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Biodiversity Assessment of Tirukkovil Lagoon System

The World Conservation Union (IUCN) Sri Lanka

December, 2007

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IUCN Research Team

Mr. Naalin Perera (Fauna Ecologist)
Mr. Sampath Gunatilake (Fauna Ecologist, Archaeology expert)
Mr. Asela Chandana (Fauna Ecologist)
Mr, Dilup Chandranimal (Flora Ecologist)
Mr. Prasanna Samarawickrama (GIS Specialist)
Mr. Sameera Karunarathna (Fauna Ecologist)

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EXECUTIVE SUMMARY

The biodiversity baseline survey was undertaken by IUCN in the Tirukkovil Lagoon area to assist in a mangrove replanting strategy for the Sewalanka Foundation. Baseline data of the Tirukkovil area will help the Foundation to determine the mangrove restoration strategies and future monitoring mechanisms to measure the success of ecological restoration of mangroves in the Tirukkovil lagoon.

Tirukkovil is a very remote village located in the south-eastern part of Sri Lanka in the Ampara district. Primary livelihoods of the people of Tirukkovil are subsistence lagoon fishing and agriculture. People of Palakuda and surrounding communities have been connected to mangroves in Tirukkovil lagoon system for generations. About 2km stretch of mangroves near the Palakuda river mouth was destroyed by the tsunami. Mangroves of Tirukkovil lagoon has been degraded by many human activities prior to the tsunami. Total of 9 mangrove species have been recorded and *Rhizophora mucronata* and *Luminetzera racimosa* are the dominant species of mangroves in the Tirukkovil Lagoon.

A literature survey was conducted to understand the biodiversity of the area. The flora of Tirukkovil area was surveyed by using Line Intercept Methods that have been widely used in terrestrial and aquatic systems. Eight (8) transects were deployed in the study area to determine species occurrence in the area. Geographic location of each transect was determined by using the GPS equipment. Field sampling of faunal species except freshwater fish were carried out parallel to floral transects. Occurances of freshwater fish species were determined by using cast net and by investigating catch of the lagoon fishermen. Due to the prevailing unsafe security conditions night samplings were not conducted.

Five main natural habitat types have been identified under broad terrestrial and wetland ecosystem categories. Tropical thorn forests (scrub jungles) and beach vegetation are the main terrestrial habitats identified and mangroves, and flood plains were identified as major wetland habitats in the sampling area. Home gardens, including coconut cultivations, and chena were found to be the man-made habitats in the Tirukkovil area. Tropical Thorn Forest is severely degraded due to human activities such as chena cultivations and heavy fuel wood collection.

A total of 148 plant species, including 9 mangrove species, belonging to 60 families were recorded in the Tirukkovil lagoon area. Six species of mangroves can be classified as true mangrove species and three species can be classified as mangrove associated species.

149 species of vertebrates belonging to 75 families were recorded in the Tirukkovil area which represents 15% of vertebrate fauna recorded in Sri Lanka. 7 endemic and 15 nationally threatened species are among the vertebrate fauna recorded from the Tirukkovil area. Vertebrate fauna diversity of Tirukkovil area consist of 18 species of fish, 11 species of amphibians, 25 species of reptiles, 78 species of birds, and 18 species of mammals. Butterflies were the only invertebrate group that was sampled in this survey. 52 butterfly species, including seven nationally threatened and one endemic species, belonging to five families were recorded from the area.

Damage caused by the Tsunami to the mangroves of Tirukkovil lagoon is not very visible. Tsunami waves have funneled through the Palakuda river mouth and destroyed 2% of the mangroves of Tirukkovil lagoon. Mangrove habitats around the main water body of the lagoon have been degraded by many anthropogenic activities prior to the tsunami. Interviews conducted with the people of Palakuda reveled that mangroves were cleared for security reasons.

It has become obvious that conducting a mangrove restoration project in the Tirukkovil Lagoon is vital to sustain lagoon fisheries activities. However, well planned restoration project with the strong community participation is an essential for a successful mangrove restoration program. Community awareness on mangroves and its restoration, nursery establishment, vacancy planting and post monitoring of mangrove recovery will help to make this restoration program a model. Systematic awareness programmes for the people of Tirukkovil on the natural ecosystems surrounding the area is also essential.

1. BACKGROUND

IUCN has undertaken biodiversity and socio-economic baseline surveys in the Tirukkovil lagoon system that include Komari, Mulliadi, Tandiadi, and Omari lagoons. The survey was based on data collected in preliminary studies and will assist in determining the exact nature of future mangrove replanting in the area. The data generated will enable planner to assess the environmental and socio-economic impacts of mangrove restoration activities as well as assess the effects of mangrove restoration activities. The baseline data will also help to evaluate the ecological impact of mangrove restoration in Tirukkovil lagoon by selecting a few taxonomic groups as indicators.

2. INTRODUCTION

Tirukkovil Lagoon is situated about 300 km southeast of Colombo in the Ampara distrct and about 18 km south of Akkareipattu in Tirukkovil divisional secretariat, consist of 22 Grama Niladari divisions. Tirukkovil is an old traditional settlement and the main livelihood of the local communities is paddy cultivation and fishing. Tirukkovil village is surrounded by sandy beaches and it is a characteristic landscape feature in the coastal belt. The Tirukkovil lagoon has rich mangrove vegetation and several mangrove islands situated within the lagoon. Dominant species of mangroves in Tirukkovil Lagoon is *Rhizophora mucronata* and *Luminitcera racemosa*.

The primary livelihood of the people in this area is subsistence coastal and lagoon fishing. People in Tirukovil lagoon area have been using the mangrove ecosystem for their daily fishing activities for generations. Mangrove fish harvest provides not only the economic benefit to the local community but also provide main source of protein, mainly to the people of Palakuda area. Majority of the lagoon fisherman are from Palakuda area but some fishermen from surrounding communities also visit Tirukkovil lagoon for their daily fishing activities.

Coastal communities around Tirukkovil lagoon are highly depending on mangrove forest products directly either for subsistence use or commercial purposes. Many mangrove ecosystem resources, such as fish, vegetable, fuel wood, and timber for construction are harvested for subsistence purposes. Majority of the people are engaged in coastal and lagoon fishing, shrimp farming as their primary income source.

The healthy ecological functions of mangroves are important to sustain the coastal livelihoods for the communities of Tirukkovil. Mangroves habitat act as a source of sediment and nutrient retention and fish breeding ground. Furthermore, it also provides important part to complete the life cycle of many marine and brackish water fish species. Ground water discharge and recharge, carbon sequetion, storm protection, and flood control are other important ecological functions performed by mangroves.

The damage to the mangrove ecosystem in Tirukkovil lagoon from the tsunami is very minimal. Approximately about 2km stretch of mangroves on the both side of the lagoon near the river mouth of Palakuda has been destroyed by the tsunami. It is a very small area of mangroves in comparison to the total area of mangrove in the entire lagoon system. Natural regeneration of mangrove saplings has also been observed during the survey.

3. CLIMATE

The Tirukkovil area is situated in the dry zone in the eastern coastal belt of Sri Lanka. The mean annual temperature of the area ranges from 25^0C to 27^0C. The North east monsoon from November to February is the main rainy season of the area and the mean annual rainfall of the area is 1500mm to 2000mm.

4. GEOLOGY AND SOIL

The predominant rock types of the area are Precambrian Granitic gneiss, Hornblend-biotite gneiss, Magmatitic and Biotite gneiss. This area is composed of Alluvial soil of variable drainage and texture, Regosols of recent beach and sand dunes in the flat terrain.

5. METHODOLOGY

5.1 Flora Sampling

Species/population (higher plants) parameters of diverse vegetation types in the lagoon cluster of Tirukkovil area were studied using standard scientific techniques, with appropriate modifications to suit field conditions.

The forest (i.e. tropical dry thorn forests & scrub jungles) vegetations as well as non-forest vegetation (i.e. aquatic vegetation) were surveyed using Line Intercept Methods that have been widely used in terrestrial and aquatic systems (Bauer 1943, White 1965, Schmid 1965). Eight (8) transects were deployed in the study area to determine the percentage occurrence of the species in the plant community. These transects were selected randomly to represent the major habitat types in the lagoon (Figure 7). Observations were made along a known direction and known geo-location after setting up a line (tape) with set line intervals, in which species presence or absence were recorded (Grieg-Smith, 1983; Madsen et al., 1996; Titus 1993; Getsinger et al., 1997) Random observations also made out of the transects to determine the species occurrence due to the time constrain for the survey.

5.2 Fauna sampling

A literature survey was conducted to understand the previous faunal sightings in the area. Preliminary survey was carried out in the area for selecting sampling points and appropriate sampling techniques. Field sampling of faunal species except freshwater fish were carried out parallel to floral transects. Night samplings were not done due to prevailing unsafe security condition of the area. Specific sampling techniques are summarized in table 1.

Table 1: Sampling techniques used to document fauna in the Tirukkovil area

Group	Method
Fish	Cast nets (1cm gill size) drag net (1mm gill size)
Herpetofauna (Amphibians and Reptiles)	100m x 10m belt transects
Birds	100m x 50m line transects (direct observations & calls)
Mammals	Belt transects, direct and indirect observations
Butterflies	100m x 10m belt transects

The identification and nomenclature of species were based upon the latest field guides and taxonomic publications and they are summarized below in table 2.

Table 2: Identification and nomenclature of species

Group	Source
Flora	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).
Fishes	De Bruin et al., Pethiyagoda 2006, Pethiyagoda 1991, Jayaram 1999
Herpetofauna (Amphibians & Reptiles)	De Silva, P.H.D.H (1980), Das, I. and De Silva, A. (2005), De Silva A. (2006), Dutta, S.K. and Manamendra-Arachchi, K.N. (1996) Manamendra-Arachchi, K. and Pethiyagoda, R. (2006)
Birds	Harrison & Worfolk (1999), Kotagama, 2006
Mammals	Phillips, 1980, Kotagama 2005**,** Weerakoon and Goonatilake (2006)
Butterflies	D'Abrera (1998), Woodhouse, 1950, Perera and Bambaradeniya (2006)

5.3 Preparation of digitized maps of the Tirukkovil area

Recent satellite images and land-use maps obtained from the Survey Department were subjected to a ground truthing exercise and geo-referencing using GPS equipments. Digital maps of the habitat types, tsunami destruction and recommendation for mangrove recovery plan for the area were then prepared by using GIS and remote sensing techniques.

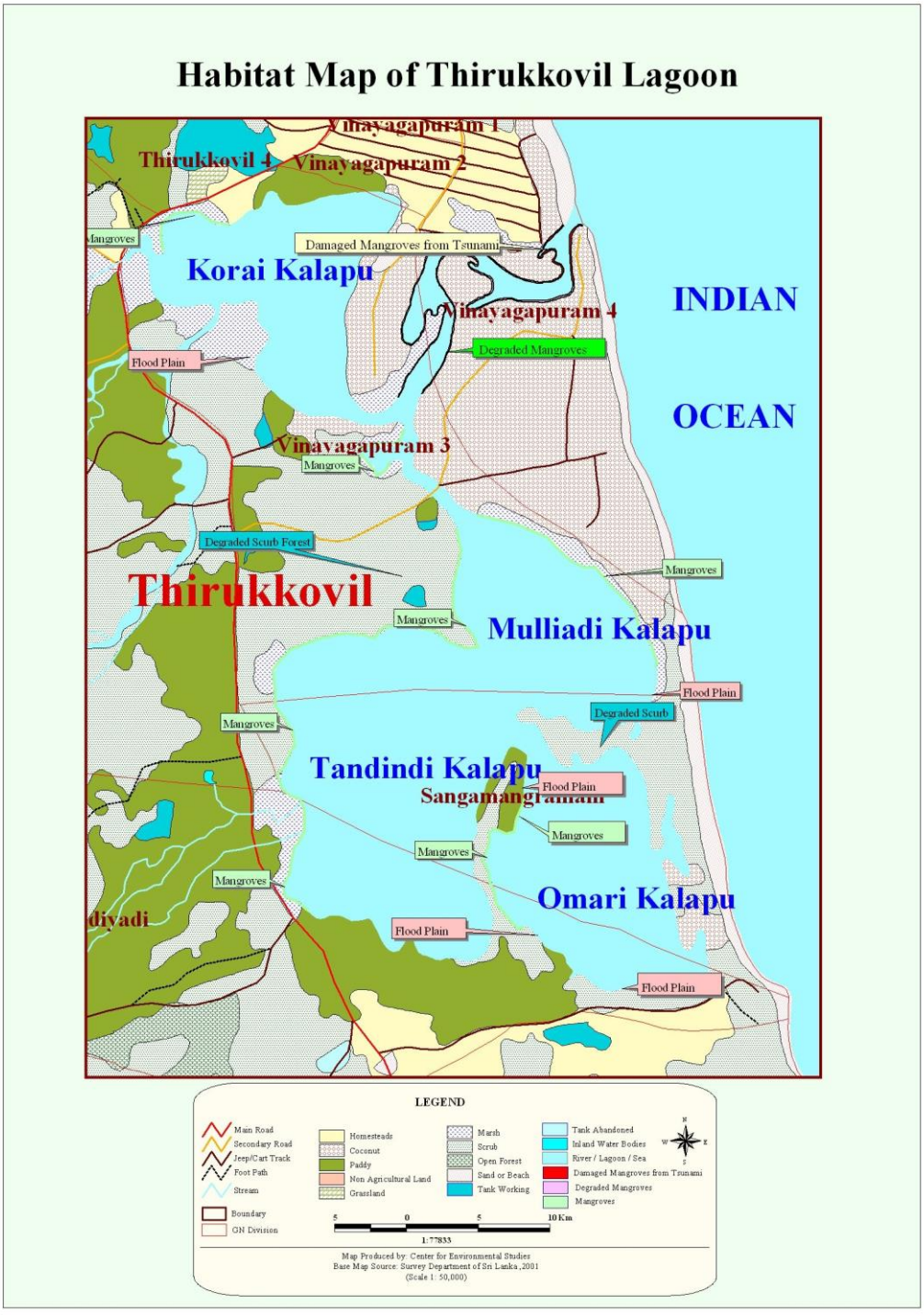

Figure 1: Map of major habitat types and Tsunami Mangrove Damaged in Tirukkovil project area

6. RESULTS

6.1 Habitat diversity and flora of Tirukkovil area

Wetland and terrestrial habitats can be classified as the major habitat categories in the Tirukkovil lagoon sampling area. Wetland habitats mainly consist of mangroves, lagoons, and flood plains. Terrestrial habitats consist of beaches, tropical thorn forest**,** home gardens and coconut plantations (Figure 1). A Beach habitat is in a better condition whilst wide spread tropical thorn forest habitat is fairly degraded due to human activities. Home gardens and coconut cultivations are the man made habitats in the project area. 148 plant species, including nine mangrove species, belonging to 60 families were recorded in the habitats from Tirukkovil lagoon area. Six species of mangroves can be classified as true mangrove species and three species can be classified as mangrove associated species. This represents a small fraction (0.04%) of plant species that are being recorded in Sri Lanka. Mangrove areas that were not destroyed by the tsunami were degraded due to the clearance for security reasons in time to time.

6.2 Characteristic of Different Habitat types

Tropical thorn forest

This is one of the common vegetation types in the surrounding area of the lagoon. The scattered tall tree species such as Palu (*Manilkara hexandra), Maila (Bauhinia racemosa), Weera (Drypetes sepiaria) and Milla (Vitex altissima)* are distributed throughout this vegetation type. Shrub plants species such as *Lolu (Cordia dichotoma), Cordia minoica, Papula (Vernonia zylanica), Eraminiya (Ziziphus oenoplia), Kara (Canthium coromandelicum), Kukurumanna (Cantunaregum spinosa)* are the dominant species in the tropical thorn habitat around Tirukkovil lagoon. Wild Date *(Phonex pusilla)* were high in abundance and widely distributed in this habitat type. Fruits of the Wild Dates are very attractive food source for many species of birds that inhabit the area. The ground layer of the tropical thorn forest consist of plant species such as Lunuwarana (*Crateva adansonii, Cordia curassavica , Tembiliya (Engenia bracteata), and Heen Epala (Urena lobata) .* Although this habitat type is one of the main vegetation types in the area, it has been subjected to severe degradation due to human interventions. Major threats that have been observed in this forest type are illegal logging, fuel wood collection, clearing of land for chena cultivation, and free ranging cattle.

Mangroves

Mangroves are the major habitat around the Tirukkovil lagoon area. *Rizophora mucronata and Luminitcera racemosa* are the dominating species in this habitat type and they are widely distributed throughout the lagoon system. These two species are in the immediate lagoon water line and the thickness of the mangrove is varying from 2m-10m in different locations. Mangrove habitat in the Tirukkovil lagoon system is not continuous and degraded since some areas were cleared for security reasons. *Exocaria aggalocha, Agicerus coniculatum, Heritaria littoria and Bruguiera gymnorhiza* are the other true mangrove species recorded in the area*. Acanthus illisifolius, Acrosticum auraria*, and *Clerodendrum inerme* are the three mangrove associated species found

Figure 2: Mangroves can be identified as the major habitat in the Tirukkovil area

throughout in the study area. Although *Exocaria aggalocha, Agicerus coniculatum, Heritaria littoria and Bruguiera gymnorhiza* have been recorded in the present survey, their abundance is very low in the sampled area. *Acrosticum aureum* one of the food plants amongst the mangrove associate species. These mangrove species mixed with other terrestrial plant species form a very productive swamp habitat around the lagoon.

Flood plains

Flood plains are formed in the area adjoining the lagoons due to the periodic inundation of the lagoon water. Flood plains are very productive coastal wetlands rich in brackish water biodiversity. They are sometimes called tidal marshes, because they occur in the zone between low and high tides. This vegetation type in this marshy habitat consists of herbaceous salt tolerant plants. Species such as, *Malittan (Salvadora persica), Gan Sooriya (Thespesia populnea)* were also recorded in this habitat.
These flood plains harbor a few sedge species such as *Frimbristylis cymosa* and *Frimbristylis dichotoma.* Cattail (*Typha angustifolia*) and submerged herbaceous plants, namely, *Monochoria vaginalis* can also be found in this habitat type. There is good ground cover with few grass species such as Mana (*Imparata cylindrical)* being present in this habitat. These flood plan habitats are playing a vital role as a feeding ground for many wetland bird species in the Tirukkovil lagoon system.

Beach vegetation

Beach vegetation is one of the healthiest habitat types found in the project area. Well established broad beach stretch is protected the due to the minimum use by the fishermen. The seashore vegetation is distributed along the entire belt of the beach. Plant species in this habitat exhibit remarkable adaptation to withstand heavy winds and desiccation. A carpet of densely grown creepers namely Mudu-geta-kola (*Hydrophylax maritime), Maharawana rewul (Spinifex littoreus)* and *Bin Thamuru (Ipomoea pes-caprae),* are commonly found along the beach. Tree species such as Palu (*Manilkara hexandra), Domba (Calophyllum inophyllum),* and *Gan Sooriya (Thespesia populnea)* are grown towards the land side of the beach stretch.

Figure 3: Flood plains are one of the major habitats in Tirukkovil lagoon and they are playing a vital role as feeding grounds for many species of wetland birds.

Home garden and Chena

Figure 4: Some coconut cultivation in Palakuda village is extending to the edge of the mangrove habitat in the lagoon

Both home gardens and chena lands are man-made habitats. The total biomass of these habitats is very low due to the heavy anthropogenic effects. Natural scrub vegetation has been severely degraded by chana cultivation practice and fuel wood collection by the surrounding villagers. The scattered tree, shrub and herbs are mixed in this habitat type. Dominant species in this habitat are Pitawakka (*Phyllanthus pinnatus), Hik (Lannea coromandelica), Tal (Borassus flabeillifer), Keppetiya (Flueggea leucopyrus), Malittan (Salvadora persica), Eraminiya (Ziziphus oenoplia), Hinguru (Lantana camara), Amba (Mangifra indica), and Babila (Hibiscus micranthus).* Coconut *(Cocus nusifera)* plantation is located between the Tirukkovil Lagoon and the coastal stretch in the Palakuda area.

6.3 Fauna of Tirukkovil

All vertebrate groups including freshwater fish, amphibians, reptiles, birds and mammals were sampled during the current survey. From the major habitat and vegetation types within the project area, a total of 149 species of vertebrates belonging to 75 families were recorded The vertebrate fauna of Tirukkovil represents about 15 % of the total vertebrate fauna recorded in Sri Lanka of which 7 species were found to be endemic while 15 are listed as nationally threatened. When considering the composition of taxa and proportional representation, birds were found to be the most abundant group (Figure 1).

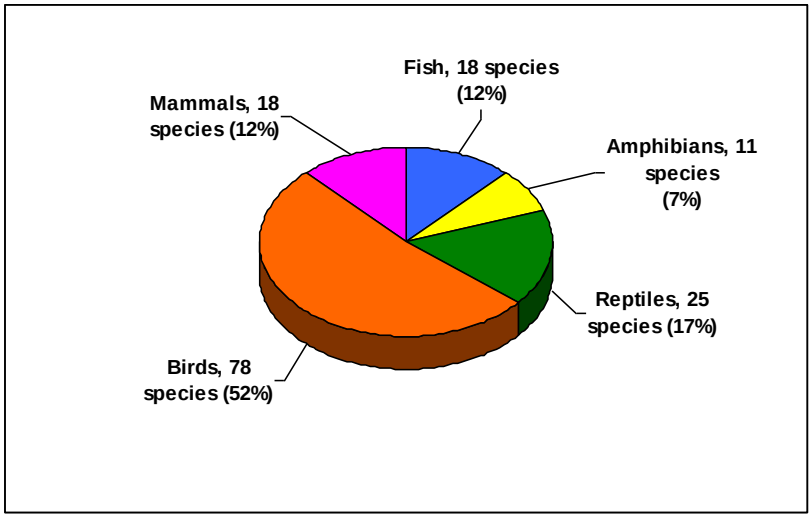

Figure 5: Proportional Representation of Vertebrate Fauna of Tirukkovil Area

Table 3: Summary of the species composition of vertebrate fauna found in the Tirukkovil area

Group	Families	Species	Endemic	Threatened
Fish	17	18	0	0
Amphibians	3	11	1	1
Reptiles	11	25	2	6
Birds	35	78	2	3
Mammals	10	18	2	5
Total	**75**	**149**	**7**	**15**

The fish fauna of Tirukkovil was represented by 18 species from 17 families. All the major categories of fish species such as, marine, brackish water and freshwater fish species, have been recorded in the Tirukkovil lagoon system. Hundreds of fishermen were observed during the survey period and it is evident that the Tirukkovil lagoon is playing a major role to sustain people who are living around the lagoon. This is clear evidence that mangrove vegetation plays a significant role in providing shelter for millions of hatchlings in the lagoon system and eventually helps to increase the fish harvest for the surrounding community. Introduced fish species to our wetland systems such as Thilapia (*Oreochromis mossambicus)* is representing a larger portion of the fish catch in the lagoon.

Figure 6: Thilapia (*Oreochromis mossambicus)* representing larger percentage of the fish catch from the Tirukkovil Lagoon

Lack of night sampling due to the prevailing security condition is the major constrain to determine the amphibian diversity in the project area. Few amphibian species were record during the current survey and they consist of 11 species belonging to 3 families. Amongst them, Atukorale's dwarf toad (*Bufo atukoralei*) is both endemic to Sri Lanka and considered nationally threatened (IUCN Sri Lanka, 2000).

25 species of reptiles belonging to 11 families were recorded from Tirukkovil, of which two are endemic and six nationally threatened (IUCN Sri Lanka, 2000). Nationally threatened Marsh Crocodile *(Crocodylus paluster*)and Estuary Crocodile (*Crocodylus porosus*)species were also recorded during the survey. Amongst the recorded reptile species, Fan throat lizard *(Sitana ponticeriana)* high in abundance and inhabit the sand dunes and their associated vegetation. The recorded reptile species are restricted to the arid zone coastal belt of Sri Lanka.

78 species of birds belonging to 35 families were recorded in the Tirukkovil lagoon area. Many of the birds that have been recorded in the area are wetland bird species. The Sri Lanka jungle fowl (*Gallus lafayetii),* and Brown capped babbler (*Pellorneum fuscocapillum*) were the endemic bird recorded during the current survey. Spot-billed Pelican (*Pelecanus philippensis*) Great Thick-knee (*Esacus recurvirostris),* Yellow-wattled Lapwing (*Vanellus malabaricus*) are globally threatened species among them (IUCN Sri Lanka, 2000).

A total of 17 mammal species were recorded from the study area of which two are endemics, namely the Toque monkey (*Macaca sinica),* and Mouse deer (*Moschiola meminna*). Three nationally threatened species such as the Rusty spotted cat *(Prionailurus rubiginosus),* Fishing cat *(Prionailurus viverrinus), and* Asian elephant *(Elephas maximus)* were also recorded in the current survey. Indirect evidences reveled that the smalls cat species such as Rusty spotted cat and Fishing cat are common inhabitants due to high abundance of small pray items, which they can find easily, in the mangrove habitat.

According to the villagers, seasonal migration of Flying fox fruit bat (*Pteropus giganteus)* and other bat species are common around the Mangrove vegetation. Due to the security situation, night sampling, the method used, to determine nocturnal small mammal species, was not conducted. Hunting of mammals and habitat degradation can be identified as major threats to the mammalian fauna of the study area.

Invertebrates

During the present survey, butterflies were the only invertebrate fauna that were sampled. 52 butterfly species belonging to five families were recorded from the Tirukkovil area. The butterflies found in Tirukkovil represented about 21% of the total Sri Lankan butterfly fauna. There were seven nationally threatened and only one endemic species, the Bird wing (*Troides darsius*) recorded during the survey. Nympahlidae family represents the largest species diversity of butterflies in the Tirukkovil area.

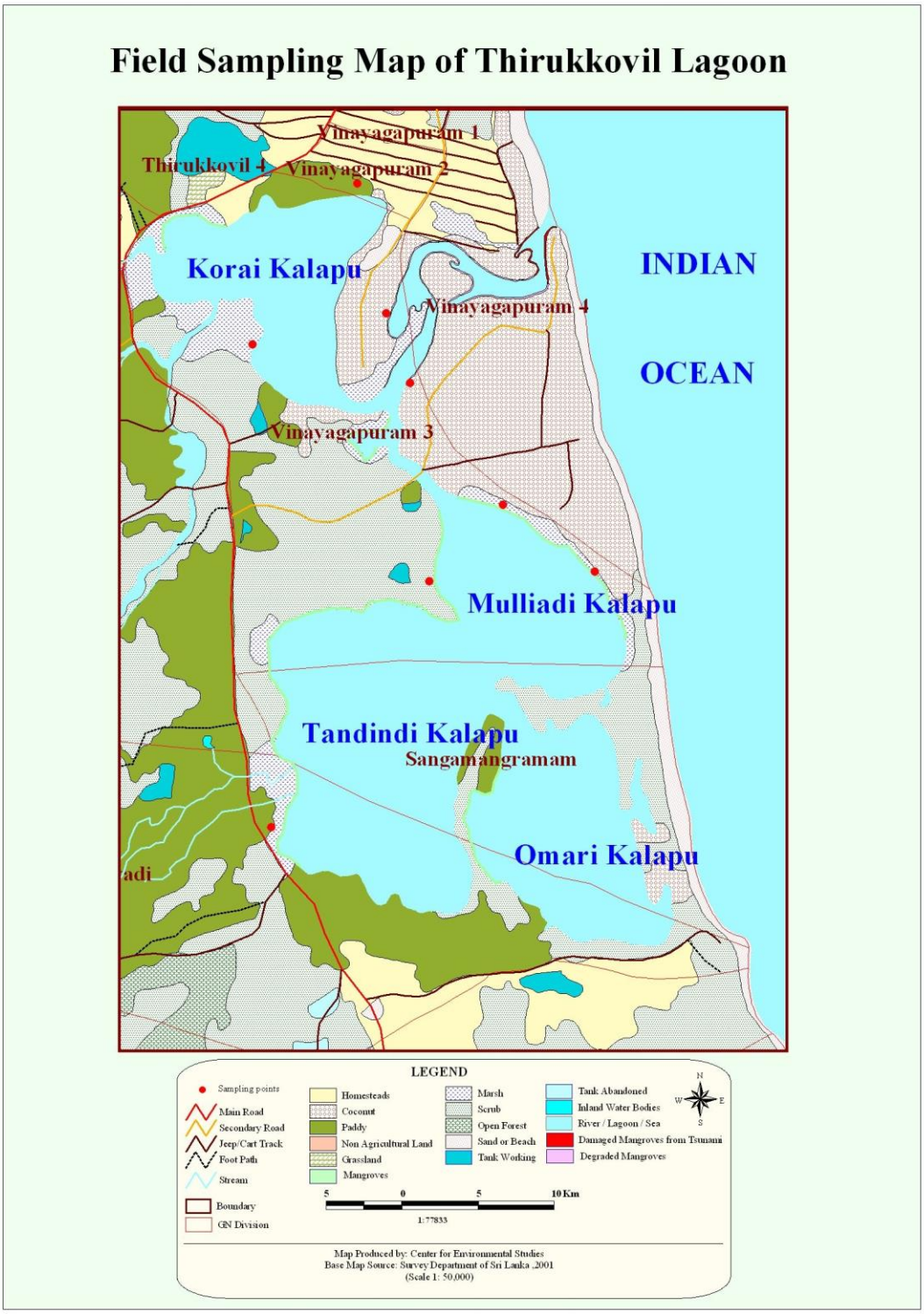

Figure 7: Map of Sampling Locations in Tirukkovil Lagoon

7. EFFECT OF TSUNAMI ON MANGROVES

Total damage of the mangroves has occurred within the first 200-300m from the Palakuda lagoon mouth (Figure 1). Mangroves on the both sides of the lagoon near the river mouth were destroyed by the tsunami waves. Partial damage of the mangroves was observed about 300-500m from the lagoon mouth. Approximately, 2% of the mangroves in Tirukkovil lagoon have suffered damage from the tsunami. Although the tsunami damage is minimal to the mangrove habitat in Tirukkovil lagoon system, there are evidences that mangrove degradation has been taking place due to the other human interventions. There are some areas of mangroves were cleared by the security purposes and fish landing sites.

8. RECOMMENDATIONS

Mangrove Rehabilitation program

A mangrove restoration program in the Tirukkovil lagoon can be conducted with the close collaboration of the local lagoon fisheries societies. Proper training on importance of mangroves, seed collection, nursery establishment, and replanting should be given to the local people prior to the launch of the project. This training can be provided through awareness programs and field demonstrations as well. There are plenty of vacant areas without mangroves and these areas can be replanted to establish the continuity of the mangrove habitat. Ecologically, it is very important to have a continuous mangrove habitat for continued existence of the flora and the fauna in the lagoon system. It is also important to use all the true mangroves and mangrove associates species that currently exist in the lagoon to maintain the mangrove biodiversity. There were many boat landing sites observed during the survey and these boat landing sites interrupt the continuity of the mangrove habitat. Interviews conducted with fishermen reveled that they have established these landing sites since there is on vegetation in those site. Local fisherman's are willing to establish few permanent landing sites if the replanting program conducted to fill those gaps. Sewalanka should attempt to establish few permanent boat landing sites in consultation with the fishermen who are using the Tirukkovil lagoon for fishing to establish the contiguous mangrove habitat. It is very important to avoid mangrove replanting in the flood plain area since it is an important micro habitat within the mangrove ecosystem. Post planting care and the vacancy planting mechanism should also be in place and it is a one of the key factors to the success of the mangrove restoration programs.

Figure 8: Boat Landing Sites

Awareness programmes

Environmental awareness program

Effective public awareness on the surrounding environment with the special emphasis on mangroves will help to conserve the surrounding natural ecosystems as well. A systematic public and school awareness campaign on the surrounding environment should be considered an integral part of the conservation activities in the Tirukkovil area. There was no such awareness activities conducted in this area due to the remoteness and lack of attention by the conservation agencies. Awareness programs on the sand dunes, mangroves, turtles, fisheries and the wetland system can be highlighted and that will ultimately help to conserve such ecosystems and species.

9. ECOLOGICAL PARAMETERS FOR FUTURE MONITORING

Few taxonomic groups can be identified as indicators, to measure the success of the ecological restoration of mangroves. These indicators will help to determine whether the natural processes of the restored mangrove ecosystem return to the original state. Changes to the restored ecosystem can be monitored at least once a year to determine the progress of natural recovery of the restored mangrove ecosystem of Tirukkovil by using the following indicators:

1. The floristic composition of the restored area can be monitored in relation to the species composition of the undisturbed mangrove habitat in the adjacent area.
2. Species of fish can be compared with the fish species that have been recorded in the undisturbed mangrove areas.
3. Species composition and the abundance of the wetland birds can be compared with the bird species that have been recorded in the undisturbed mangrove areas.

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Annex I: Checklist of Plant Species of Tirukkovil Area

Family	Scientific Name	Common Name
Acanthaceae	*Acanthus ilicifolius*	Ikiliya(S)
	Asytasia variabilis	
	Barleria prionitis	Katukarandu(S)
	Blepharis maderaspatensis	
	Hygrophila schulli	neeramulliya(S)
	Rhinacanthus nasutus	Anitta(S)
	Stenosiphonium cordifolium	Bu-nelu(S)
Aliamataceae	*Limnophyton obtusifolium*	
Amaranthaceae	*Achyranthes aspera*	Karaalhaba(S)
	Aerva lanata	Polpala(S)
	Altenanthera sessilis	Mukunuwenna(S)
Anacardiaceae	*Lannea coromandelica*	Hik(S)
Apocynaceae	*Carissa carndas*	karamba(S)
Areacaceae	*Borassus flabeillifer*	Tal(S)
Asclepiadaceae	*Calotropis gigantea*	Wara(S)
	Tylophora indica	Binnuga(S)
Asparagaceae	*Asparagus racemosus*	Hatawariya(S)
Asteraceae	*Cosmos caudatus*	
	Eclipta prostrata	kikiridiya(S)
	Emilia sonchifolia	kudupahara(S)
	Eupatorium odoratum[IAS]	Podisinnomaran(S)
	Sphaeranthus africanus	Velmudda(S)
	Tridax procumbens	
	Vernonia cinerea	Monerakudumbiya(S)
	Vernonia zylanica	Pupula(S)
	Xanthium indicum[IAS]	Uru-kossa(S)
Bignoniaceae	*Dolichandrone spathacea*	Diyadanga(S)
	Stereospermum colais	Dunumadala(S)
	Cordia curassavica	
	Cordia dichotoma	Lolu(S)
	Cordia minoica	
	Cordia oblongifolia	
Capparaceae	*Capparis brevispina*	Wal-dehi(S)
	Capparis zeylanica	welangiriya(S)
	Crateva adansonii	Lunuwarana(S)
Celastraceae	*Maytenius emarginata*	
Clusiaceae	*Calophyllum inophyllum*	Domba(S)
Colchicaceae	*Gloriosa superba*	Niyagala(S)
Combretaceae	*Evolvulus alsinoides*	Vishnukranthi(S)
	Luminitcera racemosa	Beriya(S)
	Terminalia arjuna	Kumbuk(S)
Convolvulaceae	*Cuscuta chinensia*	Agamulnathiwela(S)
	Ipomoea pes-caprae	Mudu-bin-tamburu(S)
Cucurbitaceae	*Momordica charantia*	Batu-karvila(S)

	Trichosanthes cucumerina	Dummalla(S)
Cyperaceae	*Cyperus rotundus*	Kalanduru(S)
	Frimbristylis cymosa	
	Frimbristylis umbellaris	Hal-pan(S)
	Schoenoplectus auticulatus	Maha-gata-pan(S)
Dioscoreaceae	*Dioscorea bulbifera*	Udala(S)
	Dioscorea pentaphylla	Katu-ala(S)
	Dioscorea tomentosa	Uyala(S)
Ebenaceae	*Diospyros montana*	
	Diospyros ovalifolia	Habara(S)
	Maba buxifolia	
Erythroxylaceae	*Erythroxylum monogynum*	Devadara(S)
Euphorbiaceae	*Croton aromaticus*	Wel-keppetiya(S)
	Drypetes sepiaria	Weera(S)
	Euphobia herta	Budada kiriya(S)
	Euphorbia antiquorum	Daluk(S)
	Euphorbia thymifolia	Bindadda Kiriya(S)
	Excoecaria agallocha	Thela(S)
	Flueggea leucopyrus	Heen-katupila(S)
	Jatropha curcas	Wata-endaru(S)
	Jatropha gossypiifolia	
	Phyllanthus amarus	Pitawakka(S)
	Ricinus communis	Endaru(S)
Fabaceae	*Alysicarpus vaginalis*	Aswenna(S)
	Bauhinia racemosa	Maila(S)
	Bauhinia tomentosa	kahapetan(S)
	Cassia auriculata	Ranawara(S)
	Clitoria ternatea	Katarodu(S)
	Derris scandens	Kala-wel(S)
	Desmodium triflorum	Heen-undupiyaliya(S)
	Entada pusaetha	Puswel(S)
	Mimosa pudica	Nidikumba(S)
	Sesbania bispinosa	
Goodeniaceae	*Scaevola plumieri*	Heen-takkada(S)
Hydrocharitaceae	*Hydrilla verticillata*	Halpenni(S)
Lamiaceae	*Leonotis nepatiifolia*	Yakwanassa(S)
	Leucas zeylanica	Gatatumba(S)
Lecythidaceae	*Barringtonia acutangula*	Ela-midella(S)
Loganiaceae	*Strychnos potatorum*	Ingini(S)
Loranthaceae	*Dendrophthoe falcata*	
Malpighiaceae	*Hiptage parvifolia*	math anguna(S)
Malvaceae	*Abutilon indicum*	Anoda(S)
	Hibiscus micranthus	Babila(S)
	Hibiscus tiliaceus	Belipatta(S)
	Parvonia odorata	
	Thespesia populnea	Gan suriya(S)
	Urena lobata	Heen-epala(S)

Marsiliaceae	*Marsilea quadrifolia*	
Melastomataceae	*Memecylon umbellatum*	Korakaha(S)
Meliaceae	*Azadrachta indica*	kohomba(S)
Menispermaceae	*Cyclea peltata*	Kahipittan(S)
	Tinospora cordifolia	Rasakinda(S)
Moraceae	*Ficus arnottiana*	Patanbo(S)
	Ficus mollis	Wal-aralu(S)
	Ficus racemosa	Attikka(S)
Myrtaceae	*Engenia bracteata*	Tembiliya(S)
	Syzygium cumini	Madan(S)
Myrsinaceae	*Aegiceras corniculatum*	Heen Kadol (S)
Nyctaginaceae	*Boerhavia diffusa*	Pita-sudu-pala(S)
Nymphaeaceae	*Nymphaea pubescens*	Olu(S)
Ochnaceae	*Ochna lanceolata*	Bo-kera(S)
Palmae	*Phoenix pusilla*	Walindi(S)
Passifloraceae	*Passiflora foetida*	Padawel(S)
Periplocaceae	*Hemidesmus indicus*	Eramusu(S)
Poaceae	*Chloris barbata*	Mayuru-tana(S)
	Dactyloctenium aegyptium	Putu-tana(S)
	Imperata cylindrica	Illuk(S)
	Oryza sativa	Wi(S)
	Spinifex littoreus	Maharawan -rvula(S)
Pontederiaceae	*Eichhornia crassipes*	Japan-jabara(S)
	Monochoria vaginalis	Diyaberaliya(S)
Pteridaceae	*Acrostichum aureum*	Keren koku (S)
Rhamnaceae	*Ziziphus oenoplia*	Eraminiya(S)
Rhizophoraceae	*Bruguiera gymnorhiza*	Mal kadol(S)
	Rhizophora mucronata	Kadol (S)
Rubiaceae	*Benkara malabarica*	Pudan(S)
	Canthium coromandelicum	Kara(S)
	Cantunaregum spinosa	Kukukurumanna(S)
	Hydrophylax maritima	Mudu-gata-kola(S)
	Ixora pavetta	Maha-rtambala(S)
	Oldenlandia corymbosa	Walpathpadagam(S)
	Tarenna asiatica	Tarana(S)
Salvadoraceae	*Azima tetracantha*	
	Salvadora persica	Malithan(S)
Sapindaceae	*Allophylus cobba*	Kobbe(S)
Sapotaceae	*Manilkara hexandra*	Palu(S)
Scrophulariacaea	*Scoparia dulcis*	walkottamalli(S)
	Bacopa monnieri	Lunuwila(S)
Solanaceae	*Physalis micrantha*	Nai miris(S)
Sterculiaceae	*Ptrerospermum suberifolium*	Welan(S)
	Waltheria indica	
	Herertiera littoralis	Etuna (S)
Tiliaceae	*Grewia carpinifolia*	
	Grewia helicterifolia	Boradamanya(S)

Typhaceae	*Typha angustifolia*	Hambu pan(S)
Verbenaceae	*Clerodendrum inerme*	Buranda(S)
	Gmelina asiatica	Heendemata(S)
	Lantana camara[IAS]	Hinguru(S)
	Phyla nodiflora	Hiramanadatta(S)
	Premna latifolia	Beheth midi(S)
	Premna obtusifolia	Maha midigas(S)
	Vitex altissima	Milla(S)
	Vitex trifolia	Nieke(S)
Vitaceae	*Cayratia trifolia*	Wal-rat-diya-labu(S)
	Cissus quadrangularis	Hiressa(S)

Annex II: Checklist of Mammals of Tirukkovil Area

Family	**Species Name**	**Common Name**
Cercopithecidae	*Macaca sinica* [E]	Sri Lanka toque monkey
	Semnopithecus priam	Grey langur
Canidae	*Canis aureus*	Jackal
	Canis familiaris [D]	Domestic dog
Felidae	*Felis chaus*[Tr]	Jungle cat
	Felis catus [D]	Domestic cat
	Prionailurus rubiginosus[Tr]	Rusty-spotted cat
	Prionailurus viverrinus[Tr]	Fishing cat
Herpestidae	*Herpestes edwardsii*	Grey mongoose
Elephantidae	*Elephas maximus*[TR]	Elephant
Bovidae	*Bubalus bubalis* [D]	Domestic water buffalo
	Bos indicus [D]	Domestic hump-backed cattle
Suidae	*Sus scrofa*	Wild boar
Tragulidae	*Moschiola meminna* [E]	Sri Lanka mouse-deer
Sciuridae	*Funambulus palmarum*	Palm squirrel
	Ratufa macroura	Giant squirrel
Leporidae	*Lepus nigricollis*	Black-napped hare
Hystricidae	Hystrix indica	Porcupine
Total number of Species - 18		
E- endemic -2		
Tr- nationally Threatened – 3		
D – Domestic -4		

Annex III: Checklist of Birds of Tirukkovil Area

Family	Species Name	Common Name
Accipitridae	*Accipiter badius*	Shikra
	Haliaeetus leucogaster	White-bellied Sea-eagle
	Haliastur indus	Brahminy Kite
	Spilornis cheela	Crested Serpent Eagle
Alaudidae	*Alauda gulgula*	Oriental Skylark
	Mirafra assamica	Rufous-winged Bushlark
Alcedinidae	*Alcedo atthis*	Common Kingfisher
	Halcyon capensis	Stork-billed Kingfisher
	Halcyon smyrnensis	White-breasted Kingfisher
Anhingidae	*Anhinga melanogaster*	Oriental Darter
Apodidae	*Cypsiurus balasiensis*	Asian Palm Swift
Ardeidae	*Ardea cinerea*	Grey Heron
	Ardea purpurea	Purple Heron
	Ardeola grayii	Indian Pond Heron
	Ardeola grayii	Pond Heron
	Bubulcus ibis	Cattle Egret
	Butorides striatus	Striated Heron
	Casmerodius albus	Great Egret
	Egretta garzetta	Little Egret
	Dupetor flavicollis	Black Bittern
	Ixobrychus sinensis	Yellow Bittern
	Mesophoyx intermedia	Intermediate Egret
	Nycticorax nycticorax	Night Heron
Burhinidae	*Esacus recurvirostris*[TR]	Great Thick-knee
Centropodidae	*Centropus sinensis*	Greater Coucal
Cerylidae	*Ceryle rudis*	Pied Kingfisher
Charadriidae	*Himantopus himantopus*	Black-winged Stilt
	Vanellus indicus	Red-wattled Lapwing
Cisticolidae	*Cisticola juncidis*	Zitting Cisticola
	Prinia socialis	Ashy Prinia
Columbidae	*Streptopelia chinensis*	Spotted Dove
	Treron pompadora	Pompadour Green-pigeon
Coraciidae	*Coracias benghalensis*	Indian Roller
Corvidae	*Aegithina tiphia*	Common Iora
	Artamus fuscus	Ashy Woodswallow
	Corvus macrorhynchos	Black Crow
	Corvus splendens	House Crow
	Tephrodornis pondicerianus	Common Woodshrike
Cuculidae	*Clamator jacobinus*	Pied Cuckoo
	Phaenicophaeus viridirostris	Blue-faced Malkoha
Dendrocygnidae	*Dendrocygna javanica*	Lesser Whistling-duck
Hemiprocnidae	*Hemiprocne coronata*	Crested Treeswift
Hirundinidae	*Hirundo daurica*	Red-rumped Swallow

	Hirundo rustica	Barn Swallow
Jacanidae	*Hydrophasianus chirurgus*	Pheasant-tailed Jacana
Magalaimidae	*Megalaima haemacephala*	Coppersmith Barbet
	Megalaima zeylanica	Brown-headed Barbet
Meropidae	*Merops leschenaulti*	Chestnut-headed Bee-eater
	Merops orientalis	Green Bee-eater
	Merops philippinus	Blue-tailed Bee-eater
Muscicapidae	*Saxicoloides fulicata*	Indian Robin
Nectariniidae	*Dicaeum erythrorhynchos*	Pale-billed Flowerpecker
	Nectarina asiatica	Purple Sunbird
	Nectarina lotenia	Loten's Sunbird
	Nectarina zeylonica	Purple-rumped Sunbird
Passeridae	*Anthus rufulus*	Paddyfield Pipit
	Lonchura punctulata	Scaly-breasted Munia
	Passer domesticus	House Sparrow
Pelecanidae	*Pelecanus philippensis*^{TR}	Spot-billed Pelican
Phalacrocoracidae	*Phalacrocorax fuscicollis*	Indian Cormorant
	Phalacrocorax niger	Little Cormorant
	Pavo cristatus	Indian Peafowl
Picidae	*Chrysocolaptes lucidus*	Greater Flameback
Psittacidae	*Psittacula krameri*	Rose-ringed Parakeet
Pycnonotidae	*Pycnonotus cafer*	Red-vented Bulbul
	Pycnonotus luteolus	White-browed Bulbul
Rallidae	*Amaurornis phoenicurus*	White-breasted Waterhen
	Gallinula chloropus	Common Moorhen
	Porphyrio porphyrio	Purple Coot
Scolopacidae	*Actitis hypoleucos*	Common Sandpiper
	Gallinago gallinago	Common Snipe
	Tringa totanus	Common Redshank
Sturnidae	*Acridotheres tristis*	Common Myna
Sylviidae	*Orthotomus sutorius*	Common Tailorbird
Threskiornithidae	*Platalea leucorodia*	Spoonbill
	Threskiornis melanocephalus	Black-headed Ibis
Timaliidae	*Pellorneum fuscocapillum En*	Brown-capped Babbler
	Turdoides affinis	Yellow-billed Babbler
EN - endemic, TR- Thretened		
Total number of species - 78		

Annex IV: Checklist of Reptiles of Tirukkovil Area

Family	Species Name	Common Name
Crocodylidae	*Crocodylus paluster* [TR]	Marsh Crocodile
	Crocodylus porosus [TR]	Estuarine crocodile
Bataguridae	*Melanochelys trijuga* [TR]	Black Turtle
Testudinidae	*Geochelone elegans* [TR]	Indian Star Tortoise
Trionychidae	*Lissemys punctata* [TR]	Flapshell Turtle
Agamidae	*Calotes calotes*	Green garden lizard
	Calotes ceylonensis [EN,TR]	Painted lip lizard
	Calotes versicolor	Common garden lizard
	Sitana ponticeriana	Fanthroat lizard
Gekkonidae	*Hemidactylus brookii*	Spotted house-gecko
	Hemidactylus frenatus	Common house-gecko
Scincidae	*Lankascincus fallax* [EN]	Common lankaskink
	Mabuya carinata	Common skink
	Mabuya macularia	Bronzegreen little skink
Varanidae	*Varanus bengalensis*	Land monitor
	Varanus salvator	Water monitor
Colubridae	*Ahaetulla nasuta*	Green vine snake
	Amphiesma stolatum	Buff striped keelback
	Cerberus rynchops	Dog-faced water snake
	Dendrelaphis tristis	Common bronze back
	Ptyas mucosa	Common rat snake
	Xenochrophis piscator	Checkered Keelback
Elapidae	Bungarus caeruleus	The common krait
	Naja naja	Indian cobra
Viperidae	*Daboia russelii*	Russell's viper
Total number of species - 25		
E- Endemic, TR- Threatened		

Annex V: Checklist of Amphibians of Tirukkovil Area

Family	Species Name	Common Name
Bufonidae	*Bufo atukoralei* EN,TR	Atukorale's dwarf toad
	Bufo melanostictus	Common house toad
Microhylidae	*Microhyla ornate*	Ornate narrow mouth frog
	Microhyla rubra	Red narrow mouth frog
	Ramanella variegata	White-bellied pug snout frog
Ranidae	*Euphlyctis cyanophlyctis*	Skipper frog
	Euphlyctis hexadactylus	Sixtoe green frog
	Fejervarya limnocharis	Common paddy field frog
	Hoplobatrachus crassus	Jerdon's bull frog
	Sphaerotheca breviceps	Banded sand frog
	Polypedates maculatus	Chunam tree frog
EN - endemic, TR- Thretened		
Total number of species - 11		

Annex VI: Checklist of Fish Species of Tirukkovil Area

Family	Species Name	Common Name	Habit
Bagridae	*Mystus gulio*	Long-whiskered Catfish	F,B
Cichlidae	*Etroplus suratensis*	Pearl Spot	F,B
	Oreochromis mossambicus	Tilapia	F,B
Adrianichthyidae	*Oryzias sp.*	Blue Eyes	F,B
Scatophagidae	*Scatopgagus argus*	Spotted Scat	B
Terapontidae	*Terapon jarbua*	Jarbua terapon	B,
Monodactylidae	*Monodactylus sp.*		B
Mugilidae	*Liza sp.*	Mullet	B,M
Gerreidae	*Gerres abbreviatus*	Deepbody silverbiddy	B,M
Leiognathidae	*Leiognathus sp.*	pony fish	B,M
Lutjanidae	*Lutjanus argentimaculatus*	Red snapper	B,M
	Lutjanus sp	Snapper	B,M
Engraulididae	*Thryssa sp.*		B,M
Carangidae	*Carangoides sp.*	Travally	B,M
Gobidae	species 01 (Unknown species)	Goby	B
Osphronemidae	*Tricogaster pectoralis*	Snakeskin gourami	F
Channidae	*Channa stratus*	Murrel	F
Anabantidae	*Anabas testudinus*	Climbing perch	F
Tetradontidae	*Tetradon sp.*	Puffer sp.	B
Total number of Species - 18			
F- Freshwater B-Brackish water, M - Marine			

Annex VII: Checklist of Butterflies of Tirukkovil Area

Family	Species Name	Common Name
Papilionidae	*Troides darsius* [EN,TR]	Ceylon Birdwing
	Pachliopta hector	Crimson Rose
	Pachliopta aristolochiae	Common Rose
	Papilio domoleus	Lime Butterfly
	Papilio polytes	Common Mormon
	Papilio polymnestor	Blue Mormon
	Graphium agamemnon	Tailed Jay
Pieridae	*Leptosia nina*	Psyche
	Delias eucharis	Jezebel
	Belenois aurota,	Pioneer
	Cepora nerissa	Common Gull
	Appias paulina[TR]	Lesser Albatross
	Ixias marianne	White Orange Tip
	Catopsilia pomona	Lemon Emigrant
	Pareronia ceylanica	Dark Wanderer
	Colotis amata	Small Salmon Arab
	Eurema hecabe	Common Grass Yellow
Nympahlidae	*Tirumala septentrionis*	Dark Blue Tiger
	Parantica aglea	Glassy Tiger
	Danaus chrysippus	Plain Tiger
	Euploea core	Common crow
	Ariadne ariadne	Angled Castor
	Phalantha phantha	Leopard
	Junonia lemonias	Lemon Pansy
	Junonia atlites	Grey Pansy
	Junonia iphita	Chocolate Soldier
	Junonia almana	Peacock Pansy
	Hypolimnas misippus	Danaid Eggfly
	Neptis hylas	Common Sailor
	Acraea violae	Tawny Costor
	Melanitis leda	Common Evening Brown
	Orsotriaena medus	Nigger
	Mycalesis perseus	Common Bushbrown
	Nissanga patnia	Gladeye Bushbrown
	Ypthima ceylonica	White Four-ring
	Elymnias hypermnestra	Common Palmfly
Lycanidae	*Rathinda amor*	Monkey-puzzle
	Syntarucus plinius	Zebra Blue
	Castalius rosimon	Common Pierrot
	Freyeria trochilus	Grass Jewel
	Zizina otis	Lesser Grass Blue
	Zizula hylax[TR]	Tiny Grass Blue
	Euchrysops cnejus[TR]	Gram Blue

	Spindasis ictis	Ceylon Silverline
	Spindasis vulcanus	Common Siverline
	Chilades lajus	Lime Blue
Hespiriidae	*Hasora taminatus*^{TR}	White banded Awl
	Sarangesa dasahara^{TR}	Common Small Flat
	Suastus gremius	Indian Palm Bob
	Caprona ransonnettii^{TR}	Golden Angle
	Iambrix salsala	Chestnut Bob
	Spalia galba	Indian Skipper
	Taractrocera maevius	Common Grass Dart
Total number of species - 52		
E- Endemic , TR- Threatened		