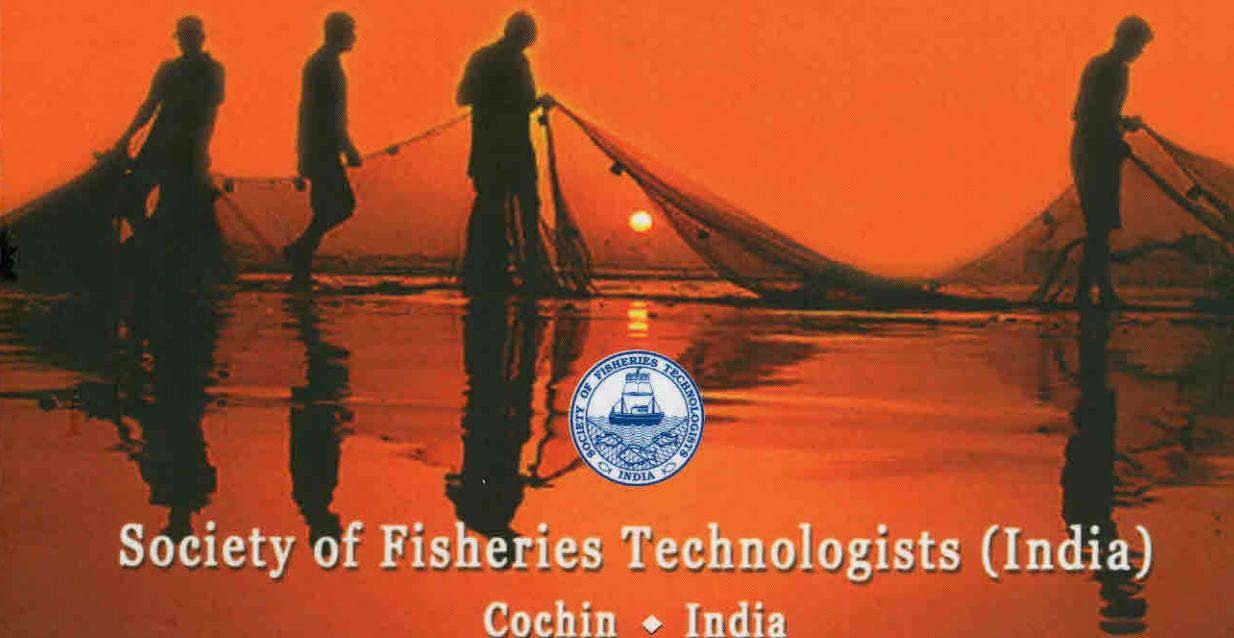


Coastal Fishery Resources of India

• Conservation and Sustainable Utilisation



Society of Fisheries Technologists (India)

Cochin ♦ India

Coastal Fishery Resources of India: Conservation and Sustainable Utilisation

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Validation of Potential Fishing Zones along Saurashtra Coast, Gujarat

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Introduction

Satellite based sea surface temperature (SST) images are being used as an input for locating potential zones of productivity and hence fish availability for commercial fishing operations since last three decades (Breaker, 1987). With the availability of chlorophyll images the relationship and the potential zones of productivity could be more easily predicted (Arnone, 1987; Solanki *et al.*, 2003). Potential Fishing Zone (PFZ) forecasts were started in India during 1989-90 using NOAA-AVHRR derived sea surface temperature data (Solanki *et al.*, 1998). First attempt to correlate the fish catch with temperature along the Indian waters was by (Nath *et al.*, 1991). An integrated approach for fishery resource exploration using the SST data from NOAA-AVHRR and chlorophyll data from SeaWiFS was perfected by Solanki *et al.* (2001a). With the launch of the Indian remote sensing satellite (IRS P4), the data on the chlorophyll was available from OCM and hence synergistic analysis of temperature and the ocean colour was made possible using Indian satellites along for fishery forecasts (Solanki *et al.*, 2001b). The validation of the forecasts was carried out by Fishery Survey of India and Central Institute of Fisheries Technology and the results showed that there was an increase in catches by around 70% when compared to non-PFZ areas. This technology was then transferred to the Indian National Centre of Ocean Information Services (INCOIS, Hyderabad) for wider dissemination among the Indian fishermen (Solanki *et al.*, 2003). Since then, INCOIS has been transferring the PFZ advisories for the different coastal states of India. CIFT has been collaborating with INCOIS for validation of the PFZ advisories along the Gujarat coast. The objective of this study is to evaluate the catches generated by commercial trawlers fishing in the notified PFZ areas and

the non-PFZ (NPFZ) areas. Economic analysis and characterisation of the catches from the PFZ and NPFZ areas have been attempted.

Materials and Methods

The study was carried out along the Saurashtra coast of Gujarat. Two major fishing harbours of the region *i.e.*, Veraval and Diu were selected for the study. Data was collected from the commercial trawlers operating from these harbours. A structured survey form was made including the parameters regarding the fishing operations and the actual location of fishing using GPS. The survey forms were given to the skippers of commercial trawlers and their input was collected and analyzed for the study. The data on other factors like the length, engine power and other technical characteristics of the vessels were collected from the registration details of the trawlers. Vessels selected for the comparative study had similar fishing power and other accessories so that direct comparisons could be made between the catches obtained from different fishing areas.

The validation was carried out during the period from September 2008 to December 2008. A total of 34 PFZ advisories from INCOIS were released during this period. The catch details were collected when the vessels reached the harbour after fishing operations. A sample representing the catch was also collected for identifying the species and studying the length statistics of the species. The value of the catch for each species was collected from the sales records of the vessel.

In order to characterise the catches generated from the PFZ and NPFZ areas, the species that contribute the most in these areas in terms of biomass were worked out and a multivariate test of Similarity Percentages (SIMPER) was carried out to find the species that characterized the catches between the two areas (Clarke and Warwick, 2001; Selleslagh and Amara, 2008). Four indices that represented the diversity and evenness of the assemblages caught from the PFZ and NPFZ areas were also worked out. The indices calculated were Total number of species (S), Margalef Index of diversity (d), Shannon evenness H' , Pielou's evenness (J') and Simpson index ($1-\lambda$). A non-metric multidimensional analysis ordination (nMDS) was carried out on the Bray-Curtis similarity matrix of the data for two dimensional delineation of the assemblages generated in the PFZ and NPFZ areas using the PRIMER™ Software (Clarke and Gorley, 2001).

Results and Discussion

Out of the total 34 PFZ advisories received during the period, 19 fishing operations could be validated. Out of the total of 19 geo-referenced validations, 7 results were from non-PFZ locations and the rest from fishing near the PFZ areas notified by INCOIS. The fishing locations and the month-wise area details are shown in Fig. 1.

The number of days the vessels remained at sea for fishing ranged from 9 to 10 days. The catch were normalized to 10 day fishing operations and represented. The mean total catch when the vessels fished near the PFZ areas was recorded as 3.09 tonnes per trip and the mean total catch recorded when fishing in NPFZ areas was 4.08 tonnes. In terms of revenue generated, fishing in the PFZ areas generated higher revenue of Rs. 2,63,170 for 10-day trip. When fishing was carried in the non-PFZ areas, the revenue realized was only Rs. 1,70,165. The average expense for the vessels using the PFZ advisories per trip was estimated at Rs. 46,276 and for the other vessels the mean expenditure was Rs. 52,471. The average profit for the vessels fishing in the PFZ and non-PFZ areas were Rs. 2,16,896 and Rs. 1,17,694, respectively for a trip duration of 10 days. Analysis using Kolmogorov-Smirnov two sample test has shown that the differences in the total catch and profit were statistically significant ($P < 0.05$). The results of the diversity indices calculated for the catches in the PFZ and non-PFZ areas are shown in Table 1. The mean values for the indices were not significantly different between the assemblages caught from the PFZ and NPFZ areas ($P > 0.05$).

Table 1: Means of the diversity indices for the assemblages in the PFZ and non-PFZ areas

Location	S	d	J'	H'	1-λ
PFZ	14	1.63	0.63	1.64	0.69
NPFZ	15	1.72	0.70	1.87	0.77

The SIMPER analysis showed that the average similarity (69.47%) of species assemblages was higher when fishing was carried out in the NPFZ areas, whereas the similarity among the species was only 31.58% in the PFZ areas (Table 2). The similarity in the NPFZ areas was due to the contribution of three low value fishes among the top five like *Nemipterus japonicus*, *Priacanthus hamrur* and *Saurida tumbil*. In case of PFZ areas, four among the top five species (except *Solenocera* sp.)

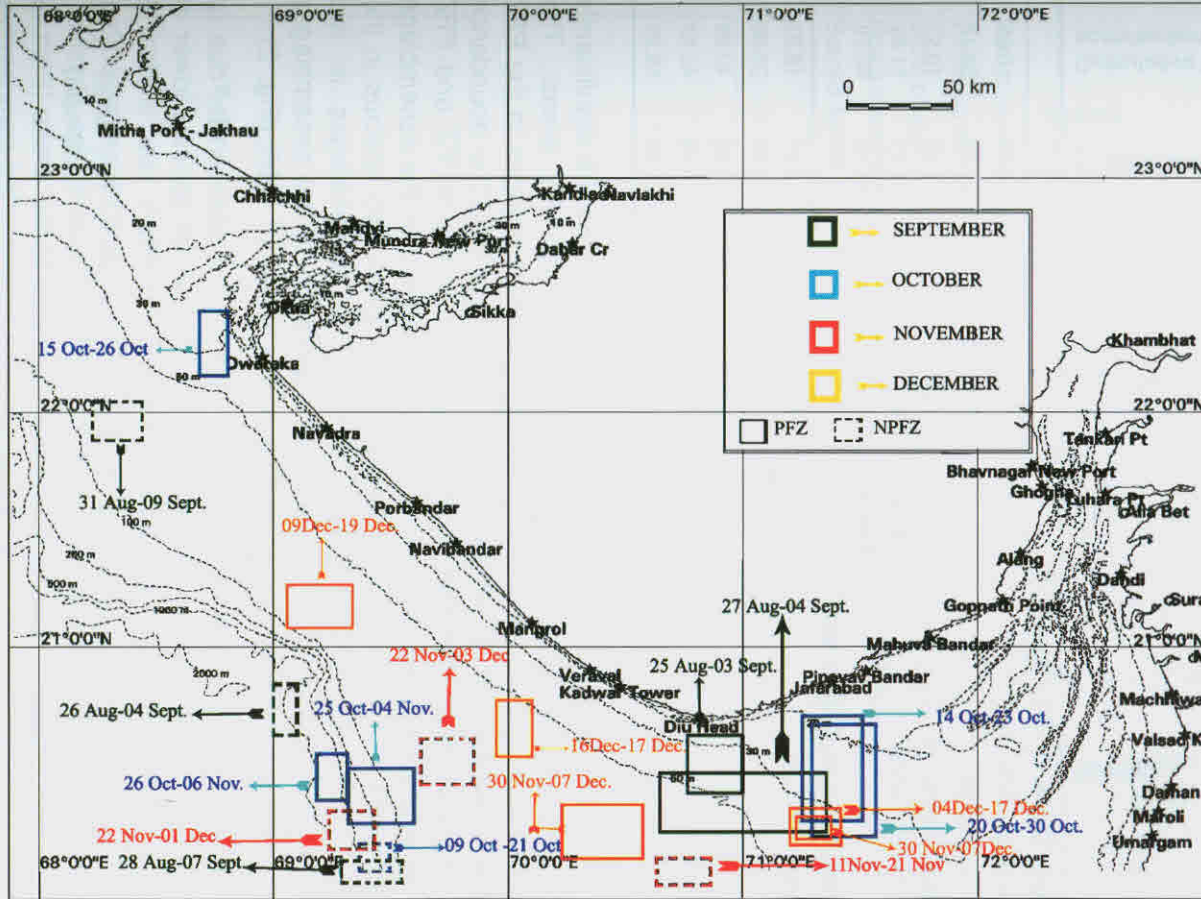


Fig. 1. The area of operation of the commercial trawlers in the PFZ and NPFZ areas for different months

Table 2: Species contributing to the average similarity between the PFZ and NPFZ areas

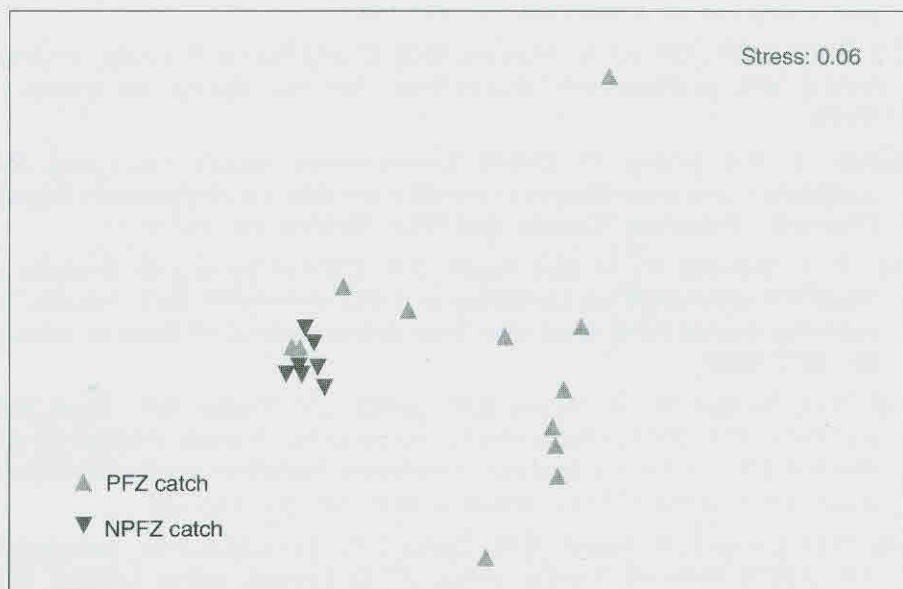
Species	Average abundance	Average similarity	Similarity/SD	% contribution	Cumulative % contribution
Average Similarity NPFZ (69.47%)					
<i>Nemipterus japonicus</i>	1378.57	11.60	7.20	16.69	16.69
<i>Sepia pharaonis</i>	612.14	8.84	4.16	12.73	29.42
<i>Uroteuthis duvauceli</i>	345.71	7.74	6.40	11.15	40.57
<i>Priacanthus hamrur</i>	450.00	7.73	10.41	11.12	51.69
<i>Saurida tumbil</i>	478.57	7.71	6.27	11.10	62.79
Average Similarity PFZ (31.58%)					
<i>Trichiurus lepturus</i>	922.92	5.71	0.82	18.07	18.07
<i>Arius</i> sp.	308.33	4.42	1.07	13.99	32.06
<i>Johnius dussumieri</i>	91.67	2.53	0.66	8.02	40.08
<i>Solenocera</i> sp.	58.33	2.05	0.79	6.49	46.57
<i>Uroteuthis (P) duvauceli</i>	236.25	1.79	0.49	5.66	52.23

were high value species and this explains the reason for the significantly higher profit when fishing was carried out along the PFZ areas. The average dissimilarity noticed among the species assemblages in the PFZ and NPFZ areas was 68.36. The results clearly showed the abundance of *Nemipterus japonicus* and *Trichiurus lepturus* in the NPFZ and PFZ catches respectively and the reason for the difference in the assemblage structure was due to the presence/absence of these two species in the catches (Table 3). The ordination plot of the assemblages in two dimensional scales also shows the clear separation of the assemblages caught from the different areas with a stress value of 0.06 (Fig. 2).

The presence of high value fishes in the PFZ areas can be due to the higher productivity which attract fishes to forage on species lower in the trophic level. Although the sample size of the study was limited, it clearly shows the difference in the structure of the assemblages generated in the PFZ and NPFZ areas. The difference can be due to the physical, chemical and biological parameters associated with these areas (Platt *et al.*, 2005; Chandran *et al.*, 2004; Wu *et al.*, 2008). Controlled comparative experiments with standard nets and concurrent analysis of physico-chemical parameters from PFZ and NPFZ areas will help in elucidating the reasons for changes in the assemblage structure.

Table 3: Species contributing to the average dissimilarity between the PFZ and NPFZ locations

Species (Average dissimilarity = 68.36)	Average abundance (PFZ)	Average abundance (NPFZ)	Average dissimilarity	Dissimilarity/SD	% contribution	Cumulative% contribution
<i>Nemipterus japonicus</i>	187.50	1378.57	5.04	1.57	7.38	7.38
<i>Trichiurus lepturus</i>	922.92	0.00	4.66	1.33	6.82	14.20
<i>Sepia pharaonis</i>	26.67	612.14	4.23	1.84	6.19	20.39
<i>Priacanthus hamrur</i>	47.08	244.43	3.56	1.80	5.20	25.59
<i>Saurida tumbil</i>	105.83	450.00	3.46	1.49	5.06	30.66

**Fig. 2. nMDS plot showing the separation of assemblages in the PFZ and NPFZ locations**

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