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Fishes from Tamiraparani river system, Tamil Nadu

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ABSTRACT

Streams and rivers originating from Western Ghats have been conferred with diverse fish fauna. Owing to the diverse ichthyofauna, the present investigation was designed to study species diversity, distribution, diversity indices, human use pattern and conservation status of fishes in four fragments of Tamiraparani river system. Altogether, 125 fish species belonging to 13 orders, 44 families and 73 genera were identified from upstream, midstream and lower estuary of Tamiraparani river. In total, 66 fish species were recorded from Vannarapettai, 63 species from Manimuthar, 58 species from Srivaikundam and 53 species from Punnakayal estuary. Cypriniformes (43 species) was the order with diverse species composition and Cyprinidae was the most dominated group represented by 39 species. The river supports 64% food fish, 25.6% ornamental fish and 10.4% ornamental as well as food fish. Out of 125 species, six species were endangered and four vulnerable. Calculated values for various diversity indices were observed on higher side. Our study indicated that the Tamiraparani river system supports highly diverse fish fauna.

Key words: Conservation status, Diversity indices, Fish Fauna, Tamiraparani river system

Tamil Nadu is endowed with rich aquatic resources in the form of streams, rivers, canals (7400 km), major reservoirs (52000 ha), Irrigation tanks (98000 ha) and estuaries (56000 ha) (De 2011, Government of Tamil Nadu 2015). Streams and rivers originating from Western Ghats have been conferred with diverse fish germplasm resources (Johnson and Arunachalam 2009, Mogalekar and Jawahar 2015, Qayoom *et al.* 2018). Cauvery, Vaigai, Tamiraparani, Periyar and Pennar are some of the important rivers of Tamil Nadu which discharge freshwater into Bay of Bengal through the various estuaries (Mogalekar *et al.* 2017). Comprehensive studies on the distribution and diversity of fishes in the Tamiraparani river system especially from upstream to estuarine section is lacking. In view of the paucity of such information, a study was done to investigate the distribution and diversity of fishes in the four different localities of Tamiraparani river system from Manimuthar to Punnakayal.

Tamiraparani river is a perennial river of southern Tamil Nadu and has been mentioned as the Porunai Nathi in Sanskrit literature. The river originates from the peak of Periyapothigai hills above Papanasam along the eastern slope of Western Ghats in the Tirunelveli district of Tamil Nadu. Tamiraparani river basin lies within 08° 82 and 09° 232 N latitude and 77° 092 and 77° 542 E longitude. It traverses to a length of 120 km through Tirunelveli district about 80 km including 24 km in Western Ghat hills and 40 km in Thoothukudi district and finally it confluences in Bay of Bengal at Punnaikayal village of Thoothukudi district. The catchment area of Tamiraparani with tributaries is 4536 km^2. As most of its catchment areas lie in the Western Ghats, river has benefit of both the monsoons, which make it perennial. The annual yield from the river basin is estimated at 48487 million cubic feet. Reservoirs constructed across the river basin are Papanasam, Servalar, Manimuthar, Gadana, Ramanadhi, Karuppanadhi, Gundar, Adavinainar and Vadakku Pachaiyar. It forms a delta in Punnakayal village of Thoothukudi district before out-falling into Gulf of Mannar along Bay of Bengal. The area of the delta is 140.93 km^2 (Government of Tamil Nadu 2015).

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MATERIALS AND METHODS

Fish sampling was done from June 2015 to May 2016 in four different habitats of Tamiraparani river system, viz. Manimuthar dam and its up-stream waters, Vannarapettai midstream, Srivaikundam dam and Punnakayal estuary in 500 m reach of study sites with the help of local fishermen as well as by survey team. Summary of study sites including location (Latitude, longitude and elevation), habitat, general feature, fishing depthand distance covered for sampling are given in Table 1. Species collection, identification, confirmation and preservation was carried out using available literature (Talwar and Kacker 1984, Talwar and Jhingran 1991, Jayaram 2010, Eschmeyer *et al.* 2016, Mogalekar 2017). The check list was prepared, fishes were categorized into food or ornamental based on the utilization,

Table 1. Summary of sampling sites in Tamiraparani river system, Tamil Nadu

Sampling site	Latitude and longitude (Elevation)	Habitat	Description of sampling site, fishing depth, distance covered for sampling
Manimutthar (S1)	8°37'09.10"–8°38'40.96"N and 77°23'44.87"–77°24'32.07"E (107 to 102 m)	Dam and Upstream-river	One of the major dam on Tamiraparani river in Tirunelveli district with total catchment area of 920 ha. The depth of the dam is about 110 feet and depth of fishing varied from 10–50 feet.
Vannarapettai (S2)	8°43'44.94"–8°44'00.27"N and 77°42'56.11"–77°43'01.52"E (34 to 32 m)	Midstream-river	Major fish landing centre on the Tamiraparani river in Tirunelveli. The depth of fishing ranged from 15–30 feet.
Srivaikundam (S3)	8°37'49.30"–8°37'35.49"N and 77°54'29.95"–77°54'38.83"E (19 to 13 m)	Dam and Midstream-river	Major fish landing centre on the Tamiraparani river system in Thoothukudi district. Depth of the fishing varied from 5–20 feet.
Punnakayal (S4)	8°37'41.63"–8°37'40.66"N and 78°07'07.93"–78°07'23.03"E (0 m)	Downstream estuary	The river Tamiraparani drains into Punnakayal estuary in Thoothukudi district. The estuary is characterised by muddy flats and mangrove forests. Depth of fishing was 5–15 Feet.

and conservation status was assessed as per IUCN red list category (IUCN2016). Meteorologically, the whole study period was classified as south-west monsoon (June to September, 2015), post-monsoon (October to December, 2015), north-east monsoon (January to February, 2016) and pre-monsoon (March to May, 2016) (Government of Tamil Nadu, 2015). Total numbers of fishes were recorded on monthly basis from the four sampling stations. Seasonal species abundance data was calculated by taking average value of monthly fish abundance data. Seasonal species abundance data used as input data for the calculation of biodiversity indices such as Shannon Wiener species diversity (H'), Margalef's species richness ('d'), Pielou's species evenness (J'), taxonomic diversity (Δ), variation in taxonomic distinctness (Lambda+) by using PRIMER V6 (Plymouth Routine in Multivariate Ecological Research) software.

RESULTS AND DISCUSSION

Systematic classification of fishes recorded in the Tamiraparani river system with note on human use and conservation status are given in Table 2. The recorded 125 species belong to 13 orders, 44 families and 73 genera. Seventy two species were recorded from freshwater habitat of river and remaining 53 species were from estuarine habitat. In total 66 species of fishes belonging to 7 orders, 22 families and 38 genera were recorded from midstream of Tamiraparani river at Vannarapettai, 63 species of fishes belonging to 6 order, 15 families and 32 genera from upstream of Tamiraparani river in and around Manimuthar Dam, 58 species belonging to 8 orders, 19 families and 33 genera from Srivaikundam dam and 53 species belonging to 10 orders, 31 families and 39 genera from Punnakayal Estuary. The top three orders with diverse species composition were Cypriniformes (43 species, 19 genera and 4 families), Perciformes (36 species, 23 genera and 17 families) and Siluriformes (19 species, 8 genera and 6 families). The most diverse family was the Cyprinidae with 39 species and 16 genera, followed by Bagridae with 6 species and 1 genera, and Carangidae with 5 species and 3 genera (Table 2).

Study on fish diversity of Tamiraparani river system is the first of its kind and revealed presence of 125 species contributing about 86.80% of total freshwater fish diversity (Devi and Indra 2000) and about 80.12% of freshwater ornamental fish diversity published from Tamil Nadu (Mogalekar and Jawahar 2015). The number of fishes observed in Tamiraparani river system was greater than that given in earlier reports from Tamil Nadu by Devi *et al.* (2007), Johnson and Arunachalam (2009), Ramanujam *et al.* (2014) which might be attributed to limited study areas. All the above reports agreed with dominance of cyprinids over other freshwater fish families. The fishes recorded in the present study were lesser than a recent report by Mogalekar and Jawahar (2015) from Tamil Nadu. Present record of 53 fish species from Punnakayal Estuary is lesser than earlier reports from estuaries of Tamil Nadu by Ramanujam and Anbarasan (2008), Ramanujam *et al.* (2014), Bharadhirajan *et al.* (2015), Khan (2015), Pavinkumar *et al.* (2015). Due to non-availability of literature on fish diversity Tamiraparani river effective comparison in rate of decline in fish diversity is not possible but the present report would serve as baseline information for future fish diversity studies.

A list of fishes of Tamiraparani river system comprises of 80 species with food value, 32 species with ornamental value and 13 species could be used for both ornamental as well as food (Table 2). Among the species listed under

Table 2. Fish diversity of Tamiraparani river system with note on human use and conservation status

Taxa	Distribution	Human Use	IUCN Status
Order: Anguilliformes			
Family: Anguillidae			
Anguilla bengalensis (Gray, 1831)	S1, S2, S3	Food	NT
Anguilla bicolor McClelland, 1844	S3, S4	Food	NT
Family: Congridae			
Conger cinereus Rüppell, 1830	S4	Food	NE
Order: Beloniformes			
Family: Adrianichthyidae			
Oryzias dancena (Hamilton, 1822)	S2, S3	Ornamental	LC
Family: Belonidae			
Xenentodon cancila (Hamilton, 1822)	S2, S3	Ornamental, Food	LC
Strongylura strongylura (van Hasselt, 1823)	S4	Ornamental, Food	LC
Tylosurus crocodilus (Péron and Lesueur, 1821)	S4	Food	NE
Family: Hemiramphidae			
Hyporhamphus limbatus (Valenciennes, 1847)	S2, S3	Food	LC
Hemiramphus marginatus (Forsskål, 1775)	S4	Food	NE
Order: Clupeiformes			
Family: Clupeidae			
Ehirava fluviatilis Deraniyagala, 1929	S3, S4	Food	NE
Nematalosa nasus (Bloch, 1795)	S4	Food	LC
Tenualosa ilisha (Hamilton, 1822)	S4	Food	LC
Family:Engraulidae			
Stolephorus commersonnii Lacepède, 1803	S4	Food	NE
Stolephorus indicus (van Hasselt, 1823)	S4	Food	NE
Order: Cypriniformes			
Family:Balitoridae			
Bhavania australis (Jerdon, 1849)	S1, S2	Ornamental	LC
Family: Cobitidae			
Lepidocephalichthys guntea (Hamilton, 1822)	S1, S2, S3	Ornamental	LC
Lepidocephalichthys thermalis (Valenciennes, 1846)	S1, S2, S3	Ornamental	LC
Family: Nemacheilidae			
Nemacheilus triangularis Day, 1865	S1, S2	Ornamental	LC
Family: Cyprinidae			
Amblypharyngodon microlepis (Bleeker, 1853)	S2, S3	Ornamental	LC
Cirrhinus cirrhosis (Bloch, 1795)	S1, S2, S3	Food	VU
Cirrhinus macrops Steindachner, 1870	S1, S2, S3	Food	NE
Cirrhinus mrigala (Hamilton, 1822)	S1, S2, S3	Food	LC
Ctenopharyngodon idella (Valenciennes, 1844)	S1, S2, S3	Food	NE
Cyprinus carpio Linnaeus, 1758	S1, S2, S3	Food	VU
Dawkinsia arulius (Jerdon, 1849)	S1, S2	Ornamental	EN
Dawkinsia filamentosa (Valenciennes, 1844)	S1, S2	Ornamental	LC
Dawkinsia tambraparniei (Silas, 1954)	S1, S2	Ornamental	EN
Dawkinsia rohani (Rema Devi, Indra and Knight, 2010)	S1, S2	Ornamental	VU
Devario aequipinnatus (McClelland, 1839)	S1, S2, S3	Ornamental	LC
Devario malabaricus (Jerdon, 1849)	S1, S2	Ornamental	LC
Esomus danricus (Hamilton, 1822)	S1	Ornamental	LC
Garra mullya (Sykes, 1839)	S1	Ornamental	LC
Garra kalakadensis Rema Devi, 1993	S1	Ornamental	EN
Catla catla (Hamilton, 1822)	S1, S2, S3	Food	LC
Hypselobarbus curmuca (Hamilton, 1807)	S1	Food	EN
Hypselobarbus dobsoni (Day, 1876)	S1	Food	DD
Hypselobarbus dubius (Day, 1867)	S1	Food	EN
Hypselobarbus kolus (Sykes, 1839)	S1	Food	VU
Labeo calbasu (Hamilton, 1822)	S1, S2, S3	Food	LC
Labeo dyocheilus (McClelland, 1839)	S1, S2, S3	Food	LC
Labeo fimbriatus (Bloch, 1795)	S1, S2, S3	Food	LC
Labeo kontius (Jerdon, 1849)	S1, S2, S3	Food	LC
Labeo pangusia (Hamilton, 1822)	S1, S2, S3	Food	NT

(*Table 2. Contd...*)

Taxa	Distribution	Human Use	IUCN Status
Labeo rohita (Hamilton, 1822)	S1, S2, S3	Food	LC
Pethia ticto (Hamilton, 1822)	S1, S2, S3	Ornamental	LC
Puntius sophore (Hamilton, 1822)	S2, S3	Ornamental	LC
Puntius amphibius (Valenciennes, 1842)	S2, S3	Ornamental	DD
Puntius bimaculatus (Bleeker, 1863)	S2, S3	Ornamental	LC
Puntius chola (Hamilton, 1822)	S2, S3	Ornamental	LC
Puntius dorsalis (Jerdon, 1849)	S1, S2, S3	Ornamental	LC
Puntius melanostigma (Day, 1878)	S1	Ornamental	NE
Puntius vittatus Day, 1865	S1, S2, S3	Ornamental	LC
Rasbora daniconius (Hamilton, 1822)	S1, S2	Ornamental	LC
Rasbora dandia (Valenciennes, 1844)	S1	Ornamental	NE
Salmostomabacaila (Hamilton, 1822)	S2, S3	Ornamental, Food	LC
Salmophasia untrahi (Day, 1869)	S2, S3	Ornamental, Food	LC
Systomus sarana (Hamilton, 1822)	S1, S2, S3	Ornamental, Food	LC
Order: Cyprinodontiformes			
Family: Aplocheilidae			
Aplocheilus lineatus (Valenciennes, 1846)	S1, S2, S3	Ornamental	LC
Aplocheilus parvus (Sundara Raj, 1916)	S1, S2, S3	Ornamental	NE
Family: Poeciliidae			
Gambusia affinis (Baird and Girard, 1853)	S2, S3	Ornamental	LC
Order: Elopiformes			
Family: Elopidae			
Elops machnata (Forsskål, 1775)	S4	Food	LC
Order: Gonorhynchiformes			
Family: Chanidae			
Chanos chanos (Forsskål, 1775)	S4	Food	NE
Order: Mugiliformes			
Family: Mugilidae			
Chelon parsia (Hamilton, 1822)	S4	Food	NE
Mugil cephalus Linnaeus, 1758	S4	Food	LC
Order: Perciformes			
Family: Acanthuridae			
Acanthurus mata (Cuvier, 1829)	S4	Food	LC
Family: Ambassidae			
Chanda nama Hamilton, 1822	S2, S3, S4	Food	LC
Parambassis ranga (Hamilton, 1822)	S2, S3, S4	Food	LC
Family: Anabantidae			
Anabas testudineus (Bloch, 1792)	S2, S3	Food	LC
Family:Carangidae			
Carangoides ferdau (Forsskål, 1775)	S4	Food	NE
Caranx ignobilis (Forsskål, 1775)	S4	Food	NE
Caranx sexfasciatus Quoy and Gaimard, 1825	S4	Food	LC
Scomberoides tol (Cuvier, 1832)	S4	Food	NE
Scomberoides commersonnianus Lacepède, 1801	S4	Food	NE
Family:Channidae			
Channa orientalis Bloch and Schneider, 1801	S2, S3	Food	NE
Channa punctata (Bloch, 1793)	S1, S2, S3, S4	Food	LC
Channa striata (Bloch, 1793)	S1, S2, S3	Food	LC
Family:Cichilidae			
Etroplus maculatus (Bloch, 1795)	S1, S2, S3, S4	Ornamental, Food	LC
Etroplus suratensis (Bloch, 1790)	S1, S2, S3, S4	Ornamental, Food	LC
Oreochromis mossambicus (Peters, 1852)	S1, S2, S3, S4	Food	NT
Oreochromis niloticus (Linnaeus, 1758)	S1, S2, S3	Food	NE
Family: Gerreidae			
Gerres filamentosus Cuvier, 1829	S4	Food	LC
Gerres setifer (Hamilton, 1822)	S4	Food	NE
Family: Gobiidae			
Glossogobius giuris (Hamilton, 1822)	S1, S2, S3	Ornamental, Food	LC

(*Table 2. Contd...*)

Taxa	Distribution	Human Use	IUCN Status
Acentrogobius ennorensis Menon and Rema Devi, 1980	S4	Food	NE
Family:Leiognathidae			
Leiognathus brevirostris (Valenciennes, 1835)	S4	Food	NE
Secutor insidiator (Bloch, 1787)	S4	Food	NE
Family: Lutjanidae			
Lutjanus argentimaculatus (Forsskål, 1775)	S4	Food	NE
Lutjanus johnii (Bloch, 1792)	S4	Food	NE
Family:Mullidae			
Upeneus moluccensis (Bleeker, 1855)	S4	Food	NE
Family:Osphronemidae			
Pseudosphromenus cupanus (Cuvier, 1831)	S2	Ornamental	LC
Family: Scatophagidae			
Scatophagus argus (Linnaeus, 1766)	S4	Food	LC
Family:Serranidae			
Epinephelus diacanthus (Valenciennes, 1828)	S4	Food	NT
Epinephelus malabaricus (Bloch and Schneider, 1801)	S4	Food	NT
Family:Sillaginidae			
Sillago sihama (Forsskål, 1775)	S4	Food	NE
Sillago vincenti McKay, 1980	S4	Food	NE
Family:Siganidae			
Siganus canaliculatus (Park, 1797)	S4	Food	NE
Siganus javus (Linnaeus, 1766)	S4	Food	NE
Siganus lineatus (Valenciennes, 1835)	S4	Food	NE
Family:Teraponidae			
Terapon jarbua (Forsskål, 1775)	S4	Food	LC
Terapon puta Cuvier, 1829	S4	Food	NE
Order: Pleuronectiforms			
Family: Cynoglossidae			
Cynoglossus arel (Bloch and Schneider, 1801)	S4	Food	NE
Family: Soleidae			
Brachirus orientalis (Bloch and Schneider, 1801)	S4	Food	NE
Order: Siluriformes			
Family: Ariidae			
Arius arius (Hamilton, 1822)	S4	Food	LC
Arius jella Day, 1877	S4	Food	NE
Arius maculatus (Thunberg, 1792)	S4	Food	NE
Arius subrostratus Valenciennes, 1840	S4	Food	NE
Family:Bagridae			
Mystus bleekeri (Day, 1877)	S1, S2, S3	Food	LC
Mystus cavasius (Hamilton, 1822)	S1, S2, S3	Food	LC
Mystus gulio (Hamilton, 1822)	S1, S2, S3, S4	Food	LC
Mystus malabaricus (Jerdon, 1849)		Ornamental	NT
Mystus oculatus (Valenciennes, 1840)	S1, S2, S3	Food	LC
Mystus vittatus (Bloch, 1794)	S1, S2, S3	Ornamental, Food	LC
Family: Clariidae			
Clarias batrachus (Linnaeus, 1758)	S1, S2, S3, S4	Food	LC
Clarias gariepinus (Burchell 1822)	S1, S2, S3	Food	LC
Family: Heteropneustidae			
Heteropneustes fossilis (Bloch, 1794)	S1, S2, S3	Food	LC
Heteropneustes longipectoralis Devi and Raghunathan, 1999	S1	Ornamental, Food	DD
Family: Schilbeidae			
Neotropius atherinoides (Bloch, 1794)	S1, S2	Ornamental, Food	LC
Family:Siluridae			
Ompok bimaculatus (Bloch, 1794)	S1, S2, S3	Food	NT
Ompok malabaricus (Valenciennes, 1840)	S1	Food	LC
Pterocryptis wynaadensis (Day, 1873)	S1	Food	EN
Wallago attu (Bloch and Schneider, 1801)	S1, S2, S3	Food	NT
Order: Synbranchiformes			
Family:Mastacembelidae			

(*Table 2. Contd...*)

Taxa	Distribution	Human Use	IUCN Status
Macrognathus aral (Bloch and Schneider, 1801)	S1, S2, S3	Ornamental, Food	LC
Mastacembelus armatus (Lacepède, 1800)	S1, S2, S3	Ornamental, Food	LC
Order: Tetrodotiformes			
Family: Triacanthidae			
Triacanthus biaculeatus (Bloch, 1786)	S4	Ornamental	NE
Family: Tetrodontidae			
Arothron leopardus (Day, 1878)	S4	Ornamental	NE

S1, Manimutthar dam and its up-stream waters; S2, Vannarapettai; S3, Srivaikundam; S4, Punnakayal estuary. EN, Endangered; VU, Vulnerable; NT, Near threatened; LC, Least Concern; DD, Data Deficient; NE, Not Evaluated.

threatened category, 6 species are endangered while 4 species are vulnerable. There are 115 species under the non-threatened category, among which 9 are near threatened, whereas 64 species belonged to least concern category, 3 species were data deficient and 39 species have not been evaluated against IUCN criteria (Table 2).

Calculated values for various diversity indices presented in Table 3. The Shannon Wiener diversity index (H') values were found to be on higher side and varied from 4.76 during north-east monsoon to 4.72 during pre-monsoon. The maximum value of Margalef richness index (d) was 21.89 also recorded during the north-east monsoon season. However the minimum value was 21.76 recorded during the post-monsoon season. The maximum value of Pielou's evenness index (J') was 0.9929 recorded during north-east monsoon and the minimum value of 0.9896 during pre-monsoon season. The taxonomic diversity index (D) calculated during the various seasons varied from86.55 during south-west monsoon to 86.24 during pre-monsoon. Variation in taxonomic distinctness (Lambda+) was maximum (536) during north-east monsoon, while minimum value (508.9) observed during south-west monsoon.

According to calculated values of Shannon Wiener diversity index and Margalef richness index ecological status of fishes in Tamiraparani river system was rich. Calculated values for Pielou's evenness index were observed on higher side. Thus, it could be inferred that the species evenness is high which might be due to representation of individual species in evenly nature and not dominated by individual species. Higher values of taxonomic diversity index suggest that, the species in the assemblage were distantly related. In the absence of literature on fish diversity indices in Tamiraparani River system effective comparison of diversity indices estimates could not possible.

Table 3. Diversity indices of finfishes in Tamiraparani river system recorded during different seasons.

Index/Season	South-west monsoon	North-east monsoon	Post monsoon	Pre monsoon
S	118	121	118	118
N	212	240	216	215
H'($\log_e$)	4.733		4.762	4.731
4.721				
d	21.84	21.89	21.76	21.79
J'	0.9921	0.9929	0.9918	0.9896
Delta	86.55	86.47	86.39	86.24
Lambda+	508.9	536	531.8	531.6

S, Number of species; N, Number of individuals; H'($\log_e$), Shannon Wiener species diversity; d, Margalef species richness; J', Pielou's species evenness; Delta, Taxonomic diversity; Lambda+, Variation in taxonomic distinctness.

The fish fauna of Tamiraparani river system is highly diverse and setting up of a local level management body is vital for the conservation and proper management of the fish biodiversity.

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