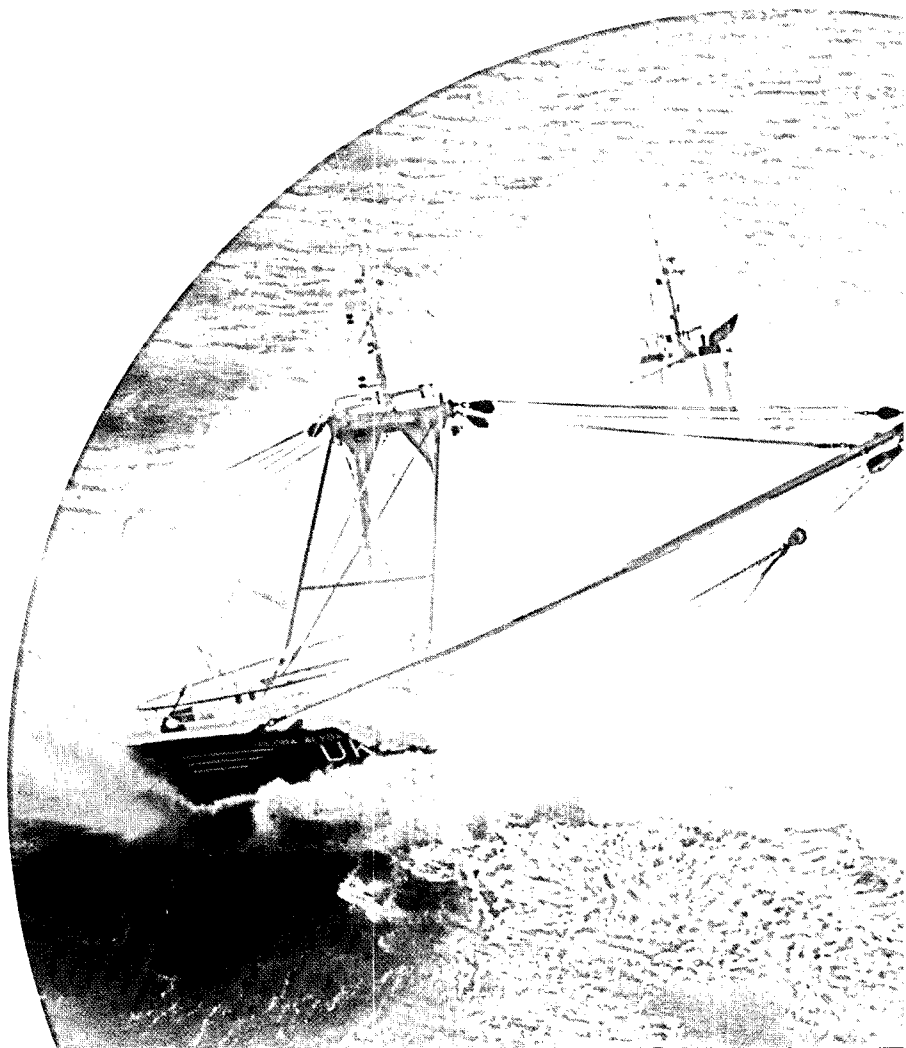
INTERNATIONAL COUNCIL FOR
THE EXPLORATION OF THE SEA

ICES C.M. 1993/B:2
Fish Capture Committee

REPORT OF THE WORKING GROUP ON FISHING TECHNOLOGY AND FISH BEHAVIOUR



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1. BACKGROUND AND TERMS OF REFERENCE.

Convener:	Bob van Marlen, Netherlands Institute for Fisheries Research (RIVO-DLO), IJmuiden, The Netherlands
Rapporteur:	Ulrik Jes Hansen, DIFTA, Hirtshals, Denmark
Meeting place:	Gothenburg, Sweden
Dates:	19–20 April, 1993

In accordance with ICES Resolution C. Res. 1992/2:9, the Working Group met in Gothenburg to:

a) consider, in particular, the survival of fish caught by, or escaped from, fishing gear;

b) evaluate the physical impact of fishing gear;

c) consider and develop the conclusions of the work of the Sub-Group indicated below;

d) consider the report of the Working Group on Long-Term Management Measures.

A Sub-Group of the Working Group under the chairmanship of Mr D.A. Wileman (Denmark) worked initially by correspondence and met in Gothenburg from 15-17 April 1993 to:

a) describe information to be recorded during selectivity trials, and specify its format;

b) review the recognized techniques for conducting selectivity experiments, including their application, advantages, and disadvantages, and make recommendations for further development and testing;

c) review the recognized methods of analysis of selectivity data to be used for the techniques described in b) above and make recommendations for further development.

It is the intention to produce a manual on recommended methodology of selectivity experiments with a view to its publication in the ICES Cooperative Research Report Series.

In accordance with ICES Resolution C. Res. 1992/2:10, a joint session of this Working Group and the Working Group on Fisheries Acoustic Science and Technology, chaired by Dr W. Karp (USA), was held on 20 April 1993, to:

a) consider the problems of near-bottom sampling in acoustic surveys and combined trawling/acoustic surveys;

b) consider the errors which may arise in near-bottom stock density estimates.

2. PARTICIPANTS OF THE FTFB AND FAST WORKING GROUPS

Country	Name
Belgium	Ronald Fonteyne Hans Polet
Canada	Marcel Boudreau Peter Koeller Chris Lang Richard Crawford Daniel Miller Yvan Simard
Denmark	Thomas Moth Poulsen Jesper Boje Ulrik Jes Hansen Bo Lundgren Karl Johan Staehr David Wileman
England	Ken Arkley G. P. Arnold Ron B. Mitson Philip MacMullen Inigo Everson Catherine Goss
Faroe Islands	Bjarti Thomsen Jan Arge Jacobsen
Finland	Petri Suuronen
France	Anne Lebourges Jacques Massé François Theret
Germany	Wilfried Thiele Eberhard Götze
Greece	George Petrakis
Iceland	Pall Reynisson Gudni Thorsteinsson
Ireland	Nick Pfeiffer John Milne
The Netherlands	Bob van Marlen
Norway	Arnt Amble Raymond Brede John Dalen Birger Enerhaug Björnar Isaksen Ludvig Karlsen Hans P. Knudsen

	Aud Vold Soldal
	Erik Stenersen
	Egil Ona
	Olav Rune Godø
	Stephen Walsh
	Atle Totland
	Ingvald Svellingen
	Åsmund Bjordal
	John Willy Valdemarsen
Scotland	Rob Fryer
	Ed Simmonds
	Dick Ferro
	Graham Sangster
	D.G. Reid
Spain	Pablo Carrera
Sweden	Olle Hagström
	Nils Håkansson
	Roger Karlsson
	Bertil Johansson
	Lars Erik Palmén
	Stig Rune Yngvesson
USA	Ellen Pikitch
	William Karp
	D.Van Holliday
	Jim Traynor
	Charles W. West

3. AGENDA AND PROCEEDINGS

Monday, 19 April 1993

3.1 Opening of the ICES-meetings at Lindholmen.
General welcome by the General Director of the Fisheries Board of Sweden, Mr Petersen. Words of thanks from the chairman of the Fish Capture Committee, Mr Fonteyne, Belgium.

3.2 FTFB - Working Group
Order of the day and appointment of rapporteur.
Introductory and practical comments by R. Karlsson, Lindholmen, and B. van Marlen, convenor.

3.3 Report of the Sub-Group on methodology of selectivity experiments

Mr Wileman, convener of the Sub-Group, explained the history of the project, from its start at the FTFB meeting in Bergen, Norway last year to the recommendations presented to the Council, and their approval at the Statutory meeting. Experts were invited by correspondence to participate in writing sections and discussing these at the Sub-Group meeting.

The terms of reference as given in ICES Resolution C. Res. 1992/2:9 were presented, and it was proposed that the Working Group should decide on the scope of the manual (constrained to towed fishing gears, concentrating on selectivity experiments and not comparative fishing experiments), the outline, the time schedule to produce it, and the system of working with referees (See Appendix I). An outline of the manual was handed out for members of the FTFB Working Group to comment at this meeting (Appendix II). This outline represented the work done over the past three days, and represented a reorganisation of the contents of the manual in order to make it more user-friendly, and enable the manual to be used both by institutes with a long tradition in conducting selectivity experiments, and by institutes that are about to enter this field of research. A list of suggested referees was also presented (Appendix III).

Subtopic 1: Formatting selectivity trials information - Ronald Fonteyne

Mr Fonteyne elaborated the headlines on data collection. All relevant data to collect had been listed, and given a priority ranking according to whether they are:

- essential for the data analysis
- known to have an effect on selectivity
- suspected to have an effect on selectivity
- maybe useful for future reference.

Subtopic 2: Practical methods of conducting sea trials - Dick Ferro

Mr Ferro presented the headlines from the experimental methods section. He warned against entering too strong recommendations in the manual, against being too categoric, because many of the techniques are rather new and are still open to debate.

Subtopic 3: Recognized methods for the analysis of data from selectivity experiments - Ellen Pikitch

Mrs Pikitch elaborated the statistical analysis chapters, and stressed the need for a proper planning of the experiments. It was the intention that for each of the methods, the following should be given: a description, the equation, its application, a discussion of the model, and numerical examples.

Plenary discussion of the draft manual produced by the Sub-Group

During the discussion it was mentioned that when the procedure to follow during the experiments is too strict it will be discarded in practical circumstances. For instance measuring mesh size after each haul could cause a great loss in experimental time, which is scarce in most experiments due to limited time available for vessels. A possible way to overcome this is to use codends that were fished before. Questions were raised about the scope of the manual. Although targeted at size selectivity experiments, the statistical techniques presented will also be applicable to species selectivity trials, and comparative fishing experiments. The section on Materials and Methods will focus on size selection experiments. Generally it was stated that selectivity data used by scientists working in the field of stock assessment are mostly outdated, and not very complete. It was recommended to define the absolute minimum set of data that should be collected to obtain a valid experiment, and which data can be regarded as less important or even optional. An outline for a qualification of data-types is given in Section 5 (Appendix III). It was also stressed that the technique of taking sub-samples from a catch has a great bearing on the results of the experiments. The manual will deal with this problem in detail. It was noted that it would be helpful to have guidelines on the number of scientists needed to do the work as required by the manual. This would particularly be very useful in the planning stage of a project. The FTFB Working Group agreed upon the scope, the outline and the time schedule in producing the document. Concerning the proposed list of referees, it was suggested to address additionally Mr W. Dickson from Scotland. It was further suggested to make sure that each member state of ICES has at least one institute represented.

3.4 Special topics

- **The survival of fish caught by, or escaped from, fishing gear**
- **The physical impact of fishing gear**

1. Sangster, G.I. & Lehmann, K. presented by : Sangster, G.I.
"Assessment of the survival of fish escaping from commercial fishing gears"

The authors described experiments into the survival of young haddock and whiting escaping from bottom trawl codends, conducted in 1992. Mesh size under study were 90mm, 100mm, and 110mm, all diamond mesh. Special attention was given to the technique used to transfer fish from the cover of a trawl to a cage normally located in shallower water. After detachment the hooped codend cover was placed inside a transportation container made out of fiberglass. This container protected the fish in the cover from the waterflow during towing to the location of observation. Although data was scarce, two conclusions could be drawn:

- fish length has a high significance on fish mortality: large fish are more susceptible than small fish,
- mesh size does not seem to have any effect on survival.

The data was collected during one hour tows, while in commercial fisheries it will normally be 3 - 4 hours. There are problems in carrying out these experiments, if towing times are long, some fish in the cover are caught long time ago, some have recently entered the cover. To improve the methodology it was suggested to handle the control fish the same way as the treated ones: to tow them in the transportation cylinder for some time. The following survival rates are recorded:

Species/mesh size	90mm	100mm	110mm
haddock	73-79%	74-86%	82-91%
whiting	65-82%	68-82%	82-90%

All control fish had a survival rate of 100%. It was mentioned that the towing time is a crucial variable in the experiments, and that in Norwegian experiments higher survival rates were found for haddock compared to whiting.

2. Soldal, A.V. & Isaksen, B. presented by : Soldal, A.V.
"Survival of cod and haddock that escape from a Danish seine"

The difference between trawls and Danish (anchor) seine nets is that many fish (~50%) escape at the sea survey when hauling in the net. Survival study techniques were presented. The codend was released from the seine by pulling a release line, and towed into a net pen by a rubber boat, where - as the tension decreased and meshes opened - fish inside the codend were able to escape into the net pen to be observed. The mortality of cod and haddock in the pens was investigated over the next 8-11 days. Survival of cod was almost complete. The mortality of haddock ranged from 3.2 to 6.8% in four parallel net pens. The average body length of fish that died was shorter than of those who survived. There was a clear dependency in the amount of scale loss of the escaped fish. The injury level of fish that died was higher than the average of escapees.

It was noted that the mortality occurred so quick that bacteria, which are normally found in higher concentrations near the surface, were not supposed to cause the mortality. The finding that bigger fish had better survival is contradictory to Sangster's results.

3. Millner, R.S., Whiting, C. & Howlett, G. presented by : Arnold, G.P.
"Estimation of discard mortality of plaice from small otter trawlers using tagging and cage survival studies"

The authors describe survival studies of plaice caught by small otter trawls carried out in February and October 1992 in the Eastern English Channel by tagging and cage retention experiments. Trawl particulars were: 13m groundrope, 60m bridles, 80mm mesh throughout, 127 hp engine power, towing speed approximately 2.5 knots. Experimental fish were captured during 1 and 2 hour tows, control fish by much shorter tows, 15 -30 minutes. Two cage experiments were carried out with 10 and 5 fish per cage. The duration of observation was 216h in February, and 135h in October. In the first experiment many fish died after 100h of observation, the cause suspected to be too many fish in the small cages (600x400x220mm). There was hardly any difference between discards and controls for the first 100h in both experiments, and the survival rate was high (>80%). The February tagging experiments showed no difference in recapture, and no increase in mortality of discarded fish compared to the control group, while the October experiments showed a higher recapture rate of control fish in the first month, and subsequent recaptures being similar.

It was noted that the difference compared to other experiments is that it takes several days before fish starts to die.

4. Suuronen, P., Lehtonen, E., & Tschernij, V. presented by : Suuronen, P.
"Behaviour of Baltic herring in a pelagic trawl and possibility to increase selectivity by using a rigid sorting grid"

The problem in the Finnish herring fishery is that in a normal herring codend there is a good selectivity only at low catches, < 150kg. At higher catches blocking starts, even when square meshes are used. Survival of escapees is low due to scale loss, both with diamond and with square meshes. Several designs of rigid sorting grids were tested to solve these problems. The overall results were promising with a noticeable release of small herring. Fish can easily swim out through the grid without a change in orientation or wriggling through as in the case of meshes. It is recommended to insert a grid as forward as possible in a trawl in the area where the belly diameter starts to increase. A two-sided grid mounted in the rear belly is suggested to improve the sorting mechanism further. In this modification no guiding netting or funnels will be used in front of the grid. This will be tested in the autumn of 1993. It is also suggested to mount a grid with an elastic system (rubbers) to avoid mesh damage around it, and perhaps change the flat shape as well. Due to the flexible arrangement in sections the grids were easy to handle on a net drum.

5. Fonteyne, R. presented by : Fonteyne, R.
"Research on the physical impact of a 4m beam trawl"

The research was done as part of an ongoing EC-project on environmental aspects of fishing gear ("FAR" MA-2-549). Instrumented beam trawls were used to measure the pressure of the gear on the bottom. Gear tracks were surveyed with divers to determine penetration depth, and the time the tracks were detectable. The preliminary results of the project revealed that tracks were detectable until 52h after fishing. The penetration depth could not be determined from sonographs, but figures for pressure of the trawl heads were given and discussed. Of a total of 600daN for the gear drag, the normal force was 265daN, meaning a pressure of 0.101daN/cm^2 for the sole plate, and 0.303daN/cm^2 for the heel. The friction force was 165daN. These measurements apply to a towing speed of 6 knots at a warplength/depth ratio of 90/25.

3.5 Other topics

3.5.1 Selectivity Studies

6. Ferro, R.S.T. presented by : Ferro, R.S.T.
"Pair trawl selectivity for 90 to 120 mm mesh sizes"

Pair trawl selectivity was reported for mesh sizes ranging from 90mm, 100mm, 110mm, and 120mm. The codends counted 100 and 120 meshes round. The method used was covered codend. Cover design: hooped. The author mentioned the existing difficulties in comparing data. A statistical model has been developed with two parameters: mesh size and number of meshes round the codend (codend circumference). Results showed that pair trawls did not appear to be as aselective as previously thought. The following results were presented (the 1988 data were obtained with a hoopless cover):

Results for haddock

Method	year	L_{50}	SR
single boat trawl	1988	22.4	4.9
single boat trawl	1992	28.1	7.5
pair trawl	1991	27.1	5.6
pair trawl	1992	29.2	7.0

7. Ferro, R.S.T. presented by : Ferro, R.S.T.
"Twin trawl/covered cod-end comparison"

The project aimed at comparing results of experiments with hooped covered cod-ends with those using twin-trawls. Apparently there was no difference in L_{50} or selection range, except for haddock where there was a difference in SR.

The discussion revealed the problems which could arise in these projects: differences in handling and operation of nets, subsampling and raising factors, pooling data etc. Average data were presented using Fryer's statistical model:

Comparison of two experimental methods

Method	Species	L_{50}	SR
twin trawl	haddock	28.4	4.7
hooped cover	haddock	28.1	7.5
twin trawl	whiting	34.3	5.4
hooped cover	whiting	32.8	6.4

A comparison between Fryer's model and pooled data was also given:

Comparison of two methods of analysis

Method	Species	L_{50} twin trawl	L_{50} hooped cover
Fryer's model	haddock	28.4	28.1
Pooled data	haddock	28.3	26.6
Fryer's model	whiting	34.3	32.8
Pooled data	whiting	32.8	33.7

8. Fonteyne, R. presented by : Fonteyne, R.
"Comparison of mesh measurements with an ICES-gauge and a flat wedge-shaped gauge"

The basic problem of measuring the size of a mesh was brought forward. The results were not new, but demonstrated the differences obtained measuring four types of netting material with the ICES-gauge and the wedge-shaped gauge, applying both hand force and the prescribed loaded of 5kgf. The ICES-gauge normally gives the lowest reading, also caused by the fact that this gauge is normally calibrated with a load of 4kgf instead of 5kgf. In the experiments the ICES-gauge was also calibrated with 5kgf tension. Materials used are given in the table below.

The implication of this is that the mesh sizes in the commercial fishery are smaller than those intended by the scientists.

Materials used in the experiments

Material	Construction	Rtex	mesh size
1 - PA	braided, single yarn	11800	75
2 - PA	twisted, double yarn	3600	80
3 - PE	twisted, double yarn	4450	75
4 - PES	braided, single yarn	13000	80

Data measured

Gauge	Mesh opening mm	% difference WG-ICES	% difference WG-5 vs WG-H
Mat 1-PA			
ICES-5	75.33		
WG-H	77.75	+3.21	
WG-5	75.13	-0.27	-3.37
Mat 2-PA			
ICES-5	81.08		
WG-H	83.27	+2.69	
WG-5	80.90	-0.23	-2.84
Mat 3-PE			
ICES-5	71.80		
WG-H	75.80	+5.57	
WG-5	73.93	+2.97	-2.46
Mat 4-PES			
ICES-5	80.87		
WG-H	80.43	-0.54	
WG-5	80.00	-1.07	-0.54

A vivid discussion arose on netting parameters, which could have influence on the mesh size in operation, mesh size measurements and the bearing on selection parameters: new materials, thicker twines, stiffness of material, uneven bar lengths. All agreed that more information and reflection were needed. It was mentioned that mesh sizes would probably be regulated more in the future, and that no reliable technique existed for measuring gill net materials. It was questioned whether mesh opening is the right variable to describe selectivity in the first place.

9. Moth-Poulsen, T. presented by : Moth-Poulsen, T.
"FAR-project : Selective whiting trawl"

The author described preliminary results of a joint EC-project aimed at developing a selective whiting trawl for the commercial fishery. The basic idea was to divert whiting to the top of the net and haddock and cod to the lower part. Three trials have so far been conducted to investigate several sorting principles. Two different approaches were taken: aiming at whole trawl separation, and inserting a selector device in the extension piece. 50% of whiting appeared in the top codend, followed by only 20% of haddock. No complete separation could be achieved.

10. Moth-Poulsen, T. presented by : Moth-Poulsen, T.
"Selectivity in Danish seines"

Two square mesh windows (90mm mesh size, Ultracross netting) were inserted in the extension of a seine. In the first trials in 1991 the alternate haul technique was used, but differences between hauls were found to be large. In 1992 trials were conducted with a covered codend. Handling the large hooped cover on the small seiner turned out to be cumbersome. Flume tank tests of the codend and cover helped to optimize the size of the cover. Data from the experiments were processed using a model describing an asymmetrical selection curve. Results suggest that Danish seines are somewhat more selective than trawls. They also show that square mesh windows do not work on cod and plaice, and that many legally sized haddock and paricularly whiting escape.

11. Polet, H. presented by : Polet, H.
"Development of a species selective beam trawl - 2nd series of experiments - September - October 1992"

To improve the roundfish selectivity of flatfish beam trawls, experiments were carried out with a number of newly designed beam trawls on board a commercial vessel, as part of "FAR" EC-project TE-2-554 coordinated by RIVO-DLO and with SEAFISH as additional contractor. The three experimental devices were a square mesh top panel, a reduced top panel and a square mesh window. The experiments showed that it is possible to improve the species selectivity for roundfish without a decrease in flatfish catches. The reduced top panel seems to be the best option to decrease the haddock and whiting catches. For cod the square mesh top panel and the reduced top panel do not show a clear improvement. The results for the square mesh windows however indicate that possibilities to release cod exist. In general the windows were more effective in releasing cod at night. Flatfish catches maintained at their normal level. Losses in income using the application in the Belgian fleet are estimated to be low.

12. Isaksen, B. presented by : Isaksen, B.
"Preliminary test with separator grid in Danish seine"

The project was initiated by commercial fishermen, who found many juvenile cod in their catches in some areas. The grid tested was made in three sections of 700x700mm each, with a bar spacing of 55mm. The codend had to be extended in length to ease handling. The separation potential was checked with a cover and showed good results with most small fish entering the cover. A video demonstrated the operation of the grid arrangement.

13. Valdemarsen, J.W. presented by : Valdemarsen, J.W.
"Grid devices to size select shrimp in trawls"

The research aimed at reducing the incidental by-catch of small shrimp and small fish. Three devices were tested in Greenland waters in 1991-1992. An arrangement of grids in a double V-shaped configuration was mounted in front of the codend of a high-opening shrimp trawl. A conical netting funnel was used to concentrate fish and shrimp in the centre of the net, but clogging by fish occurred. Flow measurements indicated low water speeds through the system. In a later experiment the grids were turned 90° with their leading edge horizontal. A third test involved a new arrangement with a leader grid in the lower part of the net. The table below gives some selection parameters obtained:

Results for grid experiments

Grid	L_{50}	SR
I. << vertical	18.3	7.9
II. << horizontal	19.5	7.2-7.7
III. two grids	24.4	8.3

Selection ogives were presented. The relatively large selection range might have been caused by the flow problem through the system. The size selectivity for shrimp was not very good. A great reduction in shrimp catches resulted, among which many of marketable size. Good release of redfish and Greenland halibut was reported.

Tuesday, 20 April 1993

3.5.2 Various gear and vessel and behaviour topics

14. Bjordal, Å. presented by : Bjordal, Å.
"A new pot design for capture of Wrasse (Labridae)"

As wrasse have become a valuable species in aquaculture as cleaner-fish for lice infested salmon in sea cages, interest to catch this species alive has grown. There was a need for a fishing gear able to catch only this species, but no other larger predators. The project resulted in the design of a small, collapsible, lantern-shaped pot. These pots are fished at depths between 2 and 25m. Average catch rates were in the range of 5 to 10 fish per pot per haul. Each pot is hauled 2-3 times a day. A fisherman typically uses 20-30 pots. Cut pieces of crab turned out to be the best bait.

15. Bjordal, Å. presented by : Bjordal, Å.
"Tracking of Norway Lobster (Nephrops norvegicus) using a radio-link telemetry positioning system"

The presentation revealed a new stationary tracking system with radio transmission between hydrophone/radio buoys and the receiving unit. Conventional systems are based on cable transmission. The new system consists of three hydrophones, each connected to a radio buoy. Each radio buoy is anchored to the seabed, and attached to a mooring buoy. The vessel receiving the signals was moored 1300m away from the hydrophone array, indicating the distance over which the system can operate. Observations were carried out in February-March

1993 on tagged lobsters. The tags were attached by epoxy glue to the carapax of the Nephrops and can last as long as one month. Two baited pots were also fitted with tags to observe the response of Nephrops to the gear. One animal was attracted to a pot and captured, the other was not affected by the bait odour. The observations lasted for 19 days.

16. Koeller, P., McCallum, B., Strong, M. & Swain, D. presented by : Koeller, P.
"Quality of SCANMAR-data collected during Canadian bottom trawl surveys"

The presentation addressed problems which can occur when using the acoustic trawl monitoring system made by SCANMAR in biological surveys. Especially when the data are used to calculate the swept area of the trawl. The paper does not address the question of sensor accuracy, but deals with the overall quality of data collected during bottom trawl surveys using SCANMAR-height and spread sensors. The system does not distinguish between valid and invalid readings, and duplicates readings when no signal is received. The sampled readings therefore have to be edited afterwards, and the paper discusses data quality, data cleaning and how to define edit criteria. The discussion revealed that the problem was widespread, and that the SCANMAR users often are not aware of the problem. Using range checks can be misleading as they involve assumptions about the dimensions of the gear that are to be measured. It was agreed that more information is needed and that the SCANMAR company ought to be addressed.

17. Enerhaug, B. & Karlsen, L. presented by : Enerhaug, B.
"Influence of vessel motion on dynamic behaviour of bottom trawl"

The paper deals with the preliminary results of a computer simulation of the dynamic interaction between a fishing vessel and her gear. The main features and the assumptions in the model are described. The model was made in *Riflex*, a computer system tailormade for static and dynamic analysis of flexible riser systems. Half of the trawl is modelled under the assumption that the trawl is symmetrical about the centre line of the vessel. Other relevant assumptions are that vessel motions are not affected by the gear, the trawl doors move only in a horizontal plane, the wingends can only move longitudinally, and seabed friction is negligible. The trawl is excitated by the motions of the towing blocks as calculated by vessel motion transfer functions. The calculations show a considerable influence of the vessel motions on both the towing warps, sweeplines and otter boards. The influence on the net itself is not analysed, but conditions at the wingends indicate that variations in the trawl opening may occur. The warp tension at the doors was found to fluctuate with more than 60% at a towing speed of 5 knots and a warplength-depth ratio of 3. The model predicts that the doors may occasionally bounce off bottom. Paying out more warp will avoid this. Further study will involve the possible application of tension balancing systems and adjustable winches, optimization of warplength-trawldoor combinations, and development of riggings with improved dynamic stability.

18. Engås, A. & Chruickshank, O. presented by : J.W. Valdemarsen
"Measurements of trawl performance of the 36/47m GOV trawl using the constraint technique"

The paper describes the results of a test with a constraining rope between the warps in front of the trawl doors of the standard GOV-sampling trawl. The intension of the rope is to minimize the influence of variations in warplength on the performance of the trawl. Normally the distance between trawl doors increases

with increasing warplength, and the warplength-depth ratio is recommended by the ICES International Bottom Trawl Survey (IBTS) Manual for the GOV. Changes in depth require other warplength settings. Constant performance and known geometry are vital for this trawl as it is used as sampling trawl in the IBTS. A 9m rope mounted between the warps 150m in front of the doors successfully met the requirements. The door spread remained virtually constant between 64m and 68m when fishing in water of 70m to 300m with warplength varying from 350m to 900m. Without the constraining rope the variation in doorspread was much larger, between 81m and 110m. The rope did not create any severe handling problems during the experiments. On other research vessels handling problems might arise when the towing blocks can not be reached easily.

3.6 Report of the Working Group on Long-Term Management Measures

Plenary discussion with reaction of our working group

Mr. Ferro, who attended the LTMM-WG meeting part-time, summarised the report (ICES C.M. 1993/Assess:7) of which the most relevant pages were copied and distributed for reference sake. It was clear that there are numerous topics where the FTFB-WG can contribute with expertise: technical measures, fleet structure, vessel operation, fishing effort measurements, and gear selectivity. Several of the members felt that it was obvious that the FTFB-WG had not been able to disseminate the available expertise. Some members stressed the need for economic modelling in fisheries. The FTFB-WG emphasized the will to participate in the LTMM-WG in an active and constructive manner.

It was also agreed that the FTFB-WG should define its role, though problems still exist in determining fishing effort, selectivity etc. It was suggested that:

- a database should be established on gear/codend selectivity.
- special attention should be directed to the ICES Cooperative Research Report on Selectivity Methods.
- a model being developed for gill net selectivity

3.7 Recommendations.

The Working Group on Fishing Technology and Fish Behaviour recommends, that the next meeting will be held in conjunction with the Working Group on Fisheries Acoustic Science and Technology, in Montpellier, France from 25 to 26 April 1994 to:

a) consider and comment on the final version of the document written by the Sub-Group on Selectivity Methods, indicated below.

b) being aware of the increasing use of netting and twine in towed fishing gears with properties which change codend selectivity, to review available information on these characteristics and the methods to measure them and to make proposals for further work, particularly in relation to associated problems of measuring mesh size.

c) consider the influence of natural behaviour, such as day/night migration, feeding, etc. on sampling variability.

d) consider and develop the conclusions of the work of the Sub-Group on Survival Experiments, also mentioned below.

The Working Group on Fishing Technology and Fish Behaviour recommends, that the Sub-Group on Selectivity Methods (Chairman Mr D.A. Wileman, Denmark) completes a draft manual on recommended methodology of selectivity experiments and will meet in Montpellier, France from 21 to 23 April 1994 to prepare the final version with a view to publication in the ICES Cooperative Research Report Series.

The Working Group on Fishing Technology and Fish Behaviour recommends, that a Sub-Group on Survival Experiments (Chairman Mr G. Sangster, United Kingdom) will work initially by correspondence and meet from 21 to 23 April 1994 in Montpellier, France to review and evaluate data and techniques for survival studies, and recommend on the future direction of research.

3.8 Meeting's closure

The Chairman thanked the participants and hosts and closed the meeting.

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