Studies on the Effect of Colour of Webbing on the Efficiency of Gill Nets for Hilsa and Pomfret off Veraval

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Influence of colour of webbing on the catch of gill nets for commercially important hilsa *(Hilsa toli* and *Hilsa ilisha)* and pomfret *(Pampus argenteus* and *Parastromateus niger)* has been studied in the coastal waters off Veraval. Among the colours tested yellow and white are recommended for hilsa and pomfret gear. Influence of fishing depth, surface water temperature and turbidity on catch are also discussed.

Colour of the net influences the visibility and consequent response of the fish (Nomura, 1959; Yoshimuta & Mitsugi. 1963; Nambiar, 1973; Blaxter *et al.,* 1964). In clear water visibility is a primary factor for efficiency of the gear (Steinberg, 1964). Further, colour influence is species dependent (Koike, 1968; Kanda *et al.,* 1958; Molin, 1961; Nomura, 1961; Jester, 1963; Nambiar *et al.,* 1970a, b; George *et al.,* 1975; Narayanappa *et al.,* 1977 and Rao *et al.,* 1980).

Panicker *et al.* (1978) have studied the selectivity of gill nets with reference to twine size, mesh size and ratio of take-up for hilsa and pomfret, the two foremost gillnet fishery along the Saurashtra Coast. The significance of colour for this gear and the influence of hydrographic parameters are dealt with in this communication.

Materials and Methods

Experimental fishing was conducted using white, yellow, orange, blue, brown and green gill nets of 50 mm, and 70 mm bar meshes. Nylon twine of 210D/2/3 was used for 50 mm and 60 mm bar mesh nets and 210 D/3/3 size for 70 mm bar mesh nets.

Dyes used were xylene fast yellow, lanasyn orange, nylosan blue, lanasyn brown and nylosan green manufactured by M/s Sandoz (India) Ltd. For white nets undyed material was used. Webbing to be dyed was scoured for 20 minutes in a solution of 1% neutral soap and 1% ammonia kept at 60°C, washed in freshwater and dried in shade. Dye-bath was prepared by making a 0.1% solution of dye and adding acetic acid to get a pH of 3.0–4.0. The volume of dye-bath was maintained at approximately ten times the material to be dyed. Dye-bath was heated to 60°C before introducing the webbing and then heated to boil. After 30 min the material was taken out, washed and dried.

Design details of the nets are given in Table 1. White, yellow, orange, blue, brown and green nets of 50 mm, and 70 mm bar mesh were arranged sequentially and the sequence was repeated. Two units of each colour were used for 50 mm and 60 mm bar mesh and three units each for 70 mm bar mesh to form a fleet of 42 units. Fishing was conducted during day time in the depth range of 22-31 m off Veraval on the Saurashtra Coast. Eighty two viable observations were taken during December, 1978 to May, 1981. Measurements of surface water temperature, fishing

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Table 1. *Design details of gill nets used*

Mesh size bar (mm)	Twine size	Material	Number of meshes in length	Number of meshes in depth	Horizontal hanging coefficient
50	210D/2/3	Nylon	600	50	0.50
60	210D/2/3	Nylon	500	50	0.50
70	210D/3/3	Nylon	430	42	0.50

Hung length, m	Hung depth, m	Head rope and foot rope	Specification of floats	Number of floats per shot	Specification of sinkers	Number of sinkers per shot
30	4.30	HDPE 6 mm	Foam plast 150 x 20 mm 10 mm hole, extra-buoyancy: 160 g each	5–6	Cement: sand (1:3) 105 x 35 mm with 10 mm whole wt. 500 g each	4–5
30	5.16	,,	,,	6–7	,,	5–6
30	5.00	,,	,,	6–7	,,	5–6

depth and extinction coefficient were taken to ascertain their influence on the catching efficiency of the gear. Extinction coefficient (EC) was computed from Secchi disc reading using the relationship, 1.7/D, where 'D' is the depth in meters at which Secchi disc just disappears from sight.

To compare the efficiency of nets, catches were worked out for the same areas of each net on each day. Days on which there was no catch by any net were omitted. To compare the efficiency, analysis of variance was carried out for the number and the weight of fish caught. The analysis of variance was also done to the logarithmic values of the number and weight obtained after adding unity to each observation, as there were 'o' values. To confirm the results, the non-parametric Friedman's test as given by Seigel (1956) was also applied.

Results and Discussion

A total of 545 hilsa weighing 311.2 kg. and 265 pomfret with a weight of 102.7 kg. were landed by the different gill nets (Table 2). Comparison of the mean catches has been done both in terms of number and weight of fish caught, separately for hilsa and pomfret using analysis of variance. (Tables 3 and 4). Inspection of all differences between pairs of means for hilsa and pomfret separately are given in Tables 5 and 6.

Effect of colour of webbing with respect to hilsa catches

Analysis of variance for hilsa showed that the difference among colours as highly significant (Table 3) based on 77 comparable set of observations. The analysis of original as well as logarithmic values showed the same result, both in terms of number and weight. Application of the non-parametric Friedman's test also confirmed the result. The test statistic T in this case (which is a chi-square with 5 degrees of freedom) worked out to 43.17**which is highly significant ($p < 0.005$). The result presented is for the numbers caught. Same conclusion could be drawn from weight also. The next step was to find out which pairs of differences

Table 2. *Catch of hilsa and pomfret in different coloured gill nets*

Colour of gill nets	Hilsa			Pomfret		
	Number	Weight, kg	CPUE, kg/1000 m^2	Number	Weight, kg	CPUE, kg/1000 m^2
White	102	54.850	0.753	65	27.450	0.377
Yellow	181	100.200	1.309	51	19.600	0.256
Orange	67	37.400	0.632	29	12.250	0.207
Blue	60	32.800	0.486	29	11.300	0.167
Brown	79	50.800	0.785	53	17.850	0.276
Green	56	35.100	0.604	38	14.200	0.244
Total	545	311.150	0.780	265	102.650	0.257

Table 3. *Analysis of variance of hilsa catches*

a) Analysis of number of fish caught (Analysis of the logarithm of numbers in brackets)

Source	S.S.	D.F.	M.S.
Total	1,885.5305 (34.7956)	461 (461)	
Between gears	97.4942 (3.0213)	5 (5)	19.4988 (0.6043) Highly significant
Between days	1,035.7734 (13.6428)	76 (76)	13.6286 (0.1795) Highly significant
Error	752.2629 (18.1315)	380 (380)	1.9796 (0.0477)

b) Analysis of weight of fish caught (Analysis of the logarithm of weight in brackets)

Total	564.2398 (19.5778)	461 (461)	
Between gears	26.9263 (1.3824)	5 (5)	5.3853 (0.2765) Highly significant
Between days	279.8144 (7.5003)	76 (76)	3.6818 (0.0987) Highly significant
Error	257.4991 (10.6951)	380 (380)	0.6776 (0.0281)

Table 4. *Analysis of variance of pomfret catches*

a) Analysis of number (Analysis of the logarithm of number in brackets)

Sources	S.S.	D.F.	M.S.	
Total	788.8320 (18.5750)	329 (329)		
Between gears	14.4847 (0.7202)	5 (5)	2.8969 (0.1441)	Highly significant
Between days	513.8187 (8.0784)	54 (54)	9.5152 (0.1496)	Highly significant
Error	260.5286 (9.7764)	270 (270)	0.9649 (0.0362)	

b) Analysis of weight (Analysis of the logarithm of weight in brackets)

Total	97.5357 (6.1742)	329 (329)		
Between gears	2.4789 (0.2155)	5 (5)	0.4958 (0.0431)	Highly significant
Between days	46.2499 (2.3777)	54 (54)	0.8565 (0.0440)	Highly significant
Error	48.8069 (3.5810)	270 (270)	0.1808 (0.0133)	

Table 5. *Inspection of all differences between pairs of means (weight after log transformation-Hilsa)*

	Means	Differences between pairs				
		$\bar{X}$-0.1283	$\bar{X}$-0.1429	$\bar{X}$-0.1677	$\bar{X}$-0.1717	$\bar{X}$-0.1867
Yellow	0.2969	0.1686* (0.0770)	0.1540* (0.0738)	0.1292* (0.0694)	0.1252* (0.0635)	0.1102* (0.0529)
White	0.1867	0.0584 (0.0738)	0.0438 (0.0694)	0.0190 (0.0635)	0.0150 (0.0529)	
Brown	0.1717	0.0434 (0.0694)	0.0288 (0.0635)	0.0040 (0.0529)		
Orange	0.1677	0.0394 (0.0635)	0.0248 (0.0529)			
Green	0.1429	0.0146 (0.0529)				
Blue	0.1283					

* Differences concluded significant

Table 6. *Inspection of all differences between pairs of means (weight after log transformation-Pomfret)*

	Means	Differences between pairs				
		X-0.0634	$\bar{X}$-0.0832	$\bar{X}$-0.0883	$\bar{X}$-0.1013	$\bar{X}$-0.1079
White	0.1459	0.0825* (0.0626)	0.0627* (0.0599)	0.0576* (0.0564)	0.0446 (0.0516)	0.0380 (0.0430)
Yellow	0.1079	0.0445 (0.0599)	0.0247 (0.0564)	0.0196 (0.0516)	0.0066 (0.0430)	
Brown	0.1013	0.0379 (0.0564)	0.0181 (0.0516)	0.0130 (0.0430)		
Orange	0.0883	0.0249 (0.0516)	0.0051 (0.0430)			
Green	0.0832	0.0198 (0.0430)				
Blue	0.0634					

* Differences concluded significant

were significant among all paired differences. For this, inspection of all differences between pairs of mean catches based on Hartyly's sequential variation of Q-method as given by Snedecor & Cochran (1968) was carried out. The comparison is shown in Table 5. The means are given in descending order of magnitude in the second column. Paired differences are given in the other columns. The differences between means required for 5% significance is given in brackets. The asterisk marks show that the differences are significant. The comparison on the basis of number and weight both for orginal and logarithmic values showed the same result. The yellow coloured net is significantly different in its efficiency when compared with all other nets while among other coloured nets there is no significant difference.

Effect of colour of webbing with respect to pomfret catch

For pomfret, 55 comparable observations were available. The analysis of variance showed significant differences among the mean catches (Table 4), both for original and logarithmic values. The transformed data showed the difference among colours to be highly significant. Similarly, as in hilsa, analysis of number and weight showed the same result in pomfrets. The non-parametric Friedman's test also confirmed the same result, T being 13.65*, which is significant at 5% level ($p<0.025$) (same conclusion could be drawn from weight also). Inspection of all differences between pairs of means was carried out as done in hilsa and the comparison on the basis of logarithmic values of weight is given in Table 6. The difference between white and blue nets was found to be significant, both in terms of number and weight on the basis of original and logarithmic values. The transformed data on weight showed the differences white-blue, white-green and white-orange also to be significant. The untransformed data on weight showed the differences white-blue and white–orange to be significant and white–green to be almost equal to the significant value. The transformed value of numbers showed, the difference white–blue to be significant and white–green and white–orange to be just significant, the differences in the last two being almost equal to the significant value. All comparisons conclude that the difference white–blue is significant.

Influence of surface water temperature, fishing depth and turbidity

The range of the depth of operation was 22–31 m and surface water temperature ranged from 22.5°C–28.5°C. No significant correlation was evident between fish catch and temperature or depth of operation. Extinction coefficient, ranged from 0.188 to 1.700. Correlation coefficient between extinction coefficient and catches of hilsa ($r = 0.2848$) and pomfret ($r = 0.1172$) was not found to be significant. This shows that extinction coefficient is not linearly related to either hilsa or pomfret catches within the observed range. But the existence of an exponential relationship of the form $Y = 2.44\ e^{0.92X}$ where Y = catch in numbers and X = extinction coefficient was evident in the case of hilsa, correlation coefficient between natural logarithm of catch and extinction coefficient being significant for hilsa ($r = 0.3347$*). For pomfret the corresponding correlation coefficient ($r = 0.2955$) was not significant perhaps, due to interference of seasonal and spacial variations in the abundance of fish.

As yellow and white coloured nets were found to be more effective for both hilsa and pomfret, these colours are recommended for hilsa and pomfret gear.

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