Fishery Technology 52 (2015) : 71 - 79

Modified Norwegian Trap for Marine Ornamental and Food Fishes off South-East Coast of India

M. Kalaiarasan*, N. Neethiselvan, B. Sundaramoorthy, S. A. Shanmugam and Xavier P. Rayan
Department of Fishing Technology and Fisheries Engineering, Fisheries College and Research Institute, Thoothukudi - 628 008, India

Abstract

Study on the performance of a Norwegian collapsible trap along Keelakarai coast of Tamil Nadu, India revealed that the trap requires modification in the funnel design to capture native species. Performance of the modified Norwegian collapsible trap (MNCT) was compared with the most popular traditional trap of Keelakarai. The study was carried out in the fishing ground located between Appa Island and Mullai Island. Design of trap and season were found to be the major factors affecting the catch rate of both ornamental and food fishes in the trap. Significant difference in the degree of vulnerability of food and ornamental fishes to traps ($p<0.01$) were noticed. The traditional trap had the highest cost per unit operational volume of INR 3720 m^{-3} and stacked volume of 0.43 m^3 $trap^{-1}$ while the MNCT was found to be more economical owing to its lesser cost per unit operational volume (INR 1667 m^{-3}) and lesser staked volume of 0.15 m^3 $trap^{-1}$. However, on weight basis, the number of traps that can be staked per tonne weight displacement of fishing vessel by MNCT was 47.17 t^{-1} against 66.67 traps t^{-1} for traditional traps. Further, no notable difference could be observed with respect to selectivity of MNCT and traditional traps over different ornamental and food fishes caught.

Keywords: Trap fishing, marine ornamental fishes, traditional trap, Norwegian collapsible trap

Introduction

Trap fishing is one of the oldest fishing methods which is still widely practiced throughout the world both in tropical and temperate regions (Recksiek et al., 1991). Trapping is a selective fishing technique (Hawkins et al., 2007) with low impacts on the habitat. Fish trap is the predominant gear used for the exploitation of reef fishes (Appeldoorn et al., 1987; Mahon & Rosenberg, 1988). The catch rates of trap vary between locations and depend on how long a trap has been soaked, as well as the internal structure (Whitelaw et al., 1991; Sheaves, 1995). Nostvik & Petersen (1999) found that fish pots were more efficient than hand line in catching cod. Campbell & Sumpton (2009) designed collapsible fish traps with funnels made up of rubber and thin mild steel as they quickly corrode or wear out in case of loss of the traps and hence would limit ghost fishing. Caeser & Oxenford (2005) compared the catching efficiency of rigid fish trap with collapsible fish trap.

The first report of trap fishing in India was in 1930s by Hornell (1938) on the operation of filter traps in the backwaters of Kerala. Prabhu (1954) reported perch traps made out of the split stems of *Acacia* spp. in Palk Bay and Gulf of Mannar. In south-west coast of India, traditional traps made of Palmyra (*Borassus flabellifer*) leaf-stalks have been reported by Miyammoto & Shariff, 1961, while traps made of leaf and stalks of date palm (*Phoenix dactylifera*) have been reported by Meenakumari & Mohanrajan (1985). In Keelakarai coast, sticks of *Acacia planifrons, Phoenix dactylifera* and roots and leaves of *Borassus flabellifer* have been used for the fabrication of fish trap (Varghese & Kasinathan, 2008).

Plastic coated metal traps were tested for their durability by Meenakumari & Mohanrajan (1985) in Colachal coast and found the possibility of combining synthetic materials like polyethylene; the trap plain binding tapes with mild steel rod. Modified semi cylindrical trap was found to catch lobsters better than traditional Colachal traps (Mahan &

Received 31 March 2014; Revised 19 December 2014; Accepted 05 February 2015

* *E-mail: kalaimuthu2010@gmail.com*

Rosenberg, 1988). There are limited reports on the use of collapsible traps in Indian waters. Remesan (2006) designed a collapsible fish trap having two rectangular stainless steel frames of 1.1 x 0.75 m and the performance of the collapsible traps was superior besides with increased life span compared to the traditional traps.

There is an organized trap fishing along Keelakarai using four different designs of traditional traps. These traps are used to capture ornamental fishes which are found associated with the coral islands and fishes for human consumption. The catch varies depending on the season and accordingly the ornamental fish buyers install collection centers adjacent to the shore to procure marine ornamental fishes which fetch higher price than the food fishes. The food fishes caught in traps also fetch better price as the fishes are in live or fresh condition. The objective of the study is to develop an efficient and collapsible fish trap as an alternative to the traditional traps which have shorter life span and occupy more space in the traditional fishing craft that are operated with severe space constraint. The present study deals with the design modification of a selected Norwegian collapsible trap to capture native ornamental and food fishes of Keelakarai coast.

Materials and Methods

The study was carried out in Keelakarai coastal waters from September 2011 to June 2012 between the Appa Island (Lat. 9º 09′05.22″ N, Long. 78° 43′51.28″ E) and Mullai Island (Lat. 9º 09′59.54″ N, Long. 78° 49′37.00″ E). This fishing ground was approximately 4 nautical miles from the coast with mean depth of 7 m. Three types of traps *viz.*, Experimental Traditional Trap (ETT) (Fig. 1) a selected design of Norwegian Collapsible Trap (NCT) (Fig. 2) and Modified Norwegian Collapsible Trap (MNCT) (Fig. 3) were used for the study. The ETT was the most popular design among the four different designs of traditional traps being used in Keelakarai. Design details of the experimental traps are given in Table 1 and details of other traps are given in Table 2.

Preliminary fishing trials were carried out with NCT covering 40 fishing operations. The poor catch rate of NCT in Keelakarai coastal waters was attributed to poor retention ability of the funnel on the smaller varieties commonly available in Keelakarai. To increase the catch rate, the NCT was modified.

Design details of the funnel of MNCT are given in Fig. 4. Tapering of the funnel was obtained both by following proper cutting pattern as well as following required take up ratio while connecting the net panels (Fig. 4). The modified funnel had five pairs of panels made up of polyethylene (PE) webbing of 30 mm mesh size and 0.75 mm twine thickness. The length of the funnel of MNCT (Fig. 4) was made relatively longer (100 cm) than that of NCT (50 cm) and fixed with a ring of 18 cm diameter at the rear end. The ring was made up of 6 mm thick mild steel rod and was positioned at about 45° angle by tying the ring with four polyethylene twines of 0.75 mm tightly to the opposite corners of the trap. MNCT was provided with funnels in the upper and lower chambers to facilitate the capture of off bottom fishes also. Further, the 40 mm polyamide (PA) square mesh webbing of NCT was replaced with

1. Wooden frame dimension: 1000 (L) x 1200 (B) x 400(H) mm
2. Covering webbing (*Acacia planifrons*): 40 mm mesh size
3. Funnal dimension: 600 mm vertical diameter x 450 mm horizontal diameter
4. Stone sinker: 2 Nos. each 5 kg

Fig. 1. Experimental Traditional Trap

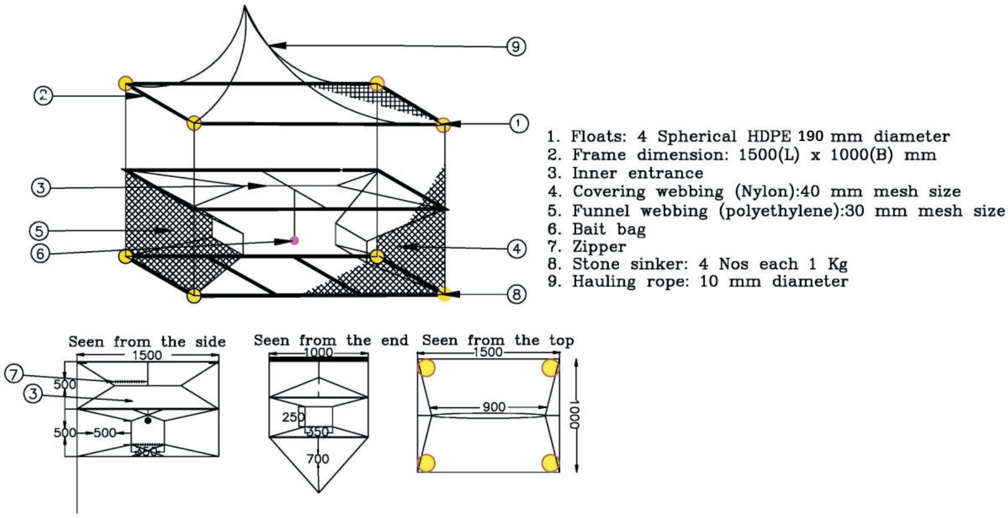

Fig. 2. Design details of Norwegian collapsible trap

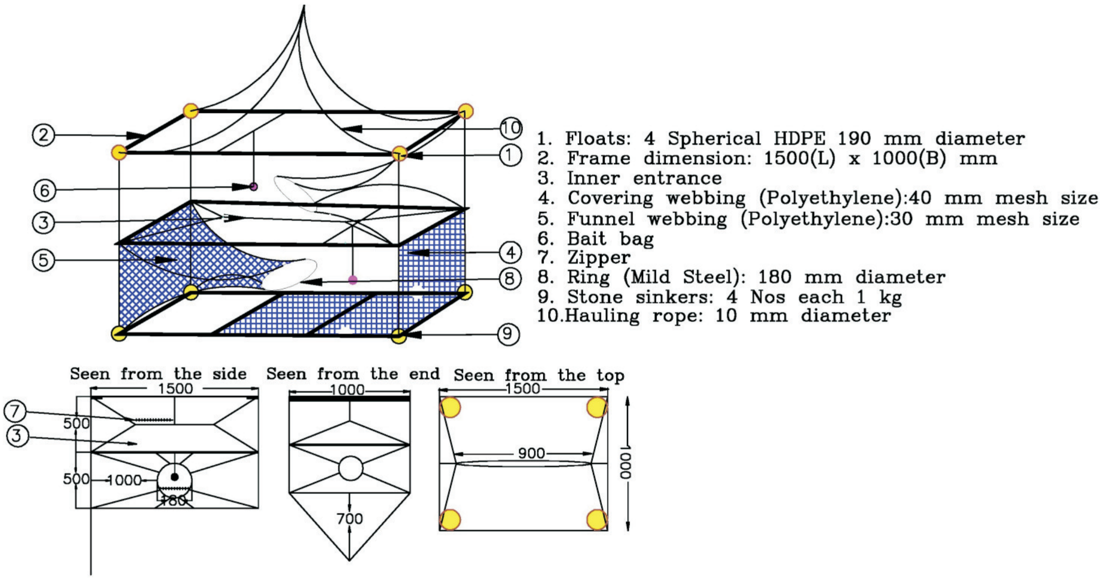

Fig. 3. Design of Modified Norwegian collapsible trap

40 mm square mesh PE webbing fabricated with 2 mm twine in order to reduce both the cost of construction of trap as well as weight increment after soaking. MNCT had two bait bags; one in the upper compartment and another in the lower compartment, made up of PA webbing (210Dx3x3) with mesh size of 30 mm.

Buoyant and sinking forces required for MNCT were standardized by fitting high density polyethylene (HDPE) floats with diameter ranging from 5 to 19.0 cm and stone sinkers each weighing 0.25 to 2 kg in different combinations. The extra buoyant forces of HDPE spherical floats were estimated as per the method of Satyanarayana (1960). HDPE spherical floats of 19.0 cm diameter one on each top corner of the trap was found sufficient to facilitate floatation of the top frame, lifting the middle frame. Four stones each weighing about 1 kg tied at the corners of bottom frame were found sufficient to position the MNCT firmly on the bottom. The operational volume (OV) of the MNCT

Table 1. Design description of the experimental traps

Sl. No.	Parts of trap	ETT (Experimental Traditional Trap)	NCT (Norwegian Collapsible Trap)	MNCT (Modified Norwegian Collapsible Trap)
1.	Frame	Nil	Stainless steel 1500 x 1000 mm	Mild steel 1500 x 1000 mm
2.	Covering material	*Acacia planifrons,* mesh size 40 mm	Polyamide (PA), mesh size 40 mm Twine specification: 210D/3/3	Polyethylene (PE), mesh size 40 mm, twine diameter : 2 mm
3.	Funnel material	*A. planifrons*	Polyethylene (PE), (mesh size 30 mm) Twine specification: 210/3/3	Polyethylene (PE), (mesh size 30 mm), twine diameter : 0.75 mm
4.	Bait bag	Nil	Polyamide (PA), (mesh size 30 mm)	Polyamide (PA), (mesh size 30 mm)
5.	Zip	Nil	700 mm (L) x 100 mm (H)	700 mm (L) x 100 mm (H)
6.	Floats	Nil	4 spherical HDPE; 190 mm diameter	4 spherical HDPE; 190 mm diameter
7.	Sinker	Stone: 2 each of 5 kg	Stone: 4 each of 1 kg	Stone: 4 each of 1 kg
8.	Hauling rope	Nil	PP, 9 m (10 mm diameter)	PP, 9 m (10 mm diameter)
9.	Marker float	Nil	HDPE: 1; 50 mm diameter	HDPE: 1; 50 mm diameter

Table 2. Comparison of experimental traps in terms of physical parameters and cost

Sl. No.	Parameters	Type of trap		
		ETT (Experimental Traditional Trap)	NCT (Norwegian Collapsible Trap)	MNCT (Modified Norwegian Collapsible Trap)
1.	Stacked volume (m^3)	0.43	0.15	0.15
2.	Operational volume (m^3)	0.43	1.50	1.50
3.	Dry weight (kg)	8.25	22.75	20.00
4.	Wet weight (kg)	15.00	25.60	21.20
5.	Percentage of weight increment after soaking	81.82	12.53	6.00
6.	Number of traps that can be stacked per m^3	2.31	9.10	9.10
7.	Number of traps that can be stacked per ton (wet weight basis)	66.67	39.06	47.17
8.	Cost (INR)	1600	4500	2500
9.	Cost per unit operational volume (INR/m^3)	3720	3000	1667
10.	Durability	6 months	3 years (estimated)	3 years (estimated)

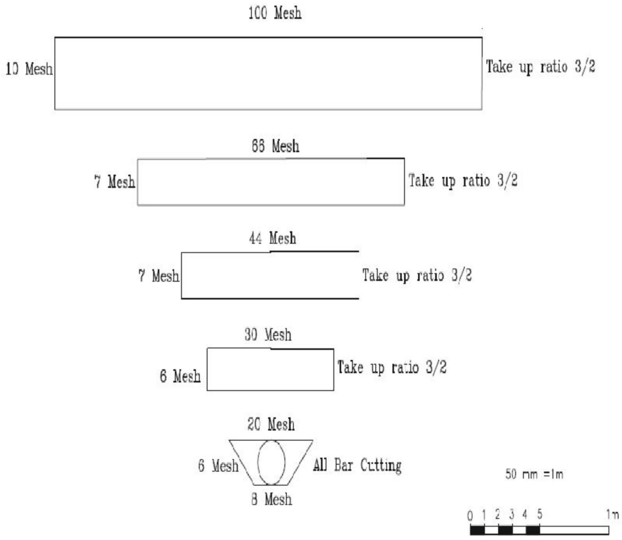

Fig. 4. Funnel design of the Modified Norwegian collapsible trap

was estimated using the following formula, OV = L X B X H (L- Length, B – Breath, H - Height) in stretched condition.

Eight traps each (ETT and MNCT) were operated simultaneously from a canoe with an overall length of 7 m powered with an in-board engine of 9.0 BHP. Experimental fishing was carried out once in a week. The ETT were baited at the rate of 4 kg of shrimp heads per trap and in the case of MNCT, each of the two bait bags was filled with 2 kg of shrimp heads. Four polypropylene ropes of 9 m long and 10 mm diameter were tied at each top corner of MNCT and tied together at the free ends to facilitate the attachment of a marker buoy. Regarding ETT, it was positioned at the sea bottom with the help of a wooden platform (1.5 m L x 0.05 m B with 0.05 m thick) which was inserted through the bottom mesh openings of the trap and kept submerged keeping 2 stones of each weighing about 5 kg one on either side of extended portion of the platform.

Traps were taken out for observation after a soaking period of 24 h. Catches were segregated family wise in the case of ornamental fishes and genus wise in the case of food fishes. Catch rate was expressed as number of fish caught per trap per soaking day and the fishes were measured nearest to millimeter using a measuring tape. Three way analysis of variance (ANOVA) was employed to determine the difference in catch among the designs, months and species observed at the significant level of 0.01.

Results and Discussion

Apart from modifications made in the funnel design, the other modifications made in the MNCT resulted in reduced dry weight and wet weight of 21.2 and 22.4 kg respectively compared to NCT

Table 3. Family wise catch details of marine ornamental fishes caught in the experimental traps (catch/trap)

Sl. No.	Family	ETT (Experimental Traditional Trap) Numbers caught	Length range (cm)	Percentage contribution (%)	MNCT (Modified Norwegian Collapsible Trap) Numbers caught	Length range (cm)	Percentage contribution (%)
1.	Pomacentridae	55.0±1.5	6.50-15.3	31	87.0±1.36	6.90-16.4	31
2.	Cheatodontidae	51.0±1.05	8.2-11.5	26	70.0±0.83	7.50-19.3	23
3.	Lutjanidae	13.0±0.76	12.0-14.2	6	22.0±1.09	12.2-14.5	8
4.	Labridae	11.0±0.86	12.0-16.9	6	20.0±1.06	12.2-19.5	7
5.	Acanthuridae	11.0±0.58	11.2-15.6	7	18.0±0.97	11.2-16.0	6
6.	Holocentridae	9.0±0.67	11.4-13.9	7	21.0±1.01	12.0-14.2	7
7.	Serranidae	14.0±0.87	12.3-14.2	6	17.0±0.60	12.3-14.5	6
8.	Scaridae	6.0±0.67	12.6-14.0	3	12.0±0.79	12.5-13.9	3
9.	Others	12±0.86	6.2-14.0	8	23.0±0.99	7.0-14.5	9
	Total	182.0±7.82			290.0±8.7		

(Table 2). The reduction in both dry and wet weight of MNCT in relation to NCT may be attributed to the use of PE instead of PA webbing. Change of webbing material also showed notable impact on the percentage of weight increment after soaking and the cost of the trap. The percentage weight increment after soaking was 6% for MNCT. The cost of MNCT could be reduced by INR 4500 to 2500. Further, the cost per unit volume also showed remarkable reduction from INR 3000 to INR 1667 when the PE was used as covering material in MNCT. Though the cost of MNCT (INR 2500/-) was 1.5 times more than the cost of ETT (INR 1600/-), the cost per unit operational volume of MNCT (INR 1667) was about 2.0 times lower than that of ETT (INR 3720). As the operational volume of the trap is an important parameter that decides the catching ability of the trap, MNCT was found to be more advantageous over ETT. It implies that collapsible traps with multiple chambers arranged vertically would pave way for increased operational volume than the non-collapsible trap. Further use of MNCT was found to reduce the stacked volume per cubic meter by about 4 times compared to ETT. However on weight basis, the number of traps that can be stacked per tonne of weight displacement of fishing vessel by MNCT was 47.17 traps t^{-1} against 66.67 traps t^{-1} displacement for ETT.

Dry weight of ETT increased from 8.5 kg to 15 kg after soaking due to high degree of water absorption by the sticks of *A. planifrons* used in the trap. Dry weight of MNCT in relation to ETT was higher, *viz.*, 21.2 kg which was mainly due to weight of MS rods used . However, operational volume of MNCT was about 2.5 times higher than that of ETT. The relatively lesser dry weight and wet weight of MNCT in relation to NCT was due to the use of polyethylene webbing in MNCT. (Table 1 & 2). Traditional trap had high cost per unit operational volume of INR 3720 m^3 and stacked volume of 0.43 m^3 $trap^{-1}$ (Table 2). By adopting collapsible trap technology, the volume of trap could be increased nearly 2.5 times with the additional weight increment of just 6.2 kg on wet weight basis. MNCT was found to be more economical owing to its lesser cost per unit operational volume (INR 1667 m^{-3}) and lesser stacked volume of 0.15 m^3 $trap^{-1}$.

Remesan (2006) used eight PVC floats to lift the upper frame (110 x 75 cm) of the collapsible traps. However, in the present study, four HDPE spherical floats of 19.0 cm diameter each with the extra buoyancy of 3.29 kg were sufficient to lift the two top frames of 150 x 100 cm of MNCT to make it a rectangular box in the sea. Optimum buoyant force required for a collapsible trap depends not only on the dimension of the frames used, but also on the weight of the frames. Of the three frames of MNCT, frames used at the top and in the middle weighed 5.16 kg each while the bottom frame weighed 7.9 kg. The dry weight of MNCT inclusive of all its accessories was 21.2 kg. Two kilogram of sinkers attached to a sinker line have been used to position

Table 4. Family wise catch details of marine food fishes caught in the experimental traps (catch/trap)

Sl. No.	Family	Scientific name	ETT (Experimental Traditional Trap)			MNCT (Modified Norwegian Collapsible Trap)		
			Numbers caught	Length range (cm)	Percentage contribution	Numbers caught	Length range (cm)	Percentage contribution
1.	Heamulidae	*Plectorhincus* spp.	31±1.2	15.2-22.7	5	32±1.19	16.3-23.9	5
2.	Holocentridae	*Sargocentron rubrum*	34±1.15	15.0-18.5	5	36±0.95	15.3-19.5	5
3.	Lethirinidae	*Lethrinus* spp.	91±0.80	16.0-25.7	14	97±1.17	17.2-27.5	13
4.	Lutjanidae	*Lutjanus* spp.	59±1.33	15.2-23.7	9	61±1.09	16.4-25.0	9
5.	Mullidae	*Parupeneus indicus*	27±1.05	14.5-20.0	4	29±0.91	15.3-22.3	4
6.	Scaridae	*Scarus* spp.	138± 1.85	15.3-30.0	21	144±1.54	15.3-33.3	20
7.	Serranidae	*Epinephelus* spp.	130± 2.39	16.9-42.0	20	139±2.32	16.8-48.0	20
8.	Siganidae	*Siganus* spp.	143±1.5	12.4-18.0	22	172±2.42	13.0-18.0	24
	Total		653± 11.27			710± 11.59		

the collapsible traps with bottom frame of dimension of 150 x 100 cm by Furevik et al. (2008) and Ovegard et al. (2011). The magnitude of sinking force of MNCT may have to be adjusted depending upon the wave and underwater current prevailing in the fishing grounds where the MNCT are to be operated.

During the experimental period, 38 species of marine ornamental fishes belonging to 16 families were recorded, however fishes belonging to mainly eight families contributed to the catch. Number of fishes belonging to different families and their length range with respect to the types of experimental traps tested are given in Table 3. The catch composition of the ornamental fish was almost same for both ETT and MNCT and neither ETT nor MNCT showed selectivity to any species. However significant difference could be ($p<0.01$) observed in the catch rates of ornamental fishes belonging to different families (Table 5). This may be attributed to the difference in their abundance as well as differences in the degree of their vulnerability to the trap. Among the 8 families of ornamental fishes, Pomacentridae (31%) dominated the catch both in ETT and MNCT followed by Chaetodontidae (26%) in ETT and 23% in MNCT (Table 3).

Food fishes were represented by eight families (Table 4). Food fishes such as *Siganus* spp., *Scarus* spp. and *Epinephelus* spp. contributed to about 20% of the total catch in both types of traps followed by *Lethirinus* spp. (14%). Significant differences could be observed between the catch rates of food fishes belonging to different genera ($p<0.01$) (Table 6). Time period and design showed significant impact

Table 5. Analysis the variance of impact of designs and seasons on the catch rate of different families of ornamental fishes

Source	df	Sum of square	Mean square	Sig.
Species	7	774.48	110.64	<0.01
Season	11	193.78	17.62	<0.01
Design	1	57.3	57.3	<0.01

Table 6. Analysis the variance of impact of designs and seasons on the catch rate of different groups of food fishes

Source	df	Sum of square	Mean square	Sig.
Species	7	4024.6	574.94	<0.01
Season	11	196.4	178.54	<0.01
Design	1	20.32	20.32	<0.01

Table 7. Month wise catch details of marine ornamental fishes caught in the experimental traps (catch/trap)

Sl. No.	Months	ETT (Experimental Traditional Trap)			MNCT (Modified Norwegian Collapsible Trap)		
		Numbers caught	Length range (cm)	Percentage contribution (%)	Numbers caught	Length range (cm)	Percentage contribution (%)
1.	September	16±2.79	6.2-16.2	9	27±2.16	6.9-19.3	9
2.	October	14±1.51	6.7-15.9	8	25±1.54	7.0-16.4	9
3.	November	21±1.65	6.4-15.6	12	33±2.21	6.2-19.5	11
4.	December	23±1.46	9.3-15.3	13	36±1.95	6.5-16.0	13
5.	January	20±2.20	9.4-16.9	11	34±2.28	6.5-18.5	12
6.	February	20±2.20	8.2-14.2	11	30±1.88	9.5-17.0	10
7.	March	17±1.23	7.2-15.9	9	26±1.51	10.4-16.8	9
8.	April	15±1.43	6.6-14.0	8	24±1.75	6.9-14.5	8
9.	May	17±1.33	6.5-15.3	9	27±1.53	7.2-15.2	9
10.	June	19±1.18	7.9-15.8	10	28±1.91	7.0-16.0	10
	Total	182±16.98			290±18.72		

Table 8. Month wise catch details of food fishes caught in the experimental traps (catch/trap)

Sl. No.	Months	ETT (Experimental Traditional Trap)			MNCT (Modified Norwegian Collapsible Trap)		
		Numbers caught	Length range (cm)	Percentage contribution (%)	Numbers caught	Length range (cm)	Percentage contribution (%)
1.	September	65±2.52	13.4-30.7	10	69±0.99	13.2-36.7	10
2.	October	67±1.65	13.0-30.0	10	72±1.55	13.0-31.0	10
3.	November	67±2.53	12.8-35.7	10	77±1.53	12.9-35.2	11
4.	December	72±1.21	12.7-31.2	11	79±1.65	12.6-32.5	11
5.	January	74±2.98	12.4-32.7	11	78±1.67	13.0-42.0	11
6.	February	68±1.24	13.0-29.3	11	73±2.41	12.8-33.3	10
7.	March	63±1.39	13.2-35.2	10	67±1.65	12.4-42.3	10
8.	April	59±1.9	13.2-42.0	9	65±1.34	12.4-48.0	9
9.	May	57±1.79	12.8-32.7	9	63±1.84	13.5-40.3	9
10.	June	61±2.07	12.9-29.5	9	67±1.84	14.2-42.3	9
	Total	653±19.28			710±16.47		

on the catch rate of ornamental fishes (Table 7) and food fishes (Table 8). The study revealed better catch efficiency of MNCT over ETT (Table 7 & 8).

While considering the space constraint, MNCT had relatively low stacked volume (0.15 m^3) and high operational volume (1.5 m^3) and hence was found ideal to operate from the traditional crafts of south-east coast of India like canoe and *catamaran*. Notable corrosion could be observed on the MS rods of the MNCT and required painting after one year of continuous usage. The study concluded that MNCT can be a better alternative to the traditional traps being operated along Keelakarai coast owing to its lesser cost per unit operational volume (INR 1667 m^{-3}) and lesser stacked volume of 0.15 m^3 $trap^{-1}$ besides higher catch efficiency.

Acknowledgement

The authors sincerely thank Dr. Halvard L. Aasjord, Senior Scientist, SINTEF Fisheries and Aquaculture, Norway and Dr. M. Sakthivel, FITT, Tamil Nadu, India for the supply of Norwegian collapsible trap design under the programme which served as the base to carry out this study. The authors are thankful to the University Authority of Tamil Nadu Veterinary and Animal Science University, Chennai, India, for the timely support to carry out the experiments. The help rendered by the fishermen of Keelakarai coast for the operation of experimental traps is gratefully acknowledged.

Reference

Appeldoorn, R., Dennis G. D. and Monterrosa, O. L. (1987) Review of shared demersal resources of the Les Series Antilles region. Food and Agriculture Organization Fisheries Report. 383: 36-106

Caesar, E. D. and Oxenford, A. H. (2005) Testing a collapsible trap design in the deep demersal fishery of Tobogo, Eastern Caribbean. Centre for Resource Management and Environmental Studies, University of the West Indies Cave Hill, Barbados. 117-118

Campbell, M. J. and Sumpton, W. D. (2009) Ghost fishing in the pot fishery for blue swimmer crabs *Portunus pelagicus* in Queenslands, Australia. Fish. Res. 95: 246-253

Furevik, D.M., Humborstad, O.B., Jorgensen, T. and Lokkeborg, S. (2008) Floated fish pot eliminates by-catch of red king crab and maintains target catch cod. Fish. Res. 92: 23-27

Hawkins, J. P., Roberts, C. M., Gell, F. R. and Dytham, C. (2007) Effects of trap fishing on reef fish communities. Aquat. Conserv. 17: 111-132

Hornell, J. (1938) The Fishing Methods of Madras Presidency. Part I. The Malabar Coast, Madras. Fish. Bull. 27: 1-69

Meenakumari, B and Mohanrajan, K.V. (1985) Studies on materials for traps for spiny lobsters. Fish. Res. 3: 309-321

Miyammoto, H and Shariff, A.T. (1961) Lobster fishing off the south-west coast of India. Anchor hook and trap fisheries. Indian J. Fish. 8: 252-268

Mahan, R. and Rosenberg, A. A. (1988) Fishery data collection systems for eastern Caribbean islands. Organization of Eastern Caribbean States Fishery Report No. 2

Nostvik, F. and Pedersen, T. (1999) Catching cod for tagging experiments. Fish. Res. 42: 57-66

Ovegard, M., Konigsison, S., Persson, A. and Luneryd, S. G. (2011) Size selection capture of Atlantic Cod (*Gadus morhua*) in floating pots. Fish. Res. 107: 239-244

Prabhu, M.S. (1954) The perch-fishery by special traps in the area around Mandapam in the Gulf of Mannar and Palk Bay. Indian J. Fish. 1: 94-129

Recksiek, C.W., Appeldoorn R.S. and Turingan, R.G. (1991) Studies of fish traps as stock assessment devices on a shallow reef in south-western Puerto Rico. Fish. Res. 10: 177-197

Remesan. M. P. (2006) Studies on the inland fishing gears of North Kerala. Ph.D Thesis submitted to Cochin University of Science and Technology, Cochin, India. 283p

Satyanarayana, A. V. V. (1960) Preliminary studies of certain characteristics of spherical fishing floats. Indian J. Fish, 7(2): 483-495

Sheaves, M. J. (1995) Effect of design modification and soak time variations on Antillean-Z fish trap performance in a tropical estuary. B MAR SC 56: 475-489

Varghese, M. and Kasinathan, C. (2008) On the live marine ornamental fish keeping at Keelakarai, Ramanathapuram District, Tamil Nadu. Marine Fisheries Information Service, 198: 18

Whitelaw, A. W., Sainsbury, K. J., Dews G. J. and Campbell, R. A. (1991) Catching characteristics of four fish trap types on the northwest shelf of Australia. Aust. J. Mar. Freshw. Res. 42: 369-382