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Variability in catch composition and CPUE of bottom trawl fishery along Parangipettai, Cuddalore and Pazhayar, Southeast coast of India, Bay of Bengal

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The present study intended to find out the variations in fish composition and CPUE (Catch Per Unit Effort) (November 2017 – March 2018) of bottom trawl fishery at three stations *viz*., Parangipettai, Cuddalore and Pazhayar. Out of 16 sampling from these three stations, the highest CPUE was recorded from Parangipettai (70 kg/hr) and Cuddalore (51.4 kg/hr) between January and February 2018. Altogether, 67 finfish and shellfish species were identified from the trawl catches, of which *Trichiurus lepturus*, *Leiognathus equula*, *Nemipterus furcosus*, *Rastrelliger kanagurta*, *Nibea maculata*, *Deveximentum insidiator*, *Nemipterus randalli*, *Terapon theraps*, *Eubleekeria splendens*, *Loligo vulgaris*, *Nemipterus japonicus*, *Sepia officinalis*, and *Leiognathus berbis* were found as commercially important fishes. Additionally, *Loligo vulgaris* (165 kg) and *Leiognathus berbis* (35 kg) were found dominantly in the total catches from January to March 2018. The present investigation revealed that amid three study areas investigated, Parangipettai and Cuddalore exhibited higher total catch, CPUE, and fish diversity, which is also highlighted in the PCA (Principal Component Analysis). The high catch noticed in these areas might be due to increased productivity in the post-monsoon season supported by corresponding monsoonal nutrient influx, as Parangipettai and Cuddalore coastal waters experience high estuarine influx. Further, it was also evidenced by the observed higher values of essential nutrients such as nitrate (Cuddalore: 7.66 µM; Parangipettai: 8.17 µM) and silicate (Cuddalore: 6.68 µM; Parangipettai: 8.48 µM), and chlorophyll-*a* concentration (Cuddalore: 1.43 µg/l; Parangipettai: 2.09 µg/l) at both the stations.

[**Keywords**: CPUE, Finfish, Fish diversity, Seasonal variability, Total catch]

Introduction

Ocean is a vast reservoir of food resources, and it has been potentially used by mankind for a very long time. The living resources in the seas/marine environment represent a treasure for current and future generations[1]. During the last few decades in India, fishery research, together with advanced technologies in resource harvesting has enhanced the traditional marine fisheries into successful market-oriented fishery[2]. Trawling is one of the most efficient methods for fish catch[3]. It is a mixed fishery that targets a number of species of different sizes and is simultaneously involved in discarding the unwanted fish catch commonly known as bycatch[4-6]. The discarded catch or by-catch also includes commercial fishes that are below Minimum Landing Size (MLS) or less profitable species[7].

In India, the total marine fish production is majorly contributed by trawlers and these are commonly used worldwide to obtain fish catch. It is the most regularly used fishing method in India and has played a substantial role in the economic growth of fisherfolk[8]. Bottom trawls are known to use non-selective gears targeting multi-species fishery with multiple sizes of fish fauna that eventually results in the generation of huge amounts of by-catch including (unwanted/non-commercial size grade of targeted and non-targeted fishes and other non-edible species)[4,9,10].

The Catch Per Unit Effort (CPUE) is the quantity of fish caught (in number or in weight) with one standard unit of fishing effort. CPUE in bottom trawling is estimated by the catchability (q) and the abundance of fish (N) in the area where the trawl is deployed[11]. To obtain accurate estimates of population abundance, it is crucial to comprehend the impact of fish behaviour and trawl gear on catch data[12]. The changes in species abundance in marine fisheries may not be identified accurately by CPUE in marine fisheries[13]. However, the CPUE from many commercial and recreational fisheries is mostly used in the assessment of fish populations, with strict proportionality between CPUE and abundance is frequently assumed[14]. There have been limited trawl fisheries studies on CPUE and catch composition in the coastal waters of Cuddalore, Parangipettai, and Pazhayar. The existing trawl fishery investigations along the studies regions primarily focused on bycatch[15,16], coral reef-associated fisheries[17], and fish diversity[18]. However, comprehensive studies on CPUE and catch composition in these coastal waters remain relatively scarce.

Marine fisheries in India are strictly restricted to inshore waters of continental shelf. The fishery resource in the Bay of Bengal includes pelagic and demersal finfishes, crustaceans, and molluscs; off these, the latter three fishery resources are mainly harvested using the bottom trawlers. There have been many scattered reports on the fishery stock and CPUE from the potential fishery zones of India through PFZ funded projects and advisories[1,19-21]. One reason for the lack of comprehensive studies on CPUE from India could be the complex nature of data collection on fishery statistics due to high landing platforms and scattered harbours all along the coastline. The present study regions are located in the Southeast coast of India and the information on CPUE and catch composition along the region is scarce except for a few attempts as highlighted above. Hence, the present study aims to investigate the monthly variations in CPUE and species composition using bottom trawl net along Parangipettai, Cuddalore and Pazhayar.

Materials and Methods

Study area and sampling strategy

The study was conducted between November 2017 and April 2018 at three coastal stations *viz.*, Parangipettai, Cuddalore, and Pazhayar, using stern trawlers (Fig. 1). Totally, 16 bottom trawl hauls were taken using a net mesh size of 18 mm at the cod end. Towing time ranged from 2.2 to 4.45 h, and the average speed was 2.5 knots/hour. Sampling was done randomly among three stations (*viz.*, Parangipettai, Cuddalore and Pazhayar) from November, 2017 to April 2018. During November 2017, sampling was not carried out in Cuddalore and Pazhayar due to monsoonal rainfall. Sampling depth ranged between 0 – 35 m. Each haul's time and GPS position was noted and is presented in Table 1. The collected catches

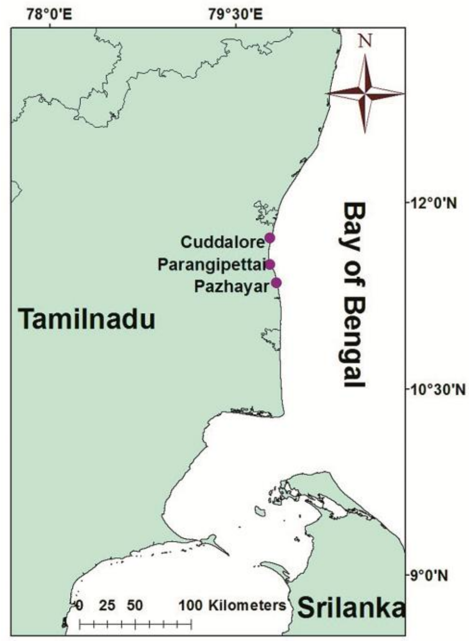

Fig. 1 — The geographical location of the study area

were sorted immediately after hauling and 5 % of the total catch were obtained and frozen in icebox for biological measurements (Figs. S1 & S2). For the CPUE analysis, total catch including commercial catch and bycatch was considered.

Physico-chemical parameters

For each station, the physico-chemical parameters such as atmospheric temperature (a. temperature), water temperature (w. temperature), salinity, pH, Dissolved Oxygen (DO), nitrite, nitrate, ammonia, silicate, inorganic phosphate and suspended solid concentration were analysed. Physical parameters such as temperature, pH and salinity were measured immediately after the sample collection by using Multistem digital Thermometer (accuracy ±0.1), Hand held Refractometer (ATAGO S/Mill-E), and pH pen, respectively. DO estimation was done by Winkler's titration method. Other physico-chemical parameters such as nitrite (NO_2), nitrate (NO_3), ammonia (NH_4), inorganic phosphate (PO_4), total suspended solids (TSS) and reactive silicate (Sio_4) were analyzed by following Strickland & Parsons[22].

Catch Per Unit Effort (CPUE) estimation

The total catch was sorted based on the species or respective faunal groups and their abundance and weights (species-wise/ group-wise) were registered. Catch Per Unit swept Area (CPUA) is mostly based on the commercial or survey data. Usually, survey data are kept constant to the extent possible[23]. The

Table 1 — GPS location and trawling operation (GPS location, swept area, depth) carried out in Parangipettai, Cuddalor and Pazhayar stations

Months	Date	Location	Start coordinates	End coordinates	Towing time (h)	Swept area (km^2)	Depth (m)	Type of net	No. of haul	Total catch (kgs)	CPUE (kg/hr)
November	18-11-2017	Parangipettai	11°30’65” N 79°48’06” E	11°31’58” N 79°47’75” E	4.0	64.18	0-25	Trawl	1	82	22.5
December	20-12-2017	Cuddalore	11°43'08.3” N 79°47'43” E	11°42’20.87” N 79°47’34.2” E	2.4	68.7	0-10	Trawl	1	89	37.08
	22-12-2017	Parangipettai	11°30'18.2” N 79°47'37.7” E	11°31’66.2” N 79°46’64.6” E	3.2	115.3	0-15	Trawl	1	93.8	29.31
	27-12-2017	Parangipettai	11°31'17.2” N 79°47'38.6” E	11°31’74.5” N 79°46’21.5” E	2.3	76.5	0-10	Trawl	1	49.1	21.31
January	15-01-2018	Cuddalore	11°43’ 37.8” N 79°47’44” E	11°42’10.8” N 79°47’32.2” E	4.4	144.5	8-20	Trawl	1	181.4	40.74
	20-01-2018	Parangipettai	11°30'56.7” N 79°47'0.02” E	11°32’31.7” N 79°47’912” E	3.08	115.3	9-20	Trawl	1	83	26.94
	20-01-2018	Parangipettai	11°32'44.6” N 79°48'0.32” E	11°31’877” N 79°48’029” E	2.47	115.3	18-23	B. Trawl	1	174.5	70.64
February	02-06-2018	Pazhayar	11°20’00” N 51°65’0.00” E	19°63’0.0” N 53°47’50.0” E	4.0	131.6	7.5-24	B. Trawl	1	43.8	10.77
	02-08-2018	Parangipettai	11°31'0.19” N 79°47'48.4” E	11°31’66.6” N 79°47’84.7” E	3.35	156.4	8.5-22	B. Trawl	1	39.08	10.74
	21-02-2018	Cuddalore	11°32'16.9” N 79°48'19.2” E	11°31’76.7” N 79°48’12.2” E	2.47	46.6	17-22	B. Trawl	1	69.4	51.41
March	21-03-2018	Parangipettai	11°31'4.80” N 79°47'37.40” E	11°31’3.39” N 79°47’52.80” E	3.04	102.5	7-25	Trawl	1	29.8	9.86
	24-03-2018	Cuddalore	11°43'1.69” N 79°51'10.02” E	11°41’35.05” N 79°47’48.08” E	2.93	101.1	10-35	Trawl	1	50.9	17.37
	28-03-2018	Pazhayar	11°23’5.85” N 79°52’25.49” E	11°21’55.32” N 79°51’3.82” E	2.35	51.7	8-30	Trawl	1	50.9	21.66
April	05-04-2018	Parangipettai	11°31'30.2” N 79°48'9.27” E	11°31’8.30” N 79°47’21.3” E	2.23	69.4	7-25	Trawl	1	37.7	16.91
	07-04-2018	Pazhayar	11°22'10.7” N 79°50'23.3” E	11°22’28.1” N 79°50’32.2” E	2.21	58.2	10-35	Trawl	1	7.2	2.35
	10-04-2018	Cuddalore	11°42’51.6” N 79°47’59.8” E	11°43’04.5” N 79 °47’55.2” E	1.8	57.9	8-30	Trawl	1	59.5	33.06

equation of Gulland[24] was adopted to calculate the CPUE index for each haul:

$CPUE = Cw/h$

Where, ‘*Cw*’ is the total catch weight (kg), and ‘*h*’ is the tow time (h) or fishing effort[24].

To evaluate the distance towed while harvesting, the Swept area for each collection was calculated, and the details of the area swept for every collection is given in Table 1. Swept area (CPUA) was calculated by following the methodology of Sparre & Venema[25].

$CPUA = Cw/a$

Where, ‘*a*’ represents the swept area for each species and for each haul and ‘*Cw*’ represent catch weight.

The swept area (*a*) or the effective path swept for every haul carried out was estimated by following equation given by Sparre & Venema[25].

$a = D.h.\ X$

Where, h = length of the head rope; D = the distance covered by the net during a haul; and X is the fraction of the head-rope length equal to the width of the path swept by the trawl.

In the present study, the value of X varied from 0.35 to 0.61. It has been stated that $X = 0.5$ is the best compromise value[25]. D is the distance swept by net, calculated for each haul in units of nautical miles[25] and subsequently converted to kilometres by multiplying with 1.82 (One nautical mile = 1.852).

Data analyses

To find out the significant temporal and spatial variations in CPUE, two-way ANOVA was conducted. Further, Principal Component Analysis (PCA) was performed to discern the variation in environmental variables in the study locations. Shannon-Wiener diversity index (H’), Richness (S) and Pielou's species evenness (J) were calculated for the fish collected from the study area. For the Cuddalore station missing data in November and missing data for Pazhayar station during January and February months were considered as zero. To determine the correlation between catch composition and environmental parameters, Pearson correlation coefficient analysis was done using Microsoft Excel 2019. All the statistical analyses were done using R software (version 3.1.3) with two different packages. The FactoMineR package was used to perform PCA, and Vegan package was used to calculate the diversity indices. All the other graphs were plotted using Microsoft Excel 2019.

Results and Discussion

In the present study, altogether 16 fishing operations were conducted at three different locations *viz*., Parangipettai, Cuddalore, and Pazhayar using mechanized trawl boat with bottom trawl net. Only commercial species of finfishes and shellfishes were identified to find out the potential fishing zone among the three selected stations.

Principle Component Analysis (PCA)

Environmental parameters observed at the study locations are given in Table 2. PCA analysis was used to understand the physico-chemical characteristics of chosen study locations. PCA identified three components with eigenvalue greater than 1, accounting for 77.4 % of the total variation. Dimension 1 accounted for 51.3 % (Fig. 2), representing variables such as a. temperature, w. temperature, pH,

Table 2 — Physico-chemical parameters of Parangipettai, Cuddalore and Pazhayar stations

Month	Date	Location	a. Temp (°C)	w. Temp (°C)	pH	DO (mg L^{-1})	Salinity	NH_3 (µM L^{-1})	NO_2 (µM L^{-1})	NO_3 (µM L^{-1})	IP (µM L^{-1})	SIO_3 (µM L^{-1})	Chl-*a* (µg L^{-1})	TSS (mg L^{-1})
November	18-11-2017	Parangipettai	1.0	26.7	7.9	5.0	30.0	0.1	0.5	6.2	0.3	8.2	0.3	59.6
December	20-12-2017	Cuddalore	28.0	27.0	7.9	5.1	32.5	0.4	0.6	5.2	1.3	5.7	0.5	46.0
	22-12-2017	Parangipettai	27.3	26.2	7.9	5.8	31.5	0.3	0.7	7.7	2.1	4.2	0.6	59.0
	27-12-2017	Parangipettai	27.4	26.6	7.9	5.1	33.0	0.5	0.8	8.1	1.2	4.2	1.1	41.0
January	15-01-2018	Cuddalore	27.5	26.4	7.9	5.3	33.5	0.1	0.7	3.6	0.6	5.0	0.9	42.0
	20-01-2018	Parangipettai	27.6	26.9	8.0	5.4	34.0	0.1	0.2	3.0	0.5	4.5	0.7	39.1
	20-01-2018	Parangipettai	29.6	28.9	8.1	5.1	34.5	0.1	0.2	5.8	0.2	5.8	0.2	39.5
February	02-06-2018	Pazhayar	27.3	27.5	8.0	5.0	30.8	0.1	0.5	1.9	0.4	3.5	0.4	34.4
	02-08-2018	Parangipettai	27.3	27.6	7.9	5.6	31.3	0.0	0.1	2.7	0.4	3.2	0.3	51.3
	21-02-2018	Cuddalore	27.5	27.7	7.9	5.1	32.0	0.1	0.2	2.8	0.3	4.2	0.3	27.7
March	21-03-2018	Parangipettai	27.8	28.2	8.1	5.4	31.5	0.1	1.2	3.2	1.0	3.0	0.6	27.7
	24-03-2018	Cuddalore	28.0	28.6	8.0	5.3	30.5	0.1	1.3	2.5	1.3	2.8	0.5	11.3
	28-03-2018	Pazhayar	27.3	27.5	8.0	5.0	15.5	0.1	0.7	4.2	1.0	3.2	0.8	29.5
April	05-04-2018	Parangipettai	28.0	28.3	8.0	5.2	31.0	0.0	0.0	0.2	0.0	0.1	0.4	22.5
	07-04-2018	Pazhayar	28.3	29.3	8.1	5.8	32.0	0.0	0.0	0.5	0.1	0.3	0.8	27.0
	10-04-2018	Cuddalore	28.6	29.3	8.0	5.4	33.0	0.0	0.0	0.7	0.1	0.2	0.5	20.8

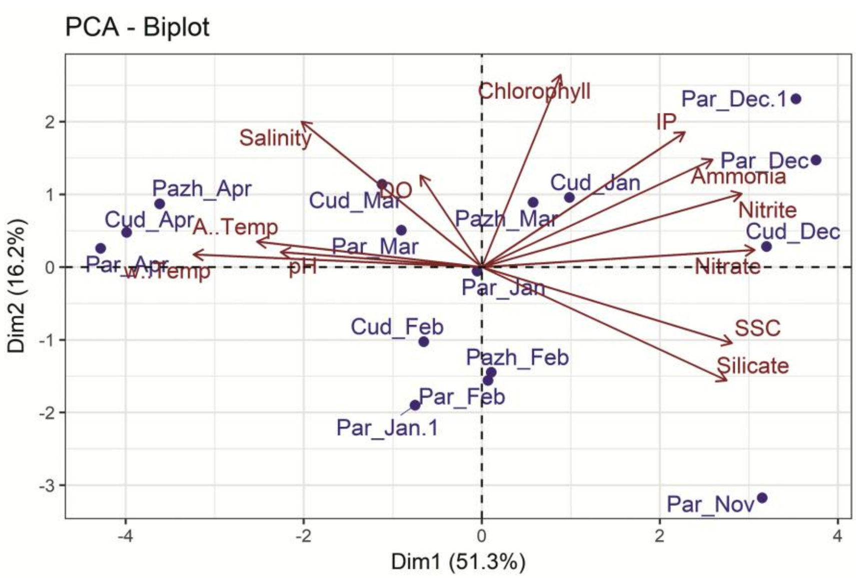

Fig. 2 — PCA of environmental variables in the study area (Pazh - Pazhayar; Cud - Cuddalore; Par - Parangipettai)

DO, and salinity with a strong negative association at stations Cuddalore and Parangipettai during April and March; and at Pazhayar in April. However, silicate and SSC exhibited a strong positive association in dimension 1 with Parangipettai and Pazhayar. Contrastingly, in dimension 2, significant positive relationship with variables like ammonia, nitrite, nitrate, IP and chlorophyll-*a* were observed in Parangipettai and Cuddalore during December and January with 16.2 % variability.

The contribution of variables in PCA analysis is determined by high contribution value of each parameter. The higher the value, the more is the contribution of variable in the dimension. Water temperature (13.61), nitrite (11.78) and nitrate (13.22) in dimension 1 contributed significantly, while in dimension 2, chlorophyll-*a* (35.13), and IP (14.64) have expressed profound contribution with greater value. Additionally, in the PCA analysis, the *cos*2 values were used to estimate the quality of representation. The components with a large value of *cos*2 contribute a relatively large portion to the total distance. Likewise, the high *cos*2 values were identified with variables such as a. temperature, w. temperature, nitrite, nitrate and chlorophyll-*a* in dimensions 1 and 2. The higher variability in w. temperature, nitrite, and nitrate observed at Cuddalore and Pazhayar in dimension 1, and the strong association of chlorophyll-*a*, IP, and ammonia at Parangipettai and Cuddalore in dimension 2, may be attributed to factors such as freshwater inflow, and terrestrial runoff during the monsoon season[26-29].

Correlation between physico-chemical variables and fish catch

Environmental parameters facilitate the aggregation of fish and other commercial fish resources thus it is important to find out the relationship between fish abundance and physico-chemical parameters[30,31]. Similar to PCA analysis, the correlation coefficient conducted for both environmental parameters and species abundance showed significant positive relationship. In Parangipettai, physico-chemical parameters such as DO, nitrate, IP and chlorophyll-*a* were in significant positive association with catch abundance; whereas, a. temperature and w. temperature showed negative relationship (Table S1). In Cuddalore, chlorophyll-*a* showed strong positive relationship with catch density (Table S2); while in Pazhayar, nitrate, IP and chlorophyll-*a* exhibited positive correlation with catch abundance (Table S3). It is been reported that fish assemblage shows significant positive association with parameters such as DO, chlorophyll-*a*, IP and nitrogenous compounds[32,33] which also corroborates with the present investigation.

Previous study conducted by Solanki *et al*.[20] reported that temperature and phytoplankton are strong controlling agents of fish population density. Similar to this statement, in the present study the chlorophyll-*a* and temperature showed significant positive and negative relationship with catch abundance. The negative relation of temperature in all three stations may be attributed to the reduced CPUE and catch composition obtained during March and April 2018, and positive association of chlorophyll-*a* might have contributed in high catch composition, CPUE and total weight. Further, it should be considered that the distribution patterns of fish communities are intricately linked to various environmental factors, such as water temperature, depth, salinity, nutrients, and currents, along with the fishes own habitat preferences[34,35]. However, past research works have emphasized that temperature and salinity play a pivotal role in determining spatial and temporal distribution of fish and gradual changes in these factors may reshape the fish community structure in a region[36-38].

Catch Per Unit Effort (CPUE) and total catch

In recent days, it is very essential to monitor the status of the resources that includes collection of biological data due to increased demand for fishery resources. Biomass and CPUE estimates are commonly employed to find out the stock indices for management of demersal resources[25]. Analysis of the fish catch data collected onboard has shown marked difference between the six months survey period. Monthly variations in the total fish catch weight (kg) and CPUE are depicted in Figures 3 & 4. Considerable variation was observed in total fish catch during the survey period at all the stations (Fig. 3). Month-wise total catch obtained for each station is represented in Figures S3 – S8. The maximum total catch was obtained at Cuddalore (181.4 kgs) and Parangipettai (174 kgs) during January, 2018 followed by December, 2017 at stations Cuddalore and Parangipettai (Figs. S4 & S5).

The Catch Per Unit swept Area (CPUA) has long been used for the measurement of fish abundance and stock assessment[39]. Likewise, Biomass along with CPUA estimation is used to study stock indices and for management of demersal resources[25,40]. In the

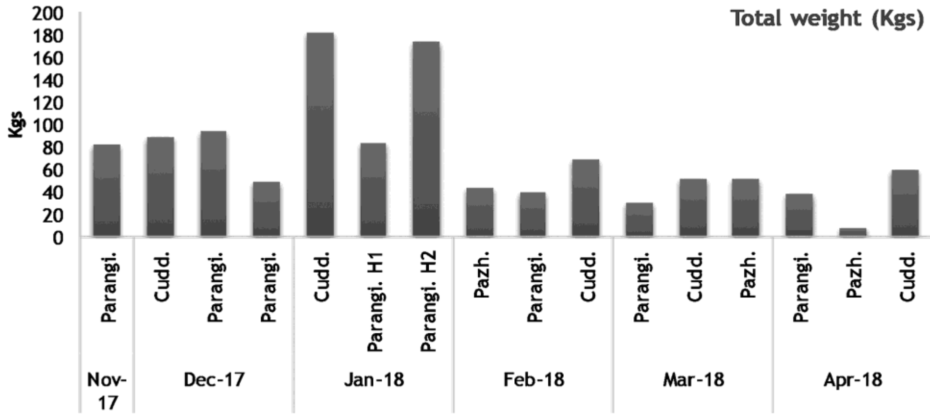

Fig. 3 — Variation in total fish weight collected at three stations during the survey period

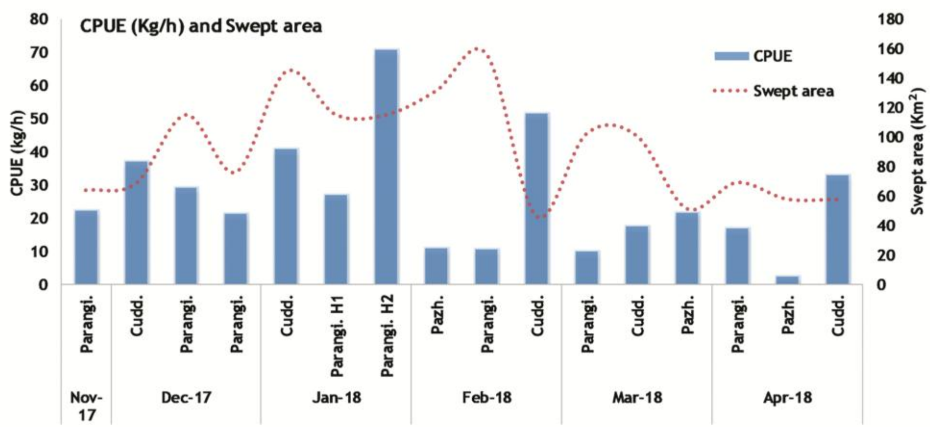

Fig. 4 — Variation in CPUE and swept area at three stations during the survey period

present study, swept area estimation was done to relate with fish catch (Table 1). The high catch was observed with high CPUA (144.5 km^2) between 8 and 20 m depth during January, 2018 at Cuddalore (Table 1, Fig. 3). Similarly, maximum high catches were observed mostly in less depth region (0 – 25 m). However, it has been reported that preference for water depth for many species might associate with the environmental conditions (biotic and abiotic factors) such as, w. temperature, salinity and the sea bottom heterogeneity[34,35].

In station-wise analysis, the highest CPUE (kg/hr) was obtained at Parangipettai (70 kg/hr) and Cuddalore (51.4 kg/hr) during January and February 2018 (Fig. 4). During December 2017, CPUE was almost similar in all the stations (Parangipettai, Cuddalore). The obtained high catches during these months might be associated with seasonal influence as reported earlier[36-38]. The maximum fish catch (total catch & CPUE) obtained during January and February, 2018 at Parangipettai and Cuddalore might be due to the onset of post-monsoon season as environmental parameters favors the plankton growth during this season and the resultant higher productivity might have supported high fish assemblages as highlighted in the literature[41,42]. Further, the freshwater influence also plays a major role in the primary production as a result it enriches the biodiversity of finfishes[18]. However, the fish catch observed in the present study was found to be lesser than the earlier reports. This might be due to the variation in environmental factors, fishing time, high exploitation by other fishing vessels and nursery breeding grounds.

Similarly, it has been reported that the high primary production just after monsoon in the Bay of Bengal is due to the nutrient supplements from the nearby land runoff[43]. From PCA results also it is inferred that Parangipettai and Cuddalore exhibited significant variation in environmental parameters. PCA results confirmed that environmental variables might significantly contribute to variations in fish catch because w. temperature, a. temperature, pH, and DO associated negatively in station Cuddalore and Parangipettai mostly during summer (March & April, 2018) where total fish catches and CPUE were observed to be less. On the other hand, IP, nitrite, ammonia and chlorophyll-*a* expressed significant positive relationship during December, 2017 and January, 2018 at same locations when high CPUE and total catch was observed. From these results, it could be inferred that the positive relationship of nitrogen compounds (nitrite, nitrate and ammonia) might have enhanced chlorophyll-*a* production that in turn could have increased high phytoplankton abundance (primary productivity)[35,36]. These factors might have supported high CPUE and total catch observed during December and January.

In a recent investigation by Prushothaman[18] on diversity and finfish assemblages from trawl catches at Parangipettai and Cuddalore revealed high species diversity and fish catch during Pre-monsoon and Post-monsoon season and reported that Cuddalore and Parangipettai region is highly subjected to freshwater influences from estuaries (Uppanar at Parvannar, Gadilam at Cuddalore and Vellar at Parangipettai) which plays a major role in the overall primary production and enriches the finfish diversity[18].

In addition, the present study observed high chlorophyll-*a* concentration from both Cuddalore (1.43 μg^{-1}) and Parangipettai (2.09 μg^{-1}) which implies that both regions exhibit high primary productivity during post-monsoon (January and February 2018) (Table 2). The high concentration of nutrients observed was also in support of high primary productivity. The nitrate and silicate concentrations were found in the range of 2.53 – 6.68 μmol^{-1} and 3.18 – 6.68 μmol^{-1}, respectively. Hence, the enhanced fish catch and CPUE observed in the present study seems reasonable during post-monsoon period.

A declining trend in CPUE was observed during March and April, 2018 (Fig. 4). Similar lowering trend in CPUE has been observed in previous investigation along West Bengal coast of India[44]. The total CPUE in three stations are comparatively lesser than the earlier investigations reported, which could be attributed to cumulative impacts of ecosystem changes[45], climate change[46], and the increased number of mechanized fishing trawlers[44].

Species composition of trawl fish catch

A species-specific analysis identified a total of 67 finfish and shellfish (crustacean) species, including a category of mixed fishes. Of these 55 species were finfishes, 4 species were found as cephalopods *viz*., *Sepia officinalis*, *Sepia* sp., *Loligo vulgaris*, *Loligo* sp., and 8 crustacean species *viz*., *Metapenaeus monoceros*, *Metapenaeus* sp., *Penaeus monodon*, *Portunus pelagicus*, *Portunus sanguinolentus*, *Charybdis feriata*, and *Charybdis* sp. Figures S3 – S8 depicts the total catch, weight and commercial fish composition caught during the study period. Amidst 16 fishing operations, the maximum fish species were obtained during November – December, 2017 and January – February 2018, at station Parangipettai, Cuddalore and Pazhayar (Figs. 3 & 4). However, the total catch of Cuddalore was comparatively higher than Parangipettai during the study period (Fig. 3).

The commercial fishes that majorly contributed in total weight/ biomass were *Trichiurus lepturus* (Ribbon fish), *Leiognathus equula* (Common Pony fish), *Nemipterus furcosus* (Threadfin Bream), *Rastrelliger kanagurta* (Indian mackerel), *Nibea maculata* (Blotched croaker), *Deveximentum insidiator* (Pugnose ponyfish), *Nemipterus randalli* (Randall's threadfin bream), *Terapon theraps* (Largescaled terapon), *Eubleekeria splendens* (Blacktip ponyfish), *Loligo vulgaris* (European squid), *Nemipterus japonicus* (Threadfin bream), *Sepia officinalis* (Common cuttlefish) and *Leiognathus berbis* (Berbis ponyfish). Of these, fish species with highest yield were *Loligo vulgaris* (165 kg & 75 kg) during January and *Leiognathus berbis* (35 kg) during February, 2018 (Fig. S5 & S6). The cephalopods are considered to be most important seafood resource as they have high market value. Earlier investigation carried out by Ramaiyan[47] stated that cephalopods contributed significantly in the annual landings, of which squids contributed significantly in total catches[48] which coincide with the present findings.

During November and December 2017, total catch was mostly contributed by different types of fishes. However, from January to March 2018, the total fish catch was predominantly occupied by cephalopods (*Loligo vulgaris*, *Sepia* spp.) in almost every station. Many studies reported that the species *Loligo vulgaris* has extended spawning period along the region and stated that this species is usually more abundant in shallow water (< 100 m)[8,49] that corroborate with the present results as the trawling was conducted below 50 m depth at station Parangipettai, Cuddalore, and Pazhayar. In general cephalopods are caught as by-catch of trawl nets along the Indian coast except Vizhinjam-Kanayakumari region where it is a targeted fishery. Trawl nets which operate up to 100 m depth account for 85% of the cephalopod landings. Of these, Cuttlefishes and squid account for about 51 % and 48 % of landings respectively along Indian coast[8,50]. However, in the present study, little contribution of *Sepia* spp. were encountered which may attribute to habitat preference and seasonal factors[34,35].

From March to April 2018, there was a decline in fish catch and was majorly dominated by species such as *Leiognathus* spp., *Gerres filamentosus*, *Trichiurus lepturus*, *Lepturacanthus savala*, and *Stolephorus commersonii* in all the stations (Parangipettai, Cuddalore and Pazhayar). These species are considered as commercially important fishery resource of the Indian coast although no detailed information on their distribution and abundance is available for some of the species[50 51].

Species diversity indices

Species diversity, richness and evenness were estimated for the collected fish individuals in all three stations. The analysis revealed that high species diversity was observed in stations Parangipettai and Cuddalore from December 2017 and January 2018 (Table S4). The observed higher H' index values for both Parangipettai and Cuddalore are 2.51 (December), 1.94 (January); and 2.06 (December), 1.90 (January), respectively (Table S4). Similarly, the maximum species richness (S) was also observed in stations Parangipettai and Cuddalore during December – January 2018. These high values in two stations might be due to the influence of physico-chemical parameters such as DO, chlorophyll-*a* and nitrate as evidenced in correlation analysis with positive relationship. Further, factors such as depth and high primary productivity owing to seasonal influence may also be attributed to high diversity observed at these two stations. Additionally, maximum evenness values were noted throughout the period in Parangipettai (except January) Cuddalore (except November), and Pazhayar (except January and March) (Table S4). Sampling was not done at Pazhayar from November to January 2018, yet the conducted species diversity analysis for the remaining three-month survey (February – April 2018), showed less species diversity and richness.

Analyzing fish community composition and species diversity is a widely employed method for monitoring environmental health and assessing fishery resources. According to earlier investigations environmental factors[52], seasonal variations[53], dominant species, and ecological niches[54] are variables, which influence succession of fish communities and diversity. The present investigation is short survey on fish species composition using bottom trawl net and the investigation showed that there was no significant spatial and temporal variation in species composition among three stations which was clearly evidenced in two-way ANOVA (Stations: $P < 0.48$; $F = 0.81$ & Months: $P < 0.63$; $F = 0.59$). However, the CPUE and total catch exhibited considerable variation ($P < 0.005$) and showed decreasing trend in both CPUE and total catch.

Conclusion

This is a random experimental fishing survey carried out for a short period using bottom trawler in order to relate to a satellite-based forecast. These study locations were planned and selected to understand the fish composition and their habitats in particular time period. Among the 16 field sampling carried out, only one month's (January 2018, 3 samplings) worth of fish harvest was found to be profitable and cost-effective. Further, as physico-chemical parameters also exhibit strong influence on the catch composition and fish assemblage, these should be considered important factors for the fish accumulation[40]. Hence, this study suggests that PFZ forecast-based position information in relation to environmental characteristics is necessary; since, it might save the fishermen time and fuel. The present study was conducted to explore the variations in total catch, CPUE and catch composition among three selected stations to determine the potential fishing regions. However, the duration of the study period is less and moreover the sampling sites at each study area were randomly selected based on fisherman traditional knowledge. Therefore, the present investigation implies that extensive research is needed in comparison with PFZ and Non-PFZ regions to understand the variation in the fish diversity, CPUE and cost effectiveness by employing various crafts and gears for the betterment of fisherfolk.

Supplementary Data

Supplementary data associated with this article is available in the electronic form at https://nopr.niscpr.res.in/jinfo/ijms/IJMS-52(03)145-154-SupplData.pdf

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Conflict of Interest

Authors declare no conflict interest.

Author Contributions

Conceptualization: AS & RKS; Sample collection, parameter analyses, fish identification, formal analysis, writing- original draft preparation: VM; Review and editing: VM, AS & RKS.

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