ISSN: 2347-5129
IJFAS 2014; 1(5): 32-37

www.fisheriesjournal.com
Received: 17-03-2014
Accepted: 14-04-2014

Gajaba Ellepola
Department of Zoology, University of Peradeniya, Sri Lanka

Kithsiri B. Ranawana
Department of Zoology, University of Peradeniya, Sri Lanka

Samitha Harischandra
Wildlife Research and Conservation Trust, New Digana road, Kundasale, Sri Lanka

Correspondence:
Gajaba Ellepola
Department of Zoology, University of Peradeniya, Sri Lanka
Email: gajaba3@gmail.com
Tel: +94771844719

Utilization of fishery resources in the Panama lagoon, Ampara District, Sri Lanka

Gajaba Ellepola, Kithsiri B. Ranawana, Samitha Harischandra

ABSTRACT
Lagoons are highly productive ecosystems. They contribute to fisheries productions of a country. The status of fishery in the Panama lagoon has not been assessed in the past. This study was conducted during June 2011 to April 2012 to assess the status of fishery in Panama lagoon. Daily catch brought to the landing centers by fishermen were used as the primary source of data to assess the status of fishery. Forty five species of fish belonging to 31 families, four species of shrimps and the mangrove crab, *Scylla serrata* were harvested from the lagoon using different fishing gears. The total production of this lagoon was estimated to be about 7405.88 kg/km²/yr. The productivity is high in the lagoon compared to the average annual productivity of lagoons in Sri Lanka. Non-regulation of net mesh sizes and certain unauthorized activities have caused certain environmental issues in the lagoon hence suitable management practices should be introduced to ensure the sustainability of the lagoon ecosystem.

Keywords: Environmental issues, Fisheries, lagoon, productivity, sustainability.

1. Introduction
Estuaries are important coastal ecosystems; they represent transition systems between freshwater and marine environments and are among some of the most biologically productive areas on earth [1]. Estuaries and lagoons represent about 13% of coastal areas worldwide and exhibit very diverse characteristics in terms of surface area (a few km² to 800 km²), shape, freshwater input, connections to sea, and anthropogenic impact [2]. These are highly productive ecosystems [3]. Lagoons and estuaries are important as nursery grounds for a number of species of fin fish and crustaceans [4]. As they provide nursery grounds for many marine species, estuarine systems are essential to the renewal of fisheries resources [5].

Sri Lanka is an island situated in the Indian Ocean south of India between latitude 6-10º N and longitude 80-82º E. Sri Lanka has a coastline of approximately 1760 km and a continental shelf area of about 31,000 km². There are approximately 121,460 ha of lagoons, estuaries and backwaters of which about one quarter is lagoons [4]. Majority of these lagoons are either permanently separated from the sea or temporary connected with coastal water bodies during certain period of the year. Of the coastal lagoons the smaller ones, especially those on the south-western, southern and south-eastern coasts are mostly permanently closed water bodies. Most of the lagoons and estuaries in Sri Lanka are shallow and has continuous water flow through freshwater systems [6].

Fish is the most important source of protein in the country, contributing approximately 60 percent of the animal protein intake and about 15 percent of the total protein consumption [7]. Although Sri Lanka has a tradition in fishing dating back to several centuries, the development of fisheries in the country has been a slow and gradual process, with little state assistance until recent times [8]. Statistics on fish production from the lagoons are often expressed together with coastal marine fisheries. For this reason, no or less separate information is available on lagoon fish production, fishing effort or catch composition [8]. But there is some documented information on the productivity of coastal lagoons in Sri Lanka. Estimated average natural production of Sri Lankan lagoons is around 22 kg/ha/yr [4]. No less than 30,000 part-time and full time fishermen are engaged in the lagoon fisheries in Sri Lanka. About 125 species of fish have been recorded from the lagoons. At least 80 of them are of marine origin [7].

Despite their high productivity, estuaries and lagoons are considered as the most anthropogenically degraded habitats on earth [9]. Human activities damage the estuary's functioning, and in many cases have caused large scale changes in natural communities. Environmental problems in these systems are related with overpopulation and uncontrolled development in coastal watersheds, as well as human activities in the surrounding areas [1]. These strong human impacts collide with the important ecological function of estuarine systems, which might threat these ecosystems' viability, health, decrease in natural productivity, change in the ecosystems' stability and ultimately causing the loss of biodiversity [10]. Fisheries have always been considered as one of the most threatening anthropogenic factors to fish populations' viability [11].

No previous detailed studies have been carried out on the fisheries resources available in the Panama lagoon in the east coast of Sri Lanka due to the civil unrest in the area. Of the multiple uses of this lagoon fishing, shrimp harvesting and tourism are the major economic processes providing livelihood for fisher populations residing around the lagoon. Therefore, it is imperative to undertake a systematic study to ascertain the status of fishery in the lagoon and environmental impact caused by the humans. There is a need to survey the biological diversity in this area to gather up to date information in order to prepare a conservation strategy for this highly valuable ecosystem. And also research into fishery resources in the lagoons in Sri Lanka has been rather poor and incomplete, both in terms of the number of lagoons studied and the aspects covered [7]. Therefore, the current study will support to fill the gap of knowledge in this discipline of brackish water fisheries in Sri Lanka.

2. Methodology

2.1 Study Area

Panama Lagoon (6º45'-6º46' N; 81º48'-81º49' E) is a shallow lagoon situated in Ampara District in the East coast of Sri Lanka. It covers an approximate total water surface area of 0.73 km² (73 ha) with an average depth of 1.48m (4.86 ft). A maximum depth of 4.26 m (14 ft) has been recorded. The salinity ranges from an average of 4.5 ppt-26.6 ppt and it shows monthly variations. The Panama lagoon is situated in the dry semi-arid climatic zone of Sri Lanka receiving a mean annual rainfall of 500-775 mm and much of it received during the northeastern monsoon from December to February. The Dry period of the lagoon region ranges from March to August whereas the wet period ranges from September to mid-February. According to the meteorological data maximum day time temperature may go up to 34 ºC and it may decrease down to 21 ºC during the night. The lagoon mouth opens to the sea from the eastern part of the lagoon with a narrow channel which is about 52 m wide. The lagoon mouth closes during September to mid-November and it remains open during the rest of the year from December to August. Artificial breaching of the lagoon mouth is done at certain times in order to facilitate transportation of boats from ocean to the lagoon and also to protect upstream agricultural lands from flooding. The main freshwater input comes to the lagoon through Wilo Oya, a tributary of the Heda Oya which enters the lagoon from the western region of the lagoon (Figure 1). Fisheries is an important secondary activity in the lagoon.

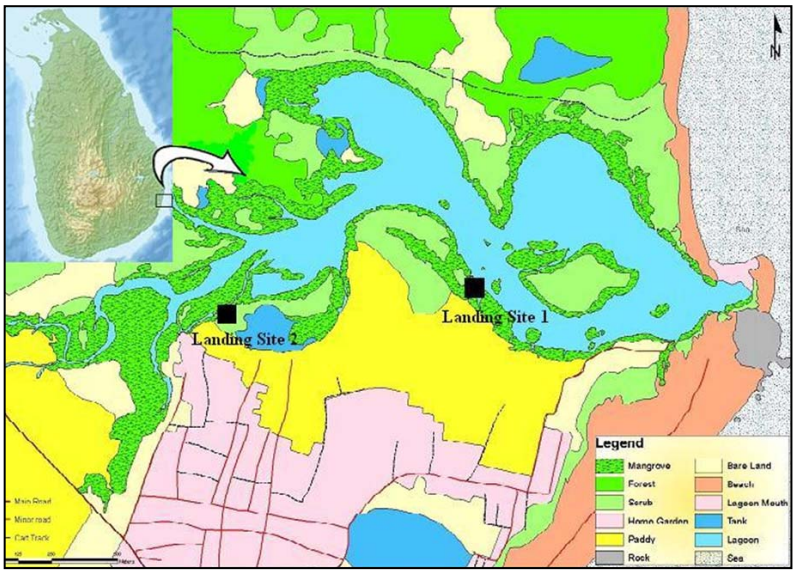

Fig 1: Land use map of the Panama lagoon and its adjacent areas. Two sampling sites; Landing site 1 and Landing site 2 are indicated in the map

2.2 Fish collection

The study was conducted from June 2011 to April 2012. First, a pilot study was conducted in the area to examine the study sites and to get an overall idea about the lagoon, its features, its background and the interactions between the lagoon and the local communities. Interviews were conducted with the people to get some basic information about the lagoon and their dependency on the lagoon.

Data collection was done monthly. Fishermen catch records serve as the primary data source for the study. The two regular fish landing sites (Landing Site1 and Landing Site2 (Figure 1) in the lagoon were visited early in the morning during the field visits to gather information from the fishermen. Daily yields brought, types of fish caught, number of fish collected and their total weights were recorded. Fish identification guides [12, 13, 14, 15] and colored photographs were used for fish identification. Secondary data collection involved collection of information from the fishing communities and community

leaders who possess good knowledge on the fish fauna available in the lagoon. Possible threats to the lagoon ecosystem were also observed during the study period.

3. Results

About 45 species of fish (belonging to 31 families) are harvested from the lagoon. The fish included freshwater forms, brackish water forms, fresh-brackish water forms and marine-brackish migratory species. The typical freshwater species were observed mostly during the rainy season during the time which the inflow of freshwater from streams was higher. About one third of the food fish species in the Panama lagoon consisted of typical brackish water forms such as the Scats (*Scatophagus argus*), Spine foots (*Siganus* spp.), Sillagos (*Sillago sihama*), Cardinal fishes *(Apogon* spp.*)*, Pony fishes (*Leiognathus* spp.), Hemirampids (*Zenarchopterus dispar)*, Terapon fishes (*Terapon jarbua, Terapon puta)*, and the Milk fish *(Chanos chanos)*. The migratory species included many "anadromous" species (marine species which move into brackish/freshwater for spawning or to spend their juvenile period) such as Snappers *(Lutjanus* spp.*)*, Trevally *(Caranx* spp.*)*, Silver Beddy *(Gerres* spp.*)*, Surgeon fish *(Acanthurus* spp.*)* and Barracudas *(Sphyraena* spp).

Only five species of fish namely *Siganas lineatus, Oreochromis niloticus, Mugil cephalus, Gerres argyreus* and *Mystus gulio* contributed to the bulk (63%) of the catch (Figure 2). These species occur regularly in the fishermen catch. The total production of this lagoon was estimated to be about 7405.88 kg/km²/yr. The productivity is high in the lagoon and it has seasonal fluctuations due to environmental changes. *Siganas lineatus* and *Mugil cephalus* are the most preferred food fishes by the Panama village community and thus sold for a comparatively higher price than all the other species.

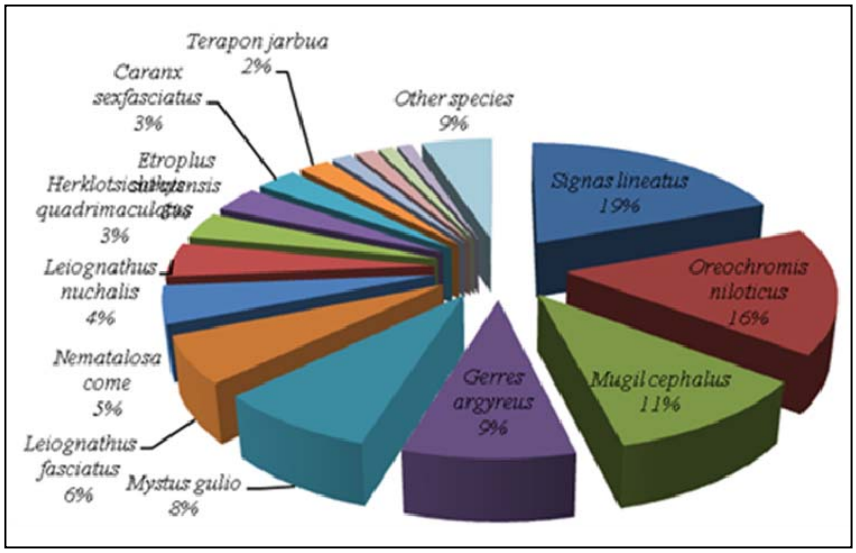

Fig 2: Composition of fishermen catch in the Panama Lagoon. (Out of the 9% of other species, each *Megalops cyprinoides, Arius thallasinus, Scatophagus argus,* and *Lutjanus argentimaculatus* contribute for 1% of the catch)

According to the CPUE *Siganas lineatus* occur more frequently in the fish catch, which means that a boat coming to the land contains 25% *Siganas lineatus* per day, while *Oreochromis niloticus, Mugil cephalus, Gerres argyreus* and *Mystus gulio* occurs in percentages of 21%, 14%, 11% and 10% respectively (Table 1).

Table 1: Percent Catch Per Unit Effort (CPUE) of species which contribute to the bulk of the yield (CPUE= Number of fish caught per day per boat).

Family	Name	Common Name	Sinhala name	CPUE (%)	
Bagridae	*Mystus gulio*	Long whiskered cat fish	Mada anguluwa	10.73	
Carangidae	*Caranx sexfasciatus*	Bigeve Travelly	Inguru Parawa	3.92	
Cichlidae	*Oreochromis niloticus*	Tilapia	Tilapia	21.1	
	Etroplus suratensis	Banded etroplus	Koraliya	4.38	
Clupeidae	*Herklotsichthys quadrimaculatus*	Blue stripe Herring	Kolamuruwa	4.48	
	Nematalosa come	Gizard shad	Katu koiya	6.25	
Gerreidae	*Gerres argyreus*	Silver Biddy	Olaya	11.39	
Leiognathidae	*Leiognathus fasciatus*	Banded pony fish	Panna	7.84	
	Leiognathus nuchalis	Pony fish	Panna	5.69	
Mugilidae	*Mugil cephalus*	Flat head Mullet	Thel Gogeya	14.19	
Siganidae	*Siganas lineatus*	Double barred spinefoot	Otti	25.39	
Terapontidae	*Terapon jarbua*	Jarbua terapon	Iri Bateya	2.89	

Fiber glass canoe with an outrigger (operated by single or two fishermen) is the main fishing craft used in the Panama lagoon. Fishing using motor boats is prohibited. Gill nets and cast nets (stretched mesh size varying from 3.5 cm to 9.0 cm)

are the main fishing gear used. Hand nets and hook and line method is also used at certain occasions. Although the Panama Lagoon Fisher Society has 106 members, only 27 members are involved in lagoon fishery on regular basis.

Crab cages are used seasonally to capture mangrove crab (*Scylla serrata*). Small hand nets are used to capture shrimps hiding among roots of mangroves during the shrimp season. Four species of shrimps namely Kiri issa (*Pinnaeus indicus*), Welli issa (*Pinnaeus semisulcatus*), Thalam issa (*Pinnaeus merguensis*) and Kara andu issa (*Pinnaeus monodon*) are harvested from the lagoon. The shrimps show peaks in the catches in months of April and May. Crabs harvests peaks during June and July. During these seasons fishermen mostly target catching shrimps and crabs rather than catching fins fish as these species are sold at very high prices (average fish price is about Rs. 175.00 whereas average shrimp price is about Rs. 600.00 per kg).

Fish yield is highest during the month of January and lowest during July (Figure 3). Monthly average total fish yield is about 440.72 kg and during most of the year, monthly total fish yield is below average. During the time which the lagoon mouth is closed (from September to November) fish yield remains fairly stable whereas during the other periods of the year it fluctuates by larger margins. However, there is no major difference between the fish yields obtained during the dry period and the rainy season.

Although, the Tsunami in 2004 has made a huge impact on the lagoon ecosystem and its surroundings the system has been stabilized now. It has destroyed most of the mangrove vegetation in the lagoon mouth area, however there are signs of regeneration of mangroves in these disturbed sites. According to the local people the lagoon has extended its surface area after the Tsunami and has become shallow due to the sand been brought into the lagoon by waves. They have also observed a decline in the fish species initially after the Tsunami but, currently it has regained its natural status which was there before the event. During the past few years, after the 30 year old civil conflict ended, there has been a visible degradation of the Panama lagoon environment due to human activities. Those activities include poorly planned settlements, deforestation, agricultural pollution, household garbage disposal, artificial breaching of the lagoon mouth sand bar, use of illegal fishing methods and contamination with oil discharged by motor boats which come ashore to park inside the lagoon. The motor boats being used in the lagoon by the Sri Lankan Navy and their unplanned usage of adjacent lands have become a major threat to the Panama lagoon.

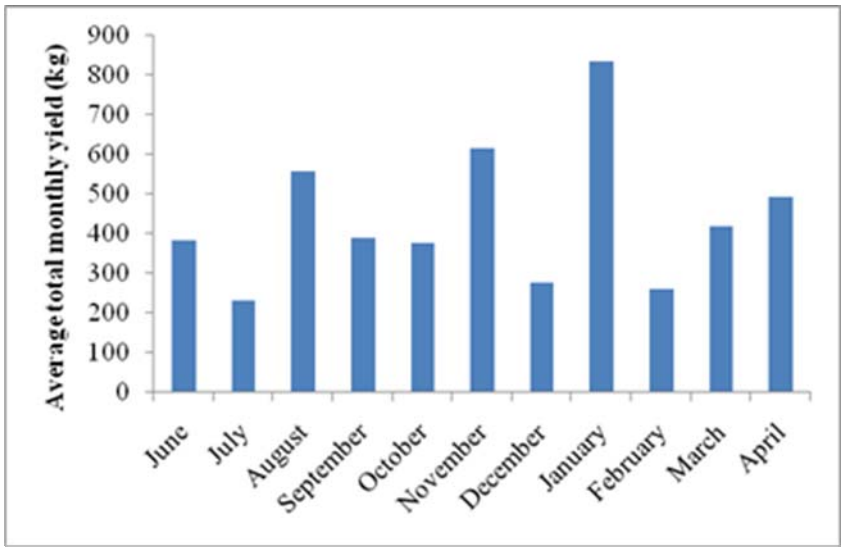

Fig 3: Monthly variation of the estimated total production

4. Discussion

Brackish water environments are potential sites for developing the fisheries sector in Sri Lanka. Since most marine and juvenile teleosts use coastal lagoons and estuaries for feeding and growth, and since they provide protection from predators and ensure high food availability [16] lagoons are highly productive ecosystems [3]. It has been estimated that the average natural production of Sri Lankan lagoons are around 22 kg/ha/yr [4] and the productivity of the Panama lagoon is 74.05 kg/ha/yr is well above the average productivity of a lagoon in Sri Lanka. The productivity of the Panama lagoon is quite similar to that of the Negambo estuary which is 72.9 kg/ha/yr and it is well above the annual productivity of the Puttalam lagoon which is 49 kg/ha/yr [17]. Therefore, Panama lagoon is a highly productive ecosystem and it contributes to the total annual production of lagoons and estuaries of Sri Lanka, which is about 5,880 metric tons [4].

The fish catch included 45 species belonging to 31 families. Dominant fin fish species included *Siganas lineatus*, *Oreochromis niloticus*, *Mugil cephalus*, *Gerres argyreus* and *Mystus guilio* while four shrimp species and the mangrove crab *Scylla serrata* dominated during certain seasons. The shrimp catch is high during the months of March and April and lower during the other periods. Penaeid prawns spend the early part of their life cycle in the lagoons. Post larvae enter the lagoon for feeding and the sub-adults migrate back to the sea. In the Panama lagoon this process occurs during March and April, which causes the shrimp catch to be high during that season. But during the monsoonal seasons the shrimp catch decreases significantly. It becomes difficult to operate cast nets when the lagoon is flooded during the monsoonal rains [4] and the shrimps may move out from the lagoon due to the breaching of the sand bar at the lagoon mouth and this may be the reason that the shrimp catch drops significantly during that season. Thirty one species of shrimps have been recorded from Sri Lankan waters. Of these only the penaeid shrimps

have a commercial value. Being one of the smallest in size, species such as *P. indicus*, and *P. semisulcatus* have a higher value among others [7] whereas the largest Penaeid prawn *P. monodon* is numerically less abundant than *P. semisulcatus* [14].

The highest catch of fin fish was observed in the month of January. Intensive fishing occurs during March to August with peak intensity during the shrimp season though the statistics does not explain that. This may be due to the over harvesting during that season. During the time which the lagoon mouth is closed the entire lagoon becomes a single unit with equal lower salinities in the entire lagoon. This seems very favorable for the inhabiting fish and during this time they grow in their body sizes and also their abundance increases as well. During the rainy season and the dry season the fish catch does not change remarkably. During the dry season the intensity of fishing is somewhat higher compared to the rainy season. Therefore, the results show that over harvesting during the dry period reduces the fish yield per boat and less number of fishermen involved in fishing during the rainy season bringing high yields contributing to maintain the balance in the system.

While the deep lagoons and estuaries are the sites of important fisheries, the shallow lagoons, mangrove swamps and saline marshes represent potential areas for aquaculture. Land that is potentially suitable for aquaculture in Sri Lanka has been estimated as 6,000 ha [18], and 57% such land being situated along the north and east coasts. Among those areas Panama lagoon in the east coast would be a good candidate site to develop the brackish water fisheries in Sri Lanka. It is evident that the productivity of the Panama lagoon can be further increased if new sustainable fishing methods are introduced. Cage fish farming and Brush Park fishing methods can be introduced to the Panama lagoon to increase the fish yields as well as the income of the people. These methods are possible because the Panama lagoon harbors species such as *Chanos chanos*, and Sea bass *(Lutjanus* sp.*)* as food fishes and *Scatophagus argus*, *Monodactylus argenteus*, *Etroplus suratensis* and *Tetraodon fluviatilis* as ornamental fishes which are suitable to be grown in the lagoon. Fisheries administrators and environmentalists often criticize brush parks as destructive fishing method capable of removing large quantities of fish from the water. However, available evidences suggests that their mode of operation is more complex, and that under the right circumstances they can contribute to the overall production and well-being of the fisheries in the water body in which they are found [19].

Over the last few decades there has been an increasing concern about man's impact on the ecosystem. The marine environment may potentially be affected by a variety of human activities, both direct and indirect, such as coastal engineering works, pollution, eutrophication, fisheries and global warming. In order to analyze the possible influences of human activities, knowledge of the dynamics of the marine ecosystem is necessary. Several natural and anthropogenic factors may have a direct influence on the environment and on food resources, distribution, growth, survival and behavior of the fish present [20]. Although no detailed studies on the biodiversity of Panama lagoon 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 [21]. Therefore, it is important to highlight that conservation and sustainable use of this lagoon ecosystem which requires different managers and researchers to work collaboratively in order to ensure that the protection and monitoring of water quality, habitat and biotic communities in the Panama lagoon maintained for the future use as well.

5. Conclusion

The results of the present study emphasize that the Panama lagoon has a potential to be developed as a highly productive ecosystem and contribute to the fisheries production of Sri Lanka. Fishing is an important secondary activity in the lagoon where fishing is the major livelihood of majority of the people living in the village. Fishing has seasonal variations in the lagoon due to the natural patterns which fishermen are well aware of. Certain human threats are causing serious damage to the lagoon ecosystem thus, it is important to take mitigatory measures to minimize the impacts for the sustainable use of the Panama lagoon.

6. Acknowledgements

The authors would like to thank Mr. Danushka Mahanama of the Wildlife Research and Conervation Trust of Sri Lanka.

7. Reference

1. Kennish MJ. Environmental threats and environmental future of estuaries. Environ Conserv 2000; 29:78–107.
2. Anonymous. Interpretation manual of Europian Union habitats EUR 27. Europian commission DG environment. Nature and Biodiversity 2007; 11.
3. De-Silva SS, De-Silva CD. Coastal lagoons, in: Fernando C. H. (Eds.), Ecology and biogeography in Sri Lanka. W. Junk Publishers, The Hague, Netherlands 1984; 64.
4. Jayawickrema SJC. Status of fishery in the Chilaw estuary. J Natn Sci Coun, Sri Lanka 1992; 20(2):199-207.
5. Able KW. A re-examination of fish estuarine dependence: evidence for connectivity between estuarine and ocean habitats. Estuar Coast Shelf Sci 2005; 64:5–17.
6. Anonymous. Coastal environment management plan for the west coast of Sri Lanka. Preliminary survey and Interim action plan, ESCAP Bangkok 1985, 197.
7. FAO/ADB. Sri Lanka Fisheries Sector Study Report of the FAO/ADB Cooperate Program. FAO, Rome. 1998.
8. Joseph L. Coastal Fisheries and Brackishwater Aquaculture in Sri Lanka. Coastal resource management project, Colombo, Sri Lanka, 1993, 13.
9. Blaber SJM, Cyrus DP, Albaret JJ, Ching CV, Day JW, Elliott M. Effects of fishing on the structure and functioning of estuarine and nearshore ecosystems. ICES J Mar 2000; 57:590–602.
10. Vasconcelos RP, Reis-Santos P, Fonseca V, Maia A, Ruano M, Franc AS *et al*. Assessing anthropogenic pressures on estuarine fish nurseries along the Portuguese coast: a multi-metric index and conceptual approach. Sci Total Environ 2007; 274:199–215.
11. Boreman J. Methods for comparing the impacts of pollution and fishing on fish populations. Trans Am Fish Soc 1997; 26:506–513.
12. Pethiyagoda R. Freshwater fishes of Sri Lanka. Wildlife Heritage Trust, Sarvodhaya Vishvalekha Press Colombo 1991; 8(1):5-13
13. Deraniyagala PEP. A Coloured Atlas of Some

Vertebrates from Ceylon. Vol. 1. National Museum, Colombo, The Ceylon Government press 1952; 2:23-64.
14. Munro ISR. The marine and freshwater fishes of Ceylon. Department of external affairs, Canberra. 1955; 1:18-284
15. De-Bruln GHP, Russel BC, Bogussh A. The marine fishery resources of Sri Lanka. FAO species identification field guide for fishery purposes. Food and agricultural organization of the United Nations, Rome, 1994, 35.
16. Kuo SR, Lin HJ, Shao KT. Seasonal changes in abundance and composition of the fish assemblage in Chiku lagoon, South Western Taiwan. Bull Mar Sci 2001; 68(1):85-99
17. Jayasuriya PMA. The present status of fin fish and crustacean fishery of Puttalam lagoon. Journal of the Natural Aquatic Research Agency 1985; 32:94-103
18. Samaranayake RADB. Status and Prospects for Brackishwater Aquaculture in Sri Lanka. Journal Inland Fisheries, Vol. 3, Ministry of Fisheries, Sri Lanka, 1986.
19. Welcomme RL. Traditional brush park fisheries in natural waters. Fisheries Management and Ecology 2005; 9:141-157
20. Whitfield AK. Fishes and the environmental status of South African estuaries. Fish Manage Ecol 1996; 3:45-57.
21. Ranawana KB. 2012. Ecological study of mangroves on Panama, Okanda and Helawa lagoons in the east coast of Sri Lanka. Project Termination Report, IUCN/MFF Small Grant Program/2011.