COMPARISON OF HERPETOFAUNAL DIVERSITY IN THREE WETLAND IN HABITATS THE SOUTH-EAST COAST OF SRI LANKA

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ABSTRACT

This comparative study investigates the diversity of herpetofauna in Rekawa, Kalametiya-Lunama and Walawa wetland habitats in the South-East coast of Sri Lanka. Data were gathered in systematic manner at fortnight intervals during 1st October 2002 to 31st March 2003 in selected habitats in three sites. Fifteen amphibians of four families and 43 reptiles of 15 families were recorded in the study area. The endemic species noted consisted of one amphibian species (Rana gracilis) and five reptile species (Lankascincus fallax, Mabuya madaraszi, Sphenomorphus rufogulus, Lycodon osmanhilli and Xenochrophis asperrimus). A higher diversity of herpetofauna was found in Walawa (Shannon index = 0.233) compared with the other two sites (Rekawa=0.176, Lunama-Kalametiya = 0.223) possibly due to numerous habitats associated with the Walawe River. A number of threats to herpetofauna have been identified, among which clearance of habitats, collecting turtle eggs, spread of alien invasive flora and highway accidents can be highlighted. Sustainable development schemes, awareness programs conducted for the villagers and for the school children and mangrove reforestation are some of recommendation made to conserve the biodiversity of the area including the herpetofauna.

KEY WORDS: Herpetofaunal, Diversity, Rekawa, Lunama-Kalametiya, Walawa estuary, South-east coast, Sri Lanka.

INTRODUCTION

Sri Lanka is an island located in the south-eastern tip of peninsular India, between northern latitudes 5° 55' and 9° 51' and eastern longitude 79° 41' and 81° 51'. The total land area is approximately 65000km^2. The land consists of three peneplains; the first (0-125m), the middle (125-750m) and the third (above750m) (Pemadasa, 1996). The island is divided in to four main climatic zones *viz* wet, dry, intermediate and arid zones according to the annual rainfall and temperature.

In terms of "biodiversity per unit area", Sri Lanka is ranked among the highest in Asia (Bambaradeniya, 2001a) and is considered as one of the 25 global biodiversity hot spots which reports diverse ecosystems resulted from a wide range of topographic and climatic variations (Myers *et al.*, 2000). In fact, the island is a mega hotspot of herpetofauna harboring 103 amphibians and 181 reptiles, out of which several taxa are geographic relicts (Crusz, 1986; de Silva, 2001). Further more, when compared with other countries with high percentage of endemic reptilian taxa, Sri Lanka rank 4th the world (De Silva, 1996).

Sri Lanka having 103 species of amphibians, of which 87 of them are endemic to the island. Ichthyophiidae, Bufonidae, Microhylidae and Ranidae are the families recorded island wide from coastal areas up to highlands (Kirthisinghe,

Pethiyagoda, 1998; *Manamendra*-Arachchi & Pethiyagoda, 2001a; Manamendra-Arachchi & Pethiyagoda, 2001b, Gower & et.al., 2005; Manamendra-Arachchi & Pethiyagoda, 2005; Meegaskumbura & Manamendra -Arachchi, 2005).

According to the published literature, Sri Lanka harbors a total of 81 inland tetrapod reptile species (48 endemic) (Deraniyagala, 1953; De Silva, 1980; Pethiyagoda & Manamendra-Arachchi, 1998; Greer, 1991; Bahir & Maduwage, 2005; Bahir & Silva, 2005; Batuwita & Bahir, 2005) and 82 inland serpentoid reptile species (44 endemic). In addition to the inland reptiles, 13 species of sea snakes and five species of marine turtles occur in the coastal waters of the island (De Silva, 1996). Among the tetrapod reptilia, three endemic genera of skinks (*Lankascincus*-6 species; *Nessia*-8 species and *Chalcidoseps*- 1) and three endemic genera of agamid lizards (*Ceratophora*-5 species; *Lyriocephalus*-1species; *Cophotis*- 1 species) are considered as geographical relicts while one endemic Uropeltid genus (*Pseudotyphlops*- 1 species) and four endemic Colubrid genera (*Aspidura*- 5 species; *Cercaspis*- 1species; *Haplocercus*-1 species; *Balanophis*- 1 species) are recognized as that of serpentoid counterparts (Crusz, 1986; Greer, 1991).

Of the total herpetofaunal species in Sri Lanka, 61% of amphibians (33 species) and 55.4% of reptiles (86 species) have been identified as nationally threatened (IUCN Sri Lanka, 2000).

Study area

Rekawa, Kalametiyá-Lunama lagoon and Walawa estuary are situated in the South-East coast of Sri Lanka (Figure 1). These sites lie between Godawaya (N 06°06'26.2" E081°03'01.1") and Tangalle (N6°02'19.7" E080°48'38.0")

Figure 1. Map showing the study sites; Rekawa, Lunama & Kalametiya and Walawa.

Rekawa is situated on the border of the intermediate and dry climatic zones on the southern coast of Sri Lanka. The prominent feature of the area is that

Rekawa is situated on the border of the intermediate and dry climatic zones on the southern coast of Sri Lanka. The prominent feature of the area is that a large brackish water lagoon surrounded by the extensive mangrove vegetation, which is the dominant vegetation, bordering the lagoon extending over an area of about 250 hectares (Cooray, 1998).

The two interconnected brackish water lagoons,namely Kalametiya (Kalamatiya lagoon is mainly fresh water now) (606 ha) and Lunama (192 ha), both lagoons are parts of the Kalametiya sanctuary. Along the coast there is a low and narrow ridge of sand dunes separating the lagoons from the sea. The highest point of the area is Ussangoda hill, which is 20m above the sea level, and 1 km east of the Lunama Lagoon (CEA/Euroconsult, 1995). Kalametiya lagoon can be roughly be divided into a silted and well-vegetated northern section and a southern part with open water surfaces. The northern section is only inundated during high floods with a maximum water depth of 1.25m (CEA/Euroconsult, 1995). Lunama lagoon does not open into the sea. The lagoon is very shallow with a mean depth of 0.75m. It has a gently sloping bed, but in the south –west, the bank rises more abruptly. The bottom is covered by a thick package of organic matter and aquatic plants (CEA/Euroconsult, 1995).

Walawa estuary is a special habitat for the many of the flora and fauna found in the area. It makes different kinds of habits and vegetations types such as mangrove, marshlands, and bogs. Before reaching to the sea, Walawa River is running parallel with the sea from Godawaya to Welipatanwila. The special feature of the estuary is that its mouth is opened to sea only during the rainy seasons of the year.

This is a preliminary study of the herpetofaunal diversity in Rekawa, Kalamatiya- Lunama and Walawa wetland areas. Being the first comparative herpetofaunal study in the selected area this research will enable to gather valuable baseline data. These eco-systems are highly fragmented and overexploited by man. It is very useful to monitor environmental variables in such a way that ecologists can detect environmental changes and relate the findings with the changes in herpetofaunal populations. For example, if the salinity and water level of a costal lagoon are recorded on a regular basis, an ecologist can extrapolate whether a particular measurement is within the typical range of fluctuations or a significant change has been occurred or being occurred based on ecological parameters (Sutherland, 1996). Amphibians and reptiles are very sensitive to the rapid environmental changes in the eco-systems (Pough *et al*, 2001); doing a survey on currently existing species of these taxa and obtaining data on ecological parameters from respective habitats, the information gathered would be applicable for the evaluation of different ecosystems in the area. Final out put of the study can also be used in continues monitoring of the herpetological diversity in the study area in future.

METETERIALS AND METHODS

The data on herpetofaunal species were gathered from 1st October 2002 to 31st March 2003 systematically. Field sampling was carried out every other week; each sampling session spanned over six continuous days. Each selected site was sampled in the morning, noon, evening and night throughout the study period in order to avoid the time bias for a particular location in the case of transects. Rekawa, Lunama-Kalametiya and Walawa were the selected sites in the study area. Sampling locations were selected in each site considering the accessibility, representative habitats, special habitats and spatial distribution in the study area through an initial reconnaissance survey.

Pit fall traps (Sutherland, 2000) -5 baskets of 12 liter each were set along a belt transect at 20m x 5m. Traps were only activated for three days per a sampling session and were searched in the early morning, noon and late evening. Direct counts used for amphibians individuals at spawning sites in the study area was often used (Sutherland, 2000). Night Sampling was carried out specially for the survey of nocturnal herpetofauna in the study area. The sampling locations were randomly selected and the special habitats were searched from 1900hrs to 2400hrs using a spotlight. The time taken to study each location was dependant on the size of the area. Visual Encounter Method was used for herpetofauna in each site in the day and night (Wickramasinghe and Bambaradeniya, 2001). Belt Transect (100m x 5m transect) was laid in the selected locations in the study sites. Each transect was searched for a 2m height from the ground level. One replicate for each transect was done in an analogous habitat (location). Visual Observation for amphibians and reptiles. were observed during the sampling period. The total number of herpetofaunal individuals recorded at each location throughout the study period was taken into account for calculations.

Following guides and keys were used for the species identification and nomenclature; for amphibians Dutta, Manamendra-Arachchi, (1996) and for reptiles Deraniyagala. (1953). De Silva. (1980). Wall, (1921). Site-specific data gathered during the survey was used to calculate Shannon Index.

RESULTS

Methods distinct habitats were identified in the study area for the herpetofaunal survey. The three study sites. Rekawa, Lunama-Kalametiya and Walawa, supported 8, 9 and 10 different habitats types respectively (Table 1).

Table 1. Selected different habitat in the three study sites.

Rekawa	Lunama- Kalametiya	Walawa
Coastal Sand Dune	Chena	Casuarina
Coconut Plantation	Coastal Sand Dune	Coastal Sand Dune
Grassland	Grassland	Coconut Plantation
Home Garden	Home Garden	Grassland
Mangrove Associated	Mangrove Associated	Home garden
Mangrove True	Mangrove True	Mangrove Associated
Paddy Field	Paddy Field	Marshland
Scrubland	Reed Bed	Paddy Field
	Scrubland	Salt Marsh
		Scrubland

The twenty six herpetofaunal families recorded in Sri Lanka, the study area supported nineteen families. In Rekawa eight families of reptiles and three families of amphibians were recorded. There were nine families of reptiles and two families of amphibians recorded in Lunama-Kalametiya. The highest richness of herpetofaunal families was recorded from the Walawa site, which include families of reptile elevan and three families of amphibians (Table 2.).

Table 2. Herpetofaunal families recorded from the study sites.

* Present - Absent

Family (recorded in Sri Lanka)	Rekawa	Kalametiya-Lunama	Walawa
Reptiles			
Crocodylidae	-	-	*
Dermochelyidae	-	-	*
Cheloniidae	*	-	-
Bataguridae	-	*	-
Testudinidae	-	-	*
Trionychidae	*	*	*
Agamidae	*	*	*
Chamaeleonidae	-	-	-
Gekkonidae	*	*	*
Lacertidae	-	-	-
Scincidae	*	*	*
Varanidae	*	*	*
Acrochordidae	-	-	-
Typhlopidae	-	-	-
Uropeltidae	-	-	-
Boidae	*	-	-
Colubridae	*	*	*
Elapidae	-	*	*
Hydrophiidae	-	-	*
Viperidae	-	*	-
Amphibians			
Ichthyophiidae	-	-	-
Bufonidae	*	*	*
Microhylidae	*	-	*
Ranidae	*	*	*

The study area represented 27% (15) amphibian and 25% (43) reptile species of Sri Lanka (Figure 2). The most common amphibian species recorded was Common Paddy field Frog (*Limnonectes limnocharis*) (242 individuals) while Fan Throat Lizard (*Sitana ponticeriana*) was the most common reptile (62 individuals) recorded in the study area. A rare species of turtle namely Leatherback Turtle (*Dermochylus coreaceae*) was observed in a sand dune in Godawaya while Scaly-fingered Gecko (*Lepidodactylus lugubris*) was also recorded in Rekawa. of fifteen amphibians and fourty three reptiles recorded in the study area, one species of amphibians and eight species of reptile are considered as threatened according to the IUCN national red list (IUCN Sri Lanka, 2000).

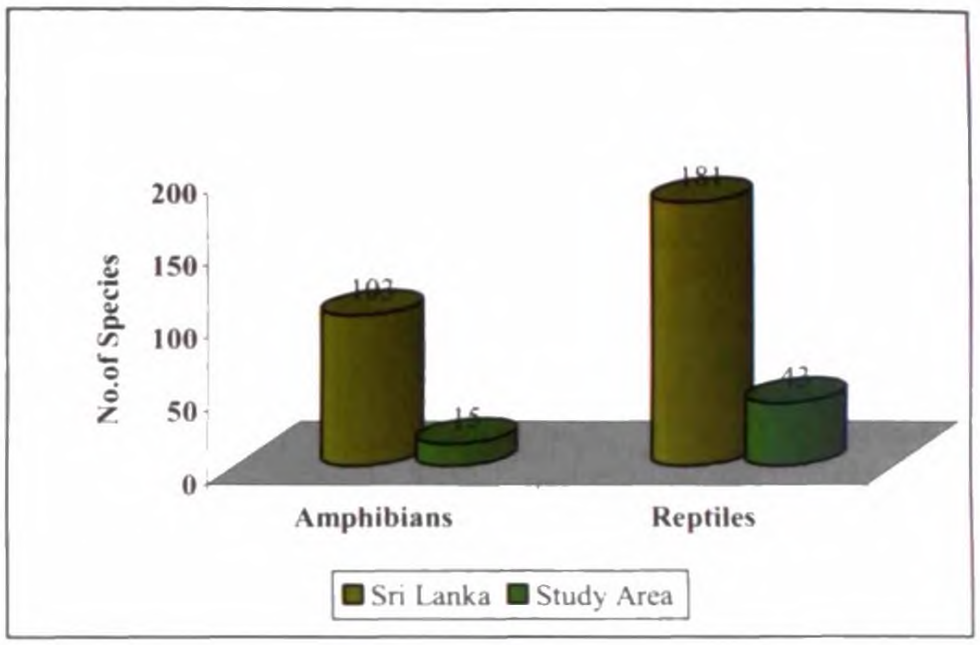

Figure 2. Herpetofauna richness in the study area compared to Sri Lankan herpetofauna richness.

The number of amphibians recorded in the Rekawa, Lunama-Kalametiya and Walawa were ten, six and fourteen species respectively (Figure 3). The reptiles recorded in Rekawa, Lunama-Kalametiya and Walawa were 12, 21and 29 species respectively (Fig. 3). The Shannon diversity index for Rekawa =0.176, Lunama-Kalametiya =0.223 and Walawa =0.233. According to the Shannon diversity index highest species diversity was recorded in the Walawa and the lowest was in Rekawa.

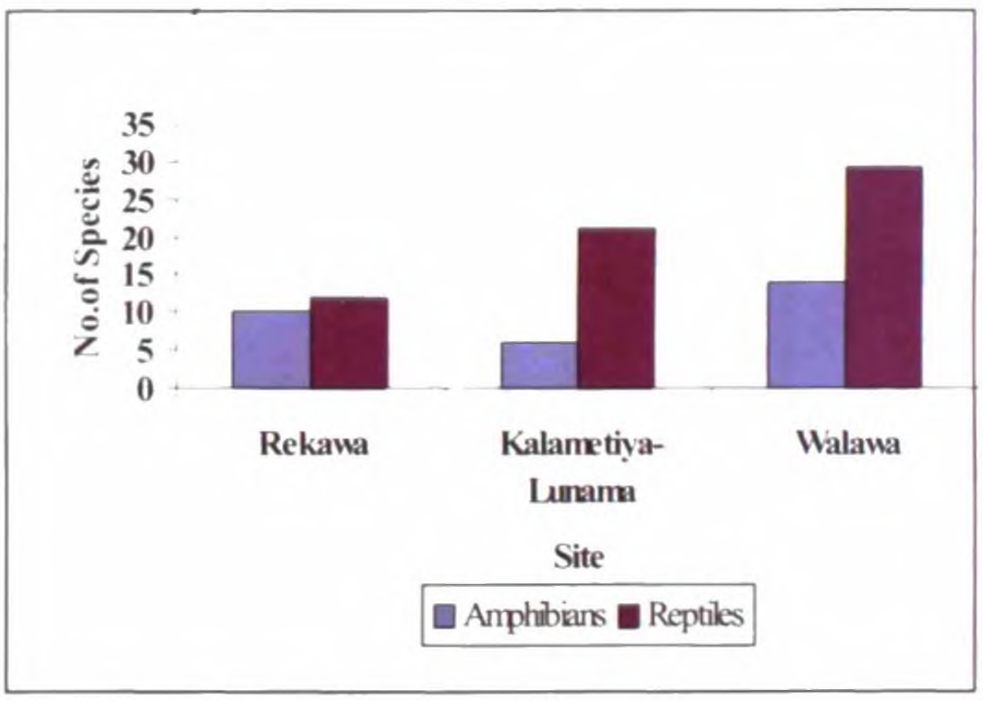

Figure 3. Number of amphibians and reptiles species recorded from the different study sites.

Out of 38 endemic amphibian species recorded Sri Lankan Wood Frog (*Rana gracilis*) was the only endemic amphibian found in the study area whereas of 81 endamic reptile species recorded Common Lanka Skink (*Lankascincus fallax*), Red Throat Little Skink (*Sphenomorphus rufogulus*), *Lycodon osmanhilli*, *Mabuya madaraszi* and Common Pond Snake (*Xenochorophis asperrimus*) were the endemic.

In all eleven different human impacts have been identified as possible threats to herpetofauna in the study area (Table 3.). Clearance of habitats for various needs including settlements, cultivations and industrial developments has

affected the vegetation types of the area resulting in habitat fragmentation. Specific threats such as collecting turtle eggs, intentional killing of snakes and discriminate use of fishing nets contribute for direct loss of herpetofauna. A remarkable number of road kills occurred during late hours especially in the rainy season. However, Lunama-Kalametiya site has severely affected by human interferences compared to other study sites. Following table summarizes the threats to herpetofauna in different sites.

Table 3. Comparative severity of identified threats to herpetofauna in different sites.

Degree of human interference; - Nil + low ++ moderate +++ high ++++ very high

Threat	Rekawa	Lunama-Kalametiya	Walawa
Clearance of habitats	+	+++	++
Shell mining.	-	++++	-
Coral Mining	++++	-	-
Poorly planned irrigation systems	++	+++	-
Discriminate use of agro-chemicals	+	++	++
Feral livestock	+	+++	+
Collection of turtle eggs	+	++++	++++
Intentional Killing	+	++	+
Fishing activities	+	+++	++
Highway accidents	+	+++	+
Spread of alien species	+	++++	+++

DISCUSSION

The reptile fauna of the area occupies a wide range of ecological niches, such as sea (eg: turtles and sea snakes), freshwater (eg: terrapins and mugger crocodile), ground surface (eg: star tortoise and cobra), trees (eg: geckoes and green vine snake and green garden lizard) and soil (eg: Skins). Amphibians are also distributed in every niche except the sea & lagoon (*Limnonectes limnocharis* being aquatic, *Polypedates maculatus* being arboreal, *Bufo fergusonii* being terrestrial and *Sphaerotheca rolandea* being fossorial.)

Some amphibian species such as *Bufo fergusonii*, *Euphlyctis cyanophlyctis* and *Limnonectes limnocharis* were very common in the study area while some were comparatively rare species such as (*Uperodon systoma*, *Kaloula taprobanica*, *Philautus leucorhinus* and *Sphaerotheca rolandea.*) When taking tetrapod reptiles in to the account, *Varanus bengalensis*, *V. salvator* and *Calotes versicolor* were the most common species. *Sitana ponticeriana* was only recorded in Walawa study site restricted to a few habitats *viz* coconut and casuarina plantations and sand dunes. *Dermochylus coreaceae*, *Crocodylus palustris*, *Lepidodactylus lugubris* and *Mabuya madaraszi* were comparatively rare in the study sites. Discussions with the villagers led to conclude that *D. coreaceae* prefers sand dunes of Walawa rather than other sites as the area is relatively less affected by human disturbances. *Python molurus*, *Xenochrophis asperrimus* and

Lycodon osmanhilli were also rare in the area and *X. piscator* was the most abundant snake in the study sites.

A survey on biodiversity status profile of Bundala national park conducted by Bambaradeniya *et al* (2002) revealed fifteen amphibians (1 sp. endemic) and forty eight reptiles (6 spp. endemic) of which one amphibian and thirteen species of and reptiles were listed as nationally threatened. It is interesting to note that Bundala being the closest national park and the wetland to the study area, to have an almost similar herpetofaunal richness.

The diverse habitat types (n=10) in the Walawa river might be the possible reason for a higher diversity in the site. A new sight record of an endemic amphibian, Sri Lanka Wood Frog (*Rana gracilis*), was recorded from a home garden and from a casuarina plantation in Walawa. Another rare observation was made in Godawaya (Walawa) beach; a female leatherback turtle (*Dermochelys coreaceae*) in December 2002.

Sixteen sea snakes are recorded from the coastal waters around Sri Lanka. *Hydrophis cynocinctus, H. gracilis, H. spiralis* were common in Walawa. According to fishermen's experience. abundance of these sea snakes can vary with the season. It is also worth to note that all the individuals found in the study were by catches from fishing nets.

A previous study conducted in Lunama and Kalametiya reported thirty eight species of reptiles and there were no information on amphibians. These include fifteen serpentoids and twenty three tetrapods; ten species were endemic while twenty three species were nationally threatened (CEA/Euroconsult, 1995). The same has recorded *Bungarus ceylonicus, Crocodylus porosus, Calodactylodes illingworthorum, Cyrtodactylus sp., Hemidactylus depressus, Calotes calotes, Dasia helianus, Mabuya beddomei, M. bibronii,* which the present study could not record.

The lowest herpetofaunal diversity was recorded from Rekawa (Fig.3). Five species of marine turtles (*Dermochelys coriacea, Caretta caretta, Lepidochelys olivacea, Eretmochelys imbricata* and *Chelonia mydas*) are recorded in Rekawa (De Silva, 1997) but during the study period *C. mydas* was the only turtle observed. There are few studies have been conducted for sea turtles in the area. Out of the total individuals of turtles nest in Rekawa beach, 93.4% was *C. mydas*, 5% was *D. coriacea* and 1.6% was *C. caretta* during a three months period, May-July 1994 (Cooray,1998).

In Sri Lanka, mangroves are found scattered mainly along the north-western, north-eastern and eastern coasts bordering lagoons and river estuaries (De Silva and De Silva, 1998). The mangrove habitats support to accommodate vast number of fauna and flora and it gives many valuable products and uses such as tannin, lime, animal feed, medicine, food and beverages, firewood and timber and brush pile for lagoon fishery industry (Pinto, 1986). Most of mangrove forest areas have been subjected to human interference for a long time. As a result of human interference, Walawa, Lunama-Kalametiya sanctuary and Rekawa have been profoundly affected by the clearance of these mangrove habitats and associated

vegetations for human settlements, chena cultivations and shell mining. Vast areas of undisturbed natural scrublands have been cleared for the establishment of an industrial zone in the Bata-Atha area, which is an important habitat for many rare herpetofaunal species such as *Calliophis melanurus*, *Geochelone elegans* etc. (pers.obs). In Walawa, coastal sand dunes and scrublands have been cleared for a coconut plantation and this can adversely affect the marine turtles which arrive at the beach in search for nesting habitats. A mangrove patch in Lunama area has been cleared for illegal shell mining. As a result of shell mining, large pits are created in the habitat and this has become a major problem for certain ground dwelling herpetofaunal species especially for terrapins and tortoises. Besides the direct habitat loss. species get trapped in these pits and eventually die.

Fragmentation of habitats results in edges (Hunter, 1990) and this could be a major problem for the survival of herpetofauna species in the area. According to Hunter,(1990) certain species need large tracts of interior forests to outlive and edges might be detrimental for them in which competition, parasitism and predation could be higher and thus problematic. Due to human activities on these habitats the quality of composition and structure of the vegetation is lost and it has a direct impact on the abundance of herpetofauna. From a research on the effect of forest structure on amphibian abundance and diversity in the Chicago region, scientists have concluded that a high quality forest supports higher species richness and diversity than a low quality forest (Nuzzo and Mierzwa, 2000).

Presence of appreciable sea grass beds, coral reefs, lagoons etc along the coastal waters around the island provide ample feeding localities for turtles (De Silva, 1997) and sea snakes (Allen and Steen, 1994). Illegal coral mining in the Rekawa coast line results in lost of feeding, breeding and nesting habitats for many sea snakes and marine turtles.

Establishment of poorly planned irrigation systems in Lunama-Kalametiya area brings silt, agro-chemicals and garbage in to the lagoons and ultimately the drainage is directed to the sea and as a result coral habitats are polluted.

Fishing activities, specially netting, cause direct injuries to the turtles and sea snakes following being trapped. A study on the effect of fishing on turtle populations (Jinadasa,1984) has showed that the sea turtles in the whole stretch of shore from Ambalangoda to Kalpitiya are caught unintentionally about 4-5 individuals per week during the heavy fishing seasons (non monsoon) and about 1 individual during the poor fishing season (monsoon). He further concludes the number caught for the entire country could be about 12 to 15 individuals per week during heavy fishing season and 3 individuals per week during poor fishing season. Not only such fishing activities, but also collecting eggs and slaughtering for human consumption are the other threats pertaining to marine turtle populations (Santhiapillai, 2000, Wickremasinghe, 1981). This problem can be minimized by educating the villagers, fisherman and school children of the respective areas.

Spread of alien invasive species is among the various threats to the biodiversity of Sri Lanka (Bambaradeniya, 2001b). Lunama-Kalametiya and Rekawa lagoons have been threatened by the distribution of *Prosopis juliflora*

primarily and also by *Opuntia dillenii* and *Eichhornia crassipes*.The siltation decreases lagoon capacity and finally silted area is invaded by these monocultures. Due to large herds of cattle and feral buffalo in Ussangoda grassland and scrublands in Ussangoda and Kalametiya, habitat destruction is maximal. Soil erosion and disturbance to the vegetation are the direct results of unlimited grazing and physical damage caused by the hooves.

Major and minor roads running through wetlands cause numerous road kills of diverse herpetofauna species. *X. piscator*, *V. bengalensis* and *L. limnocharis* were the most common species subjected to road kills. Such incidents were recorded more during the rainy season and often wetlands and paddy fields were the associate habitats found besides the roads (Rodrigo *et. al.*, 2003; Bambaradeniya et. al., 2001).

Some of the recommendations made for conservation of the herpetofauna in the area were; 1. Development schemes proposed in the area should be preplanned in order to minimize habitat destruction and to maintain habitats in a sustainable manner. 2. Mangrove reforestation can be implemented in the lagoons and estuaries of the area. 3. Awareness programs should be conducted for villagers and school children regarding every aspect of conservation (including herpetofauna and pertaining legislations). 4. Sign boards regarding animal crossing areas and underground tunnels connecting habitats on either side of the roads should be set to minimize the road kills.

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