



CURRENT STATUS OF FAUNAL DIVERSITY IN BELLANWILA – ATTIDIYA SANCTUARY, COLOMBO DISTRICT - SRI LANKA

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Abstract

The present survey shows the biodiversity decline in Bellanwila - Attidiya Sanctuary (BAS). A total of 152 species of vertebrates and 75 species of butterflies are recorded from BAS. Sixteen of these species are endemic, and five of them are nationally threatened. Vertebrates represent 11 amphibians, 27 reptiles, 22 fresh water fishes, 78 birds and 14 mammal species. Habitat destruction, industrial toxic waste and garbage dumping are the major threats to the biota of the BAS.

Key words: Wetland, Biodiversity decline, Threats, Endangered species, Colombo, Conservation

Introduction

Sri Lanka is not isolated from the current global period of mass extinctions (Achard *et al.*, 2002; Jenkins, 2003). Many species of animals, plants and other organisms are disappearing by the direct or indirect human activities in the planet: deforestation (Brook, *et al.*, 2003; Ferraz *et al.*, 2003; Pethiyagoda, 2005, 2007a), global warming (Alfred *et al.*, 2007; Harvell *et al.*, 2002; Rosa *et al.*, 2007), invasive alien species (Elton, 1958). Pollution (MacNeely, 1992), fire (Batuwita & Bahir, 2005;

Swinbanks, 1997), erosion (Hewawasam *et al.*, 2003), agro chemical use (Hayes *et al.*, 2002; Pethiyagoda, 1994), infectious diseases (Daszak *et al.*, 2000; Pounds *et al.*, 2006) and lack of systematic or scientific understanding (Pethiyagoda, 2007b; Bahir, 2009; Bahir & Gabadage, 2009a,b). Already in Sri Lanka, known extinctions include many plants and trees (Pethiyagoda, 2005), twenty-one amphibian species (Stuart *et al.*, 2004; Manamendra-Arachchi & Pethiyagoda 2005;

Meegaskumbura *et al.*, 2007) and two freshwater fish extinctions from Sri Lanka (Pethiyagoda, 1994; Pethiyagoda *et al.*, 2008b).

Because of the paucity of biological inventory in many regions of the country, other extinctions may have gone unnoticed. Indeed, since new species are still being described, it is possible that some species may go extinct before becoming known to science. It is alarming that human population density in our biologically richest wet zone is one of the highest on earth. Also, the population is growing more rapidly than average around protected areas (Wittemyer *et al.*, 2008), a trend that seriously threatens the remaining biodiversity trapped in forest reserves and this is perhaps true for Sri Lanka. Although the Western Ghats and Sri Lanka is a biodiversity hotspot for conservation priorities (Myers *et al.*, 2000; Mittermyer *et al.*, 2004), unfortunately it is one of the most populous identified (Cincotta *et al.*, 2000). Recent research highlighted the uniqueness of the Sri Lankan fauna from the mainland (Bossuyt *et al.*, 2004; Bossuyt *et al.*, 2005; Helgen & Groves, 2005). Therefore, we need to conserve and protect our natural wealth more aggressively than we have so far.

Several Sri Lankan animal and plant taxa not only contain assemblages of endemics, but these sometimes constitute old branches or distinct clades of the tree of life (Bossuyt *et al.*, 2004; Roelants *et al.*, 2004). This is significant because radiations of tens of species are found exclusively on Sri Lanka (Bossuyt *et al.*, 2005; Gunawardene *et al.*, 2007; Helgen & Groves, 2005; Meegaskumbura *et al.*, 2002). Therefore, conservation managers could treat these clades of animals and plants as the island's major natural treasure (Bossuyt *et al.*, 2005). Protecting these endemic taxa as "umbrella species" would result in protection of other rare and endangered species. It is in that perspective noteworthy that Sri Lanka's diversity largely restricted to the formerly rain-forested southwestern wet zone, knuckles mountains and the central hills where only a little natural forest with many of the endemics now survive, beset by invasive alien species of plants and surrounded by plantations and settlements. The threats to the unique biodiversity recognized and the challenges to its conservation are therefore formidable and demand urgent international and national level scientific attention, policy and planning. It is our own responsibility to conserve our natural heritage without any delay.

Sri Lanka has various wetland ecosystems, both natural and man-made, that support its biodiversity (Bambaradeniya, 2002). The importance of conservation of wetland ecosystem is recognized globally. Wetland habitats are highly productive and diverse communities that lie between terrestrial and aquatic environments (Goonatilake *et al.*, 2001). Wetlands in Sri Lanka, covering 274, 000 ha, may be categorized as; inland freshwater wetlands (rivers, streams, marshes, swamp forest, villus), saltwater wetlands (lagoons, estuaries, mangroves, sea grass beds, coral reefs), man-made wetlands (tanks, reservoirs, rice fields, salterns) (IUCNSL, 2004).

Bellanwila-Attidiya Sanctuary

Bellanwila-Attidiya Sanctuary (BAS) is listed in the directory of Asian wetlands by the IUCN in 1989 and designated as an Important Bird Area by Birdlife International (www.birdlife.org, accessed 7/8/2009). It was declared a sanctuary under the fauna and flora protection ordinance by gazette extraordinary No. 620/9 of 25th July 1990 (Gunawardana, 1991). BAS is situated within the upper catchments of the Bolgoda river basin. The core study area is roughly 1–2 km x 0.5 km (nearly 372 ha), at a mean elevation of 0.6 m above sea level. BAS area lies at the intersection of 6° 48'–52' N and 79° 52'–56' E (IUCNSL & CEA, 2006; Maduranga, 2005). This area is situated within the low country wet zone and has a tropical monsoonal climate (Gunatilleke & Gunatilleke, 1990). Mean annual temperature is approximately ~28 °C and average annual rain fall for the study area is about 2800 mm (CEA / Euroconsult, 1993).

The Bellanwila-attidiya sanctuary was surveyed by various conservationists and scientists from the early 1980's (CEA / Euroconsult, 1993; Dissanayaka & Mahaulpaha 2006; Goonatilake, 1998; Goonatilake *et al.*, 2001; Gunatilleke, 1992; Gunawardana, 1991; Henkanaththegedara *et al.*, 2005; Maduranga, 2005; Nalinda, 1988; Nanayakkara, 1988). The BAS marsh consist of several habitat types which can be categorized as shallow freshwater ponds, canals, marshes, seasonally flooded grasslands, scrublands, and paddy fields. The survey was expanded to include a man-made reservoirs, home gardens, scrublands and grasslands immediately outside its boundary (Henkanaththegedara *et al.*, 2005). The vegetation of BAS area is mainly composed of rooted emergents such as *Rhynchospora* sp., *Eleocharis* sp., and grasses such as *Brachiaria* sp., *Bacopa* sp. that grow extensively along the fringes of ponds

(Maduranga, 2005). The water surfaces are covered with *Salvinia molesta*, *Eichhornia crassipes* and flowering ornamental species such as *Nymphaea* sp. and *Nelumbo nucifera*. The margins of marshy areas and the banks of the canal are covered with mixed vegetation of *Annona glabra*, *Cerbera manghas*, *Syzygium* sp., *Melastoma* sp. (Henkanaththegedara *et al.*, 2005). Invasive alien species such as *Lantana camara* are also common.

Materials and Methods

Data were collected from random field observations during a number of visits from June 2005 to June 2006 (one year study). A summary of these data were previously posted on the Environment Sri Lanka Blog (Karunaratna, 2008). Visual encounter survey methods were used in preparing this faunalist. The fish faunal data were collected from the catches of fishermen using cast nets, hooks, ropes and gill nets. In addition, fish in shallow areas were sampled by using small trawl nets and hand nets. The avifaunal data were collected by using a standard binocular, and by calls and songs. Mammal fauna were documented through direct observations and indirect methods (eg. foot prints). Amphibian and reptile (Herpetofauna) data were assembled by collecting road kills and specimens killed by villagers and by searching under logs, stones and boulders. Several nocturnal field visits were also made in walking throughout the study area. Some small butterflies were captured using a butterfly net and closely observed using a clear glass bottle.

Vertebrates and invertebrate species were identified and classified by using published field guides (for freshwater fishes – Maduranga (2003), Pethiyagoda (1991), but later some species were confirmed by Silva *et al.* (2008; 2010), Pethiyagoda *et al.* (2008a; 2008c); Amphibians – Dutta & Manamendra-Arachchi (1996), Manamendra-Arachchi & Pethiyagoda (2005), Manamendra-Arachchi & Pethiyagoda (2006); Reptiles – Das & de Silva (2005), Deraniyagala (1953; 1955), de Silva (1990), De Silva (1980), Whitaker & Captain (2004); Birds – Harrison (1999), Rasmussen & Anderton (2005); Mammals – Phillips (1980); Butterflies – D’Abrera (1998), Woodhouse (1952), Kunte (2006). Threatened categories were assigned according to IUCNSL & MENR (2007) and some floral species were identified by Ashton *et al.* (1997).

Threats

Considerable land area of BAS wetland has been lost due to:

- (01) Habitat fragmentation
- (02) Changes in water level that degraded native vegetation habitat and provided access for invasive native and non-native weeds and accelerated the succession decline of BAS habitat.
- (03) Excess run-off of sediment, fertilizer, industrial waste, human sewage, animal waste, road salts, pesticides, heavy metals, leakage from landfills and dumps, toxic pollutants and nutrients that pollute wetlands and it exceeded the wetland's natural ability to absorb such pollutants and cause degradation. The extra nutrients are rapidly taken up by some types of aquatic plants such as *Eichhornia crassipes*. As the numbers of these plants increase, they become dominant over plants living on the sediment.
- (04) Plant and animal pest invasion.
- (05) Livestock grazing in surrounding catchments and in the BAS wetlands that damages vegetation, decreases soil stability and adds to pollution.
- (06) Loss of natural character (i.e. the natural appearance of wetlands in the landscape) and changes in plant dominance have profound effects on the animals that depend upon aquatic environments as a source of food and refuge and as a nursery for their young.
- (07) Hunting and carelessness human activity disturbs plant and animal life and may destroy parts of the physical wetland environment.
- (08) Inappropriate use of surrounding land in a catchment (eg. poorly managed farming practices causing sedimentation and/or fertilizer run-off).
- (09) Land filling and drainage of wetlands for urban or rural development.

Although legislation has greatly slowed wetland loss, the above sources of degradation continue.

Results and Discussion

The present study, the first to comprehensively document biodiversity within BAS, recorded 152 species of vertebrate fauna, 75 species of butterflies from BAS (Table - 1). Of the total number of species recorded, 16 (7%) are endemic, while 5 (~2.2 %) are nationally threatened (IUCNSL & MENR, 2007). The vertebrates comprised 11 (7.2%) species of amphibians, 27 (17.8%) species of

reptiles, 14 (9.2%) species of mammals, 78 (51.3%) species of birds, 22 (14.5%) species of fishes. Birds were the most abundant faunal group in Bellanwila-Attidita Sanctuary, according to the present survey;

amphibian and mammals were the least abundant faunal groups. Among them 12 (5.2%) are near threatened and 4 (1.7%) species are data deficient.

Table 01: Faunal diversity of Bellanwila-Attidiya Sanctuary and its vicinity BAS

Taxa	No. of Families	No. of Genera	Endemic Genera	No. of species	Endemic species	Threatened species
Amphibians	5	10	0	11	3	0
Birds	38	68	0	78	4	0
Fishes	11	12	0	22	2	1
Mammals	9	11	0	14	0	1
Reptiles	10	22	2	27	6	0
Butterflies	5	55	0	75	1	3
Total	78	178	2	227	16	5

The amphibians consisted of 11 species (3 endemics) belonging to 5 families (Appendix - 1), including toads, narrow-mouthed frogs, aquatic frogs and tree frogs. These represented approximately 10.1% of the total amphibian species in the island. Among them, 5 species are very common, they are *Duttaphrynus melanostictus*, *Euphlyctis cyanophlyctis*, *Euphlyctis hexadactylus*, *Hoplobatrachus crassus* and *Philautus popularis*, while 3 species are very rare at BAS, they are *Microhyla rubra*, *Hylarana gracilis* and *Polypedates cruciger*. Most of these species could be observed after a short spell of rain at night. However, no nationally threatened species were recorded in the BAS. According to Goonatilake *et al.* (2001) 15 species of amphibians were recorded in BAS area, but we failed to record *Duttaphrynus atukoralei*, *Hylarana aurantiaca*, *Sphaerotheca rolandae*, *Philautus leucorhinus* and *Philautus variabilis*. The latter 2 species are currently known as extinct. *Philautus popularis* was the only shrub frog recorded in BAS. Amphibians play a vital role in the functioning of natural ecosystems. Because they consume a large biomass of insects they act as natural control agents of pests in both human settlements and agricultural landscapes.

The reptiles consisted of 27 species (6 endemics) belonging to 10 families (Appendix - 2), covering 13% of the island reptiles fauna. These included 11 species of tetrapod reptiles and 16 species of Serpentoid reptiles. Among the total species, 2 species are near threatened. *Calotes calotes*, *Calotes versicolor*, *Gehyra mutilata*, *Hemidactylus*

parvimaculatus, *Hemidactylus frenatus*, *Ptyas mucosa*, *Varanus bengalensis* and *Varanus salvator* were the most common reptiles at BAS. *Oligodon sublineatus*, *Sibynophis subpunctatus* and *Xenochrophis asperrimus* are very rare in BAS. According to Nanayakkara (1988) 30 species of reptiles were recorded in BAS, but we failed to record *Python molurus*, *Acrochordus granulatus*, *Lycodon striatus*, *Oligodon arnensis*, *Dendrelaphis bifrenalis*, *Cerberus rynchops*, *Hypnale hypnale*, *Lissemys punctata* and *Crocodylus porosus* species. The snakes, both venomous and non-venomous, are widely killed in BAS due to fear and ignorance, as a precaution against snakebite. Also, several road kills were recorded during the study period, such as: *Cylindrophis maculata*, *Coeloganthus helena*, *Oligodon sublineatus* and *Sibynophis subpunctatus*. But no record of any sea snake species in the BAS area. The reptile family in which the largest number of species was recorded was Colubridae.

A total of 14 species of mammals, belonging to 9 families, were recorded in BAS (Appendix - 3), covering 13.9% of the island mammal fauna. These include the vulnerable *Prionailurus viverrinus*. No endemics were recorded. The mammals have diverse food habits, and could be categorized as granivorous, frugivorous, carnivorous and insectivorous. *Pteropus giganteus*, *Herpestes brachyurus*, *Herpestes edwardsii*, *Bandicota bengalensis*, *Bandicota indica*, *Rattus rattus* and *Funambulus palmarum* were the most common mammals, while *Kerivoula picta* and *Hystrix indica* were very rare in BAS. According to Goonatilake

(1998), 27 species of mammals were recorded in BAS area, but we failed to record *Lutra lutra*, *Moschiola kathygre*, *Canis aureus*, *Prionailurus rubiginosus*, *Mus musculus*, *Golunda ellioti*, *Lepus nigricollis*, *Semnopithecus vetulus*, *Rousettus leschenaultia*, *Cynopterus sphinx* and *Hipposideros ater*. The rats are often considered as pests because they feed or damage the food and cultivations. A *Hystrix indica* individual was captured from a canal bank in BAS. The Painted bat is one of the most significant records within this area.

A total of 22 species of fish, belonging to 11 families, were recorded in BAS (Appendix - 4), covering 18.2% of the island fish fauna. Few native species were recorded in study area; most were non-native, such as the invasive alien species *Pterygoplichthys multiradiatus*. Out of these 22 species, 1 is vulnerable, 1 is near threatened, 1 is data deficient and 2 are endemic. The fish fauna is mainly based in the Thel Ela and Katu Ela area at BAS and others are around the Bellanwila temple. The most common fish species are *Oreochromis mossambicus* and *Pterygoplichthys multiradiatus*, while *Lepidocephalichthys thermalis* and *Puntius chola* are rare in BAS. These fish form an important component of the diet of aquatic birds such as *Pelecanus philippensis* and *Phalacrocorax fuscicollis* in BAS. According to Maduranga (2005) and Nalinda (1988), 33 fish species were recorded in BAS area, but we failed to record *Megalops cyprinoides*, *Amblypharyngodon melettinus*, *Esomus thermoicos*, *Rasboroides atukorali*, *Puntius vittatus*, *Mystus keletius*, *Clarias brachysoma*, *Aplocheilichthys dayi*, *Laubuca* sp., *Etroplus maculatus* and *Channa orientalis*. Water pollution is major threat to the survival of fishes and habitat loss due to the reclamation of land and destruction of vegetation. It is a fact that the exotic species become dominant in a new habitat when the environmental conditions are conducive. Due to anthropogenic activities, the habitat quality for the resident species might become less favourable so that the exotic species might get a competitive advantage to become an invasive species. According to Vale'ry *et al.* (2008), a biological invasion consists of a species' acquiring a competitive advantage following the disappearance of natural obstacles to its proliferation, which allows it to spread rapidly and to conquer novel areas within recipient ecosystems in which it becomes a dominant population.

Birds appeared to be the dominant group of vertebrates at BAS, consisting of 78 species (4 endemics) belonging to 38 families (Appendix - 5).

BAS has is a paradise for birds, including many migratory species, and these represented approximately 15.8% of Sri Lankan avifauna. Among the total species, 9 winter migrants were recorded, while 1 species (*Pelecanus philippensis*) is globally threatened and 2 species are near threatened. But we fail to record some interesting birds such as, *Pellorneum fuscicapillus*, *Plegadis falcinellus*, *Pomatorhinus melanurus* and *Caprimulgus asiaticus* in this study. The mixture of vegetation types and aquatic habitats in BAS has made it an ideal ecotone for a variety of birds, where about half of the birds species recorded were those associated with wetland ecosystems, such as herons, egrets, cormorants, kingfishers and pelicans, all which feed on aquatic organisms. This area an important breeding habitat of native birds, and it is also a preferred feeding and resting habitat of several species. Most significant record was Chestnut-winged cuckoo in single time. *Megalaima zeylanica*, *Halcyon smyrnensis*, *Centropus sinensis*, *Psittacula krameri*, *Mesophoxys intermedia*, *Ardeola grayii* and *Columba livia* [domestic (but according to IUCN & MENR, 2007 it is critically endangered)] were very common birds, while *Spilornis cheela*, *Picus chlorolophus*, *Megalaima flavifrons*, *Anhinga melanogaster*, *Dupetor flavicollis*, *Ducula aenea*, *Haliaeetus leucogaster* and *Pelargopsis capensis* were very rare at BAS. According to Gunawardana (1991) 153 species of birds were recorded in BAS, but we failed to record even half of them.

We recorded a rich array of butterflies in BAS, including 75 species, belonging to 5 families (Appendix - 6). The butterflies represented approximately 30.9% of the total species in the island; 1 species is endemic, 3 species are nationally threatened and 7 species are near threatened. The butterflies are a group of charismatic insects in Sri Lanka, which forms a major component of the island's biodiversity. Among them, *Papilio domoleus*, *Graphium Agamemnon*, *Leptosia nina*, *Delias eucharis*, *Catopsilia pyranthe*, *Eurema hecabe*, *Danaus genutia*, *Junonia atlites*, *Telicota colon*, *Acraea violae*, *Ypthima ceylonica*, *Jamides celeno* and *Zizula hylax* were the most common. *Eurema blanda*, *Spalgis epeus*, *Curetis thetis*, *Zesius chrysomallus*, *Troides darsius*, *Tajuria cippus*, *Charaxes solon*, *Rathinda amor* and *Hypolycaena nilgirica* were rare at BAS. According to Gunatilleke (1992) and Henkanaththegegera *et al.* (2005) 61 and 70 were recorded in BAS respectively, but we failed to record *Chilades pandava*, *Lampides boeticus*, *Nacaduba sinhala*,

Elymnias singala, *Mycalensis mineus*, *Vanessa cardui* and *Eurema brigitta* species. The distribution of the butterflies in various habitat types needs further investigation and this study is just a beginning and paves the way for further studies. The highest diversity of butterflies was recorded from the open scrub jungles while the lowest close canopy habitats. The largest number of species was from the family Nymphalidae (28 sp.), followed by the families Lycaenidae (19 sp.), Papilionidae (11 sp.), Hesperidae (11 sp.) and Pieridae (6 sp.).

In each taxon, we failed to record all species that had been recorded in previous studies. In some cases, this might be because the previous studies were more thorough or better sampled all types of habitats and seasons. However, it could also be that the continuing habitat deterioration and encroachment of settlement and human activities, persecution of snakes has actually extirpated some of the species that formerly occurred here. This is certainly the case with the 2 species of amphibians noted above as extinct. We believe that most of the species “missing” in this survey have, in fact, been locally extirpated from the Bellanwila–Attidiya Sanctuary. The habitat deterioration, extinction of at least 2 species (if confirmed by more extensive surveys) and local extirpation of many species, have been caused by poor protection, resulting in the “deplorable state of the Bellanwila–Attidiya Sanctuary, beset on all sides by unauthorized construction, garbage dumping and unsustainable livelihoods...” (Amaleeta, 2006).

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Appendix 01: List of the Amphibian species recoded from Bellanwila-Attidiya sanctuary (BAS). (Abbreviation: **E** – Endemic species).

Species Name	Common Name
Family - Bufonidae	
1 <i>Duttaphrynus melanostictus</i>	Common house toad
Family - Dicroglossidae	
2 <i>Euphlyctis cyanophlyctis</i>	Skipper frog
3 <i>Euphlyctis hexadactylus</i>	Sixtoe green frog
4 <i>Fejervarya limnocharis</i>	Common paddy field frog
5 <i>Hoplobatrachus crassus</i>	Jerdon's bull frog
Family - Microhylidae	
6 <i>Kaloula taprobanica</i>	Common bull frog
7 <i>Microhyla rubra</i>	Red narrow mouth frog
8 <i>Ramanella variegata</i>	White-bellied pugsnout frog

CURRENT STATUS OF BELLANWILA–ATTIDIYA SANCTUARY

Family - Ranidae

9 *Hylarana gracilis* Sri Lanka wood frog ^E

Family - Rhacophoridae

10 *Philautus popularis* Common shrub frog ^E

11 *Polypedates cruciger* Common hour-glass tree frog ^E

Appendix 02: List of the Reptile species recoded from Bellanwila-Attidiya sanctuary (BAS). (Abbreviations: **NT** – Near Threatened Species and **E** – Endemic species).

Species Name	Common name
Family - Bataguridae	
1 <i>Melanochelys trijuga</i>	Parker's black turtle ^{NT}
Family - Agamidae	
2 <i>Calotes calotes</i>	Green garden lizard
3 <i>Calotes versicolor</i>	Common garden lizard
Family - Gekkonidae	
4 <i>Gehyra mutilata</i>	Four-claw gecko
5 <i>Hemidactylus parvimaclatus</i>	Spotted housegecko
6 <i>Hemidactylus frenatus</i>	Common house-gecko
Family - Scincidae	
7 <i>Lankascincus fallax</i>	Common lankaskink ^E
8 <i>Lygosoma punctatus</i>	Dotted skink
9 <i>Eutropis carinata</i>	Common skink
Family - Varanidae	
10 <i>Varanus bengalensis</i>	Land monitor
11 <i>Varanus salvator</i>	Water monitor
Family - Cyliodrophidae	
12 <i>Cylindrophis maculata</i>	Sri Lanka Pipe snake ^{E/NT}
Family - Colubridae	
13 <i>Ahaetulla nasuta</i>	Green vine snake
14 <i>Amphiesma stolata</i>	Buff striped keelback
15 <i>Atretium schistosum</i>	The Olive keelback watersnake
16 <i>Coelognathus helena</i>	Trinket snake
17 <i>Dendrelaphis schokari</i>	Common bronze back
18 <i>Lycodon aulicus</i>	Wolf snake, house snake
19 <i>Lycodon osmanhilli</i>	Flowery wolf snake ^E
20 <i>Oligodon sublineatus</i>	Dumerul's kuki snake ^E
21 <i>Ptyas mucosa</i>	Rat snake
22 <i>Sibynophis subpunctatus</i>	Jerdon's polyodont
23 <i>Xenochrophis asperrimus</i>	The checkered keelback ^E
24 <i>Xenochrophis cf. piscator</i>	Checkered Keelback ^E
Family - Elapidae	
25 <i>Naja naja</i>	Indian cobra
Family - Typhlopidae	
26 <i>Ramphotyphlops cf. braminus</i>	Common blind snake
Family - Viperidae	
27 <i>Daboia russelii</i>	Russell's viper

Appendix 03: List of the Mammal species recoded from Bellanwila-Attidiya sanctuary (BAS). (Abbreviation: **VU** – Vulnerable Species).

Species Name	Common Name
Family - Pteropodidae	
1 <i>Pteropus giganteus</i>	Flying fox
Family - Vespertilionidae	
2 <i>Kerivoula picta</i>	Painted bat
Family - Felidae	
3 <i>Prionailurus viverrinus</i>	Fishing cat ^{VU}
Family - Herpestidae	
4 <i>Herpestes brachyurus</i>	Brown mongoose
5 <i>Herpestes edwardsii</i>	Grey mongoose
Family - Viverridae	
6 <i>Paradoxurus hermaphoditus</i>	Palm cat
7 <i>Viverricula indica</i>	Ring-tailed civet
Family - Hystricidae	
8 <i>Hystrix indica</i>	Porcupine
Family - Muridae	
9 <i>Bandicota bengalensis</i>	Mole rat
10 <i>Bandicota indica</i>	Malabar bandicoot
11 <i>Rattus norvegicus</i>	Brown rat
12 <i>Rattus rattus</i>	Common rat
Family - Sciuridae	
13 <i>Funambulus palmarum</i>	Palm squirrel
Family - Soricidae	
14 <i>Suncus murinus</i>	Common musk shrew

Appendix 04: List of the Fish species recoded from Bellanwila-attidiya sanctuary (BAS). (Abbreviations: **VU** – Vulnerable Species, **DD** – Data Deficient species, **NT** – Near Threatened Species and **E** – Endemic species).

Species Name	Common Name
Family - Cyprinidae	
1 <i>Puntius kamalika</i>	Kaamalika's barb ^E
2 <i>Puntius bimaculatus</i>	Redside barb
3 <i>Puntius chola</i>	Swamp barb
4 <i>Puntius dorsalis</i>	Long snouted barb
5 <i>Puntius singhala</i>	Filamented Barb ^E
6 <i>Puntius sarana</i>	Olive barb
7 <i>Rasbora dandia</i>	Striped rasbora
Family - Cobitidae	
8 <i>Lepidocephalichthys thermalis</i>	Common spiny loach
Family - Bagridae	
9 <i>Mystus cavasius</i>	Gangetic mystus ^{DD}
10 <i>Mystus gulio</i>	Long-whiskered catfish
11 <i>Mystus vittatus</i>	Striped dwarf catfish

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Family - Heteropneustidae

12 *Heteropneustes fossilis* Stinging catfish

Family - Anguillidae

13 *Anguilla bicolor* Level finned eel ^{NT}

14 *Anguilla nebulosa* Long finned eel ^{VU}

Family - Aplocheilidae

15 *Aplocheilus parvus* Dwarf panchax

Family - Gobiidae

16 *Awaous melanocephalus* Scribbled goby

Family – Cichlidae

17 *Oreochromis mossambicus* Tilapia

18 *Oreochromis niloticus* Nile tilapia

Family – Loricariidae

19 *Pterygoplichthys multiradiatus* Tank cleaner

Family - Poeciliidae

20 *Poecilia reticulata* Guppy

Family - Channidae

21 *Channa punctata* Spotted snakehead

22 *Channa striata* Murrel

Appendix 05: List of the Bird species recoded from Bellanwila-attidiya sanctuary (BAS). (Abbreviations: **M** – Migrant Species, **NT** – Near Threatened Species, **DD** – Data Deficient species and **E** – Endemic species).

Species Name	Common name
Family - Pelecanidae	
1 <i>Pelecanus philippensis</i>	Spot-billed pelican
Family - Phalacrocoracidae	
2 <i>Phalacrocorax niger</i>	Little cormorant
3 <i>Phalacrocorax fuscicollis</i>	Indian shag
Family - Anhingidae	
4 <i>Anhinga melanogaster</i>	Oriental darter
Family - Ardeidae	
5 <i>Egretta garzetta</i>	Little egret
6 <i>Mesophoyx intermedia</i>	Intermediate egret
7 <i>Casmerodius albus</i>	Great egret
8 <i>Ardea cinerea</i>	Grey heron
9 <i>Ardea purpurea</i>	Purple heron
10 <i>Bubulcus ibis</i>	Eastern cattle egret
11 <i>Ardeola grayii</i>	Indian pond-heron
12 <i>Nycticorax nycticorax</i>	Black-crowned night-heron
13 <i>Ixobrychus sinensis</i>	Yellow bittern
14 <i>Dupetor flavicollis</i>	Black bittern
Family - Ciconiidae	
15 <i>Anastomus oscitans</i>	Asian openbill
Family - Threskiornithidae	
16 <i>Threskiornis melanocephalus</i>	Black-headed ibis

Family - Anatidae

- 17 *Dendrocygna javanica* Lesser whistling-duck
 18 *Anas querquedula* Garganey^M
 19 *Nettapus coromandelianus* Cotton pygmy goose

Family - Accipitridae

- 20 *Haliastur indus* Brahminy kite
 21 *Haliaeetus leucogaster* White-bellied sea-eagle
 22 *Spilornis cheela* Crested serpent-eagle
 23 *Accipiter badius* Shikra

Family - Rallidae

- 24 *Amaurornis phoenicurus* White-breasted waterhen
 25 *Porphyrio porphyrio* Purple swamphen

Family - Jacanidae

- 26 *Hydrophasianus chirurgus* Pheasant-tailed Jacana

Family - Charadriidae

- 27 *Himantopus himantopus* Black-winged Stilt
 28 *Vanellus indicus* Red-wattled lapwing

Family - Scolopacidae

- 29 *Actitis hypoleucos* Common Sandpiper^M
 30 *Tringa stagnatilis* Marsh sandpiper^M

Family - Columbidae

- 31 *Columba livia* Rock pigeon
 32 *Streptopelia chinensis* Spotted dove
 33 *Ducula aenea* Green Imperial-pigeon

Family - Psittacidae

- 34 *Loriculus beryllinus* Ceylon hanging-parrot^E
 35 *Psittacula eupatria* Alexandrine parakeet
 36 *Psittacula krameri* Rose-ringed parakeet

Family - Cuculidae

- 37 *Centropus sinensis* Greater coucal
 38 *Clamator jacobinus* Pied cuckoo
 39 *Clamator coromandus* Chestnut-winged cuckoo^M
 40 *Eudynamis scolopaceus* Asian Koel
 41 *Cuculus micropterus* Indian Cuckoo

Family - Strigidae

- 42 *Otus bakkamoena* Collared scops-owl

Family - Apodidae

- 43 *Apus affinis* House swift

Family - Hirundinidae

- 44 *Hirundo daurica* Red-rumped swallow^{E/NT}

Family - Alcedinidae

- 45 *Alcedo atthis* Common kingfisher
 46 *Pelargopsis capensis* Stork-billed kingfisher
 47 *Halcyon smyrnensis* White-throated kingfisher

Family - Cerylidae

- 48 *Ceryle rudis* Pied kingfisher

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Family - Meropidae	
49	<i>Merops philippinus</i> Blue-tailed Bee-eater ^{M/DD}
Family - Capitonidae	
50	<i>Megalaima zeylanica</i> Brown-headed barbet
51	<i>Megalaima flavifrons</i> Yellow-fronted barbet ^E
52	<i>Megalaima rubricapillus</i> Crimson-fronted barbet ^E
Family - Picidae	
53	<i>Picus chlorolophus</i> Lesser yellownape ^{NT}
54	<i>Dinopium benghalense</i> Black-rumped flameback
Family - Pittidae	
55	<i>Pitta brachyura</i> Indian pitta ^M
Family - Motacillidae	
56	<i>Dendronanthus indicus</i> Forest wagtail ^M
57	<i>Motacilla cinerea</i> Grey wagtail ^M
Family - Pycnonotidae	
58	<i>Pycnonotus cafer</i> Red-vented bulbul
59	<i>Pycnonotus luteolus</i> White-browed bulbul
Family - Laniidae	
60	<i>Lanius cristatus</i> Brown shrike ^M
Family - Muscipidae	
61	<i>Copsychus saularis</i> Oriental magpie-robins
Family – Timaliidae	
62	<i>Turdoides affinis</i> Yellow-billed babbler
Family - Cisticolidae	
63	<i>Cisticola juncidis</i> Zitting cisticola
64	<i>Prinia inornata</i> Plain prinia
65	<i>Orthotomus sutorius</i> Common tailorbird
Family - Dicaeidae	
66	<i>Dicaeum erythrorhynchos</i> Pale-billed flowerpecker
Family - Nectariniidae	
67	<i>Cinnyris asiaticus</i> Purple sunbird
68	<i>Cinnyris lotenius</i> Loten's sunbird
Family - Estrildidae	
69	<i>Lonchura striata</i> White-rumped munia
Family - Passeridae	
70	<i>Lonchura striata</i> White-rumped munia
71	<i>Lonchura punctulata</i> Scaly-breasted munia
72	<i>Passer domesticus</i> House sparrow
Family - Sturnidae	
73	<i>Acridotheres tristis</i> Common myna
Family - Oriolidae	
74	<i>Terpsiphone paradisi</i> Asian Paradise-flycatcher
75	<i>Oriolus xanthornus</i> Black-hooded oriole

Family - Dicruridae

- 76 *Dicrurus caeruleus* White-bellied drongo

Family - Corvidae

- 77 *Corvus splendens* Housecrow
78 *Corvus macrorhynchos* Jungle crow

Appendix 06: List of the Butterfly species recoded from Bellanwila-attidiya sanctuary (BAS). (Abbreviations: **EN** – Endangered species, **VU** – Vulnerable Species, **NT** – Near Threatened Species, **DD** – Data Deficient specie and **E** – Endemic species).

Species Name	Common Name
Family - Papilionidae	
1 <i>Troides darsius</i>	Ceylon birdwing ^{E/NT}
2 <i>Pachliopta hector</i>	Crimson rose
3 <i>Pachliopta aristolochiae</i>	Common rose
4 <i>Papilio crino</i>	Banded peacock
5 <i>Papilio domoleus</i>	Lime butterfly
6 <i>Papilio polytes</i>	Common mormon
7 <i>Papilio polymnestor</i>	Blue mormon
8 <i>Chilasa clytia</i>	Mime ^{NT}
9 <i>Graphium sarpedon</i>	Blue bottle
10 <i>Graphium doson</i>	Common jay
11 <i>Graphium agamemnon</i>	Tailed jay
Family - Pieridae	
12 <i>Leptosia nina</i>	Psyche
13 <i>Delias eucharis</i>	Jezebel
14 <i>Appias albina</i>	Common albatross
15 <i>Appias paulina</i>	Lesser albatross
16 <i>Catopsilia pyranthe</i>	Mottled emigrant
17 <i>Catopsilia pomona</i>	Lemon emigrant
Family - Nymphalidae	
18 <i>Eurema hecabe</i>	Common grass yellow
19 <i>Eurema blanda</i>	Three-spot grass yellow
20 <i>Eurema andersoni</i>	One-spot grass yellow ^{EN}
21 <i>Ideopsis similis</i>	Blue glassy tiger ^{NT}
22 <i>Tirumala limniace</i>	Blue tiger
23 <i>Parantica aglea</i>	Glassy tiger
24 <i>Danaus chrysippus</i>	Plain tiger
25 <i>Danaus genutia</i>	Common tiger
26 <i>Euploea core</i>	Common crow
27 <i>Euploea phaenareta</i>	King crow ^{NT}
28 <i>Euploea klugii</i>	Brown king crow ^{NT}
29 <i>Cupha erymanthis</i>	Rustic ^{NT}
30 <i>Junonia atlites</i>	Grey pansy
31 <i>Junonia iphita</i>	Chocolate soldier
32 <i>Junonia almana</i>	Peacock pansy
33 <i>Hypolimnas bolina</i>	Great eggfly
34 <i>Hypolimnas misippus</i>	Danaid Eggfly
35 <i>Neptis hylas</i>	Common sailor
36 <i>Neptis jumbah</i>	Chestnut-streaked sailor
37 <i>Euthalia aconthea</i>	Baron
38 <i>Charaxes solon</i>	Black rajah ^{NT}
39 <i>Acraea violae</i>	Tawny costor
40 <i>Melanitis leda</i>	Common evening brown
41 <i>Orsotriaena medus</i>	Nigger

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42	<i>Mycalesis perseus</i>	Common bushbrown
43	<i>Nissanga patnia</i>	Gladeye bushbrown
44	<i>Ypthima ceylonica</i>	White four-ring
45	<i>Elymnias hypermnestra</i>	Common palmfly

Family - Lycaenidae

46	<i>Spalgis epeus</i>	Apefly
47	<i>Curetis thetis</i>	Indian sunbeam
48	<i>Arhopala amantes</i>	Large oakblue
49	<i>Zesius chrysomallus</i>	Redspot
50	<i>Loxura atymnus</i>	Yamfly
51	<i>Rathinda amor</i>	Monkey-puzzle
52	<i>Tajuria cippus</i>	Peacock royal
53	<i>Hypolycaena nilgirica</i>	Nilgiri tit ^{VU}
54	<i>Jamides bochus</i>	Dark cerulean
55	<i>Jamides celeno</i>	Common cerulean
56	<i>Catochrysops strabo</i>	Forger-me-not
57	<i>Castalius rosimon</i>	Common pierrot
58	<i>Zizeeria karsandra</i>	Dark grass blue
59	<i>Zizina otis</i>	Lesser grass blue
60	<i>Zizula hylax</i>	Tiny grass blue
61	<i>Talicauda nyseus</i>	Red pierrot
62	<i>Euchrysops cnejus</i>	Gram blue
63	<i>Chilades lajus</i>	Lime blue
64	<i>Abisara echerius</i>	Plum judy

Family - Hesperiiidae

65	<i>Ampittia dioscorides</i>	Hedge hopper
66	<i>Iambrix salsala</i>	Ceylon palm bob
67	<i>Panara bada</i>	Smallest swift
68	<i>Pelopidas agna</i>	Little branded swift
69	<i>Potanthus confuscus</i>	Tropic dart
70	<i>Potanthus pseudomaesa</i>	Common dart
71	<i>Spalia galba</i>	Common red eye
72	<i>Suastus gremius</i>	Ceylon ace
73	<i>Taractrocera maevius</i>	Common grass dart
74	<i>Telicota ancilla</i>	Dark palmdart ^{VU}
75	<i>Telicota colon</i>	Pale palmdart

PLATE 02

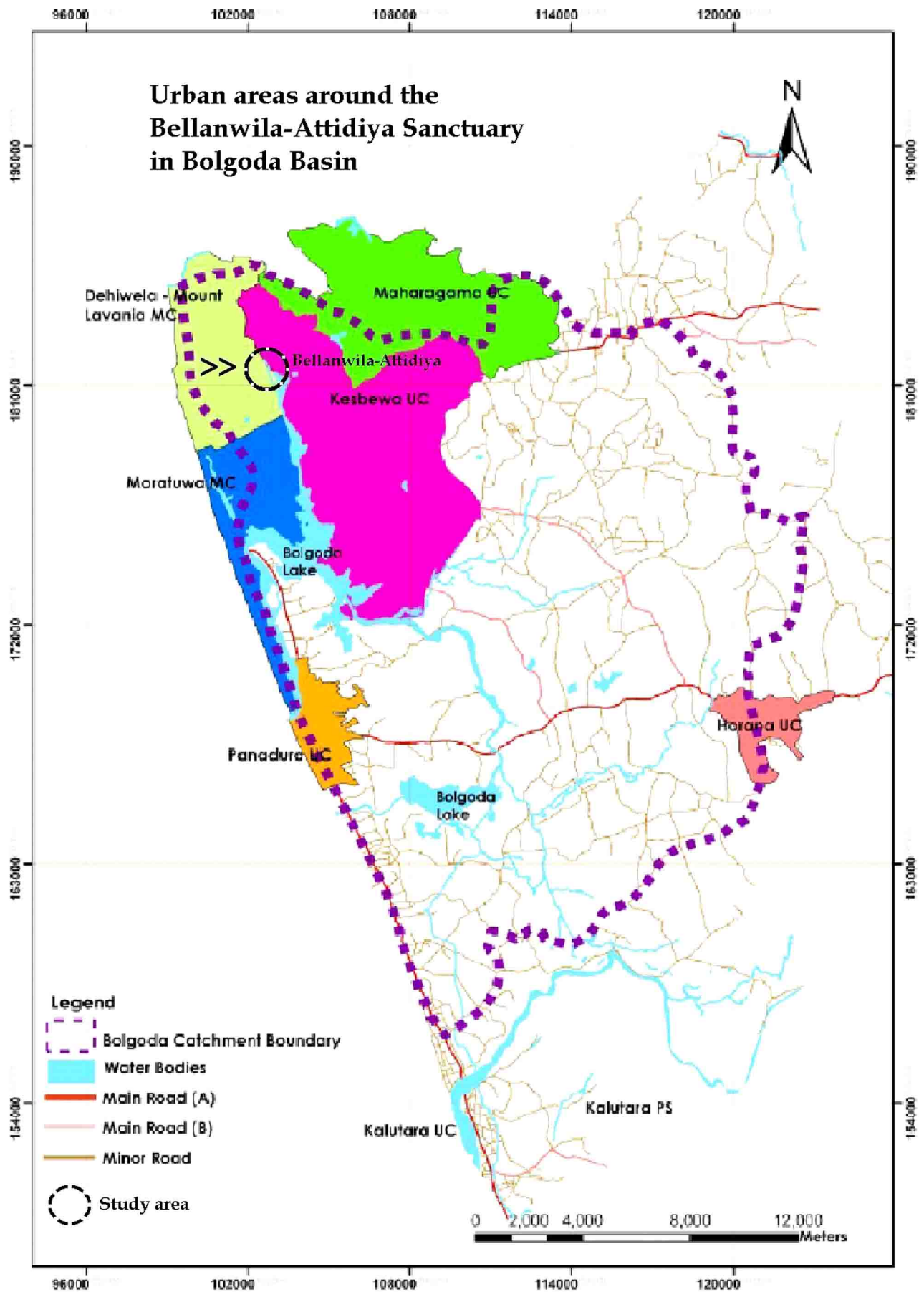


Fig. 01: Map of study area; Bellanwila-Atthidiya Sanctuary

PLATE 03



Fig. 02: Natural wetland habitat



Fig. 03: Naïve and non native aquatic flora



Fig. 04: Unplanned garbage dumping area



Fig. 05: Water covered with invasive aquatic flora



Fig. 06: Human encroachments

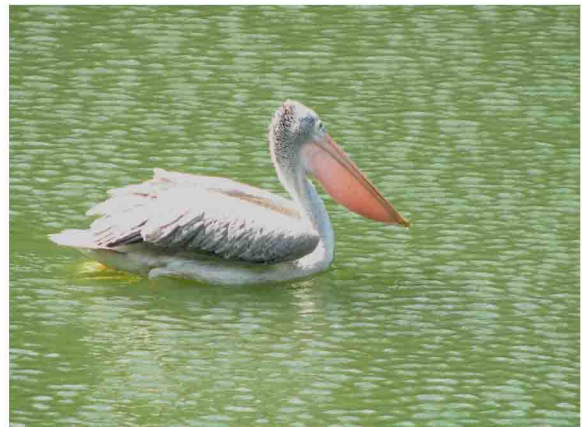


Fig. 07: Spot-billed pelican (*Pelecanus philippensis*)



Fig. 08: Nile tilapia (*Oreochromis niloticus*)

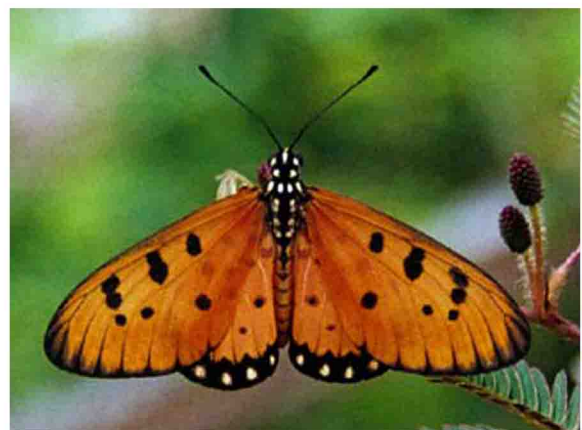


Fig. 09: Tawny costor (*Acraea violae*)