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International Council for
the Exploration of the Sea

C.M. 1986/B: 42
Fish Capture Committee



Report of the Working Group on fisheries acoustic
science and technology (F.A.S.T.)

HULL 14-16 May 1986

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

1. Introduction

1.1. Participants

The participants of the Working Group (FAST) are given in Appendix 1.

1.2. Terms of reference

At the Statutory Meeting in London it was decided ^{*)} that the following Working Groups will meet in Hull (UK) during the week from 12-16 May 1986, coordinated by the Chairman of the Fish Capture Committee:

^{*)} ICES' C.Res. 1985/2:2

1. The Working Group on Fishing Technology and Fish Behaviour (Chairman: Mr D. MacLennan) from 12-14 May, to consider in particular:

- a) recent applications of energy saving concepts in the design of fishing vessels, deck machinery and propulsion systems,
- b) engineering and behavioural aspects of the selectivity of fish sampling gears.

2. The Working Group on Fisheries Acoustics Science and Technology (Chairman: Prof. K. Olsen) from 14-16 May, to consider in particular:

- a) species identification and size classification in relation to acoustic abundance estimation,
- b) sampling gear and behavioural problems in relation to acoustic abundance estimation, in a joint session with the Fishing Technology and Fish Behaviour Working Group.

2:-3. Opening, Adoption of the Agenda and Appointment of rapporteur.

The chairman wished all the participants welcome to third meeting of the FAST Working Group in Hull. A draft of the Agenda, which were circulated to the members in advance, were presented and adopted.

2. Opening session and general business
3. Adoption of Agenda
Appointment of a rapporteur
4. Joint session with the Fishing Technology and Fish Behaviour Working Group
5. Discussion on Progress Report
6. Special topic acoustic species identification and size classification (C.Res. 1985/2:2)
7. General contribution
8. Discussion and adoption of the CALIBRATION MANUAL
9. Recommendation
10. Other business

On the proposal of the chairman Mr O. Hagström from the Marine Research Institute, Lysekil, Sweden was appointed as the rapporteur for the FAST Working Group Meeting.

4. Joint session

Chairman: P. Stewart, Scotland

Rapporteur: J. Simmonds, Scotland

A separate report of this session is given in: C.M. 1986/B:43.

("Report of the joint session of FTFG/FAST Working Group, Hull, May 1986; Sampling gear and behaviour problems in acoustic abundance estimation").

5. Progress Reports

Canada

Newfoundland Region

Newfoundland Region is the most active region in acoustic survey and development work. During 1985 seven integration surveys were done: 1 redfish, 3 capelin, 1 cod and 2 herring surveys. The acoustic estimates are used directly or in conjunction with other methods of estimating stock size to provide management advice. Development work includes automatic recording of navigation data, a dual beam system for estimation of in situ target strengths, an electronic editing system for digital acoustic data and TVG correction for in situ temperatures and salinities.

Scotia-Fundy Region

Acoustic integration surveys were done on the wintering S.W. Nova Scotia herring stock in 1985 and 1986. The herring occurred in very large aggregations that are thought to contain the major proportion of the total stock. The survey method is a mapping method to determine the sizes and the average acoustic scattering of the individual aggregations. The results to date are not used in estimation of stock size. The aim is to build a time series of acoustic data to correlate with other estimates.

Gulf Region

The work in the Gulf Region at present is a cooperative effort with the Marine Ecology Laboratory at the Bedford Institute of Oceanography to carry out surveys to determine the distribution and abundance of Gulf of St. Lawrence herring.

Quebec Region

There is no acoustic program in the region but the possibility of using acoustics for estimation of herring abundance will be investigated in 1986.

Pacific Region

The Pacific Region expects to have two dual beam systems in operation by the end of 1986. A high frequency (~ 420 kHz) system will be used on juvenile salmon in the nursery lakes to provide management advice to the Lake Enhancement Group. A 120 kHz dual beam system will be placed in the Region's new research vessel, the W.E. Ricker. The first use of this system will be comparative work with the U.S.A. National Marine Fisheries Service in Seattle, Washington.

Marine Ecology Laboratory

Experimental work with ECOLOGY continued during two sea trips and in the laboratory. The results indicated the need for, and led to the development of, a method of field calibrating acoustic dual beam data to account for some of the differences between acoustic estimates and trawl data. Commercial development of ECOLOGY has been undertaken by Seastar Instruments.

The company will build and market two systems, a large vessel system for offshore work and a high frequency system for inshore work. They also hope to develop expertise in conducting surveys and to market that service.

U. Buerkle

Denmark

Surveys for fish stock estimation

In 1985 three routine surveys in the 1). Eastern part of the North Sea, 2). Division IIIa (Skagerrak and Kattegat) and 3). Subdivision 22-24 (western part of the Baltic Sea). The two latter surveys are conducted jointly with the Swedish laboratory in Lysekil. All surveys have herring as the main target species and are staged in July-September.

The division IIIa surveys have now been conducted regularly since 1979 and a project for reviewing this serie of surveys has been initiated.

A first trial for acoustic surveying of cod in the Baltic Sea was made in March 1985. This data which apart from integration and trawl data as usual also include TS-distributions covering the entire survey is still under analysis. Preliminary results suggest that neither trawling nor identification on the echogram is feasible since cod by number is only 1-10%. The TS-distributions show some promise of allowing a split of the integration measurements into cod and clupeoids. The cod stock estimated by swept area technique at the same time at the same period shows agreement within an order of magnitude with the acoustic estimate.

Projects

The group has conducted a 3-week course in hydroacoustic fish stock estimation.

The project on studying the effect of the fish special distribution on predation pattern was continued with analyses of material from a survey

in March 1985 in the Bornholm Bassin where the cod-herring interaction was studied.

The effects of applying a threshold on the signal in integration was studied. The findings are reported to this meeting.

The study on frequency-target strength relationship was continued. A suitable tank setup and calibration procedures were established and a series of measurements is underway in 1986.

Instruments

In 1986 a towed body system carrying a SIMRAD split-beam transducer and a small CTD linked to the SIMRAD ES400 split-beam target strength analyser were installed on the R/V Dana. The towed body system is documented for this meeting.

Calibration of the acoustic transducer mounted on the towed body is facilitated by a special designed calibration rig. This system is designed and built at the Danish Institute.

Measuring the directivity function of the split-beam transducer is required since the SIMRAD ES400 only provides compensation within 2dB. Measurements have shown that the system on R/V Dana only just meet these specifications. The system under design is based on 3-4 hydrophones which after having been positioned by measuring on the calibration sphere on the acoustic axis, gives times differences between received echoes.

H. Lassen

France

Evaluation acoustique

Comme par le passé, l'IFREMER a poursuivi ses campagnes d'évaluation acoustique dans le golfe de Gascogne en avril-mai (sardine, maquereau et chinchard), dans le golfe du Lion-Méditerranée en août (sardine-anchois) et au sud mer du Nord-Manche est, en novembre (hareng). Face aux structures multispécifiques des biomasses rencontrées dans ces secteurs, un effort plus particulier est porté sur l'identification.

L'ORSTOM poursuit ses activités en région tropicale-Afrique de l'Ouest, mer des Caraïbes et Pacifique. Les campagnes saisonnières vont reprendre en Mauritanie conjointement avec celles poursuivies au Sénégal. En mai 85, une campagne d'écho-prospection a eu lieu en mer de Java (Indonésie), où l'on a recherché, par la cotation des échogrammes, à définir des "populations acoustiques" suivant les distributions et le comportement. Le même type d'approche est poursuivi aux Caraïbes. En région Pacifique, ont débuté des essais d'évaluation des populations de Thonidés rassemblés autour de radeaux.

Comportement

A l'IFREMER, des études sur le comportement ont été poursuivies principalement en utilisant les informations fournies par un sonar omnidirectionnel. Une autre technique d'observation du comportement a été recherchée par la mise au point d'un corps remorqué acoustique spécial.

A la Martinique, l'ORSTOM va entreprendre également des études du même type.

Technologie

Les études sur la classification des échos sont poursuivies par l'IFREMER avec comme objectif final l'identification directe totale ou partielle dans le cadre des programmes d'évaluation acoustique.

Une étude multiorganisme (IFREMER, ORSTOM, UNIVERSITE) est en cours concernant la mise au point de transducteurs large bande et les possibilités de ces techniques en matière d'identification d'organismes aquatiques.

La gamme des fréquences étudiées va de 20 à 450 kHz et les premières mesures ont porté sur des poissons d'eau douce (gardons et truites) sur le lac Léman.

Enfin des mesures d'index de réflexion en relation avec le comportement sur de longues périodes sont un des thèmes principaux des études acoustiques menées en Martinique.

N. Diner

Great Britain - Lowestoft

1. Acoustic Survey and calibration

Acoustic abundance estimation of fish stocks has been confined to herring and mackerel in the past year. There have been two herring surveys, one in the Central North Sea and the other in the Southern North Sea. An extensive survey of mackerel took place during January 1986 in the English Channel and the Southern Bight.

Development of the system now used, and its application, is described in the discussion document to this meeting. 'The English Survey System, including a microcomputer for instant biomass estimation'. (C R Hood).

The 38 kHz system was also used for a preliminary investigation into the quantitative assessment of plankton and a good relationship between plankton settled volume (dry weight) and acoustic intensity emerged. Comparative work at 38 kHz will be carried out in 1987.

Calibration was carried out at the Staines reservoir once more and compared to a calibration in the new acoustic tank facility at Lowestoft. The tank is briefly described by Beach and Hood, (this meeting). Results of the two calibrations were very close.

2. Tilt angle tag

The development of a small acoustic tag to measure fish tilt angles was proposed at the 1985 FAST WG meeting. It was intended to base the work on some sub miniature sensor designs and further tag miniaturisation which is now possible.

However, a few days after the WG meeting the processing facilities at Lowestoft were condemned as being below the required safety standards and their use was forbidden. Urgent efforts were made to provide replacement facilities, but the building work was completed only one month ago and the room is still not operational.

It is hoped that work will be possible in the next few months.

3. New Research Vessel

The RV CORYSTES is nearing completion. This is a 54 m replacement for RV CLIONE. It has been designed for very low underwater radiated noise levels and is fitted with a full set of acoustic survey equipment including the Simrad ES400 split-beam system.

Other acoustic systems include an updated version of the 300 kHz MAFF high-resolution sector scanning sonar, which sweeps a 0.3° beam over a 30° sector at a rate of 10 kHz. There is also a Simrad SM600 sonar.

R. Mitson

Great Britain - Marine Laboratory

Caged fish target strength measurements at 38 and 120 kHz have concluded with measurements of sandeels, which show results similar to those with mackerel. It is unlikely that further work at single frequency will be conducted with caged aggregations. Experiments have been conducted to measure acoustic extinction effects in caged aggregations of herring and

cod. Dual beam measurements on single free swimming caged herring have been made and stereo photographic data has been collected at the same time.

Frequency response measurements of aggregations of cod and herring from 27 to 54 kHz have been undertaken and highly significant differences in spectrum have been observed. Work in this field is continuing with comparisons with other gadoid species and with mackerel planned for 1986.

Survey of herring in IVa, VIa and the Clyde were carried out during the year. Improvements in calibration and with better data processing are giving consistently reliable estimates. New approaches to the statistics of survey data and estimates of survey variance are being developed to obtain confidence limits on survey results.

During acoustic surveys, data recording at the $\frac{1}{2}$ metre depth intervals and for individual transmission are now routine. A data retrieval system operating at 100 times real time allows 8 bits definition display of 12 bit data for a whole 3 week survey in 5 to 6 hours. This data retrieval and display equipment is to become the heart of a post processing system for analysis of survey data with far greater precision and detail than has been possible with real time processing techniques.

Plans for 86-87 include frequency response measurements of haddock, mackerel and herring, dual beam work on herring, including stereo photography to relate target strength and fish behaviour; A continuing survey program with more development of the data processing package for survey data; Initial work on a newly purchased Simrad ES400EK split-beam echo-sounder, including detailed performance measurements of echo level correction factors and equivalent beam angles for the split beam transducer.

J. Simmonds

Iceland

In autumn 1985 and winter 1986, routine acoustic assessment surveys were carried out on the stocks of capelin and herring. The results from these surveys are used for fisheries management.

Target strength measurements on herring were attempted, using the SIMRAD split-beam echo sounder.

The target strength values obtained are not thought to be reliable, and a more thorough study is needed.

Last year the development of a method for measuring the equivalent beam angles of hull mounted transducers was completed. Comparative measurements will be carried out this year, using the angle information available from the SIMRAD split-beam echo sounder.

P. Reynisson

Italy

Development of the research project (financed by Italian Government) that aims at assessing acoustically the Sardines, Anchovy and Spratt stocks in Italian waters, continues in I.R.P.E.M. (Ancona).

North, middle and south Adriatic sea has been sampled in June and July, channel of Sicily in September (1985).

In total 3 000 nautical miles has been sampled and 100 biological station carried out. The raw acoustic signals has been recorded on cassettes for off-line processing.

In the above survey a new acoustic system was used. It works with two frequencies (the 38 kHz hull-mounted transducer and the 120 kHz towed-body mounted transducer) and two different techniques (echo-integration and dual-beam technique). The system is controlled by a processing computer.

At present results provided by two techniques and frequencies (target strength estimation, biomass assessment) are analyzed and compared; the programs, that let to ask a variety of questions and to test hypothesis mostly for species/size identification, are refined.

M. Azzali

Norway

Behaviour

An acoustic method for quantifying the reaction of fish to imposed stimuli has been developed.

The tilt angle distribution of loosely schooling saithe has been photographically determined.

The reaction of schools of herring to the passage of a survey vessel has been recorded through use of an underwater television camera.

Target strength

Absorption of sound by dense aggregations or schools of herring may have been observed.

Use of a split-beam echo sounder (SIMRAD ES system) to measure fish target strengths in situ continues.

Theoretical computation of the target strengths of swimbladder-bearing fish continues.

Equipment

An acoustic system for measuring plankton and larval fish densities is under development.

Acoustic equipment and techniques used in the surveying of marine fish stocks were intercompared for application to freshwater fish.

The equivalent beam angle of hull-mounted transducers was measured by a vessel-tilting procedur.

Calibration

A draft of a guide for calibrating acoustic instruments used in fishdensity estimation has been prepared jointly with the Marine Laboratory, Aberdeen. This has been distributed to participants in FAST Working Group meetings for review.

Sweden

Fish behaviour and reaction

Behaviour studies of both salt water and fresh water species has been carried out using telemetric methods and underwater observations. Work on fish reaction toward stationary gears as gill net and pond net has continued. Construction of new telemetric system has been started.

Acoustics

Routine surveys are carried out in Skagerrak/Kattegat and in the Baltic area. Measurements of target strength of clupeoides and cod in-situ with split-beam sounders have started.

Olle Hagström

U.S.A.

Acoustic survey efforts at the NWAFC are centered on two species - walleye pollock (Theragra chalcogramma) and Pacific whiting (Merluccius procluctus). In the eastern Bering Sea, surveys have been carried out in 1979, 1982 and 1985, with biomass estimates of walleye pollock (including midwater plus bottom trawl estimates) ranging from about 6 to 11 million tons. Since 1980, surveys of a spawning stock of walleye pollock in the Gulf of Alaska have been carried out on an annual basis, except 1982. Total biomass values have decreased from nearly 4 million tons to less than 1 million tons in 1986. In 1986, we are scheduled to carry out the fourth survey of Pacific whiting off the west coast of the U.S.

In 1985, the first trials of a split beam/dual beam/echo integration was completed. A unique capability of the new system is the ability to carry out simultaneous dual beam/split beam target strength measurement. Initial data collection and analyses were promising and analysis is continuing.

In 1985, we carried out a calibration with a towed fin, using a tungsten carbide standard sphere and the dual beam/split beam target strength measurement system. We expect to use this calibration procedure as our standard calibration procedure.

J. Traynor

6. Special topic - Acoustic species identification and size classification

The chairman introduced the special topic and stressed the importance of identification and size classification of fish in relation to acoustic abundance estimate. He also reviewed the present knowledge in this field and underlined the need of improved methods and more data on acoustic back scattering of fish.

The special topic were addressed in 3 written and 3 verbal contributions. The contributions are listed in the order presented; verbal contributions indicated:

1. Technique utilisée à l'IFREMER pour séparer une biomasse, évaluée acoustiquement, en ses composants spécifiques, pris pour la répartir en différentes classes de taille. Résultats de plusieurs campagnes en 1983 et 1984.

N. Diner

- describes the method used to estimate the stock size of each species in a multiple species survey. Catch composition in trawl catches are weighted by the echo level during the haul and coefficient of variation of the stock estimate are given for each stock estimate.

2. Preliminary results of dual beam measurements of encaged herring.(verbal)

S. Forbes

- results indicate no day and night differences

Tilt angle measurements not analysed yet - experimental set up reported to have at the best a precision of ± 1 degree.

3. Some preliminary results using a new split-beam/dual-beam target strength measurement system.

J.J. Traynor

- a new echo sounding system which has both dual-beam and split-beam target strength measurement capability. The calibration method includes measurement of a standard target (tungsten carbide) and phase difference measurement to be used for estimates of beam pattern effects as well as correction for depth dependent sensitivity of the used transducer. The pulse width acceptance window can be specified by the operator. Preliminary result from comparison of target strength measurement using

the dual-beam and split-beam techniques draw attention to the system performance in the narrow and wide beam channels and noise sensitivity of the dual-beam system.

4. Experiences using the ES-400, split-beam echo sounder, with special reference to the single-fish recognition criterium.(verbal)

E. Ona and I. Røttingen

- in situ target strength measurements on scattering layers of herring showed a too wide acceptance window in pulse length (80-180%) for single-fish recognition when measuring small fish. It was stressed that careful judging of the data is needed. Several proposals were put forward to improve single fish recognition including variable windows, and its effect of the distribution of target strength as well as cross correlation and pulse shape analysis. The need of a better single fish recognition concept in the ES-400 system were stressed.

5. A wide band constant beam width echo sounder for fish abundance estimation.

E.J. Simmonds and P.J. Copland

- a wide band sounder system, 27-54 kHz, and experimental test set-up were described. Measurements on caged cod and herring indicate differences in frequency response which appear to be linked to swim-bladder volume, fish behaviour or both. The system indicate a potential for separating aggregation of different fish species.

6. Test of species identification using frequencial characterization with a wide band transducer.(verbal)

A. Lebourges

- a description of the experimental set-up and the wide band transducer system operating were presented. The system were used on two fresh water species and different amplitude peaks were observed. behaviour ~~No~~ observation were carried out during the experiment due to low visibility in the water.

During the general discussions following the presented contributions other methods used for partitioning echo biomass were reported.

The geometric shape and density of shoals as well as behaviour of shoals have been used to classify shoals of different species. This method is basically a subjective method and to a very large extent dependent of the experience of the observer. An attempt to reduce the subjective element in this method was reported from Italy where pattern recognition technique have been applied. It was reported that more than 60% of the shoals could be classified. However, additional information is still needed to verify the classification.

Resonance frequency response (RFD) and changes in directivity detected with sonar technique were also brought up in the discussion. With exception of RFD application in zooplankton investigation no other progress were reported.

Summed up:

It was clear from the presentation and the following discussion that while some research projects aimed at species identification were in progress, the problem was not yet solved. There are, however, good prospects of obtaining usefull results through studies of the frequency difference of target strength and in-situ target strength measurements using dual-beam and split-beam equipment. Research and development work on these technique should be encouraged.

7. General contributions

At the session on general contribution 4 verbal and 10 written contribution were presented. The contributions covered a range of topics within the acoustic field and the contribution were arranged in two subject groups: one dealing with behaviour, target strength and methodology and a second dealing with acoustic equipment. Verbal contributions are indicated.

A. Behaviour - Methodology

1. The chairman started the session with a review of the behaviour observation carried out in the northern part of Norway. A new video recording of the well known Balsfjord herring demonstrated that the herring reacted clearly in advance of an approaching vessel and the reaction culminated with a diving angel of almost 90° when the propeller passed the shoal. Olsen stressed the opinion that visual stimuli were important.

2. Observations du comportement des bancs grace a un sonar omnidirectionnel

N. Diner

- showed how sonar information could be used to study reaction of fish shoals. The result indicated no general reaction pattern of the fish shoals even if a majority of the shoals appeared to avoid the vessel.

3. Acoustic detection of fish close to the bottom; theory and practical considerations.(verbal)

E. Ona

- observations using short pulse length echo sounders indicate that the dead zone problems in acoustic estimates of demersal fish may previously have been exaggerated. Presented data showed that detection and echo integration of fish close to the bottom can be made nearly independent of the applied pulse length within the actual range of this parameter in scientific echo sounders.

4. Acoustic extinction in fish shoals.(verbal)

D. Maclellan

- demonstrated increased extinction higher for 120 kHz than 38 kHz with increased density of herring and cod respectively. The densities 20-100 fish /m³ used in the experiment were in the higher range reported from in-situ measurements. Extinction within shoals could be of importance when surveying very dense shoals as spawning and overwintering herring.

5. Split beam echo sounder - direct measurement of in-situ target strength. A summary of ongoing and recently carried out work.(verbal)

K. Foote

- discussed problems with the dynamic range and threshold of the ES-400 echosounder. A method to deal with the threshold problem was indicated. Available data on TS measurements of gadoids and herring were summarized in following TS regressions.

$$\text{Gadoids } \langle TS_{ind} \rangle = 20 \log \alpha - 67.5 \text{ dB}$$

$$\text{Herring } \langle TS_{ind} \rangle = 20 \log \alpha - 72.1 \text{ dB}$$

Whereas the herring regression is comparable with reported and used TS-regressions for clupeids, the gadoid regression is much higher than the regressions used.

6. A simple model of the effects of perspective on fish target strength.

L.M. Dickie and P.R. Boudreau

- a model that combined aspect and beam directivity with perspective of the target. Apparent changes in fish target strength is explained by the combined effects of aspect and perspective interacting with beam directivity. In the following discussion on this contribution it was put forward that signal-/noise relations could give the same change in target strength and that perspective could be related to the orientation of the towed body. The discussion underlined the need of more work in this field.

7. Comparison of acoustic counting and integrating estimates of fish density.

P.R. Boudreau and L.M. Dickie

- acoustic counting and integration gave results which have high positive correlation. Estimates of average densities derived from the two ^{however,} methods, were different and varied between surveys. It is indicated that perspective effects associated with beam pattern of fish target could explain the difference. Correction for perspective effects made the estimates more in line with trawl estimates of fish densities. However, the orientation of the used towed body as well as system sensitivity changes could have contributed.

8. Signal threshold in echointegrations.

H. Lassen

- simulated the effect of increase threshold on equivalent beam angle and its implication on integration. Recommends that increase threshold should not be used to remove unwanted targets as plankton organisms.

9. Detection of krill (*Euphausia superba*) near the Sea surface. Preliminary results using a towed upward-looking echo-sounder.

I. Everson and D.G. Bone

- discussed theoretical implications and practical considerations when using upward looking echo-sounders at angle to the surface. Concluded that this method could not for the time being used for quantitative estimation with acceptable accuracy and precision due to problems with detection of true surface echo and a TS-model that combines perspec-

tive and tilt angle distribution of krill. It was put forward that data on directivity of krill is reported and also suggested that remote sensing technique should be considered.

Summed up

It was clear from the presentation and the following discussion that ongoing work on in-situ target strength measurement with split-beam and dual-beam equipment are in progress. Reported TS-regression for clupeids obtained with several methods are converging to a more narrow bell of regression. One unique regression for clupeids for all areas or seasons is not to be expected as previously reported by this Working Group (1983) and the difference between regression may reflect real differences related to behaviour, conditions of the herring etc. Ongoing work in this field including the effects of prespective should be encouraged.

B. Equipment

1. The English survey system, including a microcomputer for instant biomass assessment.

C.R. Hood, M.H. Beach and J. Casey

- described the acoustic equipment used by Fisheries Laboratory, Lowestoft. The usefulness of a portable microcomputer with modern spreadsheet software were underlined.

2. A towed body for echo integration in shallow waters.

K-J. Staehr

- a towed body mounted with a split-beam transducer and a small CTD sond, stable in speeds of 12 knots and equiped with a hydrofoil which brings the towed body away from the ships bowwave.

3. Mise au point d'un corps remarqu   pour l'observation du comportement.

N. Diner

- a towed body system with a floater for buoyancy and a type of trawl door for bringing the towed body away from the vessel.

4. Acoustic test tank facility.

M.H. Beach and C.R. Hood

- describes the acoustic test tank at the Lowestoft Laboratory. The tank could be used for calibrations and demonstration of echo-sounder and integrator features as well as general echo sounder acoustic.

5. Digital data logger for raw data collection.

R. Person

- presented a data logger that can be used in the Agenor integrator system.

8. Discussion and adoption of the Calibration Manual.

At the first meeting of the FAST Working Group in 1984 the need of a guideline in calibration of acoustic equipment was underlined and the Working Group asked the institutes in Aberdeen and Bergen to be responsible for preparing a draft. The collaborative effort of the two institutes resulted in three preliminary drafts that were distributed before the 1985 meeting. At the 1985 meeting it was agreed upon a functional arrangement of the manual and the 4th draft of the manual have been distributed before this years meeting.

The Working Group approved of the 4th draft with the written amendment given to the authers of manual by members of the Group. It was decided that the final version should be presented to the Fish Capture Committee at the 74th Statutory Meeting this year and that the Chairman should contact the General Secretary of ICES to secure a quick publication of the manual. The Chairman expressed the Groups appreciation of the work carried out by the involved scientist at the two institutes.

9. Future work.

During the joint session meeting the FTFB - and FAST - Working Group received a kind invitation from the Federal Republic of Germany to hold their next meetings in Hamburg in May 1987.

At the FAST meeting following the joint group session, however, plans for an International Symposium on Fisheries Acoustics in Seattle in June 1987 were presented. The role of ICES in assisting the arrangement was recognized.

Many of the FAST-W.G. participate in the Seattle Symposium, but this could make participation in a FAST-W.G. meeting in Hamburg difficult.

The W.G. felt that there still should be a group meeting next year and favoured the idea of arranging a short meeting in Seattle immediately following the Acoustic Symposium. Such a meeting contribute to a rapid application of important findings presented in the Symposium as well as providing in a following-up to the W.G.'s own work.

It was emphasized that, in future meetings the FAST-W.G. should maintain contact with the FTFB-W.G.

10. Recommendations.

1. The FAST-W.G. recommends to make target strength measurements techniques and interpretation of such data the Group's main topic for the meetings in the near future.

The FAST-W.G. anticipates these discussions to be summarized in a published guide.

2. The FAST-W.G. should meet in Seattle following the Acoustic Symposium in June 1987, to consider in particular methods for measuring fish target strength and to evaluate target strength values to be used in acoustic surveys of clupeoids and gadoids.

Appendix 1. List FAST-W.G. Participants

BELGIUM	R. Fonteyne	Oostende
CANADA	P. Boudreau	Dartmund
	L. Dickie	Dartmund
	D. Green	Dartmund
DENMARK	P. Degnbol	Hirtshals
	H. Lassen	Copenhagen
	K-J. Staehr	Hirtshals
FINLAND	E. Aro	Helsinki
	P. Suuronen	Helsinki
FRANCE	J-C. Brabant	Boulogne-Sur-Mer
	N. Diner	Brest
	P. Freon	Brest
	A. Lebourges	Brest
	R. Person	Brest
	P. Souid	Brest
ICELAND	P. Reynisson	Reykjavik
ITALY	M. Azzali	Ancona
	E.J. De Boer	Roma (FAO)
	S.C. Venema	Roma (FAO)
NORWAY	K.G. Foote	Bergen
	R. Nilsen	Horten
	E. Ona	Bergen
	K. Olsen	Tromsø
SWEDEN	O. Hagström	Lysekil
UNITED KINGDOM	I. Everson	Cambridge
	S. Forbes	Aberdeen
	C.R. Hood	Lowestoft
	D.N. MacLennan	Aberdeen
	R.B. Mitson	Lowestoft
	E.J. Simmonds	Aberdeen
	A.R. Smith	Aberdeen
U.S.A.	J. Traynor	Seattle