

706.41 B

This report not to be cited without prior reference to the Council*

International Council for the
Exploration of the Sea

CM 1984/B:41
Fish Capture Committee

REPORT OF THE WORKING GROUP ON FISHERIES
ACOUSTIC SCIENCE AND TECHNOLOGY

Convenor: Kjell Olsen, Inst. of Fisheries, Univ. of Tromsø,
Norway
Rapporteur: John Dalen, Inst. of Mar. Res., Bergen, Norway
Meeting Place: Hirtshals, Denmark
Time: 2-4 May 1984

The Fisheries Acoustic Science and Technology Working Group (FAST) was established by the Council Resolution 1983/2:4 which stated:

- (i) "A Working Group on Fisheries Acoustics Science and Technology be established in order to review and coordinate investigations by scientists and technologists concerned with the survey design, planning and execution as well as data interpretation for biomass estimation, of all forms of measurements and observations pertaining to acoustic stock abundance estimation techniques and fishing operations, including behavioural, acoustic, statistical and capture topics,
- (ii) the Working Group (Chairman: Prof. Kj. Olsen) should meet from 2-4 May 1984 in Hirtshals (Denmark) to advise, in particular, on the target strengths of herring to be used in the interpretation of acoustic survey results and to consider present calibration methods with the aim of standardising the procedures of hydroacoustic calibration in ICES member countries."

The Working Group has met and the results of the discussions and recommendations made are presented in this report. It should be noted that the recommendations have not yet been discussed and ratified by ICES and the report has the status of an internal document.

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

Proceedings:

1.-3. OPENING, ADAPTION OF THE AGENDA AND APPOINTMENT OF A RAPPORTEUR

The meeting was opened by the Convenor who wished all the 23 participants from 11 countries welcome (list of participants in Appendix I). He then went through the draft of the Agenda and on request there was general agreement to put topic No 7, General Contributions after topic No 8 and 9. The final Agenda was then as listed below.

1. Opening
2. Adaption of the agenda
3. Appointment of a rapporteur
4. Progress report
5. Administrative business and joint session items
6. Joint session with the Fishing Technology and Fish Behaviour Working Group and the ad hoc Working Group on Artificial Bait and Bait Attraction.
7. Special topic discussion - target strength of herring
8. Discussion of standardization of calibration methods
9. General contributions
10. Other business

On proposal from the chairman, Mr. John Dalen was appointed rapporteur.

4. PROGRESS REPORTS

Progress reports (in alphabetic order by countries).

BELGIUM

In 1983 no research related to the specific terms of reference for this meeting has been carried out.

R. Fonteyne

CANADA

In Newfoundland hydroacoustics is being used to evaluate and monitor capelin abundance. Methods for redfish are being developed. The hardware and software of the HYDAS (Hydroacoustic Data Acquisition System) are being improved but a deep towed body and target strengths remain problem areas.

At the Marine Ecology Laboratory in Nova Scotia further changes to the ECOLOG system include an on-board computer to provide real time output. The system is deployed experimentally to verify the correlation between size distributions estimated acoustically and by trawl catches.

At St. Andrews in New Brunswick the continuing effort to develop acoustic methods for estimation of herring stocks includes development of software for analysis of digital data recorded on a single beam ECOLOG system, measurement of in situ tilt angles, and surveys of wintering and summer spawning stocks.

From Namaimo in British Columbia development of software to plot, to echo count, to echo integrate and to perform **in situ** target strength analysis in digital acoustic data is reported. Field comparisons of acoustic and other methods were made.

U. Burckle

DENMARK

(Danish Institute for Fisheries and Marine Research)

The hydroacoustical work within the Institute is directed towards improving fish stock survey techniques. At present only herring and sprat in the Kattegat/Skagerrak and in the southern Baltic Sea are investigated.

Four main projects are ongoing:

An **in situ** target strength technique is established and has been operational since autumn 1983. The system is of Craig-Forbes type. Data on herring are under processing. A dualbeam equipment using towed body transducer monitoring is under specification. The Craig-Forbes theory is under investigation.

Investigations on the reproducibility of hydroacoustical surveys were initiated in 1983 and further studies are planned in 1984. The objective of these investigations is to estimate the total variance of a stock estimate and identify the contributions of uncertainty from the various steps in the survey procedure.

The Kattegat/Skagerrak/Baltic Sea. include large shallow water areas where the standard technique using ship hull mounted transducers is inadequate. A system operated from a small fishing vessel (20 GRT) with a towed body dragging away from the ship and being stable 2 - 3 m below surface was set up. This system went into operation in autumn 1983.

Target classification is studied in an acoustical tank using wide band (30-150 kHz) techniques. These studies were initiated in spring 1984.

H. Lassen

FRANCE

Three research institutes are concerned with acoustic methods: ISTPM in Nantes, CNEXO and ORSTOM in Brest.

ISTPM is in charge of the assessment of the fish stocks. In 1983 a new programme was started on small pelagic fish in the Gulf of Biscay with one acoustic survey in April-May. The main species of interest were anchovy and horse mackerel. For technical reasons related to the research vessel, the acoustic cruise planned in November on the East Channel and south North Sea herring stock had to be cancelled. For 1984 the following cruises have been planned:

- April-May, Gulf of Biscay, anchovy, sardine and horse mackerel stocks.

- August, French Mediterranean coast.
sardine and anchovy stocks.
- November, East Channel and South North Sea,
herring.

Besides these acoustic cruises, the studies on the identification of echo records have been emphasized in two ways:

- using the species composition of the hauls
to split the biomass into its components
- trying a new type of echo classification from
the echogramme to identify the different species.

At the COB (Centre Oceanologique de Bretagne) in Brest, CNEOX and ORSTOM are going on with the development of a data processing system. A data logger, which is usable in the meantime of the integration process, is nearly completed. Independent programmable threshold, range of interest, bottom limitation etc, will authorize the user to reduce the data to be kept at a reasonable amount.

Further developments concern an echo strength classifier. The present status refers to the settlement of algorithms mainly to classify the multiple echoes in relation to acoustic and other parameters (like environment, day-night conditions, depth etc). The expected product should be able to classify simple and multiple echoes in real time according to programable parameters.

Statistical analysis of integrated values using geostatistics techniques are in process. The first results seem promising for a better understanding of the distribution and for improving the strategy of an acoustic survey.

Field research activities of ORSTOM are mainly conducted in tropical areas. They included a number of acoustic surveys in co-operation with national research institutions in the following countries: Senegal, Mauretania- Venezuela, Indonesia.

E. Marchal

FEDERAL REPUBLIC OF GERMANY

- BFA fuer Fischerei, Inst.f.Fangtechnik. Hamburg

A scattering model for the acoustic behaviour of Antarctic krill (*Euphausia S.*) has been developed. It was derived as a solution of the Helmholtz-Huygens Integral adopted to small inhomogenities inside the water column. Based on this model computer simulations for the back-scattering from larger ensembles of this type of scatterers have been performed. Special emphasis was put on microscopic echo characteristics and their influences on the correctness of the echo integration method (THIEL 1983).

In continuation of the German engagement in the Antarctic research the Second International BIOMASS Experiment (SIBEX) as a part of the international BIOMASS - programme was carried out in Oct./Nov. 1983. A combined echo- and trawl survey on Antarctic krill was performed onboard the polar research vessel "POLARSTERN".

M. Klindt

GREAT BRITAIN

MAFF, Fisheries Laboratory, Lowestoft

Development has been concentrated upon improved calibration techniques. A new lightweight towed body has been procured and a large acoustic test tank is being constructed.

Experiments have also been conducted with new ceramic transducers with circular beam patterns. The aim of this work is to reduce the problem associated with measurement of the transducer equivalent beam angles.

Routine acoustic surveys are conducted upon herring in the West, Central and Southern North Sea.

B. Robinson

Marine Laboratory, Aberdeen

Further experiments have been conducted on the target strength of caged mackerel, herring and sprat. Day/night differences have been studied and, especially in the case of mackerel, significant variations occur which correlate well with the light level. Stereo cameras have been used to measure tilt angles and other features of shoaling behaviour, to investigate the dependence of target strength on behavioural factors (in co-operation with the University College of North Wales).

Work on the dual beam technique for *in situ* target strength experiments has continued. The equipment has been used to record echoes from blue whiting layers. The results showed a bimodal target strength distribution probably caused by the presence of small pearsides among the blue whiting. *In situ* work on herring is planned for the near future.

Measurements of transducer beam patterns have shown that significant errors can arise if the nominal equivalent beam angle, calculated from theory, is assumed to apply in the interpretation of acoustic survey results. Moreover, experiments have shown that the presence of the towed body or different types of transducer mounting can significantly alter the beam pattern in comparison to that of an isolated transducer. The difference between experimental and theoretical equivalent beam angles can be as much as 20%.

Improved calibration techniques have been developed, notably a remote controlled 3 wire suspension for standard targets to calibrate transducers in a towed body. This equipment is operated under computer control to measure the on-axis integral of the echo from a 38.1 mm tungsten carbide sphere. The TVG function is measured by an electronic sampling system. It is considered that the accuracy of the complete equipment calibration achieved by the present technique is 3,6% at the

95% confidence level.

A spherical cap transducer has been designed and constructed as the first stage in the development of a wideband constant beamwidth echosounder which will operate over the octave 27 - 54 kHz.

I. Edwards

ICELAND

Last year routine acoustic surveys on stock assessment surveys of capelin and herring were carried out. To monitor the stocks of different demersal species - mainly cod and haddock - we have started to adjust the echo integration method to these species.

We will go on with *in situ* target strength observations on herring with similar methods ("single beam - Craig and Forbes") as earlier surveys but with a more computerized instrumentation.

O. Halldorsson

ITALY

(I.R.P.E.M del C.N.R. 60100 Ancona)

The assessment of pelagic resources (sardine, anchovy and sprat stocks) carried out in Adriatic Sea since 1976, with three different methods (acoustic and egg survey, V.P.A.) by two Institutes, has continued in 1983. An attempt to compare the results of different methods was made in the Third Consultation on Adriatic Stock Assessment (FAO-GFCM, Fano (Italy), June 1983). Further investigations are necessary in this direction, that seems the best approach to verify the accuracy of the acoustic method.

Work on the techniques for classifying the three most important pelagic species, on the basis of acoustic image analysis, and to discriminate them from the other pelagic species has continued. Improvements (in Hw and Sw) on the parts of the acoustic system, designed for this purpose, have been performed.

The cage experiments on the three species under surveillance have continued and the equations between TS and fish mean length, for each species, have been calculated. However, the results are not quite satisfactory because the method of direct calibration suffers, at present, of a lack of accuracy (such as neglecting the geometries of spatial patterns and the different types of behaviour of encaged fish, shortcomings in relation to volume densities of encaged fish and P.D.F. of the free swimming schools determined by empirical data, etc). That in part, could be overcome using two photocameras aimed at the top (or bottom) and side of the cage. This problem was discussed in the 2nd Consultation of the GFCM Working Group in Fisheries Acoustic (Palma de Mallorca (Spain), Nov. 1982). It is our intention to use, in the next year, the dual beam technique to measure TS and to compare the results obtained by the controlled method and the *insitu* one.

In 1983 two copper spheres (one for 38 kHz the other for 120 kHz) were used for the acoustic calibration of the system. The calibration with standard targets seems more accurate than the calibration with hydro-

phone, that presents difficulties in measuring voltage responses.

M. Azzali

NORWAY

Fish behaviour in relation to acoustic observations

Continued investigations have been undertaken to study and quantify the reaction of fish to surveying vessels. This is to establish relationships between the observed acoustic density of fish compared to the true fish density in the area to be surveyed. Doppler analysis of sonar signals have shown to possess information about the escape-swimming speed of fish.

Fish sizing from resonance echo observations has stimulated physiological studies of swimbladder dynamics in relation to different behaviour modes of the fish. Results showing strong correlations between depth/ambient pressure, swimbladder volume and the condition of the fish. This is considered to improve existing sound scattering models of fish also at ordinary applied echo sounding frequencies.

Acoustic methods

Mathematical sound scattering models of fish based on fish and swimbladder physiology and geometry are established. Data from cut surfaces of shock frozen fish are used as part of the input data to the models.

From a project of acoustic observation of zooplankton it was concluded that a multi-frequency sonar system could yield reliable estimates of zooplankton size distribution and biomass.

Comparative studies were carried out on different ways of establishing conversion functions of echo abundance into fish abundance. The results showed varying and some times minor accordance between conversion functions being estimated in different ways for the same species.

Sound absorption of vertically sound transmission through fish layers were investigated for moderate fish densities. No observable absorption was found.

Towed echo sounder transducers are regularly used in acoustic observation of fish abundances. Especially during bad weather conditions they have improved the quality of the observations.

J. Dalen

SPAIN

In the last two years, the Spanish Institute of Oceanography (IEO) has carried out joint acoustic surveys with Portugal Fisheries Research National Institute (INIP) in order to introduce acoustic evaluation in the routine assessment of the Atlantic Iberian coast sardine stock (ICES div.VIIIc-IXa).

The multispecific pelagic stocks of the Mediterranean Spain (including Balearic Islands) are also being surveyed once a year since 1982.

Occasional acoustic surveys have been carried out in Canary Islands and in some West African countries (Gabon- Senegal, Sierra Leona and Guinea).

No research has been made on fish behaviour aspects, and very little in TS determination, with the exception of some net cage experiments. At the moment there is a program to work in the determination of target strength of sardine, horse mackerel and picarel.

The equipment used for acoustic evaluation is Simrad EK 400 (38 kHz) and QD integrator. Calibration is carried out with standard copper spheres and the TS provisionally considered is the once corresponding to herring used by North Sea group.

X. Pastor

SWEDEN

Sweden carried out two routine surveys each year in co-operation with other countries. In the Division IIIa together with Denmark and Norway and in the Baltic with GDR, Polen, Denmark, FGR. The target species is herring and sprat. The integration is carried out with SIMRAD sounders connected to a computer and the calibration methods involves measurements of standard target copper spheres.

O. Hagstrøm

USA

(Charles Stark Draper Lab./NMFS-NEFC)

The development of the NEFC/CSDL low-cost acoustic sensor/processor is continuing. At sea operations have included experimental survey cruises: e.g. RV."Oregon I" (Blake Plat Eau). RV."Delware II" (George Bank) and RV."Islas Canarias" (Tenerife). The equipment has operated without failure or malfunction for over 1500 hours, including 468 hours at sea. User groups have expressed satisfaction with operation and realtime results produced to date. Modifications to include automatic sea bed tracking and normalized sampling volumes are in process.

J.B. Suomala

5. ADMINISTRATIVE BUSINESS AND JOINT SESSION ITEMS

In relation to topic no 5 of the Agenda it was proposed that the meeting in 1985 should be in Tromsø. The Fishing Technology and Fish Behaviour Working Group will meet at May 20-22 while the Fisheries Acoustic Science and Technology Working Group will meet at May 22-24. This will leave a day for a special joint session between the working groups. A proposed subject for the joint session will be: Fish behaviour problems in acoustic surveys.

6. JOINT SESSION

On topic no 6, the joint session with the two other working groups the following agenda was adopted.

1. Reorganization of the Statutory meeting

2. Our own problems

The chairman of the Fish Capture Committee, Gudny Torsteinson, presented a proposal from a special committee having considered the organizations of the statutory meetings and how they worked. There were no essential comments to the proposal, but several speakers expressed doubt both to the advanced dead-lines for presentations of papers and to the idea of appointed rapporteurs for the presentations. On topic no 2 the working groups found that there were no problems in the co-operations this far.

7. SPECIAL TOPIC DISCUSSION - TARGET STRENGTH OF HERRING

The background for this topic, target strength of herring was formulated by the Council for this particular meeting:

The working group should advice, in particular, on the target strength of herring to be used in the interpretation of acoustic survey results.

The session was started by Dalen Norway. giving a brief introduction into the terms back-scattering cross section and target strength in relation to the special topic. Olsen, Norway. reviewed the length dependent target strength equations which have been established the last ten years, i.e. target strength, per individual fish at 38 kHz.

These are:

Nakken & Olsen. (1973): $\langle TS_{ind} \rangle = 13.6 \log l - 62.8 \text{ dB}$

Dalen et al. (1976): $\langle TS_{ind} \rangle = 19.1 \log l - 70.0 \text{ dB}$

Edwards & Armstrong (1982): $\langle TS_{ind} \rangle = 17.0 \log l - 67.6 \text{ dB}$

Edwards & Armstrong (1982): $\langle TS_{ind} \rangle = 17.0 \log l - 70.3 \text{ dB}$

Anon (North Sea Group) (1983): $\langle TS_{ind} \rangle = 20.0 \log l - 71.2 \text{ dB}$

Halldorsson (1983): $\langle TS_{ind} \rangle = 17.9 \log l - 10.3 \log P - 65.5 \text{ dB}$

Halldorsson & Reynisson (1982): $\langle TS_{ind} \rangle = 21.7 \log l - 75.5 \text{ dB}$

Anon (Norway): $\langle TS_{ind} \rangle = 19.1 \log l - 74.5 \text{ dB}$

Among the assessment people there was some confusions about the different target strength values used and the differences between the equations. Examples of this are: in the North Sea area where they have used a weight normalized target strength for a mean length stock. In the Baltic Sea where the Swedes use the Icelandic equation while the other nations use the North Sea equation, and other areas where the North Sea equation are used even on other species than herring. Some discussions took place whether it was reasonable to apply one equation for all areas and all seasons. Various considerations of different survey conditions, surveys of fish of different length distributions and surveys on stocks at different stages indicated use of different target strength equations.

Summed up: It cannot be assumed that the target strenght applicable to one stock. area and season will be relevant to other fish in other

circumstances. It is not yet possible to specify a general target strength function which may be applied in all acoustic surveys for herring. The weight normalized target strength (db/kg) is significant length dependent, being smaller for larger fish. A length dependent target strength function should be used for establishing abundance estimates of herring. Preferably the length/weight relation should be established for the actual stock, area and season where the survey is carried out. There was a brief presentation of the different methods to obtain target strength data. These are: 1 - from controlled experiments as cage experiment and on stunned or killed fish. 2 - *in situ* observations which consists of direct methods as the dual beam method and indirect methods as we have seen with single beam echo sounders and statistical processing of the echo data. One should, if possible, seek for *in situ* data in connection to all assessment work. It was agreed upon the usefulness of *in situ* data, but one should support the cage experiments and the single fish experiments as complementary approaches to reach recommendable target strength data and greater understanding of the problem as a whole.

A lot of discussions to place on the behaviour aspects of the back scattering process of fish. The behaviour is often described by the tilt angle distribution of the fish, and recent work shows that the variance of the tilt angle distribution is a more sensitive parameter in relation to the back scattering strength than the mean value of the distribution.

Burckle, Canada, showed some photographic data of the behaviour of herring. These data showed great differences between day and night tilt angle distributions. At day there were rather organized distributions while they at night showed a totally stochastic distribution. These day and night differences were also confirmed by Scottish data. The need for representative data related to survey situations were stressed regarding the behaviour studies, and behaviour data from controlled experiments should be comparable to survey situations.

The Scottish cage experiments were presented by Edwards. The latest results on herring show that there were clear differences between the day and night target strength values at a mean of 3 dB. For herring the target strength at 38 kHz was always greater than 120 kHz, while for mackerel the target strength at 120 kHz was greater than 38 kHz - at a mean of 4 dB. Some swimbladder dynamic experiments were also carried out. The swimbladder volume was always reduced during the experiments, more for small fish than for large fish. There was also a change in tilt angle distribution together with a change in swimming activities. The reduced target strength did not show any strong correlation to the reduced swimbladder volume.

Several participants supported the ideas of introducing a depth dependent target strength, and also a behaviour/ship avoidance dependent target strength. Investigations from Iceland and Norway indicated that pressure is a significant parameter of the back scattering strength of swimbladder bearing fish. There were also proposals for establishing day and night values of the target strength since the behaviour could differ much from day to night. If possible, one should also consider different biological situations as feeding, pre-spawning, spawning and spent conditions of the fish. Some of these arguments were based on the rather uncritical use of the North Sea

group target strength equations for all areas, all seasons and even on other species than herring. Ideas were presented to consider the Icelandic target strength equation, representing herring of favourable behaviour and non or small influence from the survey vessel, as a reference equation. On the basis of this one should describe other surveying situations elsewhere and correct the actual applied target strength equation. Although the North Sea group equation from many aspects seems to be high, it seems that we have not enough information to change it in the proper direction. On a special request of how the North Sea group target strength equation was established, it was told that it was based on all published data from controlled single fish experiments and cage experiments being at hand in 1981 (Scottish data and Norwegian data). A target strengt equation was then established by a regression from all these merged data. Whatever target strength equations applied in different areas. one should be aware of the effect that as soon there is a recommended equation this will be taken as the "law".

Summed up:

The target strength may vary with time of day. being lower at night. It should be taken account of these observations. The target strength may vary with other factors such as depth. fish condition and behaviour. These variations are not well understood at present.

To assess the relevance of caged fish target strength experiments to fish in the sea, it is essential that the former should include behaviour measurements, especially the tilt angle distribution.

8. DISCUSSION OF STANDARDIZATION OF CALIBRATION METHODS

On this topic - standardization of calibration methods the Council had formulated:

The Working Group should consider present calibration methods with the aim of standardizing the procedures of hydro acoustic calibration in ICES member countries.

This topic was introduced by MacLennan. Scotland, presenting the methods of using standard targets, e.i. metal spheres, instead of hydrophones to measure the on-axis transmitting and receiving sensitivity of an echo-sounder. Some discussions took place about the different target strengths of spheres from tungsten carbide and copper, temperature dependent and frequency dependent target strengths of the spheres. Besides the published diagrams showing variations with these parameters there should be presented equations for the target strength of the spheres as functions of all relevant parameters.

There are doubts if one could rely on the theoretical or manufacturer's delivered value of the beam pattern function of ceramic transducers. Measurements both at the Institute of Marine Research, Norway, and at the Marine Laboratory, Scotland, have shown significant differences between the measured value of the beam angles and the values given by the manufacturer. The reasons for this discrepancy is not well understood, but the transducers should be measured where they should be used.

The time varied gain generation is also considered as a critical part of an echo sounder. On analog echo sounders measurements have shown

great differences between the measured TVG and the theoretical values. Newer digitally controlled echo sounders do not show this great differences although they are proven to exist. So the conclusion here is that the time varied gain function should be measured in a proper way (conf. Scottish. Norwegian and Canadian methods on request) and correction factors for the observed echo abundance should be made.

9. GENERAL CONTRIBUTIONS

No particular contributions were presented.

10. OTHER BUSINESS

In relation to topics for the meeting next year, topic 10, several participants expressed the need for more information of in situ target strength data and also on survey design applicable for different biological conditions.

It was decided that the meeting in 1985 should consider

- comments on the draft of the calibration manual for echo sounders and integrators.
- information about in situ target strength measurements relation to survey situations.
- acoustic survey design in relation to fish distribution patterns and
- general contributions.

A joint session with the Fisheries Technology and Fish Behaviour WG should consider "fish behaviour problems in acoustic surveys".

The WG appeals to participants to prepare written contributions.

RECOMMENDATIONS

I.

Concerning the target strength function of herring to be used to convert relative acoustic abundances into absolute abundances of fish the Working Group has considered different applied values:

By Iceland: $\langle TS_{ind} \rangle = 21.7 \log l - 75.5 \text{ dB}$

By the North Sea Group: $\langle TS_{ind} \rangle = 20.0 \log l - 71.1 \text{ dB}$

By Norway: $\langle TS_{ind} \rangle = 19.1 \log l - 74.5 \text{ dB}$

It should be stressed that the Norwegian target strength value is used for capelin and also applied for small herring.

On the basis of the facts that these values are established

- 1) for different length ranges of the measured fish.
- 2) on fish measured at different depths.

- 3) from cage experiments, in situ observations and from stunned fish measurements, and
- 4) from fish under different biological/physiological conditions the Working Group cannot from a scientific point of view recommend a unique value of the target strength of herring to be used in all areas- in all seasons or to cover all different biological/physiological conditions.

However, from recent observations on possible depth dependent target strength, the strong relation between the effective target strength and the tilt angle distribution, different levels of avoidance reaction to the survey vessel and comparative studies between stock sizes made from acoustic methods, from the VPA together with catch statistics and from egg and larvae data there are evidences to regard the North Sea Group-value to be slightly high.

But at the present stage the Working Group must conclude that there is not enough relevant information at hand to recommend any numerical changes in any of the applied target strength values. The Working Group will- however, express the need for the target strength values to be used- should if possible, include in situ observations of the scattering properties of the fish and behaviour aspects relevant to the survey situations.

II.

The WG has considered different aspects of calibration of the most important functions of echo sounders, i.e.

- 1) the on-axis sensitivity by means of standard targets
- 2) the beam angles and estimates of the equivalent beam angle for mounted transducers
- 3) TVG-function deviations and estimation of correction factors for the measured echo abundance.

The WG will recommend that calibration on standard targets should replace hydrophone calibration. Measurements of the beam angles for mounted transducers are needed on the basis of proved deviations between measured values and the theoretical beam angle.

Since significant deviations of the time varied gain may exist in echo sounders the WG will recommend this functions to be measured in proper ways and that correction factors for the observed echo abundance should be establish.

The WG will support the work to make a calibration manual for echo sounders on the basis of all published information about this matter. A draft of this manual should be prepared for the meeting in 1985. The WG will ask the institutes in Aberdeen and Bergen to be responsible for preparing this draft.

Appendix 1

PARTICIPANTS

Belgium	R. Fonteyn	Ostend
Canada	U. Buerkle	St. Andrews
Denmark	P. Degnbol	Hirtshals
	B. Lundgren	- " -
	S. Sørensen	- " -
	E. Kirkegaard	Copenhagen
	H. Larsen	- " -
Faroe Island	B. Thomsen	Torshavn
Federal Republic of Germany	H. Klindt	Hamburg
France	E. Marchal	Brest
	G. Biais	Boulogne sur Mer
Iceland	O. Halldorsson	Reykjavik
Norway	J. Dalen	Bergen
	I. Røttingen	- " -
	K. Olsen	Tromsø
Sweden	O. Hagstrøm	Lysekil
	L.E. Palmén	- " -
United Kingdom	I. Edwards	Aberdeen
	D. MacLennan	- " -
	B. Robinson	Lowestoft
<u>Invited guests:</u>		
Italy	M. Azzali	Ancona
Spain	P. Oliver	Mallorca
	X. Pastor	- " -
	J. Miquel	- " -