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ON THE RELATIVE EFFICIENCY OF DIFFERENT SHAPED OTTER BOARDS

M. MUKUNDAN, A. V. V. SATYANARAYANA AND H. KRISHNA IYER
Central Institute of Fisheries Technology (Craft & Gear wing), Cochin-5.

Rectangular, Horizontal curved and oval otter boards were tested under identical fishing conditions and their relative efficiency ascertained on the basis of towing tension and the horizontal opening of the boards. While the tension in the warps with the different otter boards was not significant, the horizontal curved board gave increased lateral spread to the net.

INTRODUCTION

Size, shape, rigging and method of attachment of otter boards have constantly attracted the attention of Gear Technologists ever since the advent of this method of fishing and many theories have beeu propounded. Yakovliev (1955), Gaun-quoted by Dickson (1959), Walderhaug and Akre and Frey and Shole-quoted by Crewe (1963) studied the hydrodynamic properties of flat rectangular boards, while their efficacy in terms of attachment of the bridles were investigated by Takayama and Koyama (1959), Satyanarayana and Mukundan (1962) and Ben yami (1963). Takayama and Koyama (1961) further recorded that otter doors having height larger than the base are relatively more effective. Sevastinov (1955), Yakovliev (1955), Matrosov (1958), Scharfe (1959), Ben yami (1963) and Dale and Moller (1963) investigated the efficiency of the oval otter boards and Knake and Whiteleather (1944), Scharfe (1959), Suberkrub (1958) and Catasta (1959) conducted similar studies on doors having hydrofoil cross section. It is, however, significant to record that the majority of the above investigations were conducted either in a tunnel or testing tank with possibly the works of Scharfe (1959) and Ben yami (*op. cit.*) as the only exceptions. Therefore keeping in view the merits and demerits of otter doors of various types and shapes enquired into elsewhere, experiments to study the relative efficiency of three different types of boards under actual fishing conditions were undertaken by the present authors and the results obtained are embodied in this paper.

MATERIAL AND METHOD

The types of boards included in the study are (i) Flat rectangular (ii) Horizontal curved and (iii) oval with single slit.

The specifications of the different boards are showa in Table I and in Text Figs.: 1 – 3.

The horizontal curved boards used are similar to those used by Knake and Whiteleather *(op. cit.)* with slight modifications. The oval board with single slit was made by dimensionally reducing the door described by Matrosov *(op. cit.)* so as to suit the trawler as well as the prevailing fishing conditions. The same net was used with the 3 boards; size of the net being 12. 9 m (42. 5') described by Satyanarayana *et. al.* (1963).

The trawler used was a small one FISHTECH No VI, Length, 9. 75 m; HP, 37. The experiments were conducted in the sea off Cochin during the 1965-66 season, at 5-20 m depths with loose mud bottom.

In the experiments, however, specific depths were chosen namely 10 m, 15m and 20 m and the length of warp correspondingly released were 60 m, 80 m and 110 m. The first series of experiments were conducted at a towing speed of 2 knots which was later raised to 2. 5 knots. The method of experimentation was as follows.

At 10 m depth, hauls were made with each type of board keeping the speed and scope - ratio constant for a days operation. The operations of the boards were arranged at random and data for 7 comparable hauls recorded. The experiments were similarly repeated at the other depths. In the second series of experiments. the method adopted was the same but the speed was increased to 2. 5 knots.

The horizontal spread between otter boards and the tension in the warps during each haul were recorded. The spread between ahe doors was measured by the method suggested by Ben yami (1959) and Deshpande (1960). The tension in the warps was estimated by the Tension meter described by Satyanarayana and Nair (1965).

RESULTS

The horizontal spread ant the tension in the warps measured are given in Tables II and III.

The average horizontal opening and towing tension noted for each combination of net and otter boards under each depth and speed are given in Table IV.

DISCUSSION

Horizontal opening:

When the curved boards were used, the horizontal spread was found to be relatively high as compard to the other two. The results of the statistical analysis of the date are given in Table V, which will show that the variation between otter boards, towing speeds and scope-ratio are highly singnificant (0.1% level).

However, the variation between replicates is not singnificant indicating the availability of more or less constant fishing conditions during the period of experimentation. Among first order interaction, only one (i. e. speed x scope-ratio) interaction is significant (1% level). This interaction may be due to the effect of speed on scope-ratio (Crewe *op. cit.*). None of the second order interaction is significant at 5% level as evidenced from Table V.

In order to examine which among the three otter boards, gives the maximum horizontal opening, Table II has been rearranged by taking the horizontal opening given by tbe three otter boards under each scope-ratio and towing speed separately. The analysis of variances of these are given in Table VI.

From Table VI, it would be seen that the variation in spread between otter boards are highly significant under each scope-ratio and towing speeds except at scope-

TABLE I GENERAL SPECIFICATIONS OF OTTER BOARDS EXPERIMENTED

TYPE	Length in cms.	Breadth in cms.	Weight in Kgs.	Area in sq. metres.	Aspect Ratio	Angle of attachment of bridle
Flat rectangular board	101.60	50.80	35	0.5161	0.5	37°
Horizontal curved board	101	50.50	35	0.5454	0.54	30°
Oval single slitted board	100	60.00	35	0.4037	0.80	42°

TABLE II HORIZONTAL OPENING OF DIFFERENT PAIRS OF OTTER BOARDS OPERATED UNDER DIFFERENT SCOPE RATIOS AND SPEEDS

Towing speed in Knots.	Replication	Horizontal opening in Metres between								
	Depth/Warp Ratio in Metres >	Flat Rectangular Board			Horizontal curved board			Oval single slitted board		
		10/60	15/80	20/110	10/60	15/80	20/110	10/60	15/80	20/110
2	1	10.30	9.17	11.04	11.13	11.00	11.64	9.50	8.62	10.69
	2	9.30	10.47	11.64	11.32	11.00	11.64	9.80	9.17	10.08
	3	10.02	9.60	10.44	11.53	10 65	12 25	10.05	9.12	10.08
	4	10 02	9.60	11.04	10.02	10.66	12.25	9.36	9.34	10.03
	5	10.02	10.04	10 44	11.19	10.04	12.25	9.69	7.74	10.08
	6	10.47	10.04	11.04	11.64	11.56	12.25	9.69	9.17	10.03
	7	10.85	10.04	11.04	11.51	11 09	12.25	9.69	9.68	10.08
2.5	1	10.15	11.09	12.84	11.04	12.22	12.31	9.36	10.04	9.84
	2	10.99	10.04	10.69	11.04	11.79	13.80	9.36	10.47	12.25
	3	10.99	10.21	11.98	11.43	11.53	13 20	9.82	9.60	10.65
	4	10.99	10.48	12.25	11.25	11.09	11.64	8.84	9.60	11.04
	5	10.15	10.65	11.28	11.04	11.79	12.25	8.84	10.04	10.09
	6	10.02	10.65	11.64	11.25	11.79	12.84	8.73	9.60	10.44
	7	10.02	10.70	12.25	11.04	12.04	12.31	8.94	11.09	10.44

TABLE III TOWING RESISTANCE OF DIFFERENT OTTER BOARDS OPERATED UNDER DIFFERENT SCOPE RATIOS AND SPEEDS

Towing speed in knots	Replication	Towing tension in Kgs. with								
	Depth/Warp Length in Metres >	Flat Rectangular Board			Horizontal curved board			Oval single slitted board		
		10/60	15/80	20/110	10/60	15/80	20/110	10/60	15/80	20/110
2	1	295	361	303	242	312	361	264	312	333
	2	254	371	322	240	322	342	212	361	333
	3	264	342	284	256	401	245	223	236	361
	4	294	342	342	326	431	361	264	371	284
	5	293	352	284	254	371	245	210	312	361
	6	274	284	342	283	264	361	194	381	284
	7	210	332	320	284	303	352	254	361	310
2.5	1	264	318	332	294	371	303	336	342	294
	2	312	327	303	284	293	331	318	303	371
	3	274	312	361	333	322	303	274	361	303
	4	293	284	332	312	245	312	401	227	284
	5	371	294	264	332	322	312	382	254	245
	6	303	303	323	310	312	361	341	236	284
	7	332	322	294	294	303	352	323	342	303

TABLE IV AVERAGE HORIZONTAL OPENING AND TOWING TENSION UNDER DIFFERENT OPERATING CONDITIONS

Depth/warp length in meters	Towing speed in knots	Average horizontal opening in metres			Average towing tension in Kgs. (nearest)		
		Flat boards	Curved boards	Oval boards	Flat boards	Curved boards	Oval boards
10/60	2.0	10.14	11.16	9.69	269	256	231
	2.5	10.47	11.16	9.13	307	308	339
15/80	2.0	9.85	10.86	8.93	339	343	333
	2.5	10.54	11.75	10.06	308	309	295
20/110	2.0	10.94	12.07	10.14	313	323	323
	2.5	11.83	12.62	10.68	315	325	298

TABLE V. ANALYSIS OF VARIANCE OF HORIZONTAL OPENING

Source of variation	S. S.	D. F.	M. S.
Total	143.5045	125	
Between otter boards (O. B.)	70.1717	2	35.0859 **
Between speeds (S. P.)	7.4605	1	7.4605 **
Between scope ratio (S. R.)	32.1667	2	16.0834 **
Between replicates (R. P.)	2.4795	6	0.4133
O.B × S.P	0.4401	2	6.2201
O.B × S.R.	0.4459	4	0.1115
O.B × R.P.	2.9411	12	0.2451
S.P × S.R.	5.4533	2	2.7267 *
S.P × R.P.	1.1584	6	0.1931
S.R × R.P.	2.2383	12	0.1866
O.B × S.P. × S.R.	1.5107	4	0.3777
O B × S.P. × R.P.	2.1679	12	0.1807
O.B × S.R. × R.P.	3.3591	24	0.1493
S.P × S.R. × R.P.	3.7232	12	0.3101
O.B × S.R. × S.P. × R. P.	7.881	24	0.3245

* Denotes significance at 1% level.
** Denotes significance at 0.1% level

ratio of 20/110 and speed 2.5 knots. On comparing their means it can be observed that the curved board gives significantly (5% Level) higher lateral opening in comparison with the other two.

Towing resistance:

Since the gear and fishing conditions are similar, the difference in tension may be attributed to the difference in the otter boards used. From Table IV, it would be seen that though the resistance of otter boards operated with gear do not show appreciable difference, the oval otter boards in general gave lesser resistance, while the curved board recorded more and the flat one coming in between. The analysis of variance on the resistance data is given in Table VII.

It can be seen from the table that the variation in tension between otter boards, between speeds and between replications are not singnificant at 5% level. But the variation between scope ratios is highl significant (0.1% level). Also as in the case of horizontal opening the first order interaction scope-ratio x speed, shows a very high significant variation (0.1% level). This may be due to the effect of speed on scope-ratio. It is difficult to interpret the highly significant second order interaction between OB X SR X SP and a possible reason for its significance may be due to the high interacting effect of speed and scope ratio.

Summarising this communication incorporates the results of comparative fishing experiments conducted off Cochin with (i) Rectangular (ii) Horizontal curved and (iii) oval otter boards. The experiments were conducted at three different depths and at two different speeds. The towing resistance on the warps and horizontal opening of the boards were taken as indices in evaluating the efficiency and the following results were

TABLE VI ANALYSIS OF VARIANCE OF HORIZONTAL OPENING UNDER DIFFERENT SCOPE RATIOS AND SPEEDS

Towing speed		200 Knots						2.5 Knots					
Scope ratio		10/60		15/80		20/110		10/60		15/80		20/110	
Source of variation	Degrees of freedom	S. S.	M. S.	S. S.	M. S.	S. S.	M. S.	S. S.	M. S.	S. S.	M. S.	S. S.	M. S.
Total	2	11.8610	—	17.0593	—	14.9604	—	19.1892	—	13.9427	—	23.1716	—
Between otter boards	2	8.3774	4.1887	12.3356	6.1678	13.0603	6.5302	16.0641	8.0321	10.5698	5.2849	13.3100	6.6550
Residual	18	3.4836	0.1935	4.7237	0.2642	1.9001	0.1056	3.1251	0.1736	3.3729	0.1872	9.8626	0.5479
Critical difference		0.4941		0.5754		0.3651		0.4679		0.4877		0.8310	
		Mean Horizontal opening											
Flat board		10.1400		9.8514		10.9543		10.4729		10.5457		11.8471	
Curved board		11.1914		10.8571		12.0757		11.1557		11.7500		12.6214	
Oval board		9.6829		8.9814		10.1529		9.0557		10.0629		10.6843	

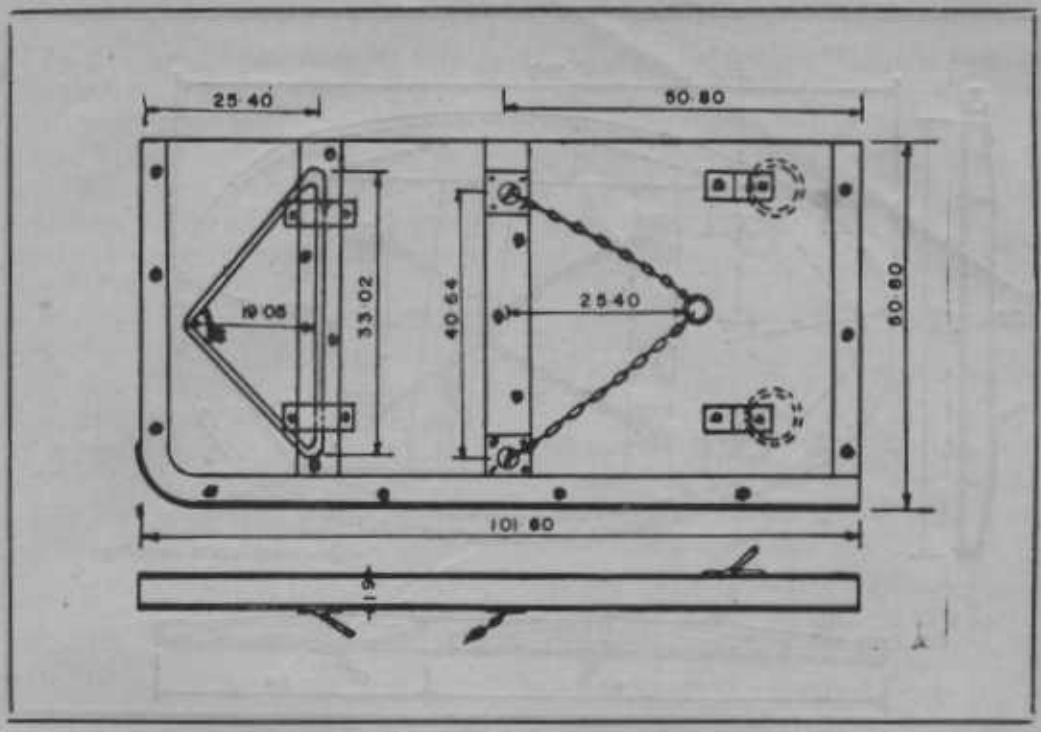

Fig I Design details of common flat rectangular otter board

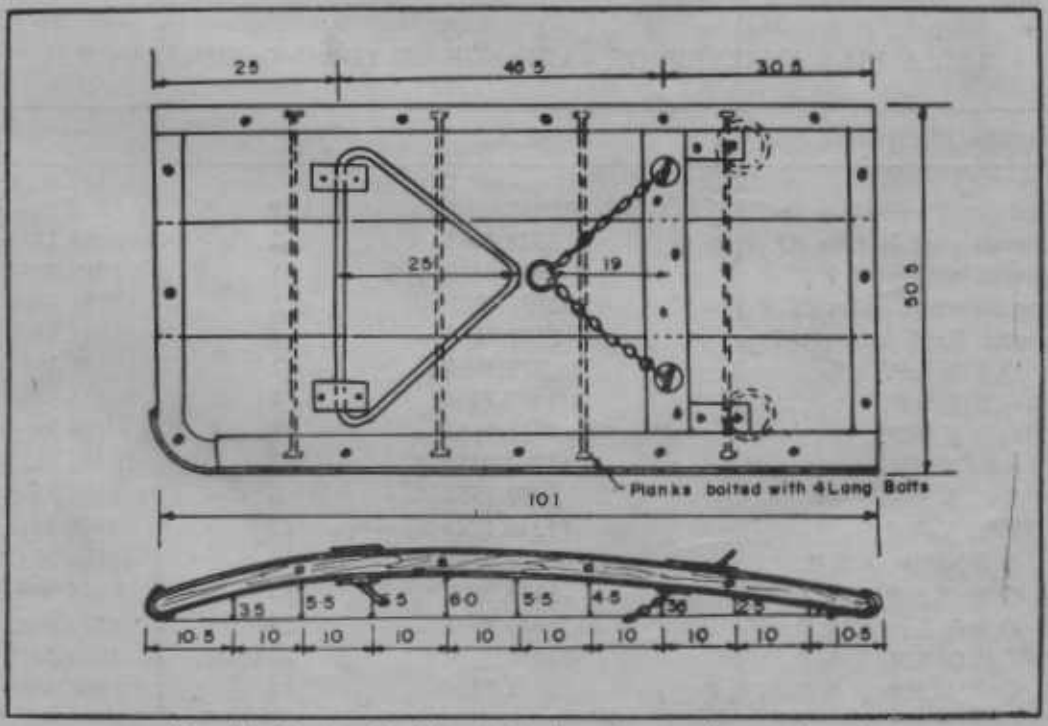

Fig II Design details of Horizontal curred otter board

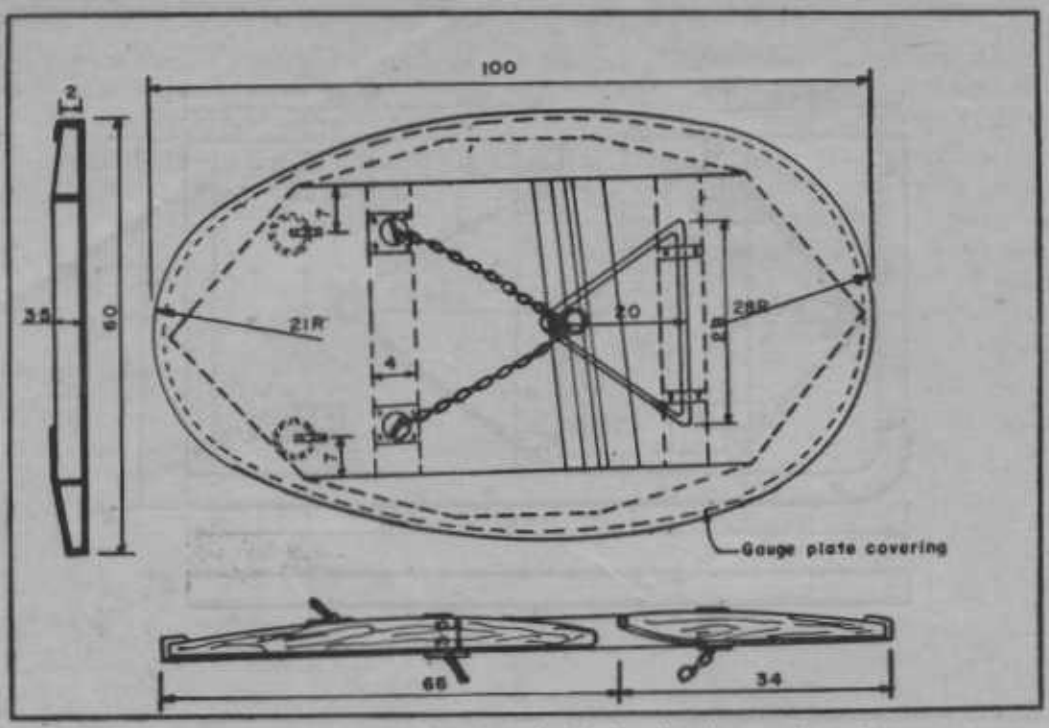

Fig 3 Design details of oval, single slitted otter board

TABLE VII. ANALYSIS OF VARIANCE OF TOWING RESISTANCE.

Source of variation	S. S.	D. F.	M. S.
Total	255033.6588	125	
Between otter boards (O. B.)	1328.4445	2	664.2223
Between speeds (S. P.)	1913.3413	1	1913.3413
Between scope ratios (S. R.)	32707.4921	2	16353.7461 *
Between Replicates (R. P.)	2501.8255	6	416.9709
O.B X S.P.	773.3968	2	386.6984
O.B X S.R.	1503.7936	4	375.9484
O.B X R.P.	4827.5555	12	402.2963
S.P. X S.R.	56912.8254	2	28456.4127 *
S.P. X R.P.	6989.1587	6	1164.8598
S.R. X R.P.	15319.1745	12	1609.9312
O.B X S.P. X S.R.	40805.1746	4	10201.2937 *
O.B. X S.P. X R.P.	5603.2698	12	466.9392
O.B X S.R. X R.P.	36649.8731	24	1522.9113
S.P. X S.R. X R.P.	22456.5080	12	1871.3757
O.B. X S.P. X S.R. X R.P.	20841.8254	24	868.4083

* Denotes significance at 0.1% level.

observed. The horizontal opening (significant at 5% level) of the net operated with curved otter board was high when compard with the other two. In general the oval board gave lesser resistance while the curved board offered more and the flat coming in between. The variation in tension between the boards, speeds and replicates were not significant at 5% level.

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