Studies on Optimisation of Bridle Lengths for Demersal Trawls

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Experiments were carried out to standardise the length of bridles in a 32 m large mesh demersal trawl and a 25 m high opening demersal trawl. Based on the comparative catch rates obtained, double bridles of 30 m length was adjudged a better choice for a 25 m high opening trawl whereas, 20 m bridles were found to improve the performance of 32 m large mesh trawl.

Demersal trawls depend upon the area of sea bed swept for their effectiveness in fish capture. The importance of bridles and sweeps in improving the performance of trawl system by herding the fish in the direction of trawl from wide swept areas has long been recognised (Bagenal, 1958; Scharfe, 1959; Chapman, 1964; Crew, 1964; Blaxter *et al.*, 1964; Narayanappa, 1968; Wardle, 1976; Joseph Mathai *et al.*, 1984; Fridman, 1986). The studies carried out at research centre of CIFT, Veraval in standardising bridle lengths of two demersal trawls are presented in this paper.

Materials and Methods

Fishing experiments were carried out with the tested designs of a 32 m large mesh trawl and a 25 m high opening trawl described by Kunjipalu *et al.* (1979) in order to standardise the length of bridles in these demersal trawls. Double bridles of 10 m, 20 m and 30 m in length made of 18 mm dia HDPE rope were used and data recorded keeping the duration of the haul fixed as one hour. Flat rectangular otter boards of the size 1524 x 762 mm weighing 100 kg each and constructed in wood and steel were employed throughout the study. Fishing operations were carried out during day time at depths varying from 20 to 45 m from the research vessel Fishtech No. 8 which is of 15.2 m LOA fitted with 165 HP engine. The towing speed was maintained at 2.5 knots at 1250/1300 rpm engine output. The gear rigged with different bridle lengths to be tested were operated in a rotational sequence so as to give equal chances maintaining identical depth, duration of the tow and engine rpm during each set of comparative experiments.

Results and Discussion

The particulars of the comparative fishing experiments conducted with different bridle lengths in the case of 25 m high opening demersal trawl and 32 m large mesh demersal trawl are furnished in Table 1. The catch details and the percentage composition of the catch by 25 m high opening trawl and 32 m large mesh trawl are furnished in Table 2. The results of analysis of variance of total catch and component groups of the 25 m high opening trawl are furnished in Table 3. Similar data regarding the 32 m large mesh trawl are given in Table 4.

In 25 m high opening trawl the mean catch rate was maximum when rigged with 30 m bridles, realising 90.82 kg /h which was 38.5% and 19.8% higher than 10 and 20 m bridles respectively. In the case of cephalopods and miscellaneous fishes better catch rate were obtained with 30 m bridles than 20 m whereas it was lower in the case of ribbon fish, *Lactarius* sp. and quality fishes. Catch rates were consistently higher for all species,

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Table 1. *Particulars of comparative fishing operations with three different lengths of bridles*

Particulars	25 m high opening trawl with double bridles			32 m large mesh demersal trawl with double bridles		
	10 m	20 m	30 m	10 m	20 m	30 m
Fishing grounds	Off Veraval, Gujarat within 20 to 45 m depth					
Number of hauls	37	37	37	36	36	36
Towing time, h	1	1	1	1	1	1
Towing speed	2.5 knots at 1250/1300 rpm engine output					
Mean warp tension, kg	656.9	664.1	665.6	674.4	679.8	679.2
Total catch, kg	2424	2814	3373	1381	1419	1212

Table 2. *Catch details and percentage composition*

(a) 25m high opening trawl	Length of bridles					
	10 m catch kg/h	%	20 m catch kg/h	%	30 m catch kg/h	%
Quality fishes (pomfret, seer, silver bar, *Pellona* sp. eel, large polynemids etc. and prawns)	1.53	2.35	2.45	3.23	1.97	2.17
Ribbon fish	11.88	18.25	15.96	21.06	12.17	13.40
Cephalopods	3.35	5.14	4.24	5.59	4.68	5.15
Lactarius sp.	1.11	1.70	2.11	2.78	1.54	1.69
Miscellaneous fish	47.22	72.54	51.04	67.34	70.46	77.58
Total catch	65.09	100.00	75.80	100.00	90.82	100.00
b) 32 m large mesh demersal trawl						
Quality fishes (pomfret, seer, silver bar and prawn)	1.11	2.89	1.55	3.93	0.94	2.79
Ribbon fish	12.25	31.94	6.23	15.81	8.41	24.97
Cephalopods	6.40	16.69	11.25	28.55	9.53	28.30
Miscellaneous fish	18.59	48.48	20.33	51.71	14.79	43.93
Total catch	38.35	100.00	39.41	100.00	33.67	100.00

Table 3. *Analysis of variance of total catch component groups of 25m high opening trawl*

	Source	ss	df	ms	F
ANOVA of total catch					
	Total	15.4338	113	-	-
	Bridles	0.1195	2	0.05975	1.806
	Days	12.8714	37	0.34788	10.539**
	Error	2.4479	74	0.03308	
ANOVA of miscellaneous catch					
	Total	41.5623	113	-	-
	Bridles	0.0432	2	0.02160	2.720
	Days	35.6438	37	0.96335	12.133**
	Error	5.8753	74	0.07940	-
ANOVA of other fish					
	Total	8.4281	11	-	-
	Bridles	0.0471	1	0.02355	0.894
	Days	6.4325	37	0.17385	6.603**
	Error	1.9485	74	0.02633	-
ANOVA of quality fish					
	Total	10.8824	113	-	-
	Bridles	0.1652	2	0.0826	2.000
	Days	7.6588	37	0.2070	5.012**
	Error	3.0584	74	0.0413	-
ANOVA of sciaenids					
	Total	24.7472	11	-	-
	Bridles	0.1009	2	0.05045	0.814
	Days	20.0622	37	0.54222	8.753**
	Error	4.5841	74	0.06195	-
ANOVA of cephalopods					
	Total	17.4247	113	-	-
	Bridles	0.0886	2	0.0443	0.993
	Days	14.0363	37	0.3794	8.507**
	Error	3.2993	74	0.0446	-
ANOVA of *Lactarius* sp.					
	Total	14.5691	113	-	-
	Bridles	0.1178	2	0.0589	1.272
	Days	11.0277	37	0.2980	6.436**
	Error	3.4236	74	0.0462	-
ANOVA of ribbon fish					
	Total	32.9672	113	-	-
	Bridles	0.1988	2	0.0994	0.702
	Days	22.2873	37	0.6024	4.2554*
	Error	10.4811	74	0.1416	-

** Indicates significance at 1% level

Table 4. *Analysis of variance of total catch and component groups of 32 m large mesh trawl*

	Source	ss	df	ms	F
ANOVA of total catch					
	Total	17.5173	107	—	—
	Bridles	0.2765	2	0.13823	1.311
	Days	9.8599	35	0.28171	2.672**
	Error	7.3809	70	0.10544	—
ANOVA of miscellaneous fish					
	Total	23.8831	107	—	—
	Bridles	0.8557	2	0.42785	3.843*
	Days	15.2357	35	0.43531	3.911**
	Error	7.7917	70	0.11131	—
ANOVA of other fish					
	Total	4.2773	107	—	—
	Bridles	0.0394	2	0.0197	0.523
	Days	1.5982	35	0.0457	1.212
	Error	2.6397	70	0.0377	—
ANOVA of quality fish					
	Total	8.8599	107	—	—
	Bridles	0.0423	2	0.02115	0.712
	Days	6.7379	35	0.19251	6.480**
	Error	2.0797	70	0.02971	—
ANOVA of sciaenids					
	Total	3.7024	107	—	—
	Bridles	0.1207	2	0.06035	2.789
	Days	2.0672	23	0.05906	2.729**
	Error	1.5147	70	0.02164	—
ANOVA of cephalopods					
	Total	23.0363	107	—	—
	Bridles	0.4361	2	0.2182	2.969
	Days	17.4531	35	0.4987	6.785**
	Error	5.1468	70	0.0735	—
ANOVA of ribbon fish					
	Total	31.0490	107	—	—
	Bridles	0.0131	2	0.0067	0.059
	Days	24.3632	35	0.6961	7.304**
	Error	6.6724	70	0.0953	—

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

groups, quality fishes and miscellaneous catch with 30 m bridles compared to 10 m bridles. 32 m large mesh trawl was found to be most efficient when rigged with 20 m bridles realising 39.4 kg/h followed by 10 m bridles with 38.4 kg/h and 30 m bridles with 33.6 kg/h. Highest catch rate for cephalopods and the quality fishes consisting of pomfrets, seer, silver bar and prawns was obtained with 20 m bridles. The miscellaneous catch was highest in 32 m trawl with 20 m bridles followed by 10 m bridles. The ribbon fish landings were higher in the case of 10 m bridles followed by 30 m bridles due to chance catch at a single instance. In case of miscellaneous catch the efficiency of the gear was significantly higher when rigged with 20 m bridles, compared to 30 m bridles. Increase in miscellaneous catch obtained by using 20 m bridles was 9.6 and 37.8% respectively, compared to 10 m and 30 m bridles. The least significant difference at 5% level for miscellaneous catch was 0.1573 and the mean of logarithm of the catch of 10, 20 and 30 m bridles lengths were 1.0148, 1.0681 and 0.8583 respectively.

Several demersal species excluding crustaceans are known to respond to herding by sweeps and bridles crossing the sea bed at a small lead in angle. Fish also respond to the noise and vibration of the otter boards and to the clouds of mud and sand generated by them. The herding effect is maximised when the trail of the sand and the mud cloud is placed in alignment along the bridles and the sweeps (Main & Sangster, 1981 and Thompson & Ben Yami, 1984). Optimum lengths of the bridles for any given trawl system would be that which will sweep the maximum sea bed area and also maintain a correct bridle angle for enhanced herding effect.

Based on the comparative catch rate obtained, double bridles of 30 m in length was adjudged a better choice for 25 m high opening trawl, whereas 20 m bridles were found to improve the performance of 32 m large mesh demersal trawl.

The authors wish to express their thanks to Shri M.R. Nair, Director, Central Institute of Fisheries Technology, Cochin for permission to publish the paper and to Shri P.A. Panicker, Project Leader for guidance from time to time. They are also thankful to Shri H. Krishna Iyer, Head of the Statistical Division for statistical analysis of the data.

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