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Inventory of fishes of Gangavali estuary in Uttara Kannada, Karnataka state

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Original Article

Abstract

Observation of the fish specimens and hydrological parameters were made from June 2011 to May 2012 at Gangavali estuary (Uttara Kannada district). The fish samples were collected from the cast-net hauls of local fishermen at the estuarine mouth zone at Gangavali station, mid-estuary zone of Ulvare, and upstream zone of Shirgunji station, representing respectively high, medium and low salinity fish zones of the estuary. Altogether 54 fish species belonging to 39 families, 14 orders were recorded. The order Perciformes had the highest representation (34 sp.), followed by Clupeiformes (5 sp.), Pleuronectiformes, Tetraodontiformes (2 sp.), Mugiliformes (2 sp.), and Myliobatiformes, Synbranchiformes, Anguilliformes, Batrachoidiformes, Beloniformes, Carcharhiniformes, Rajiformes, Scorpaeniformes and Siluriformes with one species each. The inventory has been attempted for the first time for this estuary.

Key words: *Uttara Kannada, gangavali, estuary, fish diversity.*

Introduction

Estuaries are traditionally associated with rich fishery resources, being the potential sources for feeding, spawning and nursery ground for most of the finfishes and shellfishes (Beck *et al.*, 2001, Brinda *et al.*, 2010). Tropical estuarine areas free from major developmental projects are well known for their extremely productive fisheries (Mahima *et al.*, 2014b). The current study is an attempt to bring out the fish diversity of Gangavali, a tropical estuary in Uttara Kannada district of Karnataka state, southwest India, unaffected by dams or other major developmental projects. The Gangavali River originating in central Western Ghats after winding its way through valleys and gorges of the hilly terrain meets the Arabian Sea in between the coastal towns of Gokarna in the south and Ankola in the north. The high tide travels up to the village Gundbale 24 km upstream in the river especially in the hot summer months of March to May. Fish fauna of this estuary of humid tropical Indian west coast, adjoining the Western Ghats, one of the global biodiversity hotspots, was poorly known before the current study. The documentation has been carried out as a benchmark study in the backdrop of mounting human impacts on the coastal ecosystems of the region.

Material and methods

Three stations were established in the 558 ha sized estuary at Gangavali (Station 1), Ulvare (Station 2) and Shirgunji (Station 3)-progressively upstream at 1.7 km, 8 km and 17 km respectively (Fig. 1).

Fish samples were collected monthly during June 2011 to May 2012 using cast-net hauls with the help of local fishermen. During each sampling session, catches from five consecutive hauls of the cast-net were monitored from each of the three fish landing stations. The fish specimens collected were identified using standard keys by Jayaram (1984), Day (1889), Talwar and Jhingran (1991), Munro (2000) and fishbase website (www.fishbase.org). The fishes were photographed, labeled and preserved in 70% alcohol. The important hydrological parameters *viz*, salinity was measured using EXTECH EC400 refractometer, the same was occasionally compared with Mohr-Knudsen method as described by Strickland and Parsons (1972). Dissolved oxygen (DO), was measured by Winkler's method as described by Strickland and Parsons (1972). pH and temperature were recorded using portable Extech digital meter.

Results

A total of 54 fish species belonging to 39 families 14 orders were recorded during the study period (Table 1). The order Perciformes with 34 numbers of species was more well represented (63%). The rest were in lesser numbers: Clupeiformes 5 sp. (10%), Pleuronectiformes, Tetraodontiformes and Mugiliformes 2 sp. (5%) and Myliobatiformes, Synbranchiformes, Anguilliformes, Batrachoidiformes, Beloniformes, Carcharhiniformes, Rajiformes, Scorpaeniformes and Siluriformes with one species each. Voucher specimens are deposited in the scientific collections of fish species maintained at the Kumta Field Station

Table 1. Order-wise numbers of fish species from Gangavali estuary

Order	Number of species
Perciformes	34
Clupeiformes	5
Pleuronectiformes	2
Tetraodontiformes	2
Mugiliformes	2
Myliobatiformes	1
Synbranchiformes	1
Anguilliformes	1
Batrachoidiformes	1
Beloniformes	1
Carcharhiniformes	1
Rajiformes	1
Scorpaeniformes	1
Siluriformes	1

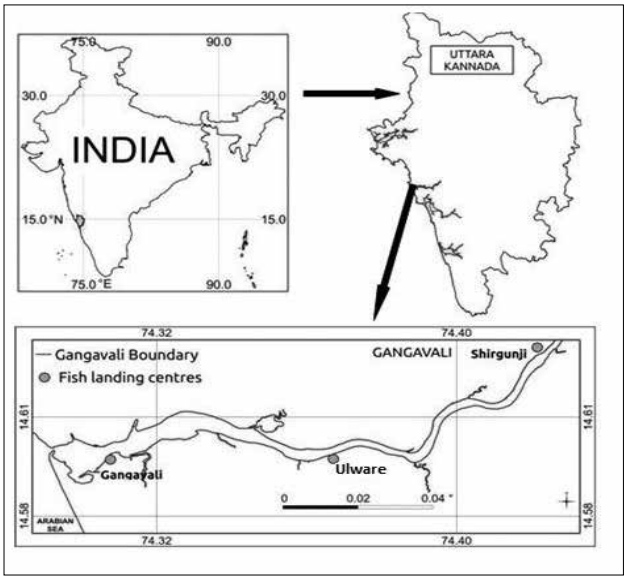

Fig.1. Gangavali river with fish landing centres

of the Centre for Ecological Sciences of the Indian Institute of Science, Bangalore and are accessible to the public. Details of the voucher specimens, with institutional catalogue numbers are given in the Table 2. Station 1 nearest to the sea had the highest diversity as all the 54 species occurred in this high salinity zone at one time or the other. The mid estuary station 2 had 44 species and the most upstream station 3 had 40 species. *Carangoides praeustus, Glaucostegus halavi, Megalaspis cordyla, Stolephorus indicus, Himantura bleekeri, Carangoides chrysophrys, Drepane punctata* were recorded only from station 1 (Gangavali). Fishes like *Cephalopholis boenak, Caranx ignobilis, Trichiurus lepturus* moved freely in stations 1 and 2. *Colletteichthys dussumieri, Nemipterus japonicus, Sardinella fimbriata, Opisthopterus tardoore, Stolephorus commersonnii, Thryssa mystax, Siganus vermiculatus, Sillago sihama, Otolithes ruber, Sphyraena barracuda, Lactarius lactarius, Eubleekeria splendens, Lobotes surinamensis, Secutor insidiator, Johnius belangeri, Sphyraena obtusata, Lutjanus johnii, Lutjanus russellii, Synaptura commersonnii, Grammoplites scaber, Arius arius, Tricanthus biaculeatus, Arothron stellatus, Etroplus suratensis, Monopterus albus, Pisoodonophis cancrivorus, Mugil cephalus, Liza parsia, Scatophagus argus, Lutjanus argentimaculatus, Glossogobius giuris, Gerres filamentosus, Eleutheronema tetradactylum, Terapon jarbua, Gerres limbatus, Secutor ruconius, Lates calcarifer, Ambassis ambassis, Apogon hyalosoma* and *Cynoglossus punticeps* were recorded from all the three stations. Among the sampled fish species 6 sp. (11.1%) were more of marine dwelling nature, 31 sp. (57.4%) were marine to estuarine habitats and 15 sp. (27.8%) shared marine and freshwater habitats. Among the fishes recorded

Table 2. Season-wise and station-wise fish species collected from the Gangavali estuary. Presence is registered by + and absence, by -. M: Monsoon, Pm: Post-monsoon, Pr: Pre-monsoon.

				Gangavali (estuary mouth)			Ulvare (mid-estuary)			Shirgunji (upstream estuary)		
Order	Family	Scientific name and habitats	Code	M	Pm	Pr	M	Pm	Pr	M	Pm	Pr
		Marine										
Batrachoidiformes	Batrachoididae	*Colletteichthys dussumieri* Valenciennes, 1837	UK2011AE114	+	+	+	+	+	+	+	+	+
Perciformes	Carangidae	*Carangoides Praeustus* Bennett, 1830	UK2011AE110	+	+	+	-	-	-	-	-	-
Perciformes	Scombridae	*Rastrelliger kanagurta* Cuvier, 1816	UK2011AE142	-	-	+	-	-	-	-	-	-
Perciformes	Nemipteridae	*Nemipterus japonicus* Bloch, 1791	UK2011AE124	+	+	+	+	+	+	+	+	+
Perciformes	Serranidae	*Cephalopholis boenak* Bloch, 1790	UK2010AE101	+	+	+	+	+	+	-	-	-
Rajiformes	Rhinobatidae	*Glaucostegus halavi* Forsskal, 1775	UK2010AE106	+	+	-	-	-	-	-	-	-
		Marine-estuarine										
Beloniformes	Belonidae	*Strongylura leiura* Bleeker, 1850	UK2011AE145	-	+	+	-	+	+	-	-	-
Carcharhiniformes	Carcharhinidae	*Scoliodon laticaudus* Miller & Henle,1838	UK2011AE129	-	+	+	-	-	-	-	-	-
Clupeiformes	Clupeidae	*Sardinella fimbriata* Valenciennes, 1847	UK2011AE144	+	+	+	+	+	+	+	+	+
Clupeiformes	Engraulidae	S*tolephorus indicus van* Hasselt, 1823	UK2011AE134	+	+	+	-	-	-	-	-	-
Clupeiformes	Clupeidae	*Opisthopterus tardoore* Cuvier, 1829	UK2011AE151	+	+	+	-	+	+	-	+	+
Clupeiformes	Engraulidae	*Stolephorus commersonnii* Lacepède, 1803	UK2011AE141	+	+	-	+	+	-	+	+	-
Clupeiformes	Engraulidae	*Thryssa mystax* Bloch & Schneider, 1801	UK2011AE152	-	+	+	-	+	+	-	+	+
Myliobatiformes	Dasyatidae	*Himantura bleekeri* Blyth, 1860	UK2012AE163	+	+	-	-	-	-	-	-	-
Perciformes	Carangidae	*Carangoides chrysophrys* Cuvier ,1833	UK2011AE132	-	+	-	-	-	-	-	-	-
Perciformes	Siganidae	*Siganus vermiculatus* Valenciennes, 1835	UK2011AE160	+	+	+	+	+	+	+	+	+
Perciformes	Sillaginidae	*Sillago sihama* Forsskal, 1775	UK2011AE111	+	+	+	+	+	+	+	+	+
Perciformes	Sciaenidae	*Otolithes ruber Bloch &* Schneider, 1801	UK2010AE103	+	+	+	+	+	+	+	+	+
Perciformes	Sphyraenidae	*Sphyraena barracuda* Edwards, 1771	UK2011AE112	+	+	+	+	+	+	+	+	+
Perciformes	Lactariidae	*Lactarius lactarius* Bloch & Schneider, 1801	UK2010AE99	+	+	+	-	+	+	-	+	+

Perciformes	Carangidae	*Megalaspis cordyla* Linnaeus, 1758	UK2012AE169	+	+	+	-	-	-	-	-	-
Perciformes	Drepaneidae	*Drepane punctata* Linnaeus, 1758	UK2012AE166	-	+	+	-	-	-	-	-	-
Perciformes	Carangidae	*Caranx ignobilis* Forsskal, 1775	UK2012AE162	+	+	+	+	+	+	-	-	-
Perciformes	Leiognathidae	*Eubleekeria splendens* Cuvier, 1829	UK2012AE164	-	+	+	-	+	+	-	-	+
Perciformes	Lobotidae	*Lobotes surinamensis* Bloch, 1790	UK2011AE128	+	+	-	+	+	-	+	+	-
Perciformes	Leiognathidae	*Secutor insidiator* Bloch, 1787	UK2011AE148	+	+	+	+	+	+	+	+	+
Perciformes	Trichiuridae	*Trichiurus lepturus* Linnaeus, 1758	UK2011AE135	+	+	+	+	+	+	-	-	-
Perciformes	Sciaenidae	*Johnius belangeri* Bleeker, 1861	UK2012AE161	+	+	+	+	+	+	+	+	+
Perciformes	Sphyraenidae	*Sphyraena obtusata* Cuvier, 1829	UK2011AE149	+	+	+	+	+	+	+	-	+
Perciformes	Carangidae	*Atule mate* Cuvier, 1833	UK2010AE107	+	+	+	-	-	-	-	-	-
Perciformes	Lutjanidae	*Lutjanus johnii* Bloch, 1792	UK2011AE123	+	+	+	+	+	+	+	+	+
Perciformes	Lutjanidae	*Lutjanus russellii* Bleeker, 1849	UK2010AE108	+	+	+	+	+	+	+	+	+
Pleuronectiformes	Soleidae	*Synaptura commersonnii* Lacepède, 1802	UK2010AE109	+	+	+	+	+	+	+	+	+
Scorpaeniformes	Platycephalidae	*Grammoplites scaber* Linnaeus, 1758	UK2011AE150	+	+	+	+	+	+	+	+	+
Siluriformes	Ariidae	Arius arius Hamilton, 1822	UK2010AE102	+	+	+	+	+	+	+	+	+
Tetraodontiformes	Triacanthidae	*Tricanthus biaculeatus* Bloch, 1786	UK2011AE117	+	+	+	-	+	+	-	+	+
Tetraodontiformes	Tetraodontidae	*Arothron stellatus* Anonymous, 1798	UK2011AE133	+	+	+	+	+	+	+	+	+
		Estuarine										
Perciformes	Cichilidae	*Etroplus suratensis* Bloch, 1790	UK2011AE155	+	+	+	+	+	+	+	+	+
		Estuarine-freshwater										
Synbranchiformes	Synbranchidae	*Monopterus albus* Zuiew, 1793	UK2011AE118	+	+	+	+	+	+	+	+	+
		Marine-estuarine-freshwater										
Anguilliformes	Ophichthidae	*Pisoodonophis cancrivorus* Richardson, 1848	UK2011AE122	+	+	+	+	-	+	+	-	+
Mugiliformes	Mugilidae	*Mugil cephalus* Linnaeus, 1758	UK2010AE104	+	+	+	+	+	+	+	+	+
Mugiliformes	Mugilidae	*Liza parsia* Hamilton, 1822	UK2011AE138	+	+	+	+	+	+	+	+	+
Perciformes	Scatophagidae	*Scatophagus argus* Linnaeus, 1766	UK2010AE93	+	+	+	+	+	+	-	+	+
Perciformes	Lutjanidae	*Lutjanus argentimaculatus* Forsskal, 1775	UK2010AE97	+	+	+	+	+	+	+	+	+

Perciformes	Gobiidae	*Glossogobius giuris* Hamilton, 1822	UK2011AE136	+	+	+	+	+	+	+	+	+
Perciformes	Gerridae	*Gerres filamentosus* Cuvier, 1829	UK2010AE105	+	+	+	+	+	+	+	+	+
Perciformes	Polynemidae	*Eleutheronema tetradactylum* Shaw, 1804	UK2011AE139	+	+	+	+	+	+	+	+	+
Perciformes	Teraponidae	*Terapon jarbua* Forsskal, 1775	UK2011AE131	+	+	+	+	+	+	+	+	+
Perciformes	Gerridae	*Gerres limbatus* Cuvier, 1830	UK2010AE98	+	+	+	+	+	+	+	+	-
Perciformes	Leiognathidae	*Secutor ruconius* Hamilton, 1822	UK2011AE119	+	+	+	+	-	+	-	-	+
Perciformes	Centropomidae	*Lates calcarifer* Bloch, 1790	UK2011AE147	+	+	+	+	+	+	+	+	+
Perciformes	Ambassidae	*Ambassis ambassis* Lacepède, 1802	UK2011AE120	-	+	+	-	+	+	-	+	+
Perciformes	Apogonidae	*Apogon hyalosoma* Bleeker, 1852	UK2011AE115	-	+	+	-	+	+	-	+	+
Pleuronectiformes	Cynoglossidae	*Cynoglossus punticeps* Richardson, 1846	UK2011AE121	+	+	+	+	+	+	+	+	+

only *E. suratensis* was entirely estuarine and *M. albus* was of estuarine-freshwater habitat (Fig. 2).

The highest salinity (35 ppt) was recorded in station 1 (Gangavali) during pre-monsoon whereas salinity was zero ppt in all the three stations during monsoon. Salinity gradient was observed throughout the investigation and increased towards the mouth of the estuary. DO content was low (3.78 mg/l) in Station 3 (Shirgunji) during pre-monsoon and maximum DO (5.9mg/l) recorded in station 1 (Gangavali) during monsoon (August). Station 1(Gangavali) and 2 (Ulware) had higher pH than other stations, where a highest pH of 8.2 was recorded in May however the lowest pH (7.1) was observed in station 3 (Shirgunji) during most of the months. The highest surface water temperature (32.6°C) was recorded during May in Station 2 and the lowest surface water temperature (25.3°C) recorded in Station 1 during post monsoon (November) (Fig. 3).

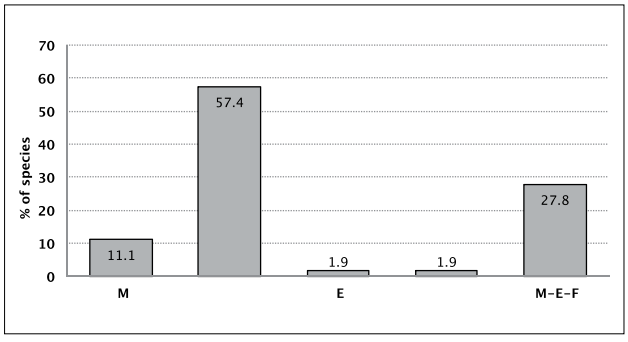

Fig. 2. Habitat based classification of fishes (M-Marine; M,E- Marine, estuarine; E- Estuarine; E-F Estuarine, fresh; M,E,F- Marine, estuarine, fresh)

Discussion

In comparison with some of the Indian west coast estuaries studied, the relatively small estuary of Gangavali fared reasonably well with 54 species of fishes. Jayachandran *et al.* (2013) reported 63 fishes from 37 families, from the much larger Kodungallur-Azhikode estuary of Vembanad wetland system in Kerala and from the Ponnani estuary of Kerala. Bijukumar and Sushama (2000) reported 112 species from 80 genera and 53 families. Naik (2003) reported 46 species of fishes from the Kali estuary in Uttara Kannada district, however, in a later study Roopa *et al.* (2011) recorded only 37 fish species from the same estuary. Shirodkar (2013) carried out research on faunal diversity of Gangavali estuary, Uttara Kannada, west coast of India and documented 46 species under 39 genera and 32 families. Mahima *et al.* (2014a) recorded 77 fishes belonging to 47 families from Aghanashini estuary of Uttara Kannada of these 17% were seasonal visitors from marine areas, 57% marine-estuarine and 24% from wide ranging habitats. The main reason for Aghanashini estuary, the nearest neighbor of Gangavali, to have more assemblage of fish species could be, obviously, attributed due to its mangroves, sedge areas, mud-flats, shell beds and also due to its larger size, almost of 5 times the size of the latter (Mahima *et al.*, 2014a).

During present study the highest number of species was recorded during in the pre-monsoon season when the salinity was at its peak. Most of the estuarine fishes are able to cope with salinity fluctuations but their ability to do so varies from

species to species and hence influences their distribution (Blaber, 2000; Chowdhury *et al.*, 2010). The salinity dynamics of natural estuaries of the Indian west coast, fluctuating seasonally from lowest (0 ppt.) in the peak rainy period to the highest level (34 ppt. during pre-monsoon hot months as in Aghanashini estuary) is the major reason for higher fish diversity, favoring both euryhaline and stenohaline marine fishes, wherein the latter entering the estuary only during pre-monsoon (Mahima *et al.*, 2014a). While studying the fish diversity in relation to estuarine salinity conditions, Mahima *et al.* (2014b) recorded lower salinity of <0.5 ppt with 29 fish species in Sharavathi estuary of Uttara Kannada district which is three times larger in area, than Gangavali which constitute a diversity of 54 fish species. These attribute the importance of salinity as a major ecological factor for the distribution of species. This situation in Sharavathi has arisen as an aftereffect of execution of hydroelectric projects in the upstream of the river causing inundation of the estuary with freshwater released from dams after electricity generation. Loss of salinity for most of the year keeps away all stenohaline marine fishes (Mahima *et al.* 2014b). Other parameters like pH, dissolved oxygen and temperature observed during the investigation, did not show any significant influence on the distribution of species since these parameters were not much varied among the seasons as compared to salinity. Similar observations were also made by Chowdhury *et al.* (2010).

Sand mining and mangrove destruction is rampantly happening along the villages of Gangavali estuary due to increased demand for sand and fire wood from far and wide, coupled with widespread unemployment the resultant of overfishing and fishery collapse in recent years, have attracted many fishermen, having skills in boating and maneuvering in water to work with sand mining contractors and sand traders. Sand mining licenses are given on administrative terms without any consideration of ecosystem that is affected. Unrestrained sand removal and mangrove destruction in these areas could be main reasons for the less fish assemblage in the estuary as compared to its neighboring Aghanashini estuary. Documentation of the fish diversity in these estuarine habitats, especially the ones located at the Indian West coast, one of the global biodiversity hotspots is, therefore, necessary, considering the strong increase on anthropogenic impacts in the region.

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