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PHOTOGRAPHY OF FISH BEHAVIOUR IN RELATION TO TRAWLS

by

B. B. Parrish, J. H. S. Blaxter and
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Introduction

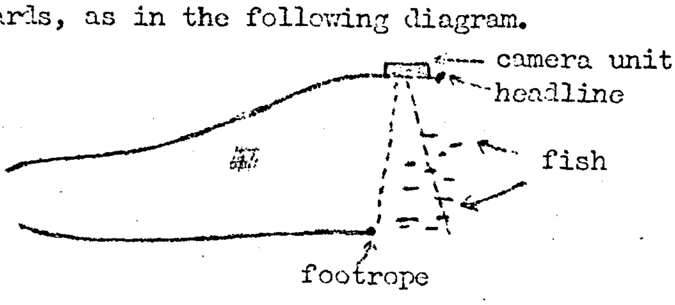
Some results of tank observations on the responses of herring and other species to moving "obstacles" in daylight and darkness were given in an earlier paper to this Committee (Blaxter, Parrish and Meadows, 1960). On the basis of these observations, it was suggested that vision might be the principal factor governing the responses of fish to the approach of towed fishing gears (e.g. trawls) and that, in consequence, these responses and the mechanism of capture may differ according to the light conditions near the sea-bed.

Although the obstacles used in these experiments included the groundropes of trawls, with and without bobbins, and model nets, it was not possible to generate in the tanks the full range of stimuli, besides visual ones, produced by trawls in the sea (especially the wide range of high and low frequency vibrations and sounds, and pressure waves set up by the trawl boards, warps, bridles and net). It was important therefore that attempts should be made to seek confirmation of these observations at sea. This paper describes briefly the methods which are being used for this purpose, and some of the preliminary results obtained so far.

Experimental Method

While continuous, direct, underwater observations by frogmen equipped with cameras is, perhaps, the most satisfactory method of investigating the reactions of fish to towed gears in shallow water in daylight, they cannot readily be made by this means in darkness, or in deep water. Similarly, observations by ciné cameras or underwater television demand continuous artificial lighting in darkness, which prohibits the study of the normal behaviour of fish at sub-threshold light intensities. Therefore "still" photography, with electronic flash, using a camera unit developed at the Marine Laboratory, Aberdeen, was adopted for making the underwater observations. The camera unit and its method of rigging are described by Craig and Priestley (1960). The camera unit was attached to the trawl before shooting, and the synchronised shutter and electronic flash set to operate at one minute intervals, a series of photographs therefore being taken at regular intervals during the haul.

In the experiments conducted so far, attention has been directed principally to the study of the reactions of fish in the vicinity of the mouth of the net, immediately in front of the groundrope. Therefore in most trials a camera unit was mounted on the "square" behind the centre of the "headline", pointing downwards, as in the following diagram.



In a few trials, however, other positions, and two cameras have been used, especially at the back and to the sides of the "square", pointing downwards and outwards, so as to photograph the "wing" region of the net.

In 1961 and 1962 observations were made, in daylight and darkness, in a number of localities in the northern North Sea in depths ranging from 50 to 200 metres. Measurements of light intensity at the bottom were taken with a photometer unit (Craig and Lawrie, 1962) and, wherever possible, the observations were made under conditions either substantially above (i.e. >1.0 photopic lux) or below (< 0.1 photopic lux) - the visual light threshold for herding determined from the tank experiments.

The films taken on each series of trials were developed on board ship, or immediately on return to the Laboratory, to enable a quick survey of the results to be made, but a more detailed analysis was made subsequently from prints taken from all negatives showing the presence of fish.

Results

The trials undertaken to date show that the photographic techniques adopted successfully record the presence of fish in the vicinity of the mouth of the trawl (In almost all trials, excluding those in which camera breakdowns occurred, some records of fish have been obtained).

In the analysis of the records attention has been paid principally to (a) the orientation of the fish relative to the direction of movement of the net (in instances where no portion of the net is shown in the photographs, this can be determined from knowledge of the position of the camera unit on the net, and of the fish and their shadows in the photograph); (b) the distance of the fish from the sea-bed, and whether they seem to be actively swimming.

In addition, the records of species identified on the photographs have been compared with those present in the catch (in all trials a small mesh cod-end or a small meshed cover over the cod-end has been used).

The data so far collected for hauls made under visual conditions (light intensities >1 photopic lux) show, in almost all frames containing fish, orientation in one direction, away from the net. Examples for herring, mackerel, a gadoid species (? whiting) and sandeels are given in Fig.1. The appearance is of active swimming in front of and away from the groundrope, as previously observed in the tank experiments and by frogmen in shallow water. In the sandeel and mackerel examples, the fish are distributed well off the bottom in the mouth of the net, whereas in the herring and gadoid examples the fish are swimming close to the sea-bed.

Although fewer records have been obtained at light intensities below the visual threshold, those which are available show, in general, a much lesser degree of orientation in one direction than those in the daylight trials. Fairly typical examples for herring and gadoids are given in Fig.2 A and B. As illustrated in those examples, frames containing more than one fish show a range of directions of swimming; furthermore, many of the fish appear to be relatively inactive, and in close contact with the sea-bed. In contrast to this general result is the sandeel example, shown in Fig.2C, which exhibits orientation and swimming away from the net, as in the daylight trials. However, some other records of sandeels in darkness reveal no signs of orientation.

In addition to observations on the orientation of fish in the mouth of the net, records are also being kept of the numbers of different species (whenever these can be identified) occurring in the photographs, and the numbers caught in the trawl, in order to provide information on the total selectivity of the gear. It is interesting to record that in the hauls in which sandeels have been observed in large numbers in the photographs, only very small numbers have subsequently appeared in the catches, nor did mackerel appear in the haul from which the example in Fig.1C was obtained.

Conclusions

Thus the preliminary results obtained from the sea trials are in general conformity with those obtained in the tank experiments in showing, under "visual" conditions, a high degree of orientation and active swimming away from the approaching net and, in darkness, a much smaller degree of orientation and less active response. However, as shown by the sandeels in Fig.2C, some directional reactions may take place, in darkness, presumably in response to other types of stimulus, especially among densely packed concentrations of fish; luminosity, caused by organisms in the water may, also, sometimes make the approaching net visible.

The observations made so far have been confined to the water immediately below the headline and in front of the groundrope of the trawl. Many more such observations, especially in darkness, and in the region of the "wings", bridles and sweeps are needed before the major differences between the reactions of different species of fish in daylight and darkness can be properly assessed by this method. A further extensive series of experiments is being planned for the coming year.

Acknowledgements

We wish to acknowledge the assistance given in this work by our colleagues, Mr. R. Priestley and Mr. A. Ranachan, who have been responsible for camera operation and maintenance, and for developing the films.

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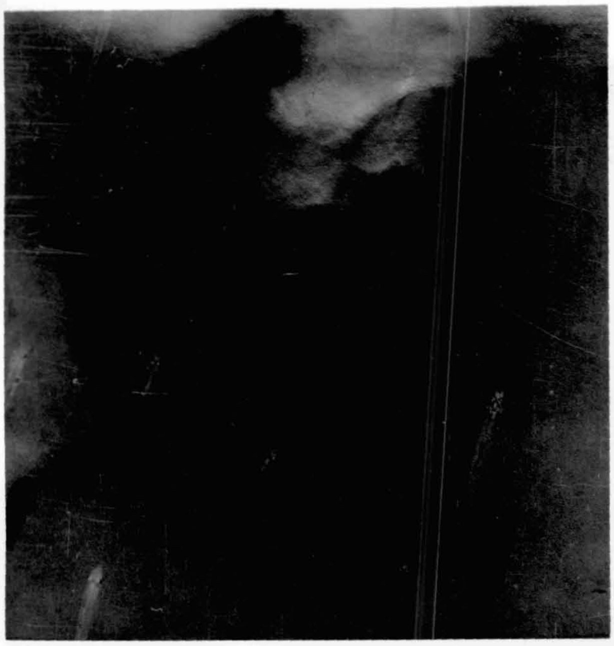
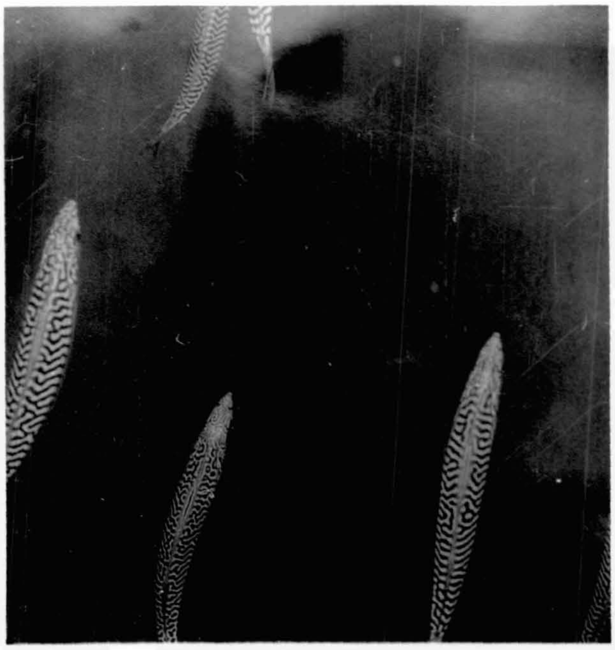
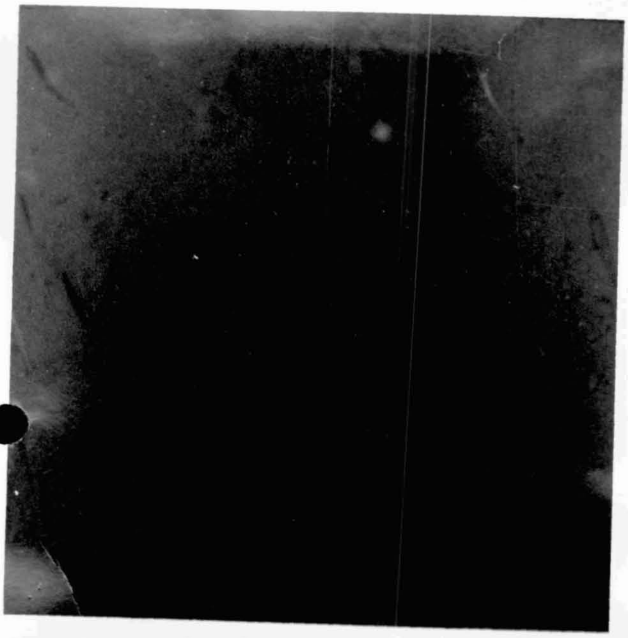


A. Herring



B. Mackerel



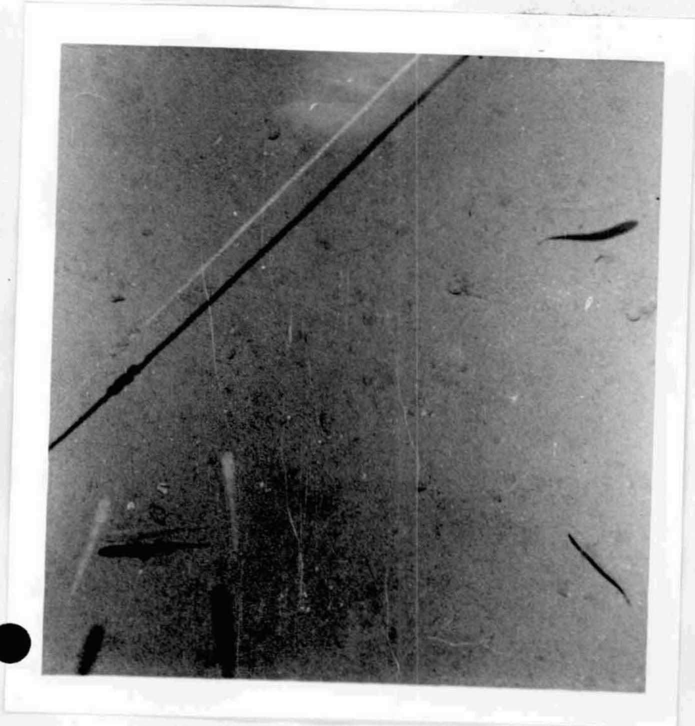
C. Gadoids

D. Sandeels

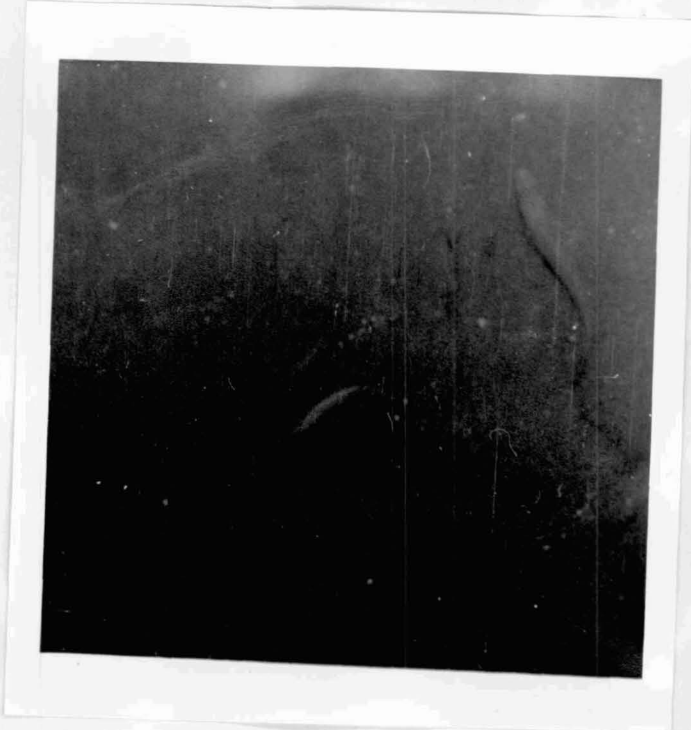
Direction ↑ of tow

Fig. 1. Examples of fish in mouth of net at light intensities above threshold.

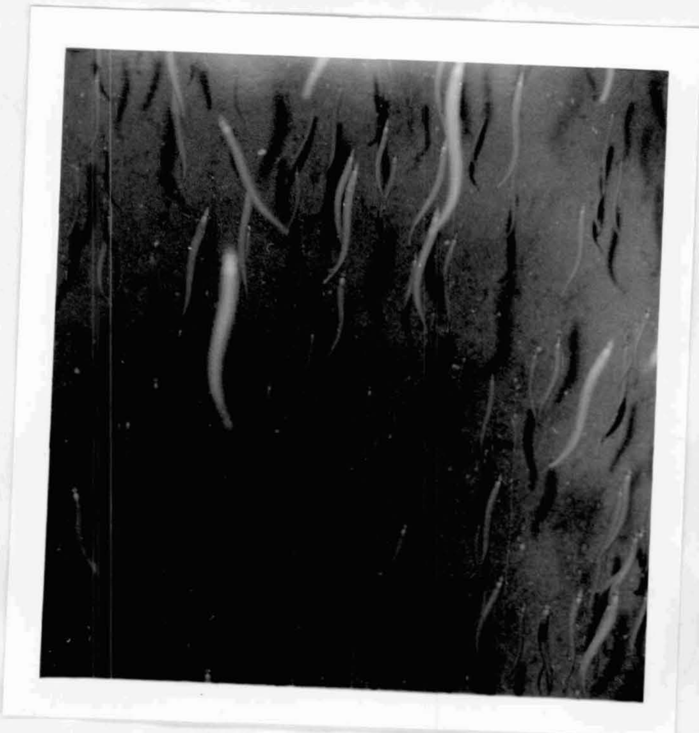
Fische vor dem Netz können nicht unterschieden und im Netz zu sehen!!



A. Herring



B. Gadoids



C. Sandeels

Direction ↑ of tow

Fig. 2. Examples of fish in mouth of net at ~~at~~ light intensities below threshold.