Evolution of Suitable Net for Medium Sized Vessels-ii Introduction of Large Meshed High Opening Fish Trawl

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Large meshed high opening trawl was found to be very efficient for the exploitation of column and off bottom fishes. The net is found more efficient than the bulged belly trawl in capturing different varieties of column fishes comprising of squids, pomfrets, barracudas, cat fishes, sharks and rays. The net offers 18% lesser resistance which in turn results in utilization of lesser horse power. The trawl is very simple in construction and requires minimum maintenance because of reduced number of meshes. The total cost of the net is less by 35% as the larger mesh size reduces the material requirement and cost of fabrication.

The development of fishing industry in India was centred around the development of shrimp fishing in the past, whereas no inroads have been made for the exploitation of the vast untapped resources of different column fishes, excepting the traditional exploitation of sardines and mackerels. There being no trawl gear exclusively for fish, the demersal fishes were caught while trawling for prawns. The introduction of bulged belly trawl has improved the catch of fish in addition to shrimp because of higher vertical opening developed by the net (Varghese & Kuriyan, 1968; Pillai *et al.*, 1978). In this communication the authors report their attempts to develop a high opening trawl with larger meshes and increased height to catch column and demersal fishes.

High opening trawl is a recent introduction (Buckingham, 1972) and is found very successful and efficient. The present trend in trawl design is to use larger meshes, as the schooling fishes seldom attempt to escape through the large meshes of the forepart of the net. The advantages of larger meshes have been already reported by Johnson (1971) and Scott (1974). The increase in mesh size has greatly improved the catching efficiency of the net. In India so far, no published work is available on large meshed trawls and hence the present investigation was initiated.

Materials and Methods

A large sized mesh trawl with 32 m head rope and high opening was designed and fabricated as specified in Fig. 1 and Table 1. The mesh size has been increased from 50% in the cod-end to 100% through the fore-part of the net when compared to the conventional trawl. Because of the increase in mesh size the total number of meshes has been reduced to 120% and webbing to 35% compared to a 32 m bulged belly trawl described by Pillai *et al.* (1978).

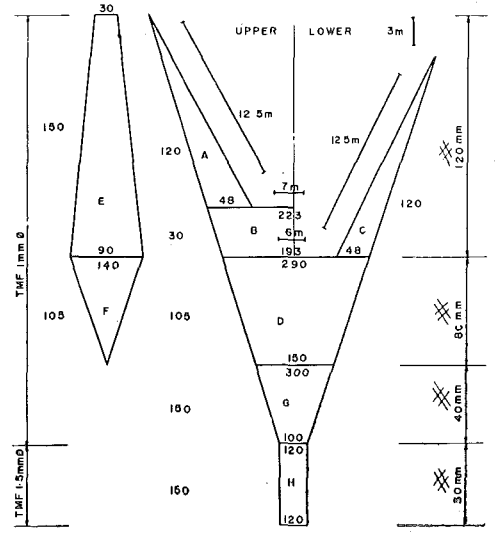

Fig. 1. 32m large meshed high opening trawl

Comparative details of the large meshed trawl and a bulged belly trawl are presented in Table 2.

Regular fishing was carried out from the CIFT vessel–Sindhukumari–15.2 m OAL fitted with a 165 HP Cummins engine during two fishing seasons at depths of 27 to 37 m off Cochin. The large meshed trawl was operated together with a 32 m bulged belly trawl to compare the effect of increased mesh size. Otter boards of 1900 x 900 mm flat rectangular wooden described by Pillai *et al.* (1978) have been used. The nets were operated one after another keeping depth, length of rope, trawling speed and duration of haul constant. The quantity of different varieties of fish caught by both the nets was recorded separately. The horizontal opening between otter boards was measured by an angle measurer and the warp tension by an electronic warp load tension meter (Sivadas, 1978).

Results and Discussion

The details of fishing and catch composition of different varieties of fishes in respect to both nets are presented in Table 3.

Total of 22245 kg of fish was landed by both the nets, of which 58% was contributed by the large meshed high opening trawl. *Synagris* and sciaenids which are mainly benthic, constituted the major portion of the catch (85%) and the catching rate was 56% and 44% for large meshed trawl and bulged belly trawl respectively, showing 12% more for large meshed trawl, while in the case of sharks, rays and other varieties such as squids and cuttle fishes, barracudas, cat fish and pomfrets which are predominently column fishes the percentage was 30–46 more for large meshed trawl. 75% of the total prawn catch was landed by the bulged belly thereby showing its efficiency over large meshed trawl. So it is clear from the catch that large meshed trawl is more efficient for all varieties of fishes and squids.

The analysis of the composition of catch of the two nets at the two different depths also showed some marked difference. Below 30 m the comparative catch rate of the two nets was 52% for large meshed trawl and 48% for bulged belly trawl and the catch per hour for large meshed trawl and bulged belly trawl was 86.5 kg and 82.6 kg respectively. So it is clear that there is not much difference in the catch rate and both nets show almost equal efficiency in this depth range. At 30 m and beyond the catch rate for large meshed trawl and bulged belly trawl was 59 and 41% respectively, showing a difference of 18% and the catch per hour for the two nets was 157 kg and 107 kg respectively indicating significant difference between the nets. Thus large meshed trawl was found to be more efficient in deeper waters beyond 30 m. It was also observed that in both the depth ranges the catch rate of column fishes in the large meshed trawl was almost double than that of the bulged belly trawl. This was due to the fact that large meshed trawl developed more vertical opening than bulged belly trawl.

Another interesting finding was that all the squids and cuttle fishes were caught beyond 30 m and a total of 880 kg was landed by the two nets, of which 580 kg of squids were accounted by large meshed trawl being 93% more when compared to the squid and cuttle fish caught by the bulged trawl. As squids and cuttle fish are important items of export its exploitation assumes greater importance. The large meshed trawl can be successfully operated for the exploitation of the vast resources of squids and cuttle fish in the seas around India.

The data were statistically analysed separately for total fish, squids, sharks and rays as these varieties constituted major items of catch and as also they are commercially important. The mean catches of the two nets were compared by analysis of variance technique. Analysis of variance of total fish catch after converting the data to logarithmic scale to stabilize the variance is presented in Table 4. The difference between the mean catches was found to be highly significant showing large meshed high opening trawl to be more efficient with respect to total fish catch. The catch of squids and cuttle fishes were converted to logarithmic scale after adding unity to each observation to tackle 'o' observations. The analysis of variance is presented in Tables 5 and 6.

Table 1. *Details of 32m large meshed high opening trawl*

Webbing	A	B	C	D	E	F	G	H
Stretched mesh mm	120	120	120	80	120	80	40	30
Upper edge meshes	1	223	1	290	30	140	300	130
Lower edge meshes	48	193	48	150	90	1	100	130
Depth meshes	120	30	120	105	150	105	150	150
No. of pieces	2	1	2	2	2	2	2	2
Cutting rate	1p3b	1p2b	1p3b	1p4b	2p1b	1p4b	1p4b	All p
Baiting rate	...	1:2	...	1:1.5	1:5	1:1.5	1:1.5	...
Rope length m	a 12.5	b 7.0	c 12.5	d 6.0	e 3.0			
Hanging co-efficient %	87	45	87	50	80			

Table 2. *Particulars of large meshed trawl and bulged belly trawl*

Particulars		Large meshed high opening trawl	Bulged belly trawl
Head rope length	m	32	32
Foot rope length	m	37	35
Wing mesh size	mm	150	80
Jib mesh size	mm	120	60
Overhang mesh size	mm	120	60
Body mesh size	mm	80	50
		40	40
			30
			20
Cod-end mesh size	mm	30	
No. of meshes		1,96,000	4,10,000
Twine size		1 mm dia	1 mm dia
		1.5 mm dia	1.5 mm dia
Material requirement		18.5 kg	29 kg

Table 3. *Catch composition of fishes caught by large meshed high opening trawl and bulged belly trawl*

Fishing season	Depth of operation	Trawling hours	Type of net	Quantity of fish caught (kg) Prawn	Squids and cuttle fish	Pomfrets and other quality fishes	Barracuda	Cat fish	Shark and rays	Synagris and sciaenids	Total	Catch/h
1977–1978	Up to 30 m	33	Large meshed trawl	16	—	19	21	56	37	2706	2855	86.5
		33	Bulged belly trawl	45	—	8	12	25	20	2620	2730	82.6
1978–1979	Beyond 30 m	63	Large meshed trawl	0	580	31	164	25	1131	7954	9885	157.0
		63	Bulged belly trawl	3	300	10	61	15	606	5780	6775	107.0
Total and % for two seasons		96	Large meshed trawl	16 (25%)	580 (65.7%)	50 (73.2%)	185 (71.7%)	81 (67%)	1168 (65%)	10650 (56%)	12740	(58%)
		96	Bulged belly trawl	48 (75%)	300 (34.3%)	18 (26.8%)	73 (28.3%)	40 (33%)	626 (35%)	8400 (44%)	9505	(42%)
Total catch				64	880	68	258	121	1794	19050	22245	

Table 4. *Analysis of variance of total catch*

Source	ss	df	ms
Total	3.79078	77	
Between gears	0.48258	1	0.48258*
Between days	3.09757	38	0.08151*
Error	0.21064	38	0.00554

Mean catch (logarithmic scale) for large meshed trawl 2.3025 and bulged belly trawl 2.1452

* Highly significant ($p < 0.001$)

Table 5. *Analysis of variance for squids and cuttle fish*

Source	ss	df	ms
Total	10.10413	61	
Between gears	1.23615	1	1.23615*
Between days	8.67058	35	0.24773*
Error	0.19741	35	0.00564

Mean catch (logarithmic scale) for large meshed trawl 1.1015 and bulged belly trawl 0.8395

* Highly significant ($p < 0.001$)

Table 6. *Analysis of variance for sharks and rays*

Source	ss	df	ms
Total	7.05858	61	
Between gears	1.01596	1	1.01596*
Between days	5.26577	30	0.17553*
Error	0.77685	30	0.02589

Mean catch (logarithmic scale) for large meshed trawl 1.4243 and bulged belly trawl 1.1683

* Highly significant ($p < 0.001$)

Table 7. *Average horizontal spread between otter boards and average tension for the two nets*

Net	Depth of operation	Average speed knots	rpm	Average tension	Average horizontal opening
	m			kg	m
Large meshed high opening trawl	27 to 37	3	1200 to 1250	450	30
Bulged belly trawl	27 to 37	3	1300 to 1350	550	28

The difference between the mean catches of the gears was found highly significant showing the large meshed high opening trawl to be more efficient than the bulged belly trawl. The difference between the mean catches of the gear was found to be highly significant and the large meshed trawl was more efficient than the bulged belly.

Based on the composition of catch in the large meshed trawl, it can be reasonably inferred that the better efficiency of this net is due to the higher vertical opening and horizontal spread. This is because of the special type of jib with more length and a short side seam with more vertical height, which enables the net to develop a wider mouth opening to catch more fish in the column water, in addition to the bottom fishes. It is possible that the larger meshes in the fore part allow more flow of water and the fishes that enter the net have to swim faster to escape through the meshes. Naturally fishes take the easier way and swim to the cod-end and get caught.

The average horizontal spread between otter boards, the average tension offered by the nets and rpm of engine are tabulated in Table 7.

The resistance of large meshed trawl is 18% lesser than that of bulged belly trawl thereby indicating lesser horse power for towing the large meshed trawl. This is evident from the fact that the large meshed trawl requires an average rpm of 1200 to 1250 for a trawling speed of three knots, whereas the bulged belly trawl requires 1300 to 1350 rpm for the same speed. The lesser resistance by the large meshed trawl is due to the larger meshes which allow more flow of water thereby reducing the tension considerably and also reduction in total weight of the net owing to fewer meshes. The use of larger mesh for reduced towing resistance has been already reported by Rehme (1973). Fig. 2 gives a clear picture of the comparative efficiency between the two nets. The use of large meshed high opening trawl has indicated an increased efficiency of 95% and 27% respectively for column and demersal fishes and 18% lesser resistance and comparatively wider mouth opening. The reduction in the resistance of the net indicates lesser utilisation of power and this enables further scope for using bigger nets with the same engine. Above all, the cost of the

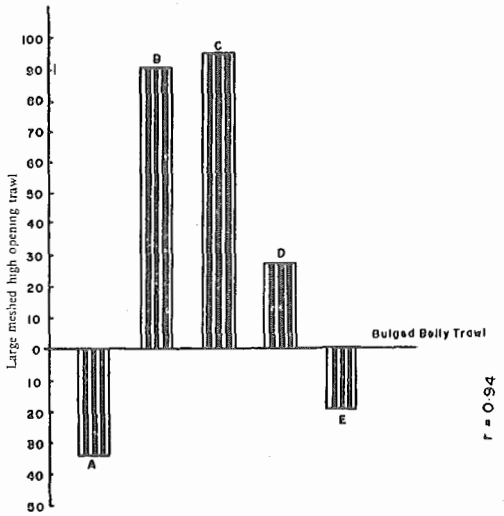

Fig. 2. Comparative efficiency of large meshed high opening trawl and bulged belly trawl A–Decrease in cost; B–Increase in squid catch; C–Increase in column fish; D–Increase in demersal fish; E–Decrease in resistance.

net can also be reduced to 35%. Further it is also observed that this net caught bigger sized fishes, allowing the small ones to escape through the bigger meshes of the codend, thereby helping in the conservation of species. The use of small meshes for the trawl net which filter small fishes should be discouraged and the mesh size could be further increased for more efficiency and better catch.

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