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Standardization of crab bottom set Gillnet for reduction of Bycatch at Thoothukudi coast, Tamilnadu, India

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ABSTRACT

A programme to assess the bycatch of Thoothukudi crab bottom set gillnet was conducted from May, 2010 to April, 2011. The resulted bycatch of this net was 79.37% (19.17 kg), 69.29% (17.66 kg) and 81.10% (16.58 kg) at North cost, Proper cost and south coast of thoothukudi respectively. Sea grass constitutes the major part of bycatch of all the three coast of thoothukudi where south coast is on top position with 52.72%. In these cost different sizes of crab gillnet are operated i.e. maximum in Thoothukudi (250 m) and minimum in south thoothukudi (70 m). The hanging coefficient of crab gillnet is same in north, proper and south coast of thoothukudi.

Key words: Bycatch, Bottom set Gillnet, Crab Net

INTRODUCTION

Gillnet is one of the oldest passive gears operated throughout the world in both inland and marine water bodies. Gillnet is a size selective fishing gear accounting for 20% of the global capture fisheries (1). It is the only gear which is operated in accordance with the article VII of Code of Conduct for Responsible Fishing of UN FAO. Around 65% of the Indian seer fish catch was from surface drift gillnets during 1989– 1999 (2, 3) and the contribution of drift gillnet to Indian tuna fishery was about 56% during 2001 – 2003(4). Gillnet is one of the important gear for capturing marine and inland fishes in India. In marine sector,especially traditional and motorized crafts operate gillnets. *Stenella longirostris* species has earlier been reported as by-catch in the gillnet fishery off Calicut (5). The common Dolphin *Delphius delphis* is the species frequently entangled in the gill net along the Indian coast and about 30 – 40 dolphins were caught annually (6). A large Devil ray *Manta birostrius* landed at Tuticorin in gillnet (Local name – Konbu Thirukhai) operated at 50 metre depth (6).

Neethiselvan *et al*. (7) optimized the mesh size was for the commercial exploitation of *Amblygaster sirm* in Thoothukudi coastal waters. According to them 30.5 mm mesh size was commercially significant to the length group of 141 to 190 mm. Neethiselvan *et al*. (8) optimized the mesh size of gillnets for *Sardinella gibbosa*. Jude *et al*. (9) standardized the mesh size of gillnets for commercial exploitation of *Euthynnus affinis* in Thoothukudi coastal waters. Wallace *et al*. (10) compiled a comprehensive database of reported data on marine turtle bycatch in gillnet, longline, and trawl fisheries worldwide from 1990 to 2008. The total reported global marine turtle bycatch

was 85,000 turtles per year. De Quevedo (11) conducted a survey, to estimate the turtle bycatch in the waters off Catalonia in Northern Spain.

MATERIALS AND METHODS

The present study was carried out for one year from May 2010 to April 2011 in the selected fish landing centres of Thoothukudi district. Nine landing centres along the Thoothukudi district having year round crab gillnetting were selected for the study. Out of 09 centres selected four were from North of Thoothukudi *viz.* Vembar, Keelavaipar, Tharuvaikulam and Vellappatti, two from Thoothukudi *viz.*

Therespuram and Inigonagar. Further three centres such as Punnakkayal, Veerapandianpattanam and Manapad were from south of Thoothukudi. The locations of fish landing centres selected for the study are shown in Fig. 1.

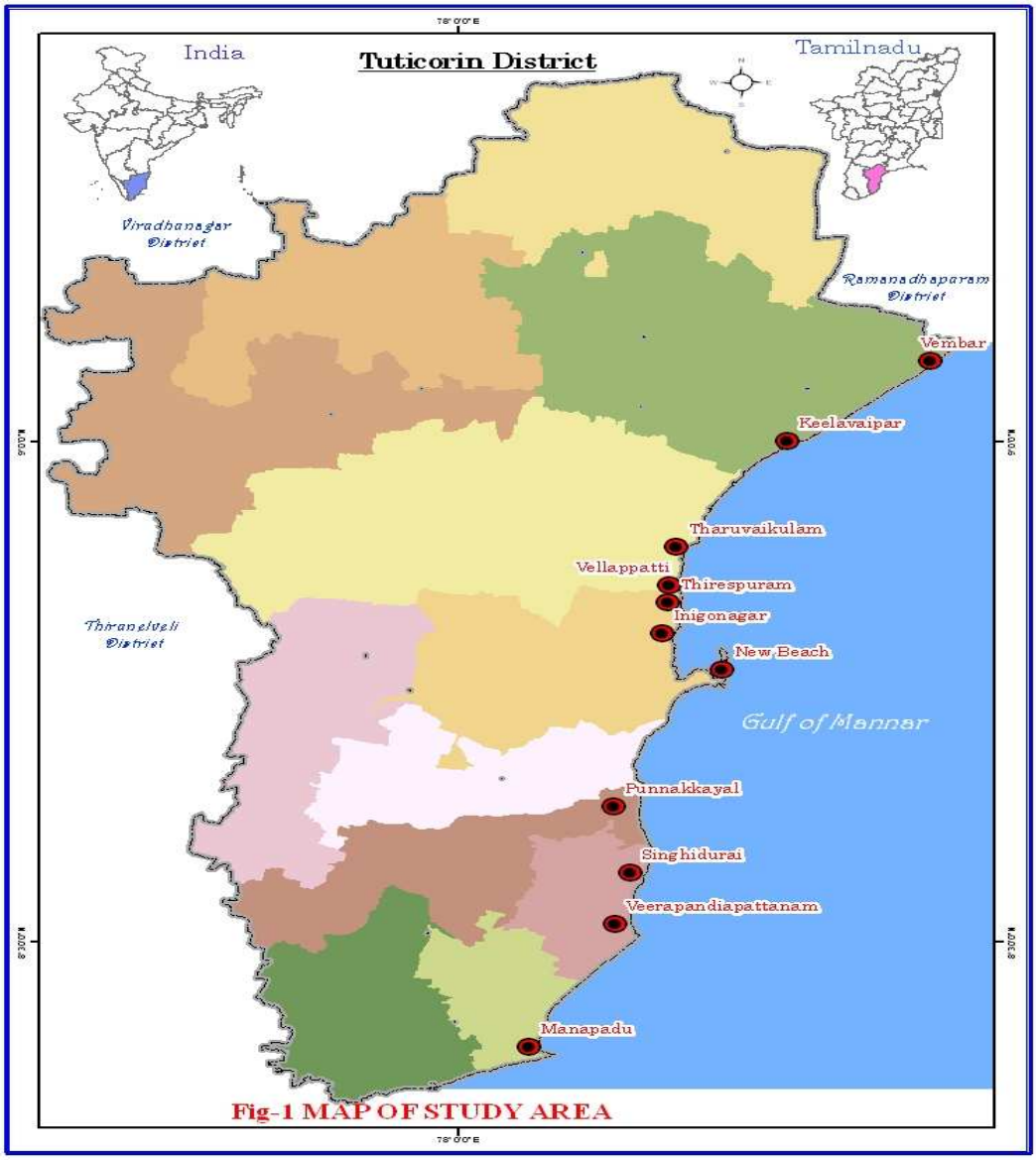

Fig-1 MAP OF STUDY AREA

Sampling was done twice a week. Crab gillnets from each landing centre were randomly selected for the collection of catches. Technical details and design features of different types of crab gillnets being operated in the selected

landing centres were documented. The design features included total length of net (in metres), depth of net (in meters), colour of twine, size of twine (in mm), mesh size (in mm), diameter of rope (in mm), types and sizes of floats and sinkers, inter distance between two consecutive floats and sinkers (in cm). Horizontal hanging co-efficient (En) was calculated for nets using the following formula.

$$En = \frac{Hung\ length\ of\ the\ netting}{Fully\ stretched\ length\ of\ the\ netting}$$

Catch Effort

Catch effort data were collected from the selected landing centers for different types crab gillnets. The catch per unit effort (CPUE) was taken as catches from the net of 200 m long, for a soaking duration of 8 hours the catch was expressed as weight in kg.

Estimation of Bycatch

Main catch and bycatch from crab gillnets from selected fish landing centers were segregated and identified species wise using FAO species identification sheets (12,13). Molluscans and crustaceans were identified based on methods prescribed by Wye (14). Sea grass and Seaweeds were identified from as per the method given by Kannan and Thangaradju (15). Target catches of fish/fish group was treated as main catch. Bycatch included fishes unsuitable for market (discardable bycatch) and other non – targeted species with value (valuable bycatch). Mean quantity of bycatch and proportion of bycatch to main catch were estimated for crab nets. Proportion of bycatch to the main catch was expressed as percentage in terms of weight. The detrimental effect of crab gillnets on bycatch species and the scheduled species along the coast of Thoothukudi district was expressed as their occurance with suitable marks as (i) rarely (√), (ii) ocassionally (√√) and (iii) frequently (√√√).

Statistical Analysis

Analysis of variance (ANOVA) with completely randomised design was used to know whether there is any significance between the quantity of bycatch with respect to crab net of different places using CPUE as input as per method prescribed by Biradar, (16).

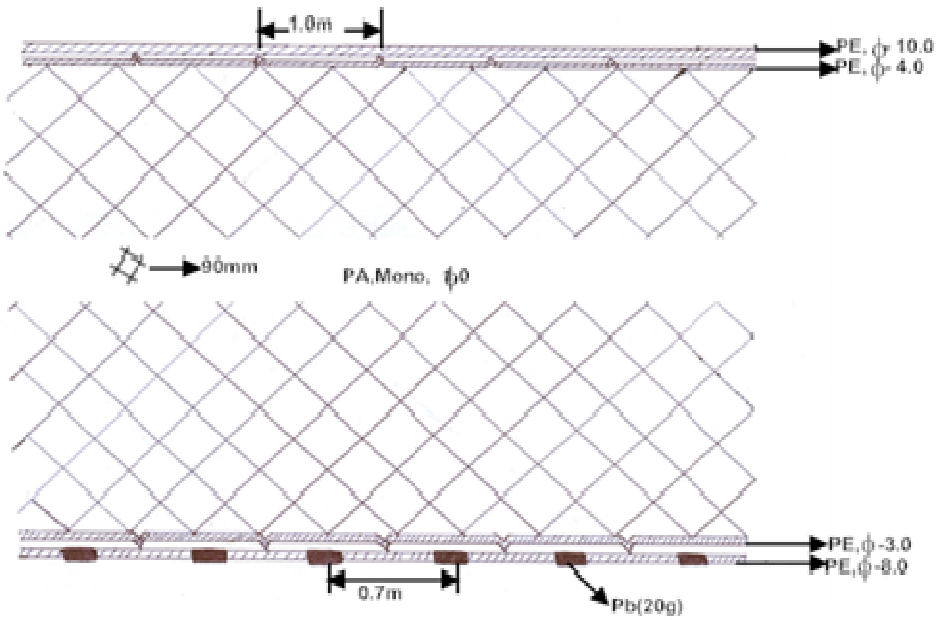

Figure 2. Crab net (Nandu valai)

RESULTS AND DISCUSSION

The Crab net is widely distributed in all the three regions (north, proper and south) of thoothukudi coast covering Vembar, Keelavaipar, Tharuvaikulam, Vellappatti, Thirespuram, Inigonagar, Punnakkayal, Veerapandianpattanam

and Manapadu fish landing centres. All the fish landing centres which is divided into three regions of thoothukudi coast have gillnet of different design features which is shown in fig 2 and table 1.

The design parameters of Crab nets operated in various landing centres of Thoothukudi districts are given in Table 2. Out of the seven centres studied the length of the net was more with 3,704 meshes at Thirespuram, although the depth of net was almost the same with number of meshes ranging from 21 to 28 numbers. The mesh size were comparable and the hanging co-efficient was uniform. In general, the nets operated south of Thoothukudi were smaller in length. The diameter of the foot rope was relatively lower than that of head rope. In all the centres studied, the Crab nets were lacking floats. Crab nets of Thoothukudi coast were soaked in the depth ranging from 3 – 22 m at the distance of 2 – 10 nautical miles (nm) from the shore. The net soaking duration also greatly varied from 8 – 13 hrs. Out of nine landing centres where the Crab nets were operated, Vellappatti from North of Thoothukudi district was found to have very shallow fishing grounds for crab fishing (3 – 4.5 m depth). But, in all the three landing centres, south of Thoothukudi *viz.* Punnakkayal, Veerapandiapattanam, and Manapadu the depth of the fishing grounds was more than 15 m.

The mesh size of Crab nets of different landing centres operated along Thoothukudi district, ranged from 80 to 120 mm. As far as gillnetting of crab is concerned, the mesh size is not an important criterion because crabs are captured mainly by entangling rather than by gilling. Further they were found lacking floats to enable operation of these nets on the bottom.

The mean quantity of bycatch and species wise contribution of the bycatch in Crab nets operated along the coast of Thoothukudi district is presented in Table 2. As far as total bycatch (Valuable + Discardable) was concerned, highest percentage of 81.10% was recorded along the coast, south of Thoothukudi. There was not much difference between the coasts, north of Thoothukudi and south of Thoothukudi with respect to bycatch from Crab gillnets. Along the coast of Thoothukudi the proportion of bycatch was 69.30%. The coast south of Thoothukudi registered the highest quantity of desirable bycatch with as much as 80.02% while that from Thoothukudi recorded the lowest value of 67.33%. More numbers of mollusc (10 species) were recorded in the bycatch of Crab nets operated along the coast of Thoothukudi with 11.71%. Though the coast north and south Thoothukudi did not differ significantly with respect to the percentage of discards of molluscan species, there existed difference with respect to the number of molluscan species that contributed the bycatch. Only four species of molluscs were found in the bycatches in south of Thoothukudi, while the north of Thoothukudi had a representation of nine species.

In the bycatch, the quantum of sea grass removed by the Crab nets operated south of Thoothukudi was extremely high (52.72%) compared to that of north of Thoothukudi (25.47%) and Thoothukudi (18.79%). The proportions of discarded sea weeds from the catches of north of Thoothukudi and Thoothukudi were estimated as 7.05% and 5.68% respectively. No sea weeds could be recorded from Crab nets operated along the coast, south of Thoothukudi. The Scleractinian group of corals were recorded with high percentage (5.43%) in south coast compare to other two areas of study. Minimum quantity of sea fans was recorded along the coast, north of Thoothukudi and Thoothukudi with no representation from the coast, south of Thoothukudi. In the case of sponge the case was reverse. Sponges were recorded from the coast of south of Thoothukudi, and with no representation from other two regions. The combined contribution by star fishes, sea urchins, jelly fishes and cuttle fishes was to the tune of 27.95% along the coast of Thoothukudi. Representation of non – calcareans, sponges and sea snakes were restricted to the coast north of Thoothukudi and they did not have representation in other two regions.

The reason for the occurance of more number of molluscan species (10 no.) in the discards of Crab nets of Thoothukudi indicates higher molluscan diversity along this compared to other coastal region of the district. This may be attributed to coral reef coupled with sandy and rocky bottom which provides conducive environment for the growth and survival of molluscan species.

Table 1. Design and operational parameters of Crab nets of Thoothukudi district

Places/Nets / Design Features	North of Thoothukudi				Thoothukudi		South of Thoothukudi		
	Vembar	**Keela vaipar**	**Tharuvaikulam**	**Vellappatti**	**Thires puram**	**Inigo nagar**	**Punna kkayal**	**Veerapandianpattanam**	**Mana padu**
No. of meshes in length	1,467	1,600	2,222	2,222	3,704	1,333	970	1,333	1,037
No. of meshes in depth	25	25	28	28	28	21	23	31	28
Mesh size(mm)	100	100	90	90	90	120	110	80	90
Twine dia. (mm)	0.9	0.6	0.9	0.9	0.9	0.9	0.9	0.6	0.6
Hanging co-efficient	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Netting material	PA mono	PA mono	PA mono	PA mono	PA mono	PA mono	PA mono	PA mono	PA mono
Colour of webbing	Green	White	Green & white	White & Green	Green & white	Green & white	Green	White	Green
Head rope/ Foot rope length(m)	110	120	150	150	250	120	80	80	70
Diameter of head rope(mm)	6.0	6.0	6.0	8.0	4.0	4.0	8.0	8.0	8.0
Diameter of foot rope(mm)	4.0	4.0	6.0	4.0	3.0	3.0	4.0	4.0	8.0
Rope material	PE	PE	PE	PE	PE	PE	PE	PE	PE
Type of sinker	Pb 20g	Pb 20g	Pb 20g	Pb 20g	Pb 20g	Pb 20g	Pb 20g	Pb 20g	Pb 20g
Gap between two consecutive sinkers (m)	0.50	0.70	1.00	1.20	1.00	0.50	1.20	0.70	0.70
Presence of stapling rope	Yes	Yes	Yes	No	Yes	No	Yes	No	Yes
Depth of operation (m)	5 - 15	10 - 15	8 - 10	3 – 4.5	12 - 15	4 – 20	4 – 15	3 - 22	6 -20
Time and duration of fishing	6 pm – 8 am 10 hrs	9 am – 6 am 21 hrs	10 pm – 6 am 8 hrs	3pm– 6 am 15hrs	6 pm – 6 am 12 hrs	6 am– 5 am 23 hrs	3 pm – 7 am 16 hrs	6 pm – 6 am 12 hrs	6 pm – 7 am 13 hrs
Distance to fishing ground (Nm)	5 - 10	3 - 8	3 - 6	4 - 10	4 - 6	2 – 5	3 - 5	5 - 7	5 - 8
Units operated per trip	36–48	30 - 48	30 - 36	36- 60	36 - 60	24 –36	36-72	30-48	36 - 42

Table 2. Mean quantity and proportion of bycatch from Crab nets operated in Thoothukudi District

Species caught	North of Thoothukudi		Thoothukudi		South of Thoothukudi	
	Catch (kg)	Contribution (%)	Catch (kg)	Contribution (%)	Catch (kg)	Contribution (%)
Main catch	**4.76**	**19.83**	**7.81**	**30.66**	**3.86**	**18.88**
Portunus sanguinolentus	2.84	11.84	2.39	9.38	1.91	9.38
Portunus pelagicus	1.15	4.82	4.57	17.96	1.38	6.76
Charybdis natator	0.45	1.88	0.65	2.55	0.33	1.62
Scylla serrata	0.30	1.28	0.19	0.76	0.22	1.12
Bycatch (Valuable)	**1.48**	**6.18**	**0.50**	**1.96**	**0.22**	**1.08**
Gerres lucidus	0.01	0.04	-	-	-	-
Panulirus homarus	0.1	0.41	-	-	-	-
Lethrinus lentjan	0.25	1.04	0.50	1.96	-	-
Plectorhinchus gibbosus	0.75	3.12	-	-	-	-
Xancus pyrum	0.37	1.56	-	-	0.22	1.08
Bycatch (Discardable)	**17.69**	**73.19**	**17.16**	**67.33**	**16.36**	**80.02**
Molluscs	**1.87**	**7.54**	**2.99**	**11.71**	**1.57**	**7.67**
Murex trapa (Dead shells)	1.01	4.24	2.20	8.92	0.55	2.70
Lambis scorpius	0.17	0.74	0.05	0.20	-	-
Lambis truncate	0.02	0.11	0.07	0.27	0.66	3.25
Turbo marmoratus	0.06	0.27	0.12	0.48	-	-
Biplex persa	0.08	0.34	-	-	-	-
Lambis crocea	0.21	0.89	0.15	0.61	-	-
Bursa spinosa	0.01	0.04	0.05	0.20	-	--
Conus milnedwardsii	0.01	0.05	-	-	-	-
Nibea albida	0.20	0.84	-	-	-	-
Babylonia spirata	-	-	0.14	0.56	-	-
Cymatium tripus	-	-	0.07	0.27	0.01	0.07
Conus textile	-	-	0.03	0.13	-	-
Placenta placenta	-	-	0.01	0.05	0.33	1.62
Fishes	**0.26**	**1.09**	**0.25**	**0.98**	**0.06**	**0.29**
Cynoglossus arel	0.12	0.52	0.06	0.25	0.06	0.29
Pastinachus sephen	0.02	0.10	-	-	-	-
Epinephalus dicanthus	0.02	0.08	-	-	-	-
Plectorhinchus gibbosus	0.08	0.34	-	-	-	-
Lethrinus lentjan	0.01	0.04	-	-	-	-
Arius sp.	-	-	0.18	0.72	-	-
Sea grasses	**6.10**	**25.47**	**4.78**	**18.79**	**10.78**	**52.72**
Halophila ovalis	6.05	25.28	4.78	18.79	10.78	52.72
Halophila beccarii	0.04	0.18	-	-	-	-
Sea weeds	**1.69**	**7.05**	**1.44**	**5.68**	**-**	**-**
Enteromorpha compressa	0.03	0.12	-	-	-	-
Ulva faciata	0.08	0.34	-	-	-	-
Ulva reticulata	1.53	6.38	0.84	3.31	-	-
Enteromorpha intestinalis	0.01	0.06	-	-	-	-
Ulva lactuca	0.03	0.13	0.24	0.96	-	-
Enteromorpha clathrata	-	-	0.35	1.40	-	-
Corals	**2.01**	**8.39**	**0.40**	**1.58**	**1.11**	**5.43**
Scleractinians	2.01	8.39	0.40	1.58	1.11	5.43
Sea fans	**0.01**	**0.06**	**0.15**	**0.61**	**-**	**-**
Gorgonians	0.01	0.06	0.15	0.61	-	-
Sponges	-	-	-	-	0.36	1.76
Calcareans	-	-	-	-	0.36	1.76
Others	**5.66**	**23.59**	**7.12**	**27.95**	**2.48**	**12.13**
Calappa lophos	0.31	1.29	1.04	4.09	0.18	0.89
Star fishes	2.14	8.92	0.84	3.32	1.77	8.69
Sea urchins	1.41	5.88	0.57	2.26	0.21	1.05
Jelly fishes	0.56	2.34	4.36	17.14	0.30	1.49
Stones	0.22	0.95	0.15	0.61	-	-
Cuttle fishes	0.01	0.05	0.13	0.51	-	-
Sponges	0.98	4.09	-	-	-	-
Sea snakes	0.01	0.06	-	-	--	-

A notable quantum of sea grass in the bycatches of Crab nets operated south of Thoothukudi as much as 50% of the discard was mainly due to the association of crabs with sea grass beds where the Crab nets had been operated. Further, abundance of sea fans in the bycatches of Crab nets operated north of Thoothukudi reveals the association

of sea fans with the coral reef beds. Higher species diversity in the bycatches of Crab nets operated along coast, north of Thoothukudi (Table 9) may be attributed to the fact that fishing ground, north Thoothukudi coast are bordered by coral reef islands which naturally support the diversified life of both marine fauna and flora. Perez and Wahrlich (17) reported that geryonid crabs and spider crabs representing 22.6% and 8.5% as non – target bycatch from gillnet of southern Brazil.

The disturbance of scheduled species by crab net is noticeable. Four species of scheduled molluscs, calcarean, sponges, Scleractinian corals and gorgonians were recorded very frequently from the Crab nets of thoothukudi coast. The details on the catch per unit effort (CPUE) estimated for each shot of 200 m long of different bottom set gillnets for a soaking duration of 8 hrs are given in Table 19. the Crab net, maximum CPUE was recorded as 32.29 kg at Keelavaipar, of which the bycatch was 25.89 kg.

Table 3 : Disturbance pattern of scheduled species by crab gillnet in Thoothukudi coast

Species	Thoothukudi North	Thoothukudi	Thoothukudi South
Molluscs			
Lambis crocea	√√√	√√√	-
Turbo marmoratus	√√	√√	-
Lambis truncata	√√√	-	√
Lambis scorpius	√√√	-	-
Conus millnedwardsii	√√	-	-
Placenta placenta	-	-	√
Sponges			
Calcareans	-	-	√√√
Corals			
Scleractinians	√√√	√√	√√
Sea fans			
Gorgonians	-	√√	-

√ - *Rarely*, √√ - *Occasionally*, √√√ - *frequently*

Table 4. Catch Per Unit Effort (CPUE) of Crab gillnet of Thoothukudi coast

Landing centres	**Catch Per Unit Effort (CPUE)**		
	Main catch	**Bycatch**	**Total**
Vembar	0.40 Kg (7.69%)	4.80 (92.30%)	5.20
Keelavaipar	6.40 (19.82%)	25.89 (80.17%)	32.29
Tharuvaikulam	0.73 (38.42%)	1.17 (61.57%)	1.90
Vellappatti	0.11 (20.37%)	0.43 (79.62%)	0.54
Threshpuram	0.89 (31.33%)	1.95 (68.66%)	2.84
Inigonagar	0.83 (21.55%)	3.02 (78.44%)	3.85
Punnakkayal	0.61 (69.31%)	0.27 (30.68%)	0.88
Veerapandian pattanam	0.40 (6.45%)	5.80 (93.54%)	6.20
Manapadu	0.42n(10.47%)	3.58 (96.00)	4.01
Mean Bycatch	75.66		

Note: Percentage of main catch and bycatch to total catch are given parenthesis

Table 5: Analysis of variance for bycatch of Crab gillnets of Thoothukudi district

Source of variation	**Degree of freedom**	**Sum of square**	**Mean sum square**	**F - ratio**	**F – table**
Nets	t – 1 2– 1 = 1	TrSS = 400.3300	$S_1 = \frac{TrSS}{t-1}$ $= \frac{400.3300}{1}$ = 400.3300	$F = \frac{S1}{S2}$ $= \frac{400.3300}{15.4430}$	1% 4.54
Error	N – t 6 – 2 = 04	ErSS = 61.7721	$S_2 = \frac{ErSS}{N-t}$ $= \frac{61.7721}{4}$ = 15.4430	= 25.92	5% 7.71

Significant at 1%

CONCLUSION

The present study revealed that there existed significant difference in the quantity of bycatch landed from crab gillnets operated along Thoothukudi coast, as evidenced through the analysis of variance (P > 0.01). The reason may be attributed to the difference in the selectivity characteristics of the gillnets. It may be concluded that among the three region (Thoothukudi north, Thoothukudi and Thoothukudi south), Thoothukudi south have least selective crab gillnet and Thoothukudi have most selective crab gillnet.

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