorded in Sri Lanka, which measures about 51 cm in size, nearly the size of a Black Crow (*Corvus macrorhynchos*) but less sturdier than the Black Crow and with a longer wing span (Harrison, 1999). This bird is common but not abundant around the northern coast of the island, and is occasionally seen in the Hambantota district. However, it is rarely seen elsewhere in the island (Henry, 1998).

I had an opportunity to report a couple of Caspian terns from an inland tank in Anuradapura district. The observations were made at around 8.00 a.m. without the help of a binocular at a distance of about 10 meters. It was a sunny morning with a little cool atmosphere and there was a mild breeze.

My attention was suddenly drawn towards two large birds, which appeared to be terns. The terns were identified as Caspian Terns due to its larger size, dark primary feathers of the under-wing, heavy bill and the shape of the head. Both birds were in winter (or non-breeding) plumage. They appeared smoky white when they were in the air. Primary feathers of the under-wing were clearly separated because of its dark grayish color, the crown and the nape were also grayish, the bill was heavily built and reddish in color (Figure 01 & 02).

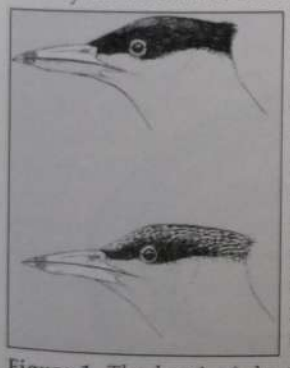

Figure 1. The head of the Caspian Tern; *above*: breeding plumage with black cap; *below*: Non breeding plumage with black lores and ear coverts, blackish cap with whitish streaks.

Both terns were in the air with the head held down. They were flying separately here and there near the margin of the tank and did not enter in to the middle of the tank. They were associated with many Whiskered Terns (*Chlidonias hybridus*) and a few Little Terns (*Sterna albifrons*). The flight was powerful with a slow wing beat. I did not hear any calls during the observation period.

The location was a small tank in Rambewa in Anuradapura district, 20 km from the Anuradapura town. The tank is connected with Mahakanaderawa tank and this tank; "the Rambewa tank" is situated close to the A20 Anuradapura-Medawach chiya highway. The tank was heavily covered with floating aquatic plants and the marginal vegetation consists of various kinds of grasses and reeds.

The importance of this record is that the Caspian tern is a coastal bird and there was no record from inland water bodies from Sri Lanka. The Caspian tern is a breeding resident on "Adam's Bridge" islets and a common winter visitor to dry zone coasts and rarely to the wet zone (Harrison, 1999). Presently they are regularly seen in the Hambantota area and some speculate that it may even breed there (Henry, 1998).

Figure 2. Non breeding Caspian Tern in the flight; note the shape of the head, heavy bill and the blackish primary feathers on the under wing.

Acknowledgements

I wish to thank Mr. Sanjaya Pingamage who joined in the observation and Mr. H.M.K.B. Herath and Miss. Bodini Herath for their encouragement and their help with this paper.

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Rediscovery of Endemic Brown Blind Swamp-eel, *Monopterus desilvai* Bailey & Gans, 1998; family: Synbranchidae, after twenty years from Sri Lanka.

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In 1993, Mr. M. Ananda Obedeera, brought to me a specimen of eel species collected from an irrigation canal located in the Aluthgama area near Bandaragama. The specimen was collected on 10th February 1993. I first believed that it is the eel species, *Ophisternon bengalense* McCelland, 1845 (E: Blind eel or Swamp eel; S: Potta Anda) based on the following morphological features; relatively smaller eyes, connected gill opening, and absence of pectoral fins. However, a closer examination showed that the upper and lower lips, nostril opening, shape of the gill opening, and caudal fin is quite unlike that of *Ophisternon bengalense* (Deraniyagala, 1952; Pethiyagoda, 1991). At this point I thought that this might be a marine moray eel species. However, a complete examination with the aid of field guides (Deraniyagala, 1952; Munro, 1955) showed that the species differ from any of the recorded moray eels.

In August 1996, I had an opportunity to listen to Prof.

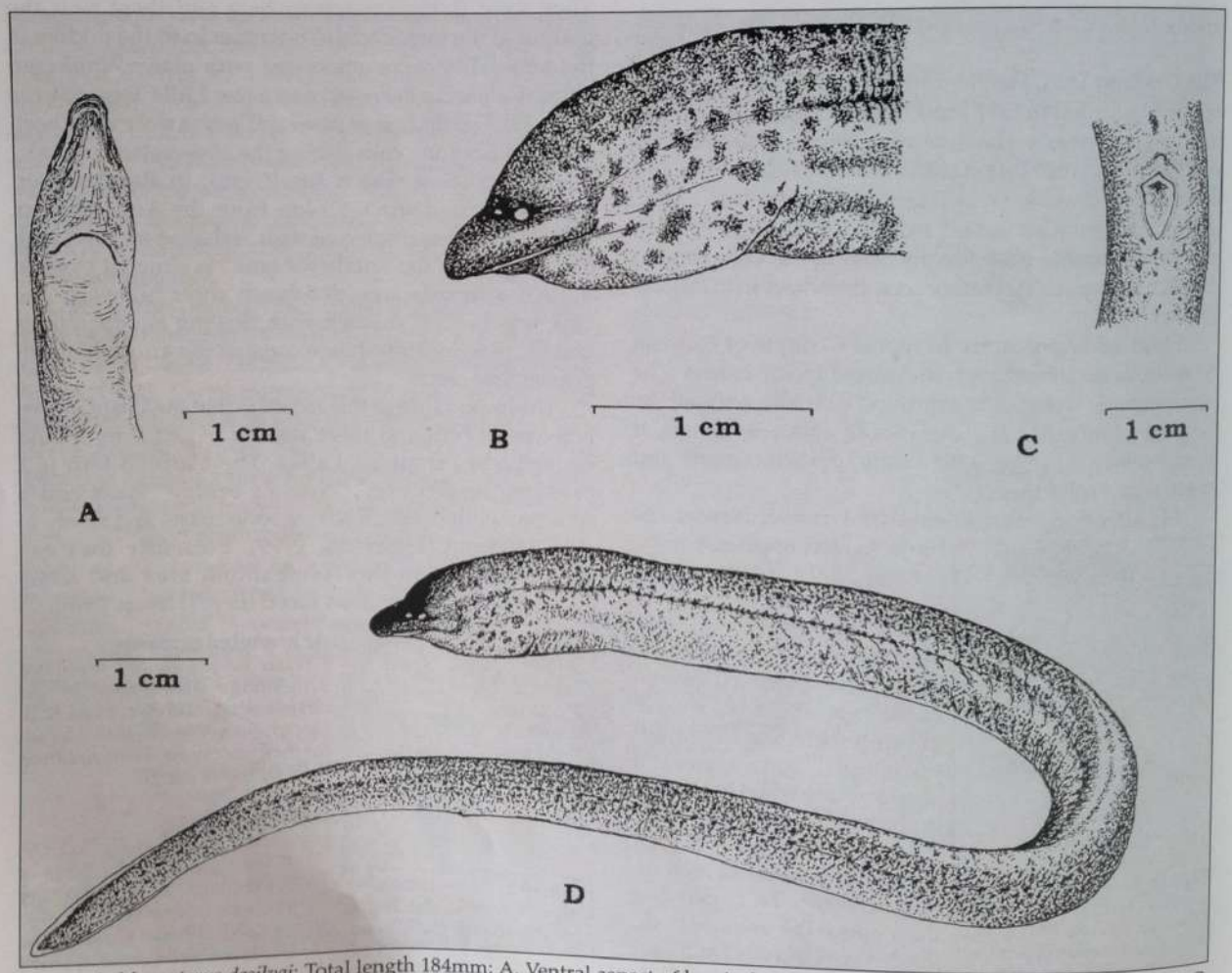

Figure. 1. *Monopterus desilvai;* Total length 184mm; A. Ventral aspect of head, showing gill opening; B. Lateral aspect of head; C. Ventral aspect of trunk, showing the vent; D. Lateral aspect of the specimen. (*Goonatilake del. 1993*).

Carl Gans (Department of Biological Science, University of Michigan, USA), during the symposium of Biology and Conservation of the south Asian Amphibians and Reptiles. At that symposium he mentioned about a freshwater eel species that is new to science (known only from a single specimen collected from Marawila near Chilaw in 1976) that can be misidentified as an Apod amphibian (*Ichthyophis spp.*). In early 1998, I wrote several letters with detailed illustration of the specimen (Fig. 01) to Prof. Carl Gans in an attempt to find more details about this species. Unfortunately, repeated inquiries from Prof. Carl Gans resulted in no reply. However, in 1998 Mr. Rohan Pethiyagoda wrote an article to *Sri Lanka Nature* magazine regarding the brown blind eel (which belongs to Family Synbranchidae) a new species of fish in Sri Lanka. In that article he mentioned, that Prof. Reeve Bailey and Prof. Carl Gans described this new endemic eel species as *Monopterus desilvai* in honor of Dr. P.H.D.H. de Silva, former director of the National Museum of Sri Lanka. Based on the description provided by Mr. Pethiyagoda in that article, I was finally able to identify the eel species I collected from Aluthgama as *Monopterus desilvai*. By this time, I was able to find another three specimens from the Bandaragama location (two live specimens in 1994 and one dead specimen in April 1998).

Eight species of eels belonging to Family Synbranchidae has been recorded from the Indian subcontinent (Talwar & Jhingran, 1991; Bailey & Gans, 1998). These include *Monopterus albus* (Zuiew, 1793); *M. cuchia* (Hamilton-Buchanan, 1822); *M. fossorius* (Nair, 1952); *M. indicus* (Silas & Dawson, 1961); *M. eapeni* Talwar, 1991; *M. roseni* Bailey & Gans, 1998; *M. desilvai* Bailey & Gans; 1998, and *Ophisternon bengalense* McCelland, 1845. However, Silas & Dawson in 1961, classified *M. cuchia, M. fossorius, and M. indicus* under family Amphipnoidae. Of these *Monopterus desilvai* and *Ophisternon bengalense* has been recorded from Sri Lanka. While *Monopterus desilvai* is endemic to Sri Lanka, *Ophisternon bengalense* has been recorded from India, Sri Lanka and Malayan region. Other six species of the genus *Monopterus* have been recorded from the Indian subcontinent (Deraniyagala, 1952; Pethiyagoda, 1991; Silas & Dawson, 1961; Talwar & Jhingran, 1991; Kottelat *et al.* 1993; Bailey & Gans, 1998).

Materials: Two dead specimens, Total length 184 mm (Fig. 01 & 02) and Total length 260 mm (Fig: 03), and two live specimens were examined.

Location: *Monopterus desilvai* was described in 1998 based on a single specimen, which was collected from Marawila in late 1976. Therefore, this is the first record of this endemic species outside of its type locality and I was able to collect four specimens during the past six years from the present site (1993 to 1999). The present location is situated in Aluthgama near Bandaragama, Kalutara district, and approximately 1 to 2 miles north of Bolgoda River (Bolgoda river basin).

Diagnosis: *Monopterus desilvai* Gans & Bailey, 1998, can be distinguished from all other Asian blind eels with eyes, based on the following characters; posterior nostril lies anterior to the level of the eyes (in others, between eyes) and the upper jaw extends further than the lower jaw. This species can be distinguished from *O. bengalense* due to the absence of rays in the caudal fin.

Figure. 2. *Monopterus desilvai*; Total length 184mm. Ventral aspect. (Photo. N. Peries)

Figure. 3. *Monopterus desilvai*; Total length 260mm. Dorso- lateral aspect. (Photo. N. Peries)

Measurements (in mm): ***Specimen 1(Fig. 1 & 2)*** Total length: 184.00; Head: 16.85; Snout: 3.65; Inter-orbital distance: 2.90; Width of gill opening: 4.90; Gape of mouth: 4.80; Snout to vent: 115.30; Height of head: 8.05; Depth of body at vent: 5.00. ***Specimen 2 (Fig. 3)*** Total length: 260.00; Head: 21.26; Snout: 5.05; Inter-orbital distance: 4.70; Width of gill opening: 6.40; Gape of mouth: 8.15; Snout to vent: 190.00; Height of head: 10.5; Depth of body at vent: 6.00.

Description: The head is conspicuous from the rest of the body (Fig. 1 A to D; Fig. 2 & 3). Eyes are greatly reduced and covered by a skin. Part of the snout and

upper jaw over hangs, the ventrally positioned mouth. Body, eel-like and robust. Ventral part of the tail partly scaled (embedded scales), but these scales are not clearly visible in the field. Dorsal and anal fold continuous without rays and greatly reduced. Pectorals and pelvic fins absent. The caudal tip is bluntly pointed. The gill openings extend under the neck to join up below the throat and nearly crescentic in shape. Furthermore, gill opening is internally attached to the isthmus.

Colour: Reddish brown in colour with dark tiny spots distributed throughout the body. Ventral aspect is lighter in colour. In the figures surface colour has become much darker due to the removal of the mucus layer by preservatives (Fig. 02 & 03).

Habitat & Habit: The eel was collected from an irrigation canal with a dark muddy substrate, within the vegetable fields. A year after the fist specimen was caught, two live specimens were caught within the same locality, and were kept in an aquarium. They were excessively shy of light, and usually hide among the vegetation, preffering substrates of pebbles or mud. Unfortunately, these two specimens escaped from the aquarium during the rainy season.

Status: This endemic eel species is categorized as a highly threatened species in *the IUCN, 1999 list of threatened fauna and flora of Sri Lanka* (IUCN Sri Lanka 2000). The many threats to this species include, capture by villagers as a source of food, and exposure to fertilizers and pesticides used in the vegetable fields.

Acknowledgments: I wish to thank Mr. M. Ananda Obedeera for providing the specimens and his help in the field. I am very grateful to Dr. Devaka Weerakoon of Department of Zoology, University of Colombo, for reading the manuscript and suggesting important improvements. Finally, I wish to thank Mr. Rohan Pethiyagoda (WHT) for providing valuable literature.

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Red-faced Malkoha Captured on Film

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The Red-faced Malkoha (*Phaenicophaeus pyrrhocephalus*) is a bird of tall canopy forests, confined almost entirely to good quality rain forests in the wet zone of Sri Lanka. Scattered populations exist in tall forest in the south east part of the island around Galge close to the Yala Protected Area complex and in the riverine forests in and around Wasgomuwa National Park. It is one of the highlights for visiting birdwatchers and is even used by a UK based Birdwatching Tour company called Nature Trek in their advertisements. The Malkoha only utters soft grunt like calls and does not have a loud or conspicuous song or call which would draw attention to it. Furthermore, it is discreet in its behavior preferring to hop about quietly in the upper canopy. Therefore, it is likely that few birdwatchers would have seen the Red-faced Malkoha in the wild.

The male and the female can be distinguished based on the color of the irides. The male has brown irides while the female has white irides. The photographs clearly show this. The photographs also show clearly how extensive the red on the face is extending to a sizeable

Figure 1. The male red-faced Malkkoha.

Figure 2. The female Red-faced Malkoha.

patch on the forehead in one of the bird's photographed. The red on the face is formed by small bristle like feathers. Many wild life photographers have attempted to photograph this bird and failed because it is usually seen in the high canopy at a distance, often backlit against the sky and obscured by the branches. I succeeded in capturing this elusive bird on film by understanding the bird's behavior, being totally focused on photographing the bird and above all a generous helping of luck. I first photographed it at Morapitiya, but the pictures had all the usual shortcomings, the bird was too small and in difficult light.

My luck turned when I visited Sinharaja with Vicky Samarasinghe one of Jetwing's Birding Guides accompanied by Ranjit Premasiri, a competent local nature guide who works for the Forest Department. Hearing a mixed species flock in the distance, we waited patiently for about half an hour to be rewarded by no less than five Red-faced Malkohas. Later in the day, we came across another three birds in another mixed species flock. The bird is usually so difficult even to sight, which is probably why the first photograph of publishable quality was not taken until recently by Steve Chalmers. During a visit to Sri Lanka he took several photographs which were published in the newsletter of the Sunbird Tours.

Being self critical of my own photographs, I am of the view that they are what photographers term 'soft'. The pictures are not razor sharp due to the low shutter speeds that had to be used with the light conditions available in the forest canopy. However, I am pleased with my choice of film, Fuji Provia 100, a professional slide film that has such fine grain, it allows for good magnification of details. There is a growing interest in wildlife and wildlife photography at present and I am sure as time goes by we will see better and better pictures of our threatened wildlife coming from a new generation of photographers equipped with better lenses and better film. What we have to hope for is that these pictures do not become a record of what we had, but instead serve to catalyze an interest to conserve our biodiversity for posterity.

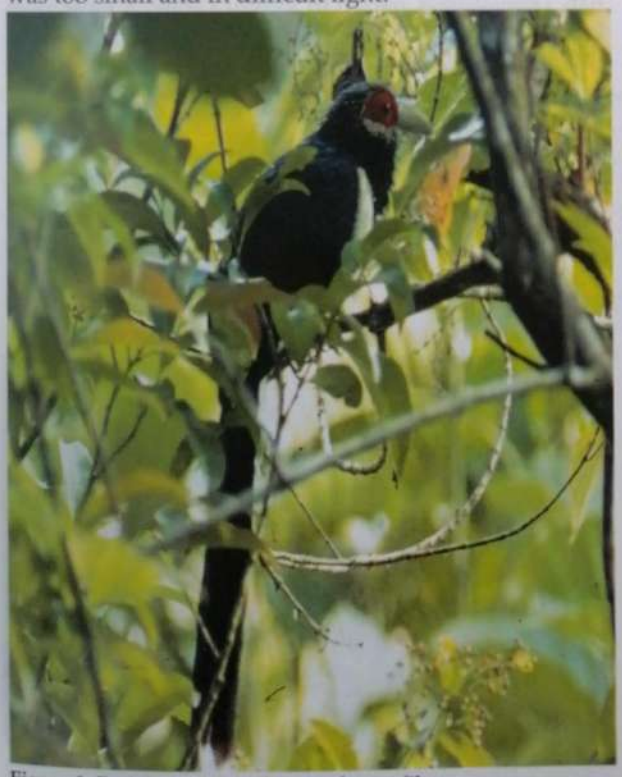

Figure 3. Red-faced Malkoha - Right profile.

Figure 4. Red-faced Malkoha - Left profile

Predators of Sri Lankan Bats

P.M.C.B. Digana, W.B. Yapa, P.V. Randeniya, and W.D. Ratnasooriya

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Bats are known to form large colonies either in dark caves as in the case of many insectivorous species, or on trees such as many old world fruit bats. These sites where the bats spend day time are known as day roosts. These day roosts attract and serve as potential feeding sites for predators including birds of prey, reptiles and other small carnivorous mammals. The relationship between bats and predators is rather complex and the impact of predation depends on the bat species, the type of day roost used, location of the day roost (which determines the nearness to the foraging site) and type of predators in the area (Fenton, 1995; Tuttle and Stevenson, 1982).

In Sri Lanka, bats are one of the most successful mammals representing 30 species (Bates and Harrison, 1997). However, no information is available on the natural predators of Sri Lankan bats. During a survey made by us (from October 1995 to March 1999), it was observed that some bat roosts serve as potential feeding grounds for certain predators. We identified nine species of predators (see Table 1) at 17 locations. Rat snake (*Coluber mucosus mucosus)* is the most common predator of bats in these sites. They were observed catching bats in five day roosts (3 buildings & 2 caves), and mainly preyed on smaller sized bats, for example Indian Pygmy bat (*Pipistrellus tenuis*) and pups of Schreibers'Long-fingered bat (*Minioptrerus schreibersii*). On one occasion a rat snake was seen devouring a medium sized bat, a black-bearded tomb bat (*Taphozous melanopogon)*. Rat snakes captured adult bats while they were resting in the cave, during day time. In Wavulpena cave, we observed that rat snakes regularly visited the nursery colony during the pre-weaning period and ate fairly large numbers of pups (about 20 pups during a single visit).

Domestic cats (*Felis catus*) preying on bats was observed in three locations. In all three locations bats were roosting in buildings (houses or temples). In two locations, the residents informed us that these cats catch bats almost daily. The two species preyed on by cats were the Indian false vampire bat (*Megaderma lyra)* and the dog-faced bat (*Rousettus leschenaulti*). In another location it was observed that a cat was eating a bat, but the species was not identified. It could be either of the two inhabitant species *Taphozous melanopogon* or Schneider´s Leaf-nosed bat (*Hipposideros speoris)*. Cats were seen at several other day roosts of bats, but we did not observe them actually attacking or catching a bat. Dogs (*Canis familiaris*) were seen feeding on *R. leschenaulti* which were roosting in caves adjacent to two different temples. In two other caves, cobras (*Naja naja*) were preying on an adult *H. speoris* and pups of *M. schreibersii*.

Other than cats and dogs we did not observe any other carnivorous mammals actually feeding on bats. However, we observed the presence of two other common carnivores, golden palm civet cat (*Paradoxurus zeylonensis*) and black palm civet cat (*Paradoxurus hermaphroditus*) closer to a nursery colony of horseshoe bats (*Rhinolophus rouxii*) in Wavul Galge, a large cave. Usually one finds a large number of fallen pups beneath this nursery colony, but on the days on which these carnivores were seen closer to this nursery colony, we noted that only a few pups were lying on the ground. Thus it seems that these animals prey on bat pups.

Usually, the birds of prey are the most notorious predators of bats, which usually sit and wait until bats emerge from day roosts (Novick, 1997, Tuttle & Stevensen, 1982). Two birds of prey were observed catching bats during their out flight. A single crested hawk eagle (*Spizaetus cirrhatus*) was a common sight

Figure 1. Schneider's Leaf-nosed bat *Hipposideros speoris.*

Figure 2. Great leaf-nosed bat *Hipposideros lankadiva.*

around Wavul Galge on many evenings. It often succeeded in capturing one of the emerging bats. Once, a brown hawk owl (*Ninox scutulata*) catching out-flying bats from a colony of *Hipposidereos speoris* at Lankathilaka Viharaya was observed.

However, we never observed predation of large flying foxes (*Pteropus giganteus*), although they roost in the open quite conspicuously vulnerable to any would-be predator. On some occasions we observed crows (*Corvus splendens*) and once a troop of Toque monkeys (*Macaca sinica*) attack roosting bats, but flying foxes were always able either to counter attack (often against the crows) or fly away. Similar observations were made by Pierson and Rainey (1992) who concluded that large bats, particularly on islands, have relatively few predators, other than man, of course.

Compared to the number of day roosts visited (over 400) during this study, predators were observed only in a few (17) locations. One reason for this low predation may be that bats have many behavioural adaptations during emergence and foraging, which are directed at avoiding predators (Novick, 1977; Kunz 1982 and references therein). Generally the predation of bats often occurs within or near their roosts (Fenton, 1995). Thus, it appears that there is no high predatory pressure on Sri Lankan bats. However, it should be noted that the impact of predation probably is greater than what we have observed, as most would-be predators are likely to be frightened away by human activity, thereby limiting observations of predators. Tuttle and Stevenson (1982) reported that the predation of bats by screech owl (using night-vision scope) was observed only when the observers took cover behind a blind. However, based on our observations it appears that none of the above mentioned predators would cause drastic changes in population sizes of Sri Lankan bats.

Unfortunately, we observed that the main and the most dangerous predator of bats, both of larger flying foxes as well as other insectivorous bats, is man. In the Badulla district we observed that two large colonies of flying foxes were attacked by humans with stones and sticks, often killing several bats. Perhaps, the more alarming observation made was that at several locations, cave dwelling bats were killed in large numbers by some locals as a free source of meat. Once we found carcasses of more than 300 bats (*R. leschenaulti*) during one of our many visits to Wavulpena cave. Apparently, seen us approaching the cave, the hunters fled leaving their kill behind. We have made similar observations at an abandoned mine at Bogala and in small colonies of bats roosting in several tree-holes in Thalawakele. At the Bogala mine a population of about 200 great leaf-nosed bats (*Hipposideros lankadiva*) completely disappeared most probably because of "predation" by humans. In such instances they used thorny branches to kill bats that flew around the cave when disturbed by the attackers. Although many people kill bats to supplement their meat requirement, some people kill bats since they believe that flesh of bats has therapeutic value against certain diseases such as asthma.

We strongly believe that educating the public would

Table 1: Details on the bat predators, prey species and locations.

Predator	Prey species	Maturity	Roost	Site
Rat snake (*Coluber mucosus mucosus*)	*Pipistrellus tenuis*	Adult	Building	Wagolla
	Taphozous melanopogon	Adult	Building	Kasagala temple
	P. tenuis	Adult	Building	Malsiripura
	P. tenuis	Adult	Building	Ambakka
	Miniopterus schreibersii	Pup	Cave	Wavulpena
Cobra (*Naja naja*)	*Hipposideros speoris*	Adult	Building	Degaldoruwa
	M. schreibersii	Pup	Cave	Wavulpena
Domestic cat (*Felis catus*)	*Megaderma lyra*	Adult	Building	Yahaladuwa
	M. lyra	Adult	Building	Lawalhena
	H. speoris or *T. melanopogon*	Adult	Cave	Fa-Shiengala
	Rousettus leschenaulti	Adult	Cave	Naugala
Dog (*Canis familiaris*)	*R. leschenaulti*	Adult	Building	Thalaguli Viharaya
Golden palm civet cat (*Paradoxurus zeylonensis*)	*R. rouxii*	Pups	Cave	Wavul galge
Black palm civet cat (*P. hermaphroditus*)	*R. rouxii*	Pups	Cave	Wavul galge
Crested Hawk eagle (*Spizaetus cirrhatus*)	(not identified)	Adult	Cave	Wavul galge
Brown hawk owl (*Ninox scutulata*)	*H. speoris*	Adult	Building	Lankathilaka viharaya
Human (*Homo sapiens sapiens*)	*H. lankadiva*	Adult	Mine	Bogala
	R. leschenaulti	Adult	Cave	Wavulpena
	Pteropus giganteus	Adult	Tree roost	Badulla
	P. giganteus	Adult	Tree roost	Passara
	Pipistrellus ceylonicus	Adult	Tree hole	Talawakele

considerably minimise the killing of bats. Often, bats were attacked by very few locals, but regularly, and they can be discouraged with the help of the local community leaders such as clergy, gramasevakas and teachers. We had the opportunity to talk to some bat hunters and when we explained to them that these bats are actually insect eaters, not fruit eaters and thereby protect their crops rater than damage them the killing of bats were drastically reduced in these areas.

Figure 3. Dog-faced bat *Rousettus leschenaulti*.

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Warning displays of the water monitor *Varanus slavator* (Sauria: Varanidae)

Nimal D. Ratnayake

'Thilina' Galagediyawa, Gampola

The water monitor *Varanus slavator* is the largest saurian recorded from Sri Lanka, attaining a maximum total length of approximately 3 m. When disturbed *V. slavator* elicits a warning display that has been recorded by Daltry, (1991). In this paper I wish to report some previously unrecorded warning behavioural patterns which we observed during a recent field study at Malwatuoya, Anuradhapura (90 m MSL).

Observations

An adult gravid female (Total length = 251 cm, Snout to Vent length = 107 cm, Weight 26 kg) was observed at 14:30 hours while crossing a gravel road of the area. When it saw us, normal walking style changed to a threat walk (by raising the body dorsally) and it immediately rushed to a scrub jungle. The lizard ran for some distance and stopped. Then it hid the head between its forelimbs. When we caught it by it's tail it held its head high and turned slightly to the other side and started to jerk the tail. The neck was arched and the gular portion of the throat was expanded. After releasing the varanid, no movements were observed for 10 minutes. Then it suddenly raised its head up (step 1) and started to arch and inflate the head (step 2). It simultaneously raised the body on all four extended limbs (high stand - step 3) while raising the back dorsally (arch back - step 4). Then the varanid opened its mouth and started to hiss. It did not stop hissing for about 5 minutes. Then it put the tongue out and started striking with its tail. After about 10 strikes, it reduced the speed of breathing and kept the body flat. After this, its movements were limited and slowly moved to the jungle. It did not attempt to bite while handling.

Acknowledgements

Mr Anslem de Silva of the University of Peradeniya and Dr. Channa Bambaradeniya of IUCN-Sri Lanka for various courtises. I must extend my profound gratitude to Nadeeka Weerasinghe and Kalinga Hewamathes for the cooperation extended during the study.

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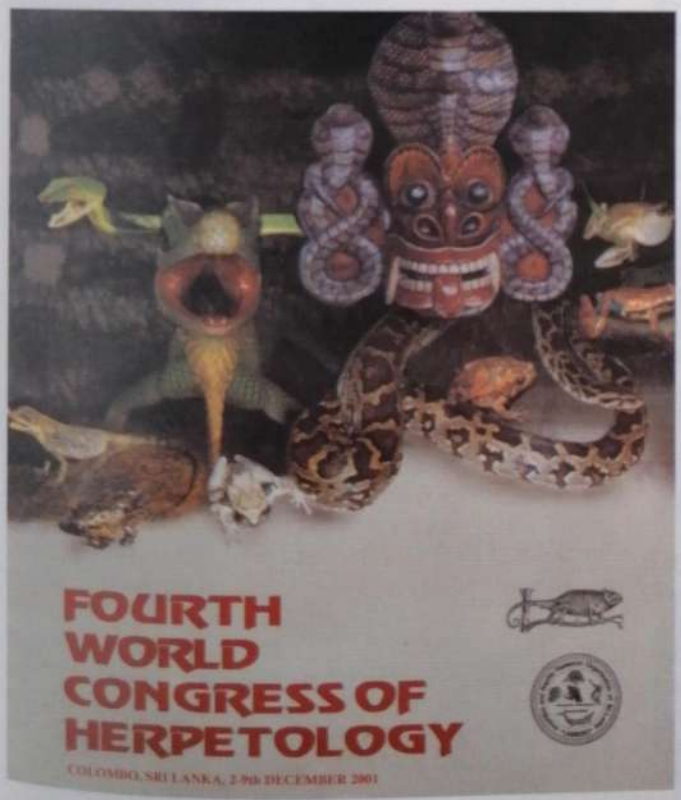
Step 1

Step 3

Step 2

Step 4



FOURTH WORLD CONGRESS OF HERPETOLOGY

The fourth World Congress of Herpetology will be held from 2 to 9 December 2001 in Colombo, Sri Lanka. The programme includes presentations, posters as well as round table discussions with a special focus on the Asian continent. This will give Sri Lankans an opertunity to interact with some of the leading Herpetologists of the world and listen to some of the current issues in herpetology.

Those who wish to present their work must send an abstract of their presentation on or before August 31, 2001 to the congress director. A limited number of sponsorships are available for Sri Lankan students who will be presenting their work at the congress. Conversely, one can join the congress simply as a participant. If so the final date for registration is August 31, 2001. For further information contact,

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Nittaewo and Other Traditions Pertaining to Animals and Plants

C.G.Uragoda

Hanuman was the leader of Vaanaras, a legendary tribe of monkey-like creatures who figure prominently in the Indian epic, *Ramayana*. These were a class of special beings who were described as having "excellent bodies covered with hair; sharp teeth four of which were canine; manes; hands; five toes and long hairy tails. Their voice was guttural like the roar of thunder. They fought with their nails and teeth" (Ramanathan, 1931).

A comparison between Vanaras and Nittaewo, a race of hairy beings last heard of in Lenama near Panama, provides an interesting parallel. There has been much speculation as to the nature and identity of Nittaewo. Some consider them a legendary race, while others including some prominent scientists find some substance in the story.

Osman Hill, who was professor of anatomy at the Ceylon Medical College and author of a monumental seven-volume work on primates, favoured *Pithecanthropus* of Java as a likely candidate to fit the description of Nittaewo (Hill, 1945). Deraniyagala (1963) suggested two possible identifications, namely a race of Neanderloid humans and early *Homo sapiens*. Dr R L Spittel at first took the legend seriously enough to suggest that Nittaewo were Negrito dwarfs, who were progenitors of the Australoid Veddha. However, in a later exposition he withdrew this suggestion and expressed skepticism of the story.

Rambukwelle (1963) failed to find any material evidence of their existence when he led an expedition to Mahalenama for this purpose. Spittel concluded that the sloth bear, which was hairy and had long claws, was the most likely candidate to foot the bill. On the other hand, Rambukwelle pointed out that the Veddhas were quite familiar with the common sloth bear and they were unlikely to make such a mistake.

It is quite apparent that basically the controversy has failed to resolve whether Nittaewo were legendary or real creatures. In the absence of concrete scientific evidence for their existence, indications are that Nittaewo were a legendary race.

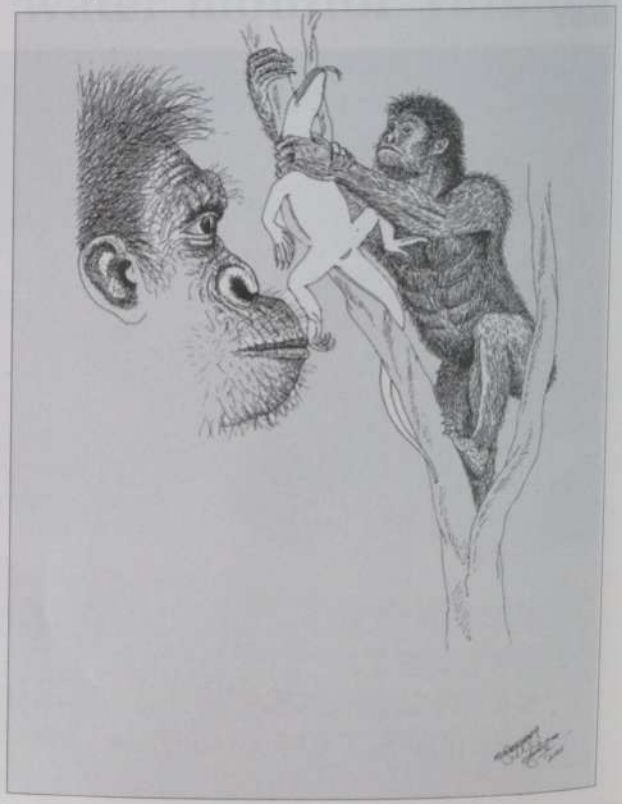
The first mention of Nittaewo was by Nevill (1886) when he presented a description of this mysterious race as given to him by Mudaliyar A de Zylva of Batticoloa. These creatures were apparently of a dark or monkey colour, covered with thick long hair and resembled orangutans or gorillas. Their hand and feet were almost human, but they had elongated claws. They walked erect like men and were expert in climbing trees. They were short of stature, being about three to four feet high, and tailless.

These creatures, according to de Zylva, lived in Tamankaduwa area, where they were known as *kilavanduro*. They were also seen in the forests of Tantirimalai and Pomparippu where they were known as Vanara.

It is apparent that there are several points of similarity between the Vanaras of the *Ramayana* and the Nittaewos of Mahalenama. Both races were hairy and ape-like, had long claws with which they fought the enemy, and their voices were loud and guttural. The only difference was that Nittaewos were tailless.

de Zylva singles out Vanaras of Tantirimalai and Pomparippu as a race allied to Nittaewo. Vanara is the very name given to Hanuman's tribe of the *Ramayana*.

In Sri Lanka, subsidiary tales of a local flavour have sprung off the main *Ramayana* story. Apart from Ritigala, and Rumassala, there are Sitawaka, Sita Eliya and Ravana Ella as reminders of this development. The question, therefore, arises whether the legend of Nittaewo too is an adaptation from the Vanaras of the *Ramayana*.



Ticks and leeches

Ticks and leeches are two of the leading pests that attack the jungle traveler. The narrow jungle path would permit persons to walk only in single file through the undergrowth. In this regard, there is a saying among jungle folk that the one who heads the column would catch the tick, while the tail-ender would get the leech. A study of the pattern of behavior of these two creatures would testify to the truth of this adage.

Ticks are normally found in the jungle in clusters of thousands, which congregate into balls the size of pepper seeds. These hang from the undersurface of the foliage of shrubs, waiting in readiness to cling on to any passing man or animal that brushes against them. Once such a cluster transfers itself to man, the ticks rapidly disperse all over the body, and inflict bites as painful as needle pricks. The leader of the single file tends to suffer the most, as he would catch the largest number of ticks. Subsequent members of the column would be spared, as by the time they come up, the tick population would have been depleted.

Leeches, on the other hand, have a different *modus operandi*. They feel the vibration of the tramping feet as the column of persons passes by. This is a signal for them to poise for attack, and as the process takes a little time, the leader of the column has already passed by. It is those who bring up the rear that are exposed to attack by leeches.

Drooping eyelids

The first line of contact for snake-bite victims, specially in rural areas, is often the local traditional practitioner. A patient's prognosis will depend on auspicious or inauspicious signs. In Jaffna, one of the methods of predicting the outcome of the illness is by asking the patient to look at the sun at midday. His inability presages a poor prognosis.

The bites of cobra, Russell's viper, Ceylon krait and common krait, which are all deadly venomous snakes, may all cause ptosis or drooping eyelids due to a neurological reaction. While the majority of Sri Lankan snakes are non-venomous, ptosis indicates that envenoming has occurred, and that too by a deadly venomous snake. The victim would be unable to raise his paralyzed eyelids and consequently unable to see the midday sun, which would be vertically above his head. The Jafffna practitioner was right when predicting a poor outcome, especially when anti-venom was not readily available those days.

Traditional classification

Species of the genus, *Ocimum* possess strongly aromatic volatile oils, and hence are locally used as insect repellents. Four members of the genus found in Sri Lanka are *O. sanctum* (S. madurutala), *O. americanum* (S. heentala), *O. basilicum* (S. suwandatala), and *O. gratissimum* (S. gastala). It may be seen that all four species have Sinhalese names that contain the suffix, -*tala*, a remarkable agreement with the scientific classification.

Tala as a suffix probably does not occur with any other Sinhalese plant name, though *tala* by itself is the Sinhalese term for sesame or gingili. The indications are that the Sinhalese names for these four species, namely madurutala, heentala, suwandatala and gastala were given on some basis of similarity, which was apparent to the ancient Sinhalese people. This nomenclature has later turned out to be a rational one, for all these plants having the common suffix, *tala* were subsequently classified as members of the genus, *Ocimum*.

The mention by Burmanus (1736) of two vernacular names, rathatala and tala-kola for species of *Ocimum* described by him testifies to the fact that this radical was in use as far back as 1736 even before Linnaeus applied his classification in 1747. The Sinhalese classification of *Ocimum* appears to be an example of what Pridham (1849) meant when he wrote, "It is supposed that the Sinhalese once had a complete system of Botanical arrangement....".

Flying squirrel

Flying squirrel, whose Sinhalese name is hambewa, may take refuge in the crown of the kitul *(Caryota urens)* tree. In areas where these elusive animals are found, one may see them at night on flashing a torch at the crown of the tree.

Its English name is a misnomer, for it does not fly. It climbs a tree and launches itself into the air through which it glides to the base of a nearby tree. This feat is accomplished through a parachute effect conferred by an outstretched pair of membranes that connect the fore and hind legs. It is reasonable to suggest that this unusual Sinhalese name is derived from this attribute (*ham* – skin: *bewa* = downloaded). If this origin is accepted, it may well be interpreted as "downloaded by the skin", a true description of its gliding faculties.

Heat treatment

Many a house possesses a hot water bottle, which in effect is a rubber bag that is filled with hot water before use. It is an item of equipment employed in western medicine for reducing pain in any part of the body.

Heat-treatment for pain was known to Sri Lankans for a long time, and the traditional method was to apply a heated coconut husk. It was the Sri Lankan substitute for the imported hot-water bottle. The leathery exterior of the husk was used as the surface of contact with the skin. The coconut husk was ideally suited to double up as a hot water bottle, for it would retain heat for a considerable time. Its fibrous mesh is bound together

by a lignin-containing pith that would minimize radiation of heat to the atmosphere.

Elephants and woodapple

There is a widely held belief in Sri Lanka that elephants swallow woodapples in their entirety and then pass the empty shells in their dung. Woodapples are spherical fruits often the size of a tennis balls. They have hard outer shells with a soft pulp within, which has a biter-sweet taste in the ripe fruit. The implication of the tradition is that by some internal action, perhaps mediated through their body heat, elephants extract the pulp leaving behind the empty shell intact.

If each of these shells has a small opening, the ready explanation is that this has been created by insects attacking the shell while lying on the ground after having been expelled by the elephant.

Woodapple tress (*Limonia acidissima;* S. divul; T. vila) are quite common in elephant infested Sri Lankan jungles, where they become conspicuous when in fruit. Ripe fruits fall to the ground and are an attraction to elephants. When fruits are offered to tame elephants, they crush them between their jaws before swallowing.

Somanader (1969) has offered a scientific explanation for this phenomenon. His theory draws authoritative support from G M Henry, who as entomologist to the Colombo Museum, carried out several experiments. His explanation was that the larvae of the common guava blue butterfly "lived inside the fruits of the woodapple tree. Eating the contents and emerging at night to sweep the droppings out through a small hole usually near the stalk. Eventually, of course the empty fruit falls and may accidentally land in the midst of elephant droppings, thus giving rise to the fable".

Nillu and the jungle fowl

The relationship between nillu, a plant that grows on the higher elevations in the country, and the jungle fowl, which normally frequents the low country, is a romantic one. *Strobilanthes sexennis* was so named on the assumption that it flowers every six years, but this appears to be a misnomer as it does so once every 11 years. The flower is mauve in colour, and the sight of the thick floral carpet laid over hills and dales as far as the eye could see is indeed a rare and unforgettable experience.

Many animals, such as the bambara (*Apis indica*), rats and honey-sucking birds, are attracted to the nillu during the flowering season, but it is a mystery what beckons the jungle fowl from its far off haunts. Perhaps it is the same intuition that guides wintering birds to warmer climes, flying undeterred over vast expanses of ocean.

When a profusion of nillu flowers and seeds litter the ground, the invading jungle fowl find a ready repast. After gorging themselves with food, they become stupefied and easily knocked down with a stick. It is a matter for surprise that a bird, which normally is extremely shy of man, should during the nillu season become an easy prey.

The causative ingredient in nillu does not kill the jungle fowl, but only produces temporary disability. Men who are aware of this effect during the nillu season would lie in wait to bag these birds with little effort. One possible explanation of this occurrence is that the sugary substance in the nectar of the nillu may undergo fermentation in a day or two after the flowers fall to the ground, and the resultant alcohol may be the cause of the stupor.

Branding of cattle

Branding is usually carried out with a red-hot iron and this obviously is a painful and a cruel method. In Badulla, in the middle of 19th century, a less painful but novel procedure was practiced where the juice of a plant was applied to the skin. The fresh juice of the badulla *(Semecarpus coriacea)* is very acrid, inflaming the skin and producing pustules. A recent study has shown that contact with any part of the tree produces a dermatological condition, which leaves behind a permanent scar (Perera, 1995). The villagers of Badulla apparently made use of this scientific fact, though unknowingly, in using the juice for branding their cattle, a much more humane procedure than burning the hide with a red-hot iron.

(Culled from "Traditions of Sri Lanka. A selection with a scientific background" by C.G.Uragoda; pp. 319, viii, 2000)

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Science Digest

Rohan Pethiyagoda

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Laughing off the stench

Nitrous oxide (N_2O), better known as laughing gas, is no laughing matter. Inhaled, the colourless, odourless gas produces hysteria (sometimes involving laughter), unconsciousness and death. Hydrogen sulphide (H_2S) is, if anything worse. Smelling of rotten eggs and known as marsh gas, it is extremely toxic and kills rapidly. Both gases contribute to the greenhouse effect that leads to global warming. If any two gases need to be avoided, these two are those two.

Now comes a disturbing study (*Nature*, 408: 346) led by S.W.A. Naqvi of India's National Institute of Oceanography, which shows that levels of these gases in the coastal waters of western peninsular India are ten times higher than the highest recorded elsewhere in the world. Given the geographical proximity, a very similar rainfall and river runoff pattern, and a shared climate regime, it would seem inevitable that the heavily populated west coast of Sri Lanka is similarly afflicted. The problem stems from the presence of large quantities of agricultural chemicals, primarily fertilizers, found in river waters in this region. India's Western-Ghat mountains form a long ridge extending very nearly from the southern tip northwards almost to Bombay. Dozens of rivers drain off the rain forests of the western slopes of these mountains, carrying with them large quantities of organic matter produced by the region's thriving agriculture. The net result has been that coastal surface waters have become eutrophic, starving deeper waters of oxygen. The result: a dramatic depletion of marine life.

'The summer monsoon that causes both upwelling and freshwater influx into the coastal zone,' Naqvi and his colleagues predict, 'may intensify in response to global warming.' It is clearly the time to begin monitoring the quality of water Sri Lanka's rivers discharge into the sea, introducing the controls necessary to conserve the marine ecosystems at least in our own coastal waters.

Reef alert

The sad plight of tropical coral reefs has been much in the news these days, and the news seems to be getting steadily worse. Last October's Ninth International Coral Reef Symposium in Bali, Indonesia attracted more than 1,500 marine biologists from across the world, giving them an opportunity to swap research findings (*Science*, 290: 1282–3).

From the hundreds of research papers presented, a few trends clearly emerged. One was that the larvae of coral-reef fishes do not tend to wander over vast expanses of ocean; on the contrary, they have remarkable fidelity to the place in which they are spawned. It was once thought that should coral-reef fishes become depleted, for example in Sri Lanka, larvae from the reefs of the Maldives and the Lakshwadeep Islands could help replenish the Sri Lankan reefs. Sadly, a large number of independent studies world-wide, using widely different techniques, suggest that this is not the case. Although connected by the ocean environment, each patch of reef appears to be an island, with fishes only rarely migrating between them. This puts enormous pressure on Sri Lanka, for instance, whose reefs are in a sorry state after decades of abuse from pollution an fishery, to re-examine how they should best be conserved.

A second lesson drawn from the Symposium is that warm water seems a surer coral killer than either pollution or fishing. The fact that corals in many places began regaining their colour just a few years after the last El Niño-La Niña event offered hope that things were on the up and up. Not so, it now seems. When warmed, corals expel the colourful algae known as zooxanthellae on which they depend, and reduce their rate of reproduction. Studies as far apart as Japan and Australia showed that stressed corals were producing far fewer eggs and sperm, which in turn will lead to reduced regeneration. Like most organisms, corals too cut down on reproduction when starved for food.

As Earth's oceans warm, it is likely that we will see a drastic shift in the ecology of coral reefs— one that will affect us all in unexpected ways.

Trout kill frogs

It has never ceased to amaze me that since it was converted into a national park a decade ago, the Horton Plains trout have become sacred. Voracious predators, rainbow trout are considered a pest in almost all countries to which they have been introduced and are known to have been responsible for dozens of fish-species extinctions world wide. Not so in Sri Lanka, where they are strictly protected in the headwaters of the Belihul Oya, where an endemic species of shrimp (*Caridina sinhalensis*) and two species of endemic crabs (*Perbrinckia punctata* and *P. glabra*) occur. What is more, several species of endemic frogs also occur on the plains.

Now comes news from the United States (*New York Times*, 28 November 2000) that trout have led to drastic declines in some amphibian species, bringing them to

the verge of extin ction. A federally funded study shows that the Mountain Yellow-legged Frog, form erly one of the regions most common species, has disappeared from more than 90 percent of its native range in the higher reaches of the Sierra Nevada mountains because it is being devoured by rainbow trout. The authors of the study, Ronal Knapp of the University of California at Santa Barbara and Kathleen Matthews of the US Forest Service studied frog populations in the Sierra Nevada for more than three years before making their worrying findings known. "There is no question that the decline of this frog is dramatic, and there is no question that trout is playing an important role in the decline and appear to be the primary cause," Knapp said.

It remains to be seen whether the Department of Wildlife Conservation will, even 120 years after trout were introduced, heed the mounting evidence and take meaningful steps to rid the Horton Plains of this notorious pest species.

Wonder drug

Despite the invective hurled at it by the purveyors of paracetamol, there can be little doubt that along with penicillin, aspirin was the wonder drug of the 20th century. Long known to reduce fever from potions made of willow bark, aspirin was finally synthesised in the early 1900s, making it the most universally used pain killer and antipyretic. Despite the vast strides the pharmaceuticals industry is making, drugs of such general value seldom emerge from research laboratories. Now it looks as if the 21st century may be the beneficiary of a drug which, if it delivers on the promise of initial trials, may well rival aspirin.

A group of molecules known as statins are now in the process of revolutionising preventive cardiovascular medicine. By inhibiting an enzyme essential for cholesterol synthesis, statins serve dramatically to reduce serum cholesterol levels. It has now emerged that statins also modulate the immune system, leading to new possibilities in immunosuppressant medications. This could be of immense value in facilitating organ transplants (minimising the chances of rejection) and also in the treatment of auto-immune diseases. Separate studies have shown that statins show promise in treating Alzheimer's disease and osteoporosis.

It will be some years yet before this research leads to commercially-available medicines, but there is a good chance that these recently-discovered group of drugs are on the threshold of bringing about the kind of revolution that aspirin did, a century ago. (*Science* (2000), 290; *Nature Medicine* (2000), 6; *Lancet* (2000), 356).

Tarantulas cure

Tarantulas present an irresistible fascination to creepy-crawly aficionados and directors of cheap horror movies. These spiders get their name from the town of Taranto in Italy, the place from which *Lycosa tarentua* was described. Although it used to be believed that victims of its bite would go into a wild dance before falling dead (an imaginary disease known as tarantism), the species is quite harmless to humans. This did not prevent the belief from being widely held and the *tarantella* became a popular 19th-century dance, with even Franz Liszt, the piano-virtuoso, composing music for it.

The name tarantula is now applied to members of the American spider family Theraphosidae, to which belong the saucer-sized *Aphonopelma* spiders favoured by Hollywood. Harmless to humans, these animals are commonly kept as pets by American bug-lovers. Not much use was found for them until a team of pharmacologists led by Frank Bode of Georgetown University, Washington, USA, investigated a chemical derived from the spider's venom. In extensive trials, they found that this peptide is able to stop a condition known as atrial fibrillation of the heart (*Nature*, 409: 35).

Atrial fibrillation is one of the most common cardiac arrhythmias to occur in humans, and the treatment developed by Bode and his colleagues has been successfully tested on rabbits. Therapies presently in use treat the symptoms of arrhythmia rather than its cause; Bode's team believes however, that the new drug, presently coded GsMtx-4, could be the first to be directed against the causes of the condition, rather than merely its symptoms.

The heat is on

The old adage, "The watched pot never boils" will, I hope, remain true also in the case of Planet Earth. The evidence is growing that Earth is not only warming, but that the *rate* of warming is increasing dramatically. While scientists argue whether global warming is a natural phenomenon or brought about by the massive emissions of greenhouse gases our industries produce, no one is arguing that the warming is real. Allowing for seasonal fluctuations, it now appears that the rate of warming is increasing by 0.25°C per decade, according to Tom Wigley of the US National Center for Atmospheric Research in Boulder, Colorado (*Geophysical Review Letters* 27: 4101). While the *trend* of warming had begun by the time weather monitoring stations sprang up world wide in the mid-19th century (thereby leading to the conclusion

that it is a natural phenomenon), the new study suggests that the increase in the *rate* of warming is clearly the result of human activity.

Antibiotics do resist

One of the reasons why the use of antibiotics is strictly controlled in most developing countries is because their indiscriminate and improper use leads to the bacteria they are designed to kill developing resistant strains. Many of the most common species of bacteria are now resistant to antibiotics that have been in widespread use, and scientists blame this largely on these powerful drugs not being used correctly. As many antibiotics are used in the livestock industry, these drugs also enter not just the human food chain but also that of wild animals (through, for example, garbage dumps). The result has been that more and more new, more potent antibiotics have continuously to be developed to replace the ones to which resistance has been developed. That, at any rate, is the 'establishment thinking'.

Many scientists have questioned however, whether antibiotic resistance is the result of exposure to antibiotics, or whether such resistance is in fact normal even in populations of animals that have never come into contact with antibiotics before (of course, there are no such human populations). A team led by Moira A. Gilliver of Liverpool University's Centre for Comparative Infectious Diseases collected and examined bacteria found in wild moose and white-tailed deer in southern Finland— so remote from human habitation that they were thought to have had a minimal probability of exposure to antibiotics.

They found that these bacteria had very little resistance to commonly used antibiotics, concluding that resistance in the rest of us *is* in fact the result of improper exposure to these drugs. Although antibiotics are technically 'prescription only drugs' in almost every country in the world, in many developing countries (including Sri Lanka) they are easily available 'over the counter'. This being so, the levels of antibiotic usage and the associated cost in terms of money and human health are bound to increase unless strict curbs are applied, and soon.

In the beginning...

Marine biologists have for long been puzzled by how it is that reefs get started. Marine biologist John Crisholm and film maker Russell Kelley made an interesting chance observation in a marine aquarium they maintained (*Nature*, 409: 152). They were amazed to find one morning that a small colony of the coral *Lobophyllia hemprichii* had moved across the tank over night. They moved the coral back, but night after night they would migrate once more to the same piece of rock at the other end of the tank.

The resear chers mounted an infrared video camera in front of the aquarium, and that solved the problem. A eunicid worm (a group of worms commonly asso ciated with coral-reefs) emerge at night and move the corals around in order to prepare a microhabitat for itself. The worm moves the corals weighing up to 20 g over distances as much as 16 cm overnight, and glues them into place with a special secretion.

The scientists postulate that eunicids could be an important and hitherto unrecognised group of animals that contribute to making reefs what they are. The worm in the aquarium used here was only about 5 cm long, but eunicids can reach almost 2 m in length, suggesting that they can bring about significant changes in coral-reef habitats.

Crispy fries

What with Bt corn getting a bad press in recent times, biotechnology lovers will no doubt get something of a fillip with the news that Aventis Corporation have filed a patent (WO 0069287) for genetically engineered potatoes that will give us fries that— wait for it— won't go soggy when they're microwaved. A problem with batter-fried foods being microwaved is that water in the heated food escapes into the batter, turning it soggy. Aventis' new potato however, provides a low-phosphate starch that result in batter having "unexpectedly superior crispness".

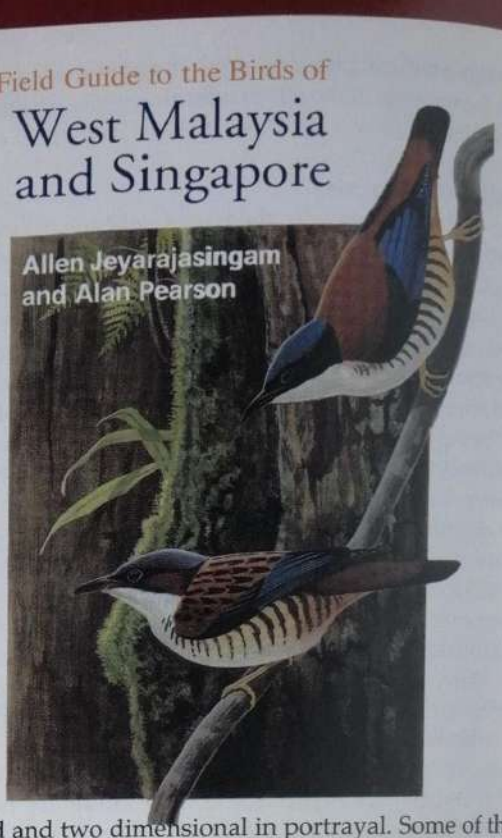
Frog tales

The *Dendrobates* poison-arrow frogs of Central America are legendary for their toxic skin secretion which, when injected, is able to kill an adult human in minutes. Asian frogs and toads are less notorious in this respect, but a recent study (*Toxicon*, vol. 38: 1267–1281) led by Manika Das of the University of Calcutta has evaluated a toxin secreted by the common Indian and Sri Lanka toad, *Bufo melanostictus*. Das found that when the toad is seized by a predator, the toxic secretion that exudes from its skin induces rapid and deep sleep in the attacker, allowing the prey to escape. Work is now in progress to analyse the toad's secre tion in order to establish whether it could lead to a medicinal product of economic value.

Book Reviews

A Field Guide to the Birds of West Malaysia and Singapore

Allen Jeyarajasingham and Alan Pearson Oxford University Press, Oxford UK. pp 460. 72 Colour Plates. ISBN 0-19-854962-8



Singapore and Malaysia are by virtue of their close proximity, two popular overseas destinations for Sri Lankan holiday makers. This book will be a part of the essential luggage for casual as well as serious birdwatchers who aim to visit the national parks and reserves in these countries.

This book fills an important gap, one I wish had been filled earlier, at the time of my previous trips to peninsular Malaysia and Singapore. Previously, visiting birders had to rely on a combination of A.G. Glenister's *Birds of the Malay Peninsula, Singapore and Penang* and *A Field Guide to the Birds of South East Asia* by Ben King, Martin Woodcock and E.C. Dickinson. Both of these had their limitations. The new book is the first modern field guide to this region with colour plates illustrating all of the species covered, 648 in all. It's arrival is no surprise given that Malaysia is a destination heavily promoted as an eco-tourist destination, which is increasingly visited by tourists who arrive for no reason other than to explore its rain forests and avifauna.

The book follows the customary regional field-guide format with maps on the inside covers, preliminary sections on bird morphology, a glossary, a description of habitats and the physical geography. Preliminary chapters also includes a treatment on conservation, the avifauna, migration, breeding and bird watching in the region. The last chapter includes a list of recommended sites. The preliminary chapters are allocated a generous 72 pages before the 72 colour plates, which are followed by the species descriptions. Six appendices and a bibliography complete the book. Two of the appendices I found to be most useful and interesting additions. One was a list of nocturnal bird calls and another a list of calls of Barbets.

The species descriptions are concise and clipped in style with approximately two birds a page. Nevertheless with 648 species to cover, the book is quite a chunky beast that will contribute to a tiring day in the field to birders laden with field equipment. I suspect a slimmed down edition with just the plates and the facing text which is focused on identification, will find ready buyers amongst the less athletic.

The text is by Allen Jeyarajasingam, a well-known Malaysian ornithologist, which clearly demonstrates his first hand experience of the birds. The plates by Alan Pearson are also quite useful although they are a touch stylized and two dimensional in portrayal. Some of the plates on the raptors looked a touch wooden. Nevertheless, they are accurate and on the whole confidently executed. The plates on Pittas, Kingfishers and Trogons will leave anyone vowing to make a field trip to the region. Plate 64 illustrating Fantails and Monarchs has the birds elegantly composed with the Paradise Flycatchers aesthetically placed on foliage. It is apparent that Alan Pearson can just as well 'paint' as well as 'illustrate' as the remit demands it.

On the whole the book lends the impression of being well thought out and put together and inspires confidence in both the text and the plates. If an incentive was ever needed for Sri Lankan birdwatchers to visit their regional neighbours, now there is one. However, be warned. Malaysia does not give up its forest birds easily. Having spent several days tramping through Taman Negara National Park and other reserves in Malaysia I have concluded seeking birds in Malaysia is harder than in Sri Lanka. Unless one is lucky to intercept a bird wave, the forests can at times be ominously silent and devoid of birds. But then again there are not too many places left in Asia where one can trek an entire day in a rain forest without seeing a soul. Although few centuries ago Sri Lanka too would have had forest cover to parallel that. To conclude, if you are birdwatching in Singapore or West Malaysia, this book is an essential piece of luggage.

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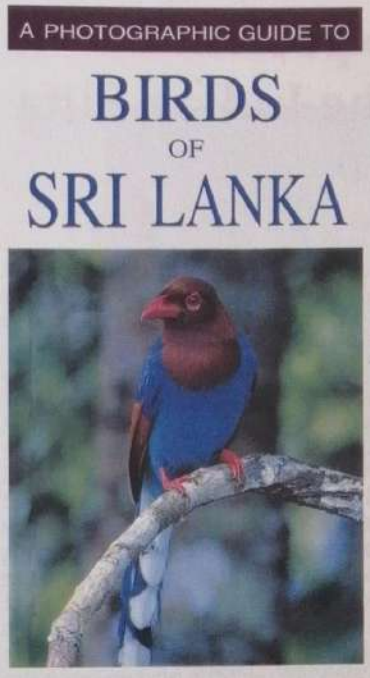
A Photographic Guide to Birds of Sri Lanka

Gehan de Silva Wijeratne, Deepal Warakagoda, and T.S.U. de Zylva New Holland Publishers, U.K. pp 144. 252 photographs. ISBN 1-85974-511-3



GEHAN DE SILVA WIJEYERATNE, DEEPAL WARAKAGODA *and* T.S.U. DE ZYLVA

This excellent book is a welcome addition to the natural history book-list from a trio of highly respected Sri Lankan naturalists. The rich diversity of Sri Lanka's birds is a national treasure and this guide will help to encourage an interest, not only among ornithologists but also in anyone fascinated by the world around us. It is a convenient size for the pocket and despite the high quality of the colour photographs, it is very modestly priced.

Because of the limited space the guide covers, in the authors' words: "the birds most likely to be seen by a visitor on a short tour, or by residents with a casual interest in birds and a few rare migrants as well". In fact they have covered 252 out of the list over 400 species and most of the ones left out are migrants or birds of the oceans which most people are unlikely to come across. Importantly, all but one of the 26 endemics, the birds that only occur in Sri Lanka, are included. The reader will have to work quite hard to find a bird in the wild that is not included.

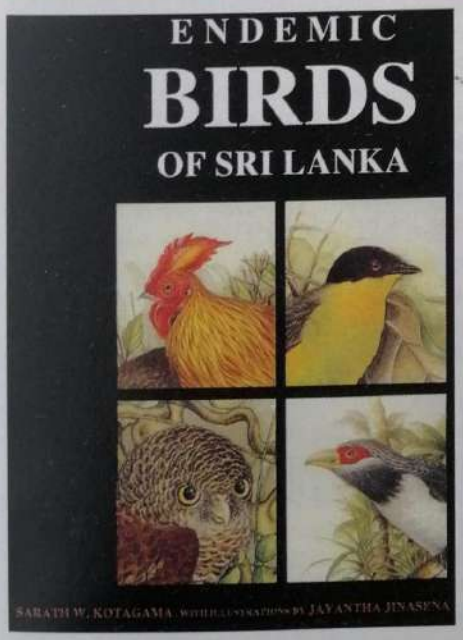
The main body of the guide has entries accompanying the photographs of the 252 species giving brief descriptions of the birds with useful hints on separating similar looking species plus a "character portrait" with notes on the habits of the birds. Differen-ces in male and female plumage are covered in the text and where the sexes are so different that the user could be fooled into think-ing that they are from different species, such as with the Koel, there are photos of both sexes to help the user. Also there are notes on distinguishing songs and calls, and habitat preference.

The guide begins with an overview of Sri Lanka's birds, lists those of particular interest and then gives the reader suggestions on how, when and where best to see them.

This is a book, which I am sure, will do much to foster an interest in Sri Lanka's birds and thus encourage the vital task of conserving them.

John Harrison

New Books



Endemic Birds of Sri Lanka

by Sarath W. Kotagama with illustrations by Jayantha Jinasena

2000 WHT Publications, Colombo. 62 pp. 26 plates. ISBN 955-9114-27-1

Images of Birds - Volume 1

by T.S.U. de Zylva

2000 Victor Hasselbald Wildlife Trust (Sri Lanka), Kurunegala. 68 pp. 33 plates ISBN 955-619-008-2

The Unexpected Visit of the Indian Pitta

Maheeka Seneviratne

Year 6, Ladies College, Colombo

It was a bright sunny day in Pokunutenna. We had just finished our lunch and were all doing something on our own. My mother and I were sewing and my younger sister was reading a book. All of a sudden someone came from the garden with his hands outstretched. It was obvious that he had something in his hand and soon we saw what it was. It was a beautiful bird that we at first did not know to identify. My father said that it was an Indian Pitta commonly known as the "Avichchiya" in Sinhalese. This beautiful bird was with his legs apart and his beak open. He was also rocking back and forth. My father guessed it was dazed and tired from its long journey from the Himalayas in India. These birds migrate during the winter season to the warmer climes. It had no outward injury so we decided to give it something to drink. Because we did not have any glucose we gave him some sugared water. We kept the little bird on our palm and slowly fed him the liquid with a spoon. As the Indian Pitta is an easily trainable bird, after the first mouthful he would open his mouth asking for more. After he finished drinking we took him to the veranda and left him on the floor. We brought him some worms too. However the bird did not touch them. I guess he did not like dead worms. After about half an hour the little bird became more alert. If anyone got up or moved he would turn his little head and look around. Once or twice he flapped his wings. All of a sudden like a little arrow he

shot out of the veranda to the mango tree outside our house. We were all delighted in having helped this migrant bird to revive himself that we clapped our hands gleefully.

The Indian Pitta is a bird that is somewhat smaller in size than the common Spotted Dove. His most striking features are his vibrant colours. These birds migrate from the Himalayan foothills in India. They fly for many miles and some strike against windows and die. The bird that fell outside our house was just simply dazed. We were all happy in being able to help this Indian Pitta. This indeed was a very rare opportunity.

YALA

Ruwanthi de Silva

Musaeus College

I so long to hear
The whisper of the trees
The songs of nature
How, it feasts my ear!

The sight of the trees
And the thorny bushes
Lining the way are tall palu trees
Where the sloth bears have a treat

The gentle giant sway
Near a water hole, so gay
The babies frolic, in their cute little way
My heart fills with joy when I see them that way

The harmless deer, so free
Feeding on grass, carefree
At the slightest sound with picked up ears
They would look around trembling with fear

The beautiful peacock with all it's splendor
Will do its dance spectacular
And tempt the peahen who's not far away
Will not resist that charm I'm sure to say

Sunset with flamingoes
What a pretty sight
Painted stalks and others
All imprinted in my mind

Agent of darkness
I hope to see
Lazing on a rock
When morn' breaks free

Waiting for nightfall
Planing intently
I see him wait guilefully
Nestling among the branches secretly

Day is done
And gone is the sun
With the moon and the stars, to rest
In the bungalow I shall nest

The crickets creek
And the animals roam, the stars smile
The owls rule the night, in grand old style
And to share this bliss, is a sheer delight

Humans and beasts
Tonight we all surrender
And sing the song of nature
While the quite winds, lull me to slumber

Society News

Millenium lecture series

The Society under the direction of the President, launched out a monthly lecture series in the millennium year, on the theme "Conservation through education and participation". The lectures were held on the first Thursday of each month. The lectures were open both to the membership, and to the general public as well.

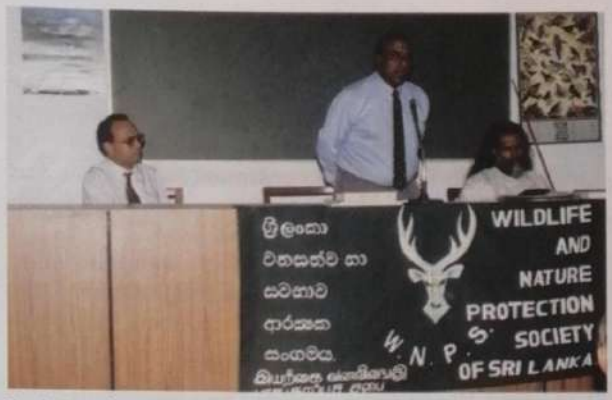
The rationale of the lecture series was the need and urgency of creating public awareness on sensitive conservation issues and to share current scientific research not only with the scientist, but with professionals of other disciplines and the public as well, as an impetus towards conservation. The lectures were well received, popular and eagerly awaited.

Year 2000 was an important year for the birdlovers of Sri Lanka. First, Important Bird Areas (IBA) programme of Sri lanka was officially launched with the participation of Birdlife International and second, Sri Lanka hosted the Pan Asian Ornithological Congress. Both these events were organized by the Field Ornithology Group of Sri Lanka. Prof. Sarath Kotagama, the President of the Field Ornithology Group of Sri Lanka and the author of the much-acclaimed *Field Guide to the Birds of Sri Lanka* delivered the lecture on "Studying Birds in Sri Lanka".

The renowned photographer, Mr. Lal Anthonis spoke on "Wildlife Photography in Sri Lanka". Mr. Anslem De Silva, President of the Amphibian and Reptile Research Organization and author of several books spoke on the "Introduction to Herpetofauna with special reference to the venomous snakes of Sri Lanka". His award winning film on the "Horton Planes" was also shown.

Dr. Devaka Weerakoon from the University of Colombo, Sri Lanka and the co-ordinator of IUCN's Threatened List of Fauna of Sri Lanka, made a thought provoking presentation on the "Endangered Fauna of Sri Lanka". Mr. Arjan Rajasuria, the national co-ordinator for Sri Lanka on the Global Coral Reef Monitoring Network Committee spoke on "Survival of Sri Lanka's coral reefs in the 21st Century".

Dr. Savitri Gunatilleke, Professor of Botany, University of Peradeniya, Sri Lanka and an authority on Sinharaja World Heritage Site spoke on "Sinharaja – its Floristic and Faunal Diversity". Dr. Nimal Gunatilleke too was present and made a valuable contribution during question time. Dr. Channa Bambaradeniya, Head of Biodiversity Unit of IUCN Sri Lanka spoke on "The growing threat of alien invasive species in Sri Lanka". Dr. Ranjith Mahindapala, Director Programmes of the IUCN Sri Lanka spoke on the "Medicinal Plants Conservation in Sri Lanka, and their sustainable use".



Prof. Sarath Kotagama who spoke on "Studying Birds in Sri Lanka" is being introduced by Mr. Ravi Deraniyagala (President, WNPS). Also in the picture is Mr. Upali Elapatha (Courtesy Associated Newspapers).

Society Bungalows

The Society's bungalows have been very popular among the membership and their guests. Built in strategic and picturesque locations, they continue to contribute much towards the study of Sri Lanka's fauna and flora and also provide a time of peace and tranquility, away from the hustle and bustle of city life.

The bungalows at Palatupana (Yala) built in 1968 and Uda Walawe built in 1989 are both being given a face lift. At the Palatupana Bungalow, a new solar power system has been installed for transmission of water and bungalow lighting. Work for the rehabilitation of the bathrooms/toilets, kitchen area and installation of sisalation in the central hall area has been completed. The refurbishing of the Uda Walawe Building has commenced.

The Society is exploring the possibilities of

The Uda Walawe bungalow.

establishing two campsites with basic facilities at Bundala and Wasgamuwa.

School Nature Clubs

The society's conservation message to the youth of the country, the leaders of tomorrow is focused through the 373 School Nature Clubs (SNC) spreaded throughout the island, catering to over 25,000 students.

The SNC programme continues to educate and generate much interest among the younger generation and involve them in conservation related activities. Through them, the society establishes a communication link to their parents and to the local communities.

World Conservation Congress 2000

The second World Conservation Congress was held in Amman, Jordan in October 2000, on the invitation of King Abdullah II, the Ruling Monarch of the Kingdom of Jordan. Some 2000 participants from 143 countries met, to discuss key environmental issues and urgent conservation challenges facing the world. Eight hundred representatives of IUCN's 950 institutional members were present.

Her Majesty Queen Noor opened the Congress in the beautiful setting of Amman's historic Roman Theatre, dating from 151 A.D., built to seat 6000. Her compelling speech on the importance of regional environmental co-operation, a major theme of the Congress was particularly well received. As part of its diverse agenda, the Congress considered trans boundry approaches for managing ecologically connected landscapes, such as river basins and regional seas, as a cornerstone for conserving shared resources.

The delegates including Ministers for the Environment and other Government Officials, as well as Heads of NGO's, reflected the unique partnership between government and civil society that characterizes the World Conservation Union. Participants also included many representatives from the IUCN's six commissions, a vast network of 10,000 scientists, educational and legal volunteer experts, drawn from all continents. Together they continue to influence, encourage and assist societies throughout the world, to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable.

Her Majesty Queen Noor of Jordan, is seen greeting Mr. Ravi Deraniyagala, the Society's President at the World Congress, Amman, Jordan (Courtesy IUCN Jordan)

President of IUCN Ms. Yolanda Kakabadse bids farewell to Mr. Ravi Deraniyagala (President WNPS) at the close of the second World Congress, Amman, Jordan (Courtesy IUCN Jordan)

Contributions to *Loris*

Memebers of the WNPS as well as any person of the general public can contribute to the *Loris*, on matters pertaining to biodiversity, natural history or nature conservation in Sri Lanka. Articles, photographs, poems or any other form of creative work can be published in the journal. The format that should be followed in providing articles to the *Loris* is given in *Loris* (22 :1).The editorial committee makes the final decision regarding the articles that are accepted for publication in the journal. The articles should be addressed to,

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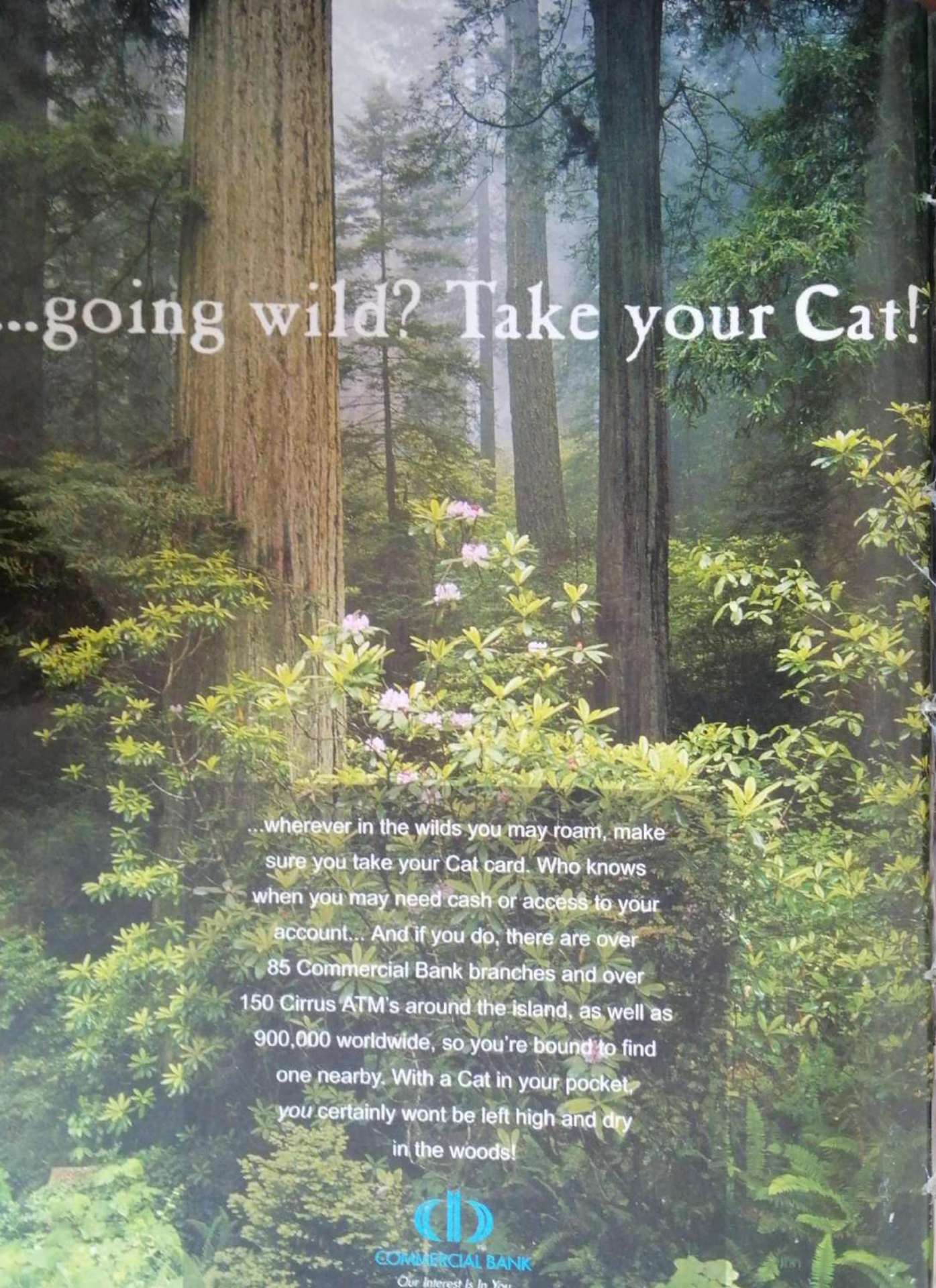
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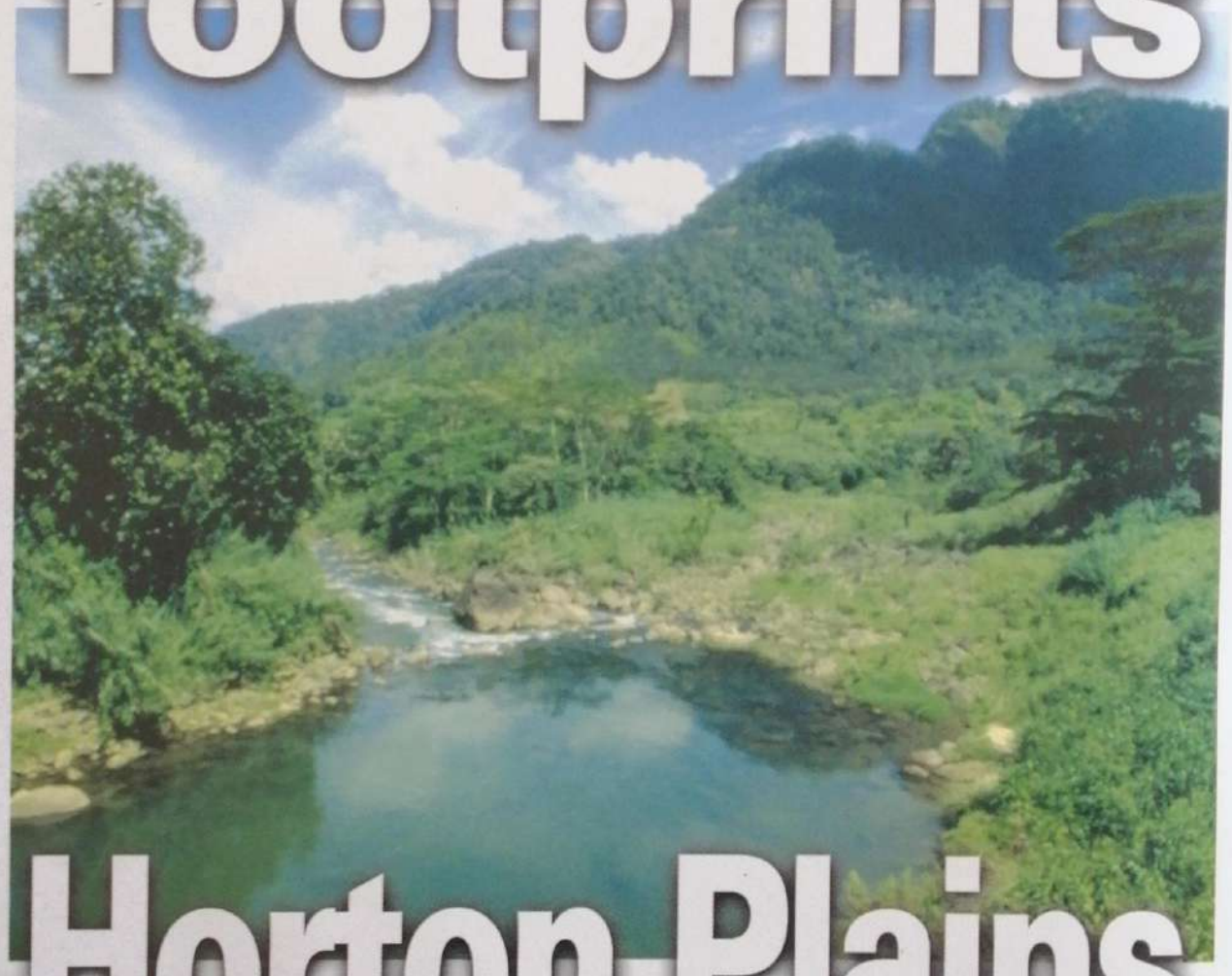

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Editorial

The Need to Inventorize Sri Lanka's Biodiversity

Even though Sri Lanka is a small island, its Biodiversity is significantly important both in a regional and global scale. Sri Lanka has the highest species density (number of species present per 10,000 sq. km) of flowering plants, amphibians, reptiles, and mammals in the Asian region. Furthermore, the wetzone of Sri Lanka along with Western Ghats of India is declared as one of the 25 "biodiversity hotspots" of the world.

However, all these assessments are based on a small set of data, as only a fraction of Sri Lanka's biodiversity is known to science today. For instance, higher plants and vertebrates are the only groups that have been studied in sufficient detail to date. Lower plants and invertebrates are largely neglected except for few selected groups such as butterflies, dragonflies, land snails, and algae. Even the vertebrates and for that matter higher plants are not completely listed as during the last two decades alone a large number of new species have been described. This includes 13 species of fish, 6 species of amphibians, and 6 species of reptiles. Even among the birds, which have been studied quite exhaustively, a new species of owl, requiring description has been reported recently (see page 45). What is most astonishing is the claim made by Wild Life Heritage Trust that there may be in excess of 200 new species of frogs in Sri Lanka yet to be described.

So far most of the information available for fauna and flora of Sri Lanka is on vertebrates and higher plants. However, these two groups make up only about 18% of all the species described to date while arthropods alone make up about 61%. There is no doubt that a large number of arthropods are awaiting to be discovered in Sri Lanka. It will be rather unfortunate if some of these organisms would perish even before we discover them. Furthermore, very little attention has been given to species that inhabit special habitats such as water falls and forest canopy. Studies done in Australia and South America has shown that the forest canopy is home to a large number of living organisms that will not be detected by traditional sampling techniques used. For this purpose a number of special techniques have been developed and using these techniques scientists have uncovered a wealth of information about the life that exist in the forest canopy. At the present level of deforestation and drying up of water falls, a number of species that are restricted to such habitats are likely to become extinct even without our knowledge.

Therefore, one of the biggest drawbacks encountered today, in conserving the biodiversity of Sri Lanka, is the lack of knowledge about what we actually have. Even the present knowledge base on the taxonomy and distribution of Sri Lanka's biodiversity is fairly outdated as this is based primarily on information collected several decades ago. Very few large-scale taxonomic studies have been conducted in recent times. This sad state of affairs has arisen due to lack of trained taxonomists as well as lack of initiative to explore the biodiversity of the country. The National Museum, the state agency that was primarily responsible for carrying out faunal inventorying in the past has become largely ineffective. The Zoological Survey that has been established under the National Science Foundation to carry out inventorying of fauna has also failed to live up to the expectations. The National Conservation Review (NCR) implemented in 1990 by the Forest Department with technical assistance from the IUCN was the only attempt at recent times to carry out a large scale inventory of Sri Lanka's biodiversity. However, the information gathered during the NCR too is biased towards vertebrates and higher plants. Furthermore, the methods employed in the survey are non-duplicable.

As a party to the Convention on Biological Diversity, Sri Lanka is expected to compile an inventory of its biodiversity. However, no positive steps have been taken so far towards achieving this goal. Nor has any attempt being made to carry out a taxonomic needs assessment for the country. Furthermore, even today training taxonomists is not considered as a priority area when awarding scholarships by government agencies. Also, the present restrictions imposed on collection of live material for scientific investigation discourage any new taxonomic studies.

On the whole the government organizations responsible for inventorying the biodiversity have done very little towards achieving this goal. On the contrary a few local and foreign academics as well as Non Governmental Organizations such as the Wildlife Heritage Trust have been in the forefront of such exploration in recent times. Their work led to the discovery of number of new species of plants and animals over the past decade. However, the task of inventorying Sri Lanka's biodiversity cannot be achieved by a handful of individuals. A bigger commitment from the government of Sri Lanka is needed if we are to successfully achieve this feat.

Therefore, steps should be taken to address these deficiencies by relevant government agencies, as inventorizing the country's biodiversity is a national need that has to be addressed sooner than later, for it is difficult to carryout conservation planning without exactly knowing what we are attempting to conserve.

A Colour Guide to Some Green Seaweed Genera in Sri Lanka

Malik Fernando

32 Barnes Place, Colombo 7

There is no reference material readily available -either in the form of scientific literature or as 'popular publications' simple enough for the non-specialist - to identify the seaweeds found in Sri Lanka's marine habitats. This colour guide has been prepared to enable identification of 17 genera of green seaweeds that occur in Sri Lanka together with brief information about their habitats.

The genera listed in the box is taken from the catalogue of Silva, Basson & Moe: plants that have been reported by various workers at various times as having been found in Sri Lanka. One exception is *Ventricaria: V. ventricosa* (formerly *Valonia ventricosa*) has not been previously reported from Sri Lanka but has been collected by the author off Pigeon Islands in Nilaveli.

All the plants described have been collected and photographed by the author except where stated otherwise. The descriptions of the genera are based on the material examined. These descriptions and photographs should enable the non-specialist to identify material in hand. In some cases, a microscope or good hand lens will prove useful to establish the genus with confidence.

Photographs of individual plants were usually taken in an aquarium by natural light. Photomicrographs were made as part of the joint St. Thomas' College and Sri Lanka Sub-Aqua Clubs' marine bio-diversity (MBIOD) project at Mount Lavinia ('95-'97) funded by the GEF Small Grants Programme. The genera are listed alphabetically.

Description of genera

***Avrainvillea*:** Dark green fan-shaped or elongated fronds made up of felted filaments with Y-shaped dichotomies (forks). Growing in sand anchored by a long, cylindrical buried holdfast ("root") consisting of compacted filaments enmeshing grains of sand or with a cylindrical basal portion adherent to rock or dead coral, depending on the species. Subtidal and intertidal pools. Three species in Sri Lanka. (Figures 1 & 2)

***Boergesenia*:** Light green, clavate (club-shaped) vesicles 30-40 mm high growing in clusters with their narrowed bases crowded, attached to the rock by rhizoids. Intertidal reef flats sheltered from waves, exposed at low tide, or shallow pools. One species in Sri Lanka. (Figure 3)

Green seaweed genera reported from Sri Lanka

ULVALES	
Monostromataceae	*Blidingia* Kylin
Ulvaceae	*Enteromorpha* Link*
	Ulva Linnaeus*
CLADOPHORALES	
Anadyomenaceae	*Anadyomene* Lamouroux
	Microdictyon Decaisne*
Cladophoraceae	*Chaetomorpha* Kützing*
	Cladophora Kützing*
	Rhizoclonium Kützing
Siphonocladaceae	*Boergesenia* J. Feldman*
	Boodlea G. Murray & De Toni*
	Cladophoropsis Børgesen*
	Dictyosphaeria Decaisne ex Endlicher*
	Struvea Sonder
	Ventricaria Olsen & J. West**
Valoniaceae	*Ernodesmis* Børgesen
	Valonia C. Agardh*
	Valoniopsis Børgesen*
BRYOPSIDALES	
Bryopsidaceae	*Bryopsis* Lamouroux*
Caulerpaceae	*Caulerpa* Lamouroux*
Codiaceae	*Codium* Stackhouse*
Halimedaceae	*Halimeda* Lamouroux*
Ostreobiaceae	*Ostreobium* Bornet & Flahault
Udoteaceae	*Avrainvillea* Decaisne*
	Chlorodesmis Harvey & Bailey*
	Rhipidosiphon Montagne
	Udotea Lamouroux
DASYCLADALES	
Dasycladaceae	*Neomeris* Lamouroux
Polyphysaceae	*Acetabularia* Lamouroux

* Genera described in this article

** Genus (and species) not previously reported from Sri Lanka

After Silva, Basson & Moe (1996)

Figure 1. *Avrainvillea erecta* (40-60mm) grows on sand bottoms with a buried holdfast. Wellawatte, 3 m.

Boodlea: Bright green, spongy clumps attached to rocks, dead coral or other seaweed (e.g. *Halimeda opuntia*). The clumps consist of filaments (600-80μ) branching in all directions, the ultimate branchlets anastomosing with neighbouring branches by means of haptera (short cells with lobed processes.) The microscopic structure is very similar to that of *Microdictyon*, differing in the sponge-like nature of the thallus as a result of branches given off in many planes. Two species in Sri Lanka. (Figure 4)

Bryopsis: Green, erect filaments (400-700μ) with the ultimate lateral branches usually in two opposite series giving a feather-like appearance. Unseptate, multinucleate plant body (coenocytic), the lateral branches with characteristic constricted bases. Six species in Sri Lanka, varying in size from 20 to 300 mm high. The species differ in arrangement of branches and ultimate laterals. Intertidal rocky shores and subtidal. (Figures 5, 6 & 7)

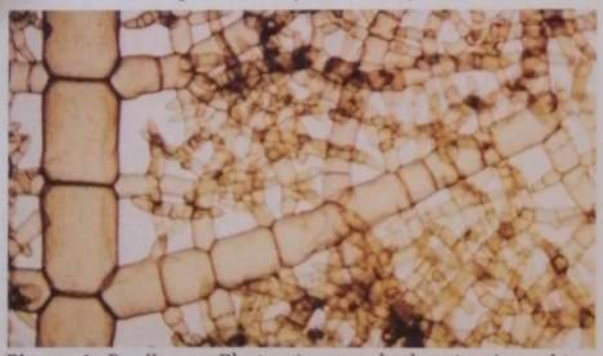

Figure 4. *Boodlea sp.* Photomicrograph showing branching filaments. Pigeon Islands, Nilaveli, 3-4 m.

Figure 6. *Bryopsis sp2.* Bar Reef, Kalpitiya, 3 m

Figure 2. *Avrainvillea lacerata* (100mm) grows attached to hard substrates. Pigeon Islands, Nilaveli, 4 m.

Figure 3. *Boergesenia forbesii.* Barberyn Reef, Beruwela. Intertidal.

Figure 5. *Bryopsis sp1.* Kandakuliya, 22 m.

Figure 7. *Bryopsis ?corticulans.* Photomicrograph showing lateral branches with constricted bases.

Figure 8. *Caulerpa sertularioides*. Mount Lavinia, rocky shore, 0.1m. (Photo. Srilal Perera, MBIOD Project)

Figure 9. *Caulerpa racemosa*. Barberyn Reef, Beruwela. Intertidal.

Figure 10. *Caulerpa nummularia*. Mount Lavinia, intertidal rocky shore.

Figure 11. *Caulerpa serrulata*. Pigeon Islands, Nilaveli, 3-5 m.

***Caulerpa*:** Dark or bright green unseptate, multinucleate plant body consisting of a creeping axis giving off rhizoids from the under surface and erect axes from the upper surface. The erect axes are of varying height with lateral branches that take numerous forms. These lateral branches are usually in two opposite series, sometimes arranged all round the axis and varying in shape from cylindrical, club-shaped, top-shaped, trumpet-shaped, stalked globules, ovoids or discs to flattened, ribbon-like expanses. Thirty five species in Sri Lanka, including many varieties and forms. The synonymy is long and frequently changing. (Figures 8, 9, 10 & 11)

***Chaetomorpha*:** Bright green, cylindrical cells joined end to end to form unbranched filaments (75-500μ). Either attached to hard substrates by rhizoids from a basal cell that is narrowed below and many times the length of subsequent cells or long, unattached filaments entangled with other algae, the cells sub-equal. High intertidal rocky shores, reef flats and tide pools to subtidal. Nine or ten species in Sri Lanka. (Figures 12 & 13)

Chlorodesmis: Hair-like (100-220μ) unseptate, erect filaments forking repeatedly, attached below by rhizoids to rock, crowded to form a dark green, flat-topped cushion. Bases of forks constricted. The filaments 2 cm

Figure 12. *Chaetomorpha antennina*. Wellawatte, intertidal shore structure.

Figure 13. *Chaetomorpha crassa* entangled with *Gelidiella acerosa* (a red alga). Barberyn Reef, Beruwela. Intertidal.

Figure 14. *Chlorodesmis caespitosa*. Portion of a cushion from Wellawatte, Kinross first reef, 2 m.

Figure 16. Unattached *Cladophora* sp. in salt marsh pool, Kalpitiya peninsula.

Figure 17. Photomicrograph: Detail of terminal branches of *Cladophora vagabunda*. Rocky shore pool, Mount Lavinia.

Figure 15. Attached *Cladophora* sp. in tide pool, Barberyn Reef, Beruwela.

Figure 18. *Cladophoropsis ?sundanensis* cushions on Barberyn Reef, Beruwela. Intertidal.

high, their lower parts buried in fine sand, the upper parts free and entangled. Subtidal. Identified as *Chlorodesmis caespitosa* on the symmetrical constrictions of the dichotomies and the presence of needle-like crystals within the filaments. (Eric Coppejans, pers. comm.)

One species - *Chlorodesmis caespitosa* - reported from Sri Lanka by J. Agardh in 1887, the type locality being Colombo. There are no specimens in the National Herbarium in Peradeniya and no citations of other records from Sri Lanka in the Indian Ocean Catalogue. S. Balasubramaniam lists *Ch. hildebrandtii* (identified tentatively) from Mandativu in his privately circulated (undated) check-list of the marine algae of Jaffna. The present collection from Wellawatte on March 10, 2002 is probably the first time it has been re-collected in the type

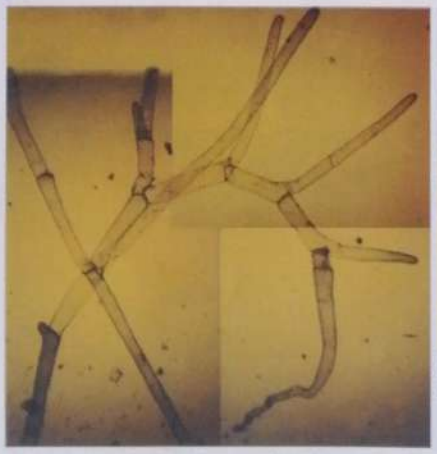

Figure 19. Photomicrograph: Detail of filaments of *Cladophoropsis* showing characteristic branching pattern.

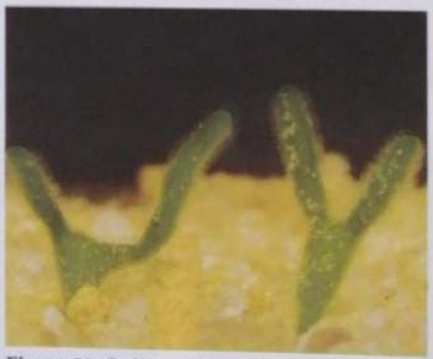

Figure 20. *Codium* cf. *decorticatum*. Panadura, 18.5 m.

Figure 21. *Codium* cf. *decorticatum*. Photomicrograph: One of the smaller utricles in side view (utricles 160-250μ wide).

locality since it's discovery 115 years ago (Figure 14).

Cladophora: Dark green branched filaments consisting of cylindrical cells joined end to end, attached to hard substrates or unattached. Branching in various patterns according to the species; branches progressively narrower (500-40μ). Tide pools, salt marsh pools, subtidal. Eight or nine species in Sri Lanka. (Figures 15, 16 & 17)

Cladophoropsis: Hair-like (90-150μ), branched, septate filaments tightly interwoven to form small, dark green cushions and mats on intertidal rocks sheltered from waves. The cushions soft to touch but keep their shape out of water. Septa are not developed at the bases of branches, resulting in a distinctive appearance. One species reported from Sri Lanka (*Ch. membranacea*). However, my plants from Beruwela agree more with the characteristics of *Ch. sundanensis*. (Figures 18 & 19)

Codium: Dark green plant bodies with a core of fine filaments (20-35μ) branching to form an outer layer of swollen utricles (vesicles) that give a felt-like texture and appearance. Cylindrical, branched, erect or anastomosing creeping fronds; one species forms an irregular, lobed mass attached to intertidal hard substrates. The branching forms subtidal or intertidal. Six or seven species in Sri Lanka (Figure 20 & 21).

Figure 22. Tide pool wall, Barberyn Reef, Beruwela. *Dictyosphaeria cavernosa* (light green nodules); *Valonia* sp. (dark green globules).

Figure 24. *Enteromorpha compressa*. Wellawatte, high intertidal.

Dictyosphaeria: Small (10-35 mm), light green, shiny nodules attached to the walls of tide pools, exposed at low tide, sheltered from waves. Attached by rhizoidal processes from the under surface. The nodules consist of clusters of closely adherent rounded cells; the innermost cells usually die leaving a hollow sac with a one-cell thick wall. One species in Sri Lanka. (Figures 22 & 23)

Enteromorpha: Light or dark green tufted, tubular, branching fronds one-cell thick. Attached to exposed intertidal or subtidal hard substrates by an expanded disc. Branching differs in the various species. Plant bodies limp and droop when exposed at low tide, but erect in subtidal habitats. Five species in Sri Lanka. (Figures 24 & 25)

Halimeda: Light or dark green branching tufts consisting of chains of flattened, calcified joints of various shapes: discoid, kidney-shaped, fan-shaped or irregular. Subtidal hard or soft substrates. When growing on soft substrates (sand or muddy sand) they may be anchored by a buried bulbous mass of rhizoids, buried parts of older branches, or the basal joint may be attached by rhizoids to a buried pebble or dead shell, depending on the species. Five species in Sri Lanka. (Figures 26 & 27)

Figure 23. *Dictyosphaeria cavernosa*. Close-up of a nodule from above.

Figure 25. *Enteromorpha compressa*: Photomicrograph montage: details of a single plant.

Figure 26. *Halimeda opuntia.* Barberyn Reef, Beruwela, 0-2 m.

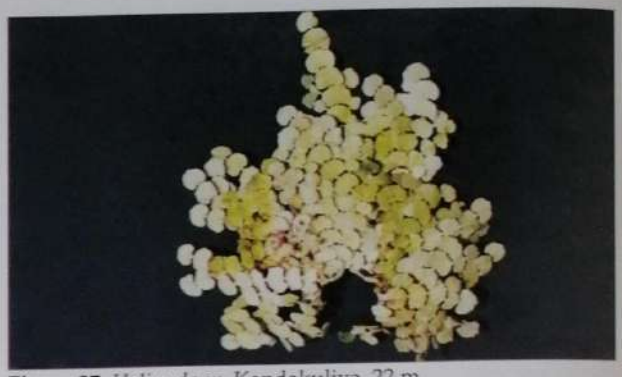

Figure 27. *Halimeda sp.* Kandakuliya, 22 m.

Figure 28. *Microdictyon ?tenuis.* Photomicrograph: detail of filaments. Pitagala (off Wellawatte), 25 m.

Figure 29. *Ulva fasciata.* Mount Lavinia. Intertidal rocky shore.

Figure 30. *Ulva rigida.* Barberyn Reef, Beruwela, 1 m.

Microdictyon: Delicate, light green, reticulate (net-like) fronds, somewhat lobed and irregular in shape. Young fronds are fan-shaped arising from a club-shaped basal cell attached to hard substrates by rhizoids. The blade consists of a network of branching, anastomosing filaments (180-50 μ wide) expanding in one plane to form a cluster of fronds. Anastomosis without short cells with lobed processes. (similar to *Boodlea* but branches in more than one plane forming a spongy mass and anastomosis achieved by means of short cells with lobed processes [haptera].) One species in Sri Lanka. (Figure 28)

Ulva: Shiny, light or dark green, two cell thick fronds attached to hard substrates by an expanded disc. The fronds ribbon-like or wide and rolled up; entire or perforated by holes of various sizes, sometimes so large that the frond is net-like. Single, or tufts of numerous fronds depending on the species and age. Intertidal or subtidal on hard substrates. May also be found on soft substrates in shallow water attached to pebbles and dead shells. Five species in Sri Lanka. (Figures 29 & 30)

Valonia: Dark green vesicles forming firm masses of various shapes. The vesicles spherical or elongate, of various sizes. Each produces daughter vesicles on their sides or summits, forming macroscopic plant bodies of various shapes according to the species. Intertidal or subtidal. Two or three species in Sri Lanka. (Figures 31a & 31b)

Valoniopsis: Firm, dark green cushions on intertidal rocks exposed to waves. The cushions made up of crisp filaments about 1 mm thick, the sparse branches interlacing to hold the structure together. The cushions are loosely attached to the substrate by rhizoids and are often broken free and cast ashore. One species in Sri Lanka. (Figures 32, 33a & 33b)

Ventricaria: Large (30-70 mm), solitary, light green vesicles growing between branches of broken, dead staghorn coral (*Acropora*). Usually only the rounded upper pole is visible, the shape being spherical, ovoid, or more or less cylindrical depending on how deep within the rubble mass it originates. One species in Sri Lanka (Figure 34). This species has not been reported previously. It is found only off Pigeon Islands, Nilaveli.

Figure 31a. *Valonia fastigiata* (side view of vesicles). Unawatunne.

Figure 31b. *Valonia fastigiata* (viewed from above). Unawatunne.

Figure 32. *Valoniopsis pachynema*. Barberyn Reef, Beruwela. Intertidal.

Figure 33a. *Valoniopsis pachynema*: upper surface of cushion.

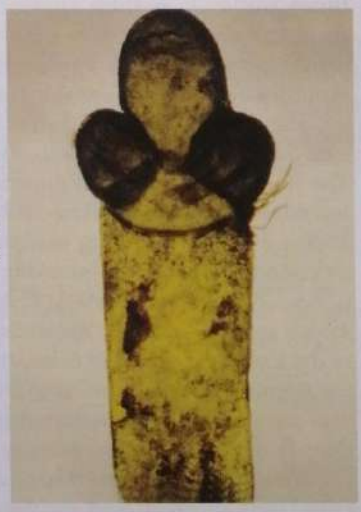

Figure 33b. *Valoniopsis pachynema*: enlarged apex of filament.

Figure 34. *Ventricaria ventricosa*. Pigeon Islands, Nilaveli, 1-2 m.

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Amphibians of Bellanwila-Attidiya Sanctuary

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Introduction

Starting from the early 80's a number of field surveys and research projects have been conducted in the Bellanwila-Attidiya marsh area (Gunatilake, 1992: Gunawardene, 1994; Nalinda, 1988; Nanayakkara, 1988; Nanayakkara, 1992). In 1993, the Central Environmental Authority, under the Wetland Management Program, compiled a checklist of fauna and flora based on their work as well as previously published works on Bellanwila-Attidiya area (CEA/ Euroconsult, 1993). However, in all these studies the amphibian fauna of Bellanwila-Attidiya marsh has been largely neglected. Therefore, the aim of this paper is to review the amphibian diversity of the Bellanwila-Attidiya sanctuary.

Wetland habitats are highly productive and diverse communities that lie between terrestrial and aquatic environments. The most obvious and unique feature of these wetlands is their characteristic vegetation that produces diverse habitats within the ecosystem. These ecosystems support a variety of animal life of which amphibians make up a major component.

The study area lies within 6º 50' - 6º 51' N and 79º 51' - 79º 54' E in the southeastern outskirts of Colombo city. The mean temperature is approximately 27º C and the recorded average annual rainfall for this area is between 2500 - 5000 mm arising mainly from the two major monsoons. The average humidity of the area is about 80% (CEA/ Euroconsult, 1993). The Bellanwila – Attidiya marsh is one of the few remaining freshwater wetlands in the Colombo area and is located in the flood plains of the upper Bolgoda Canal area (Nalinda, 1988). The area was partly cultivated with paddy until about 1979-1980 (Nanayakkara, 1992). The marshy area consists of shallow freshwater ponds, marsh and seasonally flooded grasslands and scattered shrubs and small trees.

Methodology

The study commenced in April 1995 and continued over a period of three years. Weekly excursions were made to various parts of the study area. Observations were done along the small canal, marshy areas, and home gardens. The species were identified using calls and visuals observations. Whenever possible specimens were collected and identified alive using a hand lens (x10) and released to the same locality. Species identification and nomenclature were based on diagnostic characters and descriptions given by Bossuyt and Dubois (2001); De Silva, (1996); Dutta & Manamendra-Arachchi (1996); Kirthisinghe (1957); Manamendra-Arachchi & Pethiyagoda (1998), and Manamendra-Arachchi (2000). Abbreviations used in the text are E: common English name, S: common Sinhala name.

Results

A total of 15 species were recorded during the study period including four endemic species namely, *Bufo atukoralei, Rana gracilis, Philautus leucorhinus* and *Polypedates cruciger*. These 15 species fall in to three families namely, Bufonidae (toads), Microhylidae (narrow mouth frogs), and Ranidae (frogs).

Among the species recorded in this area *B. melanostictus* is the most common species, especially in the immediate vicinity of human dwellings. *B. atukoralei, R. variegata,* and *S. rolandae* are the rarest species within the area. *B. atukoralei,* originally recorded from southern parts of Sri Lanka was also recorded in this area. *R. aurantiaca* known as a rain forest species was found in abundance among the *Anona glabra* (Wel Atta) vegetation. This sighting is one of the very few records of its coastal distribution. A brief description of the species found in the area is given below.

Family: Bufonidae

Bufo atukoralei Bogert & Senanayake, 1966
Attukorale's dwarf toad (E); Attukorlalage kuru gemba (S); Figure 1
Rare, nocturnal, recorded in home gardens. Only two specimens were found during the study period. The species is endemic to Sri Lanka.

Bufo melanostictus Schneider, 1799
Common house toad (E); Geyi gemba (S); Figure 2
The commonest toad in the area, nocturnal, becomes active soon after sunset. It spends the daytime hiding in holes, under stones and pots of plants. Found in cleared or disturbed habitats in home gardens, land fills and roadsides in the area.

Family: Microhylidae

Kaloula taprobanica Parker, 1934
Common bull frog (E); Visituru ratu madiya (S); Figure 3
Nocturnal and fossorial in habit and recorded in human

settlements, home gardens, marsh and water holes. In rainy days males croak while floating on the surface of the shallow water. Usually found on rainy days. Call: a loud groaning honk.

Ramanella variegata (Stoliczka, 1872)
White-bellied pugsnout frog (E); Bada-sudu motahombu madiya (S); Figure 4
Nocturnal and fossorial in habit. One specimen was found inside the bathroom of a house located in the eastern side of the study area during the rainy season. The call can be heard from rain water pools in the land fill areas.

Family: Ranidae
Subfamily: Raninae
Euphlyctis cyanophlyctis (Schneider, 1799)
Skipper frog (E); Utpatana madiya (S); Figure 5
Entirely aquatic in habit and is active during daytime as well as nighttime. Recorded in small water ponds in land fill areas and wells around paddy fields. It has the peculiar habit of skipping over the surface of water when alarmed. After a series of leaps on the surface of the water it frequently dives obliquely towards the bottom, where it burrows into the mud.

Euphlyctis hexadactylus (Lesson, 1834)
Six-toed green frog (E); Sayangili pala madiya (S); Figure 6
One of the largest species that can be seen within the area (snout to vent length varies between 10-15 cm). Exclusively aquatic in habit and is active during daytime as well as in the night. Inhabits water bodies found throughout the area. The adult usually sits among weeds in the water. When disturbed, it dives through weeds. This species was common during the study period but at present it has become rare in the area.

Limnonectes limnocharis (Boie, 1835)
Common paddy field frog (E); Vel madiya (S); Figure 7
This is the commonest species in the study area. During the daytime it hides in damp places, and comes out at night. During the rainy season this frog can be seen in the early morning hours and all through the nights in canal banks, marshes, paddy fields and terrestrial habitats. When disturbed they leap in to the water but rapidly swim ashore again. Emits a raspy chirp that is repeated rapidly. Two colour varieties were observed of which one had a distinct mid dorsal yellow line.

Hoplobatrachus crassus (Jerdon, 1853)
Jerdon's bull frog (E); Jerdonge hala madiya (S); Figures 8a & 8b
Exclusively aquatic, mostly active at night when they come out of water and are usually found singly on the banks of canals and paddy fields. In the dry season they bury themselves several feet below the surface and reappear with the onset of the rainy season. The male frog emits a loud croak and calls incessantly producing a deafening noise.

Rana aurantiaca Boulenger, 1904
Small wood frog (E); Kuda beddi madiya (S); Figure 9
This species wanders freely through *Annona glabra* (Vel Atta) vegetation and woody habitats and may even occur in well-wooded home gardens. Males form large calling groups at frequent intervals along the *Annona* vegetation, and emit a *cheek chik chik* sound.

Rana gracilis Gravenhorst, 1829
Sri Lanka wood frog (E); Lanka beddi madiya (S); Figure 10
This species generally frequents woody areas, but occasionally seen on canal banks. It is terrestrial or partly arboreal in habit and occasionally seen adhering to the bark of trees or on the leaves of shrubs and bushes. Emits a call that goes as *oeak orck orke*, and when it is handled the call of this frog is not unlike the mew of a kitten, plus a sort of high pitched *tuk tuk* repeated several times. The species is endemic to Sri Lanka.

Sphaerotheca rolandae (Dubois, 1983)
Marbled sand frog (E); Lapavan veli madiya (S); Figure 11
Nocturnal and terrestrial in habit and was recorded only from home gardens. During the daytime it usually burrows in sandy soil. The specimen was found in a sand pit at a construction site. Rare species.

Subfamily: Rhacophorinae
Philautus leucorhinus (Lichtenstein & Martens, 1856)
Striped pygmy tree frog (E); Iri atikitta (S); Figure 12
One of the smallest tree frogs recorded within the area and found exclusively in disturbed areas or open shrubby areas (especially in home gardens). The frog was collected at night generally by following the call of the male frog (*treek treek*). The species is endemic to Sri Lanka.

Philautus variabilis (Günther, 1858)
Variable pygmy tree frog (E); Vichalya atikitta (S); Figure 13
One of the smallest species recorded from the arboreal habitats in the marsh. The peculiar call (*treek tick treek tick tick*) is often heard in grasses, shrub lands and home gardens, yet difficult to sight or capture.

Polypedates cruciger Blyth, 1852
Common hourglass tree frog (E); Sulaba pahimbu gas madiya (S); Figure 14
The largest tree frog species recorded from Sri Lanka. Active at the night and hides during daytime in wet

Figure 1. *Bufo atukoralei* Bogert & Senanayake, 1966
(Photo: Inoka Perera)

Figure 2. *Bufo melanostictus* Schneider, 1799
(Photo S. Goonatilake)

Figure 3. *Kaloula taprobanica* Parker, 1934
(Photo: A. L. Peiris)

Figure 4. *Ramanella variegata* (Stoliczka, 1872),
(Photo: S. Goonatilake)

Figure 5. *Euphlyctis cyanophlyctis* (Schneider, 1799)
(Photo: Inoka Perera)

Figure 6. *Euphlyctis hexadactylus* (Lesson, 1834),
(Photo: Inoka Perera)

Figure 7. *Limnonectes limnocharis* (Boie, 1835)
(Photo: A. L. Peiris)

Figure 8a. *Hoplobatrachus crassus* (Jerdon, 1853),
(Photo: Ranil Perera)

shady places within home gardens (some were even found within the bathrooms of houses in the locality). Males form calling groups around standing water bodies and in woody areas, especially in home gardens. Females make foam nests overhanging such pools. The species is endemic to Sri Lanka.

Polypedates maculatus (Gray, 1834)
Common tree frog (E); Hunu gomara gas madiya (S); Figure 15
Nocturnal in habit and frequently found adhering to vertical surfaces such as walls and glass panes of windows. Females make large foam nests before mating above the water level. Males emit a *tuk tuk* call that can be heard within the temporary ponds covered with grasses in the reclamation lands often after heavy rain. Rare species when compared to *P. cruciger*.

Discussion

A total of 15 species of amphibians belonging to the families, Bufonidae, Microhylidae, and Ranidae were recorded during the study period. This assemblage included four species that are endemic to Sri Lanka and four nationally threatened species, namely *Bufo atukoralei*, *Rana aurentiaca*, *R. gracilis*, and *Polypedates cruciger* (IUCN Sri Lanka, 2000b).

Although, *Microhyla rubra* and *Limnonectes corrugatus* were recorded from the Colombo area by Kirthisinghe in 1957, (the exact location is unknown) and IUCN Sri Lanka in 2000a (from Muthurajawela Marsh situated north of Colombo) respectively, we failed to find either of these species within the Bellanwila–Attidiya marsh.

When comparing the two Bufonid species, *B. atukoralei* had a much lower population density and emerge only during the early part of the rainy season. Among the Ranids, *L. limnocharis* was observed within all the habitats in the study area while *E. cyanophlyctis*, *E. hexadactylus* and *H. crassus* was observed only from water bodies. Among the tree frogs *Polypedates* species were observed from the wetland habitats as well as cool wet places in buildings in the vicinity of the marsh area. However, *Philautus* species were restricted to shrub areas in the wetlands and home gardens

Alteration of the quality of habitat and loss of habitat appears to be the main threats to the amphibian fauna of the area. A number of factories in the Bellanwilla-Attidiya area release their effluents into the waterways passing through the marsh. Furthermore, the Dehiwala-Mount Lavinia Municipal council uses the northern and eastern parts of the marsh for garbage dumping. These two factors appear to have a detrimental effect on the habitat quality. However, the effect of these two activities on the amphibian fauna as well as other fauna in the Bellanwila-Attidiya marsh is yet to be determined. During the last decade a great deal of the available habitat in the Bellanwila-Attidiya marsh has been lost due to clearing of shrubs for construction purposes around the area as well as human encroachment of the marsh. Furthermore, road kills due to passing vehicles along the Bellantota - Ratmalana road and Dehiwala - Maharagama road has also contributed to the loss of frogs and toads, especially during the breeding season. Finally, a recent rapid survey (2000-2001) conducted by our team indicated that *E. hexadactylus*, *E. cyanophlyctis* and *H. crassus* populations has undergone a decline in the area since the conclusion of this study (1995-1997).

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Observing Seabirds off the West Coast of Sri Lanka

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Introduction

In the course of a research study on small cetaceans off the west coast of Sri Lanka in 1994, I had the opportunity to observe seabirds that frequent our coastal and offshore waters over a period of six months. My study began in May with the onset of the south-west monsoon (not by choice) and continued through October with regular fortnightly trips out to sea in a 3.5 ton mechanized fishing boat. The area covered included the waters from the shore to a distance of 16 km offshore between Negombo and Beruwala on the west coast. This area was surveyed twice a month with each cruise transect covering a distance of approximately 82 km.

Although my primary focus was on cetaceans this provided an ideal opportunity to observe seabirds, which are rarely seen from land. It was all the more interesting as the south-west monsoon months are the period when one normally avoids going out to sea off the west coast and therefore opportunities for observing bird-life at sea are rare. The first three months of the study were most interesting but also somewhat risky and uncomfortable to say the least, as the monsoon lived up to expectations. The sea was sometimes extremely choppy with heavy swells and frequent squalls that left my companions and myself cold and soaked to the skin most of the day. However, there were many rewards in the form of numerous sightings and close encounters with both cetaceans and seabirds including two new records for Sri Lanka.

Species Diversity and Monthly Variations

A total of 21 species of seabirds were recorded over the six-month period (Table 1) but observed numbers of each species fluctuated from month to month. The species that were commonly recorded every month throughout the six month period were the Bridled Tern (*Sterna anaethetus*), Wilson's Storm-petrel (*Oceanites oceanicus*), Flesh-footed Shearwater (*Puffinus carneipes*) and Wedge-tailed Shearwater (*Puffinus pacificus*). Fair numbers of Large Crested Terns (*Sterna bergii*) were also observed in all months except May, Lesser Crested Terns (*Sterna bengalensis*) were observed in all months except May and September and Common Terns (*Sterna hirundo*) were observed in all months except May and June. The largest number of species observed in a single month was 13 in the month of June, followed by 10 species in the month of October.

In May, only 5 species were observed but this included 17 Pomarine Jaegers (*Stercorarius pomarinus*) in a single day. This is a species that was not recorded at all in the subsequent five months of the study although it is considered to be a regular summer (northern summer) visitor to the coastal waters off west and south Sri Lanka (Harrison, 1999). June was a month of high species diversity with several rare species especially petrels being identified. These included 3 Ashy Storm-petrels (*Oceanodroma homochroa*), 1 Swinhoe's Storm-petrel (*Oceanodroma monorhis*), 1 Jouanin's Petrel (*Bulweria fallax*), 1 Barau's Petrel (*Pterodroma baraui*), 1 Brown Booby (*Sula leucogaster*), 1 Short-tailed Shearwater (*Puffinus tenuirostris*) and 3 Caspian Terns (*Sterna caspia*). Of these the Ashy Storm-petrel, Barau's Petrel, Jouanin's Petrel and the Brown Booby were not seen in any other month during the study. In July a total of nine species were recorded with the only rarities being a single Audubon's Shearwater (*Puffinus lherminieri*) and 2 more Short-tailed Shearwaters. This was the only sighting of an Audubon's Shearwater throughout the study period.

Figure 1. A Wilson's Storm-petrel (*Oceanites oceanicus*) off the West Coast.

Figure 2. A Flesh-footed Shearwater (*Puffinus carneipes*) off the West Coast.

In August too, nine species were observed with a single Short-tailed Shearwater and 6 Roseate Terns (*Sterna dougallii*) which were not recorded in any other month. September also had nine species being sighted but of these a single Black-naped Tern (*Sterna sumatrana*) proved to be a new record for Sri Lanka as the species had not been identified off our coasts before. Therefore, Laksiri Karunaratne who accompanied me and identified the specimen reported the sighting to the Ceylon Bird Club and it was accepted as a new species for Sri Lanka (Ceylon Bird Club Notes in Loris, June 1995). It is now listed as a winter vagrant to our west coast (Harrison, 1999), although its normal range includes the Indian Ocean and Southeast Asian waters. In addition to this a single Brown-headed Gull (*Larus brunnicephalus*) and 1 Masked Booby (*Sula dactylatra*) were also among the species observed in September. Both these species were not sighted in any other month of the survey. Ten species were recorded in October with another new record being added to Sri Lanka's list of birds. This was in the form of 2 Bulwer's Petrel's (*Bulweria bulwerii*) that were sighted and once more identified and reported to the Ceylon Bird Club by Laksiri Karunaratne (Ceylon Bird Club Notes in Loris, 1995). In addition to this 3 more Swinhoe's Storm-petrels and 8 Caspian Terns were also observed in October.

Further Notes on the More Numerous Species

Flesh-footed Shearwater

In the months of May, September and October the Flesh-footed Shearwater was the more numerous species of Shearwater to be seen (Figure 3). Numbers sighted increased in the month of June, declined again in July-August and increased markedly in September when the largest numbers were observed (Figure 3). However, these large numbers in September were followed by a dramatic decline in October. This species is referred to as a passage migrant off our west coast (Harrison, 1999) and is believed to pass southward in June-July and northward in September-October. However, in 1994 they were present throughout the period between May and October with peak numbers in June and September followed by a rapid decline in October. It was also observed that when the weather was clear and sunny with less wind Flesh-footed Shearwaters were encountered further offshore at a distance beyond 10 km from land. On windy, cloudy or rainy days with heavy swells they were encountered from around 6 km offshore. They were also frequently sighted in association with schools of feeding dolphins and even in the vicinity of whales that were encountered during the course of the study.

Wedge-tailed Shearwater

Small numbers of this species were seen in May but increased in June and reached a sharp peak in August-September before declining dramatically in October (Figure 3). From June to August this species outnumbered the Flesh-footed Shearwater (Figure 3). The species was rarely encountered closer than 10 km offshore with the majority of sightings being confined to the waters between 12 and 16 km offshore. Unlike the Flesh-footed Shearwater, even when the sea was rough this species stayed beyond 10 km off the coast. Wedge-tailed Shearwaters were primarily encountered as solitary individuals that flew low into the troughs between waves when the sea had heavy swells. This species was never sighted in association with feeding dolphins but on a single occasion in August when the species was most numerous a lone Wedge-tailed Shearwater was sighted flying low above a Blue Whale (*Balaenoptera musculus*) and keeping pace with it over a long distance while it was moving. The natural range of this species is the tropical Indian and Pacific Oceans. It is considered to be a fairly regular summer visitor to the coastal waters off

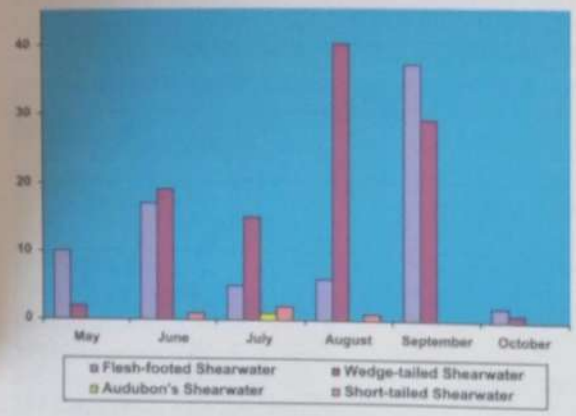

Figure 3. Species and numbers of Shearwaters observed off the West Coast of Sri Lanka from May to October 1994.

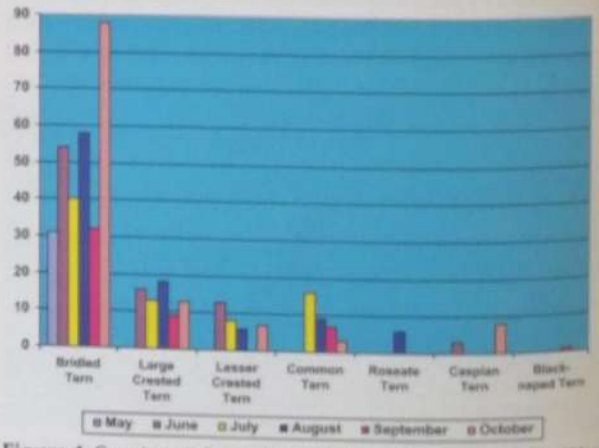

Figure 4. Species and numbers of Terns observed off the West Coast of Sri Lanka from May to October 1994.

the west and south coast of Sri Lanka.

Bridled Tern

Bridled Terns were the most common species of Tern encountered in all six months of the study with a clear peak in numbers in October (Figure 4). They were generally seen in small to medium sized flocks at a distance of 1-8 km offshore. While they were rarely encountered beyond 10 km offshore, they were frequently seen in the vicinity of feeding schools of dolphins. They were also observed hunting actively where shoals of small fish occurred. The range of this species includes the Indian Ocean, Southeast Asian waters and the West Pacific (Harrison, 1999). It is a frequent visitor to the coastal waters off the west coast of Sri Lanka.

Large Crested Tern

This resident species was encountered in fair numbers from June to October with no clear peak period when numbers increased (Figure 4). Most often Large Crested Terns were observed as individuals or pairs between 1 and 8 km offshore. The majority of sightings were however, between 2-5 km offshore. They were also occasionally sighted in association with schools of dolphins.

Lesser Crested Tern

This species was seen in small numbers in June, July, August and October (Figure 4). They were always encountered between 1 and 4 km offshore but were never seen beyond this. Lesser Crested Terns were seen mainly as individuals or in pairs. They are believed to be common visitors off the west coast of Sri Lanka (Harrison, 1999). The flocks found here may belong to the Australasian population and as such are probably wintering here (southern winter).

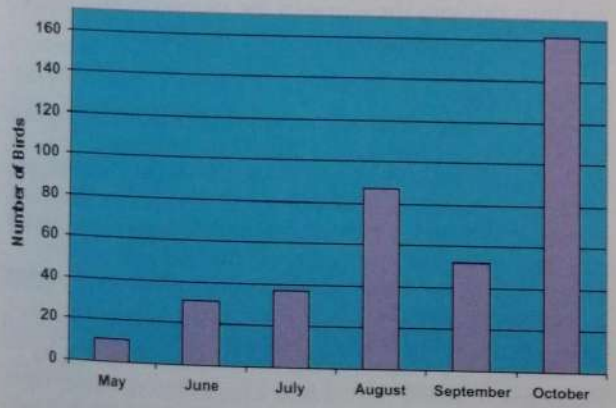

Figure 5. Monthly fluctuation in numbers of Wilson's Storm-petrels observed off the West Coast of Sri Lanka in 1994.

Figure 6. A raft of Wilson's Storm-petrels (*Oceanites oceanicus*) off the West Coast.

Common Tern

A fair number of Common Terns were seen in August but numbers declined from then on till October (Figure 4). They were always observed between 1 and 4 km offshore and never encountered beyond this. This species is listed as a winter (northern winter) visitor and summer loiterer that possibly breeds on islets off the east coast of Sri Lanka (Harrison, 1999).

Wilson's Storm Petrel

This species was found to be common throughout the study period. Numbers sighted in May were low at 11 individuals, but increased steadily through the following months to reach a peak of 161 birds in October (Figure 5). In the first three months of the study they were encountered as lone individuals or pairs but by August small groups were seen skimming the water in their characteristic fashion. By October however, large rafts of Wilson's Storm-petrels were seen alighting on the water with 126 individuals being counted in a single flock. The species is known to breed in the Antarctic from December to February and the birds found off our west coast may possibly be a part of this population that winters (southern winter) over here. The large flocks seen gathering in October could be in readiness for the return migration. Wilson's Storm-petrels were seen from as close as 2-3 km offshore all the way to 16 km which was the outer limit of the study area. They were also frequently encountered in association with schools of dolphins and whales alike.

Conclusion

In conclusion it can be said that the data collected in this short-term study is useful due to the general dearth of data on seabird observations at sea during the south-west monsoon. However, it would be even more interesting if such a study could be carried out throughout the year to monitor the distribution, movement and migration patterns of seabirds in the coastal waters around Sri Lanka during both the southern and northern winters. Also if such a short period of study resulted in two new

Table 1. Species and Numbers of Sea Birds Observed off the West Coast of Sri Lanka Between May and October 1994

Species	May	Jun.	Jul.	Aug.	Sep.	Oct.
Bridled Tern (*Sterna anaethetus*)	31	54	40	58	32	88
Large Crested Tern (*Sterna bergii*)	0	16	13	18	9	13
Lesser Crested Tern (*Sterna bengalensis*)	0	13	8	6	0	7
Common Tern (*Sterna hirundo*)	0	0	16	9	7	3
Roseate Tern (*Sterna dougallii*)	0	0	0	6	0	0
Caspian Tern (*Sterna caspia*)	0	3	0	0	0	8
Black-naped Tern (*Sterna sumatrana*)	0	0	0	0	1	0
Brown-headed Gull (*Larus brunnicephalus*)	0	0	0	0	1	0
Pomarine Jaeger (*Stercorarius pomarinus*)	17	0	0	0	0	0
Brown Booby (*Sula leucogaster*)	0	1	0	0	0	0
Masked Booby (*Sula dactylatra*)	0	0	0	0	1	0
Wilson's Storm-petrel (*Oceanites oceanicus*)	11	31	37	87	52	161
Ashy Storm-petrel (*Oceanodroma homochroa*)	0	3	0	0	0	0
Swinhoe's Storm-petrel (*Oceanodroma monorhis*)	0	1	0	0	0	3
Barau's Petrel (*Pterodroma baraui*)	0	1	0	0	0	0
Bulwer's Petrel (*Bulweria bulwerii*)	0	0	0	0	0	2
Jouanin's Petrel (*Bulweria fallax*)	0	1	0	0	0	0
Flesh-footed Shearwater (*Puffinus carneipes*)	10	17	5	6	37	2
Wedge-tailed Shearwater (*Puffinus pacificus*)	2	19	15	40	29	1
Audubon's Shearwater (*Puffinus lherminieri*)	0	0	1	0	0	0
Short-tailed Shearwater (*Puffinus tenuirostris*)	0	1	2	1	0	0
Total Number of Birds	**71**	**161**	**137**	**231**	**169**	**288**

species being identified and added to Sri Lanka's list of birds it is imperative that many more await observation and identification. Therefore, this is an area for Sri Lankan bird watchers and researchers to focus on in the future. I for one am certainly convinced that many more exciting discoveries await those who venture out to sea for this purpose.

Acknowledgements

I am deeply indebted to my friend Laksiri Karunaratne who helped identify most of the birds. He not only accompanied me on most of the trips out to sea but also made his extensive library of bird books available even on days when the weather made me question the wisdom of carrying them on board. I am also grateful to my friend Prasanna Weerakkody who accompanied me on all the sea trips through the worst of the monsoon and helped both with the sightings and with identification.

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Some Information on Elephant Owners of Sri Lanka

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Domesticated elephants have been an integral part of Sri Lankan society for centuries. Over the years people have made use of domesticated elephants in their work as a beast of burden, for ceremonies, in cultural and religious pageants and processions (Jayawardene 1994). In Sri Lanka the elephant is so much a part of the island's history, religion, mythology, culture and even its politics (Santiapillai & de Silva 1994). In fact Sri Lankan elephant is considered as a charismatic species. Elephants have been captured, tamed, trained and owned by man for many years. As such there is a distinctive system of ownership and husbandry in elephants of Sri Lanka. Elephants are still managed in captivity and therefore documentation of their owners and ownership system is important.

A study was designed to collect information regarding owners of domesticated elephants in Sri Lanka. This was done, by questioning mahouts and owners individually during the period April 1993 to April 1994. The study was conducted in 12 of the 24 administrative districts of the island, namely Galle, Matara, Colombo, Gampaha, Kalutara, Ratnapura, Kegalle, Nuwara Eliya, Kandy, Matale, Kurunegala and Anuradhapura.

Information regarding addresses of owners was initially obtained from Rev. Galaboda Gnanissara Thero, the chief incumbent of the Gangaramaya Temple, Hunupitiya, Colombo 2. Later some information was obtained from "Aliwedamahattayas" or native elephant doctors and veterinary surgeons.

The sample consisted of 82 owners, all of whom were Sinhala Buddhists. Furthermore, 79 owners out of the 82 were males (96%). Of the 82 owners, 11 were unmarried (13.4%) and 71 were married (86%). Out of the married owners 69 (97%) had children and only two (3%) did not have children. The mean number of children per owner was 3 ± 0.23 (range 0 - 8).

The average age of the owner was 51.4 ± 1.3 years (range 18 - 77). Most owners, 28 were between 40 - 50 years of age (34%). There were 22 owners between 51 - 60 years of age (27%).

The eighty-two owners of the survey were distributed in 12 districts. Majority of them, 28 (34%) were resident in the Colombo district. Second and third highest number of owners was from Kegalle (14) and Gampaha (11) districts respectively. Seven owners were from Ratnapura district and six each were from Kalutara and Kandy districts. Low numbers were found in districts like Galle (2), Kurunegala (2), Matara (3) and the lowest numbers were found in Nuwara Eliya (1), Matale (1) and Anuraddhapura (1) districts.

Ownership of domesticated elephants fell into two categories. Private owners owned 97% (136 elephants) and the government owned only 3% (4 elephants). Out of the 82 private owners of elephants 68 were individual owners (83%). This individual ownership of elephants often passes from generation to generation within families, until the elephants are sold, gifted or died. Out of 140 elephants surveyed, 106 (76%) elephants were distributed among these individual owners.

The remaining 30 (21%) in private ownership belonged to places of religious worship such as temples (including the Dalada Maligawa) and dewales. In the case of a temple the custodian of its elephants is the chief incumbent while in the case of dewales, the custodian of the elephants is either the Basnayaka Nilame (B.N.: lay administrator of the dewale) or the Kapumahattaya (lay official who conducts devote ceremonies). In the case of the Dalada Maligawa (temple of the Sacred Tooth), the custodian of elephants is the Diyawadana Nilame (D.N.: lay administrator of the Dalada Maligawa). The custody and management of elephants belonging to these places of worship change hands whenever there is a change in the chief incumbent, the D.N., B.N, or Kapumahattaya.

In the case of the four Government owned elephants, the ownership belonged to the Department of Wildlife Conservation. However the custody of these elephants had been entrusted to government authorities such as the Mahaweli Economic Agency (MEA) and the North Western Provincial Council (NWPC). There was no particular owner for the elephants in these two places. However, there were persons in charge of the elephants. In this study they were not considered as owners.

Out of the 68 individual private owners, 31 were landed proprietors (46%), while 28 were businessmen (41%). Nine (13%) owners were engaged in other kinds of occupation such as government servants (4), Ayurvedic physicians (2), mahouts (2) and sub post officer (1). Out of the elephant owners in the 14 places of worship seven were priests, one was the DN and other four were BN and two were Kapumahattayas.

Out of the 68 individual private owners, 10 (15%) claimed that their parents as well as grandparents had owned elephants, 37 (54%) claimed that only their parents had owned elephants, while one (2%) claimed that only his grandparents had owned elephants. The remaining 20 (29%) were first-generation owners of elephants. Out of the 14 temples and dewales that owned elephants only four had had elephants previously. The method of acquisition of elephants was examined with respect to the present owners and four basic methods

were evident. Purchased (56.4%). Received as a gift (29.3%). Caught from the wild (12.8%). Captive born (1.4%).

The number of elephants owned by a single owner varied between 1-10 with an average of 2. Very few owners (7) had more than three elephants. When asked the reason for owning elephants, most of the owners gave more than one reason. However, most owners (58%) claimed that the main reason why they own elephants is because it is a source of income. Other reasons given for owning elephants were affection for elephants (9%), as a status symbol (9%), family tradition (8%), ability to provide elephants to participate in religious processions (8%) and finally because elephants are considered a symbol of luck and prosperity (4%).

Out of 82 owners interviewed, 34 owners kept their elephants either in the compounds of their residences or on their estates (41%), 26 kept them at their mahouts' premises (32%) while the remaining 22 kept their elephants both with them as well as with the mahouts (27%). Out of those owners who kept their elephants with their mahouts, most of them (88%) visited their elephants regularly varying from once a week to once in six-months. Three (12%) owners did not visit their elephants at the site where the mahouts kept them, but the mahouts of these elephants visited their respective owners with the elephants on special occasions such as Sinhala and Tamil New Year or during perahera time.

Only five out of 82 owners (6%) had insured their elephants. Out of the 82 owners 60 (74%) expressed willingness to acquire additional elephants in the future. However, ten of them wanted additional elephants only if the government would offer the animals at a low price and provide assistance for maintenance of elephants. They also suggested that the government should provide facilities to purchase elephants from the Pinnawela elephant orphanage. Only four owners of elephants were interested in breeding their elephants. Even though most of the current elephant owners showed willingness to acquire additional elephants, most of them found providing optimum husbandry conditions for elephants in captivity difficult, due to high maintenance cost, high prices of elephants and the scarcity of good mahouts.

According to Santiapillai & de Silva, 1994, the future of wild elephants in Sri Lanka appears to be unhealthy. The number of wild elephants has been decreasing in recent years mainly due to two factors, decrease of natural forest cover, which leads to intense conflict between man and elephant. Crossette, 1987, has demonstrated that larger animals are often confined to larger countries, as they require large areas for ranging. It has also been shown that the extinction rate is usually higher in large animals (Lewin 1984). Furthermore, species with restricted geographical ranges are more likely to become extinct than species with broader geographical ranges. This indicates that the land area of Sri Lanka may be too small to support a large animal like the elephant. Therefore, in time to come elephants are likely to become extinct in the wild and will be kept only under captive conditions. With proper capture programs, high standards of husbandry, captive breeding (natural as well as artificial insemination) and proper training of mahouts, domesticated elephants may be the only hope for saving the Sri Lankan elephant in the future.

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Menik Ganga

H.D. Goonetilleke

Hail Menika Ganga
Hail to thee
On your banks
On which I roamed
When fretful of monotony
I turned my back on home

When tired of the city's noise
Of the wiles and snares of men
I sort your open spaces
And your wooded glens

Neath overhanging pallu
and gnarled old kumbuk trees
You wind your straight and muddy course
Through Yala to the seas

Like an amber serpent
That lost it's nesting place
Through Kataragama's jungles
Your silent way you trace

Flow on romantic river
Flow onward to the sea
And when over your placid waters
There blows a gentle breeze
Think not it's a wind
That blows from jungles near
But a sigh straight from the heart
Of one who loves you dear

Alien Invasive Species

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In the effort to conserve our natural biological heritage it is reasonable to focus on Alien Invasive Species. It is true that many alien species have invaded critical habitats for endangered species and rendered them vulnerable to extinction. It is true that immediate responses in terms of policy and action need to be developed. But before embarking on hasty activity, it will be useful to examine the ideas and concepts that underlay this concern. First, a matter of clarification. The words 'alien species' refers to an organism outside its natural range. An 'alien invasive species' is identified, as an organism that becomes established in natural or semi-natural ecosystems or habitats, is an agent of change, and threatens native biological diversity (IUCN, 2000). However, the trick comes in when defining what constitutes a semi-natural ecosystem. In a natural ecosystem the concept is clear. The Kudzu vine (*Mucuna*) in the hardwood forests of the Southwestern United States, the Brown tree snake (*Boiga* sp.) on Christmas Island or the Housecat (*Felis domesticus*), are all examples of invasive species that can cause damage to a natural ecosystem. But what kind of damage do they inflict on semi-natural ecosystems? Farmers seeking to improve their fallow look on a Kudzu vine with favour; a house cat is often an essential part of grain farming livestock.

Therefore, the question of having the capacity to identify between natural and anthropogenic ecosystems is a critical element in biodiversity planning. It is never clearer than in the questions that arise out of the use of the words "semi-natural" in the IUCN report. When addressing the scope and identity of biodiversity, there are two distinct measures that should be taken into consideration (Senanayake, 1994a). They are the natural or native biodiversity and the human influenced or anthropogenic biodiversity. If ecosystems are examined in this light two types of ecosystems can be identified natural and anthropogenic.

Natural forests contain only the original patterns of biodiversity. The native species occurring in established serial patterns. Humans have not impacted these formations and processes with a frequency or intensity to change established serial patterns.

Natural biodiversity exists as the product of a long history of interactions between organisms, landscape and climate. It is high in some ecosystems and low in others, but it does provide a measure of the naturally sustainable state for that ecosystem. Therefore the words 'semi-natural' would seem to coincide with the term anthropogenic ecosystems.

In natural systems the biodiversity measure is comprised wholly of native species. In anthropogenic ecosystems that measure is set by definition and can often entail the inclusion of exotic or alien species (Senanayake, 1991). Some authors suggest that traditional systems of land use, high in biodiversity, may provide the paradigm for future agriculture (Altieri, 1983). Agricultural fields have been recommended by others to be an ideal area to develop *in situ* conservation efforts (Wilkes, 1991). The capacity of anthropogenic systems to sustain a large proportion of native species has been extensively recorded (Senanayake and Jack, 1998). Often such ecosystems contain many elements of the local biota, they begin with anthropogenic impacts that occur with a frequency or intensity to change established seral patterns and natural biodiversity levels. They contain elements of exotic species, in many cases exotic species are essential to their sustainability.

When traditional agricultural systems are measured in terms of all organisms, these ecosystems often demonstrate some of the highest biodiversity values. The organisms that contribute to this gain are often exotic in origin. In some anthropogenic ecosystems many indigenous species have been lost, but other exotic species have taken their place.

In the lowland forest gardens of Sri Lanka, more than 70% of the 43 species of trees recorded were exotic (Senanayake, 1987). In other anthropogenic ecosystems, indigenous species have co-adapted to provide a sustainable agro-ecosystem (Senanayake, 1983). This dynamic system of a constantly shifting mosaic of natural and anthropogenic ecosystems operated for over 3000 years on this island, to provide us with the living record of an amazing pattern of biodiversity that has been sustained till today (Senanayake, 1994b). However, the ability of the modern landscapes to continue this function comes increasingly into question.

As the demand for the production of economic goods increases so does the nature of the anthropogenic ecosystems. Thus a forest gives way to a forest village, a traditional rice paddy field, a rubber estate or a pinus plantation. Anthropogenic systems can then range from modified forests to urban situations where biodiversity gains are usually accomplished through the addition of exotic species. However, if the management system does

not consider the value of maintaining high levels of biodiversity, these gains are quickly lost and unstable, monocultures begin to dominate the landscape.

It is against this background that the questions of invasive alien species have to be posed. It is important that the current demand for policy be based on sound science and commonsense reasoning. For example, the mahogany (*Swietenea macrophylla*) has been identified as an invasive species. This may be true in natural ecosystems but it is certainly untrue for anthropogenic systems. In fact in many home gardens of Southwestern Sri Lanka this tree contributes a substantial income source as a timber tree. It has also been identified as a good host tree for native epiphytes. But if this tree was used in a different cultural or management context, such as a monoculture broad acre plantation it could impact native biodiversity negatively and take on the characteristics of an AIS. Thus, it is not only the plant that must be evaluated but also the method of its use. The tea plant (*Camellia sinensis*) does not disrupt native biodiversity in a home garden, but in a plantation, another reality emerges. No discussion on AIS could be complete without considering the management systems of alien crop plants.

It is a fact that many alien species such as wheat in America, corn in Africa, tea and rubber in Asia have

Species & Life Form	Purpose	Distribution	Affected Habitats/ ecosystems	Origin
Albizzia moluccana	Quick growing firewood	Wet zone	Secondary, seral species	Indonesia
Albizzia lebbek	Quick growing firewood/ shade tree	Wet zone	Secondary, seral species	Indonesia
Aristia eckloni	Ornamental	Montane zone	Native, insectivorous plant communities	South Africa
Acassia dealberta	Wind break	Montane zone	Secondary, seral species	Australia
Casuarina equisetifolia	Timber & firewood	Dry zone	Littoral, sand communities	Australia
Diffenbachia sp.	Ornamental	Wet zone	Shaded, marsh habitats	South America
Eucalyptus sp.	Timber & firewood	Montane zone	Wet patanas	South America
Furcreae gigantica	Fibre	Montane zone	Dry patanas/ cliffs	South America
Limonocheris humboltii	Accidental/ aquaculture?	Low land	Low land swamps	Brazil
Miconia magnifica	Ornamental	Wet zone	Secondary rainforests	Brazil
Mimosa pudica	Accidental	Low land	Low land herbs	Europe
Pistia stratoides	Aquaculture	Low land	Low land swamps	
Plantago lanciolata	Accidental	Montane zone	Native, insectivorous plant communities	

The Treasures of the Forest

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The 'Shilpa Shastra' recognizes Ayurveda as one of the supreme sciences passed down to man through the millennia. Ayurveda or " *the Science of Long life* " as still practiced, is in keeping with the holistic traditional Asian mind set, recognised by Dr Robert Nisbett (2000) in his recent study as being totally different to the rational approach that has found credence in the West.

Ayurveda, which uses products derived from plant extracts for curative purposes, is known to cleanse the human system and eliminate the cause of the malady completely. This differs somewhat from the Western approach which concentrates on the symptom rather than the cause.

The training of an Ayurveda physician, together with the identification of the special raw materials required for the preparation of the medicines and oils for successful treatment, is a life long process. Unfortunately, at times due to the lack of suitable acolytes to pass on this knowledge, many well known physicians have carried their unique knowledge to the grave.

As an effort to protect this rare collection of medicinal plants, many Kings of Lanka established and protected special forests. However, due to the increasing difficulty of collecting the rare species in the wild, successive governments in the recent past have attempted to set up Ayurveda arboratariums for the systematic propagation of these plants. The short fall in the collection needed locally for Ayurvedic consumption was imported from countries like India. The arboratariums never produced plants in sufficient quantity, possibly due to the short duration of the programs, however, the general awareness and identification of medicinal plants increased.

Visits to the Ritigala Forest and Archaeological Reserve have become depressing events, as one is often confronted with large bundles of medicinal plants, carefully collected, stacked and readied for transport to Colombo, mostly for export. As awareness increased, the exploitation of this rare commodity, quadrupled.

A common weed in most home gardens, 'Polpala' *aerva lanata*, is boiled and consumed as a diuretic herbal tea. Today, this plant is hardly seen anywhere as it has been collected and exported to countries like Russia, to be taken as a cure to reduce the ill effects caused to human life by the excessive mineral content in their drinking water.

This sudden awakening and renewed interest in the west of the plant extracts used in Ayurvedic treatments, has led to extensive pirating and the scientific analysis of this precious commodity. The Multi-National Corporations foreseeing the great potential are willing to go to any lengths to encourage this blatant piracy, in a desperate effort to totally monopolize its future use.

The exporters of forest products do not pay anything back to the Environment. They only grab; they take and sell it for personal monetary gains. This refers not only to plants but also to fish, insects, reptiles and small mammals etc, as well. If this greed driven enterprise continues unabated, many of the forest products will reach levels of non-sustainability, leading to their complete extinction in the wild.

Mahindapala's *"Sri Lanka's Medicinal Plants"* (Loris Vol. 22. No. 4), documents the support of the International NGO 'IUCN' and the role of the Global Environment Facility (GEF) in the project for the *"Conservation and Sustainable use of Medicinal Plants"*. The project defines and demarcates medicinal plant reserves in bio-geographically-representative areas and proposes the use of these areas as Centres for a wide range of activities covering *"Conservation, Propagation, basic Processing, Ethnobotanical and Ecological studies and Awareness promotion. From these centres, activities will spread to other areas through extension and out reach programs"*.

The IUCN / GEF project will also mobilise the Grama Niladhari Divisions and the Communities living in the vicinity of the Medicinal Plant Conservation Areas (MCPA's), to participate in the exploration, packaging of medicinal plant products, the production of Ayurvedic medicines, etc. These Communities will be enticed and encouraged into these new vocations at the expense of engaging in their traditional agricultural practices.

This will have a short-term advantage that will eventually lead to long term extinction of the plant stocks in the wild and to the complete destruction and disorientation of a traditional Community. This shift in vocation, often at the instigation of an ill advised NGO has led to the sorry state of the agricultural economy today.

"The initial Socio-economic, Ethnobotanical surveys and the Resource Inventory of the MCPA's have been completed". Under the Resource Inventory, early GIS studies carried out under research grants, confirmed by officialdom as being available with the Forest Department, but according to other sources still held privately by the researchers, have produced baseline data maps of the areas in question.

As an after thought or *"complimentary activity, a research programme on propagation and cultivation of selected medicinal plant species"*, is also being considered. The project also envisages the training of a new breed of

acolytes who will be *"able to register in the government's Ayurveda system"*.

Most plants take time to grow and to establish in natural conditions. The final success or failure of the plants in the nurseries or plantations is related at times to unpredictable external conditions like climate which is beyond anyone's control. Therefore, on an average, the plantations will require a lead-time of at least 5-10 years for predictable success. Unfortunately, the GEF project has a duration of only FiveYears, of which Two and a half Years have already been expended. The Project duration will not even cover the lead-time required for the successful establishment of the medicinal plant nurseries.

The popularised identification and establishment of nurseries in the 1970's and 80's led to a sudden increase in pirating and in the export of the rarest medicinal plants. There is a general fear that the present IUCN / GEF effort will lead to similar circumstances where the scarce and rare resource of this island will be gathered, pirated, patented and sold on the world market, eventually leading to their complete extinction in the wild.

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Corridors, Corridors and More Corridors

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The whole issue of corridor creation is reaching absurd, ill-informed proportions. Thus it might serve to re-examine the approach that is being advocated for decision making in this country. The last article on the subject in Loris (Vol. 22 No. 4 Page 22) is an example. Basing a premise on a tautology often boded poor results. The statement " The proportion of animals moving would decrease with habitat fragmentation" is an example. Habitat fragmentation happens mostly through relentless, anthropogenic processes of corridor thinning, degrading and severing. As habitats become disconnected they become isolated and are called fragments. It also stands to reason if not commonsense that as the habitat fragments the mobility potential of any animal to move within it will decrease. To put it another way as the cage gets smaller the movement of an animal becomes more limited. I think that any person with a little bit of common sense would know this. But what has any of this to do with the validity or non-validity of the concept of an Elephant corridor?

Corridors are not always great passages of forest with elephants and other animals waltzing through them constantly. Corridors have to be perceived as linear or connective ecosystems that allow the passage of animals. Even if this occurs once every fifty years it is still considered as a corridor as it allows for the passage of genes within the population.

In the design of corridors it is the ' pore width' that is important. Any corridor can be visualized as a pipe or conduit with a screen at one end. If the pores of the screen are large the potential flow is large and the resistance small; if the pores of the screen are small the potential flow would be small and the resistance large. For example a corridor planted with a monoculture of pine will allow for only a very few species to use it, as the number of species determines the pore size (very small in this case), it will afford great resistance to the movement of species that do not live in pine trees. On the other hand if a corridor was planted in a diverse array of trees there will be a great number of species, thus a very large pore size. This will afford a very large number of species that can use it and will provide low resistance to species that use other trophic inputs than the trees themselves.

If migration is simply the act of moving from one space to another then the maintenance of corridors will be critical merely to sustain migration. However, migration is more than that. Migration is the act of moving from one place to another in a regular pattern. Thus all corridors must be situated along such regular or well-traveled tracks.

The current hysteria against corridors is unscientific and dangerous. Without the immediate planning for critical corridors we could jeopardize many critical populations of organisms. It should be remembered that elephants are often the mega indicators of ecosystems that contain hundreds if not thousands of other species. Thus the creation of corridors serves not just elephants; they ensure gene flow and thereby sustain many populations of endangered species.

While studies on individual animals might be useful for population management it cannot answer the question of the affectivity of gene flow. The question of whether elephants in Wasgamuwa were migrating to Maduru Oya is a red herring. The question to be asked to assess the value of a corridor is, whether the elephant populations between Wasgamuwa and Maduru Oya overlap along the proposed corridor. If they do, then the corridor functions! It is on such thinking that the concept of " Landscape Ecology " should be utilized for planning purposes.

Book Review

Dancing Naked in the Mind Field

Kary Mullis. (2000) Vantage Books.
New York. 222 pp. US$ 13.00 pbk.

How should we respond to the hype and controversy over issues such as global warming and the AIDS epidemic? The answer may be found in this fascinating book, written by the brilliant Nobel Prize winning chemist Dr Kary Mullis, whose discovery of the polymerase chain reaction (PCR), redefined the world of DNA, genetics and forensic science. He not only challenges us to question the authority of scientific dogma but also provides us a rare insight into the workings of an eccentric, unusual and uncanny mind. This is a book that should be compulsory reading for both scientist and layman alike burdened with legitimate doubts about the seriousness of global warming, and especially about man's role in it. The book also highlights the danger of scientists uncritically accepting the received truths from the scientific establishment, and makes one appreciate very much the wisdom of the Royal Society's succinct motto, "Nullius in Verba" (take no one's word for it). It is a book that every science student in our universities must read in order to think for himself and understand the implications of research that is heavily reliant on grants from powerful drug-companies. There is often more to the matter than what meets the eye, and nowhere is this truer, than in the case of research funded by drug companies with vested interests. The book draws our attention to the folly of blindly accepting any proposition, even from eminent scientists, so long as it is based on second hand or hearsay evidence.

Kary Mullis was born in North Carolina in 1944. He attended the Georgia Institute of Technology in Columbia, South Carolina and from there he went to the University of California at Berkeley where he received his doctorate in 1973. As a chemist, he was interested in unravelling the mystery of DNA, the King of molecules. The natural function of DNA is to reproduce itself. This happens every time a cell divides into two daughter cells. DNA make up the genes, and there are between 30,000 and 40,000 genes in man. The tightly packed human DNA resides in 46 chromosomes; 22 matching pairs of autosomes and the two sex chromosomes, X and Y. It was while driving along the Highway 128 in California one night that Dr Mullis, in a flash of intuition, understood the possibility of amplifying DNA in the lab "by the repeated reciprocal extension of two primers hybridised to the separate strands of a particular DNA sequence". So dawned the age of the Polymerase Chain Reaction (PCR). For his discovery of the polymerase chain reaction, he would receive the Japan Prize in 1992 and the Nobel Prize in 1993. The Cetus Company where he worked however made US$ 300 million from Hoffman-La Roche for the PCR!

When he was a young boy, Mullis received a Chemistry Set as a Christmas present from his mother. This was the beginning of his life long interest in chemistry. When the Russians launched the space race by sending Sputnik I into orbit, science education in America benefited greatly from the millions of dollars that the American government poured into it. After graduating from high school, Mullis worked at Columbia Organic, a supplier of research chemicals. His job was to go through the orders and find the cheapest supplier of the chemicals, some of which had several different names. He had to translate them into their chemical names. One day he found out a bizarre transaction: Columbia Organic was buying a chemical from the Swiss company, Fluka for one of their customers in Illinois. Columbia Organic was paying Fluka US$ 100 for a gram. But Columbia had the same chemical in stock but under another name. So when Columbia Organic placed an order with Fluka, they would in turn order the required amount from Columbia Organic for US$ 24 a gram and send it to the customer in Illinois!

We perceive our environment through our five senses: hearing, vision, taste, touch and smell. Aristotle recognized this fact some 2000 years ago when he wrote "Nihil est in intellectu quod non primus in sensu (Nothing is understood by the intellect which is not first perceived by the senses). The human ear can detect sound frequencies up to roughly 20,000 cycles per sec, beyond which, we can no longer hear, even though the air around our ears is still vibrating. Dogs and bats can hear higher pitches than we can, children higher than adults, and women higher than men. A variety of sensory systems produce signals beyond human experience: bees recognize patterns of polarized skylight; birds use a magnetic compass while migrating; fish use distortions in the electric field for orientation and detection of prey that live in murky waters. About 20% of the known species of mammals use sound as a means of "viewing" their surroundings. Given that our window on sound is narrow, Mullis argues that "our ears must have evolved mostly for the purpose of listening to ourselves." On the other hand, our biggest window is vision. Light has many manifestations, and the most familiar form that our eyes use for seeing is sunlight. Light is made up of seven colours, and each colour is different because of its wavelength. As the Astrophysicist Prof. Jayant Narlikar points out, all wavelengths are extremely short and are measured in nanometres (nm) (1 nanometre = one billionth of a metre). Red light has the longest wavelength

in the range of 620-770 nm, while violet and blue light have wavelengths in the range of 390-450 nm. The wavelengths of other colours lie in between. Nature however does not limit itself to this range 390-770 nm.

Mullis did a "thought experiment" in which he tried to find out what would happen if he wiggled a little magnet at greater frequencies? At a frequency of 428 trillion times per second, the magnet would start making red light; and at 550 trillion times per second, it would glow green; at 800 trillion times per second, the light would no longer become visible. A little faster, it might even burn you (ultraviolet light). That our vision is centred on the 550 index we call green, Mullis argues is "because we developed our vision while we were living under the canopies of giant trees that let in only the green light!"

In the late 1970s, when Mullis was working at the University of Kansas Medical Center, he began to accumulate electronic equipment that was left behind when labs would close down for lack of funds. It was at this time that his second wife left him. So he had room to experiment with the equipment he salvaged. While at Berkeley he came to know that there were people, especially those in India, who could control their heart rate with their mind. We now know that *Amblyrhynchus*, the marine iguana lizard in the Galapagos islands, whose principal enemy is the shark, can stop its heartbeat momentarily on the approach of a shark. The shark locates the lizard from listening to its heartbeat. Mullis decided to carry out experiments on the electrical conductivity of his skin. He found that the resistance in his skin would range from about 14,000 ohms to about 100,000 when he hooked his wrists to 9 volts. He then decided to control the resistance of his skin. By fooling around, he discovered that in order to raise the resistance, he "had to think about something really boring or meditative", with the voltage meter reading occasionally going as high as 180,000 ohms. On the other hand, a look at a naked woman in Playboy would swing the needle immediately below the 10,000 ohms mark! It was so much fun that he even added an oscilloscope.

He did more weird things. Once he decided to inhale some nitrous oxide or laughing gas. He would inhale a little at a time from a cylinder at home, and let his mind "sail off briefly into something primeval and human-less." But when one day after having taken a powerful antihistamine with his girlfriend Cynthia Gibson to ward off the effects of mosquito bites the previous night, he gulped some nitrous oxide for a couple of minutes of bliss, he passed out. When he woke up, the gas was still running, the tube was frozen, and his lips and tongue were numb. He had to be rushed to the hospital by Cynthia and it took a month for him to recover. But the story is not over. How did the tube come out of his mouth when he was unconscious long enough to have his mouth and lips frozen? It turned out that one of his friends, Katherine O'Keefe had the ability to travel on the astral plane - something that her mother taught her when she was a child. According to Mullis, "She had been in transit when she had seen me dying. She knew I would later play a role in her life, so she stopped and pulled out the tube."

As J.M.W.Slack writes in his book, "Egg and Ego", nowadays, assessment of researchers is not by the content of the articles, not even by their titles, but just by the names of journals in which they are published, "Fashionable journals" such as Cell, Nature, Science. In 1968, while still a student at Berkeley, Mullis submitted an article entitled, "The Cosmological Significance of Time Reversal" to the foremost scientific journal in the world, Nature, and was quite surprised when it was accepted. Years later after he invented the PCR, he sent a paper on PCR to Nature with the assumption that it would be accepted. Much to his dismay, both Nature and Science rejected it. It was however published later in Methods in Enzymology, by Ray Wu who understood the power of PCR.

As an editorial in Nature argues, "Science is ultimately about ideas moving around inside people. It does not reside in text books or in large pieces of equipment." Scientific pronouncements must be supported by experimental data. Mullis is at his best when discussing the scientific method and dealing with those scientists who advise governments and make comfortable salaries arranging scientific symposia and stories for the media. Mullis refers to them as "parasites with degrees in economics or sociology who couldn't get a good job in the legitimate advertising industry. They are responsible for a lot of the things that you accept year after year as your problems". We seem to take everything that the scientific community says to be the gospel truth. As Mullis points out, very little experimental verification has been done to support important societal issues, such as "the belief that AIDS is caused by human immuno-deficiency virus, the belief that fossil fuel emissions are causing global warming, and the belief that the release of chlorofluorocarbons into the atmosphere has created a hole in the ozone layer." Mullis comes down heavily on those scientists who "speak out strongly about future ecological disaster and promote the notion that humans are responsible for any changes going on". St Jude calls those who mislead humanity "clouds without rain". If something is not clear, we should look to find out who really benefits from it. As Mullis found out, the "American patent on the production of freon, the principle chlorofluorocarbon used in refrigerators and air conditioners, expired just about the same time freon was banned. Those countries that had just begun

producing freon without paying for the privilege were asked to stop. And a new chemical compound, a commercial product that would be protected by patent, would soon be substituted and make a lot of money for the company that produced it".

Mullis also questions the indirect evidence that points to a decrease in the ozone layer, as reported from the increase in the incidence of skin cancers. Instead of correlating skin cancer to UV levels, he wonders why no one has ever thought of measuring the UV light reaching the earth for a few years in the Antarctica? He seriously doubts if man's activities alone could destroy the ozone in the upper atmosphere. He envisages the following scenario in the event of a hole appearing in the ozone layer: "The UV rays from the sun would come through that hole and strike the Earth's atmosphere, where they would be absorbed by the miles-thick layer of oxygen surrounding the Earth. Then it would make more ozone. When the UV rays from the sun combine with oxygen, they form ozone. The ozone thus forms absorbs UV light, which continues to come from the sun, and prevents it from penetrating any farther into the oxygen below that has not been converted to ozone."

Global warming may be a part of a complex of human-generated problems that includes not only pollution, degradation of forests, loss of biodiversity but also the great imbalance in the wealth and standard of living between the developed and the undeveloped worlds. Mullis is not convinced that human actions alone are responsible for global warming or ozone depletion. According to him, "the temperature of the Earth is due to the size and shape of the orbit that it follows around the sun, the angle that its rotational axis is tilted to its orbit, the length of its days, the radioactive decay and residual gravitational heat deep below the crust, and the elements that were here from the beginning, and God knows what else, but not us". He feels that we may be in fact heading back into another glacial period. As The Economist points out, long before mankind, and even the industrial age that led to the burning of huge quantities of fossil fuels, global climate warmed and cooled in cycles, as a result of such natural events as volcanic eruptions, fluctuations in solar radiations, and quirks in the earth's rotation. So why do scientists, even those that go to make the UN's Inter-Governmental Panel on Climate Change (IPCC), conclude that man's actions have "contributed substantially to the observed warming over the last 50 years". The reason, according to Mullis is that "scientists have a considerable financial stake in our continuing belief that these problems threaten our lives and must be solved. They get paid for it". The current annual budget of the IPCC is of over US$ 1 billion!

Many of us without a question have accepted it as a scientific fact that AIDS is caused by the Human Immunodeficiency Virus (HIV). But Mullis while working at the Specialty Labs in Santa Monica searched the scientific literature to find out whether there was any incontrovertible proof to link HIV with AIDS. He looked for the reference specifically in recognized peer-reviewed primary journals, where every single experimental detail must be described so that the experiment could be repeated by another scientist to check the outcome. He did computer searches, and found that neither Luc Montagnier of Pasteur Institute in Paris (France), nor Robert Gallo of the US National Institutes of Health, "nor anyone else had published papers describing experiments which led to the conclusion that HIV probably caused AIDS". Thus no one seems to have ever proven that HIV causes AIDS. Peter Duisberg, the brilliant virologist at Berkeley expressed doubts about such a link, but he was sidelined. As Mullis reveals in his book, Editors rejected Peter Duisberg's manuscripts, and his research funds were cut off.

The true nature of the big drug companies came to light when Dr Mullis as a Nobel Laureate was invited to speak at a conference organized by the Glaxo Pharmaceutical Company in 1995. Glaxo offered to defray the cost of all travel and accommodation and also pay an honorarium of US$ 1,500 to Dr Mullis. Glaxo had been successfully marketing AZT as a drug against AIDS. But the sad truth was that "no one has ever recovered from AIDS, even though they have recovered from HIV". Dr Mullis had always maintained that AZT was "not only useless against AIDS, but in fact it was poisoning people". So when Dr Mullis informed Glaxo that he would speak about the fact that there was no scientific evidence that HIV was the probable cause of AIDS, his lecture was cancelled. This is not an isolated incident. More recently a similar thing happened to the British psycho-pharmacologist Dr David Healy who was invited to take up a post at the Center for Addiction and Mental Health (CAMH) at University of Toronto, in Canada. He lost the post because of his discovery that one of the best selling anti-depressant drugs Prozac can also make some people commit suicide. Prozac is manufactured by the pharmaceutical group Eli Lilly whose profits from its sales in 2000 alone amounted to some US$ 2.6 billion! Unfortunately for Dr Healy, it also provides funding to the CAMH to the tune of more than US$ 1.5 million.

Dr Kary Mullis is an extraordinary scientist, who has written a Tio Pepe of a book, which is a delight to read. Cheerfulness keeps breaking through the pages of his book. It is one of the most enlightening and thought provoking books that I have read in my life.

Charles Santiapillai
110 Wattarantenne Passage
Kandy, Sri Lanka

Ode to Horton Plains

Hans Swan

New South Wales, Australia

An awesome windswept wilderness art thou O Horton Plains !
Secluded and mist-veiled crown atop Lanka's fabled mountains.
Thy forest-patches dark and dense with gnarled and moss-bearded trees,
Thy downs shag-piled with tussocks, quivering in the breeze.

Thy fern-embroidered terrain, bejeweled in regular season
With golden gorse and orchids, and scarlet rhododendron;
And thy glades and forest paths, suffused with purple and blue,
With the once-in-ten-year blooming of the mysterious "nillu".

Bear-monkeys leap and leopards lurk in thy forest canopy,
While hare and barking deer dart through the tangled understory.
And out upon thy dew-kissed downs, handsome elk at dawn do graze,
While on thermals high above, eagles soar in the morning haze.

Trout and crab and shrimp abound in thy sparkling icy streams,
Where hikers pause to quench their thirst, and anglers, to live their dreams.
How tranquil these murmuring brooks, on their course to Baker's Falls,
Where they crash and boom in concert with the trill of wild-birds' calls.

Gracing thy southern frontier, is a sheer and stupendous drop.
This peerless rampart is "World's End" – an eerie, spine-chilling stop !
Where man and beast have plunged to grief, into the abyss beyond,
But where, before the mists roll in, the views art simply "ex-monde" !

Once a colonial hunting ground for sambhur and wildboar,
Now protected habitat, with beagles and guns no more.
Thy early patrons Farr and Grigg, so enraptured were by thee,
They had their ashes laid to rest, in thy soils for eternity !

A grand masterpiece of nature, the beauty art non pareil;
Even Adam, cast from Eden, didst surely think thee surreal !
This sequestered Shangri La, with its repose and bracing clime,
Impels the soul to leap for joy and to praise the One, Divine!

Let all men know and love thee for thy raw and pristine splendour,
And thus cautiously steer thee from roads to eco-disaster.
For to lose this glorious gem in Lanka's bespangled crown,
Is to deprive man his birthright and to confirm the devil's renown.

Like many of those before me, I too have been awed by thy charm,
Which art no less bewitching in this modern millennium!
Though so far now from my reach, lying right out there at World's End,
O Horton Plains I'll soon return, for my wistful heart to mend !

Planning for Conservation of Biological Diversity: Lessons Learnt from Sri Lanka

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Introduction

Sri Lanka, though one of the smallest nations in Asia harbours biological diversity of global significance. Its varied topography, diverse physical environment, unique biogeographic location and tropical conditions have given rise to extremely high levels of biological diversity, higher than in most other tropical Asian countries, when measured per unit area (Braatz, 1991). Much of this diversity is endemic, presumably a reflection of the island's separation from the Indian subcontinent since the late Mesozoic. More than 3650 species of flowering plants, 300 species of pteridophytes, about 400 birds, almost 100 mammals and more than 160 reptiles are known to occur and new species, of even higher plants and animals, are still being discovered (IUCN, 1993).

Sri Lanka is also one of the Asia's most densely populated countries and much of its natural forests have been cleared for settlement, cultivation, development and timber production. The forest area *per capita* has declined from 1.3 ha in 1900 to less than 0.1 ha in 1999 (Sayer and Whitmore, 1991, Legg and Jewell, 1992). Sri Lanka, fortunately, has a strong tradition in conservation and its system of conservation areas is one of the most extensive in Asia and covers about 14% of the total land area (Wijesinghe *et al.*, 1989). These relatively impressive area figures notwithstanding, a number of deficiencies beset the conservation of its biological diversity and management of wildlife and protected areas (PAs). These arise mainly from the Department of Wildlife Conservation (DWLC), the agency responsible for the management of PAs, not being able to keep pace with the drastic demographic, land use, socio-economic and political changes that have come about since its inception in the mid 50s. Management of PAs is largely ineffective and suffers from inadequate scientific inputs and weak institutional structures. The situation is further compounded by a majority of PAs being small (30% of PAs are less than 100 ha and 54% are less than 1000 ha) and isolated, reflecting the fragmented nature of the remaining natural habitats (Baldwin, 1992).

The forests of Sri Lanka are in the custody of three government agencies: Forest Department, Department of Wildlife Conservation and the Government Agents. The forests under the charge of the Forest Department (approximately 16% of the geographical area) are managed for the production of timber and other goods, although recently some areas have been declared 'Conservation Forests'. The land administered by the DWLC (approximately 12.4% of the geographical area) comprises the protected areas (PAs) declared under the provisions of the Fauna and Flora Protection Ordinance (FFPO), 1937. The FFPO provides for two categories of PAs, *viz.* 'national reserves' (Strict Nature Reserves, Nature Reserves, National Parks, Jungle Corridors, Refuges and Buffer Zones) and 'sanctuaries'. The differences between various categories of PAs are very meager and often vague. There are usually restrictions on entry and the use of PAs but anything can be done with a permit from the Director of DWLC. The Government Agents (GAs), who administer the districts, control additional areas called 'people's forests'. These areas are subject to heavy encroachments, especially in the dry zone and are primarily meant for meeting the needs of the people for forest products and agricultural land.

Protected Area Management Planning Process

It is widely recognised that the establishment and management of PAs is one of the best ways to conserve biological diversity. This paper discusses the authors' experiences in preparing the management plans for the PAs under the administrative control of the DWLC. The DWLC obtained a Global Environment Facility (GEF) grant for capacity building, from UNDP, in 1992. The project was implemented by FAO, and activities undertaken included human resource development, research, provision of equipment and vehicles, among other things, in addition to the preparation of management plans for most of the protected areas. While four management plans (Yala, Uda Walawe, Bundala and Lunugamwehera national parks) were prepared by the Chief Technical Advisor (CTA) of the project, the authors prepared management plans for Wasgamuwa National Park (and the Riverine Nature Reserve), Minneriya National Park (and a complex of contiguous PAs), Victoria-Randenigala-Rantambe Sanctuary, Horton Plains National Park (HPNP), Hakgala Strict Nature Reserve (HSNR), Peak Wilderness Sanctuary (PWS) and the Ritigala Strict Nature Reserve (Mathur and Pabla,

1999). Out of these, HPNP, HSNR and the PWS fall in the wet evergreen montane areas while the other areas are located in the dry or the intermediate zone. The project adopted a two-step approach to the planning process. Step I consisted of the preparation of Resource Inventories through national consultant teams, consisting of serving and retired academics and technocrats. Step II involved the preparation of the plans proper by international consultants, on the basis of the information compiled through the inventories supplemented by field visits and consultations. The quality of resource inventories for different PAs varied between 'very good' and 'very bad', the strengths of the good inventories also varied between biological aspects and socio-economic issues. The DWLC had already adopted the plan format developed by the Wildlife Institute of India (Sawarkar, 1995) and the authors generally used this format and modified it whenever it became necessary to do so.

Protected Area Management Issues

In order to plan for the conservation of biological diversity it is important to develop an understanding of the range of management issues. The management issues in Sri Lankan PAs can be broadly divided into three categories *viz.* ecological, socio-economic and institutional. These issues are briefly discussed below:

Ecological Issues

The plight of the Asian elephant *(Elephas maximas)*, large scale deforestation and conservation of endemic biota are the three main ecological issues in Sri Lanka. There are believed to be some 2000 elephants, consisting of many fragmented populations (Desai, 1998), mainly restricted to the dry zone that lies in a wide band stretching across the country, from the Northwest to Southeast. These animals suffer from the usual problems of habitat loss and vindictive killings at the hands of farmers. However, a large part of the elephant mortality is also attributed to trap guns set up for poaching other animals around villages. The elephants are in severe conflict with the marginal agriculturalist over all of their range, on account of their damaging crops and houses, and for killing human beings. Although the government pays some compensation for damage to houses, there is no system of compensating the victims for crop damage, despite it being quite widespread. Human deaths are compensated through an insurance scheme operated by the DWLC, which provides up to Rs. 50,000 (approximately US $ 700) per case, depending upon the age and earning status of the victim. More than 50% of the Sri Lanka's elephant population is believed to inhabit areas outside the PAs, and thus become involved in such conflict situations.

The elephant enjoys the highest priority for conservation and nobody talks about the leopard (*Panthera pardus fusca*), which is a subspecies endemic to the island. There has never been a census of the species and its status is uncertain. With very little control on poaching in general, and the rampant use of trap guns, the continued existence of the leopard is likely to be in serious jeopardy.

Although the PAs were primarily established for the conservation of elephants and other associated fauna, they also provide protection to nearly all of the endemic species of flora and fauna. 90% of the endemic plant species and 84% of the endemic animal species are reported to be represented within the existing 54 protected areas (IUCN, 1993).

Although Sri Lanka is a very green country, due to high and well-distributed rainfall, deforestation, mainly due to the high human density and development programmes, is going on at an alarming rate. Sri Lanka is believed to have lost its forest cover from 84% of its land area to the present level since 1881 (IUCN, 1993). The loss in the wet zone has been nearly total, much more than in the other regions. There is a complete ban on the exploitation of natural forests now. Although natural forests were converted to tea, rubber and coconut plantations for economic reasons, these plantations are now meeting almost 70% of the timber and fuelwood requirements of the country. The land under PAs administered by the DWLC amounts to approximately 40% of the total forest cover in the country. If effectively managed, they are a sure guarantee for preserving the endangered and endemic species, as well as the forest cover of the country.

Socio-economic Issues

Sri Lanka is primarily a developing country with a very high human density (approximately 300 persons/km^2). As a result, the pressure on natural resources is very high. Traditionally, the human concentration in the Southwest (wet zone) has been much higher than in other areas. Therefore, governments have been encouraging people to move to the dry zone. As most of the PAs are also situated in the same region, the pressure on PAs has been rising constantly. With the large-scale destruction of forest cover under the various stages of the Mahaweli Development Programme, the problems have become especially acute. Shifting cultivation, locally called *chena*, the traditional practice of cultivation in the dry zone, is decimating the forest cover. In fact *chena* cultivation is generally considered to be the right of the rural people in the dry zone and the forests in the custody of the GAs are considered to be primarily meant to serve this purpose. However, because of the indistinct boundaries, the PAs are also equally vulnerable to this menace. Apart from the *chena* cultivation, quarrying for gems is another major bane of the forests. Most of the PAs, and other areas as well, are being dug for gems by villagers with support

from rich middlemen. Although dependency for fuelwood is also relevant in this context, trees in the home gardens do alleviate this pressure considerably. Non-wood forest products (NWFP) are intimately connected with the lives and culture of the country. For example, more than 600 species are used by the people for domestic and commercial purposes around the Peak Wilderness Sanctuary. Destruction of forest cover for developing the irrigation system under the Mahaweli Development Programme, and resettling people in the command area has been the major motive for creating many of the PAs in the dry zone. However, destruction of the buffer zones, for settling people, has made the management of these PAs more difficult. The new settlers are also believed to be more indulgent on poaching and other illicit activities than the traditional villagers who occupied these areas.

A large part of the Sri Lankan population, though Buddhist, is non-vegetarian. Therefore, the demand for meat products is very high. As there is no tradition of keeping goats and sheep, the demand encourages poaching of wild deer and wild pig. Wild pig is not protected by law, but spotted deer and sambar, though protected by law, are also under tremendous poaching pressure. As people are not permitted to keep guns in view of the ongoing ethnic conflict in northern Sri Lanka, trap guns and snares are the tools of choice used by such poachers. As these methods are non-discriminating, a large number of elephant injuries result from these guns. It is a well-known fact that injured elephants are more aggressive and likely to cause damage to human life and properties.

Institutional Issues

The Department of Wildlife Conservation (DWLC) is beset with many institutional problems. At the field level, the department is organised into ranges and beats. These officers have no definite jurisdiction. Sometimes one PA is under the charge of two rangers, while another ranger may be responsible for parts of two PAs at the same time. The same is also true of the beats. This arrangement militates against accountability and commitment to one's charge. The department is severely understaffed, so much so that a beat may be responsible for hundreds of square kilometres of forest. In many areas the jurisdiction of DWLC overlaps with that of the FD, which simply leads to wastage of scarce staff and other resources. For example, Sinharaja World Heritage Site has a DWLC range office, while the FD has employed sufficient staff to look after the area. The department has no professional structure, although there is the usual bureaucratic hierarchy. Till recently, even well-known national parks had no professional level managers and were managed only by rangers, without any training. The management of PAs is still limited to visitor management only. As the first plans have just been prepared, the management of PAs so far, has only been adhoc.

Current Management Strategies and Practices

As mentioned above, DWLC has a number of ranges and beats scattered all over the country, without any specific jurisdiction. The main responsibility of the staff posted in these offices is to attend to elephant related problems and poaching, except in notified PAs, where action against cases of habitat damage is also taken. Because of the shortage of staff and mobility, the number of cases caught is not very high, although the frequency of offences is quite high. In the absence of management plans, as mentioned above, the management of PAs has been essentially adhoc. The management of national parks is generally limited to visitor management, in addition to the maintenance of some waterholes and other infrastructure. In other categories of PAs, visitors are not permitted. As the road density in these PAs (other than national parks) is low, and there are no field operations for the staff to supervise, the patrolling of the interiors of PAs is rather limited. No efforts have been made so far to reduce the pressure of neighbouring communities on forests through ecodevelopment interventions. However, because of reasonably high park entry fees and bungalow occupation fees, the earnings of many national parks are quite impressive, and there is a lot of scope to increase the revenue further.

Planning Proposals

The areas dealt with, by the authors fall into two broad geographical tracts, namely, the Mahaweli region and the Central Highlands, while one area (VRR sanctuary) falls in the Intermediate zone. Although the general management issues in all areas were similar, they differed from each other in terms of their relative importance or intensity. The management proposals listed below, accordingly, vary in their application from area to area, both qualitatively and quantitatively.

Organisational Changes

The plans recommend a substantial improvement of the field presence of the DWLC, both in terms of personnel and materials. The organizational changes recommended by the plans are essentially two:

a) All important national parks must be headed by a professional wildlife manager of the rank of an Assistant Director, rather than by a ranger, as was the practice so far. This would give the department the badly needed facelift and will facilitate the flow of intellectual/professional input into field operations. Fortunately, this recommendation fits with the current organizational thinking in the department and has been adopted in a few national parks. All field officers (beats and ranges) must have

a definite jurisdiction for the sake of responsibility, commitment and accountability.

b) The protected areas should be subdivided into small, basic, spatial units and given a definite identity for facilitating management planning, implementation and documentation of management related incidences. We call these sub-units **'compartments'**. These parcels will have permanent boundaries and will form the basic units of organization of the PAs into administrative units, such as beats and ranges, or management zones. The compartment is given a numeral as its identity and can be delineated on the ground on the basis of geographical/topographical features (Mathur, 1991).

Human-Elephant Conflict (HEC) Resolution

This is one of the most intractable issues faced by the conservation community, people and politicians in Sri Lanka. While nearly 50 persons are killed by elephants annually, in addition to the destruction of crops and houses, nearly 100 elephants also get killed in this conflict (Desai, 1998). The main reason for this conflict is the attraction of agricultural crops for elephants. Although the destruction of crops by elephants is widespread, the actual loss suffered by the individual farmers can be minimized generally, if a constant vigil is kept by them (Desai, 1998). However, the continuous fear of attack by elephants and the unending nightly vigils results in a tremendous deterioration in the quality of life of the farmers who inhabit areas closer to PAs. The DWLC and other agencies have been trying, though unsuccessfully, to confine the elephants to PAs with the help of electric fences. A functional fence is an exception, rather than the rule. Among many reasons for the failure of the power fences is the lack of maintenance, for various reasons. However, a successful fence would itself be an ecological disaster as it would compartmentalize the habitat and fragment the elephant populations. Community involvement in fence maintenance has also not been successful. Keeping these facts in mind, we have proposed a promotion programme for private fences, around fields, rather than around PAs, through high governmental subsidy. Group fences would lower costs substantially and maintenance of short private fences will also be relatively easy. The subsidy should be treated as an agricultural subsidy for crop protection as argued by Pabla and Mathur, 1998a, 1998b.

Another important recommendation in this context is the subsidy on crop insurance around PAs. This is based on the fact that farmers suffer crop and other damage because of a government programme to preserve elephants and it must also pay for their upkeep. When elephants feed on crops, their upkeep is subsidised by the owner of the crop, which the society must reimburse to him. Moreover, whatever the state or the individuals do, losses are inevitable, although individual efforts by the owners can reduce the losses to some extent. Therefore, we propose that the state should encourage the farmers in vulnerable areas to go for crop insurance and the government should meet a substantial part of the premium. The crop insurance scheme recently launched by India, in which the premium, based upon the vulnerability of an area to natural calamities, is paid by the government, may be used as a model for this purpose.

Ecodevelopment

Ecodevelopment is the term used to describe rural development initiatives aimed at strengthening conservation, by mitigating the dependencies of nearby human communities on natural resources. The commonest dependencies are for fuelwood for personal use or for sale, grazing livestock, and collection of non-wood forest products (NWFP), although their intensity varies from area to area. The solutions to these dependencies lie in the introduction of fuel-saving devices, such as fuel-efficient cook-stoves, biogas, solar cookers etc. and promotion of alternative income generation programmes, through a participatory process, with the help of other government and non-government agencies. As ecodevelopment planning is a time-consuming process, and has to be linked with assured funding and technical resources, detailed microplanning could not be taken up because of the limited time available to the authors. But the planning process and broad strategies, along with indicative budget estimates, are provided in the management plans. Recently, a detailed ecodevelopment plan has been prepared for the Uda Walawe National Park by another consultant. This plan can be used as a model for preparing ecodevelopment plans for other areas.

Habitat Management

We have generally recommended rather conservative habitat manipulations. As the grasslands form a critical part of the elephant habitats, weeding and clearing grasslands of the invasion of woody plants, from the periphery, is proposed. This will be done by cutting the shrubs at the ground level and burning the debris on the stump, repeatedly if necessary. Burning of moist grasslands in alternate years, if not burnt accidentally, is also proposed to maintain the productivity of grasslands in case of Wasgamuwa National Park. No active fire protection measures are proposed in view of the high rainfall and low incidence of fires. However, fire management trials, in collaboration with the scientific community, are recommended for Horton Plains National Park to study the role of fires in the ecology of the high altitude grasslands. Similar management trials regarding the removal of impenetrably dense crops of

Strobilanthes on the forest floor is also proposed, as the role of this plant on the local ecology is not yet well understood.

Wild Pig Management

The wild pig (*Sus scrofa*) is one of the commonest animals in Sri Lanka and is treated as a crop pest. Its killing outside protected areas is not prohibited but the sale and transport of its meat is not allowed. Its killing in agricultural fields and poaching in forests, along with spotted deer (*Axis axis*) and sambar (*Cervus unicolor*) is rampant, although official records do not say so. The problem of crop raiding by wild boars, monkeys and porcupines is really acute around protected areas. There is no compensation scheme for crop damage due to wild animals. Professional poachers take the benefit of poaching, while the common farmers suffer losses. We have proposed a community-based, pilot programme of trophy hunting of wild pigs in the villages surrounding PAs. It is proposed that the returns will be shared by the DWLC and the communities. The communities will use the revenues primarily for compensating crop damage, while the surplus can be used for other community development programmes. The programme is aimed at the management of pig population as well as for promoting community participation in wildlife management. If the returns from the scheme are good, which hopefully they will be, people may want more animals, rather than less, around their villages. The programme has been proposed in the plans for Victoria-Randinegala-Rantambe (VRR) sanctuary and Peak Wilderness sanctuary.

Buffalo Management

There are thousands of feral buffaloes (*Bubalis bubalis*) in the PAs of the dry zone. Although they are called wild buffaloes, the existence of wild genome in them is doubtful in most PAs. In Wasgamuwa National Park, their population is anywhere between 5000 and 10000, and they live along the periphery of the park, close to villages. The vegetation in the interior is too dense to be suitable for the species. These buffaloes compete with elephants for all their requirements and are far more than what the habitat can support. One reason for the elephants to raid crops may be the competition from the growing buffalo population. Therefore, we have proposed that the growth of the buffalo population be checked by removal of about 10% of the population every year. We have left the question of methodology open in deference to Buddhist sentiments. The captured animals can be either sold to farmers or converted into beef, depending upon the prevailing policies. This is proposed to be a revenue-generating exercise, to be run by private operators, under contract and supervision of the DWLC.

Leopard Conservation

As mentioned earlier, no attention has been given to this important sub-species of the globally endangered cat. There is no information on its populations and their dynamics. We have proposed monitoring of its population in alternate years, through pug-marks and other secondary evidence. In addition, a compensation programme for livestock losses due to leopard is also proposed.

Rehabilitation of Mined Habitats

Illicit mining for gems is a major problem all over the forests in Sri Lanka. For example, the western and northern parts of Wasgamuwa National Park have been seriously affected by mining. The miners dig deep and narrow pits, with steep walls. Whereas this significantly reduces the available habitat to animals, there are incidents of elephants and other animals falling in them to death. Therefore, we have proposed their filling to minimize the chances of mortality or injury to animals.

Tourism

Out of all the different categories of PAs in Sri Lanka, tourism is permitted only in national parks. A few PAs earn substantial revenues from these operations, mainly through entry fees and bungalow charges. Locals and foreigners are charged different rates. However, there are no interpretation or educational facilities, except a few small units in some PAs. The new plans propose private and community participation in running tourism facilities in the parks and strengthening of interpretation services.

Boundary Demarcation

Absence of clearly demarcated boundaries is a major cause of conflict with neighboring communities in most PAs. Neither the managers nor the people know the boundaries, except where prominent natural or man-made features form the boundary, which is rather rare. We have recommended the revision of existing boundaries to make them more identifiable and their demarcation by cutting lines and constructing concrete pillars.

Research, Monitoring and Training

As research is an important objective of the creation of PAs, we have laid sufficient emphasis on collaborative research in the plans. The research topics have been identified in consultation with local experts and their tentative costs and duration indicated. A user-friendly wildlife monitoring programme has been proposed (Pabla, 1998). The process consists of recording wildlife encounters by the staff, while on routine patrols, in a standardized format. The data so collected over a period of time can provide insights into the population

dynamics and distribution of most mammals. Training needs for field staff has also been identified and various general and special fields of training are indicated.

Financial Implications

The estimated cost of implementation of the seven management plans is approximately US $ 16.74 million. We must however, admit that looking at the current funding levels of the department, these costs are rather high. The reason for such high costs is that at present the staffing levels are extremely low and infrastructure is almost non-existent. Most of the costs are meant for staff salaries, infrastructure, ecodevelopment and research. Although we understand that such a high level of funding is difficult to find even with external funding, substantial relief can be expected if ecodevelopment and research costs can be co-financed by other stakeholders. However, we suggest that the targets recommended in the management plans, especially for staffing and research, be used as long-term targets and an incremental approach to their acquisition be adopted.

Conclusions

Sri Lanka is perhaps the only nation in the world, with a fairly complete inventory of the biological diversity existing in its Protected Area Network System. Sri Lanka also has the unique distinction of having management plans for all the major PAs. It is to be emphasized that for all the PA sites, management plans have been prepared for the first time. Hitherto, the management had been adhoc and there were no traditions of implementing sound wildlife management practices. The strategies prescribed in the plans will have to be carefully implemented and closely monitored. However, many of the innovative approaches proposed in the plans will be difficult to implement without an enabling policy framework. For example, the proposals relating to mitigation of human-elephant conflict, such as providing a subsidy for private electric fences and subsidy on crop insurance, and the reduction in the population of feral buffaloes in Wasgamuwa National Park and a cooperative trophy hunting programme for wild boar both as a means of reducing crop damage as well as generating community participation in wildlife management cannot be implemented without policy level decisions at the highest levels.

The two-step approach adopted by the DWLC of first having the resource inventories of PAs prepared by a team of national consultants and then having a team of international consultants work with the DWLC planning unit has been very appropriate and efficient. The preparation of resource inventories was a multidisciplinary task and generally beyond the capabilities of the PA managers. It would be very useful if other countries in the region could also adopt this approach for the preparation of PA management plans.

As indicated above the financial implications of implementing the management plans are high and it would be appropriate for the DWLC to use these plans to obtain a loan / grant from one of the multilateral donor agencies *viz.* the Asian Development Bank and the World Bank.

Acknowledgements

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Black-tailed Godwits *(Limosa limosa)* and the questions they raise for conservation in Bundala National Park.

Jon Bryson

15/1/1, Tickell Road Colombo 8.

There is something special about seeing a large, single species flock of birds. This generally occurs in Sri Lanka during the migration season, as migratory species attempt to make maximum use of a feeding site on arrival at it or prior to leaving. As birds are highly mobile, they move from area to area in search of sites with the maximum feeding potential (that is, obtaining the most amount food with the least expenditure of energy). This sometimes results in thousands of birds massed on suitable sites but can also result in great variations in bird numbers from year to year, even at popular locations.

Black-tailed Godwits, *Limosa limosa,* are gregarious birds by nature and can be seen feeding in small flocks (100 +) around Bundala National Park from October to March on flooded grassland and muddy lake shores, in both fresh and saline water. Identification of this relatively large, long legged wader is comparatively easy because of its characteristic long straight bill, which is black tipped with a flesh coloured base (shorter in males). It shows magnificent chestnut brown coloration in breeding plumage on both chest and head. Unfortunately, it tends to take a dull gray color when in Sri Lanka (non breeding plumage). In flight, it shows striking white wing bars and rump with a contrasting black tail (Hayman 1998, Henry 1971, Harrison 1999).

In November, with the onset of the rains, the small flocks mass in large numbers of up to a 1000 and can be best seen from the road that leads from the Hambantota, Tissamaharama road to the park office of the Bundala National Park. The rains rapidly flood this grassland area where large numbers of cattle and water buffalo feed and water. The excrement from these animals results in the area becoming enriched with nutrients and organic material (eutrophic), (De Silva *et al,* 1998) adding to the natural high productivity of all wetlands (second only to Tropical Rain Forests, see table 1). These conditions cause the formation of a nutrient rich 'soup', ideal conditions for an explosion in the populations of crustaceans and invertebrates. These crustaceans and invertebrates are the attraction for the Godwits who can now gorge themselves, even in very large numbers, until the food source is depleted or the area becomes flooded by continued rain to a level exceeding their maximum feeding depth.

This area also supports large numbers of Garganey Ducks *(Anas querquedula)* at this time. This is possible as there would be little competition for food as both species use different feeding strategies. Garganey Ducks are surface filter feeding omnivores (Soothill & Whitehead 1978), whereas the long bill of the Godwits allow them

Table 1. Net annual primary productivity of major terrestrial ecosystems.

Ecosystem type	Area / 10^6 km^2	Net primary Productivity per unit Area / g m^2 or t km^2		World net primary Productivity / 10^9t
		Normal range	Mean	
Tropical rainforest	17.0	1000-3500	2200	37.5
Temperate deciduous forest	7.0	600-2500	1200	8.4
Boreal forest	12.0	400-2000	800	9.6
Tundra and alpine	8.0	10-400	140	1.1
Desert and semi-desert scrub	18.0	10-250	90	1.6
Cultivated land	14.0	100-3500	650	9.1
Wetlands (swamp and marsh)	2.0	800-3500	2000	4.0
Estuaries	1.4	200-3500	1500	2.1

Letters to the Editor

Vicky Atukorale

Please permit me to add a few words to the many tributes recently paid to Athu (Atu) in LORIS. I am probably one of the very few surviving individuals to have actually dived with Athu (the others are Callistus Almeida, Peter Hettiarachchi and A.J.Thaha, all of Kinross Club).

Athu's diving equipment was very basic, a facemask and a hand spear. He made his spears from smooth mild steel rods of 3/8" diameter (the type then used for reinforcing concrete). Their lengths varied from approximately 5 to 51/2 feet. One end was sharpened to a point and would be re-sharpened on a rock from time-to-time. The spears were without barbs to maximize penetration. Athu favored the French "Champion" masks above all other, although he would use anything available when necessary.

Athu never used swim fins and therefore could not reach any great depths. I dived with him on several occasions in the 1970's, by which time he was well past his prime. Most of his diving was in water 10-15 feet deep although on occasion I saw him reach c.20 feet. As Athu did not use swimfins or a spear gun, he was not able to take fast-moving pelagic and oceanic fish; he therefore confined his efforts mainly to reef fish such as surgeonfish, sweetlips, snappers, goatfish, angelfish and an occasional ray, octopus, spiny lobster, etc. The largest fish he killed while diving with me was a three-pound brown sweetlip (*Gaterin sivalingami*).

His *modus opperandi* was to hyperventilate before each dive. He stalked his prey until it was about two feet from the spear point when a quick thrust would impale the target. He next passed his left hand over the struggling prey and gripped the spear near its point. Thus, with one hand on each side, the impaled prey could not escape. He would then surface quickly.

Athu once discussed with me the reason he never used swim fins or a spear gun. He was taught to spear fish in the late 1930's by the leader of a group of Polynesian entertainers who were stranded in Sri Lanka (then Ceylon) at the outbreak of the Second World War. The Samoan who taught him used only diving goggles (not to be confused with modern swimming masks) and hand spear. In respect and veneration of his "Master" Athu dived as his teacher did. He did compromise however, and used a modern facemask, but only because the original "Fernez" goggles were no longer manufactured.

Athu scorned modern developments such as wet suits, which he contemptuously referred to as "Monkey Suits" and SCUBA gear, which to him were "Mosquito Sprayers" because of their vague resemblance to knapsack (pesticide) sprayers.

I hope that this note has shed some additional light on a most remarkable personality.

Rex I. De Silva
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The Death of the Wellawatte Canal

There is an area in the heart of Wellawatte, which was at one time a mini jungle. This is the lower most part of Wellawatte Canal. This area starts from the Wellawatte Mills and goes up to the sea.

I have been taking this road over the past 10 years to reach Galle Road from my house at Peterson Lane. There were huge trees on both sides of the Canal. There used to be several water monitors warming their dark bodies in the morning sun. I had often heard the call of the Water-hens [korawakka] here. There was much bird life including Kingfishers, Storks, Magpie robins, Mynahs, Bulbuls and so forth. The canal was full of fish. This small area looked like an illustrated page from a fairy tale book.

Three to four years ago, the Sri Lanka Land Reclamation and Development Corporation developed this canal, on behalf of the government. The first stage of development was to cut down all the trees standing on the canal bank. Next, a concrete wall was erected on both sides of the canal, using huge stones and iron sheets. Thus, my "mini jungle" disappeared. This led to an imbalance in the environment.

Those birds who could fly went to safer places. Other animals who lost their habitats died of starvation. All the water-hens disappeared. I never heard their familiar call afterwards. Today only a handful of trees can be seen. Although there was a mighty hurry to cut down all the trees for this "development project", no one wants to plant even a single tree there now. However, there are a few birds and animals even now who have braved death and destruction.

The canal has now become a dumping ground. The wastewater of the area has been diverted to the canal. The garbage thrown includes the refuse from kitchens, plastic cans of all shapes and colour and polythene bags. These items finally end up in the sea. The tide ultimately brings the garbage back to the sea beach. The end result is that the Wellawatte sea beach is totally polluted. The beach is covered with ugly polythene bags, plastic containers, etc. This is indeed a very sad story. Furthermore, this garbage has lowered the water quality in the canal. The water is as dark as ink and smells strongly.

I kindly request the Land Reclamation Corporation and the Colombo Municipal Council to rectify this situation by planting trees on the canal banks. The Municipal Council, if possible must release a few water-

hens to this area. I am sure that the National Zoo will help the Colombo Municipal Council in this regard. The Municipal Council also must impose fines on the people who dump garbage to the canal.

I earnestly request His Worship Omar Kameel, Mayor of Colombo, who lives close to this area, to get this part of the canal declared as a bird sanctuary and protect the environment. The area to be looked after should include the Wellawatte Beach as well, where there are several squatters living at present.

The birds and trees do not ask for jobs, salaries, bonuses or housing complexes. They do not demand very many things. They only ask to be undisturbed by man. They want only the shelter of a few trees.
Can we resurrect the canal, which is dead? I am sure we can if we are dedicated to the cause of conservation.

Nimali Fernando
Year 10, St. Bridget's Convent, Colombo 7

The Seven Sisters and the Four Eggs

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T.S.U. de Zylva (1984) in a description of the common babbler (*Turdoides affinis*) observed that a group of 5-6 birds bring food to nestlings. However, the eggs per nest were always less than four. Why are there more adults looking after the young, he wonders. In this article we attempt to answer the question posed by de Zylva and review the unique type of mating system seen in babblers.

The babblers are a large family of tropical and subtropical birds. They are classified in the Family Muscicapidae (consisting of babblers, warblers, thrushes and flycatchers), and subfamily Timaliinae (Ripley, 1982). This family includes 252 species, distributed in Africa, South Asia, Australia and North America (Birkhead, 1991). They are small to medium sized perching birds, usually dull coloured and inhabit terrestrial habitats. Most species are noisy and live in groups.

Approximately 100 species of babblers belonging to 35 genera have been described in the Indian subcontinent. In Sri Lanka, 8 species of babblers belonging to 7 genera have been recorded (Wait, 1983; Kotagama & Fernando, 1994). These eight species are *Pellorneum fuscocapillum* (endemic species), *Pomatorhinus horsfieldii, Dumetia hyperythra, Rhopocichla atriceps, Chrysomma sinensis, Turdoides affinis, Turdoides rufescens* (endemic species) and *Garrulax cinereifrons* (Endemic species).

*Turdoides affinis** Ripley (English: seven sisters, yellow billed babbler or common babbler; Sinhala: demalichcha; Tamil: pulini kuruvi or kalani kuruvi) is one of the commonest members of this group in Sri Lanka.

Mating systems in birds

Different types of mating and parental care systems are found in birds. Monogamous birds mate with one individual. In this system the male and the female work together to rear their brood. In the polygamous system, the male or the female may have many mates. Depending on the species, both or one of the parents rears the brood. In some bird species the breeding pair is assisted by one or more helpers to rare the young. This is referred to as cooperative breeding or communal breeding.

*Synonyms: *Malacocircus striatus* Swainson, 1833, *T. striatus* Dumont

Communal breeding was first discovered in the 1930's and was studied in three tropical bird species: brown jay, bush tit and banded backed wren. Now it is known that about 220 birds show communal breeding habits. Examples include birds of the families Alcedinidae (kingfishers) and Meropidae (bee-eaters) (Krebs & Davies 1986). There are two types of communal breeding systems. One type is where the parentage is shared. The other type is known as the helper-at-the-nest system where only one pair breeds and the others help in functions such as finding food and protection from predators. They contribute physically and not genetically in the rearing of the young. The helpers are also referred to as alloparents. This behavior is a form of altruism. The helper-at-the-nest system is found in over 200 species of birds. The helper-at-the-nest system is the explanation for the seven sisters, who tend only four eggs. The helpers at the nest belong to both female and male in the case of the babblers. In the king fishers the alloparents are males. In a study of the jungle babblers it was revealed that an individual acts as an alloparent for many years. However, less than 25% of the alloparents attain breeding status.

Why helper-at-the-nest system?

The alloparents cannot pass genes directly to the offspring. This is contradictory to the fitness as defined by Darwin. Such altruistic behavior increases the survival ability of the group as a whole; this is known as inclusive fitness. This can be compared to worker ants or bees in a colony. They do not reproduce themselves but they contribute to the functioning of the colony so that fitness of the group of related genes increases.
There are several advantages of communal breeding that contribute to the survival of the gene pool of the particular group. These advantages include:

- Less work during food provision. It has been shown experimentally that adults make fewer foraging trips. This has been shown in *Turdoides caudatus* (common babbler) (Gaston, 1978) and *Pomatostomus temporalis* (gray crowned babbler) (Councilman, 1977).

- Breeding in groups decrease mortality of the young ones. The annual survival rate of juveniles is high in the presence of helpers at the nest.

Social structure of the babblers

In social animals a hierarchy is maintained by means of various types of behavior used as signals. For instance the pecking behavior in the domestic chickens has a linear hierarchy where the dominant individuals will not be pecked by subordinate chickens. This is known as the pecking order. Cattle show butting and monkeys use the grooming behavior to establish hierarchies. Amotz Zahavi working over three decades on the Arabian babblers (*Turdoides squamiceps)* has shown that the helping behavior is the system by which the social status is maintained in these birds.

A dominance hierarchy forms within the helpers at the nest in the nest. The hierarchy is based on the age and sex, where the older individuals are more dominant than young ones and the males dominate over females. In similar age and sex groups, it is the 'being nice' behavior that determines the hierarchy (Carlisle and Zahavi, 1986). This 'being nice' behavior includes feeding adults and nestlings, sentinel behavior and preening. Thus it will be the dominant individual that will preen others and also feed the lower ranking birds. How this seemingly altruistic behavioral trait is sustained is a center of controversy. It is argued that as 'being nice' promotes an individual to become the alpha or dominant individual and thus it will be able to mate more, which will increase its genetic contribution. Thus if you observe a babbler preening or feeding another bird it is trying to be nice with an ulterior motive of reproducing more of its own offspring! This is in contrast to a world where a lot of fighting, cheating, butting and pecking goes on to woo the mates and to produce offspring.

The oldest is the most dominant member and will inherit the alpha position upon the death of the dominant same sex breeders (Gaston, 1978 and Zahavi, 1974). Young birds in a group delay dispersal for one to three years and they act as helpers at the nest waiting their turn to become the alpha individual. Another study on the Arabian babblers showed that behaviorally dominant males -the alpha males produced 95% of the offspring whereas alpha females produced 99.5% of the offspring (Lundy et.al., 1998). The babblers are also highly territorial birds, defending their territory from any intruders. It has been found when the size of the group increases it results in greater territory. It has also been observed in Arabian babblers that with the increase in group size more fledglings are produced (Wright, 1998).

Foraging behavior

We have studied the foraging behavior of the babblers. The group feeding flock size varies between eight and seventeen. They feed on various types of food items, picking earthworms in moist soil being the favorite one. During feeding one bird was on sentinel duty and was more alert than the others. Previously we have shown that their daily movement during foraging follows a highly predictable path (Dharmaretnam *et al*, 1999). The foraging path is determined by availability of water, which in turn is related to earthworm availability. They avoided the site during the time when there was more human activity. Peak feeding activity took place in the morning between 8.30 - 9.30 hours. The earthworm, which was the common food item, was held in the leg while being eaten. The typical vocalization of the babblers was high in the late morning between 10.30 – 11.30 hours. The evening activities included preening and feeding. One or two squirrels were also found in the vicinity of the feeding area of the babblers. Presence of a natural enemy such as a crow elicits aggressive behavior in the squirrel, which in turn causes all the babblers to fly from that particular place. A similar observation of tagging by the common palm squirrels was also observed by De Zylva (1984).

Wait (1983) has noted mobbing behavior in the common babbler. They throw themselves and 'fight bill and claws' on cats, hawks and vermin. However, we have not observed such mobbing behavior during the study period. Whenever a crow came along the tagging squirrels made a vocalization and the whole flock flew away. Thus it could be speculated that the squirrel and babblers have a mutualistic association. The squirrel warning the babblers of the predator and the babblers in turn leading the squirrels to food patches. We are conducting observations to shed more light on this aspect of behavior.

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Seabird Studies off the West Coast 1981-2001

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The Seabird Watch (SW), which functioned informally in the late 1970's, has operated as an organization since 1981. Its main purpose is to study and monitor Sri Lankan seabirds. Whilst its activities are intended to cover the entire island, on account of security constraints and logistical considerations, most projects have been restricted to the western coastal regions. The SW operates in close co-operation with the Field Ornithology Group of Sri Lanka (FOGSL). This release outlines some of the activities of the SW in its two decades plus of existence.

A study was conducted from 1981-1994 on the annual mass-migration of seabirds. The migrants, consisting mainly of Bridled Terns *Sterna anaethetus* together with smaller numbers of other species, were observed from (land-based) stations along the west coast. Sooty Terns *Sterna fuscata*, Common Terns *Sterna hirudo*, Brown Noddies *Anous stolidus*, Lesser Noddies *Anous tenuirostris*, Brown Boobies *Sula leucogaster*, Wilsons Storm Petrels *Oceanites oceanicus*, Pomarine Skuas *Stercorarius pomarinus*, Brown skuas *Catharacta (antarctica) lonnbergi* and other species were present in small numbers during the migration. Some of these species were on migration, whereas Skuas were present as kleptoparasites preying on the migrating terns. The role of a few other species is uncertain. Interestingly resident Great Crested Terns *Sterna bergii*, were observed occasionally to act as kleptoparasites on the migrating seabirds.

It is estimated that in peak years as many as half million seabirds migrate southwards off the west coast during daytime. The route taken by the migrating seabirds was traced along the western coast from Kandakuli in the north down to Dondra Head in the south. (This is of course the main SW observation area and undoubtedly the actual migratory route is more extensive). Interestingly, the intensity of migration declined noticeably south of Kosgoda. It is suspected that as the ocean currents bifurcate near here it may in some way, presently not understood, affect the intensity of migration further south. Limited observations along the south coast from Dondra Head to Hambantota revealed only stragglers. It appears therefore, that the main migration veers away from our coast beyond Dondra Head. Nevertheless this conclusion is tentative and further studies may indicate otherwise. (Observers on the south coast could possibly make a useful contribution here).

A method was developed to estimate flight-speeds of the migrating Bridled Terns. This suggested that the birds fly rather slowly at speeds ranging from 13-26km / hr. These results should nevertheless be treated as preliminary.

A parallel study was conducted on migrating Flesh-footed Shearwaters *Puffinus carneipes* – an Australian species that migrates into the Northern Indian Ocean during the southern winter. Their route off the west coast is similar to that followed by the migrating Bridled Terns, except that intensity of migration does not decline significantly south of Kosgoda.

A study involving both museum research and field observations revealed that the large skuas reported in our waters were Brown *Skuas Catharacta (antarctica) lonnbergi*. It was also established for the first time that the (sub) species is a trans-equatorial migrant in the Indian Ocean. Data suggests that most if not all Brown Skuas in the Northern Indian Ocean originate from Crozet, Amsterdam, Kerguelen, Heard, Prince Edward and other islands in the Southern Indian Ocean and also from New Zealand.

Preliminary studies on threats to seabirds indicate that some species (gulls etc.) are captured for food in north-western coastal regions. A few seabirds (mainly Boobies) are drowned in drift nets. Conversion of the littoral areas of many coastal wetlands into evaporation ponds for salt production or ponds for shrimp farming deprive several species of resident terns of breeding space. Work also remains to be carried out on the numerous other threats to our seabirds. For example the effects of oil and other forms of marine pollution have not properly been assessed to date.

Three seabird species were added to the Sri Lankan list on the basis of specimens. These are:

1. Jouanin's Gadfly Petrel *Bulweria fallax*.
2. Brown Skua *Catharacta (antarctica) lonnbergi*.
3. Lesser Noddy *Anous tenuirostris*.

Eight species were also added on the basis of reliable sight-records accepted by the SW and FOGSL. These are listed below.

1. White-headed Petrel *Pterodroma lessonii*.
2. Barau's Petrel *Pterodroma baraui*.
3. Soft-plumaged Petrel *Pterodroma mollis*.
4. Audubon's Shearwater *Puffinus l'herminieri*.
5. South Polar Skua *Catharacta maccormicki*
   (Note: earlier records in Whistler, Wait, Henry, Phillips etc. were based on misidentification of a Brown Skua. See De Silva, 1989 for details).

6. Black Noddy *Anous minutus*.
7. White-cheeked Tern *Sterna repressa*.
8. Black Tern *Chlidonias niger*.

To complement its own studies the SW collects and collates information on seabirds from other sources and is currently compiling a database of seabird information. Conservation activities are an important adjunct to its research. Together with other seabird organizations, the SW protested to the South African Government against the construction of an airstrip at Marion Island, which would have adversely affected seabird populations. It also supported international efforts to introduce legislation restricting bait-throwing devices, which threatened albatrosses and other seabirds (both of these protests were successful). The SW was represented at PASOC 1 (1996) and PASOC 2 (2000). It also participated at the IOMAC conference held in 1998 where the importance of seabirds as indicators of the quality of marine environments were outlined. SW has also been represented in the IUCN / SSC Seabird Specialist Group.

Acknowledgements

The SW wishes to acknowledge with thanks the advice and guidance provided on several technical issues, by Professor S.W. Kotagama, President of FOGSL.

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Report from the Ceylon Bird Club for 2000

Nanda Senanayake

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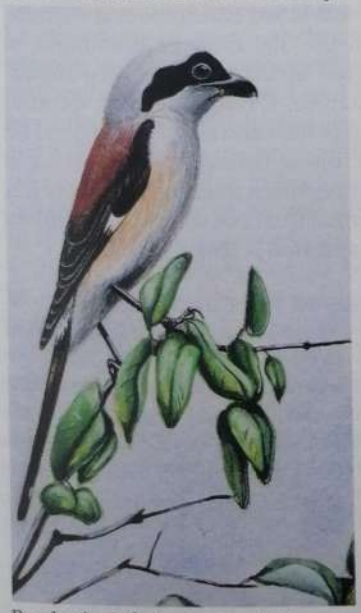
The new committee of the Ceylon Bird Club was appointed in August. A General Meeting was held in November. Deepal Warakagoda gave a talk, illustrated with photographs, on Black-winged Stilts with black hindneck markings. Pathmanath Samaraweera presented a talk and slide show on bird photography and its ethics.

Unusual records

A Bay-backed Shrike *Lanius vittatus* was observed for the first time in Sri Lanka at Bundala in February by Paul Holmes and three others. It was seen through February and March by many members. Deepal Warakagoda has recorded a Dusky Warbler at Bellanwila-Attidiya marsh and a Citrine Wagtail at Udawalawe. Both are second records for the country. Bonelli's Eagle was recorded for the first time since 1858, by Deepal Warakagoda at Bundala. The above four reports are yet to be ratified by the Records Committee.

A sudden eruption in the number of Rosy Starlings was observed across the island during the 1999-2000 migration season, with two flights each with more than 100,000 birds recorded in early 2000. Fairly large numbers were recorded in late 2000, during the next season. Pallas's Grasshopper Warbler was reported from Bellanwila, Kalametiya and Pattipola. Blyth's Pipit was observed mainly at Udawalawe as usual, and also in the south-east and Kaudulla. A Ceylon Crested Drongo with a racket tail was reported at Gilimale and a discussion took place on its identity in the CBCN. Great Cormorant was recorded at many sites in the dry zone. European Bee-eater at Bulutota, its third site in the island. Reports on Common Coot at Vaddukoddai and Yala, Broad-billed Roller at Sinharaja, and Common Cuckoo at Colombo were also received. In mid-June 15 species of migrant waterbirds loitering on at Bundala was reported. A Blue-eared Kingfisher was reported from Wasgamuwa in September. A Flesh-footed Shearwater skeleton was picked up at Kalpitiya.



Bay-backed Shrike *Lanius vittatus*
Painting by Pathmanath Samaraweera

Habitats

The destruction of forests continues unabated owing to the lack of adequate planning and vigilant supervision in National Parks, Forest Reserves and other Protected Areas. The boundaries of many wet-zone forests are under constant threat due to encroachment for the cultivation of tea, which is a lucrative crop at the moment. Not often mentioned these days is the age-old threat to forests from chena cultivation. The needless destruction of wildlife habitats for the Kukule Ganga hydropower project is detailed in the July issue of CBCN.

The decimation of some species of amphibians, serpents and lizards by the increase in Jungle Crows, Common Mynahs and Common Coucals at Horton Plains, following human activity there, was described in the May issue.

The situation in the north and east of the island is still largely unknown.

Waterfowl count

The club carried out the 'mid-winter' waterfowl census, in collaboration with Wetlands International, for the 17th successive year in January-February 2000. Coverage was resumed in the Batticaloa and Welikanda areas, from which there was no ornithological data for many years due to the armed conflict. Except for some parts of the Jaffna peninsula, which have been covered almost every year, the rest of the north and east remained unvisited.

Most of the sites visited had high water levels, and were hence shunned by water birds. The total count came up to *Ca.*104,000 birds belonging to 90 species. A detailed report has already appeared in the December 2000 issue of *Loris*.

Endemic species

The 26 endemic species were recorded satisfactorily in their respective habitats and usual sites. The following reports were notable. Ceylon Spurfowl near Kuliyapitiya. White-headed Starling in a feeding flock at Morapitiya. Ceylon Wood Pigeon at Morapitiya in June and a nesting site south-west of Gampola.

Birds of prey

Raptors: 24 species were recorded, of which eight are migrant. Commonly reported, as usual, were Shikra, Brahminy Kite, Crested Hawk-Eagle, Crested Serpent Eagle and White-bellied Sea Eagle. Satisfactory numbers of reports of Crested Honey-Buzzard, Brown Baza (four), Grey-headed Fishing Eagle, Mountain and Rufous-bellied Hawk-Eagles, Black-winged Kite, Besra Sparrowhawk (six), Crested Goshawk, Shahin and

Peregrine Falcons, Kestrel, Montagu's Harrier and Booted Eagle. Under-represented were Marsh and Pallid Harrier and Osprey. A Bonelli's Eagle was sighted at Bundala.

Owls: Of the ten resident species eight were reported, most often being Brown Fish Owl, the endemic Chestnut-backed Owlet and Collared Scops Owl. Barn Owl and Bay Owl were not recorded, nor the migrant Short-eared Owl. Few reports of Brown Wood Owl, Forest Eagle Owl, Little Scops Owl and Jungle Owlet were received. Brown Hawk Owl was under-represented probably due to lack of reporting as it is common and widespread.

Digest

Since it was founded in 1943 the club has published its monthly journal, the *Ceylon Bird Club Notes*, regularly for every month to date. The more notable observations in it for 2000 are given below.

January

Dusky Warbler and Pallas's Grasshopper Warblers at Bellanwila-Attidiya. *Ca.* 1,000 Greater Flamingos at Bundala. Orange-headed Ground Thrush and European Bee-eaters at Yala. Brown Baza at Horton Plains. Rosy Starlings in great numbers at Udawalawe, Kalametiya (at each a flyover of more than 100,000), Yala and Polonnaruwa. White Wagtails and Besra Sparrowhawks at Udawalawe, 12 Ruffs at Sittarakala, Glossy Ibis and Pallid Harrier at Kalametiya, and nesting of White-necked Storks west of Angamedilla.

February

A Bay-backed Shrike, *Ca.* 300 Greater Flamingos, Long-toed Stints, Small Cuckoo and Peregrine Falcon at Bundala. Montagu's Harrier near Welikanda. Ceylon Spurfowl near Kuliyapitiya. Orange-headed Ground Thrush at Sigiriya. Black Drongo at Mirijjawila. Indian Reef Heron at Hambantota. Ceylon Frogmouth and Rufous Woodpecker at Ihala Bope. European Bee-eaters at Yala, one at Bulutota. Pallas's Grasshopper Warbler at Kalametiya. Broad-billed Sandpipers at Kirinda. Black-capped Kingfisher at Tissamaharama.

March

Osprey and Montagu's Harrier at Udawalawe. Common Coot at Vaddukoddai. Pallas's Grasshopper Warblers at Pattipola. White-necked Storks at an elevation of 1,000 m, Blue-faced Malkoha at 720 m and a pair of Shahin Falcons, on north side of Knuckles. *Ca.* 50 Greater Flamingos at Hambantota. Nesting of Three-toed Kingfisher and Ceylon Crested Drongo at Sinharaja. Openbill 1 km south of Sinharaja. 30 Great Cormorants at Vadamaracchi.

April

Nesting of Malabar Pied Hornbill at Yala, and Thick-billed Flowerpecker at Giritale. Common Coot at Yala. Peregrine Falcon at Colombo Fort. Broad-billed Roller at Sinharaja.

June

White-tailed Tropicbird at Kirinda. White-headed Starling in a feeding flock, and Ceylon Wood Pigeons, at Morapitiya. In mid-June 15 species of migrant waterbirds, including *Ca.* 650 Greater Flamingos, loitering at Bundala.

August

Nesting of Ceylon Wood Pigeon at Suriyakanda. *Ca.* 250 Greater Flamingos at Palatupana. Broad-billed Sandpipers at Puttalam.

September

Shahin Falcon at Kurunegala and Udawalawe. White-headed Starling near Sitagangula on the Kuruwita - Adam's Peak path. Red-faced Malkoha and Blue-eared Kingfisher at Wasgamuwa. Besra Sparrowhawk at Randenigala. Three-toed Kingfisher at Yagirala south-east of Matugama. Flesh-footed Shearwater skeleton at Kalpitiya.

October

150 Oriental Pratincoles at Weerawila, 125 at Sella Kataragama. Ruff and Temminck's Stint at Talangama Tank. Common Cuckoo in Colombo. Marsh Harrier at Udawalawe. Red-necked Phalaropes and two Ruffs at Palatupana.

November

Indian Reef Heron, Black Drongo, and European Bee-eaters at Yala. Eight Ceylon Wood Pigeons and one nest south-west of Gampola. 15 Glossy Ibis at Boralesgamuwa. Marsh Harrier and Pallas's Grasshopper Warblers at Bellanwila-Attidiya. Montagu's Harrier, Osprey and two Small Cuckoos at Udawalawe. *Ca.* 900 Greater Flamingos at Bundala. Little Pratincoles mating at Palatupana was observed.

December

Large numbers of Grey Partridges in Jaffna area. Besra Sparrowhawk at Horton Plains. Black-capped Kingfisher and Ruff at Yala. 24 Broad-billed Sandpipers at Kirinda. A Bonelli's Eagle and *Ca.* 350 Greater Flamingos at Bundala. Citrine Wagtail at Udawalawe. Two Broad-billed Rollers at Sinharaja. Orange-headed Ground Thrush at Udawalawe, Giritale and Sigiriya. Ceylon Hill Munias at Ratnapura. Black Drongos of two sizes at Chunnakam, indicating northern migrants. A Glossy Ibis over Nugegoda. Two Small Cuckoos at Sigiriya. A Brown Baza at Horton Plains and two below Ambewela.

List of special papers in *Ceylon Bird Club Notes*, 2000

Senanayake N. (May) Are Grey Drongos being misidentified as Black Drongos?

Warakagoda D. (June) A record of the Rufous-necked Stint *Calidris ruficollis* in Sri Lanka.

Lamsfuss G. (July) Potential new migrant visitors to Sri Lanka.

Hettige U. (July) Bird diversity under threat by the Kukule Ganga hydropower project.

Warakagoda D. (August) First record of Pacific Swift *Apus pacificus* in Sri Lanka.

Warakagoda D. (August) First record of Desert Lesser Whitethroat *Sylvia (curruca) minula* in Sri Lanka.

Gunawardana J. (October) Observations on Layard's Flycatcher *Muscicapa muttui*.

The Discovery of a New Owl

Deepal Warakagoda

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On 23 January 2001 a species of bird unknown to science was discovered in Sri Lanka. It is a small owl, which lives in our rainforests.

The last discovery of an entirely new bird species in the island had been 132 years ago: the endemic Ceylon Whistling Thrush *Myiophoneus blighi* in 1868. Sri Lanka has been well explored and surveyed ornithologically for the past one-and-a-half centuries. Half a century ago W.W.A. Phillips, one of the foremost authorities on our avifauna, stated that it was "most improbable that a bird entirely new to science could now exist in Ceylon". The December 1951 issue of *Loris* carries his remark.

The possibility of the existence of an unknown nocturnal bird in our forests was first noted by me six years ago. During a night visit to a rainforest in late February 1995, I heard a peculiar, unidentified animal vocalization. My search for its source was not successful. However, I was able to make a rather poor audio recording of it. It was reminiscent of the typical song of a night bird, and hence I thought that it was more likely to be a bird. With my experience of bird sounds, I had adequate knowledge to believe that it was not, however, made by any night bird then known in Sri Lanka.

Three weeks later in the same forest I heard the call again on two consecutive days. On both days its author eluded me again, but I was able to get better recordings this time. A comparison of these was carried out with the recordings of many nocturnal birds of the Asian region. It indicated that the bird was very likely to be a small owl. All the literature I could obtain on the owls of the world was also studied to analyze the source of the sound. It seemed to me very probable that this was an owl not known before in Sri Lanka. I could now also discern that there was a small possibility of it turning out to be an entirely new species.

In April 1995 I recounted my experiences and played the recordings before a small group of experienced birders in the Rarities Committee of the Ceylon Bird Club and I told them of my thoughts. P.B. Karunaratne, the renowned naturalist, was the only person at the meeting who had noted the call before. He, however, had supposed that it was an unknown arboreal amphibian. I explained that it had to be a bird, probably a small owl of the *Otus* scops owl group, from the comparison studies carried out.

During the next six years I encountered the sound on several visits to forests. My attempts to track down its source were still unsuccessful, though I made progressively better recordings. These were used in further studies, which strengthened my belief that it probably was a small owl. In the meantime Upali Ekanayake, who had been at the Rarities Committee meeting, heard the call in a rainforest in December 1996, and told me that he, too, agreed with this idea. In October 2000 I obtained still better recordings of the call, during my closest encounter until then with its unseen author. A sustained effort of two hours to see the bird that night ended, again, in disappointment.

These last recordings were sent to Dr. Pamela Rasmussen at the National Museum of Natural History, Smithsonian Institution, U.S.A. A leading authority on the avifauna of Asia, she was then working on the taxonomy of the birds of the Indian region, with special attention to vocalizations. She, too, could not arrive at an identification of the sound, but believed that it was very likely to be of a small owl.

The next encounter was in January 2001. This was at the same place, almost certainly with the same bird, as in October, and again at close quarters. On this memorable night, after I had been struggling to see it for more than an hour, my quarry showed itself to me. In the beam of my torch, making the call which I had been tracking for so long, was a strange, small owl!

The bird, which I examined through my binocular, was strikingly different from all the other owls known in Sri Lanka. On my return home, the comprehensive world literature on owls was carefully perused again. It was obvious that this was a bird never described or depicted before. I was now nearly certain that it was an entirely new species.

Dr. Rasmussen, on receiving the news of the observation, put to me numerous and detailed queries on it, to which I replied. I remarked to her that I was reluctant to collect a specimen of the bird at this stage, as it still appeared to be very rare. She then advised that the next step should be to provide visual evidence, as proof of the existence of the species, and for use in further

Looking for the owl on the night of the first photograph. From front, Nanda Senanayake, Deepal Warakagoda, Chandima Kahandawala.

studies.

On 11 February 2001, with wildlife photographer Chandima Kahandawala, the chairman of the Ceylon Bird Club Nanda Senanayake and Udaya Sirivardana, I made an expedition to another rainforest where the bird's presence had been noted by me. That night two of the owls were tracked, one after the other, and at the end of five hours of effort we succeeded in observing the second of them. A set of photographs of the bird was obtained under difficult conditions, the first ever of the species. These depict the bird from various angles, and clearly show the distinctive features of the species. This journal carries several of these images on the cover and these pages. They have been praised by international experts as being among the best photographs taken of a newly discovered bird species in its natural habitat.

Two individuals of the owl had now been observed at two rainforests situated far apart. They were identical in their plumage detail and their unique vocalization. The distinctiveness of the undescribed species was now clear and evident.

The photographs, the audio recordings and field descriptions of the bird were sent to Dr. Rasmussen for comparative studies at her institution, which holds a comprehensive specimen collection of the known owls of the world. She now confirmed that it was a 'previously unrecognized species, almost certainly new to science.' She, too, believed that it was probably of the genus *Otus*, i.e. a scops owl. Following a press release, the public media presented the news of the discovery and the photographs, in Sri Lanka and internationally.

A brief, informal description of the bird is as follows. It is about the size of the Indian Scops Owl *Otus bakkamoena*. It has no distinct ear tufts. The tail is short, ending more or less in line with the closed wings. The bird is much more uniform in coloration than any of our other owls. The upperparts are brown tinged with rufous; face rufous-brown, with white eyebrows; breast and flanks lighter rufous-brown, grading into whitish on the belly and vent. There are fine, dark spots scattered on much of the plumage. Eyes orange-yellow. Beak, legs and claws whitish. The feathering on the legs does not extend down to the feet, unlike in most small owls.

The call is distinctly different from that of any other owl in the world. The sexes call in the same pattern but in different keys, as observed in certain other owl species.

The new owl is strictly a forest bird, and entirely nocturnal in its habits. It is very elusive, and appears to be very rare. This could be the reason why it had not come to the notice of earlier investigators of Sri Lankan avifauna. From the time of the first attempts to track it down until now, five individuals of the new species have been detected, initially all by their unique vocalization. Two of them have now been observed well.

More comparative studies carried out at the Natural History Museum at Tring in the U.K and the National Museum, Colombo further established that the existence

of this owl had been entirely unknown. It is a species endemic to Sri Lanka, i.e. found only in this country. It becomes the 12th species of owl known in the island, and the second endemic among them, the other being the Chestnut-backed Owlet *Glaucidium castononotum*, discovered in 1846.

I have set out on a project to study the distribution, ecology, biology and taxonomy of the new owl. It is being carried out with the help of a small team, and in collaboration with the Ceylon Bird Club. Formal scientific naming of the new species awaits completion of morphological studies.

I regret that at this stage it is not possible to disclose the locations where the new bird occurs or to describe its call. As it still appears to be very rare, one needs to be mindful of any disturbance to the species which may be caused by eager observers attempting to view it. The information will be provided when it is proper to do so, as we learn more about its abundance and distribution.

Note 1: This article presents the position as at June 2001.

Note 2: The pupils of the owl's eyes are naturally black. In the originals of the photographs used in this journal the eyes appear red due to an effect of the camera flash. Here, the colour of the eyes has been altered to the natural colour.

Acknowledgments

I record my gratitude to all the following persons, in the matter of the new species. Dr. Pamela Rasmussen has given me continuous guidance. Officials at the museums mentioned above permitted us to examine their specimens. Mr. Chandima Kahandawala produced the photographs which proved the existence of the species. Messrs Kahandawala, Udaya Sirivardana, Nanda Senanayake and Kithsiri Gunawardena have provided support in the field and off it. The Research Committees, officials and field personnel of the Department of Wildlife Conservation and the Forest Department gave us permission and assistance to carry out the study project in areas under their control. Mr. John Deppman donated funds to begin the project. 'U.S.' helped with this article; Mrs. Tara Wikramanayake, Dr. Pathmanath Samaraweera and Mr. Senanayake commented on its draft.

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Purple Nillu in Bloom Again at Horton Plains

Cecil Dharmasena

After a lapse of many years, the purple Nillu (*Strobilanthes asperrimus*) is flowering in profusion once again at Horton Plains. During a short visit at the end of December (2001) this very colourful mass of flowering shrub was seen especially along the Ohiya road that leads past the Ginihiriya lodge. This species is said to flower once in around 7 to 8 years.

There are about 28 species of *Strobilanthes* found in Sri Lanka of which more than 20 species occur up country according to T.C.E.T. Bond (Loris, Vol. XVII, No. 6, December 1987). The flower of the purple Nillu is actually a light purplish mauve (see photographs). The flowers are trumpet shaped and white while the large number of bracts at its base provides the purplish colour. The plant itself is an untidy looking shrub, which grows up to 10 ft. in height. After flowering, the dead stems become an untidy tangled mass of brown sticks within the undergrowth.

There were a large number of Jungle Fowl apparently feeding on Nillu seed. As is well known, the seeds cause intoxication and it was obvious that most of these birds were quite 'drunk'. Some fell over while running while others zig-zagged drunkenly along the road. It was quite an amusing sight. It was noticed that these birds were quite plump and well grown unlike their dry-zone cousins.

An additional bonus during our trip was the nocturnal visit of a Leopard to the Ohiya Forest Department bungalow where we stayed. The bungalow is surrounded by forest and beautifully located just below the plains. The Leopard had been attracted by one of the pet dogs in the bungalow. Around 8 p.m., frenzied barking and screams near the kitchen brought us running out. The Leopard had pounced on the dog at the kitchen door itself, but only managed to grab a hind foot. An hour later, it was back at the front door, but we managed to save the dogs.

In spite of the very large number of visitors to World's End, the plains are well worth a visit at this time of the year due to the excellent, clear weather.

The Rufous-Necked Stint (*Calidris ruficollis*) in Sri Lanka

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Most birdwatchers are familiar with the Little Stint *Calidris minuta*, an annual winter visitor which reaches Sri Lanka in large numbers by way of the Central Asian Flyway. Little Stints are largely replaced on the East Asian Flyway by a closely related species the Rufous-necked Stint *Calidris ruficollis* which breeds in Northern Russia and winters in East and South-east Asia, Australia and New Zealand. Until recently this species had not been recorded from Sri Lanka.

On the afternoon of 11 February 1996 I was observing a large flock of Little Stints in winter plumage at the Bundala salt pans, when I noticed a discrepant bird within the flock. I recognized it as a Rufous-necked Stint in breeding plumage. (I was familiar with the species having observed it some years earlier at Samut Sakhon, Thailand). A short description follows.

Size and shape much like Little Stint. Face, throat and upper breast, brick-red. Crown, brick-red with dark streaks. Scapulars rufous with dark central wedge. Wing coverts and tertials, greyish with lighter fringes. Breast, belly, flanks and vent region, whitish. (The breast had a few dark spots below the rufous upper breast). The bill and legs were black.

The bird differed from Little Stints in breeding plumage in that the chin and throat were brick-red, not whitish, the yellowish line at the edge of the mantle (present in breeding Little Stints) was absent and the brick-red colour was intense (*contra*. the paler coloration of the breeding Little Stint).

I observed the bird in good light using a Swarovsky 80 mm telescope at magnifications of 20-60x. The bird, which was about 30-40 metres away, remained in sight for ca. 5 minutes after which it flew off. A report of this observation appeared in Malkoha 3 (2) April-June 1996. This is the first record of a Rufous-necked Stint in Sri Lanka.

Rufous-necked Stints in non-breeding plumage are very similar to, and therefore difficult to separate in the field from, Little Stints; hence it is entirely possible that at least some of the "Little Stints" reported each year could conceivably be Rufous-necked Stints. Almost two years after my first sighting in Bundala a second bird was reported from Kirinda Kalapuwa in December 1997. These observations are interesting as they suggest that the species may occasionally visit Sri Lanka in very small numbers.

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Figure 1. A Rufous-necked Stint in breeding plumage. (Photo. John Holmes).

Figure 2. A Rufous-necked Stint in pre-breeding plumage. (Photo. Mrs. Terri Allen).

The Indian Chameleon (*Chamaeleo zeylanicus* Laurenti)

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Chameleon is a lizard-like reptile that has gained a lot of attention from the local inhabitants of Sri Lanka. Known as "bodilima" in Sinhalese, the animal is featured in many legends and myths and has a mysterious background. Although these legends may not contain any truth, the peculiar behaviour of the chameleon namely, its remarkable ability to change its body colour, has roused the interest of many a scientist and environmentalist.

Chameleons belong to the family Chamaeleonidae with a history of over 30 million years. The family contains over 100 species of chameleons. More than 80 of these species belong to the genus *Chamaeleo*. Chameleons are confined to the Old World and most of the members of the genus *Chamaeleo* inhabit Madagascar and Africa. About fifty percent of the chameleon species are found in Madagascar. Others are found in Africa, the eastern islands of the Mediterranean and two species are found in Saudi Arabia and Socotra. Only a single species is found in the Indian region: the Indian chameleon, *Chamaeleo zeylanicus* that marks the eastern limit of this family. It is also referred to as the Sri Lankan chameleon in some recent accounts.

J. N. Laurenti first described the Indian chameleon as *Chamaeleo zeylanicus* in his work "Specimen medicum, exhibens Synopsin Reptiliam emendatum" published in Vienna in 1768. His description was based on figures drawn by A. Seba in Thesaurus I (Plate LXXXII, figure 8) in 1735. The drawing was of a female chameleon from Ceylon. It was subsequently named *C. calcaratus* by Merrem in 1820. In 1853 J. Jerdon clearly identified the differences of this species from the African species and renamed it *C. zeylanicus*.

The chameleon is called Bodiliya or Bodilima in the Sinhalese language. But some lizards are also called Bodilimas in the local language. They are Pygmy Lizard or Kuru Bodilima (*Cophotis zeylanica*) and Hump-nosed Lizard or Karamal Bodilima (*Lyriocephalus scutatus*). These two lizards belong to the family Agamidae. Although these lizards resemble *Chamaeleo zeylanicus*, in appearance, true chameleons posses certain unique morphological features that set them apart, and they are a placed in a separate family.

General Description

Chameleons posses several unique characters that include special features of the skull, flat granules or tubercles covering their body surface instead of scales, modifications of hand and feet for clasping, a prehensile tail, independently movable eyes and a long protrusible tongue to capture prey.

Some of these features are adaptations for life in the branches of trees and shrubs. For example, the hands and feet of the animal are modified for grasping. The digits of the hand and feet are in groups of two and three opposed to each other. In the hand there are two digits on the outer side and three on the inner; in the foot it is the reverse.

Chameleon's posses long prehensile tails which can be coiled downwards: another adaptation for its arboreal life style by providing an additional grasping organ. The lizard *Cophotis zeylanica* also has a prehensile tail, but that of the chameleon is better adapted for the purpose.

The chameleon has large eyes, covered by thick granular lids except for a small transverse slit for the pupil. These eyes can be moved independently and have a greater range of movement than lizard eyes. The animal is capable of viewing the surrounding area without moving the head, but only the eyes.

Chameleons feed mainly on insects and their larvae. It has an extremely protrusible and cylindrical tongue. It is said that when fully extended the tongue of the chameleon is as long as or longer than its head and the body. A fully-grown chameleon is said to be able to extend its tongue up to 30 cm (12 inches). There is a record of a chameleon that has extended its tongue about 17 cm, while its body length was only about 10 cm. As this animal is extremely slow moving, the protrusible tongue enables the animal to capture its prey. I have observed several instances where a chameleon used its tongue to capture grasshoppers and dragonflies. But there are records that chameleons eat animals like small frogs too. Trench (1912) has observed a chameleon drinking water freely by licking the drops of water from leaves with its tongue.

The Indian chameleon *(Chamaeleo zeylanicus)*
Photo. Mohan Nath Hathnapitiya

The chameleon changes its colour as a response to its background or when excited. Its normal body colour is green and it can be changed from pale green to black. When excited its body colour changes to bands or blotches of black on a yellowish background. This is a widely discussed phenomenon, the main reason that has attracted the attention of humans to these animals.

The chameleon is a solitary animal. All the above mentioned adaptations and camouflage enable the animal to evade its enemies, mainly birds of prey and snakes.

The length of a fully-grown chameleon can be around 375 mm, including a 200 mm long tail. Length from snout to vent is about 175 mm.

Reproduction

Very few studies have been done on the breeding habits of the Indian chameleon. Two of these studies were done in India. Trench (1912) has given notes on breeding habits of a pair in captivity. Singh and others (1984) observed breeding habits both in captivity and in its natural habitat.

Male animal can be easily identified by the spur like prominence behind the hind foot. According to Singh et al, courtship behaviour was observed during early August and mating in the last week of August. Eggs were laid in October. The eggs were placed in a nest built by the parents, which is an oblique hall.

According to Deraniyagala the gestation period is about one month and the female lays about 10-31 eggs. Eggs are elliptical and soft-shelled. They are white in colour, about 15 - 22.5 mm in length, 9 -12 mm in breadth and 1.0 - 2.0 g in weight. During the incubation period size and weight of eggs have increased. The eggs hatched out in June after an incubation period of 8 months. The hatching period coincided with a period where small insects are abundant (in India). Therefore newly hatched chameleons had plenty of food available for them.

Distribution

Chamaeleo zeylanicus is found in the wooded districts of peninsular India south of the Gangetic plain (south of Punjab) and in Sri Lanka. In Sri Lanka, *Chamaeleo zeylanicus* occurs in the drier areas of the coastal plain. There are records of Chameleons from several areas of the northern dry zone and from the southeastern dry zone.

A. Haly says in his Report on Reptilia in the Colombo Museum in 1891 that the four specimens found in the Colombo National Museum are from Mullaitivu, Chilaw, Puttalam and Colombo (a possible mistake). Deraniyagala records it from Mankulam, Puttalam, Anuradhapura and Marichchukatte. In some wetland site reports the chameleon is found in Annaivilundawa, Puttalam lagoon area and Anuradhapura Tank area. Occasionally there are reports of sightings even in local newspapers and television channels. The animal is not common and most people think it is a rare or strange animal. Most of the reports I have seen are from the villages around Wilpattu National Park.

Although most of the records of chameleons are from the northern dry zone, there are records from the southeastern dry zone in Yala National Park. The animal shown in the figure is a female chameleon that was caught at Eluwankulama, which lies northeast of Puttalam in the coastal dry zone. It was sent to the University of Colombo by a military officer and maintained in captivity under the supervision of Dr. D.K. Weerakoon in 1996. I have also had an opportunity to observe the animal.

According to Pethiyagoda (1997), the Indian chameleon is not uncommon and can be seen in Tamilnadu, India. However, in The 1999 List of Threatened Fauna and Flora of Sri Lanka this species was listed as a threatened species. The reason of the rarity of the animal in Sri Lanka is not clear.

According to present data, the chameleon is threatened in Sri Lanka mainly due to the habitat destruction. There are several suggestions that the slash and burn agriculture in the dry zone could be a major cause for this. Chameleons are slow moving animals and unable to rush for shelter during a fire and thus may get burnt during such practices. Another reason for the rareness may possibly be the lack of observers in the areas where chameleons live. Due to the prevailing civil unrest in the northern areas it is difficult to search for this animal. Further studies are needed about this remarkable animal.

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Some Notes on Sri Lankan Cat Snakes

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The term "Cat snake" is used in the common name of species belonging to genus *Boiga*, as their eyes are like that of a cat. Of the 96 serpentoid reptiles recorded in Sri Lanka, there are five species of cat snakes which belongs to the family Colubridae. They are, *Boiga barnesii* (Barnes's cat snake), *B. beddomei* (Beddom's cat snake), *B. ceylonensis* (Sri Lanka cat snake), *B. forsteni* (Forsten's cat snake) and *B. trigonatus* (Gamma cat snake). Of these five species of cat snakes, only *Boiga barnesii* is endemic to Sri Lanka. The 1999 IUCN Threatened list of Flora and Fauna of Sri Lanka lists *Boiga barnesii* as a nationally threatened species.

Deraniyagala (1955) considered Sri Lanka as the type locality of *Boiga ceylonensis* and named it *Boiga ceylonensis ceylonensis*. Wall (1921) considered *Boiga beddomei* as a synonym of *Boiga ceylonensis*. Earlier, many herpetologists doubted the taxonomic validity of *Boiga beddomei* (Deraniyagala, 1955; De Silva, 1990). However, several herpetologists have found many specimens of *Boiga beddomei* recently, and the natural history of this species will be published in due course and will not be dealt with in this paper.

These cat snakes occupy mainly arboreal and terrestrial habitats. All these snakes are considered mildly venomous snakes. There are no authentic records of serious envenoming or deaths following bites by snakes of this genus from Sri Lanka, except a few accounts of mild local reactions caused by their bites. However, there are several unauthenticated reports of serious envenoming and even deaths due to *Boiga* species in the dry zone.

Though these snakes are only mildly venomous, all species of *Boiga* are killed by humans due to ignorance. Together with predation this is the main threat faced by these snakes at present. Clearing of forests for extensive agricultural projects and settlements is also another major threat to these snakes.

A number of cultural beliefs are associated with cat snakes. It is believed that the victim will fall into a deep sleep due to the bite of the Sri Lanka cat snake. This fact is reflected by its vernacular name "Nidi Mapila". Another belief is built around Forsten's cat snake or "Le Mapila". It is said that seven of these snakes will come through the roof in the night, and lower themselves by hanging on to one another. The one nearest to the sleeping person will bite the toe of this individual and suck the blood, which will eventually be passed on to the seventh one on the roof. This process is carried out until the stomachs of all the seven are full, by which time the victim is dead (de Silva, 1990). This belief may have arisen due to the deep red colour of this cat snake species, which led to the belief that it is indeed a vampire snake.

Description of the species belonging to Genus *Boiga*

***Boiga barnesii* (Gunther, 1869)**
(Barnes's cat snake; panduru mapila)
The smallest *Boiga* species recorded in Sri Lanka. An adult Barnes's cat snake attains a maximum total length of approximately 600 mm. It is rear fanged and mildly venomous. In general morphology, it shows a marked resemblance to *Boiga ceylonensis*. Ventral aspect is ash in colour with dark ash coloured dots, while the dorsal surface contains black and white spots.

Distribution of this endemic cat snake is highly restricted to primary, secondary and degraded forests of lowland and montane areas of the wet and intermediate climatic zones. During the day, they hide under decaying vegetation, rock ledges, underneath dried bark etc. *Boiga barnesii* is found in both arboreal and terrestrial habitats. It is nocturnal in habit. It feeds on gekkos, skinks, and other small lizards.

***Boiga ceylonensis* (Gunther, 1858)**
(Sri Lanka cat snake; nidi mapila or tith mapila)
Slightly larger than Barnes's cat snake with an average length of about 750 mm. It is rear fanged and mildly venomous. It shows a mixture of red, brown and yellow colours. Dorsal surface contains brown coloured dots.

This common snake is found in monsoon forests and grasslands of the dry zone, intermediate zone and the wet zone ascending up to 1500 m. They hide under rock ledges, bases of tall grass, hollow tree

Figure 2. Sri Lanka cat snake (*Boiga ceylonensis*) Photo. R. Somaweera

limbs etc. during the daytime. It is an arboreal snake and nocturnal in habit. It feeds on gekkos and small lizards. It lays 5 - 10 eggs at a time.

***Boiga forsteni* (Dumeril, *et al.*, 1854)**
(Forsten's cat snake; Naga mapila, Le mapila or Habarala)
Largest species among the cat snakes of Sri Lanka. It attains a total length of about 1500 mm. An oval shaped head with large eyes and a significant neck, a robust body and the long tail are some of the characteristic morphological features of Forsten's cat snake. It is rear fanged and mildly venomous. This snake may assume a pink, deep red or brown colour.

Forsten's cat snake is common in the dry zone, intermediate zone and low altitudes of the wet zone. It is mainly confined to the first peneplain of Sri Lanka. It is usually found in hollows of tall trees. It is an arboreal snake, nocturnal in habit. It feeds on birds, small mammals, bird eggs, lizards etc. It lays 5 - 10 eggs at a time. When threatened, it raises its fore body forming it into loops, vibrates the tail, and hisses.

Figure 1. Common cat snake *(Boiga trigonatus)*
Photo. R. Somaweera

***Boiga trigonatus* (Schneider, 1799)**
(Gamma cat snake or common cat snake; ran mapila or gerandi mapila)
The average length of this species is about 700 mm. Oval shaped head with large eyes, significant neck and the slim body are some of the identification features of this snake. It assumes a yellow - brown or ashy colour while the dorsal surface contains white "V" shaped marks and four lines of brown coloured dots. Ventral surface is white in colour. This snake is rear-fanged and mildly venomous.

Except the high altitudes of the country, Gamma cat snake is common in all three climatic zones, especially in dry zone. *Boiga trigonatus* is also found hiding under rock ledges, hollow tree limbs, etc during the daytime. It is an arboreal snake that is nocturnal in habit. It feeds on gekkos and small lizards.

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An identification key for Sri Lankan cat snakes

(1) Dorsal scales in 19 or 21 (23) rows at mid body
——————(2)
Dorsal scales in 23 to 29 rows at mid body
——————*Boiga forsteni*

(2) Preocular not reaching the dorsal surface of the head
——————*B.trigonatus trigonatus*
Preocular reaching the dorsal surface of the head
——————(3)

(3) One preocular, ventrals and subcaudals 311 - 342
——————*B. ceylonensis*
Two or three preoculars
——————*B. barnesii*
One preocular, ventrals and subcaudals 362 -392
——————*B. beddomei*

(Source: Anslem de Silva)

The Rape of Horton Plains

Horton Plains is a unique wilderness area, established as a nature reserve in 1969 and upgraded to a National Park status in 1988. Located in the central mountains of Sri Lanka at an elevation of 2100-2300 m, it is the highest tableland in the country. Rising majestically from this wide expanse of grassland are the twin peaks Kirigalpotta (2395 m) and Totapolakanda (2359 m), the 2nd and 3rd highest peaks in the country. Lying nestled between these are the plains for which this area is so famous and is the Watershed for two of the principal rivers in the island. Horton Plains also boasts of dense swaths of magical montane cloud forest. This gently undulating highland plateau sports many species of endemic flowering plants, low shrubs, and the introduced gorse. It is a spectacular vegetation to walk through. "Worlds End", a 700 m drop, makes walkers hold their breath not just at sight of its plunging precipice but also for the spectacular view that it affords.

There are many ways to Horton Plains. Motorable roads via Ambewela (from Nuwara Eliya or Hakgala) and Ohiya (from Haputale or Welimada) are the most frequently used by visitors to Horton Plains. Partly motorable roads from Diagama (via Lindula or Agarapathana) and Haldumulla (via Weerakongama and west Haputale) are rarely used. There are yet other footpaths for the more adventurous visitor through Belihuloya, Non-Pareil estate and Bogawantalawa.

Recently (2001) I was in a party that trekked up to Horton Plains via Bogawanthalawa. We took the estate road up to the edge of North Cove division of Loiron Estate in Bogawanthalawa. From the North Cove a trek of approximately 7 Km through the Peak Wilderness Sanctuary took us to the Horton Plains at a point called Maha Eliya.

Quite contrary to the expectations of Horton Plains the sight that awaited us was absolutely shocking and disgusting. Maha Eliya is a plain very similar to the area around the Farr Inn at the official entrance to the Horton Plains National Park. The entire area was dug up indiscriminately by illegal gem miners. Even the footpath was barely useable as huge pits are found right in the middle of the path. Our guide warned us that there could be over 1000 miners at Maha Eliya. Initially, we did not see any miners although the entire area looked dug up recently. However, as we moved into the plains along the stream, we came across people openly mining in a very organized method armed with Diesel water pumps. On our return, word had gone around that we were not a threat to the miners as such we were appalled to see over 200 miners digging in the plains. The sheer scale of the mining was absolutely pathetic and confirmed the stories of the guide. Our guide told us that according to villagers in Bogawanthalawa a number of miners have died and some still remain buried in some of the collapsed mines.

The magnitude of mining indicates that other illegal supporting activities such as poaching, brewing of moonshine, clearing of the forest for lodging and firewood etc exists. The fires for cooking were quite obvious to us. These pose a grave danger to create grassland / forest fires.

This activity will eventually lead to a situation where the politicians will get involved and finally legalize gem mining, which will be the last nail in the coffin! It is also difficult to imagine that such a large-scale mining operation can take place without the blessings of politicians.

During the golden era of our civilization the wise kings of Sri Lanka knew the importance of the forest as the source of water and life. Hence they limited their large-scale agricultural activities to the low lying areas of the country keeping the forest in the hill country undisturbed. This changed with the hill country falling into the hands of our former colonial masters the British who exploited the hill forests selfishly for their narrow commercial gain. Despite this they left relatively small tracts of forest untouched such as the Horton Plains, Sinharaja and Peak Wilderness, as they themselves realized that without these watersheds agriculture will not thrive even in the short term let alone the long term.

What we cannot comprehend is the fact that the present leaders of our country are letting the few remaining forests and more importantly such a vital eco system such as Horton Plains be destroyed in front of our very eyes knowing too well that the damage caused will be irreversible and detrimental to future generations of Sri Lankans. The present leaders like our wise kings of the past should seek the counsel of the scientific community and implement an action plan to arrest this situation without delay mobilizing the law enforcement agencies to take very firm and swift action.

We all know too well the current water crisis and the severe drought in the south is due to changes in the weather patterns caused by destruction of the forest. Horton Plains is so important in that respect as it is the watershed for a number of the principal rivers in the Island.

Both the Department of Wildlife Conservation under whose jurisdiction the Horton Plains National Park comes and the Forest Department, that administers the Peak Wilderness, have capable and dedicated officers who can resolve this matter. However, the needs of the hour are political will and direction as well as strengthening the Department of Wildlife Conservation and the Forest Department with the right resources to undertake this important task.

It is no secret that the political leaders of our country are preoccupied with manoeuvres on how to stay in power or how to come to power. Whilst this is being done the war will be lost, the economy of the country will come to a standstill and the very heart of the nation, the forests, will be lost forever.

I would like to suggest that the department of Wildlife Conservation, the Forest Department and the Police Department come together quickly and form a task force immediately and implement an action plan to arrest illegal mining. Thereafter, the two departments should work with the scientific community, the bordering villages and the plantation companies to come up with a permanent long-term solution to expand the protected area and create a buffer zone.

Until this is achieved the Wildlife Conservation Department and the Forest Department should set up a well manned beat office and a range office in Maha Eliya to stop poaching and mining and to regularize visitation from Bogawantalawa, Belihuloya and Non Pareil with proper controls and mandatory guides or interpreters. A permanent research station in Horton Plains in collaboration with the Universities will also create genuinely concerned and trained eyes to protect the plains in addition to conducting proper research to realize the true value of the resource to gain international support for conservation. The two departments should also work with the bordering villages and the surrounding estates to educate them and gain their support to conserve this important ecosystem. Sustainable economic activities confined to the buffer zones such as small-scale eco-tourism projects can also be encouraged so that there is a direct economic benefit to the local communities.

Man in his quest for greater riches today causes enormous damage to the environment despite the vast knowledge it has acquired on the very environment it chooses to destroy. Man has already contributed to the extinction of a number of animal and plant species. However, it is the pace of destruction that is most alarming. If we continue to destroy the likes of Horton Plains we will destroy the very source of life-water without which humanity will be doomed.

The writer is a Society member who chooses to remain anonymous. His report to the Society on Maha Eliya footpath was passed on to the Department of Wildlife Conservation.

- Editor

Dunumadalawa Forest Reserve

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Introduction

The Dunumadalawa (or Wakarawatta) forest reserve is a watershed forest within Kandy city limits. This protected reserve lies on the southern aspect of the city above the Kandy Lake; the Hantana range of hills forms one boundary. The reservation comes under the purview of the Kandy Municipal Council and forms a small part of an extensive forest that stretches through Hantana range towards Peradeniya and Galaha. The whole area is interspersed with tea estates, pinus plantations and small villages. The reserve protects several small but important streams, some of which supply water to the Kandy Lake (eg. Rajapihilla ela) while the two major streams (Dunumadala oya and Roseneath ela) have been dammed to form reservoirs which augment the water supply system to the city, hence the necessity to protect and provide security to this area. Many perennial springs supply water to these streams throughout the year.

With the assistance of the Ministry of Forestry and Environment, World Bank funded EA1P project (Environment Action 1 Plan), a boundary survey was completed. The project also provided assistance to protect the biodiversity of the forest, adopt soil and water conservation measures, set up a plant nursery and a reforestation programme, provide environment education and research facilities to schools and also include community participation features. The project has also set up a field study centre, which provides basic facilities for field surveys and research along with library facilities and a field museum for use by students, the community and researchers. Facilities for visitors and bird-watchers are also being developed while there are on-going programmes for schools. Many students have completed their Advanced Level field projects in the forest and there is a growing demand for such participation. Studies done included watershed characteristics and climatology, dry-weather stream flow, studies on butterflies, birds, reptiles, mushrooms (fungi) etc. This is very encouraging and more such surveys and studies by students are planned for the current year.

Physical Features

Elevation of the forest ranges between 550 and 980 metres above mean sea level (about 1800 - 3200 ft.). The reservation is about 300 hectares (750 acres) in extent. The two reservoirs (Dunumadalawa and Roseneath) total about four hectares. The area has a well-distributed rainfall pattern.

The streams have good dry weather flow with clear, drinkable water. The terrain is quite hilly with very good forest cover. There are small patches of open patana and some blocks of pinus plantations set up by the Forest Department many years ago.

Natural Vegetation

The forest resembles a mid-country wet-zone rain forest although much of it is secondary growth. It had been a coffee and cocoa estate during colonial times under a British planter named Walker (hence the former name, Walker estate or "Wakara-watta"). Thus, there are remnants of coffee and cocoa trees as well as shade trees such as Albizzia. Some of the originally planted Jak, Breadfruit, Wild Bread-fruit and Mango trees also survive to date. Yakada-marang (*Myroxylon balsamum*) and Hawari-nuga (*Alstonia*) have invaded the forest quite extensively. Other species such as Large-leaf mahogany (*Sweitinia macrophylla*), Sapu (*Michelia champac*), Kekuna or Ceylon almond (*Canarium zeylanicum*), Ma-dan or Java

Figure 1. Name board at the Entrance

Figure 2. Entrance to the forest and the field study centre

Figure 3. A view of the field study centre

Figure 4. A school and community tree planting programme at the nursery with the Mayor of Kandy and other officials

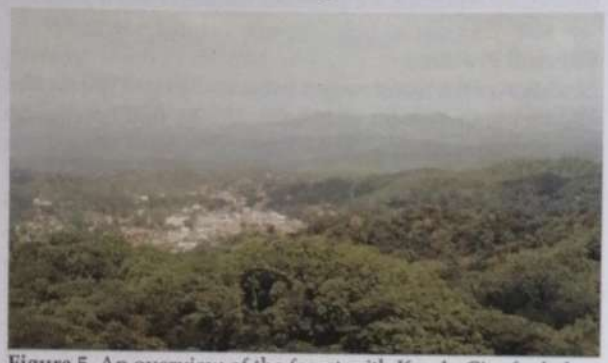

Figure 5. An overview of the forest with Kandy City far below

plum (*Syzigium cumini*), Kenda (*Macaranga peltata*), Madatiya (*Adenanthera pavonina*), Olinda (*Aaglaosperma*) and Attikka or Cluster fig (*Ficus glomerata*) are also present in the forest habitat.

One of the largest specimens of "Pus-wel" vines discovered in Sri Lanka is also found here. There are many species of ferns and tree ferns, lichens and other epiphytes, mosses, wild orchids, mushrooms and medicinal plants. These require extensive surveys and studies in future.

Fauna

Large numbers of animals, birds, reptiles, butterflies and insects and amphibians are seen along with an extremely large population of leeches. Many species of small animals, insects etc., have yet to be identified.

Several leopards (*Panthera pardus* – "kotiya") have been encountered in and around the forest and their pug marks and droppings along with partly eaten kills have been discovered. They have attacked cattle, goats, and dogs in villages and houses bordering the reserve. A large set of clear pug marks were found near the Dunumadalawa stream. A plaster cast was taken and measured which indicated that the set of foot prints belong to a large leopard of about 6.5 to 7 feet in length. This observation was further validated by an eyewitness account where a large leopard had walked into the kitchen of a holiday bungalow bordering the forest and carried off the dog while the frightened cook looked on. Recently, an expensive alsatian dog was snatched from the compound of a VIP residence. There were moves to shoot or capture the leopard after these incidents, but fortunately, saner counsel prevailed since shooting or capturing one leopard will not solve the problem.

Figure 6. The giant "pus-wela". One of the largest of this species in the country

The Indian fishing cat (*Felis viverrina* - "Kola-diviya") is fairly common here. Black palm-cat (*Paradoxorus hermaphroditus* - "kalawedda"), Ceylon small civet (*Viverricula indica* - "uruleva") brown mongoose (*Herpestes brachyurus* – "dumburu mugatiya"), slender loris (*Loris tardigradus* – "unahapuluwa"), black-naped hare (*Lepus nigricollis* – "wal hava"), porcupine (*Histrix indica* – "iththeva"), Indian otter (*Lutra lutra* – "diya balla") and the Ceylon grey flying squirrel (*Petaurista philippensis* – "maha hambawa") can also be seen here.

The toque monkey (*Macaca sinica* - "rilawa") is very common and has become a nuisance, with several troupes inhabiting the reserve and raiding the city and its environs during the day. Large numbers of wild boar (*Sus scrofa* - "wal ura") are seen and they invade village gardens at night.

A large colony of the flying-fox or fruit bat (*Pteropus giganteus* - "ma wavula") is also found here. This forest is also home to an exceptionally large number of barking

deer (*Muntiacus muntjak* - "olu muwa") and mouse deer (*Moschicola meminna* - "meminna"), a much higher concentration than in Dry-zone forests. An early morning walk will reveal at least a half dozen barking deer especially along the Hantana track.

Several Ceylon pythons (*Python molurus* - "pimbura") have been seen and an injured specimen (12 feet long) was recently captured, treated and released back into the forest. In addition several other species of snakes such as green pit viper (*Trimersurus trigonocephalus* - "pala polonga"), cobra (*Naja naja* - "nagaya"), Ceylon krait (*Bungarus ceylonicus* - "mudhu karavala") and large rat snakes (*Coluber mucosus* - "garandiya") and lizards were recorded from Dunumadalawa.

An exceptionally large number of birds have been seen and facilities and access trails for bird watching needs to be improved. A pair of white-bellied sea eagles (*Haliaeetus leucogaster*) has built a nest in an albizzia tree near the forest entrance. A number of other bird species including serpent eagle (*Spilornis cheela*), fish owl (*Ketupa zeylonensis*), brown wood owl (*Strix leptogrammica*), scops owl (*Otus bakkamoena*), jungle fowl (*Gallus lafayetii*), Ceylon shama (*Copsychus malabaricus*), bronze-wing pigeon (*Chalocophaps indica*), Ceylon grey hornbill (*Ocyceros gingalensis*), and Indian pitta (*Pitta brachyura*) have been recorded from here.

Further protective measures, enhancement of bio-diversity and provision of facilities for students and researchers are being planned. Future programmes include more facilities for visitors and for bird watching groups through an extension of the conservation project under the Kandy Municipality.

Figure 7. A view of the main "Dunumadalawa" reservoir

Figure 8. The plant nursery set up within the forest reserve

Figure 9. One of the more rarer plants

Figure 10. Tree ferns far up a tree

Figure 11. Colourful mushrooms on a dead tree trunk

Female Shikra at Wasgamuwa National Park

Jackal at Buttuwa Plains, Yala National Park

The Society's New President

The Society is privileged to have a person with multiple interests as its President for 2001-2002, namely Dr. Malik Fernando. He brings to the Society a wealth of knowledge on the fauna and flora of the country and the management of non-government organizations.
Dr. Fernando became a member of the Society in 1971 and was elected to the Committee of Management in June 2000. He became the Society's President in 2001.

Educated at St. Joseph's College, Colombo he proceeded for higher studies to UK in 1959 and obtained a Degree in Medicine from the University of Bristol in 1964. Thereafter he was employed in the UK from 1964 to 1969. Returning to Sri Lanka, Dr. Fernando served the Colombo Municipal Council and the Petroleum Corporation as the Medical Officer from 1969 up to retirement in 1998.

Dr. Fernando has diverse interests ranging from Cycling to Orchids, Marine Biology, Natural History, Wildlife and Nature. He has an in-depth knowledge of the indigenous orchids of Sri Lanka.

Dr. Fernando's interest in nature, I am sure, runs down the family. His mother, Mrs. Dorothy Fernando, is a pioneer in nature studies, and the author of "Wild Flowers of Ceylon" a collector's item now. Dr. Fernando himself is a prolific writer and a number of his articles have been published in prestigious journals and magazines.

Dr. Fernando has long years of association as an activist of NGOs. Way back in 1982 he was elected as the President of the Sri Lanka Natural History Society, and at present he remains as its patron. In the Sri Lanka Medical Association, he became a Council Member in 1984 and its President in 1992. He was elected as the

Chairperson of its Ethics Committee in 1993 and became a member of the Expert Committee on Snakebites (1983) as well as the Ethical Review Committee (1998). He has the distinction of becoming the President of the Wildlife and Nature Protection Society as well as the Orchid Circle of Ceylon in 2001. In the same year he was elected as the Vice President of the Cycling Federation of Sri Lanka. He is also the President of Sri Lanka Sub-Aqua Club.

Dr. Fernando represents the WNPS in the Flora and Fauna Advisory Committee and the IUCN. He is also a member of the Editorial Board of "Lyriocephalus", the journal of the Amphibia and Reptile Research Organization of Sri Lanka.

N.T. Ariyaratne
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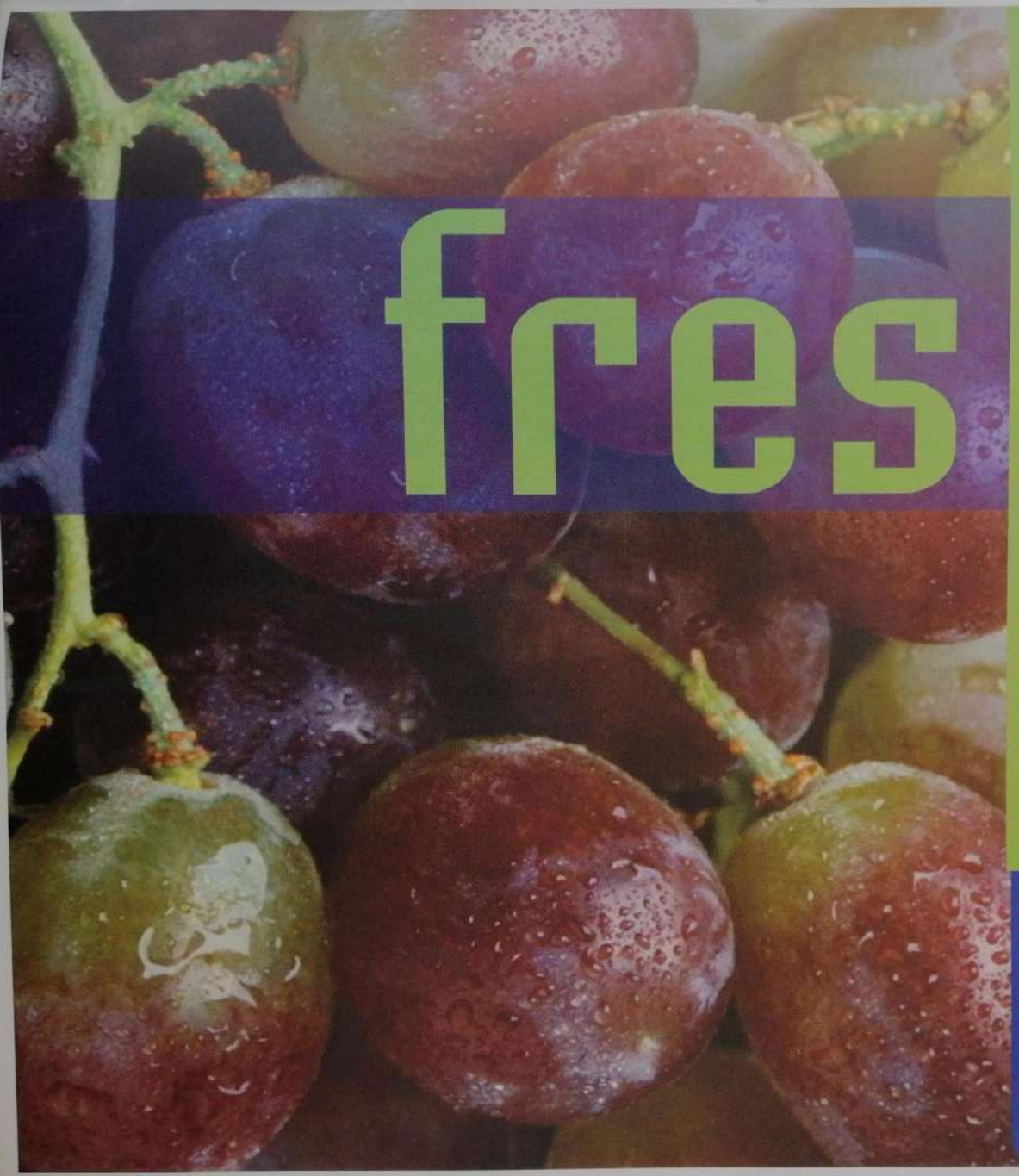

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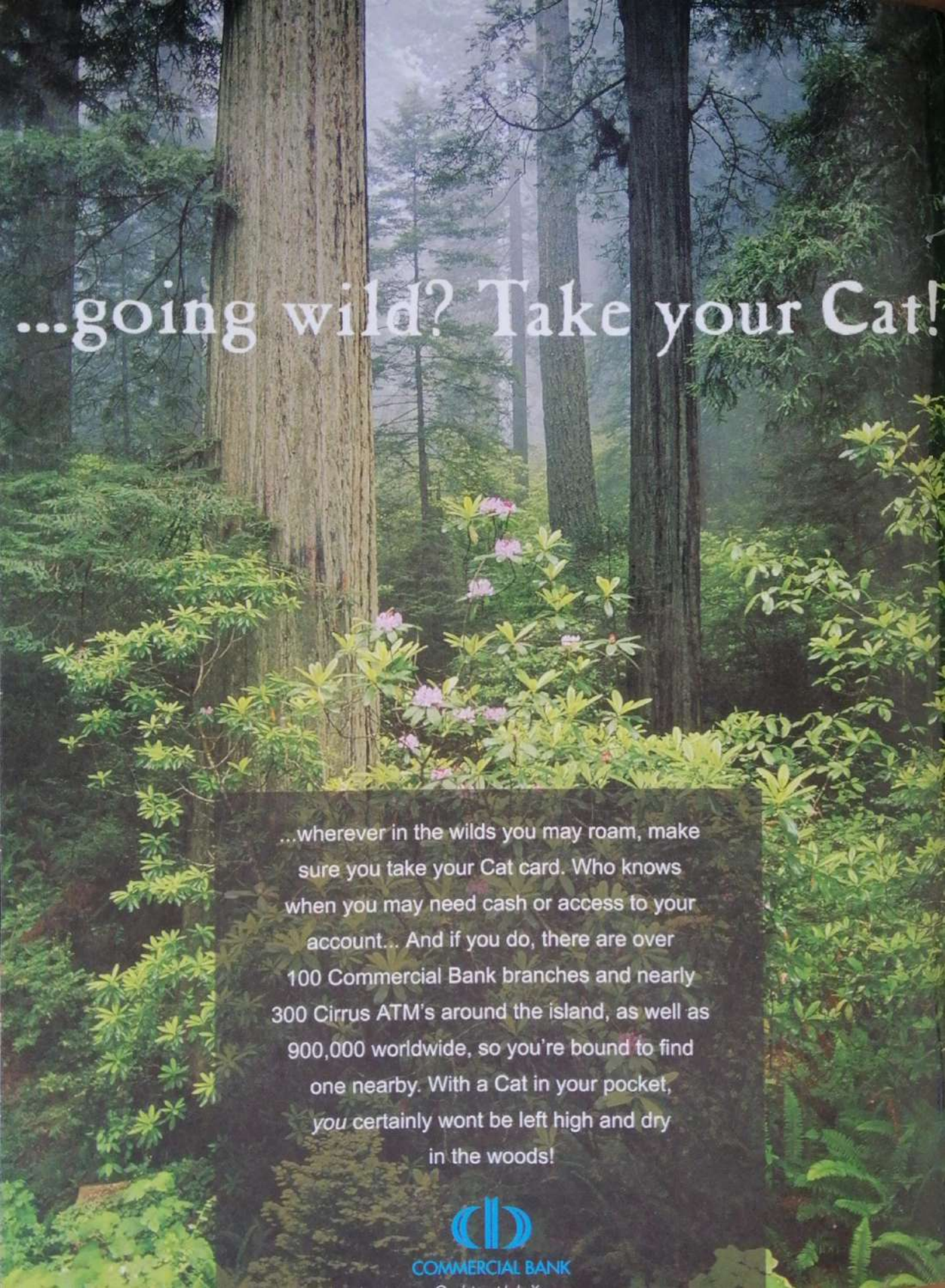
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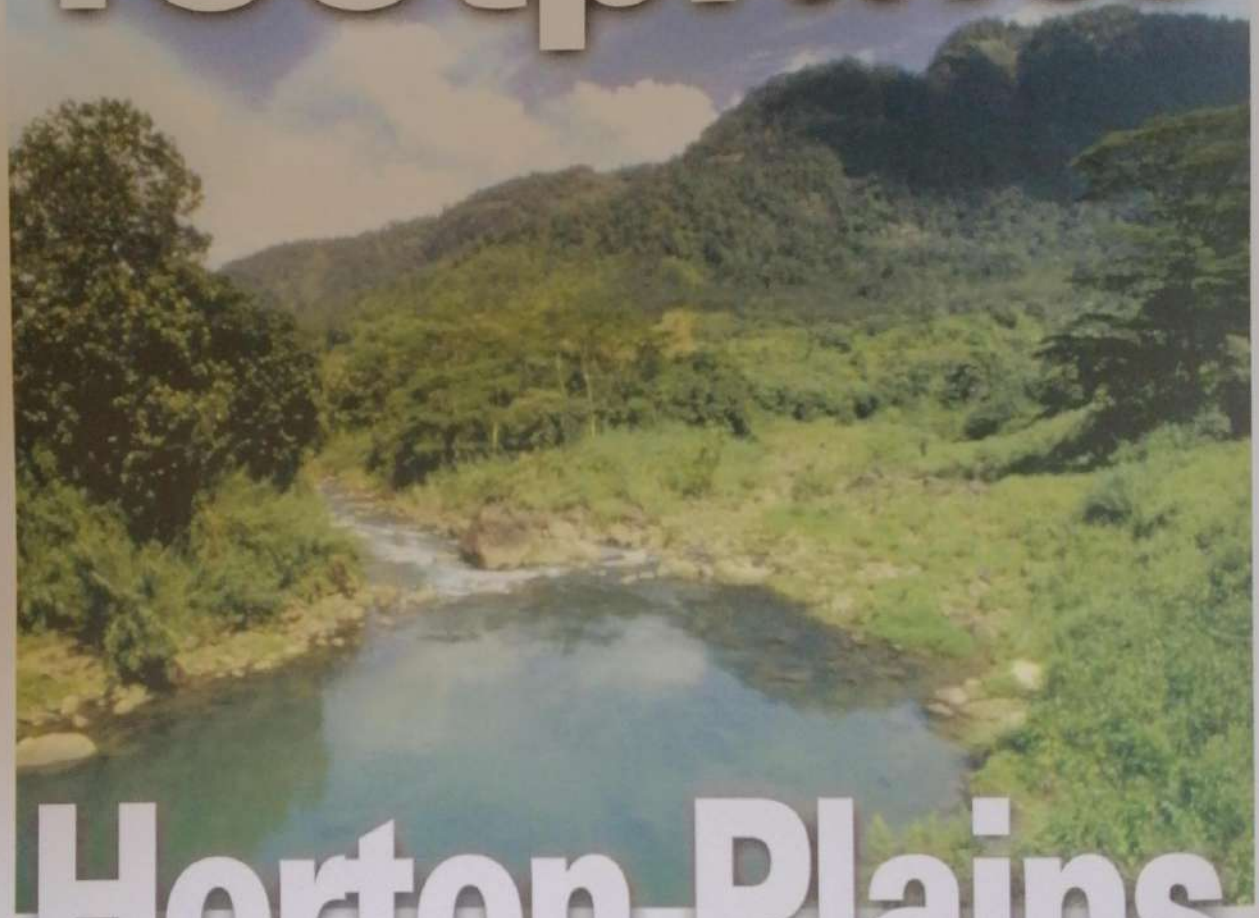

Horton Plains

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Volume 22, Number 6
December 2001

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Cover photograph: Dr. Sawan Waidyanatha

Ceratophora stoddartii Gray, 1835 Rhino horn lizzard (E), Kahamuwa an katussa (S). A slow moving subarboreal species endemic to Sri Lanka. It can be distinguished from all other horned lizards by the presence of a prominent rostral appendage restricted to the rostral scale. Usually found on moss covered tree trunks. Restricted to cloud forests at higher elevations (above 1500 m) of the cental masiff, mainly Peak Wilderness, Horton Plains and adjacent areas. It is listed as a Nationally threatened species.

Editorial

Can the protected area network of Sri Lanka effectively protect its Biodiversity?

Biodiversity is one of the most important natural resources of Sri Lanka. Its biodiversity is not only significant in a national sense but is also important in both regional and global scales. Therefore, proper management of this resource is not only a national responsibility but also a global one.

One of the main strategies used in management of this resource is *in-situ* conservation, where the resource is conserved in its natural form. One way of achieving this objective is to protect natural ecosystems using the existing legal system, preventing exploitation, neglect and degradation due to various determinate and indeterminate processes.

Sri Lanka has a long history of protection of wildlife. One of the world's earliest wildlife sanctuaries was established in Sri Lanka by King Devanampiyatissa in 246 BC. History shows that succeeding kings upheld this tradition. However, these long-standing traditions changed during the colonial era as large areas were cleared for establishment of plantations. During the post independence era the degradation of forests continued due to expanding settlements and new development programmes. At present, nearly a million hectares (14% of Sri Lanka's total land area) representing Sri Lanka's varied natural ecosystems have been set aside as protected areas. This is the second highest national total for South Asia after Bhutan (20%). These protected areas are managed by two state agencies, namely the Department of Wildlife Conservation (88% of the protected areas) and the Forest Department (12% of the protected areas).

Natural forests administered by the forest department falls into four categories. They are Conservation forests, Forest reserves, Village forests and other state forest. The protected areas managed by the Department of Wildlife Conservation (DWC) falls into two major categories, National Reserves and Sanctuaries.

National reserves include over 450,000 ha of protected areas of which nearly 75% are National parks. At present there are 15 National Parks managed by DWC. These National Parks are home to a number of endangered species, especially birds and mammals. These National Parks therefore, serve as repositories of the biodiversity of Sri Lanka and places where both local and foreign visitors can get a flavor of the rich fauna and flora that is found in this island nation. In addition, DWC also manages three Strict Nature Reserves and three Nature Reserves. DWC has also established or is in the process of establishing several jungle corridors to link large forest patches. These corridors are aimed at facilitating movement of animals between these forest patches, especially animals who range over large areas such as elephants. Apart from these National Reserves DWC also manages 55 wildlife sanctuaries.

The bulk of the protected areas of Sri Lanka focus on conserving terrestrial habitats. However, there are three marine reserves managed by the DWC at present. These are the Hikkaduwa National Marine Reserve, the Bar-Reef Sanctuary and the Pigeon Island Sanctuary.

Most of these protected areas are located in high human use areas where the rapidly growing human population places greater demands on natural resources to meet their basic needs. As such most protected areas are subjected to various threats such as encroachment, over exploitation of resources (extraction of timber, fire wood, non timber forest products, hunting and collection for export), mining, introduction of alien invasive species, over visitation etc. leading to a rapid erosion of the countries biodiversity

Even though a substantial portion of Sri Lanka's land area is designated as protected areas, more than 95% of them are located in the intermediate and dry zones of Sri Lanka, which are relatively poor in terms of biodiversity. Only a small fraction (approximately 5%) of the natural habitats in the wet zone comes under the protected area network, even though most of the biodiversity of the country is restricted to the wet zone. These wet zone forests are highly fragmented: the largest being Peak Wilderness Sanctuary (25,000 ha), Knuckles Conservation forest (21,650 ha), Sinharaja World Heritage Site (11,280 ha), Kanneliya-Dediyagala-Nakiyadeniya (KDN) Reserve (10,139 ha) and Horton Plains National Park (3100 ha). The rest is in the form of about 60 small forests, which do not have clear legal status. Most of these forest fragments are surrounded by human settlements, and are being encroached at a rapid rate so much so that some of the fragments only exist on paper. Therefore, it is clear that the present protected are a network is wholly inadequate to conserve the rich biodiversity of Sri Lanka. The greatest conservation challenge of the 21st century is to increase the number of wet zone forests included under the protected area umbrella as quickly as possible.

The Kandyan Tetrapod Herps

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A land of mountains, streams, rain, sunshine and mist, Kandy, the hill capital of Sri Lanka is a treasured city, now classified as one of the world heritage cities of the world. The picturesque lake, edged by the lush green mountains and the serene vistas have long fascinated visitors to this ancient capital.

Apart from its historical value, Kandy supports a rich biodiversity. The area is blessed in having a great variety of fauna and flora, especially herpetofauna or "herps" (amphibians and reptiles). In this article, we wish to describe the remarkable and splendid tetrapod (4 limbed) reptile diversity of the Kandy forests. The main focus is to describe tetrapod species diversity, richness and their current status in the area. Furthermore, we wish to discuss the threats faced by these tetrapods and propose several conservation measures.

The Kandyan forests

The city of Kandy, located in the 2nd peneplain or the uplands (290 – 900 m above sea level) of the wet zone is ranked as one of the leading cities in Sri Lanka in terms of biodiversity per unit area. The city of Kandy, although comparatively small in size, shows a significant variation in climate, topography and soil properties that have given rise to a striking variety of vegetation types including forests, grasslands and aquatic vegetation belonging mainly to the Kandy-upper Mahaweli floristic zone (Ashton *et al*, 1997). Being essentially a forest area, Kandy harbours four semi-isolated forest patches viz. Dhunumadalawe (Wakarawatte) hydro-catchment area, Udawattekale sanctuary, Hantana reserve forest and the Gannoruwa forest.

The historical Udawattekale wildlife sanctuary is the only protected area present in the vicinity managed by the Department of Wildlife Conservation. A forbidden forest or *Tahanchikale* in the past, it was reserved for the King and Queen of the Kandyan kingdom. It was first declared as a forest reserve in 1856 and then as a wildlife sanctuary by the first Prime Minister D.S. Senanayake on 29th July 1938. The forest barely covers an area of 252 acres (104 ha). Its main ecosystems include wet-ever green forests, secondary forests, Na (*Mesua* sp.) forest and a man made pond, the Raja Pokuna, the only permanent water body in the forest.

Dunumadalawa or the Wakarawatte hydro-catchment area covering 1200 acres (480 ha) is managed by the Kandy Municipal Council: it contains the Dunumadalawa and Rosneath tanks that provide water to one part of the Kandy town. The main ecosystems found in this wet, misty forest reserve includes wet-ever green forests, secondary forests, *Pinus* plantations, Iluk grasslands and several permanent and temporary lentic and lotic water bodies.

The Gannoruwa forest is an isolated mountain forest patch located on the north side of a sharp bend in the Mahaweli river, *ca.* 2 km north of Peradeniya. The mountain forms a ridge ca. 5.6 km long with a maximum elevation of 755m a.s.l. (Batuwita, 2000). The main ecosystems found here are wet-evergreen forests, Mahogany (*Swietenia* spp.) plantations, grasslands, home gardens and cultivations and a few seasonal streams.

The Hantana reserve forest, located in the Hantana mountain range consists of a few isolated forest patches of dense wet-evergreen forests and sub-montane forests. A major part of the mountain ridge consists of secondary forests, tea plantations, *Pinus* plantations, upland Patna grasslands, human settlements and a few slow/ fast flowing streams. Several peaks in the famous

Figure1. Leaf-littered forest floor at Gannoruwa (Senani Karunaratne).

Figure2. Pathana grassland and forest at Hantana (Senani Karunaratne).

Katusukonda range reach more than 1000 m above mean-sea-level.

Tetrapod reptiles of the Kandyan forests

The Kandyan forests are home to a wide variety of wildlife. The high diversity of ecosystems has provided habitats for a wide array of species, particularly among the herpetofauna. An ongoing field study conducted by the authors has revealed a very high diversity of tetrapod reptiles. A total of 30 species (40% of all the tetrapod species recorded from Sri Lanka) have been recorded from the area, including 5 species of agamid lizards, 12 species of geckos, 9 species of skinks, 2 species of terrapins and the 2 monitor lizard species. They occupy various ecological niches varying from deep underground cavities to forest canopy and fast flowing streams to rock crevices.

Garden lizards

Garden lizards or chisel-teeth lizards (commonly known as 'katusso' in Sinhala) belongs to the family Agamidae and are characterized by the presence of movable eyelids and imbricate (overlapping) scales. Sri Lanka is home to 15 species, out of which 12 (80 %) are endemic to the country including 3 endemic genera and a relict sub-family, Lyriocephalinae.

The Kandyan forests and the suburban home gardens harbour five species of Agamid lizards. The largest of the agamids, the green garden lizard (*Calotes calotes*) is the most common arboreal agamid dominating the forests and the other habitats, while the endemic Sri Lankan kangaroo lizard (*Otocryptis wiegmanni*) is its most common terrestrial companion. Although *Otocryptis wiegmanni* is considered to be a ground-dwelling species, it can also be seen on tree trunks, particularly the juveniles. Both the green garden lizard and the common garden lizard (*Calotes versicolor*) inhabit several anthropogenic habitats, even in the vicinity of the greater Kandy municipal town limits where several individuals of *Calotes calotes* were even recorded from beside the main roads of the city. Although not as common as the above species, the Sri Lankan whistling lizard (*Calotes liolepis*) is also found in the shaded Kandyan home gardens and forests. This endemic, rather slow moving, arboreal lizard is occasionally met but cannot be considered rare. The mountain hump-nosed lizard or *Lyriocephalus scutatus* is also a commonly found agamid reptile in Kandy, especially in the Udawattekale sanctuary, where one is likely to spot this beautiful and unique endemic lizard of Sri Lanka any day.

Deraniyagala (1953) has recorded the painted-lip lizard (*Calotes ceylonensis*), black-cheek lizard (*Calotes nigrilabris*) and the crestless lizard (*Calotes liocephalus* - one of the rarest calotine lizards in the country now restricted to the Knuckles range) from Peradeniya (near Gannoruwa). However, we have not come across any of these species during our study.

Geckos

Geckos belonging to the family Gekkonidae are the smallest and the most primitive living saurians in Sri Lanka. The Kandyan gecko diversity could be considered 'immense' because the 12 species recorded during the study period represent 60% of the total number of geckos recorded from the country, which is 20. It is a significant fact that all the recorded species show a greater abundance near or within human habitations including those in the city, than within the forested areas. This may be due to the profusion of insects, the main food source of geckos, attracted by lights. The endemic spotted bowfinger gecko (*Geckoella triedrus*) is a sub-terrestrial species found under decaying logs, rocks and leaf litter mainly in the Gannoruwa and the Wakarawatte forests. It is normally seen guarding its 2 or 3 eggs, which it sticks to the underside of a rock.

The gecko genus *Cnemaspis* is the only genus that contains purely diurnal geckos in Sri Lanka. Species in this genus are commonly called 'day geckos'. The Kandyan day gecko (*Cnemaspis kandiana*) and the endemic subspecies *Cnemaspis jerdonii scalpensis* (Jerdon's day gecko) are common geckos in all forests in Kandy where they roam about on rock surfaces, trunks of large trees, walls etc. during the day time. But the rough-bellied day gecko (*Cnemaspis tropidogaster*) was uncommon and

Figure 3. The scalyfinger gecko *Lepidodactylus lugubris* (Kanishka Ukuwela).

Figure 4. The Great forest gecko *Cyrtodactylus frenatus* (Samitha Harischandra).

Figure 5. Jerdon's day gecko *Cnemaspis jerdoni scalpensis* (Ruchira Somaweera).

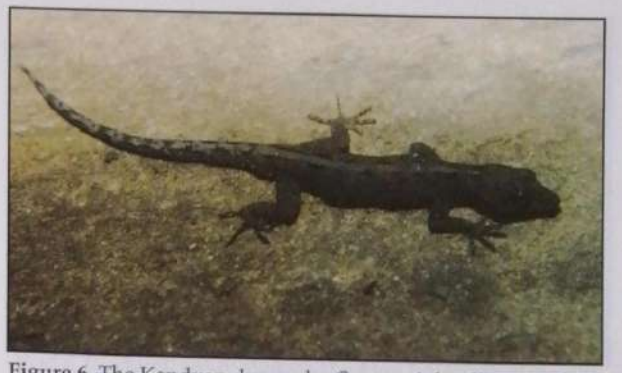

Figure 6. The Kandyan day gecko *Cnemaspis kandiana* (Ruchira Somaweera).

Figure 7. The roughbelly day gecko *Cnemaspis tropidogaster* (Ruchira Somaweera).

Figure 8. The Kandyan gecko *Hemidactylus depressus* (Ruchira Somaweera).

Figure 9. The common house gecko *Hemidactylus frenatus* (Ruchira Somaweera).

Figure 10. The slender gecko *Hemidactylus typus* (Ruchira Somaweera).

Figure 11. The fourclaw gecko *Gehyra mutilata* (Ruchira Somaweera).

Figure 12. The spotted bowfinger gecko *Geckoella triedra* (Ruchira Somaweera).

was infrequently met with in a few parts of the Hantana mountain range.

The slender-bodied, slow moving slender gecko (*Hemiphyllodactylus typus*) is a unique species that can be easily identified by its lean appearance. This species is very rare in the wild. However, we have recorded a number of sightings from houses in Dodanwela and the Ampitiya area. Although most geckos are fast movers, the scaly-fingered gecko (*Lepidodactylus lugubris*), a buff-yellow coloured gecko, moves comparatively slowly and can be handled easily.

Hemidactylus is the genus containing the majority of Sri Lankan geckos, which is 7. Out of them 3 species were recorded from the area that included 2 endemic species. The endemic spotted house gecko (*Hemidactylus brookii*) and the common house gecko (*Hemidactylus frenatus*), the most common geckos in the island, are distributed in all the 4 forests and also in most of the anthropogenic habitats. But the third species *Hemdactylus depressus* (the Kandyan gecko) that is also endemic to Sri Lanka is mainly a forest dwelling species and occupies a varied range of habitats. It is usually found in pairs. The four-clawed gecko or *Gehyra mutilata*, was found to be very common within house holds. Not a single animal was observed in natural habitats; it is the only gecko that we couldn't record in the *wild*.

The endemic great forest gecko (*Cyrtodactylus frenatus*) is the largest gecko found in and around Kandy. This nocturnal, rather slow moving species inhabits a large range of habitats including several rock outcrops and abandoned buildings in Hantana, Gannoruwa and Udawattekale areas.

Testudines

The testudines include the marine turtles, terrestrial tortoises and freshwater terrapins. Two species of terrapins are found naturally in Kandy. They dwell in several freshwater habitats including streams, lakes and paddy fields.

The hard-shelled terrapin or the black turtle (*Melanochelys trijuga thermalis*) can be found in water logged areas of all forests, except in Gannoruwa. The Raja Pokuna located in the Udawattekale sanctuary has been the best location to spot one. The soft-shelled terrapin or flap-shell turtle (*Lissemys punctata*) is rarely seen due to its habit of hiding under mud and amongst aquatic vegetation. It was recorded from Udawattekale and Wakarawatte, but it is considered that these animals were introduced to these waters.

The red-eared terrapin or red-eared slider (*Trachemys scripta*) is one of the world's worst alien invasive species (ISSG, 2000). It is reared as a pet in many houses in Kandy and still not found in the wild. This terrapin, which easily adjusts to natural conditions, can do a great deal of damage to aquatic ecosystems of the region if it establishes itself as a natural population.

There are several records from Kandy and the adjoining area testifying to the presence of star tortoises (*Geochelone eleganse*) in the wild. However according to published literature *G. eleganse*, the only land tortoise in Sri Lanka, is restricted to the 1st peneplain of the country (from sea-level up to 270m a.s.l.). These records are likely to be of escaped pets, as they are reared as pets in many houses.

Skinks

The family Scincidae accounts for 43% percent of the 67 saurians of the island with 29 described species out of which 22 species are endemic (de Silva, 2001). We were able to record 9 species of skinks from the area; but there are records of the occurrence of other species too that we failed to find. The lack of clearly illustrated field keys, similarity in the overall colour patterns and complex identification characters made field identification extremely difficult.

The genus *Nessia* is geographically relict to the island. Their closest relatives inhabit South Africa and Madagascar but not the adjacent Indian sub-continent. *Nessia monodactylus*, the toeless snake-skink is a common species in Kandyan forests. The fossorial habits of this endemic animal make it difficult to find. However, it can be seen under rocks and logs and has been recorded from all 4 forests.

Most of the skinks recorded in the area can be considered 'habitat generalists' due to their presence near human habitations and even inside houses, especially *Mabuya* species, the largest of the Sri Lankan skinks. The endemic *Mabuya carinata lankae* (common skink) inhabits almost all the forests, plantations and home gardens in Kandy but was not as common as *Mabuya carinata*. The bronze-green little skink (*Mabuya macularius macularius*) has also been recorded from Hantana and Gannoruwa.

Several species of the relict genus *Lankascincus* have been recorded from Kandy. The common Lanka skink or *Lankascincus fallax* was recorded from the leaf litter layer and puddles etc. in most habitats. There are previous records of *Lankascincus taylori* (Taylor's Lanka skink) from a tea plantation in Hantana (835 m a.s.l.) and from Udawattekale by Gans in the 1970's (Gans, 1995). However, the only site from which we were able to record

Figure 13. The humpnosed lizard *Lyriocephalus scutatus* (Ruchira Somaweera).

Figure 14. The green garden lizard *Calotes calotes* (Ruchira Somaweera).

Figure 15. The common garden lizard *Calotes versicolor* (Ruchira Somaweera).

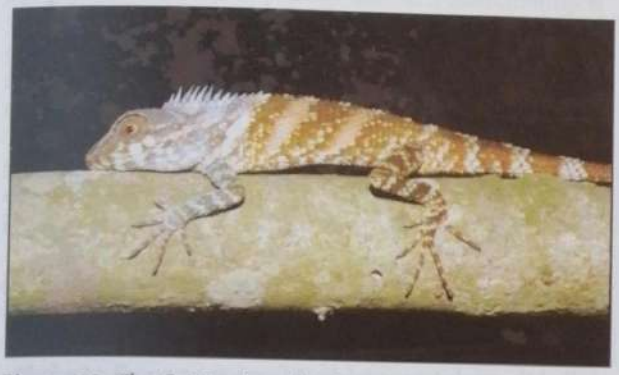

Figure 16. The Sri Lanka whistling lizard *Calotes liolepis* (Kanishka Ukuwela).

Figure 17. The Sri Lankan kangaroo lizard *Otocryptis weigmanni* (Kanishka Ukuwela).

Figure 18. The hard shelled terrapin *Melanochelys trijuga thermalis* (Ruchira Somaweera).

Figure 19. The soft shelled terrapin *Lissemys punctata* (Ruchira Somaweera).

Figure 20. The Red-eared Slider *Trachemys scripta* (Ruchira Somaweera).

Figur 21. The toeless snake-skink *Nessia monodactylus* (Ruchira Somaweera).

Lankascincus taylori was the Gannoruwa forest. Back in 1953, Deraniyagala recorded a single specimen of Deignan's Lanka skink (*Lankascincus deignani*) from Gannoruwa and several specimens of smooth Lanka skink (*Lankascincus taprobanensis*) from Kandy and Peradeniya. At present these species appear to be rather common in the Hantana range, where we observed considerably large populations of both species, beside forest streams in Udaperadeniya. Das and de Silva (1998) have recorded Gans's Lanka skink (*Lankascincus gansi*) from Gannoruwa. However, we were able to record this species only from Udawattakele.

Deraniyagala (1953) described two *Sphenomorphus* species, namely Dussumier's litter skink (*Sphenomorphus dussumieri*) and Ahl's litter skink (*Sphenomorphus striatopunctatus*) from Peradeniya. Even though we did not record these species, we have recorded the endemic red-throated litter skink (*Sphenomorphus rufogulus*) within the Kandy area (Somaweera, in press). However, the taxonomic validity of this species is doubtful as some taxonomists consider it to be a colour variation of *Lankascincus fallax* (Greer, 1991). Deraniyagala has also recorded the four-toed snake-skink or *Chalcidoseps thwaitesii* from Kandy. However, we were unable to record this species during our study.

Monitors

Although crocodiles have not been recorded in the vicinity of Kandy, the two varanids, the water monitor (*Varanus salvator*) and the land monitor (*Varanus bengalensis*) which are the largest lizards in the country, are found in the area. The land monitor is met sporadically and can be considered very rare in the area. Both species were seen at a few locations in the Hantana range but are comparatively rare in other forests. A large population consisting of more than 40 water monitors inhabits the Kandy Lake and the ditches near the Kandy fish market. The first Sri Lankan reptile to receive legal protection since 1937, the water monitor is not killed for food due to the belief that it's flesh is highly poisonous. But the land monitor is widely killed in the country and also in some suburban parts of Kandy, for food and its skin. It is listed as a 'Commercially threatened' taxon by the IUCN and also in Appendix 1 of the 1992 CITES manual (Convention on the International Trade in Endangered Species). Both monitors are predators of agricultural pests and are efficient scavengers in the environment.

A dark Future?

Nearly 205,850 people live wthin the Kandy Municipality limits, which spreads over about 28.53 km^2 of land, with more than 7200 people per km^2 (Kandy Municipal Council, 1998 *in litt.*). Kandy's overall population density is comparatively high. This means that the remaining forests around the area are under a great deal of human influence.

Much of the area's biodiversity has been lost as a result of high levels of deforestation and land degradation, poor agricultural practices and unregulated exploitation of resources. Deforestation as a result of logging and uncontrolled forest fires (as in Hantana and Gannoruwa), leading to the total loss of many habitats, is the greatest threat faced by all the species of tetrapod reptiles in the area.

Because of the deforestation and habitat fragmentation that has taken place in the recent past, reptiles have adopted a peculiar life style. Driven away from their natural habitats by sprawling urbanization and cultivation, most species have settled near forest boundaries and cultivated lands. This situation is clearly seen in the case of agamids and skinks.

Roads are a major threat to tetrapod reptiles, whether in towns or on the highways. The Gannoruwa highway and the Udaperadeniya road are two common routes where road kills of agamids and snakes abound.

Due to the prevalent negative attitude amongst the general population about these animals, especially skinks, as a result of unsubstantiated beliefs reptiles are killed through fear, misidentification or poor knowledge. Hunting of land monitors and terrapins for human consumption still continues in various parts of the area.

There is evidence that a considerable number of agamids etc. are smuggled out of the country each year. The Kandyan forests too suffer from collection of these animals. Over-collection by researchers and rearing herps as pets, especially terrapins and tortoises, particularly by persons with insufficient knowledge are also threats.

The application of weedicides, insecticides & chemical fertilizers etc., in vegetable plots, rice fields and even in home gardens is increasing in the area. The consequent decrease in the insect, earthworm and amphibian populations, important food sources for most reptiles, is likely to have an effect on reptile populations. These chemicals may also be toxic to the reptiles that inhabit cultivated areas (eg. *Calotes* sp. and skinks). In addition, fossorial skinks inhabiting cultivated lands are destroyed by field preparation activities etc.

As a result of habitat loss and urbanization many reptiles have become more vulnerable to natural/domestic predators and native opportunistic predators. Domestic cats, poultry and native birds such as the large-billed crow (*Corvus macrorhynchos*), house crow (*Corvus splendens*), common coucal (*Centropus sinensis*) and most raptors are predators of agamids, geckos, skinks and even juvenile monitor lizards. A study conducted in 99 households in a rural village in Gampola showed that pet cats in 49 houses and poultry in 16 houses killed 346 reptiles and amphibians during a period of 12 months (de Silva, 2001).

Figure 22. The red-throated litter skink *Sphenomorphus rufogulus* (Ruchira Somaweera).

Figure 23. The common Lanka skink *Lankascincus fallax* (Ruchira Somaweera).

Figure 24. Deignan's Lanka skink *Lankascincus deignani* (Ruchira Somaweera).

Figure 25. The smooth Lanka skink *Lankascincus taprobanensis* (Ruchira Somaweera).

Figure 26. Taylor's lanka skink *Lankascincus taylori* (Ruchira Somaweera).

Figure 27. The common skink *Mabuya carinata lankae* (Ruchira Somaweera).

Figure 28. The land monitor *Varanus bengalensis* (Ruchira Somaweera)..

Figure 29. The water monitor *Varanus salvator* (Ruchira Somaweera).

Lack of consistent studies on the population dynamics and distribution of these species preclude confident statements or even inferences to be drawn regarding population decline or otherwise. Consequently their conservation status cannot be determined.

Discussion

The study revealed that the Kandyan forests support rich tetrapod reptile diversity, with 30 species including 17 (54.8%) endemic forms. But if the threats detailed above continue to operate, there is a significant chance that some species along with their unique genes will become extinct from the area.

The problems affecting the natural habitats of the reptiles, in the case of Kandy, are particularly difficult to solve because of its overpopulation. However, several forms of legal protection have been given to these tetrapods. All tetrapod reptiles are listed as protected species in the country under the Fauna and Flora Protection Ordinance (Gunawardena, 1995). Most Sri Lankan tetrapod reptiles are considered to be threatened (Bambaradeniya *et al*, 2001). Of the 30 species of tetrapods recorded 15 are listed as 'Threatened species' in the 1999 IUCN list of Threatened Fauna and Flora of Sri Lanka, considering their status in the country. Also some of them have been separately assessed using global IUCN criteria (CAMP report, 2000). As Sri Lanka is a signatory to CITES, international trading of most tetrapod reptiles can be regulated using this legal instrument as well. Furthermore, export of any tetrapod or a part must be permitted by the Director of the Wildlife Conservation Department. This provides another mechanism to regulate export of these reptiles.

Ultimately it appears that successful conservation of tetrapods in the area and in the country will have to depend largely on awareness. Without good extension work that encourages full participation of local people to implement and maintain conservation plans in their areas, there is little prospect for the protection of many of the tetrapods and other wildlife species in the country.

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Liopeltis calamaria (Günther, 1858) (Serpentes : Colubridae) First Record from the Galle District, Southern Sri Lanka

Sudesh Batuwita
22, Kandewatta Road, Galle,

Liopeltis calamaria (Günther, 1858) [Reed Snake] belonging to the family Colubridae is a rather uncommon snake in Sri Lanka. According to Deraniyagala (1955) only a single specimen has been collected from the Southern Province (i.e.Warahena) and is lodged in the Colombo Museum collection. De Silva (1969) noted that the Warahena specimen in the Colombo Museum was badly damaged. He has not included the Southern Province in his index of localities. The author discovered a road kill of this snake in the Kottawa proposed forest reserve (6° 06′ N, 80°20′ E; *ca.* 60m above mean sea level) on 16th December 1998.

This species is uncommon and only a few records are available in Sri Lanka. Frank Wall (1921) observed that "In Ceylon it appears to be uncommon." He also stated "I saw no specimen in any collection" and added "No precise localities are on record." Nicholls (1929) who described this snake (plate XXXIV, figure 6 & 7) wrote, "This is a very rare snake in Ceylon and nothing is known of its haunts". Therefore, discovery of the Kottawa specimen (designated WHT 5014) drew my attention to the previous records (see figure 2) in the Colombo Museum collection. These were from Periyankulam (on the Madhu Road) and Marai Villu (Northern Province), Polonnaruwa (North Central Province), Badulla, Haputale and Uva patanas (Uva Province). Deraniyagala (1955) had added Sigiriya (North Central Province) to this list. It has also been observed in Bandara-wela (Mirahawatta area) in the Uva province (Kalum Manamendra-Arachchi, pers. com., 1986). De Silva (1990) records it from Opatha in the Southern Province, in the south western wet zone.

According to Das (1994) five species belonging to the genus *Liopeltis* are known from South Asia; only *L. calamaria* inhabits Sri Lanka.

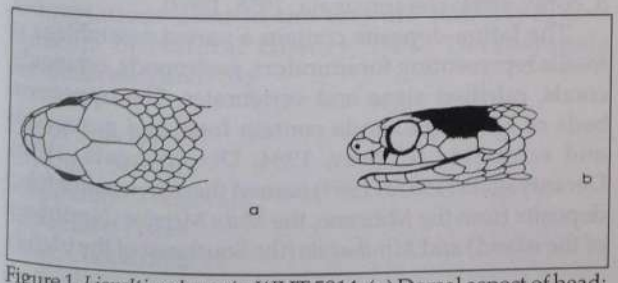

Figure 1. *Liopeltis calamaria*, WHT 5014: (a) Dorsal aspect of head; (b) Lateral aspect of head.

Description of the specimen – WHT 5014

A male specimen, colouration is in accordance with the descriptions given in De Silva (1980); of *Lepidosis* as in Nicholls (1929) and De Silva (1969). The morphometric ratios are in accordance with De Silva (1969) except two variations. First, the posterior genials are in contact with the fourth infralabial only (Figure 1b) instead of fourth and fifth infralabials as described for other specimens. Second, the number of ventral scales was 133 even though previously described specimens ranged from 129 – 132 for males. Morphometric measurements of the specimens were taken as described by Das (1998); the main measurements are given below.

Head length: 11.0mm
Snout to vent length: 200.0mm
Tail length: 285.0mm

The specimen has been deposited in the collection of the Wildlife Heritage Trust with the number WHT 5014.

Acknowledgements: I thank Messer's Rohan Pethiyagoda (Managing Trustee of the Wildlife Heritage Trust (WHT), Colombo), Dharma Sri Kandamby (Curator in Zoology, Colombo National Museum, Sri Lanka) and Kelum Manamendra-Arachchi (Research Associate of the WHT) for assisting me to confirm the identity of the snake. Mr. Mohommed M. Bahir (Research Officer of the WHT) for illustrating the specimen. Messer's A.I. Alagiyawadu, S.H.K. Wewelwala, K.P Maduwage and A. Silva (Wildlife Conservation Society – Galle) for helping me in many ways. Finally, I wish to thank Mr. Hemantha V. Situge for his encouragement and help.

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Miocene vertebrates of Sri Lanka described by P.E.P. Deraniyagala.

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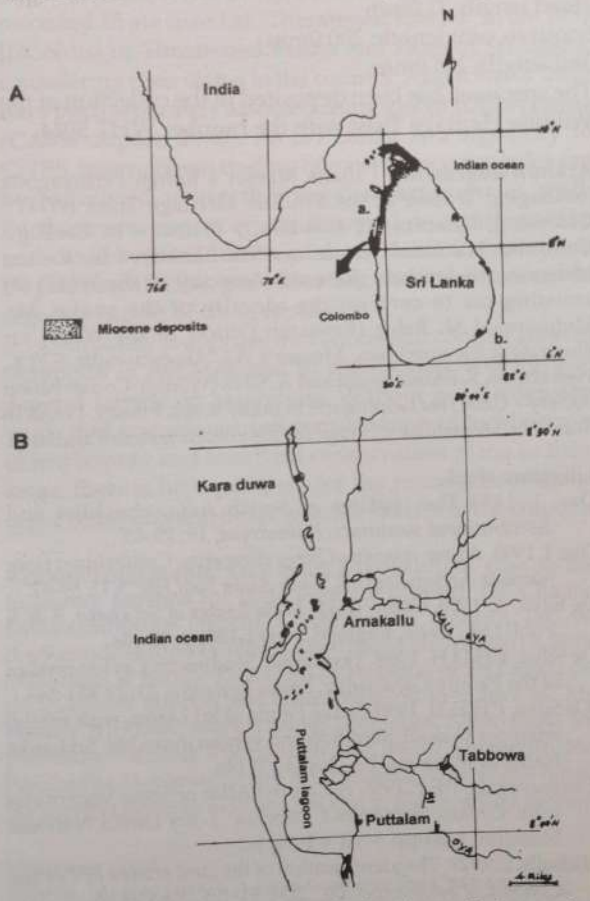
Introduction

Sri Lanka is an island with a land area of 65 610km² (Wijesinghe *et al.*, 1993) and is situated close to the southern corner of the Indian peninsular (5° 54′ – 9°52′ N, 79°39′ – 81°53′ E). The island was a part of Gondwanaland during the lower Cretaceous epoch (140 mys BP[1]) and began breaking up during the Upper Cretaceous as a fragment of the Deccan plate. The plate drifted north during the Paleocene epoch (55 mys BP). During the Miocene era (26 to 7 mys BP), Sri Lanka was separated from mainland India due to submersion of the land between the two countries (Ranasinghe, 2001).



Map 1. A. Miocene deposits of Sri Lanka: a. Malu member deposits b. Minihagal kanda deposits. B. Location of the vertebrate fossils described, Arnakallu.

The present land formation of the island is the result of millions of years of weathering by rain and wind as well as movement of the earth's crust. Miocene limestone underlies the northern, northwestern and a small extent of the southeastern part of the island. Fossils belonging to this period have been found in these areas (Cooray, 1984; Deraniyagala, 1937a; Deraniyagala, 1969).

The Miocene period

The beginning of the Miocene saw the initiation of new trends in earth's history. Geological evidence indicates that there has been a temperature decline during the Miocene period. But in spite of the lowering of temperature the Miocene period still had a green house climate (Kurten, 1971). The important events which took place during the Miocene period were: elevation of the Himalayan mountain range; separation of parts of Asia from the mainland to form large islands (Sri Lanka, Sumatra, Borneo) mammals like hyenas, giraffes, antelope and deer appeared in Asia and Europe. Sireneans were represented by several genera. Cetatheriid whales first appeared during the lower Miocene (Deraniyagala, 1969; Kurten, 1971).

Sri Lankan Miocene deposits

Tertiary rocks of Miocene age (26 to 7 mys BP) occur in two widely separated areas of Sri Lanka: the Jaffna peninsula in the extreme north and at Minihagalkande in the extreme southeast (Map 1A). The Jaffna deposit is the limestone that underlies the whole of the Jaffna peninsula and also extends in a narrow belt southwards along the north-western coast up to Puttalam. It is about 800 sq. miles in extent and several hundred feet thick. The greatest number of exposed limestone deposits are in the Puttalam area (Map 1B). A smaller outcrop of lower Miocene deposits occurs on the southeast coast of Sri Lanka at Minihagalkanda, where the beds are exposd in small semi-circular cliff-like exposures or amphitheas (Cooray, 1984; Deraniyagala, 1955, 1969).

The Jaffna deposits contain a varied assemblage of fossils representing foraminifers, gastropods, echinoids, corals, calcified algae and vertebrates. The uppermost beds of Minihagalkanda contain fossilized gastropods and echinoids (Cooray, 1984; Deraniyagala, 1958). Deraniyagala (1937a, 1969) named these two major fossil deposits from the Miocene, the *Malu Member* (Northwest of the island) and *Minihagala* (the Southeast of the island).

[1]million years before present

Palaeontological research

In 1923, Wayland and Davies first confirmed the Miocene beds in Sri Lanka. Morley Davies (1923) was able to identify the invertebrate fossils, which belonged to Gastropoda and Lamellibranchia from Minihagalkanda area. Deraniyagala discovered the first vertebrate Miocene fossils from the Northern Miocene beds (Deraniyagala, 1935; 1937a; 1937b). Eames (1950), and Tewari & Tandon (1960) attempted to determine the age of certain Upper Tertiary Miocene beds of India and Sri Lanka. Tewari and Tandon (1960) also recorded several species of micro-fauna from the Jaffna beds. For the first time, Deraniyagala (1960a; 1960b) recorded echinoderms, sponges, corals and other invertebrate fossils from Minihagalkanda. Thereafter, he described four new fossil fishes, three chelonids and three new marine mammals from Arua Kallu, Dutch Bay (1967, 1968, 1969) and two fish species from Arna Kallu, which is about fifteen miles north of Puttalam.

Objectives and methods

The aim of this paper is to collect into one publication Deraniyagla's descriptions of Miocene vertebrates that are spread over a number of papers published between 1935 and 1969 (see list of literature cited).

The first vertebrate fossils were found in 1937. Deraniyagala based his identifications, even when naming new species, on small skeletal fragments or teeth. He described 24 species: 17 fish, 3 reptiles and 4 mammals. Fifty specimens have been described, of which 12 were deposited in the British Museum of Natural History and the rest in his private collection. However, the Deraniyagala collection is not recorded in the BMNH catalogue (Paul Enson, Curator, Paleontology Dept., BMNH Pers. Comm.) and the whereabouts of his private collection is not known. His descriptions therefore assume greater importance.

The list of species and descriptions has been complied from published literature. The locality of the finds described is a 2 mile stretch along the eastern shore of Dutch Bay west of Aruakallu (Muringe Male) in the north western province (8° 17′ N, 79°49′ E). Species nomenclature is based on Deraniyagala (1953), Muno (1955), Moyle & Cech (1982) for fishes, De Silva (1996) for reptiles and Corbet & Hill (1992) for mammals. Abbreviations used in the text are BMNH: British Museum of Natural History; DPC: Deraniyagala personal collection.

List of Species

Phylum: Chordata
Subphylum: Vertebrata
Superclass: Pisces
Class: Chondrichthes
Order: Lamniformes

Family: Laminidae
Genus: *Isurus* Rafinesque, 1810

***Isurus glaucus* (Muller et Henle)**
Material: Single tooth fragment deposited in DPC.
Dimensions: Total length 19mm; basal width 6mm; apical width 3mm.
Notes: Living shark species.

Isurus sp.
Material: A single tooth deposited in BMNH (Fig. 1).
Dimensions: 16mm in height; 3mm in width.
Notes: Probably allied to living Shark species *Isurus crassidens* (Dixon)

Order: Hybodontiformes
Family: Hybodontidae
Genus: *Miosynechodus* Deraniyagala, 1969

***Miosynechodus mora* Deraniyagala, 1969**
Material: Holotype. Bilaterally compressed dorsal fin spine that possesses five longitudinal grooves. Deposited in DPC.
Dimensions: Total length 41mm; depth 6mm; width 10mm.
Notes: Shark species that became extinct during the Miocene period.

Order: Carcharhiniformes
Family: Carcharhinidae
Genus: *Galeocerdo* Muller et Henle, 1837

***Galeocerdo cuvier* (Peron et le Sueur, 1822)**
Synonyms: *Carcharias cuvieri* Peron et le Sueur, 1822; *Galeocerdo arcticus* (Faber, 1929)
Material: No. 1. A tooth with completely serrate margins deposited in BMNH (Fig. 2). Nos. 2-6. Teeth with serrate margins, deposited in DPC.
Dimensions: No. 1. Height 11mm; thickness 5mm; length of base 23mm; height of first cusp above the second 8mm. No. 2. Height 22mm; mesio-external length 30mm; thickness 4mm. No. 3. Height 17mm; mesio-external length 26mm; thickness 3mm. No. 4. Height 17mm; mesio-external length 20+mm; thickness 5mm. No. 5. Height 11mm; mesio-external length 22mm; thickness 3mm. No. 6. Height 16mm; thickness 4mm.
Notes: A living marine shark species that sometimes enters estuaries.

Genus: *Glyphis* Agassiz, 1843

***Glyphis minor* (Agassiz, 1837)**
Synonyms: *Carcharias minor* Agassiz 1837; *Corax egertoni* Agassiz, 1843; *Carcharias (Prionodon) egertoni* Wooward, 1889.

Material: Tooth with fine sub-equal marginal serration, deposited in BMNH (Fig. 3).
Dimensions: Total height 15mm; length of anterior margin 17mm; length of posterior margin 15mm; width 15mm.
Notes: A shark species that became extinct during the Miocene period.

Family: Galeolamnidae
Genus: *Galeolamna* Owen

***Galeolamna gangatica* (Muller et Henle, 1841)**
Material: Six teeth with fine serrated margins, deposited in DPC.
Dimensions: No. 1. Upper tooth; height 18mm; mesio-distal basal length 16+mm; thickness 4mm (Fig. 4a). No. 2. Upper tooth; height 18mm; mesio-distal basal length 17+mm; thickness 4mm. No. 3. Upper tooth; height 18mm; mesio-distal basal length 16mm; thickness 4mm. No. 4. Upper tooth; height 17mm; mesio-distal basal length 16mm; thickness 4mm. No. 5. Upper tooth; height 19mm; mesio-distal basal length 18mm; thickness 4mm (Fig. 4b). No. 6. Lower tooth; height 16.5mm; mesio-distal basal length 7mm; thickness 4mm (Fig. 4c. i & ii). No. 7. Vertebra; diameter 30mm; length 15mm.
Notes: A shark species that became extinct during the Miocene period.

***Galeolamna brachyura* (Gunther)**
Notes: No description given, only listed in the checklist.

***Galeolamna minor* (Agassiz)**
Notes: No description given, only listed in the checklist.

Family: Hemigaleidae
Genus: *Hemipristis* Agassiz, 1843

***Hemipristis serra* Agassiz, 1843**
Material: No. 1. Tooth with apex of the cusp broken, deposited in BMNH (Fig. 5). Nos. 2-9. Teeth from the same locality, deposited in DPC.
Dimensions: No. 1. Height 13mm; mesio-distal basal length 16mm; thickness 5mm. No. 2. Height 18mm; mesio-distal basal length 10mm; thickness 3mm. No. 3. Height 14mm; mesio-distal basal length 15mm; thickness 4mm. No. 4. Height 20mm; mesio-distal basal length 20mm; thickness 4mm. No. 5. Height 19mm; mesio-distal basal length 14+mm; thickness 5mm. No. 6. Mesio-distal basal length 16mm; thickness 4mm. No. 7. Height 17+mm; mesio-distal basal length 12+mm; thickness 4mm. No. 8. Height 18+mm; mesio-distal basal length 12mm; thickness 4mm. No. 9. Height 19+mm; mesio-distal basal length 12+mm; thickness 5mm.
Notes: Living shark species that enters rivers.

Order: Myliobatiformes
Family: Myliobatidae
Genus: *Myliobatis* Cuvier, 1817

***Myliobatis sinhaleyus* Deraniyagala, 1937**
Material: Holotype. Comprises five straight tooth plates, deposited in BMNH (Fig. 6). Others. Part of a caudal spine.
Dimensions: Holotype. Total length 13mm; width 28mm. Others. Length 24mm; width 10mm; depth 6mm.
Notes: A ray species that became extinct during the Miocene period. Similar to living *Myliobatis maculatus* Grey et Hardwicke.

Genus: *Aetobatus* Blainville, 1816

***Aetobatus sinhaleyus* Deraniyagala, 1937**
Material: Holotype. Portion of the lower tooth pile, deposited in BMNH (Fig. 7).
Dimensions: Total length 30mm; depth 8mm; width 12mm.
Notes: A ray species that became extinct during the Miocene period. Similar to the living species *Aetobatis narinari* (Euphrasen).

Order: Rajiformes
Family: Trygonidae
Genus: *Trygon* Adanson

***Trygon sinhaleyus* Deraniyagala, 1969**
Material: Holotype. Part of caudal spine, deposited in DPC (Fig. 8).
Dimensions: Total length 23mm; proximal depth 5mm; distal depth 3mm; proximal width 6mm; distal width 3mm; length of serration 1mm.
Notes: An extinct ray species.

Class: Osteichthyes
Subclass: Actinopterygii
Order: Tetraodontiformes
Family: Diodontidae
Genus: *Diodon* Linnaeus, 1758

***Diodon sinhaleyus* Deraniyagala, 1937**
Material: Holotype. Inner dental plate, deposited in BMNH (fig. 9). Paratype. Inner dental plate, deposited in BMNH.
Dimensions: Holotype. Total length 9.5mm; height 6mm; greatest width 20mm. Paratype. Total length 10mm; height 6mm; greatest width 17mm.
Notes: This Porcupine fish species became extinct during the Miocene period and showed characters that were intermediate between *Diodon scillae* Agassiz and *Diodon sigma* Martin.

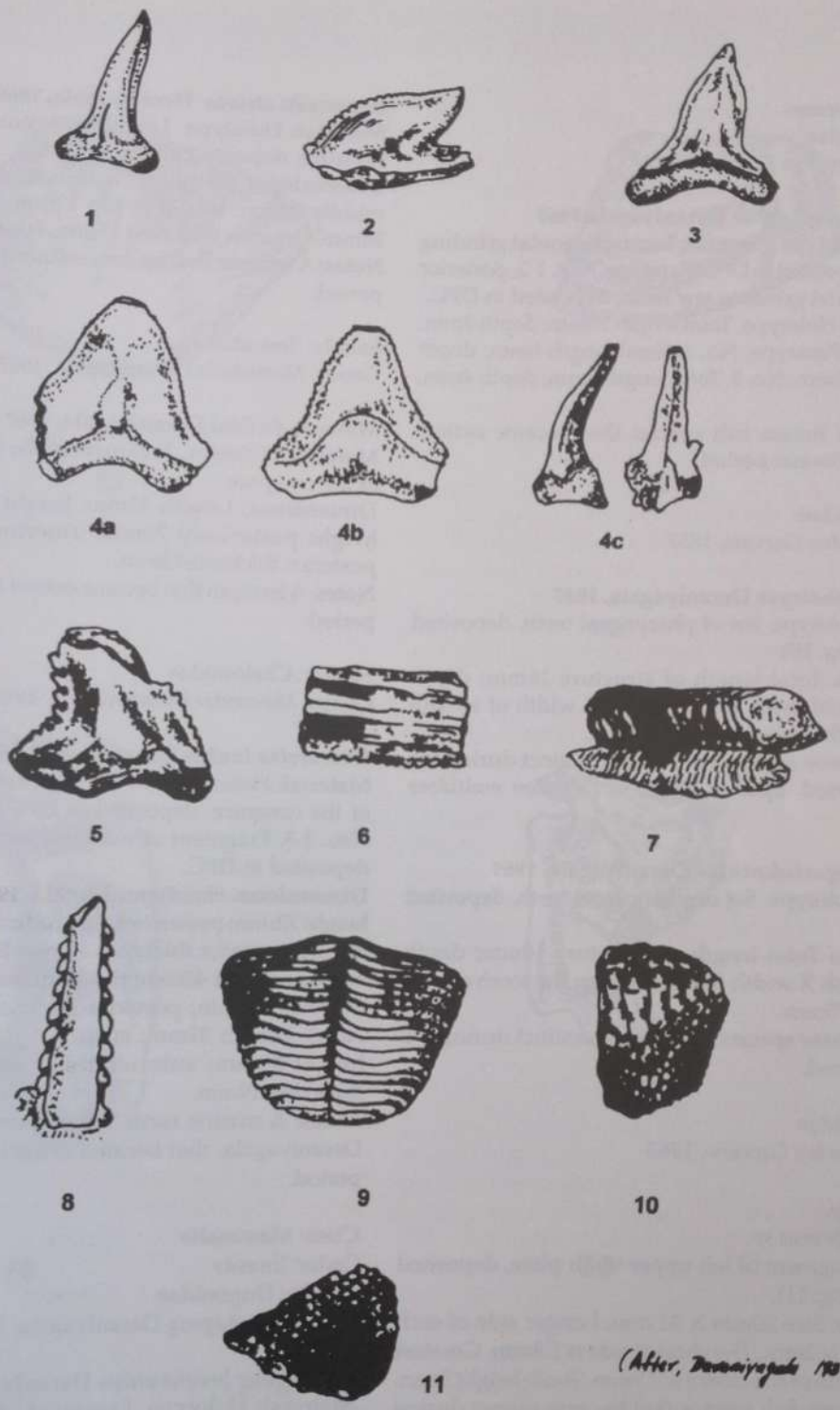


Fig. 1. Tooth of *Isurus* sp., 16mm in height **Fig. 2**. Tooth of *Galeocerdo cuvier* (specimen No. 01), 11mm in height. **Fig. 3**. Tooth of *Glyphis minor*, 15mm in height. **Fig. 4 a**. Upper tooth of *Galeolamna gangatica* (specimen No. 01), 18mm in height. **Fig. 4 b**. Upper tooth of *Galeolamna gangatica* (specimen No. 06, 16.5 mm in height. **Fig. 4 c**. Lower tooth of *Galeolamna gangatica* (specimen No. 06), 16.5 mm in height. **Fig. 5**. Tooth of *Hemipristis serra* (specimen No. 01), 13mm in height. **Fig. 6**. Holotype of *Myliobatis sinhaleyus*, tooth 13mm in length. **Fig. 7**. Holotype of *Aetobatus sinhaleyus*, tooth 30mm in length. **Fig. 8**. Holotype of *Trygon sinhaleyus*, tooth 23mm in length. **Fig. 9**. Holotype of *Diodon sinhaleyus*, tooth 9.5mm in length. **Fig. 10**. Holotype of *Labrodon sinhaleyus*, tooth 16mm in length. **Fig. 11**. Fragment of left upper tooth plate of *Scarus sp.*, size 20mmx24mm.

Order: Perciformes
Family: Sparidae
Genus: *Chrysophrys* Cuvier

***Chrysophrys miolankae* Deraniyagala,1969**
Material: Holotype. Posterior hemisphenoidal grinding jaw tooth, deposited in DPC. Paratype. Nos. 1-2. posterior hemisphenoidal grinding jaw teeth, deposited in DPC.
Dimensions: Holotype. Total length 10mm; depth 3mm; width 9mm. Paratype. No. 1. Total length 6mm; depth 3mm; width 6mm. No. 2. Total length 6mm; depth 4mm; width 6mm.
Notes: Silver Bream fish species that became extinct during the Miocene period.

Family: Labridae
Genus: *Labrodon* Gervais, 1857

***Labrodon sinhaleyus* Deraniyagala, 1937**
Material: Holotype. Set of pharyngeal teeth, deposited in BMNH (Fig. 10).
Dimensions: Total length of structure 16mm; depth 9mm; length of tooth 4mm. Length X width of a tooth from the tooth cluster is 5mm X 3mm.
Notes: A wrasse species that became extinct during the Miocene period. Species allied to *Labrodon multidens* (Munster).

***Labrodon angustidentatus* Deraniyagala, 1969**
Material: Holotype. Set of pharyngeal teeth, deposited in DPC.
Dimensions: Total length of structure 10mm; depth 10mm. Length X width of a tooth from the tooth cluster is 3mm X 0.75mm.
Notes: A wrasse species that became extinct during the Miocene period.

Family: Scaridae
Genus: *Callyodon* Gronow, 1763

Callyodon sp.
Synonyms: *Scarus sp.*
Material: Fragment of left upper tooth plate, deposited in BMNH (Fig. 11).
Dimensions: Size 20mm X 24 mm. Longer side of each tooth crown is 2mm. The shorter side is 1.8mm. Greatest diagonal width of the crown is 2.9mm. Tooth height 5mm.
Notes: A parrot fish species that became extinct during the Miocene period.

Class: Reptilia
Order: Testudinata
Family: Emydidae
Genus: *Geoemyda* Grey

***Geoemyda striata* Deraniyagala, 1969**
Material: Holotype. Left suprafemoral margin of the carapace, deposited in DPC (Fig. 12).
Dimensions: Peripheral length 32mm; length along middle 28mm; length at top 17mm. Width anteriorly 24mm. Greatest thickness 15mm; least thickness 5mm.
Notes: A terrapin that became extinct during the Miocene period.

Family: Testudinidae
Genus: *Miotestudo* Deraniyagala, 1967

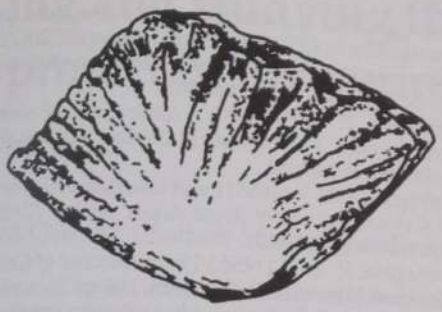
***Miotestudo ibba* Deraniyagala, 1967**
Material: Holotype. Fragment of the right humeral arch of the carapace.
Dimensions: Length 85mm; height anteriorly 50mm; height posteriorly 70mm; anterior thickness 7mm; posterior thickness13mm.
Notes: A terrapin that became extinct during the Miocene period.

Family: Cheloniidae
Genus: *Miocaretta* Deraniyagala, 1967

***Miocaretta lankae* Deraniyagala, 1967**
Material: Holotype. No. 1. Fragment of marginal bones of the carapace, deposited in DPC (Fig. 13). Paratype. Nos. 2-3. Fragment of marginal bones of the carapace, deposited in DPC.
Dimensions: Holotype. No. 1. Length 22mm; anterior height 32mm; posterior height 40mm; anterior thickness 25mm; posterior thickness 26mm. No. 2. Length 60mm; anterior height 43mm; posterior height 54mm; anterior thickness 28mm; posterior thickness 30mm. Paratype. No. 3. Length 31mm; anterior height 44mm; posterior height 58mm; anterior thickness 24mm; posterior thickness 19mm.
Notes: A marine turtle larger than *Caretta caretta gigas* Deraniyagala, that became extinct during the Miocene period.

Class: Mammalia
Order: Sirenia
Family: Dugonidae
Genus: *Miodugong* Deraniyagala, 1969

***Miodugong brevicranius* Deraniyagala, 1969**
Material: Holotype. Fragment of the left parietal and squamosal bones, deposited in DPC. Paratype. fragment of a rib, deposited in DPC (Fig. 14).
Dimensions: Holotype. Width of parietal 29mm; thickness of squamosal 27mm. Paratype. Total length 132mm; Diameter 19mm.
Notes: A dugong species that became extinct during the Miocene period. Smaller than the living species, *Dugong dugong* (Erxleben).



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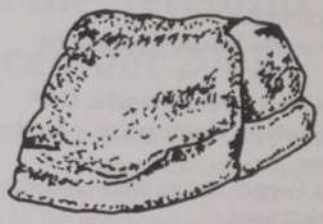

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(After Deraniyagala, 1968, 1969)

Fig. 12. Holotype of *Geoemyda striata*, supra-femoral margin of carapace, 32mm in length. **Fig. 13.** Holotype of *Miocaretta lankae*, fragment of marginal bones of carapace, 22mm in length. **Fig. 14.** Paratype of *Miodugong brevicranius*, fragment of rib, 132mm in length. **Fig 15.** Holotype of *Mioceta bigelowi*, sixth cervical vertebra, 38mm in length.

Order: Cetacea
Family: Delphinidae
Genus: *Miotursiops* Deraniyagala, 1969

***Miotursiops mulla* Deraniyagala, 1969**
Material: Holotype. Centrum of a lumbar vertebra of cordate shape.
Dimensions: Length 32mm; bilateral width 82mm; dorsi-ventral depth 73mm.
Notes: A dolphin species that became extinct during the Miocene period.

Family: Cetotheridae
Genus: *Mioceta* Deraniyagala, 1967

***Mioceta bigelowi* Deraniyagala, 1967**
Material: Holotype. Sixth cervical vertebra, deposited in DPC (Fig. 15). Paratype. Lumbar vertebra, thoracic vertebra, and a corroded vertebra, deposited in DPC.
Dimensions: Holotype. Length 35mm; width 86mm; height 65mm. Paratype. Lumbar vertebra: length 120mm; width 96mm. Thoracic vertebra: length 83mm; width 92mm. Corroded vertebra: length 109mm.
Notes: A whale species that became extinct during the Miocene period.

***Mioceta magna* Deraniyagala, 1969**
Material: Holotype. Fragment of a rib. Paratype. Fragment of a rib.
Dimensions: Holotype. Length 115mm; width 46mm. Paratype. Length 160mm; width 55mm.
Notes: A whale species that became extinct during the Miocene period. It was larger than *Mioceta bigelowi*.

Acknowledgements
I thank Mr. Gamini Adikari (Post graduate Institute of Archeology University of Kelaniya) for his kind encouragement for this paper and Dr. D.K. Weerakoon (Department of Zoology, University of Colombo) for reading the manuscript and his suggestions. I am very grateful to Mr. K. Manamandra-archchi (Wildlife Heritage Trust) for providing valuable literature and Mr. Paul Ensom (Curator Palaeontology department, British Natural History Museum) for providing information. Finally, I like to thank librarians of the National Museum Colombo, Post graduate Institute of Archeology, and Royal Asiatic Society Sri Lanka for their help during the literature survey.

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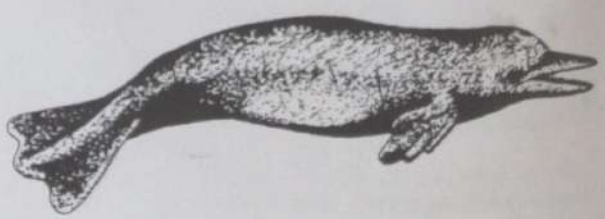

Figure 16. *Miotursiops mulla*, Deraniyagala, 1969 (after Deraniyagala).

Seeking and studying the new owl: the Serendib Scops Owl project in the period July - December 2001

Deepal Warakagoda

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The last issue of *Loris* carried the story of the discovery of a new species of owl in Sri Lanka earlier this year. It is now known by the common (or English) name Serendib Scops Owl. As mentioned in that article, a project is in progress for the study of the distribution, ecology, biology and taxonomy of the species. Given below is a summary of the new information gathered in the project during the second half of the year.

The existence of a total of at least 14 individuals of the new species is known from five sites, now, at the end of December 2001. Four of these birds are known by direct observation, and the other 10 by their vocalisation.

The birds observed have been identical in plumage detail and vocalisation, except that in the latter there is a difference in key between the sexes. The distinctness of the species is thus clearly indicated, and further confirmed.

The new owl is now known to occur in Sri Lanka throughout the year, which establishes that it is a resident in the island. The endemicity of the species, too, is thus confirmed.

We were able to capture one individual of the species. This enabled its biometrics to be taken, and further plumage detail to be studied. The captured bird was subjected to careful examination and observation. A comprehensive set of photographs was obtained. The bird was ringed, and released at the exact location where it was captured. The new photographs have been used by Dr Pamela Rasmussen for further comparative studies with other closely related owl species, at extensive collections in foreign museums, to confirm the distinctness of the species

Figure 1. The Serendib scops owl front view.

The name for the new species signifies the serendipity involved in its discovery - seen in the previous article - while also using an ancient name for Sri Lanka. The scientific name will be given when the species is described in an appropriate scientific journal. Until then it will be cited as 'Otus sp.' or 'Otus undescribed sp.', in conformity with the International Code of Zoological Nomenclature.

The work of continuing the studies in the project regularly has been difficult. The surveys are usually carried out in leech-infested forests, sometimes in difficult terrain, and sometimes in very rainy and cold conditions. Lengthy periods of patient listening and observation are required. The species, being shy and elusive, is hard to detect. Some sites have required three or more visits before they finally yielded to us their secret inhabitant.

After the standard use of mistnets was found ineffective in capturing the new owl, other techniques were developed by the project team, which finally brought success. It appears that they can be applied in capturing small owls without much difficulty in total darkness. They will be disclosed for the use of future researchers after further testing and development. Techniques of illumination also were developed by the team to minimize the disturbance to the birds by the use of artificial light, which is necessary for observing their behaviour at night. The response of the birds has shown these to be successful. They have now been discussed and recommended internationally by other researchers in wildlife studies.

Figure 2. The Serendib scops owl Back view

It appears from the data gathered from the project thus far that the new species needs for its survival a large forest of a certain high degree of density and richness, yet to be quantified. So far it has been noted only in large and intact or fairly intact rainforests. If future data also conforms to this pattern it is possible that the presence of the new owl can be used as an indicator of these characteristics for a given forest.

The project is continuing. In our visits to its habitats we hope to study, as well as it is possible, the behaviour, feeding ecology and breeding of the new species.

Acknowledgements

I record my thanks to Messrs Chandima Kahandawala, Kithsiri Gunawardena, Udaya Sirivardana and Nanda Senanayake, and Dr Pamela Rasmussen for their work in the project, on and off the field. The project team express their gratitude to Messrs John Deppman, Thilo Hoffmann and Guenter Lamsfuss, a source requesting anonymity and A Baur & Co Ltd for generous donations of funds for the project; and the Research Committees, officials and field personnel of the Department of Wildlife Conservation and the Forest Department for their permission and assistance.

The 2001 waterbird census in Sri Lanka

Kithsiri Gunawardena

Ceylon Bird Club, 39, Chatham Street, Colombo 1

One of the most important regular ornithological events in Sri Lanka is the annual waterbird census. It was conducted for the 18th successive year by the Ceylon Bird Club, from the first week of January to the first week of February 2001, in most parts of the island.

All the species of waterbirds including raptors associated with wetlands are counted during the peak of the migrant season, at locations pre-identified as popular waterbird habitats throughout the country. Measures are taken to minimize the possibility of double counting at sites in proximity to each other. The data collected, when compared with those of previous years, helps in monitoring the fluctuations in the numbers of these birds, and in avifaunal studies including those in relation to bird migration.

Members of the CBC who participated were: Elmo Alles, Lucky Abeyawardena, Bennie L Abeyratne, C B Bavinck, Niran Caldera, Gehan de Silva Wijeyeratne, Kithsiri Gunawardena, Kiran Kumaranayagam, Lester Perera, Willie Perera, Ravi Samarasinha, Pathmanath Samaraweera, Nanda Senanayake, Hemantha Seneviratne, Sampath Seneviratne, Sarath Seneviratne, Udaya Sirivardana, Deepal Warakagoda and Himal Warakagoda. The club also wishes to thank the following non-members for their help: Hiran Cooray, Nilmini Kumaranayagam, Janaka Perera, Asoka Siriwardane, Damayanthi Siriwardane, Maragaret Sloper and Robert Sloper.

The census was not conducted in the Batticaloa, Manampitiya and Kandakadu areas this year even though these areas were surveyed during the previous year. Once again many areas affected by the armed conflict had to be excluded from the survey.

As the water levels were generally high in most of the waterbird habitats this year, the period of the census was extended to the second week of February. However, the majority of the sites were surveyed during the month of January. All counters have reported that the water levels at the sites have been high. A matter of interest is where the birds go in this situation. It has been observed in a number of previous years also that large numbers of waterbirds are present during November and sometimes in December but seem to vanish with the rains during the latter part of December and January.

With a total of 51,166 birds counted, this year's count was the lowest ever recorded to date. The figure is about half of the previous year's count (ca.104,000). There was a reduction of the birds counted in the Jaffna sector by about 30%, and the area south of Galle to Yala N P by about 75% (from c.35,000 birds to a mere 8,530). However, there was an increase by more than half in the number of birds counted in the Puttalam to Chilaw sector (from ca.10,500 to 16,256).

One reason for the overall low count could be the usual drastic fluctuations in the influx of migrant birds, noted since early times. The smaller geographical coverage and the disappearance of birds due to high water levels could also have contributed to the reduction in the numbers recorded this year.

The total number of species recorded was 92, which is about the average for previous censuses. Among them the more uncommon sightings for Sri Lanka included Great Cormorant, Indian Reef Heron, Black-necked Stork, Wigeon, Common Teal, Shoveller, Pallid and Montagu's Harriers, Osprey, Common Coot, Crab Plover, Oystercatcher, Ringed Plover, Terek Sandpiper, Red-necked Phalarope, Sanderling, Temminck's Stint, Broad-billed Sandpiper and Ruff.

Photo : T. S. U. de Zylva

Habitats

The white-spot disease that plagued the prawn farms has slowed down this industry and its massive destruction of the wader habitats on the western coast. However, degradation of waterbird habitats continues in many other parts of the island. The plight of certain important habitats including what is left of the Bellanvila-Attidiya Sanctuary is pathetic.

Another threat to waterbirds recurring from time to time is that of humans killing them and removing immature birds from their nests for food. This year the newspapers widely reported such destruction and the resulting sale of the illicit cooked meat at a premium price in several restaurants from Matara to Tissamaharama. On representations being made by those concerned at this, particularly by certain CBC members, timely interventions by the officers of the Department of Wildlife Conservation have successfully reduced such occurrences.

There were also a number of very distressing reports of a few unruly, 'trigger-happy' members of the Police and armed forces violating the provisions of the Fauna and Flora Protection Act by hunting protected birds even inside sanctuaries such as Anavilundawa. The CBC wishes to request the relevant authorities to take necessary action to arrest such activities committed by a few personnel, which also bring undue disrepute and public humiliation upon their institutions.

TABLE 1. TOTALS OF WATERBIRDS AND DISTRIBUTION IN MAIN AREAS - 2001

SPECIES	NO. OF SPECIES	TOTAL	JAFFNA AREA	PUTTALAM TO CHILAW - COASTAL	PUTTALAM TO CHILAW - INLAND	SOUTH OF CHILAW, TO GALLE	S. OF GALLE TO YALA - COASTAL	SOUTH EAST - INLAND	REST OF ISLAND - INLAND
Grebes	1	410	35	1	182	19	30	119	24
Pelicans	1	320	-	-	-	70	178	63	9
Cormorants, Darters	4	4,071	939	126	542	286	1,509	491	178
Herons	12	5,148	1,535	705	118	393	410	1,515	472
Storks	5	580	236	18	6	16	98	127	79
Ibises, Spoonbills	2	460	162	22	-	-	103	108	65
Flamingos	1	1,409	253	-	-	-	1,156	-	-
Ducks	7	9,487	7,150	377	195	366	1,063	203	133
Rails, Coots	4	513	2	13	95	77	82	178	66
Jacanas	1	419	16	-	46	4	82	217	54
Waders	34	13,080	4,161	4,836	-	55	3,268	632	128
Gulls, Terns	13	15,153	3,536	10,131	16	636	542	254	38
Raptors	6	116	36	27	-	7	9	28	9
TOTAL	91	51,166	18,061	16,256	1,200	1,929	8,530	3,935	1,255

TABLE 2. TOTALS OF MAIN SECTORS COMPARED WITH PREVIOUS YEARS

	2001	2000	1999	1998	1997	1996	1995	1994
JAFFNA AREA	18,061	25,032	26,620	29,091	* 10,940	-	* 16,218	* 8,652
PUTTALAM TO CHILAW - COASTAL	16,256	10,647	14,940	23,860	15,323	17,065	28,006	13,745
PUTTALAM TO CHILAW - INLAND	1,200	4,489	3,298	6,008	7,577	7,786	131,025	5,061
SOUTH OF CHILAW, TO GALLE	1,929	4,046	1,880	1,471	3,613	1,625	5,942	6,772
S. OF GALLE, TO YALA - COASTAL	8,530	35,265	14,326	77,694	75,197	32,665	43,454	21,739
SOUTH-EAST - INLAND	3,935	8,731	4,036	2,470	3,723	2,786	1,838	1,196
BATTICALOA AREA	-	6,745	-	-	-	-	-	-
TRINCOMALEE AREA	-	-	-	-	-	-	1,256	9,433
REST OF ISLAND - INLAND	1,255	9,021	6,988	10,821	3,842	5,027	8,581	9,323
* - SMALL PART ONLY	51,166	103,976	72,088	151,415	120,215	66,954	236,320	75,921

TABLE 3. TOTALS OF GROUPS OF WATERBIRDS COMPARED WITH PREVIOUS YEARS

	2001	2000	1999	1998	1997	1996	1995	1994
Grebes	410	632	229	232	236	1,114	433	139
Pelicans	320	384	298	494	640	340	570	756
Cormorants, Darters	4,071	8,494	4,764	7,847	8,521	7,260	11,372	8,461
Herons	5,148	21,684	9,368	16,131	12,365	11,080	14,415	13,532
Storks	580	2,862	1,351	1,585	1,623	1,837	2,019	576
Ibises, Spoonbills	460	1,248	533	1,178	1,341	1,054	1,200	1,392
Flamingos	1,409	2,620	1,357	964	2,600	1,177	188	138
Ducks	9,487	25,033	18,495	72,216	24,697	17,044	163,272	18,276
Rails, Coots	513	1,612	1,123	1,716	1,650	1,589	2,755	940
Jacanas	419	1,306	1,032	1,443	1,214	1,071	1,294	736
Waders	13,080	33,047	22,583	38,538	54,707	17,349	30,774	20,257
Gulls, Terns	15,153	4,940	10,893	8,896	10,478	5,915	7,919	10,561
Raptors	116	114	62	185	143	124	109	157
	51,166	103,976	72,088	151,425	120,215	66,954	236,320	75,921

Range extention of *Calodactylodes illingworthorum* Deraniyagala, 1953. (Gekkonidae: Reptilia)

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The genus *Calodactylus* was erected in 1870 with the description of *Calodactylus aureus* from Tripathy hill in India. However, as this genus name had been assigned to a Coleopteran (Beetle) species in 1850 by Blunchard, Stand revised the genus name in 1920 to *Calodactylodes* (Bauer & Das, 2000). In 1953 Deraniyagala described the second species of this genus, *Calodactylodes illingworthi*, from Nuwaragala (7° 29'35" N, 81°26'00" E) near Maha Oya in the Eastern province of Sri Lanka. The species name was given in honor of Margaret and Percy Illingworth. Bauer and Das (2000) revised the species name to *illingworthorum* (plural) under Article 32.5 of the International Code of Zoological Nomenclature as it commemorated two people.

Deraniyagala (1953a, 1953b) made the only detailed description of this species. Thereafter, Manamendra-Arachchi (1997) published a colour catalogue of Sri Lankan geckos containing the only published colour photograph of this species. However, he has erroneously named it *Cnemaspis tropidogastor*. In 2000, Bauer and Das reviewed this genus and compared the Indian and Sri Lankan species. *Calodactylodes illingworthorum* was known only from its type locality, Nuwaragala in the Ampara district, till 47 years later Bauer and Das (2000) reported this species from Kumaradola in the Monaragala district based on a specimen collected by M.M. Bahir in 1998. we report this gecko from the Karandahela mountain (6° 65'00" N, 81°39'20" E) at Hulannuge in the Ampara district, approximately 20 miles east of Kumaradola and 39 miles south of Nuwaragala.

Diagnosis: *Calodactylodes illingworthorum* can be distinguished from its Indian relative *C. aureus* by its narrow, wedge-shaped mental (*C. aureus* has a pentagonal or rectangular scale), more rounded ear (elliptical in *C. aureus*), broad head (*C. aureus* has a narrow head) and 2-5 femoral pores (*C. aureus* has 5-9) (Deraniyagala, 1953a & 1953b, and Bauer & Das, 2000).

Material: Six individuals were observed in two different rock caves (four in one and two in the other). Two specimens were less than 9cm in length and the other four were more than 15cm in length. Seven egg-laying sites were also observed inside the caves.

Colour: Deraniyagala (1953b) describes the colour of the dorsal surface of this species as yellow ochre with dark brownish grey flecks. The mid-dorsal line has six dark brown bands, separated by light spots from the nape to the base of the tail. 11-13mm long bluish spots can be seen laterally from eye to occiput and the side of the body. Nine dark rings can be seen on the tail and the limbs contain 5 to 6 dark bands. The colour of the ventral side is pale greyish yellow with a bright orange gular patch. Specimens from the present location seem to change colour with the background and adults appeared darker than juveniles (Fig. 1-2).

Habitat: Karandahela, with a historical and monastic past lies on the western outskirts of Lahugala National Park in the Ampara district. This isolated mountain ranges from 200ft to 633ft above sea level. Its rocky nature with numerous caves, large boulders and steep rocky precipices have provided shelter for prehistoric man, Vedda tribes and religious (Buddhist) devotees. During 2 BC, Karandahela was a Buddhist shrine called "Habuthagala Vehera" built by King Kakawanna Tissa

Figure 1. *Callodactylodes illingworthorum* (about 7cm), from cave number one. (Photo: A.L. Peries)

Figure 2. *Callodactylodes illingworthorum* (about 10cm), from cave number two. (Photo: A.L.Peris)

Figure 3. Cave number two. (Photo: A.L. Peries)

Figure 4. Nests (re-used egg-site) from cave number one. (Photo: A.L. Peries)

Figure 5. Nests (new egg-site) from cave number two. (Photo: A.L. Peries)

Figure 6. Rock art of the golden gecko ? From Buddha Image house cave. (A.L. Peries)

(Nicholas, 1979 and Medananda, 1999). This place is now called the "Tharulengala" monastery (Medananda, 1999).

The area is covered by dry mixed evergreen forest and contains 50 rock caves. We have recorded a total of 65 faunal species from Karandahela mountain and the adjoining forest. Since 1948, Buddhist monks have occasionally used these caves: at present five are in use. One of the largest caves (175ft long, 31ft broad and 35ft in height) has been used as a Buddha Image house from ancient times. The largest cave of the mountain is about 512ft long and 82ft in height. In this cave we found four individuals of *C. illingworthorum*, and six egg-laying sites. Another two individuals and one egg-laying site were found in a smaller cave (fig. 3), where we also observed a day gecko species belonging to the genus *Cnemaspis*. We did not observe any major threats to this gecko other than the possibility of forest fires as a result of chena cultivation.

Egg-laying sites: Deraniyagala (1953a) has reported nesting of this species in February. These nesting spots are apparently re-used by a number of females. A nest consists of a cluster of eggs attached to the roof of the cave by their bases. The number of eggs per nest varied from 10 to 50 (Fig. 4 and 5). Four new nest-sites and three old (re-used) nest-sites were found during April.

Status: *C. illingworthorum* is endemic to Sri Lanka and very little is known of its ecology. It is listed as a Nationally Threatened species in *The 1999 list of threatened fauna and flora of Sri Lanka* (IUCN Sri Lanka, 2000).

Notes: Some rock art (human, animals and symbols) was observed in the Buddha Image house cave, which may be attributed to Stone Age man or Vedda tribes. They have been executed using white and brownish-red (*Guru*) pigments. One interesting figure is a drawing of a gecko-like lizard. This lizard figure resembles *C. illingworthorum* (compare Fig. 1 and 6). Could this be the first illustration of this gecko?

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Faunal checklist of the Area

Amphibians

Family: Bufonidae
Bufo atukoralei – Atukorale's dwarf toad
Bufo melanostictus – Common house toad

Family: Ranidae
Euphlyctis cyanophlyctis – Skipper frog

Reptiles

Family: Crocodylidae
Crocodylus palustris – Mugger

Family: Agamidae
Calotes versicolor – Garden lizard
Otocryptis wiegmanni – Kangaroo lizard

Family: Gekkonidae
Calodactylodes illingworthorum – Golden gecko
Cnemaspis sp. – *Day gecko* (Probably new species)

Birds

Family: Accipitridae
Spizaetus cirrhatus- Crested hawk eagle
Spiloris cheela - Crested serpent eagle
Elanus caeruleus - Black winged kite
Haliastur indus - Brahminy kite
Ictinaetus malayensis – Black eagle

Family: Phasianidae
Gallus lafayettii - Sri Lanka jungle fowl
Pavo cristatus - Indian pea fowl

Family: Columbidae
Streptopelia chinensis - Spotted dove
Treron pompadora - Pompadour green pigeon

Family: Cuculidae
Centropus sinensis - Common coucal

Family: Strigidae
Ninox scutulata – Brown hawk owl

Family: Caprimulgidae
Caprimulgus asiaticus - Indian nightjar

Family: Apodidae
Apus affinis - Little swift

Family: Hemiprocnidae
Hemiprocne longipennis - Indian crested swift

Family: Alcedinidae
Halcyon smyrnensis - White breasted kingfisher
Alceda atthis – Common kingfisher

Family: Meropidae
Merops oreintalis - Little green bee eater

Family: Bucerotidae
Anthracoceros coronatus - Malabar pied horn bill

Family: Capitonidae
Megalima zeylanica - Brown headed barbet
Megalaima rubricapilla – Small barbet

Family: Alaudidae
Mirafra assamica - Rufous-wing lark

Family: Hirundinidae
Hirundo rustica - Barn swallow
Hirundo daurica - Barn swallow

Family: Campephagidae
Coracina melanoptera - Black headed cuckoo shrike
Pericrocotus cinnamemeus - Small minivet
Pericrocotus flammeus – Orange minivet
Tephrodornis pondicerianum – Wood shrike

Family: Pycnonotidae
Pycnonotus cafer - Red vented bulbul

Family: Irenidae
Aegithina tiphia - Ceylon Iora

Family: Turdidae
Saxicoloides fulicata - Black robin

Family: Timaliidae
Rhopocichla atriceps - Black fronted babbler
Pomatorhinus horsfieldii - Scimitar babbler

Family: Sylviidae
Prinia socialis - Ashy prinia
Prinia subflava – Plain prinia
Orthotomus sutorius - Tailor bird

Family: Monarchidae
Terpsiphone paradisi - Paradise flycatcher
Rhipidura aureola - White browed fantail

Family: Muscicapidae
Niltava tickelliae - Tickell's blue flycatcher

Family: Dicaeidae
Dicaeum erythrorhynchos - Small flower pecker

Family: Nectariniidae
Nectarinia zeylonica - Purple rumped sunbird
Necterina asiatica - Purple sunbird

Family:Zosteropidae
Zosterops palpebrosa - Small white eye

Family: Estrididae
Lonchura punctulata - Scaly-breasted munia
Passer domestica – House sparrow

Family: Oriolidae
Oriolus xanthornus - Black headed oriole

Family: Dicruridae
Dicrurus caerulescens - White vented drongo

Family: Charadriidae
Vanellus indicus – Red wattled lapwing

Mammals
Family: Elephantidae
Elephas maximus – Elephant

Family: Cercopithecidae
Macaca sinica - Toque monkey
Semnopithecus entellus - Grey langur

Family: Suidae
Sus scrofa - Wild pig

Family: Sciuridae
Ratufa macroura - Giant squirrel
Funambulus palmarum - Palm squirrel

Family: Viverridae
Viverricula indica – Small civet cat

Family: Hipposideridae
Hipposideros speoris – Schneideres leaf nosed bat

Notes on Birds of Mannar

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Mannar Island and its surrounding areas are among the forgotten wilderness areas of the country. The area is situated in the semi-arid climatic zone of the country with a mean annual rainfall of about 950mm. However, this area carries three important wetlands included in *A Directory of Asian Wetlands* published in 1989. The area is considered rich in bird life, but the ongoing war during the past 20 years has restricted studies in the area.

I had an opportunity to visit Mannar Island and the surrounding areas with a group of friends in mid-January 2003. Although it was a brief visit we had the rare opportunity of studying the birds that inhabit this area. Our brief study was confined to six areas that we identified during the visit. These are Periya Kalapuwa lagoon and Mannar causeway (study area 1), Erukkilampiddi bay (study area 2), sand dunes in Mannar (study area 3), Talaimannar beach (study area 4), city of Mannar (study area 5), giants tank (study area 6). Of these six areas, we were able to study the birds comprehensively in four areas (areas 1, 2, 4 and 5). Observations were mainly done with the naked eye and binoculars were used whenever possible. Some of the species whose identity was doubtful were photographed and later identified using books. Still, there were a few species that we were unable to identify as we could not gather sufficient details for identification. Therefore, it should be noted that the bird list given below is an incomplete one and that the area is likely to support a much richer avifauna. Further studies on birds are recommended for the region.

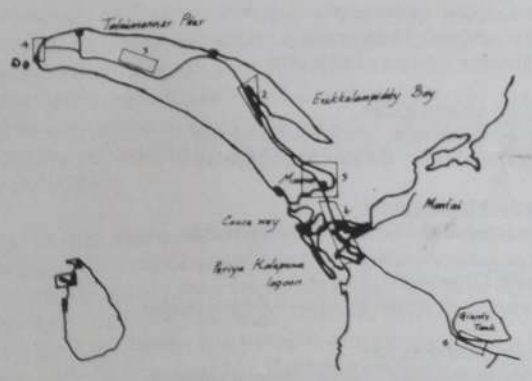

Figure 1. Map of the study area (scale 1: 250,000)

Periya Kalapuwa lagoon and Mannar Cause way (Study Area 1)

Periya Kalapuwa lies on both sides of the Mannar road within about a 5 km stretch between Vankalai junction (near the 142nd mile post) and Thalladi. Periya Kalapuwa is about 650 ha in size. This lagoon connects with the sea from two openings to the north, which can be seen from the Mannar-Mantai road. Periya Kalapuwa contains a complex of ecosystems including shallow tidal lagoons, mudflats and mangrove swamps. Coastal marshes, mudflats and mangroves extend from Periya Kalapuwa to both sides of the Mannar causeway. The causeway begins almost from the end of the Periya Kalapuwa lagoon and is about 3.5 km in length. There is a deep channel that is used by boats. The wetland area around the causeway is about 7,500 ha in size. The shallow mudflats on either side of the causeway are subjected to

Figure 2. Rosy Starling

Figure 3. Stone Curlew at Talaimannar beach

periodic submersion by tidal water. A number of mangrove species can be seen at this site, especially *Rhizophora* species. This area has supported a much more extensive mangrove ecosystem that has been cleared in recent times. Wetlands around the causeway are said to be the first landfall for many migratory birds entering Sri Lanka.

Our study was restricted to the roadsides of the area due to the prevailing security situation. During the period of this study, both the Mannar causeway and Periya Kalapuwa area contained sufficient water.

These two areas, along with the Vankalai lagoon, a large 200 ha area which lies south of the Periya Kalapuwa, is listed in the directory of Asian Wetlands as a single wetland ecosystem. However during this study we were unable to visit the Vankalai lagoon.

Erukkilampiddi bay (Study Area 2)

Erukkilampiddi bay is situated to the north of Mannar town. The bay is situated between the Mannar-Talaimannar road and the area stretching from Erukkilampiddi area. This is also a wetland identified as an important wetland in the country, but not included in the Directory of Asian Wetlands.

Our study area was the wetland at the end of the bay and the surrounding forest area. The area is situated at a distance of about 11-12 km from Mannar town. In this area, the wetland lies to the right of the road to Talaimannar. The surrounding area consists of scrub forests. The main plant species found in the area or even in the region is umbrella thorn, *Acacia planifrons*. This plant species is peculiar to the Mannar region. Eriyagama (1961) states that "These plants are not found in such profusion any where else in the island". Palmyra palm trees were also seen in the area. There were a few baobab (*Adansonia digitata*) trees seen at the edge of the bay.

Several other *Acacia* species, such as *Acacia leucocephala* (katu andara) and *Acacia chundra* are also found in this area. This area is rich in bird life, especially waders. We have also observed many flocks of rosy starlings with over 30 or more birds per flock. This bird was somewhat common in the area and was also seen in the Giant's Tank area too. A barn owl was also observed in the area.

Sand Dunes in Mannar (Study Area 3)

The area between Pesalai and Talaimannar possesses a unique landscape predominated by sand dunes. *Borassus flabellifer* (palmyra palm), *Phoenix zeylanica* and *Cassia auriculata* are the common trees found associated with sand dunes. These trees occur as stands amongst sand dunes. Wara, or *Calotropis gigantea*, was also commonly seen in many places. *Spinifix littoreus* was found growing on sand dunes. A number of xerophytes were recorded from many places around Mannar Island including *Euphorbia antiquorum*, *Opuntia spp.* and *Aloe vera*. Our observations in this area was restricted to the roadsides only.

Talaimannar beach (Study Area 4)

Talaimannar is situated in the western corner of Mannar Island. Adam's bridge, a chain of more than 20 small islands located between Mannar and Rameshwaram in India begins here. We were able to study the beaches near Talaimannar. Fishing was a common activity in the area and seabirds were a common sight. A number of these birds were seen feeding on throwaways from fishing boats etc.

City of Mannar (Study Area 5)

Although a populated area, Mannar town supports a variety of bird life. Wetlands and vegetation in the abandoned lands of the town attract a lot of birds, especially garden birds. The surrounding lagoon and the mangroves around Mannar town also support bird life.

Giants Tank (Study Area 6)

Giants Tank is situated on the right-hand side of the Mannar road near Murunkan. This is an ancient irrigation tank with an area of 1840 ha. It is fed by an ancient canal diverting water from the Malwatu Oya. The tank is a sanctuary declared under the Fauna and Flora Protection Ordinance in 1954. This tank is also included in the Asian Directory of Wetlands. Our study was limited to the bund

of the tank and also the areas along the roadside. The tank is heavily silted but supports irrigation and fisheries.

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Management of Marine and Coastal Resources in Sri Lanka

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Introduction

Under the jurisdictional arrangements of the United Nations Convention on the Law of the Sea (UNCLOS) Sri Lanka has gained rights over an Exclusive Economic Zone covering an area extending to 200 nautical miles beyond her shoreline. As a result the marine territory for which Sri Lanka has national jurisdiction is more than seven times her land area, covering some 447,140 sq. km.

As an island nation Sri Lanka has been dependent on a variety of its coastal and nearshore marine resources throughout its history. Coastal communities have practiced traditional fishing methods and artisanal fisheries since time immemorial. Likewise, the many highly productive lagoons and estuaries that dot the coastline of the country support their own fisheries. While the fisheries sector has shown steady growth over the years, the marine fisheries provide much of the protein needed not only for coastal communities but also for many of the hinterland communities within the island. In addition to this, mangroves wherever they occur around the island have been a traditional source of material for timber, crafts, food and medicine. Being located in the tropics, Sri Lanka also has both coral and sandstone reefs that fringe its coastline and have high biological diversity within them.

Resource Exploitation and Conservation Issues

Traditional fisheries in Sri Lanka were carried out using non-mechanised craft such as dugout canoes, canoes with sails and wooden rafts. The fishing gear used before the mid 1950's included hook and line, traps, gillnets and beach seines. In the 1950's the mechanisation of the fisheries began with the introduction of mechanised craft and nylon nets. Although the fisheries sector has shown steady growth since then exploration and exploitation of the fishery resource potential of the vast marine area belonging to Sri Lanka has thus far been limited. Meanwhile, increased concentration of fisheries activity within nearshore coastal waters has expanded rapidly to the extent that the resource potential of this zone may soon be over-used to the detriment of the resource itself. It has also caused resource exploitation conflicts between traditional or artisanal fishermen and the more modernised industrial fishing craft operators especially within coastal waters. The dearth of research related to stock assessment of commercially important species and the effects of increased exploitation on these stocks has resulted in a lack of definitive information which would be crucial for the management of this important resource in time to come.

Meanwhile in a bid to develop aquaculture in the 1980's, a sudden proliferation of coastal shrimp farms took place along the north-western seaboard. This rapid expansion of shrimp farms paid little respect to environmental concerns such as destruction of mangroves, which in turn led to a multiplicity of other environmental problems such as flooding along this coastline. In this respect economic expediency took precedence over environmental sustainability and in time led to economic catastrophe in the form of viral diseases that affected the prawn farms themselves, casting a doubt on their further economic viability.

The highly sensitive and biologically rich coral reefs too are continuously exploited as a source of lime for use in the construction industry. Although extraction of coral has been declared an offence many years ago, violation of the law continues unabated. In addition to this, destructive fishing practices such as the use of dynamite, anchoring of boats on reefs and unregulated tourism cause additional damage to these reefs. Inland land-use practices such as agriculture and tourism development along the coast also result in increased sedimentation and pollution leading to the destruction and degradation of reef areas.

Mangrove areas are also subjected to uncontrolled exploitation. While local communities exploit mangrove resources at a subsistence level, in recent times entire mangrove areas have been cleared for aquaculture and

Figure 1. Mechanised commercial fishing fleet at Negombo.

Figure 2. Land degradation in the coastal belt due to unauthorized mining of fossil shell deposits at Kalametiya

land reclamation activities. The extent of mangroves along the coastline of the island is thus dwindling rapidly and leading to other environmental issues. The importance of mangroves in protecting coastlines from erosion and serving as nursery grounds for many species of marine organisms including species of fish and crustaceans that are important to fisheries has been largely ignored.

All brackish water environments, including lagoons, estuaries and associated habitats such as the few remaining mangroves and seagrass beds that are dynamic and highly productive ecosystems are becoming increasingly polluted through land-based sources. Industrial and domestic effluent, solid waste and oil from fishing craft contaminate these ecosystems. Unregulated inland land-use practices that cause increased soil erosion also have highly detrimental effects on the coastal ecosystems through increased siltation and turbidity. Uncontrolled use of agro-chemicals for inland agriculture is another form of pollution, which is a cause for concern in coastal waters. The importance of these ecosystems not only as breeding and nursery grounds for commercially important species of fish and crustaceans but also as important habitats for endangered wildlife such as marine turtles, the highly endangered dugong and aquatic birds both resident and migratory has been overlooked.

As a developing country, the fisheries sector as well as many other sectors that affect marine and coastal habitats in Sri Lanka have been developing rapidly in the last three decades. Unfortunately no corresponding conservation activities to protect the resources in these marine and coastal habitats have taken place. This becomes quite evident when one looks at our extensive protected area network within which there are only two marine protected areas and one Ramsar site declared to-date, while terrestrial protected areas are numerous throughout the island. Even these two marine protected areas have been declared only with the aim of protecting two specific coral reef areas at Hikkaduwa and the Bar Reef. Unfortunately, the concept that all coastal and marine habitats are interconnected and that the ocean is an open system where everything is connected to everything else is yet to be understood in the management of our marine and coastal resources.

The Role of Integrated Coastal Management

Failure to conserve important marine and coastal habitats and their denizens has been exacerbated by the highly sectoral policies of the responsible institutions. These institutions may also have a lack of personnel with the know-how and training to deal effectively with coastal and marine environmental issues. However the first attempt at dealing with the protection of the coastal environment was made with the declaration of the Coast Conservation Act in 1981 and the formation of the Coast Conservation Department (CCD). According to this act the Coastal Zone of Sri Lanka is "the area lying within 300 meters of the mean high water line and a limit of two kilometers seaward of the mean low water line". This legislative enactment was intended mainly to address the problems of coastal erosion exacerbated by development activities within the coastal zone. The CCD subsequently prepared an initial Coastal Zone Management Plan in 1990 through a consultative process and this was further improved by a Revised Coastal Zone Management Plan in 1996. While the coastal zone is under the jurisdiction of the CCD marine protected areas are administered by the Department of Wildlife Conservation (DWLC) and mangrove areas by the Forest Department (FD). As a result, in activities related to conservation the sectoral approach still predominates with institutions acting in isolation under their specific mandates while overlapping jurisdiction creates its own administrative problems.

In essence, the sectors dealing with resource exploitation (coastal fisheries, aquaculture, land reclamation) have developed independently while sectors dealing with environmental protection (CCD, DWLC, FD) have also developed independently. There is little or no coordination or co-operation between practitioners and/or managers in each sector. In this

scenario it is evident that conventional sectoral management is not effective in dealing with the complex multi-sectoral coastal environmental issues that arise in a developing country. As a result there is an urgent need for Integrated Coastal Management (ICM) interventions with a broad cross-sectoral approach that is adequate to deal with these complex issues. However ICM initiatives introduced in developing countries like Sri Lanka at present merely pay lip service to the concept. There are several accepted definitions for integrated coastal management such as:

- "The term integrated coastal management (ICM) is used to describe a continuous and dynamic process that unites government and community, science and management, sectoral and public interests in preparing and implementing an integrated plan for the protection and development of coastal systems and resources." (GESAMP, 1996)
- "Integrated coastal zone management is a dynamic process in which a coordinated strategy is developed and implemented for the allocation of environmental, soio-cultural and institutional resources to achieve the conservation and sustainable use of the coastal zone." (ESCAP, 1995)
- "Integrated marine and coastal area management is a participatory process for decision making to prevent, control, or mitigate adverse impacts from human activities in the marine and coastal environment and to contribute to the restoration of degraded coastal areas. It involves all stakeholders including: decision makers in the public and private sectors; resource owners, managers and users; non-governmental organisations; and the general public." (SBSTTA/IUCN, 1996)

However this ICM concept has been designed and adopted according to a largely westernised or developed country mindset. The socio-political situations prevalent in most developing countries like Sri Lanka are therefore hardly conducive to the practice of such a concept. If ICM interventions are to be useful in Sri Lanka both the concept and the methodology should be adapted to suit the local situation. An essential ingredient for the success of an ICM initiative is stakeholder participation at both the planning and implementation stages. This means that coastal communities who will be affected beneficially or adversely by such initiatives must become effective participants and their needs and aspirations must necessarily be built into the ICM programme.

Sri Lanka like many developing countries cannot meet the costs of ICM initiatives by itself and is therefore forced to initiate such activities with the assistance of donor funding. For this reason ICM interventions are often tailor-made to suite donor priorities and in so doing the priorities of the communities these projects are meant to assist are lost along the way. As a result the ICM interventions become unsustainable in the long-term, because local support and community participation that are necessary for success are lacking after the initial stages. Inevitably the management interventions thus introduced will not last beyond the lifetime of the donor-funded project. Neither environmental integrity nor sustainable resource exploitation nor community upliftment will be achieved in any meaningful or long lasting manner.

Conclusion

It is therefore imperative that we should make use of lessons learned and make our ICM initiatives more practical and result oriented if they are to achieve the ultimate goal of sustainable management of coastal and marine resources. Only through well-planned and carefully implemented ICM interventions with full stakeholder participation can the aspirations of our coastal communities be met without jeopardizing ecological integrity and environmental quality in fragile coastal habitats. In doing this it is essential to take into consideration the unique qualities of both socio-cultural and environmental factors inherent in each individual scenario.

The present practice of blindly adopting ICM as practiced in developed countries and expecting it to be a cure-all by performing miracles in Sri Lanka is both unrealistic and a waste of precious financial resources. The ICM concept should be adapted in an innovative manner to suit unique local situations if positive results are to be expected. Such effective adaptations can help us achieve the end result of long-term coastal resource management, maintenance of sustainable habitat quality and an adequately developed living environment for coastal communities through successful ICM programmes.

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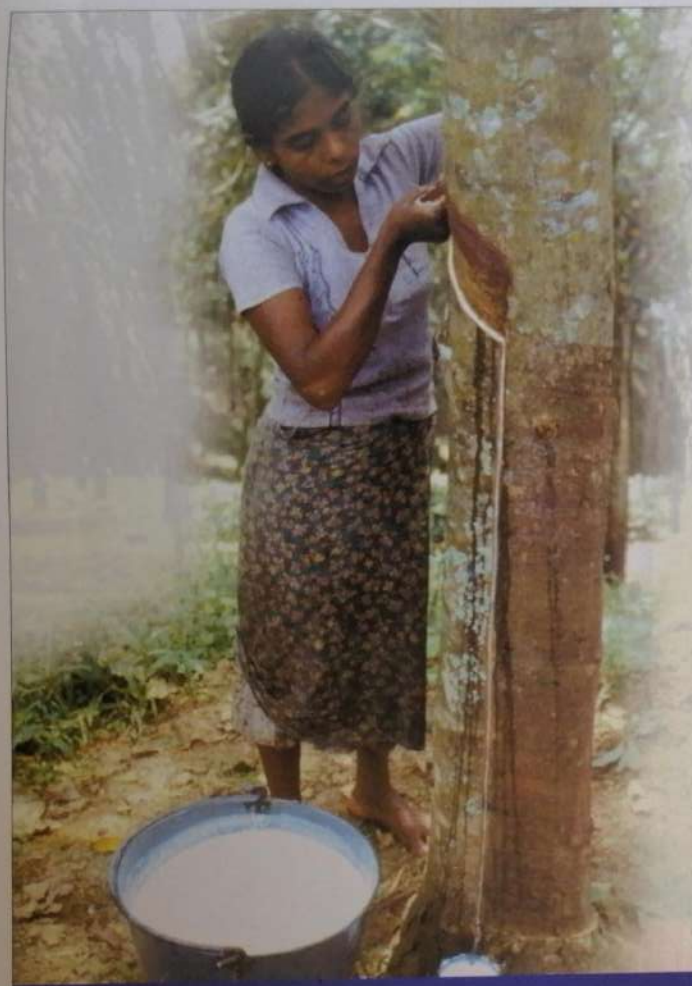

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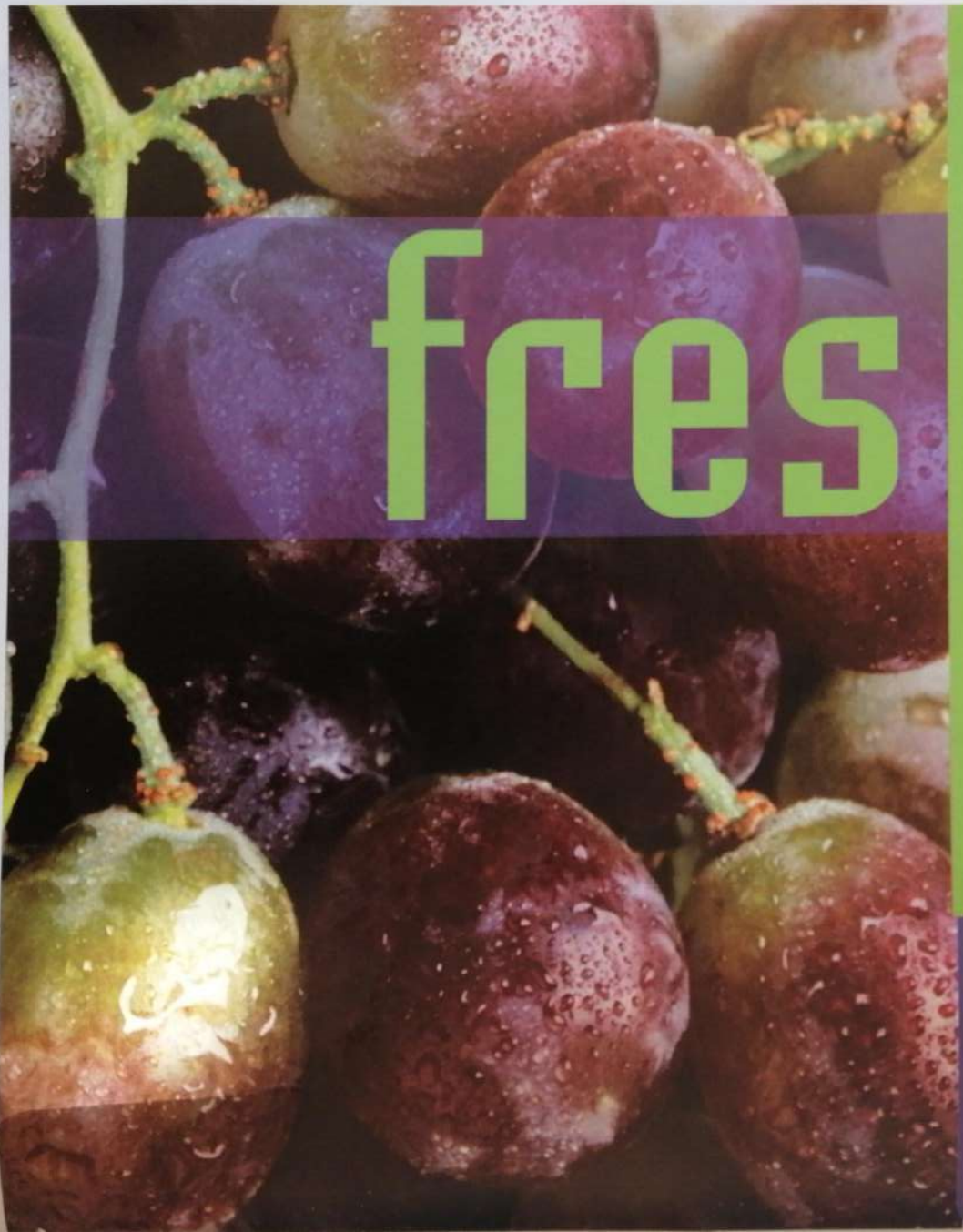

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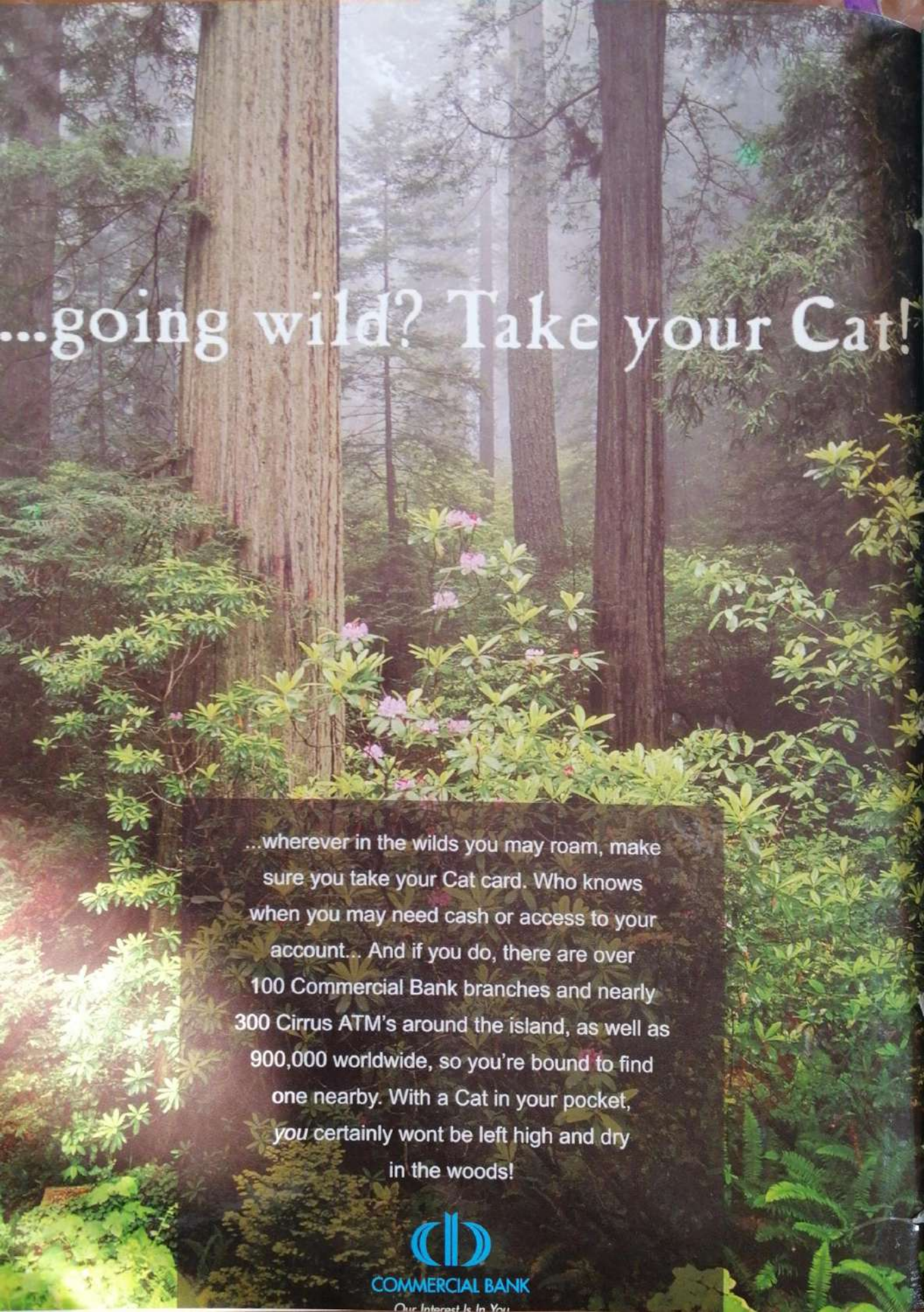
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