Fish Capture Committee

ICES CM 1997/B:2

REPORT OF THE

WORKING GROUP ON FISHING TECHNOLOGY AND FISH BEHAVIOUR

Hamburg, Germany
14–17 April 1997

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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Table of Contents

1. INTRODUCTION

1.1 Members and Observers

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D .N. MacLennan
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1.2 BACKGROUND AND TERMS OF REFERENCE

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Date: 14-17 April 1997

In accordance with ICES C. Res. 1996/ 2:17 the Working Group on Fishing Technology and FishBehaviour (Chairman: Dr. S. J. Walsh, Canada) will meet in Hamburg, Germany from 14 to 17 (AM) April 1997 to:

a) evaluate progress in estimating and improving both catching efficiency and size and species selectivity in the static fishing gears used in commercial fisheries and in assessment surveys for finfish and shellfish;

b) review the progress of the Study Group on Grid Sorting Systems;

c) review the report of the Study Group on Unaccounted Mortality in Fisheries;

d) review the report of the Workshop on the Selection of a Demersal Sampling Trawl for the Baltic Sea as requested by the Baltic Fish Committee;

e) evaluate new codend mesh selection data for commercial fishing gears and consider priorities for future research on this topic; and

f) consider other related research in fishing technology and fish behaviour.

SUGGESTED WORK ITEMS FOR THE FTFB WORKING GROUP

In addition to the above Fish Capture recommendations, the FTFB Working Group also made the following suggestions for work to be initiated prior to the next meeting, April 1997 to

a) investigate the feasibility of accessing the Russian literature on theoretical and applied research on fishing effort and trawl catchability;

b) discuss the results of the 1996 FTFB Questionnaire on the problems related to the acquisition of data from measuring fishing gear performance by acoustics and other underwater observations and advise the Working Group on a the need for any action;

c) investigate the feasibility of setting up of a FTFB webpage;

d) report on the progress of setting up an ICES database on commercial trawl selectivity;

e) discuss the report of the "ad hoc group" setup to examine in detail the problem and mechanisms of integrating estimates of bottom survey trawl catchability more effectively into the stock assessment process; and

f) report on the feasibility of establishing a bibliography of trawl selectivity experiments.

2 STUDY GROUP AND SUBGROUP REPORTS

2.2 Report of the Study Group on Unaccounted Mortality, Alain Fréchet, Canada

On April 12-13, the Study Group composed of participants of 10 nations met at the Institut für Fischereitechnik in Hamburg. The meeting was opened by Alain Fréchet who welcomed all participants and set the agenda for the two day discussions. This was the second meeting of the Study Group, the first being held in Aberdeen, Scotland in 1995 (ICES CM 1995/B:1). Members of this study group have worked by correspondence between 1995 and 1996 (ICES CM 1996/B:5).

The session started with a review of the correspondence that was exchanged over the two years and detailing links that were established with other Study Group such as the Study Group on Ecosystem Effects of Fishing Activities, the Study Group on the Use of Grates and other Sorting Devices and the Study Group on the Use of Selectivity in Stock Assessments.

The overall impact of a fishing activity can be given as:

$F = F_C$ (Landed catch) + F_B (Illegal, misreported and unreported landings) + F_D (Discard mortality) + F_E (Escape mortality) + F_G (Ghost fishing mortality) + F_A (Avoidance mortality) + F_P (Predation mortality) + F_O (Drop out mortality) + F_H (Habitat degradation mortality)

A total of 29 project reports dealing with different components of this equation and involving some 17 countries and three working papers were presented and discussed. In the following discussion on priorities for future research the Group identified limitations in current understanding of the various sub-components of fishing mortality. The group had to acknowledge that there has been limited advancement of definitive information on most components of fishing mortality since the last meeting. The research carried out over recent years has concentrated primarily on the estimation of mortalities associated with pelagic and demersal towed gears. Estimates of mortality resulting from the use of static gears remain lacking.

Under the approach of the Precautionary Principle a better understanding of the overall mortality to a fishing activity has implications for fisheries management . The estimate of overall removals is essential to the assessment and the establishment of a reference catch level. The overall mortality associated to a particular gear could be used to prioritize its impact on a given stock. As an example of another implication for management , in increase in mesh size is usually accompanied by an increase in effort, such an initiative may be detrimental to a fish stock if escapement mortality is high. The Group recognizes that practical attempts to estimate the magnitude of individual sub-components of mortality need considerably investment, in terms of personnel and resources. A greater commitment from the scientific community and its funding authorities is required to achieve viable data in more fisheries.

Although there has been notable advancement in methods used for acquiring data for some mortality categories, most still require development. Particular effort is needed to insure that the data collected is a realistic reflection of the actual situation in commercial fisheries. A potentially large impact on juvenile fish has been identified by escape survival studies. Future work in all areas should attempt to account for mortality in juvenile age groups and identify fisheries in which the juveniles form a high proportion of the fished population.

The incidence and fate of fish that have multiple encounters with fishing gear is unknown. This is maybe most serious with mobile gear. Issues critical to this situation include species, size , degree of injury or stress and time between encounters.

In particular the Group points out that continuing efforts are necessary to increase the awareness of fisheries managers , fisheries scientists and the fishing industry to the potential importance of Unaccounted Fishing Mortality. The Group emphasizes the collection of accurate data on illegal , misreported or unreported landings and recommends the acquisition of data on discards accompanied with reports on the survival of this discards. Future work on survival of escapes in mobile gear should include data on whole gear selectivity and survival after escape. To be directly applicable in stock assessment and

management these data should be forwarded in a compatible form. With regard to ghost fishing the group recommends systems of greater accountability for lost gear ,e.g. by individual tagging ,and encourages research on bio-degradable twines in order to reduce the duration of ghost fishing of lost gear. A database under the coordination of the Group should be constructed to collect and collate all available data on all sub-components of fishing mortality (except landed catch, illegal , mis-reported or unreported landings).

General consensus among the members of the Group was that in account of the number of still unsolved issues the Group should continue its work in the present form. This should be done by correspondence in 1998 and by a further meeting in 1999.

Discussion: The Working Group (WG) thanked the Study Group for making its report available. The WG applauded the efforts to collate the vast amount of data collected in an up till now in this relatively new field of research. The WG noted that fisheries science is often driven and funded by what is the easiest to achieve and consequently some of the parameters of the equation may never be measured. The WG supports the views of the Study Group concerning the continuation of work and acknowledges that it will also continue to provide a venue for this research. It stresses that the final report should be more positive in showing more of what has already been achieved than the mere enumeration of gaps in knowledge.

2.2 Report of Sub-Group on Selection of a Demersal Sampling Trawl for the Baltic Sea, Ulrik Jes Hansen, Denmark (ICES CM 1997/J:6)

A workshop was held in Gdynia in January 1997 with participation of biologists and gear technicians from most of the countries bordering the Baltic. The workshop recollected available information on the various survey vessels and trawls used for sampling the groundfish fish stocks in the Baltic. Also a compilation had been made for the workshop of the geographical distribution of the individual trawl-stations of the various national surveys on which the current national time series are based. The outcome was that a standardization of the gear and procedures was greatly needed. Also it was apparent that none of the national time series could be said to represent the entire Baltic area. Therefore - on an international scale - they could be sacrificed.

The workshop discussed the technical and biological properties a new trawl should possess and recommendations were prepared. The workshop recommends:

1) that two different sizes of a modern four-panel trawl with long wings be used: one for the large survey vessels (> 800 HP) and one for the smaller vessels (< 400 HP).

The construction of the groundgear is considered of significant importance for the new survey trawl as several investigations have demonstrated size dependent escapement of fish beneath the trawl.

2) that the groundgear for the small survey trawl aboard the smaller vessels should be a light footrope;

3) that for the large vessels the BIFS Working Group are recommended to select between two groundgear options:

a) the first option is a light rock-hopper groundgear which is sub-optimal on smooth bottom and cannot be used on the very hardest ground; and

b) the second option is using two groundgears: a proper rock-hopper gear and a light foot-rope. This option enables the whole of the Baltic to be covered, but is

disadvantageous for the data processing; and

4) prior to the implementation of the new survey trawls, a thorough test-phase including both the test of the new gear itself and comprehensive comparative trials be undertaken to establish the links to previous survey trawls and determine the differences in fishing efficiency between the old and the new trawls.

Discussion: The Chairman and the Sub-Group were congratulated for the completion of the background research and the holding of a successful Workshop. The Working Group (WG) recognizes the difficult task the Sub-Group faced in advising on a multi-species bottom survey trawl to be used by the present 8 research vessels surveying the Baltic Sea and felt that the Report was very objective in clearly defining the problems and proposed solutions.

The WG notes that the ideal situation for any bottom trawl survey would be to have only one vessel, one trawl size and one groundgear option covering the entire distribution of the stock. However, like most stocks, distribution of various Baltic Sea stocks and their life history stages, for example cod, are in areas that are not readily acceptable to one vessel size and one survey trawl. Trawling operations are generally restricted by bottom type, i.e. rough vs. smooth grounds, and accessibility of vessel to sampling areas, i.e. inshore vs. offshore. Consequently, in these situations assessment biologists may have to compromise on either the sampling design, i.e. restriction in areal coverage, sizes and species sampled, etc., the choice of vessel-trawl combination or both. Such is the case in the Baltic Sea surveys.

The WG notes that using more than one vessel with different horsepowers and the same identical trawl will result in different fishing powers that will require intercalibration via comparative trials. This becomes complicated when a second size trawl is used for the smaller vessels. The difficulty of inter-calibrating large and small trawls would be further increased when more than one groundgear type is used on the large trawl. Calibration of fishing powers may not be realistic achievable here since combinations of the "new" standard trawl will have to be inter-calibrated, to allow the abundance indices to be additive and then calibrated against the "old" standard trawls to maintain the time series.

In its lengthy discussion on this report, the WG recognized that bottom contact and areal coverage are critical factors in survey trawl selection and made the following observations on the vessel/gear combinations proposed in the Report:

1) elimination of vessels less than 400 HP and using the larger vessels (>800 HP) to carry out the entire survey with one survey trawl would, from a fishing power perspective, eliminate the need to deal with more than one trawl. From a biological/assessment point of view this could mean that much of the shallow areas in the southern Baltic, not accessible to most of the large vessels, may not be covered, i.e. a restriction in areal coverage and a reducion in the amount of information on the 0- group and prerecruit cod. Intercalibration would be simpler here but at a cost to sampling design;

2) scaling one survey trawl to fit both large and small vessels allows all geographic areas to be covered and after suitable intercalibration the indices can be additive and the time series maintained. Here the large vessels would use one groundgear to fish deeper waters and hard bottoms, and the smaller vessels would use a scaled

down version of the survey trawl, with an appropriate footgear designed to fit their trawl drum, to fish shallow waters and smooth ground suitable to its HP. These surveys should produce both indices of prerecruits and SSB for several species. Inter-calibration would be more difficult but still achievable;

3) calibration of fishing powers on large vessels will be further complicated by choice of more than one footgear making inter-calibrations within the large vessel fleet more difficult. Heavy groundgear on smooth grounds where small cod are located is inefficient due to the size dependent escapement underneath the trawl. Light groundgear, on the other hand, should reduce escapement but cannot be used on all bottom types. The Workshop suggested an intermediate groundgear as the best compromise. The shortfall is that there may be more trawl damage in some areas i.e. rocky bottoms of the Northern Baltic, and the trawl will be less efficient than a light gear for catching small cod. However, if the proportion of escapes is assumed constant from survey to survey and some reduction in areal coverage of rough bottom habitats is acceptable then this may not be a problem from an assessment point of view.

The WG suggests that if the present 8 research vessels of varying horsepowers continue to be involved in Baltic Sea surveys then a compromise of two sizes of the same trawl with two sizes of groundgear, one for large vessel and one for small vessel would be the best option from an intercalibration perspective

The WG notes that selection of the survey gear for the Baltic Sea will necessitate a long transitional period with optimization of the riggings for the selected trawl(s) and intercalibrations between the new standard trawl(s) and the old standard trawl(s).

The WG suggests that the BIFS Working Group consider the Workshop Report and the comments here in the context of its objectives for areal coverage, size and species sampling in the Baltic Sea surveys and the selection of a multi-species bottom survey trawl. One single trawl cannot be recommended that will match all vessel sizes, bottom types and geographical areas.

2.3 Progress Report of the Study Group on Grid (Grate) Sorting Systems in Trawls, Beam Trawls and Seine Nets, Bjørnar Isaksen, Norway

The chairman announced the receipt of a letter from Mr. B. Isaksen who has taken over the chair from Mr. J. Valdemarsen presently leading the Fishing Gear Technology Unit of FAO, Rome. The new chairman informed that he intends to work along the lines set by C.Res 1996/2:20 and is looking forward to give a report on present activities of the study group at the 1997 Annual Science Conference. Mr. Isaksen connected his letter with a call for contributions to the planned bibliography on sorting grids.

3 SPECIAL TOPIC: SELECTIVITY AND EFFICIENCY OF STATIC GEAR

3.1 Development of a new longline bait based on surplus fishing products, Svein Løkkeborg, Norway

A new longline bait based on surplus products from the fishing industry has been developed at the Institute of Marine Research in Bergen. The bait is based on minced fishing products as stimulant, alginate as binder ,and fine-meshed fabric as reinforcement. Three fishing experiments were conducted in the longline fishery for cod (*Gadus morhua)* and haddock (*Melanogrammus aeglefinus)* in the Barents Sea to test the catching efficiency of the new bait in comparison with traditional mackerel bait. Baits based

on minced mackerel, herring or capelin were tested, and all three variants gave considerably higher catch rates for haddock. The three variants of the new bait gave catch rates of cod that varied between 25% and 107% of the catch rates of traditional mackerel bait. These results showed that the new bait has highly species-selective properties. The physical and practical properties of the bait are also superior to traditional bait in that it is more suitable for mechanized baiting and easier to remove from the hook.

Discussion: The WG noted that no quantitative data were available on the discard rate with this new bait but the general impression is that it is low. Problems of seasonal shortage in the provision of adequate bait initiated the research. Explanations for the observed different preference of cod and haddock for the new bait are still speculative but species related taste preferences or the competition for food seem to be the main reason. More research seems to be needed to reduce the increased catch of smaller fish. A change in hooksize seems less promising than a larger bait size.

3.2 Longlining tests as a possibility for solving bycatch problems in the German Baltic fisheries, Otto Gabriel, Germany

With the aim to reduce unwanted bycatches and discards in the Baltic eel fisheries with trawls and the cod gillnet fishery , the first investigations were started last year. In the case of eel fisheries results from longlining are compared with small mesh size trawling during summer time, where the target species only amounts to a small part of the catch (about 4%) and most of the remaining part is undersized fish or seasonal restricted fish which must be discarded. In the second case results from longline test fisheries are compared with gillnetting for cod . These fishery is problematical during winter time in some regions when a high amount of seabirds can be killed.

Gears and methods were presented and some temporary results have been discussed. They emphasize the importance of such investigations and demonstrate the value of an alternative technology for these two fisheries which are under pressure from bycatch and discard problems. Some improvements seem necessary in the baiting process and in the use of more suitable baits for increasing catchability in longlining. These investigations will be continued.

Discussion: Strategies to improve longline efficiency to that of a similar effort of gillnets (hooks/nets per day) were discussed. The WG looks forward to seeing future results of methods to reduce both fish and bird bycatch.

3.3 Selection and mortality in pelagic longline fisheries for haddock, Auld Vold Soldal and Irene Huse, Norway

The bycatch of haddock (Melanogrammus aeglefinus) below legal size in the pelagic longline fisheries for haddock off the coast of Finnmark, northern Norway, is often high. The project reported here was aimed at reducing the bycatch of undersized haddock through alterations in gear technology and fishing strategy.

Fishing experiments with commercial longline vessels were carried out in June/July 1995 and 1996. The following modifications of fishing gear and fishing technology were tested: longlines with increased sinking speed (i.e. twice the normal lead weight); hooks with an inedible plastic body attached to the shank; hooks with nylon bristles attached to the

shank; restructured bait based on mackerel (*Scomber scombrus*) and sandeel (*Ammodytes lancea*); mackerel bait of twice the normal size; restructured mackerel bait of twice the normal size.

None of the methods tested gave the desired improvements in the size distribution of the haddock catches. The experiments carried out during the 1995 season indicated a 15% reduction of haddock below legal size by increasing the sinking speed of the longlines. These findings were, however, not confirmed in the 1996 experiments. Traditional mackerel bait of twice the normal size had the largest effects on the size distribution of the catches (about 40% reduction in undersized fish), but the number of hooks tested was low, and thus the confidence. An increase in bait costs due to larger bait size, will, however, not be accepted by commercial fishermen.
In the survival experiments, where 18 haddock were torn off the longline hooks at the sea surface and kept in sea water tanks for five days, no mortality was found. One of the fishes was in bad condition at day five, and would probably not have survived if it was released to the sea. Still, the survival rate was surprisingly high. Additional experiments have to be carried out to confirm these results. If the observed survival rate is shown to be correct, the mortality of haddock below legal size in the pelagic longline fisheries may be considerably lower than earlier expected.

As a spin off of the catching experiments, it was shown that the catch rates of lines baited with restructured mackerel bait was at the same level as that of traditional mackerel bait.

Discussion: The WG noted the sample size in the survival part of the study was small and look forward to continuing research on longline survival. It questioned whether the method of removing fish from the longline actual reflected the type of damage occurring to fish in commercial practice. The WG recognizes that although the new bait type was more selective, fisherman would be reluctant to switch because of higher bait costs. This was another example of conflict between fisheries management and the socio-economics of responsible fishing.

3.4 Selectivity of gillnets in the North sea, English Channel and Bay of Biscay, Thomas Moth Poulsen, Denmark

The presentation is the executive summary of the final report of a 3 year joint project between DIFTA, IFREMER, SEAFISH and DIFRES founded by the European Commission under the FAIR program. Selectivity characteristics is measured for 3 important gill net metiers for each of the Danish, English and French commercial fleets. A statistical model is developed to describe how gill net selectivity is dependent upon major gear design parameters. It is demonstrated how the model can be used to analyze gill net fleet fisheries management problems.

Discussion: The discussion touched the points of adequate choice of mesh sizes in such investigations and of comparisons with other fishing gear on the same fishing ground. The Working Group noted that trawls catch generally a much lower size spectrum than appropriate set nets. "Corner effects" of increased catch in one mesh size by the sudden change from one mesh size to the other in a fleet of set nets have been tried to avoid by leaving holes where fish swimming along the fleet may escape. The tests have been designed with the aim to operate as closely to commercial conditions as possible. The single research nets , therefore, had the length of commercial ones. If a commercial fishing effort with its possible negative implications to selectivity and survival was reached is still questionable. The problem of ghost nets and their possible origin and importance was briefly discussed.

3.5 The probability of ling to encounter gillnets as a function of time of day, Arill Engås and Terje Jørgensen, Norway

The probability of ling (*Molva molva*) to encounter a fleet of four gillnets within a soaktime of 12 h (1800-0600 hr.) during four selected sampling periods is calculated on the basis of in situ observation of fish movements and random simulated start positions and setting directions of the gillnet fleet. The movements were studied by means of a stationary positioning system. Five ling were tagged by allowing them to voluntarily swallow bait-wrapped acoustic transmitters close to the sea bed, but only three or four of the ling were used in the calculations of encounter probability. The expected number of encounters for a gillnet fleet of 110 m within a soaktime of 12 h vary between 0.10 and 0.30 with a fish density of three fish per 0.10 $(\text{n.mile})^2$.

Discussion: The WG expressed interest in the use of acoustic tracking data and simulation to estimate fish densities. A repetition of these trials with cod as target species is planned for later this year. Special attention will be paid to the length dependency of the encounters and to possible day/ night differences. The WG notes the difficulties in estimating meaningful catchability coefficients and swept area in gillnets.

3.6 Trials with creels fitted with an escape gap in a fishery for velvet swimming crabs (Necora puber), A. M. Shanks, J. H. B. Robertson and D. J. Bova, United Kingdom

Fishing trials demonstrated the effectiveness of incorporating an escape gap in creels in reducing the retention of undersized velvet crabs (Necora puber) in a Scottish fishery. Three different gap sizes were tested and their selectivity was compared. It was concluded that a gap size of 25 mm would release 50% of crabs of the minimum legal size of 65 mm.

Discussion: The reasons for the presented differences in catches and the effect of time of the day , fishing ground and season were discussed. The WG noted the economical effects of the suggested technical measures

3.7 Variability in gillnet selectivity, Rene Holst, Denmark

A model was presented for incorporation of different levels of random variation. The model was demonstrated on data from experiments with gillnets, but is without any changes applicable to experiments with towed gears and other longitudinal data in general.

Discussion: The WG noted that the reasons for the demonstrated seasonal differences could not be explained. An influence of the unequally distributed fishing effort could not be excluded. The WG agrees that the traditional method of pooling many datasets from several fleets or trips may result in loss of information or misleading conclusions about selectivity and encourages a more thorough investigation of single sets as prescribed in the 1996 ICES Manual of Methods of Measuring the Selectivity of Towed Fishing Gears

3.8 Investigating ways of reducing salmon by-catch in cod traps, W. M. Hickey and G. Brothers, Canada

The cod trap fishery in Newfoundland coincides with the annual Atlantic salmon spawning migration and generally results in a high by-catch of salmon. Between June 26 and July 21, 1996 experiments to reduce the by-catch of salmon in cod traps were carried out from three communities on the West Coast of Newfoundland, Canada. The catch of salmon and cod in cod traps without experimental devices was

compared to that in experimental traps set nearby. All devices tested were designed to take advantage of the fact that cod (groundfish) are usually found near the bottom while salmon (pelagic fish) usually swim near the surface. The devices tested were: (1) two 37 x 3 - meter deflectors attached to the leaders; (2) large mesh in the top three meters of the leader; (3) leaders sunk three meters under the surface. Traps using deflectors caught 74% fewer salmon than control traps. All traps with experimental devices caught fewer salmon than the control traps. Cod catches for both types of traps were about equal.

Discussion: Measurements of salmon from the catches were not taken, but mostly young fish were concerned. Compared to the mesh size in top of the leader used in Sweden (modification 2) the suggested size is relatively small. Improvements of the results may be possible by making use of the behavioral effects of different netting colors on the fish. The WG noted that commercial fishermen seems to favor the least expensive method, i.e. the sunken leaders (modification 3).

3.9 The effect of a seal exclusion device on the efficiency of a salmon trap, Hakon Westerberg and Joakim Stenström, Sweden (Poster)

Seal damages to salmon and whitefish trap nets is a growing problem in the Northern Baltic. An essential part of making a trap safe for seals is a gate at the entrance to the bag, which has the property to keep the seal out but still allows entry of the fish. Trials were made with conical gate design to assess its effect on the efficiency of a salmon trap. The behaviour of individual fish at the bag entrance was observed by video cameras with and without the gate in place.

With the open entrance approximately 1/3 of the fishes approaching the entrance turned back. Of those that entered the bag more than half escaped. With a gate fitted with 48 mm meshes in the side panels all observed fishes turned. Most turns were made within the gate after swimming into the side panel. A modification was made by switching to 100 mm mesh size. This resulted in that 2/3 of the fish turned at the entrance , but of those that entered the bag none escaped., which means that the net efficiency was essentially the same as without gate.

It was found that the observation activity as such reduced the catch of the experimental trap by almost 80%, compared to undisturbed neighboring traps, whether the gate was in place or not. Seal damages - holes or fish remains- were found at two emptyings each with and without the gate. With the gate the catch was as expected in comparison to neighboring traps but without the gate all fish were lost.

Discussion: The WG noted the success of this seal exclusion device and look forward to seeing future research in this area.

3.10 Development of a new cod pot and comparative trials with commercial pots, Dag Furevik, Norway

A new cod pot called "two- chamber pot" has been developed at the Institute of Marine Research. The project was started because of the need for a new gear to catch cod of high quality, i.e. for life storage. The two chamber pot gave higher catch rates for cod than the commercial pots, and is now considered as an alternative to other static gears.

In comparative fishing trials between the new two- chamber pot and longline, 6-7-pots caught the same amount of fish as one tub of longline (300 hooks). The size distribution of cod caught on longline and in the pots were fairly similar, but the longline caught slightly more of the smaller fish.

Discussion: The WG noted that the investment costs for the pots are considerably higher than costs for a longline of equal efficiency but the maintenance costs are lower. Only 0.5 kg of bait is needed per trap and day. The traps are collapsible so that a large number can be transported. Floats and weights ensure an upright stand of the pot on the sea bottom. The pots were set out on a backbone line each 50 meters apart from the next. The WG also noted the success of introducing this pot to replace the traditional gillnet fishery in areas where the bycatch of the valuable King crab was high.

3.11 Selectivity investigations in gillnetting for Baltic cod, T. Mentjes, Germany

Data collected from 1980 to 1985 comparative fishing with gill- and trammel nets were analyzed. The difference between the retention curves were normalized to the maximum. There were great difference in the number of caught fish. To find out the reasons for the differences in catches of different net types, detailed investigations on the catch mode have begun in 1996 and will continue in 1997. The 16 different catch mode classes and subclasses where described. Catches of gillnets of three different height and two different mesh sizes were analyzed. 50 to 70 % of the catches where gilled or wedged, 15 to 25% where meshed between the maxilla and the end of gill cover. The method of meshing was influenced the season, mesh size and net height. The part of entangled fish, after they are caught by one of the above mentioned modes decreased with the net height. 5% of the caught fish are gilled one time, while most of them are gilled two or more times. The part of two other catch modes, hooking at the maxilla and catching a net bar and afterwards entangling vary with the seasons and mesh size.

Discussion: Reported changes in the capture mode were explained by the increase in slack netting with an increase in net height. Most fish were caught in the lower part of the net so that escape of gilled fish from higher part cannot be excluded. For measuring mesh size meshes were stretched without strain and then measured with a ruler. The WG noted that a precise measuring instrument for set nets giving reproducible results is necessary.

3.12 General Discussion of Special Topic:

The extent of the research into the use of static gears is reflected in the 11 scientific papers from 6 ICES countries. Most of the papers dealt with selectivity studies of commercial static fishing gears, but also included studies on statistics and fish survival. One paper recounted research into estimating catchability coefficient by using fish behaviour data from gillnet studies in a simulation model to estimate fish densities.

Static fishing gears are used regularly in many commercial fisheries and are also used to provide one of the estimates of stock size in Greenland, Norway, Canada, Denmark, USA, Sweden, Finland and Estonia. The WG noted that estimation of the fishing effort and catchability coefficients of static gears is more difficult than in mobile fishing gears. From a stock assessment point of view, comparative studies into variability in catch rates and catch composition of static gears vs. mobile gears will tell us more about the stock complex and biology of the target species.

The WG noted that in static gears, the standardized methodology used in conducting selectivity studies and statistical analysis of the data has not kept abreast with recent developments in towed gears. The variance observed in the estimation of selectivity curves in static gear is still poorly understood. The WG encourages

future research to include a variety of factors which influence this variability such as fish behaviour, twine size, twine materials, twine color and seasons. Direct estimation of the catching power of static gears is not an easy task and usually indirect methods of selectivity are used as illustrated in several of the presentations. For gillnets, freshwater selectivity studies have used directed estimates of selectivity of the gear using large tanks and also marked populations.

Similar to mobile gears studies, the WG recognizes that survival studies are a necessary area of investigation in static gear research as emphasized by the 1997 ICES Study Group on Unaccounted Mortality in Fisheries. First attempts to determine the survival of fish caught by static gear have already been made but the methodology still needs development. The WG encourages all ICES countries working on selectivity of static gears to include survival studies.

4 SELECTIVITY STUDIES OF TOWED GEARS

4.1 Optimization of species selective beam trawls, Ronald Fonteyne, Belgium

The main objective of this EU funded project (AIR2) was to reduce the roundfish by-catches of beam trawls without substantially reducing the catches of the flatfish target species. The most promising selective devices developed under an earlier FAR-project were retained for further improvement. Models of the modified gears at a scale of 1:5 were tested in the Seafish flume tank in Hull for a first technical evaluation. The best practical configurations were then constructed at full scale and tested at sea. Underwater video observation techniques were used to ensure that the fishing gears performed as predicted. At the end of this phase in the project the final choice was made of the species selective devices to be used in the comparative fishing experiments. The species selective devices deployed were:

1. for R-nets:
(i) square mesh top panel with/without a square mesh window
(ii) cutaway cover with/without a square mesh window

2. for V-nets:
(i) large mesh top panel
(ii) cutaway cover.

Representative vessels of the most significant beam trawler sub-fleets were chartered to perform the catch comparisons between experimental and standard gears. These gears were towed simultaneously which allowed for catch comparisons between the two gear types operating under identical conditions. The significant roundfish and flatfish catches were weighed and the fish were measured to plot the length-frequency distributions. It was found that square mesh top panels and cutaway top panels were suitable for releasing significant numbers of whiting and haddock from R-nets. A condition was that the net was sufficiently large to allow for a large enough escape opening. No good results were obtained with the smaller Eurocutter nets. The application of a large mesh top panel in V-nets resulted in a substantial decrease in whiting and cod catches for all vessel classes. The application of a cutaway top panel had no effect on the catches of a V-net.

An economic evaluation demonstrated that the overall effect of the roundfish catches on the total earnings was marginal. Therefore releases of these fish did not affect earnings noticeably.

Discussion: The WG noted that there was a higher escapement of cod and haddock at night but were unable to conclude what behavioral differences could be responsible for the differences in day/night results. It also noted that changes in hydrodynamic properties of the gear can result from these

modifications mentioned and affect catchability. The author noted that sole catches increase when the upper panel was removed and this may be related to a decrease in opening and better bottom contact by the groundgear. Research on selective beam trawls in Denmark has shown that the use of a cut-away square or a large mesh top panel had a tendency to increase catches of large cod. The WG was impressed by the commercial video of research results and felt that it was an excellent method of demonstrating these results to the fishing industry.

4.2 Grid sorting in a bottom trawl fishery for lemon sole, Kristian Zachariassen and Stein Halti I Jakupstovu, Faroe Islands

In experiments with grids in a bottom trawl fishery for lemon sole and plaice at Faroes, almost the entire catch of lemon sole could be sorted into one codend, whereas plaice, the larger cod, saithe and Monkfish could be retained in a second one. Some preliminary results from experiments in 1996 with the grid sorting system were presented.

Discussion: The discussion clarified further technical details of the sorting grid used (function of small extra bars, size of the grid, material, problems with seaweed). The WG noted that this was thought to be the first example whereby one flatfish species could be separated from another and look forward to seeing future results.

4.3 A comparison of two different methods to evaluate selectivity of a codend, Erdmann Dahm, Germany

There is presently a still ongoing discussion among gear technologists about the possible effects of masking by the cover in selectivity investigations though large improvements have been demonstrated by the recently introduced use of the ringed-cover technique. Direct comparisons between the new technique and the alternative two-trawl technique are yet rare. The presented contribution reported on the results of such a comparison carried out on the German research vessel "Walther Herwig III" in November 1996. A divided trawl was used as reference to the 140- feet trawl with ringed cover which is normally used on this ship for selectivity investigations in arctic regions. Catches in a range from 100 to 1200 kg were obtained in tows of 60 to 120 minutes duration. The correct function of both trawls was assured by net geometry measurements and video observations.

It could be shown that the selection parameters for haddock and saithe obtained by both methods deviated only insignificantly. A large portion of the hauls with the divided trawl had to be excluded from the evaluation because of total lack of any selection. Until further evidence of the still possible negative effects of larger catches there seems to be no apparent need for an immediate change to a two trawl system in selectivity investigations

Discussion: The WG were encouraged by the results of this comparative studies of the two common methods used to derive codend selectivity. Most members agreed that in many cases split trawl selectivity studies gave results that were often difficult to interpret than generally found in cover codend studies. However, it noted that in the case where twin trawls are used in the commercial fishery then selectivity studies should stay with twin trawls.

4.4 Experiments with ' exit windows' in a demersal trawl fishing in the Faroes, Kristian Zachariassen and Stein Hjalti i Jakubstovu, Faroe Islands

Due to above average recruitment of the 1993 and 1994 year classes the number of

discards of undersized haddock in the bottom trawl fishery at the Faroes increased in 1995 and 1996. In order to find a way to reduce discarding , The Faroe Island's institute, Fiskirannsoknarstovan, in 1995 and 1996 did some experiments with "exit windows" based on Swedish design. The results showed that discarding on deck was significantly reduced when using exit window panels in the cod end as compared to ordinary cod ends. In this report some preliminary results of the experiments are presented.

Discussion: The WG noted that there was a problem with meshed fish (mostly redfish) in the exit window panel and this was a cause for concern since this blocking would affect escapement. Saithe apparently are not so effectively sorted out as haddock.

4.5 Experiments with grid sorting in a mixed industrial fishery at the Faroes, Kristian Zachariassen and Stein Hjalti i Jakubstovu, Faroe Islands

In experiments with a grid sorting system in a mixed industrial fishery at Faroes, the bycatch of undersized haddock was reduced from an average 5% in weight to 1.3%. With the introduction of a species "funnel" with 200 mm diamond meshes the bycatch of legal sized human consumption fish species could be retained.

Discussion: The WG noted that the use of such equipment leads to some loss in total catch but this was compensated by the remarkable reduction of the unwanted haddock bycatch.

5. TECHNICAL STUDIES

5.1 New results in basic research for ropes and net design, M. Paschen, Germany

Recent research has focused on three areas: 1) calculation of net and rope systems; 2) prediction of behaviour of moored systems and towed underwater vehicles and 3) load analysis of cables and chains towed along the bottom. Computer hardware and software are used extensively to calculate net and rope systems. Underwater video is used to measure behaviour , motion and shape of moored systems and towed underwater vehicles and the analysis is visualized in 3-D. A channel was constructed to measure drag resistance of towed cables along the bottom with and without water in the channel to identify which factors contribute most to the drag coefficient.

Discussion: The WG noted the tremendous amount of research that was going into the study of these systems. Innovative computer hardware and in particular software development has made much of this research possible and the WG looks forward to seeing future results of these experiments.

5.2 Alternative stimulation in fisheries: EU-concerted action ALSTIM, Bob van Marlen, Netherlands

The EU - financed project ALSTIM aimed at reviewing existing knowledge in the field of alternative stimulation in fisheries, create an opportunity for scientific workers to visit current experiments in other nations, and give guidelines for further research. The project resulted in an extended report including references on topics such as: visual stimuli and ways to manipulate behaviour, reactions to sound, use of light stimuli, use of electrical stimuli and olfaction. Many of the references belong what is often referred to as `gray literature`. Seven institutes were involved in this project, RIVO-DLO IJmuiden, IMR Bergen, SOAEFD Aberdeen, SEAFISH Hull, BFAFi Hamburg, RVZ Ostend and FGFRI Helsinki. The authors are: Arill Engås, Ingvar Huse, Clem Wardle, Chris Glass, Bill Lart, Roger Horton, Klaus Lange, Hans Polet and Esa Lehtonen, with Bob van Marlen acting as editor. The

project ran between 1 Sep 1994 and 31 Dec. 1996. Included were visits to Japan and Russia to retrieve information on these topics from outside Europe.

Conclusions were presented for the various topics, and gaps in knowledge identified. The draft final report was recently sent to the European Commission and will be available after approval. Requests for copies should be notified to B. van Marlen, e-mail b.vanmarlen @rivo.dlo.nl. All authors were thanked for their contributions. Afterwards a short video was presented on the Sea Ranching Program running in Japan to illustrate ways to condition and recall fish to feeding stations along the coast to increase catch opportunities for fishermen.

Discussion: The WG were impressed by the amount of research material being reviewed. Particularly the video demonstration of the Japanese research on sound conditioning of fish provoked a lively discussion on legal aspects of ownership of fish aggregated by such means.

5.3 Flow measurements in a trawl, W. Thiele, Germany

The flow through a trawl is very important for the catchability and it is also responsible for the selectivity of the gear. Investigations by other scientists show that the flow through a trawl is decreasing up to 30 % of the trawling speed. Measurements of the flow by using the SCANMAR speed sensor were carried out inside and outside of a selectivity cod-end. The cod-end was equipped with a "hooped" cover and sorting grid in the upper part.

The results show that the speed of the flow inside the cod-end is strongly influenced by the mesh size and the cover. Additional to the flow measurements with SCANMAR a method for the estimation of the flow by video and computer calculation was introduced. Further investigations on the behaviour of fish in the codend show that cod shows no active escapement reaction. However, herring shows panic-like reactions and goes through the meshes without hesitation. The investigation will be continued in the next months.

Discussion: The WG recommended to include trials with exit windows into the follow up experiments and to have a closer look onto the calibration of the SCANMAR sensors used to measure water flow speeds. It was suggested that Baltic cod could be induced to pass through the grid by using guiding panels in the codend.

5.4 The kite cover or "Fisherman's friend- you know they hate handling the big hoops", Thomas Moth - Poulsen, Denmark

A cover that creates space between codend- and cover meshes by means of flexible kites instead of hoops was developed in DIFTA's flume tank in Hirtshals. The cover is easy to handle and can be winded up on the net drum. The cover was tested in scale 1:2 against a standard hooped cover with a 3 m diameter inside hoop as described in the ICES selectivity manual. Drag of the innovative cover was only 10 % higher than the standard cover with a horizontal and vertical width and height on 3.5 m although the cross section was not strictly circular. The impact on total gear resistance is therefore minimal. The waterflow was measured at several locations and the flow between the cover and codend was the same for the standard and innovative cover.

Specifications on the kite cover will be available from DIFTA during May-June 1997. The cover is to be tested by Sweden in the Baltic cod fishery in June 1997

assisted by underwater observations to monitor fish behaviour and cover geometry.

Discussion: The Working Group acknowledged this new development in codend covers with great interest and is looking forward to the results of the upcoming full scale tests. Details of the rigging were explained in a special ad hoc meeting during lunchbreak.

5.5 Development of a new rolling gear for beam trawls with reduced bottom impact, Klaus Lange, Germany

According to the shape of the groundrope of a shrimp trawl the axes of the rollers are orientated tangential to the curve of the groundrope. So only the axes of the rollers in the center are perpendicular to the towing direction and the rollers are running correctly. The rollers on both sides are more or less gliding on the sea bottom. By this effect bottom friction and drag of the gear is increased as well as the bottom impact.

To decrease drag and bottom impact a new design for the side rollers was developed which makes it possible to mount all rollers with their axes perpendicular to the towing direction. First trials with a small 3 m beam trawl were performed in the Baltic in 1996. An underwater-video-camera mounted on the beam made it possible to check the performance of the new rollers during trawling. The results of these preliminary trials were encouraging. Full scale trials in cooperation with commercial shrimp trawlers are planned in 1997.

Discussion: The WG discussion centered on the problems of environmental impact to the seabed by roller gear. It was encouraged by this new methodology which may lessen impact on the bottom and increase trawling efficiency and look forward to new results.

5.6 Influence of twine material on codend selectivity (Nephrops and hake), Fabien Morandeau, France (Poster)

Nature of the twine and his diameter have an influence on codend selectivity. This aspect was admitted by the ICES in 1995(FTFB) The goal of the scientific cruise 12 was to measure the influence of the material used in the manufacture of codends on the trawl selectivity. The materials tested were: double twine, PE single twine and PA single twine.

Discussion: The WG noted that this poster quite clearly demonstrates that twine material can have an obvious effect on codend selectivity in hake and Nephrops.

5.7 Evaluation of mesh measurement methodologies for fisheries inspection and research (MESH) - EU Concerted Action, Ronald Fonteyne, Belgium

A current EU- project was begun out of the consensus that the current mesh measurement procedures do not give reliable and reproducible results. Participants from 14 nations and also from the European fishermen association and the European association of yarn and rope makers will make a common effort over the coming year to take an inventory current mesh measurement procedures in inspection and science, to define problems related to these procedures and to compare the procedures in both applications, to review other (non-EU) measurement procedures, to collect information on measurement methods for specific netting and to describe related problems and, finally, to define the requirements for correct mesh size measurements and to make recommendations for the development of a new mesh gauge. A first meeting of all participants has taken place in Karlskrona ,Sweden, in January. At present a number of public hearings with netmakers and fishermen are being

organized in the countries participating. A summary of the information collected so far and of the results of the meetings will be drawn during a second project meeting in December in Athens, Greece..

Discussion: The WG acknowledge the importance of this work and noted that the Canadian and US- participants expressed great interest in the outcome of this project.

5.8 General Discussion of Topics 4 and 5:

The topics of selectivity of mobile gears (5 papers) and technical studies (8 papers) continues to show the level of involvement of fishing gear research in many ICES countries. Most of these papers dealt with methodology to improve selectivity and reduced unwanted by catch of other species in beam trawls and otter trawls. The WG noted that it is clear from the number of technical studies that there is ever increasing new developments in improving our understanding of fishing gear dynamics that should lead to improvements in gear selectivity. Much of this development is greatly added by new instrumentation, data analysis and computer software.

Regrettably the WG notes an overall decline in fish behaviour research because many fisheries institute rank this work as low priority although it has contributed greatly to the present progress in development of more selective fishing. The WG argues that this is counter-productive because fish behaviour is the key to explaining much of the variability in selectivity experiments. The WG encourages the ICES Community to support basic research in fish behaviour if it hopes to make significant progress in development of efficient selective devices and responsible fishing.

There is a lack of sufficient data on whole trawl selectivity which would be much more relevant to management based on technical measures than simply codend selectivity. The WG notes that the economics and the fish stock related consequences of the introduction of more selective gear are a largely unknown field and should be the subject to further research

The WG notes that all though there are good examples of success in size and species separation it acknowledges that the fishing industry is still reluctant to accept the immense progress in knowledge gained on the selectivity of towed gears during the last decennium. From a fisheries management perspective, fisherman need incentives to apply species selective gear and to renounce circumventing existing regulations. It was felt that in a management situation where the industry was regulating itself then the adoption of selectivity results would be more common in commercial operations.

6 FISH AND SHELLFISH SURVIVAL STUDIES

6.1 The injuries sustained by haddock (Melanogrammus aeglefinus) escaping from trawl codends and the implications of these to survival, Mike Breen and Graham Sangster, United Kingdom

A preliminary assessment of the injuries sustained by haddock (*Melanogrammus aeglefinus*) escaping from trawl codends is described. This includes a detailed study of the magnitude and distribution of skin damage on individual haddock from the same experiment. The injuries observed include skin damage, fin rot, liver contusions, gill hemorrhage and eye damage. These injuries are described in relation to survival rates from a concurrent investigation and their implications to the individual's survival are discussed. Of these injuries only the gill damage was considered capable of causing death in the

first 72 hours after escape; the period of peak mortality. However this was only observed in 13% of fatalities, whereas a large proportion of fatalities (77%) did sustain skin damage. Detailed analysis revealed that skin damage was inversely related to both mesh size and fish length. Similar trends were seen in the survival study. Moreover, it was shown that moribund fish had significantly greater skin damage than living fish. There is at present no conclusive evidence implicating skin damage as a direct cause of death in fish. It is suggested, however, that the interaction of physiological stresses induced by the skin damage and high concentrations of lactic acid in the swimming muscles may have been capable of producing a fatal shift in the fish's metabolism.

In conclusion this paper highlights how little is currently known about the mechanisms causing escape mortality. It is recommended that any future work must be comprehensive in its approach and should include: post mortem assessments of injury; physiological analysis; pathological investigation of secondary infections; and assessment of the effects of stress due to both injury and captivity.

Discussion: The WG noted that model experiments under strictly controlled conditions would certainly be helpful to identify the importance of the factors mentioned. It also suggested that special attention should be paid to the physiological condition of the fish before capture. It is estimated that the condition explains much of the variance of the results.

6.2 Nephrops survival after escape and discard from commercial fishing gear, GI Sangster et al., United Kingdom

This paper presents the first years results of a joint Scottish/Danish/Norwegian/Swedish EC Fair Project on the survival of Nephrops norvegicus after (a) cod-end escape and (b) discarding from a commercial trawl. The experiments were carried out by a Scottish prawn trawler in July/August 1996 in the Inner Sound Fishery, North West Scotland. New designs of Nephrops holding pens were set out on the seabed in the lee of Longa Island, close to the fishing area. Each pen contained a separate cell for an individual Nephrops to prevent cannibalism and fighting. Each cell contained substrate and an artificial burrow. After trawling, animals from the cod-end cover and sorting deck were randomly collected and held in individual perforated tubes submerged in seawater deck tanks. Divers transferred the Nephrops to the seabed pens on arrival at the experiment site. Creel caught controls were similarly treated. Triplicate groups of escapee, discard and control categories were monitored daily by divers for at least fourteen days. Triplicate sets of Nephrops survival data, including controls were obtained for 60 mm square mesh, 100 mm diamond mesh and 70 mm diamond mesh deck discards.

Discussion: The WG applauded the attention to detail in setting up the experimental design and underwater site. The discussion centered around the question whether these results are transferable to real fishing conditions particularly if an increased mortality by predators on the weakened and stressed Nephrops does occur in a commercial setting. The suggested method to avoid the bycatch of undersized Nephrops in the trawl fishery is to raise the footrope which should improve the survival. The WG noted that with these estimates of escapement mortality (20%) along with the estimate of 67% discard mortality, which is close to 75% value used in ICES stock assessment of this species, and the known levels of catch, it should make it possible to measure more precisely fishing mortality and encouraged the completion of these calculations for stock assessment review.

7 SURVEY GEAR STUDIES

7.1 Measurements of gear and environmental parameters during surveys with the GOV trawl, Peter Stewart, United Kingdom

Studies of fishing gear performance and fish behaviour in nets have shown that capture efficiency is very variable. To investigate the catching performance of the GOV trawl, data were collected on 11 surveys. It was thought that catch would depend mainly on fishing ground, depth, year, swept volume, net speed, water temperature and light intensity. A preliminary analysis of the data collected on catches of cod, haddock and whiting, gear performance and environmental factors was presented. The catch variability was greater than that of the measured parameters. Catch was found to be spatially and depth dependent and there is a year effect. It was not possible to relate catch sizes to any of the other parameters. The variability in towing speed and hence gear performance was very high and there is need to improve speed control during the surveys. The high level of variance in the data raises questions about the need for careful standardization of survey trawls.

Discussion: The Working Group noted that the presented analysis was only preliminary and did not include all parameters and recommended that the doorspread-catch relationship be investigated in further analysis. The results, however, show how necessary such review is and how standardization may not reduced survey variability to the extent one hopes. In this context the discussion pointed out the overwhelming importance of a steady and close bottom contact of the trawl footgear to the seabed and of the necessity to have a continuous record of all environmental parameters measurable.

7.2 Standardization of otter trawlers participating in the sentinel fisheries in the northern Gulf of St. Lawrence in 1996, Alain Fréchet, Canada

New projects aimed to make a follow-up of the abundance of cod started in 1994, following the closure of the directed fishery towards this specie. Sentinel fisheries directly involve fishermen in the gathering of biological data which are used afterwards in the context of the stock assessment process. These projects are conducted aboard small inshore vessels and aboard larger boats that use otter-trawls. The surveys conducted by nine otter trawlers in the Northern Gulf of St. Lawrence (3Pn, 4RS) use a stratified random survey design. A standard otter trawl with a liner is used by all boats in order to estimate abundance and recruitment of groundfish. In order to allow inter-vessel comparison of the catch rates it is essential that the net be deployed in a similar fashion throughout. The basic parameter that is used in the calculation of an index of abundance is the trawlable unit. This is done by a « standard » tow of a half hour on the bottom with a constant swept area which is represented by the wing span. This wing span was measured in 1995 among the different boats at sea and results indicated a 25% variability between boats. The purpose of this document is to present the impact of the use of a restrictor cable to make these boats as uniform as possible.

The method, initially developed in Norway a decade ago was used here. Not only does this method allow to standardize all boats but it also allows for any change in vessels without hampering the sampling gear that is the trawl. Moreover, it is well known that the sampling area of the trawls is influenced by the depth at which the trawling occurs, this may bias the estimation of biomass. The use of a restrictor cable cancels out this effect.

The calibration done with the restrictor cable allowed to reduce the inter-vessel variability of 25% to 6% with no bias due to depth. In the future all nine sentinel boats using otter trawl will use these restrictor cables. The calculation of abundance indices will use 16.5 meters (54 feet) as wing spread distance for all boats.

Discussion: The WG cautions that it is important to test whether the height of restrictor rope from the bottom can affect fish behaviour and hence catchability. Constant control of the height of the restrictor rope above seabed seems essential. The material of the restrictor rope (presently mostly steel wire)may not yet be the best and it was suggested that Kevlar would give less problems.

8 REPORTS ON SUGGESTED WORK ITEMS FOR THE WORKING GROUP

8.1 Report on accessing Russian literature on theoretical and applied research on fishing effort and trawl catchability, Alexander Fridman, United States

A letter from Prof. Fridman was presented to the Working Group members dealing with theoretical models developed in Russia to determine the minimum admissible mesh size. This model , elaborated by A.V. Melnikov , shall help to analyze the effect of various factors on the trawl selectivity, and also to forecast the consequences of mesh size change , especially with regard to the economic losses. The model has been fine tuned and further elaborated in the second level doctoral dissertation of A. V. Melnikov and Prof. Fridman recommends its translation.

Discussion: The WG drew the attention to the present inherent danger that most valuable information from Russia might be lost on account of the present problems of financing research. Persons like Prof. Fridman would be best suited to help with the exchange of information. There are, however, problems of funding requirements to attempt to save this treasure of information. The WG noted that the EU might be willing to help as part of their personal exchange programs. A further funding source could be UNESCO. The WG would offer a letter of reference in support of any funding proposal only if it was permitted to examine a list of items that were proposed to be translated. Such an inventory such contain an Abstract (in English) of each item to allow the WG members to comment on the utility of such work.

8.2 Update on FTFB webpage, Nick Lowry, Denmark

Mr. N. Lowry demonstrated his ideas on structure and possible benefits of a FTFB webpage. The FTFB E-Mail list is already functioning and provides a mean of rapid information dissemination. It is, however, questionable if not other documents as e.g. terms of reference of the Working Group, National Reports , Bibliographies etc. should be made available for reference via the World Wide Web. The ICES Server cannot be used for this purpose as updates of the information stored cannot be done by the ICES personnel. A solution would be to place the files locally on any server attached to the WWW and to link them to the ICES web page.

Discussion: The Working Group noted the progress made in this matter with satisfaction and suggested that the Webpage contain a core of information that is tailored to non-FTFB members. The WG requested further investigation into what financial commitments and organizational prerequisites must be given for different alternatives of the webpage and to report on it during the next meeting.

8.3 Update on creation of an ICES database on commercial trawl selectivity, Bob van Marlen, The Netherlands

An EU-feasibility study with the aim to identify the conditions for the establishment of such a database, the costs, the availability of data , the views of potential users and the type of database wanted has been approved in the meantime. A first meeting of participants from 10 nations took place in IJmuiden, The Netherlands, in January. At present potential users and data deliverers are being interviewed. A summary of this will be drawn during a planned meeting in Copenhagen in June. It will be followed by an inventory of available data. The final report is bound to be delivered in the middle of 1998.

Discussion: The Working Group noted the progress in this matter with satisfaction and awaits the outcome of the 1988 report.

8.5 Report of the Adhoc Group on integrating survey trawl estimates of catchability in stock assessment O.R. Godø, Norway

In stock assessment models where trawl survey CPUE is used catchability is defined as the proportion of the stock removed by one unit of fishing effort (q) . Scientists conducting trawl performance studies usually define catchability as the proportion of animals within the swept area/volume that are caught. It is necessary to distinguish this which is actually trawl efficiency (Q) from the catchability (q). Both are related by the equation

$$q = Q \cdot (a/A) \cdot (A / A^*)$$

where a=swept area/volume
A=survey area/volume
A*= stock area/volume

with the relation A/A* defining the availability coefficient

If availability deviates from 1 then trawl performance experiments cannot directly estimate q.
There are at least 4 distinct experimental approaches to estimate Q for bottom trawls under suitable conditions. It could be shown that Q varies with light, depth, bottom roughness and maybe a number of other environmental variables. Until the sources and magnitude of Q variability is better known, it is prudent to use Q estimates for stock assessment with caution.

Age -structured stock assessment models can do without an experimental estimate of q provided the time series of catch and survey CPUE data are adequate. There is , however, a need for experimentally derived estimates of Q when a) commercial catches are poorly known or the catch time series ends due to a fishery closure, b) survey CPUE series are too short to constrain model estimates of q, c) population age structure is poorly known as e.g. in crustacean fisheries, and d) survey CPUE have to be converted to true relative abundance by species and size.

The adhoc group recommends the establishment of a forum where scientists working on trawl performance, survey design and stock assessment can work together on common issues. The importance of the willingness of each representative from all three disciplines is stressed to consider the needs and capabilities of the others.

Discussion: The WG strongly supports the recommendations of the adhoc group and the WG Chair has informed the participants that a copy of the report will be sent to the chairman of the ICES Method Working Group for advice on the continutaion of this project.

8.5 Report of the analysis of the FTFB questionnaire "Measuring fishing gear/fish behaviour and problems related to data acquisition", Gerard Bavouzet, France

Many research facilities in ICES member countries are using a wide variety of sophisticated electronic, video and engineering hardware and software to monitor trawl performance and fish behaviour. Since this is a very limited field. i.e. research not commercial, many institutes are using the same or very similar equipment. It is expected that common problems will arise with methods of deployment, retrieval, data logging, etc. However, these problems and their solutions are very rarely mentioned in research reports or published proceedings. FTFB Working Group members agreed that some initial investigation into this area may be warranted to determine the extent of the problem with the view that it may be a Special Topic in the future.

This work item was suggested (1994) in order to reduce costly software and hardware development time through the sharing of expertise amongst member countries. The ultimate product of this work item may be a manual describing accepted operational methodologies i.e. deployment procedures as well as the hardware and software used in monitoring gear performance and fish behaviour. Alternatively a more simple inventory list of researchers in ICES member countries with their area of expertise and hardware capabilities may suffice.

In an effort to gauge support for this initiative and the extent to which researchers feel it merits ICES FTFB involvement we requested the delegates to complete the a questionnaire. The questionnaire consisted of three sections: the first, covers general information about you and your institute; the second, asks for details on your method of data acquisition and what data is collected; and the third, asks for your or your institute views on ICES co-operation in data acquisition.

Discussion: The WG supports the proposal to seek funding to organize a technical workshop in the near future and appoints the following representatives to the steering committee from UK (C. Hall), France (G. Bavouzet), USA (A. Carr) and Canada (B. McCallum). This committee will report on their efforts at the next meeting and are expected to provide the justification and rationale for such a meeting.

8.5 Report on feasibility on establishing a bibliography of trawl selectivity experiments, Pingguo He, Canada

The report suggests that the FTFB Working Group needs to focus on an annotated bibliography to suit the demands of various users. Such a bibliography should be very detail and cover all aspects of selectivity.

Discussion: The WG recognizes that setting up an annotated bibliography was an enormous task requiring a large amount of time and effort followed by continuous update. Because there was a lack of support and volunteers this suggested item shall be drop from FTFB business at the present time.

9. RECOMMENDATIONS FOR THE NEXT MEETING

9.1 The Working Group on Fishing Technology and Fish Behaviour recommends that the next meeting will be held (Chairman Dr. A. Engås) in conjunction with the FAST-Working Group in La Coruña, Spain, from 20 - 24. Apr. 98 to:

a) review and evaluate recent selectivity studies of both mobile and static gear from the area of the North Sea;

b) review the report of the Study Group on Grid (Grate) Sorting Systems in Trawls, Beam Trawls and Seine Nets;

c) make recommendations for future research in neglected areas; and

d) consider other related research in fishing technology and fish behaviour

Justification:

a) Selectivity studies of both mobile and static gear from the area of the North Sea will be the main theme of the meeting. In the last decade, many researchers from various ICES countries have been involved in a wide variety of selectivity studies in the North Sea area. It is time for a major review of the progress and the omissions in research and the successes of implementation of this work into technical measures developed for North Sea fishery management. Such a thorough review should identify the gaps in research and help plan the direction of future research in the North Sea.

b) The Study Group will report on this item

1999 Venue: The Working Group on Fishing Technology and Fish Behaviour recommends that the meeting in 1999 be held in St. Johns, Newfoundland, Canada

SUGGESTED WORK ITEMS FOR THE FTFB WORKING GROUP

In addition to the above Fish Capture recommendations, the FTFB Working Group also made the following suggestions for work to be initiated prior to the next meeting, April 1997.

a) define the contents of a methods manual for use in selectivity studies of static gear (Action: T. Moth-Poulsen, Denmark)

b) report on progress of setting up a technical workshop for FTFB instrument users (Action: G. Bavouzet, France)

c) finalize the setting up of a FTFB webpage (Action: N. Lowry, Denmark and S. Walsh Canada);

d) report on the progress of setting up an ICES database on commercial trawl selectivity (Action: B. Van Marlen, The Netherlands);

e) report on progress of recent research addressing the unaccounted fisheries mortality issue (Action: A. Fréchet, Canada) and

f) investigate the feasibility of compilation of a survival database (Action: M. Breen, United Kingdom);

Adjournment

The meeting ended 1230 hrs on 17 April 1997. The Chairman thanked all members for their excellent contributions to the meeting. Special thanks to Erdmann Dahm and his staff for hosting the meeting.

10 NATIONAL COUNTRY REPORTS

Belgium(R. Fonteyne and H. Polet)

Selectivity: Within the framework of the EU- AIR-program the project "Optimization of a species selective beam trawl" (contract AIR2-CT93-1015) was finished. The development of species selective beam trawls aims at the reduction of roundfish discards while maintaining the flatfish catch rates. This project was carried out in collaboration with RIVO (NL) and SEAFISH (UK). The coordination is held by RVZ. Further comparative fishing

experiments with experimental gears towed at one side of the vessel and the standard gears towed at the other side were carried out with chartered commercial beam trawlers. The experimental gears selected for these trials were a beam net with a partly square mesh top panel and a beam net with a reduced top panel. With these configurations the whiting and haddock catches could be reduced by 30 to 50 % for larger vessels (700-1200 hp) but the effect was less pronounced for a 300 hp beamer. The new gears were not only evaluated with regard to their selective properties but also the economic impact has been assessed. The overall effect of the roundfish catches on the total earnings was rather marginal and therefore releases of these fish did not affect earnings noticeably.

Ecological effects of fishing activities: In the framework of the EU-project "IMPACT II - The effects of different types of fisheries on North Sea and Irish Sea benthic ecosystems" (contract AIR2-94-1664) the studies on the impact of fishing gear on the sea bottom and the benthos populations was continued. This project runs in collaboration with fisheries research institutes and universities in the Netherlands (coordinator), Belgium, Germany, Ireland and the UK. During a campaign with RV BELGICA the pressure on the sea bottom exerted by a 4 m beam trawl rigged with a chain matrix was measured under different operational conditions. Seabed disturbance was studied by side scan sonar and RoxAnn observations of the trawl tracks. Our measurements showed that the pressure exerted by the sole plates was about 2 N.m-2 and that the trawl tracks remained for maximum 52 hours. The relationship between vessel hp and gear pressure on the bottom could be established. The pressure of the gear increases only slightly with vessel hp since the higher weights are compensated by the larger sole plate surface and the higher towing speeds. The detailed inventory of vessels and gears engaged in bottom trawling was finished. This inventory led to a detailed definition of the vessel type, operational parameters, catch handling habits and a standard fishing gear for a number of sub-fleets in the Belgian, Dutch and German fishing fleets. This sub-project is being coordinated by RVZ.

In 1995 the project "Research into the Crangon fisheries unerring effect" (BIO 94/C 144/04), in collaboration with RIVO (NL), DIFMAR (DK), University of Humberside (UK) and Institut für Seefischerei (DE), was started. The purpose of this project was to collect detailed information on the North Sea shrimp fleets and fishing gears and to quantify the discards in this fishery. In 1996 the fleet inventory was finished. The discard monitoring phase ends half 1997 and has already provided a large amount of data on the discarding of shrimp (*Crangon crangon*), sole, plaice, dab, flounder, cod, whiting, gurnards and bib in the shrimp fisheries of the co-operating countries. It is the intention to make a follow-up project where the collected data will be entered into stock assessment models in order to assess the impact of these discard practices on the commercial stocks.

The same concern incited us to start a study on the whole trawl selectivity of the shrimp beam trawl. The results demonstrate that the selectivity of the net is quite important compared to the cod-end selectivity. Factors like the volume and the composition of the catch have a strong influence on the selectivity. As a second step in this project some initial trials were carried out with a sorting grid fitted in the shrimp beam trawl in order to reduce the by-catch of fish and benthic organisms. These experiments will be continued and other technical means to reduce discards, like the use of electric pulses as an alternative stimulation, will be investigated.

Fishing gear research: The EU-project "Alternative stimulation in fisheries" (AIR3-94-1850) carried out together with RIVO (NL), the Institute of Marine Research (NO), the Finnish Game and Fisheries Research Institute (FI), SEAFISH (UK) and the Institut für Seefischerei (DE) was finished. Feasibility studies were made on the possible introduction of new fishing methods in the Belgian fishery. The methods investigated were jigging, dredging for bivalves (Spisula subtruncata), deep water otter trawling, squid fishery and electrical fishing for shrimps.

Mesh size measurement In the frame of the EU FAIR-program a Concerted Action project on mesh measurement, for which RVZ is the

coordinator, was prepared. All EU fishing countries plus Norway are involved in this project in which both fisheries research institutes and fisheries inspectorates participate. The overall objective is to evaluate the present mesh measurement procedures for fisheries inspection and for research, to identify the problems related to these measurements and to define the requirements for a mesh gauge suitable for both inspection and scientific purposes.

Canada (S. Walsh)

Newfoundland Region

Shrimp size selectivity: Work continued on the development of an effective shrimp size sorting grid installed into shrimp trawls behind the Nordmore Grate. Modifications included installing of a guiding funnel in front of the size sorting grate, increasing the grate length, and cutting groves in the horizontal support bars on the face of the grate. *Danish Seine Net Mesh Size:* A codend mesh size selectivity experiment was used to investigate ways of reducing the by-catch of cod and also the catch of small American Plaice (< 30 cm). Codends with 145 mm and 155 mm diamond and square meshes were tested. The alternate hall technique was used to compare the size and species of fish caught with the different codend mesh sizes. Contact person: Gerald Brothers, Coordinator-Conservation Technology, Program Planning and Coordination Division, Fisheries Management Branch, Department of Fisheries and Oceans, P. O. B. 5667, St. John's, Newfoundland, Canada, A1C-5X1. Telephone (709)772-4438, Fax (709)772-2110, e-mail gb@dfonfl01.nwafc.nf.ca

Salmon by-catch in Cod traps: An experimental cod trap was set in close proximity the sentinel traps which were used as controls. All traps were approximately the same size, ranging from 12 to 15 meters deep, 90 to 110 meters on-the-rounds, and 100 to 140 meter leaders. Mesh sizes were 102 mm in the trap walls, and 178 mm in the leaders. Experiments were carried out with deflectors, 37 meters long by three meters deep attached to the leader and the front corners of the trap, large mesh (406 mm) in the top three meters of the leader, and sinking the leader three meters. *Salmon by-catch in Capelin Traps*: An experiment to reduce the by-catch of salmon in capelin traps was initiated with capelin trap fishers. Each crew used two capelin traps during the capelin fishery in June/July. One trap in each community was a traditional trap, nine meters deep, and 90 meters on-the-rounds with 19 mm mesh throughout. Leader lengths varied from 55 meters to 140 meters. The control traps had 102 mm mesh leaders, while the experimental traps had 106 mm mesh in the top three meters of the leader. Contact person: Gerald Brothers, Coordinator-Conservation Technology, Program Planning and Coordination Division, Fisheries Management Branch, Department of Fisheries and Oceans, P. O. B. 5667, St. John's, Newfoundland, Canada, A1C-5X1. Telephone (709)772-4438, Fax (709)772-2110, e-mail gb@dfonfl01.nwafc.nf.ca

Fish Behaviour: Experimental work was begun to study natural behaviour, vessel-fish reactions and trawl induced behaviour in cod and American plaice using acoustic tags. The hypothesis is to test if temperature has an effect on natural and vessel/trawl behaviors. Complementary laboratory work with Memorial University Fisheries and Marine Institute was initiated to study the effect of temperature on swimming speeds and endurance in both species. Contact person: Pingguo He, Fisheries and Marine Institute, Memorial University of Newfoundland, St. John's, Newfoundland, Canada, phe@gill.ifmt.nf.ca
Survey trawls: Comparative fishing experiments were carried out between old standard trawl and new standard trawl to develop conversion factors for all commercial groundfish indices. Contact person: Stephen J. Walsh, Northwest Atlantic Fisheries Center, P. O. B. 5667, St. John's, Newfoundland, Canada A1C-5X1, Tel. 001-709-722-5478, Fax 001-709-772-4188, e-mail walsh@athena.nwafc.nf.ca

Salmon studies: A large scale salmon trap was designed for an industrial client in British

Columbia and underwater observations of salmon behaviour near the trap were conducted. *Crab studies:* A project investigating biology, distribution and behaviour of the deepwater procupine crab (*Neolithodes grimaldii*) was carried out. Crab specimen from turbot gillnets were examined and the rate of bycatch analyzed from log books from fishermen. Live specimen were kept and feeding behaviour and reaction to the pot was observed in the tank. *Longlining:* A technical and economic evaluation of longlining for deepwater turbot in Northwest Atlantic was conducted to determine feasibility of this fishing gear for the Canadian turbot fishery. Contact person: Pingguo He, Fisheries and Marine Institute, Memorial University of Newfoundland, St. John's, Newfoundland, Canada, phe@gill.ifmt.nf.ca

Laurentian Region

Shellfish: The sampling efficiency of the New England hydraulic dredge for the harvest of Stimpson's surf clam (*Mactromeris polynyma*) was examined in the Gulf of St. Lawrence. Field experiments were conducted on both research and commercial boats. Results are published in J. Lambert and P. Goudreau, 1996, Can. Ind. Rep. of Fish. and Aquat. Sci. No. 235, 28 p.

Trawl performance: Inter-vessel variability in wing spread among nine commercial boats conducting a stratified random groundfish survey which was estimated initially as high as 25 % was reduced to 8 % through the use of a restrictor cable. SCANMAR technology was deployed on each vessel to monitor gear behaviour. Contact person: Alain Fréchet, Maurice Lamontagne Institute, P.O.B. 1000, 850 route de la mer, Mont Joli, Québec, Canada G5H 3Z4, Tel. (418)775-0629, Fax (418)775-0679, e-mail a_frechet@qc.dfo.ca

Maritimes Region

Selectivity studies: The Province of New Brunswick, in collaboration with DFO Headquarters Region, Ottawa, conducted a number of commercial fishing gear trials in the Gulf of St. Lawrence in 1996. Pair trawling techniques for shrimp were tested, as too was a double separator grate system to reduce finfish bycatch and grade the shrimp according to size. Nets designed to fish selectivity for cod and flounder species were tested on otter trawls and Danish seiners. Nets with panels of different mesh size, intended to simultaneously optimize the net's size selection for cod and founders, were also tested on these two vessel types. Contact person: Ralph G. Halliday, Marine Fish Division, Science Branch, Bedford Institute of Oceanography, P.O.B. 1006, Dartmouth, Nova Scotia, Canada B2Y 4A2, Tel. 9024263240, Fax 9024261506, e-mail r_halliday@bionet.bio.dfo.ca

Denmark

Size selectivity of gill nets

Methodology: The institute has participated in a Commission of the European Communities (CEC) financed study, co-ordinated by ConSat (Denmark), developing a standard methodology for collecting and analyzing size selectivity data in gill nets. The institutes prime role was to collect and analyze available European data sets using software developed by the coordinator. *Measurements*: A 3 year CEC AIR project entitled "Selectivity of gill nets in the North Sea, English Channel and Bay of Biscay", co-ordinated by DIFTA with participation of Seafish (UK), IFREMER (France) and DIFRES (Denmark) was completed. Size selectivity was measured in 9 different métiers (combinations of target species, gill net type, twine material and fishing area). The target species were cod, hake, sole and plaice. A summary of the results was presented at the Working Group Meeting. A 2 year CEC study entitled „Size selectivity and relative fishing power of Baltic cod gill nets", coordinated by DIFTA with the participation of IMR (Sweden) and ConStat (Denmark), was initiated. The effects of twine thickness and hanging ration are to be investigated.

Size selectivity of codends

Methodology: DIFTA has developed in the flume tank a new design of codend cover which avoids the use of large internal hoops. Three canvas kites

are attached to the sides and top in order to generate the forces to keep the cover clear of the test codend and prevent masking. The front part of the cover is in square mesh and the aft part in diamond mesh. The work forms part of the CEC FAIR project „Improving Technical Management in Baltic Cod Fishery (BACOMA)", co-ordinated by FGFRI (Finland), in which the selectivity of Baltic cod trawl codends are to be measured. The institute is participating in the CEC Concerted Action „MESH", co-ordinated by RVZ (Belgium) investigating the different methods of measuring codend mesh size (mesh opening). *Selectivity measurements:* DIFTA has worked on the topic „Investigation of the effect of catch size" within the CEC AIR project „Study of factors affecting the variability of cod-end selectivity". Two sea trials were carried out in co-operation with the Marine Lab, Aberdeen. The first of these investigated possible ways of artificially simulating larger catches. This was achieved by placing small mesh bags containing dead fish into the cod-end at the start of the tow. Observation with a towed underwater TV vehicle showed that these bags took up the same shape as would be expected with a real catch and did not affect the expected behaviour of fish in the cod-end. The second sea trial tested the effect of this artificial increase in catch size on the codend selectivity. The results proved inconclusive, no demonstrable effect of artificially increasing catch size could be shown. This was in contrast with the results from other studies in the project series where there was a relationship between the catch and the resulting selectivity. Analysis is continuing to try to ascertain the causes of these results.

Codend selectivity database: The institute is participating in the CEC Concerted Action co-ordinated by RIVO-DLO (Netherlands) which aims to establish an international database of codend selectivity measurements. *Predictive selectivity model*: DIFTA has commenced its work in this CEC FAIR project co-ordinated by IFREMER (France). Half scale model tests have been made in the flume tank of a low solidity 110 mm mesh codend to determine the effect of catch size upon codend geometry. Codend maximum diameter was found to increase for catches up to 1.6 tons. The meshes were then open by 55 % of the full stretched mesh size immediately in front of the catch. *New codend designs:* The institute has participated in a project financed by the Danish Ministry of Food aiming to reduce catches of mackerel under 350 g. Two different codends were tested both using 75 mm mesh windows in specially impregnated netting produced by Carlsen Net (Denmark), one designed by Y-Design (Sweden) using „Exit Windows" and one designed by DIFTA using square mesh sections. Catch size composition of the 2 vessels using the new codends was found to be improved compared to that of other vessels working in the same area.

Species selectivity: A one year CEC study to develop a selective flatfish trawl in co-operation with IMR (Sweden) has been completed. The aim was to design a new trawl capable of increasing flatfish catches and reducing cod by-catch rates. The design incorporated a large mesh, high spread, low height mouth to increase flatfish catches and 130 mm square meshes round the fore part of the codend to release roundfish. It was tested against a conventional trawl in a twin trawl rig in the Danish North Sea plaice fishery. It caught 14 % more plaice by weight, 56 % less cod under 40 cm mls by numbers but 13 % more large cod over 50 cm by numbers. Overall reduction in cod by-catch was 31 % by numbers per kg of plaice above mls. *Survival of roundfish and Nephrops escaping from commercial fishing gear*: This CEC FAIR project began in 1996, co-ordinated by DIFTA in co-operation with the Marine Laboratory (UK), IMR (Norway) and IMR (Sweden). DIFTA developed gear to allow sampling of escapes from square mesh panels, using kites to hold a cover clear of the panel and improved existing gear for collection of codend escapes. Sea trials were carried out off the west coast of Scotland. The ear was tested and found to perform properly. Techniques were developed for the collection of Nephrops escapes and discards and assessment of their mortality rates. Physiological effects of capture in a trawl were investigated for Nephrops.

Energy saving trawls: DIFTA participated in a project part financed by the Danish Energy Ministry where it assisted the Danish sheet netting manufacturer Utzon and the net maker Cosmos Trawl in producing new trawl designs incorporating twines with high strength - low drag characteristics for the Russian fleet in Murmansk. *Survey trawls* A staff member has chaired the FTFB Sub-Group producing recommended specifications for standard trawls to be used by research vessels conducting national surveys in the Baltic.

Estonia (A. Järvik and O. Kaljuste)

In 1996 any experimental investigations by fishing technology and fish behaviour were not provided in Estonia.
However, the revision of current situation in fishing technology was started. The types and amount of fixed gears used in Estonian coastal waters below the 20 m depth in 1996 were follows:

- herring pound-nets:	230
- traps and fykes:	2 560
- gill nets:	30 000
- longlines (*10^3):	204
- towed nets:	2

The using of trawls below the depth 20 m is prohibited in Estonia. The number of professional fishermen employed in coastal fishery is 1 130, subsistence fishermen - 3 500. The last ones mainly fished by gill nets. The coastal catch in coastal zone was in 1996 equal to appr. 14 000 tons, mainly Baltic herring - 11 800 tons. The others most important species were pike-perch, perch, flounder, carpike and vimba. During the recent years the intensity of coastal fishery was increased. In 1997 the study of the selectivity of gill nets is planned.

Germany (E. Dahm)

During 1996 the Institute for Fishery Technique, Hamburg, (IFH) concentrated on the following topics:

*1. Selection in the Baltic cod fishery:*_It was expected that there is a better selection in codend of trawls of side trawlers than those of stern trawlers because when hauling on a side trawler the trawl is drifting for some time without being towed. So the codend meshes can open completely to give the fish a better chance for escape. When hauling the gear on a stern trawler, the vessel is steaming ahead slowly all the time, so there is always some stress in the codend preventing the meshes from being fully opened. In May 1996 comparative tests were performed in the Baltic with a stern trawler and a side trawler for a number of different codend configurations. In no case there was a significant difference in L50 with the two types of trawlers. *2. Selection and efficiency of gillnets in the Baltic cod fishery*: A considerable number of small German fishing vessels are using gillnets in the Baltic cod fishery. With this type of gear there is a much better selection than with trawls, but very few data are available on the efficiency of gillnets. Cod were mainly caught in the lower parts of the nets. This might be an indication that the height of gillnets can be reduced without reducing the catch.

3. Investigations in the selectivity of sorting grids in the brown shrimp fishery: It was the intention to reduce the amount of bycatch, esp. small flatfish, in the brown shrimp fishery by means of sorting grids. Grids of the Nordmöre type made of stainless steel with bars of 8 mm diameter and 20 mm distance between the bars proved to be suitable for this purpose. Grids of plastic material did not resist the mechanical stress and broke. *4. Investigations with sorting grids in the Baltic eel fishery:*_In the Baltic eel fishery with trawls there is a considerable amount of bycatch of young cod and flatfish with a negative effect on these stocks. Using sorting grids, the species selection of eel trawls could be improved, but the number of eels escaping is still too high. Further investigations are necessary before sorting grids can be recommended in this fishery.

5. Factors influencing the selectivity of trawls: In the frame of the EU research project VARSEL seasonal influences on the selectivity of trawls were investigated. The differences found with cod, haddock and whiting were apparently not based on differences of the length/circumference-ratio during the year. The variations of this ratio were negligible. *6. Investigations in different methods of codend selection:*_There is one main disadvantage with the traditional codend/cover-methods for trawl selection experiments: the codend meshes can be partly masked by the small mesh netting of the cover

which may lead to unreliable results. Using hoops of stiff plastic pipes to spread the cover, the masking effect can be avoided, but shooting and hauling of the gear becomes much more complicate with such hoops. A codend/cover arrangement with only one hoop proved to be sufficient for the purpose of keeping the cover clear from the codend. A direct comparison between a ringed-cover of this kind and the divided trawl technique to measure the selectivity of a given codend resulted in only minor differences between both methods.

7. Unwanted bycatches in gillnet fisheries: Unwanted bycatches of ducks in the winter gill net fishery in the Baltic are less and less acceptable by the public even if experts agree that these losses do not affect the total stock size. Tactical measures in the mode of fishing as well as changes in the net construction have been tested both on research and on commercial fishing boats. Results, however, are not yet sufficient for decisions which way to go for regulations with only small impact on the practical fishery.

8. Fishing effort: Completion of a database covering all technical aspects of the whole German fishing fleet was continued in the frame of an interinstitutional work force. Trials performed so far to correlate fishing power and any of the recorded technical parameters showed negative results. An economic model for the evaluation of the economic situation of parts of the fishing fleet is presently under development *9. Measurement of the propulsive power of a fishing boat at sea:* Trials to transfer a successful method of horse power measurement onto fishing boats failed due the unexpected bearing clearance of the shaft.

10. Improvement of a pelagic trawl used as reference for hydroacoustic stock assessment: The mode of operation of a trawl towed sideways of the ships axis has been fine-tuned further.

11. Alternative stimulation of bottom dwelling flat fish: The replacement of the heavy chain gear of a bottom trawl for sole by a waterjet fixed to the beam proved to be technically feasible and allows a comparative fishing contest between both fishing methods in the near future. In case of success a reduction of the ecological damage of the beam trawling fishery is expected. *12. Mechanized longline fishing as an alternative to ecological more detrimental fishing methods:* A mechanized longline system was tested as an alternative to gill netting as well in the eel as in the cod fishery of the Baltic. Data on the economic viability of the alternative have still to be collected. *13. Roller gear elements with less effect onto the benthos*: Rollers or discs under the wings of a bottom trawl normally only turn reluctantly because of being towed sideways and , therefore , tend to dig into the bottom. A new developed roller gear element with a different arrangement of the axis tries to avoid this disadvantage. First trials with a small beam trawl observed by an underwater video camera and the new device showed satisfying function of the later.

Iceland (G. Thorsteinsson)

Selectivity: Following successful introduction and acceptance of the bycatch-excluder grid (Nordmöre-grid) in the offshore shrimp fishery in 1995, several experiments with other selective devices were conducted in 1996 and 1997. These experiments have been successful or promising and some designs are already in use voluntary. The following selective devices have been tested:

Sort-X. Experiments have been carried out for some years with the Norwegian Sort-X grid. Good results have been obtained for cod and haddock. Bottom trawling is now permitted on otherwise protected fishing ground off the east coast if a grid with a bar distance of 55 mm is used. A big area off the south and southeast coast will probably be excluded from trawling without the Sort-X grid in the near future. *Hour-glass*. Experiments with an Icelandic grid design, nicknamed Hour-glass, are running. The purpose is to release small fish in bottom trawling. The results are promising. A patent for this design has been applied. *Shrimp size sorting grid.* A shrimp size sorting grid, similar to the Canadian version, has been tested voluntarily by some shrimp boats of the N-coast with good results. Experiments with different bar distances have been carried out with the alternate

haul method and the covered "codend" method. A combined bycatch excluder-shrimp size sorting grids have been tested in a similar way. Shrimp trawling with both grid types will be permitted on a shrimping ground where trawling without size sorting grid is prohibited. *Nephrops grid.* A grid design similar to the shrimp sorting grid was tested with the twin-trawl method in May 1996. The bar distance was 25 mm. The results of this short trial are promising. The main results are dealt with in a poster/paper contribution at the FTFB Working Group meeting in Hamburg, April 1997.

TV-observations: In June/July some bottom trawl designs and a Gloria midwater trawl were observed with an underwater TV. A special cod-excluder trawl design was tested and observed. *Discards and survival of Nephrops*: Some experiments on the discards and survival of caught Nephrops were conducted during the Nephrops fishing season 1996. The main results are reported in a poster/paper contribution to the FTFB meeting in Hamburg. *Gill netting*: The influence of mesh size of bottom set cod gillnets on length distribution and catching method (gilling, wedging and entangling) was investigated during the winter cod fishing season 1996. The percentage of dead fish in relation to mesh size and kind of catching was of special interest. The results of these experiments will be presented at a later date.

Sweden (P.-O Larsson, V. Tschernij, M. Ulmestrand and H. Westerberg)

1. Studies on cod trawl selectivity in the Baltic: Further experiments with "Swedish exit windows" in Baltic cod trawls have been undertaken to compare their selectivity features in relation to standard diamond meshes in the whole codend and to "Danish exit windows". Also new constructions aiming at improving selectivity have been tested. Some sources of variation in selectivity were studied. The largest variation was found between seasons, about 5 cm difference (30 - 35 cm) in L50 with the same vessel, the same gear and rigging and on the same fishing ground.

2. Survival of escapees from Baltic cod trawls: In cooperation with Finnish colleagues survival experiments have been done with cod escaping from Baltic cod bottom trawls. A new construction of collecting cages, developed in Finland, was tested, aiming at collecting escapees during a selected time period of a normal commercial haul. Technical problems resulted in just a few acceptable test hauls, but they indicated the survival of also small cod escaping during the latest 20 minutes of a four-hour haul to be high. *3. Survival of escapees and discards in the Nephrops trawl fishery:* Selectivity experiments with Nephrops trawls continued in 1996, mainly with tests of 60 and 70 mm square meshes in the whole codend, with greatly improved selectivity for both Nephrops and roundfish. As part of an EU-project a study of the survival of escapees from such trawls started (in Scotland with Swedish participation). Also survival of discarded Nephrops was studied (excluding predation). This survival was only about 35% as an average, while the escaping Nephrops had a very low mortality. No conclusive results on roundfish survival have been obtained so far, but the project continues.

4. Development of a selective flatfish trawl: In an EU-project jointly with DIFTA, in Denmark, trials to develop a trawl selective for flatfishes started in 1996. The main features, aiming at reducing bycatch of roundfish, are a low height of the upper panel, the headline extending well down the main of the trawl, large open meshes in parts of the upper panels and Baltic exit window with 120 mm meshes in the codend. The results so far are promising. In the Swedish trials in the Baltic the catch of marketable flounder (>25 cm) was 48% larger in numbers and 64% in weight with the experimental trawl compared to the catch with the hired commercial vessels own trawl, while the catch of undersized flounder was insignificantly lower. The catch of cod decreased with 75% in number and 10% in weight when using the experimental trawl. *5. Selectivity experiments with vendace trawls in the northern Baltic Sea:* In the northern Baltic Sea there is a trawl fishery for vendace (Coregonus albula), exclusively during the spawning season for the commercially very valuable roe. The bycatches of immature, only slightly smaller vendace has been large and contributed to a severe decrease in stock size. Attempting to reduce those bycatches, selectivity and survival experiments started in 1996.

Selectivity data are still not conclusive but survival of escapees proved to be very high, so selectivity experiments will continue.

6. Effects of trawling activities: The effect of shrimp trawling on benthos, fish and Pandalus populations are investigated in the Gullmar fjord on the Swedish west coast. The fjord was closed for trawling in 1990. During 1996 a manipulative experimental study was designed and started. Six subareas of the fjord were defined and sampled as untrawled areas in 1996. In three of the six areas trawling will be done in 1997 and fish and shrimp composition in the catches documented. In late 1997 the six areas will be resampled for benthos and any differences obtained will be possible to connect to the trawling activity. *7. Seal exclusion device in salmon trap nets:* Trials have been performed with modifications of the door openings to salmon traps to keep seals out but not affect the salmon entering the trap. A conical opening with 100 mm meshes proved to reduce the salmon entrances with 33% but all these salmon were withhold by the trap so the catch efficiency was the same as in standard traps.

USA

Massachusetts Division of Marine Fisheries, Conservation Engineering Project (H. A. Carr, H. Milliken, H. Yachmetz)

The Massachusetts Division of Marine Fisheries' (MDMF) Conservation Engineering group has been involved in the several research initiatives. The state of Massachusetts and the federal Saltonstall - Kennedy program have provided the financial backing for these projects.

Longline Survival: A study to determine the survivability of cod and haddock in the demersal longline fishery is being investigated. The second of three cruises of seven days duration will be accomplished at the end of April with the last cruise scheduled for July. After passing through the „crufifier" the cod and haddock are tagged and held for seventy-two hours in wire mesh cages which are returned to the bottom. Control fish are caught in fish traps. Both are observed after seventy-two hours and the mortality rates noted. This study is being conducted in conjunction with the New England Aquarium who are studying the blood chemistry of the cod and haddock in order to determine what chemical processes are occurring that may be associated with the stress of capture. *Longline Selectivity*:A large percentage of cod and haddock that are caught on the commercial longline gear using 11/0 hooks are undersized. MDMF is conducting a study to determine if an increase in the hook size from 11/0 to 15/0 will increase the size of the fish retained by the gear. The gauge of the typical 15/0 hook was a concern of the fishermen because it does not bend easily if it fouls in the block used to retrieve the gear. Because of this concern, Mustad Hooks provided MDMF with special 15/0 hooks constructed out of the same gauge wire as the 11/0 hooks. The expected completion of this study is late April.

Raised Footrope Small Mesh Silver Hake Net: MDMF has had considerable success in reducing the bycatch of flatfish and other regulated groundfish species in the small mesh silver hake, *Merluccius bilinearis*, fishery. The experimental net incorporates a raised footrope that separates and excludes the flatfish species and retains the majority of the silver hake. This nest allowed the Provincetown fishermen to target silver hake after the fishery was closed down because the fishery, without the raised footrope, did not catch below 5 % regulated groundfish, a federal mandate. Fishing with the raised footrope, the catch of regulated groundfish species was below 5 % and fishermen were allowed to fish under an experimental fishery permit issued by the National Marine Fisheries Service (NMFS). This study is being replicated this summer in Gloucester, MA and if successful, MDMF will ask NMFS to consider making the fishery for silver hake, exempted from the prohibition of fishing in area with large concentrations of flatfish. *Raised Footrope Small Mesh Dogfish Net*: The raised footrope mentioned above will be studied in the dogfish, *Squalus spp.*, fishery which also can continue only if it is proven

that the fishery has a bycatch rate of less than 5 % of regulated groundfish.

Lobster Trawl Right Whale Bycatch Reduction: Two federal laws relating to endangered marine mammals impose the potential prohibition of fixed gear fishing in New England waters. The issue is gear encounter, entanglement, and the resulting death of certain whales. To this end, MDMF has been experimenting with weak links and breaking strengths to assist in the development of a device that is easily implemented and unobtrusive to the fishermen.

University of Rhode Island, Fisheries Center (J. DeAlteris)

Fisheries
DeAlteris and Kinlan, Rebuilding Groundfish Stocks: Catchability of the Gear and Selectivity of the Fishers.
DeAlteris and Skrobe, Impact of Mobile Fishing Gear on the Seabed.
DeAlteris and Williams, Quantifying the Performance of Traps in Coastal Fisheries.

Aquaculture
Castro and Codd, Growth and Survival of Hatchery Raised Lobsters on an Artificial Reef.
DeAlteris, Comparison of the Growth and Mortality of juvenile Summer Flounder in Recirculating Systems and Coastal Pens.
DeAlteris, Optimizing Filtration Technology for Recirculating Seawater Systems.
DeAlteris and Castro, Design, Site Selection and Construction of an Artificial Reef for Lobsters.

Manomet Observatory, Bycatch Reduction Project (C. Glass, S. Drew)

Manomet Observatory and Massachusetts Division of Marine Fisheries has implemented a new study on fish behaviour and bycatch reduction.

Overfishing is a major cause of the current crisis in northeastern fisheries and fishing mortality on several species must be reduced. Real progress on bycatch reduction in the region has been hindered by the scarcity of information on specific losses. In response, Manomet has analyzed observer data from over 10,000 tows aboard commercial trawlers from North Carolina to Maine to determine the characteristics of bycatch in northeastern fisheries. Based on this information, and with the participation of local fishermen and international experts on bycatch reduction, Manomet and MDMF now proposed to develop more selective trawl gear for several northeast fisheries. Initial trials will focus on squid fisheries in the Martha's Vineyard and Nantucket area. Further studies will concentrate on groundfish bycatch problems in the Gulf of Maine.

University of Georgia Marine Extension Service (R. Vendetti)

The University of Georgia Marine Extension Service has been involved the development of new gear for the shrimp trawl industry. Two major accomplishments were the introduction of the twin-trawl system (towing four nets - 1970s) to the southeastern US shrimp fishery and the certification of TEDs (turtle excluver devices - 1980s). In fact, until about 1993, all types of TEDs certified for use in North, Central and South America were certified aboard our research vessel the Georgia Bulldog.

The issue of the 1990s has been fisheries bycatch. One of the main problems in solving bycatch has been the unintended loss of the targeted harvested species. Using advanced technology in submersible cameras, we have successfully conducted underwater video studies that reveal events which cause shrimp losses. Fish exclusion was shown to occur at an early phase in the trawl operation while the shrimp losses were shown to mainly occur during haul-back. By clearly identifying at least one of the problems with these new devices, research is now focused on the retrieval of the fishing gear and we are closer to a solution.

We have also developed a unique method of technology transfer. Different segments of the shrimp fleet are chosen for side-by-side comparative towing. The captains relay their vessel's capabilities and bycatch gear types, as well as the shrimp and fish catch results on a tow-

by-tow basis. Fishing under the same conditions (weather, debris, tide, catch composition, etc.) makes the instant research results more realistic and believable for the commercial fishermen.

North Carolina Division of Marine Fisheries (J. Gearhart, S. McKenna)

Bycatch reduction work was conducted in the long haul seine fishery and the penaeid shrimp trawl fishery. Bycatch monitoring was conducted in the ocean sink gill net fisheries. The long haul seine and the sink gill net monitoring studies were funded under a grant from the Atlantic Coast Fisheries Cooperative Management (ACFCMA). The bycatch reduction work in the trawl fishery for penaeid shrimp was completed using state funds.

One new BRD design, the Sea Eagle fish excluder, similar to the Florida Fish Excluder (FFE) was tested during the 1996 shrimp season. The Sea Eagle BRD, developed by commercial fisherman Bill Hickman, is constructed of PVC pipe and is installed in the tailbag of the trawl. Like the FFE, finfish bycatch reduction is a function of the size of the opening and the placement of the gear in the tailbag. Several sizes of the Sea Eagle BRD were installed and tested in various locations in the tailbag. One size/placement combination of the Sea Eagle meets the requirements of Amendment 1 and 2 of the weakfish FMP, 50 % reduction of weakfish, *cynascion regnlis*. To obtain the required reductions, an eight-inch diameter Sea Eagle BRD was installed 15 meshes down from the centerline of the top of the tailbag and 40 meshes ahead of the tailbag tic-off. When installed in this position, the eight-inch Sea Eagle reduced total finfish bycatch by 54 % (by weight). The number of weakfish caught was reduced by 50.5 %, while the shrimp loss was minimal (4.8 % by weight). Spot, *Leiostomus xanthurus*, and croaker, *Micropogonias undulatus*, catches were reduced by 53 % (by weight) and 57 % (by weight) respectively. A standard protocol to test and certify news BRDs to be used in the penaeid shrimp fishery was developed during the 1996 season. Further testing, of new BRD and fish stimulator combinations, is scheduled for the 1997 shrimp season.

Escape panels were tested in the long haul seine fishery during the 1996 season. The panels tested were constructed of 19/16 inch plastic rings connected with plastic wire ties. Two 2 meters by 2 meters panels were installed in the bunt net (last encircling net in the fishing operation) along the cork and lead lines. Twelve samples were collected during the 1996 season and commercial evaluations will continue during the 1997 season. Preliminary analysis indicates juvenile finfish reductions ranging from 25 % to 50 %.

The ocean sink gill net fisheries for spiny dogfish, *Squalus acanthus*, bluefish, *Pomatomus saltatrir*, monkfish, *Lophiur americanus*, croaker and weakfish were monitored for striped bass, *Morone smatilis*, bycatch during the 1996 season. Commercial vessels fishing along the northern coast of North Carolina were contracted an observers placed onboard to sample landed and discarded catches. Observers sampled seventy-five commercial trips during January, February, and March 1997. Monitoring will continue during the 1997-98 fishing season.

Alaska Fisheries Science Center (D. Somerton)

Research on Survey Trawls 1996-1997

The primary focus of our 1996-97 research is on estimating escapement under the footrope of our two primary survey trawls: the Poly Nor'Eastern, a 4-seam trawl with rubber bobbins on the footrope and the 83-112 Eastern, a 2-seam flatfish trawl with a simple cable footrope. During the summer of 1996, we attached an auxiliary bag under the Poly Nor'Eastern, much like the studies conducted by Walsh, Engas and Godo, to capture fish escaping under the footrope. For most species of flatfish, the probability of capture increased asymptotically with body length. For Dover sole, however, capture probability reached a maximum then declined with length. Underwater video observations showed that Dover sole tended dive toward the bottom as it tired rather than rising like other flatfishes. This indicates that capture

probability models may need to be more complicated that the 2 or 3 parameter Logistic functions usually chosen to describe size selection. In summer 1997, the Poly Nor'Eastern with the attached auxiliary bag will utilized to collect escapement data for species missed during the first experiment. In addition, an auxiliary bag designed for the 83-112 trawl is presently under construction and will be also deployed in summer 1997.

Several manuscripts have recently been completed that consider the trawl performance experiments we have conducted in previous years: 1) Somerton, D. A. and P. Munro. Estimating the catchability of a bottom trawl, 2) Somerton, D. A. Estimating trawl efficiency of snow crab with a Leslie depletion experiment. 3) Weinberg, K., C. Rose and S. McEntire. Using an underwater video system to estimate flatfish escapement beneath a trawl. All three manuscripts are currently in review and will be submitted to Fishery Bulletin.

An additional study planned for summer 1997 is to test the effect of low intensity lights, which are used in video observations of fish behaviour, in the ability of fish to escape under the footrope. Experiments to estimate escapement under the footrope with auxiliary bags are currently limited to bottom conditions that are generally smoother than those occurring over much of our survey areas. In Weinberg et al.'s manuscript an alternative approach to estimating escapement is presented which utilizes direct observation with a video system employing lights. The assumption, in this case, is that the lights have no effect on the probability of capture. Many researchers have strong opinions on the potential for lights to bias escapement estimates, but the effects have never been experimentally documented.

Although not directly related to trawl performance, the Alaska Fisheries Science Center will also conduct research in summer 1997 on the effects vessel noise on the vertical herding of semi-pelagic species into the trawl path. Working with Olav Rune Godo from the Institute of Marine Research, Chris Wilson at the Alaska Fisheries Science Center designed an acoustic buoy to track the movement of individual fish in response to an approaching vessel. The buoy is currently under construction and will be deployed during a September cruise.

Alaska Fisheries Science Center, National Marine Fisheries Center (C. Rose)

Effects of Light Level on Pollock Behavior in the Intermediate (Extension) : An infrared sensitive camera was used with infrared illuminators to observe pollock behavior in the intermediate under low light conditions (insufficient for SIT observation). Compared to well lit conditions, the pollock exhibited less consistent orientation and passed through the net more quickly.

Injuries to Crabs Passing under Trawl Footropes: Crabs (king and snow) which had passed under several commercial trawl footropes were recaptured with an under-trawl net and examined for injuries. A footrope suspended with flotation was used as a control. Observable injuries occurred on 5 - 13 % with 3 % in the control (probably from handling of the net). Further studies including survival of injured crabs are planned. *Open Top Intermediate*:Further tests of a modification for reducing halibut and roundfish catches in sole fisheries have been carried out. The modification consists of removing the top half of mesh from approximately 8 meters of the intermediate. Halibut and cod escapes have been around 50 % and pollock from 70 - 90 %, while sole loss has ranged from 6 - 15 %. Most tests have used video counts, so performance at low light levels remains untested. Testing during commercial operations is planned.

University of Washington, FRI (D. Erickson, E. Pikitch)
National Marine Fisheries Service, NWFSC/FAM (R. Methot, R. Conser)

Survival of trawl-caught and discarded sablefish, Anoplomona fimbria :A pilot study was conducted during July 1996 to evaluate the usefulness of a sea-bed caging method for estimating short-term mortality of discarded sablefish. Sablefish were placed into cages and returned to the sea-bed for a periods of 1, 2, 4, and 6 days. We found that at least 2 caging days were necessary to detect most

trawl-caused mortality. Results of the control group (self-caught sablefish) suggested that confinement within the cages caused mortality when trapped for 4 days or more. Two-day survival was low (less than 20 %) when deck exposure exceeded 20 minutes. This field season was conducted during summer months, however, when both the air temperature and surface water temperatures were high. Additional field seasons are planned for summer 1997 and winter/spring 1998. Objectives will be to estimate survival over a wide range of fishing and handling conditions (night versus day, short versus long tows).

University of Washington, FRI (E. Pikitch, D. Erickson)
University of Alaska, FITC (C. Bublitz)
Finnish Game and Fisheries Research Institute(P. Suuronen, E. Lehtonen, V. Tschernij)

Mortality of walleye pollock (Theragra chalcogramma) escaping from the codend and intermediate section of a pelagic-trawl during commercial fishing conditions: The ultimate goals of this study, managed by the Alaska Fishery Development Foundation, are (a) estimate the survival of walleye pollock escaping through pelagic-trawl meshes and (b) evaluate whether adequate escapement can be promoted in front of the codend
(i. e., in the area of the intermediate or extension). Field trials will take place June 1997 in the Gulf of Alaska to test the methods. If this pilot study is successful, then a larger scale study will take place during 1998.

UK (Scotland)

Cod-end selectivity: A 15 day cruise to measure the selectivity of pair seine cod-ends was undertaken, using 90, 100 and 110 mm diamond mesh with both 100 and 120 meshes round the circumference. A total of 32 valid hauls were made and haddock were the predominant species. The final analysis has not yet been completed. The analysis of data from the EU project on the variation of selectivity with season, twine thickness and speed continued. Further data were collected to assess the relation between girth, length, maturity and condition of haddock. Staff participated in cruises arranged by other project partners to study seasonal effect and to compare the cover and twin trawl methods of selectivity measurement. A cruise to assess the effect of catch size on selectivity was undertaken with Denmark. Artificial catches (made of netting bags each containing 25 kg of recently caught fish) were inserted in the cod-end prior to shooting. The results showed no significant difference in the selectivity of the additional fish caught, up to catches of approximately 1000 kg in total. It is not clear whether the experimental procedure caused this unexpected result. *Fish behaviour*: Investigation continued of the behavioral aspects of selectivity in nets and codends during two cruises on Clupea. Further work was carried out on the visual impact of codend construction, fish reaction to gear in darkness and the modification of water flow near the netting. More data were collected on tail beat frequencies in escape zones. Pockets of netting were attached to the net to assess escape routes in darkness. Structures which created dead zones of water flow were tested with some success in increasing escape rates. A new Benthos digital camera with flash was tested for observing fish reaction in dark conditions. A model of fish reaction in nets was developed. Participation in the EU concerted action project ALSTIM allowed wider consideration of the importance of fish behaviour in fish capture and selection. *Nephrops survival and damage after cod-end escape*: A new EU-funded project was started in collaboration with Denmark, Sweden and Norway. New techniques were used for holding triplicate groups of Nephrops in cages over periods of at least 27 days. Controls were obtained from creels. The survival of, and damage to escapees from 60 square mesh and 70 and 100 mm diamond mesh cod-ends and of deck discards were monitored.

Gear performance and fishing effort: A short cruise was undertaken to complete the collection of data comparing the performance of single and twin scraper trawls. A 16 day cruise on FRS

Scotia aimed to develop methods of studying selectivity, fish behaviour and gear performance of gears used in the deep water fishery at the edge of the UK continental shelf. While bad weather limited the results, useful experience was obtained in handling TV and cod-end covers suitable for this work. Significant catches of deepwater species were made. Six hauls of engineering data were obtained. As an addition to the pair seine selectivity trials, five days of engineering trials were undertaken to measure loading and geometry of the net and ropes. Excellent data were obtained which should allow the estimation of rope shape and ground friction coefficients between rope and seabed. Analysis of the data is continuing.
Physical and mathematical modeling: The SFIA flume tank was used to develop a new design of cod-end cover for low headline nets. The variation of cod-end drag at half scale was also studied and it was found that cod-end diameter was of more significance than e.g. netting material. The existing cod-end geometry model was developed further, including a modification to take account of the effect of twine stiffness.

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APPENDIX I

Report of the analysis of the FTFB questionnaire "Measuring fishing gear/fish behaviour and problems related to data acquisition", Gerard Bavouzet, France

The questionnaire was send at the end of February. We got some problems with the E-mail, from a PC and we had to send again the questionnaire (three times all together). We got also some problems with the text editor (import and export functions). Concerning those E-mail problems on transferring formatted data or text, it would be useful knowing the E-mail software used on the PC and its version number, the used encoding procedure, the used editor text and its version number. Those would help a lot.

Concerning the questionnaire, we got 18 responses from different countries and laboratories:

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WALSH Steve	FISHERIES AND OCEANS	CANADA
WEST Charles W	INSTITUTE OF MARINE RESEARCH	NORWAY

Following is a quick summary of the answers.
Section 1 gives any information on the replies (name, institute).
We start on section 2, with four general questions about maintenance, collaboration, inventory and insurance.

Concerning the maintenance, the results are very dissimilar, ranging from nobody to 30 people in computer sectio and data processing, engineering (electronic, electrical, mechanical, gear) and in specific area (sonar).

Concerning the collaboration with the others institutes or private sector, in the deployment of instruments or deployment methodologies in the past, most have collaborate, with the exception of 3.

Concerning the inventory of hardware and/or software to support the fishing gear/fish behaviour studies, 12 do, 3 don't.

Concerning the instrumentation insurance for loss or damage while it is deployed in the field, 7 can, 8 don't.

The questionnaire asks next on instrumentation used, instrumentation which the lab has in-house, and parameters logged. 5 don't have and don't use any tension meters, the others have just one or all types of tension meters.

Only one doesn't have any geometry instrumentation. For the others, everybody owns one height measurement sensor, 11 have more than five parameters (principally eight, distance, depth, angle and speed).

10 take care about the vessel parameters.

12 use a sounder and 8 echo-integrate

Just 1 doesn't get environmental measurement (sub-surface). The rest get all or a part of it.

3 don't get environmental measurement (surface). The rest get all or a part of it.

Concerning the data logging, 2 seems to work without data logging (no response). Most have developed their own logging package or use a hybrid system.

Concerning underwater observations, towed platforms are used by 7, 8 don't use any. Many different models are existing, manufactured or own development.

Most (11), use trawl mounted cameras and recorders of different brand in different configurations.

We find all types of cameras.

On section 3, the ranking of the most significant problem facing the data acquisition concerning hardware and software is very dissimilar and shows the differences between institutes own facilities.

Just 5 feel a need to measure new parameters (ground gear contact, detailed fish behaviour in too dark conditions for SIT cameras, water visibility, light level with a handy light meter, rate of fish entering trawl, flow speed with heading and inclinometers in a small size for codend measurements and self recording, bottom effect-forces of doors on the ground).

On section 4, we got many responses. Following are examples of responses for the two questions concerning a manual or a catalogue, and the question concerning the best approach by the FTFB.

Manual:

1) Yes. Anyone who conducts this experiments are potential users.
2) A need exists, the question is: what's the degree of use. Users would be for anyone. First using or considering options for gear usage.
3) No. Unless all institutes use same equipment and methodologies.
4) Selectivity manual developed by the SubGroup will be quite useful.
5) Could be advantageous i.e. SCANMAR solutions found. Many of these problems have been recently published.
6) Yes. Use for reference in novel situations and as an aid to standardizing and optimizing methodologies.
7) Yes. As a how-to manual describing accepted methodologies. Potential users would include anybody interested in the gear technology/fish behaviour/selectivity fields.
8) A manual would be of limited use due to the small number of potential users and the widespread awareness of the technology already existing. Private contacts on issues on specified concern are more efficient.

Catalogue:

1) Yes. Anyone who conducts this experiments.
2) Yes. We could reference it for acquiring programs we may wish.
3) Yes. Internet or ICES mail or ....?
4) No. This would be a massive task. Equipment is re-newed/replaced so often that the inventory would quickly become out of date. Maybe could use Internet for transfer of ideas/equipment specifications. Need to continue dialogue/discussions between engineers. Need to compare calibration standards and records as these are basis on which all measurements are made.
5) Maybe.
6) Catalogue would quickly provide researchers with a list available items resulting in greater co-operation and efficiency in use of this items.
7) OK. If it leads to possibility of buying or sharing the equipment. Most is made only for internal use.
8) Yes. Catalogue would serve to point researchers in the direction of individuals and equipment that have common research goals and requirements.
9) A catalogue might facilitate sharing and collaboration among institutes. It would help prospective new users find out where to get the best advice. Such a catalogue could be quickly developed from this questionnaire.

FTFB approach:

A-Ranking:

Type, rank1, rank2, rank3, no response
Manual: 5,3,2,5
Catalogue: 6,4,0,5
Not at all: 1,0,0,14

B-Comments:

1) Not before further discussion of the objectives of compiling such catalogues first, summarize responses to the survey.
2) No.
3) Manual as companion to the work on conducting selectivity studies - Working Group?
4) WEB pages for equipment's and problems encountered.
5) Data acquisition is subject too fast evolution. A manual would be too fast out of date. A catalogue can be updated more easily.
6) Manual of experimental procedures, deployment methodologies. Manual would include catalogue of researchers/expertise/equipment as an appendix.