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Gear and Behaviour Committee

Report of the Working Group on the Reactions of Fish to Fishing Operations

List of Participants

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Dr W. Fischer	Germany (Hamburg)
Dr S. J. de Groot	Netherlands (IJmuiden)
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W. Czajka	Poland (Gdynia)
R. Robles	Spain (Vigo)
Dr G. P. Arnold, Dr M. Greer Walker, J.P. Bridger, A.R. Margetts	United Kingdom (Lowestoft)
P.D. Anthony, A. Corrigall, J.J. Foster, Dr A. D. Hawkins, Dr C. C. Hemmings, Dr C. S. Wardle, D.A. Wileman	United Kingdom (Aberdeen)

The Working Group met between 14 and 16 May 1974 at the Department of Agriculture and Fisheries for Scotland, Marine Laboratory, Aberdeen. Dr C. C. Hemmings acted as chairman and Dr. M. Greer Walker as reporter.

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1 INTRODUCTION

Day 1

The participants were welcomed by Mr J. J. Foster. Dr Hemmings summarized the main points of the previous meeting of this Working Group at Nantes in 1973 and the reaction of the Gear and Behaviour Committee to the Nantes proposals and introduced the subjects to be considered by the present meeting.

2 PROCEEDINGS

a Experimental studies of swimming speeds

Dr Wardle introduced the subject by summarizing what is known about speed and endurance of swimming in fish. He discussed the limits of swimming speed and endurance and the experiments being undertaken to measure these limits. The physiological processes underlying swimming were considered and ideas presented of how these could be of help in elucidating the process of capture. Dr Greer Walker described the role of the two main types of muscle fibre during swimming derived from laboratory experiments. Discussion centred upon the anaerobic white fibres and their role in sustained swimming.

b Direct observations in the sea

Dr Hemmings and Dr Wardle showed selected films of fish swimming in front of the Danish seine net using divers. Small plaice and haddock were observed swimming with typical burst and glide behaviour before tiring and dropping back into the net. Film of the Granton trawl efficiency project was then shown by Dr Greer Walker. The technique using RV CORELLA to attack acoustically-tagged fish under surveillance from the ARL Scanner aboard RV CLIONE was described and the reaction of plaice to RV CORELLA's Granton trawl was demonstrated.

c Demonstration of the Behaviour Unit at Aberdeen

The techniques used to measure the parameters of swimming fish in the large circular tank were demonstrated, together with the television system used in the analysis. The properties of isolated muscle in electric fields was also demonstrated and the manner in which these observations were related to tail movement in the entire fish discussed.

Day 2

d The effect of capture and release on fish behaviour

There is evidence from carp and tuna that fish can learn to avoid baited hooks for periods of up to several months. However, the reaction to a trawl is probably a simple optomotor response and not remembered. Cod that are handled out of water, even with anaesthetics, take up to 24 h for a complete physiological recovery and up to 3 days to establish territories in a new environment, although there is no evidence to suggest that territories are established in the open sea in the same way as is shown by littoral and freshwater species. The group agreed that the manner of fish handling was important as it was difficult to establish if, for instance, an acoustically-tagged fish was behaving naturally. It was proposed that the ideal method of tagging was for divers to tag plaice on the bottom where recovery from stress would be rapid. However, there is as yet little evidence available on this point and it would be a difficult exercise with more active species and could only be carried out in suitable circumstances. To ascertain the effect of acoustic tags on fish, it was suggested that the performance of tagged and normal fish be compared experimentally. In addition, the joint CLIONE/MARA cruise in September would afford an opportunity to compare and improve the different methods of tagging. The closely

related problem, namely, the effect of the observer on the fish, was next discussed and an example given of the proximity of the ship affecting a shoal.

Conventional tagging may also adversely affect fish. The recovery of tagged herring and sardines were particularly low in some experiments although the French tuna recoveries appeared normal. Hobson's work on tagged squirrel fish showed that the marked fish were the first to be predated.

e The use of underwater TV

This equipment was not being used to any extent by members of the group.

f The use of diving techniques

Dr Hemmings described the diving techniques used at Aberdeen. Three methods of observation were described: firstly, watching the trawl go by with the diver stationary in the water: secondly, holding on to the gear: and, thirdly, holding on to a line towed by the ship. In each case vocal communication gives the time base for quantitative observations. However, this technique is limited and a towed underwater vehicle is being developed with 18 h life support system, 90 m working depth and a speed of 6 knots. It was thought particularly interesting to use this technique to observe the pelagic trawl which might be acting purely as a filter.

g Gear design and behaviour studies

During this session gear experts present were asked to comment on the data so far and make suggestions for future work.

Preliminary results from the Granton trawl efficiency project and comparative fishing experiments suggest that certain gears may be up to 90 per cent efficient and although an improvement of a few

per cent is important in terms of value it would be difficult to measure. It was thought important to concentrate on the doors and bridles and their shepherding effects on fish. More information is necessary on the separate effects of noise, visual stimuli and mud clouds by day and by night. It was suggested that to study these phenomena either one parameter should be made dominant in the field or that parameter should be brought into the laboratory for study. It was noted that divers rarely observed interactions between fish and doors or bridles, possibly because they happen relatively rarely and divers are unable to remain in observation positions for any length of time.

h The significance of light in the capture process

Dr Arnold introduced this session by describing the science of photometry and that of radiometry. The basic units of the two were defined and their relation to the work of the group noted. Dr Hemmings informed the group of experiments in progress to measure the underwater visible range of divers. However, the spectral sensitivity for the human and fish eye is different. Mr Anthony described laboratory experiments to test the contrast perception of cod by means of classical conditioning techniques and it was hoped that these two experiments would provide some necessary information on fish vision. The shortage of knowledge on problems of bioluminescence and the ability of fish to adapt to light and dark were also discussed.

i The significance of noise in the capture process

Dr Olsen reviewed the present state of our knowledge on this subject. Sound may be used for orientation in the Arctic waters where there is little light and although noise from ships and predators frighten fish and directional hearing in fish is good the precise

effects of gear noise are unknown. Mr Foster described a project to produce a field map of sound in the vicinity of a trawl with fish moving within it. This could be done by day and by night. It is known that fish congregate in trawled areas, possibly attracted by the noise, in order to feed. Sound fluctuates and fish react more positively when the rate of change of signal is greatest. Possibly sound may only act as a distant stimulus which alerts the fish, sight is probably more important at close quarters even at low light levels.

j The significance of electrical stimuli in the capture process

Dr Kure reviewed the present state of our knowledge for the group. In the sea pelagic fish swim towards the + electrode where the extraction pump is situated. Experiments in a rectangular tank have established the swimming activity at different gradients (volts/metre). The threshold for taxis in mullet for a speed of 1 m/s was 11 v/m but the effects of the tank shape are difficult to interpret. Dr de Groot continued by describing experiments with electrified shrimp trawls. Catches of marketable shrimps were increased by about 100 per cent, particularly in summer when, due to the clear water, catches were noticeably low. There were technical problems due to the resistance in the cables and the use of intermittent pulses to catch sole has proved uneconomic.

k Survey of large seawater tank facilities in ICES countries

Mr Anthony submitted a draft of the questionnaire and this was discussed using the Aberdeen facilities as an example. The purpose is to inform intending visiting scientists of existing facilities and to provide information of use in the design and construction of future facilities. It was decided by the delegates that the scope of the survey should be widened to cover all facilities which are being or might be used for fish behaviour research including small specialised tanks and permanent field sites.

3 WORK TAKING PLACE NOT ALREADY MENTIONED AND OF INTEREST TO THE COMMITTEE

Scotland

-- Tracking acoustically-tagged cod in a sea loch by means of a hydrophone array. They appeared more active at night but the general level of activity was low.

-- Seasonal thyroid levels are being investigated in relation to fish vulnerability.

-- The reaction of cod to artificial barriers in a large tank.

Germany

-- The behaviour of schools of salmonids.

-- The reaction of fish to pelagic trawls using the multi-netzsonde.

Poland

-- Observations are being made under natural conditions using cameras and a two man underwater vehicle. The aim is to improve trawls.

-- Electric stimuli are being used on pelagic and bottom trawls to increase their efficiency.

France

-- Gear is being designed to catch Nephrops but exclude hake.

-- Various baits are being tested to improve the catch of tuna.

Norway

-- The movements of acoustically-tagged fish in fiords using a hydrophone array.

-- The effect of weak electromagnetic fields on fish.

-- The behaviour of shoals using a multibeam sonar.

England

-- Tracking acoustically-tagged plaice and cod in the open sea in relation to tidal currents using the ARL Scanner.

-- The effect of weak electromagnetic fields on fish.

-- The development of telemetering techniques to record remotely physiological parameters from acoustically-tagged fish.

4 RECOMMENDATIONS

1 The Fish Behaviour Working Group shall meet again for 3 days at Ostend in April 1975 under the chairmanship of Dr Hovart to consider especially the biological and physiological aspects of electric fishing and fish behaviour in relation to electric fields, and, further, to review progress on other fish behaviour topics. One day of this meeting shall be devoted to a joint meeting with the Fisheries Engineering Working Group dealing with engineering aspects of electric fishing.

2 In reconsideration of recommendation 3 from the 1973 Working Group at Nantes this meeting recommends that different institutes answer the questionnaire on experimental tank facilities.

3 In discussing the specialized tank facilities available for fish behaviour studies the Working Group decided that further consideration should be given to more fundamental aspects of aquarium design and operation. This broader subject is also important in the field of aquaculture.

Accordingly, it is recommended that a working group should be established jointly with the Fisheries Improvement and Shellfish Committees to discuss the design and practical operation of seawater aquarium systems. The proposed working group should initially meet

on a single occasion, but might itself consider whether it should be reconvened periodically (perhaps triennially). The meeting should be held at a place having extensive modern aquarium facilities and Texel, in the Netherlands, is suggested with Dr S. J. de Groot as convener.