Bycatch from Trawlers with special reference to Its Impact on Commercial Fishery, off Mangalore

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Introduction

Trawling, though one of the most efficient methods of fish capture, is also found to be the most important human caused physical disturbance on the world's continental shelves and hence the physical destruction of ecosystems (Jennings and Kaiser, 1998). Trawl fishery is generally a mixed fishery, targeting a number of species and sizes, simultaneously. Discarding is the practice of returning an unwanted section of the catch back to the sea during fishing operations (Alverson, 1994; Van Beek, 1998; Hall, 2000). Discards not only include non-commercial species, but also commercial species that are below minimum landing size (MLS) or less profitable species owing to market conditions and quota restrictions (Catchpole *et al.*, 2005). The resource damage due to discarding of the bycatch has been taken seriously by international bodies like FAO and during the past decade, a decline in global discards has been observed in the major world fisheries due to decline of catches with high discards rates, greater utilisation for human consumption and the progressive attitude by fisheries managers, user groups, and society towards the need to resolve the bycatch problem (FAO, 2004).

Boopendranath (2007) has reviewed the studies on bycatch and discards from the Indian waters. Sivasubramanyam (1990) observed that shrimp bycatch in Visakhaptnam is constituted by 85 species and Gordon (1991) estimated that 25-30% of discards comprised of juvenile shrimps along the Visakhapatnam coast. BOBP study indicated that the quantity of bycatch discarded by the east coast trawlers have been 0.1-0.13 million t, during the year 1988 and abundant groups in the bycatch were Sciaenidae, Leiognathidae, Nemipteridae, Clupeidae, Trichiuridae, Carangidae, Mullidae, Harpodontidae, and Menidae (Gordon, 1991). Menon, (1996) had estimated that 6,200 t juvenile fishes and prawns were discarded back into the sea during 1980-84 and Rao (1998) estimated the discards from Visakhapatnam coast as high as 0.2 million t. Kurup *et al.* (2003) made a detailed study of bottom trawl discards along Kerala coast pertaining to 2000-01 and 2001-02. The quantity of discards thrown back into the sea during 2000-01 and 2001-02 has been estimated as 0.26 and 0.23 million t, respectively. In Karnataka, the first attempt on bottom trawling was made by the Japanese trawler M.S. Kaiko Maru in 1961 and during 1963-67, vessels of Indo-Norwegian Project conducted systematic exploitation of coastal fishing grounds (Kurup *et al.*, 1987). The target species of trawl in Karnataka are shrimps, squids, cuttlefish, threadfin breams and ribbonfishes. In Karnataka, the bycatch quantity from trawlers was estimated to be 56,083 t during 2001 and 52,380 t during 2002 which formed 54.4% and 47.9% of the trawl catch, respectively. The quantity of discards was 34,958 t (33.9%) and 38,318 t (35.1%), respectively (Zacharia *et al.*, 2006).

In this paper, the extent of resource damage implied due to bycatch discards and the spatio-temporal distribution of discards from trawlers operating, off Mangalore, Karnataka, are discussed so as to evolve operation based discard reduction strategies in trawl operations.

Materials and Methods

The bycatch data from single day operating trawlers and multi-day trawler were collected separately from Mangalore fisheries harbour, twice in a week to estimate monthly and annual trash fish landings by these trawlers (Srinath *et al.*, 2005). Data on discards were collected onboard of multi-day operating trawler by recording the commercial catch and discard catch from each haul. Along with data, an unsorted portion of discarded catch was collected as sample. The samples were preserved in ice and stored in fish-hold. All the species were identified up to species level (Chhapgar, 1957; Fisher and Bianchi, 1984; Chan, 1998; Froese and Pauly, 2007). Qualitative and quantitative analysis of the samples were carried out in the laboratory and data were recorded. Apart from catch and discard data, details of boat operation, net operation were recorded from each cruise and each net operation.

The period of observation was from 4 September, 2007 to 8 June, 2008. The samples were collected from a depths ranging from 10 m to

150 m from the fishing ground extending between 10°50'-15°39' N lat and 75°17'-73°25' E long.

Results and Discussion

Bycatch from single day trawlers

It is estimated that during the fishing year (2007-2008) single day operating trawlers from Mangalore Fisheries harbour landed 1,601 t of fishes out of which 583 t (36.44%) were of non edible, low valued fauna which is landed as trash. The highest trash landing was during December (47.2%). Stomatopods were the most dominant group among the bycatch, followed by finfishes, whereas, non-edible crabs, invertebrates, cephalopods and other molluscs were present in lesser quantities. The bycatch from single day trawlers consisted of 35 species of finfishes, 20 species of crustaceans, 20 species of gastropods, 3 species of cephalopods, 2 species of stomatopods, 3 species of echinoderms, 2 species of coelenterates and one sea snake.

Bycatch and discards from multi-day trawlers

In the multi-day trawlers total landing was estimated as 65,589 t, out of which 2,418 t (3.69%) were landed as trash, which formed part of the bycatch caught during the last two days of the fishing. The low valued bycatch caught earlier to the last two days were discarded. The data from the sampled trawler showed that 14% of the catch was discarded during the process which amounts to be 9,199 t. Sujatha (1995) reported that in Visakhapatanam about 11% of the trawl catch was discarded. Month-wise break up of catch, trash and discard from single-day trawlers and multi-day trawlers from Mangalore fisheries harbour during the fishing year 2007-2008 are given in Table.1.

Composition of discarded bycatch

The bycatch was constituted by commercial edible species and non commercial biota like non-edible crabs, gastropods, echinoderms, gorgonids and sea snakes. Out of the 202 species identified, 45 species were of commercial value to the fishery of Mangalore. Species of commercial value present in the discards are listed in Table 2.

Out of 45 commercial species, 38 species were finfishes, two species of cephalopods, three species of shrimps, one species of lobster and edible crab each. Major portion of the bycatch by weight was *Saurida tumbil* (12.5% among commercial species and 4.7% in the total discards)

Table 1: Month-wise details of landings and discards (t) from single day trawlers and multi-day trawlers at Mangalore during the year 2007-2008

	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Single day trawlers											
Landings, t	46	15	59	385	472	192	144	125	163	0	1601
Trash, t	0	0	26	182	120	72	65	51	67	0	583
% of trash	0.0	0.0	44.2	47.2	25.5	37.3	45.5	40.9	41.3	0.0	36.4
Multi-day trawlers											
Landings, t	4781	9198	10699	5742	6339	2194	4389	11472	8716	2061	65589
Discards, t	779	1398	1573	1270	1001	320	443	1709	1534	441	9199
Trash, t	158	276	310	253	644	261	182	394	116	78	2419
% of discards	16.3	15.2	14.7	22.1	15.8	14.6	10.1	14.9	17.6	21.4	14.0
% of trash	3.3	3.0	2.9	4.4	10.2	11.9	4.2	3.4	1.3	3.8	3.7

and by numbers, *Photopectoralis bindus* contributed maximum (33% among commercial group and 21.1% among overall discards). Month- wise frequency of occurrence of species in the bycatch showed that as many as 14 commercial species were seen invariably in all the months. *Platycephalus* sp. and *Saurida tumbil* were observed in most of the sampling days from September to June. An estimated 63.7% (by numbers) of bycatch was constituted by juveniles of commercially important fishes causing significant damage to the stocks of these species. In terms of weight, commercial species constituted 37.4% of total bycatch. Sujatha (1995) identified 228 species from the discards in Visakhapatanam which constituted about 11% of the trawl catch. Luther and Sastry (1993) found that bulk of the landings in different maritime states in different fishery comprised of juveniles, Sivasubramanyam (1990) observed 50% of the bycatch sample studied was immature fish in trawlers from Bay of Bengal. Pillai (1998) also observed that 40% of the catch from Indian seas was juveniles. Spatio-temporal and bathymetric variation in abundance of the species in the bycatch was recorded which will be useful for introducing fishing restrictions based either on season or on fishing grounds to reduce the bycatch in trawl fisheries.

Stock assessments are generally based on landing data only and ignoring discards in the population analysis may lead to serious bias in the perceived dynamics of the population. In particular, the estimates of year class strength will be underestimated (Casey, 1993; Dingsor, 2001). Discarding and juvenile exploitation are two important factors impacting negatively on the stocks as well as on the fishery economy. The mortality

Table 2: Temporal and bathymetric distribution of commercial fishes recorded from discarded bycatch

Species	Period of occurrence	Depth range	% in total number	% in total weight
Alectis indicus	Nov-Jan	12 -53	0.10	0.38
Cynoglossus bilineatus	Sept-Apr	85-132	0.02	0.05
Cynoglossus macrostomus	Oct-Apr	10-87	0.32	0.36
Cynoglossus puncticeps	Jan	87-87	0.00	0.01
Decapterus russelli	Sept-Nov	16-55	1.85	1.10
Dussumieria acuta	Sept-May	10-55	0.40	1.40
Encrasicholina devisi	Nov-Jun	30-55	4.32	1.06
Epinephelus diacanthus	Sept- Jan	25-85	0.04	0.10
Gymnothorax sp.	Sept, Mar	92-150	0.03	0.19
Johnius sp.	Oct- Jan	10-52	0.22	0.28
Lactarius lactarius	Nov-Mar	12-53	0.26	0.42
Photopectoralis bindus	Oct-June	10-55	21.05	1.20
Eubleekeria splendens	Jan	15-30	0.03	0.01
Uroteuthis duvauceli	Oct-June	20-111	2.99	0.99
Lutjanus sp.	Apr, May	29-127	0.32	0.21
Megalaspis cordyla	Mar- May	51-121	0.17	0.46
Mene maculata	Sept-Jun	16-47	1.01	2.17
Muraenesox cinereus	Dec, Jan	31-109	0.59	0.72
Nemipterus japonicus	Dec-May	29-73	2.66	0.79
Nemipterus mesoprion	Sept-Jun	30-150	5.94	3.75
Parapenaeus fissuroides	Mar-May	36-111	1.02	0.59
Platycephalus sp.	Sept-Jun	20-150	1.36	2.15
Portunus sanguinolentus	Nov, Dec	25-140	0.27	0.14
Priacanthus hamrur	Sept-May	43-150	0.39	0.74
Psettodes erumei	Sept-Apr	37-150	0.60	0.96
Pseudorhombus sp.	Jan-Jun	36-132	1.31	0.84
Rachycentron canadum	Jan-May	40-47	0.01	0.05
Rastrelliger kanagurta	Sept-May	20-60	1.17	1.18
Sardinella gibbosa	Sept-Nov	10-50	0.20	0.28
Sardinella longiceps	Oct-Jan	10-53	0.42	0.46
Saurida tumbil	Sept-Jun	30-132	6.04	4.66
Saurida undosquamis	Sept-Jun	29-85	0.50	2.00
Scomberomorus commerson	Nov, Dec, May	38-90	0.36	0.15
Secutor insidiator	Jan-Jun	10-55	2.05	1.29
Sepiella inermis	Apr, May	15-50	0.44	0.46
Sepia elliptica	Feb-May	46-48	0.09	0.12
Solenocera choprai	Sept-May	30-126	0.83	0.23
Sphyraena sp.	Nov-May	12-40	0.17	0.29
Stolephorus insularis	Sept- Apr	16-43	0.93	0.76
Stolephorus waitei	Feb-May	32-42	0.05	0.05
Thenus orientalis	Jan-Jun	12-92	0.04	0.19
Trachinocephalus myops	Feb-May	29-130	0.09	0.19
Trachypenaeus curvirostris	Feb-Jun	35-92	1.49	0.71
Trichiurus lepturus	Sept-Jun	12-53	0.91	2.56
Upeneus sp.	Feb-Jun	36-132	0.29	0.67

due to fishing could be much higher than that estimated from the resource landed, as discards are not taken into consideration. Studies on geo-temporal distribution of juvenile and adult threadfinbreams, *Nemipterus mesoprion* in trawling grounds off Karnataka was carried out during the fishing year 2007-2008. The study showed that only 30% of *N. mesoprion* (in terms of numbers) caught were landed as commercial catch and the rest 70% was discarded as they were juveniles of low commercial value. (Dineshbabu *et. al.*, 2009). Apart from the resource damages, the exploited biomass of these species is not accounted in the estimation of their stocks. Since the stock assessment studies form the basis for management policies, the estimation of discards of individual species is very essential for legitimate stock estimates and successful policy decisions (Dineshbabu and Radhakrishnan, 2009).

If the fishers were able to know, in advance, the species and size composition of the potential catch in an area, they could make better decisions concerning fishing operations and, if necessary, shift the grounds, when there is a dominance of bycatch or endangered and protected species in the area. In this way, hauls with high proportion of bycatch or with incidence of endangered and protected species, could be avoided or reduced. Information on spatio-temporal distribution of discards obtained from commercial and experimental fishing operations, thus, offers a strategy for reducing discards by restricting operations in areas and during periods of high incidence of bycatch discards and juveniles.

Spatio-temporal resource mapping, on a long term basis, especially in a GIS platform, could lead to better management of coastal fishery resources and responsible harvesting options and facilitate reduction in bycatch and discards and operational costs of fishing. The study highlights the importance of maintenance of fishing log and reporting by the commercial operators, for better management of the fishery.

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