DEVELOPMENT OF ELECTRO-TRAWL SYSTEM IN MARINE ENVIRONMENT

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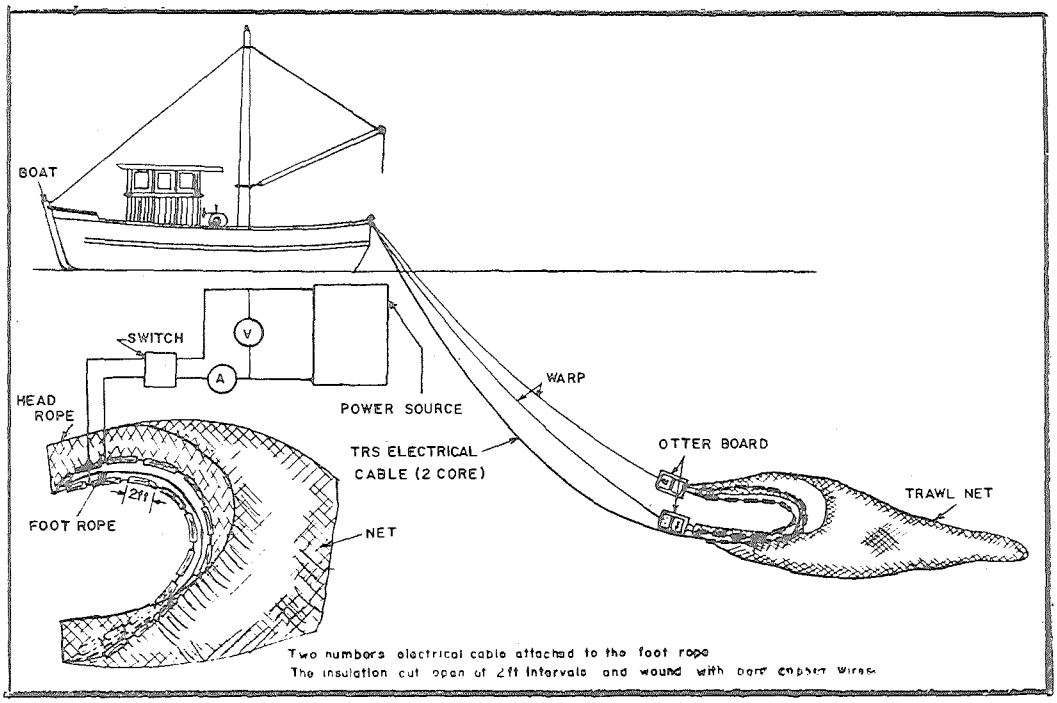
High voltage pulsed current produced on board a trawler is fed to electrodes distributed along the foot rope of a trawl net through 2 core TRS cable which builds up a homogeneous electrical field around the net mouth. By comparative fishing tests with the electrified and non-electrified 32 m. long wing trawl net, the increase in total catch of shrimps and fishes was found to be 19.8 and 36%, respectively.

INTRODUCTION

Electro-trawl system is being successfully tried in UK, West Germany and USA and the work presented in this paper is the first of its kind in India. Efforts were directed towards the development of such a gear system which can enhance the catch per unit effort without affecting the quality of the catch.

Sea water is universally known to have high conductivity compared to that of the fish, so that a high current is required to maintain a given field strength. Therefore the overall power consumption necessary to induce reaction similar to those obtained in fresh water is greatly increased (Mck. Bary 1956, Namboodiri, 1966 and Kruetzer, 1964). A current of 10 Amperes which would be sufficient in fresh water, would, for the same effective range, have to be increased to about 10,000 Amperes in sea water. This indicates that continuous direct current in sea water would be uneconomical. With the discovery that fishes have the same reactions to pulsed direct current, provided the shape, duration and rate of impulses are suitable, a solution to this problem was found (Kruetzer, *op. cit.*).

Studies on the impulse current for electrical fishing have revealed that it will not be economically feasible to use A.C. or D.C., for the purpose except for tank experiments (Dickson, 1954; Namboodiri, 1967). Higman (1956) established that a pulsed direct current produced definite behaviour patterns in shrimp and that increasing the strength and duration of electrical impulses induced variations in behaviour. In the case of shrimp, comparison of activity levels between different pulse rates shows the highest level of



activity at pulse rates between 4 and 6 per second (Klima, 1968).

Materials And Methods

The experiments were conducted on board Motor Fishing Vessel Sindhukumari (15.2 m. OAL with 165 H.P. engine) in depths ranging from 15-30 m. off Cochin. The source of impulse current was an impulse generator developed in the Institute (Namboodiri *op. cit.* 1967). The experiments were conducted with pulse rates ranging from 5 to 10 per second. Electrodes were attached to the foot rope of a 32 m. long wing trawl as shown in Figure 1.

The electrodes were connected through 2 core tough rubber sheathed (TRS) cable from the impulse generator on board the vessel. The TRS cable was wound on a separate hand winch from which it was paid out simultaneously along with the trawl warps taking care to see that no mechanical tension was induced on the cable. Two numbers of 400 Amperes welding cables attached on the foot rope with the insulation on the cables cut open at 60 cm. intervals and wound with bare copper wires formed the electrodes. The positive and negative electrodes were arranged in such a way that they were positioned at 30 cm. interval.

The fishing cruises were undertaken in the fishing seasons of 1971-72 and 1972-73. To determine the catching ability of the electrified trawl, both electrified and non-electrified hauls were made alternatively in statistically arranged pairs. Nineteen sets of such comparative hauls were taken with the same net, but with and without electrical stimulation. Random sampling of the fish and the shrimp caught in both the types of operation was done and their total lengths noted,

TABLE I

VARIANCE ANALYSIS

	SS	df	ms
Between hauls	4210.526	1	4210.526*
Between days	10969.724	18	6089.429*
Error	16348.724	18	908.162
Total	130168.974	37	

*Significant at 5% level

TABLE II

CATCH DETAILS OF ELECTRIFIED AND NON-ELECTRIFIED HAULS

Name of species	Total weight in kg. in electrified hauls	Total weight in kg. in non-electrified hauls	Percentage increase in electrified hauls
Lactarius sp.	213.0	126.0	36.00
Nemipterus sp.	364.0	290.0	,,
Sciaenids	123.0	80.5	,,
Miscellaneous fish	707.0	538.0	,,
Prawns	72.5	60.5	19.8
Total	1479.5	1095.0	35.2

to study whether this factor has any variation while the pulsed current is used.

RESULTS AND DISCUSSION

It would be affirmed that the electrical trawling has been successful because it is based on sound behavioural observations (Klima, *op. cit.*). The principal responses of fish to electricity are now well known. At low level of field strength fish can be frightened. Past work on electrification of trawls has been aimed at stunning fishes in the mouth of the net and preventing escape. This requires mean power level in the region of 250 KW and although the generation and transmission of such powers are perfectly feasible on board large trawlers, it is not necessary to think solely in terms of stunning. Fishing gear operates on the basis of herding by optic and acoustic stimuli and it would seem

TABLE III

AVERAGE TOTAL LENGTH OF FISH AND SHRIMP IN ELECTRIFIED AND NON-ELECTRIFIED HAULS

Species of fish	Average total length in non-electrified hauls (in cm.)	Average total length in electrified hauls (in cm.)
Sharks	62.80	72.00
Lactarius sp.	14.17	15.35
Nemipterus sp.	14.30	14.50
Sciaenids	14.50	16.25
P. stylifera	11.00	12.35
P. indicus	16.20	15.70
M. affinis	13.50	13.00

more logical to increase the herding efficiency by the use of electrical fields which frighten rather than stun. Herding should use less power and might be best accomplished by electrifying the trawl sweeps. It is noteworthy that the electro-trawl herds rather than stuns its prey (Stewart, 1971).

There are two factors to be considered in any assessment of the performance of an elecrified trawl. Firstly, there is the effect of electrical field on the catching efficiency of the net, which can be determined by taking successive hauls with the field either on or off. Secondly, there is the effect of the electrodes and associated net mounted equipments on the performance of the net itself, eg., the weight of the cable is to be taken into account while weighing the foot rope and any adverse effect of over weight on the foot rope has to be successfully overcome. These two factors were given due consideration in the execution of the experiments.

The comparative catch data were analysed by the variance analysis technique. The results obtained are presented in Table I.

The analysis shows that the variation of catches between the hauls taken using electricity and the control hauls is significant at 5% level. The variation is also significant between the days of operation.

Use of impulse current had enhanced the catch by 35.2%. The species wise catch data are presented in Table II.

The total lengths of fish and shrimp caught in the electrified trawl showed considerable increase in the case of sharks, *Lactarius* sp., *Nemipterus* sp., *Sciaenids* and *Parapenaeopsis stylifera*. However, such an increase was not observed in the case of *Penaeus indicus* and *Metapenaeus affinis* (Table III).

It was found that the catches made with the electrified gear were always composed of larger fishes than in the control catches. This is due to the fact the larger fishes are more affected by a given electrical field strength than the smaller fish, i.e. the pulse rates are specific to the size of fishes and hence selective fishing is possible (Kruetzer *op. cit.*). This clearly indicates that the use of electricity in trawl fishing will not be detrimental to the younger stock, thereby dispelling the fear of causing depletion.

The estimates of the fishery experts regarding the proportion of fish actually caught to that present in the path of the trawl gear varies between 10 and 60%. This is because fish may be frightened by the trawl gear to such an extent that they either avoid the gear completely or escape through large meshes in the front portion of the trawl net (Kruetzer *op. cit*). The use of impulse current for trawling purposes presumably can bring down the rate of such escapement. The main conclusion that can be drawn from these experiments is that the electrical stimulus effectively induces fishes and shrimps to leave the bottom and bring them in line with the movement of the trawl.

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