INTERNATIONAL COUNCIL FOR
THE EXPLORATION OF THE SEA

ICES C.M. 1990/B:40
Fish Capture Committee

REPORT OF THE WORKING GROUP ON FISHING TECHNOLOGY AND FISH BEHAVIOUR

International Council for the Exploration of the Sea
Palægade 4
DK-1262 Copenhagen K
Denmark

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1. Introduction

Convener:	B. van Marlen, Netherlands Institute for Fishery Investigations, IJmuiden, The Netherlands;
Rapporteur:	S. J. Walsh, Department of Fisheries and Oceans, St. John's, Newfoundland, Canada.
Meeting Place:	Rostock, German Democratic Republic.
Dates:	23th and 24th April 1990.

In accordance with ICES Resolution **C.Res.1989/2:5** the Working Group met in Rostock on 23th - 24th April 1990, convened by Mr. B. van Marlen to :

a) **Review and report on the size and species selectivity of fishing gear and the need for further research in this field;**

b) **Evaluate methods for determining the survival of fish and shellfish that come into contact with fishing gear but are not captured;**

c) **Review and report on engineering aspects of working on fishing vessels;**

d) **Consider the specification of standard gear for surveying fish stocks, and the preparation of new manuals dealing with the construction and operation of such gear;**

e) **Consider the communication within ICES of problems and advice on topics within the fish capture field, and the need for closer links between the several Committees concerned with the exploitation and management of fish and shellfish stocks, and report its findings to the relevant Committees;**

In accordance with ICES Resolution **C.Res.1989/2:6** a joint session of this Working Group and the Working Group on Fisheries Acoustic Science and Technology was held on 25 April 1990 to discuss matters of mutual concern, chaired by Dr. P.A.M. Stewart.

2. Participants of FTFB and FAST Working Groups.

Country	Name	Institute
Belgium	Fonteyne, R.	Fisheries Research Station
Canada	Cooper, C.G.	DFO Scotia Fundy Development
	Crawford, R.	Freshwater Institute, Fisheries and Oceans
	Hickey, W.	Department of Fisheries and Oceans
	Koeller, P.A.	Bedford Institute of Oceanography
	McPhee, S.B.	Bedford Institute of Oceanography
	McCallum, B.R.	Marine Institute Newfoundland and Labrador
	Nakashima, B.S.	Science Branch Fisheries and Oceans
	Simard, Y.	Institute Maurive-Lamontagne Fisheries and Oceans
	Walsh, S.J.	Flatfish Section,Science Branch Fisheries and Oceans
	Warren, W.G.	Science Branch Fisheries and Oceans
	Way, E.W.	Department of Fisheries and Oceans
China	Lu Chi	Shanghai Fisheries University
Cuba	Corujo, C.H.	Academie of Science of Cuba
Denmark	Degnbol, P.	Institute for Fisheries and Marine Research
	Hovgård, H.	Greenland Fisheries Research Institute
	Knudsen, L.H.	Danish Fisheries Technology Institute
	Lehmann, K.	Greenland Fisheries Research Institute
	Lundgren, B.	Institute for Fisheries and Marine Research
	Vinther, M.	Institute for Fisheries and Marine Research
Faroe Islands	Jacobsen, J.A.	Fiskirannsóknarstovan
Finland	Suuronen, P.	Finnish Game and Fisheries Research Institute
France	Gerlotto, F.	OSTROM
	Guillard, J.	Institut National de la Recherche Agronomique
Germany F.R.	Lange, K.	Institut für Fangtechnik
Germany D.R.	Bednorz, M.	Universität Rostock
	Fischer, H.J.	Fischfang Rostock
	Gabriel, O.	Institut für Hochseefischerei
	Götze, E.	Institut für Hochseefischerei
	Hamann, K.	Institut für Hochseefischerei
	Jesper, A.	Fischfang Rostock

Country	Name	Institute
Germany D.R.	Kästner, D.	Institut für Hochseefischerei
	Klüber, U.	Institut für Hochseefischerei
	Kordian, A.	Institut für Hochseefischerei
	Leitzke, H.	Universität Rostock
	Liebisch, D.	Fischfang Rostock
	Neumann, M.	Intertext
	Niedzwiedz, G.	Fischfang Rostock
	Öberst, R.	Institut für Hochseefischerei
	Paschen, M.	Universität Rostock
	Richter, U.	Institut für Hochseefischerei
	Rothbarth, H.	Institut für Hochseefischerei
	Scheel, R.	Fischfang Rostock
	Schmidt, U.	Institut für Hochseefischerei
	Stamer, H.	Institut für Hochseefischerei
	Stengel, H.	Universität Rostock
	Stüwe, G.E.	Institut für Hochseefischerei
	Thiele, W.	Institut für Hochseefischerei
	Trost, G.	Hochschule für Seefahrt
	Vaske, B.	Institut für Hochseefischerei
Iceland	Reynisson, P.	Marine Research Institute
	Thorsteinsson, G.	Marine Research Institute
Italy	Fiorentini, L.	Instituto di Ricerche Pesca Marittima
Netherlands	Buys, A.M.	Netherlands Institute for Fishery Investigations (RIVO)
	Storbeck, F.	RIVO
	Veenstra, F.A.	RIVO
	van Marlen, B.	RIVO
Norway	Amble, A.	Institute of Fishery Technology Research
	Beltestad, A.K.	Institute of Fishery Technology Research
	Bodholt, H.	SIMRAD Subsea A/S
	Dalen, J.	Institute of Marine Research
	Dickson, W.	Institute of Fishery Technology Research
	Godø, O.R.	Institute of Marine Research
	Isaksen, B.	Institute of Fishery Technology Research
	Karlsen, L.	Institute of Technology, University of Trondheim
	Løkkeborg, S.	Institute of Fishery Technology Research
	Olsen, St.	Institute of Fishery Technology Research
	Olsen, K.	Norwegian College of Fishery Science, University of Tromsø
Poland	Gorzenski, M.	Nautical School Szczecin
	Sendlak, H.	University of Agriculture Szczecin
	Swiniarski, J.	University of Agriculture Szczecin
	Szulc, M.	Nautical School Szczecin

Country	Name	Institute
Spain	Sanchez, F.	Instituto Espanol de Oceanografia
Sweden	Hakansson, N.	Institute of Marine Research
	Johansson, B.	National Board of Fisheries
	Kadefors, R.	Lindholm Development Center
United Kingdom	Bone, D.G.	British Antarctic Survey
	Cheesley, N.R.	Institute of Marine Studies
	Everson, I.	British Antarctic Survey
	Ferro, R.S.T.	Marine Laboratory
	Mitchell, C.	British Antarctic Survey
	Mitson, R.B.	Marine Laboratory
	Simmonds, E.J.	Marine Laboratory
	Stewart, P.A.M.	Marine Laboratory
	Tumilty, J.E.	Seafish Industry Authority
U.S.A.	Traynor, J.	Alaska Fisheries Science Center
U.S.S.R.	Berdichevsky, Z.	VNIRO, Moscow
	Bondarenko, B.	VNIRO, Moscow
	Jarwik,	BaltNIIRCH
	Kamarauskas, A.	NPO, Klaipeda
	Maximow, I.M.	NPO, Klaipeda
	Schirokow,	BaltNIIRCH
	Tesler, V.	VNIRO, Moscow
	Toliusis, S.	NPO, Klaipeda

3. Agenda

3.1 Presentation of papers and verbal contributions with discussion on special topics.

3.1.1 Size and species selectivity of fishing gear and the need for further research in this field.

1. Codend selection processes.
   (P.A.M. Stewart - Verbal and Video)

2. Analysis of catch comparison data.
   (Paper by R.S.T. Ferro and P.A.M. Stewart - presented by R.S.T. Ferro)

3. Selectivity of Baltic herring pelagic trawl investigated by cover bag and twin codend methods.
   (P. Suuronen & A. Jarvik - Verbal)

4. Preliminary trials with square mesh codends in herring trawls.
   (P.Suuronen - Verbal)

5. Preliminary results from commercial fishing trials of square mesh panels in trawls and seine nets.
   (J.E. Tumilty - Paper + Video)

6. Developments in shrimp sorting grate operations.
   (L. Karlsen - Verbal)

7. Pilot experiments with the plan grate sorting techniques.
   (L. Karlsen - Verbal)

8. Selectivity in codends with short lastridge ropes.
   (Paper by B. Isaksen & J.W. Valdemarsen - presented by B. Isaksen)

9. A New approach to size selectivity in commercial codfish trawls using the "Trollex" system.
   (Paper by R.B. Larsen - presented by B. Isaksen + Video)

10. Grid sorting system to reduce bycatch of fish in shrimp trawl.
    (B. Isaksen - Paper)

11. Direct comparison of 140mm and 155mm diamond mesh using parallel tows.
    (C.G. Cooper - Paper)

12. Modelling trouser trawl selectivity data.
    (Paper by R. Millar & S.J. Walsh - presented by S.J. Walsh)

3.1.2 Methods for determining the survival of fish and shellfish that come into contact with fishing gear but are not captured.

13. Incidental fishing mortality in herring purse seining.
    (A.K. Beltestad - Paper)

14. Simulated gear injuries on cod and haddock, a tank experiment.
(Paper by A. Engås, B. Isaksen & A.V. Soldal -
presented by B. Isaksen + Video)

3.1.3 Engineering aspects of working on fishing vessels.

15. Safety integrated redesign of Dutch beam trawlers.
(F.A. Veenstra - Paper)

16. Integrating wheelhouse electronics onboard Dutch beamtrawlers.
(A.M. Buys - Paper)

17. Research for a better work environment in Swedish fishery.
(R. Kadefors - Paper + Video)

18. Design philosophy for catamaran fishing vessels.
(A. Amble - Paper)

19. Integration of fishing and aquaculture - present Norwegian development of system for catching and storing fish alive.
(A. Amble - Verbal)

3.2 Presentation of papers and verbal contributions with discussion on other topics.

3.2.1 Economics and modelling of fishing operations.

20. Techno-economic evaluation of novel fishing gears and systems.
(Paper by N.R. Cheesley and B.P. Gates - presented by N.R. Cheesley)

21. A simulation model to determine the optimal freezingrate of a stern trawler for a given catch input.
(B. van Marlen - Paper)

22. Economic results of stern freezer trawlers in relation to technical parameters.
(Paper by Dai Tianyuan, J.W. de Wilde & J. de Jager -
presented by B. van Marlen)

3.2.2 Various gear design and engineering topics.

23. A Computer-Aided-Design workplace for Research and Development in fishing technology.
(G. Niedzwiedz, Paper and Demonstration)

24. Application of the method of discrete towing systems for the calculation of fishing gear .
(H. Leitzke - Paper)

25. Prediction of the trawl door position in pelagic trawls.
(M. Paschen - Paper)

26. Model studies based analysis of effects of pelagic trawl mouth construction and opening on geometric and resistance-related characteristics of trawls.
(Paper by J. Swiniarski, P. Nowakowski & H. Sendlak - presented by J. Swiniarski)

27. New purse seine construction.
(A.K. Beltestad - Paper)

28. Performance measurements on a single-door trawl towed at the sea surface.
(Paper by B. van Marlen, H.B.H.J. de Jong, M. Paschen & B. Schäfer, presented by B.van Marlen)

29. Investigations in a 180 foot bottom trawl .
(K. Lange - Verbal + Video)

30. Otterboard research at the Marine Institute.
(B. McCallum - Verbal)

31. The hydrodynamic drag and shape characteristics of two panel demersal trawl nets.
(Lu Chi - Paper summarizing his Ph.D. Thesis)

32. The development of an automatic longline fishery in the Baltic.
(O. Gabriel - Verbal)

3.2.3 Observation techniques and behaviour.

33. The behaviour of Cod *(Gadus Morhua)* towards baits of different shapes.
(S. Løkkeborg - Paper)

34. Underwater observations of fish in trawls.
(H.J. Fischer - Verbal + Video)

35. Fish behaviour in relation to Danish seining.
(G. Thorsteinsson - Verbal + Video)

36. Changes in school structure according to external stimuli.
(Paper by P. Freon, M. Soria & F. Gerlotto - presented by F. Gerlotto)

37. Study of learning capabilities of tropical clupoid using an artificial stimulus.
(Paper by M. Soria - presented by F. Gerlotto)

38. Fish swimming speed at low temperature.
(B. McCallum - Verbal)

39. Controlling the variability of survey gear performance.
(P.A. Koeller - Paper)

40. How to catch small fish with a large mesh.
(J.A. Jacobsen - Verbal)

3.3 Discussion on general topics.

d) **Specification of standard gear for surveying fish stocks, and the preparation of new manuals dealing with the construction and operation of such gear.**

e) **The communication within ICES of problems and advice on topics within the fish capture field, and the need for closer links between the several Committees concerned with the exploitation and management of fish and shellfish stocks.**

3.4 National Progress Reports:

The following member states submitted a National Progress Report prior to or during the meeting. Due to restrictions in time, these reports were not presented or discussed at the Working Group sessions. However it was felt, that they contain a lot of valuable information and should not be disregarded.

1. **Belgium.**
2. **Canada.**
3. **Denmark.**
4. **Federal Republic of Germany.**
5. **Finland.**
6. **France.**
7. **German Democratic Republic.**
8. **Iceland.**
9. **Ireland**
10. **The Netherlands.**
11. **Spain.**
12. **Sweden.**
13. **United Kingdom - England.**
14. **United Kingdom - Scotland.**

3.5 Recommendations.

4.1 Summaries of papers, video's and verbal contributions on special topics.

4.1.1 Size and species selectivity of fishing gear and the need for further research in this field.

1. Codend Selection Processes. (Peter Stewart)

A short video on fish escaping codends was shown. The intent of showing compiled reactions of fish in codends was to generate questions needed to be answered on codend selectivity. Escape may be a confusing idea with emergence being active or passive. Flow and turbulence are important parameters influencing fish behaviour and emergence, with reactions probably differing between species. Fish density in the codend may also have an influencing effect on escape.

2. Analysis Of Catch Comparison Data. (Dick Ferro)

This paper discusses the difficulties of analyzing the data and proposes some criterion for judging the performance of codends for such data. Percent discards analysis is not a precise method for assessing selection. A **catch comparison diagram** was described which may help in deciding before the trials whether a significant result is likely.

3. Selectivity Of Baltic Herring Pelagic Trawl Investigated By Cover Bag And Twin Codend Methods. (Petri Suuronen)

Previous selectivity studies (USSR) were done in the 1960's using codend covers. Now new experiments using (1) **trouser trawls** and (2) **codend covers** revealed that L50 differ between these two calculation methods. However, the L50 from the trouser trawl studies agreed with earlier selectivity studies. It is believed that codend covers may restrict escapement and some escapement may take place before the covered section is reached. Herring L50 were much smaller with the cover codend (9 cm) than that of the trouser trawl.

4. Preliminary Trials With Square Mesh Codends In Herring Trawls. (Petri Suuronen)

Preliminary trials were made to investigate selectivity using (1) **alternate hauls** and (2) **trouser trawl** on Baltic Sea herring. It was found that trouser trawls gave equal catches but such was not the case in alternate hauls. Trouser trawls will be the preferred method for future studies on square mesh.

5. Preliminary Results From Commercial Fishing Trials Of Square Mesh Panels In Trawls And Seine Nets. (John Tumilty)

Square mesh panels were inserted into the top side of the extension piece just ahead of the splitting strap. This area was chosen because it is known that more fish escape generally in this area. On the research vessel a divided trawl was used to make the initial test. The video of these trials showed fish behaviour in the codends with whiting escaping through the square mesh. Commercial trials were carried out using a 75mm mesh in the top square panel. Evaluation of selectivity was done using the alternate tow method. Further experiments are planned for a 90mm mesh panel.

6. Developments In Shrimp Sorting Grate Operations. (Ludwig Karlsen)

A leading panel of net was introduced ahead of the grate to encourage shrimp to go through the grate while allowing fish to escape through the opening in the top panel. Further trials have shown that the grate needed to be more forward of the codend so as not to interfere with hauling during commercial operation. Underwater television was used during investigations and showed that by changing the opening in the top panel from rectangular to a triangular shape gave a larger opening. Further investigations will look at the effect of this change on fish escapement. Another experiment involved the use of two grates in twin codends. (19mm and 21mm). Commercial trawlers found that the standard grate of size (19mm openings between bars) did not work effectively with large catches. However, the double grate experiment showed that O-group cod and haddock catches were less with the standard grate when compared to the 21mm grate and these results have shown that area closure is not required in gadoid nursery areas. Legislation has been introduced with the grate system becoming obligatory in northern Norway shrimp fishery.

7. Pilot Experiments With the Plangrate Sorting Techniques. (Ludwig Karlsen)

A grate was placed inside a trawl. A small mesh panel ahead of the grate leads fish directly to the grate with small fish escaping upward through the opening in the top panel and larger fish entering the codend. Several pilot experiments were made on shrimp trawls and results showed that the system functions well to sort out small haddock and cod allowing them to escape.

8. Selectivity In Codends With Short Lastridge Ropes. (Bjørnar Isaksen)

Initial trials with experimental codends using divided trawl compared a standard codend with a lastridge roped codend on catches of cod. The roped codend gave better selection and these results were similar to that found in square mesh studies. However, roped codends do not have the association onboard handling problems that square mesh codends have. So far the system is not used in the commercial fishery.

9. A New Approach to Size Selectivity in Commercial Codfish Trawls Using The "Trollex" System. (Bjørnar Isaksen)

The "Trollex" system uses the metal grid sorting principles to achieve size selectivity and to allow small fish to escape. A second grid is used to prevent small fish from entering the codend. Initial experiments used a control bag attached above the opening in the top panel and several trials were made to determine the best positioning of the grids. Many small cod, haddock, and redfish escaped up into the control bag. A video was shown outlining this research. Commercial testing is scheduled for this year.

10. Grid Sorting System To Reduce Bycatch Of Fish In Shrimp Trawl. (Bjørnar Isaksen)

A Nordmøre shrimp grid was installed approximately in the middle of the extension piece and incorporated a triangular fish release opening in the top panel. The experiments were designed to study separation of redfish and shrimp, and Greenland halibut and shrimp. Different angles of attack of the grate were studied. Approximately 100% separation is achieved for cod and haddock older than 1 year old and for redfish older than 2 years but less for younger fish. The shrimp loss is far below the acceptable 5% limit and quality of shrimp is excellent.

11. Direct Comparison Of 140mm And 155mm Diamond Mesh Using Parallel Tows. (Chris Cooper)

A joint experiment between Canada and the USA using the two commercial trawlers carried out direct comparisons of 140mm and 155mm diamond mesh codends. Each vessel was equipped with duplicate trawls and doors and performed parallel tows to study selectivity of cod, haddock, and flounder. For gadoids it was found that 140mm square mesh and 155mm diamond retained the same length distributions and number of fish agreeing with previous results using the trouser trawl method.

12. Modelling Trouser Trawl Selectivity Data. (Steve Walsh)

Analysis of trouser trawl data is often complicated by unequal sample sizes of fish, on the larger size groups, being collected in the test (wide) mesh codend thereby violating the 50:50 split assumption in logistic model applications. **Conditional probability theory** was used to model this problem and when incorporated into the logistic model gave more reliable estimates and better fit to the selection curve. The model was tested on American plaice data collected from 155mm diamond and square mesh studies using the trouser trawl method. Further testing is planned.

4.1.2 Methods for determining the survival of fish and shellfish that come into contact with fishing gear but are not captured.

13. Incidental Fishing Mortality In Herring Purse Seining. (Arvid Beltestad).

This paper describes a project proposal to investigate ways to reduce the incidental herring mortality in purse seining, mostly due to net bursts. These net bursts were reported mainly during daytime sets when schools are large and dense. An estimate is that bursts occur in 30% of daytime sets. Observations of behaviour of fish in net pens will be done later this year with the aid of an UTV-camera.

14. Simulated Gear Injuries On Cod and Haddock, A Tank Experiment. (Bjørnar Isaksen)

Fish were kept in a circular tank and after a period of acclimation were subjected to measurements of (1) swimming activity; (2) swimming activity after net injuries were induced by forcing the fish to swim through a net panel; and (3) swimming activity after scale damage was induced by removal with a scapel. Haddock appeared to be more sensitive to simulated net injuries than cod. Sea trials are planned to study effects of codend escapement using cages attached to codends.

4.1.3 Engineering aspects of working on fishing vessels.

15. Safety Integrated Redesign Of Dutch Beam Trawlers. (Frans Veenstra)

A new safety system based on safety analysis philosophy can be used on redesigned or new vessels. Most accidents aboard ships are related mostly to gear handling and as well as others related to fish handling, falling down etc. Knowing the breakdown of injuries one could examine the data and look at these problems using retrospective solutions on micro, meso, and macro scales. This is done by looking at a retrospective matrix which identifies areas that can be changed structurally or otherwise. If a solution is found, one could look forward to the prospective matrix to assist in decision making. Using these matrices could reduce occupational accidents and improve working conditions.

21. A Simulation Model To Determine The Optimal Freezing Rate Of A Stern Trawler For A Given Catch Input. (Bob van Marlen)

To understand fishing operations **simulation models** incorporating **stochastic** and **deterministic** characteristics were used. The aim was to determine the internal arrangement of a ship, that processes and freezes its catch onboard in terms of the size of its components. The system can be monitored over time and the simulation model could be used to focus on **queueing phenomena** of fish and frozen halfproducts during processing and storing in the fish-holds. A random type model was found to be better than a means type model. Further work will continue, and will include techno-economic appraisal.

22. Economic Results Of Stern Freezer Trawlers In Relation To Technical Parameters. (Bob van Marlen)

Regression techniques were used to relate technical dimensions and economic performance of Dutch stern freezer trawlers. The optimum size of a vessel for a fishery can be calculated from the models which described relationships of freezing hold capacity and economic estimates. Results show that it is not economically justifiable to build very large freezer trawlers for the operation around Great Britain and Ireland. This conclusion does not hold however for a worldwide operation profile, with larger distances to travel and use of vessels as freezer-transporter.

4.2.2 Various gear design and engineering topics.

23. A Computer-Aided-Design Workplace For Research And Development In Fishing Technology. (Gerd Niedzwiedz)

A PC-program was written to aid in solving several problems in design of fishing gears and loads working on them. The program can produce drawings and material lists corresponding to given standards for a trawl. It also allows for design calculations and re-calculations of nets and trawl doors. A practical demonstration of this program was given on a PC.

24. Application Of The Method Of Discrete Towing Systems For The Calculation Of Fishing Gear. (Hartmut Leitzke)

The method of discrete towing systems was developed in 1978, and allows the technologist to solve the problem of re-calculating very complex net and rope systems in water. This system can be simulated on a computer to detect flaws on unwanted effects and make changes prior to construction of the gear. The method is based on determination of mechanical equilibrium conditions to calculate shapes and forces from external loads acting on the net or rope system. Other applications are being investigated.

25. Prediction Of The Trawl Door Position In Pelagic Trawls. (Mathias Paschen)

Algorithms best suited for adaptation of pelagic trawl doors to a certain fishing gear were developed with the aid of a computer. The techniques were tested on two pelagic cable trawls with 8m2 Suberkrub doors. Investigations focused on influence of angle of attack of the trawl warps, trawl door spreads, trawl warp pull, fishing gear resistance and drain on engine power. Software solutions can be used to calculate the angle of attack, trimming and heeling angle of all ropes or wires of towed trawl doors and towed objects, shearing dragons or towed sounders.

26. Model Studies Based Analysis Of Effects Of Pelagic Trawl Mouth Construction And Opening on Geometric And Resistance-Related Characteristics Of Trawls. (Jozef Swiniarski)

This paper introduces fishing gear model study techniques and some results of experiments of the effects of pelagic trawl mouth construction and opening on geometry and resistance related trawl characteristics. Experiments were carried out on lake INSKO using a catamaran with three model nets. Change in construction of a 6 wing trawl mouth from rope mesh to big mesh resulted in a 40% increase in mouth area with drag remaining unchanged.

27. New Purse Seine Construction. (Arvid Beltestad)

Polyester webbing is used in major parts of the North Sea purse seines to achieve high sinking speeds. Polyester has a higher specific weight than polyamide but lower strength and elasticity. The objective is to reduce cost, increase resistance to wear and tear, and improving catching efficiency. Further developments will continue. As well, buoyancy of a new float made of ethylenvinylacetate proved to be inferior to the traditional PVC float.

28. Performance Measurements On A Single-Door Towed At The Sea Surface. (Bob van Marlen)

A single door trawl, initially tested as a model on lake INSKO, was tested at sea. After several modifications, the rig with a single door on one side and a danleno (plus weight) on the other side was proven mechanically feasible. A cooperative research programme has been established in 1988 between the "Institut für Hochseefischerei und Fischverarbeitung" of Rostock and the Netherlands Institute for Fishery Investigations (RIVO) of IJmuiden. Collaborative measurements were conducted onboard FRV "Ernst Haeckel" in september 1989. The trawl was instrumentized and towed at the surface using a Suberkrub or a biplane door on the port side only. This gear has the advantage in that it can be towed outside the wake of the vessel. Two different nets were tested. High-lift doors are recommended to be used as the spreading force has to be generated by one door. Further research will be conducted this year.

29. Investigations In A 180 Foot Bottom Trawl. (Klaus Lange)

A video was shown of this trawl rigged with heavy ground gear, equipped with Polyvalent doors and Pony doors. Some experimental comparisons were made of a single aluminum kite vs. a **canvas kite** as part of the net headrope. The canvas kite increased headline height over the aluminum kite.

30. Otterboard Research At The Marine Institute. (Barry McCallum)

The Marine Institute has developed the capability to evaluate performance of otterboards to design criteria to satisfy test models in the flume tank. Doors were fixed on a structure with instruments attached to measure angle of attack. Further work is planned.

31. The Hydrodynamic Drag and Shape Characteristics Of Two Panel Demersal Trawl Nets. (Lu Chi)

Experiments were conducted to look at (1) panel drag; (2) floats and wing spread changes; (3) visualization (flow) and speed tests of water; and (4) friction measurements of ground gear. All comments were used to generate net drag. Further work will look at (1) hanging ratios from body sections to the codend and (2) angle of attack of the wing section.

32. The Development Of An Automatic Longline Fishery In The Baltic. (Otto Gabriel)

After reviewing information on longlining in other areas the GDR and USSR jointly got involved to research the area. Trials using a **random baiter** using 2m monofilament, 55cm hooks at 2.2m distance were tested at sea on a 17m cutter. The system can bait 4000 hooks/hr and retrieve 800/hr.

4.2.3 Observation techniques and behaviour.

33. The Behaviour Of Cod *(Gadus Morhua)* Towards Baits Of Different Shapes. (Svein Løkkeborg)

Experiments using natural bait (shrimp) and artificial bait (rectangular shape) were set up to study behaviour of cod towards these baits. Cod showed no difference in the response towards the two bait types. Fish behaviour was video-taped with prey attached to longlines. The behaviour of small and large cod towards the bait were significantly different. Bait shape does not appear to be an important characteristic to consider in development of artificial bait.

34. Underwater Observations Of Fish In Trawls. (Hans Joachim Fischer)

Investigations were made of cod, using an underwater vehicle, in a mid-water trawl to look at fish behaviour. As well, some taping of horse mackerel (off Namibia) in the codend showed even after escaping these fish still followed the trawl retaining schooling behaviour. As the trawl slowed fish tried to escape forward to the large meshes or out through the mouth when hauling. Meshing was reduced by 20% when an extension piece was added. Squid were observed in a pelagic mid-water trawl, no escape behaviour was evident. Evidence was presented which showed that the angle of attack should be kept 4o all along the net which leads to lower fuel and material consumption.

35. Fish Behaviour In Relation To Danish Seining. (Gudni Thorsteinsson)

Investigative work was carried out off the coast of Iceland. A video showed a commercial seine in action. Small cables had higher contact and escape, but large cables herd plaice more readily. Cod, haddock, and catfish showed strong reactions to the ropes and moved away from the gear. It was concluded that this was a highly efficient gear for plaice but may not be good for cod and haddock.

36. Changes In School Structure According To External Stimuli. (François Gerlotto)

Experiments were conducted on schooling behaviour in tropical pelagic schools. It was found that schools dove when the acoustic vessel was halfway over it. The school which measured 50m wide by 50m deep was spread out near the surface. However, when the school was disturbed, the internal structure and volume of the school changes. Airplane

photography and scuba techniques were used to describe the school shape. The effect of an acoustical and or visual stress on a school by day is not only an avoidance reaction (vertical and or lateral movement) but also increase in density.

37. Study Of Learning Capabilities Of Tropical Clupeoid Using An Artificial Stimulus. (François Gerlotto)

Experiments were set up in a tank to study the learning and conditioning capabilities of small tropical pelagic fishes to stress. Two tanks were set up, one as a control and the other as a test. The latter tank had a removable net that could be lowered and raised. Sound pulses of 5 second duration and a frequency of 2000 Hz with the net lowered, were given and behaviour recorded. The experiment was repeated 15 times. The fish were conditioned to react by the 10th experiment, the control fish did not exhibit any such behaviour. This learning behaviour could also be developed in wild fish and may affect fish catching.

38. Fish Swimming Speed At Low Temperature. (Barry McCallum)

Cod, 36-52cm, were studied in a model flume tank with swimming endurance and swimming speeds tested under low temperature (0^{o}C). Results showed that large cod could maintain trawl speed constantly not taking in effects of temperature. This may have a lot of influences in catchability by the trawl.

39. Controlling The Variability Of Survey Gear Performance. (Peter Koeller)

Experiments show that in a survey trawl door spread increases with depth and so does wing spread. Data were corrected for wing spread and and door spread and biomass estimates varied greatly from traditional estimates of using fix wing spread in swept area models. A case was made to use a fixed scope (warp/depth ratio) to maintained fixed door spread. However, biologists are reluctant to accept any gear changes.

40. How To Catch Small Fish With A Large Mesh. (Jan Arge Jacobsen)

In the Faroes mesh size off the codend increased from 135mm to 155mm but without an increase in the extension piece. No change was seen in the size distribution of the catch and a lot of small fish were presented in the catches. Some examples were given of how a net designer could decrease the selective properties of a codend by adding more meshes in its circumference whilst still not violating the rules. Alterations were also reported to decrease the diameter of the extension piece causing a build-up and fish to break into the codend in large numbers with no selectivity taking place. Now legislation will be introduced to overcome this problem.

5. Report of discussion on general topics d) en e) mentioned in C.Res. 1989/B:5.

5.1 Specification of standard gear for surveying fish stocks, and the preparation of new manuals dealing with the construction and operation of such gear.

The group splitted into five smaller groups each with an appointed chairperson to facilitate discussion. These subgroups met for approximately 45 minutes, after which the five chairmen reported to the complete FTFB Working Group in a plenary session. A synopsis of response from the five subgroups is given as follows:

The strongest recommendation is that a Study Group be set up whose composition would include **gear technologists** (FTFB) and **biologists** whose task should be to consider the following projects:

1) **Collect all existing data** on problems and changes to the two main ICES survey gears: the GOV and the ISAACS-KIDD trawls which have taken place since the 1981 manual was drafted.

2) A **new manual** should be drafted for all other fishing gears in ICES sponsored surveys.

3) In this new manual it should be stated that **rigid adherence** to the standard protocol be maintained.

4) The manual should be **updated** on a regular basis and that standards outlined should not be "cast in stone" but have leeway for improvements based on new information.

5) A section of the manual should contain a **list of do's and don'ts** if people want to change sections of the gear i.e. what will happen if you use longer bridle lengths.

6) Users of the manuals, that is scientists and fishing crew, should be used as a source of **feedback** to make improvements in the manual.

7) **Continuous investigations** should be made on the survey gears to detect problems and suggest future investigations.

8) **New survey strategies** may need to be investigated to incorporate changes in catchability and selectivity related to fish distribution and area investigation.

5.2 The communication within ICES of problems and advice on topics within the fish capture field, and the need for closer links between the several Committees concerned with the exploitation and management of fish and shellfish stocks.

The five subgroups felt that there was a great need to be connected to other ICES working groups to further communication of our efforts. Specifically formation of a joint Study Group which should include FTFB and ACFM along with other interested groups. Some other topics were outlined which need to be addressed and they are:

1) A joint Study Group should bring recent findings to meetings of the Advisory Committee for Fisheries Management (ACFM) of ICES and any other related Committees. In case a joint Study Group is not formed, the chairman of the Fish Capture Committee should appoint individual or individuals to write a summary document of recent findings and report it to ACFM.

2) It was felt that referred papers could be more effectively used at ICES meetings by inclusion in other sessions and that the Fish Capture Theme Sessions have more potential, not yet fully recognized, for dissemination of information.

3) Other forms of communication could be symposiums, 1 day seminars and invitations to other working group chairmen to attend our Working Group meeting.

4) FTFB members should be encouraged to participate in other working groups and ICES meetings to find out what these groups are doing.

5) It was felt that communication should be a 2-way street with **fishery managers** who should be bringing to our groups attention problems that need answers. For our efforts we should provide information directly to managers in the form of summarized documents or an extra chapter added to FTFB report.

6. Recommendations

Following the discussion the following Recommendations were drafted:

6.1 The Working Group on Fishing Technology and Fish Behaviour (Chairman: Mr. B. van Marlen) recommends that the next meeting should be held in **Ancona, Italy** from **11 to 13 April 1991** in conjunction with the Working Group on Fisheries Acoustic Science and Technology to consider in particular the survival of fish and shellfish that escape from fishing gear.

6.2 It is further recommended that a **joint session** of the Working Group on Fishing Technology and Fish Behaviour and the Working Group on Fisheries Acoustic Science and Technology should be held on **April 14** to discuss matters of mutual concern.

6.3 A **Study Group** should be formed to review recent data concerning the selectivity of fishing gears, to present a report summarising this data, to improve the methodology of cod-end selectivity studies, and to recommend selection parameters for use in stock assessment calculations.

6.4 A **Study Group** should be formed to review information on sources on inefficiency in existing survey trawls and when needed to recommend improved trawl designs and performance monitoring information for survey trawls. The aim is to derive a more extended manual for the construction, operation, performance monitoring, calibration and maintenance of survey trawls, beyond the reach of **ICES C.M.1981/H:9**, dealing with the GOV-trawl and the ISAACS KIDD net and to distribute these findings to the appropriate other ICES Committees.