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FINFISH CONSTITUENTS OF TRAWL LOW VALUE BY-CATCH OFF MANGALORE

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ABSTRACT- Trawling remains a controversial method of fishing due to the poor selectivity of trawl net and catching of huge quantity and diversity of non target fishes. By-catch is recognised as an unavoidable portion of fish catch but quantity varies according to the type of gear operated. FAO has considered the resource damage due to discarding of by-catch as serious issue. Mangalore fisheries harbour is one among the major fishing harbours of Karnataka state with its significant contribution to the Trawl landings. The study was conducted to assess the recourse damage due to indiscriminate fishing and landing of juveniles of commercially important species in low value by-catch due to smaller size and improper handling. The quantity of low value by-catch was estimated from the landings of single-day and multi-day trawler landings for the period of August 2012 to May 2013. The quantity of low value by-catch (trash fish) generated by trawlers of Mangalore was estimated as 32,426 t (19% of the total trawl catch). A total 121 species of finfishes belonging to 55 families have been identified constituting the low value by-catch. Order Perciformes contributed 61.16 per cent (74 species) to the total number of species, followed by Clupeiformes and other groups, whereas the family Carangidae contributed 11.57 per cent (14 species) to the total number of species, followed by Engraulidae and other families. Presence of wide diversity of finfishes in low value by-catch showed an alarming signal of fisheries resource damage.

Key word : By-catch, finfish, resource damage, Mangalore.

INTRODUCTION

Trawling is one of the most efficient methods of catching fish world over and is also the most important human caused physical disturbance to the world's continental shelves, and consequently, the physical destruction of marine ecosystem (Jennings and Kaiser, 1998). Trawl fishery is generally a mixed fishery 'targeting a number of species and sizes, simultaneously. Trawl nets are mainly designed to catch economically important species such as shrimps, squids, cuttlefish, groupers, snappers, threadfin breams and ribbonfish. As an active non selective fishing gear, trawl net collects every organism in its path and the incidental catch of non-target species called by-catch has become major concern allied to trawling.

In general non-targeted, non-commercial species in the by-catch will be thrown overboard, a practice called discarding (Van Beek, 1998). Most of the by-catch are brought to the landing centre by single-day trawlers (SDT) whereas onboard discarding is done by multi-day trawlers (MDT) where the by-catch obtained in the first few days is thrown back into the sea and the portion retained called trash fish (Zacharia *et al*., 2006). Due to demand for fish meal is on the rise, low value by-catch (trash) is being landed by the trawlers. The trash consist not only low value fish but also juveniles of commercially important species and the dominant groups are threadfin breams, flat heads and lizard fishes (Dineshbabu, 2011).

Reasons for discarding the fishes were studied by several workers (Saila, 1983; Northridge, 1991; Murawski, 1993; Jennings and Kaiser, 1998; Pillai, 1998; Bijukumar & Deepthi, 2006; Zacharia *et al*., 2006; Boopendranath, 2007 and Gibinkumar *et al*., 2012). During 1980-81 and 1981-82, the annual by-catch in trawl fishery of Karnataka was estimated as 85% of the total trawl catch, stomatopods being the major constituent (Kurup *et al*., 1987). For the years 2008 and 2009, on an average a total of 1,757t of fishes were landed by SDT out of which 64%were landed for edible purpose and rest was landed as low value by-catch (trash). Where as in case of multi-day trawlers, the average total landings was 98,692t in that 93% was edible and the rest was trash. More than 300 species of fishes and shellfishes were identified from trawl landings of Mangalore and most life stages of many of the species were represented in LVB. Lizard fishes, puffer fishes, stomatopods, threadfin breams and flatheads are the major contributors to trash (Dineshbabu *et al.,* 2012).

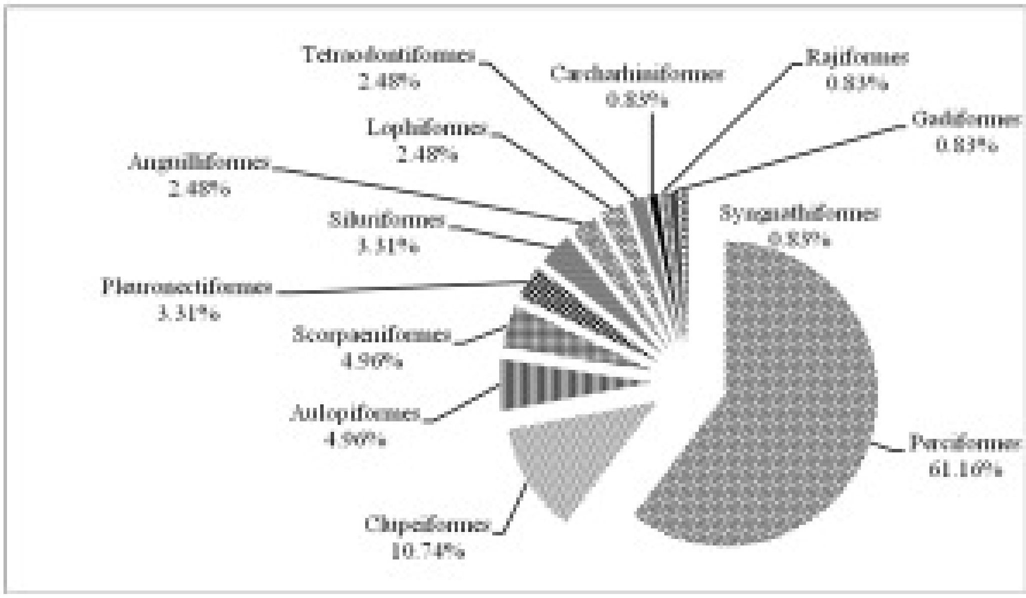

Fig. 1 : Diagrammatic representation of the % number contribution of each order during the study period.

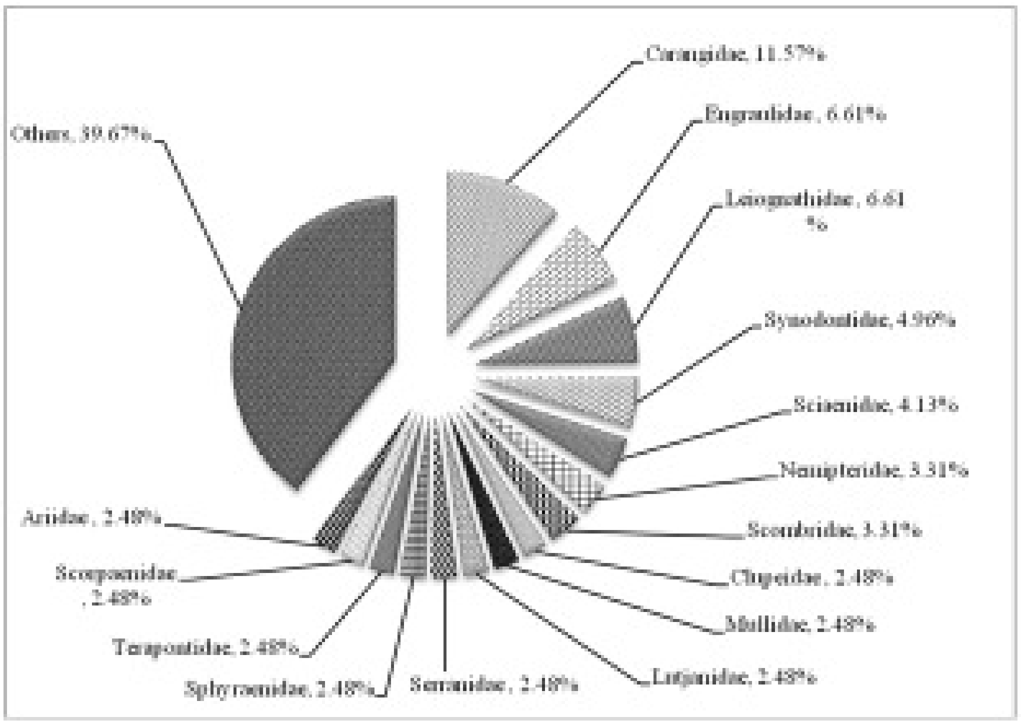

Fig. 2 : Diagrammatic representation of the % number contribution of each family during the study period.

Intensity of trawl fishing has a vicious impact on benthic ecology and biodiversity (Dayton *et al.*, 1995) and the biological and economic loss due to discarding is one of the important issues fishery managers have to tackle (Kelleher, 2005). The diversity of species is the main cause of the higher magnitude of discards found in tropical waters. It is significant to note that the by-catch comprised about 40% juveniles and those in the early stage of development which are invariably discarded leading to the depletion of the resources (Pillai, 1998). Hence, in this study an attempt has been made to characterize the finfish composition of low value by-catch generated from trawlers of Mangalore.

MATERIALS AND METHODS

Trash fish landing data were collected from trawl landings at Mangalore Fisheries Harbour from August 2012 to May 2013. Collection schedule was once a week. The catch was recorded as those landed for "edible use" and the rest landed as low value by-catch or "trash". Fishing details like date, cruise no, overall length of fishing vessel, tonnage, depth of shooting, hauling depth, hauling

Table 1 : List of finfish species recorded in trawl low value by-catch off Mangalore.

Order	Family	Species
Carcharhiniformes	Hemigaleidae	1. *Chaenogaleus macrostoma* (Bleeker, 1852)
Rajiformes	Rhinobatidae	2. *Rhina ancylostoma* Bloch and Schneider, 1801
Anguilliformes	Muraenidae	3. *Gymnothorax annulatus* Smith and Bohlke, 1997
	Muraenesocidae	4. *Muraenesox bagio* (Hamilton, 1822)
		5. *Muraenesox cinereus* (Forsskal, 1775)
Aulopiformes	Synodontidae	6. *Harpadon nehereus* (Hamilton, 1822)
		7. *Saurida tumbil* (Bloch, 1795)
		8. *Saurida undosquamis* (Richardson, 1848)
		9. *Synodus indicus* (Day, 1873)
		10. *Synodus macrops* Tanaka, 1917
		11. *Trachinocephalus myops* (Forster, 1801)
Clupeiformes	Clupeidae	12. *Anodontostoma chacunda* (Hamilton, 1822)
		13. *Sardinella gibbosa* (Bleeker, 1849)
		14. *Sardinella longiceps* Valenciennes, 1847
	Dussumieriidae	15. *Dussumieria acuta* Valenciennes, 1847
	Engraulidae	16. *Encrasicholina devisi* (Whitley, 1940)
		17. *Encrasicholina punctifer* Fowler, 1938
		18. *Stolephorus commersonnii* Lacepede, 1803
		19. *Stolephorus indicus* (Van Hasselt, 1823)
		20. *Stolephorus insularis* Hardenberg, 1933
		21. *Stolephorus waitei* Jordan and Seale, 1926
		22. *Thryssa malabarica* (Bloch, 1795)
		23. *Thryssa mystax* (Bloch & Schneider, 1801)
	Pristigasteridae	24. *Opisthopterus tardoore* (Cuvier, 1829)
Gadiformes	Bregmacerotidae	25. *Bregmaceros mcclellandi* Thompson, 1840
Lophiiformes	Antennariidae	26. *Antennatus dorehensis* (Bleeker, 1859)
	Lophiidae	27. *Lophiomus setigerus* (Vahl, 1797)
	Ogcocephalidae	28. *Halieutaea indica* Annandale and Jenkins, 1910
Perciformes	Ambassidae	29. *Ambassis ambassis* (Lacepede, 1802)
		30. *Ambassis gymnocephalus* (Lacepede, 1802)
	Apogonidae	31. *Apogon aureus* (Lacepede, 1802)
		32. *Apogon fasciatus* (White, 1790)
	Ariommatidae	33. *Ariomma indicum* (Day, 1871)
	Callionymidae	34. Callionymus margaretae Regan, 1905
	Carangidae	35. *Alectis ciliaris* (Bloch, 1787)
		36. *Alectis indica* (Ruppell, 1830)
		37 *Alepes djedaba* (Forsskal, 1775)
		38. *Atule mate* (Cuvier, 1833)
		39. *Carangoides armatus* (Ruppell, 1830)
		40. *Carangoides malabaricus* (Bloch & Schneider, 1801)
		41. *Carangoides oblongus* (Cuvier, 1833)
		42. *Decapterus macrosoma* (Bleeker, 1851)
		43. *Decapterus russelli* (Ruppell, 1830)
		44. *Megalaspis cordyla* (Linnaeus, 1758)
		45. *Parastromateus niger* (Bloch, 1795)
		46. *Selar crumenophthalmus* (Bloch, 1793)
		47. *Seriolina nigrofasciata* (Ruppell, 1829)
	Centrolophidae	48. *Psenopsis cyanea* (Alcock, 1890)
		49. *Psenopsis intermedia* Piotrovsky, 1987
	Cepolidae	50. *Acanthocepola indica* (Day, 1888)
	Drepaneidae	51 *Drepane punctata* (Linnaeus, 1758)

Table 1 continued....

Table 1 continued....

	Echeneidae	52. *Echeneis naucrates* (Linnaeus, 1758)
	Ephippidae	53. *Platax orbicularis* (Forsskal, 1775)
	Gerreidae	54. *Gerres filamentosus* Cuvier, 1829
	Haemulidae	55. *Pomadasys furcatus* (Bloch & Schneider, 1801) 56. *Pomadasys maculatus* (Bloch, 1793)
	Lactariidae	57. *Lactarius lactarius* (Bloch and Schneider, 1801)
	Leiognathidae	58. *Gazza achlamys* (Jordan & Starks, 1917) 59. *Gazza minuta* (Bloch, 1795) 60. *Leiognathus brevirostris* (Valenciennes , 1835) 61. *Leiognathus dussumieri* (Valenciennes, 1835) 62. *Leiognathus lineolatus* (Valenciennes, 1835) 63. *Leiognathus splendens* (Cuvier, 1829) 64. *Photopectoralis bindus* (Valenciennes, 1835) 65. *Secutor insidiator* (Bloch, 1787)
	Lutjanidae	66. *Lutjanus lutjanus* (Bloch, 1790) 67. *Lutjanus malabaricus* (Bloch & Schneider, 1801) 68. *Lutjanus russellii* (Bleeker, 1849)
	Menidae	69 Mene maculata (Bloch and Schneider, 1801)
	Mullidae	70. *Upenus moluccensis* (Bleeker, 1855) 71. *Upenus sundaicus* (Bleeker, 1855) 72. *Upenus vittatus* (Forsskal, 1775)
	Nemipteridae	73. *Nemipterus japonicus* (Bloch, 1791) 74. *Nemipterus randalli* Russell, 1986 75. *Parascolopsis aspinosa* (Rao and Rao, 1981) 76. *Scolopsis vosmeri* (Bloch, 1792)
	Pinguipedidae	77. *Parapercis alboguttata* (Gunther, 1872)
	Pomacentridae	78. *Pomocentrus caeruleus* Quoy and Gaimard, 1825
	Priacanthidae	79. *Priacanthus hamrur* (Forsskal, 1775)
	Rachycentridae	80. *Rachycentron canadum* (Linnaeus, 1766)
	Sciaenidae	81. *Johnius carouna* (Cuvier, 1830) 82. *Johnius carutta* Bloch, 1793 83. *Johnius dussumieri* (Cuvier and Valenciennes, 1830) 84. *Otolithes cuvieri* Trewavas, 1974 85. *Otolithes ruber* (Bloch & Schneider, 1801)
	Scombridae	86. *Auxis rochei rochei* (Risso, 1810) 87. *Rastrelliger kanagurta* (Cuvier, 1816) 88. *Scomberomorus commerson* (Lacepede, 1800) 89. *Scomberomorus guttatus* (Bloch and Schneider, 1801)
	Serranidae	90. *Epinephelus chlorostigma* (Valenciennes, 1828) 91. *Epinephelus diacanthus* (Valenciennes, 1828) 92. *Pseudanthias parvirostris* (Randall and Lubbock, 1981)
	Sphyraenidae	93. *Sphyraena barracuda* (Edwards, 1771) 94. *Sphyraena jello* Cuvier, 1829 95. *Sphyraena obtusata* Cuvier, 1829
	Terapontidae	96. *Terapon jarbua* (Forsskal, 1775) 97. *Terapon puta* Cuvier, 1829 98. *Terapon theraps* Cuvier, 1829
	Trichiuridae	99. *Trichiurus lepturus* Linnaeus, 1758
	Uranoscopidae	100. *Uranoscopus affinis* Cuvier, 1829 101. *Uranoscopus marmoratus* Cuvier, 1829
Pleuronectiformes	Cynoglossidae	102. *Cynoglossus bilineatus* (Lacepede, 1802) 103. *Cynoglossus macrostomus* (Norman, 1928)
	Psettodidae	104. *Psettodes erumei* (Bloch and Schneider, 1801)

Table 1 continued....

Table 1 continued....

	Soleidae	105. *Zebrias quagga* (Kaup, 1858)
Scorpaeniformes	Dactylopteridae	106. *Dactyloptena peterseni* (Nystrom, 1887)
	Paralichthyidae	107. *Pseudorhombus elevates* Ogilby, 1912
	Platycephalidae	108. *Platycephalus indicus* (Linnaeus, 1758)
	Scorpaenidae	109. *Brachypterois serrulata* (Richardson, 1846) 110. *Dendrochirus brachypterus* (Cuvier, 1829) 111. *Pterois russelii* Bennett, 1831
Siluriformes	Ariidae	112. *Arius arius* (Hamilton, 1822) 113. *Arius maculatus* (Thunberg, 1792) 114. *Netuma thalassina* (Ruppell, 1837)
	Plotosidae	115. *Plotosus canius* Hamilton, 1822
Syngnathiformes	Fistulariidae	116. *Fistularia petimba* (Lacepede, 1803)
Tetraodontiformes	Balistidae	117. *Odonus nigar* (Rupell, 1836)
	Diodontidae	118. *Cyclichthys orbicularis* (Bloch, 1785) 119. *Diodon hystrix* Linnaeus, 1758
	Tetraodontidae	120. *Lagocephalus inermis* (Temminck and Schlegel, 1850)

time, net type, mesh size, number of hauls per day etc. were noted. Along with fishing information, an unsorted portion of discarded catch was collected as sample. The discarded samples were preserved in ice and stored in fish-hold and brought to the laboratory in fresh condition to identify the fishes to species level.

Qualitative and quantitative analysis of the samples were carried out in the laboratory. The catch was identified up to species level using Fischer & Bianchi (1984) and Roper *et al.,* (1984), and the taxonomic information was verified using Appeltans *et al.,* (2011); Froese & Pauly (2011) and NIO (2011).

RESULTS AND DISCUSSION

Mangalore landing centre is the important trawl landing centre in Karnataka and contributing more than 40% to the total trawl fisheries. During the study period trawlers landed 1.73 lakh tonnes of fishes, out of which 81% was retained for commercial purpose and the rest (19%) was trash.

A total 121 species of finfishes belonging to 82 genera, 55 families and 13 orders were recorded in trash fish landings during the study period (Table 1). Order Perciformes contributed 61.16% (74 species) to the total number of species, followed by Clupeiformes with 10.74% (13 species), Aulopiformes and Scorpaeniformes with 4.96% each (6 species each), Pleuronectiformes, Siluriformes and Tetraodontiformes with 3.31% each (4 species each), Anguilliformes and Lophiiformes with 2.48% each (3 species each) to the total fish species, whereas other orders together contributed less than 4% (Table 1 and Fig. 1). Family Carangidae contributed 11.57% (14 species) to the total number of species, followed by Engraulidae and Leiognathidae with 6.61% each (8 species each) , Synodontidae with 4.96% (6 species) , Sciaenidae with 4.13% (5 species), Nemipteridae and Scombridae with 3.31% each (4 species), Clupeidae, Mullidae, Lutjanidae, Serranidae, Sphyraenidae, Terapontidae, Scorpaenidae, Ariidae with 2.48% each (2 species each) to the total fish species, whereas other families contributed around 40% (Tab 1 and Fig, 2). In a country like India where marine fishery consist of multispecies composition, the occurrence of by-catch consisting of several species of fish is bound to happen, especially for the trawler operators with regard to on-board handling, preservation, storage, processing and marketing. Since the return from by-catch sometimes known as trash fish, is poor compared to the valuable catch of shrimp and table fish (Chandrapal, 2005).

Some recent studies (Bhathal, 2005) have assumed that no discards exist for trawl fisheries in India presumably due to burgeoning trash fish demand in poultry and aquaculture feed sectors in the last two decades. Jayaraman (2004) based on a study in 2003 estimated trash fish to constitute 10-20% of total catches (2,71,000 t) landed by trawlers operating along Indian coast. 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. Gibinkumar *et al*. (2012) found 281 species in the trawl catch, off southwest coast of India. It was observed that at Mangalore, highest percentage of juvenile fishes by weight in bycatch was of *Nemipterus* spp. (4,023 t) which resulted in an annual revenue loss of Rs.16.5 crores. The economic loss due to discards of juvenile fishes by trawlers at Calicut was estimated as Rs.6.6 crores (Anon., 2011).

In Karnataka finfish was the most dominant group among by-catch accounting for 78.9 per cent in multi day trawlers (MDT). Crabs, cephalopods, shrimps and other crustaceans, molluscs other than cephalopods were found in lesser quantities. The by-catch consisted of 27 families of finfishes represented by 53 species. The by-catch of single day trawlers (SDT) consisted of 20 families of finfishes represented by 35 species (Zacharia *et al.,* 2006). Deneshbabu *et al.* (2012) reported that the single day trawlers generally operate in waters up to 30 m depth and the entire catch is brought to shore, which is separated as commercial catch and the rest as low valued bycatch (LVB) termed as trash. The landing of SDT at Mangalore in 2008 was 1,946 t, of which 74% was of edible grade and 26% was LVB. In 2009, out of 1,568 t landed, the composition of edible grade and LVB was 53% and 47% respectively. A total of 123 species were identified from trash fish landing of SDT. Stomatopods were the major components of the trash forming 63% in 2008 and 43% in 2009. In 2008, a total of 1,00,002t of fishes were landed by MDT out of which 97,381 t (98%) were landed for edible purpose and rest was landed as trash. In 2009, landing reduced to 83,148 t, out of which only 70,429 t (83%) were landed for edible purpose and the rest were landed as LVB (trash). Presently boats with high fish hold capacity bring the by-catch on all days for fish meal preparation.

CONCLUSION

The demand for targeted resources has paved way for indiscriminate bottom trawling along the coast with an ultimate result of massive wastage of low value, high volume by-catch including a wide spectrum of non-edible benthic biota. The small cod end mesh of bottom trawlers has also exploited juveniles and sub-adults of commercial species in large quantities. By-catch problem can be reasonably addressed by allowing trawling with bigger size nets. Since the stock assessment studies form the basis for management policies, the estimation of discards of individual species is very essential to adopt successful policy decisions.

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