C.M. 1980/B:10
Fish Capture Committee

FIRST REPORT OF THE PLANNING GROUP FOR THE SYMPOSIUM ON FISHERIES ACOUSTICS

*General Secretary
ICES
Palaegade 2-4
DK-1261
Copenhagen K
Denmark

Supplement to C.M. 1980/B: 10

Fish Capture Committee

Planning Group for the Symposium on Fisheries Acoustics

1. Ref. Para 3 of the report it is proposed that lecture (b) on physical calibration of equipment should be invited from Dr. Joseph A. Blue, Chief of Measurements Branch, Naval Research Laboratory, Underwater Sound Reference Division, U.S.A.

   Other selections will be made shortly.

2. Ref. appendix 2 a further country report has been received from Dr Armin Lindquist of Sweden. This is reproduced below.

In the Baltic the first echo integrations were made in 1975 and they have continued since then. The same equipment has been used, but the method has been improved, and a really quantitative survey was carried out for the first time in 1978 in cooperation with the German Democratic Republic, the Swedish research vessel Argos doing the acoustic work and GDR research vessel Eisbar mainly the trawl work. This survey was repeated in 1979 and is planned for 1980, in October. Surveys are made for both pelagic species in the Baltic, namely herring and sprat. Both are most dispersed in October. The results are used by the Working Group for the Assessment of the Baltic Pelagic Stocks (C.M. 1979/J 3 and C.M. 1980/....).

C is calculated from single fish recordings, giving 6 ton/NM^2 or TS of = 38 dB. The same C value has been used for all sizes of herring and sprat and no corrections have been made for day and night catches.

The most important task is now to make more cage experiments for a better determination of C.

In area IIIa (Skagerack and Kattegat) echo integrations started in 1975, too, and have continued since then. Those for 1979 have been used directly by ACFM and since the herring stock of IIIa nowadays consists of young herring mainly, the acoustic method is the only for making stock assessments. The survey in August/September 1980 will be used in a special session of ACFM during October to assess TAC of herring in 1981 in IIIa.

A C value of 15 has been used, independent of length distribution. The only important species are again herring and sprat. There is a strong need for more cage experiments.

After all the experience we have gained, I am convinced that this method will stay with this laboratory. The great problems are, of course, the quantitative estimates but there are some interesting observations, in the Working Group reports for the Baltic, showing that the difference between the VPA and echo survey is not very great. The method has of course given very valuable information about the horizontal distribution of herring and sprat. Surveys of this kind have to be carried out by at least two vessels, one making the acoustic work and the other trawling (as in the case of the Baltic and the echo operation with GDR). In area IIIa a Danish pelagic pairtrawler has co-worked with Argos and trawled the fish for indentification.

8 September 1980

Two further reports are:-

South Africa:

Fisheries acoustic research in the Republic is conducted by the Sea Fisheries Institute, Department of Agriculture and Fisheries.

Since 1979, the Institute has been involved in developing acoustic techniques for surveying Antarctic krill (Euphausia superba), and for studying its behaviour and dynamics in an area to the south of the African continent. The Institute is to participate in the international FIBEX-BIOMASS study on krill in February/March 1981. An acoustic program is also underway to assess the distribution and dynamics of macroplankton and micronekton in the vicinity of Gough, Marion and Prince Edward Islands.

In addition to a commercially-produced echo-integrator (120 kHz) the Institute uses a locally-designed digital data logger and microprocessor-based digital integrato for quantitative studies. The Institute has also developed a remotely-controlled calibration system for the calibration of hull-mounted high frequency transducers.

Acoustic surveys have been conducted off South West Africa (Namibia) since November 1978. These consist of 5 to 6 monthly cruises covering the summer spawning season of the major pelagic and mesopelagic species such as anchovy (Engraulis capensis) and horse mackerel (Trachurus trachurus). Sonar mapping is combined with vertical sounding to produce distribution maps which are related to egg and larvae distribution as a guide for studying the movement of stocks and ultimately providing management information.

With the delivery of a new 78-m deep sea research vessel in 1981, acoustic work in the Republic will be expanded to include work on demersal and mesopelagic fish such as hake (Merlucius capensis) and horse mackerel off the South African coast. The vessel has been specifically designed to be acoustically quiet to facilitate acoustic studies and is being equipped with a long-range sonar, a wide range of calibrated echo-sounders and a multi-purpose fast digital data logger, to enable a variety of quantitative work to be carried out to depths in excess of 1 000-m.

The Institute is investigating aspects of echo-integration theory through computer simulations based on a 3-dimensional Poisson distribution model.

IAN HAMPTON

New Zealand:

New Zealand has been investigating the use of acoustics for fish population assessment for about six years. For most of this time work has concentrated on developing hardware, in particular a digital echo-recording system with a capability for echo-counting, integrating and other analytical techniques.

During 1979 a survey of both pelagic and demersal fish was carried out over three cruises in the Hauraki Gulf in northern New Zealand. The cruises were primarily for equipment evaluation, however, consideration was also given to survey designs and a scheme using transects selected randomly from the set of 1° lines of latitude crossing the Gulf was adopted. A number of trawls were also carried out for species identification, the catch consisting principally of Snapper and Jack Mackerel.

During 1980 work has commenced on a study of small pelagic fish (Sprat, Anchovy and Pilchard) off the East Coast of New Zealand. A preliminary cruise was carried out in February and further cruises are planned for October and December. Systematically allocated transects were used in the preliminary survey and it is proposed to investigate the use of post-stratification using hydrographic data (Salinity) since the distribution of the fish is thought to be influenced by the hydrographic regime.

ROGER COOMBS

ABSTRACTS

The Planning Group met in Reykjavik in May 1980, and prepared a draft prospectus which is submitted as Appendix 1.

Each country submitted a brief report, and these are attached as Appendix 2.

Countries are requested to submit cruise reports or similar summaries of survey results, particularly those containing statistical tests of significance.

Countries are requested to keep the group informed about standard acoustic targets, and about any research on this topic.

La groupe de planification s'est réunie a Reykjavik pendant Mai 1980, et vient de préparer un prospectus tentative, lequel est presenté ci-joint Appendix 1.

Chaque pays a soumit un rapport court, et ceux là constituent Appendix 2.

Les pays sont invités à soumettre des rapports de voyage ou bien des sommaires égales, surtout ceux qui traîtent des tests de signification.

Les pays sont invités également à rendre compte des cibles d'étalonnage dont ils se servent et des recherches concernant ceux là.

Report on 1st meeting held on 7 May 1980 at the Marine Research Institute, Reykjavik.

Present:	R E Craig (Convener)	Marine Laboratory, PO Box 101, Aberdeen, Scotland.
	J B Suomala Jr. (Via Convener)	Charles Stark Draper Laboratory 555 Technology Square Cambridge MASS 02139 USA
	U Buerkle	Biological Station Department of Fisheries and Oceans St Andrews, New Brunswick, Canada
	J Jakobsson	Marine Research Institute Skulagata 4, Reykjavik Iceland

A Kemmerer	National Fisheries Engineering Laboratory NMFS/NOAA NSTL Station MS 39529 USA
O Nakken	Institute for Marine Research PO Box 1870-721 5011 Bergen Nordnes Norway
J. Scharfe	Department of Fisheries FAO Via delle Terme di Caracalla 00100 Rome Italy

1st Session

(1) The group considered the general character and scope of the proposed symposium. It was decided to concentrate rather strongly on quantitative assessment of fish population, and not to include acoustics as an aid to fish capture, nor purely bio-acoustic subjects. It was decided to avoid any excess of purely engineering contributions, and the draft prospectus has been rather carefully worded to this end.

(2) It was decided that the meeting should take place in a single forum, and that parallel sessions should be avoided. There was emphasis on the need for ample discussion time, and it was agreed to provide if necessary for review and summary of papers by expert rapporteurs. This however could not be arranged until there was more information about the likely number of papers.

(3) It was agreed to invite selected authors to prepare review papers on major topics and the likely subjects for these are:

(a) General physical principles of acoustic population assessment.

(b) Procedures for physical calibration of equipment.

(c) Fish and other organisms as acoustic targets.

(d) Design and execution of acoustic surveys in relation to distribution patterns of fish.

(4) The outline prospectus was considered and amended as necessary. The revised version of this is attached. The dates for the symposium were agreed as 21-24 June 1982 in Bergen, Norway.

(5) Note was taken of a letter from C.S. Venema FAO and the convener was asked to write and welcome the offer by FAO to prepare an up-to-date bibliography of fisheries acoustics.

2nd Session

(6) The group met to consider its second mandate i.e. to encourage co-operation between countries on this topic, if necessary before the actual symposium. The convener introduced the subject and invited a brief summary of the state of the art in the different countries. These summaries are appended to this report as they seemed to the group to be of some lasting value and interest. The convener was instructed to seek similar brief report from K. Udanov, U.S.S.R.; Malcolm Castle, Australia; Roger Coombes, New Zealand; Ian Hampton, South Africa; and Armin Lindquist, Sweden.

(7) Various proposals for collaboration were considered, without any strong reaction. Three matters however were strongly recommended, and are supported by the whole group.

(a) Members are requested to send to the convener a detailed statement of their method of physical calibration referring clearly to the principles and practical aspects.

(b) Members are to keep the convener informed of any studies on standard acoustic targets in the countries concerned, and on any progress in selecting or developing better standard targets.

(c) Members should send to the convener as many reports as possible giving survey results and statistical confidence limits. While summary papers are desirable for the symposium, what is wanted now is a quick circulation of existing cruise reports, and similar documents, to assist less experienced groups in survey planning. The convener should arrange for papers on (a), (b) and (c) to be copied and circulated to members of the group.

(8) The group will need to meet again in about 1 year's time to prepare recommendations on standard targets and calibration procedures. This is clearly essential if the group is to have any influence on international co-operation. (It is clearly not necessary to meet so soon merely to progress the arrangements for the symposium.) In order to conserve national travel funds it is proposed to meet at the same time and place as other working parties of the Fish Capture Committee i.e. in Nantes, France, in the period 4-8 May 1981.

R E Craig
Convener
27.6.80

APPENDIX 1

SYMPOSIUM

on

Fisheries Acoustics
Bergen, Norway

21 to 24 June 1982

organised by the

International Council for the Exploration
of the Sea (ICES)

with the collaboration of

United Nations Food and Agriculture
Organisation (FAO)

SYMPOSIUM sur les Techniques acoustiques appliquées à la peche

BERGEN, Norvège

21 au 24 juin 1982

organisé par

Le Conseil International pour l'Exploration de
la Mer (CIEM)

avec la collaboration de l'

Organisation des Nations Unis pour l'alimentation
et l'Agriculture (FAO)

The Council first recognised the importance of Fisheries Acoustics through its Herring Committee, and arranged the preparation of an extensive review edited by W C Hodgson and A Fridriksson (Rapp et Proc Verb CXXXIX 1955). Later the topic was transferred to the gear and Behaviour Committee, now renamed the Fish Capture Committee. On behalf of this committee A R Margetts convened a symposium in Bergen in June 1973, and the proceedings were published, with help from FAO (Rapp et Proc Verb 170 1977).

The support of FAO was most valuable in this enterprise, and it should be noted that the successive gear congresses arranged by that organisation included sections on fisheries acoustics, and that the 3rd Congress held in Reykjavik in 1970 was devoted very largely to it.

Council decided by resolutions in 1978 and 1979 that the time had come to convene a new symposium, and is pleased to accept the offer of accommodation and facilities offered once again by Norway.

PROGRAMME

Fish stock Assessment by acoustic methods is the dominant theme for this symposium but papers on other applied aspects of fisheries acoustics will be considered.

The following classification of subjects will be adopted, subject to availability of contributions:

(1) General principles.

(2) Engineering: Design features of equipment for quantitative estimation of fish populations.

(3) Procedures for physical calibration including calibration stability of equipment, and reliability of beamshape information.

(4) Fish and other organisms as acoustic targets.

(5) Fish schools as acoustic targets.

(6) Systems and procedures used in practical surveys.

(7) Design and execution of surveys in relation to distribution patterns of fish.

(8) Reports of survey results including estimates of precision and comparison with other types of estimate.

(9) Other relevant topics.

PROCEDURES AND DEADLINES

There will be invited review papers on the main topics. Other contributions are invited on the topics listed above. Summaries (about 300 words) of proposed papers should reach the convener or vice-convener before 31 August 1981. Authors of accepted papers will be informed in November 1981, and will receive instructions concerning the coding, format,

reproduction and mailing of their contribution. The contributions should be in French or English and should not exceed 3,000 words. A summary should be provided in French and English of not more than 300 words.

All papers will be circulated in full in advance of the Symposium. For this to be done, the necessary number of copies must reach the ICES Secretariat not later than 31 March 1982.

The conveners wish to allow time for discussion, and reserve the right to have related papers presented collectively via a Rapporteur, or if necessary to limit the number of contributions.

Those proposing to attend the meeting should inform the ICES Secretariat not later than 31 March 1982.

Addresses:

Convener

R E Craig
Marine Laboratory
PO Box 101
Aberdeen AB9 8DB
Scotland

Vice-Convener

John B Suomala Jr
Charles Stark Draper Laboratory
555 Technology Square
Cambridge, Mass 02139
USA

For administrative purposes please contact:

General Secretary
ICES
2-4 Palaegade
1261 Copenhagen K
Denmark

Le conseil d'abord a saisi l'importance des techniques acoustiques de pêche par son "Comité du Hareng" et a organisé la preparation d'une large synthèse editée par W.C. Hogson et A. Fridriksson (Rapp. et Proc. Verb. CXXXIX 1955). Plus tard, le sujet a été traité par le "Comité des engins et du comportement", à l'heure actuelle rebaptisé "Comité de capture des animaux marins". Au nom de ce comité, A.R. Margetts a organisé un symposium à Bergen, en juin 1973 et le compte-rendu a été publié avec l'aide de la F.A.O. (Rapp. et Proc. Verb. 170 1977).

Le soutien de la F.A.O. dans cette entreprise a été tres important et l'on doit remarquer que les congres successifs concernant les equipements de pêche organisés par la F.A.O. comprenaient des sessions sur les techniques acoustiques de pêche, et que le 3eme congres à Reykjavik en 1970 leur était consacré en grande partie.

Le Conseil a decidé, par des resolutions en 1978 et 1979 qu'il serait intéressant d'organiser un nouveau symposium et est heureux d'accepter, une fois encore, l'invitation de la Norvège.

Programme

L'évaluation des stocks de poisson par les techniques acoustiques est le thème dominant de ce symposium mais d'autres articles seront étudiés, sur les techniques acoustiques appliqué à la pêche.

La classification suivante des sujets sera adoptée sous reserve de la disponibilité des articles:

(1) Principes generaux.

(2) Ingéniérie : études de projets d'équipement pour l'estimation quantitative des populations de poisson.

(3) Procédures pour l'étalonnage physique incluant la stabilité de la calibration de l'équipement et la fiabilité de l'information concernant la forme du faisceau.

(4) Poissons et autres organismes comme cibles acoustiques.

(5) Cibles acoustiques constituées par des bancs de poissons.

(6) Systèmes et procédures utilisés dans les études pratiques.

(7) Projets et exécutions des études compte tenu la distribution des poissons.

(8) Rapports des résultats des études y compris les calculs de précision et de comparaison avec les autres types d'estimation.

(9) Autres sujets adequats.

Procédures et dates limites

A cette occasion, des articles de synthèse traitant des sujets principaux seront traités. Les experts sont invités à presenter des autres articles concernant les sujets mentionnés sur la liste ci-dessus. Des résumés (environ 300 mots) des articles proposés devront parvenir au Président du Symposium ou au Vice-Président avant le 31 aout 1981. Les auteurs des articles retenus seront informés en novembre 1981 et recevront des instructions concernant le codage, le format, la reproduction et l'expedition de leur article qui devra être en français ou en anglais et ne devra pas depasser 3000 mots. Un résumé n' excédant pas 300 mots devra être fourni en français et en anglais.

Tous les articles seront distribués avant le symposium. Pour ce faire, le nombre de copies necessaires doit parvenir au secretariat du CIEM au plus tard le 31 mars 1982.

Les organisateurs souhaitent qu'un certain temps soit imparti a la discussion et se réservent le droit de présenter collectivement, par un rapporteur, les articles présentant des analogies, ou, si necessaire, de limiter le nombre d'articles présentés.

Les personnes desireuses d'assister a la réunion devront en informer le secretariat du CIEM au plus tard le 31 mars 1982.

Adresses:

Président

R E Craig
Marine Laboratory
PO Box 101
Aberdeen AB9 8DB
Ecosse

Vice-Président

John B Suomala Jr
Charles Stark Draper Laboratory
555 Technology Square
Cambridge, Mass 02139
Etats Unis

Pour les sujets d'ordre administratif, contacter:

M Le Secretaire General
CIEM
2-4 Palaegade
1261 Copenhagen K
Danemark

APPENDIX 2

REPORTS FROM COUNTRIES ON THE PRESENT STATUS OF ACOUSTIC SURVEY METHODS

UNITED KINGDOM

Acoustic surveys using vertical sounding and echo-integration are carried out regularly on blue whiting, sprat, and herring.

The value of these surveys and the reliance placed upon the results differs considerably between species, as follows:

Blue whiting: Surveys are mainly in the first 4 months of the year. The results are not thought to be particularly accurate nevertheless they have provided the major evidence for the stock size, and for determining national policy in relation to this species.

Sprat: Surveys have been carried out mainly in December-January in coastal waters, but a few surveys have taken placed further offshore in July. The winter surveys are not regarded as particularly accurate, but provide a valuable check on the other sources of information. In fact none of the available techniques can provide an accurate estimate of this stock.

Herring: Herring in UK waters are at present scarce and there is difficulty in locating them. International surveys using trawl and acoustic methods have not given useful quantitative data, but confirm that the stock is abnormally low.

USA

Echo counting techniques are used in the United States on an infrequent basis for assessment surveys of salmon in lakes primarily in the northwest region. These techniques also have been used in the Great Lakes, but rather infrequently.

Echo integration techniques are being used operationally off the northwest coast and in the Bering Sea for assessment surveys of Pacific hake, west coast herring, and walleye pollock. Emphasis is on the use of a towed transducer system, real time digital integration, and in-situ target strength measurements with a dual beam system.

Sonar mapping is used operationally in the south western region of the United States primarily for assessment surveys of northern anchovy. Conceptually, the technique consists of projecting a pulse of acoustic energy through the waters and timing the period when it encounters and leaves a fish school (range). These surveys are used in conjunction with egg and larvae surveys and monitoring the commercial catch.

FRANCE

1 Systematic acoustic surveys have been done in the Bay of Biscay to locate schools of sardines, anchovy and sprat. These allowed the preparation of charts for fishermen, showing where fish could be caught. The populations were sampled by pelagic trawl, but this is not considered to give quantitative information, because the different species are not equally easy to catch.

2 A cruise was made by 'Thalassa' in 1978 off the coasts of Iceland and W. Scotland, making an echo-integrator survey of Blue Whiting. The results are considered to be very approximate.

3 In 1979 'Thalassa' participated in the International ICES acoustic survey for herring, again using the echo-integrator. A commercial trawler was used on this operation as a scouting vessel.

4 In June 1980 'Thalassa' will make a 10 day calibration cruise in the Bay of Biscay. In July, following the Council recommendation, France will contribute her part of a second international herring survey.

5 'Thalassa' uses Simrad equipment for echo-integration.

6 We think that assessments by echo-integration should be supplemented by fish sampling (probably by trawl), in order to identify as clearly as possible the fish being detected. The aim is to describe the stock of a particular species, and not merely to measure an undetermined biomass.

7 In 1981, France will participate in the international FIBEX-BIOMASS project, to assess Krill stocks in the Antarctic.

CANADA

In Newfoundland, capelin integration surveys have been done since 1976; redfish counting surveys were started in 1978. A microprocessor-based data logger and an upward looking towed transducer are being developed. Underwater photography is being used for independent estimation of school densities.

In the Maritime region, no routine acoustic assessment surveys are done at present. Interest is in developing this capability for herring and mackerel using a microprocessor-based data logging system. The data logger is in the final stages of construction and will be used this summer on feeding herring concentrations. Other work includes target strength measurements, both under controlled conditions and in situ with a dual beam transducer. Most of the work on the latter has been software development to analyse echo return patterns. Unknown behaviour is thought to be the chief hindrance to quantitative estimates; a towed underwater photographic vehicle has been built to attempt to photograph fish in their 'natural' state as a vessel passes.

In British Columbia, large-scale biomass estimation surveys of pelagic and semi-pelagic species are being done. A dual beam system and methods to study the detailed structure of echo return signals are being developed to determine in situ target strengths.

ICELAND

Herring

The recovery of the Icelandic summer spawning herring has been monitored by echo integrator surveys since 1973. These surveys are carried out in December when the adult stock has assembled on the wintering grounds which are close to the shores of SE Iceland. At this time of the year the stock seems to be aggregated in one or two large schools. Usually the area is about 10-20 sq n.m. and the vertical extension about 10-20m in waterdepth within 100m. The results of these surveys have been used with catch in number at age data to calculate fishing mortalities of the season immediately preceding the survey. These fishing mortalities have then been used to initiate a VPA. Thus a database is being built up to correlate the echo abundance estimates with stock assessments which are based on fisheries data. The echo integration results are used to manage the herring fishery.

Capelin

Since 1978 echo abundance surveys have been carried out to estimate the size of the Icelandic Capelin stock. Since 1979 these surveys have been carried out in close co-operation with Norwegian colleagues. It appears that optimum results are obtained in October and in January - February when the area of distribution is relatively limited and at present surveying effort is concentrated in these months. Due to the rapidly changing weather and ice condition as well as the behaviour pattern of the capelin it has been common practice to wait out in the field for optimum conditions. When conditions become favourable the area of distribution is generally known in detail. Abundance estimates can then be made within a short period of time. The results of the above surveys are used to manage the capelin fishery.

0-group since 1970 echo integration has been used in conjunction with pelagic trawling to monitor the abundance of 0-group fish in the Icelandic area. These surveys are carried out in August each year.

NORWAY

1 SURVEYS

The Institute of Marine Research, Bergen, makes extensive use of hydroacoustic surveys to obtain information on stock size and composition of the fish stocks of main commercial importance in Norway. The use of echointegration techniques in combination with frequent sampling (trawl catches) of the recorded fish enable the scientists to arrive at estimates of number of individuals for each species and year-class within the areas which are investigated during each cruise.

1.1 Capelin

Since 1971 regular surveys have been carried out in the Barents Sea two or three times a year; in January, in June-July and in September-October. The September-October surveys are conducted in co-operation with research vessels from USSR, and the results from these surveys are the main input to the stock assessment work which is the basis for the management of the fishery. Comparison of the acoustic estimates with estimates based on tagging experiments, egg and larval surveys and catch statistics indicates that the acoustic estimates are the more reliable ones.

In 1979 similar cruises were carried out in co-operation with the Institute of Marine Research, Reykjavik, on capelin in the Iceland - Greenland - Jan Mayen waters.

1.2 Cod and haddock

Regular cruises have been undertaken each year since 1976 with the purpose of estimating the amount of immature cod and haddock in the Barents Sea. When comparing the estimates of individuals of one particular year-class in successive years the results seem reasonable, but the acoustic estimates show deviations from VPA-estimates of approximately 50 to 200 percent.

1.3 Sprat and herring

In November-December each year the amounts of 0-group herring and sprat in Norwegian fjords and coastal waters are estimated from acoustic surveys. Some preliminary work has also been carried out on North Sea herring and sprat during 1979-1980.

1.4 Blue whiting

Yearly cruises in March-April cover the spawning fields and migration routes of blue whiting. Estimates of spawning stock size are arrived at and the results show a fair degree of reliability when comparing the estimates from year to year.

2 EXPERIMENTAL WORK

Experimental work is carried out with the aim of quantifying the limits of confidence of the acoustic estimates and to increase the precision of the results. The experimental studies are concentrated on problems related to fish behaviour and carried out in two different projects:

1. Field investigations to study how the recorded fish react to the survey vessel under varying conditions (fish density, depth, size and maturity stage, etc.).

2. Theoretical and experimental studies to establish scattering cross sections as functions of species, length, density and behaviour.