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International Council for the Exploration of the Sea

C.M. 1976/B:2
Gear and Behaviour Committee

REPORT OF THE WORKING GROUP ON REACTIONS OF FISH TO FISHING OPERATIONS

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Rapporteur: Dr S J De Groot

1. Meeting time and place: 29 March, 1976, Hull

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3. Introduction

The aims of the Working Group have not changed since its first meeting at Nantes in 1973. They are: to discuss current practical problems in fishing operations, particularly those that might involve aspects of fish behaviour, to keep in touch with techniques and facilities used to observe the reaction of fish to fishing operations, to maintain an up to date approach to relevant studies of fish physiology and behaviour, to discuss interpretation of fish behaviour in relation to fishing operations, and to identify and encourage co-operative experimental work where this seems worthwhile.

The first meeting, in Nantes in 1973, defined these aims. The second meeting, in Aberdeen in 1974, gave special attention to the swimming performance of fish and the third meeting, in Ostend in 1975, concentrated on the effects of electric fields on fish. The special subject approved for the fourth meeting, in Hull in 1976, namely, methods of observing reactions of fish to gear in the sea, was seen to involve techniques also useful for observing the gear. Therefore, by arrangement with the convenor of the engineering working group, it was made the subject of a special joint session reported as C.M. 1976/B:3 Gear and Behaviour Committee title "Report by Special Joint Session on the Methods for Observing Gear and the Reactions of Fish to Gear".

4. Agenda

Progress reports - summaries from member countries.

Current research - technical discussions on swimming performance, effects of electrical fields, other subjects.

Research aquarium design (C.M. 1975/B:3)

Research aquarium survey (1974).

Future special topics.

5. Progress Reports and Current Research Topics

FRANCE. G Kurc reported on continuing work on the following fields. a. Analysis of the reaction of tuna to artificial baits of different types and colour (work carried out at sea using computerised data). b. Electric fishing experiments using two types of tank in order to analyse the directional effects of the electric stimulus. c. Acoustic mapping of pilchard, anchovy and sprat described in a written contribution.

NORWAY. K Olsen presented a summary of work going on in Norway. Fish behaviour in relation to fishing technology is now a subject of increasing interest in Norway. Both questions of improved selective catching methods in the future and an increased research effort in gear technology to day, have focussed attention on these aspects of fishing. In particular such questions have been recognised to be of vital importance by the recent established Institute of Fishery Technology Research and much of the activities reported below are parts of the research program of this institute.

The bycatches of undersized fish of commercially valuable species by prawn trawlers have long been a serious problem. An attempt to reduce such bycatches is under investigation utilizing expected differences in the behaviour patterns of fish and prawns in combination with mesh selection. A diagonally mounted sorting net in the trawl belly has a herding function for fish but not for prawns and the fish can be released through an opening at the top of the trawl. Extensive full scale comparative fishing experiments with this gear have been carried out at sea. In order to obtain optimal performance of this sorting net, simulated trawling with models is being undertaken in a big circular aquarium. The work is continuing and for improved observations in real fishing operations a new low intensity underwater TV will be used.

Recently a new type of deep sea fish trap has been developed and fishing trials have indicated that an optimal performance of their construction is difficult to obtain until sufficient knowledge exists of how the various fish species behave when entering the trap. The position of the bait within the trap, the shape of the tunnels and the netting material itself is all believed to effect the fishing efficiency. A study of these factors under fishing conditions is at present being undertaken by use of a TV set attached to the trap. (Videotape illustrating some aspects of this fish behaviour was shown to the meeting.)

Basic investigations into the principles of fish attraction in bait fishing (vision/smell/gradient detection and orientation) are planned both through laboratory experiments and by field observations. One aspect of the experimental work on artificial bait with the aim to produce a bait has already gone on since 1973. The results of these studies, which have mainly been carried out on cod, show that cod are able to select preferred baits in a choice situation. A ranked preference for various bait organisms has been shown, but in some cases a particular feeding history of a fish may alter its preference of diet. On this basis a prototype of an "artificial" bait has been produced and tested both in choice tests and in practical fishing. The choice experiments showed no significant difference in reaction to the smell of the artificial bait and the natural bait, but in practical fishing the hooking frequency was clearly higher with natural bait. This preliminary result indicated that the specific behaviour of a fish when tasting and swallowing an artificial bait ought to be taken into account.

Attraction of fish by sound has been used in connection with experiments examining temporary storage of live fish in a small fjord-inlet. Last year 250 tons of saithe were stored for a period of 4 months. During this period a sound/food conditioning technique was applied with the aim to obtain sufficient concentration of the fish for easy recapture. The results have shown that conditioning of such large numbers of fish is possible with reasonable effort and further experiments for optimization of the technique are planned.

Available acoustic tag systems offer various possibilities for behaviour studies of free swimming fish. An advanced system for very precise tracking (the "Pin Point" system) is completed and several tags giving information about heartbeat, tailbeat, depth of movement or temperature are operative.

With the aim to develop a method for direct measurement of migration speed in fish some preliminary experiments on cod have been undertaken in the Barents Sea utilizing acoustic tags. By surveying the area with a sonar of 120 kHz the tagged fishes could be spotted and followed for a period of more than a week.

The experiments will be continued in 1976 off the Lofoten Islands.

The effect of dredging and other industrial activities at the entrance of a salmon river (Orkla) on salmon about to enter the river has been investigated also by use of acoustic tags. The results indicated that although the fish seem to meet some difficulties at the river entrance they still manage to pass.

Some theoretical work has been done to develop mathematical models describing fish behaviour as interactions between environmental influences and the momentary sensitivity to these by the fish. The sensitivity to the various stimuli is regarded as a function of the biological condition in a fish. Continuation of this work is considered in relation to various aspects of modelling marine ecosystems.

S Olsen described a new research programme by Ludvig Karlsen into the quantitative and qualitiative effects of varying the dimensions of long line fishing gears. The conclusion was that considerable scope for optimising the long line fisheries through relatively simple changes in standard gear parameters were possible. They therefore planned to continue these experiments off northern Norway this coming spring.

UNITED KINGDOM (DAFS, Aberdeen). P Anthony presented a paper "Progress of Fish Vision Research at the Marine Laboratory, Aberdeen" describing new experiments defining the light levels necessary for cod to see objects. The technique used depended on the heart beat conditioning method similar to that previously used for studying fish hearing.

A Hawkins described sensitivity studies of fish in relation to chemical constituents of bait using the heart beat conditioning technique. He described a comprehensive study on development of long line fishing including investigation of the behaviour of fish to new types of baits, hooks, floating or on the bottom. It has already been found that the best artificial baits could compete with the poorer natural baits. A significant variation between alginate gels made by different chemical processes was found in feeding tests.

P A M Stewart reported current work, initiated partly at the request of this working group, which has led to further understanding of the detailed reaction of fish to pulsed electric fields. Some key experiments were described indicating that direct stimulation of muscle was the major effect of pulsed fields in modifying the behaviour of fish. A comprehensive publication on this subject is now in preparation by Wardle and Stewart. Dr Stewart indicated that further tests are being made on the use of barriers to fence fish in areas of a sea loch.

C S Wardle summarised what is known of the swimming speed of fish and related this to speed of fishing gear components. He pointed out two publications on this subject, 1. "Limit of Fish Swimming Speed" 1975, Nature Lond., Vol. 255, pp. 725-727. 2. "The Effects of Size on swimming speeds of fish in Scale Effect in Animal Locomotion edited T J Pedley, Academic Press, in press.

UNITED KINGDOM (MAFF, Lowestoft). R Margetts reported that their research aquaria were mainly out of commission during the year. Therefore all effort was concentrated on experiments at sea. Previously they had found that released tagged plaice often stayed in mid water instead of settling on the bottom and they showed a vertical migration related to the tide. A hypothesis that plaice

make use of the tide for migration had been proposed by F R Harden Jones. Present experiments involved fishing for plaice with a mid water trawl and it has been found that in the Southern Bight of the North Sea pre-spawning plaice were caught in mid water on a south going tide, whereas spent plaice were caught in mid water on a north going tide. This migration mechanism has also been noticed with tagged cod in the sector scanner experiments. G A Arnold is continuing his hydrodynamic studies of the shape of plaice. Behaviour studies on the shoaling (attraction) of fish around artificial obstacles are being undertaken.

UNITED KINGDOM (WFA, Hull). M Hatfield and A J Dean presented a White Fish Authority Industrial Development Unit field report no. 323 entitled "Mechanised Baiting and Reconstituted Baits" which included an interesting finding of comparative fishing trials using natural and artificial baits where a variety of artificial baits were found to have no catching power whereas that of the control mackerel bait was poor but repeatable. Details of these experiments can be seen in the field report available from the White Fish Authority.

GERMANY, Federal Republic of. G Freytag reported on the work carried out by H Mohr on the blue whiting on Porcupine Bank. The German investigators are interested to find out what stimulus is involved in causing the evasive reaction when fish encounter the fishing gear.

NETHERLANDS. R C Peters discussed his findings on the sensitivity of fish to the presence of natural electric fields and related these to the further use of artificial fields and the possible further developments in the light of his physiological findings. Peters findings show a surprisingly sensitive system in many fish species for the location of minute electric fields such as might be found in a decaying bait. Great interest was shown by the meeting in possible further investigation in relation to long lining. It was suggested that one property of artificial baits overlooked by investigators might be that the electrical fields surrounding such a bait complex might be characteristic to the fish sensory system.

6. Research Aquarium Design

C.M. 1975/B:3 Gear and Behaviour Committee was presented to the meeting as report of the ad hoc meeting on design and practical operation of research aquarium systems, held at Texel, Netherlands from 7 - 10 April 1975. This report 78 pages long describing details of many of the ICES countries marine aquaria and with a useful bibliography on marine aquaria resulted from the working group convened in Texel, Netherlands by Dr S J de Groot with Mr P Anthony as Rapporteur. The report is available from the Library, The Netherlands Institute for Fishery Investigations, Post Box 68, Haringkade 1, Ijmuiden 1620. The completion of this valuable report has to some extent superceded the research aquarium survey initiated in 1974.

7. Recommendations

A D Hawkins suggested that in 1977 the working group should discuss "Methods of Attracting Fish". S Olsen suggested that in 1978 the meeting might discuss in detail "The Relation between Fish Behaviour, Efficiency and Selectivity". The meeting agreed with these proposals.

8. Appendix to this Working Group

C.M. 1976/B:3 Gear and Behaviour Committee "Report by Special Joint Session on the Methods for Observing Gear and the Reactions of Fish to Gear".

9. Films shown by WFA

The White Fish Authority have made a number of films complete with sound tracks describing many of the common fishing techniques of great interest to members of this working group. A complete list of films made by WFA is available from WFA, Hull. These films are normally available from WFA, Hull.