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Fin Fish Biodiversity Of A Tropical Sal Estuary, Goa, West Coast Of India

Nandadeep U. Fal Dessai
Research Scholar, Department of Marine Science, Goa University, Goa.

Abstract: Sal estuary represents rich biodiversity because of the heavy rains during the south west monsoon and lack of any industrial development along the banks of the river. Attempt was made to survey the fin fish biodiversity along the estuary to fulfill the lack of adequate information regarding estuarine fisheries. Hydrological parameters were analysed during the study period and found to be highly influencing. Fishes were caught near shore by using gill nets and cast nets. About 35 fin fishes were recorded belonging to 28 families. The distribution varies according to the environmental conditions. Some of the important fin fishes found in this estuary are Mugil cephalus, Gerres filamentosus, Sillago sihama, Etroplus suratensis, Arius arius, Lutjanus argentimaculatus, Acanthopagrus berda and Lobotes surinamensis. Some of the fresh water species are also observed in the Sal river. In future, Industrialization along the bank of the estuary may threaten the species diversity and need necessary laws for conservation of biodiversity.

Key words: Estuary, Fin fishes, Biodiversity.

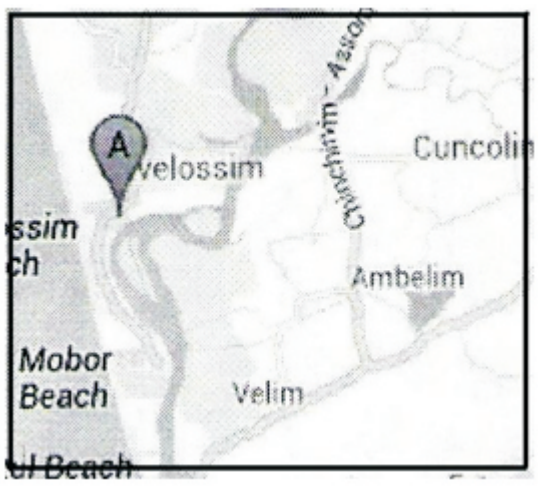
INTRODUCTION :

There are ample fin fish resources in the Sal estuary and subjected to vary with respect to seasons and ecological conditions. There are 35 species belonging to 28 families among which more than 50% of the species support a very good commercial fishery of this biotope. An extensive work has been carried out on the fish biology, ecology and fisheries aspects of different estuarine complexes of the west coast of India but so far there is no record of the fin fish biodiversity of this estuary. Sal estuary is one of the most productive estuaries of Goa , which drains its fresh water in to the Arabian Sea near Betul after meandering about 35 Km. In the present study an attempt has been made to project some information of this community's biodiversity with space and time factor.

MATERIALS AND METHODS

The present study was carried out in the Sal estuary (Cavelossim) for the period of six months covering around 8Km stretch (Fig 1) and divided into two stations to encompass two different habitats of the study area. The sampling was conducted seasonally from 1st August to 31st January 2013 both during monsoon and Post monsoon seasons. Regular monthly water samples were collected from the study stations by using the outrigger boat and was analysed for different hydrological parameters such as water temperature, salinity, dissolved oxygen and pH in the laboratory. Differences in physicochemical parameters among the different stations were calculated. A census of all gears operating at the study area was undertaken by visiting fishing ground and individual landing sites very early in the morning and by asking questions to the fisher folks on the operating, frequency of usage and composition of catches of these gears. The fin fishes were collected from the respective study stations using Gill net (Kaantali), Cat net (Raampon), Hook and line and Pole and line.

Fig 1. Map of Sal river showing study station



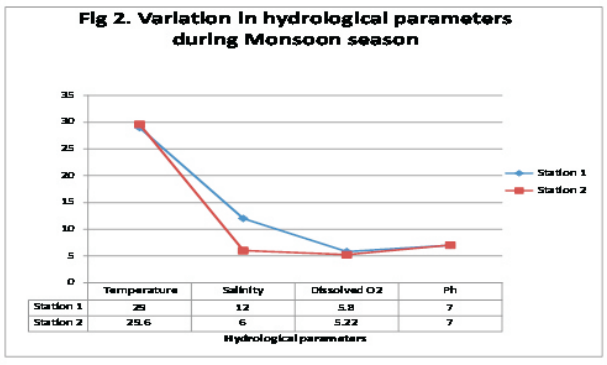
RESULTS AND DISCUSSION

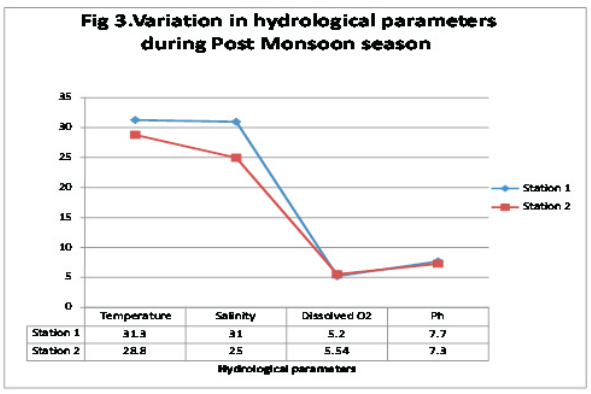
HYDROGRAPHIC PARAMETERS:

The water temperature was minimum during the monsoon season and had gradually increased during the post monsoon season (Fig 2&3). The salinity had showed drastic change between the stations and seasons (Fig 2&3). Salinity in an estuary varies according to one's location in the estuary,

the daily tides, and the volume of fresh water flowing into the estuary. Salinity in an estuary typically declines in the rain, where increased freshwater flow from streams and groundwater. Salinity levels usually rise during the summer when higher temperatures increase levels of evaporation in the estuary. The dissolved oxygen on an average was same throughout the study period and its concentration varied between 4 to 6.5 mg/l(Fig 2&3). Concentration of dissolved oxygen is found to be highest during the monsoons. This may be due to the high solubility of gases at lower salinity. The higher pH observed during post-monsoon as compared to monsoon season may be caused by the removal of carbon dioxide due to high photosynthetic activity during these seasons and the low solubility of this gas due to higher water temperature (Fig 2&3).

Dew, (1981) studied temperature influence on the abundance and availability of marine and estuarine fishes. The pH of water affects the normal physiological functions of aquatic organisms, including the exchange of ions with the water and respiration. Such important physiological processes operate normally in most aquatic biota under a relatively wide pH range (McKee and Wolf, 1963). Since the present study was restricted to the biodiversity of fin fishes of Sal river estuary with certain hydrographic parameters. Most ecosystems are sensitive to changes in pH and the monitoring of pH has been incorporated in present study revealed balanced pH during the study period which holds the fin fish diversity in equilibrium. Dissolved oxygen (DO) and temperature also influence the faunal diversity of the estuary as DO is essential to all forms of aquatic life including the organisms that breaks down man-made pollutants. From the study area DO recorded was around 4.5 to 5.5 which is healthy symptoms of this estuary ultimately boosting the productivity of this region. Generally, Salinity tends to decrease with increasing distance from the river mouth but this may not always true, as the salinity gradient mainly depends upon runoff from the land, rainfall and evaporation from the estuarine itself (Perkins, 1976). Temperature is an important water quality parameter and is relatively easy to measure. Water bodies will naturally show changes in temperature seasonally and daily; however, man made changes to stream water temperature will affect fish ability to reproduce. Temperature of the study area is normal as average i.e. 290c. With the present physico-chemical parameters studied during the study period influence the fin fish diversity of this estuary as no drastic changes were evidenced in any of the parameters.





Source: Personal computation, 2013

FIN FISHES BIODIVERSITY:

Fish species composition of this study comprised of 35 species belongs to 31 genuses from 9 orders of 28 families (Table 1). The most dominant families were Mugilidae, Ariidae, Sciaenidae, Cichlidae, Ambassidae, Lactaridae, Gerreidae, Teraponidae, Leiognathidae and Sillaginidae. The constitution by other families with Platycephalidae, Latidae, Lutjanidae, Lobotidae, Sparidae, Scatophagidae, Clupeidae, Batrachoididae, Serranidae, Hemiramphidae, Bothidae, Soleidae, and Tetraodontidae was comparatively less. Seasonal fluctuations of water quality have influenced the fish composition in Sal estuary. Fishes of freshwater origin have restricted themselves to the upper reaches of the river and were found in higher density during the certain period of the year. But, they were completely absent in the mid and lower reaches of the river. Similar findings were also noticed (Anuradha Bhat, 2003; Sreekantha et al., 2008) in the neighboring estuaries of the Uttar Kannada district of Karnataka State. Some of the species like Etroplus surentensis, Mugil cephalus, Sillago sihama, Ambassis gymnocephalus, Terapon jarbua, Euryglossa orientalis and Scatophagus argus were restricted themselves to the lower reaches of the estuary preferring the higher saline water and were found only during the pre and post monsoon seasons. It is surmised that, these fin fish species prefer higher and moderate saline waters to thrive well to establish their niche. In contrast to this, the species of Puntius chola and Clarias batrachus were found only in the fresh water biotope and some of them were even restricted to southwest monsoon season only. In some cases, when there was pure fresh water regime established in the mid reaches of the estuary, these species were found showing their inclination towards fresh water. Based on the salinity factor, the resident species of fin fishes move towards saline/fresh or saline mixed fresh water and vice versa to find suitable habitat to establish their territory in this aqua ecosystem. In continuation of this factor, many other hydrographic parameters also influence the standing stock of fishes. The fishes caught during the study period were showing high abundance in the post monsoon season and lowest in the monsoon season.

Table1. Systematic classification of fin fishes of Sal estuary

CLASS	ORDER	FAMILY	SPECIES
Osteichthyes	Clupeiformes	Clupeidae	*Sardinella longiceps*
		Clupeidae	*Sardinella albella*
	Beloniformes	Hemiramphidae	*Hemiramphus far*
	Perciformes	Ambassidae	*Ambassis gymnocephalus*
	Perciformes	Teraponidae	*Terapon jarbua*
	Perciformes	Lactaridae	*Lactarius lactarius*
	Perciformes	Carangidae	*Caranx para*
		Carangidae	*Caranx sexfasciatis*
	Perciformes	Leognathidae	*Leognathus splendens*
	Perciformes	Serranidae	*Epinephalus diacanthus*
	Perciformes	Lutjanidae	*Lutjanus argentimaculatus*
	Perciformes	Sciaenidae	*Johnius carouna*
		Sciaenidae	*Otolithes cuveiri*
	Perciformes	Mugilidae	*Mugil cephalus*
	Perciformes	Monodactylidae	*Monodactylus argenteus*
	Perciformes	Scatophagidae	*Scatophagus argus*
	Perciformes	Siganidae	*Siganus javus*
		Siganidae	*Siganus canaliculatus*
	Pleuronectiformes	Soleidae	*Synaptura commersonnii*
		Soleidae	*Euryglos saorientalis*
	Tetraodontiformes	Tetraodontidae	*Chelonodon patoca*
	Siluriformes	Ariidae	*Arius arius*
	Perciformes	Latidae	*Lates calcarifer*
	Perciformes	Sillaginidae	*Sillago sihama*
	Perciformes	Gerreidae	*Gerres abbreviates*
		Gerreidae	*Gerres filamentosus*
	Perciformes	Lobotidae	*Lobotes surinamensis*
	Scorpaeniformes	Platycephalidae	*Thysanophrys chiltonae*
	Perciformes	Sparidae	*Acanthopagrus berda*
		Cichlidae	*Etroplus suratensis*
	Pleuronectiformes	Bothidae	*Rhombus arsius*
		Cichlidae	*Oreochromis niloticus*
	Batrachoidiformes	Batrachoididae	*Austrobatrachus dussumeirri*
	Siluriformes	Clariidae	*Clarias batrachus*
	Cypriniformes	Cyprinidae	*Puntius chola*

Source: Personal Computation, 2013,

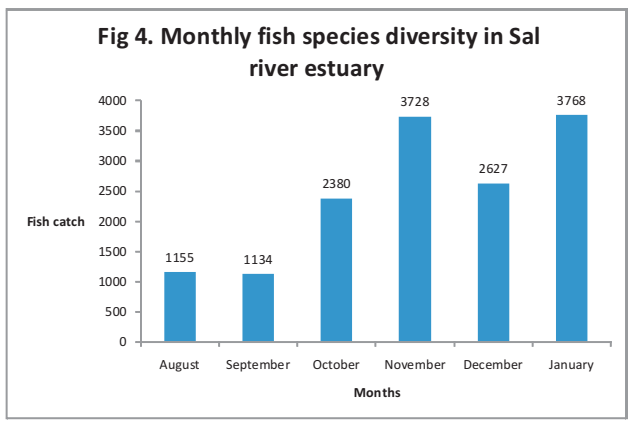
Table2. Common names of fin fishes of Sal estuary

SR NO	Scientific names	C ommon names (Konkani)
1	***Etroplus suratensis***	**Kaal**
2	***Terapon jarbua***	**Khorgosso**
3	***Scatophagus argus***	**Kudgon**
4	***Epinephalus diacanthus***	**Gobro**
5	***Sillago sihama***	**Mudoshi**
6	***Gerres filamentosus***	**Shetuk**
7	***Gerres abbreviates***	**Shetuk**
8	***Arius arius***	**Sangot**
9	***Mugil cephalus***	**Shevto**
10	***Lates calcarifer***	**Chonak**
11	***Euryglossa orientalis***	**Lepp**
12	***Lutjanus argentimaculatus***	**Tambus**
13	***Siganus javus***	**Bhanshi**
14	***Siganus canaliculatus***	**Bhanshi**
15	***Leiognathus splendens***	**Khanp**
16	***Sardinella longiceps***	**Tarle**
17	***Sardinella albella***	**Pedde**
18	***Ambassis gymnocephalus***	**Burranto**
19	***Lactarius lactarius***	**Somnale**
20	***Acanthopagrus berda***	**Paaluv**
21	***Otolithes cuveiri***	**Dodiyaro**
22	***Johnius carouna***	**Dodiyaro**
23	***Monodactylus argenteus***	**Kombale**
24	***Chelonodon patoca***	**Kaccho**
25	***Thrysanophrys chiltonae***	**Bhovor**
26	***Oreochromis niloticus***	**English fish**
27	***Caranx para***	**Konkare**
28	***Caranx sexfaciates***	**Konkare**
29	***Hemiramphus far***	**Toli**
30	***Lobotes surinamensis***	**Gurr**
31	***Austrobatrachus dussumeirri***	**Moliyo**

32	***Synaptura commersonni***	**Lepp**
33	***Rhombus arsius***	**Lepp**
34	***Clarias batrachus***	**Thigur**
35	***Puntius chola***	**Kerr**

Source: Personal Computation, 2013,

Seasonal distribution and abundance of fin fishes were studied. The abundance and distribution of fishes depends upon the different season. Other than this, the distribution of fishes was directly or indirectly affected by hydrological parameters like temperature, salinity, Dissolved oxygen, and pH. Besides, it depends on the locality, the amount of rainfall in that area, the flow of water and type of substrate (rocky, sandy, etc). Accordingly, October to May is found to be the peak season of abundance of fin fishes (Fig 4). The fish diversity was very less during the monsoon season, i.e., from August to October. The dominant fish species present during this season are Ambassis gymnocephalus, Arius arius, Etroplus suratensis, Gerres abbreviates, Sillago sihama, Scatophagus argus, Siganus javus, Johnius carouna and Monodactylus argenteus. The other fishes were comparatively less in this season. The fish diversity was more during the post monsoon season (Fig 4), i.e., from November to January. The catch composition was also very high. Among these, Terapon jarbua, Arius arius, Mugil cephalus, Johnius carouna, Lactarius lactarius, Leiognathus splendens, Monodactylus argenteus, Sillago sihama and Ambassis gymnocephalus was the most dominating species. There was no fluctuation in the number of catches throughout the season. The number in catch increased compared to the catch during monsoon season. Other species, such as Lutjanus argentimaculatus, Acanthopagrus berda, Oreochromis niloticus, Otolithes cuveiri, Lobotes surinamensis, Lates calcarifer of high commercial value are also found in the post monsoon season and play a major role in the total percentage contribution.



Source: Personal computation, 2013

Univariate fin fish diversity index of Sal estuary was calculated by using PRIMER-v5 (2001- software) and found to be high Margalef species richness (d) was recorded during the month of September (3.0327) followed by January, November and December around (2.8) (Table 3). However, Shannon Weiner Diversity index (H') has good discriminating ability clearly brought out the species diversity is more during the month of September (2.6) which justifies the Margalef species richness. Then the species diversity based on species richness (d) and Shannon Weiner Index(H') lower during the month of August (2.4) &(2.2), justifying the seasonal attribute. Similarly, species composition among the fin fishes of Sal estuary was in the range of 56% to 83%. The Dendrogram (Fig 5) clearly reveals August and September month forming one cluster with maximum of 83.72%. It shows that these two months has created ideal and uniform environmental setup which has together similar diversity, while November and January month got linked at 79.5% forming a cluster. October and December month forms cluster separately at 72 and 73% which got linked to the 1st cluster at 68%.Since the present study was restricted to the biodiversity of fin fishes of Sal estuary with certain hydrographic parameters, an elaborated study has to be undertaken to acquire data on their distribution in detail. Probably this task would give better picture on diversity of fin fishes with space and time.

Table3. Univariate fin fish diversity indices of Sal estuary

Months	S	N	d	J	Brillouin	Fisher	H*(loge)
August	18	1080	2.4334	0.76474	2.1847	3.0683	2.2248
September	22	1017	3.0327	0.85795	2.6004	3.9629	2.652
October	19	2235	2.334	0.82039	2.3923	2.8504	2.4156
November	22	3363	2.586	0.81107	2.489	3.1553	2.507
December	21	2329	2.5796	0.7172	2.1614	3.1835	2.1835
January	24	3243	2.845	0.81784	2.5788	3.5147	2.5991

Source: Personal Computation, 2013.

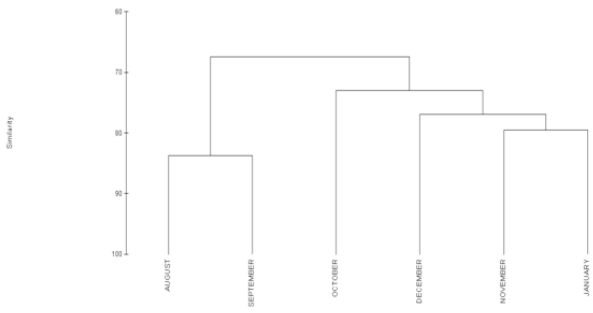
Where, S ---- Total species
D ----Margalef species richness
N ----Total individuals
H ----ShanonWeiner Index
J -----pielov'seveness

Bray-Curtis similarity for fin fish of Sal estuary

	August	September	October	November	December
August	-	-	-	-	-
September	83.716	-	-	-	-
October	72.18	73.614	-	-	-
November	56.073	66.12	70.409	-	-
December	65.456	75.416	70.536	78.824	-
January	68.012	68.739	77.937	79.514	74.974

Source: Personal computation, 2013

Fig5. Dendrogram of complete linkage of fin fish diversity among different months habitat of Sal estuary



Source: Personal computation, 2013

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