PROTECT

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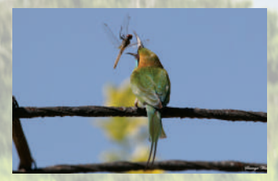
Cover page: Caught in action!!

A Green Bee Eater on the brink of capturing a dragonfly.



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Editorial

"Take a quiet walk with Mother Nature. It will nurture your mind, body and soul" - Anthony D. Williams

Poornima Kumari

It is with great pride and pleasure that The Zoologists' Association of University of Peradeniya publishes this inaugural edition of the Student Journal, "Protect Nature Sri Lanka". The aim of this journal is twofold. Firstly, to provide University students a platform to publish their research and experiences with nature in any form they like. The journal accepts research articles, review articles, popular articles, short communications, case studies, perspectives, opinions, commentaries, book reviews, student project reports, sighting records, observations, poems, drawings, cartoons, and nature photographs.

Secondly, but most importantly, to pass the message to the society, especially to the student community, that protecting nature should come above all other achievements we crave in life. Our very existence remains in the hands of Mother Nature. If we destroy her, we will perish along with her. Through this journal we want to highlight the beauty of nature and how much we have destroyed it through our selfish and blind activities. We want everybody not to take Nature for granted, but learn to love it.

On behalf of the association, I wish to extend my heartiest gratitude to Dr Suyama Boyagoda, Senior Treasurer, Zoologists' Association, for her encouragement, guidance and supervision throughout the year to make this journal a reality. I gratefully acknowledge Dr Shalika Kumburegama for editing and proof reading the articles, and Mr. Gajaba Ellepola, Mrs. Chathurika Munasinghe and Dr Piyumali Perara for reviewing the articles. I also thank Prof. Sudharma Yatigammana, Head of the Department of Zoology and all the other academic staff members of the Department, who helped us to complete this tedious task.

We sincerely hope everybody will enjoy reading this journal and the articles will stimulate many of you to contribute to our next issue.

Please send you contributions to Zoologists' Association, Department of Zoology, University of Peradeniya, Sri Lanka or to the E-mail address <zaup.uop@gmail.com>.

«««««««««««««««««««« Their Story »»»»»»»»»»»»»»»»»»»»

HE, challenged HER,
Ever since HE could "think"
HE, manipulated HER,
For hIS own selfish benefit
HE, exploited HER,
Till SHE was exhausted, ruined
Then realization dawned!
HE was digging his own "grave",
Beneath where HE buried many bones
HE was a part of HER,
Whose time flow is immensely great
HE must now use his "thinking",
The gift SHE gave all along,
To save, revive, conserve HER being,
And thus ensure his safe wellbeing,
Until the sun and moon survives
Him, the MAN, the forever "scientist"
HER, the NATURE, the "mother" of all
Their story, our story continues still...

Poornima Kumari

Photograph © Malinda Narampanawa

Research

Egg laying behavior and initial growth related measurements of Sri Lankan Kangaroo lizard (*Otocryptis wiegmanni*) under captivity

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ABSTRACT

Otocryptis wiegmanni is an endemic lizard commonly known as "Sri Lankan Kangaroo Lizard". Facts related to growth and reproduction are not adequate for this species. Here we summarize the egg laying behavior of six gravid females of *O. wiegmanni* captured from Lower Hanthana and the initial growth patterns of hatchlings. The observations were done under semi-captive conditions in the laboratory. To study the growth pattern of embryos, measurements of the eggs (weight, length and the width) and hatchlings (weight, tail length and snout-vent length) were taken. Female *O. wiegmanni* prefer loamy sandy soil type to lay eggs. The eggs are laid in a 5 cm deep hole dug using its' fore limbs and snout. Digging alternate with observing the surroundings and was carried out for nearly 1 ½ hours, with 9-14 s intervals of digging and 58-120 s intervals of observing. After digging, the female lizard re-positions (by turning 180°) its cloaca just above the hole to lay eggs. The hole was closed by dragging the soil with its forelimbs and pressing the soil with the snout. Egg clutches contained 3 to 5 eggs with an average length of 11.44±0.25 mm, width of 6.94±0.50 mm and weight of 0.31±0.02 g. The weight of a hatchling at birth was 0.33±0.04 g. Initial average tail length was 38.12±3.80 mm and initial average snout-vent length was 19.12±0.64 mm. Snout-vent length increased by 3.0–5.4 mm/month during the initial 2 ½ months.

Key words: Sri Lanka, Peradeniya, Captivitive breeding, Growth, Reproduction

INTRODUCTION

The genus *Otocryptis* is comprised of three species of agamid lizards, a single species from Indian sub-continent and two species from Sri Lanka. Indian species, *Otocryptis bedomii* (Boulanger, 1885) is endemic to Western Ghats. Remaining two species, *Otocryptis wiegmanni* and *Otocryptis nigristigma* are restricted to wet zone and dry zone of Sri Lanka, respectively (Bahir and Silva, 2005). *Otocryptis wiegmanni* is commonly known as "Sri Lankan Kangaroo Lizard". It occupies tropical moist lowland forests throughout the wet zone of Sri Lanka from sea level up to 1,340 m above sea level (Bahir and Silva, 2005). *Otocryptis wiegmanni* is frequently

seen in habitats with adequate leaf litter and forest cover particularly in the vicinity of a forest stream (Das and De Silva, 2011). They also can be found in both natural and anthropogenic habitats such as home gardens and cultivations (Somaweera and Somaweera, 2009). Although, according to literature, their behavioral and ecological data are adequate and only few studies have been carried out on their growth and reproduction (Sudasinghe and Kusuminda, 2013). Therefore, this study was carried out to understand the basics of growth patterns and reproduction of *O. wiegmanni,* as they are key aspects in the life history of a species.

MATERIALS AND METHODS

From time to time thirty seven lizards (females; *N*=22, males; *N*=15) were captured from Lower Hanthana (80º 36' 00.9"E, 7º15'00.3"N) and introduced to a 150 x 70 x 70 cm^3 glass fronted cage with a wooden bottom and plastic neting on other sides (Figure 2). Four different soil types, sandy, gravel, loam and loamy sandy (soil from their natural habitat), were provided as bottom substrates at the four corners inside the cage. Soil was laid from the middle of the cage to the corners with the soil depth gradient increasing towards the corners from a minimum of 1 cm up to maximum 12 cm depth. Cage was kept outside the laboratory with adequate leaf litter, a few plants, rocks, dry twigs and a water container to provide conditions similar to their natural habitat. Lizards were fed with live grasshoppers, termites and other insects. Among the twenty two females, only six individuals were gravid and laid eggs. General behaviors of the lizards including their egg laying behavior were observed and recorded using a camcorder (SONY DCR-SR45). During the study period six egg laying events and a single copulating event (https://youtu.be/9imqYUx3_5c) were observed. After the eggs were laid, eggs were carefully taken out, measured and weighed using a vernier caliper and a digital balance, respectively. The depth of the nesting holes was measured from the surface of the soil layer in the cage using a vernier caliper. After taking measurements the eggs were buried at the same place where they were found. After the eggs hatched, the hatchlings were marked using a permanent marker and measured (tail length and snout-vent length) and weighed once a week using a vernier caliper and a digital balance, respectively. The growth rate was measured every 7 days up to79 days beginning from the hatching date. The growth data were analyzed using software, Minitab 16 and MS-Excel 2010.

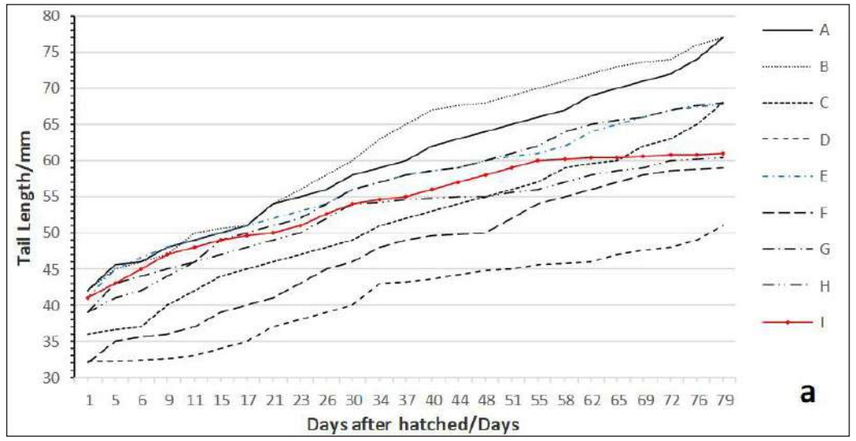
RESULTS

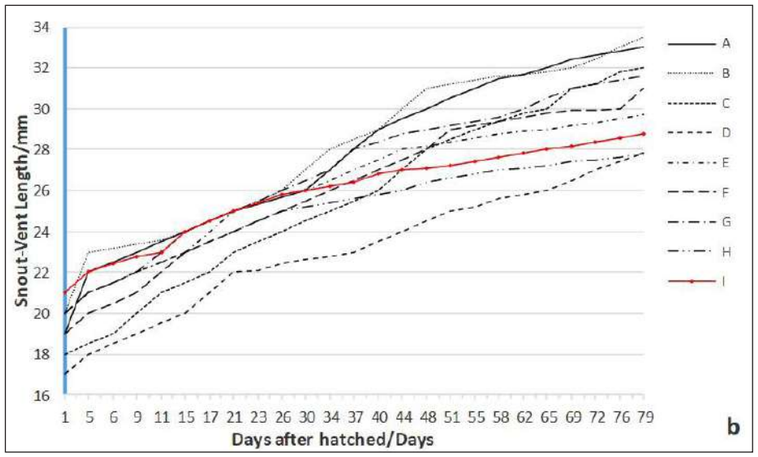
Though the cage floor was covered with different soil types (sandy, gravel, loam and loamy sandy), all six females of *O. wiegmanni* chose the loamy sandy soil type which was taken from their natural habitat to lay eggs. All gravid females started egg lying between 1000 h to 1400 h; the mean environmental temperature was 27.7 °C at the time of laying eggs. All females showed a similar egg laying behavior. When considering a single egg lying event, female started digging the ground when there was less noise and calm condition (without anthropogenic disturbances). She stopped digging when it hit the wooden bottom, realizing the low soil depth. Then she moved to another place with the same soil type and started digging again. The Female dug nearly 4-6 places and finally she selected the most favorable depth to lay eggs. Once the place with optimum depth was chosen, the female started digging by using its forelimbs and snout for few seconds. Then she stopped digging and observed the surrounding environment for 1 minute. Digging and observing was done alternately for nearly 1.5 hours with an average of 11s intervals of digging and average of 90 s intervals of observing the surrounding. After digging up to 5 cm she stopped digging. She turned 180º and positioned the cloaca just above the hole. Then she started to lay eggs. The eggs were elongate and white in color; with a clutch of five. Soon afterwards she covered the hole with soil using her snout and forelimbs. She dragged the soil using its forelimbs and pressed the soil using its' snout. Hole was completely filled with soil up to the ground level. She spent nearly 1 hour and 15 minutes to cover the hole while observing intermittently.

Likewise, during the study period from middle of February to end of September 2015, six (6) egg lying events were observed. The number of eggs laid varied between 3 to 5 eggs per clutch with a total of 26 eggs which had slight differences in lengths and widths (Table 1 and Figure 3).

Table 1: Egg laying events of *Otocryptis wiegmanni* from February to September 2015 under captive condition

Date of egg laying	Egg laying time/ hour	No of eggs in the clutch	No of hatchlings	Mean length of eggs/mm	Mean width of eggs/mm	Mean weight of the eggs/g	Atmospheric temperature when egg laying/ºC	Incubation period /days	Hatching time/hour	Atmospheric temperature when hatching /ºC	Soil Temperature when hatching/ºC
28th February	1040	3	3	11.82±0.43	7.82±0.51	0.34±0.04	-	71	0930	26.5	-
21st March	1104	5	3	11.32±0.30	7.11±0.21	0.31±0.03	29.3	71	-	-	-
10th April	1435	5	5	11.28±0.41	6.59±0.31	0.30±0.00	27.5	65	1035	27.8	-
3rd June	1258	5	4	11.20±0.21	6.58±0.27	0.28±0.01	28.1	65	-	-	-
1st July	1339	4	4	11.30±0.14	6.53±0.43	0.29±0.01	27.2	64	0855	23.6	23.1
28th July	1400	4	3	11.69±0.33	7.02±0.13	0.33±0.03	26.5	65	0800	23.7	22.9





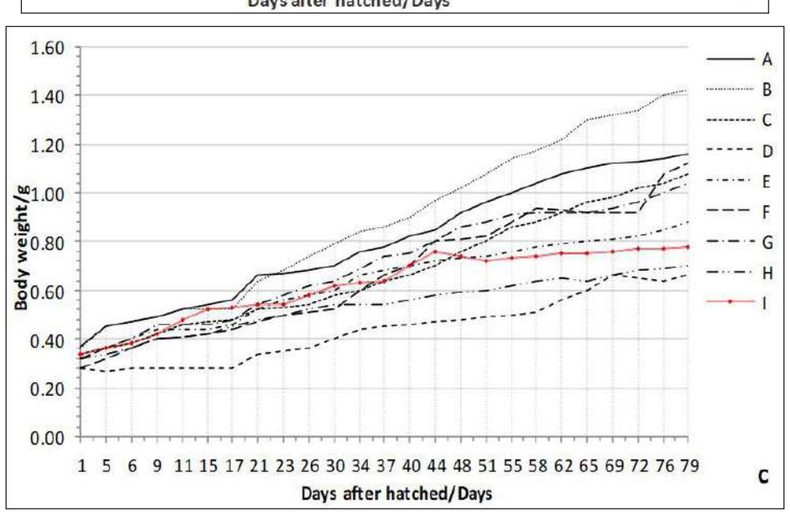


Figure 1. Initial growth patterns of *O. wiegmanni* under captive condition. (a) Tail length (in mm), (b)Snout-Vent length (in mm) and (c) Body weight (in grams) with respect to days after hatching. Letter "A" to "I" in the legend area denotes the individual ID of *O. wiegmanni* juveniles. All the graphs shows that tail length, snout-vent length and body weight are rapidly increased with time during the initial 79 days after hatched.

Figure 2. Inside the wooden bottom cage showing provided semi-natural conditions for the lizards

Otocryptis wiegmanni did not provide any parental care to her egg clutches. The initial growth rates of 9 individuals showed similar patterns. The snout-vent length, tail length and body weight of the juvenile lizards showed an increased rate of development, from day 1-79 after hatched. The weight at birth (n=22) was nearly 0.33±0.04 g (Figure 1c), Initial tail length was 38.12±3.80 mm and initial snout-vent length 19.12±0.64 mm (Figure 1a and 1b). Snout-vent length increased by 3.0–5.4 mm per month during the initial 2.5 months. Two hour old hatchlings had the ability of catching small grasshoppers and termites. They were very active 1 day after hatching. Differentiating between sexes was not possible soon after hatching. A tiny, reddish orange color dewlap was observed in some of the individuals and they started showing territorial behavior with expanding their dewlap after one month (Figure 4).

Figure 3. Eggs of *Otocryptis wiegmanni* with a scale (cm)

Figure 4. One month old Juvenile *Otocryptis wiegmanni* on a leaf

DISCUSSION

All activities related to reproduction such as mating, egg laying and courtship displaying behaviors occurred during daytime between 1000-1435 h. Sudasinghe and Kusuminda (2013) obtained a similar result in a different study. Further, the time period recorded for egg laying of all other *Calotes* sp. thus far documented in Sri Lanka are also similar. The results suggest that these lizards are highly active between the above time period and may require increased body temperatures to perform these high energy activities. Egg laying requires a higher amount of energy and also may require thermal energy gained from the atmosphere. Egg hatching occurred in the morning between 0800-1035 h when the environmental temperature was between 23.6-27.8 °C (25.4±2.0 °C). Many species

of living reptiles (all crocodilians, many turtles and some lizards) show a temperature-dependent sex determination. It remains to be investigated whether the sex determination of *O. wiegmanni* is temperature dependent or not.

The initial growth measurements of *O. wiegmanni* show a common pattern followed by other lizards such as *Calotes versicolor* (Bhagyarekha, 2010) but at a different rate. The Snout-vent length of *Calotes versicolor* increased by 3.0–12.0 mm per month at initial growth, but snout-vent length of *O. wiegmanni* increased by 3.0–5.4 mm per month during the initial 2.5 months. This may be proportionate to the larger body size of *C. versicolor* compared to *O. wiegmanni*. The rate of initial development is quite similar among all nine individuals because the conditions in captivity was similar for all individuals.

When they reached 1 g in weight and the total body length above 99 mm they tend to show territorial behavior due to limited resources such as space and food available in the cage.

CONCLUSION

Otocryptis wiegmanni did not provide any parental care to her egg clutch. Normally they lay 3 to 5 eggs in one clutch and take 65 to 71 days for hatching. It prefers sandy mixed loamy soil to lay eggs. The weight at birth was nearly 0.33±0.04 g. Initial tail length was 38.12±3.80 mm and initial snout-vent length was 19.12±0.64 mm. Snout-vent length increased by 3.0–5.4 mm per month during the initial 2.5 months.

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Short Communicatoin

Do Ants Make Optimum Decisions?

Economic Decision Making of Saint Valentine ant (*Crematogaster dorhni*) and Black ant (*Technomyrmex* sp.)

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It was interesting to observe that some ants have more preference for sugary food sources and they mostly gather around sweeter foods than less sweet ones. For example, they usually have more preference for crystallized sugar over fruits. It is fascinating to observe the ability of the ants to find the shortest pathway leading to a food source. Although we do not see "talking ants," they exhibit remarkable ability to forage for the best food source and communicate to colony members about the quality and the quantity of the food source.

Ants are social insects which show unique kinds of colony behaviors. They are omnivorous insects that belong to family Formicidae. As social insects, ants typically live in structured nest communities that may be located underground, in ground-level mounds, or in trees. Carpenter ants nest in wood and can be destructive to buildings. Some species, such as army ants, defy the norm and do not have permanent homes, instead build temporary shelters out of living ant bodies to protect the queen and the larvae when needed. In an ant colony, there are four types of ants, which are called castes. Ant communities are headed by a queen or queens, whose function in life is to lay thousands of eggs that will ensure the survival of the colony. Workers, the ants who can be seen out of nests, are females without wings who never reproduce, instead search for food, look after the offspring of the queen, and keep the nest clean. Soldier ants protect the colony against predators and other threats. Male ants, which are commonly known as drones, mate with the queen, after which they may die.

Ants communicate with each other through chemicals called pheromones. There are two types of pheromones, alarm pheromones, and trail pheromones. Alarm pheromones are released by the ants when there is a threat to the colony and to alert the soldiers to protect the colony. Trail pheromones are used to mark the path to a food source from the colony. Individuals who find a food source, release trail pheromone while coming back to the nest carrying some of the food. This trail of pheromones leads the other ant members to the food source.

In our study, foraging behavior and the preference for food quality were observed in *Crematogaster dohrni*, commonly known as Saint Valentine ant, which shows a high preference for sucrose (sugar). During foraging, ants make decisions to maximize energy efficiency and decide to follow the shortest route to

a food source, select a food source with the highest energy load over a low energy one or select a food source closer to the colony rather than one far away. To survive, the insect society must organize their workforce efficiently. This organization involves making collective decisions that optimize the colony's fitness. During this study, several questions were asked to formulate a hypothesis. They are; how does an ant colony locate its food source? How does the ant colony achieve an allocation of the majority of its workers to the most profitable feeder? How do the foragers find an optimal pathway leading to a food source? Several experiments were carried out to find answers to these questions.

In the first experiment, 20 g of sucrose was dissolved in 100 ml of distilled water, and a dilution series was prepared by using it as the stock solution (The concentrations of the dilution series were 1M, 0.9M, 0.8M, 0.7M, 0.6M, 0.5M, 0.4M, 0.3M, 0.2M, and 0.1M). Then, three drops of each solution were placed in separate watch glasses and placed near the colony of ants. The sugar containers were kept at a same distance from the nest. The time taken for the arrival of the first ant to each drop was measured using a stop-watch.

In the second experiment, 5g of sugar was dissolved in 10 ml of distilled water, and three drops were placed in a watch glass. Some pebbles marked with chalk were placed on a line forming a pathway from the ant colony to the watch glass containing sucrose. The ants were observed for several hours. The experiment was repeated with pebbles removed.

According to Figure 1, ants always followed the stronger scent of the food source. These experiments

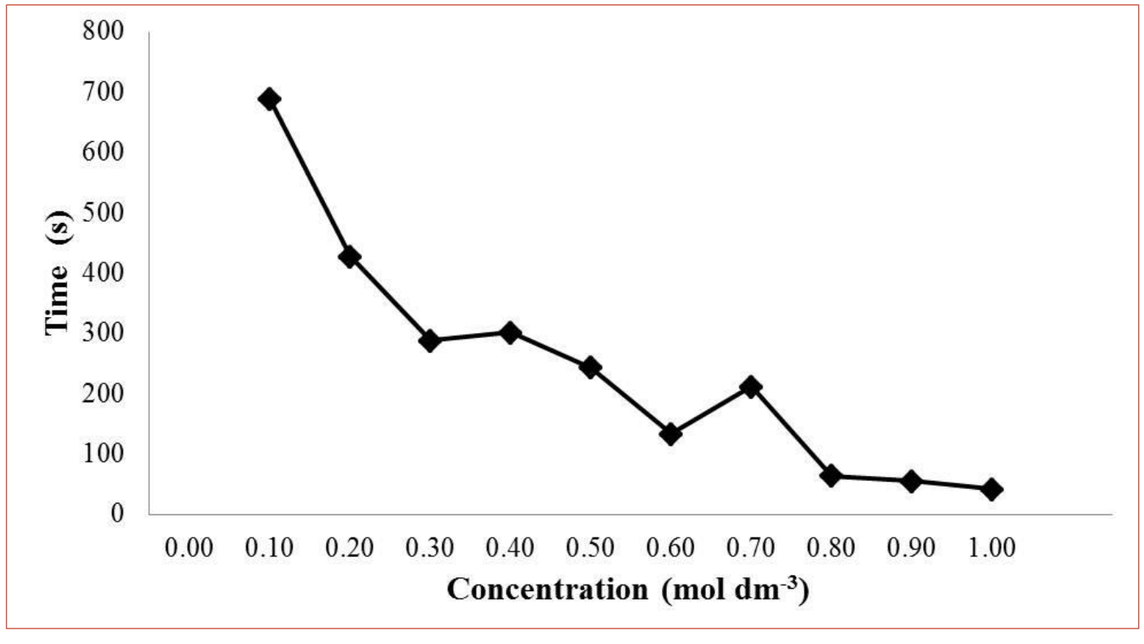

Figure 1: Time taken for the first ant to find the food sources with different sucrose concentrations (0.00 - 1.00 mol dm-3).

demonstrated that *C. dohrni* can detect an odor presented in the solution received during single trophallaxis and that they use this memory to locate the food once at the source. Because once olfactory memory is established, they always tend to move towards the best sugar source. Even though different foragers go for few different food choices, in this case, different sugar concentrations, foragers always signal other foragers to go for the best quality sugar source. Probably, foragers use this olfactory social information to identify unfamiliar food sources and their individual information once they have visited and experienced the source. We predict when information is given by different ants to other foragers via antennal tapping or mouth to mouth contact decision is made by other foragers by considering the quality and distance to the food source. Most nectarivorous ants take the nectar in their crop to the nest where it is unloaded through trophallaxis to receiver nestmates. Also, it is known that these ant species have olfactory memory to track the food source with better quality. Ants can incorporate sucrose levels and odor of the source during successive foraging cycles and use this memory to locate the nectar in the absence of other cues. They should establish olfactory memory to come over and over again to the food source. During the experiments, we did not observe any trail leading to food source among *C. dohrni.* Once olfactory memory was established among the ants, they usually try to go for very familiar scents when it comes to the decision area.

The third experiment was carried out to explain the behavior of *Technomyrmex* sp. in finding the optimal pathway leading to a food source. *Technomyrmex* sp (Figure 2) are known to have pheromone trails to track back the food source and do communication among the nestmates. Wet tissue paper was used to build a maze around the food source. When foragers search for food, they lay a pheromone trail which is followed by other foraging ants in the colony. When a food source is located, they lay an even stronger pheromone trail over the previous trail connecting nest and the food source. More forager ants get attracted via this pheromone trail to the food source.

According to the optimality theory, ants choose high nutrient food source. Once a forager goes through the maze we have built and found the food source, they usually scout around the food source and measure the quantity and the quality. Then a trail is established in the maze. Once the barriers are removed, the ants stay in the pre-established trail as they have established a pheromone trail. But some foragers tend to go off the trail and find some optimal shorter paths. When ants reach the overlapping path point at first, there is a lower probability of going through the new trail. But after 15 to 20 minutes, foragers choose the more optimal path leading to the food source. A decision is made to choose the optimal pathway (Figure 3).

In conclusion, decision making of two ant species was observed and studied under optimality models. Usually, foragers are assigned to a food source according to cost and benefit theory. More workers

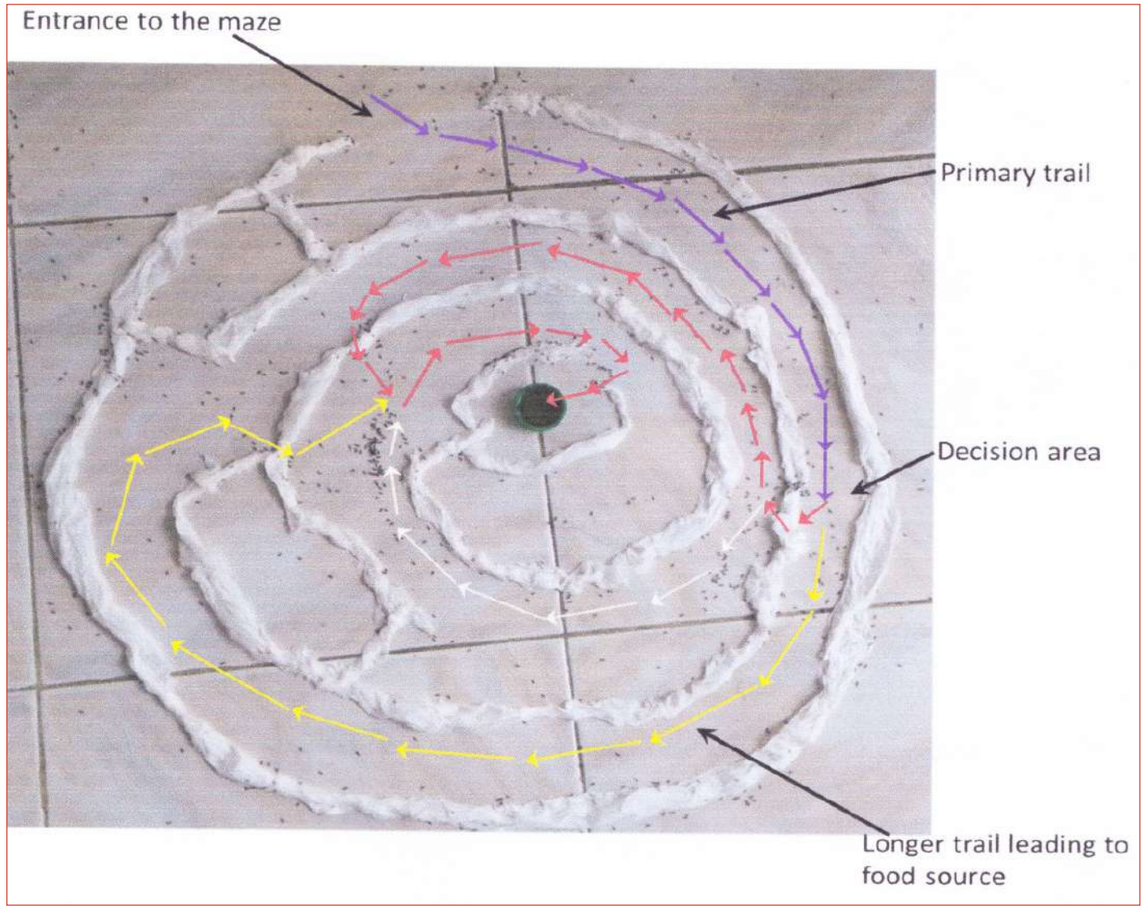

Figure 2. Experimental setup to check the optimal decision making when *Technomyrmex* sp. presented with the maze model. In this maze model three primary trails were established as given in arrows. Some places of the maze have gone dry and ants have breached from that wall and found shorter paths towards the food source. The longest path was about 120 cm, shown in yellow color. Other two pathways are about same in length (80 cm and 82 cm).

are assigned to better, larger and lower distance food sources to collect more food while spending less energy, and vice versa. Moreover, foragers in the field always tend to choose the shortest pathway leading to food sources over the longer pathway. But for extensive distances (about 10 m) they do not show this decision-making behavior. Also, some ant species show olfactory memory establishment based on the scent of the food source. They show optimal decision making once encountered with unknown scents. Furthermore, they show preference of food source with single *trophallaxis* and they use this memory to locate the food once at the source.

This project was designed and conducted for the ZL 311 (Ethology) practical lessons under the guidance of Dr. Suyama Boyagoda.

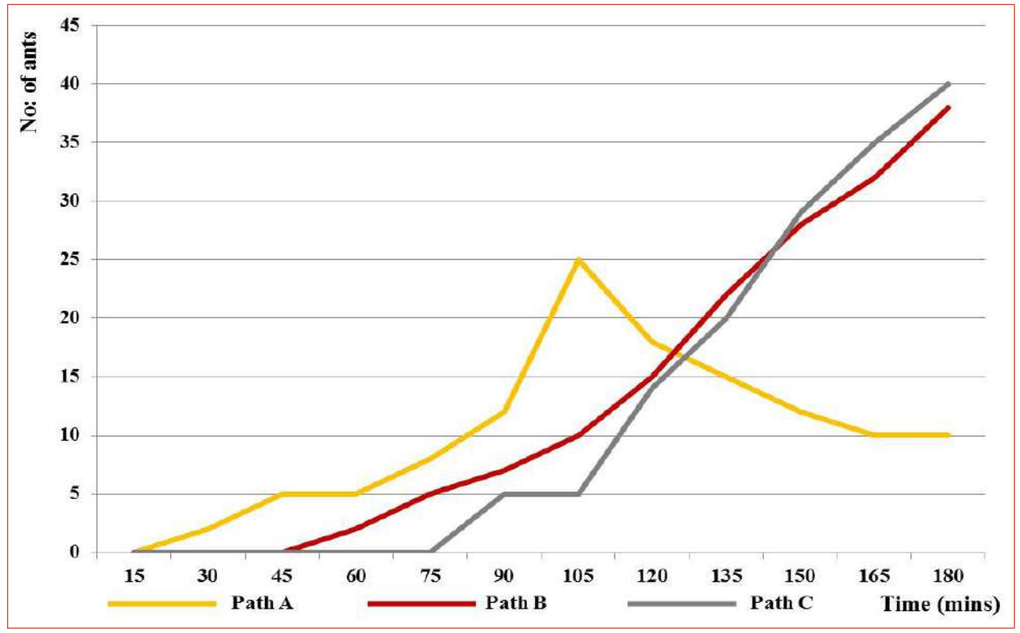

Figure 3: Number of ants visited on each paths of the maze model within three hours. Most of the ants preferred the longest path until other two shorter paths established by other foragers and most of the ants followed the optimal pathway making the economic decision.

Nature Conservation
R.G.M.K. Jayathunga

Knuckles, a land of 'Dragons'!!!

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Agamas or 'Dragons'

Agamas or 'Dragons' are one of the reptile groups that belong to family Agamidae. These terrestrial creatures are diurnal and possess characteristic elongated bodies with horny scales and a crest down the mid-dorsal which distinguish them to be unique. The majority of the species dwell on trees, dead branches, bushes, stones or on leaf litter in forested areas. These cold blooded agamids maintain their body temperature by basking during the day time. Only a few Agamas feed on flower petals and seeds (Das and de Silva, 2011), while the majority are insectivorous and feeding on diverse insects. The courtship strategies of agamas occur mainly through visual communication with characteristic posture and body colorations. They show internal fertilization and deposit eggs in shallow nests on the ground.

Knuckles…"*Dumbara Mitiyawatha*"

The Knuckles mountain range (Figure 1) lies in the central province of Sri Lanka, in the districts of Kandy and Matale. It is also known as "*Dumbara Mitiyawatha*" or "*Dumbara kanduwetiya*" with the meaning of "Mist-laden Mountain Range" (Cooray, 1984). This area, considered as the second most important forest area of the country serves as an important watershed of the Mahawali River. Knuckles harbours many geological, historical and archeological features specific to the area which increase the value of the region. The profound richness in both flora and fauna of knuckles with its high endemism and diversity of agamid lizards characterize it to be among the most conserved regions of Sri Lanka.

Figure 1. Knuckles mountain range

Table 1: Agamid species in Knuckles mountain range (List is based on the direct observations of the authors, Goonewardene et al., 2006 and the updated list of Reptile Database, 2018)

Genus	Species	Common name	Conservation status
Calotes	*Calotes calotes*	Common green forest lizard	LC
	C. versicolor	Changeable lizard	LC
	*C. ceylonensis**	Painted-lipped lizard	NT
	*C. liolepis**	Whistling lizard	NT
	*C. liocephalus**	Crestless lizard	EN
	*C. pethiyagodai**	Pethiyagoda's crestless lizard	NE
	*C. manamendrai**	Manamendra-Arachchi's Whistling Lizard	NE
Ceratophora	*Ceratophora tennentii**	Tennent's leaf-nosed lizard	CR
Cophotis	*Cophotis dumbara**	Knuckles pygmy lizard	CR
Lyriocephalus	*Lyriocephalus scutatus**	Hump-nosed lizard	VU
Otocryptis	*Otocryptis wiegmanni**	Sri Lankan kangaroo lizard	LC
	*O. nigristigma**	Black-spotted kangaroo lizard	LC

*Endemic species; LC-Least concern; VU-Vulnerable; EN-Endangered; NT-Near threatened; NE-Not Evaluated

Diversity of 'Dragons' in Knuckles

A total of 21 Agama lizards belonging to six genera (*Calotes*-9 species; *Ceratophora*-5 species; *Cophotis*-2 species; *Lyriocephalus*-1 species; *Otocryptis*-2 species and *Sitana*-2 species) have been reported from Sri Lanka, of which 19 species (~90%) are considered as endemic to the island. The Knuckles mountain region provides shelter for 12 species which is 57% (12/21) of agamid lizards reported in Sri Lanka (Table 1, Figure 2). Among them, 10 species are endemic to the country and three species, i.e., Tennent's leaf-nosed lizard (*Ceratophora tennentii*), Knuckles pygmy lizard (*Cophotis dumbara*) and Pethiyagoda's crestless lizard (*Calotes pethiyagodai*) are restricted to the Knuckles mountain range. *Ceratophora tennentii* and *Cophotis dumbara* are considered as critically endangered species and Calotes liocephalus is an endangered species. Further, vulnerable species such as Hump-nosed lizard (*Lyriocephalus scutatus*) is also found in the Knuckles mountain region.

Threats to Agamid species in Knuckles

Deforestation, habitat fragmentation, and habitat alteration are the major problems faced by the agamas in Knuckles region. Fragmented forest patches act as barriers for lizards to move from patch to patch. Extraction of fire woods from forest areas and cardamom plantations destroy the

niches of these organisms. Road kills has also been identified as one of the current threats to these agamid fauna. Pesticides uses in agricultural fields in and around the mountain range have been poisoning the fauna of the region (Senanayake, 1980). The other identified threats include, the predation by domestic animals (i.e., domestic cats, dogs) and other opportunistic wild animals (i.e., coucals, crows, rat snakes, wild boars), forest fires caused by natural and human activities (Goonewardene et al., 2006) and pollution caused by local and foreign visitors. The region has been heavily commercialized resulting in people invading the protected area and introducing commercial buildings to facilitate the increasing demand of such visitors.

Our responsibilities in protecting agamid lizards in Knuckles

Public awareness programs are one of the most important methodologies that can be implemented to educate on the value of this area. Entries to this ecologically sensitive area should be restrained and proper rules and regulations should be implemented. The implementation of such rules must be followed by constant monitoring for an effective output. Extraction of fire wood and timber from the forests of the Knuckles mountain range should be prohibited. Active and continuous research programs should be conducted to identify the biology and ecology of agamas in this area and the problems associated with them. Practical conservation approaches are needed for the protection of decreasing populations of agamids in the area. Systematic reforestation activities should be implemented to connect the fragmented areas in order for these lizards to enhance their habitats.

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Common green forest lizard
Calotes calotes

Changeable lizard
Calotes versicolor

Knuckles pygmy lizard
Cophotis dumbara

Tennent's leaf-nosed lizard
Ceratophora tennentii

Pethiagoda's crestless lizard
Calotes pethiyagodai

Crestless lizard
Calotes liocephalus

Sri Lankan kangaroo lizard
Otocryptis wiegmanni

Black-spotted kangaroo lizard
Otocryptis nigristigma

Whistling lizard
Calotes liolepis

Hump-nosed lizard
Lyriocephalus scutatus

Painted-lipped lizard
Calotes ceylonensis

Manamendra-Arachchi's whistling lizard
Calotes manamendrai

Figure 2. Agamid species in Knuckles mountain range (Photographs by W.G.D. Chathuranga)

She was a mother too...

Natasha Grabau

Her son lays dead. Knocked lifeless by the inhumane box of metal on four wheels and its human owner seated behind the steering wheel. She runs to the road, never caring for her own safety from the oncoming swarm of vehicles from either side. She wants her son to get up, to follow her. But the universal reality that death is permanent, that it cannot be cheated, she cannot grasp. She moans. Pleads the vehicles to stop. She runs to some, wants them to get down and help her lift her kid. But nobody does. She cries; bitter, heart-broken hot tears of a mother that has lost her wee child. And she is shot! A single bullet, released by a gun was all it took to join the heartbroken mother with her just dead son.

What an atrocity! Such a horrible act! To kill an innocent grieving mother? Where has justice gone to?

But that is exactly what happened. A mother is a mother, be it human or animal. This recent incident stirred much talk among the humans comfortably seated over a cup of tea, at home with their children safe and sound under the roof. Idle chit chat or heated debate did not come to the aid of a grieving mother.

An elephant toddler crosses the road, his trunk swinging playfully. A speeding vehicle approaches, knocks the baby off his feet. The baby lies on the ground. Pain triumphs and he peacefully lets go of his final breath. His time on earth was short indeed.

His elephant mother cries out loud and rushes to the spot. She pleads her son to get up, to stop fooling around. She pushes with her strong trunk, taps with her legs, but the kid won't open his eyes. She runs to the oncoming vehicles. She pleads them to stop. She wants them to help her. But all they could see was an angry elephant determined to crush them to death. And rightly so! These humans had taken away the life of her wee child. Still a toddler, still helpless, still a dependent. They had not grieved with her, offered their apologies or sympathies. They had not been punished by the law, the way they would have been if a human child lay dead on the road.

Was not her son a child too? Was not the life of an elephant a life too? Was not she a mother too?

Were not her grievances as true as a human mother and may be more so?

And yet, all they could see was a wild elephant running with her trunk raised high. All they could think was of their own safety, of not getting killed by this "wild" elephant.

That's when they intervened; the wildlife department fellows with some police officers. One bound to protect the lives of the animals and the other of the humans. But still, they shot the mother! The helpless, grieving mother! Neither cared for the life of this huge four legged creature who had, moments ago, lost her kid. Where was the wildlife chap and his oath to protect the 'wildlife' or did not this devastated mammalian mum qualify as a wildlife entity?

The gun had no choice. Its trigger had been pulled. It has no conscience to not let go of the bullet within it. But its holder had the conscience lacked by the inanimate gun. He could have made the choice to not pull the trigger.But no! The life in front of him was disposable. And he assumed he could be the one to dispose it. He did not have to face the consequences, for who were the elephants to judge the humans?

I suppose this is justice written in our books. What have we to worry about taking away a life accidently or willingly, as long as they are not human?

Is this ok?

Is this humane?

EXTINCTIONS BEFORE OUR EYES: DO WE CARE ENOUGH?

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It's really disheartening but true: We are now possibly in the middle of the sixth mass species extinction. Our planet is currently facing the worst outbreak of species extinctions after the Cretaceous-Tertiary extinction event, the most well-known event which wiped out dinosaurs 65 million years ago. Although extinction is a natural phenomenon, it occurs at a rate of about one to five species per year under natural conditions. Ecologists estimate we're now losing species at 1,000 to 10,000 times the background extinction rate, which literally let dozens of species towards extinction each day. Calculating extinction rates can be difficult, since no one knows exactly how many species are out there. Scientists have identified at least 1.9 million species and estimated there to be 5 ± 3 million extant species on Earth. The Millennium Ecosystem Assessment, which involved more than a thousand experts, estimated an extinction rate of up to 8,700 species a year, or 24 a day. It could be a scary future certainly, with as many as 30 to 50 percent of all species possibly heading toward extinction withinthe next fifty years.

Past mass extinctions were caused by events like natural climate change, asteroid strikes and volcanic eruptions. But the current crisis

Figure 1: 'Hakka patas' explosives used to scare away elephants and wild boars have become the major killer of globally Endangered Asian Elephant in Sri Lanka. Photograph by: A.T.M. Gunananda

is caused mainly due tohuman actives. In fact, 99 percent of currently threatened species are at risk due to human activities that causehabitat loss, introduction of exotic species, and rapid global warming.

The International Union for Conservation of Nature (IUCN) has assessed roughly 3% or 16,928 described species worldwide arebeing

threatened with extinction. This constitutes roughly 38% of the IUCN assessed species. Vertebrates are vanishing at a rate of 8 to 100 times faster than the recently calculated background rate of 2 mammal extinctions per 10,000 species per 100 years (2 E/MSY).

If we take a look at our country, Sri Lanka is among the 35 bio diversity hotspots along with the Western Ghats of India. Although it is seemingly something to be proud of, a biodiversity hotspot specifically refers to an areawith at least 0.5% of vascular plants recognized as endemics, while it has lost at least 70% of itsoriginal habitat. According to the National Red List 2012 of Sri Lanka, 43% of vertebrates are considered to be nationally threatened and falls in to Critically Endangered (CR), Endangered (EN) and Vulnerable (VU) categories (Table 1). Among

Figure 2: Many Sri Lankan amphibians are threatened mainly due to habitat loss, pollution and rapid global warming. This photograph shows the Critically Endangered Kandian Torrent Toad (*Adenomus kandianus*). Photograph by: L.J MendisWicramasinghe

the evaluated angiosperm plant species, 6.5% are listed as extinct while 61% are listed as threatened. Nearly 37% of the threatened plant species are considered asCritically Endangered (CR). These plants are at high risk of extinction unless current habitat degradation is mitigated.

Table 1: Numbers of the Sri Lankan vertebrate species considered as threatened.

Number of species in each category is subjected to changes due to species discoveries and taxonomic revisions since 2012

	No. of species, National red list 2012 of Sri Lanka				
Vertebrate taxon	Total sp.	CR	EN	VU	Total Threatened
Mammals	121	13	28	19	60
Birds	240	18	18	30	66
Reptiles	211	38	50	17	105
Amphibians	111	35	27	6	52
Freshwater Fishes	91	10	19	5	58
Total	778	114	142	77	341

On a global scale, at present amphibians are highly threatened than birds or mammals with 32.5% being globally threatened compared to 12% of birds and 23% of mammals. The GlobalAmphibian Assessment conducted in 2004 has shown that 34 species of amphibians have faced extinction during the past 500 years. Unfortunately, 21 out of them were from Sri Lanka.

According to the first global assessment of trends in pollinators (2015), on average 2.4 pollinator species per year have moved one Red List category towards extinction in recent decadesThisrepresents a substantial increase in the risk ofextinction for these species. Accordingly in Sri Lanka, out ofthe 149 bee species listed up to date, 75% are under threatened categories. If pollinators disappear, there will be a huge ecological impact. The number and diversity of wild plants couldfall drastically which would adversely affect the fragile balance ofthe whole ecosystem.

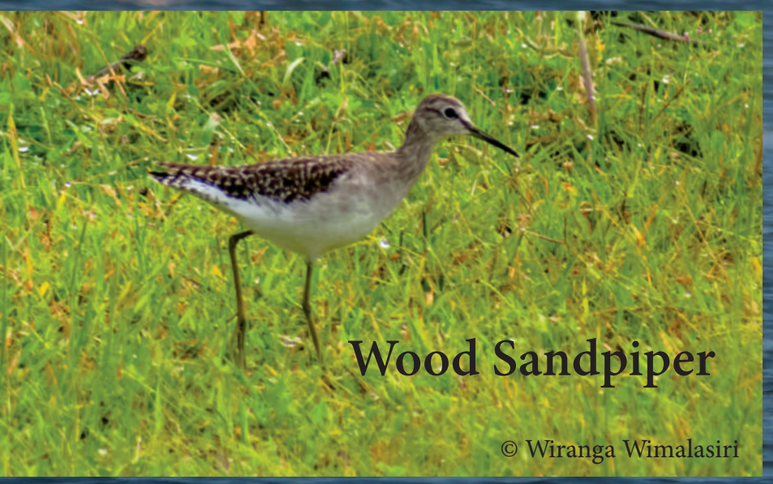
What's clear is that thousands of species are at great risk of extinction in the coming decades. If the current rates of extinction persist, we will soon be bankrupt of many biodiversity benefits. This loss would be undeniablypermanent because after a mass extinction, it takes hundreds of thousands to millions of years to re-diversify. It requireshuge effort at all levels, from individual to global, to halt species extinction and avoid the sixth mass extinction. We must intensifyefforts to conserve already threatened species, toconservetheir pristine habitats, prevent overexploitation for economic gain, and mitigate pollution and global warming.

The clock has already started ticking for the next mass extinction and we are desperately running out of time….

The Nature Gallery

Greater Flamingo

KNOW YOUR BIRDS



Wood Sandpiper

© Wiranga Wimalasiri

Green Bee-eater

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Little Stint

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Indian Roller

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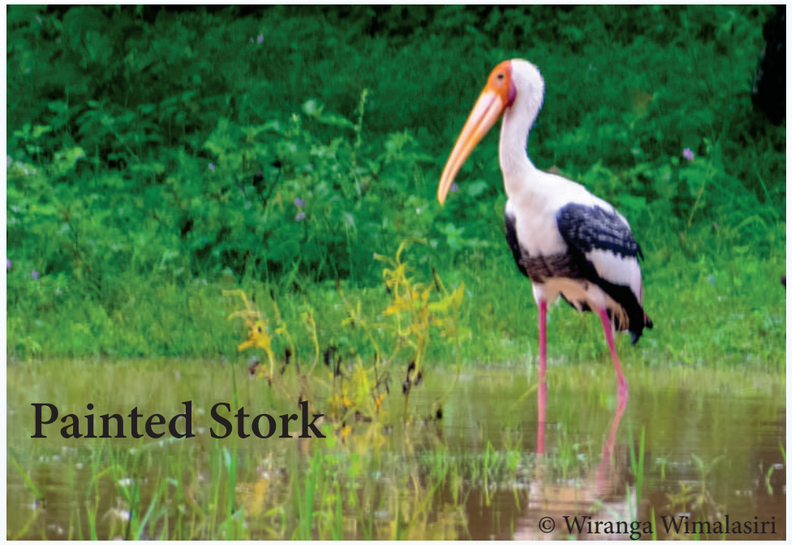
Oriental Magpie-robin

© Hansani Sandukalani



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PRIMATES OF SRI LANKA

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• Who are 'Primates?'

Primates are tremendously diversified mammalian order which includes approximately 350 to more than 625 species. Structurally, primates show very little deviations from the basic primitive mammalian pattern. But, speaking of behavioral differentiations, they exhibit a great variation from other mammalian orders. However, the order primates encompasses six natural groups: the lemurs (Madagascar), the lorises (Africa, South Asia, & Southeast Asia), the tarsiers (Indonesia and the Philippines), the New World monkeys (South and Central America), the Old World monkeys (Africa, Asia) and finally apes (Africa, Asia) and humans (throughout the planet Earth).

• What species do we have?

South Asian Primate report (2003) suggested that, 33 of the 43 primate species are endemic to South Asia. India tops the list with 13 endemic taxa whereas, Sri Lanka harbors five primate species (with four species endemic) comprising 12 distinct subspecies, all of which are endemic to the island (Table 1).

Table 1. Number of primate genera and species present in Sri Lanka

Family	Genera [no of endemic species]	Species [no of endemic subspecies]
Lorisidae	*Loris* [02]	*L. lydekkerianus* [02]
		L. tardigradus [02]
Cercopithecidae	*Semnopithecus* [00]	*S. priam* [01]
	Trachypithecus [01]	*T. vetulus* [04]
	Macaca [01]	*M. sinica* [03]

• Family Lorisidae

Lorises are the only prosomian (primitive primate) group on the island. They are characteristically small, long and slender bodied tailless woolly nocturnal mammals. They possess long limbs, short index finger with secondarily evolved grooming claw, large orbits which are close together in the short rounded skull and wet nose (rhinarium). Female slender loris gives birth to singles or twins. However, there are two genera of Asian lorises: *Loris* (the slender lorises) and *Nycticebus* (the slow lorises). Among that, Sri Lanka provides home only to two species of slender lorises: *L. tardigradus* (endemic to the island and confined to the wet zone of Sri Lanka) and *L. lydekkerianus* (shared by southern India and found in the dry zone of Sri Lanka). Slender lorises live in both dense forest and lighter woodland and are spread fairly evenly throughout the island under four separate subspecies classifications (Color plate 1 and Table 2)

Color plate 1. Four separate sub-species classification of the genus *Loris* inhabits in Sri Lanka.
A: *L. t. tardigradus*
B: *L. t. nycticeboides*
C: *L. l. nordicus*
D: *L. l. grandis*
(© M. de Silva and N. Hapuarachchi)

• Family Cercopithecidae

This family contains all the Old World monkeys and it is divided into two sub-families: the vegetarian colobinae (including colobus monkeys and langurs) and the omnivorous cercopithecinae (including guenons, talapoin, baboons and macaques).

- *Semnopithecus priam* (Hanuman langur/ Tufted grey langur) (Color plate 2):

Once thought to be a wide ranging species but it was separated into seven species with in the Indian peninsula, one sharing with the Sri Lankan island. Subspecies *S. p. thersites* found to be endemic to the country. They inhabit throughout well wooded areas of the country's dry zone, from south of Jaffna, in the North, to the shores of the extreme Southern coast. Sri Lankan form characterized by the tail carriage (highly visible 'S' shape formation when walking). They are large bodied (female 11.2 kg and male 18.2 kg) greyish in colored with black faces, tallest non-human primates in the island. Their long limbs give them a distinct gait and locomotive style known as semi brachiation. This species of langur has a whorl or parting of the hair above its brow, which causes a 'brushed up' fringe. They are semi-terrestrial diurnal species. The social structure is variable, but is usually one male-multi-female or multi male-multi-female. Group size range from 11-64 individuals but it can be up to 125 individuals. Home range size can be from 50-130 ha, with day range length average of 360 m. Primarily grey langurs are folivores but, they feed fruits, flowers and cultivated crops. The age of female at her first birth is about 51 months and birth occurs year round. Gestation period is about 168-200 days.

- *Trachypithecus vetulus* (*Semnopithecus vetulus*) (Purple-faced leaf monkey):

Endemic colobine species to the island. Heavily built body (female 5.5 kg, male 8 kg) with long glossy brown blackish hair is one of the most distinguishable characters of this species. Their faces are dark purplish-black and un-haired. They have very long tail exceeding the head and body. Purple-faced leaf monkey are exclusively arboreal and diurnal. Diet composed mainly of leaves, fruits, flowers and seeds. They are social animals where troop size ranges from 4-40 individuals. But, lone males also have found. Mating season

Table 2. Four separate sub-species classification of the genus *Loris* inhabits in Sri Lanka

Sub-species	Characteristic features	Distribution	Ecology	Social behavior
L. t. tardigradus (The southwestern Ceylon slender loris)	Dp: red-brow with or without a dorsal stripe. Ios: very narrow and white or absent	Wet lowland forests up to 470 m. Southwest part of country from Colombo to Ranna in the South coast	Completely insectivorous even carnivorous. Associated with vines and branches. Seems to require continuous canopy to move between forest patches	Sleeps in groups of up to five individuals. Engaged in intensive grooming sessions at dawn and dusk. Communicate via scent marking and loud calls
L. t.nycticeboides (The Horton plains slender loris)	Dp: brown with no reddish tinge. Fur very long, soft and thick. Ios: white and narrow. Cop: dark chestnut brown	Central Sri Lanka 1500-2000 m montane mist forests	More carnivorous than the lowland sub- species. Associated in cloud forests, montane forests and evergreen forest	Nothing yet known
L. l.nordicus (The northern Ceylon slender loris)	Dp: grey, grey-brown or buff-brown. Cop: dark grey, grey or grey-brown	Confined and occurs throughout the dry zone	Insectivorous or feed on animal prey including lizards and snails. Associated with acacia, bamboo, deciduous dry, edge, scrub and secondary forests	Forages at night alone or in groups of two or three. Grooming is common. Food sharing occur peacefully within the group members
L. l.grandis (The highland slender loris)	Dp: dark grey or grey-brown. More heavily furred than *L. l.nordicus* or L. t. *tardigradus*. Ios: white and bifurcates above the Cop.	Central province (average altitude 900 m)	Mainly carnivorous. Associated with montane, primary evergreen and deciduous rainforest and cloud forest	Probably same as L. l.*nordicus*

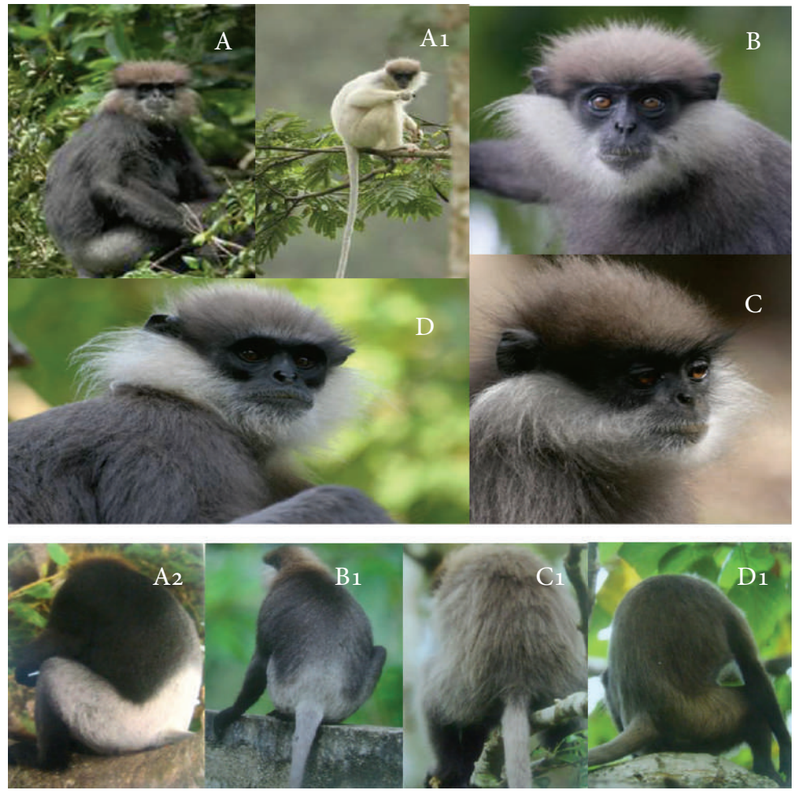
Dp: Dorsal pelage Ios: Inter-ocular stripe Cop: Circumocular patch

Color plate 2. *S. priam* inhabit in dry zone of Sri Lanka (© G. Wijeraththne)

occurs during wet season of the island. A female gives birth to young after reaching her sexual maturity after about 1278 days. Gestation period is about 195-211 days and they give birth to singles or occasionally two. Life span of them is about 26 years. Four sub-species are recognized within Sri Lanka (Color plate 3 and Table 3).

- *Macaca sinica* (Toque monkey):

Endemic species found throughout the island. Among the other *Macaca* species, *M. sinica* is the smallest of all macaques (females 3.5 kg, males 5.3 kg). They are diurnal species that are primarily arboreal but also comfortable in terrestrial life. Toque macaques are basically frugivores, but they also consume flowers, leaves and insects, thus they are considered as opportunistic omnivores. Toque macaques are social animals, living in groups of multi-males and multi-females; the sex ratio typically reflects more females than males in a group with a clear male-dominance social hierarchy system. Troop size range from 8-45 individuals. Size of home range varies, range from 0.17 km2 to 1.17 km2. No distinct breeding season for toque macaques; mating takes place whenever females come into estrus, but births of young peak around February-April.



Color plate 3. Four separate sub-species classification of the genus *T. vetulus* inhabits in Sri Lanka. A: *T. v. vetulus* A1: Galanthus color morph of *T. v. vetulus* A2: Rump patch of *T. v. vetulus* B: *T. v. nestor* B1: Rump patch of *T. v. nestor* C: *T. v. monticola* C1: Rump patch of *T. v. monticola* D: *T. v. philbricki* C1: Rump patch of *T. v. philbricki* (© M. de Silva and N. Hapuarachchi)

Table 3. Four separate sub-species classification of the genus *T. vetulus*

Sub-species	Characteristic features	Distribution
T. v. vetulus (Southern purple faced leaf monkey)	Rr: distinct silvery white furred patch. Dp: grey black hair. Cw: brown or grey-brown furred (Galanthus color morph have been reported)	South wet-zone rain forest from south of Kalu gaga to Ranna
T. v. nestor (Western purple faced leaf monkey)	Rr: less contrasting, large silvery grey furred and diffused patch. Dp: lighter and greyer brown than T. v. *vetulus*. Smallest sub-species	North wet-zone from north of Kalu gaga as these limited rainforest extends. Mainly found in home gardens and they are well adapted to anthropogenic environments
T. v. monticola (Bear monkey)	Very distinct sub-species. Rr: slightly or no distinct rump patch. Dp: brown with a thick pelage. Cw: long and white	High-mountains (altitude about 1200-2000 m including mainly Horton Plains and Hakgala)
T. v. philbricki (Northern purple faced leaf monkey)	Rr: much less conspicuous. Dp: brown furred. Cw: silky and very long. Largest sub-species but not so sturdily built as T. v. monticola	Dry zone of the island including east and north of Matale, into the low country of Kanthale and Polonnaruwa as far west as Paymadu

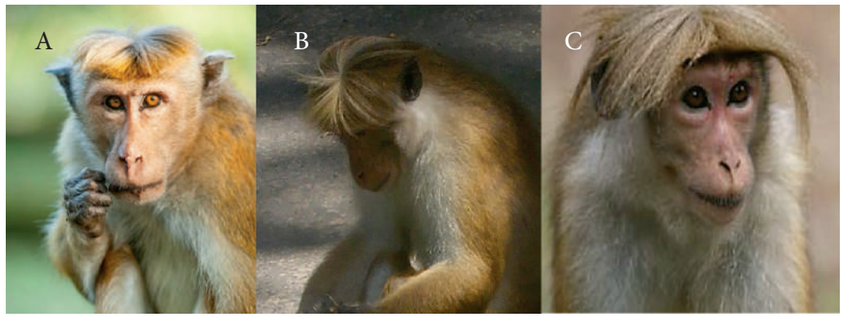
Rr: Rump region Dp: Dorsal pelage Cw: Cheek whiskers

Crown pattern exhibits clear cut of geographic variation and hence it is suitable for sub-specific definition. Thus, three subspecies have been recognized so far which are endemic to the country (Color plate 4 and Table 4).

• Threats and conservation

As Ministry of Environment report (2012) suggested, majority of the endemic and threatened mammals are confined to the wet zone and especially, the montane zone where habitat loss and degradation are taking place at a rapid rate. Fragmentation of habitats also has a detrimental effect on mammal populations, especially small mammals who have low mobility like slender lorises. Expansion of human settlements into forested areas has made wild species into pests such as toque macaques and colobines. Conflicts between human and monkeys have increased nowadays. T. v. *nestor* (Western purple faced leaf monkey) is assed as Critically Endangered and recognized as one of the 25 most endangered primates in the world (IUCN: Primates in Peril report, 2008-2010). *M. sinica*, *L. tardigradus* and *T. vetulus* are assessed as Endangered. The threats to *S. priam* and *L. lydekkerianus* are estimated at Least Concern level which is to be far less severe.

To maximally preserve the diversity of Sri Lankan primates conservation objectives must focus not just on the species as a single taxonomic entity, per se, but also on intra-specific variation. Effective conservation needs firstly: to officially acknowledge the existence and importance of mammal subspecies and secondly, to preserve habitats that are critical to their survival. Moreover, effective management plans such as translocation to hostile habitats are important. Finally, primates based research operations and enhancing the scientific knowledge throughout the general public should increase in order to conserve these graceful, arboreal, woolly mammals in Sri Lanka.



Color plate 4. Three separate sub-species classification of *Macaca sinica* inhabits in Sri Lanka. A: *M. s. sinica* B: *M. s. aurifrons* C: *M. s. opisthomelas* (© BBC Disnie Nature and G. Wijeraththne)

Table 4. Three separate sub-species classification of *M. sinica* inhabits in Sri Lanka

Sub-species	Characteristic features	Distribution
M. s. sinica (The red monkey)	Cap: radiating hairs are shorter and entirely golden brown. Dp: reddish or chestnut colored fur	Northern half of Sri Lanka (in the low country dry zone)
M. s. aurifrons (The dusky toque monkey)	Cap: radiating hairs are longer and generally untidy; anterior part is strongly yellowish and dark brown at posterior part. Dp: dusky chestnut-orange or dusky yellowish colored fur	Throughout suitable areas in the whole wet zone of the country and in the lower hills of the hill zone
M. s. opisthomelas (The mountain toque monkey)	Cap: radiating hairs are much longer (up to 110 mm) and straw colored. Dp: greyish-olive with very little to no red	Central mountains mainly, Horton Plains

Dp: Dorsal pelage

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DO YOU EVER THINK WHY YOUR MOTHER CARES ABOUT YOU, THAN YOUR FATHER...? HERE'S THE ANSWER...

GAYANI DISSANAYAKE

Mothers typically love, care, and support their children more than fathers. Factors like antenatal bonding, hormones, experiences and even our own childhood all interact together to influence the bond between a mother and child.

The relationship between mother and child begin before birth. 'Antenatal bonding' – feeling connected to the unborn baby- is an important predictor of the infant–mother relationship. That emotional bond of mother toward her unborn baby is critical to social, emotional and cognitive development of the baby.

Oxytocin, commonly known as the bonding hormone, is known to be released in large amounts during birth and breast feeding to help regulate maternal bonding in mammals. Oxytocin is a powerful hormone that acts as a neurotransmitter in the brain. It regulates social interactions, playing a role in behaviors from maternal-infant bonding and milk release to empathy and generosity. Oxytocin is the hormone that underlines trust. There are differences between mothers and fathers in the types of interactions with the baby that seems to produce rises in oxytocin. For mothers, it is behaviors such as baby-talk, staring in to the baby's eyes and affectionate touch. Through these activities oxytocin level increases in the mother and collaterally mother's love increases towards the baby. For FATHERS???

Even though most mothers are busy with other activities, mainly to find more money for the family, they still stay home with the children more often than fathers. Factors (cooking food for her children, helping with school work, playing together , storytelling and discussions about daily activities) that strengthen the mother-child bond increase with the time they spend together, so that bond between mother and child increases unawares.

Those are the common factors we know about why mothers care more than fathers about their children. There are other untouched factors about mother's love.

Women can produce only a limited number of children within their life time and raising those children carries its own cost. So they generally cannot afford to increase their reproductive output by capitalizing on additional mating opportunities. Beyond a certain age(menopause), women become incapable of producing children at all. This physiological strategy probably evolved to ensure that women take good care of the few children that they do bear.

When they reach menopause, other avenues of reproduction become practically non-existent for women. So their existing children are their only hope, their only vehicles for passing on their genes. Like it or not, this is perhaps the fundamental biological basis for a mother's exceptional love.

Another reason why a woman invests her resources, time, effort, heart and soul into her offspring is because she can be 100% sure that she's the mother of her children. After all, she's the one who gave birth to her child. The child is essentially a part of her body. She's 100% sure that her offspring contains 50% of her genes.Whereas fathers may not be so sure.

Did you find the answer why your mother cares about you more than your father? Lost additional mating opportunities coupled with paternity uncertainty have shaped the human male psyche to invest slightly less in their offspring than the females. However, thanks to education, cultural values, traditions, religious beliefs and other forms of social conditioning, some males are able to rise above this biological tendency.

ZOOLOGISTS' ASSOCIATION UNIVERSITY OF PERADENIYA

GAYANI DISSANAYAKE

The Zoologists' Association of University of Peradeniya was formed in early 1990's by the undergraduates of the University with the guidance of the Head of the Department of Zoology. The striking feature of the association at the time of its inception was that the membership consisted mostly of non-zoologists, who were interested in the natural history of the country. Thus, conservation of nature and acquisition and dissemination of knowledge on ecosystems and fauna of the Island became the prime interest of the membership. To date the association remains very popular among non-zoologists, as well asZoology students. In fact, some of the office-bearers of the association do not follow Zoology as a subject at the University. The membership of the association has grown over the years with a current membership of more than 200 undergraduates.

The primary aim of the association is to increase awareness of nature among the University community and school childrenandto educate them on nature conservation through visitsto natural ecosystems, wild life reserves and parks and, organizing seminars, talks, workshopson fauna of Sri Lanka. The latest addition to the association's activities is the publication of a student journal 'Protect Nature Sri Lanka", through which we hope to take the message of the importance of protecting nature to the student community.

Following are some of the memories of ZAUP in the years 2017/2018.

Hike to upper Hanthana mountain range with Association of Young Biologists of, Rajarata University

Fund raising program 'sticker stall' at Diamond Jubilee celebration- Open day at Science Faculty

'Introduction to Sri Lankan fauna' talk series

Field visit to Gannoruwa forest reserve

Our beautiful PERA...

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