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Variations in the diversity of commercially important finfishes in Vellar Estuary, south-east coast of India

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ABSTRACT

Ninety two species of commercially important finfishes (12 marine, 63 estuarine cum marine, 9 estuarine and 8 freshwater) were recorded in Vellar Estuary. Diversity indices as Shannon diversity, Margalef richness index and phylogenetic diversity were high. The gradual (serial) change in species diversity from the mouth to upstream and seasonal variations (cyclic) studied using RELATE were statistically significant. The factors responsible for serial changes in diversity were observed to be salinity and strength of monsoon (indirectly salinity).

Keywords: Cyclicity, Diversity, Finfish, PRIMER, Seriation, Vellar Estuary

Estuaries serve as important nursery areas for many species including fishes (Gunter, 1967; Joseph, 1973; Weinstein, 1979; Mann, 1982). While extensive databases exist on the distribution and abundance of offshore species, only few comprehensive databases on estuarine fish diversity are available (Darnell *et al.*, 1983; Monaco *et al.*, 1990). Hence, the diversity and pattern of distribution of commercially important finfishes were studied from Vellar Estuary situated on the south-east coast of India ($11^{\circ} 27' - 11^{\circ} 30'N$; $79^{\circ} 42' - 79^{\circ} 46'E$).

The samples for the present study were collected from July 2009 to June 2010 from 5 stations in Vellar Estuary (station I extending from the mouth of estuary up to 3 km upstream, station II from 3 to 6 km, station III from 6 to 9 km, station IV from 9 to 12 km and station V from 12 to 15 km). Cast net having 6 feet dia and a mesh size of 20 mm was operated from a dugout canoe for collecting monthly samples. In each station, 7 hauls were made. The number of fishes caught in each operation was recorded. The fishes were brought to the laboratory and identified using standard reference books (Jones and Kumaran, 1980; Fishcher and Bianchi, 1984; Ramaiyan and Senthilkumar, 1997). The average abundance was expressed as number per haul of cast net. The monthly data were categorised into four seasons namely pre-monsoon (July 09 - September 09), monsoon (October 09 - December 09), post-monsoon (January 10 - March 10) and summer (April 10 - June 10). PRIMER (Plymouth Routines in Multivariate Ecological Research version 6.1.5) was used for calculating the diversity indices and the routine RELATE was used for testing serial and cyclic changes.

The present study revealed occurrence of 92 species of finfishes in Vellar Estuary (Table 1). Among these, 8 were freshwater species, 9 were truly estuarine, 12 marine and the remaining 63 species were estuarine cum marine. The number of fishes collected varied from a minimum of 15 per haul during monsoon to 95 per haul during summer. The number of fishes observed was in the ranges of 21-63, 15-48, 29-72 and 33-95 per haul respectively during pre-monsoon, monsoon, post-monsoon and summer seasons with the maximum recorded in station I and minimum in station V. The number of species recorded in the 5 stations was in the ranges of 29-82, 12-59, 31-76 and 37-86 respectively during the pre-monsoon, monsoon, post-monsoon and summer seasons. The Shannon diversity ($H' \log_2$) was in the ranges of 3.13-5.81, 1.91-2.5, 3.12-5.66 and 3.59-5.98 during the pre-monsoon, monsoon, post-monsoon and summer seasons respectively. Higher diversity values were recorded in station I and lower values in station V.

As in the number of organisms and number of species, the diversity decreased from station I to station V indicating serial changes in species composition and diversity. Index of Multivariate Seriation (IMS-RELATE) was used to test its significance. The Spearman correlation coefficient (ρ) value computed for serial changes in species composition from the mouth of the estuary to freshwater zone was 0.321. The histogram (Fig. 1) showed that the observed ρ value (0.321) is greater than any of the 999 simulated values. Therefore, the null hypothesis of no tendency to seriation at all ($\rho=0$) was decisively rejected (0.2 %).

Table 1. Finfish species recorded in Vellar Estuary

Species	Order	Family	Species	Order	Family
Freshwater species			<i>Mugil cephalus</i>	Mugiliformes	Mugilidae
<i>Anguilla bicolor bicolor</i>	Anguilliformes	Anguillidae	<i>Chelon parsia</i>	Mugiliformes	Mugilidae
<i>Catla catla</i>	Cypriniformes	Cyprinidae	<i>Chelon planiceps</i>	Mugiliformes	Mugilidae
<i>Labeo rohita</i>	Cypriniformes	Cyprinidae	<i>Chelon macrolepis</i>	Mugiliformes	Mugilidae
<i>Cirrhinus mrigala</i>	Cypriniformes	Cyprinidae	<i>Chelon subviridis</i>	Mugiliformes	Mugilidae
<i>Cyprinus carpio</i>	Cypriniformes	Cyprinidae	<i>Valamugil cunnesius</i>	Mugiliformes	Mugilidae
<i>Oreochromis mossambicus</i>	Perciformes	Cichilidae	<i>Hemiramphus far</i>	Beloniformes	Hemiramphidae
<i>Wallago attu</i>	Siluriformes	Siluridae	<i>Hyporhamphus limbatus</i>	Beloniformes	Hemiramphidae
<i>Anabas testudineus</i>	Perciformes	Anabantidae	<i>Ambassis gymnocephalus</i>	Perciformes	Ambassidae
Truly estuarine species			<i>Ambassis ambassis</i>	Perciformes	Ambassidae
<i>Elops machnata</i>	Elopiiformes	Elopiidae	<i>Epinephelus tauvina</i>	Perciformes	Serranidae
<i>Megalops cyprinoides</i>	Elopiiformes	Megalopidae	<i>Apogonichthyoides niger</i>	Perciformes	Apogonidae
<i>Nematalosa nasus</i>	Clupeiformes	Clupeidae	<i>Sillago sihama</i>	Perciformes	Sillaginidae
<i>Chanos chanos</i>	Gonorynchiformes	Chanidae	<i>Alectis ciliaris</i>	Perciformes	Carangidae
<i>Etroplus suratensis</i>	Perciformes	Cichilidae	<i>Alectis indica</i>	Perciformes	Carangidae
<i>Lates calcarifer</i>	Perciformes	Latidae	<i>Carangoides malabaricus</i>	Perciformes	Carangidae
<i>Scatophagus argus</i>	Perciformes	Scatophagidae	<i>Caranx ignobilis</i>	Perciformes	Carangidae
<i>Siganus javus</i>	Perciformes	Siganidae	<i>Alepes kleinii</i>	Perciformes	Carangidae
<i>Siganus canaliculatus</i>	Perciformes	Siganidae	<i>Caranx heberi</i>	Perciformes	Carangidae
Marine species			<i>Caranx sexfasciatus</i>	Perciformes	Carangidae
<i>Stolephorus commersonii</i>	Clupeiformes	Engraulidae	<i>Scomberoides tol</i>	Perciformes	Carangidae
<i>Sardinella fimbriata</i>	Clupeiformes	Clupeidae	<i>Lutjanus argentimaculatus</i>	Perciformes	Lutjanidae
<i>Sardinella sindensis</i>	Clupeiformes	Clupeidae	<i>Lutjanus fulviflamma</i>	Perciformes	Lutjanidae
<i>Sardinella longiceps</i>	Clupeiformes	Clupeidae	<i>Lutjanus johnii</i>	Perciformes	Lutjanidae
<i>Eleutheronema tetradactylum</i>	Perciformes	Polynemidae	<i>Lutjanus russellii</i>	Perciformes	Lutjanidae
<i>Sphyaena barracuda</i>	Perciformes	Sphyaenidae	<i>Secutor ruconius</i>	Perciformes	Leiognathidae
<i>Sphyaena jello</i>	Perciformes	Sphyaenidae	<i>Secutor insidiator</i>	Perciformes	Leiognathidae
<i>Scomberomorus commerson</i>	Perciformes	Scombridae	<i>Eubleekeria splendens</i>	Perciformes	Leiognathidae
<i>Pampus chinensis</i>	Perciformes	Stromatidae	<i>Leiognathus equulus</i>	Perciformes	Leiognathidae
<i>Cynoglossus lida</i>	Pleuronectiformes	Cynoglossidae	<i>Photopectoralis bindus</i>	Perciformes	Leiognathidae
<i>Cynoglossus puncticeps</i>	Pleuronectiformes	Cynoglossidae	<i>Lethrinus nebulosus</i>	Perciformes	Lethrinidae
<i>Cynoglossus arel</i>	Pleuronectiformes	Cynoglossidae	<i>Pomadasys kaakan</i>	Perciformes	Haemulidae
Estuarine cum marine species			<i>Pomadasys maculatus</i>	Perciformes	Haemulidae
<i>Thryssa dussumieri</i>	Clupeiformes	Engraulidae	<i>Gerres filamentosus</i>	Perciformes	Gerreidae
<i>Thryssa malabarica</i>	Clupeiformes	Engraulidae	<i>Gerres erythrourus</i>	Perciformes	Gerreidae
<i>Thryssa mystax</i>	Clupeiformes	Engraulidae	<i>Gerres methueni</i>	Perciformes	Gerreidae
<i>Thryssa vitrostris</i>	Clupeiformes	Engraulidae	<i>Gerres limbatus</i>	Perciformes	Gerreidae
<i>Coilia dussumieri</i>	Clupeiformes	Engraulidae	<i>Lobotes surinamensis</i>	Perciformes	Lobotidae
<i>Setipinna taty</i>	Clupeiformes	Engraulidae	<i>Drepane punctata</i>	Perciformes	Drepanidae
<i>Opisthopterus tardoore</i>	Clupeiformes	Pristigasteridae	<i>Upeneus sulphureus</i>	Perciformes	Mullidae
<i>Ilisha kampeni</i>	Clupeiformes	Pristigasteridae	<i>Kathala axillaris</i>	Perciformes	Sciaenidae
<i>Ilisha melanostoma</i>	Clupeiformes	Pristigasteridae	<i>Johnius carutta</i>	Perciformes	Sciaenidae
<i>Escualosa thoracata</i>	Clupeiformes	Clupeidae	<i>Dendrophysa russelii</i>	Perciformes	Sciaenidae
<i>Hilsa kelee</i>	Clupeiformes	Clupeidae	<i>Terapon puta</i>	Perciformes	Terapontidae
<i>Anodontostoma chacunda</i>	Clupeiformes	Clupeidae	<i>Terapon jarbua</i>	Perciformes	Terapontidae
<i>Arius subrostratus</i>	Siluriformes	Ariidae	<i>Parastromateus niger</i>	Perciformes	Carangidae
<i>Arius arius</i>	Siluriformes	Ariidae	<i>Acanthurus mata</i>	Perciformes	Acanthuridae
<i>Plotosus canius</i>	Siluriformes	Plotosidae	<i>Acanthocephala abbreviata</i>	Perciformes	Cepolidae

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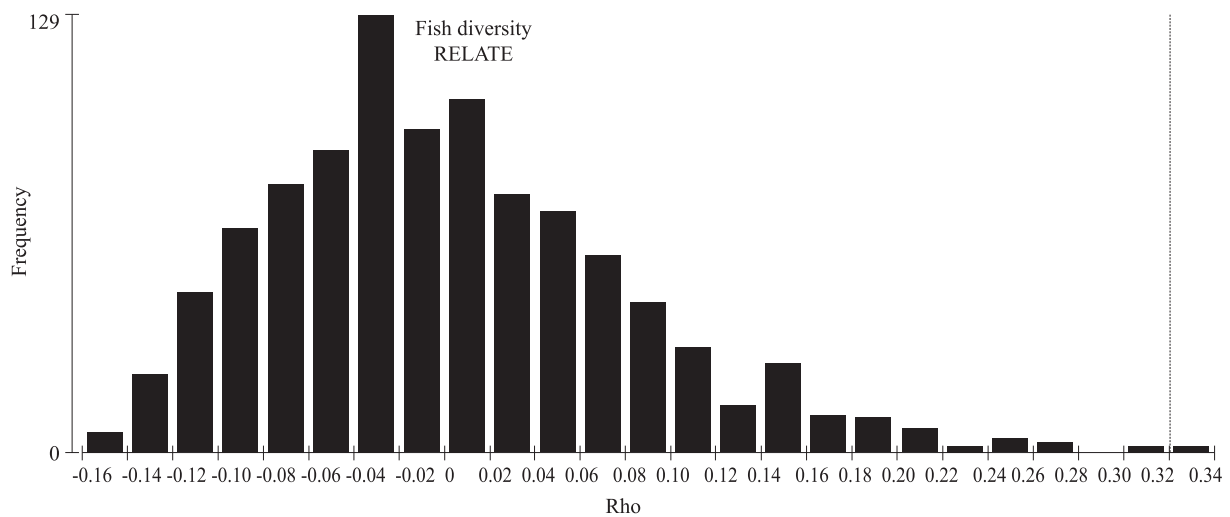


Fig. 1. Histogram showing the simulated 'rho' values and rho value of the sample data of finfish suggesting serial changes in diversity in Vellar Estuary

With respect to seasons, the number of organisms, number of species and diversity decreased from pre-monsoon to monsoon and increased during the post-monsoon season to reach the highest during summer showing cyclic changes. The 'rho' value obtained for the finfish data of Vellar Estuary was 0.283. As this value fell away from the simulated values in the histogram (Fig. 2), the null hypothesis suggesting no cyclic changes in the diversity of finfishes in Vellar Estuary was rejected at 0.1%. The MDS (Fig. 3) also clearly showed the cyclic pattern of distribution of fishes in Vellar Estuary.

Differences in number of species, abundance and diversity have been observed in various estuaries in India

(Sasmal and Choudhury, 2009) and elsewhere (Darboe and Oddsson, 2002). The variation in the abundance is attributed to the availability of resources and fluctuating conditions namely salinity and type of substrate (McLusky and Elliot, 2004). Flooding can influence abundance of estuarine fish populations both directly (Marais, 1982, 1983) and indirectly by altering salinity (Hoff and Ibarra, 1977; Quinn, 1980; Marais, 1988; Moser and Gerry, 1989). Due to flooding and subsequent lowering of salinity, freshwater fishes such as major carps enter the estuary. During excessive flooding during monsoon, freshwater fishes from the aquaculture ponds also enter the estuary due to breaching of bunds. With the return of the dry

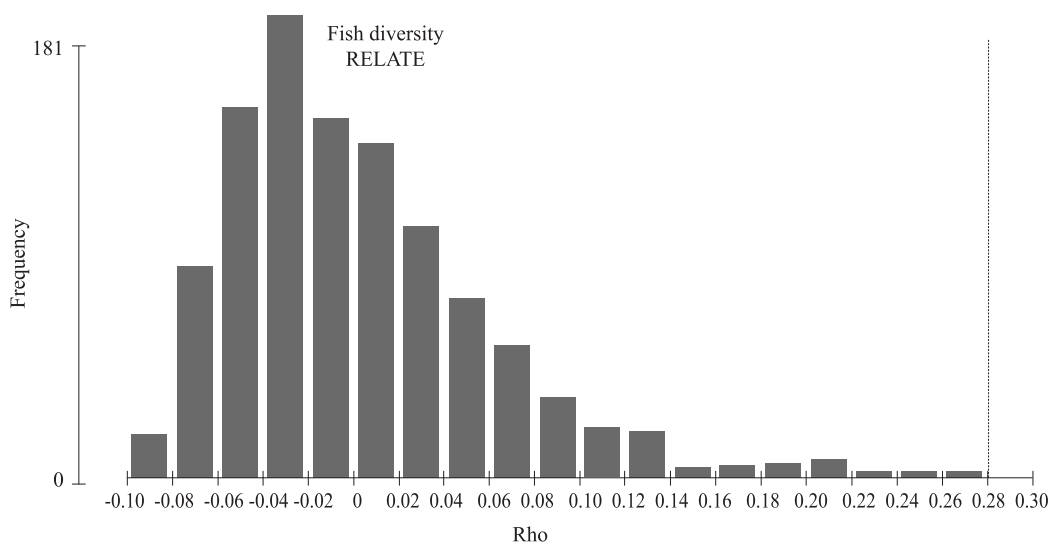


Fig. 2. Histogram showing the simulated 'rho' values and rho value of the sample data of finfish suggesting cyclicality in diversity of finfish in Vellar Estuary

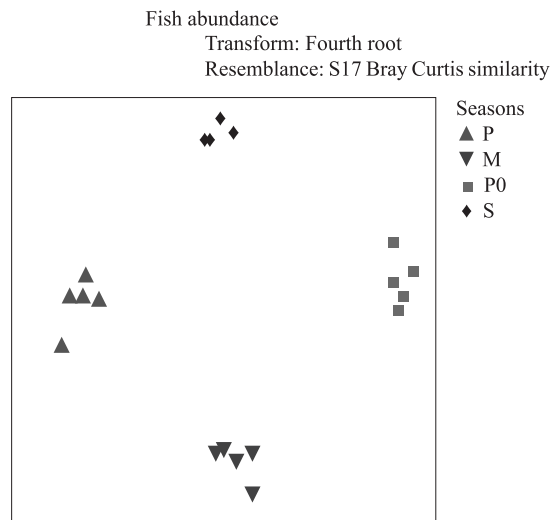


Fig. 3. MDS plot showing cyclic changes in fish diversity in Vellar Estuary. P: pre-monsoon, M: Monsoon, Po: Post monsoon, S: Summer

season they migrate further upstream from the estuary to river. This accounts for the occurrence of freshwater fishes in the present study in Vellar Estuary during the monsoon season.

Introduction of statistical packages enabled analysis of fishery data in various ways for better understanding of the distribution pattern of fishes. The permutations test done comparing the spread of IMS values with the original value obtained for the samples clearly showed both serial and cyclic changes in the distribution of fishes in the Vellar Estuary. It will be worthwhile to study the intensity of such changes in different monsoonal regimes.

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