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OBSERVATIONS ON FLAT FISH REACTIONS TO A MODEL ELECTRIFIED BEAM TRAWL

by

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Introduction

Recent comparative fishing experiments have demonstrated that an electric stimulus can be used as an aid to capture (Boonstra, 1975; Stewart, 1975 a and b). These experiments were based on earlier investigations of the reactions of several marine species to electrical stimulation (Boonstra and de Groot, 1970; Stewart, 1973 and 1976). The fishing experiments were conducted by attaching electrodes to beam trawls so that the zone ahead of the groundrope was electrified. Fish encountering an electrified gear will react to the gear itself and to the electrical stimulus. To examine the reaction of fish to these interacting stimuli the experiment described in this paper was carried out.

Direct observation of fishing gear has provided detailed information on the herding effects of the various components (Hemmings, 1973). It is clearly hazardous however, for divers to make direct observations on an electrified gear in conditions of limited visibility. To overcome this problem a towed manned sledge, supporting two 3m beam trawls, was used to provide divers with a safe platform from which to make observations. One model beam trawl was rigged with an electric tickler system and the other with a chain tickler to investigate the reactions of flatfish to an electrified gear and a conventionally rigged gear. Flatfish reactions to electrical stimulation were investigated prior to this experiment using the same electrode array (Stewart 1976). Intermittent bursts of DC pulses were found to be effective in inducing fish to leave the sea bed, the most efficient burst frequency being 20Hz. This form of stimulus was used in the model trawling experiment.

Apparatus and Experimental Procedure

Figure 1 is a schematic diagram of the experimental equipment showing the sledge, pulse generating equipment, electrodes and beam trawls. The equipment, excluding the nets, is described in detail elsewhere (Stewart and Cameron 1974). The trawls were rigged on each side of the sledge. The spars with headlines attached were kept 25cm off the bottom by wheels at their outer ends. The width of each net at the spar was 3m, and the mesh size of the nets and cod-ends was 40mm. The footropes were 5.4m long with 120g lead weights at 0.5m intervals. The starboard side had electric ticklers and the port side a 1cm chain tickler. The electrical stimulus was 1 second long bursts of 4 ms long DC pulses at 20Hz with 1 second intervals between bursts, and either 50 V or 80 V between the electrodes.

The experimental hauls were made in the southern Moray Firth in an area where the bottom is mainly sand, with scattered strips of small stones and weed and the depth ranges between 8 and 12 m. The towing speed was 0.6 to 0.8 ms^{-1}. Four tows, each of about 60 minutes duration, were carried out. The observations made during these tows were consistent and demonstrated the principal forms of fish behaviour occurring under these conditions.

Results

The fish observed were mainly plaice Pleuronectes platessa and the common dab Limanda limanda. On the port side, fish did not move from their positions on the bottom until they were about to be touched by the chain. They were then herded in front of the chain and, after being herded for a few minutes, sometimes accelerated ahead of the gear and escaped to port. At the low towing speed large fish managed this easily. Other fish, presumably when tiring, turned and swam back over the chain and footrope into the net. The chain churned up the bottom and generated a small mud cloud which completely obscured the footrope. No fish were seen to enter this mud cloud from above, but some small flat fish were overrun by the chain.

On the starboard, electrified side the fish were forced off the bottom by the electrical stimulus and then herded by the footrope. The zone in which they attempted to swim, however, was rendered inhospitable by the electric fiel[d]. The fish reacted in three ways: by swimming rapidly from side to side of the net, as far above the electrodes as possible, for up to 30 seconds, then dropping back into the net; by dropping back into the net immediately; or by escaping under the footrope. Only small and medium sized fish was seen to escape under the footrope and no fish was seen to escape from the front of the net after being overtaken by the electrodes. One tow was conducted with the electrode voltage increased to 80 V which made the zone ahead of the footrope even more inhospitable and the fish appeared to turn back into the net more readily.

The fish caught were classified into three size groups, 0 to 14 cm as small, 15 to 24 cm as medium and 25 cm and over as large. The loss of fish under the footrope reduced the catch by the electrified side and more fish were caught in the non-electrified side. In three recorded hauls the total catch in the electrified side was 6 large, 22 medium and 8 small fish, and the total catch in the non-electrified side was 8 large, 28 medium and 10 small fish. Most small fish entering the nets escaped through the meshes. The net with the chain tickler contained a considerable quantity of stones, weed and other benthic material, whereas the net with the electrodes contained very little deb[ri]s.

Discussion

The observations made by the divers revealed sources of inefficiency in both the electrified and non-electrified nets. On the electrified side the escape of fish under the footrope appears to be a major defect of a gear with a light weight 'tickler' system. To overcome this deficiency a more heavily weighted footrope, or a light chain rigged in front of the footrope to obscure it with a mud cloud, is required. On the non-electrified side, at the low towing speed, fish escaped from the front of the net. No fish was seen to escape from the front of the electrified gear and if losses under the footrope could be prevented electric 'ticklers' could have considerable potential as an aid to capture. The small amount of debris produced by electric ticklers is an advantage, but this will be cancelled, at least partially, by any increase in the weight of the footrope.

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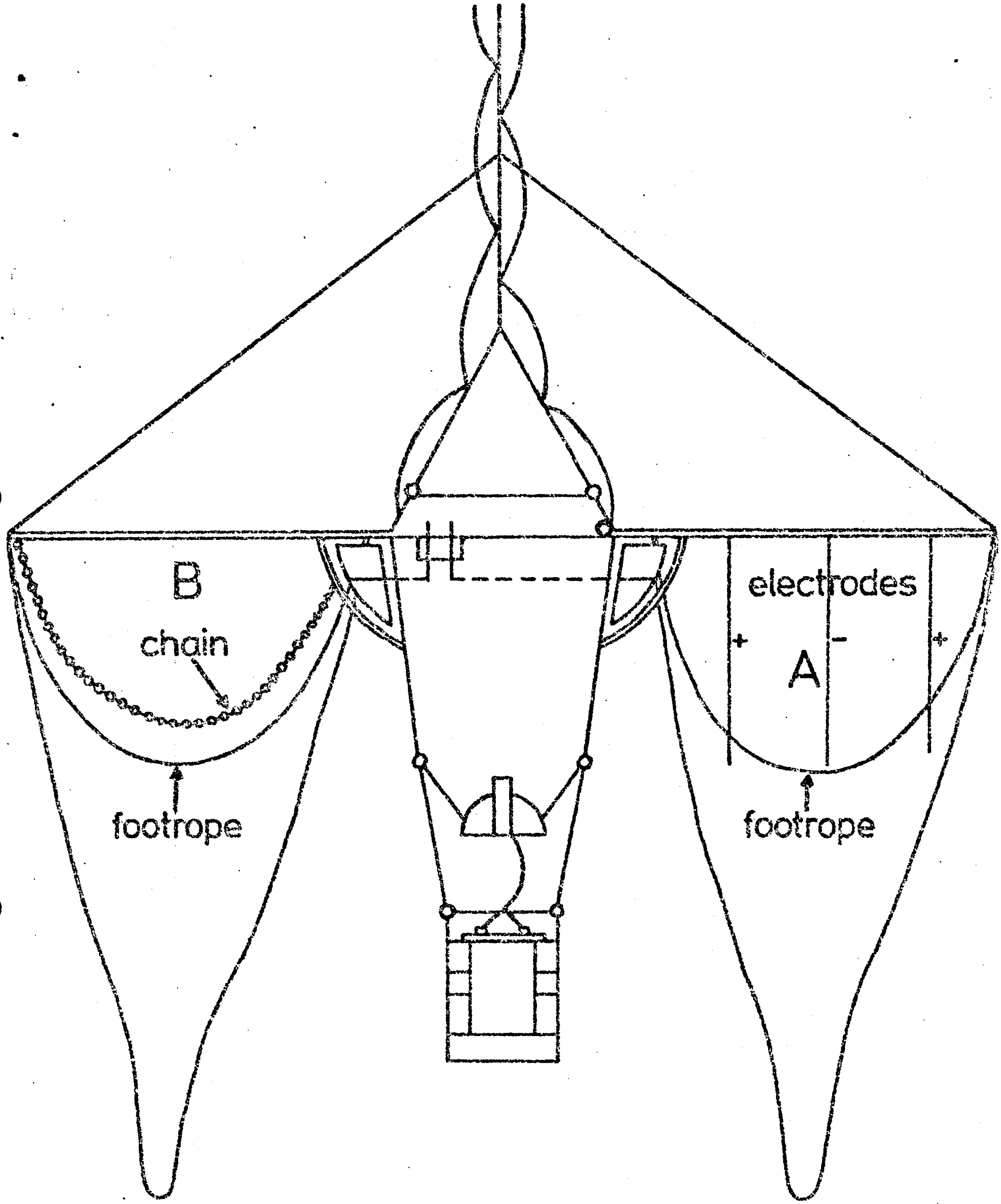

Fig 1. Schematic diagram of towed sledge and nets.