ON THE OPTIMUM BUOYANCY—WEIGHT RELATION FOR A BOTTOM TRAWL

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Comparative fishing operations were carried out with 0.55; 0.75 and 1.00 buoyancy-weight relations of bottom trawl in order to find out the optimum relation. Two nets Viz, 18.26 m. (60′) two seam nylon and 16.16 m. (23′) two seam cotton trawls were used for the experiment. The results showed that the total catch per trawling hour with 0.75 B-W relation was 16.5% and 32.08% more than that with 0.55 and 1.00 B-W relation for nylon net used. A similar trend was noticed with cotton trawl also as the catch rate with 0.75 B-W relation was 13.89% and 25.78% more than that with 0.55 and 1.00 B-W relation. However, the analysis of catch composition indicated that the off bottom fishes like lactarius, upenoides sp., synagris sp. etc., were of more percentage with 1.00 B-W relation, near bottom fish like saurida, sciaenids etc., were more with 0.75 B-W relation, while the bottom fishes like soles, prawns, skates and rays etc., were more with 0.55 B-W relation.

INTRODUCTION

To improve the efficiency of a trawl net in filling its cod end with more catch, the essential requisite should be to have a good aperture and mouth open area, through which, fish is entrapped and driven towards its cod end. Eversince the advent of trawl net for fishing, several efforts were made for keeping the mouth of the net open and Satyanarayana et.al. (1970) in their experiments for the increased vertical opening of a trawl, have recorded the various means so far used. In spite of all these efforts the best and the most common method of keeping the mouth of a trawl net is by the use of floats as buoyant material on head rope and weights as sinking material on foot rope: their inter-relationship has direct influence on the functioning of the mouth of the trawl and any imbalance between them is likely to cause malfunction of the working of the net. Since there is no systematic effort in this line, the present study was taken up to evaluate the optimum buoyancy-weight relationship for a bottom trawl in order to improve its efficiency and the results with findings are presented in this paper.

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Materials and Methods

Two trawl nets (i. e) 18.26 m. (60′) two seam nylon as per the design details given by Satyanarayana et.al. (1962) and 16.16 m. (53′) two seam cotton, were used in the experiments. The latter net was of similar design of the former net except for the altered rope lengths on which the webbing was mounted. Horizontal curved otter boards of 120 cm. x 60 cm. and weighing 50 kg. each with 20 m. single sweep wire system on either side connected to an iron butterfly danleno were used along with the nets. The nets were fixed with a fixed lead weight of 15.9 kg (35 lb) on foot rope and with 11, 15 and 19 Nos. of 5″ dia alluminium alloy spherical floats, having buoyancy of 788 gms each (Satyanarayana, 1960) on head rope. Thus the experimental gear was operated with the approximate buoyancy-weight relationships at 0.55, 0.75 & 1.00 each in order to assess the optimum for its catching power.

Fishing experiments were conducted during 1968-69 fishing season between July 1968 to January 1969 in the depth ranges of 20 to 50m. within the grounds covered by latitudes and longitudes of 16° to 17° N and 82° E. Fish Tech No. 7, a wooden 12.16 m. (40′) trawler as described by Narayanappa et.al. (1968) was used for fishing operations. On each fishing day the experimental gear was operated with 0.55, 0.75 and 1.00 buoyancy-weight relationships. Initially 18.26 m. nylon net was used and later on 16.16 m. cotton net was used for conclusive observations.

Results

The results of the experimental fishing are shown in Tables 1 a & 1 b separately for each of the nets studied.

The catch rate, as is evident from the above tables, is found more with 0.75 buoyancy-weight relation for both the gear operated, followed by 0.55 and 1.00 buoyancy-weight relationships.

Discussion

Catch rate : The perusal of Table 1 a & 1 b indicate that the catch rate (i.e) catch

Table I a

Showing results of fishing experiments with 18.26 m. (60′) nylon two seam trawl.

Buoyancy-weight relationship.	0.55	0.75	1.00
Period of experimentation.	—	July to September	—
Depth range of fishing/ Warp lengths released	—	20 to 50, 110 - 250 m.	—
No. of strictly comparable hauls/ Trawling time.	—	25/25.00 hrs.	—
Average towing speeds.	—	2.00 to 2.20 knots	—
Total catch in kg.	2351.00	2726.50	1875.00
Catch/Trawling Hr. in kg.	94.04	109.06	75.00
Extreme range of catch rate - kg. per Tr. Hr.	31.0 to 184.0	30.0 to 266.0	14.0 to 200 0

TABLE I b

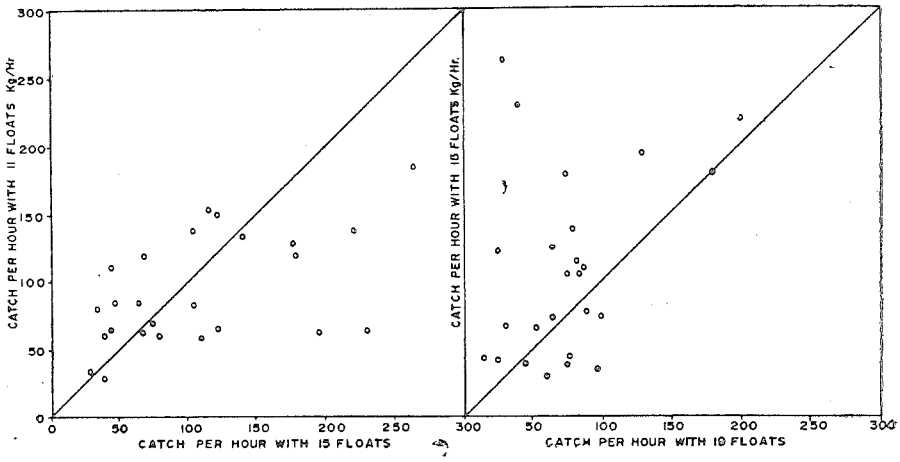
Showing results of fishing experiments with 16.16 m. (53') two seam cotton trawl.

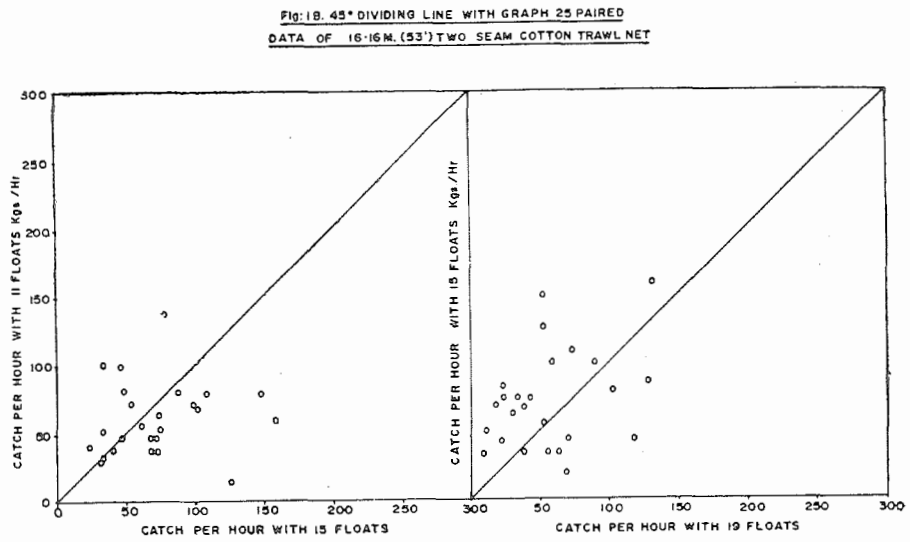
Buoyancy-weight relationship.	0.55	0.75	1.00
Period of experimentation.	—	September, '68 to January, '69	—
Depth range of fishing/ Warp length	—	20 to 50/110 to 250 m.	—
No. of strictly comparable hauls/ Trawling time.	—	25/25.00 hrs.	—
Average towing speed.	—	2.10 to 2.25 knots	—
Total catch in kg.	1592.00	1812.00	1440.50
Catch per Trawling Hr. in kg.	63.68	72.48	57.62
Extreme range of catch rate in kg/Tr. Hr.	11.00 to 137.0	25.0 to 161.0	10.0 to 133.0

of fish per one trawling hour with 0.75 B-W relation on 18.26 m. net is 16.50% more than whith 0.55 B-W relation, while the same is 32.08% more than that with 1.00 B-W relation. Similarly in the case of 16.16 m. net the catch rate with 0.75 B-W relation is found more by 13.89 and 25.78% than that of 0.55 and 1 00 B-W relationships. 45° dividing line graphs for 25 pairs of catch rate data from each of the nets, were drawn in text figure 1 a and 1 b.

These graphs pictorially represent two adjacent relations of 0.75 B-W relation for each of the nets, which clearly show that the number of cases within the 0.75 B-W relation area (i.e) middle, exeeds those lying on the 0.55, B-W relation towards its left and 1.00 B-W relation towards its right and indicate the superior catch rate of gear with 0.75 B-W relations than the other two. The weight frequency distribution of catch per haul also significantly indicated that the frequency of

FIG. 1A. 45° DIVIDING LINE GRAPH WITH 25 PAIRED DATA OF 18·28 m. (60') TWO SEAM NYLON TRAWL NET





higher catch rate with the net having 0.75 B-W relation in comparison with others was more.

Statistical treatment of the data was attempted by the analysis of variance technique and for analysis purpose, the catch per hour figures were converted to logarithmic values. Analysis with respect to catch rate, horizontal spread & tension was done separately for 18.26 m. (60′) and 16.16 m. (53′) nets and the results are presented in Table II a and II b respectively.

It could be seen from Table II a, that there is significant difference ($p \leq 05$) in the average horizontal spread as well as the catch per hour figures. For 18 26 m. net, the catch per hour of nets with different number of floats is also signifi-

TABLE II a

Analysis of Variance table for 18.26 m. net (60′)

Source.	ss	df	ms	F
Calch per Hour:				
Total	5.1038	74		
Between floats.	0 3775	2	0.1888	4.01*
Between replications.	2.4648	24	0.1027	2·18*
Error	2.2615	48	0.0471	
Horizontal spread:				
Total	1,321.24	74		
Between floats.	66.19	2	33.095	3.79*
Between replications.	835.77	24	34.824	3.98**
Error.	419.28	48	8.735	
Tension:				
Total	45,210.50	74		
Between floats.	235.50	2	117.75	0 23
Between replications.	21,127.16	24	880.29	1.77*
Error.	23,849.84	48	496.83	

TABLE II b

Analysis of Variance Table for 16.16 m. (53') net.

Catch per hour:	ss	df	ms	F
Total	4.8345	74		
Between floats.	0.2283	2	0.11415	2.54
Between replications.	2.4456	24	0.10196	2 25*
Error.	2.1606	48	0.04501	
Horizontal spread:				
Total	619.5025	74		
Between floats.	38.2962	2	19.1484	2.92
Between replications.	266.6684	24	11.1112	1.69
Error.	314.5379	48	6.5528	
Tension:				
Total	49,387.00	74		
Between floats.	895.50	2	447.75	0.78
Between replications	21,045.33	24	876.88	1.53
Error	27,446.17	48	571.79	

cant ($p. \leq 05$). The average logarithmic catch per hour of the nets fitted with 11, 15 and 19 floats is respectively 1.9322, 1.9543 and 1.7937 kg. In 16.16 m. net (Table IIb) all the three numbers of floats were having more or less same effect as no significant difference in average could be tracedout in catch per hour, horizontal spread and tension.

Satyanarayana et al (1970) have found that by fixing an additional float line over the usual head rope, the catch could be increased considerably and the B-W relationship of the above rigging is at 0.83 neglecting the weight of 10.4 m. length of 13 mm. dia. coir rope used for float line. The result of the present investigation is in confirmation with the above earlier finding, though from a small 30' mechanised boat. Thus it can reasonably be concluded that the 0.75 B-W relation appears to be optimum for the bottom trawls experimented, along this area. It also appears that by increasing the buoyancy further, the net is likely to lift off the bottom leaving scope for the escapement of fish below the foot rope or by decreasing the buoyancy, the net is likely to plough through the bottom causing considerable damage to the gear in dragging mud as is also noted by Dickson (1963).

Catch composition :

The catch was analysed to study the possible differences in their composition at the three relations, into three categories as 'A' -just off bottom, 'B' -very near bottom and 'C' - on the bottom fauna depending on their reported habitat and availability during the period of operation. The details of analysis are shown in Table II.

It is clear from the table that 'on the bottom' fauna are more in percentage with 0.55 B-W relation while percentage of category 'A' is more with 1.00 B-W relation, while 0.75 B-W relation landed more of very near bottom fauna. Inspite of this, the total catch of categories

TABLE III

CATCH COMPOSITION AT DIFFERENT RELATIONS IN BOTH THE NETS.

Type of net.		60′ Two Seam Nylon						53′ Two Seam Cotton					
Buoyancy/weight ratio.		0.55		0.75		1.00		0.55		0.75		1.00	
Catch composition.	Group of Fish.	Total catch (kg)	% of total.	Total catch (kg)	% of total	Total catch (kg)	% of total	Total catch (kg)	% of total.	Total catch (kg)	% of total.	Total catch (kg)	% of total.
Lactarious Upenoids Synagris Caranx Moon fish Silver bellies Trichiurs Clupids. Saurida	'A'	715	30.41	907	33.27	724	38.61	880	55.28	1023	56.46	876	60 83
Sciaenids Catfish Prawns Soles	'B'	839	35.69	1066.5	39.12	589	31.42	174	10.93	278	15.34	220	15.28
Skates & Rays Eels Miscellaneous	'C'	797	33-90	753	27.61	562	29.97	538	33.79	511	28.20	344.5	23.89
Total.		2351.0	100.00	2726.5	100.00	1875.0	100.00	1592.0	100.00	1812.0	100 00	1440 5	100.00

TABLE IV

Showing the Horizontal spread between Otter Boards and Warp resistance in each of the different combinations.

Name of gear and No. of floats attached.	Horizontal spread between O. B. in m.			Warp resistance in kg.		
	Average	Minimum	Maximum	Average	Minimum	Maximum
1. 18.26 m. two seam nylon net with:						
a) 11 floats	27.25	20.32	36 86	412.0	375.0	465.0
b) 15 floats	25.96	19.75	38.96	408.0	375.0	465.0
c) 19 floats	24.97	16.78	33.36	412.0	375.0	465.0
2. 16.16 m. two seam cotton net with:						
a) 11 floats	25.85	21.74	36.40	403.0	350.0	450.0
b) 15 floats	24.91	22.35	31.41	411.0	325.0	450.0
c) 19 floats	24.09	21.34	32.29	408.0	360.0	450.0

A and B is more with 0.75 B-W relation only.

Horizontal opening and warp resistance :

The horizontal opening between otter boards and the warp resistance in each of the cases with the three different relationships are shown in Table III.

Table III clearly reveal that the horizontal spread between otter doors was found more with 0.55 B-W relation and showed decreasing trend with increasing B-W relation thereby indicating the possible increase in the vertical spread of the mouth of the net. On the other hand the resistance of gear in water as recorded from the towing wire on board the vessel, showed more or less constant in all the three relations for both the nets which indirectly indicate that the mouth open area is more or less same.

Statistical analysis for horizontal spread and tension reveal as per Table II a & II b that in the case of 18.26 m. net there is significant difference in average horizontal spread and the values of the same for the nets with three different number of floats 11, 15 and 19 were respectively 27.25, 25.96 and 24.95 metres. Thus, it could be seen that 11 floats gave more horizontal opening compared to 15 and 19 floats. But there is no significant difference with 16.16 m. net.

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REFERENCES

Dickson, W. 1963 *Modern Fishing gear of the World-2.* Fishing news Limited, London. pp. 181-191.

Narayanappa, G., Narasimha Raju, D. A., & Satyanarayana, A. V. V. 1968 *I. P. F.C.* 13th. Session, Sec. III. pp. 450-455.

Satyanarayana, A. V. V., Narayanappa, G and Narasimha Raju, D. A. 1970 *Fishery Techhol. 7, (1).* pp. 23-32.

Satyanarayana, A. V. V., Kuriyan, G. K., and Nair, R. S. 1962 Proc. *I.P.F.C.* 10th Session. Sec. II. pp. 226-63.

Satyanarayana, A. V. V. 1960 *Indian.. J.. of Fish. 7 (2).* pp. 489-95.