



E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2019; 7(5): 81-88
© 2019 JEZS
Received: 14-07-2019
Accepted: 18-08-2019

Suraj Kumar Pradhan
ICAR-Central Institute of
Fisheries Education (CIFE), Off
Yari Road, Versova, Andheri
(West), Mumbai, Maharashtra,
India

S Abuthagir Ibrahimi
ICAR-Central Institute of
Fisheries Education (CIFE), Off
Yari Road, Versova, Andheri
(West), Mumbai, Maharashtra,
India

Nakhawa Ajaya Dayaram
ICAR- Central Marine Fisheries
Research Institute, Mumbai
Research Centre (CMFRI),
Andheri (West), Mumbai, India

Latha Shenoy
ICAR-Central Institute of
Fisheries Education (CIFE), Off
Yari Road, Versova, Andheri
(West), Mumbai, Maharashtra,
India

Correspondence

Suraj Kumar Pradhan
ICAR-Central Institute of
Fisheries Education (CIFE), Off
Yari Road, Versova, Andheri
(West), Mumbai, Maharashtra,
India

Catch composition and mapping of DOL net fishery of bhayander estuary, Thane, Maharashtra

Suraj Kumar Pradhan, S Abuthagir Ibrahimi, Nakhawa Ajaya Dayaram and Latha Shenoy

Abstract

Dol net is one of the most important passive traditional gears operated in the estuaries of the Maharashtra state. Fortnight sampling from Sep 2016 to May 2017 carried out by questionnaire based survey and onboard sampling in single-day dol-netters. The catch composition of the dol net noted monthly and the catch comprised of 73 species, of which the major contributors were *Harpadon nehereus* (Bombay duck), *Coilia dussumieri* (Grenadier anchovy), *Lepturacanthus savala* (Small head hairtail), *Johnius amblycephalus* (Bearded croaker), *Mystus gulio* (Tengra), *Parapenaeopsis sculptilis* (Rainbow shrimp), *Charybdis (Charybdis) callianassa* (True crabs), *Enhydrina schistosa* (Beaked sea snake), *Arius maculatus* (Spotted catfish) and *Acetes indicus* (Jawala paste shrimp). The catch per unit effort (CPUE) and mean discard to total catch in dol net was 14.1 kg and 8.11%. The present study revealed that on an average 2.72% (maximum 8.3%) of the total catch was plastic. The catch composition and the mapping of the available resources in this estuary is the baseline information and will be helpful for further steps to be taken for management and conservation of the dol net fishery.

Keywords: Estuary, dol net, catch composition, mapping

Introduction

An estuary is the coastal waterbody between land and sea and the sea water measurably dilutes with the land discharge^[3]. Estuaries have turned into sensitive ecosystem due to the increase in population in many coastal cities, thereby increasing the pressure on the coastal natural systems. High nutrient flow makes the estuary productive, many species of fin fish and shell fishes depend on estuarine waters either entire or for some part of their life. Among many issues which hamper our estuarine resources, bycatch is a major issue. It creates conservation failure in case of bycatch of endangered species such as aquatic mammals, turtles, fishes etc.^[6]. Dol nets of estuarine regions are loaded with huge bycatch of numerous juveniles which is the major challenge for the supply of healthy recruits to the adjacent coastal bodies. Data on month-wise percentage availability of juveniles, bycatch and adults of all marine species in India is needed to take proper management decisions with regard to multi-species and multi-fishery country^[12]. The traditional artisanal fishing practiced in inshore areas of the state is unorganized and largely marginalized like subsistence level fishing^[4]. The artisanal fishermen depend on the dol net fishery for their livelihood whole round the year.

Geographical Information System (GIS) is an advanced tool for the mapping of natural resources and their associated habitat. The use of GIS for natural resource management in India is not at par with the international level. The incorporation of primary data to the GIS tool is helpful for the better visualisation and decision making process. There is no documentation on the species composition in the dol net fishery of Bhayander estuary, so the present study revealed the species composition and the catch per unit effort (CPUE) also mapped to show the variation in catch pattern in pictorial format. The information from the map obtained by the CPUE is necessary to know the variation in the catch quantity and the pattern of fishing in this locality. Seasonal variation gives an idea about the species abundance and their distribution pattern.

Materials and Methods

The Thane district is bound by Nashik district to the north-east, Pune and Ahmadnagar districts to the east and Palghar district to the north. The Arabian Sea forms the western boundary, while it is bound by Mumbai City District and Mumbai Suburban District to the

southwest and Raigad District to the south. The Bhayander estuarine area lies between 19° 18' 02" N to 19° 21' 23" N,

72° 34' 55" E to 72° 53' 16" E. Geographical location of study area is given (Fig. 1).

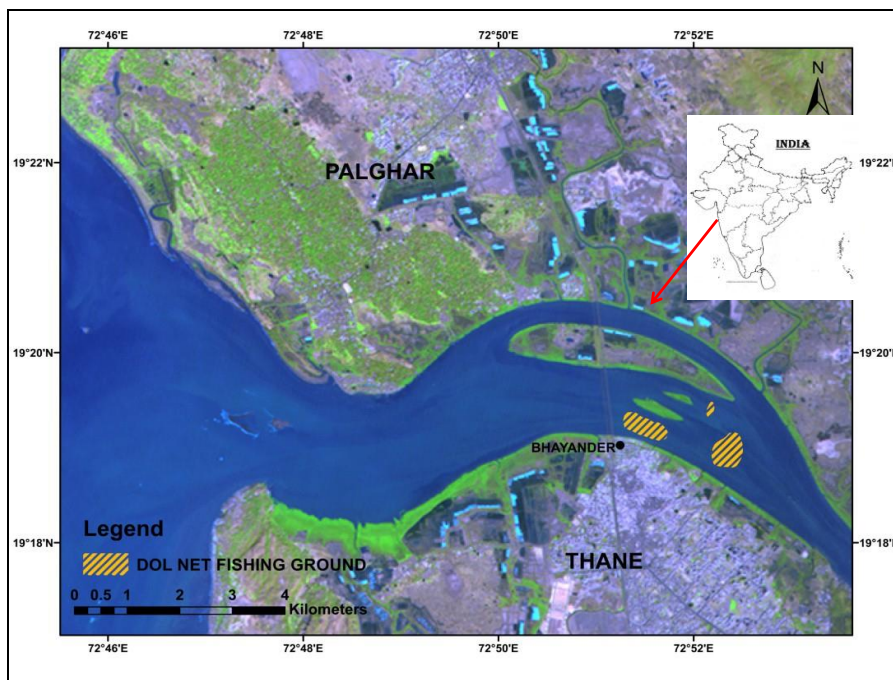


Fig 1: Area of dol net fishing stations

The time scale of study was from September 2016 to May 2017. The species were identified [5, 18] and unsegregated catch of single-day operation from Bhayander estuarine area observed on board the fishing vessel in each month. The period signifies one complete season of dol net fishery status except period during monsoon fishing ban. Month-wise catch per haul and species composition by weight basis analysed after segregation from single-day dol-netters. The ArcGIS, one of the most powerful GIS software for mapping, developed by Environmental System Research Institute (ESRI) Redlands, California was used for analysing the geographic data. The thematic maps of fisheries resources and fishing activities were prepared by utilizing base map and

geographical coordinates. Fisheries spatial information system for Bhayander estuary region was designed and organised on ArcGIS 10.3 platform using spatial and temporal catch data.

Results

In total 73 species were recorded in the dol net fishery of Bhayander estuary. Major species that comprised the catch composition of single-day bag net fishery included *Harpadon nehereus*, *Coilia dussumieri*, *Lepturacanthus savala*, *Johnius dussumieri*, *Mystus gulio*, *Metapenaeus sculptilis*, *Charybdis (Charybdis) callianassa*, *Enhydrina schistosa*, *Arius maculatus* and *Acetes indicus* (Fig. 2 to Fig. 4).

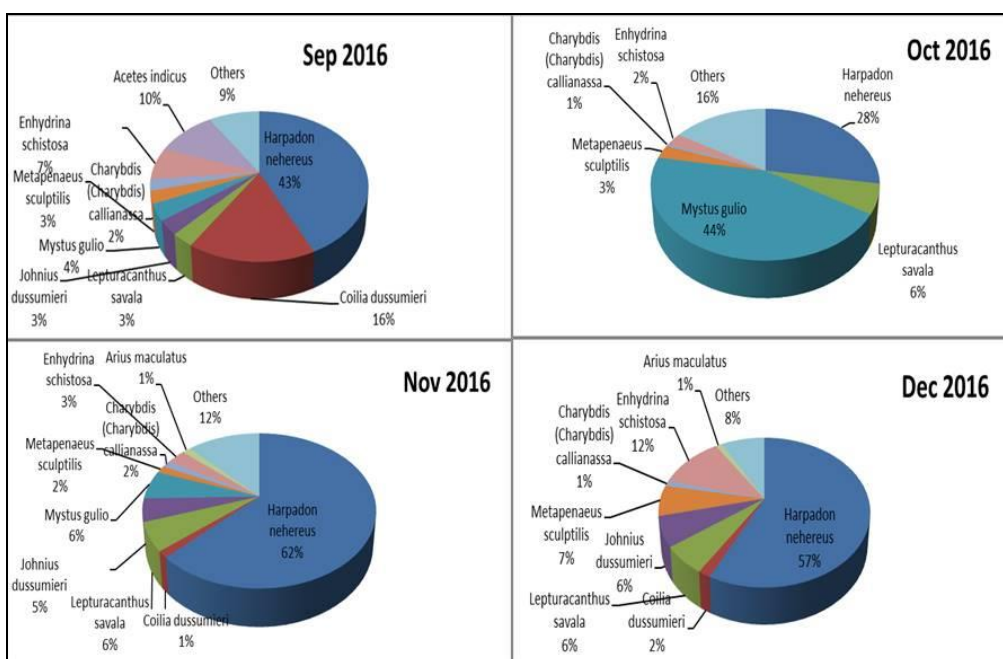


Fig 2: Major catch composition of dol net for September, October, November, December

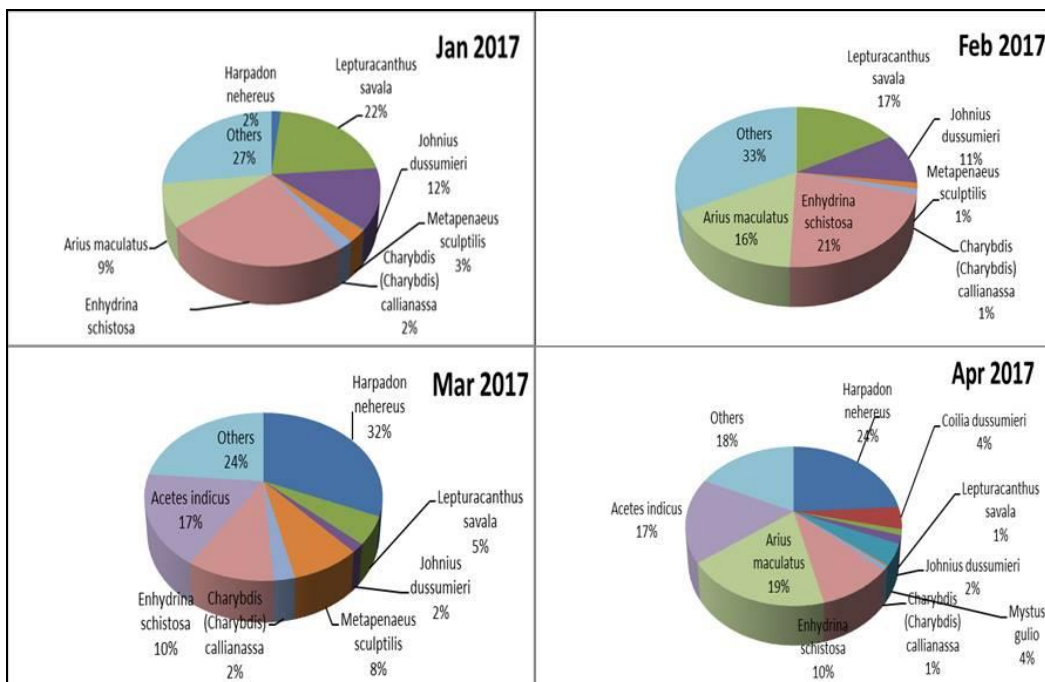


Fig 3: Major catch composition of dol net for January, February, March, April

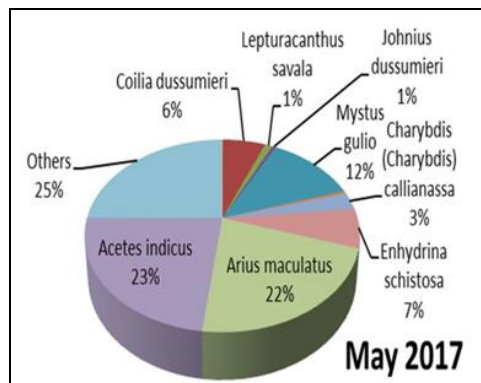


Fig 4: Major catch composition of dol net for May

Species-wise monthly catch composition of dol net is given (Fig. 5). Bombay duck was the highest contributor to the total catch barring but in the months of February and May the species was totally absent in the catch. Temporal distribution of species caught by single day dol-netters of Bhayander estuary is given in Table 1. Some species like *Lepturacanthus savala*, *Metapenaeus sculptilis*, *Charybdis (Charybdis) callianassa*, *Enhydrina schistosa* were present in all the months sampled (Sep-2016 to May 2017). Details of number of fish species caught in each month are given (Figure 6). Maximum number of species i.e., 39 was caught during September 2016.

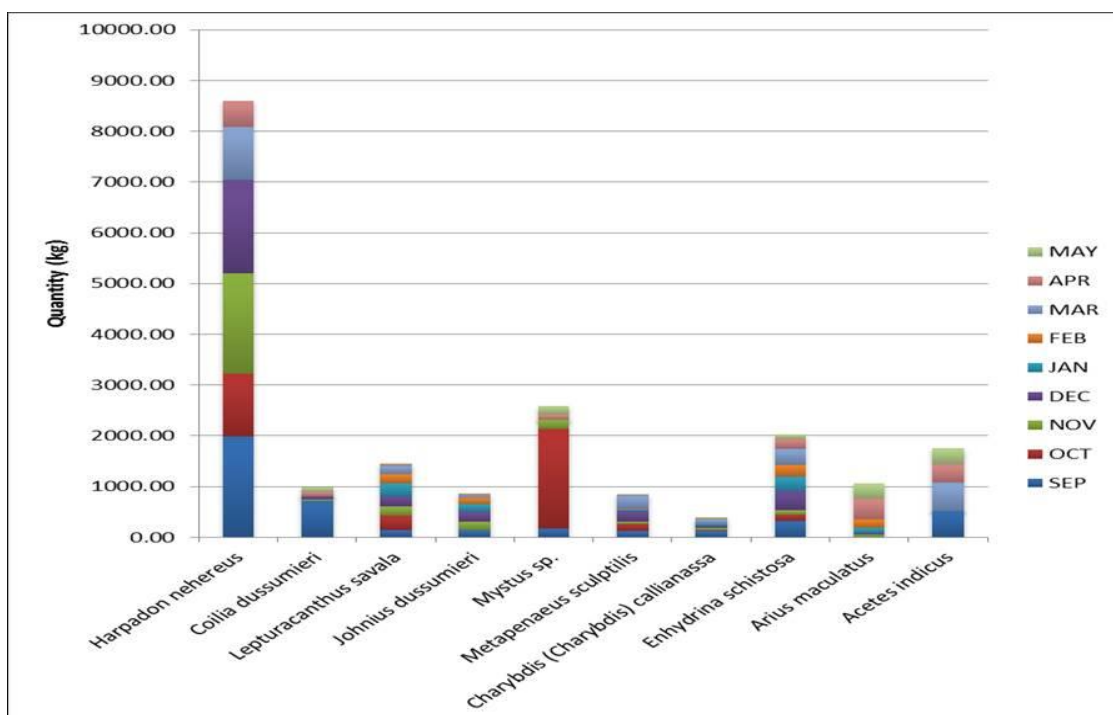


Fig 5: Species-wise monthly catch composition of dol net (Major Contributors)

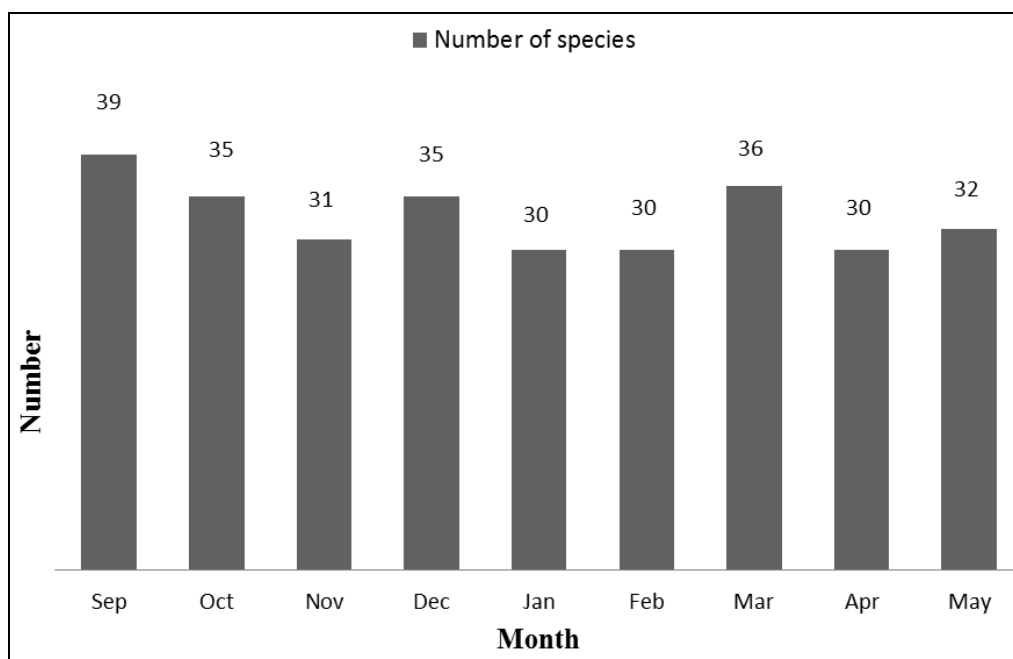


Fig 6: Temporal variations in number of species in dol net of Bhayander estuary

Table 1: Temporal distribution of fishes from dol net of Bhayander estuary

Finfishes	Sep 2016	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	Mar 2017	Apr 2017	May 2017
Anguilliformes									
<i>Pisodonophis boro</i> (Hamilton, 1822)		+	+			+			
Aulopiformes									
<i>Harpadon nehereus</i> (Hamilton, 1822)	+	+	+	+	+		+	+	
Batrachoidiformes									
<i>Allenbatrachus grunniens</i> (Linnaeus, 1758)	+	+	+						
Clupeiformes									
<i>Anodontostoma chacunda</i> (Hamilton, 1822)		+		+			+	+	
<i>Coilia dussumieri</i> Valenciennes, 1848	+		+	+				+	+
<i>Escualosa thoracata</i> (Valenciennes, 1847)						+	+	+	+
<i>Ilisha filigera</i> (Valenciennes, 1847)	+	+	+	+		+	+		
<i>Nematalosa nasus</i> (Bloch, 1795)		+			+	+		+	
<i>Pellona ditchela</i> Valenciennes, 1847	+		+	+	+	+	+		
<i>Stolephorus indicus</i> (van Hasselt, 1823)									+
<i>Thryssa dussumieri</i> (Valenciennes, 1848)	+		+			+		+	
<i>Thryssa hamiltonii</i> Gray, 1835	+	+			+	+	+	+	+
<i>Thryssa mystax</i> (Bloch & Schneider, 1801)	+	+		+	+		+	+	+
<i>Thryssa setirostris</i> (Broussonet, 1782)					+	+	+		
Gadiformes									
<i>Bregmaceros maclellandi</i> Thompson, 1840		+		+	+	+			
Perciformes									
<i>Alepes djedaba</i> (Forsskål, 1775)	+	+				+			+
<i>Alepes kleinii</i> (Bloch, 1793)	+	+							
<i>Boleophthalmus boddarti</i> (Pallas, 1770)									
<i>Boleophthalmus dussumieri</i> Valenciennes, 1837	+	+			+	+			
<i>Decapterus russelli</i> (Rüppell, 1830)					+		+	+	
<i>Eleutheronema tetradactylum</i> (Shaw, 1804)	+	+	+				+	+	+
<i>Eupleurogrammus muticus</i> (Gray, 1831)				+			+	+	
<i>Filimanus heptadactyla</i> (Cuvier, 1829)									+
<i>Johnius dussumieri</i> (Cuvier, 1830)	+		+	+	+	+	+	+	+
<i>Johnius macrorhynchus</i> (Lal Mohan, 1976)			+	+					+
<i>Johnius vogleri</i> (Bleeker, 1853)				+				+	
<i>Lactarius lactarius</i> (Bloch & Schneider, 1801)							+	+	
<i>Lates calcarifer</i> (Bloch, 1790)	+	+							
<i>Leptomelanosoma indicum</i> (Shaw, 1804)							+	+	
<i>Lepturacanthus savala</i> (Cuvier, 1829)	+	+	+	+	+	+	+	+	+
<i>Mugil cephalus</i> Linnaeus, 1758	+	+		+			+	+	+
<i>Otolithoides biauritus</i> (Cantor, 1849)	+		+	+	+	+	+	+	+

<i>Pampus argenteus</i> (Euphrasen, 1788)		+		+			+	+	+
<i>Pampus chinensis</i> (Euphrasen, 1788)				+					
<i>Parastromateus niger</i> (Bloch, 1795)									+
<i>Protonibea diacanthus</i> (Lacepède, 1802)				+		+	+	+	+
<i>Scatophagus argus</i> (Linnaeus, 1766)	+	+	+			+			
<i>Scomberomorus guttatus</i> (Bloch & Schneider, 1801)	+	+	+		+			+	+
<i>Sillago sihama</i> (Forsskål, 1775)				+	+				
<i>Terapon jarbua</i> (Forsskål, 1775)	+	+					+		
<i>Terapon theraps</i> (Cuvier, 1829)			+	+					
<i>Trichiurus lepturus</i> Linnaeus, 1758			+	+	+				
<i>Trypauchen vagina</i> (Bloch & Schneider, 1801)	+				+	+			+
Pleuronectiformes									
<i>Cynoglossus arel</i> (Bloch & Schneider, 1801)	+	+	+	+					
Siluriformes									
<i>Sperata seenghala</i> (Sykes, 1839)	+	+	+					+	+
<i>Arius maculatus</i> (Thunberg, 1792)			+	+	+	+		+	+
<i>Mystus gulio</i> (Hamilton, 1822)			+	+	+			+	+
<i>Osteogeneiosus militaris</i> (Linnaeus, 1758)									
<i>Plotosus lineatus</i> (Thunberg, 1787)		+	+	+	+				
Tetraodontiformes									
<i>Lagocephalus lunaris</i> (Bloch & Schneider, 1801)	+	+							
Shellfishes									
Shrimps									
Decapoda									
<i>Acetes indicus</i> H. Milne Edwards, 1830	+						+	+	+
<i>Acetes johni</i> (Nataraj, 1949)							+	+	+
<i>Exhippolysmata ensirostris ensirostris</i> (Kemp, 1914)	+	+		+			+	+	+
<i>Exopalaemon styliiferus</i> (H. Milne Edwards, 1840 [in H. Milne Edwards, 1834-1840])								+	+
<i>Metapenaeus affinis</i> (H. Milne Edwards, 1837 [in Milne Edwards, 1834-1840])	+	+		+	+	+	+		
<i>Metapenaeus brevicornis</i> (H. Milne Edwards, 1837 [in Milne Edwards, 1834-1840])	+					+	+	+	+
<i>Penaeus monodon</i> Fabricius, 1798	+				+		+		
<i>Penaeus indicus</i> H. Milne Edwards, 1837	+	+	+	+	+	+	+		
<i>Metapenaeus monoceros</i> (Fabricius, 1798)	+	+		+	+	+			
<i>Metapenaeus sculptilis</i>	+	+	+	+	+	+	+		
Crabs									
Decapoda									
<i>Ashtoret lunaris</i> (Forsskål, 1775)			+				+		+
<i>Charybdis (Charybdis) callianassa</i> (Herbst, 1789)						+	+		
<i>Charybdis (Charybdis) lucifera</i> (Fabricius, 1798)		+			+	+	+		
<i>Charybdis (Charybdis) orientalis</i> Dana, 1852		+				+			
<i>Portunus (Portunus) sanguinolentus</i> (Herbst, 1783)	+						+	+	+
<i>Scylla serrata</i> (Forsskål, 1775)	+	+	+	+	+	+	+		+
<i>Scylla tranquebarica</i> (Fabricius, 1798)	+			+	+				
Cephalopods									
Myopsida									
<i>Loliolus (Loliolus) hardwickei</i> (Gray, 1849)	+		+	+			+		
<i>Uroteuthis (Photololigo) duvaucelii</i> (d'Orbigny [in Férussac & d'Orbigny], 1835)	+		+	+		+			+
Octapoda									
<i>Cistopus indicus</i> (Rapp, 1835)		+	+		+				
Sepiida									
<i>Sepiella inermis</i> (Van Hasselt [in Férussac & d'Orbigny], 1835)		+	+	+		+			+
Seasnakes									
Squamata									
<i>Enhydrina schistosa</i> (Daudin, 1803)	+	+	+	+	+	+	+	+	+
Stomatopoda									
<i>Oratosquilla</i>	+		+		+		+	+	

+ Occurrence

The monthly discards for single-day dol-nets of the estuary were estimated as 8.11% with maximum 15.37% in January (Fig. 7). Jellyfishes, sea snakes, juveniles of several fish

species and plastics comprised the major components of discards. The discarded juveniles were with very low chances of survivability, due to the stress in the cod end.

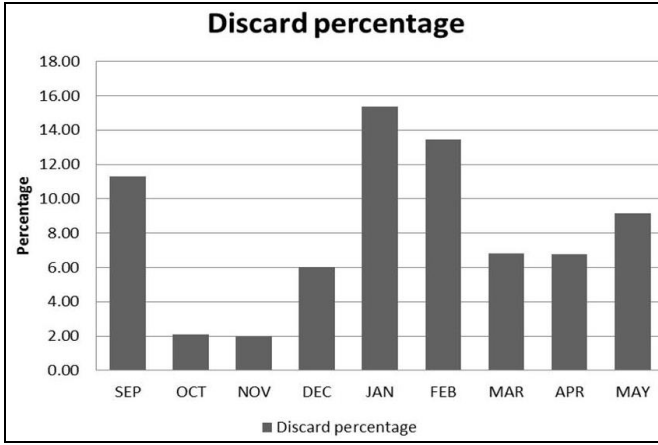


Fig 7: Discard percentage from dol-nets

which increased their sorting time and work load.

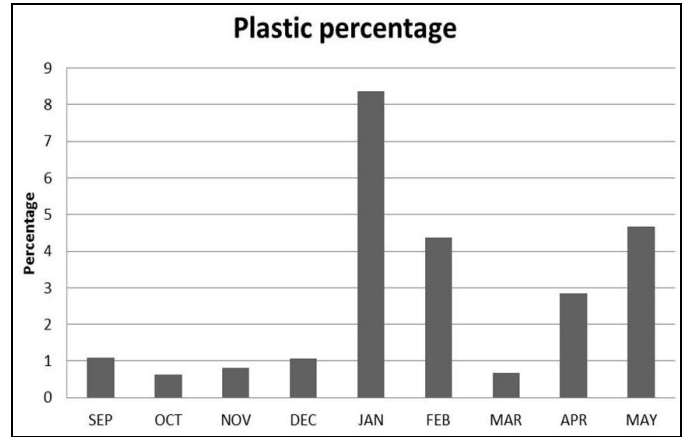


Fig 8: Plastic percentage in dol nets

The present study reported that waste constitutes an average 2.72% (maximum 8.3%) of total dol net catch (Fig. 8). Most of the waste material was garbage/plastics that included plastic bags, water bottles, cold drink bottles, disposable cups, milk pouch, soap covers, synthetic ropes, synthetic gear etc. Maximum plastic was recorded in January and May 2017. Fishermen usually segregate the plastics from their catch

Available information mapped in GIS (Fig. 9 to Fig. 13). The highest catch per unit effort (CPUE) reported in October month (29.5 kg) and the lowest in April (1 kg) followed by January and February. But in an average the CPUE was 14.1 kg.

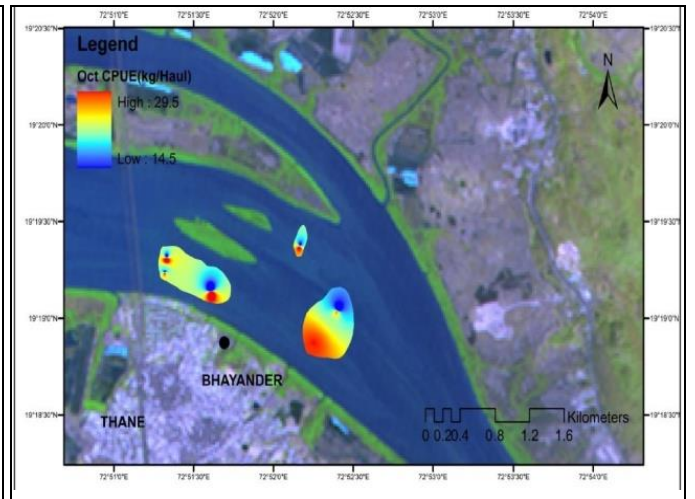
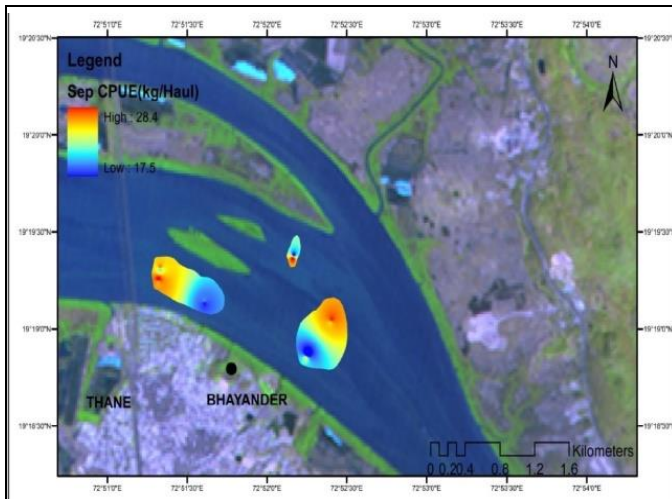


Fig 9: Thematic map of dol net stations and CPUE for September and October

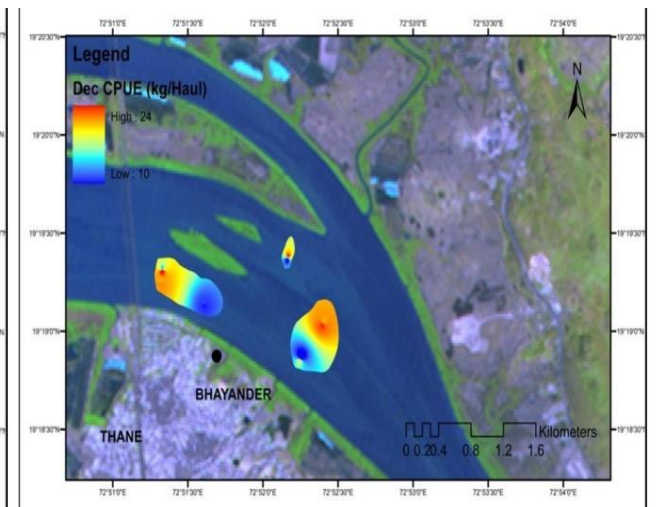
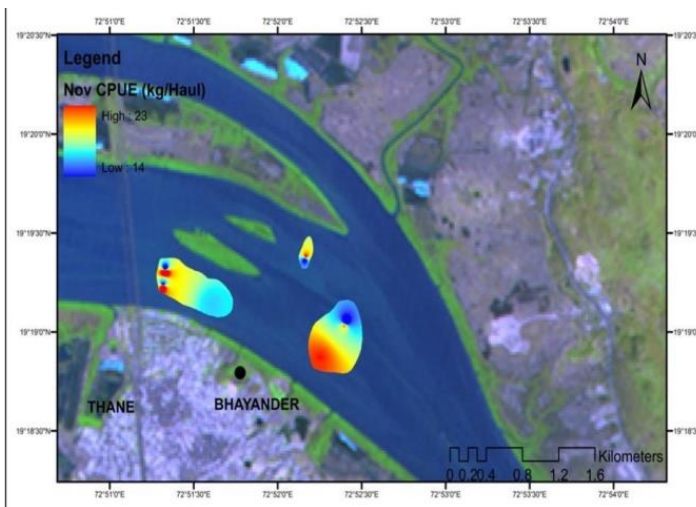


Fig 10: Thematic maps of dol net stations and CPUE for November and December

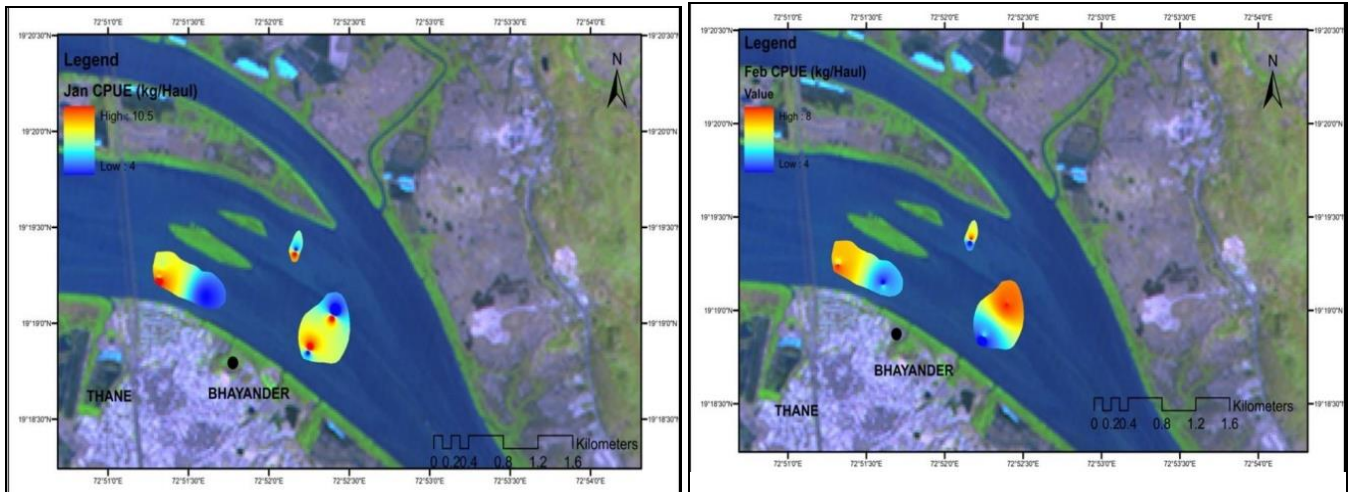


Fig 11: Thematic map of dol net stations and CPUE for January and February

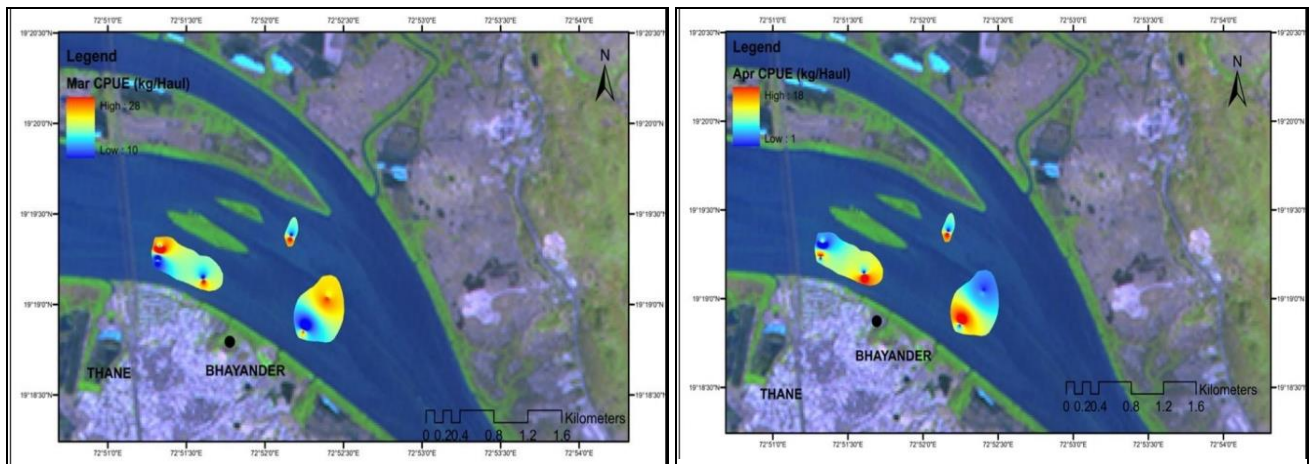


Fig 12: Thematic map of dol net stations and CPUE for March and April

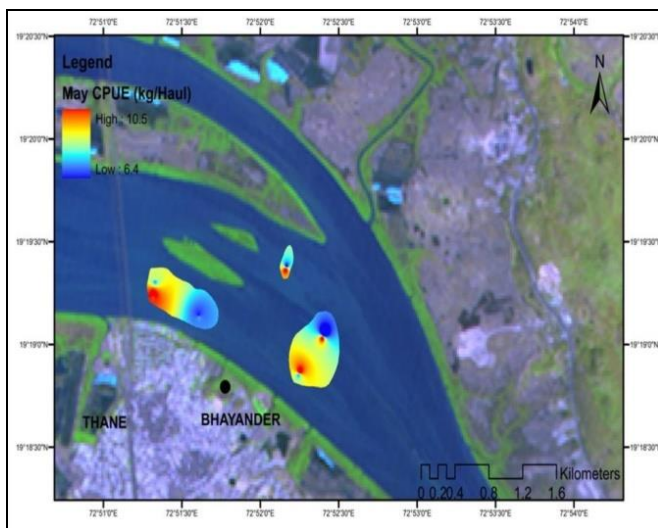


Fig 13: Thematic map of dol net stations and CPUE for May

Discussion

High monthly variation in the species composition was observed during the sampling period. The catch composition as observed in the present study almost similar, but fluctuated seasonally from the work of earlier researchers [9, 10, 13, 15, 16, 17, 19, 20, 21]. The fishermen emphasized on the decline of the catch in compared to previous years and the traditional fishermen are affected the most. The length based stock assessment of 36 species of commercially important finfishes,

elasmobranchs, crustaceans and cephalopods by analytical methods showed that 60% of the stocks are over-exploited. It was observed during the sampling that the total catch during the winter reduced in compared to post-monsoon season [4]. First reason is the reduce in the tidal amplitude in Feb-Mar due to the coastal current diverts its flow direction from north to south [1] and secondly due to the religious believe and tradition culture during Feb-Mar month, most of the fishermen suspends fishing operation [4] which in combine affect the catch in winter season. The catch per unit effort declining and the return from the dol net catch is meagre, so it's now necessary for the sustainability of the fishery resources in concerned with dol net fishery by adopting management practices described [7]. Average of 15.62% discards to total catch from single-day-dol-netters of Maharashtra and the need for management measures to reduce such huge discards in these nets have been emphasized [11]. River basins and estuaries act as a major connecting bridge for inland waters and coastal waters for debris transport [14]. All such garbage/plastics were the indicators of intensity of pollution leading to long term adverse impacts on the ecosystem. The waste load had increased considerably and started affecting the fishing operation [2]. The study revealed the catch composition, discards and the mapping of the resources of dol net and these in information are necessary to manage the estuarine fisheries. Major issue was the amount of juvenile and discarded catch, so the cod end mesh size of the dol net should be revised to exclude the

juveniles and the market demand of the discarded species can be enhanced through the consumer awareness. There should be source and support of alternative livelihood to the fishermen during the winter season, as the quantity of catch drastically reduced due to environment and social impact. The historical information and the fishermen perception clearly indicates the decline in the catch over the years, so it's necessary to adopt the management and the selectivity of the net to be readdressed in concerned to dol net. As the dol net fishing efficiency depends on the tide, so the catch varies due to the change in the tide amplitude and the water quality of the estuary. The pictorial map of the catch helps to easy way understanding in the variation in the catch over the months. Earlier researchers also proved the application of GIS in decision making process and the importance of speed and accurate decision making process to manage the resources by using advance tool such as Geographical Information System (GIS) also emphasized^[8].

Conclusion

The present study is an attempt to find out the species composition and its seasonal variation along with the seasonal maps which show the variation of CPUE and it indicates the low abundance during winter months compared to the post monsoon. The plastic percentage to the total catch is significant and which need to be addressed during the management practices. The livelihood of the fishermen in Bhayander estuary from estuary is way long back history, but due to the low catch and pollution loads of the estuary the number of fishermen reducing over the years by diverting their occupation to other activities. So, it's the time to manage the dolnet fishery of the estuary, so that the fishermen can continue their livelihood by using this artisanal gear.

Acknowledgement

The first author is grateful to the Indian Council of Agricultural Research (ICAR), New Delhi for granting Junior Research Fellowship (JRF) during the study. Authors are thankful to Dr. Gopal Krishna, Director, ICAR-Central Institute of Fisheries Education, Mumbai for providing facilities to complete the research work successfully. The support and help extended by Dr. V. V. Singh, former Scientist-in-Charge, Mumbai Research Centre of ICAR-Central Marine Fisheries Research Institute (CMFRI), Mumbai and all the Scientists for helping in species level identification of fishes is duly acknowledged.

References

1. Banse Karl. Hydrography of the Arabian Sea shelf of India and Pakistan and effects on demersal fishes. In Deep sea research and oceanographic Abstracts. 1968; 15(1):45-79. Elsevier. [https://doi.org/10.1016/0011-7471\(68\)90028-4](https://doi.org/10.1016/0011-7471(68)90028-4).
2. Boopendranath MR. Waste minimisation in fishing operations. *Fishery Technology*. 2012; 49(2):109-119.
3. Cameron WM, Pritchard DW. Estuaries In: M. N. Hill (editor): The Sea John Wiley and Sons, New York. 1963; 2:306-324.
4. Deshmukh VD. "Responsible marine fisheries: Reflections from Maharashtra." 2013, 113-118.
5. Fischer W, Bianchi G. FAO Species Identification Sheets For Fishery Purposes of Western Indian Ocean (Fishing Area, 51), FAO, Rome, 1984.
6. Hall MA, Alverson DL, Metzals KI. By-catch: problems and solutions. *Marine Pollution Bulletin*. 2000; 41(1):204-219. [https://doi.org/10.1016/S0025-326X\(00\)00111-9](https://doi.org/10.1016/S0025-326X(00)00111-9)
7. Ibrahlim SA, Pradhan SK, Nirmal T, Ratheesh Kamat SS, Shenoy L. Catch composition and discards in set bagnets of Karanja estuary, Raigad, Maharashtra. *Journal of Indian Fisheries Association*. 2017; 44(1):17-29.
8. Isaak DJ, Hubert WA. Integrating new technologies into fisheries science: the application of geographic information systems. *Fisheries*. 1997; 22(1):6-10. [https://doi.org/10.1577/1548-8446\(1997\)022<0006:INTIFS>2.0.CO;2](https://doi.org/10.1577/1548-8446(1997)022<0006:INTIFS>2.0.CO;2)
9. Khan MZ. Dol net fishery off Nawabunder (Gujarat). *Fishery Technology*. 1982; 3:92-99.
10. Khan MZ. A note on the dol-net fishery off Jaffrabad (Gujarat) with special reference to Bombay duck, from 1979-80 to 1981-82. *Indian Journal of Fisheries*. 1987. 34(2):188-192.
11. Kumawat T. Study on compliance of bag net fisheries of Maharashtra coast, India with provisions of FAO CCRF. M. F. Sc. Dissertation. Central Institute of Fisheries Education (University under Sec. 3 of UGC Act, 1956), Versova, Mumbai, India – 400061. 2014.
12. Luther G, Appanasastry Y. Occurrence of spawners, juveniles and young fish in relation to the fishery seasons of some major fishery resources of India-a preliminary study. *Marine Fisheries Information Service, Technical and Extension Series*. 1993; 122:1-8.
13. Pillai SK. Some observations on dol (bag) net fishery at Sassoon dock, Bombay. *Journal of the Bombay Natural History Society*. 1983; 82(3):331-340.
14. Possatto, Fernanda E, Mário Barletta, Monica F Costa, Juliana A. Ivar do Sul, and David V. Dantas. "Plastic debris ingestion by marine catfish: an unexpected fisheries impact." *Marine pollution bulletin*. 2011; 62(5):1098-1102. <https://doi.org/10.1016/j.marpolbul.2011.01.036>
15. Rajan KN, Sukumaran KK, Pillai SK. On'dol'net prawn fishery of Bombay during 1966-76. *Indian Journal of Fisheries*. 1982; 29(1, 2):29-36.
16. Raje SG. Disposal of catch from'dol'net at Versova, Bombay. *Marine Fisheries Information Service, Technical and Extension Series*. 1991; 113:18-20.
17. Raje SG, Deshmukh VD, Das T, Sarang JD. 'Parkawala' fishery for catfish at Versova, Mumbai. *Marine Fisheries Information Service, Technical and Extension Series*. 2004; 180:12-13.
18. Sparre P, Ursin E, Venema SC. Introduction to Tropical Fish Stock Assessment, Part 1. Manual, FAO Fish. Tech. FAO, Rome, 1989; 306:337.
19. Srinath M, Beena MR, Augustine SK, Kuriakose S, Sreenivasan J. *Marine Fisheries Profile Maharashtra*. [Dataset], CMFRI. 2007. http://eprints.cmfri.org.in/5497/1/10_Maharashtra_profile.pdf
20. Srinath M, Jacob V, Kanakkan A, Mani PT, Karbhari JP. Appraisal of the Marine Fisheries of Maharashtra. CMFRI Special Publication. 1987; (37):1-46.
21. Srinath M, Kuriakose S, Mini KG, Beena MR, Augustine SK. Trends in landings. In: Status of Exploited Marine Fishery Resources of India. CMFRI, Cochin. 2003, 254-285. ISBN 81-901219-3-6.