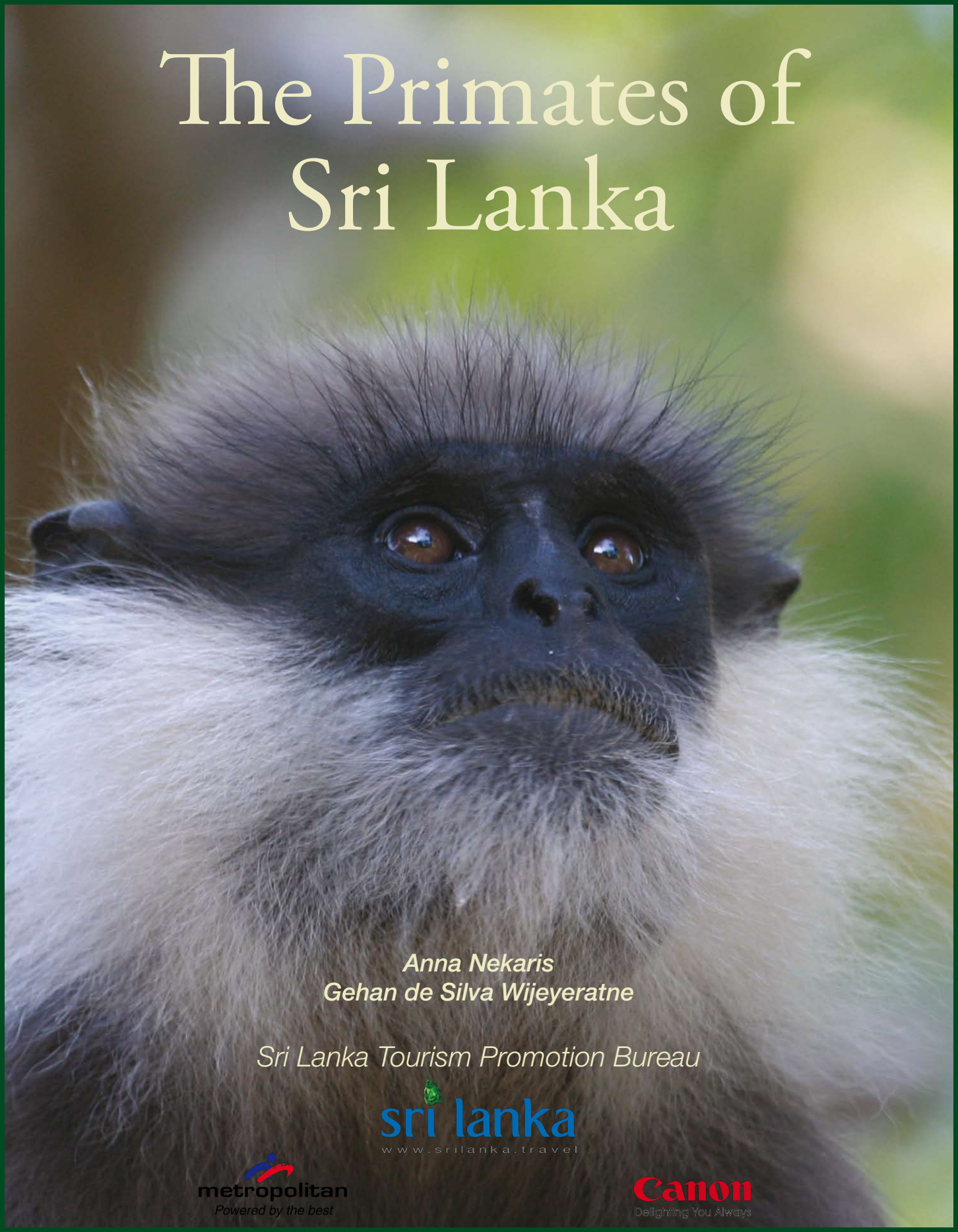
The Primates of Sri Lanka



Anna Nekaris
Gehan de Silva Wijeyeratne

Sri Lanka Tourism Promotion Bureau

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The Primates of Sri Lanka

Anna Nekaris
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Foreword - A Sri Lankan Perspective

Primates and Tourism

Sri Lanka Tourism has long recognised the need for sustainable development and the value of the natural resources of the country. The state agencies and the private sector have over the last few decades worked towards minimizing the impact of tourism in the environment. The accreditation process by the Sri Lanka Tourism Development Authority has for several decades required meeting environmental standards in waste managements and minimizing environmental impacts. Over the years, some of the larger hotel properties have created what are in essence private refuges for wildlife. Both Tour Operators and Hoteliers in Sri Lanka have embraced environmental initiatives with a renewed vigor to combat climate change. The conservation of biodiversity will be an important dividend of this renewed focus of the tourism industry.

One group of animals which will benefit from this will be our close genetic cousins, the primates. For ethical and scientific reasons we should conserve the island's primates, at least five species, based on current scientific thinking. There are also moral reasons. We share an evolutionary heritage and genetically more than ninety percent of our genes are shared with some species of primates.

Sri Lanka is also one of the best destinations in the world for watching primates. Major tour operators feature itineraries for watching primates. At least one European tour operator, does nothing but primate watching tours. This book is an important summary of what is known about the island's primates, written in an easily accessible form. It is beautifully illustrated and designed and will help Sri Lanka to be recognized as one of the best destinations for watching primates.

Conservation and scientific research in Sri Lanka has a long history of benefiting from collaboration with international scientists. We are delighted that Dr Anna Nekaris has been able to engage in studying Sri Lanka's primates and that the tourism industry has been able to support her work and that of her students. Primates are a good example of animals which can be studied through observations in sites with public access without the onerous requirement of research permits. We hope this book will inspire both professional scientists and enthusiasts to pursue the scientific study of the island's biodiversity. We also hope that the general public will realize that scientific research can be carried out by observation even in a back garden in a large city or in the public parks and gardens of a town. We hope Sri Lankans are inspired to study the diverse fauna and flora around them, which in their private and public spaces often require no formal permissions. We need to create a culture of scientific study by amateurs as in Europe and the USA for example. We will then have thousands of amateurs engaging in modest but worthwhile research projects. This will then lay the foundation of knowledge and interpreters which Sri Lanka needs to fulfill its potential as a destination for nature tourism.

Bernard Goonetilake
Chairman - Sri Lanka Tourism Development Authority
Chairman - Sri Lanka Tourism Promotion Bureau

Dileep Mudadeniya
Managing Director
Sri Lanka Tourism Promotion Bureau

Foreword - An International Perspective

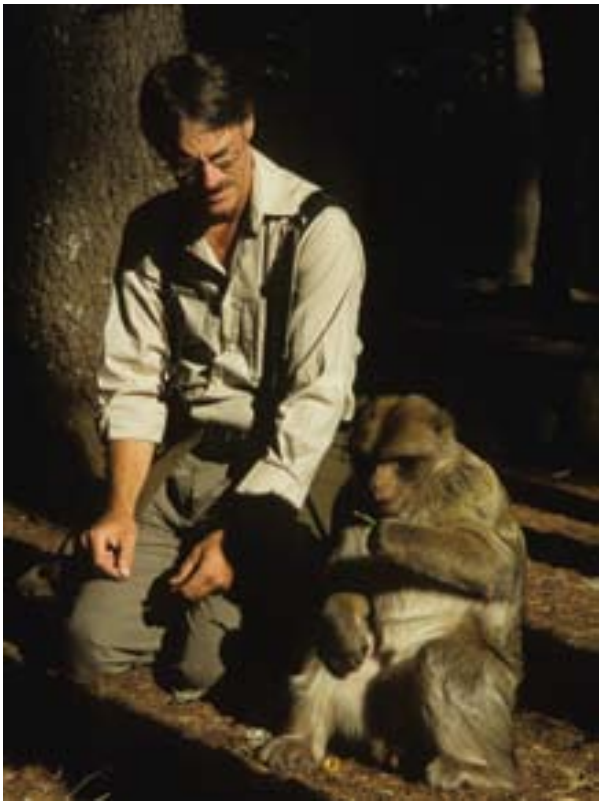
Sri Lanka is a special place with many species of plants and animals found nowhere else in the world. This wonderful book will tell you what is known about each of the 5 species and 12 subspecies of lorises and monkeys. Many of these are easy to see and observe in the beautiful temple grounds and forests of Sri Lanka.

The author Anna Nekaris is one of the most dedicated nocturnal primate researchers on the planet. The photographs by Gehan de Silva Wijeyeratne are some of the best I've seen. The book provides both general and detailed information about all the known forms of primates. Best of all it tells you the places to see and observe them. I wish I had this book on my visit to Sri Lanka in 2003 and I will surely use it on my next visit.

I visit many primate habitat countries in the world; many primates are very difficult to see and observe. Their numbers are declining, their forests are shrinking. They are being hunted and eaten by humans with the orphaned infants sold to the pet trade. Their habitat is being destroyed by logging, fire, and conversion for agriculture. Over one-third of all primate species are listed by IUCN as threatened or endangered (http://www.iucnredlist.org/info/tables/table4a).

Though some types of monkeys are easy to see in Sri Lanka, there are two primates, which are found in no other country, that are so Critically Endangered they are on the list of the 25 most endangered primates in the world. Their fate is in your hands. You can use this book to learn about them and then act to protect them. They may be as close as your back garden in Colombo or in the small remaining forests of Horton Plains. They need your help to protect them and the habitats they need to survive. I hope you will get involved, plant trees, donate money and join others to save the forests and the species that make it their home.

Noel Rowe
Director of Primate Conservation Inc
Author of the Pictorial Guide to the Living Primates



Acknowledgements

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Anna Nekaris

Nekaris first and foremost thanks Gehan de Silva Wijeyeratne and the Sri Lanka Tourism team for inviting her to contribute the text to accompany Gehan's stunning photographs. The names of the team at Jetwing are not repeated here, as Gehan has already gratefully recognised them in his own acknowledgements. She also acknowledges the large number of people, including research colleagues, and organisations who have aided her primate research in Sri Lanka since 2001 – the list is too long and I am sorry for any that I forgot to mention here! The Sri Lankan Department of Wildlife Conservation and the Sri Lankan Forest Department (especially H. D. Ratnayake and S. Fernando) provided research permits for many aspects of the research, and also gave Nekaris the wonderful opportunity to present a training session on slender lorises for the Wildlife Training Centre at Giritale. G. Samarakoon, and S. Weerdawardene of DWC provided invaluable aid in the field. My three local counterparts over the years, Jayantha Jayewardene, Erik Wikramanayake, and Asoka Gunawardene, made the research possible. Sri Lankan students and local assistants have played a vital part in this research; our heart-felt thanks go to Bandara, Cyril, S.N. Gamage, A. Jinendra, W.K.D.D. Liyanage, W. Karunaratne, G.D.C.P. Kumara, S. Mirandu, Myhse, Nallaka, T. Ramanadan, V.Perera, S. Sanjeewa, Sanjiva, Sunita, R. Vandercone, and D. Widanapathirana. A number of local researchers and land and business owners provided their expert advice along the way including: G.P. Abeynayake, W. Dittus, Hiranthika, G. Lasanthi, Gihan, C. Jayaweera, Maleni, Mohan, R. Pethiyagoda, A. Perera, R. Perera, S. Perera, C. Santiapillai, Sashi, Sonali C. Suraweera, and S. Wijeymohan. Karen Conniff, S. Wimalasuriya, Dave Molden, Olivia Molden, Rosie Molden, Piyaseeli, Abraham, Sandy, Cheyenne, S. Illangacoon, C Perera, Sherine Perera, and Jetwing Hotels provided us with homes away from home. We thank A. de Vos and the staff of the Wildlife and Nature Protection Society for their support and free tea and cakes whenever we visited their offices. Madduma Daruwa (Piyasena Gunesekara) and A.H.D. Siripala provided excellent botanical guidance. I thank A.P.A. Gunasekera and all the other drivers who got us around Sri Lanka. I thank my students and field assistants for their tremendous efforts to provide the data needed for helping to preserve Sri Lanka's primates: M. Abare, G. Ash, H. Baker, A. Baxter, A. Beresford, L. Bernede, L. Birkett, L. Bohun, A. Boulton, D.S. Coultas, R. Davies, R. Drake, C Eschmann, I. Geens, K.R. Hart, E. Leavitt, R. Moore, E.R. Pimley, J. Stokes, and P. Troni. S. K. Bearder, C.P. Groves, S. Jaffe, V. Nijman, M. Richardson, H. Schulze and J. Thorn aided in the intellectual development of this project. H. Parathian produced the drawing of the family tree. Funding to Nekaris and her students, including Sri Lankan counterparts, was provided by People's Trust for Endangered Species, Margot Marsh Biodiversity Foundation of Conservation International, Primate Action Fund, Columbus Zoo, BP Conservation Awards, National Geographic, Cleveland Zoo, Primate Conservation Inc., the Undergraduate Research Scholarships Scheme and Oxford Brookes University.

Gehan de Silva Wijeyeratne

First and foremost I would like to thank Dr Anna Nekaris for agreeing to write the text. Anna together with her students have engaged in much work to study the Sri Lankan primates and their work has led to a heightened awareness of them. I first met Anna when she gave a lecture at the monthly lecture series of the Wildlife and Nature Protection Society. Subsequently Jetwing assisted her students with logistics support to undertake observations of Sri Lankan primates. Anna had a wide experience of primates from many parts of the world and had conducted studies shedding new light on primates on Sri Lanka. She was also good at popularizing primates through writing and presentations. I had been photographing primates for some time with a book in mind. I was delighted when Anna was enthusiastic about doing a book on the primates of Sri Lanka which combined a popular approach with a

series of technical appendices. My thanks to Noel Rowe for accepting Anna's invitation to write the foreword from an international perspective. Our thanks to Renton de Alwis and Hiran Cooray for their foreword from a Sri Lankan perspective.

Books authored and photographed by me and published by Jetwing Eco Holidays are made possible by the support of all my colleagues in Jetwing and others in the tourism industry. Past and present members of the Jetwing Eco Holidays team including Ajanthan Shantiratnam, Aruni Hewage, Paramie Perera, Nadeeshanie Perera, L. de S Gunasekera, Chandrika Maelege, Amila Salgado, Ayanthi Samarajewa, Shehani Seneviratne and Nirusha Ranjitkumar have helped in numerous ways. Chandrika Maelge's earlier design work with Jetwing Eco Holidays continues to be a source of inspiration for our publications. My thanks to my fellow Jetwing Directors who share my vision of the private sector supporting research and conservation.

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I could not have got this far in my efforts to popularise natural history if it were not for the support of my late parents Dalton and Lakshmi de Silva Wijeyeratne and my brother and sisters. My Uncle Dodwell de Silva sparked my interest in wildlife and the interest in photography was encouraged by my Aunt Vijita de Silva and my sister Manouri, who gave me my first cameras.

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Images

All images by Gehan de Silva Wijeyeratne have been taken in the wild under natural conditions. Some of the images of the Lorises have been taken with animals handled in the course of research approved by the Department of Wildlife Conservation. Michael Leibfritz's images were taken in Frankfurt Zoo, with the zoo's permission, of animals in their captive breeding program.

Photographers who may take inspiration from this book are asked to keep in mind that the welfare of the animals always comes first. Primates accept a photographer's presence when patience is exercised, allowing wonderful opportunities for photography. With nocturnal mammals, take care not to spot-light mammals directly. Use a weak red light to locate them. Please follow the regulations of the Department of Wildlife Conservation and the Forest Department. In protected areas, searching for mammals with spotlights will require permission.

Gehan's images are taken on Canon Digital SLR bodies and Canon professional lenses.

All images are copyright of Gehan de Silva Wijeyeratne, unless otherwise stated.

Chapter 1

Cousins

Sri Lanka is a haven for unique flora and fauna, and is considered one of the world's biodiversity hotspots. Both national and international wildlife enthusiasts flock to the island to see animals found nowhere else on earth. Some of these animals deeply affect the senses of those visitors lucky enough to catch a glimpse of them. Of Sri Lanka's 33 endemic bird species, a sighting of, say, the rare Sri Lanka Bush-warbler or Sri Lanka Red-faced Malkoha may create a life-long memory for the devout ornithologist; while large mammals, such as the local races of the Asian elephant and the leopard, leave those fortunate enough to see them with a sense of awe.

There is, however, another group of mammals in Sri Lanka which, upon encountering them, strike an even deeper chord in the heart of the observer. Unlike the usual fleeting glimpse of a leopard, it is often possible to get very close to these animals, and to spy on their antics for hours on end. One can observe them in farmers' fields, outside temples, and alongside the twisting roads leading into the mountains. One might even hear their eerie cries echoing through the night. These are Sri Lanka's primates, and what makes them so endearing is their close affinity to humans.

Today, over 625 kinds of non-human primates are recognised; five of these are found in Sri Lanka, comprising twelve distinct races or subspecies, all of which are found nowhere else on earth (endemic). Although very different in appearance, these animals share a number of characteristics with one another, and with humans as well. Some of these are noticeable at a glance: primates have forward-facing eyes, flat nails instead of claws, and an opposable thumb. Other traits become more evident if one watches their behaviour. The large brain is evidenced by the mischievous and almost Machiavellian way a monkey might extract a snack from your rucksack. The long life history of primates (long pregnancy, elaborate care of young, long lifespan) becomes obvious when a young monkey learns from her aunt how to care for a baby. The importance of social behaviour in the regulation of primate society is evident during spats over a comfortable sleeping place, or even when watching a courtship ritual of one of our most distantly related primate cousins, the lorises.

Two groups of non-human primates are found in Sri Lanka. Scientifically, these are known as the strepsirrhines (meaning moist-nosed) and the haplorhines (meaning dry-nosed). Two species of moist-nosed primates, the red and grey slender loris, share a number of characteristics that distinguish them from the monkeys. Their moist nose is related to a sharpened sense of smell. They have special scent marking glands, and the part of their brain devoted to smell is larger than that of monkeys. Scent is vital to keep track of friends and foes, as lorises are active at night (nocturnal) where low light conditions limit visual communication; this fact is also evidenced by their enormous eyes, which differ in structure from the monkeys, containing as they do a reflective layer *(tapetum lucidum)* that helps them to see in the dark. Lorises have secondarily evolved a unique 'toilet' or grooming claw on each foot that they use for grooming themselves. Having less dextrous hands than monkeys, they have also developed an additional method for grooming one another. This is the toothcomb (formed by their lower front teeth), which also serves a second function – that of scraping gum or other exudates from trees.

Sri Lanka's monkeys, purple-faced leaf monkeys, grey langurs, and toque macaques, differ from the lorises in several respects. Their eyes are adapted for the daytime (they are all diurnal), and they possess good colour vision, used for social signalling and for finding brightly coloured food. All have ischial callosities – permanent sit pads on their buttocks that allow them to comfortably perch on a branch. They have replaced olfactory messages with more complex vocal signals. They have larger brains, and take longer to raise their infants. Large brain size results in a more complex social life in general, making the intelligence of the monkeys closer to that of humans; for

instance, monkeys deceive one another for social gain, and reconcile after a quarrel. Sri Lanka's monkeys fall into two different groups, each possessing additional unique specialisations.

The purple-faced leaf monkeys and grey langurs fall into a sub-grouping known as the colobines. These primates are sometimes referred to as the cows of the primate world, as they are leaf specialists, and therefore have large complex stomachs designed to cope with this difficult-to-digest resource. Their teeth are similarly adapted, and are replete with sharp crests to efficiently slice through vegetation. Both of these monkeys, however, are not averse to including more energy rich and tasty foods into their diets!

The toque macaques belong to the subgroup known as the cercopithecines. Biologically, they are specialised fruit and seed-eaters. Their teeth are shaped to mash fruit into a fine pulp, and to grind seeds like a mortar and pestle. They are even equipped with cheek pouches. These operate as storage containers to help gather as much food as possible before a higher ranking animal enters the scene to usurp a desirable resource. Despite their efficiency as fruit eaters, toque monkeys can devour just about anything digestible. This flexibility is also evident in the other twenty or so macaque species, which are spread across Asia, North Africa and even southern Europe, making them one of the most successful and least endangered of all primate groups. It has also resulted in their being dubbed "weed species", as they can thrive in highly disturbed habitats, even when other mammals have gone locally extinct.

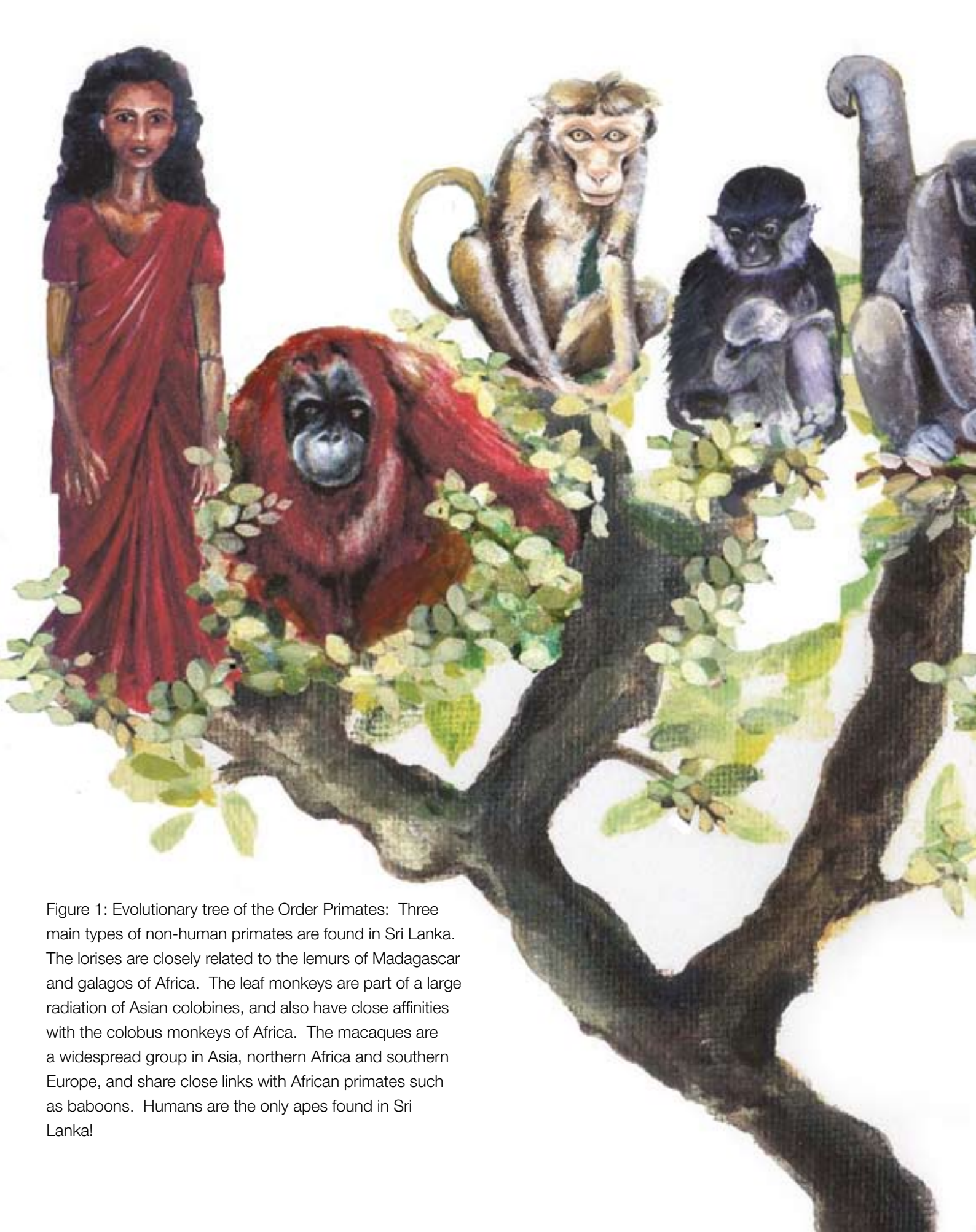

Figure 1: Evolutionary tree of the Order Primates: Three main types of non-human primates are found in Sri Lanka. The lorises are closely related to the lemurs of Madagascar and galagos of Africa. The leaf monkeys are part of a large radiation of Asian colobines, and also have close affinities with the colobus monkeys of Africa. The macaques are a widespread group in Asia, northern Africa and southern Europe, and share close links with African primates such as baboons. Humans are the only apes found in Sri Lanka!

Chapter 2

Social Security

All primates are social. They play an active role in raising their young, which are dependent on their mothers from a few months to many years. They may form strong alliances with members of the opposite sex, and allegiances with their kin. Similarly, they may be vigilant or aggressive towards their enemies, which might include primates from other groups, or potential predators. The social lives of primates reflect a delicate balance between their activity patterns, diet, physical adaptations, and the habitats in which they live. But be the primate a loris or a toque monkey, the resemblance to human is always present.

The Night Shift

With their large woeful eyes, spindly limbs, and absence of a tail, Sri Lankan lorises have been deemed "elves of the woodlands." These tiny primates have enchanted folklorists for centuries, and arguably more tales have been concocted about the loris than any other Sri Lankan animal. Biologists have created their myths too. Long thought primitive, slow and solitary, we now know that lorises have complex social lives, and are more similar to the monkeys in their behaviour than previously thought. Two species of slender loris are found in Sri Lanka; although some features unite these primates, some surprising behavioural adaptations differentiate them.

Red Slender Loris *(Loris tardigradus)*

The red slender loris is the smallest primate in Sri Lanka, weighing about 130 g. One subspecies *(L. t. tardigradus)* is restricted to the southwestern rainforests, whereas a second *(L. t. nycticeboides)* is found only in the montane rainforests of the Horton Plains. Forest loss means that both are in extreme danger of extinction; in fact, in 2005, an international body of primate specialists declared that the Horton Plains slender loris was amongst the top 25 most endangered primates on earth!

Many report the loris to be slow and sloth-like, and early reports suggested that they could only move 10 m per night. We have recently discovered, however, that the red loris can move very fast, covering some 15 m in just two minutes! This may be facilitated by a nutritious faunivorous diet of lizards, snails, and other animal prey. Red lorises rarely eat fruit or flowers, which is also reflected in their powerful chewing muscles and razor sharp teeth, adapted for biting through tough insect exoskeletons and bones.

Red lorises communicate by way of both direct and indirect means. Scent marking allows them to keep track of the whereabouts of allies and foes. Red lorises form small groups of about 3 - 6 individuals, which sleep nestled in thick vegetation, curled up together in a sleeping ball. Although some may still call them solitary, they engage in nightly meetings with other lorises, when they groom and play together. They also call to each other extensively; calling bouts of more than 350 calls per hour have been recorded.

After 167 - 175 days, mothers give birth to one to two tiny infants, weighing about 9 g – the weight of a paper clip! After carrying them for a few weeks, the mothers engage in characteristic strepsirrhine behaviour of parking their infants. This means that the infant is kept in a safe place for the night. The mother grooms her baby intensively before she leaves it for the night. After mixing her saliva with a chemical exuded from one of her scent glands, the mother coats the infant. Some scientists suggest that this mixture is poisonous, and is used to ward off predators, but more research needs to be done to test this exciting hypothesis. The infants are not wholly alone, however; mothers forage near their young ones, and have been seen to return to them during times of danger.

Grey Slender Loris *(Loris lydekkerianus)*

Two varieties of grey slender loris (230-280 g) haunt Sri Lanka's night time forests: one in the Dry Zone *(L. l. nordicus)* and one in the Central Highlands *(L. l. grandis)*. Like their red relatives, the grey slender lorises find themselves endangered due to habitat destruction, use in traditional medicines, and the pet trade.

Grey slender lorises, although still capable of moving quickly, traverse life more slowly than do their red cousins. They too subsist on a diet high in insects, although they also eat berries, flowers, and gum in smaller proportions. They eat fewer vertebrates than red lorises, and rely more on animal prey containing high amounts of toxic chemicals, such as ants and bombardier beetles.

Grey slender lorises also live in groups, and have been seen to form congregations of as many as 11 individuals. More is known about the social organisation of grey lorises than about red slender lorises. Some males and females form pairs, while others form a polyandrous social organisation, whereby a female shares her territory and nests with multiple males. Adult females, however, rarely interact. Both olfaction and vocalisations are important for negotiating the social lives of grey lorises, although they call less than their red counterparts.

An extraordinary aspect of grey slender loris social life concerns their infant care. A gestation period of about 160 days produces one or two infants, which are parked after a few weeks. The mother rarely visits her infants during this time period; this task instead falls to the males, be they fathers or brothers. Male care of offspring is rare amongst primates, making grey lorises special in this regard.

Calls of the wild

Purple-Faced Leaf Monkey *(Trachypithecus vetulus)*

Only one species of this beautiful colobine occurs in Sri Lanka, where it is endemic. Weighing about 10-13 kg, these monkeys are swathed in a coat of silky dark hair on their backs, and bedecked with tufts of white hair on their cheeks. Albino forms are known, and have given rise to a number of folktales. Indeed, there is much variation across the island, resulting in the identification of four subspecies. *Trachypithecus v. vetulus occurs* in the southern rainforests of Sri Lanka, whereas *T. v. philbricki* dominates the northern dry forests. The distinctive *T. v. monticola,* or "shaggy bear monkey," is restricted to the montane rainforests, and is thought by some experts to be a distinct species. Clinging to remnant rainforests and home gardens of the west is *T. v. nestor,* which like the Horton Plains loris, is considered one of the most endangered primates on earth.

Purple-faced leaf monkeys are the most arboreal, or tree-dwelling, of the Sri Lankan primates. They are specialised for quadrupedalism or movement on all fours, but can make dramatic leaps through the trees. Although they are anatomically specialised for eating leaves (folivores), they will also consume fruit and flowers. In the dry zone, these monkeys may obtain 70% of their diet from only three tree species. When habitat pressure is severe, they are also known to raid home gardens. In these instances, they will relish a wide variety of fruits and vegetables, and have even been known to eat cauliflower.

A harem social organisation predominates amongst these monkeys, whereby one male lives with several females, who may be related. Group size ranges from about 6-20 individuals. Male competition for mates means that groups are very territorial, with males defending their females from other males. Often the adult male of a troop engages in sentinel behaviour, adopting a position in the highest canopy, scanning the area for predators and competitors. Normally conflict is avoided through the use of a very loud 'whoot' call. This call, in combination with a jumping display, allows groups to space themselves territorially without having to meet. In their forest habitats, these monkeys are usually quite shy, and it is this call that signals their presence. Although you may not always see a purple-faced monkey, you cannot miss this distinctive call, uttered at dawn, dusk, and often just before it rains.

Infants are born after about 200 days. As is typical amongst Asian colobine monkeys, babies are born a lighter colour than adults (pale grey with a brownish tinge). This colour signals its presence to its aunts, who might need practice handling an infant before giving birth to their own (allomothering/ aunting). The infant's colour may also be an adaptation against something more sinister. Males not part of the harem are known to wait for opportune moments to take over the troop from the resident male. If a male is successful, some suggest it is not to his reproductive advantage to provide for infants fathered by the previous male. In order to bring the females in the troop back into heat or oestrous, he then must kill the infants sired by the previous male, a process known as infanticide. Although not common amongst the purple-faced leaf monkey, it has been known to occur; the infant's colouration, thus, might cause it to stand out, and be protected during such takeovers.

Holy monkeys

Grey Langur (Common, Sacred, or Hanuman langur) *(Semnopithecus priam thersites)*

The adaptable and culturally respected grey langur has one of the widest distributions of any Asian primate, occurring across the Indian subcontinent and into Pakistan, Bangladesh and Myanmar. Most taxonomists now agree that the Sri Lankan form is unique from Indian grey langurs, but whether it is a species or subspecies is still a matter of debate.Only a small population of *S. priam thersites* occurs in the south of India, thus adding to the number of primate subspecies found only in Sri Lanka. Silver in colour with a black face, this elegant monkey is characterised by a high degree of sexual dimorphism, with males (18 kg) much larger than females (11 kg).

Although in Sri Lanka this species is sometimes known as the grey langur, it is more widely dubbed the Hanuman langur, after the Hindu god that supposedly bears its image. It is said that the black face, hands and feet of these monkeys are the result of the god Hanuman becoming burnt whilst setting fire to Sri Lanka in order to rescue Sita, the wife of Lord Rama. Because of its close connection with Hindu mythology, these monkeys are tolerated where others are persecuted. As a result, they are often to be found in villages and temples, where they are provisioned by villagers, pilgrims and priests.

The success of the grey langur comes from its ability to thrive in many habitat types, including semi-desert, open park woods, moist deciduous forests, and montane rain forests. In Sri Lanka, however, it is not found in the Wet Zone, perhaps due to competition with other primates or mammals.

Although few published studies exist for this primate in Sri Lanka, it has been intensively studied on the Indian subcontinent for more than 40 years. These studies have revealed incredibly complex and flexible behavioural adaptations. Although often seen on the ground (terrestrial), these monkeys can also move in the trees with ease. They are specialised quadrupeds, and their long tails are used for balance. In fact, the graceful long tail of these monkeys gives them their name – *lang ur* in Hindi means "long tail". These monkeys are often to be seen feasting on young leaves and flowers, but will supplement their diet with insects, soil, bark, and gum. During periods of food scarcity, they shift their food choices to less desirable and more difficult-to-digest mature leaves.

Social flexibility is another key to the success of this species. Indeed, grey langurs may occur either in one-male harems or multi-male polygynous troops, although the former is more common. Even when multiple males reside in a troop, it is the alpha male who has been genetically shown to sire the most offspring. Bachelor troops are also common, and these raucous males are often the greatest culprits in raiding the stalls of shop holders, or nicking titbits from the wary housewife's kitchen. These males also loiter on the edges of one-male bands, as in the purple-faced leaf monkeys, looking for the opportunity to take over a harem from a weakened male. In fact, more cases of infanticide are recorded for grey langur troops than for any other primate species.

Infants are born almost black in colour, again perhaps as a defence against infanticidal males. The gestation period is 168-200 days. Females are often related (males are the dispersing sex in this species), and sisters and daughters are allowed to carry, and even to suckle, the offspring of their kin. Females may also form coalitions against males attempting to take over the troop. All in all, most studies have found that grooming bonds are strong amongst grey langur females, and in general, no strict linear dominance hierarchies are observed.

Social climbers

Toque Macaque *(Macaca sinica)*

It would be difficult to visit Sri Lanka without encountering a macaque. The most resilient of Sri Lanka's primates, these curious monkeys thrive in most environments, and occur in all ecological zones in relative abundance. Three subspecies are currently recognised: *M. s. aurifrons* is found throughout the Wet Zone and the Central Highlands, whereas *M. s. opisthomelas* is found in the montane rainforests around the Horton Plains, occurring alongside the shaggy bear monkey and the Horton Plains slender loris. *Macaca s. sinica* occurs throughout the Dry Zone; this subspecies is particularly noteworthy, as it has been the subject of one of the longest behavioural studies of any primate species in the world.

Most of our knowledge about the toque macaque comes from this long-term fieldwork, which was begun in the late 1960s and carried out by primatologist Wolfgang Dittus and his team. This remarkable study has provided unique insight into this species. Macaque females (3.4-4.3 kg) are generally smaller than males (4.4 kg – 8.4 kg); females also are characterised by red splotches on their faces, which help to identify individuals. In fact, the shapes of their ears, the patterns of their whorled 'hair-dos' and general scruffiness, in the forms of scars and torn ears, make it easy to tell these animals apart, and even more enjoyable to watch their antics at the individual level.

Macaques are terrestrial quadrupeds, and spend much of their time moving on the ground. They are equally agile in the trees, where they also sleep, sometimes huddled together. These monkeys can also swim proficiently, and may even hide underwater when escaping predators. Toque macaques are sometimes called garbage monkeys. Despite a natural diet consisting mainly of fruits and seeds, they cannot resist raiding crops, kitchens and waste bins. Less revered than their langur cousins, a toque macaque caught stealing may find himself the victim of a well-aimed stone, or even a bullet. Competition for food is severe, and a number of facial expressions characterise threats by dominant males and reactions by those subordinate during feeding time.

Social life lies at the heart of toque monkey existence. Large multi-male troops of 8-43 individuals yield a network of complex dominance hierarchies. Females are philopatric, meaning that they stay resident in their natal group, whilst males emigrate at sexual maturity. Multiple matriarchies, or groups of related females, thus characterise toque monkey life. These matriarchies compete for food resources both within the troop and with other troops, resulting in strict "within troop" dominance hierarchies. Females, in turn, are dominated by males, who also have strict hierarchies; every six years, males may leave their troop if they become too low in the dominance hierarchy. Mating is promiscuous, and the offspring of a single female are rarely fathered by the same male. This despotic lifestyle leads to sophisticated alliances designed to promote upward movement in the hierarchy, as well as corresponding reconciliation after arguments through embracing, lip smacking and grooming.

Mothers pass their rank to their daughters; it is thus to the advantage of high ranking females to either give birth to a daughter, or to invest more energy in their daughters. Accordingly, male infants have a higher mortality rate, and females in the poorest health conditions give birth to fewer daughters. Allomothering is not the rule in macaque society, with the majority of infant care falling to the mother alone; in fact, infants may actually be used as social shields in battles for dominance. In such cases the infant is literally picked up by an adult in danger of attack, in order to ward off the aggressor. When toque monkey females are in oestrous, they exhibit a large red swelling on their backsides, which is of great interest to males. Multiple matings may occur. Babies are born after about 160 days.

Chapter 3

Here today, gone tomorrow?

One more type of primate is found in Sri Lanka, where it occurs in abundance, occupying all eco-regions of the country. This primate is adaptable in its diet and social structure, and has not only the largest relative brain size amongst the primates, but also among the mammals. Capable of complex and abstract thought and sophisticated use of tools, this primate – humans, or *Homo sapiens,* has changed the face of Sri Lanka.

Advances in health care, education and technology have allowed humans to flourish. In Sri Lanka alone, the human population has been escalating at a rate of 1.3% per year. With a current population size of some 20.4 million people, up from 14 million since just 1975, the population is projected to reach around 22.3 million by 2015. This massive growth in human numbers, combined with the resulting forest clearance for subsistence and commercial agriculture and housing has pushed Sri Lanka's wildlife into small pockets; although these forests may seem safe havens, they are mostly small and subject to natural events such as storms and fire, which can obliterate these populations in a matter of days. With nowhere to go to find new mates or even to eat, mammals such as elephants and purple-faced leaf monkeys are forced into human gardens and agricultural plots, either to raid crops, or merely to try to make it to the next patch of forest. This behaviour creates inevitable conflict with humans, who may not be able to see the inherent value of monkeys when crops or roofs have been destroyed.

All of Sri Lanka's primates are considered highly threatened, even the highly adaptable toque macaque. The western purple-faced monkey and Horton Plains slender loris are so rare, in fact, that they rank amongst the top 25 most endangered primates on earth. It is estimated that some of these subspecies may go extinct within the lifetime of this generation. This dire situation is recognised at an international level. For example, Sri Lanka's Wet Zone, with less than 3% of its original rainforest remaining, has been declared one of the world's Critically Endangered ecoregions, and the eleventh most important place on earth in terms of its biodiversity.

The extinction of most of Sri Lanka's primates is imminent; even if some species survive over the next 25 years, it is doubtful they will make it to the next century. There is hope, however; the extinction of our forest cousins is only guaranteed if our actions do not change. The very traits that make humans unique from other primates – our extreme intelligence, ingenuity and compassion – are the same factors that can allow us to save them. Simple life changes, such as not using polythene bags, drinking from glass bottles, or contributing your time or financial donations to a local environmental agency are a very good start to preserving Sri Lanka's wildlife. More direct actions, such as not keeping primates as pets, planting trees (particularly between isolated forest patches), and careful selection of land for sustainable farming, will have an even more important and direct conservation impact.

As our own socioeconomic standards increase, we must remember the important ethics of living simply. Our intellect does have boundaries, and we still have a lot to learn from the monkeys and lorises that live at peace with nature.

Chapter 4

Where to watch primates in Sri Lanka

This book has so far introduced you to some of Sri Lanka's most charismatic animals – the primates. Lorises, macaques, langurs and leaf monkeys cannot be truly appreciated, however, until one has had the privilege to observe them with one's own eyes. Here we list a number of localities where you can see primates in Sri Lanka. When looking for them, listen for their calls to alert you to their presence. Look also for long tails drooping from a branch. You may find a group of toque macaques bounding along a temple wall, or grey langurs basking in the sun on the side of the road. Although they may look relaxed, do not look monkeys directly in the eye; this is perceived as a threat. Let them habituate to your presence before directing a camera at them, which they perceive as a giant aggressive eye! Do not feed the monkeys; this will encourage their cheeky behaviour and may make them sick. When looking for lorises at night, keep your torch at eye level, and whenever possible, cover the lens with red glass paper; lorises cannot see red, and they will be less wary of you, not to mention less blinded by the light. Lastly, do not tease the primates. Treat them with gentleness and respect, and you may be able to watch them for hours.

The Grey Slender Loris

L. l. nordicus Polonnaruwa Wilpattu National Park	Maduru Oya National Park Minneriya National Park
L. l. grandis Knuckles Range	Udawattakale

The Red Slender Loris

L. t. tardigradus Kottawa Sinharaja World Heritage Site	Maimbulakande Strict Nature Reserve
L. t. nycticeboides Horton Plains National Park	

The Purple-faced Leaf Monkey

T. v. philbricki Polonnaruwa Wilpattu National Park	Maduru Oya National Park
T. v. vetulus Kottawa Sinharaja World Heritage Site	Oliyagankele (Wilpita)
T. v. monticola Horton Plains National Park	
T. v. nestor Home gardens of Colombo's surrounding areas	Bodhinagala Maimbulakande Strict Nature Reserve

Grey Langur: relatively common throughout the Dry Zone on road sides

S. priam Polonnaruwa Wilpattu National Park Anuradhapura	Maduru Oya National Park Minneriya National Park Yala National Park

Toque Monkey : relatively common throughout the island on road sides and at temples

M. s. sinica Polonnaruwa Wilpattu National Park	Maduru Oya National Park
M. s. aurifrons Kottawa Sinharaja World Heritage Site	Udawattakele Udawalawe National Park
M. s. opisthomelas Horton Plains National Park Peak Wilderness Sanctuary	Victoria Randenigala Rantambe Sanctuary

Strepsirrhini

The Loris by John Still (1919)

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 your thin weird cry:
I sense you passing by.
Softly and silently your tiny palms
Cleave to the bosses of your secret way,
Up 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.

Genus Loris (Geoffrey, 1796)

Slender lorises

1784. *Tardigradus* Boddaert (in part). Preoccupied.
1796. *Loris* E Geoffroy.
1811. *Stenops* Illiger (in part).
1815. *Loridium* Rafinesque. *Lemur tardigradus* Linnaeus, 1758.
1840. *Arachnocebus* Lesson. *Lemur tardigradus* Linnaeus, 1758.
1840. *Bradylemur* Lesson. *Arachnocebus lori* Lesson, 1840.

Diagnosis

Loris is characterised by a small, long and slender body, with a rounded head and a short, sharp muzzle. Its fur is woolly, but its wet nose (rhinarium), the tips of its ears, palms and sole (except heel region) are naked. Its eyes are very large, with moderately large, almost naked ears. The tail is absent and the limbs are very long and slender. The index finger is short. The skull is short and rounded; the orbits are very large and close together, separated only by a thin, bony septum. It has a typical strepsirrhine dental formula of I2:C1:P3:M3.

Distribution

The genus is confined to Sri Lanka and parts of southern India south of the Tapti River.

Reproduction

(Schulze and Meier, 1995a; Nekaris, 2003)
Copulations in this genus follow a similar pattern. They can occur after play wrestling, but most often commence after many males have pursued a female for a given time. Usually, males move into an area a few days before the female enters full oestrous and begin to follow her and try to groom her. These interactions can result in violent fights between males. During the pursuit, the males utter *krik* calls at irregular intervals, and try to inspect the female's genitals. During this the female may give defensive threats, but when she is ready to be mounted, she will signal with a suspensory posture. Copulations take place with the male clinging to the female, who is suspended quadrupedally. The female will support herself by all four limbs or just the hindlimbs. A single copulation may last 2 to 16 minutes and is ended with the female giving low-intensity threat gestures towards the male. Both individuals will lick their genitals afterwards, and sometimes the male forms a vaginal plug in the female's vagina.

Lorises give birth to singletons or twins. A female can become pregnant whilst still nursing her baby. A female will give birth in either a sitting or in a hanging posture. The newborns are born with the eyes partially opened. The mother may defend against conspecifics after birth if they become overly curious, but often she will allow an adult male from her social group groom her and the infant(s). The newborn infant will cling to the mother's belly for the first few weeks of life. Carrying of the infants by the parents will decrease once the infant is 2 to 3 months old. At this time the infant will be parked, while the mother goes off to feed. At dawn, it calls to its mother with 'zic' calls; as she approaches, the infant will climb on to her belly.

Olfactory Communciation

(Rasmussen, 1986; Schulze and Meier, 1995b; Nekaris, et al., 2006)
urine marking: Urine is deposited on a substrate for purposes of marking. Types include dot and trail marking. They can occur alone or in combination. In dot marking an individual will slow down while moving and deposit a small amount of urine on the substrate at irregular intervals while lifting one leg. In trail marking the penis or clitoris are dragged along the substrate and a continuous trail of urine is left. "Passing-over" also can occur where an individual will pass-over the back of another conspecific leaving a trail of urine.

urine washing: The hand and foot are raised on the same side, and the clitoris or penis is touched, gathering urine; then the urine is spread over the soles of the hands and feet. This behaviour could serve to function in moistening the skin, thermoregulation, or olfactory marking, and

possibly as displacement behaviour. This behaviour has also been seen when a subordinate individual is approached by a superior and the subordinate is nervous, or when approached by a human observer.

genital sniffing: A male will inspect and sniff the genitals of a female during oestrus, serving to check the receptivity of the female.

brachial excretion: A fluid is excreted from the brachial gland when an individual is under stress or fear, e.g. before defending against a predator.

Vocal Communication

(Rasmussen, 1986; Schulze and Meier, 1995b; Bearder, et al., 2002)

whistle: This loud call can be one to five syllables that each decrease in frequency. This call is uttered in situations of aggressive excitement, courtship, spacing and announcement and is emitted by adults of both sexes. This call may be heard up to 100 meters away.

chitter: This call is a series of short rhythmic clicks that can increase in intensity and turn into voiced, cricket-like screeching. This call is heard in tense situations between conspecifics (displacement of a sleeping place, desire to end grooming) and is emitted by both males and females. This call serves to communicate a low intensity threat.

monosyllabic chitter: This call is a single sharp smacking or crunching noise that is emitted by the adult female when approached by a male. This call is similar to the *zic* call of infants. Males respond to this call by retreating and turning away of the head or emitting the *krik* call.

hiss: This open-mouthed exhalation occurs in situations when a loris is threatening or being threatened by a conspecific. It also may be made to a predator.

zic: This call is high, sharp, short, and monosyllabic, and with increasing intensity turns into a voiced disyllabic trill-like call of a longer duration. It is used to communicate distress or abandonment, and is responded to by the mother or other group members with approaching and sometimes picking up of the infants.

krik: This call is low, short, and singly emitted or repeated at irregular intervals and sounds like a combination of a hiss and a crackling noise. With increasing intensity this call can resemble a human baby's voice. It is uttered in situations when males approach females for sniffing, especially during oestrus, and may be used to communicate appeasement.

growl: This call is described as "resembling the spit of a cat," a cobra, or a clogged up vacuum cleaner. It may be repeated with every exhalation when a loris is facing a predator or when an individual is very excited. The loudness of this particular call depends on the intensity of the stimulus. This call is associated with the defensive behaviours of attacking and lateral swaying. Included with this call could be fierce biting and odours from the brachial gland. It has been suggested that these combined behaviours serve to imitate a cobra.

scream: This call is when a *growl* turns into screaming, like a cat with increasing intensity of fear. Emissions from the brachial gland can occur with this call. This call is used to communicate threat or extreme fear. In India, it was heard when an animal was facing a predator, and when one was stuck on an electric line.

Appendix i

Red slender loris

Loris tardigradus

Western Red Slender Loris
Loris tardigradus tardigradus

Montane Red Slender Loris
Loris tardigradus nycticeboides

Loris tardigradus (Linnaeus, 1758)

Red Slender Loris

Loris tardigradus Linnaeus, 1758.
1758. *Lemur tardigradus* Linnaeus. Sri Lanka.
1796. *Loris gracilis* E Geoffroy. Sri Lanka.
1804. *Lemur ceylonicus* Fischer. Sri Lanka.
1840. *Arachnocebus lori* Lesson. No Locality.
1905. *Loris gracilis zeylanicus* Lydekker. Sri Lanka: Peradeniya.

Context

Southwestern Ceylon Slender Loris
Order Primates
Suborder Strepsirrhini
Infraorder Lorisiformes
Superfamily Lorisoidea
Family Lorisidae
Subfamily Lorisinae
Genus *Loris*
species *tardigradus*
subspecies *tardigradus*
subspecies *nycticeboides*

Loris tardigradus tardigradus (Linnaeus, 1758)

The Southwestern Ceylon Slender Loris
Sinhala: unuhapuluwa
Tamil: thevangu

1758. *Loris tardigradus tardigradus* Linnaeus, Sri Lanka.

Diagnosis

(Schulze and Meier, 1995a; Nekaris and Jayewardene, 2003)
Loris. t. tardigradus is the smallest of the slender loris taxa (122-170 g; head and body length less than 205 mm). Dorsally, its pellage is red-brown with or without a dorsal stripe. The ventral hair is yellowish white with dark grey hair bases. Its preauricular hair has dark hair bases intergrading to its ear from its dark brown/chestnut circumocular patches, which are rounded in shape. The interocular stripe is very narrow and white or not present. Its hands and feet are pink or yellowish pink in adults; very large eyes with relatively small ears; general colour a woody russet; muzzle long and pointed. The fur on the forearms, hands, and feet is short; the toilet claw of the second digit of the foot is well developed.

Distribution

(Osman Hill, 1933; Nekaris and Jayewardene, 2004)
Both the species and subspecies are endemic to Sri Lanka; it is found in the southwest part of the country from Colombo (although no known population still exists in the city) in the north to Ranna on the south coast. This subspecies lives in the wet lowland forests up to 470 m. The type locality is unknown but is probably the Western lowlands. Even when it was first described by Osman Hill, he suggested that it was a rare species. Recent surveys have found populations at the following sites: Masmullah Proposed Forest Reserve, Kottawa Forest Reserve, Kakanadura, Dandeniya, Polgahaivalakanda, Bangamukande, Godakawela, Oliyagankele, Kanneliya, Maimbalukande and Sinharaja.

Reproduction

(Nekaris, 2003; Nekaris and Bearder, 2007; Bernede and Nekaris, unpub. data)
Reproduction is as described for the genus, with some exceptions. Dominant males may form partnerships with smaller-bodied beta males. These male coalitions work together to pursue oestrous females. Males gather during the time of oestrous, some coming from other parts of the forest; vocal battles are common.

The gestation period is 165-175 days. Births occur throughout the year with no evidence for a birth peak. Although singletons are more common, this subspecies also gives birth to twins. These are parked near the mother at about the age of two months. She will rush back to retrieve her infant at any sign of danger.

Ecology

(Still, 1905; Nekaris and Jayewardene, 2003; Nekaris et al 2005; Nekaris and Bearder, 2007)

In 1905, Still suggested that lorises were completely insectivorous, even carnivorous. Observations bear this out, as red slender lorises have only been observed to eat animal prey. Although they will eat fruit in a captive setting, they will always choose animal prey first. In addition to insects (including moths, stick insects, dragonflies, beetles, cockroaches, grasshoppers, etc), they relish lizards *(Calotes)* and geckos. They have not been observed to eat birds, but their lightening fast grasp and swift killing bite to the head suggest this is possible. At Masmullah Proposed Forest Reserve, lorises were found in high abundance in areas characterised by *Humboldtia laurifolia,* a tree that has a mutualistic relationship with ants, providing abundant food for lorises. Lorises occurred at densities of 0.08-0.55 animals/ ha across 15 separate sites. Loris abundance was positively associated with vines and branches providing continuous passage, and trees providing a number of potential sleeping sites. Vicinity to human populations negatively impacts this species; it is not found in home gardens, and seems to require continuous canopy to move between forest patches.

Locomotion

(Nekaris and Stevens, 2007)

Although lorises are thought to be slow climbers, kinematic studies revealed that they can move at speeds of 1.3 m per second. Within a secondary tree fall zone setting, red lorises are small-branch specialists most often moving on supports less than 5 cm in diameter, and only occasionally selecting branch clusters, or substrates larger than 5 cm. Overall, they do not exhibit strong preferences with respect to branch orientation. Rapid quadrupedalism is used on arboreal supports of all diameters and orientations, but was never observed in animals moving on the ground.

Social Behaviour

(Nekaris and Jayewardene, 2003; Nekaris and Bearder, 2007; Nekaris, et al, 2007)

This subspecies sleeps in groups of up to five animals, but a male, female and their offspring is the most common group. Some males change their sleeping site on a regular basis, and may sleep within the vicinity of a female. They engage in intense grooming sessions at dawn and dusk, as well as social and solitary play. They communicate regularly via scent marking and loud calls. Home range size varies intra-sexually, particularly between the females, whose home ranges are 1.5-10 ha. Male home ranges are around 5 ha. Females tend to focus activities in a small portion of their home range in a night, whereas males traverse their entire range, sometimes more than once. Individuals with overlapping home ranges interact throughout the night. Males may affiliate with males as well as with more than one female. Females rarely affiliate with other females, and may be aggressive towards males who attempt to follow or groom them. Interestingly, lorises are very disturbed by white light and usually cease social behaviour (e.g. partners will disperse) unless red or infrared light (e.g. night vision) is used.

Vocal Communication

(Nekaris and Jayewardene, 2003; Bernede, et al., 2007)

As described for *Loris,* this taxon utters chitter, krik, and zic calls. The scream has not yet been recorded. A soft whistle, barely audible even when standing within 10 m of the animal, also forms part of its vocal repertoire.

By far the most common call is the loud whistle, used to communicate location to friendly conspecifics, warnings to non-group members, and by females to ward off encroaching males. Vocal battles are common and up to 60 calls per hour have been heard. Indeed, the whistle is so common that it is a good indicator of loris presence or absence in a forest. At least six variations of the whistle have been described, with a potential 12 additional variants. The tones within each call can be undulated, strangled, short or long and in different combinations. The maximum frequency of whistles is higher than 16 kHz. The average dominant frequency is 8.2 kHz, and the mean fundamental frequency is 6 kHz. Variation in the number of

harmonics was considerable with a maximum of 10 and a mean of 3.5. All whistles are frequency modulated.

Genetics

(Nekaris et al, 2006)
A recent genetic study based on museum specimens of known locality showed that *L. tardigradus tardigradus* forms a clade with *L. t. nyticeboides* to the exclusion of other lorises.

Conservation Status

Endangered A2cd+4cd (IUCN Cambodia 2006) Severe habitat fragmentation greatly impacts this species, which has already lost much of its native forest. It is also a popular pet and used in traditional healing cures.

Loris tardigradus nycticeboides (Hill, 1942)

The Horton Plains Slender Loris
Sinhala: unuhapuluwa
Tamil: thevangu

1942. *Loris tardigradus nycticeboides* Hill, Sri Lanka: Central Province, Horton Plains, 1830 m

Diagnosis

(Jenkins 1987; Phillips, 1980; Osman Hill, 1942; Nekaris unpub)
This subspecies is the most distinct of the Sri Lankan lorises. Its limbs are relatively shorter in reference to the trunk than in any other of the subspecies, with the hind limbs especially shortened. The skull (length 52.3 mm) is also considerably larger in all details than in *L. t. tardigradus.* The fur, being very long, soft and thick, causes the animal to look much larger than its actual bodily measurements would suggest (head and body length 204-213mm; 140 g), and makes it look superficially very much like a Southeast Asian slow loris. The limbs in particular are thickly furred towards their extremities.

The general colour dorsally is brown, with no reddish tinge; it is slightly darker on crown, nape and upper back, but much paler on lower back and hind limbs. The hair bases of the ventrum are grey followed by a buffish zone on its sides and finally with brown on the dorsum; the throat is light buff throughout. The belly is yellowish cream. The inter-ocular stripe is white and narrow. The circumocular patches are a dark chestnut brown. Notably, the ears are densely clothed with greyish-brown fur, and pre-auricular hair blends the facial markings to the ear. No dorsal stripe is present.

Distribution

(Nekaris, 2003; Molur *et al.* 2003)
Loris tardigradus nycticeboides is found in central Sri Lanka from 1500 to 2000 m in montane mist forests. Although the type locality is from the Horton Plains, and it has only ever been seen there, it may extend to other montane forests. In the lack of further concrete knowledge (e.g. close visual inspection of lorises from other areas), the extent of occurrence is less than 300km2.

Reproduction

(Nicholls, 1939)
Only one birth has been witnessed in this species. The gestation period was 174 days, resulting in the birth of twins.

Ecology

(Osman Hill 1942; Phillips, 1980; Werner, 1984; Nekaris, 2003; Nekaris and Jayewardene 2004)
The ecology may be as in other subspecies but possibly more carnivorous than the lowland subspecies. As is the case with other primates at high altitudes, it also may occur at lower densities. The forest where it occurs has been classified as cloud forest, montane forest and evergreen forest. Of actual sightings, the highest was at 2134 m and the lowest at 1829 m altitude. Temperatures in its habitat have been recorded from 15.4 C (May/June) to -4 C (Dec/Jan). A preliminary density at Horton Plains was estimated at 0.02 animals per hectare, yielding a total potential population of 78 animals.

Locomotion

(Nekaris, 2003)
This subspecies moves very much like its low country counterpart. It has been observed at low heights (2 m), and also to cross the open ground.

Social Behaviour

Nothing is yet known about the social behaviour of this subspecies.

Vocal Communication

Nothing is known about the vocal communication of this subspecies, but it is likely to be similar to *L. t. tardigradus.*

Olfactory Communciation

Nothing is known about the olfactory communication of this subspecies, but it is likely to be similar to *L. t. tardigradus.*

Genetics

Roos (2003) has shown that this subspecies allies more closely with *L. tardigradus* than with *L. lydekkerianus* (c.f. Groves, 2001). This confers with observations of museum specimens by Nekaris, who also noted that pelage characteristics were more similar to *L. tardigradus.*

Conservation Status

Critically Endangered D1 (IUCN Cambodia 2006)
The area of occupancy is estimated to be less than 500 km2; the habitat is severely fragmented. This subspecies is known to exist at no more than five locations. The area of occupancy and the extent of occurrence is in continued decline through logging, firewood collection and gem mining. This animal is also valued in traditional medicine.

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Appendix ii

Grey slender loris

Loris lydekkerianus

Northern Grey Slender Loris
Loris lydekkerianus nordicus

Highland Grey Slender Loris
Loris lydekkerianus grandis

Anna Nekaris

Loris lydekkerianus (Cabrera, 1908)

Context
Grey Slender Loris

Order Primates
Suborder Strepsirrhini
Infraorder Lorisiformes
Superfamily Lorisoidea
Family Lorisidae
Subfamily Lorisinae
Genus *Loris*
Species *lydekkerianus*
- Subspecies *nordicus*
- Subspecies *grandis*
- Subspecies *lydekkerianus* (India)
- Subspecies *malabaricus* (India)

Diagnosis

Size larger, skull length more than 50mm; rostrum shorter, less narrowed, but less expanded anteriorly, and zygomata less expanded. Pelage varying, usually fairly short, dorsally grey-brown to red-brown, ventrally pale buffy; dorsal stripe usually present, very occasionally absent; eye-rings dark to red-brown to black (Groves)

Distribution

Dry country and medium altitudes of Sri Lanka, and southern India (Groves)

Loris lydekkerianus nordicus (Hill, 1933)

The Northern Ceylon Slender Loris
Sinhala: unuhapuluwa or kalu unahapuluwa
Tamil: thevangu

1933. *Loris tardigradus nordicus* Hill, Sri Lanka: North Central Province, Talawa.

Diagnosis

(Phillips, 1980; Jenkins 1987; Schulze and Meier, 1995; Nekaris pers obs)
This subspecies has a dense woolly pelage with colouration that is grey, grey-brown, or buff-brown dorsally and white or light buff ventrally. The belly and throat are creamy buff throughout with no grey hair bases. The head and dorsum can either have frosting or not, and there is a dark dorsal stripe that meets a dark crown. The circumocular patches are dark grey, grey, or grey-brown, and the preauricular hairs are either white or light grey extending to white cheeks, making the facial mask more outstanding than in *L. tardigradus.* The ears are relatively large compared to the eyes and are black or yellow. This subspecies has a head and body length of 215-238 mm (males 227 mm; females 217 mm). The skull length measures 52.7 mm (49.7-54.1mm). Male body weight (238-287 g) is slightly larger than females (228-285 g).

Distribution

(Phillips, 1980, Nekaris and Jayewardene, 2004)
This endemic subspecies was named from its type locality at Talawa (15 m) in northern central Sri Lanka. This subspecies is confined to and occurs throughout the Dry Zone. It has recently been seen at: Mannar, Wilpattu, Anuradhapura, Sigiriya, Polonnaruwa, Mihintale, Ritigale, Minneriya-Giritale, Trincomalee, and Madura Oya. No undisputed sighting has yet been made of this species in Yala National Park, and it is uncertain if its range extends to there.

Reproduction

(Schulze and Meier, 1995; Fitch-Snyder and Schulze, 2001; Nekaris, 2003)
This subspecies has a gestation period of 162.3 days (157-172 days), and is weaned after 148 days. The

Anna Nekaris

average inter-birth interval is 14.8 months. Births occur throughout the year with no evidence for a birth peak. Mothers park their infants at about 2 months of age, and leave them throughout the night, returning only in the morning.

Ecology

(Nekaris and Jayewardene, 2003; Nekaris et al, 2006)
This subspecies has been seen in acacia, bamboo, deciduous dry, edge, scrub, and secondary forests. Temperatures range from 36 °C to 15.5 °C. The average height at which animals move is about 2.5- 3 m (70% of all observations). In only 2% of observations was it observed at 10-20 m. This subspecies was observed only to eat insect or animal prey items, including lizards and snails. They nearly always detected their prey with their eyes, and engaged in acrobatic suspensory postures to catch their prey items. They grasped the prey with one or two hands, and prey items were rarely caught and eaten directly with the mouth. Lorises were not observed to eat gum or drink water. The only potential non-insect item consumed by lorises was located on flowering *Cassia roxburghii.* Two different lactating females were observed to tug at something on the trees, and consumed several of these bits. They may have been eating the leaves, the flowers, or small insect cocoons that were woven tightly around the bases of leaves. Densities of this subspecies ranged from 1.5 to 20 animals per km; the latter figure was a distortion due to an unusual social behaviour seen at Polonnaruwa. Although predators of this subspecies may include civets and small cats, lorises showed no fear of these carnivores and travelled swiftly past them with no sign of freezing.

Locomotion

(Schulze and Meier, 1995; Nekaris and Jayewardene, 2003)
This subspecies moves quadrupedally in the trees; although it can move slowly when threatened, it is generally silent and swift. This species prefers to move on top of branches. Gaps between branches are crossed by employing horizontal bridging, whereby the hindlimbs hold on to the substrate while the forelimbs grab for the desired branch. Three limbs are usually holding on to the support when moving in a quadrupedal fashion. This subspecies is capable of rapidly scaling a large tree trunk, although it prefers small supports around which it can firmly clasp its hands.

Anna Nekaris

Social Behaviour

(Nekaris and Jayewardene, 2003; Nekaris, 2002; Schulze and Meier, 1995)
This subspecies forages at night alone or in groups of two or three. On rare occasions these groups may be larger. One such incidence occurred at Polonnaruwa where a

minimum of 9 and a maximum of 11 animals foraged and played peacefully in a single tree with no signs of sexual activity. This included a mother carrying a singleton and another carrying twins. This subspecies usually sleeps with one or four other conspecifics, and chooses one of three or four sleep sites night after night. Grooming is common and males frequently groom infants when they are parked or on the mother's belly. Peaceful food sharing occurs amongst members of a group, although it is not active. Male home ranges are probably about twice the size of females. Females show tolerance for one another in this subspecies, unlike the closely-related *L. l. lydekkerianus* in India.

Social play occurs in this species with adult males and juveniles participating in play wrestling most often, but older individuals may participate. A typical wrestling bout would include two individuals facing each other and gripping the head from the back and pulling the head back. The hands and feet are attempted to be bitten lightly, but not a severe enough bite as to draw blood. A female carrying twins on her belly was seen to play so vigorously with a male that all four fell out of a tree!

Vocal Communication

(Schulze and Meier, 1995b; Nekaris and Jayewardene, 2003)
All vocalisations described here have similar functions as for *Loris,* above.

whistle: This call can have a frequency of up to 14 kHz with a maximum intensity between 6 and 9 kHz. This call is heard in situations of aggressive excitement and is emitted by adults of both sexes.

chitter: This call can last up to 4 minutes and have a frequency of up to 20 kHz. It is heard in defensive situations between conspecifics and is emitted by both males and females, with females emitting the call more frequently.

krik: This call has a duration that ranges from 50 to 75 milliseconds and frequencies that range from 4 to 9 kHz. It may be uttered in situations where an infant will threaten or attack its mother as a response to when other group members quarrel.

scream: This call lasts more than 0.15 seconds and can have a frequency of up to 18 kHz.

Olfactory Communciation

See description for Loris

Genetics

(Groves 1998)
Diploid number: 62

Conservation Status

Endangered A2cd+4cd (IUCN Cambodia)

Pages 52 and 53, Anna Nekaris

Loris lydekkerianus grandis (Hill and Phillips, 1932)

The highland slender loris
Sinhala: unuhapuluwa or kalu unahapuluwa
Tamil: thevangu or kadu-papa

1932. *Loris tardigradus nordicus* Hill and Phillips, Sri Lanka: Province, Gammaduwa, 675m.

Diagnosis

(Phillips, 1980; Per obs)
Loris l. grandis is more heavily furred than *L. l. nordicus* or *L. t. tardigradus.* This subspecies has a pelage coloration that is dark grey or grey-brown dorsally, and sometimes a rusty brown on the lumbar region, as if it was swiftly painted with a brush. It is ventrally white or light buff on the distal ends of the hairs with basal half being black, unlike *L. l. nordicus,* where ventral hairs have no dark hair bases. The throat of *L. l. grandis* is pure white. This subspecies possesses an indistinct dark dorsal stripe that usually is frosted. The circumocular patches are black, brown, or red-brown. The white interocular stripe bifurcates above the circumocular patches. The cheeks and pre-auricular hair are more white, similar to *L. l. nordicus.* The coat of this subspecies is thicker when compared with *Loris tardigradus tardigradus.* It falls in the middle of the size spectrum of Sri Lankan lorises, with a head and body length of 209-256 mm, and a body weight of about 220 g. The skull length from the tip of the nose to the base is 51.3 mm.

Distribution

(Osman Hill and Phillips, 1932; Phillips, 1980; Nekaris and Jayewardene, 2004)
This endemic subspecies is found in the Central Province at an average altitude of 900 meters. The type locality is Gammaduwa, in the East Matale Hills (730-1040 m) in the Central Mountains. Although it has been found only in the East Matale Hills, it is probable that it occurs also throughout the lower foot-hills of the mountains of central Sri Lanka. The highest altitude from which it has been obtained is 1036 m. Even in 1932, it was a very uncommon animal even in its type locality. Lorises have recently been seen at Udawattakele and in the Knuckles Range which may conform to this subspecies.

Reproduction

Breeding habits appear to be closely similar to the lowland subspecies *(L. l. nordicus).*

Weaning duration: 167-175 days (reservation on subspecies identification) (Goonan 1993)

Ecology

(Phillips, 1980; Nekaris and Jayewardene 2004)
Phillips, who kept this species in captivity, reported that it fed on tree-frogs, geckoes and large insects of various kinds, and that it was probably mainly carnivorous. The temperatures of its habitat range from 11-20 °C. Its habitat has been described as montane, cloud, primary, evergreen, and deciduous rainforest, and cloud forest. Estimates of abundance for this taxon ranged from 0.11-3.3 animals/ km.

Locomotion

Same as for *L. l. nordicus.*

Social Behaviour

Probably the same as for *L. l. nordicus* (Phillips)

Vocal And Olfactory Communication

Not known; probably the same as for *L. l. nordicus.*

Genetics

(Goonan et al 1995)
Diploid number: 62 (16:18:26)

Conservation Status

Endangered A2cd+4cd; B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v) (IUCN Cambodia)

Page 54, Michael Leibfritz

Haplorhini

The Monkeys – by John Still (1919)

The monkeys move among the higher ways,
Along the roads that link the larger trees,
The restless road set swinging by the breeze.
Among the leafy boughs their home is found,
But yet they love to linger on the ground
Through the long afternoons of sunny days.
At any sign of peril up they spring,
Racing across the ground to reach the maze
Of branches, where they sit and safely swing,
Uttering hollow, melancholy tones.
But sometimes fate is swifter than they trow.
Then while the leopard trips their brother's bones
They hoot and dash about from bough to bough
With frantic, impotent, pathetic rage,
Like half-formed men of some remoter age.

Appendix iii

Purple-faced Leaf Monkey

Trachypithecus vetulus

Southern Purple-faced Leaf Monkey
Trachypithecus vetulus vetulus

Western Purple-faced Leaf Monkey
Trachypithecus vetulus nestor

Bear Monkey
Trachypithecus vetulus monticola

Northern Purple-faced Leaf Monkey
Trachypithecus vetulus philbricki

Trachypithecus (Reichanbach, 1862)

1823 *Semnopithecus pyrrhus,* Horsfield
1829 *Cercopithecus johnii,* Fischer
1862 *Trachypithecus* Reichenbach
1862 *Kasi,* Reichenbach

Trachypithecus vetulus Erxleben, 1777
Purple-faced leaf monkey or langur

Context

Order Primates
Suborder Anthropoidea
Infraorder Catarrhini
Superfamily Cercopithecoidea
Family Cercopithecidae
Subfamily Colobinae.
Genus *Trachypithecus*
species *vetulus*
- subspecies *vetulus*
- subspecies *nestor*
- subspecies *philbricki*
- subspecies *monticola*

Four subspecies are recognised within the species, with the possibility of a fifth (Brandon-Jones, *et al.,* 2004).

Diagnosis

(Philips, 1980; Groves, 2001)
This species can be distinguished from other leaf monkeys by its heavily built body (females - 5.5 kg; males 8 kg), with long glossy brown or blackish brown hair. Its girth consists almost exclusively of dark hairs, both ventrally and dorsally; a paler brownish windswept crown contrasts with its white (sometimes brown-tipped) cheek whiskers; hair of the lower back is shorter than elsewhere on the body; it possesses a whitish throat and inter-anal region, with white pubic region on females. The face is a dark purplish-black, giving it its name, and un-haired. It has a very long tail (690-750 mm), which exceeds the length of head and body (490-648 mm). Newborns contrast against the mother, with a silvery grey coat. The skull is relatively gracile and lacks strong brow ridges. The species has a typical colobine dental formula: I 2/2, C 1/1, P 2/2, M 3/3.

Distribution

(Roonwal and Mohnot, 1977; Phillips, 1980)
This endemic species is found throughout Sri Lanka, occurring in wooded areas and home gardens. It inhabits the dry lowland forests of the northern and central areas as well as the montane evergreen forests of the central highlands at altitudes of more than 2000 m.

Reproduction

(Jay, 1975; Rudran, 1973b; Roonwal and Mohnot, 1977; Harvey et al., 1987; Rowe, 1996;)
The mating season occurs during the wet season of the respective part of the island. Females reach sexual maturity at 1278 days. After 195-211 days, they give birth to one, or occasionally two, infants; weight at birth is 432 g. By 12-16 weeks the infant resembles the adult in pelage colouration, but not fully until 28 weeks. From 12-20 weeks, the infants become more independent of the mother and also begin to engage in social play. At 12-20 weeks the infant begins to eat solid food. After 28 weeks, young are reliant on solid food and move independently. Weaning occurs at 7-8 months of age. The inter-birth interval is 16-24 months. Allomothering or aunting behaviour has been observed. These monkeys can live to 26 years.

Ecology

(Seidensticker, 1983; Hladik, 1977; Douglas, 2006; Nekaris et al, in press)
This is a diurnal and an arboreal species, but will move on the ground where trees are sparse, traversing it as quickly as possible. Group sizes range from 2 to 16 individuals. The home ranges of bachelor troops overlap the home ranges of uni-male troops. This species occurs in primary, secondary, semi-deciduous dry, riverine, coastal, scrub, and montane cloud forest up to 2195 m.

The purple-faced langur is folivorous, but it will also consume fruit, flowers, and seeds. The diet of this species tends to be low in protein (11.5% of the dry weight). The dietary strategy has been described as energy minimizing; low nutritional gains means that animals also are less active. This species has been observed to consume soil from termite mounds. Water is obtained by licking rainwater off leaves and branches and drinking water collected in tree cavities.

Predators of the purple-faced langur include humans, *Homo sapiens*, and leopards, *Panthera pardus.*

Locomotion

(Ripley, 1967; Grand, 1975; Fleagle, 1988)
The purple-faced langur moves through the forest quadrupedally. It can move twice as fast as *M. sinica or S. priam.* This species can make spectacular drops of 50 or more feet when calling or retreating into the forest.

Social Behaviour

(Manley, 1978; Manley, 1986; Rudran, 1973a; Eschmann, 2007)
The purple-faced langur has a uni-male or harem social system, which includes a resident male, one to seven adult females, and a number of subadults, juveniles and infants, sharing a home range of 0.9-14.9 ha. Some groups may have two adult males. Bachelor groups exist containing 2 to 14 individuals and have their own territories, which are usually ecologically poorer than uni-male groups; membership tends to be flexible, with group members changing periodically. 'Wanderers,' mobile units of males and females, may also occur. Wanderers are mostly sub-adult males that have just left their natal group and are searching for females to build a harem, but also can be adult males that have been ousted from their group during a take-over; one or two females may accompany them. Harems gain and lose females over time. Males disperse from their natal group near puberty.

Purple-faced leaf monkeys are territorial; the resident male defends his territory aggressively against conspecific groups, but usually this takes the form of loud vocalisations and ritualised displays. Takeovers of the harem group by males from bachelor groups have occurred. To prevent this, a harem male acts as a sentinel, spending part the day on watch for intruders, sitting at vantage points, such as the crown of emergent trees and often vocalises. Harem males will also attack other males and whole groups by chasing individuals, or grappling with them and falling to the ground; sometimes these fights result in death. Adult females also join in on territorial defence with a reduced version of the territorial display usually directed towards

females of the opposing troop. This territorial aggression may result in difficulties for females trying to join a new harem. Females may approach a harem male slowly, without staring at the male and always keeping her back facing him. This mimics sexual behaviour and may reduce the aggression of the male and allow the female to join the harem. Females may also join a harem when there is a takeover by another male, as at this point all females are unfamiliar to him.

Infanticide has been reported to occur during male take-overs of the group. Mothers may abandon injured infants after a takeover. After uni-male group replacement, births occur at regular intervals, signalling a synchrony of female sexual cycles.

Social play in the purple-faced langur includes chasing, light wrestling, and swinging from branches. Infants begin social play from 12-20 weeks of age.

Vocal Communication

(Roonwal and Mohnot, 1977; Manley, 1986; Hohmann, 1988, 1989, 1990; Douglas, 2006; Eschmann, 2007; Eschmann, et al. 2007)

The purple-faced leaf monkey is highly vocal. A number of calls have been described; although subtle differences exist between subspecies, these call types can be roughly generalised to all taxa.

great call sequence: This territorial call is emitted by the resident male in response to the sighting of an intruder, a similar call, or after the eviction of intruders. It can also be emitted spontaneously, sometimes before rainstorms, or as a response to loud noises (vehicles, airplanes, temple chanting, trap guns). Whilst calling, the emitter may run vigorously, bounding through the trees and make exaggerated dropping leaps. The strongest stimuli for the emission of this call were found to be similar calls from other adult males. This behaviour resembles the *whoop*

display of the Nilgiri langur, *Trachypithecus johnii.*

loud call: consisting of harsh barks, whoops and snorts, made towards groups infringing upon the home range, towards other loud calls, or towards predators

hooh call: a full, deep, throaty call given by adult males in the early morning

shrill squeak: emitted by individuals when they are curious

twitter: a call bird-like in its nature and emitted when an individual is expressing pleasure or excitement

infant whine: a high-pitched call emitted by the infant when distressed

Olfactory Communication

genital sniffing: Adult males may sniff the genital region of a female to see if she is in oestrus.

Genetics

(Hohmann, 1988; Zhang and Ryder, 1998; Brandon-Jones, et al, 2004)
We have chosen to follow Groves' (2001) taxonomy for this species. Some authors, however, place the purple-faced leaf monkeys in the genus *Semnopithecus.* Based on sets of P1 alleles, Sri Lankan leaf monkeys seem to be derived from a southern taxon of grey langurs. The purple-faced langurs thus form a clade with Hanuman langurs and Nilgiri langurs to the exclusion of other monkeys once included in the genus *Trachypithecus* (capped langurs, golden langurs and Phayre's langurs). Vocal analysis indicates natural hybridization between *S. johnii* and *S. entellus* (thus implicating this relationship also with *S. johnii* and *S. vetulus*), but they are more closely linked with *Trachypithecus* in cranial morphology, neonatal pelage colour and sexually dichromatic pubic hair colouration.

Remarks

Formerly *Presbytis senex senex* until revised by Napier 1985.

Conservation Status

EN A1cd. These monkeys are at great risk due to habitat loss and fragmentation. They may be shot when entering home gardens and fields. They are also kept as pets.

Southern Purple-faced Leaf Monkey

Trachypithecus vetulus vetulus (Erxleben 1777)

The Southern Purple-faced Leaf Monkey
Sinhala: kalu vandhura
Tamil: mundi
1777. *Cercopithecus vetulus* Erxleben, Syst. Reg. An. 25.
1852. *Presbytes cephalopterus* Kelaart, Prod. Faun. Zeyl. 1.
1935. *Pithecus vetulus vetulus* Phillips, Mammals, 14.
1939. *Kasi senex vetulus* Pocock, Faun. Brit. Ind. Mammalia, 151.

Diagnosis

(Phillips, 1980; Groves, 2001)
This subspecies is characterised by grey-black hairs with light tips; the main body appears generally black. The hairs of the lumbar region and distal part of tail (rump region) are light brown with long creamy tips, making these areas overall silvery white. The head, including cheek whiskers, are brown or grey-brown, contrasting with its blackish body. The cheek whiskers conceal lower half of ears only. It is strongly sexually dimorphic (head plus body length 540-648 mm in males, 492-525 mm in females; weight 6.6-7.7 kg in males, 5.0-5.2 kg in females).

Distribution

(Groves, 2001; Nekaris, et al., in prep b)
This is the southerly wet-zone form, in rainforest from south of the Kalu Ganga to about Ranna, ascending to nearly 1,000 m inland. It has been recently recorded at the following sites: Oliyagankele, Kekunadura, Welihena, Masmullah, Kottawa, Dandeniya, Wattahena, Polgahaivalakande, Pitigala, Galle (surrounding suburbs), Kanneliya and Sinharaja World Heritage Site. Molur et al (2004) also suggest it occurs in the following locations:

Western Province

Matugama: Anasigalla

Sabaragamuwa Province

Kegalle: Peak Wilderness;
Ratnapura: Asantanakande OSF, Balangoda, Bambara kande, Bambarabotuwa FR, Delgoda PF, Delwala PR, Denihena (Sinharaja FR), Gongala OSF, Hadapan Ella, Kabaragalapatana OSF, Kiribatgala OSF, Kobahandunkanda PR, Kudawe (Sinharaja FR), Messana PR, Morahela, Mulawella (Sinharaja FR), Nihiti Mukalana, Paragala OSF, Peak Wilderness Sanctuary, Rakwana, Rammalakanda PR, Samanala Wewa FR, Sinhagalle

(Sinharaja FR), Sinharaja Research Station, Suryakande (Sinharaja FR), Udawalawe NP, Walankanda, Walawe Basin FR, Weddagala

Southern Province

Galle: Akurassa PR, Kudagala PR, Darakulkanda PR, Dediyagala FR, Dellawa PR, Galle town, Malambura, Sinharaja CF, Tibiruwakota OSF
Hambantota: Kanumuldeniya, Katuwana, Mulgirigala, Rammalakanda, Ranna,
Matara: Badullagale FR, Deniyaya, Derunagala OSF, Diyadawa FR, Kalubowitigana OSF, Kirindi Mahayayakele CF, Kurulagala OSF, Mulatiyana FR, Panilkande FR, Paravahara, Silver Kande FR;
Kalutara: Beruwela, Bulathsinhala, Dombagahana, Kande, Kalugala, Mathugama, Meegahatenna, Ranwaragalakandakanda, Waturana FR, Yagirala FR

Ecology

(Bernede, 2003; Bernede and Nekaris, 2004; Douglas, 2006; Nekaris, et al, in prep)
In fragmented forests measuring 2-24 ha in Sri Lanka's Wet Zone, purple-faced leaf monkey densities were much less than observed in the Dry Zone. In forest fragments around Pitigala, densities ranged from 1.18-3.16 individuals/ km; lone males were also seen. An albino animal was seen in Dandeniya forest. Abundance estimates were greater in sites providing higher proportions of potentially important food species (73 species) from the following 32 families: Anacardiaceae, Annonaceae, Arecaceae, Bombacaceae, Burseraceae, Celastraceae, Chloranthaceae, Clusiaceae, Combretaceae, Dipterocarpaceae, Ebenaceae, Elaeocarpaceae, Ebanaceae, Elaeocarpaceae, Euphorbiaceae, Fabaceae, Flacourtiaceae, Lauraceae, Meliaceae, Moraceae, Moringaceae, Musaceae, Myristicaceae, Myrtaceae, Oleaceae, Rhizoporaceae, Rosaceae, Rutaceae, Sapindaceae, Sapotaceae, Staphyleaceae, Symplocaceae. They also have been seen in home gardens; jak fruit is the most commonly-raided species.

Social Behaviour

(Douglas, 2006; Nekaris, et al., in prep a)
Earlier this century, troops numbering 30-40 were common. Only one site, Oliyagankele, has yielded large troops, but no more than 25 individuals. These monkeys sometimes associate with toque

macaques. They are also commonly seen associating with giant squirrels *(Ratufa macroura melanochra).* They are almost exclusively arboreal, coming to the ground to cross a road. Usually the adult male leads the troop, and each group member follows, with a spectacular leap, taking the same arboreal pathway. This species is wary of humans. Males often alarm call at human observers. Their social behaviour may be similar to that of *T. v. philbricki,* but smaller group sizes and the constraints of living in highly fragmented forest may impact their behaviour.

Vocalisations

(Nekaris, et al, in prep; Douglas, 2006)
The great call of this subspecies has been analysed in detail. The first phrase commences with a single harsh bark typically followed by a series of whoop units. Individual units are typically composed of an emphatic and tonal exhalation phase, followed by an aspirated inhalation phase. Monophasic and tonal units often precede phrases 2 and 4 and are present in residual calls. Defined crescendos and decrescendos are audible in phrases 2 and 4, and visible by an increase in amplitude. The fundamental frequency of loud calls is approximately 500 Hz, with maximum frequency registering at approximately 2000 Hz. Two harmonics are observed in spectrographic composition of the calls. The number of phrases per call vary from 2-4, and differ between sites of varying levels of disturbance.

This subspecies generally begins its dawn calling at 0524 h. It rarely calls after 1600 h. When disturbed, these monkeys may call during the night.

Conservation Status

EN A2cd + 4cd; This subspecies is regularly seen kept as a pet. They are also shot when entering home gardens. The greatest threat to this taxon, however, is habitat loss and severe fragmentation of their remaining habitat.

Western Purple-faced Leaf Monkey

Trachypithecus vetulus nestor (Bennett, 1835)

The Western purple-faced leaf monkey
Sinhala: vandhura
Tamil: mundi
1833. *Semnopithecus nestor* Bennett, Proc. Zool. Soc. 67
1852. *Presbytes albinos* Kelaart, Prod. Faun. Zeyl. 7.
1876. *Semnopithecus kelaarti* Schlegel, Mono. des Singes. 52.
1923. *Pithecus vetulus phillipsi,* Hinton. Ann. & Mag. Nat. Hist. (9) XI, 510.
1935. *Pithecus vetulus nestor* Phillips, Mammals, 18.
1939. *Kasi sinex nestor* Pocock, Faun. Brit Ind. Mammalia. I.

Diagnosis

This taxon is lighter and more grey-brown than *T. v. vetulus,* with a less contrasting (silvery grey) large and diffuse rump patch. Its forearms and shanks are darker (nearly black). The crown of the head and nape of the neck are paler brown. Its long tail is slightly tufted at the tip. It is the smallest of the four subspecies with little sexual dimorphism (head plus body length 504-560 mm in both sexes, weight 3.4-3.8 kg in males, 3.1 kg in females).

Distribution

(Dela, 1998, 2004; Dela and Rowe, 2006; Parker, 2006; Parker and Nekaris, in press)
Another Wet Zone subspecies, from north of the Kalu Ganga as far as the limited rainforest extends. As little rainforest remains, this subspecies is mainly confined to home gardens. It has been observed in 2006 at the following sites: Ruwanella, Labugama, Hanwella, Pugoda, Nissarana Forest, Kaduwella, Talangama, Piliyandala, Bandaragama, Giriulla, Kottawa (not the forest reserve), and Galatura. In

1998, it was found in Panadura. It seems to occur in only two protected areas: Maimbulakande Nature Reserve, Gampaha and Dombagaskande Forest Reserve, Ingiriya.

Reproduction

Not studied but probably similar to other forms.

Ecology

(Dela, 1998, 2007; Parker and Nekaris, in press)
Troop sizes for this taxon range from 4-25 individuals, although lone males have also been seen. The only long-term study of this taxon by Dela was on a troop of 15 individuals, who occupied a home range of 9 ha. These monkeys are found in human-modified environments, including home gardens and rubber plantations. Rapid human population growth and development of the major urban area (Colombo) and its environs restricts the range of this taxon, and could result in low juvenile recruitment rates.

Some populations of this taxon have adapted to a diet of mature fruit, including mangoes, rambutans and jak fruit. They are almost completely dependent on human-cultivated fruits.

Because these monkeys eventually come into contact with humans, conflict is inevitable, mainly involving crop raiding (primarily of fruit trees) and using rooftops as 'runways' and damaging the tiles. Interviews with local people showed that conflict was greatest in areas with the largest populations, and in particular with those people who came into daily contact with the monkeys. Indeed, conflict can be so severe that land owners may shoot the monkeys. Predators of this taxon might include dogs and poachers.

Social Behaviour

(Dela, 1998, 2007; Eschmann, 2007)

The social behaviour of *T. v. nestor* probably resembles that of *T. v. philbricki.* Territorial fights have been observed, and included loud whoop calls and vocal battles. Troop members move into areas of range overlap to forage, but quickly retreat if members of the neighbouring troop come into sight.

In rare cases, fights have escalated and resulted in the death of one of the harem males. Infanticide has been observed as a result of male take-overs.

Conservation Status

(Dela and Rowe, 2006)

CR A2cd + 3cd + 4cd. This species only occurs in two very small protected areas that are infringed upon by human disturbance; most forests in its range are degraded or cleared.

Bear Monkey

Trachypithecus vetulus monticola (Kelaart 1850)

The Highland Purple-faced Leaf Monkey or Shaggy Bear Monkey
Sinhala: maha vandhura
Tamil: mundi
1850. *Presbytis cephalopterus* var. *monticola* Kelaart, Jour. Asiat. Soc. Ceylon. 11, 321.
1852. *Presbytis ursinus* Kelaart, Prod. Faun. Zeyl. 2.
1935. *Pithecus vetulus monticola* Phillips, Mammals, 21.
1939. *Kasi senex monticola* Pocock, Faun. Brit. Ind. Mammalia I.

Diagnosis

(Deraniyagala, 1955; Groves, 2001)
This very distinct subspecies is brown with a thick pelage, making it appear much larger than its weight. It has only a slightly contrasting crown and rump patch, and a relatively short tail (400-435 mm) and exhibits long, white cheek whiskers that hide its ears. It is comparable in size to *T. v. philbricki* (head and body length 552-590 mm) but built more robustly (9.0-9.3 kg in both sexes).

Distribution

This is a high-mountain subspecies, living at altitudes from 1,200 to 2,000 m. It is principally known from the Horton Plains National Park and Hakgala.

Reproduction

(Rudran, 1973b)
At Horton Plains a distinct birth peak was not found, but some groups showed birth synchrony. This may be due to high food availability and rainfall throughout the year.

Ecology

(Hladik and Hladik, 1972; Rudran, 1973b)

The diet of *T. v. monticola* consists of young leaves (75%), coriaceous leaves (16%), and flowers and fruits (10%). The average group size at Horton Plains was 8.9 individuals.

Social Behaviour

(Rudran, 1973a)

Infanticide has not been observed, and replacement of harem leaders tends to occur at low frequency. This may explain the presence of more immature individuals in social groups.

Vocal Communication

Refer to the general comments on vocalisations for the species.

Conservation Status

EN A2cd + 4cd; B1 ab (ii, iii, iv, v)

Northern Purple-faced Leaf Monkey

Trachypithecus vetulus philbricki (Phillips, 1927)

The Northern purple-faced leaf monkey
Sinhala: kalu vandhura
Tamil: mundi
1927. *Pithecus philbricki* Phillips, Cey. Jour. Sci. B. XIV, 57.
1935. *Pithecus vetulus philbricki,* Phillips, Mammals, 23.
1939. *Kasi sinex sinex* Pocock, Faun. Brit. Indi. Mammalia, I, 154: Part IV (E) 9.
1954. *Presites sinex harti* Deraniyagala, Ceylon Adm. Rep. Part IV (E) 9.

Diagnosis

(Hill, 1936; Deraniyagala, 1955; Phillips, 1980; Groves, 2001)
This subspecies is generally brown, like *T. v. nestor*, but the rump patch is much less conspicuous. The lower part of the limbs is black and the very long (810-850 mm) and slim tail is pale-tipped (tawny to white) without a tuft. It exhibits silky and very long whiskers. Although not so sturdily built as *T. v. monticola*, it is the largest of the subspecies (head and body length 552-640 mm in both sexes; weight of males 6.0-7.7kg and of females 4.76-7.25 kg; very large animals may reach 11.4 kg). In east Matale hills, small troops containing one or more albino or semi-albino individuals have been found in the past.

Distribution

(Deraniyagala, 1955; Phillips, 1980; Groves: 2001, Nekaris per obs.)

Found throughout the Dry Zone to the east and north of Matale, and into the low country of Kantale, and Polonnaruwa as far west as Paymadu; it reaches as high as 1,500 m in the East Matale and Madukelle Hills. It has recently been confirmed from the following sites: Anuradhapura, Giant's Tank, Wilpattu National Park, Wasgomuwa National Park, Minneriya-Giritale Sanctuary, Polonnaruwa, Sigiriya and Vavuniya.

Reproduction

(Rudran, 1973b)

At Polonnaruwa a mating season may exist from October to January, which coincides with the beginning of the peak period of rainfall, food abundance, and declining temperatures; this is followed by a birth period between May and August. At Polonnaruwa the inter-birth interval was found to be around 22-25 months. Adult females may initiate sexual behaviour by first head-shaking, then presenting to the adult male.

Ecology

(Hladik,1977; Dittus 1985)

This subspecies prefers to eat fibrous and desiccated fruits; it prefers immature leaves to more mature ones because they are high in protein and low in lignin. At Polonnaruwa, *T. v. philbricki* spent 60% of feeding time on leaves, 12% on flowers, and 28% on fruits. Two-thirds of leaves consumed were mature. Most of the food eaten by this species came from twelve tree species: *Adina cordifolia, Schleichera oleosa, Drypetes sepiaria, Alangium salvifolium, Elaeodendron glaucum, Grewia polygama, Syzygium cumini, Holoptelea integrifolia, Garcinia spicata, Walsura piscidia, Ficus* spp., and *Sapindus trifoliatus. Adina cordifolia* accounted for 40% of the diet, with the leaves, flowers, and fruits eaten. *Schleichera* oleosa and *Drypetes sepiaria* together accounted for 30% of the diet. The diet is highly seasonal. During the winter monsoon season (February to March), *T. v. philbricki* consumes a large amount of young leaves and shoots. From May

to June, it increases its fruit consumption; unripe fruits such as those from *Elaedendron glaucum* are preferred. During the major dry season from July to September, leaf monkeys consume flowers *(Adina cordifolia)*. During the October to November monsoon, mature and young leaves and shoots are consumed. From December to January, leaves become the principle focus of the diet.

Concentrated browsing on preferred food plants in the post-cyclone diets of *T. vetulus* and *S. entellus* appear to have heightened tree mortality among some food species. Over-browsing aggravated stress on trees that had already suffered damage from the cyclone, and thus langur browsing possibly affected forest composition.

Social Behaviour

(Rudran, 1973a)

Average group size at Polonnaruwa was 8.4 individuals.

The lack of sub-adults and juveniles observed in troops at Polonnaruwa may be due to take-overs and the subsequent killing of infants by infanticidal males.

Vocalisations

(Hohmann, 1988, 1989, 1990)

The great call of this subspecies has been analysed in detail. It is composed of three basic patterns (one phrase) (in order): a biphasic harsh bark, two whoop units that consist of a tonal exhalation phase and a non-tonal inhalation phase, and a monophasic snort. The interval is relatively long (mean of 0.979 seconds) between the whoop units and the monophasic snort. The whoop has harmonic frequency bands that range between 0.2 and 7.8 KHz. The monophasic snort has a band width between 2.5 and 7.6 KHz. The harsh bark has a mean band width of 8.5 KHz. The number of phrases that occur in a bout of calling range from 1 to 5, and the mean number of units

in a bout was found to be 19.47. The peak time for calling was between 05.00 to 09.30 a.m.

Conservation Status

EN A2cd +4cd

Remarks

(Deraniyagala, 1955; Brandon-Jones, et al., 2004). This taxon includes another subspecies *(T. v. harti)* as a junior synonym, and some authors recommend that it should be treated as a distinct subspecies. This form is said to be darker, more reddish brown, with golden tips to the hairs, more prominent light rump patch, and averaging smaller in size (male head plus body length 465-605 mm, weight 8.8 kg). It is at the most northern end of a cline in size and colour. From the neck towards the shoulders it is light chocolate brown with golden tips to most of the hair; the legs from the knees downwards, and also the extremities, are black. The tail is greyish or whitish towards its tip. It also differs from *T. v. philbricki* in the development of the tympanic bulli. It ranges from the north-western half of Sri Lanka from the type area (Thunakei or Tunukkai, Northern Province) down to Vanativillu and to Tantirimale. This race is probably derived from the darker ones that occur in the Western part of Sri Lanka and appears to have extended northwards into the Dry Zone to evolve this large dark race. Its troops comprise of only three to four individuals.

Appendix iv

Sri Lankan grey langur

Semnopithecus priam

Semnopithecus priam (Blyth, 1844)

Grey Langur

The Ceylon Tufted Grey Langur
Sinhala: vandhura, konde vandhura, elli vandhura
Tamil: mundi, mundi-kurangu

1844. *Semnopithecus priam* Blyth. India: Coromandel coast
1844. *Semnopithecus pallipes* Blyth. Southern India.
1847. *Semnopithecus priamus* Blyth. Emendation.
1847. *Presbytis thersites* Blyth. Sri Lanka: Trincomalee.

Context

Order Primates
Suborder Anthropoidea
Infraorder Catarrhini
Superfamily Cercopithecoidea
Family Cercopithecidae
Subfamily Colobinae
Genus *Semnopithecus*
species *priam*
subspecies *thersites*

Diagnosis

(Phillips, 1980; Rowe, 1996; Groves, 2001)
Once thought to be a wide-ranging species, grey or Hanuman langurs have recently been separated into several species. The Sri Lankan form is characterised by tail carriage of "the southern type". It is large [female: 11.2kg (6.7-15.6), male: 18.3kg (10.6-19.8)] with lanky limbs. It is brownish grey, variable in tone but usually greyer than *S. dussunieri* from the Malabar coast of India. It is small in size like *S. hypoleucos* from the South Coorg region of Kerala. Its slender tail is longer than other southern species (750-855 mm), and considerably longer than its head and body length (female: 406-680 mm, male: 510-780 mm). Its head, including cheek whiskers, is creamy white, but this can blend with the body colour. The crown of the head is bedecked with a coconut-like crest, which (together with surrounding region of central crown) is browner than the rest of the head. It also has a pronounced fringe. The underside and inner sides of limbs are paler (creamy yellow) than the upper side, the rump is whitish. The tail is darker than in other forms, with a white tip. Its hands are paler than the body, and its feet are often nearly white. The adult brain weight is 135.2 g.

Distribution

(Roonwal and Mohnot, 1977; Phillips, 1980; Groves, 2001)
Grey langurs, of which now seven species are recognised, are found throughout almost the whole of the Indian Peninsula, with the exception of the western deserts of Pakistan; from the Himalayas southwards to Sri Lanka. *Semnopithecus priam thersites* is a subspecies endemic to Sri Lanka, where it is found throughout the well-wooded areas of the country's Dry Zone from south of Jaffna, in the North, to the shores of the extreme southern coast. Normally, it does not ascend the adjoining foothills to any great altitudes nor does it intrude into the Wet Zone. On the western side of the island, it is rarely seen south of Puttlam to Chilaw, but on the eastern side, its range extends southwards to the southern coasts, where it can be seen as far west as Tangalla. It also ranges in India from Aramboli, on the southern tip, through the Dharmapuri Range to the Palkonda Hills. This species is found in a variety of habitats, including scrublands; the grey langur is regularly found on the outskirts of towns and in temples.

Reproduction

(Hrdy, 1977; Rajpurohit and Sommer, 1993)
Little information is available on *Semnopithecus* life history in Sri Lanka, but data from Indian species may illuminate the reproductive strategies of the Sri Lankan form. Grey langurs are unusual in being continually sexually receptive, with a 24.1 day oestrous cycle; this means that births occur year-round. The age of a female at her first birth is 51 months. She gives birth after a gestation period of 168-200 days, with an inter-birth interval of 16.7 months. The infant is weaned after 13-20 months. Four life stages are recognised: infant: 0-15 months; juvenile: 15-48 months, sub-adult: 48-98 months, sexual maturity: 46.5-47 months. These monkeys can live up to 20 years.

Ecology

(Ripley, 1970; Hladik and Hladik, 1972; Hladik, 1977; Oppenheimer, 1977; Kirkpatrick, 2007)

The grey langur is a semi-terrestrial and diurnal species. In Sri Lanka, this species is restricted to the scrub forests of the Dry Zone, where it can also be found in urban areas. *Semnopithecus p. thersites* is a folivorous species, but will also consume fruits, flowers, and cultivated crops; it prefers to eat fruits that are mature and fleshy. A study at Polonnaruwa found the diet to consist of: 48% leaves (27% young leaves and 21% mature leaves), 45% seed/fruit and 7% flowers. The plants eaten by this species are detailed below:

Myrtaceae: fruit, flower, flush (young leaves), leaf (1 species)
Rhamnaceae: flower (1 species)
Rubiaceae: fruit, flower, flush (young leaves), leaf (4 species)
Rutaceae: flush (young leaves) (1 species)
Sapindaceae: fruit, flower, flush (young leaves), bud, seed (4 species)
Sapotaceae: fruit, flower, flush (young leaves), bud (2 species)
Sterculiaceae: fruit, flower, flush (young leaves), leaf (2 species)
Tiliaceae: fruit, flower, flush (young leaves), leaf, seed (2 species)
Ulmaceae: fruit, flower, flush (young leaves), leaf, bud, seed (1 species)

In some parts of Sri Lanka, cultivated crops and “hand-outs” from people constitute a large portion of the monkeys’ diet. This species forages mostly in the early morning and just before nightfall.

Locomotion

(Fleagle, 1988)

Grey langurs are the most terrestrial of any colobine. They spend up to 80% of the day on the ground, and almost all feeding is within 5 m of the ground. They move through the forest and on the ground quadrupedally. The grey langur also uses a leaping gait through the forest.

Social Behaviour

(Struhsaker and Leland, 1987; Sugiyama, 1965; Mohnot, 1971; Hrdy, 1977; Vogel and Loch, 1984)

The social structure is variable, but is usually one male-multifemale, or multi-male – multi-female. Group sizes generally range from 11-64 individuals, but in the latter social system, group size can be up to 125 individuals. Langur groups may break into subgroups in some seasons. In a harem system, the male defends his mates, whereas females defend their resources. In uni-male troops the resident male's tenure is usually less than two years. He is under constant pressure from other males attempting to take over the troop. When a group of males takes over a troop, they may systematically kill infants sired by the previous male; usually one establishes himself as the new resident male. The male will then mate with females shortly after the take-over; those who lost young should resume cycling, and thus can carry the new male's offspring. This reproductive strategy, 'the sexual selection hypothesis,' was first documented in this species. It should be noted that an alternative theory suggests that this is not a reproductive strategy, but rather infants are simply injured during the aggressive take-overs and subsequently die.

Female grey langurs are philopatric and matrilineal. Aunting behaviour is common. Related females may hold, carry, groom and suckle their relatives' infants. Emigration by males occurs at age 4. Emigrating males form all-male bands whilst seeking a new troop or harem of females. Home range size can be from 50-130 ha, with a day range on average of 360 m. A bisexual troop at Polonnuruwa had a home range of 0.05-0.19 km2.

Vocal Communication

(Hohman, 1989)

loud call: given by adult males during group encounters or in response to the loud call of other groups; highest rates occurred early in the morning from 06.00-10.00 a.m.; can consist of up to four phrases, including a whoop. The unit may possess a noisy inhalation phrase.

Harsh bark: given by the adult male at the appearance of a predator, including humans, leopards *(Panthera pardus)*, jackals *(Canis aureus)* and domestic dogs.

teeth grinding: agonistic intra- and inter-group encounter.

grunt-bark: given by adult males and females at group encounters or to signify group movement; also a feature of aggressive interaction within or between groups.

grunt: given by adult males and females during affiliative approach.

rumble: given by adult males and females to signify physical contact such as mounting or embracing.

cough: given by adult females, juveniles and infants to indicate mild agonism or social tension.

alarm call: given by adult males and females at the appearance of a predator in close proximity.

warble: given by adult females, juveniles and infants indicating play, or agonistic inter- and intra-group encounters.

whistle: given by adult females, juveniles and infants indicating loss of contact; also a response to male display.

shriek: given by adult females, juveniles and infants indicating sexual harassment; also a response to male display.

squeal: given by adult females, juveniles and infants as a response to rejection of physical contact.

hiccup: given by adult males and females, juveniles and infants indicating group encounter.

contact tremolo: given by juveniles and infants indicating affiliative approach, such as huddling or embracing.

isolation peep: given by juveniles and infants indicating loss of physical or visual contact.

milk grumble: uttered by infants when nursing.

Genetics

See section on *Trachypithecus vetulus* describing relationships with that species.

Conservation Status

VU A1 cd.

Appendix v

Toque Macaque

Macaca sinica

Toque Monkey
Macaca sinica sinica

Dusky Toque Monkey
Macaca sinica aurifrons

Mountain Toque Monkey
Macaca sinica opisthomelas

Macaca sinica (Linnaeus 1771)

Context

Order Primates
Suborder Anthropoidea
Infraorder Catarrhini
Superfamily Cercopithecoidea
Family Cercopithecidae
Subfamily Cercopithecinae
Genus *Macaca*
species *sinica*
subspecies *aurifrons*
subspecies *sinica*
subspecies *opisthomelas*

Diagnosis

(Fooden, 1979; Rowe, 1996; Groves 2001)

Macaca sinica is sexually dimorphic (female: 3.4-4.3 kg, male: 4.4-8.4 kg). The tail length (female: 465-596 mm, male: 549-622 mm) of the toque macaque is at least equal to head plus body (female: 400-453 mm, male: 418-533 mm). The fur is yellow-brown or golden brown; they have black ears and a black lower lip. The notable feature of this species is that crown hairs are elongated, and radiate from a central whorl to form a cap extending forward as far as the brow and backward to nape. Females' faces vary in shades of red. The species has a typical cercopithecine dental formula: I 2/2, C 1/1, P 2/2, M 3/3. The adult brain weight is 69.9 g.

Distribution

(Phillips, 1980)

This species is endemic to Sri Lanka, and occurs across the whole island. One subspecies is found in each main climatic zone, with intermediate forms sometimes found in contact zones.

Reproduction

(Dittus, 1975, 1998; Rowe, 1996; Vandercone and Santiapillai, 2003; Thierry, 2007)

Toque macaques pass through four developmental stages

1. Infant: 12 months
2. Juvenile: 12-60 months
3. Subadult: 60-84 months
4. Sexual maturity: male: 60-84 months, female: 54-66 months

a. Sexual dimorphism: 0.58, Socionomic sex ratio (F/M):2.4

Female ovulation is shown via an oestrous swelling of her perineum, which turns bright pink or red. Matings are single mount, with high-ranking males tending to get more copulations. A female usually gives birth for the first time between 56-60 months of age; an interval of 18 months passes before the next infant is born. Birth peaks occur at different points across the island. They give birth to 1-2 infants after a gestation period of 152-175 days. Toque macaques live for about 30 years.

Ecology

(Nolte, Kuruvilla, pers obs)

The toque macaque is a diurnal species that is primarily arboreal, but is also very comfortable on the ground. It is found in lowland, gallery, and semi-deciduous forest near permanent water sources, and occurs at elevations up to 1900 m.

The toque macaque is a frugivorous species, but it also consumes flowers and insects. These monkeys will also raid crops and garbage dumps. Toque macaques, like other cercopithecines such as baboons and guenons, possess check pouches, not unlike those seen in a common mouse or hamster. These cheek pouches are filled at resource sites. After filling cheek pouches, smaller animals (females and lower-ranking males) run for shelter or climb trees; they may also hold food in each hand and a foot as they run to evade a dominant animal. Little has been published on the details of their feeding ecology, but it is probably very comparable to the closely-related bonnet macaque *(M. radiata)* of South India.

Bonnet macaques are mainly frugivore (70%)-insectivores (30%); they have been observed to eat 68 plant species, with 24 food species accounting for 92% of all feeding observations. The tamarind tree *(Tamarindus indicus)*, also found in Sri Lanka, is a keystone food resource, providing both unripe and ripe fruit, as well as young leaves. Ripe figs *(Ficus)*, bamboo, herbs and mushrooms also constituted a large part of their diet. Amongst the insects, bonnet macaques relish crickets, cicadas, termites and caterpillars. Bark may also be investigated by probing and peeling with the hands whilst searching for insect prey. Water is taken directly by the mouth from rivers or tree trunk hollows. It is also taken by putting their hands and arms in water holes and licking the droplets off their hands/fingers.

Toque macaques sleep in trees, normally engaging in mutual grooming beforehand. They select tall trees with dense foliage, using the highest and safest branches for their roosts. Usually two or more monkeys sleep clasping each other. They sometimes stir in the night, and make a distinct call. They also have a very dull eyeshine.

Dogs and leopards are the main predators of this species.

Locomotion

(Phillips, 1980; Fleagle, 1988)
The toque macaque is a quadrupedal species. These monkeys also can swim well.

Social Behaviour

(Dittus, 1975, 1977a, 1987, 1988; Dittus and Ratnayake, 1989; Vandercone and Santiapillai, 2003)
Toque macaques exhibit a multi-male - multi-female social structure, with 2.3 females per male per troop. Group sizes range from 8-76. Toque macaques have overlapping home ranges and a clear male-dominance hierarchy. Competition between groups in part determines food availability and contributes to limiting group size. Males emigrate on average every 5.83 years; females are philopatric. Males seem to change their troop when they are likely to lose position in the hierarchy. All-male (bachelor) subgroups may be peripheral to the main troop.

Home range size is between 17 ha to 115 ha, depending on the environment. Troop ranges overlap as well, resulting in inter-troop contest competition. The harsher the environment is, the fewer young and old animals will survive in the troop. Toque macaques exhibit a strict dominance hierarchy, where adults dominate juveniles, juveniles dominate infants, and males dominate females. Juvenile females fare the worst because mothers protect only their youngest offspring. This also results in intra-troop contest competition.

Vocal Communication

scream calls: given by the toque macaque when it is approached by a non-group conspecific.

loud call: emitted by the male; used to maintain inter-group spacing. A group will move away upon hearing this call.

Conservation Status

VU A1c.

Macaca sinica sinica (Linnaeus 1771)

Red Monkey, Toque Monkey
Sinhala: rilawa
Tamil: kurangu, siru kurangu (Jaffna)

1771. *Simia sinica* Linnaeus, Mant. Plant. 521.
1852. *Macaca sinicus* Kelaart, Prod. Faun. Zeyl. 8.
1931. *Macaca sinica sinica* Pocock, Jour. Bomb. Nat. Hist. Socy. XXXV, 285
1939. *Macaca sinica inaurea* Pocock, Faun. Brit. Ind. Mammalia, I. 36.
1965. *Macaca sinica longicaudata* Deraniyagala, Spolia. Zeyl. 30. 261. (Phillips)

OR

1771. *Simia sinica* Linnaeus, Mant. Plant. 521.
1838. *Cercopithecus pileatus* Ogilby. Not of Kerr, 1792
1852. *Macaca sinicus* Kelaart, Prod. Faun. Zeyl. 8.
1886. Cyamolgus (Zati) audeberti Reichenbach. 'Bengal.'
1931. *Macaca sinica iaurea* Pocock. Sri Lanka: Cheddikulan, Northern Province.
1941. *Macaca (Zati) sinica opisthomelas* Hill, 1942. Sri Lanka: Horton Plains.
1965. *Macaca sinica longicaudata* Deraniyagala. Sri Lanka: Menik Ganga, Kataragama District, Northern Province. (Phillips and Groves combined)

Diagnosis

(Phillips, 1980; Groves, 2001)
The radiating hairs of the cap are shorter and entirely golden brown in this Dry Zone form. The general colour of the dorsal area and outer limbs is reddish or chestnut. Overall size is moderate (3.4-6.5 kg) with the head and body about 419-526 mm. This monkey is sturdily built with rather stout and short limbs. The tail (526-567 mm) is longer than the head and body. The face is made prominent by rather hollow cheeks. The ears are also prominent and obtusely pointed. These ears have been made famous in Dittus' film on these monkeys – The Temple Troop – by a monkey called Spock! The adult female usually develops a red face at maturity and these marks aid in identifying individual females.

Distribution

Fooden (1979) gave the range of this subspecies as the northern half of Sri Lanka (the low country dry zone), approximately from 80 N on the west coast to 7030'N in the east, with most of the rest of the island being a contact zone with *M. s. aurifrons.* Even in 1980, Phillips mentioned that numbers were restricted due to deforestation.

Reproduction

Although following the general pattern for mating described above, this taxon has a birth season from February to April. Infants have a high mortality rate.

Ecology

(Dittus, 1986)

Due to a strict dominance hierarchy, lower ranking individuals are forced to feed in less rich areas or on poorer resources, as they are supplanted by dominant individuals. The majority of all threats (81.5%) have been recorded during foraging, and 36% of the time, food was taken from the one threatened. At Polonnaruwa, inter-group resource competition has been shown to jeopardise the fitness of females of low ranking groups, and so to limit the growth of such groups, particularly at times of environmental stress.

Toque macaques have been seen in association with both grey langurs and with purple-faced leaf monkeys. They have also been seen to arouse a sleeping grey slender loris, and to groom it.

Social Behaviour

(Dittus, 1975; 1977a; 1977b; 1979; 1986)

The red monkey has a multi-male – multi-female social system, accompanied by a promiscuous mating system. The average group size is 24.8 (8-43). Troops are comprised of 13% adult females, 31% adult males, 6% subadult females, 37% juveniles and 12% infants. Females are philopatric; multiple matrilines may occur within a troop in strict hierarchy. Hierarchies also occur within matrilines with regard to grooming and resource competition. Females inherit their mother's rank and may have better reproductive success.

In a case study at Polonnaruwa, a take-over of a subordinate group was observed, whereby a dominant group subsumed its range. Prior to the take-over, the dominant group had consistently won all contests for resources at common feeding sites. Although animals were unrelated, strong social ties were formed; small group sizes of both groups pre-take over may have facilitated this. Still, females of the subordinate group lost their ranks, and survivorship of their infants decreased. Within eight years, all but one of the original females remained in the group, although males survived this take-over well.

Genetics

(Keane et al, 1997)

Genetic studies have been carried out on the Polonnaruwa toque macaques using paternity exclusion analysis. These tests revealed that offspring produced by a female usually consist of half-siblings because few males father more than one offspring with a particular female. Inbreeding was rare, as no evidence of offspring produced by matings between first degree relatives was found. As is common in many primate species, the mating system and the social system were not identical. Extra-group copulations may occur, and must be considered when looking at the overall reproductive output of a troop. Multiple males father offspring in the troop each year, but within a particular breeding season, opportunities may be limited to only a few males. Indeed, many males within a group may end up with low reproductive success, fathering relatively few offspring when weighted against group size.

Conservation Status

EN A2cd + 4cd. Toque macaques are at greatest risk of extinction due to habitat loss. They are also commonly kept as pets.

Macaca sinica aurifrons (Pocock, 1931)

1931. *Macaca sinica aurifrons* Pocock, Jour. Bomb. Nat. Hist. Socy. XXXV. 286. Rayigam Korale, Western Province.

The Dusky Toque Monkey.
Sinhala: rilawa
Tamil: kurangu

Diagnosis

(Phillips, 1980; Groves, 2001)
The dusky toque macaque is characterized by longer and generally untidy radiating hairs in its characteristic cap; the anterior part is strongly yellowish, contrasting with a darker, browner posterior part. The general colour of the dorsal area and outer limbs is dusky chestnut-orange or dusky yellowish. In body size (3-5 kg), it is similar to *M. s. sinica,* with head and body length measuring 429-495 mm and the tail 458-604 mm.

Distribution

(Phillips, 1980)
The type locality for this taxon is Rayigam Korale, in the Western Province. It is found throughout suitable areas in the whole of the Wet Zone and in the lower hills of the Hill Zone. North of a line from about Negombo, on the western coast and inland to the Dambulla area in the Central Province, it meets and gradually merges into the nominate subspecies, and again it merges into the nominate subspecies in the Southeast, in the lowlands on the contact zone to the East of a line from about Balangoda in the foothills to Ranna on the South Coast, between Tangalla and Hambantota. Inland, in the hills of higher altitudes, it merges gradually, into the mountain subspecies.

Reproduction

(Vandercone and Santiapillai, 2003)
At Udawattakele, females gave birth to a single infant annually, although twins were infrequently observed. Mating was observed from late September to the end of March, and a birth peak was seen from March to September. The infant sex ratio was 1:1. Oestrus females exhibited a pink or red vulva. In older females the vulva appeared to be swollen. Often mucous-like secretions were observed around the genital opening of oestrus females. During the mating season oestrous females preferred to form temporary bonds with dominant adult males, and antagonised adolescent and sub-adult males that tried to mount them. Extra-group males followed a troop during the mating season.

Ecology

(Wijeyamohan et al, 1996; Vandercone and Santiapillai, 2003; Bernede and Nekaris, 2004; Nekaris et al, in press)

The average troop size observed at Udawattakele was 37.7 (range 20-76; 21-36) including infants. On average a troop comprised 13% adult males, 30% adult females, 8% subadult males, 32% juveniles and 18% infants. All male groups were observed, usually in the vicinity of bisexual troops. These groups ranged from 2-12 individuals, and consisted of males from all age classes over sub-adult. Studies carried out in a number of protected forests in the Wet Zone, including Masmullah, Oliyagankele, Kakanadura, Dandeniya, Welihena, Polgahaivalakande and Sinharaja found troop sizes to range from 6-35, with the average troop size being 12 individuals.

In fragmented forests of Sri Lanka's Wet Zone measuring 2-24 ha, toque macaque densities were much less. In forest fragments around Pitigala, densities ranged from 3.17-7.75; the maximum group size observed was 12 animals. Abundance estimates were greater in sites providing higher proportions of potentially important food species (73 species) from the following 32 families: Anacardiaceae, Annonaceae, Arecaceae, Bombacaceae, Burseraceae, Celastraceae, Chloranthaceae, Clusiaceae, Combretaceae, Dipterocarpaceae, Ebenaceae, Elaeocarpaceae, Ebanaceae, Elaeocarpaceae, Euphorbiaceae, Fabaceae, Flacourtiaceae, Lauraceae, Meliaceae, Moraceae, Moringaceae, Musaceae,

Myristicaceae, Myrtaceae, Oleaceae, Rhizoporaceae, Rosaceae, Rutaceae, Sapindaceae, Sapotaceae, Staphyleaceae, Symplocaceae. Animals regularly traversed farmlands and home gardens to move between fragments.

Social Behaviour

(Wijeyamohan et al, 1996; Vandercone and Santiapillai, 2003; Bernede and Nekaris, 2004; Nekaris et al, in press)

Although no published reports exist on the details of social behaviour and dynamics, observations in published accounts agree closely with those reported by Dittus in his numerous accounts from his long-term studies of *M. s. sinica.* In general, social behaviour is likely to be similar.

Conservation Status

EN A2cd + 4cd. Extreme habitat loss and habitat fragmentation are the greatest threat to this subspecies; they are occasionally kept as pets.

Macaca sinica opisthomelas (Hill, 1942)

The Mountain Toque Monkey
Sinhala: rilawa
Tamil: kurangu

1942. *Macaca sinica opisthomelas* Hill, Jour. Bomb. Nat Hist. Socy. XLIII, 3,401.

Diagnosis

This montane species has a unique straw-coloured cap of long (up to 110 mm) radiating hairs. The general colour of the dorsal area and outer limbs is greyish-olive with very little to no red. It appears to be larger than the lowland species due to its abundance of longer hairs. In fact, its head and body length is 426-456 mm, with a tail of 448-498 mm. It is a bit heavier than lowland forms, weighing in at 3.4-6.5 kg.

Distribution

The type specimen comes from the Horton Plains (2100 m) in the central mountains of Sri Lanka. Its range is rather discontinuous. At lower altitudes it grades gradually into the Wet Zone subspecies *(M. s. aurifrons)*. Because of this discontinuity, and the presence of many intermediate forms, Groves (2001) regards this as synonymous with *M. s. aurifrons.*

Reproduction

This taxon probably is similar to the lowland subspecies.

Ecology

Diet may differ for this subspecies, as the climate is colder and wetter, and vegetation differs, with mosses and lichens being common.

Behaviour

No systematic study of behaviour has been published for this subspecies. It can be observed along roadsides in small troops. Its behaviour appears to superficially resemble that of the other two subspecies.

Conservation Status

EN A2cd + 4cd.

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Glossary

A

Agonistic: Referring to any activity related to fighting, whether aggression or conciliation and retreat.

Alloparent: An individual that assists the parents in caring for the young.

Alpha: Referring to the highest-ranking individual within a dominance hierarchy.

Anthropoid: an animal within the primate suborder Anthropoidea, when using a grade-based classification. Monkeys, apes, and humans are anthropoids

Altricial: Born helpless, and with a long period of dependancy. Primates are behaviourally altricial (opposite of precocial).

Arboreal: Referring to animals that are adapted to life in the trees. Arboreal animals spend most of their time scampering around in trees rather than on the ground, in the air, or water.

Aunting: A behaviour in which a female other than an infant's mother assists the parent in infant care; aunts may carry or defend the infant.

B

Bachelors/ floaters: Individuals unable to claim a territory, and hence forced to wander through less suitable surrounding areas.

Basic rank: The dominance rank that an individual can attain as a result of his or her own competitive abilities.

Bilophodonty: A condition of the molar teeth in which the mesial and distal pairs of cusps form ridges or lophs.

Binocular vision: Seeing with two eyes that have an overlapping field of view. This is essential to stereoscopic vision.

Biodiversity: The number and variety of organisms living within a specified geographic area.

Biological species concept (BSC): The theory that holds that species are groups of interbreeding natural populations, which are reproductively isolated from other such groups.

Brachiator: An organism whose locomotor system involves arm-over-arm propulsion.

Bunodent: Teeth with low, rounded cusps.

Bushmeat: The term for any wild animal hunted for food, medicine, or traditional cultural uses.

C

Cantilever: Springing out from a branch to catch prey with the hands while the hind legs hold on to the branch.

Cathemeral: May be active during either the day or night.

Census: The systematic count of a population.

Cercopithecine: A member of the Old World monkey subfamily Cercopithecinae, which includes the baboons, guenons, and macaques.

Cheek pouches: Cheeks that are so elastic that they can expand to allow temporary storage of food. This is useful when there is competition. Old World monkeys of the subfamily Cercopithecinae (macaques, baboons, etc.) have cheek pouches of this sort.

CITES: a.k.a The Convention for the International Trade of Endangered Species, an international agreement between governments that has the goal of ensuring that the international trade of plant and animal species does not threaten their survival. There are three levels of classification (called Indexes I-III), and regulations associated with those classifications dictate in what quantities plants and animals can be traded (if at all) as well as rules governing the import and export of these species.

Clavicle: Collarbone; the bones that connect the sternum with the scapula.

Colobine: Members of the Old World monkey subfamily Colobinae, which includes the Asian langurs, leaf monkeys, odd-nosed monkeys and African colobus monkeys.

Competition: The active demand by two or more organisms (or two or more species) for a common resource.

Congener: Species belonging to the same genus that share the same habitat.

Contest competition: The form of competition that occurs when access to a resource can be monopolised by one or more individuals.

Core area: An area in which one or more individuals spend most of their time, and where they obtain most of their food.

Cranial capacity: The volume of the brain, usually determined by measuring the volume of the inside of the neurocranium.

Critically Endangered (CR): A taxon is Critically Endangered when it is considered to be facing an e*xtremely high risk of extinction* in the wild.

Crop raiding: The act of entering into a cultivated area and stripping the plants of edible parts, often causing damage to the entire crop; in addition to the actual stealing of fruits or vegetables, this behaviour is seen in a number of primates living in close proximity to humans.

Cusps: The elevated, somewhat pointed portions of the chewing surfaces on premolar and molar teeth.

D

Data Deficient (DD): A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status.

Day range and monthly range: Denote the area over which a group travels in a given period of time.

Deciduous dentition: The milk teeth or first set of teeth in the mammalian jaw. The deciduous dentition is replaced by the permanent dentition.

Demography: The size and composition of groups or populations, as determined by births, deaths, immigrations, and emigrations of individuals in these groups or populations.

Dental formula: The quantity of each type of tooth (e.g., incisor, canine, premolar, and molar) in each quadrant of the mouth, counting from the front. The human dental formula is 2.1.2.3. The Old World monkeys and apes also share this dental formula.

Digits: Fingers and toes. See pentadactylism.

Dispersal: Emigration from a social group; can involve emigration from a natal group or, in secondary dispersal, emigration from another group into which the individual has previously immigrated.

Display: A behaviour pattern that has been modified in the course of evolution to convey information. A display is a special kind of signal, which in turn is broadly defined as any behaviour that conveys information regardless of whether it serves other functions.

Diurnal: Active during daylight hours.

Dominance hierarchy: The physical domination of some members of a group by other members, in relatively orderly and long-lasting patterns. Except for the highest- and lowest-ranking individuals, a given member dominates one or more of its companions and is dominated in turn by one or more of the others. The hierarchy is sustained by hostile behaviour, sometimes of a subtle and indirect nature.

Dorsal: Of, on, or near the back of the body.

E

Ecology: The scientific study of the interaction of organisms with their environment, including both the physical environment and the other organisms that live in it.

Edge habitat: The zone of regeneration created when trees and growth are cleared in a forest, either for human use (such as agricultural planting or the building of structures) or naturally because of disasters such as floods or fires. The plant and animal species that repopulate the perimeter of the cleared area are usually generalists that can thrive in a variety of situations, and that outcompete and replace other species because of their ability to exploit the highly disturbed area.

Egalitarian: The absence of a hierarchy, or "pecking order" Access to resources is more likely to be determined by who gets to them first, rather than by any other attributes of individuals.

Endangered (EN): A taxon is Endangered when it is considered to be facing a *very high risk of extinction* in the wild.

Endemic: A species that is unique to a defined place or region. It is only to be found in that place or region, and not naturally found anywhere else.

Ethology: The study of whole patterns of animal behaviour in natural environments, stressing the analysis of adaptation and the evolution of the patterns.

Extinct (EX): A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat at appropriate times throughout its historic range have failed to record an individual.

Exudate: A substance, such as gum, sap, or resin, which flows from the vascular system of a plant.

F

Flagship species: A popular, charismatic species that serves as a symbol and rallying point to stimulate conservation awareness and action in a particular region.

Feeding strategy: The total activity, locomotor, ranging, grouping, social and dietary pattern of an individual or a species that pertains to feeding.

Female defence polygyny: A form of polygyny in which a male defends two or more females from other males.

Folivore: An animal that primarily eats leaves.

Fragmentation: The process of breaking up blocks of forest into smaller areas by cutting roads, creating human settlements, or otherwise destroying large enough tracts of it to permanently separate it from a once contiguous area.

Frugivore: an animal that primarily eats fruit.

G

Genetic diversity: Variation at the level of individual genes, which provides a mechanism for organisms and populations to adapt to an ever-changing environment.

Gestation: The period between conception and birth during which an unborn young is within its mother's uterus. Pregnancy is another word for gestation.

Gracile: Describes any slender, lightly built body or body part.

Grooming: Carefully picking through hair or fur with hands, or combing it with the toothcomb, looking for insects, twigs, and other debris. Primates frequently allogroom, which is to say they groom each other to reinforce social relationships and to reduce psychological tension.

Group: Any set of organisms, belonging to the same species, which remain together for a period of time while interacting with one another to a distinctly greater degree than with other conspecific organisms.

Group structure: The size and composition as to age and sex of a primate group.

H

Habitat: The organisms and physical environment in a particular place.

Habituated group: A group of animals that is accustomed to being watched and followed by researchers, and which tolerates the presence of humans; this often takes long periods of time (from months to years) to achieve with primates.

Haplorrhine: An animal within the primate suborder Haplorhini. Monkeys, tarsiers, apes, and humans are haplorhines.

Harem: A group of females guarded by a male, who prevents other males from mating with them.

Head shaking: This is where the female shakes her head back and forth before she presents to the male.

Home range: The area over which a group normally travels in pursuit of its routine activities.

I

Incisors: Chisel-shaped teeth at the front of the mouth in mammals. Most primates normally have 8 incisors (2 in each quadrant of the mouth). The common mammal pattern is 12 incisors (3 in each quadrant). See dental formula.

Infanticide: The killing of infants. Found in some uni-male species where a successful male rival kills nursing babies. The sexual selection hypothesis argues that this behaviour makes females come into oestrous sooner.

Infant parking: The process by which infants are left by the mother in a nest or on a branch, rather than being carried.

Insectivore: An animal that mainly eats insects and invertebrates.

Inter-birth interval: The elapsed length of time between births. It is usually longer for larger primates, and shorter for smaller ones.

Inter-membral Index (IMI): The ratio of forelimb length to hindlimb length, as a measure of limb proportions. If an animal's intermembral index is around 1, that animal is probably a quadruped. If it is less than 1, the animal probably gets around by leaping or bipedalism. If it is greater than 1, the animal probably uses suspension or brachiation.

Invertebrate: An animal that lacks an internal skeleton. All animals other than fish, amphibians, reptiles, birds, and mammals are invertebrates. Approximately 95% of all animals are invertebrates.

Ischial callosities: Hairless, callused areas on either side of the rump of monkeys in the Cercopithecinae (macaques, baboons, etc.) and the small apes of Asia.

IUCN: a.k.a The World Conservation Union, the largest and most important network of people, governments, institutions, and non-governmental organizations working towards conserving the integrity and the diversity of nature around the world, through the equitable and sustainable use of natural resources.

IUCN Red List: A list of the conservation status of species, subspecies, and some subpopulations on a global scale that is compiled by scientists, in order to highlight taxa threatened with extinction and to promote their conservation. It is a widely used reference, and is an authoritative compilation of species' status in the format of an online database as well as a published handbook.

J

Jarman/Bell principle: A general rule that the nutrient requirements of large-bodied animals are absolutely higher than those of smaller animals, but lower relative to their body size. Therefore, larger animals tend to feed on more abundant but lower-quality foods than smaller animals.

K

K selection: Selection favouring superiority in stable, predictable environments, in which rapid population growth is unimportant.

Kay's threshold: Approximate body weight (around 500 g) that separates primarily insectivorous from non-insectivorous primates.

L

Life history: The age at sexual maturity, age at death, and age at other events in an individual's lifetime that influence reproductive traits.

M

Matrilines: Females related to one another though maternal descent.

Maternal rank inheritance - matrilineal: Passed from the mother to her offspring, as for example access to a territory or status within a dominance system – sometimes called dependent rank. A consequence of this is that the status of all females drops with each successive daughter that is born into a higher-ranking matriline.

Microhabitat: A small, narrowly defined and specialized habitat occupied by a particular species.

Mobbing: The joint assault on a predator too formidable to be handled by a single individual, in an attempt to disable it or at least to drive it from the vicinity.

Monogamy: The condition in which one male and one female join to rear at least a single brood.

Morphology: The shape of anatomical structures.

Multi-male, multi-female group: A group of animals in which several adult males and several adult females are reproductively active.

N

Natal group: The group into which an individual is born.

Near Threatened (NT): A taxon is Near Threatened when it does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for, or is likely to qualify for, a threatened category in the near future without ongoing conservation measures.

Niche: The range of each environmental variable, such as temperature, humidity, and food items, within which a species can exist and reproduce. The preferred niche is the one in which the species performs best, and the realized niche is the one in which it actually comes to live in a particular environment.

Niche divergence: The process by which potentially competitive species reduce competition through separation in some or multiple aspects of their ecologies.

Nocturnal: Being awake and active when it is dark, and sleeping during the day.

Noyau (solitary): Living alone. A lifestyle where the only groups are transient ones, such as a female and her immature offspring, or a temporary breeding alliance.

O

Oestrous: The period of time when female animals are sexually excited and receptive to mating. Oestrous occurs around the time of ovulation in many species.

Old World: The Old World is Europe, Asia, and Africa. The New World is the Americas.

Olfactory: The sense of smell.

Omnivore: An animal that eats both animal and vegetable materials.

Opposable: A digit (usually the thumb) capable of moving so as to touch with its tip the tip of any other digit on the same limb.

Order: A Linnaean classification category above the level of family and below class. Each order can consist of many families, genera, and species.

P

Parental investment: Any behaviour toward offspring that increases the chances of its survival, at the cost of the parent's ability to invest in other offspring.

Patriline: Males related to one another through paternal descent.

Parturition: Giving birth.

Pentadactylism: Having five digits on the end of feet and hands. This trait is characteristic of all primates except for the spider monkey which has five toes on each foot but only four fingers on each hand. Pentadactylism is an ancient mammalian trait that was inherited from their reptile ancestors.

Pheromones: Chemicals produced and secreted by an individual that can have a powerful affect on the behaviour and development of other individuals (usually in the same species). Pheromones are common throughout the animal world, including humans.

Philopatric: Individuals that remain in their natal, or birth, group.

Phylogenetic species concept (PSC): A theory that holds that diagnosable geographic forms of the same basic "kind" of organism should be treated as distinct species; the PSC is less restrictive than the BSC.

Phylogeny: Evolutionary relationship within and between groups.

Polyandry: The acquisition by a female of more than one male as a mate.

Polygyny: In animals generally, the tendency of each male to mate with two or more females.

Population: A set of organisms belonging to the same species and occupying a clearly delimited space at the same time. A group of populations of the same species, each of which by definition occupies a different area, is sometimes called a metapopulation.

Population structure: The demographic character of the population, population density, and the density and dispersal of groups within the breeding population or deme.

Precocial: Referring to young animals that are able to move about and forage at a very early age.

Predator: Any organism that kills and eats other organisms.

Presenting: A behaviour performed by the female to elicit copulation from the male, often in the presence of subordinate males; this pattern tells the male that she is ready for copulation.

Prosimian: Of or belonging to the Prosimii, a suborder of primates (using a grade concept of species) that includes the lemurs, lorises, galagos, pottos, and tarsiers

Q

Quadrupedal: A locomotory style that involves the use of all four limbs.

R

r selection: Selection favouring rapid rates of population increase, especially prominent in species that specialize in colonizing short-lived environments or which undergo large fluctuations in population size.

Rank acquisition: Inheritance of the rank of a high-ranking female by her offspring

Rhinarium: A moist, hairless pad of skin at the end of a nose. This is a characteristic of strepsirrhines, dogs, and some other animals.

Robust: Describes any large, or heavily-built body part.

S

Sacculated stomach: A complex stomach in which digestion is aided by intense microbial action; a specialised adaptation in colobines.

Scent mark: An olfactory message communicated by rubbing glandular secretions or by leaving urine or faeces at a specific site.

Scramble competition: The form of competition that occurs when resources cannot be easily monopolised or defended, and are therefore distributed on a "first-come / first-served" basis.

Sentinel: One who watches or guards; specifically, an individual set to guard a place, from surprise, to observe the approach of danger, and give notice of it. A sentry.

Sexual dimorphism: Referring to anatomical differences between males and females of the same species. Primate males are usually significantly larger and more muscular than females. This is especially true of semi-terrestrial monkeys and the great apes. Humans are also sexually dimorphic.

Sexual skin or swelling: A nearly hairless, large swollen patch of skin around the genital area of female primates that becomes very prominent when they are in oestrous. These areas swell with fluids and turn bright pink or red due to hormonal changes that occur in preparation for ovulation. The sexual skin also produces odours that excite males of the species. They become highly attentive to the females at this time. Sexual skins are found among many of the Old World monkey species in the subfamily Cercopithecinae (e.g., macaques) as well as the chimpanzees and bonobos.

Social organisation: The pattern of social interactions that occurs between individuals and within and between groups; it is a description of social behaviour. It also can be defined as the spatial distribution of a population, or the relations amongst groups.

Social structure: consists of two components - *group structure and population structure.*

Society: A group of individuals belonging to the same species and organized in a cooperative manner. The diagnostic criterion is reciprocal communication of a cooperative nature, extending beyond mere sexual activity.

Stereoscopic vision: The ability to see things in three dimensions (3-D). Stereoscopic vision is what allows for true depth perception.

Strepsirrhine: Of or belonging to the Strepsirrhini, a suborder of primates that includes the lemurs, lorises, pottos, and galagos.

Subspecies: A geographic segment of a species, distinguishable from other such segments by strong gene frequency differences (traditionally, 75% of individuals are different from members of all other subspecies).

Sympatry: Overlap in the geographical range of two species or populations.

T

Tannin: A form of secondary plant compound that reduces digestibility of food in the gut.

Tapetum lucidum: A reflecting layer immediately behind, and sometimes within, the retina of the eye of many vertebrates; it serves to reflect light back to the retina, increasing the amount caught by the retina. This improves vision in low light conditions. Many nocturnal animals possess *tapetum lucida*.

Taxon: A grouping of organisms (named or unnamed). Once named, a taxon will usually have a rank and can be placed at a particular level in a hierarchy. The plural is taxa.

Taxonomy: The naming, describing, and classifying of organisms into different categories on the basis of their appearance and other diagnostic characteristics, as well as their evolutionary relationships. The biological sciences primarily use the Linnaean classification system for this purpose.

Terrestrial: Ground dwelling.

Territory: The active defence of individual or group home range boundaries by actual or ritualised agonistic encounter, thereby maintaining essentially exclusive use of the home range.

Threatened: A taxon that is Critically Endangered, Endangered or Vulnerable.

Toilet claw: A claw found on the second toe of prosimians that functions in grooming.

Toothcomb: In prosimians, a formation of the lower incisors into a comb-like structure for grooming.

Troop: A group of animals, usually members of the same society.

V

Ventral: Located on the belly or side of the body where the belly is located.

Vocalisations: Sounds produced mainly by the throat and mouth. Primate vocalizations include a wide variety of hoots, whistles, grunts, and the like.

Vulnerable (VU): A taxon is Vulnerable when it is considered to be facing a *high risk of extinction* in the wild.

W

Weaning: The process of switching a young mammal from mother's milk to other food.

Weed species: Animals that thrive in human-altered habitats.

Z

Zoonotic disease: A disease that can be transmitted to people by vertebrate animals.

Anna Nekaris

Dr. Anna Nekaris is a Reader in Biological Anthropology and Primate Conservation at Oxford Brookes University, and tutor in Human Sciences, Archaeology and Anthropology at Oxford University, United Kingdom. Anna's degrees are as follows: BA in Biological Anthropology, University of Missouri, Columbia, USA; Certificat de Primatologie, Universite Louis Pasteur, Strasbourg, France; AM and DPhil in Biological Anthropology, Washington University, St Louis, USA. She has conducted research on South Asian primates since 1993. She is co-editor of two books, *Mating, Birthing and Rearing Systems of Nocturnal Primates* and *Primates and Their Predators,* and author of more than 40 articles in international scientific journals.

She is a member of the editorial board of the international journal ***Folia Primatologica,*** and Primate Conservation subject editor for the international journal *Endangered Species Research*. She has undertaken reviews for 15 international journals and 7 funding organisations. She is an external examiner for PhD and MPhil students for University of Cambridge, Selwyn College and University of Oxford, Keble College. She is the convenor of the Marketing Working Party and member of the Conservation Working Party of the Primate Society of Great Britain.

Anna Nekaris' main research interests fall under the areas of conservation, ecology, phylogenetics and speciation. To study various aspects of these fields, her fieldwork has taken her to Trinidad, Senegal, Utah, India, Sri Lanka, Singapore, Indonesia, China, Thailand, Uganda and Kenya. Although she has conducted fieldwork on bats, small carnivores (including civets and cats), mouse deer, and giant squirrels, her primary research focus is on primates. Anna has conducted long-term studies of Indian and Sri Lankan slender lorises. Amongst others, research topics have included behavioural ecology, life history and foraging behaviour. In collaboration with national and international researchers and students, she has also looked at the community ecology of Sri Lanka's rainforest primates, including toque macaques and purple-faced leaf monkeys. In particular they have examined the effects of fragmentation on populations throughout Sri Lanka's sparse remaining rainforests. Anna has had extensive training in Distance sampling, census techniques and home range analysis and has applied this to her primate research. Her current research project looks at the diversity of Asian slow lorises, both in the field and using museum specimens. This research has taken her to Indonesia, Thailand, Cambodia, Singapore and Vietnam, where at least five species of slow loris are found. Morphological, behavioural and vocal analyses are being used to uncover diversity within this group. Her photographs of lorises appear in numerous scientific and popular works.

Gehan de Silva Wijeyeratne

First and foremost I would like to thank Dr Anna Nekaris for agreeing to write the text. Anna together with her students have engaged in much work to study the Sri Lankan primates and their work has led to a heightened awareness of them. I first met Anna when she gave a lecture at the monthly lecture series of the Wildlife and Nature Protection Society. Subsequently Jetwing assisted her students with logistics support to undertake observations of Sri Lankan primates. Anna had a wide experience of primates from many parts of the world and had conducted studies shedding new light on primates on Sri Lanka. She was also good at popularizing primates through writing and presentations. I had been photographing primates for some time with a book in mind. I was delighted when Anna was enthusiastic about doing a book on the primates of Sri Lanka which combined a popular approach with a series of technical appendices.

My thanks to Noel Rowe for accepting Anna's invitation to write the foreword from an international perspective. Our thanks to Bernard Goonetilake and Dileep Mudadeniya for their joint foreword from a Sri Lankan perspective. Our thanks also to the Sri Lanka Tourism Promotion Bureau for publishing this book to create more awareness for the conservation of primates and also to illustrate their important as an economic asset.

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I could not have got this far in my efforts to popularise natural history if it were not for the support of my late parents Dalton and Lakshmi de Silva Wijeyeratne and my brother and sisters. My Uncle Dodwell de Silva sparked my interest in wildlife and photography. The interest in photography was encouraged by my Aunt Vijita de Silva and my sister Manouri, who gave me my first cameras.

My wife Nirma and my two daughters Maya and Amali are also a part of the team. Their contribution is not always obvious in the finished product but their support and encouragement is very strong. They put up with the house being over-run with an ever growing collection of books and me not spending the time they deserve from me because I spend my private time working on the 'next book'.

This book demonstrates that collaboration between Sri Lankans and foreign nationals can be rewarding and result in a pooling of resources and sharing of knowledge. In our bid to raise awareness locally for primates in peril, we need to work across borders.

Books

Birds

de Silva Wijeyeratne, G., Warakagoda, D., & de Zylva, Dr T.S.U. (2000). *A Photographic Guide to the Birds of Sri Lanka*. New Holland, London. ISBN 1-85974-511-3.

Descriptions and photographs of 252 species of birds, covering the endemics and those likely to be seen on a short visit. Written in plain English for beginners and people with a casual interest. Illustrated with some of the best Sri Lankan bird photographs available, by master photographer T.S.U. de Zylwa.

de Silva Wijeyeratne, G. (2006). *Birds of Sri Lanka and Southern India*. Gehan's Photo Booklet Series. 42 plates. Eco Holidays: Colombo. ISBN 955-1079-10-8

A booklet comprising of 42, A5 sized colour plates with captioned photographs. Covers 263 of Sri Lanka's 444 recorded species of resident and migratory birds. Eco Holidays: Colombo. A pdf of the booklet can be downloaded (free of charge) from www.jetwingeco.com.

de Silva Wijeyeratne, G., Perera, L. (2004) *Shorebirds, an artist in the field*. 48 pages. Eco Holidays: Colombo. ISBN 955 - 1079 - 03 - 5

The book, is probably the first in the 'Wildlife Art Book' genre, by a Sri Lankan publisher. The book showcases the work of Lester Perera. Lester's art captures the spirit of the place, whilst preserving an authenticity of the identity of the birds. Complemented with articles by Gehan de Silva Wijeyeratne.

Harrison, J. (1999). *A Field Guide to the Birds of Sri Lanka*. 48 color plates by Tim Worfolk. Oxford University Press. Oxford. 219 pages. Hardback ISBN 0-19-854961-X, paperback 0-19-854960-1.

Kazmierczak, K. (2000). *A Field Guide to the Birds of the Indian Subcontinent*. Illustrated by Ber van Perlo. 2000. Pica Press, UK. ISBN 1-873403-79-8. 352 pages. 90 colour plates. Distribution maps.

Kotagama, S., & Fernando, P. (1994). *A Field Guide to the Birds of Sri Lanka*. Wildlife Heritage Trust, Colombo. 224 pages. ISBN 955-9114-07-7

238 species illustrated in colour. The text has been kept brief as the book is aimed at encouraging an interest in birds amongst the wider Sri Lankan public. This and the Sinhala edition have both been priced to make them affordable to a wider audience, contributing in no small way to recruiting more birdwatchers.

Rasmussen, P. C. and Anderton, J. C. (2005). *Birds of South Asia*. The Ripley Guide. Vols 1 and 2. Smithsonian Institution and Lynx Edicions, Washington , D.C. and Barcelona. Vol 1: 180 colour plates, 378 pages. Vol 2: 683 pages. ISBN 84-87334-65-2.

The latest of the regional guides. No one serious about Asian birds can be without the two volumes which contain the latest round of 'splitting'. Volume 1 which is the field guide is well illustrated and is user friendly with the distribution maps facing the plates.

Butterflies

Banks, J. and Banks, J. (1985, several reprints). *A Selection of the Butterflies of Sri Lanka*. Published by Lake House Investments: Colombo. 34 pages.
Authored and illustrated by John and Judy Banks. Butterflies are arranged by colour and size. A very useful guide for beginners.

d'Abrera, B. (1998). *The Butterflies of Ceylon*. Wildlife Heritage Trust: Colombo. 224 pages.
ISBN 955-9114-15-8 Fairly comprehensive, with good colour plates of specimens. If you are serious about Sri Lankan butterflies you need this book. Out of print in Sri Lanka but the UK edition can be ordered on the net.

de Silva Wijeyeratne, G. (2004). *Butterflies of Sri Lanka*. 3rd print. 8 pages. Jetwing Eco Holidays: Colombo. An A5 sized colour booklet with captioned photographs to 62 species.

de Silva Wijeyeratne, G. (2006). *Butterflies of Sri Lanka and Southern India*. Gehan's Photo Booklet Series. 26 plates. Jetwing Eco Holidays: Colombo. ISBN 955-1079-11-6.

A booklet comprising of 26, A5 sized colour plates with captioned photographs. Covers 96 of Sri Lanka's 243 described species of butterflies and skippers (Lepidoptera). A pdf of the booklet can be downloaded (free of charge) from www.jetwingeco.com.

de Silva Wijeyeratne, G. (2007). *Butterflies of Sri Lanka and Southern India*. Gehan's Poster Series. Jetwing Eco Holidays, Colombo. A1.

A photographic poster illustrating 132 of the commoner species of butterflies of Sri Lanka and Southern India. A lavish poster folding out from A4 format into a size of 8 sheets of A4 (A1). Ideal for a class room or a child's bedroom.

Dragonflies

Bedjanic, Matjaz, de Silva Wijeyeratne, G., and Conniff, K. (2007). *Dragonflies of Sri Lanka*. Gehan's Photo Guide Series. Jetwing Eco Holidays: Colombo. 252 pages (A5). ISBN 978-955-1079-15-4.

The first photographic field guide to the dragonflies of Sri Lanka covering 91 of the 118 species found in Sri Lanka. It includes 35 of the 52 endemic species. A landmark publication and the first modern photographic field guide to the Odonata of South Asia.

Bedjanic, Matjaz, de Silva Wijeyeratne, G., and Conniff, K. (2006). *Dragonflies of Sri Lanka and Southern India*. Gehan's Photo Booklet Series. 1st Edition. 21 plates. Jetwing Eco Holidays: Colombo. ISBN 955-1079-08-6.

A booklet comprising of 21, A5 sized colour plates with captioned photographs. Covers 78 of Sri Lanka's 117 described species of dragonflies and damselflies (Odonata). A pdf of the booklet can be downloaded (free of charge) from www.jetwingeco.com.

other books

de Silva Wijeyeratne, G. (2006). *Wildlife of the Dry Lowlands*. 1st Ed. Gehan' Photo Guide. A photographic guide to the commoner animals and plants of the dry lowlands. Published by Jetwing Eco Holidays. Colombo. 110 pages of colour plates. ISBN 955-1079-01-9

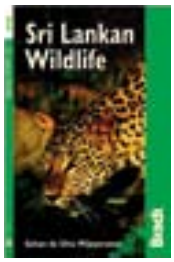
A Pictorial Guide to the commoner plants and animals of the dry lowlands. Names and introductory text in English, Sinhala, French and German.

de Silva Wijeyeratne, Gehan. (Ed.) (2004). *Leopards & other Wildlife of Yala*. ISBN 955 - 1079 - 00 - 0.

Compiled & Edited by Gehan de Silva Wijeyeratne. Photography by Gehan de Silva Wijeyeratne. 232 pages. A Jetwing Publication: Colombo.

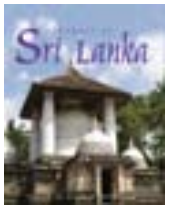
de Silva Wijeyeratne, G. (2005). *Sri Lanka National Parks and Reserves*. Eco Holidays, Colombo. 36 pages. ISBN 955-1079-05-1

A thirty six page overview of the key sites for eco-tourism in Sri Lanka with brief details on logistics. Lavishly illustrated with colour photographs and laid out in a coffee table book style to be used as a marketing tool as well as an introduction to Sri Lanka's wilderness areas.



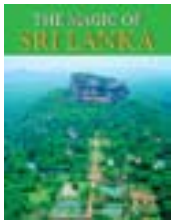
de Silva Wijeyeratne, G. (2007). *Sri Lankan Wildlife*. Bradt Travel Guides, UK. ISBN-10 1 841621 74 9, ISBN-13 978 1 841621 74 6. Pages 144.

An overview of Sri Lanka's wildlife and wilderness areas, illustrated with over 120 photographs. Probably the best overall introduction to Sri Lankan wildlife.



de Silva Wijeyeratne, G. (2007). *Portrait of Sri Lanka*. New Holland Publishers, London. 120 pages. Hard Cover & Dust Jacket. ISBN 1-84537-110-0.

A beautifully designed souvenir guide to Sri Lanka's people, culture, landscapes and wildlife. A part of New Holland's Portrait series.



de Silva Wijeyeratne, G. (2005). *Magic of Sri Lanka*. New Holland Publishers, London. 80 pages. Softback. 21 cm x 28 cm. ISBN 1-84537-110-0.

An eighty page 'souvenir guide' showcasing Sri Lanka's people, culture, landscapes and wildlife.

de Silva Wijeyeratne, G. (2008) *A Photographic Guide to Mammals of Sri Lanka*. New Holland, London. 128 pages. ISBN 978-1-84773-142-5.

The only photographic guide to the mammals of Sri Lanka. Good accounts of the behaviour and ecology of the mammals likely to be seen by visitors.

Useful Information

Organisations

The Sri Lanka Natural History Society, Email: rdes33@yahoo.co.uk.
Founded in 1912, the Sri Lanka Natural History Society (SLNHS) has remained an active, albeit small Society with a core membership of enthusiasts and professionals in nature conservation. The SLNHS organizes a varied program of lectures and slide presentations for its members. The subject matter of the talks embraces all fields of natural history including marine life, birds, environmental issues and the recording thereof via photography etc. They organize field excursions regularly. Excursions include day trips as well as longer excursions with one or more overnight stay.

Field Ornithology Group of Sri Lanka (FOGSL), Department of Zoology, University of Colombo, Colombo 3. Tel: 5342609, Fax 5337644. E-mail: fogsl@slt.lk
FOGSL is the Sri Lankan representative of Bird Life International, and is pursuing the goal of becoming a leading local organization for bird study, bird conservation and carrying the conservation message to the masses. They have a program of site visits and lectures throughout the year and also publish the Malkoha newsletter and other occasional publications. Education is an important activity and FOGSL use school visits, exhibitions, workshops and conferences on bird study and conservation to promote their aims.

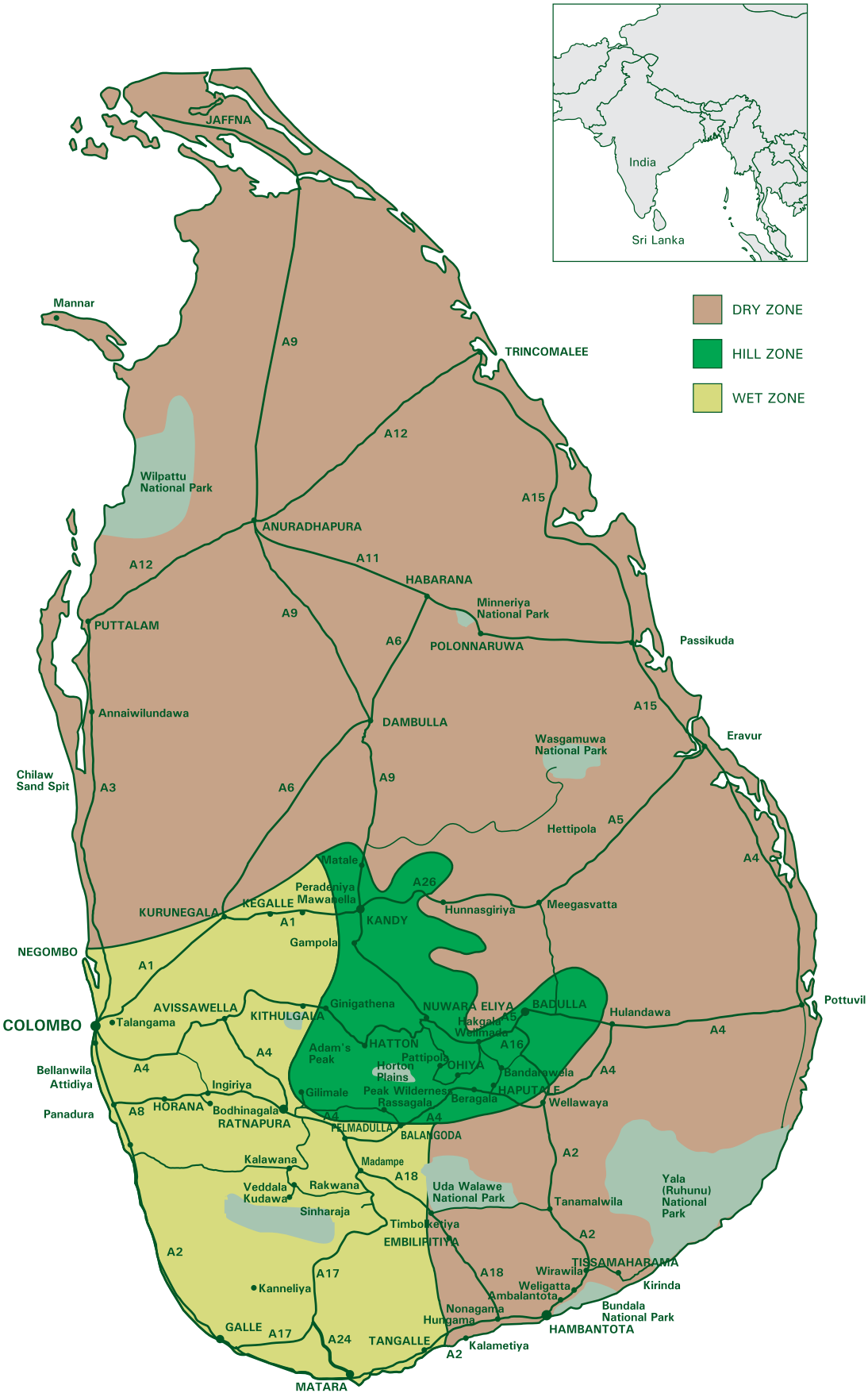
Wildlife and Nature Protection Society (WNPS), 86 Rajamalwatta Road, Battaramulla. Tel: 2887390, Fax 2887664. E-mail wnps@sltnet.lk
The WNPS publishes a bi-annual journal, Loris (in English) and Warana (in Sinhalese). Loris carries a wide range of articles, ranging from very casual, chatty pieces, to poetry, to technical articles. The society also has a reasonably stocked library on ecology and natural history. Various publications, including past copies of Loris are on sale at its office.

The Young Zoologists' Association of Sri Lanka, National Zoological Gardens, Dehiwala. Tel: 4204566, Fax: 2714542
At present, the YZA has nearly one hundred school branches and has also set up branch associations. The bulk of its membership is composed of school children and undergraduates, the rest being graduates, professionals and nature lovers from all walks of life.

Ruk Rakaganno (Tree Society of Sri Lanka), 2nd Floor, The Professional Centre, 275/75 Prof. Stanley Wijesundera Mawatha, Colombo 7. Tel/Fax: 2554438. Email: rukraks@sltnet.lk
Ruk Raks was started to combat the destruction of Sri Lanka's forests. It conducts urban and rural tree planting programs and various activities to raise awareness and appreciation of trees, particularly among the youth. Current activities include replanting and awareness programs in coastal areas, the maintenance of a nursery of primarily indigenous trees and the management of the IFS - Popham Arboretum in Dambulla. It organizes seminars and field trips.

Sri Lanka Wildlife News
Sri Lanka Wildlife News is a quarterly compilation of news, events, birds, leopards and other wildlife sightings, trip reports, articles, recent publications etc of interest to wildlife enthusiasts, conservationists and photographers. To receive this free, e-mail-based newsletter, e-mail gehan@jetwing.lk with 'subscribe wildlife news' in the message header.

Pages 144-145, Michael Leibfritz


India
Sri Lanka
DRY ZONE
HILL ZONE
WET ZONE
JAFFNA
Mannar
TRINCOMALEE
Wilpattu National Park
ANURADHAPURA
HABARANA
Minneriya National Park
PUTTALAM
POLONNARUWA
Passikuda
Annaiwilundawa
DAMBULLA
Wasgamuwa National Park
Eravur
Chilaw Sand Spit
Hettipola
Matale
Peradeniya
Mawanella
KURUNEGALA
KEGALLE
KANDY
Hunnasgiriya
Meegasvatta
Gampola
NEGOMBO
Pottuvil
AVISSAWELLA
Ginigathena
NUWARA ELIYA
BADULLA
Hulandawa
COLOMBO
Talangama
KITHULGALA
Hakgala
Welimada
Adam's Peak
HATTON
Pattipola
OHIYA
Horton Plains
Bandarawela
Bellanwila Attidiya
Ingiriya
Gilimale
Peak Wilderness
HAPUTALE
Panadura
HORANA
Bodhinagala
Beragala
Wellawaya
RATNAPURA
PELMADULLA
BALANGODA
Kalawana
Madampe
Veddala Kudawa
Rakwana
Uda Walawe National Park
Yala (Ruhunu) National Park
Tanamalwila
Sinharaja
Timbolketiya
EMBILIPITIYA
TISSAMAHARAMA
Wirawila
Kanneliya
Weligatta
Kirinda
Ambalantota
Bundala National Park
Nonagama
Hungama
HAMBANTOTA
GALLE
TANGALLE
Kalametiya
MATARA
A1
A2
A3
A4
A5
A6
A8
A9
A11
A12
A15
A16
A17
A18
A24
A26

Primate society is full of drama and intrigue with alpha males being overthrown by male coalitions, expulsions, immigrations, etc. This book is a fascinating insight into the complex social behaviour of primates.

The book is illustrated throughout with excellent photography making it a beautiful book as well as an essential source of reference for anyone with an interest in Asian natural history and its conservation.

This is the first guide to the primates of Sri Lanka collating together what is presently known about them. The technical species accounts are preceded by a popular introduction to primates and their behaviour. The island has three species of diurnal (day-time) primates of which two are endemic. Of the two species of nocturnal lorises, one is endemic with possibly one or more sub-species likely to be elevated to a full species.

"Sri Lanka is a special place with many species of plants and animals found nowhere else in the world. This wonderful book will tell you what is known about each of the 5 species and 12 sub-species of lorises and monkeys. Many of these are easy to see and observe in the beautiful temple grounds and forests of Sri Lanka.

The author Anna Nekaris is one of the most dedicated nocturnal primate researchers on the planet. The photographs by Gehan de Silva Wijeyeratne are some of the best I've seen…"

Noel Rowe
Director of Primate Conservation Inc.
Author of the *Pictorial Guide to the Living Primates*

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