

PRELIMINARY OBSERVATIONS ON THE EFFECT OF ELECTRICAL SEINE ON FISH CATCH

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Fortysix experiments were done with the electric seine in 24 tanks with A. C. and interrupted A. C. The source of electrical energy was a 3 KW A. C. generator of water-cooled diesel engine. A control seining without applying electricity was conducted for every experiment with electric "seine" to have a comparison for the efficiency of electric "seine" over control ones. Electric seine was found to have an increased catch over control seining both in numbers and in weight. Electric seine with two electrodes was found to have better effect over three electrodes. Benthic fishes like *Cirrhin mrigala*, *Notopterus notopterus*, *Cyprinus carpio*, *Glossogobius giuris*, *Ophicephalus* sp. and *Mystus* sp. were found to be more sensitive in electric "seine". Increased catch of small fishes like *C. mrigala*, *N. notopterus* and *Ophicephalus* sp. has been observed in electrical "seine" in addition to larger ones.

INTRODUCTION

In order to increase the catch of benthic fishes per unit effort from a body of water various fishing gears have been devised and tried in different waters with different fish populations. In various approaches to the problem, nets of different types, traps and other fishing devices have been used. Each of these methods has its own limitation, sphere of usefulness and percentage of capture. In recent years attention has been given to the electrical methods of capturing fish with different types of current. Notable contribution in

this respect has been made by Pratt (1951), Smith (1950) and Funk (1947). The present paper is limited to the use of alternating current of 50 cycles and interrupted A/C with the help of a specially designed electrical "seine".

MATERIALS AND METHODS

Fortysix experiments were conducted with electrical seine net in twentyfour tanks of Balasore and Cuttack districts of Orissa. The tanks were of different physico-chemical conditions and the conductivity of the water varied from 6000 to

19,000 ohms per c. c. of water. Experiments were conducted with continuous A/C and interrupted A/C of different frequencies along with a control haul for each experiment in order to compare the efficiency of electrical fishing method with the conventional one.

The net used in these experiments consisted of a seine net framed with 1.5 cm hemp rope, fitted with electrodes of flexible copper wire so as to charge the net during the operation. The length of the framed net varied from 60 to 150 m with the variation of the width of the tank. The width of the framed net was 7.5m with mesh size of 5 cm in stretched condition. The webbing of the net was made of Terylene code 6. Lead sinkers of 250g each in weight were provided in the foot rope at an interval of 3m from each other. Round polythene floats were provided on head rope of the net at a distance of 2m from each other. The ground electrode ran along the bottom rope of the net leaving a gap of 1 m from each side of it and the top one was fitted in the same manner 5m below the head rope.

The third electrode was fitted in between ground and top ones along the entire length of the net. (Fig 1). In 16 experiments only two electrodes were used, in which, the ground one and the top one

were connected with neutral (negative) and the phase (positive) of 220V A/C respectively. The source of electricity was a portable A/C generator of 3 KW capacity, run by 5 H. P. Kirloskar water cooled diesel engine. It gave 220 V at 1500 rpm. The generator was connected with a portable control panel consisting of volt-meter, ampere meter and fuses.

During the experiment with three electrode system, the electrode at the top and the middle were connected with the phase while the neutral line was connected with the ground electrode. Round flexible copper wire of 23/.0076 was used as connecting cable. Electrodes of the net were connected with the generator through the control panel so that the voltage between the electrodes and amount of current drained can be recorded with the help of voltmeter and amperemeter. Interrupted A/C was produced with the help of a mechanical interrupter connected in between the generator and the control panel. It produced frequencies of 2 per min. to 10 per min. with different periods of impulse and pause by the combination of different pinions of the gearing system.

Each time before the operation of the net with electric charges, it was operated without the application of electric current to compare the efficiency of electrical

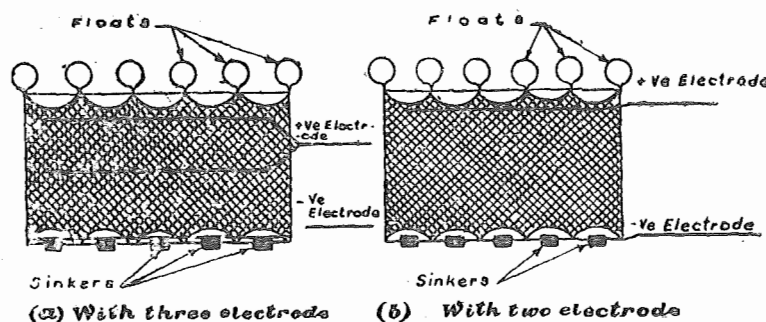


FIG. 1
Showing the Electric Seine with three & two Electrodes.

fishing method with that of ordinary net. The catch of the control haul was then measured for size, number and weight specieswise after which the entire catch was released in the same tank to keep the population constant. As the current flows through the electrode it creates an electrical field vertically through the column of water in the vicinity of the net which moves from one end of the tank to the other as the net is dragged. Fishes got stunned on coming within the field and were collected in the net as it moved. The galvanonarcosis of the fish caused by the electrical field created by the electrodes of the seine net reduced the percentage of escape to the minimum.

RESULTS AND DISCUSSION

Effect of three electrodes on electrical seine

30 experiments were conducted with three electrodes. Control seine was operated in every experiment, in the same tank so as to judge the efficiency of electrical seine. Water temperature varied from 32°C to 36°C and resistance 8000 to 15,000 ohms per c. c. With continuous A/C of 50 cycles, 4 experiments were conducted. An increased catch of 138% by numbers and 122% by weight over the control net was obtained in average of all the 4 tanks (Table 2).

Four experiments were made with interrupted A/C of frequency 2 per min. The period of both impulse and pause was 15 seconds each. The catch was increased by 106% by weight and 71% in numbers in these four tanks (Table 2). With interrupted A/C of frequency 3 per min, 9 experiments were conducted with 15 sec and 5 sec as period of impulse and pause respectively. Percentage of excess catch ranged from 120 by numbers & 67 by weight. By reversing the period of impulse and pause in the same frequency of interruption of 3 per min experiments were

repeated in two tanks which resulted in excess catch both by numbers and weight (Table 2). With the increased frequency of interruption of 4/min and with period of impulse and pause at 10 sec and 5 sec respectively the percentage of excess catch was 110 by numbers in 6 experiments. The increase in weight of catch was 126 percent (Table 2). The percentage of excess catch was found to be 113 by numbers and 54 by weight when the electrical seining was done with interrupted A/C of 10/min. (Table 2), the period of impulse and pause being 4 and 2 seconds respectively.

EFFECT OF TWO ELECTRODES ON ELECTRICAL "SEINE"

Sixteen experiments were conducted with two electrodes using continuous A/C and interrupted A/C of different frequencies. In four experiments, taken up with continuous A/C, there was an excess catch of 101% by numbers and 95% by weight over the catch in control net (Table 2). Five experiments were done with interrupted A/C of 2/min in which the periods of impulse and pause were 15 seconds each. In these experiments 233% of excess catch by numbers and 273% by weight were observed over the catch of control net (Table 2). Seven experiments were conducted with interrupted A/C of 4/min with period of impulse as 10 sec and pause as 5 sec. In these experiments 85% of excess catch by numbers and 90% by weight were observed.

EFFECT OF TYPE OF CURRENT

Though the best result was obtained with interrupted A/C of frequency 2/min with 2 electrodes in respect of average% of excess catch in electrical net over control net both in number and in weight (Table 2) yet the% of excess catch in electrical net over control net was comparatively low in the interrupted A/C of same frequency when tried with three electrodes. But in

every case an increased % of excess catch was observed in electrical net over control net both in numbers and in weight (Table 2).

EFFECT OF ELECTRICAL SEINING ON VARIETIES

(i) With continuous A/C

A specieswise analysis of catch of electrical seining with both two and three electrodes over the control was done to observe the effect of electrical seining on different varieties. With continuous A/C and with three electrodes the % of average catch of *C. catla*, *C. mrigala*, *L. rohita*, and *C. carpio* was from 1.6 to 16.8 in control hauls, but in electrical fishing their % varied from 4 to 35.1 (Table 3). Similar effect was observed when the experiment was conducted with two electrodes in which case these fishes represented 3.5 to 35.5% in control haul but 21.5 to 52.5% in electrical netting (Table 4). Effect on *L. bata* was slightly different from these species. Electrical netting made an average catch from 0.2 to 0.6% in respect of other species whereas the control netting failed to collect any of these species in 5 experiments (Table 3).

(ii) With interrupted A/C

L. rohita, *C. mrigala*, *N. notopterus* and *Ophicephalus* sp. formed the major catch in electrical 'seining' both with two electrodes and three electrodes when interrupted A.C. of frequency 2/min was used. Though the control haul failed to collect species like *N. notopterus* and *Ophicephalus* sp. yet 21.5% and 1.2% of total catch on average have been observed in respect of above species in electrical seining (Tables 3 & 4). With interrupted A/C of frequency 3/min the average total catch of *C. mrigala*, *Ophicephalus* sp., *C. carpio*, *G. giuris* in electrical haul dominated over the control haul (Table 3). There was a tendency of an increased catch of *C. catla*,

L. rohita, *C. mrigala*, *N. notopterus* and *C. carpio* in electrical 'seining' with interrupted A/C of frequency 4/min (Tables 3 & 4). Marked effect on *Ophicephalus* sp., *M. pancailus* and *M. cavasius* was observed as electrical netting could collect these species and not the control one.

Effect of Electrical seining on different size groups.

Analysis of catch of 5 hauls with five different types of current using three electrodes showed increased catch of smaller size groups of *C. mrigala*, *N. notopterus* and *Ophicephalus* sp. in electrical seining irrespective of the nature of current (Table 5). Perhaps the fishes of smaller size groups which escape through the control seine net were caught by the electrical seining. Similar results were observed with electrical seining with two electrodes (Table 6) irrespective of the nature of current.

EFFECT OF NUMBER OF ELECTRODES ON THE EFFICIENCY OF THE ELECTRIC SEINE.

Of the nine electrical seining with two electrodes an increased catch of over 200% was obtained in 5 experiments. But an excess catch of over 200% was observed in 3 experiments only out of 15, in which electrical seining was tried with three electrodes (Table I) which gives an indication of the superiority of two electrodes over three. Though the seine net can encircle a large population of the tank the % of escape by ordinary seine net is more than that of catch. The fishes generally escape by jumping and burrowing through silt and weeds at the time of hauling of the seine net. As the electrical seine is gradually hauled up the fish population of the tanks exhibit the oscillotactic reaction and are finally narcotised as the net closes up to one side when the non-electrical field between the side of the tank and the net is reduced to minimum. As

soon as the fish enters into the electric field near about the net, it is narcotised reducing the % of escape

Unlike the one used by Funk (1947) the electric seine used in the present experiments was of Terylene webbings into which electrodes were fitted. The purpose of using the webbings in electric seine was to collect the narcotised fishes in the net instead of collecting them by dip nets as adopted by Funk, a procedure which excludes the possibility of catching fish in deep water. Moreover the chances of escapes after getting a little electric shock were reduced as the net behind the electrodes collects those fishes. The collection of fish with the help of dip net involves the service of other personnel, is time consuming and less effective in turbid waters. Burnet (1952) has observed a catch of 26 to 71% of the population by a single run with impulse D/C. Pratt (1951) on comparing the efficiency of D/C with A/C observed that out of the total marked fishes released in a stream barricaded by nets on both sides, 44.8% was recovered by D/C but with A/C the extent of recovery was only 28.8%. He further observed that the D/C unit gave better results, particularly in swift and turbid waters. Since the present set of experiments are limited to the use of A/C only comparative efficiency of A/C with that of D/C could not be made.

Burnet (*op. cit*) obtained better effect with pulse modulated D/C than with continuous D/C. The impulse frequency used by him was as high as 20 cycles/sec, but the maximum impulse frequency used in the present experiments did not exceed 10 cycles/sec with period of 2 sec pause which is just sufficient for the fish to escape from the electric field. Similar results were obtained by Pratt (*Op. cit.*) who harvested 100% of brook trout, 80% rainbow trout and 20% brown trout which are of benthic habitat with A/C fish shocker. In

the present experiments, an increased catch of *L rohita*, *C mrigala*, *N notopterus*. *C carpio*, *G giuris*, *Ophicephalus sp.* and *Mystus sp.* was observed in the electric seine as compared with the control seine irrespective of the nature of current. It may therefore be concluded that the bottom dwelling fishes are more susceptible to the electric seine than the pelagic ones. Eels were found to be more sensitive than most of other species (Smith & Elson, 1950).

Electric "seine" collected an increased number of small sized long gear sun fish and green sunfish in the upper Gasconde river (Funk, *loc cit*). Larger sized fishes escaped from the electrical field easily. In addition to larger fish groups, an increased catch of smaller size groups of *C mrigala* *N notopterus* and *Ophicephalus sp.* in the electrical seine revealed that the small sized fishes were affected by the electrical field and were caught which otherwise escaped through the control net (Tables 5 & 6).

CONCLUSION

Increased catch both in numbers and weights have been observed in electrical seine over the control one. The effect of electrical seining was due to the narcosis of fishes as they come to the proximity of the electrical field reducing the % of escape of fishes to minimum. Continuous A/C seems to have better effect over interrupted A/C. In interrupted A/C fishes may possibly get better chances to escape during the period of pause when the electrical field from the electrical seine disappear. No significant effect has been observed with changes of frequency of interruption. Introduction of third electrode does not prove to be advantageous as the excess catch is more in electrical seine with two electrodes both in nos and in weight. Electrical seine in general increased the catch of all varieties of fishes over control seine except in case of *Barbus sarana* where

TABLE I DIMENSIONS AND CHARACTERISTICS OF THE TANKS WITH COMPARATIVE RESULTS OF
ELECTRIC "SEINE" AND CONTROL "SEINE"

Area in acres	Period of operation in minutes	Depth in feet	No of electrodes used	Nature of current	Impulse time in sec.	Pause time in sec.	Voltage between electrodes.	Current drained in amps	Catch in nos. with ordina- ry haul (a)	Catch in nos. with electri- cal haul (b)	% of excess catch $\frac{b-a}{a} \times 100$
0.48	15	5.5	3	A/C. interr- upted 4/min	10	5	200	14	38	64	68
"	"	5.3	"	"	"	"	"	"	19	64	70
0.51	20	-do-	"	"	"	"	"	"	63	154	144
0.48	15	"	"	"	"	"	"	"	107	251	135
"	"	"	"	"	"	"	"	"	103	127	23
0.51	20	10.0	"	3/min	15	"	"	12	13	41	215
"	"	"	"	"	"	"	"	11	10	23	130
"	"	"	"	"	"	"	"	14	15	62	313
0.48	15	6.0	"	"	"	"	210	"	5	7	40
0.51	20	7.0	"	"	5	15	"	15	4	7	75
"	"	"	"	"	15	5	"	14	7	7	—
"	"	6.0	"	2/min	"	15	200	15	10	12	20
0.48	15	5.5	"	10/min	4	2	190	16	6	35	483
0.51	20	"	"	"	"	"	200	15	28	40	43
3.20	30	7.0	"	2/min	15	15	"	14	8	18	125
0.12	45	10.0	2	4/min	10	5	220	12	—	15	1500
0.70	20	5.0	"	"	"	"	210	14.5	50	87	286
"	"	5.3	"	"	"	"	"	14	185	276	50
0.48	15	5.0	"	"	"	"	200	15	35	55	57
"	"	4.4	"	"	"	"	"	"	15	78	420
6.80	35	18.0	"	2/min	15	15	210	14	7	27	286
"	"	"	"	"	"	"	"	18	8	31	287
1.60	25	12.0	"	"	"	"	"	17.5	2	4	100
13.80	45	20.0	"	"	"	"	"	14	13	29	123

TABLE II PERCENTAGE OF EXCESS CATCH OF ELECTRICAL NET OVER CONTROL NET
IN DIFFERENT TYPES OF CURRENTS

Nature of current	No. of electrodes used	Frequency of inter- ruptions/ min.	Time of impulse in sec	Time of pause in sec	No. of experiments	Average perce- ntage of excess catch in electri- cal net over control net in numbers	Average perce- ntage excess catch in electri- cal net over control net in Kg.
A/C, Continuous	3	—	—	—	4	138	122
A/C, interrupted.	3	2	15	15	4	71	106
"	"	3	"	5	9	120	67
"	"	"	5	15	2	50	50
"	"	4	10	5	8	110	126
"	"	10	4	2	3	113	54
A/C. Continuous	2	—	—	—	4	101	95
A/C. interrupted	"	2	15	15	5	233	273
"	"	4	10	5	7	85	90

TABLE III COMPARATIVE CATCH IN ELECTRICAL SEINE AND CONTROL SEINE
IN RESPECT OF DIFFERENT VARIETIES

Voltage-input-240					No. of electrodes-3			
Variety of fish	A/C. continuous: % of average catch of 5 experiments		Interrupted A/C 2/min % of average catch of 5 experiments		Interrupted A/C: 3/ min % of average catch of 6 experi-		Interrupted A/C : 4/ min % of average catch of 8 experi-	
	Ordinary Haul	Electrical haul	Ordinary Haul	Elecrtical haul	Ordinary Haul	Electrical haul	Ordinary Haul	Electrical haul
<i>C. catla</i>	16.8	24.5	—	1.6	6.5	19.3	31.2	56.7
<i>C. mrigala</i>	9	35.1	25	48.2	3.3	12.5	6.7	12
<i>L. rohita</i>	13.6	32.8	—	—	—	—	3.1	6.6
<i>C. carpio</i>	1.6	4	2	3.6	.7	4.2	—	—
<i>L. bata</i>	1	1.6	—	—	8.2	15	7	11.2
<i>L. calbasu</i>	—	.5	1 6	2	—	—	5	1.2
<i>C. reba</i>	—	.3	—	—	—	—	—	—
<i>B. sarana</i>	—	.2	—	—	—	—	—	—
<i>G. giuris</i>	—	.6	—	—	3.2	18.8	.4	1.1
<i>H. fossilis</i>	—	.2	—	—	—	—	—	—
<i>O. punctatus</i>	—	.2	—	1.2	5.8	26.7	—	.1
<i>N. Notopterus</i>	—	—	—	—	—	—	2.4	6.5

TABLE IV COMPARATIVE CATCH IN ELECTRICAL SEINE AND CONTROL SEINE IN
RESPECT OF DIFFERENT VARIETIES

Voltage-input-240					No. of Electrodes-2	
Variety of fish	A/C continuous: % of average catch of 2 experiments		Interrupted A/C: 2/min. % of average catch of 4 experiments		Interrupted A/C: 4/min. % of average catch of 7 experiments	
	Ordinary haul	Electrical haul	Ordinary haul	Electrical haul	Ordinary haul	Electrical haul
<i>C. catla</i>	14	23	—	1.5	25	29.2
<i>L. rohita</i>	35.5	52.5	3.2	43	3.8	6.6
<i>C. mrigala</i>	3.5	21.5	5	17.5	5.9	11.7
<i>L. bata</i>	2	1.5	—	—	13.9	20.9
<i>L. calbasu</i>	—	—	1.7	2.5	.6	.9
<i>N. notopterus</i>	—	—	—	21.5	6	13
<i>O. punctatus</i>	—	—	.7	13.7	—	1.4
<i>M. pancailus</i>	—	—	—	—	—	1.4
<i>C. carpio</i>	—	1.5	—	—	10.7	14.7
<i>M. cavasius</i>	—	—	—	—	—	.9
<i>B. sarana</i>	—	—	2.7	1.7	—	—

TABLE V DIFFERENT CATCHES IN BOTH CONTROL AND ELECTRICAL
SEINE WITH 3 ELECTRODES

C. H: Control Haul						E. H: Electrical Haul					
Species	Size Range cm	4/min		3/min		2/min		10/min		A. C. continuous	
		C.H.	E.H.	C.H.	E.H.	C.H.	E.H.	C.H.	E.H.	C.H.	E.H.
<i>L. rohita</i>	11-15	1	1	—	—	—	—	—	—	—	—
	16-20	—	1	—	3	—	—	2	5	38	84
	21-25	—	3	1	6	8	8	1	1	21	38
<i>C. mrigala</i>	16-20	3	20	—	—	—	—	—	—	4	25
	21-25	1	10	—	—	1	—	1	1	2	7
	26-30	1	6	—	2	3	5	—	—	—	—
	31-35	—	6	—	1	3	8	1	1	—	—
	36-40	—	1	1	1	1	4	—	2	—	—
<i>N. notopterus</i>	11-15	1	16	—	—	—	—	—	—	—	—
	16-20	1	9	2	4	—	—	—	—	—	—
<i>G. giuris</i>	11-15	2	4	2	7	—	—	—	7	—	—
<i>Ophicephalus sp.</i>	6-10	—	1	—	—	—	—	—	—	—	—
	11-15	—	—	2	3	—	—	—	—	—	—
	16-20	—	—	—	17	—	—	—	1	—	—
	26-30	—	—	—	—	—	—	—	—	—	—
	31-35	—	—	—	—	—	1	—	—	—	—
<i>M. pancailus</i>	11-15	—	—	—	—	—	—	—	12	—	1
	16-20	—	—	—	—	—	—	—	6	—	—

TABLE VI DIFFERENT CATCHES IN BOTH CONTROL AND ELECTRICAL SEINE
WITH 2 ELECTRODES

C. H: Control haul						E. H: Electrical haul	
Species	Size range cm	4/min		2/min		A C. continuous	
		C. H.	E. H.	C. H.	E. H.	C. H.	E. H.
<i>L. rohita</i>	11-15	—	—	—	—	—	—
	16-20	—	2	—	—	38	64
	21-22	—	—	—	6	21	26
<i>C. mrigala</i>	16-20	—	—	—	—	4	14
	21-25	—	—	—	—	2	7
	26-30	—	—	—	—	—	—
	31-35	—	—	—	—	—	—
	36-40	7	16	3	12	—	—
<i>N. notopterus</i>	11-15	16	27	—	—	—	—
	16-20	9	21	—	3	—	—
<i>Ophicephalus sp.</i>	6-10	—	—	—	—	—	—
	11-16	—	—	—	—	—	—
	16-20	—	—	—	—	—	—
	26-30	—	1	—	—	—	—
	31-35	—	—	—	3	—	—
<i>M. pancailus</i>	11-15	—	3	—	—	—	—
	16-20	—	5	—	—	—	—
<i>C. Carpio</i>	16-20	—	1	—	—	—	—
	21-25	—	18	—	—	—	—
<i>M. cavasius</i>	11-15	—	3	—	—	—	—

more fishes were caught in control seine. Fishes like *L calbasu*, *C reba*, *G giuris*, *H. fossilis*, *C carpio*, *Ophicephalus sp*, *N notopterus*, *M cavasius* and *M. pancailus* could be caught in electrical seine, when control seine failed to catch them, which indicates that benthic fishes are more prone to electric shocks and exhibit galvanonarcosis earlier. Fishes of smaller size groups which otherwise escape through control seine were caught in electrical seine irrespective of nature of current, particularly in respect of *C mrigala*, *N notopterus*, and *Ophicephalus sp*.

REFERENCES

- Burnet, A. M. B. 1952 *Australian J. Mar Fresh Water Res.* **3**(2), 111-125.
- Funk, John L. 1947 *Trans Am. Fish Soc.*, **77**, 49-60.
- Godfry, H. 1956 *Canadian Fish Culturist*, **19**, 1-8.
- Lennon, Robert E and Parker, Philip. S. 1956 *Trans. Am Fish Soc.*, **86**, 234-240.
- Pratt, Virgil. S. 1951 *Ibid*, **81**, 63-68.
- Smith, G. F M. and Elson, P. F. 1950 *Canadian Fish. Culturist*, **9**, 1-13.
- Saunders, J. W. and Smith M. W. 1954 *Ibid*, **16**, 1-8.