PRELIMINARY EXPERIMENTS ON ELECTRICAL FISHING IN FRESH WATTER

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INTRODUCTION

Fishing using electricity is a new technique and is still in the experimental stages in many of the advanced countries. While no published records are available in India, considerable work has been done in Germany (Mayer Waarden, 1953, 1954a, 1954b, 1955, 1957; Hattop 1957, 1958a, 1958b; Kreutzer 1951, 1954; Denzer 1954, 1956; Halsband 1955, 1956), United States (Smith 1955a, 1955b, 1955c; Halton *et. al.* 1954; Lennon and Parker 1958; Wathwe *et. al.* 1964), USSR (Shentiakov 1963; Shentiakov *et. al.* 1959; Nikonorov *et. al* 1959; Nikoronov Ivan 1964; Badamshin *et. al.* 1964), Canada (Smith and Sanders 1954), Newfoundland (Murray 1958), United Kingdom (Mck-Bary 1956; Dickson 1954). These papers mainly deal with the behaviour of the fish in the electrical field, the physiological effects of electrical current on fishes, methods of electrofishing, electric fencing etc.

Electrical fishing in fresh water is easier, less dangerous for the same voltage and requires less power (Lt. Cd. (Sp) B. Mck. Barry 1956) than for that being carried out in sea to cover the same area, as the conductivity of fresh water is too low compared to sea-water. The effect of an electric field on the fish will depend upon the voltage drop on its body due to the passage of electric current.

The following experiments on electrical fishing were conducted with a view to studying the distribution of electrical field when an alternating current is passed through two fixed electrodes in fresh water and to study the reaction of different fresh water fishes to the field.

MATERIAL AND METHODS

All the experiments were conducted in a fresh water pond of about size 70′ × 60′ and a maximum depth of 12′ at the middle. The main characteristics of the water are given below:

1. Salinity : 0.26 parts/1000
2. Conductivity : 1.38×10^{-3} ohm^{-1}/cm. at 25°C.
3. Bottom of the pond : Sandy mud.

Experiments were carried out using the following fishes available in the pond.

	Fishes	Max. length	Max. girth
1.	Cat fish	380mm.	121mm.
2.	Climbing perch	173mm.	127mm.
3.	Murrels	300mm.	135mm.
4.	Tilapia	125mm.	120mm.
5.	Megalops	270mm.	185mm.

The necessary electrical power was drawn from a 6.5 K. W., 400V, 50 cycles, 3 phase diesel generator set. The electrode used for the experiment is shown in Fig. 1.

The connections to the electrodes were given through 2-core T. R. S. Cables. Two mild steel sheet metal electrodes – Fig. 1– were used for the measurement of potential distribution and for studying the effect of electric field on fish. Live fishes were kept in a bag net for one day, before being used for the studies.

Experiments to study the potential distribution in water:

The two electrodes were suspended from a sisal rope tied across the pond in such a way that the conducting portion remains completely immersed in water. The distance between the electrodes was adjusted to 5'. The electrodes were connected to the two phases of the generator. Although the rated voltage of the generator was 400V between phases, on load it gave on the terminals of the electrode only 330V between phases. An earthing pipe was fixed near the tank to get a good earth point. An earth lead was taken in the dingy and it was connected to an Avometer. A field measuring probe was connected to the other terminals of the Avometer. The measurements were taken by the measuring probe at different points radially on the surface and at different depths.

Experiments to study the reaction of fishes to an electric field:

The effect of electric field on fish was tried by putting live fishes of different size groups, one at a time in a small bag made of net and hanging the bag at different points in the field from a rope tied radially from the electrode. The voltage at the point and the distance from the electrode were noted. The fishes were exposed to the field for 30 seconds. If the fish were stunned (turned upside down in certain cases, lying still on their sides in the case of cat fish), within the 30 seconds at a point, that point is taken as the effective point.

Results and discussion

Fig. 2 shows the formation of the curves of equipotential lines around the electrodes when they are fixed at 5' apart and a voltage of 330 is applied across them. It is clear from the figure that there exists a minimum potential region in between the two electrodes. The plane of this region is perpendicular to the plane connecting the two electrodes. In a field of alternating current the fish takes a transverse position with respect to the direction of current (Mayer Waarden 1957). This phenomenon is called oscillotaxis. It is happening in the minimum potential region mentioned above. In Fig. 2, even though the form of the equipotential curves is the same for both the electrodes they are not equal. This is because the voltage developed in each phase of the generator was not the same. This is clear from Table – 1 which shows the potential measurements taken at different points in the field.

Fig. 3 shows the relationship between voltage and distance from the electrode.

A third degree polynomial of the form $Y = aX^3 + bX^2 \times cX + d$ where a, b, c and d are constants were fitted to the observed data by the principle of least squares. The equation obtained by fitting the third degree polynomial for the data was:

$$Y = -0.00077X^3 + 0.12599X^2 - 7.24000X + 149.58030.$$

where Y denotes voltage in direction 240° from AB from earth and X denotes pistances from electrode, B in inches (Table-1). The closeness of fit of this polynomial can be seen from the graph. In the graph the points plotted denote observed data points and the curve drawn represents the graph of fitted third degree polynomial for the data.

Table – II shows the voltage drop on the body for each fish for electronarcosis, the length of fish, the distance from electrode at which it happens, the voltage etc. It has been assumed in the calculations that the voltage per cm multiplied by the fish length is the equivalent of the voltage over the fish, since it was difficult to measure the actual voltage drop over the free swimming fish and since from field measurements the voltage at different points in the field are available.

Fig. 4 shows the relationship between the voltage drop on the body of the fish and the length of fish for the effect of electronarcosis for Cat fish, Murrels and Megalops. The relations are in the form of first degree equation.

For Cat fish, the equation is

$Y = 0.4707X + 0.0339$

where Y = voltage drop

X = fish length (cm).

The correlation co-efficient between voltage drop and fish length r = 0.9977, which is significant at 10% level, indicating significant correlation between the two.

For murrels, the relation is $Y = 0.4793X - 0.1158$

where Y = the voltage drop on the fish

X = length of the fish (cm).

The correlation co-efficlent r = 0.9984 which is significant at 10% level indicates significant linear relationship.

For Megalops the relationship is

$Y = 0.4731X + 0.0317$

where Y = voltage drop on the fish

X = length of the fish (cm).

The correlation co-efficient between voltage drop and length of fish r = 0.9997 which is significant at 10% level, indicates significant linear relationship between the two.

In Fig. 5, the voltage drop on the fish length is plotted against the maximum girth of fish for electronarcosis effect on Cat fish, Murrels and Megalops.

For Cat fish, the relationship is

$Y = 1.8138X - 3.6842$

where Y = voltage drop

X = maximum girth of fish (cm).

The correlation co-efficient between voltage drop and maximum girth of fish r = 0.8764 which is significant at 10% level indicates correlation between the two.

For Murrels, the relationship is

$Y = 1.1233X - 1.6223$

where Y = voltage drop and

X = the maximum girth of the fish (cm).

The correlation co-efficient r = 0.9093 which is significant at 10% level indicates significant linear relationship between the two.

For Megalops the relationship is

$Y = 0.6268X + 1.6814$

where Y = voltage drop

X = maximum girth of fish.

The correlation co-efficient between voltage drop and girth of fish r = 0.9856 which is significant at 10% level indicates significant linear relationship between the two.

In Fig. 6, the voltage drops on fish length is plotted against the weight of fish for the effect of electronarcosis for Cat fish, Murrels and Megalops.

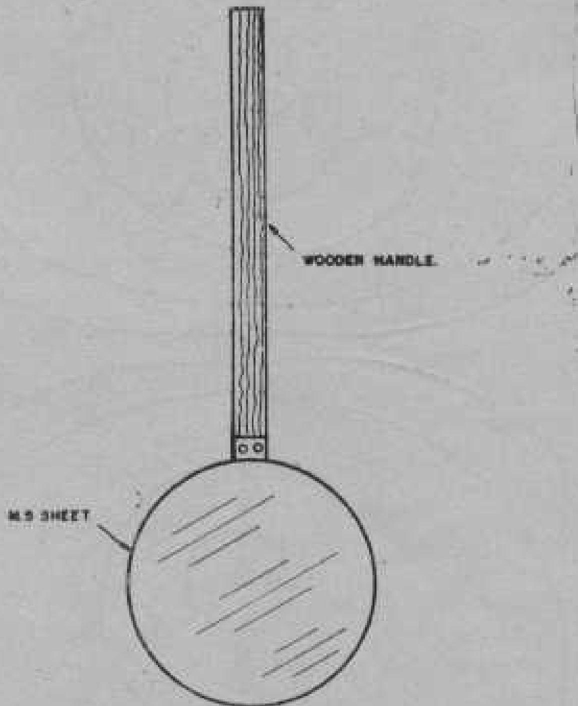
For Cat fish, the relationship is

$Y = 0.0584X + 4.6675$

where Y = voltage drop

X = weight of fish (g).

FIG. 1



M.S SHEET ELECTRODE

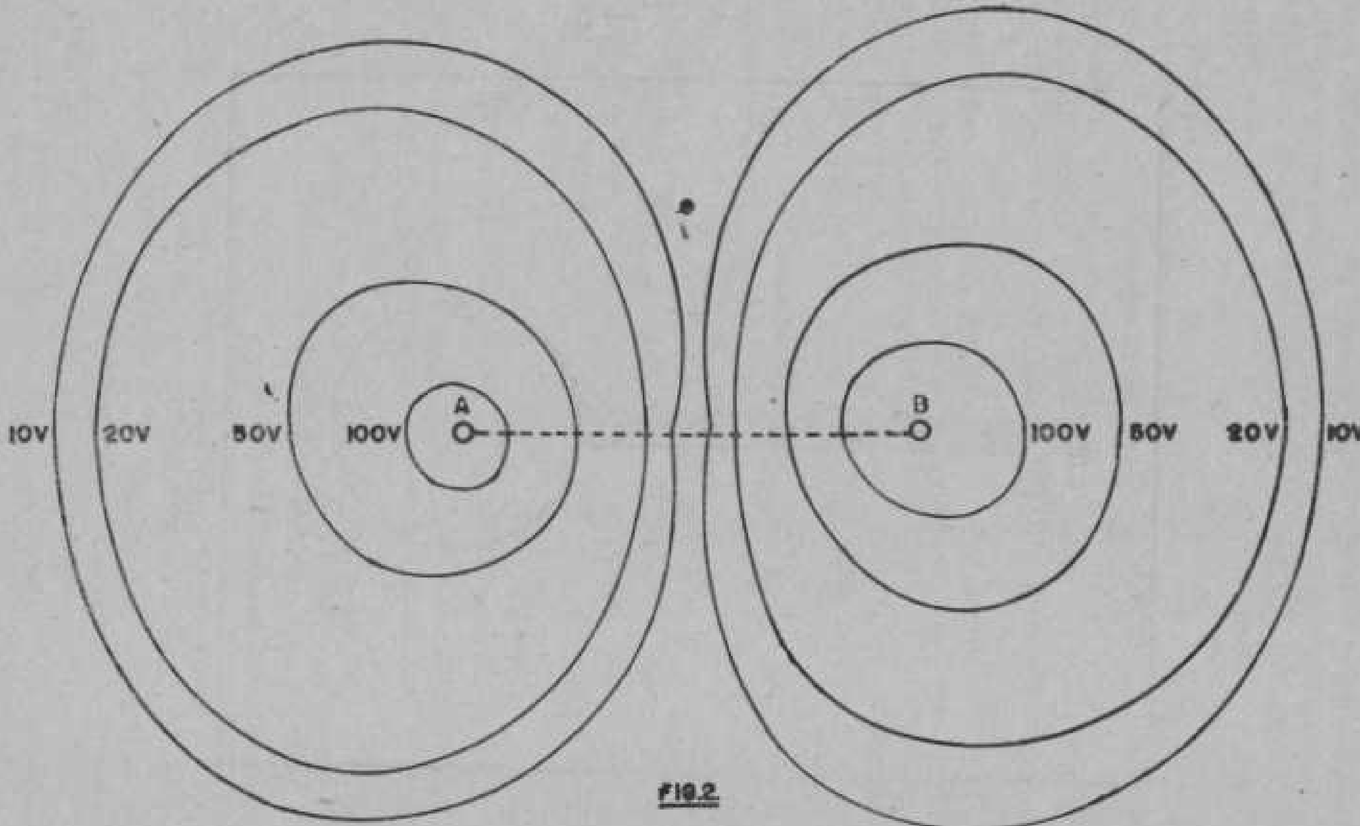


FIG.2

CONTOURS OF POTENTIAL GRADIENT IN FRESH WATER.

Electrodes .... Metal Sheet.
Distance between Electrodes .. 5 ft.
Voltage between Electrodes .... 330 V

Conductivity of water .. $1{\cdot}38 \times 10^{-3}$ ohms^{-1} cm at 25°c.
A and B .... Electrodes connected to the 2 phases of a 3 phase Generator.