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Parallel Twin-body Trawl for Shrimps, its Design and Efficiency

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Comparative studies with a new 17 m parallel twin-body trawl and a 17 m bulged belly trawl conducted off Cochin during 1974-'77 are reported. The parallel twin-body trawl showed an increase of 28% in catch over that of bulged belly with a break up of 39.9% and 23.1% for prawns and fishes respectively. The increase in catch is attributed to the extra wide mouth opening (26.6%) of the parallel twin-body trawl. Parallel twin-body trawl had 8.96% lesser resistance which resulted in lower utilization of horse power.

In shrimp trawls extra long wing, additional tickling mechanism, an even sweep of the bottom and extra wide mouth opening are desirable. Introduction of long wing trawls by Satyanarayana *et al.* (1962) and Kuriyan (1965), the use of tickler chain in shrimp trawling (Miyamoto *et al.*, 1963; Deshpande & George, 1965; Deshapande & Kartha, 1967), double rig trawling (Panicker *et al.*, 1977) and twin trawling (Ramarao *et al.*, 1977) are aimed at better catch for shrimps. However, the idea of obtaining extra wide mouth opening by suitable modification in the trawl design has not been attempted to except in Japan (Nakamura, 1973). This appears to be a realistic approach suitable for our conditions where shrimp fishing is mainly carried out from small vessels except in a few cases where imported trawlers are employed for double rig and twin rig trawling. This prompted the authors to take up studies on the possibilities and economic aspects of a new twin-body trawl for shrimps.

In parallel twin-body trawl two small nets are put side by side, the inner wings are removed and connected in parallel. According to Nakamura (1973) when a conventional trawl and a twin-body trawl are made with identical flow resistance, the latter opens about 30% wider than the former and the angle of netting in the wing and body against the flow are smaller resulting in reduced meshing of fish.

A twin-body trawl can be either parallel or vertical. In the case of the former, two nets are put side by side and connected after removing the inner wings, while in the latter which is a two floor net, the bodies are vertically connected. In the parallel twin-body trawl, extra wide mouth opening is obtained while in the vertical twin-body trawl high opening of the mouth is possible.

Materials and Methods

In the present study, the two bodies of the net are connected from the front of the belly. Design details of the 17 m bulged belly and 17 m twin-body trawl are given in Figs. 1, 2 and Table 1. Horizontal curved otter boards of size 120 x 60 cm and 55 kg in weight as described by Mukundan *et al.* (1967) are employed. Fishing trials were conducted from a 9.75 m boat fitted with an engine of 34.5 horse power. Parallel twin-body trawl and bulged belly trawl were employed in rotation keeping fishing parameters constant. Fishing was carried out in the depth range of 10–30 m off Cochin.

Results and Discussion

Analysis of data has shown an overall increase of 28% catch with a break up of 39.90 and 23.10% respectively for prawns and fish for twin-body trawl over bulged belly trawl (Fig. 3 and Table 2). The horizontal opening has indicated an increase of

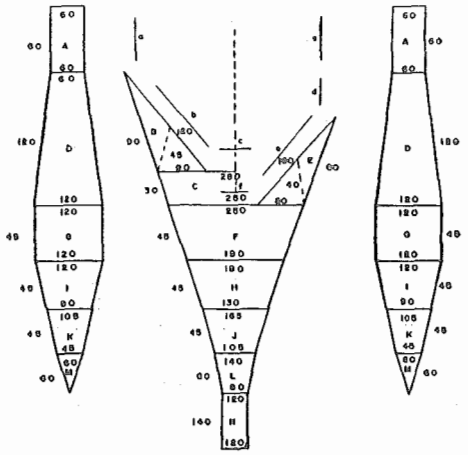

Fig. 1. *Design of 17 m bulged belly trawl*

20.60% for twin-body trawl, the average horizontal spread being 12.00 and 9.95 m respectively for twin-body and bulged belly trawls. The average tension offered by the two nets was 447 and 491 kg for twin-body and bulged belly trawls respectively showing an overall reduction of 8.96% of resistance in case of twin-body trawl and hence a lesser utilization of horse power (Fig. 3 and Table 2). Material required for the twin-body trawl was about 15% lesser than that of bulged belly trawl.

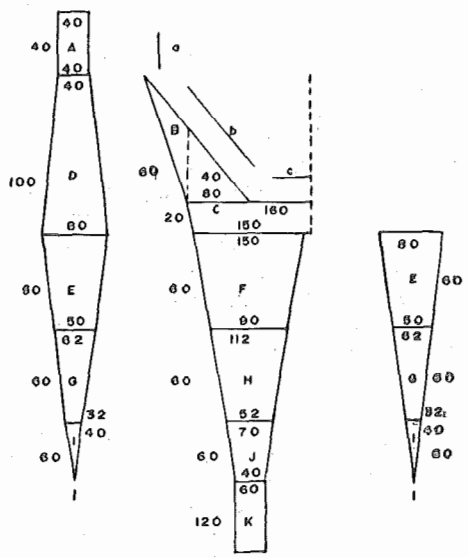

Fig. 2. *Design of 17 m twin-body trawl*

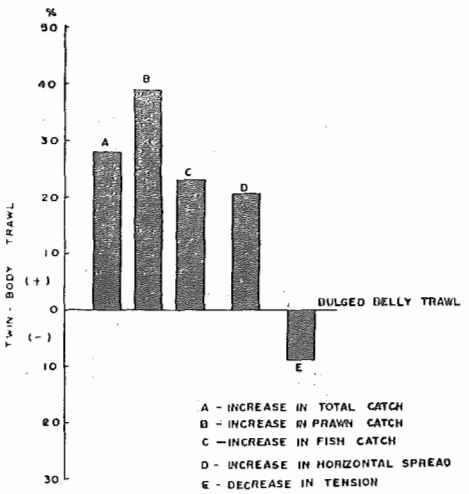

Fig. 3. *Comparative efficiency of twin-body and bulged belly trawls.*

The analysis of variance of 45 hauls has shown that,

1. Between net variations were very highly significant ($p<0.001$) for horizontal spread, tension and prawn catch. However, there was no significance in fish catch.

2. Horizontal spread and prawn catch of twin-body trawl were significantly high compared to bulged belly trawl.

3. Tension was significantly high in bulged belly trawl compared to twin-body trawl.

4. The variations in total catch between nets were significant at 5% level.

5. Variation between hauls was found to be very highly significant ($p<0.001$) in all cases (Table 3).

The anova of prawns and total catch in respect of the 100 paired hauls have shown that between nets and between hauls the variations were very highly significant ($p<0.001$). The fish catch was significant at 5% level (Table 3).

Table 1. *Data sheet of* 17 *m bulged belly and* 17 *m twin-body trawls*

Webbing	A	B	C	D	E	F	G	H	I	J	K	L	M	N
						17 m Bulged belly trawl								
Stretched mesh mm	50	50	50	50	50	50	50	50	50	40	40	30	30	20
Upper edge meshes	60	1	280	60	1	250	120	190	120	165	105	140	60	120
Lower edge meshes	60	90	250	120	80	190	120	130	90	105	45	80	1	120
Depth meshes	60	90/180	30	120	80/160	45	45	45	45	45	45	60	60	120
Number of pieces	2	2	1	2	2	2	2	2	2	2	2	2	2	2
Baiting ratio	..	1:2	1:2	1:4	1:2	1:1.5	—	1:1.5	1:3	1:1.5	1:1.5	1:2	1:2	..
Cutting rate	All p	1p2b	1p2b	3p2b	1p2b	1p4b	All	p1p4b	1p1b	1p4b	1p4b	1p2b	1p2b	All p
Hanging co-efficient	0.75	0.55	0.50	0.75	0.55	0.50	..	..	..	..	..	..	..	..
Rope length m	a2.25	b5.0	c2.5	d1.50	e4.5	f2.5	...	..	..	..	..	..	..	..
Weight of webbing kg						13.00								

Material–Webbings A to M–1 mm dia Garfil blue colour and N-0.75 mm dia Garfil blue colour double twine

						17 m Twin-body trawl					
Stretched mesh mm	50	50	50	50	50	50	40	40	30	30	20
Upper edge meshes	40	1	160	40	80	150	62	112	40	70	60
Lower edge meshes	40	80	150	80	50	90	32	52	1	40	60
Depth meshes	40	80/160	20	100	60	60	60	60	60	60	
Number of pieces	4	4	4	2	4	4	4	4	4	4	4
Baiting ratio	...	1:2	1:2	1:5	1:4	1:2	1:4	1:2	1:3	1:4	...
Cutting rate	All p	1p2b	1p2b	5p2b	3p2b	1p2b	3p2b	1p2b	1p1b	3p2b	All p
Hanging co-efficient	0.75	0.62	0.50	...	...	...	...	...	...	...	...
Rope length m	a1.50	b5.0	c2.0	...	...	...	...	...	...	...	...
Weight of webbing kg						11.00					

Material–Webbings A to J–1 mm dia Garfil blue colour, and K–0.75 mm dia Garfil blue colour double twine

Table 2. *Fishing and comparative catch details of* 17*m bulged belly and* 17 *m twin-body trawls*

Particulars	Bulged belly trawl	Twin-body trawl
Fishing ground	Off Cochin 9°50′ to 10°15′ N. Lat. and 76°12′ E. Long. between 10 and 30 m depth	
Number of hauls	100	100
Duration (h)	75	75
Average tension (kg)	491	447
Horizontal spread (m)	9.95	12.00
Catch (kg)		
Prawn	544.00	761.00
Fish	1286.00	1582.00
Total	1830.00	2343.00

Table 3. *Analysis of variance of catch, tension and horizontal opening*

Source	Prawns SS	DF	MS	F	Fish SS	DF	MS	F	Total SS	DF	MS	F
					Catch of 45 hauls							
Total	5.1470	89			10.8502	89			6.0307	89		
Between nets	0.5444	1	0.5444	26.950**	0.1079	1	0.1079	3.202	0.2635	1	0.2645	16.128**
Between hauls	3.7142	44	0.0844	4.178**	9.2575	44	0.2104	6.243**	5.0461	44	0.1140	6.994**
Error	0.8884	44	0.0202		1.4848	44	0.0337		0.7201	44	0.0164	
					Catch of 100 hauls							
Total	13.5186	199			21.3471	199			11.9666	199		
Between nets	1.1469	1	1.1469	61.005**	0.1416	1	0.1416	4.752*	0.4127	1	0.4227	28.687**
Between hauls	10.5092	99	0.1062	5.649**	18.2595	99	0.1844	6.188**	10.0881	99	0.1019	6.932**
Error	1.8625	99	0.0188		2.9460	99	0.0298		1.4568	99	0.0147	
	Tension of 45 hauls				Horizontal opening of 45 hauls							
Total	32090.00	89			106.41	89						
Between nets	18590.00	1	18590.00	190.97**	96.10	1	96.10	1372.86**				
Between hauls	9340.00	44	212.27	2.19**	7.24	44	0.16	2.29**				
Error	4260	44	96.82		3.07	44	0.07					

** indicates ($p<0.001$) and *indicates ($p<0.05$)

The comparative performance of the gear (Table 2) has clearly indicated better efficiency of parallel twin-body trawl. The extra wide mouth opening of the twin-body trawl (44.45%) when compared to the horizontal spread of bulged belly trawl (36.86%) is a clear indication that twin-body trawl can be used when extra wide mouth opening is required. Side by side with this increase in horizontal spread (20.60% over bulged belly trawl) there is a considerable reduction in the resistance of the gear (8.96%).

The overall increased efficiency of the gear (28.00%) in general and the substantial increase of the shrimping efficiency (39.90%) in particular of the twin-body trawl is a clear indication of the superiority of this design where all the salient features of the bulged belly trawl are incorporated. This increased efficiency in catch of the twin-body trawl can be attributed to the extra wide mouth opening provided in the design. The lower resistance offered by the twin-body trawl (8.96%) can be due to the smaller angle of netting against the flow at the wing and belly region and the lesser quanity of material requirement. This reduction in the resistance of the gear indicates lesser utilization of horse power and scope for further increase in the size of the gear (Panicker *et al.*, 1977).

Frequency of occurrence of increase in catch was about 70% in the case of twin-body trawl (Fig. 4). The frequency of increase in catch recorded by bulged belly trawl was about 23% out of which 80% falls under 20 kg catch level indicating that this increase was only due to chance catch. In the case of horizontal spread and tension it was fully on the side of twin-body trawl and bulged belly trawl respectively. This indicates a constant extra wide mouth opening at lower gear resistance in the case of twin-body trawl with an increase in the shrimping efficiency coupled with an increase in total catch. Statistical analysis also confirms this.

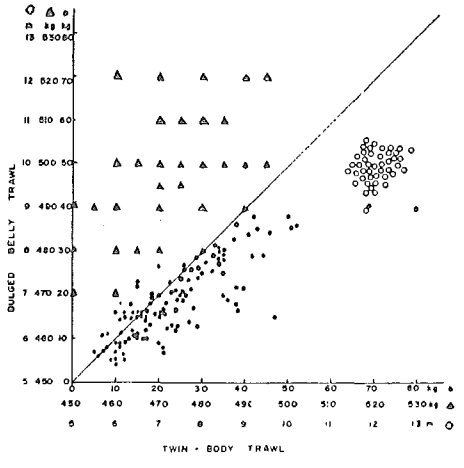

Fig. 4. *Catch, tension and horizontal spread of bulged belly and twin-body trawls*

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