PRELIMINARY OBSERVATIONS ON THE USE OF UNDER-WATER LIGHT IN FISH CATCH

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Experiments with drift gill net with under-water lights were carried out in the sea and estuarine region along with a control net of the same specifications without any light in the same fishing ground for comparison. The experimental net caught more fish in number and weight than the control. Fishes like pomfrets *(Pampus chinensis, Parastromateus niger)*, seer *(Scomberomorus spp)*, hilsa *(Ilisha spp)* etc showed positive phototaxis and were gilled encircling the point of illumination. Young skates *(Mobula spp)* and *Polynemus tetradactylus* were antiphototactic. The number of fishes caught increased with increase in period of illumination. The catch of larger fishes was maximum at 60 mts of illumination and the total catch increased with increase in intensity of light. Additional cost of operation with under-water light was Rs 1-25 per hr but the catch was 4 to 5 times greater than that of the control net.

INTRODUCTION

The use of light to catch fish has been practised universally from time immemorial. Torches of cocoanut-tree and plantain-tree leaves were used in early days (Rasalan and Datingaling 1955) to attract fish. These have been gradually replaced by mantle and electric lamps with the advancement of knowledge. Sasaki (1950) devised and tried a fish-attraction lamp system to improve the catch of the set net. While studying the effect of light on fishes in an aquarium, Oka (1950) observed an increase in catch of fish along with increase in intensity of light. Such phototactic response varied with species and size of fishes. Miyasaki (1950) observed schooling of fishes after a few hours with an electric matuda fishing lamp in a purse seine which depended on the intensity of light and

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phase of the moon. Pel (1950) has mentioned about the wide use of petrol gas lamp of 200 to 800 candle power in a moonless night in East Indonesia for concentrating the shoal. Under-water light gave better results than that kept 3.3 ft above water surface.

Krefft and Schubert (1950) found the gathering of fishes 5 mts after a 100 W spot light mounted on the starboard was switched on in a dark night and calm sea. Young (1960) reported that the bait fishing boats of California landed 1 to 15 tonnes of sardines and anchovies per day by using 500 to 700 W bulbs with reflectors. Richardson (1952) noted that pilchard shoals came up to the surface zone when a vertical search light of 24 V and 60 W was flashed on them. The shoal went back to its original depth of habitation after the light was turned off. Just the opposite behaviour was observed in the case of herring shoal. The degree of such movement varied with the intensity of illumination. Takayama (1955) reported that in sea zooplankton was first attracted by the illumination followed by small fishes and finally by larger ones Blinov (1958) observed that the use of electric cables with lamps in a drift net complicated the shooting of the net and was not economical. He also reported that herring and mackerel appeared in the illuminated area 2 to 3 minutes after the use of search light and the catches exceeded by 150 kg/net. Dragesund (1958) observed that herring shoals came up to the surface at night but moved down during the day.

The present work is aimed at studying the behaviour of different fishes towards under-water light during fishing operations.

Materials And Methods

The experiments were conducted in the Chandipur coast and in the Budhabalang estuary with varying light intensities and periods of illumination. In the sea, power was supplied from a 3 KW A. C. diesel generator driven by a 5 HP vertical engine which gave a voltage of 220 at 1450 rpm. The generator was fixed on the deck of the vessel near the engine room. The control panel consisted of a switch board having a voltmeter, ammeter and switches. The connecting wire used was a flexible cable of 23/.0078 size and of 400 m length. The under-water lamps consisted of thick glass coiled coil bulbs which were connected to the main line in parallel at a distance of 25 m from each other. The lamp was made water-tight by covering the socket of the bulb and holder with cycle tube leaving the glass of the bulb exposed. This was done by fusing one end of the tube with the cable and keeping the other end pressed tightly on the glass of the bulb near the socket (Fig 1). 6 to 10 lamps of 200 W each were connected with the main line in parallel and were kept in position by connecting the cable carrying the lamps with the foot rope of the net with a twine so that all the lamps remained under water at a depth of 2 fathoms. (Fig 2).

The net used in the experiment consisted of two pieces 275 m in length and 5.5 m in width in framed condition. The material of the net was Amylon code 4 with 10 cm mesh. One piece was used as the experi-

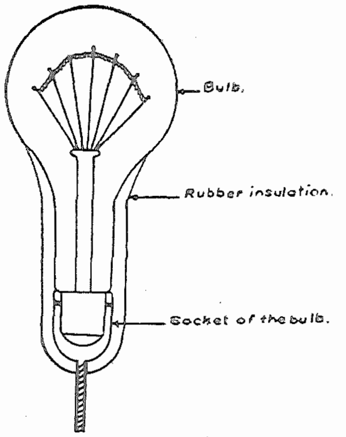

Fig. 1 Showing the water tight arrangement of the lamp.

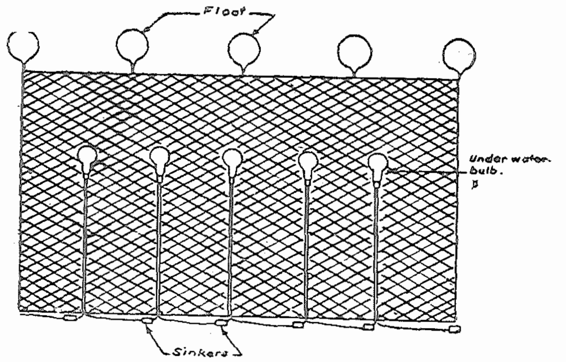

Fig.2 Gill net showing under water light arrangement.

mental net with lights fixed while the second one formed the control. Both were provided with head and foot ropes of Manilla rope of 7 mm in diameter. Polythene floats were attached to the head rope at distances of 7 m from each other while the foot ropes were provided with lead sinkers of 250 g at distances of 8.5 m from one another. Six polythene floats tied together at either end of the head rope formed the master float. The head ropes were provided with long ropes at one end to tie the net with the vessel.

In the evening both the experimental and control nets were plied and allowed to drift along with the vessel with the waves and wind. The generator was then started and the lights switched on for the required time and then switched off. The nets were hauled up after the specified period of operation and the catches analysed separately for number, weight and size groups of each variety of fish. The experiments in the estuary were identical to those in the sea except that the nets used were 140 m in length and 5.5 m in breadth in framed condition in the place of drift gill nets. A master sinker of 10 kg weight each was attached to either end of the foot rope to keep the net in position. The generator was kept on the bank of the river from where a long cable was used to connect the bulbs. The nets were plied with the help of a boat and the rest of the procedure was the same as the one described for the experiments in the sea.

Results And Discussion

Under constant period of illumination, fishes like seer, pomfret and hilsa were gilled surrounding the points of illumination. The catches of the experimental net had a numerical superiority over those of the control except in the first experiment; but in total weights of the catches the former was always superior. (Table 1). Fishes like *Polynemus* spp and skates appeared to be antiphototactic since their catch in numbers was less in the experimental net than in the control (Table 2). Although the total number of *Mobula* spp caught in the experimental net was less than half that of the control, their weight was almost three times that from the control net, which indicates that larger skates were attracted towards the light and gilled. The number of fishes caught increased with increase in period of illumination and 153 fishes were caught when the lights were on for 90 mts. (Table 3).

Table 4 shows that more of larger fishes were gilled in 60 mts of illumination irrespective of species. More than 26% of the total catch were above 75 cm in length in this case while there was no fish at all above this length under the other periods tried. Under a constant period of illumination of 30 mts, the catch decreased

TABLE I COMPARISON OF CATCHES BY DRIFT GILL NET WITH AND WITHOUT UNDER WATER LIGHT

S. No.	Total catch in Control net		Experimental net	
	Nos	Kg	Nos	Kg
1	117	12.95	83	15.50
2	25	19.21	33	28.61
3	3	0.57	11	2.16
4	8	4.45	54	19.70
5	20	21.90	27	27.00
6	6	7.80	34	45.90

TABLE II ANALYSIS OF THE CATCHES OF THE NETS

Species	Total catch Control net Nos	Kg	Experimental net Nos	Kg
Arius app	23	20.00	26	27.50
Polynemus tetradactylus	7	2.00	5	0.80
Sciaenids	17	,,	33	3.50
Pampus chinensis	6	7·00	41	5.30
Pleurenectids	3	0.25	5	0.70
Skates	65	3.50	28	9.00
Scomberomorus spp	13	5.25	36	20.35
Chirocentrus dorab	13	3.50	16	11.10
Engraulis tolera	1	0.07	5	9.65
Ilisha spp	1	0.40	8	4.00
Sharks	4	6 00	19	34 50
Parastromateus niger	3	3.20	7	6 50
Neothunnus spp	1	4 50	3	9.00

in number and increased in weight with increase in intensity of illumination (Table 5). Maximum catch in weight was observed when an intensity of 1400 W was used indicating the phototactic response of larger fishes in that intensity, Analyses of the catches for size groups in these experiments are shown in table 6.

In the estuary, experiments with 800 W illumination increased the catch in both numbers and weight of pomfrets and *Pangasius* spp compared to the control (Table 7), which shows the phototactic respo·se of the above fishes. Maximum catch in numbers and weight was obtained in illumination for a period of 120 to 145 mts (Table 8), which appears to be the optimum. But the % of catch of larger fishes is more in 90 and 120 mts (Table 9) Though it has been reported that the use of electric cable with lamps in drift gill nets complicates the shooting of the nets and is uneconomical, no such difficulties

TABLE III CATCHES OF DRIFT GILL NET WITH UNDER-WATER LIGHT FOR DIFFERENT PERIODS OF ILLUMINATION

Intensity of illumination .. 1400 W
Size of net .. .. .. 275 m x 5.5 m
Period of operation .. .. 10 hrs

Period of illumination mts.	Quantity of fish caught No	Kg
30	33	28.61
45	40	16.10
60	56	131.75
80	59	22.50
90	153	47.30

TABLE IV PERCENTAGE OF DIFFERENT SIZE GROUPS OF FISHES IN THE CATCHES OF DRIFT GILL NET WITH UNDER-WATER LIGHT FOR DIFFERENT PERIODS OF ILLUMINATION

Intensity of illumination .. 1400 W
Size of net .. .. 275 m x 5.5 m
Period of operation .. .. 10 hrs

Size group cm	% of total catch for periods of illumination in mt-. 30	45	60	80	90
10-15	3.3	2.5	1.8	2.0	0.7
16-20	–	35.0	9.0	20 0	41.1
21-25	–	15 0	5.4	32.0	34.5
26-30	10.0	2.5	–	18.0	5 6
31-35	30.4	2 5	12.5	–	1.9
36-40	6.6	15.0	10.8	8.0	0.7
41-45	6 6	10 0	16.0	4 0	3.1
46-50	26.6	10.0	3.6	2.0	5.6
51-55	6 6	–	5.4	–	1.4
56-60	6 6	2.5	–	2.0	–
61-65	3 3	–	3.6	2 0	2 8
66-70	–	2.5	–	4.0	–
71-75	–	2.5	1.8	6.0	1.9
76-80	–	–	5.4	–	0.7
81-85	–	–	6.1	–	–
86-90			3.6		
91-95			3.6		
96-100			1.8		
101-105					
106-110					
111-115			1.8		
116-120					
121-125			1.8		
126-130			1.8		

TABLE V CATCHES OF DRIFT GILL NET WITH DIFFERENT INTENSITIES OF ILLUMINATION

Period of illumination .. 30 mts
Period of operation .. 10 hrs
Size of net .. .. 275 m x 5.5 m

Intensity of illumination in watts	Quantity of fish caught No	Kg
1200	54	19.70
1400	35	32.61
2000	23	30.60

TABLE VI PERCENTAGES OF DIFFERENT SIZE GROUPS OF FISHES IN THE CATCHES OF DRIFT GILL NET WITH DIFFERENT INTENSITIES OF LIGHT

Period of illumination .. 30 mts
Period of operation .. 10 hrs
Size of net .. 275 m x 5.5 m

Size of the fishes	% catch for intensities of illumination in watts:		
cm	1200	1400	2000
10–15	–	3.3	3.7
16–20	–	–	18.5
21–25	–	–	20.6
26–30	–	10.0	7.4
31–35	–	30.4	7.4
36–40	8.1	6.6	16.6
41–45	8 1	6.6	7.4
46–50	11.8	26.6	7.4
51–55	11.8	6.6	1.8
56–60	2.9	6.6	–
61–65	5.6	3.2	3.7
66–70	2.9	–	–
71–75	5.9	–	3.7
76–80	35.2	–	–
81–85	2.9	–	1.8

TABLE VII COMPARATIVE CATCHES IN GILL NETS WITH AND WITHOUT LIGHT IN ESTUARY

Species	Total catch in Control net		Experimental net	
	No	Kg	No	Kg
Parastromatens niger	–	–	2	0.25
Pampus chinensis	17	1.7	52	7.40
Chirocentrus dorab	1	0.2	–	–
Crab	–	–	2	0.30
Pangasius pangasius	–	–	1	0.30

TABLE VIII CATCH IN SET GILL NET WITH DIFFERENT PERIODS OF ILLUMINATION IN ESTUARY

Intensity of illumination .. 800 W
Period of operation .. 7 hrs
Size of net .. 140 mx 5.5 m

Period of illumination mts	Total catch No	Kg
30	2	0.5
60	7	1.2
90	9	1.6
120	13	2.5
145	16	2.5
150	6	0.7
210	1	0.2

TABLE IX PERCENTAGES OF CATCHES OF DIFFERENT SIZE GROUPS OF FISHES IN SET GILL NET WITH DIFFERENT PERIODS OF ILLUMINATION IN ESTUARY

Intensity of illumination .. 800 W
Period of operation .. 7 hrs
Size of net .. 140 m x 5.5 m

Size grop	% catch for periods of illumination in minutes:					
cm	30	60	90	120	145	150
5–10	100	10	–	–	19.0	–
11–15	–	10	16	–	25.0	16.6
16–20	–	50	25	18	43.5	–
21–25	–	30	25	73	12.5	66.8
26–30	–	–	25	9	–	16.6
31–35	–	–	9	–	–	–

were experienced in the present experiments. Under-water lights gave better illumination in the sub-surface zone than the above water light resulting in better congregation of fish (Pel, *loc cit*) The fact that skates could not be caught in the experimental net in larger numbers than in the control may be due to the antiphototactic habit of such size groups.

Horse mackerel fishing is done in Japan using a suspended electric light of 350 W just below the surface of the water (Young, *loc cit*). Increase in the period of illumination appears to exert enhanced phototactic effect on smaller size groups (Table 4) so much so fishes of the size group 31–45 cm formed 39.3% of the total catch at 60 mts illumination. But when the period was more than 60 mts, still smaller size groups predominated causing numerical superiority in catches even though weight of the catch was less. Hence in our marine condition, 60 mts of illumination appears to be the optimum. The % of larger fishes was more in lesser intensities of light which may be due to the affinity of the larger size fishes towards the lesser intensity light, which observation requires further confirmation. The economics of fishing with under-water light show that while there is an additional expenditure of Rs 1.25 per running hour, the catch is increased at least by three times that of the control. Thus it is difficult to agree with Blinov (*loc cit*) according to whom fishing with under-water light is uneconomical.

Conclusion

Fishes like pomfrets, seer, sharks, hilsa and *Polynemus* spp appear to be influenced by light and exhibit positive phototaxis since the total catch in number and weight is more in the experimental net than in the control. Congregation of fishes around under water light increases with period of illumination, reaching an optimum at 60 mts when more of larger fishes are caught in the experimental net. Numerical superiority in catches is observed with rise in intensity of illumination, 2000 W catching fishes double in number to that of 1200 W. Larger fishes are attracted by an illumination of 1400 W. Similar results are obtained from the estuartne region also.

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