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Fish Species Abundance and Diversity in Chandipur, Bay of Bengal, India

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Abstract: ***Fish diversity and annual average landings of fishes were studied in Chandipur coast, along east coast of India from July 2010 to March 2011. The data were collected and analyzed by using software SPSS version 16.0 to study the potential fishery status of the coast. Highest landing (64.086±11.32 MT) was reported in November 2011 and lowest (28.91±5.12 MT) in March 2011. The diversity indices showed higher values for Shannon-Weinner (3.26), Margalef species richness (3.53) and Evenness (0.91) and no significant difference was observed in month wise fish landings (F=37.89, P=0.001). The most abundant families were found to be Sciaenids, Clupeids, Polynemids, Stromatids and Arrids which shared about 87% of total fishery annually. Our result demonstrated that higher diversity values might be due to availability of abundant food resources and suitable environmental conditions at Chandipur, Bay of Bengal which offered high species richness with a potential, economical and valuable fishery resource.***

Keywords: chandipur, fish diversity, fish landing, abundance, dendrogram

1. Introduction

The marine fishery resource is a self renewable one and marine fisheries in India have a potential contribution in ago economic development, employment generation, supplying of animal protein and earning foreign currency. Fisheries resource in India is one of the largest and diversified natural resource of the world on the basis of fish species abundance [1].The baseline information on the diversity and abundance of fishes is a primary requisite for any management strategy [2].Diversity of any natural population is partially dependent on the environmental variables [3] Unfortunately anthropogenic interferences depleting the living resources by degrading the coastal habitats and ultimately affect the fish diversity.

Chandipur, Bay of Bengal is in the north east coast of India and experiences a tropical monsoon climate with high temperature and medium rainfall. The coast provides diversified exploitable pelagic and demersal fishery resource. The bay shows considerable spatial and temporal variability [4] and higher productivity [5].Further the bay receives regular flush of nutrient rich silt, supply of organic matter due to seasonal river discharges and provides a large fishery resource supporting coastal livelihoods and earning foreign currency also. The fishery of this region includes fin fishes, shell fishes and others of economical important fishes and organisms. The strategy of fisheries potential and fish diversity of Chandipur coast has not been well documented till date. No detailed and comprehensive findings are available on biological and ecological aspect of the marine fisheries of the Chandipur-on-sea except some scattered works. Hence it needs to be monitored as priority basis. The main objective of the present study was to provide information on availability, diversity and annual average fish landings of Chandipur and their % composition in order to assess potential of the coastal fishery.

2. Materials and Methods

2.1 Study Site

The area under study is Bay of Bengal at Chandipur (Fig. 1), India. The geographical location is between latitude $21^{0}3'$-$21^{0}47'$ N and longitude $86^{0}02'$-$87^{0}20'$E. The coast is endowed with extensive ares of river

Figure 1: Study site, Chandipur,Bay of Bengal(source-maps of india.com)

deltas, mangrooves and estuaries. The coastal region experiences high temperature of about 40-43^{0}C in Summer but water temperature averages 21-27^{0}C and high rain fall of about 1600-1800 mm during monsoon. Along 18 km stretch of Chandipur three sampling stations (Sts) were chosen for collection of fish samples in this study. The stations were Balaramgardi(St 1),Bahabalpur(St 2)and Srijung(St 3).The samples were collected periodically twice in every month from July 2010 to March 2011 for a period of nine months from pre contacted fishermen. Trawl nets and gill nets were widely used by the fishermen of that region. Collected samples were then sorted, counted and brought to the laboratory in ice box for identification [6]-[8].Samples were fixed in 10% buffered formalin and then dipped in to 70% ethanol for final preservation. Identification was then

confirmed by website fish base [9]. Simultaneously with fish sampling the landing data of every month was collected from Marine fishery Office located at district Head quarter Balasore,8 km from study site.

2.2 Data analysis

Statistical analysis of data were undertaken by using SPSS software version 16,0.Species diversity indices were assessed by Shannon-weinner index(H) [10], Margalef (M) species richness [11] and Evenness index (PIE) [12].One way analysis of variance (ANOVA) was calculated among different diversity indices to test the variation and significance. Landing data analysis was done using t-test to show significance among stations.

3. Result

3.1 Species composition

Both marine and estuarine species were observed in the landing centers of Chandipur. A total of 135 estuarine and marine fish along with crustacean species were available and out of that 69 species belonging to 21 groups of finfish species were observed during the whole study period. Twenty one most abundant species were found frequently at all the three sampling stations (Table 1) and they belong to family Clupeidae, Engraulidae, Chirocentridae, Herpadontidae, Ariidae, Mugillidae, Polynemidae, Sillaginidae, Scianidae, Stromatidae ,Forminidae, Scrombidae and Centopomidae.

Table 1: List of most abundant species found at three Sampling stations of Chandipur in 2010-2011

order	*family*	*species*	*Code*
Clupeiformis	Clupeidae	*Sadinella longiceps*	1
		Hilsa ilisha	2
		Pellona ditchela	3
		Opisthopterus tardoore	4
	Engraulidae	*Thryssa mystax*	5
		Coilia dussumieri	6
	Chirocentridae	*Chirocentrus dorab*	7
Scopeliformes	Herpadontidae	*Herpadon nehereus*	8
Cyprinodontiformes	Ariidae	*Tachysurus tenuispinis*	9
Mugilliformes	Mugilidae	*Mugil cephalus*	10
Polynemiformes	Polynemidae	*Eleutheronema tetradactylum*	11
		Polydactylus paradiseus	12
Perciformes	Sillaginidae	*Sillgo sihama*	13
	Sciaenidae	*Johinus dussumieri*	14
		Pama pama	14
		Johinus carutta	16
	Scrombidae	*Scomberomorus guttatus*	17
	Forminidae	*Parastromateus niger*	18
	Centropomidae	*Lates calcarifer*	19
	Stromatiidae	*Pampus argenteus*	20

Table 2: Mean along with (±SE) for the species/group wise and monthwise fish landing 2010-11

Name of the Species	Average Annual Landing	Standard Deviation (SD)	Standard Error ±(SE)	% Composition
Shark	16.675	8.964	3.169	1.603
Mullet	25.656	8.924	2.975	3.396
Rays	20.363	6.286	2.222	1.958
Oil Sardine	12.425	7.048	2.492	0.866
Other Sardine	10.344	4.351	1.450	1.144
Hilsa Shad	87.256	106.689	35.563	6.830
Other shad	116.322	133.931	44.644	6.391
Anchovies	49.733	26.237	8.746	4.313
Other cleupeides	37.933	21.280	7.093	3.365
Bombay duck	7.580	3.469	1.551	0.377
Chirocentrus	17.867	10.250	3.417	1.380
Polynemids	7.833	4.511	1.504	0.852
Trichuridae	35.400	23.563	7.854	3.143
Indian Makel	7.888	5.202	1.839	0.556
Other Makrel	7.775	5.101	1.804	1.147
Eels	13.267	5.985	1.995	0.473
Cat fish	71.778	36.824	12.275	3.950
Sciaenids (Croaker)	162.689	87.927	29.309	15.565
Black pompret	43.178	29.641	9.880	4.493
Silver pompret	74.156	46.231	15.410	5.463
Sole (flat fish)	9.578	4.084	1.361	1.034

The family Clupeidae showed more number of species followed by Scianidae and Polynemidae. Annual average landing data was reflected that Shads were most abundant groups, (203.57±35.56 MT) followed by Sciaenids (162.68±29.3 MT) and Pomfrets (117.37±9.88 MT). The % composition of 21 groups of fishes showed that the higher % of annual landing was shared by Sciaenids (15.56%) but Shades (13.22%) and Pomfrets (9.95%),Clupeids (7.70%), Cat fishes (3.95%), Mullets (3.39%) and Mackrels (1.69%) (Table-2). On analysis of monthwise landing data it was cleared that highest landing was observed in winter months of November (57.28±9.58 MT), December (64.08±11.32 MT) and January (60.42±10.86) 2010, whereas lowest landings was found in March 2011 (28.91±5.12).No significant difference was observed in landings between months ($F = 6.88, P \leq 0.01$) (Table 3). Paired t-test between stations showed significance of fish landings between Chandipur and Bahabalpur ($F = 3.761, 3.208$, $p \leq 0.01$).

Table 3: Analysis of variance of species/group wise and month wise fish landing 2010-11

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	302056.5	20	15102.83	6.885**	0.000	1.636969
Within Groups	348774.9	159	2193.553			
Total	650831.5	179				

The groups such as Polynemidaes, Trichurids, Stromatids, Lactarids and flat fishes(Platycephalids) typical to tropical waters contributed less than 5% to total abundance Fig.2).The biomass was dominated by species belonging to the families Scianidae,Arididae,Clupeidae and Stromatidae. Station 3 showed maximum (109.22 ±15.59 MT) annual landings and Station2 showed the minimum (83.14 ±11.30 MT) value (Table 4). The high standard deviation in abundances indicated fluctuation in monthly catches. Of the 21 most abundant species observed at all the three stations three were of estuarine habitat as *Silalgo sihama*, *Mugil cephalus* and *Lates calcarifer*.

Table 4: Monthwise average fish landing with standard error (±SE) during 2010-11

Months	*2010-11*	
	Mean	*±SE*
July	44.429	7.305
August	45.429	7.389
September	47.200	7.983
October	49.371	7.068
November	57.286	9.581
December	64.086	11.324
January	60.429	10.863
February	42.229	5.851
March	28.914	5.120

3.2 Species Diversity

Month wise different species diversity indices were calculated (Table 5) which showed that the pooled Shannon-weinner index (H) value was of 3.26 whereas pooled value for Margalef species richness of 3.53 and evenness index of 0.91.

Table 5: Average fish landing of three stations during 2010-11

STATIONS	2010-11	
	Mean	±SE
S1	87.7429	12.530
S2	83.1429	11.308
S3	109.2286	15.595

Highest (H) value (3.56) was observed in October 2010 and lowest value (3.11) for Shannon index (H) was found in March 2011.Maximum value of M (4.91) was observed in March 2011 and minimum (4.15) during October 2010.Highest evenness value (1.02) was calculated in October 2010 and lowest (0.87) in December 2010.One way factorial analysis for different diversity indices showed significant F value ($F = 30.9792, P \leq 0.01$) which rejected the null hypothesis. Shannon-weinner index (H) for stations showed pooled value of 3.33 where as pooled value of Margalef among stations was calculated to be 3.69 and evenness 0.94 (Table 6).

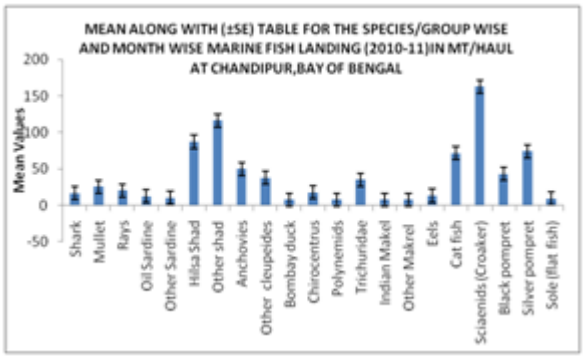

Figure 2: Annual average abundance of 21 groups/species in 2010-11 at Chandipur.

Fig.3 depicted the dendrogram of the hierarchical grouping of species those were mostly abundant during whole study period at Chandipur. This indicated that there was a moderate similarity (D > 45% similarity) in the occurrence and abundance of species at the coast. The largest cluster consisted of

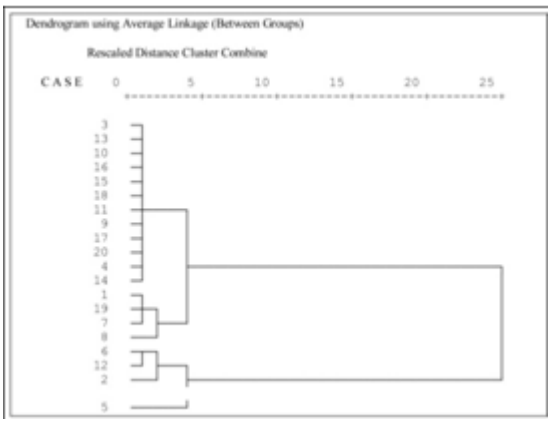

Figure 3: Dendrogram showing similarity between species at Chandipur , Bay of Bengal.

10 species: *S longiceps, C.dussumieri, p.ditchela, L.calcarifer, P.niger, H.hehereus, J.carutta, M.cephalus, C.dorab and S.sihama.* These species were more abundant in monsoon and post monsoon. These clustering confirmed the co-occurrence of species at study area.

4. Discussion

In the Present study 21groups/species of trawl catches were observed which contributed 11.6% of total fishery of the coast [13]. There were also indications that the group Sciaenids, Shads, Pomfrets, Clupeids and catfishes dominated over the year as compared to other species. From monthly abundance value it was clear that value increased from October to January which specified the availability of more number of individuals during these months. This might be related to reproduction, feeding and migration [14].Similar fluctuations of species diversity and abundance had been reported from the shallow waters of the west coast of India [15].The lower number of species must be due to differences in sampling gear and habitat characteristics which ultimately affect species abundance [16].

Table 6 Different diversity indices for nine months during 201011

INDEX	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	TOTAL
Shannon Wiener Diversity (H)	3.15	3.15	3.46	3.56	3.14	3.13	3.12	3.20	3.11	3.26
Margaleaf Richnes (M)	4.62	4.47	4.58	4.15	4.47	4.40	4.43	4.65	4.91	3.53
Evenness Index (PIE)	0.88	0.89	0.97	1.02	0.88	0.87	0.88	0.90	0.88	0.91

Table 7 Different diversity indices for three stations during 2010-11

INDEX	S1	S2	S3	TOTAL
Shannon Wiener Diversity (H)	3.28	3.30	3.27	3.33
Margaleaf Richnes (M)	4.23	4.26	4.12	3.69
Evenness Index (PIE)	0.92	0.92	0.91	0.94

The abundance and diversity of marine fish species might be associated with feeding, nursing and reproductive habits [17]. The increase in number of individuals of each species during winter months viz. October, November and December might be due to post spawning period resulted in more numbers of juveniles and adults [18].Another group Mullets including the species *Sillago sihama* and *Mugil cephalus* showed their consistent occurrence in the bay which suggested that some species of estuarine origin were marine immigrants but completed their life cycle in that zone. This indicated the dominance of both marine and estuarine residents over the bay [19].

Sciaenids, flatfish, pomprets and clupeids were resident coastal marine species contributed more than 60% of the total fish species in the present study suggesting the dominance of species of marine origin [18]. High diversity value was attributed to availability of food resources and suitable environmental conditions of the coast which was also demonstrated by [16]. High diversity and species richness is a characteristic feature of sub tropical and tropical waters [20]-[21]. Higher Shannon-Weinner index specified presence of a large number of species which used the bay as their habitat. The coast indicated higher abundance of finfishes of commercial value. The present study, however did not suggest the abundance and dominance of one or two species. And cluster analysis of most dominant 21 species showed similarity between them to a large extent. This corroborates earlier findings from west coast of India. [21]

5. Conclusion

The present findings contributed additional knowledge of coastal and demersal fish diversity than qualitative and quantitative aspects, as little was known about the estuaries and bays of the Indian coast. And the Bay of Bengal at Chandipur offered high species richness with a rich biodiversity. The conclusions were drawn to predict the diversity however based on the data of one year only. Thus further study is required.

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