Catch per Unit Effort Comparison between Potential Fishing Zone and non-Potential Fishing Zone from 2008 to 2011 of West Bengal coast, India

Sachinandan Dutta1,*, Sourav Maity1,2 & Sugata Hazra1
1 School of Oceanographic Studies, Jadavpur University, Kolkata -700032, India.
2 Indian National Centre for Ocean Information Services, Hyderabad-500090, India.
*[E.Mail: duttasachi@gmail.com]

Received 10 February 2014; revised 22 October 2014

The Catch per Unit Efforts (CPUE) of Potential Fishing Zone (PFZ) and non-Potential Fishing Zone (non-PFZ) has been evaluated for four years from 2008 to 2011 in the West Bengal coast of the northern Bay of Bengal, India. The CPUE is calculated in kg per hour against 182 validated PFZ forecasts. The CPUE in PFZ areas are found to be consistently higher, often double than that of non-PFZ areas (34.63 ± 18.59 kg h⁻¹ in PFZ, 17.15 ± 9.12 kg h⁻¹ in non-PFZ). That indicates the benefit of utilization of PFZ advisories. The total CPUE, however has been found to be declining in recent year (R²=0.7987) due to increasing the number of mechanized fishing vessels and overexploitation of marine fishes.

[Key words: Catch per Unit Effort, Marine fishery, Potential Fishing Zone, Bay of Bengal, Overexploitation.]

Introduction
Ocean provides food to mankind; economic benefits and recreation. Living marine resources represent a treasure for current and future generations. Potential Fishing Zone forecasting has been developed by Indian National Centre for Ocean Information Services (INCOIS) from the information based on satellite derived Chlorophyll and Sea Surface Temperature (SST) data. This forecasts are freely circulated to local fishermen around the coast of India by fax, phone, internet, electronic display boards, newspaper and radio broadcasts in local languages. Satellite remote sensing can be an extraordinarily effective and powerful tool in marine fishery research, management and operational fishing. In India, in the last few decades, fisheries research together with the technological advancement in the harvest and post-harvest period accelerated the process of transformation of a subsistence oriented traditional marine fisheries into a market oriented multifarious industrial activity with considerable strength and capabilities. It has long been recognized that CPUE may not accurately reflect changes in abundance of marine fisheries. Despite its well-documented shortcomings, the CPUE from many commercial and recreational fisheries is used in the assessment of fish populations, with strict proportionality between CPUE and abundance frequently assumed. For a given stock of fish the proportion of the locally available stock that is captured by a unit of effort is constant. In India different authors like Chaudhury et al., Solanki et al., Pillai and Nair, Solanki et al., Chandran et al., Srinivasa et al., Deshpande et al. work on PFZ and utilization of PFZ advisories. The present study has been conducted to evaluate the marine CPUE in PFZ and non-PFZ of West Bengal coast, India, and to establish the total CPUE trend for the four years of the study period (2008-2011).

Materials and Methods
The PFZ validation program has been conducted in West Bengal since 2007. The present study is based on the data collected from northern Bay of Bengal of West Bengal coast, India (Fig. 1) for the period of 2008 and 2011. West Bengal has a ~200 km coast line having a magnificent mangrove forest of ‘Sundarban’ in eastern side and an open coast of Digha-Shankarpur in western part. Continental self of West Bengal is wide and shallow having a muddy bottom and its configuration is affected by the large river...
systems and tidal currents. Marine fishing zone of West Bengal has enormous potential for commercial fishes due to influx of nutrients laden water in the Bay of Bengal through rivers and creeks of the three coastal districts. With a very large body of inland water for capture and culture fisheries, West Bengal is better known for its considerable inland water fish production. Marine fisheries sector has developed gradually, only during the late ’50s in West Bengal.

The present study is conducted by validation of INCOIS generated PFZ forecasts. A total number of 182 forecasts were validated between 2008 and 2011 by hiring fishing boats from Frasergunj Fishing Harbour, West Bengal, India in the northern Bay of Bengal (NBOB) (Fig. 1). A total of ten fishing boats were directly and indirectly used for validation of the PFZ forecast. All the boats having on average six cylinders 160 HP engine, about 55-59 feet length and 30-35 tonnes in weight, with capacity of 30 tonnes. Fishing locations were marked by Global Positioning System (GPS) in the PFZ and non-PFZ areas. The CPUE in its basic form can be defined as the total catch divided by the total fishing effort in a given period, or in formula $U = \frac{C}{f}$, in which $U$ denotes the CPUE, $C$ denotes the total catch and $f$ stands for the total fishing effort. The CPUE was calculated in kg per hour, from the catch per haul data.

**Results and Discussion**

Potential Fishing Zone is a technique of identifying the fish shoals depending upon certain oceanic features. In 2008 the mean CPUE was 47.47 ± 21.59 kg h$^{-1}$ in PFZ and 22.96 ± 7.77 kg h$^{-1}$ in non-PFZ. The CPUE was found minimum in the month of March and April, 2008 (Fig. 2). Mean CPUE in PFZ and non-PFZ were 46.65 ± 14.87 & 24 ± 7 kg h$^{-1}$ simultaneously in 2009, but in the month of March to April the same lowering trend prevailed in both the zones (Fig. 3). The overall CPUE declined in November and December, 2010 (Fig. 4), whereas the mean CPUE in PFZ and non-PFZ were 36.81 ± 16.64 kg h$^{-1}$ and 17.46 ± 8.68 kg h$^{-1}$ respectively. In 2011 the mean CPUE in PFZ was 7.87 ± 4.80 kg h$^{-1}$ and in non-PFZ it was 3.64±1.93 kg h$^{-1}$. In few cases the CPUE of non-PFZ is equal and higher than the PFZ in 2011 (Fig. 5). Overall CPUE was observed to be high in PFZ than non-PFZ in the West Bengal coast of NBOB from the year 2008 to 2011 (Fig. 6). So, it could be inferred that the PFZ forecasts stand immense beneficial to the fishermen to minimize the effort and maximize the benefit. The increase in CPUE for vessels using PFZ advisories is about 4.3 times more than those vessels fishing in non-notified locations. The CPUE is comparatively high along the PFZs from the surroundings. Solanki et al. validated PFZ derived from chlorophyll and SST along Gujarat using gill net and reported 2–3 fold increase in catch in the PFZ zone. The total CPUE was found to be decline in recent year ($R^2=0.7987$) (Fig. 7) in West Bengal water. The overexploitation could be ascertained as the main cause behind this decline in the CPUE, as the number of fishing vessel is increasing day by day. Potential Fishing Zone forecast from satellite derived data of oceanic parameters was found to be useful in increasing the fish catch in the forecast areas. CPUE data found to be consistently higher in notified areas than that in the non-notified areas. There is a summer low of CPUE during the month of March and April in

---

**Fig. 1** - Location map and bathymetry of the study area, off West Bengal, India, in the northern Bay of Bengal. Depth contours are in meters.
most of the year. The comparatively lower catch of post monsoon (November and December) of 2010 is due to failure of monsoon in this part of Bay of Bengal which also lead to the breeding failure of Hilsa in that year leading to an extremely low monsoon catch in 2011. In spite of the consistent success in predicting existence of fish shoals from satellite derived SST and chlorophyll-a data the CPUE in West Bengal marine fishing sector was found to decline over the present years. The decline apparently indicates non sustainable fishing practice due to increasing number of mechanized boats (fishing efforts).

Fig. 2- Compression of CPUE between PFZ and non-PFZ in 2008 from West Bengal coast.

Fig. 3- Compression of CPUE between PFZ and non-PFZ in 2009 from West Bengal coast.
A statistical offering from Frasergunj fishing harbor (Fig. 8) indicates that with increasing number of boats the CPUE increased until the year 2007, but started to decline 2008 onwards, with increasing efforts. The number of registered mechanized boats in West Bengal has gone up from, 889 in 2002-03 to 2172 in 2009-10. Thus overexploitation of fish stock can be inferred from the present study.
Fig. 7- Decline trend on the total CPUE from 2008 to 2011.

Fig. 8- Catch per unit boat in Frasergunj Fishing Harbour. Number of boats increases from 2001 to 2010, and catch increases up to 2007 and then decreases.

**Conclusion**

Satellite based marine fishery forecast that is Potential Fishing Zone forecast is very useful to the fishermen, as it is decreasing the fishing effort on one hand and increasing the profit as a consequence. But due to huge fishing pressure the fishing effort is declining in recent years. Overexploitation of the most important natural resource has to be tackled in sustainable manner for the future. By removing fishing pressure from specific areas and regulating fisheries in the surrounding waters, managers and stakeholders expect to enhance fishing yields and to conserve marine habitats at the same time\(^\text{16,17}\). Hence a strong fishing regulation must be implemented with a scientific approach for the sustainable management of marine fishery of West Bengal and maintaining the optimum CPUE throughout the year.

**Acknowledgement**

Authors are grateful to the fishermen from West Bengal coast for their assistance during data collection and acknowledge the Indian National Centre for Ocean Information Services (INCOIS) for funding the Potential Fishing Zone (PFZ) validation project, for conducting the present study.

**References**


