PART II

SCIENTIFIC AND TECHNICAL

THE NARCOTISING IMPULSE THRESHOLD VALUES OF CERTAIN FRESH WATER FISHES

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The effect of impulse current on the fish at a particular impulse rate and voltage depends on the size and kind of the fish. It is directly proportional to the temperature and inversely proportional to the conductivity of the medium.

INTRODUCTION

The use of impulse current for electrical fishing is a recent advancement introduced by German Scientists Denzer and Kruetzer (Meyer Waarden 1957). Impulse current is best suited for electrical fishing purpose because it produces the proper wave form to cause a reaction to the fish. Morgan (1951) has reported that impulse current is relatively more efficient for electrical fishing. Subsequent work of Dickson (1954) proved it to be more economical. Halsband (1959) has shown that impulse current has a greater physiological effect on the fish and that its influence on the metabolism is less harmful than either direct or alternating currents. Since reactions of fishes are affected by impulse rate (Meyar Waarden *loc. cit.*), the temperature and conductivity of the medium (Cattley, 1955, Flux John 1967), it is but reasonable to assume that selective fishing should be possible by varying these parameters. As a preliminary step, experiments were conducted to determine threshold values of impulse rate for narcotising certain fresh water fishes and the results are reported in this paper.

MATERIALS AND METHODS

The fresh water fishes used for the experiments were climbing perch (*Anabas scandens* Cuv. & Val.), tilapia (*Tilapia mosambica* Peters), murrel (*Ophiocephalus* sp.) and cat fish [like *Clarius magur* (Cuv. & Val.) and Macaones sp.]. The fishes after collection were acclimatised for a minimum period of 24 hrs in a cubical tank each side measuring 120 cm.

The actual experiments were conducted in a plastic trough of size 450 mm x 300 mm. Two numbers of 20 gauge copper sheet of size 100 mm X 100 mm were used as the electrodes. They were tied to glass rods which could be moved to any desired position in the trough depending upon the position of the fish. The impulse current was obtained from an impulse generator described elsewhere (Nambooiri 1967). The generator was run by a petrol engine, by varying the revolution of which the impulse rate was varied. The impulse generator was connected to a 230V 50c/s single phase supply through a variable rectifier. By varying the input voltage to the generator the desired output impulse voltage was obtained.

Threshold values of impulse rate

By keeping the impulse rate constant and varying the voltage, the minimum voltage required for electronarcosis of a particular fish was noted. The time of exposure of fish in the electrical field was 15 sec in all the experiments. Subsequently the impulse rate was varied, keeping the voltage at the minimum value required for electronarcosis. In both the cases the time required for recovery and length of fish were recorded. The experiments were repeated for a number of fishes of the same species, but having different modal lengths.

Effect of conductivity

Small quantities of brine were added to vary the conductivity of the medium. The fish was acclimatised to the changed condition before passing the current. The impulse rate and the voltage were kept constant. The experiments were repeated, with varying concentrations using different species of fishes. Conductivity of each sample was measured with a conductivity bridge.

Effect of temperature

The temperature of the water was varied by adding ice or hot water. The fish was put in the medium before changing the temperature. The procedure followed was the same as in the previous experiment. The experiments were repeated for various temperatures and different fishes.

Results and Discussion

At low voltage and pulse rates the fish vibrates its fins and gill covers vigorously. But when the pulse rate is increased to the level of narcotising value, keeping the voltage at the minimum required, the respiratory movements of the fish ceases, its opercula flare widely and finally the fish turns on its side. At this stage the fish becomes rigid, resulting in the cessation of all movements. But they attain normalcy gradually from this state of narcosis, when the current flow is cut off.

The correct pulse rate is the decisive factor for the successful working of the fishing gear using this principle. The pulse rate at which the fishes are narcotised differs considerably for various species and for fishes of various sizes. Table I shows the results of the study of impulse rate for various species of fishes. While tilapia of size group 7-9 cms required an impulse rate of 51 per second at 8V for narcotising and took 1 minute for complete recovery, anabas of the same size group required only 42 impulses at 8V and the time of recovery was 2 mts. Similar differences can be noticed for other species as well. The time required for recovery of the fish after stunning denotes the intensity of the effect

TABLE I THRESHOLD VALUES OF IMPULSE RATE AND IMPULSE VOLTAGE FOR ELECTRONARCOSIS FOR DIFFERENT TYPES OF FRESH WATER FISHES.

Voltage	Impulse rate per second	Name of fish	Length of fish in cms	Reaction	Time of exposure in sec.	Time for recovery in minutes
8	51	Tilapia	7— 9	Narcotised	15	1.0
8	46	Tilapia	10—12	-do-	-do-	1.5
12	45	Anabas	4— 6	-do-	-do-	1.5
8	42	Anabas	7— 9	-do-	-do-	2.0
8	38	Anabas	10—12	-do-	-do-	2.0
8	37	Clarius	18—20	-do-	-do-	2.5
10	40	Clarius	14—16	-do-	-do-	2.0
7	32	Murrel	16—18	-do-	-do-	1.0
9	36	Macrones	16—20	-do-	-do-	1.0

of electrical field on the fish. The results of the experiments show that there is significant difference in the effect of impulse current on different species of fishes Further when anabas of size group 4-6 cms required 45 impulses per second at 12V for narcotisation, those of size group 10-12 cms required only 38 impulses per second at 8V. Thus within the same species also there is significant difference in the reaction to impulse current. Kreutzer (1954) and Halaband (1959) have shown that small fishes require higher pulse rates than larger ones. Peglov is of the view that the pulsating frequency should match with the rapidity of the swimming movements of the fish (Bary 1956) and hence shorter fishes required higher frequency. The above results also support this view that the threshold values of impulse rate decrease with the increasing size of the fish. Since different species of fish react variously to pulse rhythms a selectivity in the catch can be arrived at by setting the equipment at a pulsating rate adapted to one particular species.

TABLE II REACTIONS OF VARIOUS TYPES OF FRESH WATER FISHES TO IMPULSE CURRENT AT VARYING CONDUCTIVITIES

Name of fish	Conductivity of the medium	Voltage	Impulse rate per sec.	Length of fish in cms	Time of exposure sec.	Reaction
Macrones	0	10	40	13—15	10	Stunned
	0.014605 ohm-1/cub. cm.	10	40	13—15	14	-do-
	0.031483 ohm-1/cub. cm.	10	40	13—15	18	-do-
Clarius	0	8	40	11—15	15	-do-
	0.13731 ohm-1/cub. cm.	8	40	11—15	15	Not stunned
	0.13731 ohm-1/cub. cm.	12	40	11—15	15	Stunned
Anabas	0	7	35	13.0	15	Stunned
	0.13731 ohm-1/cub. cm.	7	35	13.0	15	Not stunned
	0.13731 ohm-1/cub. cm.	13	35	13.0	15	Stunned

The effect of electrical influence on the fish is dependant on the distribution of electrical field in the surrounding area which in turn depends upon the conductivity of the medium. Table II shows the reaction of various fishes to impulse current at different conductivities of the medium. From the table, it would be seen that with the increase in the conductivity the effect is less. This result is in agreement with the view of Meyer Waarden (*loc, cit.*) He states that as the conductivity of the water increases greater voltage has to be applied in the case of direct current. But Flux John (*op. cit.*) found that as the resistivity of the medium increases the effect is less for alternating current. This difference in the effect of electrical field may be due to the type of current used for the experiment.

The change in temperature affects the conductivity of the medium which increases with the decrease in temperature (von Brandt 1964) and hence at lower temperature a higher voltage has to be applied to cause a reaction to the fish. Table III shows the reaction of tilapia to impulse current at different temperatures. From the experiments it can be seen that at higher temperatures impulse current has greater effect on the fish with regard to electronarcotisation. Lethlean (1953) found that trout required higher voltages to produce stimulation and paralysis at lower temperatures, which is in agreement with the above result. Lamarque (1965) also got the same result.

TABLE III REACTION OF FRESH WATER FISH "TILAPIA" to IMPULE CURRENT AT VARYING TEMPERATURES

Temperature °C	Voltage	Impulse rate per second	Length of the fish in cms	Time of exposure	Reaction
25	6	48	9.0	15 secs.	Frightening
30	6	48	9.0	15 ,,	Frightening
35	6	48	9.0	15 ,,	Stunned
25	8	48	9.0	15 ,,	Frightening
30	8	48	9.0	15 ,,	Stunned
25	10	48	9.0	15 ,,	Stunned

CONCLUSIONS

By using impulse current selective fishing is possible. An increase in the conductivity of the medium decreases the effect of impulse current on fish. At higher temperatures impulse current has got greater effect on the fish.

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