A New Large Mesh Trawl for Demersal Fishery

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A new large mesh demersal trawl of 32 m head rope length is found more efficient for the exploitation of demersal fishes off Veraval. Increased catch with a proportionate increase of demersal fishes was obtained when compared to a standard bottom trawl of 32 m head rope length with small meshes, suggesting the possibility of increasing the mesh size of trawl nets in the forepart. This increases the mouth area of net which enhances the fishing power by covering a large area per tow. The net is simple in construction, easy to repair and maintain and fewer in the number of meshes.

The utilisation of the fishery resources in the seas around India was concentrated until very recently to the inshore waters and the offshore region was left mostly unexploited. Surveys by the Government of India fishing vessels indicated the existence of substantial fishery resources in the offshore waters (Anon, 1972 a; Jayaraman *et al.*, 1959; Joseph, 1974; Rao *et al.*, 1966). The North West Coast extending from Ratnagiri to Kutch has the largest shelf area of about 200,000 km^2 and is well known for its rich demersal fishery resources. Of late, inshore shrimp trawlers are trying to venture to offshore waters for capturing demersal fishes as inshore shrimp trawling is becoming uneconomical. Suitable trawl gear and accessories have to be developed for offshore fishing as the inshore gear would not be suitable and effective for offshore waters. Introduction of large mesh demersal trawls is one of the recent advancements in offshore and deep sea trawling (Anon, 1974; Anon, 1975 a, b; Anon, 1977). Advantages of mid water and pelagic trawls have been reported by several workers (Anon, 1972 b; Anon, 1973; Johnson, 1971; Gorman, 1975; Rehme, 1973), but no attempt has been made in India with large mesh trawls. There is a general tendency to reduce the mesh size of trawls in India resulting in decreased catch per unit effort in inshore trawling. Trawl nets with less than 20 mm mesh in the codend and less than 50 mm mesh in the forepart are common. This tendency must be discouraged from the trawl fisheries management point of view. Investigations with a new 32 m large mesh demersal trawl were carried out in the sea off Veraval, North West Coast of India and the results reported in this paper. Depths of 40 metres and beyond is treated as 'offshore' and less than 40 metres as 'inshore' in this study.

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Materials and Methods

Investigations were conducted from December, 1977 to May, 1978 from boat Fishtech 8 having 15.2 m overall length fitted with 165 hp engine. The new trawl was used along with a 32 m long wing trawl described by Kartha (1976) for comparison. Details of the new trawl, is given in Figure 1 and Tables 1, 2 & 3. A comparative account of both the nets is given in Table 4. A pair of rectangular flat otter boards described by Kuriyan *et al.* (1964) was used. Double sweeps of 5 m in length of high density polyethylene twine of 18 mm diameter were kept in between net legs and otter boards for all the operations. Trawling speed was 2.5 knots per h at 1200 rpm of the engine for all the hauls. Ground, depth, warp, course and duration were also kept strictly comparable. Catch composition of important species of fish in each haul was recorded. Trawl warp tension was measured by the device described by Satyanarayana and Nair (1965). Horizontal opening between otter boards was measured and calculated by the method suggested by Benyami (1959) and

Table 1. *Details of the 32 m two seam large mesh trawl* *

Webbing	A	A1	B	B1	C	C1	D	E	E1	F	G	H	I
Twin diameter mm	2.5	2.5	2.5	2.5	2.0	2.5	1.5	2.0	2.5	1.5	1.5	2.0	2.0 (double)
Breaking strength kg	63	63	63	63	45	63	36	45	63	36	36	45	45x2
Streched mesh mm	150	150	150	150	120	150	100	100	150	60	40	30	30
Upper edge	24	1	24	1	219	180	195	187.5	130	166	150	133	133
Lower edge	60	24	45	24	163	175	100	100	125	100	100	133	133
Depth	80	12	123	12	47.5	5	95	87.5	5	66	50	150	75
Baiting rate Inner	1:1.8	1:1	1:1.2	1:1	...	...	...	...	...	...	...	...	...
Outer	1:1	1:1	1:1	1:1	1:1.7	1:2	1:2	1:2	1:2	1:2	1:2	...	...
Co-efficient of hanging	1.00	1.00	1.00	1.00	—	0.50	...	...	0.50	...	...	...	...
Hanging	$\frac{a}{A+A1}$	$\frac{13.75}{13.70}$	$\frac{d}{B+B1}$	$\frac{20.25}{20.25}$	—	$\frac{b}{C1} = \frac{4.5}{9.0}$	—	—	$\frac{c}{E1} = \frac{3.0}{6.0}$	—	—	—	—

* Blue, high density polyethylene with single trawl knots. Total weight of net 75 kg

Table 2. *Details of lines and ropes**

	a	b	c	d	e	f
Material	High density polyethylene					
Diameter mm	18	18	18	18	18	18
Breaking strength kg	3460	3460	3460	3460	3460	3460
Length m	13.75	4.50	3.0	20.25	5.0	5.0

*Head rope 32 m, foot rope 43.5 m

Table 3. *Details of floats, sinkers and otter boards*

	Floats	Sinkers	Otter boards
Number	21		2
Material	plastic	iron	iron and wood
Shape	spherical	link chain	rectangular flat
Diameter mm	150	6	—
Length mm	—	—	1524
Breadth mm	—	—	762
Static buoyancy kg	1.550	—	—
Weight in air kg	0.300	40.0	100.0

Table 4. *Comparative design details of the two nets*

Particulars	32 m long wing trawl	32 m large mesh demersal trawl
Mesh size mm		
Wings	60 50	150
Body	50 40 30	150 120 100 60 40
Codend	25	30
Total meshes	2,06,675	1,41,900
Twine size mm		
Wings	1.5	2.5
Body	1.5	2.0 1.5
Codend	1.5 double	2.0 2.0 double
Weight of webbings kg	27.0	51.0
Type	Light duty, four seam and overhang	Heavy duty, two seam, overhang and high rise
Lenght of head rope m	32.0	32.0
Lenght of foot rope m	37.0	43.5
Length of wing m	14.75 (upper) 17.25 (lower)	13.75 (upper) 20.25 (lower)
Size of rope	18 mm dia. polyethylene	18 mm dia. polyethylene
Floats	Hard plastic—17 Nos. 15 cm dia. 1550 g extra buoyancy	21 Nos. 15 cm dia. 1550 g extra buoyancy
Chain	Iron link chain 6 mm dia. 33 kg	Iron link chain 6 mm dia. 40 kg

Table 5. *Results of comparative fishing with* 32 *m long wing trawl and* 32 *m large mesh demersal trawl*

Particulars		32 m long wing trawl	32 m large mesh demersal trawl
Depth of operation m		27–58	27–58
Number of days		38	38
Number of hauls		50	50
Duration h		50	50
Trawl warp tension kg	Average Range	542 436–632	584 506–684
Horizontal opening at otter boards m	Average Range	28.18 (54.19%) 22.92–33.5 (44.00%–64.40%)	27.35 (52.54%) 22.38–31.75 (43.00%–61.00%)
Catch kg	Total Catch per unit effort kg/h Range	2077.800 41.555 6.000–176.500	4791.750 95.835 9.500–451.000

Deshpande (1960). Percentage of horizontal opening was calculated from the total head line length (52 m) which included length of head rope (32 m), length of net legs (5m+5m) and sweeps (5m+5m).

Results and Discussion

During 38 days, 50 comparative hauls were made (Table 5) of which 27 were at 40 to 58m in depths ('offshore') and 23 in 27 to 39m depths ('inshore'). Results obtained in 'offshore' and 'inshore' waters were tabulated (Table 6). Catch with respect to 'offshore' and 'inshore' waters is presented in Table 7.

From Tables 5, 6 and 7 it is evident that the large mesh trawl is very efficient for demersal fishes in the 'offshore' and 'inshore' waters. The increase in catch per unit effort of the new net was found to be 1.71 times (171 per cent) in the 'offshore' and 0.87 times (87 per cent) in the 'inshore' waters compared to small meshed net. The new net has 3 times bigger mesh (Table 4) in the forepart than that of the conventional net. Tables 6 and 7 show that the large meshed net is more efficient in the 'offshore' waters than in the 'inshore' and is highly selective in catching quality fishes like perches, eel, seer and ghol that abound in offshore waters. With regard to fishes like *Lactarius,* elasmobranchs, sciaenids and miscellaneous varieties (Table 7) the new net was found superior in capturing all the demersal species, cephalopods and crustaceans. This is true with respect to inshore waters (Table 7), although slight variations have been observed due to random catches.

From the increased catch of high swimming and fast moving fishes like seer, eel, perches, ghol, silver bar etc., and bottom dwellers like lobsters, prawns, elasmobranchs, and flat fishes, the new net was highly efficient for bottom dwellers and high swimming fishes besides other demersal species like *Lactarius,* sciaenids, cephalopods and ribbon fishes. Thus the large meshed net had an overall versatility for capturing all the demersal species including smaller and miscellaneous varieties. The escape of fishes through the large meshes in the forepart of the net was insignificant. It was also noticed that only high swimming and

Table 6. *Results of comparative fishing with 32 m long wing trawl and 32 m large mesh demersal trawl in depth of 40 m, above and below*

Particulars		40 m and above (40–58 m)		Below 40 m (27–39 m)	
		32 m long wing trawl	32 m large mesh demersal trawl	32 m long wing trawl	32 m large mesh demersal trawl
Number of hauls		27	27	23	23
Duration h		27	27	23	23
Trawl warp tension kg	Average	549	605	535	563
	Range	436–632	530–684	459–605	506–658
Horizontal opening at otter boards m	Average	30.12(57.93 %)	28.88 (55.51 %)	26.24 (50.45 %)	25.78 (49.57 %)
	Range	26.44–33.50	26.04–31.75	22.92–30.35	22.38–29.80
		(50.80 %–64.40 %)	(50.00 %–61.00 %)	(44.00 %–58.40 %)	(43.00 %–57.30 %)
	Total	1066.350	2891.100	1011.450	1900.650
Catch kg/h	Catch per unit effort	39.500	107.100	44.000	82.620
	Range	6–120	18–451	6.5–176.5	9.5–372

Table 7. *Catch composition of 32 m long wing trawl and 32 m large mesh demersal trawl at depths of 40-58m and 27-39m*

Name of fish	40–58 m				27–39 m			
	32 m long wing trawl		32 m large mesh demersal trawl		32 m long wing trawl		32 m large mesh demersal trawl	
	Weight kg	%	Weight kg	%	Weight kg	%	Weight kg	%
Perches	7.40	4.0	180.10	96.0	5.70	79.0	1.50	21.0
Ghol	0.00	0.0	25.00	100.0	0.00	0.0	0.00	0.0
Eel	0.00	0.0	45.50	100.0	0.00	0.0	0.00	0.0
Seer	1.50	5.0	28.50	95.0	0.00	0.0	0.00	0.0
Pomfret	11.70	63.0	7.00	37.0	0.00	0.0	0.00	0.0
Silver bar	41.25	55.0	33.90	45.0	5.50	46.0	6.50	54.0
Ribbon fish	197.10	68.0	90.70	32.0	82.25	45.0	100.75	55.0
Lactarius	119.00	36.0	215.50	64.0	366.00	30.0	866.00	70.0
Elasmobranchs	0.50	0.8	69.25	99.2	*98.00	100.00	0.00	0.0
Cephalopods	127.00	33.0	254.00	67.0	34.50	45.0	42.00	55.0
Prawns & lobsters	0.90	5.0	16.65	95.0	2.50	25.0	7.40	75.0
Sciaenids	0.00	0.0	71.00	100.00	70.00	22.0	250.00	78.0
Miscellaneous	560.00	23.0	1854.00	77.0	347.00	36.0	626.50	64.0
Total	1066.35	27.0	2891.10	73.0	1011.45	35.0	1900.65	65.0

* Single big skate

Table 8. *Analysis of variance of fish caught*

Source	ss	df	mss
Total	8.43826	53	
Between gears	2.79830	1	2.7983***
Between days	3.91557	26	0.1506*
Error	1.72439	26	0.06632

Mean catch in terms of logarithms:

32 m long wing trawl ... 1.4658

32 m large mesh demersal trawl ... 1.6934

* Significant at 5% level
***Significant at 0.1% level

Table 9. *Analysis of variance of horizontal opening at otter boards*

Source	ss	df	mss
Total	140.583	53	
Between gears	21.092	1	21.09200***
Between days	90.472	26	3.47969**
Error	29.019	26	1.11613

Average horizontal opening:

32 m long wing trawl ... 30.1293
32 m large mesh demersal trawl ... 28.8793

** Significant at 1% level
*** Significant at 0.1% level

Table 10. *Analysis of variance of warp tension*

Source	ss	df	mss
Total	188,159.4896	53	
Between gears	41,944.8970	1	41,944.8970***
Between days	113,578.9896	26	4,368.4227**
Error	32,635.6030	26	1,255.2155

Average warp tension:

32 m long wing trawl	... 549.2963
32 m large mesh demersal trawl	... 605.0370

** Significance at 1% level
*** Significance at 0.1% level

Table 11. *Analysis of variance of logarithm of fish caught*

Source	ss	df	mss
Total	8.05126	45	
Between gears	1.05035	1	1.05035***
Between days	5.50003	22	0.25000**
Error	1.50088	22	0.06822

Mean catches in terms of logarithms:

32 m long wing trawl	... 1.4432
32 m large mesh demersal trawl	... 1.7455

** Significant at 1% level
*** Significant at 0.1% level

Table 12. *Analysis of variance of horizontal opening at otter boards*

Source	ss	df	mss
Total	154.876	45	
Between gears	2.379	1	2.379 N.S.
Between days	131.034	22	5.95609***
Error	21.463	22	0.97559

Average horizontal opening:

32 m long wing trawl	... 26.2422
32 m large mesh demersal trawl	... 25.7874

N. S. Not significant
*** Significant at 0.1% level

Table 13. *Analysis of variance of warp tension*

Source	ss	df	mss
Total	76,772.3696	45	
Between gears	9,269.7609	1	9,269.7609**
Between days	45,867.8696	22	2,084.9031*
Error	21,634.7391	22	983.3972

Average warp tension:

32 m long wing trawl	... 535.0435
32 m large mesh demersal trawl	... 563.4348

* Significant at 5% level
** Significant at 1% level

fast moving fishes like seer and silver bar are gilled in the upper belly and flat fishes in the lower belly and none in wings and square of the new net. The escapement struggle of fishes may be more at the belly, throat and cod-end. Thus it seems that the reduction of mesh size at the forepart of a trawl is quite unwarranted and instead a possible increase in mesh size at the fore-part is more desirable.

The increased catch of high swimming fishes in the large meshed net indicates the high rising of its head line than that in the conventional net. However this has not prevented the bottom contact as is evident from the catch of bottom dwellers. It may be noted from Tables 5 and 6 that the horizontal opening attained by the new net is slightly less than that of the conventional one, the total effective mouth area covered by the new net being much higher. This may be due to the increased high rising of the head line with a good bottom contact. Increased horizontal opening of the conventional net had no added advantage in the catching efficiency.

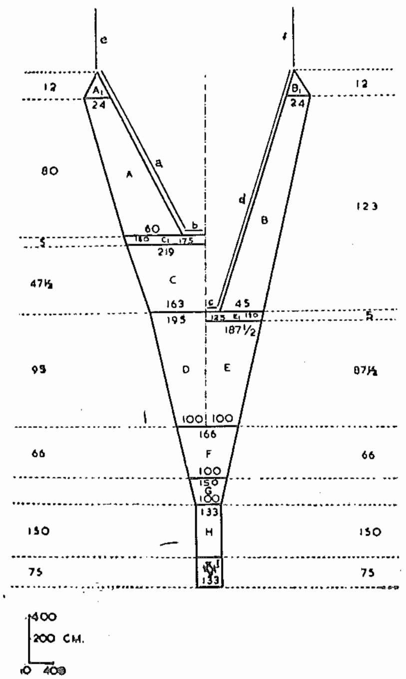

Fig. 1. *32m Large mesh demersal trawl*

Increase of mesh size in the front portion results naturally in increased flow of water through the body of the net and less frightening effect on the fish. As the filtration is quick, fishes in the mouth area have to swim faster to escape which enhances the catching efficiency of the trawl. By increasing the mesh size in the front portion, larger trawls with wider mouths can effectively be operated in place of small meshed nets.

The average warp tension of the new net was slightly more (Tables 5 and 6) than that of the conventional net. This may be due to thicker twines, wider mouth area and increased water flow through the net. Weight of webbing can be brought down by reducing the twine size. However, minimum 2 mm diameter twine for the front portion and 1.5 mm diameter for the belly, throat and cod-end may be retained as the net is of a heavy duty purpose. Slackening of foot rope can be altered if desired. However, 25% increase in foot rope length over head rope length helps to maintain better bottom sweep when the net tend to rise high at the head line. The new net is simple to construct, easy to repair and fewer in the number of meshes. A 32 m long wing trawl has 2,06,675 meshes and a bulged belly trawl of 32 m head rope length 4,60,780 meshes, whereas the new net has only 1,41,900 meshes.

The analysis of variance for logarithm of fish caught, horizontal opening and warp tension for offshore is given in Tables 8, 9 and 10.

The difference between the mean catches is found to be very highly significant (Table 8). It appears that 32 m large mesh demersal trawl is more efficient than 32 m long wing trawl. The difference between the mean horizontal opening of the gears was highly significant (Table 9). The mean measurements show a larger average horizontal opening for the 32 m long wing trawl. Difference between the average warp tensions of the two gears was found very highly significant (Table 10). Average warp tension was more for 32 m large mesh trawl.

The analysis of variance for logarithm of fish caught, horizontal opening and warp tension for inshore waters are given in Tables 11, 12, and 13. The difference between the mean catches is very highly significant (Table 11). It appears that 32 m large mesh demersal trawl is more efficient than 32 m long wing trawl with reference to catch. The difference between the mean horizontal opening of the two gears was not significant

(Table 12), but that between average warp tension is highly significant (Table 13), the average tension being more in 32 m large mesh trawl.

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