International Council for the Exploration of the Sea

C.M. 1971/B:3
Gear and Behaviour Committee

Report of the Gear and Behaviour Methodology Working Group

TERMS OF REFERENCE

a To review the research methods and techniques (involving both direct observation and instrumentation techniques) useful in studies of fish capture, including the fishing gear itself and fish behaviour in relation to the fishing gear and fishing method.

b To assess the priorities of study in gear and behaviour research.

MEETING

The Working Group convened by A. R. Margetts (Chairman, Gear and Behaviour Committee) met in London on 3-6 May 1971.

ATTENDANCE

The following members and guests attended:

Members:	Belgium:	G. Vanden Broucke
	Canada:	P. J. G. Carrothers
	France:	G. Kurc A. Percier
	Federal Republic of Germany:	A. von Brandt H. Mohr
	Ireland:	J. P. Hillis (Rapporteur)
	Netherlands:	J. G. de Wit H. C. Besançon S. J. de Groot
	Norway:	G. Sundnes
	Spain:	R. Robles
	United Kingdom (England):	A. R. Margetts (Chairman) J. P. Bridger
	United Kingdom (Scotland):	J. J. Foster C. C. Hemmings D. N. MacLennan A. D. Hawkins
Guests:	FAO:	J. Schärfe
	FAO (Poland):	W. Dickson

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AGENDA

Methodology

The Group agreed, in general, to the Convenor's draft agenda. Consideration was to be given particularly to three aspects of gear and behaviour methodology, which were:

1 a critical appraisal of methods that have been and are being used (especially their strengths and advantages and their weaknesses and limitations for particular purposes);

2 a survey of facilities and equipment that are available, indicating what others would be essential or desirable;

3 an appraisal of where cooperative effort could be most beneficial.

The known and currently used methods and techniques were broadly classified as follows:

a Direct observation and photography

Diving
Submersibles: free and tethered, manned and unmanned
Underwater habitats
Cameras
Television
Sound recording

b Measuring instrumentation

Measuring instruments
Data transmission
Data logging and processing

c Sonar instruments

Multi-transducer gear-mounted
Searchlight sonar
Sector-scanning sonar

d Comparative fishing (including statistical analysis)

Controlled experiments, e.g. alternate haul, parallel fishing
Analysis of fishing records
Selectivity experiments

e Experimental tanks, laboratories and ranges

Tank design
Flumes
Models
Aquaria

As there was to be an ICES/FAO Symposium on Acoustic Methods in Fishery Research, to be held in 1973, consideration would be given to acoustic methods applicable only to particular gear and fish-capture investigations, but not to methods for fish-finding as such. Also purposely omitted from consideration were the more technological aspects of fishing developments - such as efficiency increase by reduction of unproductive fishing time, search techniques, etc. - which were outside the scope of ICES.

Assessment of priorities

1 Subjects under regular review by ICES, e.g. selectivity.

2 ICES immediate requirements.

3 International collaboration and integration with other international organizations.

PROCEDURE

Within each agenda subject, a brief review of the methods was presented by an expert in that particular field and this was followed by a discussion appraising the methods and drawing attention to particular features of methods which were either their prime advantages or their limitations for some purposes. Attention was drawn especially to where future development or improvement in a method appeared to be feasible and gave definite promise of producing better results. The extent and location of method facilities amongst member countries was noted.

Methodology

In the following paragraphs, descriptions of methods (which are available elsewhere in publications) are not given, nor are many of the well-known attributes of methods both good and bad and including costs. The order of the paragraphs corresponds to the order of the agenda items.

a Direct observation and photography

Diving, submersibles and underwater habitats all concern man in the sea. There he is both observer and recorder, with great flexibility of action and purpose, even to the extent of changing his programme. An essential equipment is a commentary recorder with known time base.

For the future the following equipment would improve effectiveness:

1 range-gated laser,

2 closed-circuit breathing system (being quieter and so allowing closer approach to fish),

3 heated diving suits,

4 improved navigation methods for free submersibles.

For most gear studies towed manned submersibles were considered to be preferable to free manned submersibles.

ICES countries with teams of fisheries research divers were: Scotland, Canada, France, Norway and England.

The use of paired stereo-cameras with computer to construct 3D pictures is being developed in Scotland and should allow length and distance measurements to be made.

In general, cameras were proving to be more useful than television because of the blur effect of the latter, but it was noted that modern developments in image intensification and tube performance render television cameras more sensitive than the human eye or still cameras.

The importance of sound underwater to fish catching and fish behaviour is now recognized, yet knowledge about it is very incomplete. Included in needed investigations are a study of the possibility of fish being sensitive to echo-sounder transmissions, a study of noise-making sources on fishing gear (which may be possible by use of an array of hydrophones on the seabed or hydrophones on the gear), and the collection of "sound signatures" of individual fishing vessels steaming and working.

b Measuring instrumentation

Speed measurement is fundamental to all gear engineering projects, yet the accuracy of this is still inadequate. For speed through the water, the ship-mounted electromagnetic and Doppler logs are clearly better than towed propeller logs. For speed over the ground, satellite navigation may in some circumstances be better than Decca and radar fixing. Development of the Doppler-type system may in future provide a better net speed meter.

There is a need to quantify much more precisely the speed and flows of water around and through nets. Research is also needed into the reaction of fish in relation to variations in pressure and water speeds in the vicinity of moving fishing gear.

In general, engineering is able to satisfy gear measurement requirements, but a method of accurately and reliably measuring the angle of attack of otter boards has not yet been devised.

For data transmission between gear and ship, after a thorough comparison of their relative merits, it appeared better to concentrate on development of cables rather than wireless links. Cables can cope with all the electronic apparatus and the required speeds of data transmission for most fishing gear applications, while in others handling problems may give rise to difficulties. Wireless links restrict the volume of data flow. An international pooling of cable specification requirements could facilitate the obtaining of correct cables: the Group requested that the Chairman of ICES Gear and Behaviour Committee should collect from members both the details of cables already satisfactorily in use and their anticipated requirements of special cables with a view to coordinating development. Simultaneous multiplexing of signals as distinct from time-division multiplexing will speed the transmission of data; it puts heavy demands on a wireless link but not on to a cable link.

Processing of data on the dynamics of fishing gear necessitates the use of computers. There is at present a lack of uniformity in the programming and computing between fisheries institutes in different countries. For effective international cooperation it is essential that there shall be an exchange system of programs and a standardization of computer type, digitalization, etc. In establishing a data bank careful forethought must be given to vetting data.

This Working Group recommends that, as a matter of urgency, ICES should set up a working group to look into the practicality of adoption of exchangeable computer techniques and data.

The following ICES countries possess ship-borne computers: France, Germany, Norway, Scotland, Poland, Spain. The following have gear and behaviour programs: Germany, England, Poland, Scotland. Only Scotland is using a ship-borne computer with appropriate programs directly in gear investigations.

c Sonar instruments

The pattern of fish behaviour as seen by "netzsonde" can sometimes be used to identify fish species near a trawl. The use of a netzsonde on a bottom trawl confirms whether the net is truly on the bottom and at what depth. Details of bottom topography are more accurately seen by netzsonde than by ship's sounder. Time varied gain is needed on all acoustic equipment.

Electronic sector-scanning sonar gives a panoramic view independent of light and turbidity; its high resolution is over a range of 400 m, thus restricting effective working depth to 75 m. Using the scanner together with a transponding fish tag, the speeds and small movements of a fish have been studied, and it is expected that reactions of a fish to gear may be followed.

England is the only country with a ship-borne electronic sector-scanning sonar.

d Comparative fishing

Comparative fishing is necessary especially because we still do not have a means of assessing gear efficiency in absolute terms.

It is recommended that an ICES working group should draw up guiding rules for the conduct of comparative fishing experiments and the improvement of standardization of methods and data collection.

Means for assessing gear efficiency quantitatively are required; counting and integrating apparatus in front of the gear is indicated. The acoustic arch and echo-integration apparatus under development in England might assist in this.

In analysing commercial fishing logs the choice lies between relatively few records of fairly high quality given voluntarily or a much larger volume of data of inferior quality obtained by obligation or offer of reward. Even with good will, the volunteers seldom persist with log-keeping especially when trawling since it is so demanding on their time. Improvement of this situation is unlikely.

In mesh measuring, improvement is to be sought by relating the loading of a mesh gauge to the thickness of the netting twine. Better understanding is needed of the mechanism of mesh selection and of variations in selectivity; this may be possible via simple tank experiments. Experiments with gill nets have already shown that large powerful fish can raise the selection factor of the bigger meshes.

e Experimental tanks, laboratories and ranges

The experimenter has the environment largely under his control, but psychological pressures on the fish and danger of epidemic diseases have led Norwegian workers to concentrate on working in fjords rather than tanks. Conversely, for

some experiments, Scottish workers have moved from sea lochs to tanks. "Race-track" or "stadium" shaped tanks appear to be most suitable for many swimming reaction experiments. Flatfish soon (1-3 stimuli) learn how to avoid moving objects. After a period of sustained activity, flatfish take a long time (up to 24 hours) to recover. Learning by fish invalidates some repetitive experiments.

Large experimental fish-behaviour tanks exist at Aberdeen and Bergen. At Lowestoft a flume is in use. At Boulogne a gear experimental tank is in use and another is to be built at Lorient.

While small models are relatively easy to make and test and can give some idea of the general shape that a net will take up, measurements of drag etc. on less than $\frac{1}{4}$ scale models are inaccurate. Models of $\frac{1}{4}$ to $\frac{1}{2}$ scale are too big for almost all available tanks and experiments on these have to be carried out in open water.

ICES gear and behaviour priorities

It is noted that Gear and Behaviour Committee will at times necessarily be concerned with special problems emanating from or closely associated with the needs of NEAFC and ICNAF and fisheries regulatory measures, usually channelled to it through Liaison Committee, and that these will generally require immediate attention. Also Gear and Behaviour Committee is already charged with keeping under review certain subjects, e.g. mesh selection, and features of gear and fishing affecting fishing effort measurement, which from time to time will require concerted examination.

This Working Group, accepting the above, further recognizes that:

1 ICES Gear and Behaviour Committee has a very wide remit which includes all matters related to fishing gear, fish behaviour in general, fish behaviour in relation to fishing gear, fish-finding, and engineering in relation to fish-catching.

2 There is a growing interest in member countries of ICES for gear and behaviour research.

3 Many of the above-mentioned items are interrelated and therefore a good communication system between scientists working in these fields is becoming more and more necessary. Among these scientists there is a growing demand for collaboration within their own discipline and coordination with other and related disciplines.

4 Many scientists working in these fields are for a number of reasons not able to attend the Gear and Behaviour Committee meetings at the annual Council meetings.

5 The many disciplines involved and the problems noted in 4 above make the Gear and Behaviour Committee meetings a poor vehicle for the exchange of technical information.

6 The Gear and Behaviour Committee of ICES could become more effective for collaboration and coordination in selected fields of gear and behaviour appropriate to the general scope of ICES, with due consideration for the activities of other existing international bodies.

This Working Group recommends that the following working groups should be set up:

I A working group to advise on working procedures (directed to a rational and central plan) for data collection and processing in fish capture research.
NOTE: The further objective of this plan would be the establishment of an international data bank in which would be stored data from gear/behaviour and other relevant experiments.

II A working group concerned with the standardization of scientific methods of comparing the catching performance of different fishing gears.
NOTE: It is anticipated that a document (manual) providing guidance on experimental procedures would be produced.

III A working group to study and, if necessary, carry out or promote collaboration in research concerned with sound and vibrations, in so far as sound and vibrations affect the fish capture process.

IV A coordinating working group consisting of the Chairman of Gear and Behaviour Committee together with the chairman and one other designated member of each existing gear and behaviour working group, to keep under review the progress of these working groups and advise the Gear and Behaviour Committee on future working group requirements.

NOTE: (a) This Working Group expects that engineering problems concerning fishing gear and fishing vessels and their interrelationships will arise. Some gear and behaviour working groups may encounter special engineering problems outside their immediate expertise. This Working Group therefore advises that the coordinating working group should consider the setting up of a separate working group to meet these needs.

(b) The separate working groups will be required to report to the coordinating group as well as to the Gear and Behaviour Committee.