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CATCH COMPOSITION AND DISCARDS IN SET BAGNETS OF KARANJA ESTUARY, RAIGAD, MAHARASHTRA

S. Abuthagir Iburahim[1], Suraj Kumar Pradhan[1], T. Nirmal[1], Ratheesh[2], S.S. Kamat[1], Latha Shenoy[1]*

[1]ICAR- Central Institute of Fisheries Education, Mumbai-400061, India

[2]ICAR- Central Marine Fisheries Research Institute, Mumbai Research Centre, Mumbai- 400061, India

ABSTRACT

Dol netting is one of the major fishing methods used mainly by traditional fishermen of Maharashtra. Study of catch composition of dol nets operated in Karanja estuary of Raigad district, Maharashtra was carried out during September 2016 - May 2017. A total of ten single-day dol-netters were selected for the purpose of this study. Fortnightly on-board sampling and questionnaire-based sampling were carried out to fulfil the objectives of the study. The number of fishing days per month ranged from 12-16 due to tide-based restrictions. Dol net catch comprised 50 species of fin fishes, 3 species of elasmobranchs, 13 species of shrimps, 10 species of crabs, 5 species of cephalopods, 2 species of jellyfish, 4 species of sea snakes, 1 species of lobster and 2 species of stomatopods. Major catch composition of dol nets recorded during the study included *Acetes indicus*, *Arius maculatus*, *Charybdis callianassa* , *Chrysaora Caliparea*, *Coilia dussumieri* , *Harpadon nehereus* , *Lepturacanthus savala* , *Miyakella nepa*, *Mystus gulio* and *Parapenaeopsis sculptilis*. Significant discards such as jellyfishes, juveniles of several fishes and plastics were recorded in the dol nets operated in the Karanja estuary.

***Corresponding author e-mail:**
lathashenoy@cife.edu.in

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Introduction

Set bagnet is one of the main indigenous gears operated by small-scale fishermen in countries such as Bangladesh, India, Indonesia, Malaysia, Myanmar, and Thailand. There exist some regional variations in net design and mode of operation. Bangladesh and India lead in the usage of this net in their coastal fisheries (Islam *et al.,* 1993). Bagnet operated in the north-west coast of India is locally called *Dolnet, Bokshi jal* or *Kavi jal* whereas it is known as *Behundi jal* on the north-east coast. On the Kerala coast; it is named as *ooni vala*. Dol net can be operated to capture fish not only from near bottom but also from mid-column to a few fathoms below the surface of the water. The techniques of setting, rigging, and operation of the gear are rather complex. It is amazing that the illiterate fishermen have perfected

operation of this gear using indigenous knowledge of natural forces such as waves, tides and currents. The bag nets are mostly operated by the poorest segments of coastal communities which majorly involve juvenile fishing in most parts of its existence (Islam *et al.,* 2004). Estuaries support the sustenance of marine fisheries resources as the life cycle of many marine fishes has an estuarine phase. Overfishing, inadequate management and habitat degradation result in decline of fish stocks which in turn poses a challenge to the sustainability of estuarine fisheries in tropical areas.The livelihood of most of the small scale fishers living in and around Karanja village solely depends upon dol net fishing. The presence of Jawaharlal Nehru Port Trust around Karanja and a new fishing jetty coming up in the vicinity would probably alter the natural estuarine flow. Further, this could result in several changes including fisher's livelihood, dol net catch, fish catch composition etc. There is very little information available with regard to the estuarine fisheries resources of Karanja.

MATERIAL AND METHODS

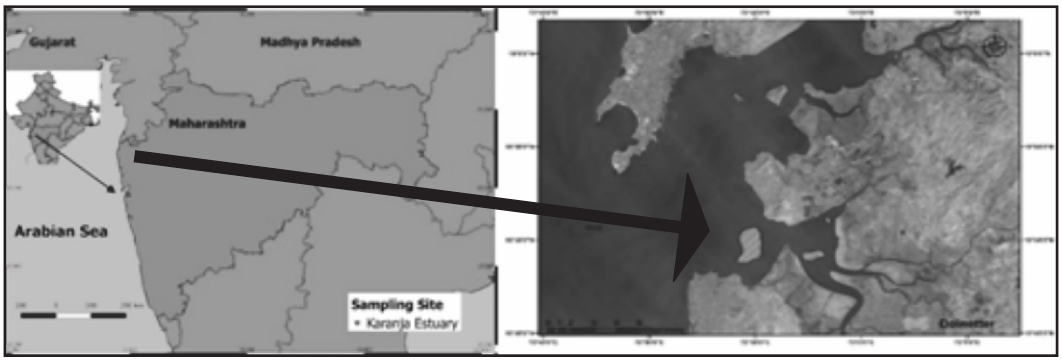
Karanja estuary (18°50'5.60"N to 18°51'50.71"N latitude and 72°53'40.12"E to 72°59'5.83"E longitude) situated along the eastern shore of Mumbai harbour surrounds the Karanja village (Map 1). In the present study, fish catch and discard data was collected during September 2016 to May 2017 from 10 dol netters operated in this estuary. The species were identified based on Fischer and Bianchi (1984), Rasmussen (2001), Carpenter and Niem (2001). Catch per haul was calculated from the total weight of catch in a haul from single-day dol netters. The month-wise species composition by weight was analyzed after segregation of the catch from dol netters. The month-wise quantity of garbage/plastics in the unsegregated fish samples taken from the selected dol netters from Karanja estuary was measured using a digital balance.

RESULTS

Catch Composition

Analysis of species-wise monthly catch composition of single-day bag net fishery showed that the *Acetes indicus*, *Arius maculatus* , *Charybdis (Charybdis) callianassa* , *Chrysaora caliparea, Coilia dussumieri* , *Harpadon nehereus* , *Lepturacanthus savala* , *Miyakella nepa*, *Mystus gulio* and *Parapenaeopsis sculptilis* were the major contributors between September 2016- May 2017 (Figure 1). Catch of *Miyakella nepa , Arius maculatus, Charybdis (Charybdis) callianassa, Mystus*

Map 1: Dol net sampling stations in Karanja estuary



gulio was higher during pre-monsoon whereas catch of *Acetes indicus, Harpadon nehereus, Lepturacanthus savala* and *Chrysaora caliparea, Coilia dussumieri* was higher during post-monsoon (Figure 2).

Details of monthly availability of the species caught by single-day dol netters of Karanja estuary are given in (Table 1). Some species like *Charybdis (Charybdis) calianassa* ,*Coilia dussumieri, Enhydrina schistosa, Harpiosquilla harpax, Lepturacanthus savala, Metapenaeus brevicornis, Miyakella nepa, Parapenaeopsis sculptilis* and *Parapenaeopsis stylifera* were present in all the months sampled. However, species *like Acetes indicus, Harpadon nehereus, Coilia dussimeri* and *Chrysaora caliparea* showed high seasonal variation. Details of month-wise number of fish species caught are given in Figure 3. Maximum number of species i.e. 53 was caught during October 2016 while lowest diversity was noted during December 2016.

Fig. 1: Major catch composition of dol net fishery of Karanja estuary

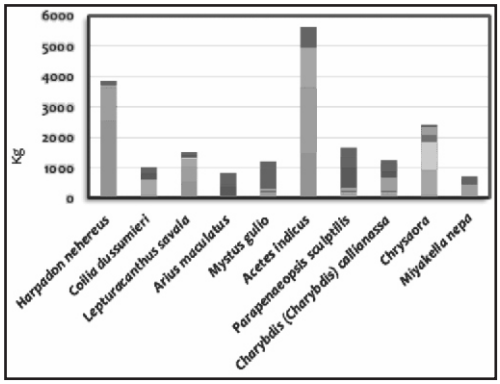


Fig. 2: Catch of major species & plastics in pre-monsoon and post-monsoon

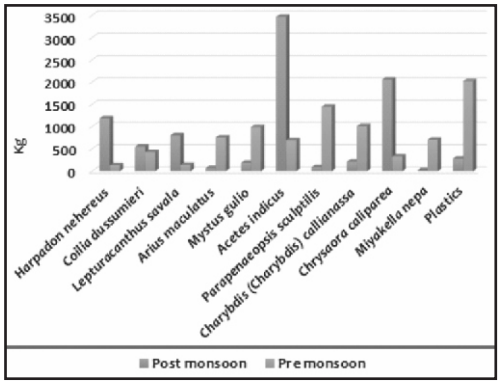


Fig. 3: Temporal distribution of number of fish species along Karanja estuary

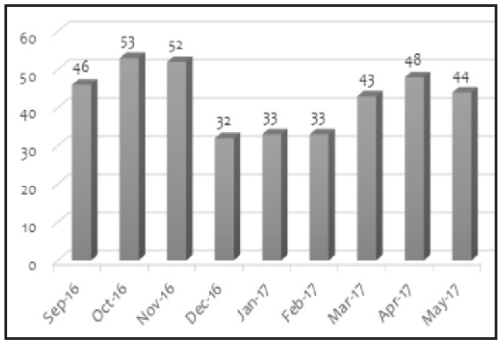


Fig.4 :- Total catch and discard from single-day dol netters

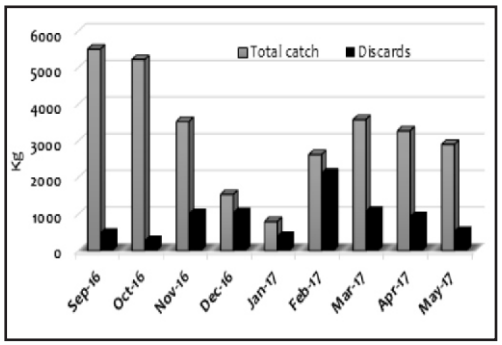


Fig. 5: Month-wise plastic catch in dol nets

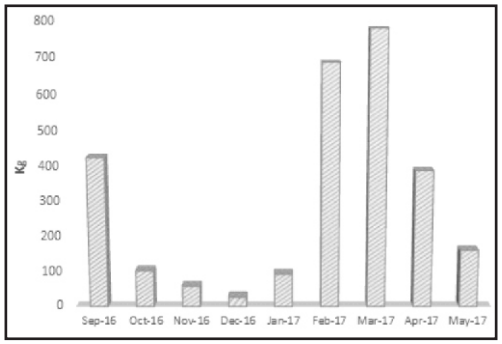


Table 1: Temporal distribution of fishes in the Karanja estuary

Order Fish species	Family	Sep 2016	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	Mar 2017	Apr 2017	May 2017
Anguilliformes										
Congresox talabonoides (Bleeker, 1853)	Muraenesocidae	+	-	+	+	-	-	-	-	-
Pisodonophis boro (Hamilton, 1822)	Ophichthidae	-	-	+	-	+	+	-	-	-
Aulopiformes										
Harpadon nehereus (Hamilton, 1822)	Synodontidae	+	+	+	-	-	-	-	+	+
Saurida tumbil (Bloch, 1795)	Synodontidae	+	-	-	-	-	-	+	+	+
Beloniformes										
Strongylura strongylura (van Hasselt, 1823)	Belonidae	-	+	-	-	-	+	+	+	+
Clupeiformes										
Anodontostoma chacunda (Hamilton, 1822)	Clupeidae	-	-	-	-	-	-	+	+	+
Coilia dussumieri Valenciennes, 1848	Engraulidae	+	+	+	+	+	+	+	+	+
Nematalosa nasus (Bloch, 1795)	Clupeidae	-	-	-	-	-	-	+	+	+
Pellona ditchela Valenciennes, 1847	Pristigasteridae	+	+	+	+	-	+	+	-	-
Stolephorus indicus (van Hasselt, 1823)	Engraulidae	-	-	-	+	+	-	-	-	+
T. dussumieri (Valenciennes, 1848)	Engraulidae	-	+	+	+	-	-	-	-	-
T. hamiltonii Gray, 1835	Engraulidae	-	-	+	+	+	-	-	-	-
Thryssa mystax (Bloch & Schneider, 1801)	Engraulidae	-	+	+	-	-	-	-	-	-
T. dayi Wongratana, 1983	Engraulidae	-	-	+	+	-	-	-	-	-
T. setirostris (Broussonet, 1782)	Engraulidae	-	-	+	-	-	-	+	+	-
Stolephorus waitei Jordan & Seale, 1926	Engraulidae	-	-	+	+	-	+	-	-	+
Gadiformes										
Bregmaceros mcclellandi Thompson, 1840	Bregmacerotidae	-	+	+	-	+	+	+	+	-

Perciformes										
Alepes kleinii (Bloch, 1793)	Muraenesocidae	-	+	+	+	+	+	+	-	+
A. djedaba (Forsskål, 1775)	Carangidae	-	-	-	-	-	-	+	+	+
Boleophthalmus dussumieri Valenciennes, 1837	Gobiidae	+	+	-	-	+	+	+	+	+
Decapterus russelli (Rüppell, 1830)	Carangidae	-	+	-	-	-	+	+	+	+
Eleutheronema tetradactylum (Shaw, 1804)	Polynemidae	+	+	+	-	-	-	-	+	+
Eupleurogrammus glossodon (Bleeker, 1860)	Trichiuridae	+	+	+	-	-	-	-	-	-
E. muticus (Gray, 1831)	Trichiuridae	+	+	-	-	-	-	-	-	-
J. macrorhynus (Lal Mohan, 1976)	Sciaenidae	-	+	+	-	+	-	-	+	-
J. dussumieri (Cuvier, 1830)	Sciaenidae	-	-	-	+	+	-	-	+	+
J. glaucus (Day, 1876)	Sciaenidae	-	-	-	-	-	+	+	-	-
Johnius vogleri (Bleeker, 1853)	Sciaenidae	-	-	+	-	-	-	-	-	-
Lepturacanthus savala (Cuvier, 1829)	Trichiuridae	+	+	+	+	+	+	+	+	+
Filimanus heptadactyla (Cuvier, 1829)	Polynemidae	-	-	+	-	-	-	-	-	-
Leptomelanosoma indicum (Shaw, 1804)	Polynemidae	-	-	+	-	-	+	-	-	-
Otolithoides biauritus (Cantor, 1849)	Scienidae	+	-	+	+	+	-	+	+	+
Pampus argenteus (Euphrasen, 1788)	Stromateidae	+	+	-	+	-	+	-	+	+
P. chinensis (Euphrasen, 1788)	Stromateidae	-	-	+	-	-	-	+	-	-
Parastromateus niger (Bloch, 1795)	Carangidae	+	+	+	+	+	-	-	+	+
Protonibea diacanthus (Lacepède, 1802)	Scienidae	+	-	+	+	+	+	+	+	+
Scatophagus argus (Linnaeus, 1766)	Scatophagidae	-	+	+	+	+	+	+	+	+
Scomberomorus guttatus (Bloch & Schneider, 1801)	Scombridae	-	-	+	+	+	+	-	+	-
Sillago sihama (Forsskål, 1775)	Silaginidae	-	+	-	-	-	-	+	+	+

Trichiurus lepturus Linnaeus, 1758	Trichiuridae	+	+	-	-	-	-	-	-	-
Trypauchen vagina (Bloch & Schneider, 1801)	Gobiidae	+	+	+	-	+	-	-	+	+
Terapon jarbua (Forsskål, 1775)	Terapontidae	-	-	-	-	-	+	-	+	-
Terapon theraps Cuvier, 1829	Terapontidae	+	+	-	-	-	-	-	-	-
Liza ramada (Risso, 1827)	Mugilidae	-	+	-	-	+	-	+	+	+
Pleuronectiformes										
Cynoglossus arel (Bloch & Schneider, 1801)	Cynoglossidae	-	-	-	-	+	-	+	-	+
Siluriformes										
Arius maculatus (Thunberg, 1792)	Ariidae	-	-	+	-	+	-	+	+	+
Mystus gulio (Hamilton, 1822)	Bagridae	+	+	+	-	+	+	+	+	+
Osteogeneiosus militaris (Linnaeus, 1758)	Ariidae	+	+	-	-	-	-	-	-	-
Plotosus lineatus (Thunberg, 1787)	Plotosidae	+	+	+	-	+	+	+	+	+
Tetraodontiformes										
Lagocephalus spadiceus (Richardson, 1845)	Tetraodontidae	+	-	+	+	-	+	-	+	-
Elasmobranch										
Carcharhiniformes										
Scoliodon laticaudus Müller & Henle, 1838	Carcharhinidae	-	-	-	-	-	-	+	+	+
Myliobatiformes										
Himantura uarnak (Gmelin, 1789)	Dasyatidae	+	-	-	+	-	-	-	-	+
Orectolobiformes										
Chiloscyllium griseum Müller & Henle, 1838	Hemiscylliidae	+	-	-	-	-	-	-	-	-
Shrimps										
Decapoda										
Acetes indicus H. Milne Edwards, 1830	Sergestidae	+	+	+	-	-	-	-	+	+
A. johni Nataraj, 1949	Sergestidae	+	+	-	-	-	-	-	-	-
Exhippolysmata ensirostris ensirostris (Kemp, 1914)	Lysmatidae	-	+	-	-	-	-	+	+	+

Exopalaemon styliferus (H. Milne Edwards, 1840 [in H. Milne Edwards, 1834-1840])	Palaemonidae	-	+	-	-	-	-	-	-	-
Metapenaeus affinis (H. Milne Edwards, 1837 [in Milne Edwards, 1834-1840])	Penaeidae	+	-	-	-	-	-	+	-	_
M. brevicornis (H. Milne Edwards, 1837 [in Milne Edwards, 1834-1840])	Penaeidae	+	+	+	+	+	+	+	+	+
M. monoceros (Fabricius, 1798)	Penaeidae	-	+	+	-	-	-	-	-	-
Parapenaeopsis hardwickii (Miers, 1878)	Penaeidae	-	+	+	-	-	+	+	-	-
Parapenaeopsis stylifera (H. Milne Edwards, 1837 [in H. Milne Edwards, 1834-1840])	Penaeidae	+	+	+	+	+	+	+	+	+
P. sculptilis (Heller, 1862)	Penaeidae	+	+	+	+	+	+	+	+	+
Penaeus indicus H. Milne Edwards, 1837	Penaeidae	+	+	+	-	-	-	-	-	-
P. monodon Fabricius, 1798	Penaeidae	+	+	+	-	+	-	+	+	-
Solenocera crassicornis (H. Milne Edwards, 1837 [in Milne Edwards, 1834-1840])	Solenoceridae	+	-	+	-	-	+	+	+	-
Crabs										
Decapoda										
Ashtoret lunaris (Forskål, 1775)	Matutidae	-	-	+	+	-	-	-	+	+
Charybdis annulata (Fabricius, 1798)	Portunidae	+	-	-	-	-	-	-	-	+
C. callianassa (Herbst, 1789)	Portunidae	+	+	+	+	+	+	+	+	+
C. feriata (Linnaeus, 1758)	Portunidae	-	-	-	-	-	-	-	+	+
C. (Charybdis) lucifera (Fabricius, 1798)	Portunidae	-	+	+	+	-	-	-	-	-
C. (Charybdis) orientalis Dana, 1852	Portunidae	+	+	-	-	-	-	-	-	-

Portunus sanguinolentus (Herbst, 1783)	Portunidae	+	+	+	+	+	+	+	+	-
Scylla serrata (Forskål, 1775)	Portunidae	+	-	-	-	-	-	+	+	+
S. tranquebarica (Fabricius, 1798)	Portunidae	-	+	-	-	-	-	-	-	-
Thalamita crenata Rüppell, 1830	Portunidae	+	+	+	+	-	-	-	-	-
Cephalopods										
Myopsida										
Loliolus (Loliolus) hardwickei (Gray, 1849)	Loliginidae	+	+	+	+	-	-	-	-	-
Uroteuthis (Photololigo) duvaucelii (d'Orbigny [in Férussac & d'Orbigny], 1835)	Loliginidae	+	+	+	+	-	-	-	+	-
Octopoda										
Cistopus indicus (Rapp, 1835)	Octopodidae	-	+	+	+	-	+	+	-	-
Octopus vulgaris Cuvier, 1797	Octopodidae	-	+	-	-	-	-	-	-	-
Sepiida										
Sepiella inermis (Van Hasselt [in Férussac & d'Orbigny], 1835)	Sepiidae	+	+	-	-	+	+	+	+	-
Jellyfish										
Semaeostomeae										
Chrysaora *calliparea (*Péron & Lesueur, 1810)	Pelagiidae	+	+	+	+	+	+	-	+	+
*Chrysoara budjenkii (*Péron & Lesueur, 1810)	Pelagiidae			+	+					
Hermit crab										
Decapoda										
Clibanarius padavensis de Man, 1888	Diogenidae	-	-	-	+	-	-	+	-	-
Sea Snakes										
Squamata										
Acrochordus granulatus (Schneider, 1799)	Acrochordidae	-	-	-	+	-	-	-	-	-
Enhydrina schistosa (Daudin, 1803)	Elapidae	+	+	+	+	+	+	+	+	+

Hydrophis cyanocinctus Daudin, 1803	Elapidae	-	-	+	-	-	-	-	-	-
Lapemis curtus (Shaw, 1802)	Elapidae	+	+	+	-	-	+	+	+	+
Lobster										
Decapoda										
Scyllarus Fabricius, 1775	Scyllaridae	+ -	-	-	-	-	-	-	-	+
Squilla										
Stomatopoda										
Oratosquillina interrupta (Kemp, 1911)	Squillidae	-	-	-	+	+	+	+	+	+
Miyakella nepa (Latreille in Latreille, Le Peletier, Serville & Guérin, 1828)	Squillidae	+	+	+	+	+	+	+	+	+
(+: Found; -: Not found)										

Discards

The month- wise analysis of discard of catch in the estuary from single-day dol netters of Karanja (Figure 4) evidently revealed that more than 5 % discard of the total resource caught was recorded during the entire fishing year (September, 2016 - May, 2017). Month of February had more discards. The main content of discard in the dol nets was jellyfishes and plastics in addition to juveniles of several fish species. It emerged from the present study that plastic/garbage trapped in dolnet was high which was noticed in every single operation of dolnet (Figure 5). Plastics of various categories were noted in the sampling with domination of food packet covers.

DISCUSSION

Catch Composition

Observations during the present study revealed that the catches in dol net fishing operations consisted of 51 species of fin fishes, 3 species of elasmobranchs, 13 species of shrimps, 10 species of crabs, 5 species of cephalopods, 2 species of jellyfish, 4 species of sea snakes,1 species of lobster and 3 species of stomatopods. Among the catch composition, *Acetes indicus*, *Harpadon nehereus*, *Chrysaora caliparea*, *Parapenaeopsis sculptilis* , *Lepturacanthus savala*, *Charybdis callianassa*, *Mystus gulio*, *Coilia dussumieri*, *Arius maculatus* and *Miyakella nepa* were the major contributors in the dolnet fishery. The catch composition noted in the present study varied from the work of earlier researchers (Rajan *et al*., 1982; Pillai, 1983; Khan, 1987 and 1989; Srinath *et al.,* 1987; Raje, 1991; Srinath, 2003; Raje *et al*., 2004). Huge catch of juveniles of several fish species were recorded throughout the year from the study area due to usage of small mesh size (8mm) in the cod end part (*khola*) of dol net. This grave situation rings the alarm bell highlighting the need for operation of a properly designed net to ensure sustainable use of fishery resources.

Discards/ waste

The plastic filtration was maximum in February-March 2017. Most of the waste material was garbage/plastics that included plastic bags, disposable water bottles, cold drink bottles, disposable cups, milk pouches, soap covers, synthetic ropes, synthetic gear etc. Fishermen usually segregated plastics from their catch which increased their working time. All such garbage/plastics were the indicators of intensity of pollution leading to long term and high adverse impacts on ecosystem. The waste had increased considerably and affected fishing operations in our waters (Boopendranath, 2012). In the present study it was noted that the fishermen had to spend additional time to segregate their catch from the plastics before reaching the shore and all the segregated wastes were again thrown back into the same estuary.

Worldwide almost 280 million t of plastic materials are produced annually, much of which ends up in landfills or the oceans and among eighty percent of marine litter originating from land based sources, plastics occupy a major quantity (Shaw and Sahni, 2014). River basins and estuaries act as a major connecting bridge for inland waters and coastal waters for debris transport (Possatto *et al*., 2011). Fishermen around the world have encountered plastic and allied debris bycatch in their fishing nets (Boopendranath, 2012). There was a tremendous impact on aquatic fauna due to plastic debris ingestion and entanglement worldwide, which resulted in change of normal physiological functions such as growth and reproduction which ultimately threatens our valuable aquatic resources (Sigler, 2014). Collection of floating debris and recycling it could be a valuable solution which has now been realized in various parts of the world with several different new innovative approaches (*Sarker et al*., 2012).

Findings of the present study revealed that discards formed more than 5% of the total catch in every haul. Main component of discard from the dol netters were jelly fishes. A huge quantity of Scyphozoan jellyfish such as *Chrysaora caliparea* and *Chrysoara budjenkii* was recorded in the present study with seasonal dominance during November 2016 to January 2017.Swarming dynamics of scyphozoan jelly fishes have great influence on the coastal ecosystem (Saravanan et al., 2016). There are scanty reports about jellyfish population abundance, their benefits, and impacts on the coastal ecosystem in Indian waters (Panda and Madhu, 2009). Though Indian fishers were known to catch jellyfish since 1984, the exact data is unavailable in the FAO jellyfish catch statistics (Brotz and Pauly, 2017). Information on jellyfish fisheries along west coast of India is even sparser (Brotz, 2016) and in recent years, massive swarms of jellyfish have been observed along Maharashtra coast predominantly in dolnetters and trawlers (Purushottama *et al*., 2015). Kumawat *et al.* (2015) stressed the need for management measures to reduce huge discards in dol nets of Maharashtra.

CONCLUSION

Management of estuarine fish resources requires information on catch composition, discards and their temporal distribution. This study highlighted the temporal difference in catch composition and unused discards due to poor market demand. September to October comprised the peak fishing season. Analysis of the results revealed that on an average plastic formed 10.4% of the total catch from dol netter per trip. Significant discard of jelly fishes was recorded during November and December 2016 and January 2017. Findings of the study could be used as a support tool

to suggest measures to ensure sustainability of dol net fishery resources of estuarine regions while highlighting the need to adopt management measures to utilize the discards of dol netters of Karanja estuary.

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