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FRESHWATER POND ECOSYSTEMS AND ICHTHYOFAUNAL DIVERSITY OF LAKSHADWEEP ISLANDS, INDIA

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Abstract: The fresh water ecosystems and associated biodiversity of islands are special cases as they are tiny and isolated freshwater habitats in the middle of sea. The freshwater fish fauna of these island ecosystems are introduced over a period of time and are very little documented. Lakshadweep is an Archipelago under the union territories of India with an area of 32 sq. km and has 11 inhabited Islands, 12 atolls, 3 reefs and 5 submerged banks; located between 8°-12°13' North latitude and 71°-74° East longitude. The freshwater ecosystems and freshwater fish diversity of Lakshadweep islands were not surveyed or investigated till now. Hence a survey has been conducted during January to June, 2013 to document distribution of freshwater pond ecosystems and fish diversity of ten inhabited Islands of Lakshadweep. A total of 436 fresh water ponds were recorded in whole ten Islands. More number of ponds are in Kalpeni Island (90 numbers) followed by Amini (75), Agathi (54) and Kiltan (53). Bitra has least number of ponds with only eight ponds. Most of these ponds are square shaped man made ecosystems with a dimension of about 5 – 10 m^2, constructed near to mosques and the houses and are mainly used for human needs. There are two big ponds of about 25 m^2each in Amini and Kavaratti islands and one pond in Minicoy Island. In the present study 16 species of freshwater fishes were identified from Lakshadweep Islands. Of which, two species namely *Gambusia affinis* and *Poecilia reticulate* were found in all the ponds of surveyed islands whereas all of the sixteen species were found in Kavaratti Island. Tilapia, *Oreochromis mossambicus* were not found in the ponds which are used largely for human purposes and in any ponds of Bitra. Most of the species in Kavaratti were introduced recently after 2008 for aquarium purpose. Being the major freshwater resources, these ecosystems are the base for human settlement in these Islands. Most of the fish species are exotic and anticipated threats are to be forecasted realizing the need for protecting aquatic biodiversity of the area since all of these Islands are still in a stage of ecological succession. The proposed developmental activities such as construction of Airport may be a threat for these ecosystems and freshwater fish diversity. So it is recommended that to conduct strict impact assessments before starting such activit.

Key words: Island biodiversity, Pond ecosystem, Freshwater fishes, Lakshadweep

INTRODUCTION

The ecology and biodiversity of islands are influenced largely by the inhabiting fauna and flora of surrounding marine ecosystems. The freshwater ecosystems in the islands support the life of a variety of vertebrate and invertebrate species, introduced artificially or naturally over a period of time. Some of them are established reproducing populations such as introduced fishes in Pacific islands (Maciolek, 1984; Eldredge, 2000) and some others are still in a phase of succession. However, due to lack of accurate inventories, information on many of the fresh water fishes found in these Islands is inadequate (Pande *et al.*, 1991).

Studies on the freshwater fishes of Indian islands are scanty and most centered to Andaman and Nicobar group of Islands (Day 1870, 1875,1878; Mukarji, 1935; Herre, 1939,1941; Sen, 1975). The early contributions on freshwater fish fauna of Andaman Islands were fragmentary or restricted to a particular group. Talwar (1990) compiled information on the freshwater fish diversity of Andaman Islands. Recently, Palavai and Davidar (2009) surveyed 77 perennial streams and one perennial river in Andaman Islands and reported 17 species of freshwater fishes of which 11 were native to Andaman Islands.

Lakshadweep, the tiniest Union Territory of India is an archipelago comprising 36 Islands, situated in the Arabian Sea between 08°00'N and 12°30'N latitude and 71°00'E and 74°00'E longitude and at a distance of 220 - 440 km from the west coast of India. The lagoons and the

surrounding waters and corals reefs are replete with a wide variety of flora and fauna. Many studies were conducted to document the marine biodiversity of Lakshadweep islands (Jones and Kumaran, 1980; Pillai and Jasmine, 1989; Murty, 2002). However, studies on the freshwater ecosystems and diversity of freshwater fish species are lacking in Lakshadweep Islands, which is inevitable for the sustainable management and utilization of these resources. The present study is an attempt to assess the distribution of freshwater pond ecosystems and to document the diversity of freshwater fishes of Lakshadweep Islands.

MATERIALS AND METHODS

Study Sites

The survey was conducted in ten inhabited islands of Lakshadweep archipelago namely Kavaratti, Agatti, Kadmath, Kalpeni, Minicoy, Androth, Amini, Kiltan, Chetlet and Bitra (Fig. 1). Geographical positions of each island are given in Table.1.

Pond Survey and Specimen Collection

The survey was conducted during January to June 2013. Total number of ponds in each of ten Islands was recorded. Information about the history of ponds were collected from local people. Representative specimens of each fish species were collected from all freshwater ponds of each 10 Islands selected for the study using scoop net and gill net. Information on the introduction and establishment of each species were gathered from fisheries department as well as from local people associated with ponds.

Species Identification

Each specimen was identified up to species level using text books, monographs, reprints and online databases. The standard identification keys used included those of Day (1875), Munro (2000) and Froese and Pauly (2013).

RESULTS AND DISCUSSION

A total of 436 ponds were recorded in Lakshadweep islands. All ponds were constructed near to Mosques and houses and are used mainly for human needs. During the survey, it was realized that more number of ponds are in Kalpeni Island (90) followed by Amini (75), Agathi (54) and Kiltan (53) (Table. 2). Most of ponds are rectangle shaped small sized ones with a dimension of about 5x7 to 8x10 m. There are two big ponds of about 20x25 m in Amini and Kavaratti islands and one pond in Minicoy Island.

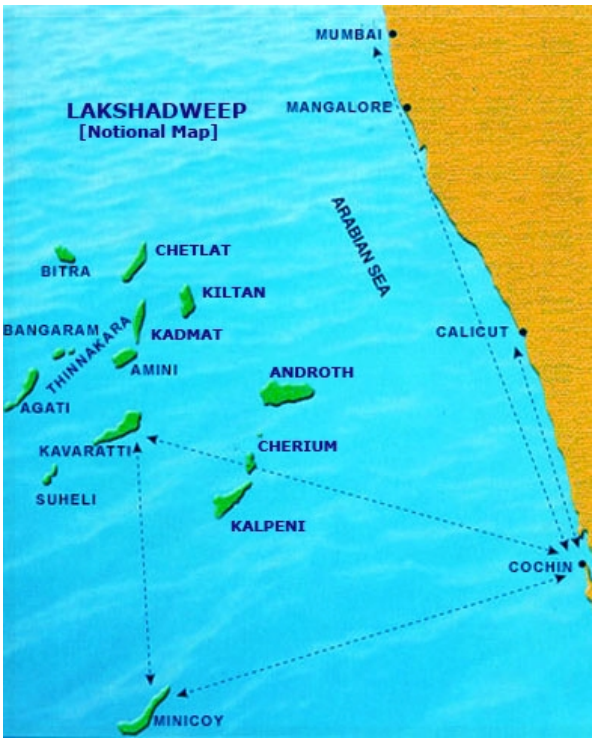

Fig. 1. Map of Lakshadweep islands showing study areas.

Table 1. Geographical positions of Study sites.

No.	Islands	GPS Location
1.	Kavarathi	10°33' N lat. & 72°38' E long.
2.	Agathi	10°51' N lat. & 72°11' E long.
3.	Amini	11°7' N lat. & 72°44' E long.
4.	Androth	10°49' N lat. & 73°41' E long.
5.	Chethleth	11°41' N lat. & 72°43' E long.
6.	Bitra	11°36' N lat. & 72°48' E long.
7.	Kadmath	11°13' N lat. & 72°48' E long.
8.	Kiltan	11°29' N lat. & 73°00' E long.
9.	Kalpeni	10°33' N lat. & 72°38' E long.
10.	Minicoy	08°17' N lat. & 73°04' E long.

Table 2. Distribution of freshwater ponds in Lakshadweep islands.

Sl No.	Island	Large ponds	Small ponds	Total
1	Agathi	0	54	54
2	Amini	2	73	75
3	Androth	0	41	41
4	Bitra	0	8	8
5	Chethleth	0	29	29
6	Kadmath	0	43	43
7	Kalpeni	0	90	90
8	Kiltan	0	53	53
9	Kavarathi	2	30	32
10	Minicoy	1	10	11

None of the Lakshadweep islands have rivers or creaks but one among the two large ponds of Kavarathi is a brackish water pond. A brackish water pond is situating in the southern part of the Minicoy Island also. These were formed during the process of growth of the island where the outlet of the bay has been blocked by sand and later modified as brackish water ponds. Being the major freshwater resources, these pond ecosystems are the base for human settlement in these Islands. The proposed developmental activities such as construction of Airport may be a threat for these ecosystems and freshwater fish diversity. So it is recommended that to conduct strict impact assessments before starting such activities.

In the present study 16 species of freshwater fishes were identified under 5 orders, 6 families and 14 genera (Table. 3). Most of the fishes were under the order Cyprinodontiformes and Perciformes (5 species each) followed by Cypriniformes (4 species), Siluriformes and Characiformes (1 species each) (Fig. 2). Three species namely Tilapia *(Oreochromis mossambicus)* (Peters, 1852), Mosquito fish *(Gambusia affinis)* (Baird and Girard, 1853) and Guppy (*Poecilia reticulata)* (Peters, 1859) are common in all over Lakshadweep islands. Other 13 species are found only in Kavaratti island along with these three species (Table. 3) and were not introduced in ponds and are stocked household earthen or concrete tanks. Mosquito fish and Guppies were found common in almost all ponds of all the ten islands surveyed whereas Tilapia was not found common in all ponds and is entirely absent in Bitra island (Fig. 3).

Most of the freshwater fish species in Lakshadweep islands are exotic, introduced for various purposes over a period of time. Tilapia was introduced in Lakshadweep islands for stocking in ponds associated with Mosques. Mosquito fish and Guppies were introduced by the health department for mosquito controll in all the islands. Mullet, Indian major carps and Etroplus were introduced in the ponds of Kavaratti for the purpose of aquaculture on experimental basis. It has been come to know that these fishes were introduced recently only after the year 2008. Details of fish introductions are given in Table 3.

Most fish introductions in islands were associated with aquaculture; commercial and sport fishing, the ornamental fish trade,

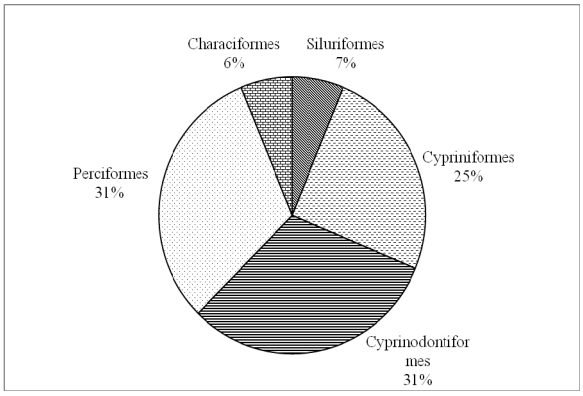

Fig. 2. Species diversity of freshwater fish orders of Lakshadweep islands

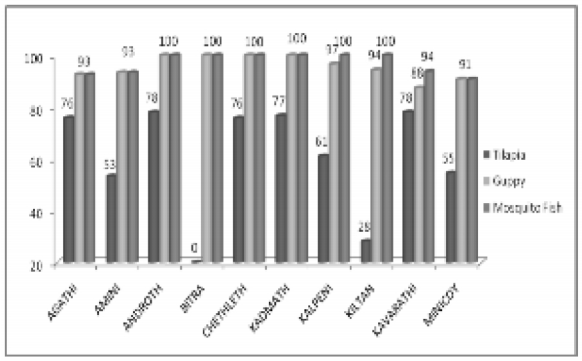

Fig. 3. Percentage of ponds with freshwater fishes in Lakshadweep islands

Table 3. Classifies list of freshwater fishes in Lakshadweep islands

Sl. No.	Species	Common name	Distribution	Mode/purpose of Introduction
1	**Order: Siluriformes** **Family: Clariidae** *Heterobranchus bidorsalis* Geoffroy Saint-Hilaire, 1809	African Catfish	Kavaratti only	Introduced during 2010 by a private person
2	**Order: Cypriniformes** **Family: Cyprinidae** *Carassius auratus auratus* (Linnaeus, 1758)	Goldfish	Kavaratti only	Introduced through Aquarium Industry
3	*Catla catla* (Hamilton, 1822)	Catla	Kavaratti only	Introduced by fisheries department during 2009 for aquaculture
4	*Cirrhinus cirrhosus* (Bloch, 1795)	Mrigal carp	Kavaratti only	Introduced by fisheries department during 2009 for aquaculture
5	*Labeo rohita* (Hamilton, 1822)	Roho labeo	Kavaratti only	Introduced by fisheries department during 2009 for aquaculture
6	**Oredr: Cyprinodontiformes** **Family: Poeciliidae** *Gambusia affinis* (Baird & Girard, 1853)	Mosquito fish	All islands	Introduced for Mosquito control by health department
7	*Poecilia reticulata* Peters, 1859	Guppy	All islands	Introduced for Mosquito control by health department
8	*Poecilia sphenops* Valenciennes, 1846	Molly	Kavaratti only	Introduced through Aquarium Industry
9	*Xiphophorus hellerii* Heckel, 1848	Green swordtail	Kavaratti only	Introduced through Aquarium Industry
10	*Xiphophorus maculatus* (Ganther, 1866)	Southern platyfish	Kavaratti only	Introduced through Aquarium Industry
11	**Order: Perciformes** **Family: Cichlidae** *Astronotus ocellatus* (Agassiz, 1831)	Oscar	Kavaratti only	Introduced through Aquarium Industry
12	*Etroplus suratensis* (Bloch)	Green chromide, Pearl spot	Kavaratti only	Introduced by fisheries department for aquaculture
13	*Oreochromis mossambicus* (Peters, 1852)	Mozambique tilapia	All islands except Bitra	Introduced for Stocking in Ponds associated with Mosques
14	*Pterophyllum scalare* (Schultze, 1823)	Freshwater Angel fish	Kavaratti only	Introduced through Aquarium Industry
15	**Family: Osphronemidae** *Colisa lalia*	Dwarf gourami	Kavaratti only	Introduced through Aquarium Industry
16	**Oredr: Characiformes** **Family: Characidae** *Gymnocorymbus ternetzi* (Boulenger, 1895)	Black tetra	Kavaratti only	Introduced through Aquarium Industry

biological control, and research; some were intentional and others accidental (Maciolek, 1984). The most widely introduced fish families in islands are Cichlidae and Poeciliidae (Nico and Walsh, 2011). Over 95% of existing anchialine pools of Hawaii islands are invaded primarily by poeciliids and tilapia (Yamamoto and Tagawa, 2000). Similar phenomenon was observed in Andaman and Nicobar islands (Palavai and Davidar, 2009) and the common species observed from Lakshadweep islands in this study are also same.

The anticipated threats of exotic species are to be forecasted realizing the need for protecting aquatic biodiversity of the area since all of these

Islands are still in a stage of ecological succession. The introductions of freshwater fish species to island ecosystems have led to marked and often repeated changes to insular aquatic faunas (Jenkins *et al*. 2009), with effects that have often been variable and unanticipated. For instance, the introduction of Mozambique tilapia (*Oreochromis mossambicus*) on many Pacific islands led to the near disappearance of traditional milk fish (*Chanos chanos*) culture (Nelson and Eldredge, 1991; Spennemann, 2002; Jenkins *et al.* 2009).

Earlier studies in the mainland of India indicate that introduction of exotic fishes like Tilapia had replaced the native fish fauna in many freshwater ecosystems (Bijukumar, 2000). The Mosquito fish (*Gambusia*) and Guppy introduced to India may also have negative impacts on aquatic biodiversity. The Mosquito fish are prolific breeders and are capable of entering into the microhabitats of rare, native species and are, in many instances, reported as predators (Rinne, 1995). There have been periodic attempts to eradicate some populations in Pacific Islands (Kolar *et al*. 2010). However, there are no attempts for eradication of these species in Lakshadweep Islands. Since there is no other native species in the Lakshadweep islands, there is no report on any threats. But there is an urgent need for introduction of more species of aquaculture importance by replacing these exotic species in order to supplement the marine fish food by promoting freshwater aquaculture.

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