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Trawl net by-catches off Visakhapatnam with special reference to Finfish

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ABSTRACT

The study recorded eight groups of marine organisms namely coelenterates, shrimps, crabs, stomatopods, gastropods, cephalopods, echinodermates and finfish in the trawl net by-catch landings at Visakhapatnam fishing harbor. Among eight groups finfish, crabs, shrimps and stomatopods were dominant. Seasonal density distribution based on number percentage revealed that the group finfish contributed significantly to the by-catches during post-monsoon season 2006-07 (56.58%), 2007-08 (38.88%) and summer 2006-07 (35.05%). Crabs were more dominant group during monsoon 2006 (46.24%) and 2007 (47.94%). Season wise density distribution based on weight percentage finfish was the most dominant group in almost all seasons except monsoon 2007, where crabs (33.04%) were dominant. The density distribution of group finfish was represented by 38 families. Among 38 families, leiognathidae was most dominant family. The study recorded 67 species of finfish belonging to 51 genera. Among 67 species, Photopectoralis bindus was the most dominant species based on number percentage, while Uranoscopus archionema was the dominant species based on weight percentage.

Key words: trawl net by-catch, major groups, finfish, season, density distribution, Visakhapatnam fishing harbor

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INTRODUCTION

With the increase in trawl fishing, there has been a considerable increase in the landing of the by-catch resulting in a need to improve the utilization of small low – value fish species. The fishing trawlers bring in large quantities of by-catch, besides the principal fishery groups i.e. fishes, prawns, squids, cuttle-fish and lobster. This by - catch comprises a wide variety of groups which include juvenile fish, small shrimps, crabs, stomatopods etc. The use of the term by-catch varies from country to country and can change both seasonally and with locations. One category of by-catch includes fish which are not used for direct human consumption and which may be either landed or discarded in the sea itself. The other category is low value fish used for human consumption. The composition and the quantity of the by-catch depend on the gear, area of operation and season.

From the Indian waters, there are few reports on the quantity, quality and species composition of by-catch obtained during trawling operations. The first estimation on the quantity of by-catch associated with shrimp trawling [3] showed that 79.18% (3,15,902 tonnes) of the total landings are represented as by-catch. Investigations carried out by CMFRI during 1999 in Karwar, Mangalore, Kochi, Mandapam and Kakinada regions showed the target: by-catch ratios along the south-west and south-east regions of India as 1:4.6 and 1:2.6 respectively [12]. In India, trawl fishing by-catches may be used for human consumption (fresh or dried), direct animal feeds (fish and poultry), fish meal (for poultry), fish oil (shrimp feed production), and for other uses (fertilizers, sauces etc). Most of the work on by-catches was carried out on west coast of India [11,19,8,18,9,22,2,21]. Few studies on by-catch were carried out on east coast of India [16,17]. Due to paucity of information on trawl by-catches of Visakhapatnam, the present study deals with the density distribution of the by-catch in relation to major groups and finfish.

MATERIALS AND METHODS

By-catch samples were collected, at 10 days intervals from Visakhapatnam fishing harbor (Figure 1) during April 2006 – March 2008. Most of the by-catch landings at Visakhapatnam fishing harbor are brought by sona boats. The sona boat length ranging from 14 to16 m, shrimp trawl net one cod end type, length ranging from 12 to13 m, cod end length ranging from 2 to 3 m and cod end mesh size 8 mm. power range of vessel is 90 to 120 Hp, speed of the fishing boat is 2-4.5 knots. Each month, three samples (sample size ranging between 250 and 3500 g) were collected at random from daily trip trawls (both night fishing and day fishing of Sona boats) which bring a catch of 100 – 500 kg per trip. The samples were brought immediately to the laboratory where they were washed with tap water and sorted into groups. All the groups were weighed. The members of the group finfish were identified up to species-level using standard taxonomical keys given by Nelson [13], FAO fish identification catalogues [6,7], Talwar & Kakker [20], Smith & Heemstra [14]. The three samples days were pooled and treated as a single sample for that month. The Percentage composition (group-wise for all organisms; family-wise and species-wise for finfish) of the by-catch was expressed as density distribution, both for number and weight. ANOVA (Microsoft excel) was carried out for density distribution of by-catch organisms in relation to major groups.

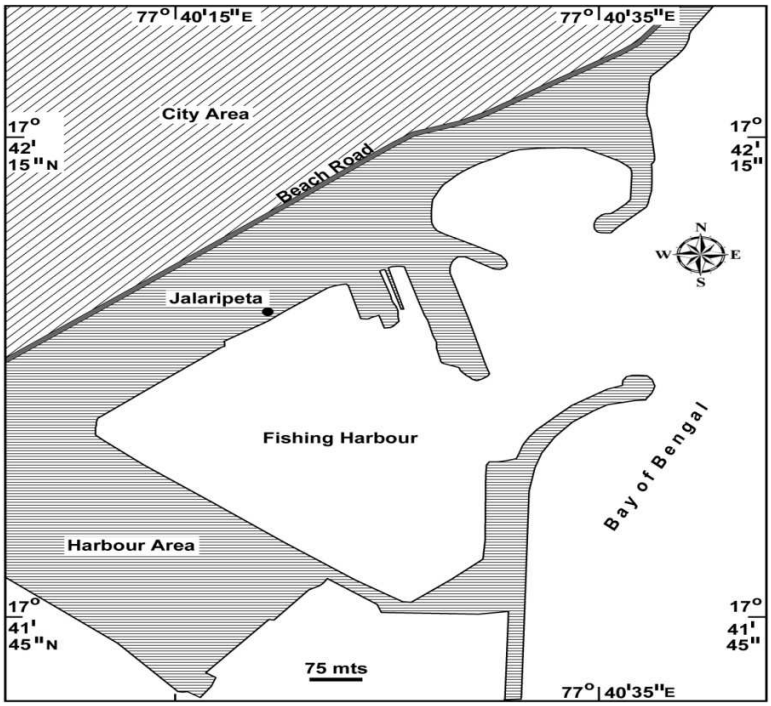

Figure 1: Map of the study area: Visakhapatnam Fishing Harbor, Bay of Bengal

RESULTS

Group wise density distribution:

The present study recorded eight major groups of marine organisms namely coelenterates, shrimps, crabs, stomatopods, gastropods, cephalopods, echinodermates and finfish in the trawl by-catch landings at Visakhapatnam fishing harbor. Among eight groups finfish, crabs, shrimps and stomatopods were dominant (Figure 2 A & B).

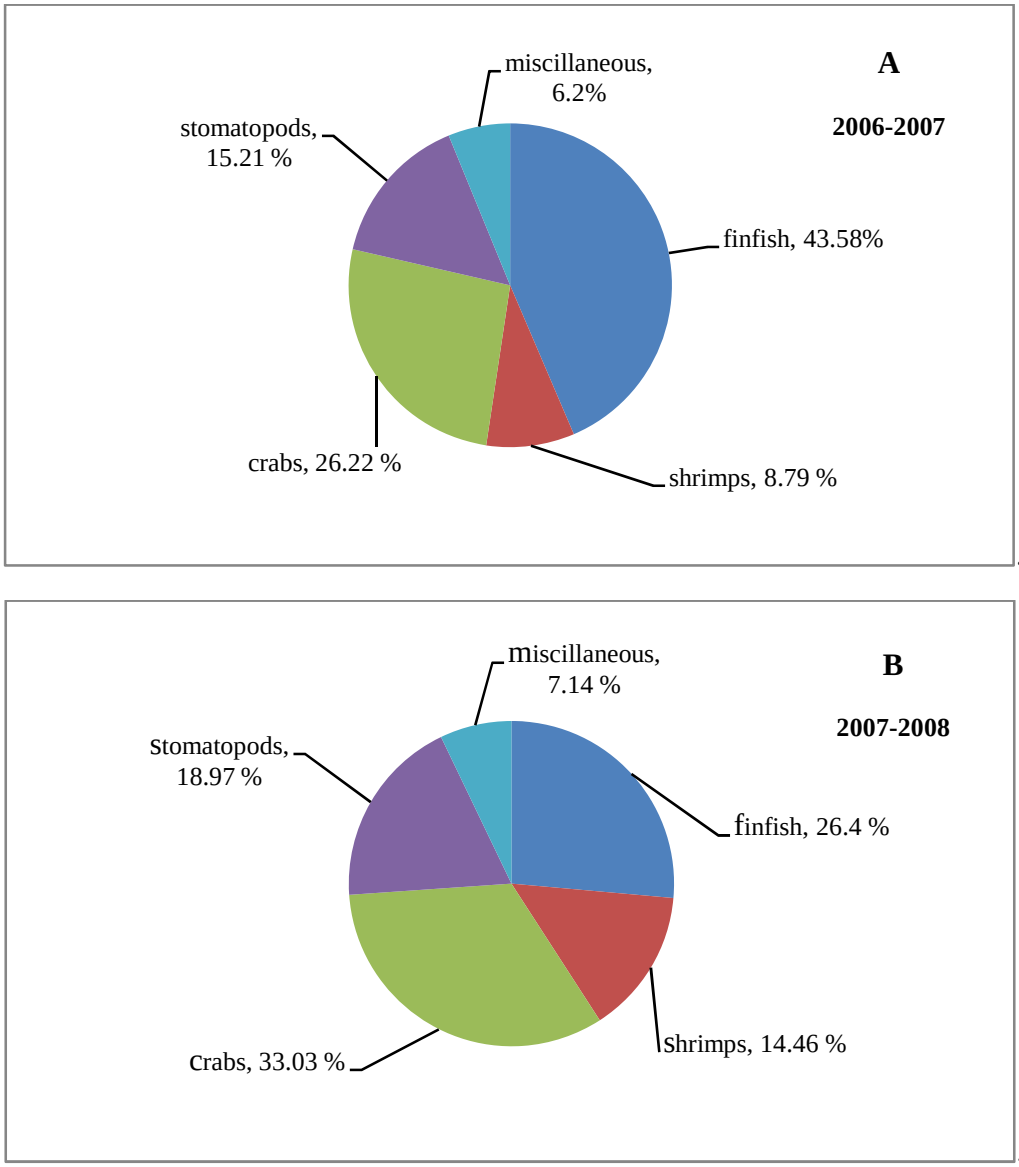

Figure 2: Percentage composition of trawl net by-catch

Group wise seasonal distribution:

An analysis of the seasonal density distribution based on number percentage revealed that the groups finfish, crabs, stomatopods, and shrimps contributed significantly to the by-catches, more or less, in all seasons. The group finfish contributed significantly to the by-catches during post – monsoon season 2006-07 (56.58%) and 2007-08 (38.88%) and summer season 2007 (35.05%). The group crabs was more abundant during monsoon season 2006 (46.24%) and 2007 (47.94%) (Table 1). The season-wise density distribution based on weight percentage indicated the abundance of groups finfish, stomatopods, and crabs. The two groups finfish and crabs dominated in the by–catches during the monsoon season in both (2006-07 and 2007-08) the years. The group finfish contributed very significantly (63.84 - 71.57%) to the by–catches during post–monsoon season in both the years. During summer season also, the group finfish dominated (57.56%) in the by-catches. The group crabs was more abundant during monsoon,2007 (33.04%) (Table 2). Analysis of variance (Two-way) showed statistically significant difference ($p<0.05$) in distribution of major groups (No./Wt.) during the study period.

Table 1: Season-wise density distribution (as number percentage) of different animal groups at Visakhapatnam

Season	Coelenterates	Shrimps	Crabs	Stomatopods	Gastropods	Cephalopods	Echinodermates	Finfishes
Monsoon, 2006	2.35	3.13	46.24	14.99	1.09	0.48	6.28	25.44
Post – monsoon, 2006-07	1.32	10.42	12.35	14.47	1.46	1.78	1.62	56.58
Summer,2007	1.92	14.13	24.18	18.21	2.71	1.63	2.17	35.05
Monsoon,207	0.69	14.68	47.94	18.35	2.53	1.14	0.68	13.99
Post – monsoon, 2007-08	4.16	11.12	8.34	29.16	8.34	-	-	38.88

Table 2: Season-wise density distribution (as weight percentage) of different animal groups at Visakhapatnam

Season	Coelenterates	Shrimps	Crabs	Stomatopods	Gastropods	Cephalopods	Echinodermates	Finfishes
Post – monsoon, 2007-08	1.58	1.06	3.74	23.33	6.45	-	-	63.84
Monsoon, 2007	0.41	2.17	33.04	22.57	3.01	7.05	0.19	31.56
Summer, 2007	0.84	1.58	12.59	16.93	2.45	7.57	0.48	57.56
Post – monsoon, 2006-07	0.52	1.05	5.78	12.09	1.18	7.48	0.33	71.57
Monsoon, 2006	1.43	0.48	33.12	19.17	1.37	3.02	1.88	39.53

Table 3: Family wise density distribution (as numbers percentage) of different finfish families at Visakhapatnam

S. No.	Family	2006 - 07	2007 - 08	2006 - 08
1	Antenneridae	-	0.47	0.10
2	Apogonidae	17.03	11.16	15.86
3	Ariidae	0.23	0.47	0.28
4	Bothidae	0.35	-	0.28
5	Bregmacerotidae	2.66	1.39	2.41
6	Carangidae	0.12	2.32	0.55
7	Clupeidae	0.12	-	0.10
8	Cyanoglossidae	3.01	0.93	2.59
9	Elopidae	0.23	0.93	0.37
10	Engraulidae	3.24	0.93	2.78
11	Fistularidae	0.35	0.47	0.37
12	Gobiidae	7.07	5.11	6.68
13	Holocentridae	-	0.47	0.10
14	Leiognathidae	30.59	21.86	28.85
15	Leptocephalidae	0.69	-	0.55
16	Menidae	0.12	1.39	0.37
17	Monodactylidae	-	0.47	0.10
18	Mullidae	10.89	13.49	11.41
19	Nemipteridae	7.53	4.65	6.96
20	Ogcocephalidae	-	0.93	0.18
21	Ophichthidae	3.01	5.58	3.52
22	Ostracidae	-	0.47	0.10
23	Platycephalidae	2.32	2.32	2.32
24	Pomadasyidae	1.51	2.32	1.67
25	Priacanthidae	0.11	1.86	0.46
26	Sciaenidae	1.04	2.32	1.30
27	Scombridae	-	1.86	0.37
28	Scorpeanidae	1.51	1.39	1.48
29	Soleidae	0.35	0.93	0.46
30	Stolepheridae	0.35	-	0.28
31	Stomateidae	-	0.94	0.18
32	Synodidae	0.81	0.94	0.83
33	Teraponidae	-	0.47	0.10
34	Tetraodontidae	0.58	4.18	1.30
35	Torpenidae	0.12	-	0.10
36	Trichiuridae	0.46	0.47	0.46
37	Urolophidae	0.12	-	0.10
38	Uronoscopidae	3.48	6.51	4.08

Family - wise finfish density distribution:

The density distribution of the group finfish was represented by 30 finfish families during 2006-07 and 32 families during 2007-08 (overall 38 families represented during both the years 2006-2008). Based on number percentage, the family Leiognathidae (30.59%) was most abundant followed by family Apogonidae (17.03%) during 2006-07. In 2007-08, the dominant families were Leiognathidae (21.86%) and Mullidae (13.49%). Nearly 23 families of finfish

were represented by less than 1 percent (Table 3). The density distribution of the group finfish based on weight percentage was dominated by leiognathidae (17.24%) and mullidae (15.69%) during 2006-07. mullidae (14.62%) and carangidae (14.09%) were dominant families during 2007-08. Nearly 17 families of finfish were represented less than 1 percent (Table 4).

Table 4: Family wise density distribution (as weights percentage) of different finfish families at Visakhapatnam

S. No.	Family	2006 - 07	2007 - 08	2006 - 08
1	Antenneridae	-	0.21	0.08
2	Apogonidae	10.20	4.12	8.01
3	Ariidae	0.85	1.44	1.07
4	Bothidae	0.34	-	0.22
5	Bregmacerotidae	0.74	0.34	0.60
6	Carangidae	0.33	14.09	5.28
7	Clupeidae	0.07	-	0.05
8	Cynoglossidae	2.4	0.13	1.59
9	Elopidae	0.11	0.56	0.27
10	Engraulidae	1.62	1.23	1.48
11	Fistularidae	0.58	0.89	0.69
12	Gobiidae	7.73	1.75	5.58
13	Holocentridae	-	0.47	0.17
14	Leiognathidae	17.24	8.74	14.18
15	Leptocephalidae	1.59	-	1.02
16	Menidae	0.63	1.67	1.01
17	Monodactylidae	-	2.45	0.88
18	Mullidae	15.69	14.62	15.31
19	Nemipteridae	3.19	2.51	2.94
20	Ogcocephalidae	-	0.72	0.26
21	Ophichthidae	4.69	2.94	4.06
22	Ostracidae	-	0.20	0.07
23	Platycephalidae	4.43	2.01	3.55
24	Pomadasyidae	2.18	1.96	2.11
25	Priacanthidae	0.26	3.75	1.52
26	Sciaenidae	1.29	4.94	2.59
27	Scombridae	-	3.37	1.21
28	Scorpeanidae	3.86	1.79	3.11
29	Soleidae	0.41	0.45	0.42
30	Stolepheridae	0.07	-	0.04
31	Stomateidae	-	1.17	0.42
32	Synodidae	1.48	2.27	1.76
33	Teraponidae	-	1.97	0.71
34	Tetraodontidae	2.73	6.73	4.16
35	Torpenidae	0.7	-	0.45
36	Trichiuridae	0.86	1.06	0.94
37	Urolophidae	0.18	-	0.12
38	Uranoscopidae	13.55	9.45	12.07

Species - wise finfish density distribution:

The study recorded 67 species of finfish belonging to 38 families and 51 genera. The finfish species density distribution based on number percentage revealed more or less similar number of species during 2006- 2007 (52 species) and during 2007-2008 (50 species). *Photopectoralis bindus* was the dominant species in both the years i.e. 2006-07 (19.35%) and 2007-08 (14.88%). The other dominant species were *Apogon quadrifasciatus* and *Upeneus vittatus*. (Table 5). The finfish species density distribution, based on weight percentage, showed the dominance of *Uranoscopus archionema* (13.54%) during 2006-2007 and *Upeneus vittatus* (13.40%) during 2007- 2008. The other dominant species were *Photopectoralis bindus*, *Parachaeturichthys polynema*, *Apogon quadrafasciates* and *Alectis indicus* (Table 6).

Table 5: Species wise density distribution (as numbers percentage) of finfish species at Visakhapatnam

S. No	Species Name	2006 - 07	2007 - 08	2006 - 08
1	*Antennaris diagopus*	-	0.47	0.1
2	*Apogon quadrafasciates*	10.19	8.37	9.83
3	*Apogon poecilopterus*	6.83	2.79	6.03
4	*Arius jella*	0.23	0.46	0.28
5	*Pseudorhombus elevatus*	0.35	-	0.28
6	*Bregmaceros maccleliandi*	2.66	1.39	2.41
7	*Alepes vari*	-	0.47	0.10
8	*Alectis indicus*	-	0.93	0.18
9	*Atule mate*	-	0.47	0.10
10	*Dussumieria acuta*	0.12	-	0.10
11	*Decapterus macrosoma*	0.12	0.47	0.18
12	*Cynoglossus cynoglossus*	1.27	0.93	1.20
13	*Cynoglossus puncticeps*	1.16	-	0.92
14	*Cyanoglossus arel*	0.58	-	0.46
15	*Elops machnata*	0.23	0.93	0.37
16	*Thryssa dussumieri*	3.01	0.46	2.50
17	*Thryssa engraulids*	0.23	-	0.18
18	*Thryssa setirostris*	-	0.47	0.10
19	*Fistularia petimba*	0.35	0.46	0.37
20	*Parachaeturichthys polynema*	7.07	5.12	6.68
21	*Adioryx ruber*	-	0.47	0.10
22	*Gazza minuta*	7.76	2.32	6.68
23	*Photopectoralis bindus*	19.35	14.88	18.46
24	*Leiognathus blochii*	0.92	2.79	1.30
25	*Leiognathus equulus*	1.28	0.47	1.11
26	*Leiognathus daura*	1.28	1.39	1.30
27	*Conger conger*	0.23	-	0.18
28	*Conger cineros*	0.46	-	0.37
29	*Mene maculate*	0.12	1.39	0.37
30	*Monodactylus argenatus*	-	0.47	0.10
31	*Upeneus vittatus*	5.91	10.69	6.86
32	*Upeneus tragula*	3.01	1.86	2.78
33	*Upeneus sulphureus*	0.92	0.93	0.92
34	*Upeneus moluccensis*	1.04	-	0.83
35	*Nemipterus japonicas*	6.26	3.72	5.75
36	*Nemipterus randalli*	1.28	0.93	1.20
37	*Halieuta spicata*	-	0.93	0.18
38	*Ophichthus polyophthalmus*	2.89	5.58	3.43
39	*Ophichthus apicals*	0.12	-	0.10
40	*Lactoria diaphana*	-	0.47	0.10
41	*Platycephalus tuberculatus*	0.35	0.47	0.37
42	*Sarsogona tuberculata*	1.97	1.86	1.95
43	*Pomadasys maculates*	1.39	2.32	1.56
44	*Diagramma pictum*	0.12	-	0.10
45	*Priacanthus boops*	-	1.86	0.37
46	*Priacanthus hamrur*	0.12	-	0.10
47	*Johnius carutta*	0.81	2.32	1.11
48	*Johnius vogleri*	0.23	-	0.18
49	*Auxis rochi*	-	0.47	0.10
50	*Rastrelliger kanagurtha*	-	0.47	0.10
51	*Apolectis niger*	-	0.93	0.18
52	*Brachiurs zebra*	0.12	-	0.10
53	*Scorpionopsis gibbosa*	1.39	1.39	1.39
54	*Aesopia Carnuta*	0.23	-	0.18
55	*Synaptura commersoniana*	0.12	0.93	0.28
56	*Stolephorus buccaneeri*	0.35	-	0.28
57	*Pampus argenteus*	-	0.93	0.18
58	*Saurida tumbil*	0.81	0.93	0.83
59	*Terapan jarbua*	-	0.47	0.10
60	*Lagocephalus spadicieus*	0.46	0.47	0.46
61	*Lagocephalus lunaris*	0.12	0.47	0.18
62	*Tetrodon leopards*	-	3.25	0.66
63	*Torpedo fuscomaculata*	0.12	-	0.10

64	*Lepturacanthus savala*	0.35	0.47	0.37
65	*Trichiurus lepturus*	0.12	-	0.10
66	*Urolophus armatus*	0.12	-	0.10
67	*Uranoscopus archionema*	3.47	6.51	4.08

Table 6: Species wise density distribution(as weights percentage) of finfish species at Visakhapatnam

S. No	Species Name	2006 - 07	2007 - 08	2006 - 08
1	*Antennaris diagopus*	-	0.21	0.08
2	*Apogon quadrafasciates*	7.91	3.11	6.18
3	*Apogon poecilopterus*	2.29	1.01	1.83
4	*Arius jella*	0.85	1.45	1.07
5	*Pseudorhombus elevatus*	0.34	-	0.22
6	*Bregmaceros maccleliandi*	0.74	0.34	0.60
7	*Alepes vari*	-	2.72	0.98
8	*Alectis indicus*	-	7.81	2.81
9	*Atule mate*	-	2.98	1.07
10	*Dussumieria acuta*	0.07	-	0.05
11	*Decapterus macrosoma*	0.33	0.58	0.42
12	*Cynoglossus cynoglossus*	0.67	0.14	0.48
13	*Cynoglossus puncticeps*	1.42	-	0.91
14	*Cyanoglossus arel*	0.31	-	0.20
15	*Elops machnata*	0.11	0.56	0.27
16	*Thryssa dussumieri*	1.07	0.59	0.90
17	*Thryssa engraulids*	0.55	-	0.35
18	*Thryssa setirostris*	-	0.65	0.23
19	*Fistularia petimba*	0.58	0.89	0.69
20	*Parachaeturichthys polynema*	7.73	1.75	5.58
21	*Adioryx ruber*	-	0.47	0.17
22	*Gazza minuta*	4.37	0.49	2.97
23	*Photopectoralis bindus*	9.75	4.43	7.83
24	*Leiognathus blochii*	1.97	2.84	2.28
25	*Leiognathus equulus*	0.19	0.77	0.41
26	*Leiognathus daura*	0.96	0.21	0.69
27	*Conger conger*	0.22	-	0.14
28	*Conger cineros*	1.37	-	0.88
29	*Mene maculate*	0.63	1.67	1.01
30	*Monodactylus argenatus*	-	2.45	0.88
31	*Upeneus vittatus*	10.69	13.4	11.62
32	*Upeneus tragula*	2.17	0.66	1.62
33	*Upeneus sulphureus*	1.13	0.56	0.92
34	*Upeneus moluccensis*	1.78	-	1.14
35	*Nemipterus japonicus*	2.68	1.66	2.31
36	*Nemipterus randalli*	0.51	0.85	0.63
37	*Halieuta spicata*	-	0.73	0.26
38	*Ophichthus polyophthalmus*	4.65	2.94	4.03
39	*Ophichthus apicals*	0.04	-	0.03
40	*Lactoria diaphana*	-	0.21	0.07
41	*Platycephalus tuberculatus*	0.17	0.09	0.15
42	*Sarsogona tuberculata*	4.24	1.90	3.41
43	*Pomadasys maculatus*	1.71	1.96	1.81
44	*Diagramma pictum*	0.47	-	0.31
45	*Priacanthus boops*	-	3.75	1.35
46	*Priacanthus hamrur*	0.26	-	0.17
47	*Johnius carutta*	0.93	4.93	2.37
48	*Johnius vogleri*	0.35	-	0.22
49	*Auxis rochi*	-	2.77	0.99
50	*Rastrelliger kanagurtha*	-	0.22	0.08
51	*Apolectis niger*	-	0.39	0.14
52	*Brachiurs zebra*	1.39	-	0.89
53	*Scorpionopsis gibbosa*	2.45	1.79	2.22
54	*Aesopia Carnuta*	0.36	-	0.23
55	*Synaptura commersoniana*	0.05	0.45	0.19
56	*Stolephorus buccaneeri*	0.07	-	0.04
57	*Pampus argenteus*	-	1.17	0.42
58	*Saurida tumbil*	1.47	2.26	1.76

59	*Terapan jarbua*	-	1.97	0.71
60	*Lagocephalus spadicieus*	2.62	0.86	1.98
61	*Lagocephalus lunaris*	0.10	2.47	0.96
62	*Tetrodon leopards*	-	3.39	1.22
63	*Torpedo fuscomaculata*	0.70	-	0.45
64	*Lepturacanthus savala*	0.61	1.06	0.77
65	*Trichiurus lepturus*	0.25	-	0.16
66	*Urolophus armatus*	0.18	-	0.12
67	*Uranoscopus archionema*	13.54	9.44	12.07

DISCUSSION

An analysis of the total density distribution (both as number and as weight) of the by- catch indicates the reduction of the by- catch during April 2007-March 2008 than in April 2006-March 2007. The reduction of the by- catch may be attributed to the variations of the fishing effort of the fishing vessels. The composition of the different groups in the by-catch between the two years did not vary. Even though, the percentage composition (either based on number or based on weight) showed variations the dominant groups were remain same in both the years. The by–catch was mainly composed by crabs, stomatopods, shrimps, echinoderms, cephalopods and coelenterates besides the dominant group finfishes. The group–wise by–catch composition indicates the dominance of benthic groups (i.e. crabs, stomatopods, gastropods etc.) in the by–catches. The dominance of benthic groups in the by–catches may be attributed to the type of trawling (demersal trawling) carried out by the fishing vessels. The variations in the density distribution of these groups in the by – catches reflect their abundance (as number or weight) in the natural habitat. Seasonally the group crabs dominated in the catches during monsoon season in both the years while the group finfishes dominated during post–monsoon and summer seasons in both the years. An year–wise analysis for finfish families indicated the dominance of the families leiognathidae, apogonidae, mullidae, carangidae in the by-catches during the study period (April 2006–March 2008) which may be reflected their abundance in shallow coastal waters. The density distribution of finfish families indicate that the family leiognathidae was more abundant as percentage number while the family uranoscopidae was dominant as percentage weight. These variations in the dominant in the finfish families may be due to the weight differences of the concerned organisms. Even though uranoscopidae was represent by less number of organisms, their heavy weights made them as a significant family in the by-catches. The remaining families as represented in the by-catches sporadically depending on their favorable time periods.

The year - wise density distribution of the finfish species revealed the dominance of *Photopectoralis bindus*, as per number percentage in both the years. The finfish species *Uranoscopus archionema* and *Upeneus vittatus* were dominant in the catches as weight percentage. These variations in the finfish species in the year wise studies may be due to their weight variations. Since uranoscopids and upenids relatively weight heavily their dominance in the by – catches as weight percentage in nature. The sporadic occurrence and dominance of the other finfish species in the by – catches reflect their abundance in the natural waters. Stomatopoulos [15] records that silver bellies, flatfish, ribbonfish, sciaenids, carangids and catfish constitute low value fish in India. All these groups of finfishes listed by FAO are recorded in the present study.

FAO [4] further reports some commonality of families that occur in the by-catch of the shrimp trawling throughout the tropical world. These families include ariidae (marine catfishes), carangidae (jawks), clupeidae (herrings, shads), gerridae (mojordos), sciaenidae (croakers), trichuridae (ribbonfish). It further points out that families like leiognathidae (pony fish) are not wide spread, but where they are found they can make up large proportions of the non - target catch. In the present study the family leiognathidae forms one of the important families of finfish in the by-catch composition. Andrew and Pepperell [1] reported that finfishes make up the majority of the catch in many shrimp trawling and the sizes of the fish are generally small <20 cm and often of similar size to the shrimp. In the present study also finfishes contribute significantly in the by-catch. Majority of these finfishes are small in size (<20 cm). Zynudheen *et.al*. [22] reported that the by-catch is mainly composed by sciaenids (15.6%), engraulids (12.80%), ribbonfish (8.9%), cuttlefish (7.7%) and the other species in trawl by-catches of Gujarat coast in India. In the present study the by-catch is dominated by leiognathidae (30.59%), apogonidae (17.03%) and mullidae (13.49%). Masatosi *et.al*. [10] record the dominance of mullidae (42%) and nemipteridae (9%) in the by-catches of Kangkar fish landings center Singapore. Sujatha [17] reported about 224 species of fish belonging to 69 families representing in the by - catch at Visakhapatnam. In the present study 67 species of fish belonging to 38 families were reported in the by-catch at Visakhapatnam, this large variation may be due to most of the by-catch fish species now comes under commercial catches.

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REFERENCES

[1] Andrew, N.L. and Pepperell, J.G, *Oceanogr. Mar. Biol. Annu. Rev.*, **1992,** 30, 527-565.
[2] Biju Kumar, A and Deepthi G.R., *Current Science*, **2006,** Vol.90, No: 7.
[3]CMFRI Frad, Marine fish production in India during January-June 1979. Marine Fisheries Information Service, Technical and Extension Series, **1979,** 11.pp 1-9.
[4] FAO Fisheries Technical Guidelines for responsible Fisheries. No.12, Rome, FAO, **2009,** 97pp.
[5]FAO. Report of the four GEF/UNEP/FAO regional workshops on reducing the impact of tropical shrimp trawl fisheries. **2000,** FAO fisheries report no. 627. Rome: FAO.
[6]Fischer, W and Whitehead P.J.P., FAO Species identification sheets for fishery purposes. Eastern Indian Ocean (Fishing area 57) and Western Central Pacific (Fishing area 71), **1974,** 4 Vols. Rome: FAO.
[7]Fischer, W and Bianchi G., FAO Species identification sheets for fishery purposes. Western Indian Ocean (Fishing area 51). Prepared and printed with the support of the Danish International Development Agency (DANIDA). **1984,** 6 Vols. Rome: FAO.
[8]George, M.J., Suseelan, C. and Balan, K, *Mar. Fish. Inf. Serv. Tech. Extn. Ser.*, **1981,** 28: 3-13.
[9]Kurup, B.M., Premlal, P., Thomas, J.V. and Vijay Anand, *J. Mar. Biol. Assoc. India*, **2003,** 45:99-107.
[10]Masatosi Sinoda, Pang Yong Lim, and Sen Min Tan, *Bulletin of the Japanese Society of Scientific Fisheries*, **1978,** 44 (6); 595-600.
[11]Menon, N.G, Impact of bottom trawling on exploited resources. In Marine Biodiversity. Conservation and Management (eds. Menon, N.G. and Pillai, C.S.S.), Central Marine Fisheries Research Institute, Cochin, **1996,** pp.97-102.
[12]Menon, N.G., Malwar N., Zachariah P.U. and Jagadish. I, Central Marine Fisheries Research Institute, Annual Report 1999-2000, Cochin, **2000,** pp. 55-57.
[13] Nelson, Joseph S. Fishes of the world. A Wiley Inter Science Publication, **1984,** 2nd Edition 477 pp.
[14]Smith, M.M. and Heemstra P.C., (eds.), Smith Sea Fishes. Macmillan South Africa, Johannesburg, **1986,** xx+ 1047p.
[15]Stamatopoulos, Sample based fishery surveys: A technical hand book. FAO Fisheries Technical Paper, **2002,** No. 425, Rome: FAO, 132p.
[16] Sujatha, K. *Fish. Tech*., **1995,** Vol. 32 (1): 56-60.
[17]Sujatha, K, *J. Aqua. Biol*., **1996,** 11 (1&2):17-23.
[18]Sukumaran, K.K., Telang, K.Y. and Thippeswamy. O, *Mar. Fish. Inf. Serv. Tech. Ext. Ser.*, **1982,** 1982, 44, 8-14.
[19]Sunil Kumar K. and Zacharia P.U., *Ind. J. Mar. Sciences*, Vol. 26, **1997,** 366-371.
[20]Talwar, P.K. and Kakker R.K., Commercial Sea Fishes of India. Edited by Director, Zoological survey of India, **1984,** 4:997pp.
[21]Zacharia, P.U., Krishna Kumar P.K., Ravindran, Durgekar N., Anoop, A. Krishnan and Muthiah C., Assessment of by-catch and discards associated with bottom trawling along Karnataka coast, India. In Sustain Fish (eds.), School of Industrial Fisheries, **2006,** Cochin University, Kerala.
[22]Zynudheen, A.A., Ninan, G., Sen, A. and Badonia. R, NAGA, *World Fish Center Q.*, **2004,** 27, 20-23.