A survey of herpetofauna on Long Island, Andaman and Nicobar Islands, India

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ABSTRACT - In the last 150 years, herpetological studies in the Andaman and Nicobar Islands have uncovered forty species of terrestrial reptiles and eight species of frogs from the Andaman Islands. However, fine scale information on the distribution and status of the herpetofauna of Andaman and Nicobar Islands is still lacking. In an attempt to fill the gaps in information, as the first in a series, we conducted a short survey of the herpetofauna of Long Island, Middle Andaman. Twenty-nine species were recorded from this small island, including six species of frogs and twenty-three species of squamate reptiles. The efficiency of various sampling techniques used is discussed in the context of the diversity and density of herpetofauna from the Andaman Islands.

STUDIES of the herpetofauna of the Andaman and Nicobar archipelago date back to the mid 19th Century, with the earliest being those of Blyth (1846), Steindachner (1867) and Stoliczka (1870; 1873). Since then, there have been subsequent descriptions of new herpetofauna, studies and reviews (Smith, 1940; Biswas & Sanyal, 1965; 1978; 1980; Tiwari & Biswas, 1973; Das, 1995; 1996; 1997; 1998a; 1998b; 1999; Vijayakumar, 2005; Harikrishnan et al., 2010). The above surveys and studies have accounted for 93 described and extant species of amphibians and reptiles to date. Almost every survey conducted on the islands has found species that are new to science or new distributional records for the islands (see Das & Vijayakumar, 2009; Hallermann, 2009; Harikrishnan et al., 2010). Some surveys have lead to the rediscovery of species that were known only from the original descriptions (Murthy & Chakrapany, 1983; Das, 1997; Vijayakumar & David, 2006). This paper documents a short survey of two months duration on Long Island, Middle Andaman and provides a few noteworthy records.

Long Island is situated east of the Middle Andaman Island at ca. 12.376º N, 92.924º E. The shortest distance between Long Island and Middle Andaman is approximately 1.2 km. The maximum elevation is less than 50 m and it has an approximate area of 14 km^2 (Davidar et al., 2001). It is 7 km long and only 2 km at its widest point. The northern and central parts of the island are covered by tropical evergreen forests, while the southern part is primarily composed of forest plantations and agricultural land. Mangrove forests occur on the northern and western coasts. The terrain is nearly flat and there are no perennial streams, although there are several small channels that function as annual streams during the monsoons. The island receives the southwest monsoon with the bulk of rainfall falling between June and October. Our survey was conducted during the dry summer months and rainfall occurred only during the last few days of the survey.

MATERIALS AND METHODS

Surveys were conducted from 2 April 2010 to 2 June 2010 both diurnally and nocturnally. We used multiple methods to search for herpetofauna and conclude species richness and abundance for the island. Data were collected using the following five different sampling strategies:

(a) Species richness, encounter rates and relative abundance; We conducted time-constrained visual encounter surveys (VES). Two observers walked through the forest, observing and recording all the individual reptiles and amphibians encountered for one hour at a time. The range of microhabitats examined included rocks, fallen logs, tree trunks, dead bark of trees and streams. We conducted surveys during day and night to record both diurnal and nocturnal species. 'Day' was considered to be

Method	Individuals	Species	Unique Species	Effort (min x 2 observers) Initial/Sample	
VES	494	18	4	0	60
Quadrats	30	5	0	0	30
Pitfall traps	5	3	0	180	5
Glue traps	7	3	0	15	5
Opportunistic	-	23	9	-	-

Table 1. Summary of the methods employed in detecting reptiles and amphibians. Unique species are those that were detected by only one sampling method.

the time between 06:00 and 18:00 and 'night' was 18:00 to 06:00, irrespective of sunrise and sunset. we adopted these time distinctions because even though the islands are situated at eastern latitude, they follow the Indian Standard Time (IST). We used the number of person-hours of sampling to derive encounter rate of a species per hour.

(b) Density and species richness of forest floor herpetofauna: We laid quadrats of 5 × 5 m at random points along trails and at varying distances and directions using a nylon rope. Each quadrat had its closest edge at the random point taken from the trail, and the other corners diverged away from it. A quadrat took up to five minutes for installation, and any animal that was disturbed or ran away from the quadrat area during this was noted. The quadrats were left undisturbed for 15 minutes to minimize the effect of disturbance caused during installation. Thereafter, two observers approached the quadrat from opposite directions. The quadrat being examined was initially checked for arboreal animals on trees, saplings and climbers up to a height of about 3 m. This was followed by extensive search of the forest floor. Two people searched the quadrat starting from the opposite corners and approached the centre in a clockwise manner to minimize the chances of animals escaping before detection. All leaf litter was moved, rocks turned and fallen logs broken to reveal animals. Dead bark was peeled off from the trunk of trees. The time taken for the completion of a quadrat and the number of species and individuals detected during the sampling were recorded. Since detection probabilities were not evaluated, the density thus obtained was not absolute.

(c) Pitfall traps: This passive sampling technique was deployed for detecting elusive terrestrial and subterranean forms. A pitfall trap array consisted of three buckets, 250 mm deep and 240 mm in diameter, buried in the ground with their rims flush with the ground. A 450 mm high and 15 m long plastic sheet placed across the pits served as the 'drift fence' for guiding animals towards them. The pits were located at 5-m intervals. These pitfall traps were placed continuously both during the day and night time for six days per session and were checked twice daily. After a six-day period, the array was moved to a new location.

(d) Glue traps: Cardboard sheets 200 × 300 mm with a thin layer of mouse glue were used to capture reptiles and amphibians. Ten such traps were placed in a grid of 20 × 10 m at distances of 5 m from each other. Within the grid, glue was placed on substrates that were likely to increase captures, such as near fallen logs or at the base of trees.

(e) Opportunistic records: These were records and observations of species that were obtained incidentally rather than during a specific sampling occasion. Such species records were pooled with that of the other systematic methods to contribute to total species richness data.

RESULTS

Twenty-nine species were recorded comprising six species of amphibians belonging to five genera and three families, and 23 species of reptiles belonging to 20 genera and 8 families. Twelve species (54.5% endemism) of reptiles endemic to Andaman and Nicobar Islands were recorded. All species were identified in the field using published keys or original descriptions. Therefore, identification was provisional and there were several species whose identity is yet to

be confirmed. Table 1 provides a summary of the efficiency of different methods used for sampling.
(a) Species richness, encounter rates and relative abundance: Visual encounter surveys were conducted during both the day and night time for 40.8 man hours and yielded 494 individual sightings of 18 species. Encounter rates and relative abundance for individual species recorded during VES were calculated. *Coryphophylax subcristatus* was the most common species, followed by *Cyrtodactylus rubidus* (Table 2). The results of VES surveys are summarised in Table 2. A list of species recorded for Long Island with the sampling methods that recorded each of them is shown in Table 3.

(b) Density and species richness of forest floor herpetofauna: Following the methods of Scott (1976), 18 quadrats of 5 × 5 m dimension were surveyed which covered a total of 450 m^2. The average time taken to complete examination of a quadrat was 15 minutes (range 7 to 40 minutes). Thirteen of the 18 quadrats (72%) had animal detection. We recorded 30 individuals of 5 species of reptiles from the quadrats. Only forest floor and semi-arboreal species were found during quadrat sampling. Frogs were not detected in any of the quadrats. The mean density of reptiles in quadrats was 1.66 per quadrat, the median values were 1 and 2 (5 times each), and the maximum was eight. The density of forest floor and semi-arboreal reptiles was 0.07 individuals m^{-2} or 700 individuals ha^{-1}.

(c) Pitfall trapping: The pitfall traps were performed for six days in two different locations totalling 12 trap days. Five individual reptiles belonging to three species were recorded using this method. No frog species were recorded in pitfall traps. This was the most efficient method for sampling terrestrial and burrowing forms such as the fossorial skink *Lygosoma* aff. *bowringii*, that was detected just once using other sampling methods. Two other species, *Eutropis andamanensis* and *Coryphophylax subcristatus*, were captured on single occasions in pitfall traps.

(d) Glue traps: Glue traps were highly effective at capturing forest floor reptiles and semi-arboreal reptiles. The ten glue traps captured seven individuals of two species of lizards; *Coryphophylax subcristatus* (n = 6) and *Eutropis andamanensis* (n = 1) during a 12-hour period. The high frequency with which *C. subcristatus* was captured made the traps very difficult to monitor and so they were ceased after 12 hours.

No.	Species	N	Encounter Rate/Hour	Relative Abundance
1	*Coryphophylax subcristatus*	285	6.97	0.57
2	*Cyrtodactylus rubidus*	91	2.23	0.18
3	*Eutropis andamanensis*	22	0.54	0.05
4	*Limnonectes* sp.	22	0.54	0.05
5	*Gekko verreauxi*	17	0.42	0.03
6	*Eutropis tytleri*	15	0.37	0.03
7	*Microhyla* cf. *chakrapani*	12	0.29	0.02
8	*Trimeresurus andersoni*	6	0.15	0.01
9	*Lycodon capucinus*	6	0.15	0.01
10	*Cerberus rynchops*	5	0.12	0.01
11	*Bufo melanostictus*	3	0.07	-
12	*Bungarus andamanensis*	2	0.05	-
13	*Hemidactylus* aff. *platyurus*	2	0.05	-
14	*Xenochrophis tytleri*	2	0.05	-
15	*Hemidactylus frenatus*	1	0.02	-
16	*Kaloula baleata ghoshi*	1	0.02	-
17	*Ingerana charlesdarwini*	1	0.02	-
18	*Phelsuma andamanense*	1	0.02	-

Table 2. Summary of results of VES surveys for 41 person-hours.
N is the total number of individuals of each species.

	VES	Quadrats	Pitfall Traps	Glue Traps	Opportunistic
Amphibians					
Bufo melanostictus	1	0	0	0	1
Limnonectes sp.	1	0	0	0	1
Ingerana charlesdarwini	1	0	0	0	1
Fejervarya cf. *cancrivora*	0	0	0	0	1
*Kaloula baleata ghoshi**	1	0	0	0	0
Microhyla cf. *chakrapani**	1	0	0	0	1
Reptiles					
Varanus salvator andamanensis	0	0	0	0	1
Hemidactylus frenatus	1	0	0	0	1
Hemidactylus cf. *brookii*	0	0	0	0	1
Hemidactylus aff. *platyurus*	1	0	0	0	1
*Gekko verreauxi**	1	0	0	0	1
*Phelsuma andamanense**	1	0	0	0	1
*Cyrtodactylus rubidus**	1	1	0	0	1
Gehyra mutilata	0	0	0	0	1
Hemiphyllodactylus typus	0	0	0	0	1
*Coryphophylax subcristatus**	1	1	1	1	1
Unidentified agamid	0	0	0	0	1
*Eutropis andamanensis**	1	0	1	1	1
*Eutropis tytleri**	1	0	0	0	0
Lygosoma aff. *bowringii*	0	1	1	0	0
Typhlopidae	0	0	0	0	1
*Dendrelaphis andamanensis**	0	0	0	0	1
Lycodon capucinus	1	1	0	0	1
Ptyas mucosa	0	0	0	0	1
*Xenochrophis tytleri**	1	0	0	0	0
Cerberus rynchops	1	0	0	0	0
*Boiga andamanensis**	0	0	0	0	1
*Bungarus andamanensis**	1	0	0	0	1
*Trimeresurus andersoni**	1	0	0	0	1
Total	**18**	**5**	**4**	**3**	**24**

Table 3. Checklist of species recorded from Long Island, with the methods used. Species that are endemic to the Andaman and Nicobar Islands are indicated by *. Blind snakes, Typhlopidae were only identified to family.

(e) Opportunistic records: The maximum number of species was detected opportunistically. The species recorded only through opportunistic records are: *Fejervarya* cf. *cancrivora*, (n = 1), unidentified arboreal agamid lizard (n = 4), typhlopid snakes (n = 2), *Boiga andamanensis* (n = 1), *Hemidactylus* cf. *brookii* (n = 1), *Ptyas mucosa* (n = 3), *Dendrelaphis andamanensis* (n = 16), *Hemiphyllodactylus typus* (n = 2) and *Gehyra mutilata* (n = 1). Two blind snakes (Family: Typhlopidae), an Andaman cat snake (*Boiga andamanensis*) and a lizard resembling the Brook's gecko (*Hemidactylus* cf. *brookii*) were observed crossing a road at night. The green bronzeback (*Dendrelaphis andamanensis*), though very common, was not detected during any of the above sampling occasions but was observed several times while walking along roadsides. Two Indo-Pacific slender geckos (*Hemiphyllodactylus typus*) and the four-clawed gecko (*Gehyra mutilata*) were observed inside an old building.

DISCUSSION

Long Island had relatively high species richness with 23 species of reptiles and six species of frogs. This is probably because of its proximity

Figure 1. *Bufo melanostictus* common Asian toad.

Figure 2. *Kaloula baleata ghoshi* Andaman bullfrog.

Figure 3. *Microhyla* cf. *chakrapani* Chakrapani's narrow-mouthed frog.

Figure 4. *Fejervarya* cf. *cancrivora* mangrove frog.

Figure 5. *Limnonectes* sp.

Figure 6. *Ingerana charlesdawini* Darwin's litter frog.

to the much larger Middle Andaman. From the relatively few quadrats examined, forest-floor reptile density in Long Island appeared to be high. However, this is almost certainly an underestimate, since small open quadrats allow the escape of many individuals before they are detected by researchers (Rodda & Dean-Bradley, 2002). The figures reported herein are thus an index of density, and more intensive sampling is in progress in the Andaman and Nicobar Islands to get a better idea of the true species richness and density of terrestrial herpetofauna. Cases of high densities of reptiles on

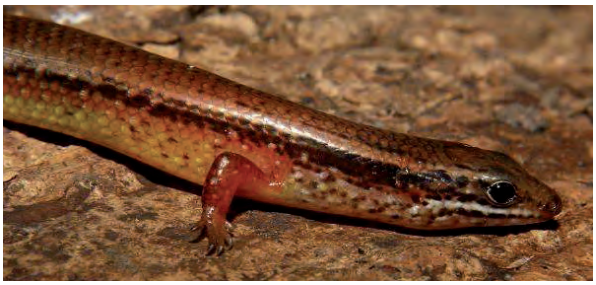

Figure 7. *Lygosoma* aff. *bowringii* Bowring's supple skink.

Figure 8. *Eutropis andamanensis* Andaman litter skink.

Figure 9. *Coryphophylax subcristatus* Bay Island forest lizard. ▲

Figure 10. *Phelsuma andamanense* Andaman emerald gecko. ◄

Figure 11. *Eutropis tytleri* Tytler's litter skink.

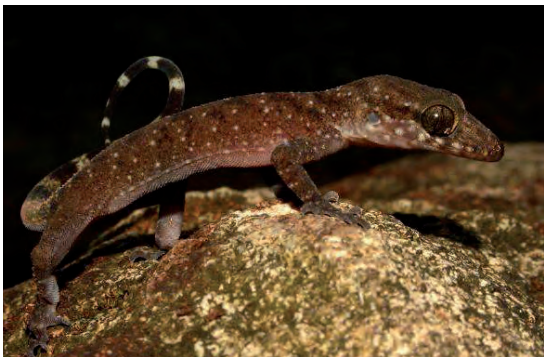

Figure 12. *Cyrtodactylus rubidus*
Andaman bent-toed gecko.

Figure 13. *Hemiphyllodactylus typus*
Indo-Pacific slender gecko.

Figure 14. *Lycodon capucinus*
island wolf snake.

Figure 15. *Cerberus rynchops*
dog-faced water snake.

Figure 16. *Dendrelaphis andamanensis* green bronzeback.

Figure 20. *Xenochrophis tytleri* Andaman keelback.

Figure 20. *Bungarus andamanensis* Andaman krait.

Figure 20. *Trimeresurus andersoni* Andaman pitviper, dark morph (insert - normal coloration).

islands are known from around the world, and the most compelling explanation for this phenomenon is excess density compensation (Case, et al., 1979; Rodda & Dean-Bradley, 2002).

It is also interesting to note that apart from the human commensals such as house geckos (*Hemidactylus frenatus* and *Hemidactylus brookii*), among the forest reptile community only the genus *Eutropis* had more than one species. This pattern is reminiscent of Fox's rule for the assembly of small mammal communities, in that species are added to a community in such a way that every genus in the available pool is represented by at least one species before a second member of any genus is added to the community (Fox, 1989).

Maximum numbers of species were recorded opportunistically, followed by time constrained VES. Though opportunistic encounters and VES seemed to be the most efficient methods to arrive at species richness of the reptile and amphibian

community, they provided meagre quantitative information on the abundance of species. Some species that are common in human habitations, such as green bronzeback *Dendrelaphis andamanensis* and Andaman emerald gecko *Phelsuma andamanense* were not abundant in systematic sampling methods, perhaps because of their preference for more open and disturbed habitats.

An index of density could only be calculated for the limited number (5) of species that were recorded during quadrat sampling. Randomly placed 5 × 5 m quadrats were inadequate in sampling most species of snakes and amphibians. Large and active species of ground-dwelling skinks, Andaman litter skink *Eutropis andamanensis* and Tytler's litter skink *Eutropis tytleri*, were encountered frequently in the forest, but due to their alertness and flight behaviour they were never recorded in the quadrats. Our observations on the behaviour of *Eutropis tytleri* suggest that this species could be predominantly crepuscular and semi-arboreal in habit unlike its other congeners. Nocturnal species such as Andaman bent-toed gecko *Cyrtodactylus rubidus* were often seen living in cracks in the soil close to the roots of trees, and could only be sampled during the day by digging the soil.

Pitfall traps with drift fence were effective in capturing small fossorial lizards that were rarely detected using other methods (e.g. Bowring's supple skink *Lygosoma* aff. *bowringii*). Larger lizards (SVL > 100 mm) could not be sampled using the dimensions of our pitfall traps. The glue traps were highly efficient in capturing animals but it was not logistically possible to use them for long periods. The high frequency with which common species were being captured (e.g. *Coryphophylax subcristatus*) meant that the traps had to be checked at least once every hour. This was a severe logistical constraint, and we suggest that these traps be used only when large numbers of specimens have to be collected.

This short survey has revealed that some species are either new records or potentially new species. An arboreal unidentified agamid lizard we saw resembled *Calotes andamanensis*, a species that was described in the 19th Century and known only from a single specimen. Reports of the Indo-Pacific slender gecko (*Hemiphyllodctylus typus*) from the Andamans remain to be confirmed and further examination of these individuals is required. The supple skink (*Lygosoma* aff. *bowringii*) showed consistent and marked morphological differences from populations in Southeast Asia, and we consider its taxonomy to be incomplete.

The Andaman Islands are part of the Indo-Burma biodiversity hotspot and are vital for the conservation of biodiversity. In the Andaman archipelago, there are about 300 islands and very few have been thoroughly inventoried for terrestrial herpetofauna. Effective conservation and management activities require fine scale knowledge of the distribution of species in this large group of islands. This survey is one small step towards gaining a better understanding of the distribution and status of amphibians and terrestrial reptiles in the Andaman Islands.

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