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An Assessment of the Status of Biodiversity  
in the Maduganga Mangrove Estuary

C. N. B. Bambaradeniya, S. P. Ekanayake,  
L. D. C. B. Kekulandala, R. H. S. S. Fernando,  
V. A. P. Samarawickrama and T. G. M. Priyadharshana

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# Summary

The Maduganga estuary and mangrove islets are a complex coastal wetland ecosystem situated in the Galle District of Southern Sri Lanka. The total area of the estuary is 915 ha, of which 770 ha consist of open water, while islands account for 145 ha. With the view of safeguarding the ecological functions, resources and values of the Madu ganga estuary for conservation and future sustenance of biodiversity, IUCN Sri Lanka carried out a systematic assessment of biodiversity during a six-month period, from May to October 2000. Field monitoring of fauna and flora was carried out at fortnightly intervals, in a systematic manner, using scientifically accepted biodiversity assessment techniques. A zoning exercise was carried out according to ecological significance and threats to biodiversity, using appropriate indicators.

The survey revealed that the Maduganga wetland consists of 10 major wetland vegetation types. These vegetation types harboured a total of 303 species of plants belonging to 95 families. The total plant species included 19 endemics, 8 nationally threatened species and 9 invasive alien species. Based on the extent of occurrence (ha), mangroves and mangrove mixed swamps were the dominant wetland vegetation types in Maduganga. In addition to these wetland vegetation types, three major terrestrial vegetation types are also found in the islands and the surrounding mainland area of the Maduganga estuary. Perennial crops (mainly cinnamon) dominated the terrestrial vegetation types. A total of 98 plant species were recorded from the multi-species home gardens. When considering the species richness of flora in different wetland vegetation types, mangroves harboured the highest number of species, closely followed by mangrove mixed swamps. Maduganga estuary harbours a small population of a very rare, threatened mangrove species - *Lumnitzera littorea*. A total of 248 species of vertebrate fauna, belonging to 121 families were recorded from Maduganga. These included 20 species (8 %) of endemics, while 30 species (12 %) are nationally threatened. The native vertebrate fauna of Maduganga represents 30% of Sri Lanka's native inland vertebrate species.

Maduganga, perhaps one of the last remaining tracts of pristine mangrove forest in Sri Lanka with a rich biodiversity, now appears to be threatened with the same predicament that many of the island's mangroves now find themselves in, owing to increasing human activity. At present, this wetland is not a protected area under any Government Department. Therefore, it is envisaged that the findings of this survey will contribute to the conservation of this unique coastal wetland.

**Key words:** Maduganga mangrove estuary, biodiversity, threats

# 1. Introduction

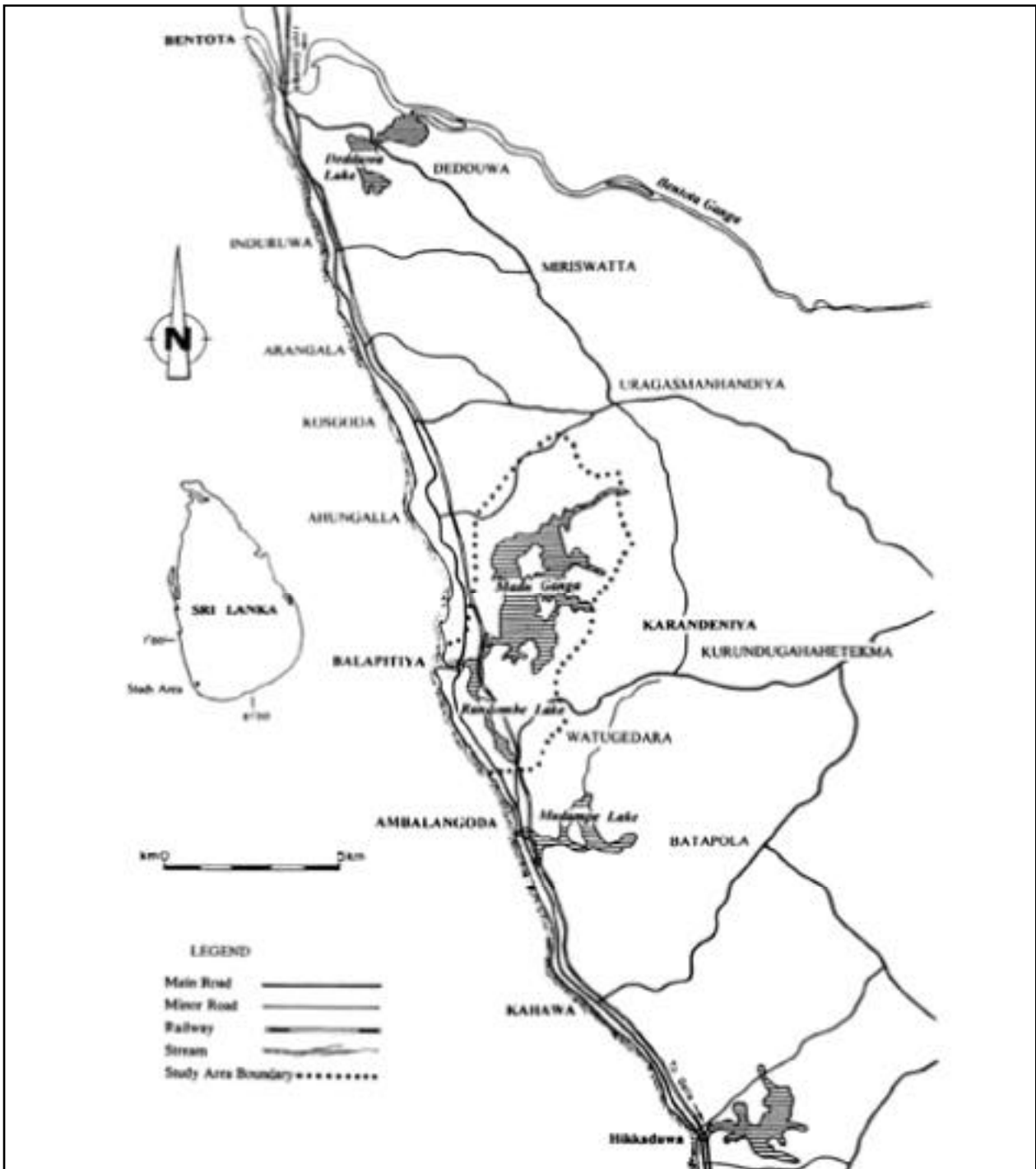
Mangroves are evergreen forests that occur in the inter-tidal zone along sheltered coastlines, mainly in the tropical region. The mangrove vegetation possesses physiological and structural adaptations to grow in saline and muddy conditions. Being highly productive ecosystems, mangroves serve multiple functions/uses, including ecological and socio-economic benefits (Aksornkoae, 1993).

Mangroves in Sri Lanka occur in a patchy distribution in the island's coastline, in areas adjacent to lagoons, estuaries and river-mouths. In most areas in the island, mangroves are restricted to a narrow strip, due to the low (<1m) tidal amplitude. Based on the topography, flooding characteristics and floristic composition, five types of mangrove, namely, riverine, fringing, scrub, overwash and basin have been identified in the island (Balasubramaniam, 1985). According to an analysis of satellite images carried out in 1992 (Legg and Jewell, 1995), the total area of mangrove habitats in the island was estimated to be 8,687 ha, which is about 0.13% of the total land area. The future sustenance of mangrove ecosystems in Sri Lanka is undermined by the steady deterioration of mangrove habitats from over-exploitation of resources and from clearing for coastal aquaculture, agriculture and urban development.

The Maduganga estuary is an area that harbours a relatively undisturbed mangrove habitat that is spread over several small islands. It is situated within the two Divisional Secretariats of Balapitiya and Karadeniya in the Galle District of Southern Sri Lanka (Figure 1). The total area of the estuary is 915 ha, of which 770 ha consist of open water, while islands account for 145 ha. A total of 15 islands are surrounded by water throughout the year. Maduganga estuary has three major inflows: Boralessa Ela, Heen Ela and Magala Ela. The area falls within the South-Western Lowland Wet Zone of Sri Lanka and hence experiences a perennially wet climate. Thick mangrove vegetation is prevalent along the northern and northwestern banks of Maduganga, at the lagoon mouth and on majority of the islands. A highlight of this area is the presence of a rare and threatened mangrove species - *Lumnitzera littorea*, commonly referred to as 'Rathamilla'. Cinnamon cultivations form the dominant land use type in the area. At present, a nature based tourism industry is developing rapidly at Maduganga. In addition, resident traditional fishermen are involved in commercial fishing activities in the Maduganga estuary (CEA/Euroconsult, 1997).

Although no detailed studies on the biodiversity of Maduganga have been carried out previously, the importance of this wetland in terms of its high ecological, biological and aesthetic significance has already been identified, through information gathered from preliminary surveys. The area has been recognized as a priority wetland for conservation, with two conservation management plans being developed during the last decade by the Central Environmental Authority (CEA/ Euroconsult, 1997) and the Forest Department (Anonymous, 2000). Amidst these initiatives, activities related to the growing human population pressure are threatening the Maduganga wetland, by causing considerable stress on the ecology and biodiversity of this ecosystem.

Therefore, with a view to contributing towards safeguarding the ecological functions, resources and values of the Maduganga estuary for conservation and future sustenance of biodiversity, IUCN Sri Lanka undertook a systematic survey to document the status of biodiversity in this coastal wetland. This paper intends to highlight the biodiversity of Maduganga, and provide scientific knowledge in a simplified manner to facilitate future initiatives to conserve this valuable coastal wetland ecosystem.



**Figure 1.**  
*Location of the Maduganga mangrove estuary*  
 (Source: CEA/Euroconsult, 1997)

## 2. Methodology

### *Period of field survey, sampling frequency and time*

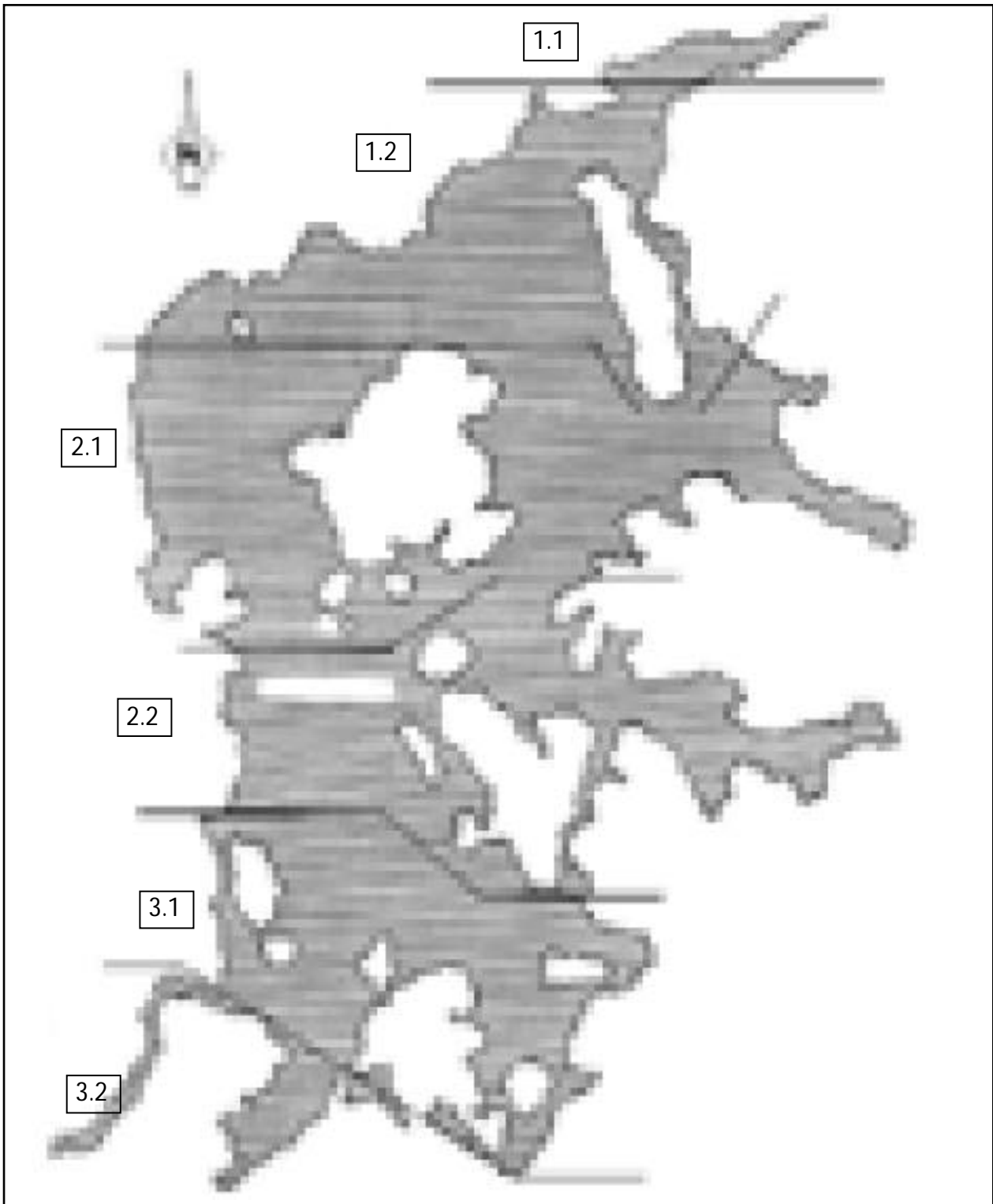
A six-month field survey commenced at the beginning of May, 2000 and was completed by the end of October, 2000. Field sampling was carried out at fortnightly intervals; each sampling session spanning over six continuous days. In order to avoid a time bias for a particular sampling site when recording fauna, each selected sampling site was covered at different times of the day during the above survey period. Nocturnal visits were also made to all sampling sites, during each sampling session.

### *Sampling sites*

After an initial reconnaissance survey, the Maduganga ecosystem was divided into six major strata (Table 1; Figure 2), based on the occurrence of different plant communities and a hypothetical salinity gradient (Upper reaches of estuary - lower salinity; Lower reaches of estuary - higher salinity). These strata were sampled for fauna and flora at 2-3 random sampling sites. Apart from the islands, the mainland area around the estuary was surveyed up to a maximum of 50m from the edge of water.

**Table 1**  
**Sampling sites in Maduganga estuary**

<b>Region</b>	<b>Strata &amp; Physical features</b>	<b>Major vegetation Community</b>
1. Upper areas (Low salinity)	1.1. Streams, Marshland 1.2. Kothduwa & Dikduwa islands	<i>Cerbera-Syzygium-Bruguiera</i> <i>Rhizophora-Bruguiera-Exoecaria</i>
2. Mid areas (Moderate salinity)	2.1. Honduwa, Erawanaduwa, Dimiduwa, Maduwa & Mimaduwa islands. 2.2. Miraladuwa, Naiduwa & Muwanduwa islands.	Mixed vegetation  <i>Rhizophora-Bruguiera-Exoecaria</i> -mixed vegetation.
3. Lower areas (High salinity)	3.1. Katuduwa, Thiniyaduwa, Mahaladuwa, Galmanduwa, Gonaduwa & Madaduwa Islands 3.2. Rivermouth, Randonbe lake	<i>Rhizophora</i> dominant, <i>Bruguiera- Exoecaria-</i> <i>Dolichandron</i> mixed vegetation  <i>Rhizophora</i> dominant mangrove system



**Figure 2**  
*Sampling Strata of Maduganga estuary*

***Preparation of digitized maps on vegetation types***

The aerial photographs of the Maduganga mangrove wetland taken in 1995 were subjected to ground-truthing to ascertain the different vegetation types and their extent. This information was used in developing a GIS database, from which a digitized map on vegetation types in Maduganga was produced.



## ***Field sampling techniques***

Sampling methods were designed to identify and quantify all groups of vertebrates, some selected groups of invertebrate taxa, and floral communities in representative habitats within the study area. Flora was enumerated using the belt transect technique (25m x 5m). Distinct vegetation types were identified according to the vegetation structure and composition. At least 3 replicates were taken from each vegetation type to accommodate the floristic variations within a site. Abundance of each plant species in a given plot was recorded according to Braun-Blanquet method (cited in Sutherland, 1996).

The fauna sampled regularly included all groups of vertebrates and also two groups of invertebrates (butterflies and molluscs) for which there is adequate information in Sri Lanka. Standard sampling techniques specified in Sutherland (1996) were adopted, with slight modifications to suit the existing field condition. Fish were sampled by cast netting (10 random casts/site/strata) and by observing the commercial catch. Herpetofauna in islands and mainland were sampled along transects (50m x 5m) and by placing pitfall traps. Birds were documented by 0.5 hour point counts (100m radius; 3 sites/strata). Mammals were documented in a qualitative manner, using direct observations and indirect methods (defecation, tracks). Butterflies in islands and mainland were documented along 50m x 5m transects. Terrestrial molluscs were documented in 2m x 5m belt transects. Aquatic crustaceans and molluscs were documented in a qualitative manner, using the commercial catch, and collection of specimens.

## ***Identification and nomenclature of fauna and flora***

The fauna and flora of Maduganga were identified and classified using the guides stated in Table 2 below:

**Table 2**  
**Guides used for the identification and taxonomy of flora and fauna**

<b>Group</b>	<b>Source</b>
<b>Flora</b>	Dassanayake, M. D. & Fosberg, F. R. (eds.) (1980 - 1991); Dassanayake, M. D., Fosberg, F. R. and Clayton, W. D. (eds.) (1994 - 1995) Dassanayake, M. D., and Clayton, W. D. (eds.) (1996 - 1999)
<b>Fish</b>	Pethiyagoda (1990); De Bruin <i>et al.</i> (1994)
<b>Amphibians</b>	Dutta & Manamendra-Aarachchi (1996)
<b>Reptiles</b>	Deraniyagala (1953); De Silva (1990)
<b>Birds</b>	Harrison & Worfolk (1999)
<b>Mammals</b>	Phillips (1980)
<b>Butterflies</b>	D'Abrera (1998)
<b>Molluscs</b>	Brackish water - Pinto (1986); Terrestrial - Naggs & Raheem (2000)
<b>Crustaceans</b>	Pinto (1986); De Bruin <i>et al.</i> (1994)

### ***Identification of ecologically important areas (critical habitats)***

Areas of high ecological significance, which are critical habitats that needs priority conservation action, were identified using the following ecological criteria:

- Biodiversity - the variety or richness of habitats, communities and species (the latter was assessed using species richness of woody plants and birds as surrogates of biodiversity).
- Naturalness - extent to which the area has been protected from, or has not been subjected to, human-induced destruction, degradation or modification. (Assessed by the status of habitat degradation/deterioration)
- Representativeness - the degree to which the area represents a habitat type, ecological process, biological community or other natural characteristic, within the Maduganga mangrove estuary. (Assessed by the number of representative habitat and vegetation types)
- Dependency/Uniqueness in terms of providing habitat for endemic and/or threatened species of fauna and flora. (Assessed by number of endemic and/or threatened species in a strata)
- Integrity - the degree to which the area is an effective, self-sustaining ecological entity, in time and space, within Maduganga mangrove estuary. (Assessed by the overall status of above criteria)

The six major strata surveyed were assessed for each of the above ecological criteria, using a set of scores ranging from 1-5; the highest score being given to the higher significance of each criteria. The strata that received a cumulative score of above 20 were considered as areas of high ecological significance in Maduganga.

### ***Assessment of threats***

The threats were categorised under habitat deterioration/degradation, direct exploitation of species and spread of invasive alien species. The various threats to biodiversity under the above categories in each strata were assessed at three levels of significance; low, moderate and high, and the overall threat status of each strata was determined according to the frequency of threat significance levels.

### 3. Flora of Maduganga

#### ***Floristic composition and vegetation types***

The Maduganga wetland consists of 10 major wetland vegetation types (Table 3; Figure 3). A total of 302 species of plants belonging to 95 families (Appendix 1) were documented from these vegetation types. When considering the woody plants in the different vegetation types, 121 species under 43 families were documented in the sampling plots. The total plant species include 19 endemics and 8 nationally threatened species (IUCN Sri Lanka, 2000), while 9 are invasive alien species. Herbs represent the dominant plant life-form (59%) in Maduganga, while non-woody climbers forms the least common (1%) plant life-form (Figure 4). Based on the extent of occurrence, mangroves and mangrove mixed swamps are the dominant wetland vegetation type in Maduganga. The mangrove scrubs, mangrove mixed swamps, and bank scrubs represent different stages of degraded mangrove vegetation. The most abundant mangrove species is *Rhizophora apiculata*, while *Lumnitzera littorea* is the least found mangrove species.

In addition to these wetland vegetation types, three major terrestrial vegetation types are also found in the islands and the surrounding mainland area of the Maduganga estuary (Table 3). Perennial crops (Cinnamon, Coconut and Rubber) dominate the terrestrial vegetation types. The northern mainland of Maduganga is dominated by Cinnamon cultivations, while Coconut and Rubber plantations are more common in the southern mainland area. A small patch of degraded remnant lowland rainforest is located in the uppermost reaches of Maduganga. A total of 98 plant species, consisting of 41 woody species were recorded from the multi-species home gardens (Appendix 2).

When considering the species richness of flora in different wetland vegetation types in Maduganga, mangroves harbour the highest number of species, closely followed by mangrove mixed swamps (Figure 5). A total of 14 species of true mangrove and mangrove associate plants were recorded from these two vegetation types. The tall shrub swamps, palm swamps, lentic macrophyte assemblages and tall sedge brackish marshes harbour a lower number of plant species.

#### ***Distribution patterns of mangrove and non-mangrove woody flora***

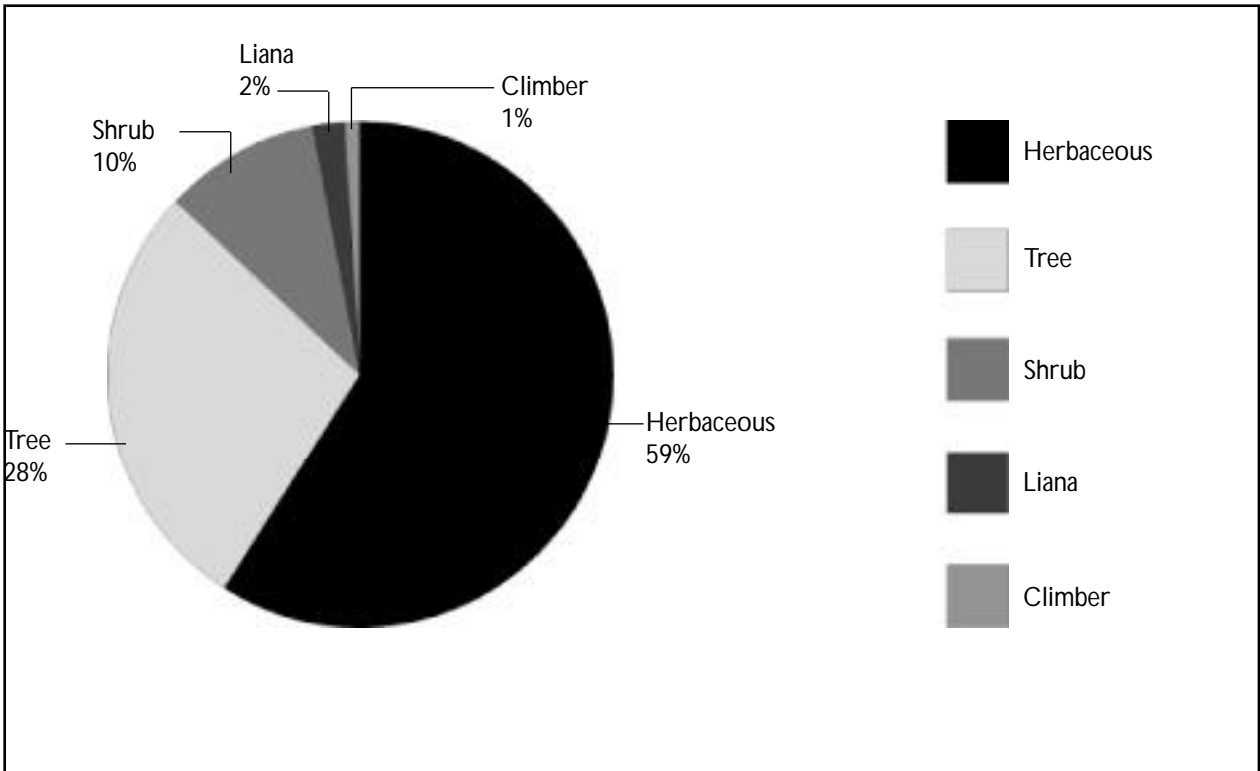
Analysis of the distribution of mangrove plant species in sampling plots within Maduganga showed some interesting patterns. The sampling plots located within 3 km range from the estuary mouth were considered as proximal plots, and those located above 3 km were considered as distal plots. *Bruguiera sexangula* occurred mostly in distal plots indicating their preference for low salinity. Similarly, relatively high abundance of *Bruguiera gymnorrhiza* and *Sonneratia caseolaria* was observed in distal plots indicating their preference for low salinity. Conversely, *Xylocarpus granatum* and *Lumnitzera littorea* were found mainly in the proximal

plots, while *Excoecaria agallocha* and *Rhizophora apiculata* occurred in high abundance in the proximal plots, indicating their preference for high salinity. Other true Mangrove species did not show such a zonation. The width of the mangrove strip along the mainland area was generally wider, compared to that of the islands. The relatively narrow strip of mangrove in islands could be attributed to the steep gradient of islands, and the resultant low tidal amplitude.

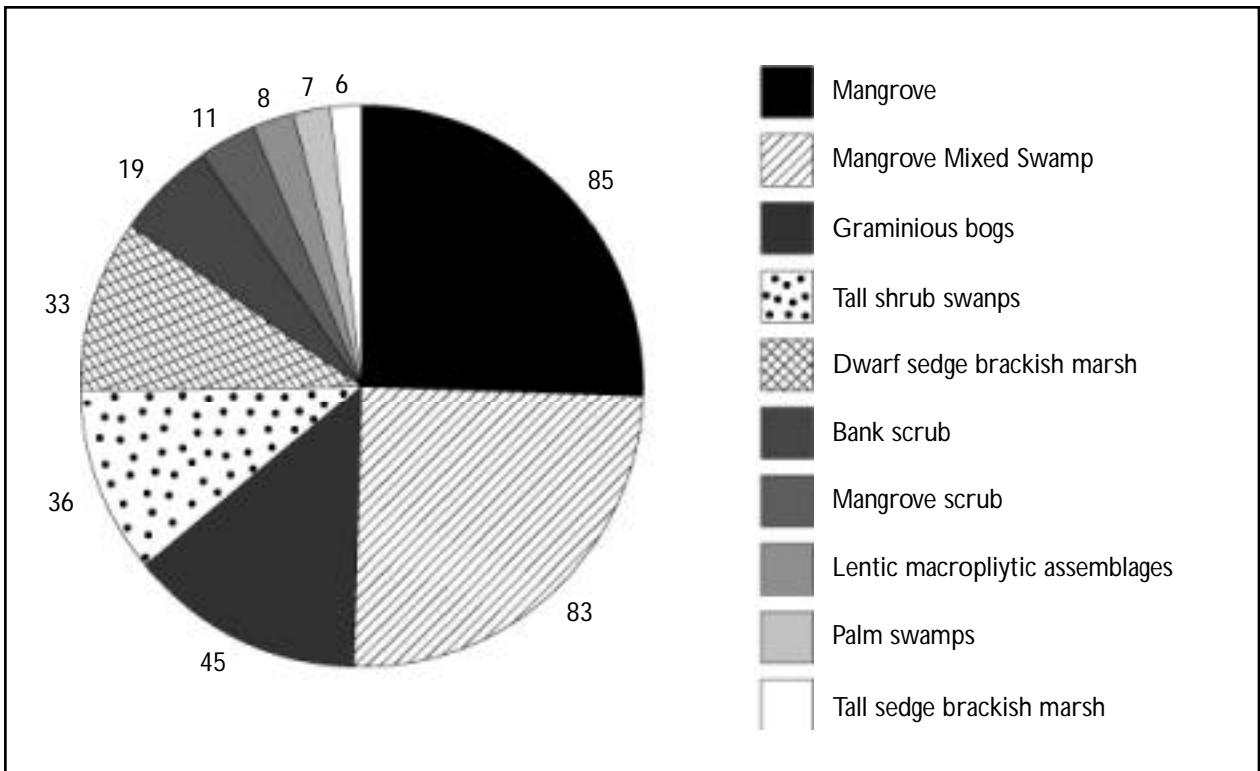
**Table 3**  
**Wetland and terrestrial vegetation types, their major plant communities and extent in the islands and mainland area of the Maduganga estuary**

<b>Wetland Vegetation Type</b>	<b>Plant community</b>	<b>Extent (ha)</b>
1. Mangroves	<i>Rhizophora-Bruguiera-Sonneratia</i>	61
2. Mangrove scrubs	<i>Excoecaria-Lumnitzera-Clerodendrum</i>	20
3. Mangrove mixed swamps	<i>Rhizophora-Dolichandrone-Hibiscus</i>	63
4. Bank scrubs	<i>Hibiscus-Pandanus-Derris</i>	10
5. Tall shrub swamps	<i>Annona glabra</i> assemblage	2
6. Palm swamps	<i>Nypa fruticans</i> assemblage	0.5
7. Tall sedge brackish marshes	<i>Typha angustifolia</i> assemblage	1
8. Dwarf sedge brackish marshes	<i>Cyperus- Eleocharis- Xyris</i>	19
9. Graminious bogs	<i>Ischaemum-Panicum-Cyperus</i>	23
10. Lentic macrophytes	<i>Nymphaea-Salvinia-Utricularia</i>	0.2
<b>Terrestrial Vegetation Type</b>	<b>Plant community</b>	<b>Extent (ha)</b>
1. Remnant lowland rainforest	<i>Alstonia-Artocarpus-Wormia-Dillenia</i>	5 -8
2. Multi-species home gardens	<i>Cocos-Artocarpus-Mangifera</i>	20-25
3. Perennial crops	<i>Cinnamomum; Cocos; Hevea</i>	190 - 200

It is interesting to note that among the indigenous non-mangrove woody plants documented, 12 species (including 5 endemics) were restricted to the plots surveyed in islands of Maduganga. These included *Mesua ferrea* (Clusiaceae), *Dillenia retusa* (Dilleniaceae), *Schefflera stellata* (Araliaceae), *Cleistanthus pallidus* (Euphorbiaceae), *Chionanthus albidiflorus* (Oleaceae), *Antidesma pyrifolium* (Euphorbiaceae), *Apama siliquosa* (Aristolochiaceae), *Myristica dactyloides* (Myristicaceae), *Olax zeylanica* (Olacaceae), *Ziziphus oenoplea* (Rhamnaceae), *Gardenia latifolia* (Rubiaceae), and *Symplocos cochinchinensis* (Symplocaceae). Most of these species prefer undisturbed habitats.



**Figure 4**  
*Plant life forms observed in Madhuganga*



**Figure 5**  
*Species richness of flora in different wetland vegetation types at Maduganga*

## 4. Fauna of Maduganga

### *Species composition and relative abundance of vertebrate fauna*

A total of 248 species of vertebrate fauna, belonging to 121 families were recorded from Maduganga. These included 20 species (8 %) of endemics, while 30 species (12 %) are nationally threatened (IUCN Sri Lanka, 2000). Among the endemic vertebrate species at Maduganga, 70% are nationally threatened. A comparison of the status of vertebrate fauna of Sri Lanka and in the Maduganga wetland is shown in Table 4. The native vertebrate fauna of Maduganga represents 30% of Sri Lanka's native inland vertebrate species. This is a significant proportion, when considering the size of this wetland. It is interesting to note that about 42% of the vertebrate species documented during the present survey are new records to the Maduganga wetland. Compared to the survey carried out by the Central Environmental Authority (CEA, 1997), the present survey enabled to document a higher number of fish and bird species.

**Table 4**

**A comparison of vertebrate fauna in Sri Lanka and Maduganga wetland.**

<b>Group</b>	<b>Sri Lanka</b>	<b>Maduganga</b>
Fish	Freshwater 78 (32E,39T)	70 <sup>1</sup> (2E, 2T)
Amphibians	58 (38E, 33T)	12 (3E, 4T)
Reptiles	155 (81E, 86T)	31 (7E, 11T)
Birds	226 + 200 WM (23E,61T)	111 (13 WM, 6E, 7T)
Mammals	90 (14E, 34T)	24 (2E, 6T)

E - Endemic, T - Threatened (IUCN - SL, 2000), WM - Winter migrant

<sup>1</sup>Fish species - Freshwater, brackish water & marine species.

The fish consisted of 70 species belonging to 41 families (Appendix 3). Among them, two species are endemic, two are nationally threatened, while 1 species is exotic. The fish include freshwater forms, brackish water forms, fresh-brackish water forms and marine-brackish migratory species. The typical freshwater species included Striped Rasbora (*Rasbora daniconius*), Giant Danio (*Danio malabaricus*), Horandandiya (*Horadandiya atukarali*), Barbs (*Puntius* spp.) and the Walking Catfish (*Clarias brachysoma*). These were observed only in the uppermost (north-east) reaches of Maduganga where water salinity is comparatively lower, due to the inflow of freshwater from streams. About one third (23 species) of the fish species in Maduganga consist of typical brackish water forms such as the ambassids (*Ambassis* spp.), Pony fish (*Leiognathus* spp.), Mono (*Monodactylus argenteus*), Target fish (*Therapon jabua*), Mud skipper (*Periophthalmus koelreuteri*) and the Milk fish (*Chanos chanos*).

The migratory species include both “catadromous” species (species that migrate from fresh to marine habitats for reproduction) and “anadromous” species (marine species which move into brackish/fresh water for spawning or to spend their juvenile period). A typical catadromous species include the Short-finned Eel (*Anguilla bicolor*), while anadromous species include the Snappers (*Lutjanus* spp.), Trevally (*Caranx* spp.), Silver Beddy (*Gerres* spp.), Surgeon fish (*Acanthurus* spp.) and Barracuda (*Sphyraena* spp.).

The amphibians consisted of 12 species belonging to 4 families (Appendix 4), including toads, narrow-mouthed frogs, aquatic frogs and tree frogs. These represent approximately 22% of the total amphibian species in the island. Among them, 3 species are endemic, while 5 species are nationally threatened.

The reptiles consisted of 31 species belonging to 12 families (Appendix 5), covering 20% of the island’s reptilian fauna. These included 19 species of tetrapod reptiles and 12 species of serpents. Among the total species, 7 are endemic, while 11 are nationally threatened. The Water Monitor (*Varanus salvator*) is the most common reptile in Maduganga. Breeding populations of the two species of crocodiles (Estuarine Crocodile - *Crocodylus porosus* and Mugger - *C. palustris*) also occurs in Maduganga. Among the other reptiles, the Indian Python (*Python molurus*) and the Sri Lanka Kangaroo lizard (*Otocryptis weigmanni*) are two rare reptiles that occur in the remnant patch of lowland rainforest located in the upper reaches of Maduganga.

Maduganga harbours a rich avifauna. A total of 111 species belonging to 48 families (Appendix 6) were recorded during the survey, which is much higher than the number recorded by Siriwardena in 1997. These represented approximately 43% of Sri Lanka’s native avifauna. Of the native species, 6 are endemic, while 7 are nationally threatened. About 10% (13 species) of the total bird species in Maduganga consisted of winter migrants. The mixture of vegetation types in the islands and the surrounding mainland area, together with the estuary, has made Maduganga an ideal ecotone for a variety of birds. About 35% of the bird species recorded included those associated with wetland ecosystems, such as herons, egrets, cormorants, teals, waders, kingfishers and terns that feed on aquatic organisms. The islands in the estuary serve as an ideal roosting site for the above species. A notable feature of the species composition of avifauna in Maduganga is the low occurrence of waders, which may be related to the lack of a shoreline and mudflats around the islands and mainland areas, which are the preferred habitats of wading birds.

The mammals of Maduganga consisted of 24 species belonging to 16 families (Appendix 7), representing approximately 26% of the island’s mammalian fauna. Among them, 2 species are endemic, while 6 species are considered nationally threatened. The mainland area of Maduganga is one of the few refuges of the threatened Hog Deer (*Axis porcinus*). The small patch of remnant lowland rainforest in the upper reaches of Maduganga harbours three species of threatened arboreal mammals (Purple-faced Leaf Monkey - *Trachypithecus vetulus*, Golden Palm Civet - *Paradoxurus zeylonensis* and the Slender Loris - *Loris tardigradus*). The area also serves as an important refuge of three carnivorous mammals - the Fishing Cat (*Prionailurus viverrinus*), Eurasian Otter (*Lutra lutra*) and the Jackal (*Canis aureus*). Apart

from these mammals, a few species of insectivorous bats (micro-chiroptera) and shrews were frequently observed.

### ***Species composition and relative abundance of selected invertebrate fauna***

Only two groups of invertebrates - butterflies and molluscs were surveyed and the number of species recorded is presented in Table 5. Approximately 20% of the butterfly species of Sri Lanka were recorded from Maduganga (Appendix 8). These ranged from the small lycaenid species to the large swallowtail species. However, not a single endemic butterfly species was observed. About 10% of the butterfly species in Maduganga are threatened.

The molluscs recorded include 14 land snails (Appendix 9) and 11 brackish water species (Appendix 10). Approximately 60% of the land snails in Maduganga (mainland and islands) are endemic and threatened as well. Among the land snail species, two are invasive alien species (Giant African Snail - *Achatina fulica* and Slug - *Laevicaulis alte*). The endemic *Glessula paneantha* is a highly threatened land snail. In addition, the endemic *Acavus haemastoma* - a relict species that depicts Gondwanaland fauna is also present in some of the islands and mainland areas of Maduganga. The most common molluscs in mangrove habitats included *Telescopium telescopium*, *Cerithedia cingulata*, and *Nerita polita*.

The most common crustacean species recorded in the Maduganga estuary include the Mud Crab (*Scylla serrata*), Grapsid Crabs (*Chiromantes spp.*), the Mud Lobster (*Thalassina anomala*) and the White Prawn (*Penaeus indicus*).

**Table 5**  
**A comparison of butterflies and molluscs in Sri Lanka and Maduganga**

<b>Group</b>	<b>Sri Lanka</b>	<b>Maduganga</b>
Butterflies	243 (20E, 76T)	50 (5T)
Terrestrial molluscs	235 (198E, 116T)	14 (8E,8T)
Aquatic molluscs (Brackish Water)	Unknown	11

E - Endemic, T - Threatened (IUCN Sri Lanka, 2000).



## 5. Ecological Zoning to Identify Critical Habitats in Maduganga

Based on the assessment of the six strata surveyed in Maduganga using five predetermined ecological criteria (Table 6), the upper areas of Maduganga, consisting of strata 1.1 and 1.2 (indicated in Figure 2), can be considered as areas of high ecological importance. These are critical habitats which needs priority conservation attention. The vegetation types that harboured a higher number of mangrove plant communities - mangrove, mangrove mixed-swamps and mangrove scrub extents were relatively higher in the upper region of Maduganga. The mangrove scrub vegetation in the Pathamulla area - located in the lower reaches of Maduganga (strata 3.2) harbours a small population of a vary rare, threatened mangrove species - *Lumnitzera littorea*, and hence is of conservation importance.

**Table 6**  
**Assessment of areas of high ecological significance in Maduganga**

Region	Upper area		Mid area		Lower area	
	1.1	1.2	2.1	2.2	3.1	3.2
Biodiversity	5	5	4	3	3	2
Naturalness	4	4	3	3	2	2
Representativeness	4	4	3	3	3	3
Habitat Dependency/Uniqueness	4	4	3	3	3	4
Integrity	4	4	3	3	3	3
<b>Cumulative Score</b>	<b>21</b>	<b>21</b>	<b>16</b>	<b>15</b>	<b>14</b>	<b>14</b>

**# Strata (arranged from upper to lower reaches of Maduganga estuary) :**

1.1 - Streams and marshland; 1.2 - Kothduwa & Dikduwa islands; 2.1 - Honduwa, Erawanaduwa, Dimiduwa, Maduwa & Mimaduwa islands; 2.2 - Miraladuwa, Naiduwa & Muwanduwa islands; 3.1 - Katuduwa, Thiniyaduwa, Mahaladuwa, Galmanduwa, Gonaduwa & Madaduwa; 3.2 - Rivermouth & Randombe lake

## 6. Major Threats to Biodiversity in Maduganga

Maduganga, perhaps one of the last remaining tracts of pristine mangrove forest in Sri Lanka with a rich biodiversity, now appears to be threatened with the same predicament that many of the island's mangroves now find themselves in, owing to increasing human activity. The major threats that affect the biodiversity of Maduganga can be summarized under three major categories; habitat deterioration/degradation; direct exploitation of species and impact of invasive alien species. The different factors that contribute to these threat categories are given below:

### ***Factors resulting in deterioration/degradation of habitats in Maduganga***

Clearing of mangrove vegetation is evident in most islands as well as mainland areas. This has happened over several years, mainly to cultivate cinnamon on a commercial scale, while some areas have been cleared to construct houses and other temporary makeshifts, especially for the illegal liquor ('Kasippu') trade. Cultivation practices associated with cinnamon poses several threats to this wetland. For instance, agrochemicals (fertilisers, insecticides, fungicides and weedicides) are heavily used in cinnamon cultivations, and harmful residues of these chemicals are eventually washed off into the estuary, resulting in adverse impacts on aquatic biodiversity. The undergrowth of these cultivated lands is kept free of weeds by regular weeding, and this leads to soil erosion, resulting in siltation of the estuary. Even the leaf litter accumulated in most cinnamon land are collected and used to extract oil, and this too aggravates soil erosion. Another source of agricultural runoff that affects the quality of water in this estuary is the rice fields located upstream, where agro-chemicals are used heavily.

Discharge of sewage and other waste material from households as well as dumping of garbage (including sawdust) is on the increase at Maduganga. This has led to the accumulation of nutrients in aquatic habitats, and poses a severe health hazard as well. It has also affected the scenic value of this wetland. As the tidal amplitude in lagoons and estuaries in Sri Lanka is generally low, the tendency for the accumulation of chemical residues and silt in these coastal wetlands is high, and this is clearly evident in Maduganga. As a result of nutrient accumulation, certain shallow areas of the estuary where the water flow is also very slow shows signs of eutrophication and organic pollution. Land reclamation also takes place in many parts of Maduganga, especially for construction purposes.

The high powered (with 20-25 horse power diesel engines) motorized boats operating in Maduganga are also contributing to the deterioration of habitats. For instance, most boat operators drive these boats at very high speeds that cause high turbulence of water leading to erosion of banks in islands. This is clearly evident especially along narrow areas of the estuary, where fringing mangroves have also been destroyed. The constant turbulence (due to the operation of boats at regular intervals) also prevents the establishment of mangrove saplings in eroded areas, while the breeding sites of fish and crustaceans are also adversely affected. Discharge of oil from these boats also contributes to pollution of the estuary. Furthermore, the

noise emitted from these boat engines disturbs the animals of Maduganga, especially the nesting waterfowl.

Sand mining occurs mainly in the lower reaches of Maduganga. This practice disrupts the water currents, resulting river bank erosion, while the migration and breeding sites/habitats of some fish and prawns (especially the bottom dwelling species) are also affected.

### ***Factors contributing to direct exploitation of species in Maduganga***

Poaching of animals (ie., Hog deer, Mouse deer, Terrapins, Wild boar, Crocodile, Whistling teals and other water fowl) takes place regularly in Maduganga. According to local residents, this practice is now on the increase, as wild meat is purchased and served at some restaurants around Maduganga. Poaching may lead to the local extinction of animals such as the Hog deer (*Axis porcinus*) and Crocodile (*Crocodylus porosus* and *C. palustris*), which are nationally threatened. Some animals (ie., Hog deer, Langurs, Civet cats, Mongoose, Crocodiles, Python and birds) are captured and kept in captivity, under poor conditions. These animals are displayed for tourists who visit Maduganga.

Two ornamental fish varieties (Mono - *Monodactylus argenteus* and Spotted scat - *Scatophagus argus*) of export value are heavily exploited in Maduganga, which could lead to drastic reductions of their populations. According to the traditional local fishermen, there has been a decrease in their commercial fish catches over the past 5 years. Besides the effects of pollutants, unsustainable fishing practices may also have contributed towards a decrease in fish populations in Maduganga. For instance, some fishermen use nylon nets with small mesh size, resulting in capturing juvenile fish. Furthermore, certain fishermen leave the nets in the estuary for up to a week, resulting in trapping and drowning reptiles such as crocodiles, pythons and other serpents. Fish are also entangled in discarded nets in several places of the estuary. Overall, the fishery trade in Maduganga (both food fish and ornamental fish harvests) is not being regulated at present, and this may also be a major cause to the decrease of fish, due to over-exploitation.

Although village communities harvest plant species such as Pandanus and reeds to produce mats and bags, this is done in a sustainable manner. However, mangrove trees are cut in a non-sustainable manner by the producers of illegal liquor, to be used as firewood for the distillery process. Some hoteliers who take tourists to Maduganga removes colourful water lilies such as *Nymphaea stellata* in an unsustainable manner, mainly to prepare garlands for tourists.

### ***Impacts of exotic species in Maduganga***

Several species of invasive alien species and unmanaged domestic animals pose a threat to the biodiversity of Maduganga. The invasive alien fauna documented includes one species of fish (Tilapia - *Oreochromis mossambicus*), 2 species of molluscs (Giant African Snail - *Achatina fulica* and the slug - *Laevicaulis alte*) and 3 species of mammals (Common ship rat - *Rattus rattus*, House mouse - *Mus musculus*, and feral domestic cats - *Felis catus*). These invasive

alien faunal species affect the native biodiversity as direct exploiters (ie., predators - feral cats; disease vectors - molluscs, rats and mice) and superior competitors for resources (ie., Tilapia).

As mentioned earlier, 9 invasive alien plant species were also documented from Maduganga. The terrestrial invaders include *Annona glabra*, *Swietenia macrophylla*, *Alstonia macrophylla*, *Chromolaena odorata*, and *Lantana camara*, while the aquatic invaders include *Eichhornia crassipes*, *Salvinia molesta*, *Hydrilla verticillata* and *Najas marina*. Of these invasive plants, *Annona glabra*, *Hydrilla verticillata* and *Najas marina* have spread into many places in Maduganga. Unfortunately, the spread of *Annona glabra* has been facilitated by members of a local NGO in Maduganga, who have used this species for replanting purposes. According to local fishermen, the two submerged invaders - *Hydrilla verticillata* and *Najas marina* have entered Maduganga about 4-5 years ago. It is possible that the accumulation of nutrients (through agricultural runoff, and discharge of organic wastes) in the estuary may have led to the proliferation of these two species.

The invasive alien plants form thickets and shades out native vegetation, and thereby displace them gradually. At the extreme level, the invasive alien plants may entirely modify the structure and function of an ecosystem, which could occur in many ways. For instance, the invasive plant species can produce substances that are toxic to other native plant species (allelopathic substances) and thereby make the soil unsuitable for the original native plant communities. The aquatic invasive alien plants that form dense mats (ie., Floating species such as *Salvinia molesta* and *Eichhornia crassipes* and submerged species such as *Najas marina* and *Hydrilla verticillata*) tends to accumulate greater amount of sediment. In addition, species such as *Salvinia*, *Eichhornia* and *Annona* results in high loss of water through increased transpiration, resulting in gradual conversion of wetland into terrestrial habitats. Furthermore, the dense mats of aquatic invasive plants leads to drastic fluctuations of dissolved oxygen, hence affecting the aquatic fauna. The final outcome of such uniform stands of invasive alien plants is the narrowing down of native biological diversity in a particular locality.

### ***Threatened areas of Maduganga***

The threats discussed above were assessed at the different sampling strata of the Maduganga wetland, and the results are presented in Table 7. When considering the threats according to overall habitat degradation, direct exploitation of species, spread of invasive alien species and human population pressure, a few interesting features are evident in the six predetermined sampling strata of Maduganga. For instance, considering the overall status of habitat degradation, there is an increase from the upper to lower areas of Maduganga, corresponding to an increase in human population density. Conversely, illegal activities related to direct exploitation of species (ie., poaching) is high in upper areas of Maduganga, and decreases towards lower areas. Similarly, the threats related to the spread of invasive alien species is moderate to high in the upper reaches, compared to the lower areas of Maduganga. It is alarming to note that the upper reaches of Maduganga, which was found to be the region of high ecological significance, is threatened by direct exploitation of species as well as the spread of invasive alien species.

**Table 7**

**Evaluation of threats associated with different areas of Maduganga  
(the indicator used to assess different categories of threat is given in parenthesis)**

Region	Upper area		Mid area		Lower area	
	1.1	1.2	2.1	2.2	3.1	3.2
<b>Strata#</b>						
● Clearing of mangrove (area cleared)	M	H	H	H	H	H
● Dumping of garbage (number of dumping sites)	L	M	L	M	L	H
● Discharge of agro-chemicals (area of agricultural land under agrochemical usage)	H	H	M	M	L	L
● Fuel discharge from boats (signs of oil spillage in water)	L	M	M	M	H	H
● Discharge of sewage and other waste material from households (number of households discharging sewage/waste)	L	L	L	L	M	H
● Siltation (area subjected to deposition of silt)	H	M	M	L	L	L
● Erosion of riverbanks (area eroded)	M	L	M	L	M	H
● Sand mining (frequency of occurrence)	—	—	—	—	M	H
● Land reclamation (area reclaimed)	L	M	L	M	M	H
● Operation of motor boats (motor boat traffic/frequency of use)	L	M	M	M	H	H
<b>Overall habitat degradation</b>	<b>L</b>	<b>M</b>	<b>M</b>	<b>M</b>	<b>M</b>	<b>H</b>
● Poaching (frequency of occurrence)	H	M	H	M	L	L
● Capturing of animals for Captivity (frequency of occurrence)	H	M	M	L	M	L
● Unsustainable harvesting of fish (field observations on harvesting methods and species exploited)	M	M	M	M	H	H
● Unsustainable harvesting of plants (field observations on species exploited)	H	M	M	M	M	M
<b>Direct exploitation of species</b>	<b>H</b>	<b>M</b>	<b>M</b>	<b>M</b>	<b>M</b>	<b>L</b>
● Spread of invasive alien animals (number of species and their spread)	M	M	M	M	L	M
● Spread of invasive alien plants (number of species and their spread)	H	H	H	M	L	L
<b>Threat of invasive alien species</b>	<b>M-H</b>	<b>M-H</b>	<b>M-H</b>	<b>M</b>	<b>L</b>	<b>L-M</b>
<b>Human population density</b>	<b>L</b>	<b>L</b>	<b>M</b>	<b>M</b>	<b>M</b>	<b>H</b>

**Severity of threat: L - Low; M - Moderate; H - High**

#Strata (arranged from upper to lower reaches of Maduganga estuary) : 1.1 - Streams and marshland; 1.2 - Kothduwa & Dikduwa islands; 2.1 - Honduwa, Erawanaduwa, Dimiduwa, Maduwa & Mimaduwa islands; 2.2 - Miraladuwa, Naiduwa & Muwanduwa islands; 3.1 - Katuduwa, Thiniyaduwa, Mahaladuwa, Galmanduwa, Gonaduwa & Madaduwa; 3.2 - Rivermouth & Randoembe lake

## 7. Recommendations for Conservation of the Maduganga Mangrove Estuary

The present survey has clearly revealed that the Maduganga wetland harbours a rich biodiversity, including several endemic as well as threatened species of plants and animals. However, the study also revealed that this wetland is now being threatened by various anthropogenic activities, including the nature-based tourism operations. While the Maduganga area has potential to be developed as a sustainable eco-tourism site due to its ecological, cultural and scenic value, it is important to conserve the area as this is one of the few extensive mangrove areas in the country which is still relatively undisturbed.

Considering the overall findings, the following recommendations are made to facilitate the future sustenance of this unique mangrove estuary.

1. Declare Maduganga wetland as a protected area (PA), under a relevant Government Conservation Department.
2. Initiate studies to document the current socio-economic status related to resource use in Maduganga, as well as the physico-chemical and hydrological status of Maduganga wetland.
3. Avoid the construction of irrigation structures that may alter the ecology and hydrology of Maduganga.
4. Ban the construction of tourism related infrastructure facilities (tourist hotels, guest houses etc.) in the islands of Maduganga.
5. Prepare a tourism master plan, in order to regulate tourism operations in Maduganga, and also to ensure that local communities reap the benefits of nature-based tourism operations in Maduganga.
6. Establish a coordinating body that consists of relevant stakeholders (local administrators, members from local communities, Government Conservation Departments and the Sri Lanka Tourist Board) to manage the Maduganga Wetland.
7. The local administrators and Government Conservation Agencies should take immediate steps to mitigate harmful practices that are degrading Maduganga, with particular emphasis on the northern reaches of the estuary, which is of high ecological significance.
8. A programme should be initiated to manage the spread of the two most problematic invasive alien plants in Maduganga - *Annona glabra* and *Najas marina*.

9. The Department of Agriculture should take steps to promote soil conservation and organic agricultural practices among cinnamon cultivators in Maduganga.
10. With the help of local communities, initiate mangrove restoration activities under scientific guidance, especially in areas with mangrove scrubs, mangrove mixed swamps and bank scrub vegetation types that were identified and mapped during the present survey.
11. The local administration should regulate the operation of motorized boat, and introduce speed limits for boat operators.

## Acknowledgements

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## Appendix 1

### List of flora recorded from Maduganga, their status and life-forms (Status: IAS - Invasive Alien Species; E - Endemic; T - Nationally Threatened)

No.	Family	Botanical name	Status	Life-form
1	Acanthaceae	<i>Barlaria prionites</i>		Herbaceous
2	Adiantaceae	<i>Vittaria</i> sp.		Herbaceous
3	Aizoaceae	<i>Trianthema portulacastrum</i>		Herbaceous
4	Amaranthaceae	<i>Alternanthera sessile</i>		Herbaceous
5	Amaryllidaceae	<i>Crinum zeylanicum</i>		Herbaceous
6	Anacardiaceae	<i>Anacardium occidentale</i>		Tree
7	Anacardiaceae	<i>Mangifera indica</i>		Tree
8	Anacardiaceae	<i>Mangifera zeylanica</i>		Tree
9	Anacardiaceae	<i>Semecarpus nigro-viridis</i>		Tree
10	Anacardiaceae	<i>Spondias dulcis</i>		Tree
11	Annonaceae	<i>Annona glabra</i>	IAS	Tree
12	Annonaceae	<i>Cananga odorata</i>		Tree
13	Annonaceae	<i>Cythocalyx zeylanica</i>		Tree
14	Annonaceae	<i>Enicosanthum acuminata</i>	E	Tree
15	Annonaceae	<i>Uvaria zeylanica</i>		Liana
16	Apocynaceae	<i>Alstonia macrophylla</i>	IAS	Tree
17	Apocynaceae	<i>Cerbera manghas</i>		Tree
18	Apocynaceae	<i>Pagiantha dichotoma</i>		Tree
19	Apocynaceae	<i>Walidda antidysenterica</i>	E	Shrub
20	Araceae	<i>Alocasia macrorrhiza</i>		Herbaceous
21	Araceae	<i>Amorphophallus campanulatus</i>		Herbaceous
22	Araceae	<i>Pothos scandens</i>		Herbaceous
23	Araliaceae	<i>Schefflera stellata</i>		Shrub
24	Aristolochiaceae	<i>Apama siliquosa</i>		Shrub
25	Aristolochiaceae	<i>Pentatropis carpensis</i>		Herbaceous
26	Asclepiadaceae	<i>Aristolochia indica</i>		Herbaceous
27	Asclepiadaceae	<i>Gymnema lactiferum</i>		Herbaceous
28	Asclepiadaceae	<i>Hemidesmus indicus</i>		Herbaceous
29	Asteraceae	<i>Ageratum conyzoides</i>		Herbaceous
30	Asteraceae	<i>Blainvillea acmella</i>		Herbaceous
31	Asteraceae	<i>Emilia sonchifolia</i>		Herbaceous
32	Asteraceae	<i>Eupatorium odoratum</i>	IAS	Herbaceous

No.	Family	Botanical name	Status	Life-form
33	Asteraceae	<i>Mikania cordata</i>	IAS	Herbaceous
34	Asteraceae	<i>Sphaeranthus</i> sp.		Herbaceous
35	Asteraceae	<i>Vernonia cinerea</i>		Herbaceous
36	Balsaminaceae	<i>Hydrocera trifoliata</i>		Herbaceous
37	Bambusaceae	<i>Bambusa vulgaris</i>		Tree
38	Bignoniaceae	<i>Dolichandrone spathacea</i>		Tree
39	Bombacaceae	<i>Ceiba pentandra</i>		Tree
40	Boraginaceae	<i>Cordia dichotoma</i>		Tree
41	Butomaceae	<i>Limnocharis flava</i>		Herbaceous
42	Capparidaceae	<i>Capparis moonii</i>		Shrub
43	Capparidaceae	<i>Cleome rutidosperma</i>		Herbaceous
44	Caryophyllaceae	<i>Drymaria cordata</i>		Herbaceous
45	Celastraceae	<i>Salacia reticulata</i>	T	Liana
46	Ceratophyllaceae	<i>Ceratophyllum demersum</i>		Herbaceous
47	Characeae	<i>Chara</i> sp.		Herbaceous
48	Clusiaceae	<i>Calophyllum inophyllum</i>		Tree
49	Clusiaceae	<i>Garcinia quaesita</i>	E	Tree
50	Clusiaceae	<i>Mesua ferrea</i>	E	Tree
51	Combretaceae	<i>Lumnitsera littorea</i>	T	Shrub
52	Combretaceae	<i>Lumnitsera racemosa</i>		Shrub
53	Combretaceae	<i>Terminalia bellirica</i>		Tree
54	Combretaceae	<i>Terminalia catappa</i>		Tree
55	Commelinaceae	<i>Commelina clavata</i>		Herbaceous
56	Commelinaceae	<i>Murdannia</i> sp.		Herbaceous
57	Convolvulaceae	<i>Argyreia populifolia</i>		Herbaceous
58	Convolvulaceae	<i>Argyreia thwaitesii</i>		Herbaceous
59	Convolvulaceae	<i>Cuscuta chinensis</i>		Herbaceous
60	Cycadaceae	<i>Cycus circinalis</i>	T	Tree
61	Cyperaceae	<i>Carex indica</i>		Herbaceous
62	Cyperaceae	<i>Cyperus compressus</i>		Herbaceous
63	Cyperaceae	<i>Cyperus haspan</i>		Herbaceous
64	Cyperaceae	<i>Cyperus pilosus</i>		Herbaceous
65	Cyperaceae	<i>Cyperus platystylis</i>		Herbaceous
66	Cyperaceae	<i>Cyperus sphacelatus</i>		Herbaceous
67	Cyperaceae	<i>Cyperus tenuispica</i>		Herbaceous
68	Cyperaceae	<i>Elaeocharis actangula</i>		Herbaceous

No.	Family	Botanical name	Status	Life-form
69	Cyperaceae	<i>Elaeocharis dulcis</i>		Herbaceous
70	Cyperaceae	<i>Elaeocharis genticulata</i>		Herbaceous
71	Cyperaceae	<i>Elaeocharis spiralis</i>		Herbaceous
72	Cyperaceae	<i>Fimbristylis acuminata</i>		Herbaceous
73	Cyperaceae	<i>Fimbristylis cinnamometorum</i>		Herbaceous
74	Cyperaceae	<i>Fimbristylis ferruginea</i>		Herbaceous
75	Cyperaceae	<i>Fimbristylis pubisquama</i>		Herbaceous
76	Cyperaceae	<i>Fimbristylis quinquangularis</i>		Herbaceous
77	Cyperaceae	<i>Fimbristylis tetragona</i>		Herbaceous
78	Cyperaceae	<i>Fimbristylis triflora</i>		Herbaceous
79	Cyperaceae	<i>Fimbristylis umbellaris</i>		Herbaceous
80	Cyperaceae	<i>Fuirena capitata</i>		Herbaceous
81	Cyperaceae	<i>Fuirena ciliaris</i>		Herbaceous
82	Cyperaceae	<i>Fuirena umbellata</i>		Herbaceous
83	Cyperaceae	<i>Polycarpea corymbosa</i>		Herbaceous
84	Cyperaceae	<i>Rhynchospora corymbosa</i>		Herbaceous
85	Cyperaceae	<i>Schoenoplectus juncooides</i>		Herbaceous
86	Cyperaceae	<i>Scleria levis</i>		Herbaceous
87	Cyperaceae	<i>Scleria sumatrensis</i>		Herbaceous
88	Dilleniaceae	<i>Dillenia retusa</i>	E	Tree
89	Dilleniaceae	<i>Wormia triquetra</i>	E	Tree
90	Dipterocarpaceae	<i>Shorea affinis</i>	T	Tree
91	Droseraceae	<i>Drosera burmanii</i>		Herbaceous
92	Elaeocarpaceae	<i>Elaeocarpus serratus</i>		Tree
93	Eriocaulaceae	<i>Eriocaulon quinquangulare</i>		Herbaceous
94	Eriocaulaceae	<i>Eriocaulon cinereum</i>		Herbaceous
95	Eriocaulaceae	<i>Eriocaulon setaceum</i>		Herbaceous
96	Eriocaulaceae	<i>Eriocaulon sexangulare</i>		Herbaceous
97	Eriocaulaceae	<i>Eriocaulon truncatum</i>		Herbaceous
98	Eriocaulaceae	<i>Eriocaulon willdenovioanum</i>		Herbaceous
99	Euphorbiaceae	<i>Antidesma pyrifolium</i>	E	Tree
100	Euphorbiaceae	<i>Breynia vitis-idea</i>		Shrub
101	Euphorbiaceae	<i>Cleistanthus pallidus</i>	E	Tree
102	Euphorbiaceae	<i>Cleistanthus sp.</i>		Tree
103	Euphorbiaceae	<i>Croton bonplandianus</i>		Herbaceous
104	Euphorbiaceae	<i>Croton hirta</i>		Herbaceous
105	Euphorbiaceae	<i>Croton laccifer</i>		Shrub
106	Euphorbiaceae	<i>Euphorbia hirta</i>		Herbaceous
107	Euphorbiaceae	<i>Excoecaria gallocha</i>		Shrub

No.	Family	Botanical name	Status	Life-form
108	Euphorbiaceae	<i>Glochidion zeylanicum</i>		Tree
109	Euphorbiaceae	<i>Macaranga peltata</i>		Tree
110	Euphorbiaceae	<i>Manihot esculenta</i>		Shrub
111	Euphorbiaceae	<i>Phyllanthus amarus</i>		Shrub
112	Euphorbiaceae	<i>Phyllanthus debilis</i>		Herbaceous
113	Euphorbiaceae	<i>Phyllanthus emblica</i>		Tree
114	Euphorbiaceae	<i>Phyllanthus niriuri</i>		Herbaceous
115	Euphorbiaceae	<i>Phyllanthus urinaria</i>		Herbaceous
116	Euphorbiaceae	<i>Sebastiana chamaelea</i>		Herbaceous
117	Fabaceae	<i>Abrus precatorius</i>		Herbaceous
118	Fabaceae	<i>Aeschynomene indica</i>		Herbaceous
119	Fabaceae	<i>Albizia lebbek</i>		Tree
120	Fabaceae	<i>Atylosia rugosa</i>		Herbaceous
121	Fabaceae	<i>Caesalpinia</i> sp.		Shrub
122	Fabaceae	<i>Clitoria ternatea</i>		Herbaceous
123	Fabaceae	<i>Dalbergia candenatensis</i>		Liana
124	Fabaceae	<i>Derris trifoliata</i>		Liana
125	Fabaceae	<i>Desmodium ferrugenum</i>		Herbaceous
126	Fabaceae	<i>Desmodium gangeticum</i>		Herbaceous
127	Fabaceae	<i>Desmodium heterocarpum</i>		Herbaceous
128	Fabaceae	<i>Desmodium triflorum</i>		Herbaceous
129	Fabaceae	<i>Entada puseatha</i>		Liana
130	Fabaceae	<i>Erythrina variegata</i>		Tree
131	Fabaceae	<i>Gliricidia sepium</i>		Tree
132	Fabaceae	<i>Humboldtia laurifolia</i>		Tree
133	Fabaceae	<i>Indigofera linnaei</i>		Herbaceous
134	Fabaceae	<i>Mimosa pudica</i>		Herbaceous
135	Fabaceae	<i>Mimusops elengi</i>		Tree
136	Fabaceae	<i>Phaseolus vulgaris</i>		Herbaceous
137	Fabaceae	<i>Pongamia pinnata</i>		Tree
138	Fabaceae	<i>Samanea saman</i>		Tree
139	Flacourtiaceae	<i>Flacourtia inermis</i>		Tree
140	Flacourtiaceae	<i>Scolopia acuminata</i>	E	Tree
141	Flagellariaceae	<i>Flagellaria indica</i>		Climber
142	Flagellariaceae	<i>Hanguana malayana</i>		Herbaceous
143	Gleichiniaceae	<i>Dicranopteris linearis</i>		Herbaceous
144	Hernandiaceae	<i>Hernandia nymphaefolia</i>		Tree
145	Hippcrateaceae	<i>Reissantia indica</i>		Climber
146	Hydrocharitaceae	<i>Blyxa auberti</i>		Herbaceous
147	Hydrocharitaceae	<i>Hydrilla verticillata</i>	IAS	Herbaceous
148	Hydrocharitaceae	<i>Vallisneria natans</i>		Herbaceous
149	Lamiaceae	<i>Leucas zeylanica</i>		Herbaceous

No.	Family	Botanical name	Status	Life-form
150	Lauraceae	<i>Casyththa filiformis</i>		Herbaceous
151	Lauraceae	<i>Cinnamomum zeylanicum</i>	E	Tree
152	Lecythidaceae	<i>Barringtonia racemosa</i>		Tree
153	Lentibulariaceae	<i>Utricularia aurea</i>		Herbaceous
154	Lentibulariaceae	<i>Utricularia caerulea</i>		Herbaceous
155	Lentibulariaceae	<i>Utricularia reticulata</i>		Herbaceous
156	Lentibulariaceae	<i>Utricularia uliginosa</i>		Herbaceous
157	Liliaceae	<i>Asparagus falcata</i>		Herbaceous
158	Liliaceae	<i>Gloriosa superba</i>		Herbaceous
159	Linaceae	<i>Hugonia ferruginea</i>	E	Tree
160	Loranthaceae	<i>Dendrophthoe falcata</i>		Herbaceous
161	Loranthaceae	<i>Dendrophthoe neelgherrensis</i>		Herbaceous
162	Loranthaceae	<i>Helixanthera ensifolia</i>	T	Herbaceous
163	Lycopodiaceae	<i>Lycopodium cernum</i>		Herbaceous
164	Malvaceae	<i>Hibiscus rosasinensis</i>		Shrub
165	Malvaceae	<i>Hibiscus tiliaceus</i>		Shrub
166	Malvaceae	<i>Sida acuta</i>		Herbaceous
167	Malvaceae	<i>Thespesia populnea</i>		Tree
168	Melastomataceae	<i>Melastoma malabathricum</i>		Shrub
169	Melastomataceae	<i>Memecylon rostratum</i>	E	Shrub
170	Melastomataceae	<i>Memecylon</i> sp.		Shrub
171	Melastomataceae	<i>Memecylon sylvaticum</i>	E	Shrub
172	Melastomataceae	<i>Osbeckia aspera</i>		Herbaceous
173	Melastomataceae	<i>Osbeckia octandra</i>	E	Herbaceous
174	Meliaceae	<i>Azadirachta indica</i>		Tree
175	Meliaceae	<i>Chukrasia tabularis</i>		Tree
176	Meliaceae	<i>Swietenia macrophylla</i>	IAS	Tree
177	Meliaceae	<i>Xylocarpus granatum</i>		Tree
178	Menispermaceae	<i>Anamirta cocculus</i>		Liana
179	Menispermaceae	<i>Cissampelos pereira</i>		Herbaceous
180	Menispermaceae	<i>Cyclea burmanni</i>		Herbaceous
181	Menyanthaceae	<i>Nymphoides aurantiaca</i>	T	Herbaceous
182	Menyanthaceae	<i>Nymphoides indica</i>		Herbaceous
183	Moraceae	<i>Artocarpus heterophyllus</i>		Tree
184	Moraceae	<i>Artocarpus incisus</i>		Tree
185	Moraceae	<i>Ficus amplissima</i>		Tree
186	Moraceae	<i>Ficus benghalensis</i>		Tree
187	Moraceae	<i>Ficus caulocarpa</i>		Tree
188	Moraceae	<i>Ficus hispida</i>		Tree
189	Moraceae	<i>Ficus religiosa</i>		Tree
190	Musaceae	<i>Musa acuminata</i>		Herbaceous
191	Myristicaceae	<i>Myristica dactyloides</i>		Tree

No.	Family	Botanical name	Status	Life-form
192	Myrtaceae	<i>Syzygium caryophyllatum</i>		Tree
193	Myrtaceae	<i>Syzygium cumini</i>		Tree
194	Myrtaceae	<i>Syzygium operculatum</i>		Tree
195	Najadaceae	<i>Najas marina</i>	IAS	Herbaceous
196	Nymphaeaceae	<i>Nymphaea nouchali</i>		Herbaceous
197	Nymphaeaceae	<i>Nymphaea pubescens</i>		Herbaceous
198	Ochnaceae	<i>Gomphia serrata</i>		Tree
199	Ochnaceae	<i>Ochna jabotapita</i>		Tree
200	Olacaceae	<i>Olax zeylanica</i>		Tree
201	Oleaceae	<i>Chionanthus albidiflorus</i>	E	Tree
202	Oleaceae	<i>Jasminum angustifolium</i>	E	Herbaceous
203	Onagraceae	<i>Ludwigia adscendens</i>		Herbaceous
204	Onagraceae	<i>Ludwigia decurrens</i>		Herbaceous
205	Onagraceae	<i>Ludwigia peruviana</i>		Herbaceous
206	Opiliaceae	<i>Cansjera rheedii</i>		Shrub
207	Orchidaceae	<i>Spathoglottis</i> sp.		Herbaceous
208	Orchidaceae	<i>Vanilla walkerae</i>	T	Herbaceous
209	Palmae	<i>Areca catechu</i>		Tree
210	Palmae	<i>Caryota urens</i>		Tree
211	Palmae	<i>Cocos nucifera</i>		Tree
212	Palmae	<i>Nypa fruticans</i>	T	Herbaceous
213	Palmae	<i>Phoenix zeylanica</i>	E	Tree
214	Pandanaceae	<i>Pandanus amaryllifolius</i>		Shrub
215	Pandanaceae	<i>Pandanus tectorius</i>		Shrub
216	Parkeriaceae	<i>Ceratopteris thalictroides</i>		Herbaceous
217	Passifloraceae	<i>Passiflora foetida</i>		Herbaceous
218	Phytollaccaceae	<i>Rivina humilis</i>		Herbaceous
219	Poaceae	<i>Axonopus affinis</i>		Herbaceous
220	Poaceae	<i>Axonopus compressus</i>		Herbaceous
221	Poaceae	<i>Brachiaria reptans</i>		Herbaceous
222	Poaceae	<i>Chrysopogon aciculatus</i>		Herbaceous
223	Poaceae	<i>Cirtococcum trigonum</i>		Herbaceous
224	Poaceae	<i>Dactyloctenium aegyptium</i>		Herbaceous
225	Poaceae	<i>Digitaria ciliaris</i>		Herbaceous
226	Poaceae	<i>Digitaria longiflora</i>		Herbaceous
227	Poaceae	<i>Dimeria fuscescens</i>		Herbaceous
228	Poaceae	<i>Echinocloa crusgali</i>		Herbaceous
229	Poaceae	<i>Eragrostis atrovirens</i>		Herbaceous
230	Poaceae	<i>Eragrostis uniloides</i>		Herbaceous
231	Poaceae	<i>Isachne globosa</i>		Herbaceous
232	Poaceae	<i>Isachne kunthiana</i>		Herbaceous
233	Poaceae	<i>Ischeamum indicum</i>		Herbaceous

No.	Family	Botanical name	Status	Life-form
234	Poaceae	<i>Ischeamum rugosum</i>		Herbaceous
235	Poaceae	<i>Leerasia hexandra</i>		Herbaceous
236	Poaceae	<i>Leptochloa chinensis</i>		Herbaceous
237	Poaceae	<i>Panicum notatum</i>		Herbaceous
238	Poaceae	<i>Panicum repens</i>		Herbaceous
239	Poaceae	<i>Paspalum scrobiculatum</i>		Herbaceous
240	Poaceae	<i>Paspalum vaginatum</i>		Herbaceous
241	Poaceae	<i>Pennesetum polystachion</i>		Herbaceous
242	Poaceae	<i>Setaria gracilis</i>		Herbaceous
243	Poaceae	<i>Setaria verticillata</i>		Herbaceous
244	Polygonaceae	<i>Antigonon leptopus</i>		Herbaceous
245	Polypodiaceae	<i>Drymoglossum</i> sp.		Herbaceous
246	Polypodiaceae	<i>Drynaria</i> sp.		Herbaceous
247	Portulaccaceae	<i>Portulaca oleracea</i>		Herbaceous
248	Portulaccaceae	<i>Portulaca suffruticosa</i>		Herbaceous
249	Portulaccaceae	<i>Talium triangulare</i>		Herbaceous
250	Pteridaceae	<i>Acrosticum aureum</i>		Herbaceous
251	Rhamnaceae	<i>Ziziphus lucida</i>		Shrub
252	Rhamnaceae	<i>Ziziphus oenoplea</i>		Shrub
253	Rhamnaceae	<i>Ziziphus rugosa</i>		Shrub
254	Rhizophoraceae	<i>Bruguiera gymnorhiza</i>		Tree
255	Rhizophoraceae	<i>Bruguiera sexangula</i>		Tree
256	Rhizophoraceae	<i>Carallia brachiata</i>		Tree
257	Rhizophoraceae	<i>Ceriops tagal</i>		Tree
258	Rhizophoraceae	<i>Rhizophora apiculata</i>		Tree
259	Rhizophoraceae	<i>Rhizophora mucronata</i>		Tree
260	Rubiaceae	<i>Canthium dicoccum</i>		Tree
261	Rubiaceae	<i>Dentella repens</i>		Herbaceous
262	Rubiaceae	<i>Gaertnera vaginans</i>		Shrub
263	Rubiaceae	<i>Gardenia latifolia</i>		Shrub
264	Rubiaceae	<i>Hedyotis cymosa</i>	E	Herbaceous
265	Rubiaceae	<i>Hedyotis fruticosa</i>		Herbaceous
266	Rubiaceae	<i>Hydyotis fruticosa</i>		Herbaceous
267	Rubiaceae	<i>Ixora coccinea</i>		Shrub
268	Rubiaceae	<i>Ixora parviflora</i>		Shrub
269	Rubiaceae	<i>Knoxia zeylanica</i>		Herbaceous
270	Rubiaceae	<i>Oldelandia herbacea</i>		Herbaceous
271	Rubiaceae	<i>Ophiorrhiza mungos</i>		Herbaceous
272	Rubiaceae	<i>Spermacoce mauritiana</i>		Herbaceous
273	Rubiaceae	<i>Spermoacoca hispida</i>		Herbaceous
274	Rubiaceae	<i>Tarenna asiatica</i>		Tree
275	Rutaceae	<i>Acronychia pedunculata</i>		Tree

No.	Family	Botanical name	Status	Life-form
276	Salviniaceae	<i>Salvinia molesta</i>	IAS	Herbaceous
277	Sapindaceae	<i>Cardiospermum halicacabum</i>		Climber
278	Sapindaceae	<i>Filicium decipiens</i>		Tree
279	Schizaeaceae	<i>Lygodium microphyllum</i>		Herbaceous
280	Scrophulariaceae	<i>Bacopa monnieri</i>		Herbaceous
281	Scrophulariaceae	<i>Lindernia rotundifolia</i>		Herbaceous
282	Scrophulariaceae	<i>Scoparia dulcis</i>		Herbaceous
283	Smilacaceae	<i>Smilax zeylanica</i>		Herbaceous
284	Sonneratiaceae	<i>Sonneratia caseolaris</i>		Tree
285	Sterculiaceae	<i>Heritiera littoralis</i>		Tree
286	Sterculiaceae	<i>Melochia corchorifolia</i>		Herbaceous
287	Symplocaceae	<i>Symplocos cochinchinensis</i>		Tree
288	Thelypteridaceae	<i>Cyclosorus</i> sp.		Herbaceous
289	Tiliaceae	<i>Corchorus fascicularis</i>		Herbaceous
290	Tiliaceae	<i>Triumfetta rotundifolia</i>		Herbaceous
291	Typhaceae	<i>Typha angustifolia</i>		Herbaceous
292	Ulmaceae	<i>Trema orientalis</i>		Tree
293	Umbelliferae	<i>Centella asiatica</i>		Herbaceous
294	Verbenaceae	<i>Clerodendrum indicum</i>		Shrub
295	Verbenaceae	<i>Clerodendrum inerme</i>		Shrub
296	Verbenaceae	<i>Lantana camara</i>	IAS	Shrub
297	Verbenaceae	<i>Stachytarpheta jamaicensis</i>		Herbaceous
298	Verbenaceae	<i>Vitex altissima</i>		Tree
299	Viscacea	<i>Viscum capitellatum</i>		Herbaceous
300	Viscaceae	<i>Notothixos floccosus</i>	E	Herbaceous
301	Xyridaceae	<i>Xyris complanata</i>		Herbaceous
302	Xyridaceae	<i>Xyris indica</i>		Herbaceous



## Appendix. 2

### List of plant species observed in homegardens in the islands and mainland area of Maduganga wetland

No.	Family	Botanical name	Common name (S)	Life- form
1	Adiantaceae	<i>Vittaria</i> sp.		Herbaceous Epiphyte
2	Amaranthaceae	<i>Alternanthera sessile</i>	Mukunuwenna	Herb
3	Anacardiaceae	<i>Anacardium occidentale</i>	Kaju	Tree
4	Anacardiaceae	<i>Mangifera indica</i>	Amba	Tree
5	Anacardiaceae	<i>Spondias dulcis</i>	Emberella	Tree
6	Annonaceae	<i>Cananga odorata</i>		Tree
7	Apocynaceae	<i>Alstonia macrophylla</i>	Hawari nuga	Tree
8	Apocynaceae	<i>Cerbera manghas</i>	Kaduru	Tree
9	Araceae	<i>Alocasia macrorrhiza</i>	Habarala	Herb
10	Araceae	<i>Pothos scandens</i>		Herbaceous Climber
11	Asclepiadaceae	<i>Hemidesmus indicus</i>	Iramusu	Herbaceous Climber
12	Asteraceae	<i>Ageratum conyzoides</i>	Hulan thala	Herb
13	Asteraceae	<i>Emilia sonchifolia</i>		Herb
14	Asteraceae	<i>Eupatorium odoratum</i>	Podisinno	Herb
15	Asteraceae	<i>Mikania cordata</i>	Gahale wel	Herbaceous Climber
16	Asteraceae	<i>Vernonia cinerea</i>	Monerakudumbiya	Herb
17	Bambusaceae	<i>Bambusa vulgaris</i>	Unabata	Tree
18	Bombacaceae	<i>Ceiba pentandra</i>		Tree
19	Clusiaceae	<i>Calophyllum inophyllum</i>	Domba	Tree
20	Clusiaceae	<i>Garcinia quaesita</i> <sup>E</sup>	Goraka	Tree
21	Combretaceae	<i>Terminalia catappa</i>	Kottamba	Tree
22	Commelinaceae	<i>Commelina clavata</i>	Girapala	Herb
23	Convolvulaceae	<i>Argyreia populifolia</i>	Girithilla	Herbaceous Climber
24	Cycadaceae	<i>Cycus circinalis</i> <sup>T</sup>		Shrub
25	Cyperaceae	<i>Fimbristylis cinnamometorum</i>		Herb
26	Cyperaceae	<i>Fimbristylis quinquangularis</i>		Herb
27	Cyperaceae	<i>Fimbristylis umbellaris</i>		Herb
28	Cyperaceae	<i>Fuirena capitata</i>		Herb

No.	Family	Botanical name	Common name (S)	Life- form
29	Dilleniaceae	<i>Dellinia retusa</i>		Tree
30	Euphorbiaceae	<i>Euphorbia hirta</i>		Herb
31	Euphorbiaceae	<i>Macaranga peltata</i>	Kenda	Tree
32	Euphorbiaceae	<i>Manihot esculenta</i>	Maiyokka	Shrub
33	Euphorbiaceae	<i>Phyllanthus emblica</i>	Nelli	Tree
34	Euphorbiaceae	<i>Phyllanthus niruri</i>		Herb
35	Fabaceae	<i>Abrus precatorius</i>	Olinda	Herbaceous Climber
36	Fabaceae	<i>Albizia lebbek</i>		Tree
37	Fabaceae	<i>Clitoria ternatea</i>	Nilkatarodu	Herbaceous Climber
38	Fabaceae	<i>Desmodium ferrugineum</i>		Shrub
39	Fabaceae	<i>Desmodium triflorum</i>	Undupiyali	Herb
40	Fabaceae	<i>Erythrina variegata</i>		Tree
41	Fabaceae	<i>Gliricidia sepium</i>	Wetahira	Tree
42	Fabaceae	<i>Indigofera linnaei</i>	Naripila	Herb
43	Fabaceae	<i>Mimosa pudica</i>	Nidikumba	Herb
44	Fabaceae	<i>Phaseolus vulgaris</i>	Bonchi	Herbaceous Climber
45	Fabaceae	<i>Samanea saman</i>	Mara	Tree
46	Lauraceae	<i>Cinnamomum zeylanicum</i> <sup>E</sup>	Kurundu	Tree
47	Liliaceae	<i>Gloriosa superba</i>		Herbaceous Climber
48	Loranthaceae	<i>Dendrophthoe neelgherrensis</i>		Parasitic Herb
49	Malvaceae	<i>Hibiscus rosasinensis</i>	Wada	Shrub
50	Malvaceae	<i>Hibiscus tiliaceus</i>	Belipatta	Shrub
51	Malvaceae	<i>Sida acuta</i>		Herb
52	Malvaceae	<i>Thespesia populnea</i>	Gan suriya	Tree
53	Meliaceae	<i>Azadirachta indica</i>	Kohomba	Tree
54	Meliaceae	<i>Chukrasia tabularis</i>		Tree
55	Meliaceae	<i>Swietenia macrophylla</i>	Mahogani	Tree
56	Menispermaceae	<i>Anamirta cocculus</i>	Thithawel	Woody Liana
57	Menispermaceae	<i>Cissampelos pereira</i>		Herbaceous Climber
58	Menispermaceae	<i>Cyclea burmanni</i>	Kesibissan	Herbaceous Climber
59	Moraceae	<i>Artocarpus heterophyllus</i>	Kos	Tree

No.	Family	Botanical name	Common name (S)	Life- form
60	Moraceae	<i>Artocarpus incisus</i>	Del	Tree
61	Musaceae	<i>Musa acuminata</i>	Kesel	Herb
62	Palmae	<i>Areca catechu</i>	Puwak	Tree
63	Palmae	<i>Caryota urens</i>	Kithul	Tree
64	Palmae	<i>Cocos nucifera</i>	Pol	Tree
65	Pandanaceae	<i>Pandanus tectorius</i>	Wetakeyya	Shrub
66	Passifloraceae	<i>Passiflora foetida</i>	Padawel	Herbaceous Climber
67	Poaceae	<i>Axonopus affinis</i>		Herb
68	Poaceae	<i>Axonopus compressus</i>		Herb
69	Poaceae	<i>Cirtococcum trigonum</i>		Herb
70	Poaceae	<i>Dactyloctenium aegyptium</i>		Herb
71	Poaceae	<i>Digitaria ciliaris</i>		Herb
72	Poaceae	<i>Digitaria longiflora</i>		Herb
73	Poaceae	<i>Dimeria fuscescens</i>		Herb
74	Poaceae	<i>Eragrostis uniloides</i>		Herb
75	Poaceae	<i>Isachne globosa</i>		Herb
76	Poaceae	<i>Isachne kunthiana</i>		Herb
77	Poaceae	<i>Ischeamum indicum</i>		Herb
78	Poaceae	<i>Ischeamum rugosum</i>	Kudukedu	Herb
79	Poaceae	<i>Leptochloa chinensis</i>		Herb
80	Poaceae	<i>Panicum notatum</i>		Herb
81	Poaceae	<i>Panicum repens</i>	Etora	Herb
82	Poaceae	<i>Paspalum scrobiculatum</i>		Herb
83	Poaceae	<i>Paspalum vaginatum</i>		Herb
84	Poaceae	<i>Pennesetum polystachion</i>		Herb
85	Polygonaceae	<i>Antigonon leptopus</i>		Herbaceous Climber
86	Polypodiaceae	<i>Drymoglossum</i> sp.	Panampethi	Herbaceous Epiphyte
87	Polypodiaceae	<i>Drynaria</i> sp.		Herbaceous Epiphyte
88	Portulaccaceae	<i>Talium triangulare</i>		Herb
89	Rhizophoraceae	<i>Carallia brachiata</i>		Tree
90	Rutaceae	<i>Acronychia pedunculata</i>	Ankenda	Tree
91	Sapindaceae	<i>Cardiospermum halicacabum</i>	Penela	Herbaceous Climber

No.	Family	Botanical name	Common name (S)	Life- form
92	Sapindaceae	<i>Filicium decipiens</i>	Pihimbiya	Tree
93	Sonneratiaceae	<i>Sonneratia caseolaris</i>	Kirilla	Tree
94	Umbelliferae	<i>Centella asiatica</i>	Gotukola	Herb
95	Verbenaceae	<i>Clerodendrum indicum</i>	Pinna	Shrub
96	Verbenaceae	<i>Lantana camara</i>	Hinguru	Shrub
97	Verbenaceae	<i>Stachytarpheta jamaicensis</i>	Balunaguta	Herb
98	Verbenaceae	<i>Vitex altissima</i>	Milla	Tree

E - Endemic; T - Threatened

Abbreviations used in appendices 3 - 10 :

Status: E - Endemic; T - Nationally Threatened (IUCN Sri Lanka, 2000); AIS - Alien Invasive Species; Ex - Exotic species; WM - Winter migrant.

Abundance: VC - Very Common; C - Common; UC - Uncommon; R - Rare

## Appendix 3

### List of Fish recorded at Maduganga

Family	Species	Status	Abundance	Habitat
Anguillidae	Short-finned Eel - <i>Anguilla bicolor</i>		UC	FW,BW
Cyprinidae	Striped Rasbora - <i>Rasbora daniconius</i>		UC	FW
	Giant Danio - <i>Danio malabaricus</i>		UC	FW
	Swamp Barb - <i>Puntius chola</i>		UC	FW
	Filamented Barb - <i>Puntius sinhalaya</i>	E	UC	FW
	Redside Barb - <i>Puntius bimaculatus</i>		UC	FW
	Silver Barb - <i>Puntius vittatus</i>		UC	FW
	Horadandiya - <i>Horadandiya atukorali</i>	T	UC	FW
Clupeidae	Sardine - <i>Sardinella</i> spp.		C	BW,M
	Chacunda-gizzard Shad - <i>Anodontosoma chacunda</i>		VC	BW,M
Heteropneustidae	Stinging Catfish - <i>Heteropneustes fossilis</i>		UC	FW,BW
Hemiramphidae	Congaturi Halfbeak - <i>Hyporhamphus limbatus</i>	VC	BW	
Oryziidae	Blue-eye - <i>Oryzias melastigma</i>		VC	BW
Aplocheilidae	Dwarf Panchax - <i>Aplocheilus parvus</i>		C	FW,BW
Ambassidae	Common Glassfish - <i>Ambassis commersoni</i>	VC	BW	
	Naked-head glass perch - <i>A. gymnocephalus</i>	C	BW	
	Glass perchlet - <i>Ambassis urotaenia</i>		UC	BW
Carangidae	Big-eye Trevally - <i>Caranx sexfasciatus</i>		VC	BW,M
	Black-tipped Trevally - <i>Caranx heberi</i>		UC	BW,M
Monodactylidae	Mono - <i>Monodactylus argenteus</i>		R	BW
Cichlidae	Orange Chromide - <i>Etroplus maculatus</i>		C	FW,BW
	Pearl Spot - <i>Etroplus suratensis</i>		UC	FW,BW
	Tilapia - <i>Sarotherodon mossambicus</i>	Ex	C	FW,BW
Gobiidae	Bar-eyed Goby - <i>Glossogobius giuris</i>		C	BW
	Scribbled Goby - <i>Awaous melanocephalus</i>	UC	FW,BW	
	Rhino-horned Goby - <i>Redigobius balteatops</i>		C	BW
Anabantidae	Climbing Perch - <i>Anabas testudineus</i>		C	FW,BW
Channidae	Murrel - <i>Channa striata</i>		UC	FW,BW

Family	Species	Status	Abundance	Habitat
Lutjanidae	Red Snapper - <i>Lutjanus argentimaculatus</i>		VC	BW,M
	Ehrenberg's Snapper - <i>Lutjanus ehrenbergii</i>		C	BW,M
	Black-spot Snapper - <i>Lutjanus fulviflamma</i>		C	BW,M
	Blubber-lip Snapper - <i>Lutjanus rivulatus</i>		C	BW,M
Clariidae	Walking Catfish - <i>Clarias brachysoma</i>	E;T	UC	FW
Therapontidae	Target Fish - <i>Therapon jabua</i>		VC	BW
Gerreidae	Deep-bodied Silver Beddy - <i>Gerres abbreviatus</i>		VC	BW,M
	Common Silver Beddy - <i>Gerres oyana</i>		VC	BW,M
	Whip-finned Silver Beddy - <i>G. filamentosus</i>		UC	BW,M
Scatophagidae	Spotted Scat - <i>Scatophagus argus</i>		UC	BW
Soleidae	Oriental Sole - <i>Euryglossa orientalis</i>		UC	BW
Leiognathidae	Pug-nosed Pony fish - <i>Secutor insidiator</i>		C	BW
	Short-nose Pony fish - <i>Leiognathus brevisrostris</i>		UC	BW
	Whip-finned Pony fish - <i>Leiognathus leuciscus</i>		UC	BW
Belonidae	Spot-tail Needle fish - <i>Strongylura strongylura</i>		C	BW
Sphyraenidae	Great Barracuda - <i>Sphyraena barracuda</i>		R	BW,M
	Pick-handle Barracuda - <i>Sphyraena jello</i>		R	BW,M
Apogonidae	Translucent cardinal fish - <i>Apogon thermalis</i>		C	BW
Tetratodontidae	Gangetic Blow fish - <i>Chelonodon patoca</i>		UC	BW,M
	Puffer fish - <i>Tetraodon fluviatilis</i>		C	BW
Pomacentridae	Waigeu Demoiselle - <i>Abudefduf sexfasciatus</i>		UC	BW,M
Triacanthidae	Short-nosed Tripod fish - <i>Triacanthus biaculeatus</i>		UC	BW,M
Centropomidae	Giant Sea Perch - <i>Lates calcarifer</i>		C	BW
Serranidae	Peacock Grouper - <i>Cephalopholis argus</i>		UC	BW,M
	Malabar Grouper - <i>Epinephelus malabaricus</i>		UC	BW,M
Engraulididae	Indian Anchovy - <i>Stolephorus indicus</i>		VC	BW,M
Periophthalmidae	Mudskipper - <i>Periophthalmus koelreuteri</i>		C	BW
Siganidae	Streaked Spinefoot - <i>Siganus javus</i>		UC	BW
	Gold-lined Spinefoot - <i>Siganus lineatus</i>		UC	BW
Chaetodontidae	<i>Chaetodon decesatus</i>		UC	BW,M
	<i>Chaetodon trifascialis</i>		C	BW,M
Haemulidae	Minstrel Sweetlip - <i>Plectorhinchus schotaf</i>		UC	BW,M
	Harry Hotlips - <i>Plectorhinchus gibbosus</i>		UC	BW,M
Mugilidae	Green-backed Mullet - <i>Liza subviridis</i>		C	BW,M
	Horn-lip Mullet - <i>Oedalechilus labiosus</i>		UC	BW,M
Dasyatididae	Honeycomb Stingray - <i>Himantura uarnak</i>		UC	BW,M
Acanthuridae	Elongate surgeon fish - <i>Acanthurus mata</i>		C	BW,M

<b>Family</b>	<b>Species</b>	<b>Status</b>	<b>Abundance</b>	<b>Habitat</b>
	Epulette surgeon fish - <i>Acanthurus nigricauda</i>		UC	BW,M
Muraenesocidae	Indian Pike Conger - <i>Congresox talabonoides</i>		UC	BW
Bagridae	Long-whiskered Catfish - <i>Mystus gulio</i>		C	FW,BW
Eleotrididae	Upside down sleeper - <i>Butis butis</i>		C	FW,BW
Chanidae	Milkfish - <i>Chanos chanos</i>		C	BW

Habitat: FW - Fresh water, BW - Brackish Water, M - Marine.

## Appendix 4

### List of Amphibians recorded at Maduganga

Family	Species	Status	Relative Abundance
Bufonidae	Common Toad - <i>Bufo melanostictus</i>		VC
	Athokorale's Dwarf Toad - <i>Bufo atukoralei</i>	E;T	R
Microhylidae	Common Bull Frog - <i>Kaloula taprobanica</i>		UC
Ranidae	Common Paddy field Frog - <i>Limnonectes limnocharis</i>		C
	Indian Bull Frog - <i>Hoplobatrachus crassus</i>		R
	Common Wood Frog - <i>Rana temporalis</i>		UC
	Small Wood Frog - <i>Rana aurantiaca</i>	T	UC
	Sri Lanka Wood Frog - <i>Rana gracilis</i>	E;T	UC
	Six-toed Green Frog - <i>Euphlyctis hexadactyla</i>		VC
	Skipper Frog - <i>Euphlyctis cyanophlyctis</i>		C
	Hour-glass Tree Frog - <i>Polypedates cruciger</i>	E;T	R
Rhacophoridae	Variable Pigmy Tree-Frog - <i>Philautus variabilis</i>		UC



## Appendix 5

### List of Reptiles recorded at Maduganga

Family	Species	Status	Relative Abundance
Crocodylidae	Estuarine Crocodile - <i>Crocodylus porosus</i>	T	UC
	Mugger - <i>Crocodylus palustris</i>	T	UC
Trionychidae	Flapshell Turtle - <i>Lissemys punctata</i>	T	R
Bataguridae	Parker's Black Turtle - <i>Melanochelys trijuga</i>	T	UC
Varanidae	Water Monitor - <i>Varanus salvator</i>		VC
	Land Monitor - <i>Varanus bengalensis</i>		UC
Agamidae	Green Garden Lizard - <i>Calotes calotes</i>		C
	Common Garden Lizard - <i>Calotes versicolor</i>		VC
	Sri Lanka Kangaroo Lizard - <i>Otocryptis weigmanni</i>	E,T	VR
Gekkonidae	Common House Gecko - <i>Hemidactylus frenatus</i>		VC
	Rough-belly Day Gecko - <i>Cnemaspis tropidogaster</i>	T	R
	Kandyan Day-Gecko - <i>Cnemaspis kandyanus</i>		UC
	Kandyan Gecko - <i>Hemidactylus depressus</i>	E;T	R
	Spotted House Gecko - <i>Hemidactylus brookii</i>	E	C
	Fourclaw Gecko - <i>Gehyra mutilata</i>		VC
Scincidae	Common Lanka Skink - <i>Lankascincus fallax</i>	E	UC
	Smooth Lanka Skink - <i>Lankascincus taprobanensis</i>	E;T	R
	Bronze-green Little Skink - <i>Mabuya macularius</i>		C
	Common skink - <i>Mabuya carinata</i>	E	UC
Colubridae	Green vine snake - <i>Ahaetulla nasutus</i>		UC
	The Olive Keelback - <i>Atretium schistosum</i>		UC
	Rat Snake - <i>Ptyas mucosus</i>		C
	Common Bronzeback - <i>Dendrelaphis tristis</i>		UC
	Common Pond Snake - <i>Xenochrophis asperrimus</i>	E;T	UC
	Checkered Keelback - <i>Xenochrophis piscator</i>		C
	Buff-striped Keelback - <i>Amphiesma stolata</i>		C
Acrochordidae	Wart Snake - <i>Acrochordus granulatus</i>	T	R
Elapidae	Cobra - <i>Naja naja</i>		UC
Viperidae	Russell's Viper - <i>Daboia russellii</i>		UC
	Merrem's Hump-nosed Viper - <i>Hypnale hypnale</i>		UC
Boidae	Indian Python - <i>Python molurus</i>	T	VR

## Appendix 6

### List of Avifauna recorded at Maduganga

Family	Species	Status	Relative Abundance
Phalacrocoracidae	Little Cormorant - <i>Phalacrocorax niger</i>		VC
	Indian Cormorant - <i>Phalacrocorax fuscicollis</i>		UC
Anhingidae	Oriental Darter - <i>Anhinga melanogaster</i>		R
Ardeidae	Intermediate Egret - <i>Mesophoyx intermedia</i>		UC
	Little Egret - <i>Egretta garzetta</i>		UC
	Large Egret - <i>Casmerodius albus</i>		R
	Cattle Egret - <i>Bubulcus ibis</i>		UC
	Purple Heron - <i>Ardea purpurea</i>		R
	Indian Pond Heron - <i>Ardeola grayii</i>		UC
	Little Green Heron - <i>Butorides striatus</i>		UC
	Night Heron - <i>Nycticorax nycticorax</i>		R
	Yellow Bittern - <i>Ixobrychus sinensis</i>		R
	Black Bittern - <i>Dupetor flavicollis</i>		R
Ciconiidae	Asian Openbill - <i>Anastomus oscitans</i>		R
Threskiornithidae	White Ibis - <i>Threskiornis melanocephalus</i>		R
Jacaniidae	Pheasant-tailed Jacana - <i>Hydrophasianus chirurgus</i>		R
Rallidae	White-breasted Waterhen - <i>Amaurornis phoenicurus</i>		C
	Indian Moorhen - <i>Gallinula chloropus</i>		R
	Purple Coot - <i>Porphyrio porphyrio</i>		R
Anatidae	Lesser Whistling Teal - <i>Dendrocygna javanica</i>		VC
Recurvirostridae	Black-winged Stilt - <i>Himantopus himantopus</i>		R
Scolopacidae	Whimbrel - <i>Numenius phaeopus</i>	WM	R
	Common Sandpiper - <i>Actitis Hypoleucos</i>	WM	R
Rostratulidae	Greater Painted-Snipe - <i>Rostratula benghalensis</i>	T	R
Burhinidae	Eurasian Thick-Knee - <i>Burhinus oedicephalus</i>		R
Charadriidae	Red-wattled Lapwing - <i>Vanellus indicus</i>		R
Laridae	Large Crested Tern - <i>Sterna bergiivelox</i>	WM	R
	Whiskered Tern - <i>Chlidonias hybridus</i>	WM	UC
	Little Tern - <i>Sterna albifrons</i>		R
Podicipedidae	Little Grebe - <i>Tachybaptus ruficollis</i>		VC
Alcedinidae	White-breasted Kingfisher - <i>Halcyon smyrnensis</i>		C
	Stork-billed Kingfisher - <i>Pelargopsis capensis</i>		R
	Common Kingfisher - <i>Alcedo atthis</i>		C

Family	Species	Status	Relative Abundance
Accipitridae	Pied Kingfisher - <i>Ceryle rudis</i>		R
	Shikra - <i>Accipiter badius</i>		R
	Serpent Eagle - <i>Spilornis cheela</i>		R
	White-bellied Sea Eagle - <i>Haliaeetus nipalensis</i>		R
	Mountain Hawk Eagle - <i>Spizaetus nipalensis</i>		R
	Brahminy Kite - <i>Haliaster indus</i>		VC
	Western Marsh Harrier - <i>Circus aeruginosus</i>	WM	R
Columbidae	Pale Harrier - <i>Circus macrourus</i>	WM	R
	Spotted Dove - <i>Streptopelia chinensis</i>		VC
	Rock Pigeon - <i>Columba livia</i>		R
	Orange-breasted Green Pigeon - <i>Treron bicincta</i>		UC
	Emerald Dove - <i>Chalcophaps indica</i>		R
	Green Imperial Pigeon - <i>Ducula aenea</i>		UC
	Pompadour Green Pigeon - <i>Treron pompadora</i>		UC
Turnicidae	Barred Button Quail - <i>Turnix suscitator</i>		R
Phasianidae	Jungle Fowl - <i>Gallus lafayetti</i>	E	R
Meropidae	Blue-tailed Bee-eater - <i>Merops philippinus</i>	WM	R
Cuculidae	Common Coucal - <i>Centropus sinensis</i>		C
	Blue-faced Malkoha - <i>Phaenicophaeus viridirostris</i>		R
	Asian Koel - <i>Eudynamys scolopacea</i>		VC
Psittacidae	Rose-ringed Parakeet - <i>Psittacula kramerii</i>		UC
	Layard's Parakeet - <i>Psittacula calthropae</i>	E;T	R
	Sri Lanka Lorikeet - <i>Loriculus beryllinus</i>	E;T	R
Hirundinidae	Barn Swallow - <i>Hirundo rustica</i>	WM	C
	Red-rumped Swallow - <i>Hirundo daurica</i>		R
Apodidae	Asian Palm Swift - <i>Cypsiurus balasiensis</i>		R
	Alpine swift - <i>Apus melba</i>	T	R
Caprimulgidae	Long-tailed Nightjar - <i>Caprimulgus indicus</i>		R
	Common Nightjar - <i>Caprimulgus asiaticus</i>		UC
Bucerotidae	Grey Hornbill - <i>Tockus griseus</i>	E;T	R
Corvidae	House Crow - <i>Corvus splendens</i>		C
	Jungle Crow - <i>Corvus macrorhynchos</i>		VC
Coraciidae	Indian Roller - <i>Coracias benghalensis</i>		R
Capitonidae	Brown-headed Barbet - <i>Megalaima zeylanica</i>		C
	Crimson-headed Barbet - <i>Megalaima haemacephala</i>		R

Family	Species	Status	Relative Abundance
	Small Barbet - <i>Megalaima rubricapilla</i>	E	R
Pycnonotidae	Red-vented Bulbul - <i>Pycnonotus cafer</i>		C
	White-browed Bulbul - <i>Pycnonotus luteolus</i>	VC	
Sturnidae	Common Mynah - <i>Acridotheres tristis</i>		C
Laniidae	Brown Shrike - <i>Lanius cristatus</i>	WM	R
Oriolidae	Black-headed Oriole - <i>Oriolus xanthornus</i>		R
Picidae	Red-backed Woodpecker - <i>Dinopium benghalense</i>		R
	Rufous Woodpecker - <i>Micropternus brachyurus</i>	T	R
Muscicapidae	Common Tailorbird - <i>Orthotomus sutorius</i>		C
	White-browed Prinia - <i>Prinia inornata</i>		UC
	Great Reed Warbler - <i>Acrocephalus stentoreus</i>		R
	Fantail Warbler - <i>Cisticola juncidis</i>		UC
	Ashy Prinia - <i>Prinia socialis</i>		UC
	Magpie Robin - <i>Copsychus saularis</i>		UC
	Brown-capped Babbler - <i>Pellorneum fuscicapillum</i>	E;T	R
	Common Babbler - <i>Turdoides affinis</i>		C
	Asian Paradise Flycatcher - <i>Terpsiphone paradisi</i>		R
	White-browed Fantail - <i>Rhipidura aureola</i>		R
	Orange-breast Blue Flycatcher - <i>Muscicapa tickelliae</i>		R
	Brown Flycatcher - <i>Muscicapa daurica</i>	WM	R
Motacillidae	Grey Wagtail - <i>Motacilla cinerea</i>	WM	R
	Forest Wagtail - <i>Dendronanthus indicus</i>	WM	R
	Indian Pipit - <i>Anthus rufulus</i>		UC
Nectariniidae	Purple Sunbird - <i>Nectarinia asiatica</i>		R
	Purple-rumped Sunbird - <i>Nectarinia zeylonica</i>		C
	Loten's Sunbird - <i>Nectarinia lotenia</i>		VC
Dicaeidae	Pale-billed Flowerpecker - <i>Dicaeum erythrorhynchos</i>		VC
Ploceidae	White-rumped Munia - <i>Lonchura striata</i>		R
	House Sparrow - <i>Passer domesticus</i>		R
	Spotted Munia - <i>Lonchura punctulata</i>		UC
	Black-headed Munia - <i>Lonchura malacca</i>		UC
Dicruridae	White-vented Drongo - <i>Dicrurus caerulescens</i>		UC
Strigidae	Collared Scops Owl - <i>Otus bakkamoena</i>		R
	Little Scops Owl - <i>Otus scops</i>		R
	Brown Fish Owl - <i>Ketupa zeylonensis</i>		R

<b>Family</b>	<b>Species</b>	<b>Status</b>	<b>Relative Abundance</b>
Alaudidae	Oriental Skylark - <i>Alauda gulgula</i>		R
Irenidae	Common Iora - <i>Aegithina tiphia</i>		C
	Gold-fronted Chloropsis - <i>Chloropsis aurifrons</i>		R
	Jerdon's Chloropsis - <i>Chloropsis cochinchinensis</i>		R
Artamidae	Ashy Swallow-Shrike - <i>Artamus fuscus</i>		R
Campephagidae	Little Minivet - <i>Pericrocotus cinnamomeus</i>		R
Zosteropidae	Common White-eye - <i>Zosterops palpebrosa</i>		R
Pittidae	Indian Pitta - <i>Pitta brachyura</i>	WM	R

## Appendix 7

### List of Mammals recorded at Maduganga

Family	Species	Status	Abundance
Cercopithecidae	Purple-faced leaf monkey - <i>Trachypithecus vetulus</i>	E;T	UC
Loridae	Slender Loris - <i>Loris tardigradus</i>	T	R
Leporidae	Black-naped Hare - <i>Lepus nigricollis</i>		C
Scuridae	Palm squirrel - <i>Funambulus palmarum</i>		VC
Hystericidae	Indian Crested Porcupine - <i>Hystrix indica</i>		UC
Muridae	Indian Bandicoot - <i>Bandicota bengalensis</i>		VC
	House Rat - <i>Rattus rattus</i>		VC
	House Mouse - <i>Mus musculus</i>		VC
	Brown Mouse - <i>Mus cervicolor</i>		C
Soricidae	Musk Shrew - <i>Suncus murinus</i>		C
Pteropidae	Flying-Fox - <i>Pteropus giganteus</i>		C
	Fruit Bat - <i>Rousettus seminuus</i>		C
Rhinolophidae	Horse-shoe Bat - <i>Rhinolopus</i> spp.		UC
Hipposiderosidae	Leaf-nosed Bat - <i>Hipposideros</i> spp.		UC
Viverridae	Brown Mongoose - <i>Herpestes fuscus</i>		UC
	Indian Palm-Cat - <i>Paradoxurus hermaphrodites</i>		C
	Golden Palm Civet - <i>Paradoxurus zeylonensis</i>	E;T	R
	Small Civet-Cat - <i>Viverricula indica</i>		C
Mustellidae	Eurasian Otter - <i>Lutra lutra</i>	T	UC
Felidae	Indian Fishing Cat - <i>Prionailurus viverrinus</i>	T	R
Tragulidae	Mouse Deer - <i>Tragulus meminna</i>		R
Cervidae	Barking Deer - <i>Muntiacus muntjak</i>		R
	Hog Deer - <i>Axis porcinus</i>	T	UC
Canidae	Jackal - <i>Canis aureus</i>		UC

## Appendix 8

### List of Butterflies recorded at Maduganga

Family	Species	Status	Abundance
Lycaenidae	Lesser Grass Blue - <i>Zizina otis</i>		UC
	Large Oak Blue - <i>Arhopala amantes</i>	T	C
	Dark Grass Blue - <i>Zizeeria karsandra</i>	T	R
	Tiny Grass Blue - <i>Zizula hylax</i>	T	UC
	Dark Cerulean - <i>Jamides coruscans</i>		R
	Common cerulean - <i>Jamedes alecto</i>		UC
	Indian Sunbeam - <i>Curetis thetis</i>		VC
Satyridae	Common Evening Brown - <i>Melanitis leda</i>		R
	Dark-Banded Bush Brown - <i>Mycalesis mineus</i>		R
	White Four-Ring - <i>Ypthima ceylonica</i>		UC
	Common Palm Fly - <i>Elymnias hypermnestra</i>		R
	Nigger - <i>Orsotriaena medus</i>		C
Danaiidae	Double banded Crow - <i>Euploea core</i>		UC
	Glassy Tiger - <i>Parantica aglea</i>		VC
	Plain Tiger - <i>Danaus chrysippus</i>		UC
	Common Tiger - <i>Danaus genutia</i>		R
	Common Crow - <i>Euploea core</i>		R
	Brown King Crow - <i>Euploea klugii</i>		R
	Great Crow - <i>Euploea phaenareta</i>		UC
Nymphalidae	Common Leopard - <i>Phalanta phalantha</i>		UC
	Danaid Egg Fly - <i>Hypolimnas misippus</i>		R
	Common Sailor - <i>Neptis hylas</i>		UC
	Grey Pansy - <i>Junonia atlites</i>		C
	Peacock Pansy - <i>Junonia almana</i>		R
	Chocolate Soldier - <i>junonia iphita</i>		UC
	Baron - <i>Euthalia aconthea</i>		R
	Tamil Yeoman - <i>Cirrochroa thais</i>		R
Acraeidae	Tawny Coster - <i>Acraea violae</i>		UC
Pieridae	Psyche - <i>Leptosia nina</i>		C
	Jezebel - <i>Delias eucharis</i>		UC
	Chocolate Albatross - <i>Appias lyncida</i>		R
	Striped Albatross - <i>Appias libythea</i>	T	R
	Common Albatross - <i>Appias albina</i>		UC

Family	Species	Status	Abundance
	Lemon Emigrant - <i>Catopsilia pomona</i>		R
	Pioneer - <i>Belenois aurata</i>		R
	Crimson Tip - <i>Colotis danae</i>		R
	Small Grass Yellow - <i>Eurema brigitta</i>		R
	Three-spot Grass Yellow - <i>Eurema blanda</i>		R
	Common Grass Yellow - <i>Eurema hecabe</i>		UC
	The Plain Orange Tip - <i>Colotis aurora</i>	T	R
	The Little Orange Tip - <i>Colotis etrida</i>		R
Papilionidae	Blue Mormon - <i>Papilio polymnestor</i>		R
	Common Mormon - <i>Papilio polytes</i>		UC
	Common Rose - <i>Pachliopta aristolochiae</i>		R
	Crimson Rose - <i>Pachliopta hector</i>		UC
	Lime Butterfly - <i>Papilio demoleus</i>		R
	Common Blue Bottle - <i>Graphium sarpedon</i>		UC
	Common Jay - <i>Graphium doson</i>		UC
	Tailed Jay - <i>Graphium agamemnon</i>		C



## Appendix 9

### List of aquatic molluscs recorded at Maduganga

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<b>Family</b>	<b>Species</b>
Ancylidae	<i>Ancylus ceylanicus</i>
	<i>Littorina scabra</i>
	<i>Meretrix easta</i>
	<i>Geloina coaxans</i>
	<i>Cassidula mustarina</i>
Unionidae	<i>Lamellidens testudinarius</i>
Ampullaridae	<i>Pila globosa</i>
Neritidae	<i>Septaria squamata</i>
	<i>Telescopium telescopium</i>
	<i>Nerita polita</i>
	<i>Cerithedia cingulata</i>

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## Appendix 10

### List of terrestrial molluscs recorded at Maduganga

Family	Species	Status	Abundance
Ariophantidae	<i>Cryptozona bistralis</i>		C
	<i>Euplecta emiliana</i>	E;T	R
Cerastidae	<i>Rachistia pulcher</i>		C
Acavidae	<i>Acavus haemastoma</i>	E;T	R
Camaenidae	<i>Beddomea albizonatus</i>	E;T	R
Subulinidae	<i>Allopeas gracile</i>	T	R
Glessulidae	<i>Glessula paneantha</i>	E;HT	R
Cyclophoridae	<i>Aulopoma helicinum</i>	E;T	R
	<i>Aulopoma itieri</i>	E;T	R
	<i>Leptopomoides halophilus</i>	E	UC
	<i>Tortulosa thwaitesi</i>	E	UC
Ariophantidae	<i>Mariella dussimieri</i>	T	R
Veronicellidae	<i>Laevicaulis alte</i>	Ex	VC
Achatinidae	<i>Achatina fulica</i>	Ex	VC

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