International Council for the
Exploration of the Sea

C.M. 1993/B:1
Report of Activities

FISH CAPTURE COMMITTEE

by

Ronald Fonteyne

1992

BELGIUM

(R. Fonteyne and H. Polet)

Gear Research

Gear research aimed at the development of efficient fishing gear from a technical, biological and economical point of view. As a consequence this research is often carried out in close cooperation with the fishing industry. The types of gears involved in this research were beam trawls for flatfish as well as for shrimps and semi-pelagic and high opening bottom trawls. As in the past a reduction in towing resistance was of a major concern in the development or improvement of fishing gear.

The catching performance and the towing resistance of a shrimp beam trawl with larger meshes in the top panel was compared with the traditional shrimp beam trawl. On the demand of skippers, the technical parameters of several demersal and semi-pelagic otter trawls were measured, under commercial conditions, by means of the SCANMAR equipment. The system proved to be reliable and practical in use even under difficult working conditions. The results for one of these gears were compared with flume tank measurements, showing a very good correspondence.

In cooperation with IFREMER, model tests on six traditional Belgian fishing gears have been started in the flume tank in Boulogne. The aim is to find possibilities for improvement in both gear design and riggings and to provide material (models and video tapes) for demonstration. These experiments too are carried out in close cooperation with the industry.

In the frame of the EC AIR research program the project "Investigation of the relative fishing effort exerted by towed demersal gears on North Sea human consumption species" has been started, dealing with relative fishing effort in relation to technical vessel and fishing gear parameters and performance. This project is carried out in collaboration with DIFTA (Hirtshals), the Marine Laboratory (SOAFD, Aberdeen) and the Seafish Industry Authority (Hull). Based on the analysis of the 1991 catch and effort data, the significant Belgian sub-fleets were identified. Future work will be concentrated on these fleets.

Selectivity studies

The development of a species selective beam trawl, with special emphasis on a substantial decrease of young roundfish discards while maintaining the level of flatfish catches has been the subject for the EC "FAR" research project "Improved selectivity in the North Sea Fishery - Beam Trawling". This project has been carried out in collaboration with the Netherlands Institute for Fishery Investigations (RIVO, Ijmuiden) and the Seafish Industry Authority (Hull). The designs of the species selective beam trawls were adjusted and completed by means of flume tank experiments in Hull. The full scale gears were tested on a commercial beam trawler. The experimental gears and the fish reactions were studied with RIVO's ROV operated from the Dutch RV ISIS. During three trips on a commercial vessel the catches of the selective configurations were compared with the ones of the traditional beam trawl. Good results were obtained in releasing haddock and whiting, but for cod the results were not yet consistent. No meaningful losses in flatfish catches were noted. The study has been completed with a financial evaluation of the selective gears, showing only a marginal decrease in returns. A proposal for a new EC project on the optimisation of the species selective beam trawls has been submitted under the AIR research program. In due time a new project will start, as a continuation, on the optimisation of the species selective beam trawls.

A first series of experiments have been carried out on the influence of towing speed on the by-catch of roundfish and the codend selectivity of a 4m beam trawl. At the same time a codend cover with hoops was tested out but appeared not to be able to withstand the harsh conditions in beam trawling. Further experiments with stronger materials will follow.

An EC financed project on the selectivity of traditional Belgian Nephrops trawls and discarding practices in this fishery has been started. Together with the selectivity parameters of a 70 mm and a 90 mm codend the consequences of the application of a square mesh window will be determined. The results will be compared with those of a parallel project by DIFTA, Denmark.

Together with the Seafish Industry Authority (Hull) an EC seminar with professional fishermen on discarding and possible solutions for this problem was organised in Ostend.

Cooperation has been given to the FTFB-subgroup dealing with the design, performance and analysis of selectivity experiments.

Technical/ecological aspects of trawling.

The EC FAR project "Environmental impact of bottom gears on benthic fauna in relation to natural resources management and protection of the North Sea" was continued. This project is carried out in collaboration with institutes from the Netherlands, Germany and the UK. On the research vessel BELGICA the tracks of a 4 m beam trawl were studied by means of side scan sonar techniques and in situ inspection by divers. The pressure exerted by the sole plate of the beam trawl on the bottom was measured. For this purpose an instrumented beam trawl head has been developed. At the same time changes in the benthos population due to fishing operations as well as survival of the organisms caught were studied by the Dutch institute NIOO_CEMO.

Other activities.

The inventory of net plans and rigging of gears in use in Belgium was continued.

On the demand of a Dutch manufacturer of synthetic fibres a series of tests has been started to study the abrasion and mesh stability of netting made of a new synthetic fibre.

CANADA

(P. Koeller)

N.W. ATLANTIC FISHERIES CENTRE, ST JOHN'S, NEWFOUNDLAND

Acoustics:

The group continued its strong commitment to acoustics research and application of the methodology to stock assessment of capelin, herring, cod and redfish. Research focussed on enclosure experiments on cod target strength/length relationships and the effect of fish behaviour and directivity. Target strength experiments at sea involved two vessels over a 20 day period. Enclosure and *in situ* target strength experiments were also carried out on herring. Acoustics was used in an experiment to examine the effect of trawling on spawning cod. Two cruises were carried out to map and track cod migration using acoustics. Target strength and species identification research was carried out during one of these cruises. Further *in situ* target strength work on cod and capelin included 40 days of continuous tracking of northern cod migration; and 10 days continuous observation of a cod spawning school. Target strength-length relationships were determined for cod (15-60 cm) at 120 and 38 kHz and directivities measured at both frequencies.

A total of eight acoustic surveys were conducted for the purpose of fish stock assessment. Two surveys (120 kHz) were carried out to estimate herring abundance in four of the five stock complexes in the Newfoundland region. Three surveys were conducted for capelin (49 kHz) covering NAFO Divs. 2J3K, 3L and 3NO. These surveys continued to show low capelin abundance in Divs. 2J3KL. Two surveys (38 kHz) were carried out in order to assess cod in NAFO Divs. 2J3KL and a further acoustic survey was conducted on redfish in NAFO Divs. 3P, 4V and 4R.

As a result of the Northern Cod Science Program workshop held in 1991, the Region developed plans for standardizing on 38 kHz dual beam equipment for offshore groundfish and capelin work and commenced a program of procurement, development and implementation which will continue into 1994.

Gear/Fish Behaviour, Selectivity:

Engineering trials on the Engel 145 High Lift groundfish survey trawl continued in 1993. SCANMAR acoustic sensors were used to quantify trawl geometry in terms of headline height, door spread, wing spread and trawl speed at depths from 500m to 1100m using various warp ratios. Reciprocal tows were used to ascertain the effects of current. Eight surveys were equipped with SCANMAR instrumentation, further contributing to a survey gear performance database which is being analyzed.

Trials were conducted to compare the selectivity of the Yankee 41 shrimp trawl and the Campellen 1800 shrimp trawl. Work continued on efforts to introduce a quality control strategy for the procurement and use of survey fishing gear. Tolerances for all components have been developed and are to be incorporated in the Survey Trawl Reference Manual. Research vessel crews attended a workshop in standardization of survey methodology and fishing gear technology at the Marine Institute, St. John's.

Work has begun to calibrate the selectivity of the standard groundfish survey gear rigged with a bobbin footrope against that of one rigged with a rockhopper footrope. A twin trawl system has been model tested in the flume tank as a prototype for full scale gear to be used in trials later this

year. Further development has been completed on the SEATRAWL data logging software (SCANMAR, navigation, speed, etc.) which has been modified to allow for online, data file edit capabilities.

INDUSTRY DEVELOPMENT DIVISION, ST. JOHN'S, NEWFOUNDLAND

Gear/Fish Behaviour, Selectivity:

Two selectivity trips were carried out on an offshore (51m) stern trawler to investigate the effectiveness of a horizontal panel and large square mesh to reduce the by-catch of cod while directing for American plaice. A traditional otter trawl was modified to accommodate a vertical divider panel and a twin codend; one with large square (178mm) mesh and the other with small (44mm) diamond mesh. Another trawl was modified with a horizonal panel and two small mesh codends, one placed over the other. Models of the modified trawls had been tested at the Marine Institute's Flume Tank prior to the field work. SCANMAR and underwater cameras (video and still) were used to determine if the trawls were operating properly. Preliminary results indicate that there was marginal separation of cod when using the horizontal panel and the large square mesh released the majority of cod. However, some of the commercial size flatfish species escaped. The use of 165mm square mesh may prevent this.

Commercial deepwater (700-1500 meters) gillnet operations for 22 vessels fishing Greenland Halibut were monitored. Catch comparisons were made of the fishing effectiveness for different gillnet mesh sizes, hanging ratios, depth of webbing, gillnet rigging and construction. Catch rates reflective of time of year, water depth and soak period were determined.

MAURICE-LAMONTAGNE INSTITUTE, MONT-JOLI, QUÉBEC

Acoustics:

Two acoustic cruises were conducted in the Gulf of St. Lawrence using a Biosonics 102 (38 & 120 kHz, dual beam) and a HDPS-9001. The first studied cod migration in Cabot Strait during the ice break-up, and the second was dedicated to the dynamics of capelin and krill aggregations in the Jacques-Cartier Passage in summer. Exploration of geostatistics for mapping and estimation was pursued. Two surveys explored the possibilities of using the ROXANN acoustic bottom-typing system for benthic fauna; results appear promising for species associated with sand substrate. Two other cruises using a 120 kHz EK-500 and a HDPS-9001 were dedicated to studies on mackerel migration and distribution in the Gulf of St. Lawrence in relation to environmental conditions.

Gear/Fish Behaviour, Selectivity:

Tests of the Nordmore selection grid for shrimp were conducted to assess its suitability for general adoption by the shrimp fleet. Tests on trawl rigging to reduce juvenile cod by-catch without reducing plaice catch were performed and the gear was found effective. Other tests to reduce juvenile cod and redfish by-catch were conducted with SORT-X separation devices. Tests on a time-release mechanism to allow escape of crabs caught in lost traps were completed.

BEDFORD INSTITUTE/ST. ANDREWS BIOL. STATION (DFO SCOTIA-FUNDY)

Acoustics:

Acoustic information continued to be collected during standard groundfish trawl surveys on the Scotian Shelf, and during special inshore trawl surveys covering traditionally unfished hard bottoms. Data is collected during sets and while steaming between stations. The acoustic data will be compared to trawl catches in order to evaluate the feasibility of integrating acoustic and trawl catches in abundance estimates.

The annual Chedebucto Bay herring survey was conducted in January 1993, and preliminary estimates indicate low abundance as per last year.

Gear/Fish Behaviour, Selectivity:

An experiment to test the effect of hook and bait size on the size of fish caught on commercial groundfish longline gear was completed. Both bait and hook size influenced size caught, their relative importance varying with species.

SCANMAR measurements continued on all standard groundfish surveys. A trawl mensuration working group, consisting of members from each of the four DFO Atlantic regions, was formed within the Canadian Atlantic Scientific Advisory Committee (CAFSAC). The group aims to keep regional survey biologists and gear technologists informed on developments in the area of survey trawl mensuration and quality control and to develop common approaches to data logging, editing, calibration, training, and database management.

FRESHWATER INSTITUTE, WINNIPEG, MANITOBA

acoustics:

A hydroacoustic study of the spawning migration of broad whitefish *(Coregonus nasus)* in the Arctic Red River, Northwest Territories, was initiated. River profiles were examined to locate suitable sites for a Simrad fixed location, split-beam hydroacoustic system. This newly purchased equipment will be in place in the fall of 1993. Preliminary data on the acoustic size of broad and lake whitefish at various aspects was collected. An imagining sonar system (Imagenex Corp.) was tested and determined to be valuable in providing an 'acoustic screen' across the entire river profile and quickly rendering a visual record of fish traffic.

PACIFIC BIOLOGICAL STATION, NANAIMO, BRITISH COLUMBIA

acoustics:

A joint Canada/USA survey was conducted on the transboundary Hake stocks. Joint calibration test and side-by-side acoustic surveys were conducted to compare and standardize Canadian and US estimates.

Hydroacoustic surveys for wintering herring in the North Coast were continued, and an abundance index from the hydroacoustic survey series will be used for the first time in the 1993 assessment for these stocks. An upward-looking acoustic transducer was developed and used to assess juvenile salmon populations in lakes.

Gear/Fish Behaviour, Selectivity:

Marine Fish Division has been working with the Deep Sea Trawlers Association, the Fishing Industry Services Branch and the B.C. Ministry of Fish and Food to develop and test savings gear in the shrimp and flatfish trawl fisheries. The objective of this work is to find a workable solution to the problems of by-catch and discards.

The High Seas salmon program tested a Polish rope trawl to determine its effectiveness in sampling salmon on the high seas. The trawl proved to be ineffective in the clear offshore waters but showed some promise in the turbid waters on the shelf. The salmon beam trawl designed to sample surface waters was tested at depth. A number of problems associated with net stability and winch power were encountered when fishing the gear in this configuration.

DENMARK

(D. Wileman)

A. Fishing Technology and Fish Behaviour

Danish Institute for Fisheries Technology and Aquaculture (DIFTA)

Species selective industrial fishing trawl

Field work has been carried out in a CEC FAR project aiming at separating whiting, herring and haddock in Norway pout trawls. Separation was examined by means of square mesh panels in the top of the trawl in front of the codends and by a rigid separator metal grid. The project is partly funded by EEC and is in cooperation with Marine Laboratory, Aberdeen.

The intention was to separate the pout into one codend and utilize behaviour difference to divert haddock/whiting out of the trawl or into a different codend. Performance of the trawl was monitored by a remote controlled towed vehicle (RCTV) observing the fish behaviour.

No acceptable species separation could be achieved.

Selective roundfish trawl

The aim of the project is to develop a demersal trawl that is able to separate whiting from cod and haddock in order to treat the species in a mesh size appropriate to their minimum landing size. In the design an attempt has been made to take advantage of the observed difference in behaviour of whiting: that it is more willing to escape through square meshes than cod and haddock. Several variations have been tested in three cruises on a commercial Scottish trawler. One design comprised a whole trawl separation panel, and another restricted the innovations to the codend/extension piece. A marked difference in behaviour for the three species has been detected in the experimental trawls.

The project has comprised tank testing, full scale trials and underwater observations of the test trawls using DIFTA's RCTV. Further sea trials will be conducted in 1993. This FAR project is partly funded by the CEC and is in cooperation with SFIA in Hull.

Selectivity in Danish and Scottish seines

This CEC FAR project is carried out in partnership with SFIA in Hull. The Danish research on anchor seines comprises 35 hauls in 1991 testing an experimental 90 mm diamond mesh

codend fitted with two 90 mm square mesh windows against two diamond mesh codends of 90 mm and 110 mm standard in the Danish seine fishery. The method used was the alternate hauls technique.

In 1992, 35 valid hauls was conducted testing an experimental 100 mm diamond mesh codend with two 90 mm square mesh windows against a standard 100 mm diamond mesh codend using the hooped covered codend technique.

Using the square mesh window codend gave no significant effect upon the catches of cod and plaice (main target species). A reduction in undersized haddock was accompanied by a corresponding loss of marketable fish. Selectivity parameters gave very asymmetrical and steep selection curves, and indications of L_{50} values higher than measured in other gear types.

Survival of fish

Field work has been carried out on a CEC funded project in partnership with Marine Laboratory, Aberdeen which aims to estimate survival rate of fish which have escaped through meshes in codends in a standard fish trawl. Geometry and performance of the trawl was observed by RCTV. Codend contents were examined for debris and retained species potentially harmful to the fish in the survival test. Codend selectivity parameters for the fish species in the survival test were measured.

Trawl Door Studies

The CEC FAR project carried out in partnership with Sea Fish, England and IFREMER, France was continued in 1992. Most of the practical work testing scale model doors in flume tanks was finished during 1991 but a number of analysis had to be made during 1992. An other principal task was to gather all the results in an Otterboard Manual for fishermen in the EEC. This manual is more or less finished and will be available in 1993.

Computer Assisted Trawl Simulation

The CEC FAR project CATS was initiated in 1991 and is carried out in partnership with IFREMER, France and DMI, Denmark. The purpose of the project is to develop computer software for simulation of trawl behaviour. In 1992 one trawl model was tested in a number of conditions in the DIFTA Flume Tank and comparisons were made with results from computer simulations. The CADTRAWL interface program developed in 1991 was improved and made easier to use. A version of the simulation program was made for use on personal computers and with a great effort being made to decrease the calculation time.

The project will be completed in 1993.

Model/full scale correlation

This project, which was initiated in 1991, has been continued in 1992. The objective of the project is to develop better scaling rules to be used when estimating full scale performance of trawls from flume tank tests.

The research, which is partly funded from the CEC FAR programme, is made in cooperation with RIVO and SOAFD Marine Laboratory.

In 1992 large scale models (scale 1:2.75 and 1:4.5) were constructed. Tests on these models were performed in Loch Ness by the Marine Laboratory.

The work will be finalised in 1993.

Development of Fuel saving bottom trawls

DIFTA has in cooperation with IRPEM initiated a project with the objective to develop fuel saving bottom trawls for the Italian and Danish human consumption fisheries.

The work is partly funded by the CEC FAR programme.

In 1992 traditional trawls have been tested both in the flume tank and in full scale. It is the aim of the project to test the influence on drag and geometry when using high strength netting material in new trawl designs.

The work will continue in 1993 and 1994.

The Fisheries Laboratory of the Faroes

Sampling Trawls

In the annual bottom trawl surveys at Faroes the standard bottom sampling trawl with the lighter rubber bobbins gear has been used during the last 8 years. It was anticipated that the heavier rockhopper gear would be more effective in catching the small cod and haddock than the standard rubber ground gear. Therefore, in spring 1992 a heavy rockhopper ground gear was tested against the standard rubber gear on the Faroese fishing grounds. The absence of cod at Faroes for the moment limited the results of the survey. Some data on saithe and redfish were obtained, and they indicate no statistical difference in the two riggings. As a result the standard bottom sampling trawl with the lighter rubber bobbins gear is still in use.

Deep water fishing

In winter 1992/93 experimental trawling in deep water (500-1400 m) has been carried out in the southern Faroese water, on the Hatton Bank and on the Reykjanesridge. Deep water

species such as grenadiers, black scabbard fish, sharks, smoothhead, orange roughy and oreo dories were caught. A commercial fishery on some of the mentioned species has developed.

Joint research between Greenland Fisheries Research Institute, DIFTA and the Fisheries Laboratory of the Faroes

Selective Shrimp trawls

The institutes have taken part in field work in a joint project funded by the Nordic Council. Other partners are laboratories in Norway, Sweden and Iceland. Different designs of grids have been tested in commercial scale fisheries to find the most effective design to reduce bycatch of non-marketable size shrimp and Norway Lobster. Trawl geometry and fish behaviour have been observed by RCTV.

Survival of fish

The institutes have taken part in field work in a joint project funded by the Nordic Council in cooperation with laboratories in Norway, Sweden, Iceland and Finland. The project aims at estimating survival rate of fish, which have escaped through the meshes in towed fishing gear.

In 1992 an experiment was undertaken north of the Faroes to assess the survival of saithe (Pollachius virens L) escaping through trawl meshes (145 mm codend meshes). Escaped fish were collected in fine meshes net cages mounted aft on a codend cover. The net cages were drifting freely with the current in the area north of the Faroes and located by means of radio tracked buoys. Preliminary results indicate that saithe can withstand almost the same sorting through trawl meshes as cod, with low mortality. However, more experimental work is needed to draw more firm conclusions on survival rates of saithe escaping from a codend. Therefore, in July 1993 a similar study will be carried out to statistically assess the survival rate of saithe which have escaped through a codend mesh.

B. Fisheries Acoustics Science and Technology

Danish Institute for Fisheries and Marine Research

Hydroacoustic stock assessment

Pelagic stocks in the Skagerrak/Kattegat area were surveyed by R/V DANA in July 1992 as a part of the ICES Coordinated Hydroacoustic Survey of the North Sea. The usual standard calibration of the equipment was done in the Gullmar Fjord in Sweden immediately before the cruise.

Danish scientists participated in the survey of the herring and sprat stock in the Western Baltic made by the German R/V SOLEA in October 1992.

Image analysis of acoustic data

An image analysis system has been acquired and installed (HIPS2 on a UNIX system and Global Lab Image on a fast PC) and supporting software has been developed for analysis of acoustic data obtained during surveys. The purpose is to extract parameters from the acoustical data that can be used for species recognition or categorization. Furthermore parameters describing spatial distributions of organisms are examined in connection with predation processes.

Other activities

Equipment for tracking and remote sensing has been acquired in order to monitor activities in free-swimming fish, especially feeding activities. Some preliminary field activities are planned for 1993. It is intended to establish a joint project in cooperation with England and Norway.

The work on acoustic detection of blue mussel banks started in 1992 continues in 1993.

The Fisheries Laboratory of the Faroes

Hydroacoustic stock assessment

One blue whiting survey was made in 1992. It covered the southern part of the Faroese EEZ investigating of post-spawning blue whiting on its way northwards. The 1989 year class is still the dominating yearclass. These results were reported to the ICES Working Group on blue whiting in 1992.

FAROE ISLANDS

(J.A. Jacobsen and B. Thomsen)

FISH TECHNOLOGY

In 1992 an experiment was undertaken north of the Faroes to assess the survival of saithe (*Pollachius virens* L) escaping through trawl meshes (145 mm cod-end meshes). Escaped fish were collected in fine meshed net cages mounted aft on a cod-end cover. The net cages were drifting freely with the current in the area north of the Faroes and located by means of radio tracked buoys. Preliminary results indicate that saithe can withstand almost the same sorting through trawl meshes as cod, with low mortality. However, more experimental work is needed to draw more firm conclusions on survival rates of saithe escaping from a cod-end. Therefore, in july 1993 a similar study will be carried out to statistically assess the survival rate of saithe escaped through a cod-end mesh.

In the annual bottom trawl surveys at Faroes the standard bottom sampling trawl with the lighter rubber bobbins gear has been used during the last 8 years. It was anticipated that the heavier rockhopper gear would be more effective in catching the small cod and haddock than the standard rubber ground gear. Therefore, in spring 1992 a heavy rockhopper ground gear was tested against the standard rubber gear on the Faroese fishing grounds. The absence of cod at Faroes for the moment limited the results of the survey. Some data on saithe and redfish were obtained, and they indicate no statistical difference in the two riggings. As a result the standard bottom sampling trawl with the lighter rubber bobbins gear is still in use.

In winter 1992/93 experimental trawling in deep water (500-1400m) have been carried out in the southern Faroese water, on the Hatton Bank and on the Reykjanesridge. Deep water species as grenadiers, black scabbard fish, sharks, smoothhead, orange roughy and oreo dories were caught.

ACOUSTICS

One blue whiting survey was made in 1992, it covered the southern part of Faroese EEZ of postspawning blue whiting on its way northwards. The 1989 year class is still the dominating year-class. These results were reported to the ICES Working Group on blue whiting in 1992.

FINLAND

(P. Suuronen)

Experiments were carried out in the northern Baltic Sea (ICES SD 29N) to study the escape behaviour and survival of Baltic herring escaping from a diamond mesh codend (mesh sizes 26 and 36 mm). During the survival tests, the escaping fish were captured into a hooped, small mesh netting cage, which was released from the trawl when enough fish were caught, and left at the depth of capture. After a predetermined period (1-9 days), dead and live fish were counted and the length measured. The results suggest that the survival of herring is significantly related to fish size; the highest mortality occurred in the smallest size classes (length <10 cm). Underwater observations in the belly and codend extension area of the trawl revealed that especially small herring often strike the meshes and loose scales. The selective performance of a rigid sorting grid (aluminium) in a pelagic herring trawl was tested.

Selectivity and survival experiments on vendace (*Coregonus albula* L.) escaping through a square mesh codend (mesh size 26 mm) of a pelagic trawl were conducted in Lake Juojärvi and in Lake Puulavesi in June-August. The survival trials were made with the same capture and monitoring method as used in the herring survival study. Under certain circumstances, very high mortality rates were encountered on juvenile vendace. Preliminary trials with a rigid sorting grid were conducted.

Testing of the effectiveness and selectivity of the different types of gillnet materials (bar length 45 mm) used in the pike-perch fishery continued in the Archipelago Sea. Results indicate that the twine thickness affects most strongly on the numbers of the smallest, undersized (<37 cm) pike-perch.

A few salmon were tagged with ultrasonic tags. Development of small tags that can be used to tag migratory whitefish (*Coregonus lavaretus* L.) was started.

Factors affecting the swimming behaviour of Baltic herring in relation to a herring poundnet were studied in the Archipelago Sea in October-November. The aim of the study is to clarify the possibilities to extend the herring poundnet season to autumn. Problems in the capture of feeding herring seems to be connected to the guiding performance of the leader net. The results indicate that herring are at least to some extent guided by the water currents during the dark period. Obviously, the leader net and the poundnet should be rigged parallel to the main water current.

The effects of cold winter conditions on the physical properties of netting materials was studied. The breaking strength were measured in a low-temperature chamber. Knots proved to be crucial for the strength.

The catching performance of a small meshed and large meshed wing-netting of an under-ice winter seine were compared with help of a three-winged seine and sonar observations.

FRANCE

(G. Massart)

1. TECHNIQUES DE CAPTURE

1.1. Chaluts et apparaux associés

1.1.1. Conception des chaluts assistés par ordinateur

Le projet mené en collaboration avec le Danish Institute for Fisheries Technology and Aquaculture et le Danish Maritime Institute a progressé conformément au programme proposé à la Commission des Communautés Européennes (dans le cadre de FAR).

La représentation des chaluts pélagiques et de fond tels qu'ils sont en pêche, avec leurs particularités (ralingues, bourrelet, flotteurs, lests) et leur gréement complet (funes, bras, entremises et panneaux), se fait correctement. Les comparaisons effectuées entre dimensions et tensions calculées à partir du plan d'un modèle de chalut et ces mêmes dimensions et tensions mesurées en bassin d'essai sont généralement très satisfaisantes (écarts très souvent inférieurs à 10 %).

Le travail doit s'achever avec la mise au point d'un système de maillage du chalut qui en simplifie au maximum la description pour diminuer encore les temps de calcul tout en respectant la géométrie du chalut. Cela permettra également d'initialiser le calcul à partir d'un plan de chalut réel et non d'un plan de modèle de chalut.

Par ailleurs, la méthode de calcul mise au point devrait pouvoir permettre de prévoir la forme des mailles dans le cul de chalut, donc de calculer l'un des paramètres de la sélectivité des chaluts (un projet proposé en réponse à l'appel d'offres AIR).

1.1.2. Etude des panneaux de chaluts

Cette étude menée en collaboration avec la Seafish Industry Authority (Grande-Bretagne) et le Danish Institute for Fisheries Technology and Aquaculture s'achève. La totalité des mesures à faire en bassin ont été effectuées. Tous les panneaux qui devaient être essayés en France l'ont été dans le nouveau bassin d'essais de Boulogne s/Mer. L'analyse des écarts observés (en général de l'ordre de 10 %) entre les mesures faites à Boulogne, à Hull ou à Hirtshals a permis de mettre en évidence un ralentissement de l'écoulement de l'eau au voisinage du fond mobile dans le Bassin de Boulogne, dont la cartographie détaillée des profils de vitesse n'était pas encore faite au moment des essais de panneaux.

1.1.3. Etude de nouveaux chaluts

Les essais à la mer d'un prototype de chalut "siamois" a été essayé en mer à bord du N/O GWEN DREZ. Destiné, comme les chaluts jumeaux, à accroître l'ouverture horizontale efficace sans accroître proportionnellement la surface de fil, ce prototype a fonctionné en mer de façon satisfaisante. Sa traînée est comparable à celle des chaluts jumeaux équivalents, sa mise en oeuvre sur deux funes est un peu simplifiée.

1.1.4. Travaux sur la sélectivité des chaluts

Les travaux entrepris portent sur la sélectivité interspécifique :

- langoustines/merlu dans la pêcherie du Golfe de Gascogne, avec montage d'un panneau à mailles carrées sur le cul du chalut et essais de divers montages pour confirmer les résultats déjà obtenus antérieurement. Le faible volume de captures n'a pas permis un dépouillement statistique des résultats.

- poissons plats (soles, surtout)/araignées ou coquilles St-Jacques dans les pêcheries côtières de Manche Occidentale où il faut trouver le moyen d'évacuer les crustacés et coquilles St-Jacques par le bas du chalut sans perdre de poissons plats. Des solutions (trappe, grille) ont été proposées, mais sans résultat totalement concluant et le travail doit se poursuivre en 1993. Par contre, les enseignements recueillis pendant la campagne à la mer qui a été réalisée en Septembre 92 seront utilisés lors d'essais qui débuteront en 1993 (étude commencée au dernier trimestre 92) pour protéger les jeunes baudroies dans les pêcheries multi-spécifiques baudroies/raies/cardines.

Par ailleurs, un mémoire a été rédigé présentant les résultats comparés de diverses méthodes de calcul de la sélectivité appliquées aux mêmes résultats expérimentaux.

1.1.5. Instrumentation et équipement des chaluts et filets droits

Les capteurs autonomes, à mémoire et horloge interne, capables de mesurer et de stocker in situ des informations acquises sur les engins de capture sont en cours de développement industriel et constituent une gamme comprenant :

- capteurs d'effort (0-10 tonnes ou 0-5 tonnes),

- capteurs d'immersion (0-300 m) et de température (0-40° C),

- capteurs différentiels permettant de mesurer des variations d'immersion, par rapport à un point fixe, d'engins calés au fond (sensibilité 10 cm, étendue de mesure : 0-10 m, immersion : 100 m).

Le système télécommandé de fermeture du cul de chalut a été testé à plusieurs reprises à la mer sur des chaluts de fond (à bord du N/O GWEN DREZ) et pélagiques (à bord du N/O THALASSA). Le système a marché de façon satisfaisante et permet de séparer des captures faites à des moments différents d'un même trait, ou - dans certains cas - d'interdire l'échappement de certains poissons pendant le virage du chalut.

1.1.6. Pêche profonde au chalut

Nous avons participé aux campagnes exploratoires menées par des armateurs français recherchant des espèces nouvellement commercialisées en France (en particulier Grenadier et Hoplostète) et proposé aux armateurs boulonnais, commanditaires de l'étude, un chalut à grande ouverture verticale adapté aux conditions de chalutage de ces espèces (nature des fonds, altitude de nage des poissons).

1.2. Filets maillants

1.2.1. Sélectivité des filets maillants

Comme cela a été fait pour les chaluts, une étude bibliographique sur la sélectivité des filets maillants et un mémoire portant sur l'analyse des méthodes de mesure sur la sélectivité des engins passifs ont été réalisés. A la suite de ce travail, nous avons participé à la préparation de deux projets sur l'étude de la sélectivité et des rejets des filets maillants (1 projet en réponse à un appel d'offres restreint de la CEE, 1 projet en réponse à l'appel d'offres AIR).

1.2.2. Protection des dauphins

Malgré un taux de captures de dauphins faible, la pêcherie de germons au filet dérivant dans le Golfe de Gascogne est critiquée par les écologistes. Une recherche sur les données en bioacoustique existant en France a été menée en 1992, quelques voies d'expérimentation pour écarter les dauphins des filets ont été examinées et nous avons participé à la préparation d'un projet sur les systèmes répulsifs à dauphins susceptibles d'être utilisés dans ce type de pêcherie (1 projet en réponse à l'appel d'offres AIR).

1.3. Senne coulissante

Le renouvellement nécessaire de la flotte thonière (pêche au thon rouge) en Méditerranée nous a amené à faire un travail d'analyse des facteurs d'efficacité des thoniers méditerranéens, comparable à celui déjà réalisé pour les thoniers senneurs tropicaux, et permettant l'écriture du cahier des charges d'un navire performant en termes d'économie de main-d'oeuvre et de qualité du poisson.

2. ETUDES SUR L'AMENAGEMENT DES NAVIRES

2.1. Machine à trier le poisson par analyse d'images

Appliquée au tri des petits poissons pélagiques (sardines, anchois, essentiellement), la technique de la reconnaissance d'image par ordinateur a donné des résultats très encourageants et une machine prototype est construite. La dernière difficulté à résoudre consiste dans la séparation longitudinale de poissons correctement alignés pour défiler devant la caméra.

2.2. Renouvellement de la flotte de recherche halieutique française

2.2.1. Remplacement du N/O THALASSA

Le nouveau navire sera un chalutier pêche arrière de 72 m, à propulsion diesel électrique. Un silence maximum en route et en pêche, une aptitude à chaluter à grande profondeur (treuils et sondeurs adaptés à une pêche à 2000 mètres), une grande facilité de travail offerte aux scientifiques (réseau informatique performant, acquisition de données aussi automatisée que possible) sont les qualités recherchées pour ce navire. Lancement prévu : 1995.

2.2.2. Remplacement du N/O ROSELYS II

Baptisé EUROPE, le nouveau navire est un catamaran de 28 mètres, chalutier pêche arrière construit en aluminium qui entrera en service en Septembre 93. Outre une grande polyvalence de métiers et une surface de travail très importante, ce navire sera équipé au mieux en moyens de détection, sa stabilité de plateforme devant le rendre performant en détection profonde (dont la capacité est primordiale en Méditerranée où les zones de faible profondeur sont de peu d'étendue).

3. EVOLUTION DES MOYENS D'ESSAIS

3.1. Bassin d'essais de chaluts de Lorient

Un système d'éclairage par laser des maquettes de chalut permet de visualiser des sections des modèles de chaluts en essai et un système vidéo lié à un micro-ordinateur permet d'acquérir automatiquement les coordonnées des différents points de la section ainsi éclairée.

Par ailleurs, la conduite du bassin est de plus en plus automatisée (asservissement de la vitesse du tapis à la vitesse de circulation de l'eau), rendant l'emploi du bassin de plus en plus rapide et performant.

3.2. Bassin d'essais de Boulogne s/Mer

Une étude par vélocimétrie laser a été réalisée pour connaître avec précision le degré d'hétérogénéité de l'écoulement qui subsiste dans la veine. Quelques irrégularités dans cet écoulement (très près du fond d'une part, près de la surface dans l'axe du bassin, d'autre part) ont été relevées et devront faire l'objet d'améliorations.

4. ACOUSTIQUE SOUS-MARINE APPLIQUEE A LA PECHE

4.1. IFREMER

. **Echo-intégration :**

Une recherche sur les possibilités de classification automatique des détections de poissons en bancs est en cours dans le cadre d'un contrat européen FAR : projet BIOMASS avec comme partenaire l'ICPI de Lyon, le Marine Laboratory d'Aberdeen et l'IMBC d'Iraklio en Crête. Cette recherche porte sur des paramètres

extraits en acoustique classique mais également large-bande. Pour IFREMER, qui recherche des descripteurs classifiants en acoustique bande étroite, c'est le logiciel MOVIES B qui est utilisé. Suite à une première exploitation d'une banque de données de 13000 bancs, donnant lieu à une classification encore imparfaite, quelques-uns des paramètres calculés ont été modifiés. C'est en particulier les descripteurs énergétiques qui ont été revus.

Parallèlement à ces travaux, une étude spéciale concernant l'identification des détections par chalutage a été menée. elle a consisté en la mise au point d'une poche de chalut "compartimentée" avec des fermetures télécommandées par acoustique. Le dispositif a été mise en oeuvre avec succès lors d'une campagne sur la THALASSA en novembre 92. Il est ainsi possible de mieux cibler les pêches, et, en particulier, d'isoler la capture correspondant à un seul banc de poissons.

. **Développement de nouveaux systèmes**

Le sondeur numérique OSSIAN développé par MICREL avec la collaboration d'IFREMER est maintenant parfaitement opérationnel. Il possède la qualité scientifique (TVG numérique jusqu'à 1500 m) et permet de mener des évaluations de stocks par écho-intégration. Une version bi-fréquence a été testée sur la THALASSA en novembre. Ses fonctionnalités originales et sa souplesse d'utilisation en font un appareil très apprécié des utilisateurs.

Développé par THOMSON, avec l'aide d'IFREMER pour les essais en mer, dans le cadre du projet EUREKA-HALIOS, un système de positionnement acoustique de chalut sera commercialisé en 1993. Une portée de 1500 m est visée.

L'algorithme de détermination de la nature des fonds marins à partir de signaux acoustiques émis par des sondeurs de pêche est opérationnel. La nature du fond est déterminée selon sept classes. Il est prévu de l'implanter dans le sondeur numérique OSSIAN.

. **Evaluation acoustique des stocks**

La gestion du stock d'anchois du Golfe de Gascogne a été poursuivie en collaboration avec l'Espagne avec comme support une campagne à la mer en avril.

4.2. ORSTOM

- Poursuite de l'activité du Réseau Caraïbes. Ce réseau, qui comprend des laboratoires français (ORSTOM), cubain (Instituto de Oceanologia), vénézuelien (Fundacion La Salle de Ciencias Naturales) et mexicain (Centre de Investigaciones de Quintana Roo) s'est fixé comme objectif de faciliter les contacts entre chercheurs et la mise en commun d'équipements. Dans ce cadre, on a poursuivi l'étude des concentrations de poissons dans la baie de Batano (Cuba) où une méthodologie particulière d'utilisation de l'acoustique dans les petites profondeurs a été développée (F. GERLOTTO).

- Au Sénégal également, différentes expériences ont été menées sur les fonds de faible profondeur où se concentre une partie très importante des sardinelles. On envisage de développer cette recherche, en collaboration avec l'INRA, notamment en utilisant un sonar haute fréquence (J.J. LEVENEZ).

- En Indonésie, l'étude du comportement des poissons au voisinage des dispositifs de concentration de poissons (D C P) se poursuit dans la mer de Java à l'aide d'un sondeur BIOSONICS DUAL-BEAM (120 kHz) et d'un intégrateur INES-MOVIES (D. PETIT).

- A Brest, on a commencé à analyser les données multifréquences (24, 38, 50, 80, 120 kHz) récoltées au cours de deux campagnes réalisées au large de la Guinée et le long de la Côte d'Ivoire : l'objectif est d'arriver à une meilleure discrimination des échos des poissons et du plancton. Un sondeur à large-bande (20-80 kHz), en cours de mise au point à l'IFREMER, sera également utilisé (A. LEBOURGES).

- A Montpellier, un nouveau programme d'étude des relations entre paramètres océanographiques et fluctuations spatio-temporelles des populations de poissons en Adriatique et Méditerranée nord occidentale débute avec l'Instituto de Ciencias del mar (Barcelone, Espagne) et l'Instituto Ricerca Pesca Maritima (Ancona, Italie) avec un financement CEE (programme AIR). Outre l'écho-intégration "classique", le programme prévoit des recherches sur le comportement et sur la structure des bancs (sonar haute fréquence). (F. GERLOTTO, P. FREON).

- La mise en évidence par détection acoustique de structures biologiques particulières dans une zone de l'Atlantique équatorial où se situe une importante pêcherie de thon pendant une partie de l'année a permis d'élucider en partie les causes de cette abondance : il s'agit en fait de concentration de poissons méso-pélagiques qui contrairement au schéma normal ne plongent pas de jour et deviennent ainsi accessibles aux thons qui s'en nourrissent. Les données récoltées au cours de la dernière campagne (EKS - 120 kHz, INES-MOVIES) sont en cours d'étude. Elles devraient permettre d'estimer la densité des couches et des bancs de ces poissons méso-pélagiques (E. MARCHAL).

- L'approche géostatistique dans l'étude de la répartition spatiale des détections est en cours de développement, avec une attention particulière pour les bancs (P. PETITGAS).

- Le groupe de travail francophone sur l'"Occupation de l'espace par les organismes aquatiques" a tenu sa seconde réunion en mai 92 et se réunira à nouveau en mai 93. Le thème retenu en est l'identification par l'acoustique de structures spatiales. La langue de travail est le français, mais il est ouvert à tout chercheur intéressé par ce thème (F. GERLOTTO).

GERMANY

(K. Lange)

1. Institute for Fishing Technology, Hamburg

Gillnets

Investigations in the bycatch of seabirds were performed in the Baltic Sea off the coast of Mecklenburg-Vorpommern in March and September to November. Only very few ducks were caught thus confirming the results of the '91 cruises of this research program. It is intended to continue the investigations during other months to get an overview of the problem of bycatch of seabirds all over the year.

Driftnets

Corresponding to the Council of the European Communities'ban on driftnets the institute investigated the effect of salmon driftnets in the Baltic on seabirds and marine mammals. During 3 cruises in 1991/92 only 7 birds were caught, 6 of which could be released living.

Trawls

Investigations with bagnets attached to a trawl behind the groundrope were continued to estimate number and size of fish escaping between the rollers of the groundgear. With cod 54 % of the fish escaped beneath the groundrope, especially small ones. Only cod of L > 30 cm was found 100 % in the main codend.

Otterboards

Cambered V-doors, developed at the institute, were modified to improve stability and bottom contact on rough bottom. Full scale trials were performed successfully with doors of 2,4 m^2 and an increased weight of shoes up to 160 kg.

Selection

Selection experiments with diamond and square mesh codends performed off the Norwegian coast with saithe and in the German Bight with cod did not confirm the results of former experiments when a smaller selection range was found with square meshes. Further experiments are needed to quantify the effect of square meshes on the selection range of codends.

The results of investigations in the German shrimp fishery with square meshes in the codend of beamtrawls were promising. Compared to diamond meshes the bycatch of juvenile fish as well as undersized shrimp was considerably reduced.

Fishing effort

The protection of fish stocks, many years done by quota and codend meshsize regulations, is now extended by the European Commission to a system of fishing effort restriction. For this purpose exact definitions of fishing effort, fishing capacity and fishing time are needed, especially the relations between fishing capacity and technical data of a fishing vessel. Until now fishing capacity is expressed in terms of tonnage and main engine power of a vessel. The influence of additional technical data e. g. the fishing methods was investigated.

Echointegration

In 1992 a new echointegration section was established at the Institute for Fishing Technology. The main aim of this section is the development of new techniques and the improvement of existing methods for stock assessment by means of echointegration.

A hydroacoustic assessment of pelagic species was performed inthe Baltic Sea in cooperation with the Institute for Baltic Sea Fisheries in Rostock. These investigations were part of an international monitoring programme coordinated by the ICES Planning Group for Hydroacoustic Surveys in the Baltic.

Investigations in netting material

A long term project investigating the time dependent mesh size variation of stored netting material was finished. The investigation covered different twine diameters and materials (polypropylene, polyethylene, polyamid). Mesh size reduction of 5 % (with PA) and 2,5 % (with PP, PE) was found after 2 years storage.

2. Institute of Naval Architecture and Marine Technology, University of Rostock

The institute continued investigations in the field of computer aided design of bottom trawls.

In cooperation with RIVO (Ijmuiden), IFH (Hamburg), IMR (Bergen), DIFTA (Hirtshals), and IMR (Lysekil) an EC-funded research project on midwater sampling trawls was started.

Activities in Danish seine research were continued.

ICELAND

(P. Reynisson and G. Thorsteinsson)

Acoustics

The two Icelandic research vessels used in acoustic surveying are equipped with 38 and 120 split-beam and 200 kHz single-beam EK500 echo sounders and BI500 postprocessing systems. The 38 kHz systems are used on all our acoustic surveys but the 120 and 200 kHz on fewer occations.

The yearly investigations of the Icelandic capelin were undertaken in autumn and winter. In January the spawning stock was surveyed east and northeast of Iceland. In August the juvenile stock in the Iceland-Greenland-Jan Mayen area was surveyed as a part of our traditional 0-group survey. In October a two-ship survey of the adult and juvenile components was carried out in the same area.

An acoustic survey on the Icelandic summer spawning herring was carried out in November and December 1992. An effort was made to cover both the juvenile and adult components of the stock.

A survey of the oceanic-type redfish (*Sebastes mentella*) in the Irminger Sea was carried out in June-July 1992. About 82000 nm^2 were covered between 64° N and 57° N.
A similar survey was carried out in 1991. The results are promising, and a survey is planned in September 1993.

Material for the determination of *in situ* target strength of the species encountered in our acoustic surveys is collected when conditions are favourable. The target strength of oceanic redfish was determined from data collected in the 1991 and 1992 surveys and was used in the consequent conversion of the integrated echo energy into biomass. Similar material on herring was collected but analysis has not yet been completed.

Measurements of the beam pattern of survey transducers have been carried out. Agreement with data supplied by the manufacturer is good in the case of the 38 kHz systems. More extensive measurements are required at other frequencies.

Gear and selectivity

Experiments with a 135 mm square mesh window in the front part of the upper belly of 80 mm Nephrops trawl resulted in remarkable release of small haddock and whiting. Also some decrease in the catches of herring and small cod was observed. This rig was very soon taken into use on commercial Nephrops trawlers.

A sort - ex grid was tested in bottom trawling on cod and haddock on a commercial stern trawler. The grid improved the selectivity of the trawl considerably. No major handling problems were experienced. These experiments will be continued in 1993.

Underwater TV observations were made on different selective shrimp trawls. The behaviour of shrimp, capelin and herring could be observed by good visibility in relation to separating grids, square mesh codend, net slack and square mesh windows.

Some private companies made efforts to design dredges for catching sea urchins. Experimental fishing offer promise for the utilization of sea urchins.

IRELAND

(J.P. Hillis)

There was no work to report in 1992.

(F. Veenstra and B. van Marlen)

Progress Report 1992 Technical Department RIVO-DLO

General

Via lectures, publications and discussions current technical research programmes dealing with selective fishing gears, safety and working conditions and studies on the marine environment, have been continuously propagated. The scope of research of the department was extended into the field of fish technology due to the merger between TNO Fish Technology. Department (IVP-TNO), and RIVO in 1993. In order to attract more funding from the industry a beam trawl fisheries consultation group of twelve beam trawler skippers has been established. In June 1992 a symposium on "Fish Behaviour in Relation to Fishing Operations" was held in Bergen, Norway followed by working group meetings of the International cil for Exploration of the Sea. The results were reported to the 80th Statutory Meeting of the ICES in Rostock-Warnemünde, Germany. A broad review of work on selectivity presented to the Fish Capture Committee and its working groups between 1985 and 1992 was given to the Gear Selectivity Workshop at the annual meeting of the Marine Technology Society in Washington D.C. October 1992. Many interesting presentations were given on work on the other side of the Atlantic. It should be emphasized that the topic of gear selectivity receives much attention in all parts of the world.

Safety and working conditions

Under chairmanship of the Dutch Shipping Inspectorate representatives of the beam trawl fisheries sector and RIVO discussed the various solutions suggested by RIVO and the TU Delft for possible applications on existing beamers. A report with safety recommendations has been drafted. On board of the recently built vessels UK-284 and HD-7 the sound control packages designed by TNO/RIVO in 1988 have been incorporated as far as possible, initiated and partly subsidized by the Dutch Shipping Inspectorate and the Safety Group. Although the results have not yet been published accommodation noise was found to be low with readings varying between 65 and 70 dB(A), demonstrating that the former high noise levels can indeed be reduced without excessive investment costs. In the final report for new vessels maximum noise levels will be recommended. One of the major hazards in beam trawler operations is fishermen losing balance due to ship motions. The Safety Group initiated acceleration level measurements on board two representative beam trawlers, the former HD-7 (beam 8.5 m) and the HD-64 (beam 9 m), built by shipyard "Visser". The Dutch Shipping Inspectorate funded the measurements conducted by Marin Wageningen and RIVO-DLO. The Safety Group will also define recommendations for maximum vertical acceleration levels on board new fishing vessels.

Integrated Quality Assurance Fresh Fish

RIVO put much effort in marketing the IQAS approach in the Dutch beamtrawl fisheries again this year. On one hand via publications in fisheries weekly magazines and on the other through discussions with skippers and crew members. RIVO advocates that the integrated approach does improve fish quality and at the same time the safety and working conditions onboard. This view was also presented on the second symposium for safety and working conditions aboard fishing vessels (Spain, Bamios, 15-17 Sept. 1992). For safety experts the IQAS approach is very interesting from a point of view of return on investments. Scheduled demonstration trials have been postponed until 1993, but the preliminary work and preparative engineering work was done in 1992. Together with some auxiliary conveyor belts the above deck fish handling line will be extended with the RIVO-FISHEYE™ length and weight equipment. A seaworthy type has been tested on research vessel TRIDENS. The RIVO/TU Delft developments for a plaice gutting machine will not be tested at the same time because of the negotiations with the Leba-Company (developed in the eighties a commercial not-successful prototype) took more time than foreseen. (cooperative development of a new commercial prototype) A cheaper icing and storage system for use in fish holds on beam trawlers has been designed with the company AFAK. For the conceptual and

scientific approach a graduate project has been started, accompanied by RIVO and the Technical University Delft. In the framework of the safety integrated redesigned beam trawler (Beamer 2000) three concepts have been designed for the fishhold, based on a two man and an unmanned operation, among which the solution designed by RIVO and AFAK.

Engineroom systems
On request of the Directorate of Fisheries seven final specifications for a fraude resistent power measuring system on board 300 hp beam trawlers have been compared. Two systems were judged as being feasible for further testing after comparison on board, while the Ministry is investigating consequences for general application both at national and European level.

Beamer-2000
The spin-off of the 1991 Beamer-2000 design is that the Dutch shipyards have come up with their own safety-integrated beamer designs. Company Kraak (Den Helder) ordered one at shipyard Visser (Den Helder) with various innovations originating from the RIVO/TU-Delft Beamer-2000 design such as noise control, vision lines, deck and wheelhouse layouts. In 1992 all research results have been published in a volume called "Beamer 2000" (in Dutch), of which the first one was presented to the Dutch Minister of Social Affairs, Mr. B. de Vries during an exhibition on safety and working conditions at the Fisheries Museum of Vlaardingen. This exposition displayed personal safety aspects in the Dutch fisheries: in the past, present and cast light on developments in the near future, with a Beamer-2000 model and the Wheelhouse-2000 console (Radio Holland, RIVO/TU Delft) as eye-catchers. The Beamer-2000 and IQAS-approach attracted much attention and interest of international safety experts during the second symposium on safety and working conditions on board fishing vessels (Spain, Sept. 1992). Irrespective of the approach followed (safety or quality), the designed technical solutions can lead to better working conditions and better fish quality.

ROV development
The ROV-system was applied in various projects over the year. Under water observations were done on beam trawls in project TE-2-554 from RV "Isis" in cooperation with a commercial charter working from Ostend, Belgium. The chain-mat rigging used was filmed runniong over the sea-bed on stony grounds. Alternative selective devices in twelve meter V-nets were observed from RV "Tridens" in the same project. Engineering studies were done to improve the reach of the ROV, particularly with new rotors of 20cm diameter. The results were presented to the symposium on on "Fish Behaviour in Relation to Fishing Operations" in Bergen.

Project Alternative Stimulation
Vessel noise measurements were conducted on RV "Tridens", RV "Isis" and a commercial beam trawler to identify their noise spectra both in free sailing and towing condition. The results were presented in a paper to the Working Group on Fishing Technology and Fish Behaviour (FTFB) in June 1992. Vessel noise may have a significant bearing on trawl survey results and care should be taken on noise aspects in the design of fisheries research vessels. Equipment development took place on sound (sleeve guns) and light (sparkers) stimuli. Further research on alternative flatfish and by catch stimulation is planned for 1993. (sea trials)

Trawl studies:
FAR project TE-1-154 "Fishing gear model and full-scale relationship".
EC-Project TE-1-154 aims at determining the accurate correlation between a prototype midwater trawl and a series of scale models. With this information the predictive value of model studies can be enhanced. A suitable range of model scales has been chosen to be tested in research facilities such as flume tanks and on open

water. Model experiments on scales 1/25, 1/35 and 1/40 have been conducted in the flume tank of DIFTA in Hirtshals, Denmark in June and August 1991.
Preliminary measurements have been conducted on the full-scale prototype net MAR-143 in May 1992 on RV "Tridens". Appropriate scale ratios were derived from the data of these trials, taking in mind the availability of twine materials. Models were built at RIVO-DLO and a Dutch netting company, and send to the Marine Laboratory at Aberdeen. Trials were conducted on larger models scale 1:2.75 and scale 1:4.5 in Loch Ness in October-November 1992. Full-scale trials trials are postponed to March-April 1993 and are being prepared at this time. A fourth project meeting took place in Aberdeen on 20 January 1993. Measurements on the twine thickness and mesh size of the models were done by the Marine Laboratory and DIFTA calculated the twine areas for the two models. Data of the model tests in Loch Ness is analysed now and measurements on the full-scale net being prepared.

FAR project TE-2-554 "Improved selectivity of fishing gears in the North Sea fishery - Beam trawling".
The project was rounded off in 1992 with gear observations at sea on RV "Tridens" and a commercial Belgian charter in cooperation with RV "Isis". A large diamond mesh and a hexagonal rope-mesh top panel in a 12m V-net were observed in March 1992, and a square mesh top panel, a cut-away or reduced top panel and a combination of this panel with a square mesh window were observed in a R-net on a commercial Belgian trawler in cooperation with RV "Isis". A first series of catch comparisons was also made during the lastmentioned observation trip. Comparative fishing trials were conducted on RV "Tridens" in April 1992 (RIVO-DLO IJmuiden), on MFV "Tijl" in May, and September/October 1992 (RVZ Ostend), and on MFV "Zuiderkruis" in December 1992 (SEAFISH Hull). The research shows potential for improving the species selectivity of beam trawls, particularly for whiting and haddock, without affecting the flatfish catches to a great extent. The results for cod are somewhat less consistent in different periods of the year. Constructions that seem effective are large mesh top panels in the 12m V-nets, and a reduced top panel with a square mesh window in a 9-10m round net. A follow-up project has been proposed as it was felt that more data is needed for definite conclusions and the gear modifications are still to be optimized.

FAR project TE-3-613 "Improved species and size selectivity of midwater trawls".
This project aim at improving the selectivity of midwater trawls in a mixed fishery. Problems exist particularly in the Dutch fisheries concerning the by-catch of mackerel in a horse-mackerel fishery. When the mackerel quotum is fully fished, the species is discarded at sea, which is a valuable loss of protein. It is investigated whether behavioural differences exist between the two species. Rather than just doing a lot of selectivity trials at sea, the work involves a number of experiments of live fish in laboratory tanks. The fish is trained to swim at higher speeds when being fed, and in this forced swimming condition subjected to obstructions in their path. Different behavioural patterns can thus be identified. From the first set of trials it is clear that contrast and orientation of the mesh barriers affect fish behaviour, and to some extent both species show slightly differing patterns. An illusory block in the form of a black canvass funnel invokes strong avoidance and escape reactions through sections of netting placed in front of that. Another part of the investigation is to find out whether the species mix or not. In tank experiments they show the tendency to separate when swimming freely, but as soon as the fish are herded they tend to seek shelter in one mixed school. It is difficult to say whether the fish do mix in schools at sea. Attempts to observe these species at sea have failed until now. A selective funnel construction will be designed using scale models, and observed at sea throughout this year. In addition further experiments will follow on the vertical distribution of the fish.

Separation of Mackerel from Horse Mackerel in pelagic pair trawling - National Research Programme.
Work in pelagic pair trawling has been carried out for some time in cooperation with a Dutch trawling company. The aim is to separate both species in a pelagic pair trawling operation. Idea that have been tested are a separator panel, large mesh openings in the sqaure of the net, and a trawl system consisting of two trawls on top of each other (Piggy back trawl). The results are not firmly conclusive so far. In many trips only a few long hauls have been made under pressure from earning income at the same time. Additionally one has to work with the alternate haul method for comparing catches between two gears, resulting in larger numbers required for statistical proof. The work will be continued throughout 1993 and experience related to EC-project TE-3-613, which has a more fundamental approach starting from experimental fish behaviour studies, whereas this project is more heavily based on practical field knowledge in the fisheries.

Comparison of catchability between 10m and 12m beam trawls - National Research Programme.
Comparative fishing trials were carried out on RV "Tridens" in November 1992 on request of the Directorate of Fisheries of the Ministry of Agriculture, Nature Management and Fisheries. A 12m beam trawl was converted to a 10m beam size by shortening the headline. The net itself was not altered. The beam width was brought back to 10m without losing weight, by inserting a heavier, but shorter pipe in the middle. Both a standard trawl and the converted one were fished simultaneously day and night for two weeks. The cod-ends of both nets were made of the same netting and the mesh size checked regularly. A total of 36 hauls was made. The effect was found to be significant. For sole, plaice, whiting and cod a drop in catches of about 30% resulted for the 10m trawl. In addition the narrower beam trawl caught more fish in the low length classes, in other words the size selectivity was adversely affected. Calculated in terms of yearly income for a 2000hp beam trawler, the effect is also significant, namely a loss of some 30%, mainly caused by the drop in sole catches, being the most valuable species in this analysis. The conclusion is that a severe impact on the economics of beam trawl fisheries would result without counter measures from the fishermen. They would most likely respond with gear and operational changes that would gain back some of the losses in catch. This could imply higher towing speeds and adding more weight to the gears. Added to a lower size selectivity of the newly proposed gears, adverse effects on the Benthic organisms and fish quality might be the outcome. Further research is advocated into the various effects of the technical measure before administrators would enforce it.

Informatics

• Computing

FishTag

During 1992 large quantities of tagging data were entered into this database. The database now contains 165k records with data about tagged fish. The database was used during some ICES workshops hold at IJmuiden.

• Development of programs

FishEye

The software for the FishEye system, a program capable of determining fish species and estimating their length and weigth by image processing techniques, was ported to an OS-9 environment. This system will be tested on board of small fishing vessels as part of an ongoing EEC funded project. The program was adapted in such a way that it will work as a black box that only collects the data and steers a sorting mechanism along a conveyor belt.

FishAge.
The program FishAge is now capable of determining the age of 1 to 5 year old North Sea plaice. For a test set of about 50 otoliths we found that:

a - one human expert can sometimes produce significant different means over a period of 4 years;
b - two different human experts can sometimes produce significant different means at the same time;
c - the computer system and a human experts can sometimes produce significant different means at the same time.

From this it was concluded that the age readings by the FishAge program cannot be distinguished from those as produced by a human expert.

FishEgg.
Due to the fact that funding has been suspended, the development of the FishEgg program is stopped. The intention was to develop a real time sorting mechanism for fish eggs from a plankton sample in a flow of sea water.

RIVO survey suite.
BessieTurf
The program BessieTurf was used for entering survey data on board of the Tridens and Isis. The users are satisfied with the ease of use and the program will be adapted so that the data can be directly imported into the survey analysis programs at RIVO.
FishMap.

For an EEC-funded project a program was developed to display survey data in different ways. It is used for an atlas with distribution data of various North Sea species.

FishingDistribution
To get insight in the fishing behaviour of beam trawlers small black boxes were installed on board of some test-ships. These boxes monitor the position of the ships with an interval of 6 minutes. Software was developed to retrieve this information and store it in a data-base.

NORWAY

(Å. Bjordal and E. Ona)

This report includes contributions from the following institutions:
- Institute of Marine Research, Bergen, (1)
- The Norwegian College of Fisheries Science, Tromsø, (2)
- Norwegian Marine Technology Research Institute, Trondheim (3)
- Norwegian Marine Technology Institute, Trondheim (4)

(Number in parenthesis indicate the institution(s) involved in the different activities.)

FISH BEHAVIOUR AND REACTION TO FISHING GEAR

A comprehensive study on the effects of seismic (airgun) shooting on fish distribution and catch rates has been conducted, including acoustic monitoring and catch data obtained by sampling trawl as well as commercial trawling and longlining. Within the experimental area of 40 x 40 nautical miles surrounding the seismic shooting area, echo abundance and trawl catches (cod, haddock) were reduced to 50% compared to the values obtained before shooting, while the effect on longline catch rates was slightly less than for trawl (1).

Vertical migration of shrimp was studied using a towed steel frame (8 m high) with small mesh bags at different heights above the bottom (2).

A new acoustic telemetry positioning system with radio buoys has been tested for tracking fish and crustaceans (1).

In a sea ranching program, acoustic telemetry tracking was conducted with wild and ranched salmon captured in the vicinity of the release site (1).

SELECTIVE FISHING AND SURVIVAL AFTER ESCAPEMENT

Development of grids for size selection of shrimps in trawls has been continued (1, Nordic project). Work to improve size selectivity of Nephrops using grids was initiated (1, Nordic project). Further trials have been conducted to evaluate the performance of shrimp trawls with sorting grids during sharp turns when shooting the gear, and to evaluate possible release mechanisms for big Greenland sharks (2, 1). Grid size selection trials with the IMP-planegrate have been conducted in shrimp trawling (4).

UTV-observations revealed active escapement of fish (cod) through sorting grids in seine nets, and very little passive filtering (1). High escapement of undersized cod and haddock was obtained using seine net codends with 160 mm square mesh UC-netting, while most of the

commercial sized plaice were retained (1). Three separate grid sorting trials were conducted with 50 and 55 mm bar spacing for cod, haddock, redfish and Greenland halibut (2).

In a joint Norwegian-Russian trial, the selective properties of Norwegian and Russian trawls fitted with identical sorting grids were compared (1, 2). Sharp selection was obtained in trials with one rigid and one flexible sorting grid in storing pens with saithe (1).

Sorting grids have also been tested in purse seining and pelagic trawling for mackerel (1).

Preliminary trials indicated low mortality of saithe after escapement from trawls (1, Faroe Islands). Survival after escapement experiments in the seine net fishery showed high survival of escaped cod (100%) and haddock (90%) (1).

IMPROVEMENT OF FISHING GEAR AND METHODS

Trials with intermediate live storage of seine caught cod in closed net pens on the fishing ground were conducted in the Lofoten cod fishery (1).

Improvement of sampling trawls: a new pelagic trawl for sampling larger fish has been introduced, and a 3-level trawl for near surface sampling of juvenile fish has been designed and tested (1). Studies of sampling trawls with different towing speeds, fishing depths, warp lengths and bottom conditions (hard, soft) were continued (2). In sampling trawls, strapping of the warps in front of the trawl doors to obtain fixed door spread has been tested (1).

A new longline monofilament "snap on" gangion design hs been tested (1). Based on a Canadian design, a drum storage/snap on system for deep water longlining has been constructed and tested (1). A new streamer type bird scarer gave significantly reduced bait loss during shooting of longline gear (1).

A pot for effective and gentle capture of wrasse has been developed, tested and implemented in commercial fishing (1).

Development work on large fyke nets and pots for cod has been continued, and a large (Newfoundland-style) cod trap has been tested (1).

The work on the use of liquid bait extract in Norway lobster pots has been continued (1).

Trial fishing for spider- and king crab has been carried out using gillnets and pots (1).

HYDROACOUSTICS

The acoustic systems EK500 and BI500 have been used on our research vessels for about 1000 survey days in 1992 (1).

The sonar Simrad SA-950 was installed onboard R/V "G.O. Sars" summer 1992, and have been tested on several surveys. Interface towards a workstation for downloading graphical

information and some software for this have been developed. A new sonar project has been defined in connection with the new research vessel "Dr. Fridtjof Nansen", continuing a development towards a sonar system for biomass estimation (1).

Further development on the deep towed vehicle system continued in 1992, but will be delayed by financial reasons in 1993. Most of the work in connection with bringing parts of the EK-500 into the pressure resistant nose of the vehicle is finished, as well as the communication part to the vessel oover a optical/electrical cable (1).

The first version of the mapping/charting module for BI500 is now undergoing testing, and further work will also involve more advanced tools and geographical software routines for displaying and analysis of survey data (1).

IMR has now finished modelling a larger relational database to handle all our scientific data, i.e. hydrographical, chemical, acoustical and biological data. The database, built on INGRES V 6.3, and served by two HP mod. 750 computers, was partly operational for testing in 1992. The test report of the database is now available, and groups for quality assurance and data implementation is now working steadily with filling the base (1).

Several projects concerning offshore seismic activity and fish were conducted in 1992, and are now in the reporting phase. These are:

- Two projects to determine the effect of airgun energy on eggs and larvae, one experimental and one combined field and modelling project (1).
- One project to determine the effect of seismic investigations with airguns on catch rates and fishing availability (1).
- One project to determine harmful effects on fish from explosives (1).

In situ TS have been sampled for several fish species on our standard surveys. Work on multifrequency comparisons of TS of herring has continued in 1992. Methods for experimental measurements of TS of free swimming krill, as well as trials of TS measurements inside dense herring layers have been made (1).

FISHING VESSEL TECHNOLOGY

Investigations were conducted on the resistance and seakeeping properties of catamaran fishing vessels, based on model tests in a towing tank and ocean basin (3).

A pumping and tank storing system for loading, transport and unloading of live fish has been developed and installed on a combined purse seine/seine net vessel (3).

RUSSIA

(F.M. Troyanovsky)

PINRO, Murmansk

Experimental investigations on selectivity of bottom trawls rigged with the "SORT-X" (from 30 to 140 mm mesh) were carried out during 1992. Experiments on determination of a relative differential efficiency of trawls used for surveys by Russian and Norwegian specialists have been presented relative to cod. The following data have been obtained:

- data on efficiency of the "SORT-X" system using different trawls during cod fishery;
- data on substantiation of expedience of reducing mesh-size in trawls rigged with the "SORT-X" when conducting cod fishery in the Barents Sea southern area;
- comparative data on the efficiency (in relation to different size groups) of trawls used by Russian and Norwegian specialists in trawl surveys of bottom fishes in the Barents Sea.

SPAIN

(F.J. Pereiro)

ACOUSTICS

Two acoustic surveys were conducted by the IEO in the spanish continental self.

1.- ECOMED 92. This cruise was planned, as previous years, to assess the stocks of sardine and anchovy ocurring in the Mediterranean sea from Punta Europa (Gibraltar Strait) to Cape Croisset (Gulf of Lion). From 25/10/92 to 21/11/92 an area of 16163 squared nautical miles was surveyed by the R/V "Cornide de Saavedra". A total of 3140 nautical miles were sailed following a zig-zag truck.

A Simrad echosounder EK-500 split beam 38 kHz was used.

Species were identified from 29 pelagic hauls.

2.- PELACUS 0492. was carried out onboard R/V "Cornide de Saavedra" from 22/04/92 to 12/05/92. Its main objective was to assess the sardine and blue whiting stocks occurring in spanish waters. The cruise covered the spanish Atlantic and Cantabrian continental shelf down 1000 meters depth.

A total of 2870 nautical miles were sailed following a zig-zag truck and 32 pelagic hauls were done for species identification purposes.

A Simrad echosounder EK-500 split beam 38 kHz. was used after calibrating with a copper standar target. Vessel speed was 10 knots and acoustic signals were integrated over one nautical mile intervals.

SELECTIVITY STUDIES

Studies on bottom trawl cod-end selectivity for mesh size of 50 mm. in the Gulf of Cadiz were conducted according the cover-codend method for the following species:

Hake: Merluccius merluccius
Spotted flounder: Citharus linguatula
Red mullet: Mullus spp.
Annular sea bream: Diplodus annularis
Spanish sea bream: Pagellus acarne
Deep water pink shrimp: Parapenaeus longirostris

SWEDEN

(R. Karlsson, B. Johansson, O. Hagström)

General

Below some of the work done in Fishing Technology field during 1992 is described. Where reports are available, they are mainly in Swedish.

Continued development of the MICRO-trawl concept for single boat pelagic cod-trawl.

Donsö Fiskredskap AB has made two model trawls, one traditional and one of the MICRO type. Tests with these were conducted in SSPA:s towing tank in Göteborg.

The full scale trawl was made with 4700 meshes, 80 mm mesh size. Fishing circle 334,4 m counted in open meshes, headline length 109.9 m and groundrope length 111.5 m.

The trawl was tested in commercial fishing in the Baltic Sea during the spring 1992.

Technical data

With 200-230 fathoms of warp the vertical opening was 30.6 m. Distance between trawl doors 152-166 m. Towing speed 2.6-2.8 knots.

After some adjustments the trawl fished well compared to similarly rigged, traditional trawls int he area. The tests are not yet completed.

Rolling trawl doors

Tests have been made with rolling trawl doors. The aim is to reduce the resistance during bottom trawling. In the first tests designs are made for small (12-15 m vessels). With this design the trawl door is rolling on the bottom instead of sliding. The side force is produced by "wings" mounted on the wheels. Preliminary tests indicate a to small spread and some redesigning is under way.

Improved safety and work environment for fishermen

Funds have been made available to start up courses for fishermen on safety measures and improved work environment onboard. The courses, starting up in April, will in one block cover theory and practice of survival matters like hypothermia, life rafts and fire fighting equipment and in another block theory and practical advice on work environment factors like ergono-

mics, noise, vibrations, accident risks, eating habits and psychological factors.

Safety engineers will also, during the coming two years, visit a large number of fishing vessels to check, and give advice, on safety and work environment factors onboard.

Catamarans for fishing in Swedish waters

This is an ongoing project where needs for different types of fishing are listed and preliminary designs are made. A model for a shrimp/nephrops coastal trawler is presently undergoing model tests.

Acoustic surveys

Acoustic surveys are carried out routiniously in the Baltic proper as well as in the inland lakes of Sweden. The Baltic survey are an integrated part of the ICES coordinated surveys for estimating the herring and sprat stocks.

UNITED KINGDOM

ENGLAND, Fisheries Laboratory, Lowestoft

(G.P. Arnold)

Acoustic tag development. Work was completed on the development of a 300 kHz pressure-sensitive transponding acoustic tag capable of operating down to 100 m and resolving depths of ± 0.5 m. Two tags were successfully deployed during a recent cruise and used to telemeter the depth of live plaice tracked with the sector scanning sonar on board RV 'Corystes'.

Work has continued with the development of a data storage tag designed to record depth and temperature every 15 minutes for periods of 9-12 months and to store the data for a further 5 years. Twenty prototype tags are undergoing bench testing prior to the release of the first batch of 100 tags on plaice in autumn 1993. Approximately 30% of the dummy data storage tags released on plaice in the Southern Bight in January 1991 have now been returned from the fisheries; a similar return rate was recorded for Petersen tags released as controls at the same time. A further release of dummy tags was made in January and February 1993, using rather larger tags corresponding in size, shape and weight to the data storage tags to be deployed in1993. Experiments with plaice in the laboratory's tidal stream tank indicate that plaice over 40 cm in length are not impeded by these tags and exhibit the same patterns of diurnal swimming activity as untagged fish.

SCOTLAND, Marine Laboratory, Aberdeen

(P.A.M. Stewart)

Cod-end Selectivity

Further measurements on demersal pair trawl cod-ends using the hooped cover technique were made on chartered commercial vessels. Two cod-end circumferences (100 and 120 open meshes round), each of four mesh sizes (90, 100, 100 and 120 mm) were used and selectivity data for both haddock and cod were obtained. These data are being analysed using the mathematical models developed in 1991.

An 80 mm square mesh window across the full width of the top panel was tested at the front end of the straight extension in a commercial prawn trawl to allow more juvenile fish to escape. The twin trawl system was used to generate catch comparisons between the window and a standard trawl. Reductions of 66% and 75% respectively in the catch of haddock and whiting below minimum landing size were achieved with the window but reductions in marketable fish of 28% and 74% respectively were also found for the 11 combined hauls.

Whole prawn trawl selectivity was tested with a twin trawl system under an EC study contract. A small mesh trawl to catch the entire population was towed beside a commercial prawn trawl made from either 70 or 80 mm mesh. The catches in the two sides of the twin trawl were variable and no significant differences between the selectivity of the 70 and 80 mm mesh nets could be detected.

Selection data to compare the hooped cover system and the twin trawl system were gathered during one cruise using 100 mm mesh cod-ends.

Species	Haddock		Whiting	
Method	Cover	Twin trawl	Cover	Twin trawl
50% retention length (cm)	26.6	31.5	33.8	40.0
Selection range (cm)	7.7	7.2	15.3	6.4

These preliminary results show that the hooped cover gave higher 50% lengths than predicted by the Reeves/Armstrong model but the twin trawl gave values higher than both, suggesting that the hooped cover may still not provide selection parameters which correspond to real commercial fishing conditions.

Sorting Grids

The sorting grid suitable for Scottish vessels tested in 1991 was redesigned using a rigid frame to hold the grid at a predetermined angle (45°) to the water flow and to hold horizontal the escape vent for the larger fish. Using this arrangement with 40 mm bar spacing 79% of haddock and 91% of whiting passed through the grid into the upper cod-end. However, most of the fish on the grounds during the 1992 trials were small (<30 cm) so no conclusions can be drawn on the likely loss of marketable roundfish.

Separator Trawls

This EC funded project to develop a trawl which separates human consumption species from Norway pout ended in 1992. No clear vertical separation had been achieved using an internal horizontal panel. Trials with a sorting grid were carried out on a Scottish research vessel. Square mesh panels were also tried immediately in front of the cod-end of a chartered Danish pout trawler. Neither method proved successful in separating Norway pout from small haddock or whiting and the project concludes that insufficient differences in behaviour exists between these species to be able to achieve any worthwhile separation.

Survival After Escape

An EC contract was started to study the survival of fish escaping from 90, 100 and 110 mm diamond mesh cod-ends towed at 1.5 m/s by a 550 hp vessel. Triplicated cage experiments were again used and all fish were sized at the end of the experiment. Handline caught controls all survived.

Category	Cage No	Haddock			Whiting		
		Survival %	No	Length (cm)	Survival %	No	Length (cm)
90 mm	4	79	92	22-32	82	76	21-31
	8	78	100	20-32	78	78	21-31
	12	73	85	21-31	65	68	21-30
100 mm	7	74	85	19-32	68	119	21-31
	10	82	98	19-33	82	151	20-30
	11	86	97	20-32	81	147	20-33
110 mm	2	82	150	21-31	82	62	19-32
	3	91	125	20-32	87	61	20-29
	6	81	114	20-28	90	108	19-28
Controls	1	100	36	20-32	100	38	21-32
	5	100	32	23-29	100	30	20-31
	9	100	30	24-33	100	34	23-32

It was found that fish length had a highly significant effect on survival ($p<0.001$). However, there was no evidence that mesh size affects survival. This does not mean that survival is not affected by mesh size but that these data do not provide statistical evidence for it.

Investigating the Performance of Survey Gears

Gear performance and environmental data from two further cruises with the GOV trawl were collected in 1992. These and previous data (1989-1991) for both North Sea and Scottish west coast surveys are being statistically analysed. A preliminary report suggests that while useful results have been obtained for the occurrence of different species, more investigation of modelling catch sizes is needed. This investigation is proceeding.

Fishing Effort

An EC funded project to investigate the fishing effort exerted by towed demersal gears in central and southern North Sea (ICES IVb and IVc) started at the end of 1992. Scottish, English, Danish and Belgian fleets working in this area will be studied. Catch and effort data for selected target species will be provided by national fisheries departments over the project period. This will be collated with gear performance and vessel capacity parameters and a statistical analysis carried out using agreed methods. A preliminary analysis of Scottish catch and effort data based on 1991 returns has been completed and the activity of sub-fleets identified. A survey of Scottish fishing gears used in the study area will be carried out early in 1993.

Physical Modelling

The EC project on correlation of full-scale and model trawl data has continued with the testing of two models at 1:2.75 scale and 1:4.5 scale in Loch Ness. Data on loads and net geometry were obtained using instrumentation, underwater television and sonar.

Fish Behaviour

As part of a continuing effort to investigate how cod-ends might be made more selective, tank experiments with obligate schooling mackerel were conducted. These investigated the mechanisms whereby fish can be encouraged to swim through the meshes of a confining funnel rather than keep clear. The most effective means to induce fish to pass through the meshes is a complete blockage of the funnel. This is the case at the rear of the conventional cod-end. In tank experiments, an effective illusion is a tunnel made from black canvas. Despite the clear passage along the centre of the dark tunnel, fish in experiments elect to pass laterally around the outside of the dark tunnel even if this means passing through meshes. This arrangement was tried during a research cruise and was very convincing in causing large numbers of fish to pass out through the open meshes of a square mesh window ahead of the black tunnel. This finding has pointed to other problems which need investigation. These are that positions ahead of the cod-end involve fast water flow on either side of the mesh, the fish are already exhausted, that cold water seasonally slows down swimming ability, that smaller fish have less ability than larger fish, that low light levels reduce the stimulus and glowing materials may be needed below certain low light levels. These experiments are continuing.

An acoustic range and underwater television have been used to study the behaviour and interaction of saithe and pollack fitted with telemetering tags. The detailed patterns of movement of these species around a reef have been monitored and diurnal changes in activity and shoaling noted.

Acoustics

Surveys of herring were carried out a) in the ICES area IVa North; and b) in the Orkney, Shetland and Buchan areas, in July 1991. These surveys were in conjunction with the Norwegian, Danish and Dutch fisheries research laboratories. Survey data were collected using the Simrad EK500 and recorded on a Sun computer using the BI500 software at frequencies of 38, 120 and 200 kHz. Data on temperature, salinity and sea bed type (ROXANNE) were collected during the survey. The relationships between stock depth, temperature, salinity and sea bed are being investigated from these data.

Work on the automatic identification of shoals from recorded echotraces has developed. The analysis has been transferred to a Sun computer system. The echosounder output is treated as an image and loaded using Imaging Technology high speed image processing cards. Development has been concentrated on menu driven inputs and conversion of BI500 data files for analysis. A hardware object extraction card has also been included in the system.

Work on wide-band acoustics has been restarted with the development of an improved transducer, and a new computer controlled receiver and transmitter. Studies on reflectivity continued with measurements on cod, saithe, haddock, horse mackerel and mackerel. The data are under analysis. This work is supported under the EC FAR programme and is being carried out in cooperation with ICPI Lyon, IFREMER Brest and IMB Crete.

Work on survey design methods has continued. The series of simulations to investigate the precision of estimates with different survey methods has been developed to include consideration of variance as well as abundance. The results are encouraging and indicate that systematic designs have some advantages in survey precision. Use of geostatistical estimators for variance allows examination of survey strategies. Automatic fitting procedures for vario-grams are being tried in order to obtain better understanding of the precision of the variance estimates.

U.S.A.

(J. Traynor)

Fisheries Acoustics Science and Technology Issues

Alaska Fisheries Science Center (AFSC) in Seattle has continued research on pollock (Theragra chalcogramma) and whiting (Merluccius productus) in the Northeast Pacific Ocean. During 1988 and 1989 and again in 1991-1993, acoustic surveys of the spawning population of pollock have been carried out in January-March in the deep water portion (>1000 m) of the Bering Sea, and, in 1989, 1991-1993 including shelf waters of the eastern Bering Sea. In 1993, in a multi-national effort, the survey area was expanded to include the western Bering Sea and the Aleutian Basin. Annual surveys of the Gulf of Alaska spawning stock in the Gulf of Alaska have continued through 1993. Target strength studies of fish using the split beam technique continue and standard sphere calibration is the primary calibration technique. Cooperative surveys of pollock in the Bering Sea with the Japanese Fisheries Agency have continued under the sponsorship of the International North Pacific Fisheries Commission (INPFC). The sixth triennial survey of Pacific whiting off the west coast of the U.S. was completed in the summer of 1992. (Contact persons: Bill Karp, Jim Traynor, Neal Williamson)

The Southeast Fisheries Center continued assessment and experimental work using a 38 and 120 kHz dual beam system. Survey activities include a trawl/acoustic survey of small pelagics in the North-Central Gulf of and a feasibility study using the acoustic assessment system for reef fish assessment and comparing the results with data collected using a video camera. Differences in densities obtained by the two systems were attributed to multiple counting of targets by the video system and in some locations, fish found too close to bottom for acoustic assessment. A Gulf-wide survey is planned for May-June, 1993. (Contact person: Chris Gledhill)

The Oceans Research Branch of the Naval Research Laboratory Stennis Space Center is investigating ways to improve predictions of sound scattering from dispersed and aggregated fish, with major emphasis on swimbladder resonance at 0.5 to 10 kHz. Measurements are made using a near-surface explosive device and a downwardly directional receiver. A new experimental effort is aimed at using satellite remote sensing and historical fisheries data bases to predict the distribution of fish stocks, volume scattering and biological targets. This program includes the development of new techniques to measure low frequency scattering on shelf environments and an theoretical and experimental studies of resonance scattering from individual fish and schools. (Contact persons: Redwood Nero, Richard Love)

Scientists at the Woods Hole Oceanographic Laboratory have been working on the frequency dependence of acoustic backscattering from zooplankton and micronekton and the development of appropriate scattering models. Laboratory measurements have been made of a decapod shrimp species, a copepod species and various machined objects using a laboratory sonar (50 kHz to 5 MHz) under development by Tim Stanton. The data are used to develop and test scattering models of finite length elongated bodies with realistic boundary conditions. The results show that the target strength of elongated zooplankton can be predicted very well using a bent cylinder model. Later this year, they plan to use the equipment to make measurements at sea of freshly captured specimens. (Contact persons: Peter Wiebe and Tim Stanton)

Scientists at the University of Washington continue work on the development of models for biological scatterers. Recent work centers about different methods for approximating the return from fish swim bladders. (Contact person: Clarence Clay).

At the University of Maryland, work continues with the incorporation of acoustically-derived abundance estimates into ecological models of growth in freshwater environments. (Contact person: Stephen Brandt).

Scientists at Woods Hole Oceanographic Institute and Cornell University have been jointly working on three projects associated with acoustic observations of zooplankton. 1) They are currently examining 120 and 420 kHz data collected over Fieberling Seamount, 500 nmi west of San Diego in the Pacific Ocean. The data were collected both from a towed fin and using an acoustics package mounted on the submersible ALVIN. This work was designed to enable the scientists to visualize the development of biological gaps over the tops of seamounts and to study their structure and dynamics. 2) They participated in the Georges Bank Stratification Variability Experiment by conducting bioacoustical studies of volume backscattering and target strength of plankton. This experiment was designed to investigate the stratification processes and their effects on cod and haddock larvae on Georges Bank. Measurements were made with BIOSPAR (Bioacoustic Sensing Platform and Relay) adjacent to physical oceanographic mooring sites and time series measurements were made with 120 and 420 kHz dual beam systems linked to shore via radio and satellite instrumentation. High resolution data for comparison to MOCNESS (Multiple opening/closing Net and Environmental Sensing System) and BIOSPAR data were collected with a 420 kHz dual beam system in a towed fin. 3) They have constructed a MOCNESS electronics package and modified a dual beam system for deployment on the MOCNESS net. The 420 and 1MHz transducers were mounted in a training mechanism which allowed the two transducers to be positioned anywhere on a hemisphere looking forward of the net. To be able to utilize both the acoustics and a video system, the MOCNESS

communicated via a fiber optics cable. (Contact persons: Peter Wiebe and Charles Green)

Progress continues in the development of sensors to quantify the abundance and size spectra of small zooplankton in aquatic environments. The University of Southern California and Tracor Applied Scientists, operating under the sponsorship of ONR and NSF are currently operating a mooring in 100m water depth off the southern California coast. The mooring includes several acoustical sensors which operate at frequencies of 165 kHz and 2.9 MHz. Those sensors are spaced at discrete depths throughout the water column and also include the capability of measuring water temperature and downwelling irradiance. Development of several other sensors with different frequency suites and various processing algorithms is continuing at this pilot site. The data are telemetered to a shore station daily and are accessed via a conventional modem/phone system. Two way telemetry allows modification of operating parameters in response to the changing ocean environment and also allows modification of computer codes in the mooring system's computers during this development phase of the program. Plans to expand the system to include additional sensors are being developed, as is the implementation of a similar system for use during a US GLOBEC field project on Georges Bank. That program is part of the larger international GLOBEC program and of the ICES sponsored Cod and Climate Program.

Fisheries Technology and Fish Behavior Issues

University of Rhode Island Fisheries
East Farm Campus
Kingston, R.I. 02881 USA

Recent, Ongoing and Proposed Projects in Fisheries Science and Technology at URI

Joe DeAlteris

1. Study of the demersal gillnet fishery in the Gulf of Maine: description of vessels and gear, determination of standardized unit of effort, and size selectivity of gear. (report available)

2. Evaluation of the factors affecting the hydrodynamic efficiency of the Nordmore Grate System, a bycatch reduction device used in the Gulf of Maine shrimp fishery: funnel and grate. (report available)

3. Development of an underwater video camera and recording system for observing fish behavior in the vicinity of a bottom trawl and a methodology to quantitatively utilize the resulting data. (report available, project continuing)

4. Effect of size selection within and between fishing gear types on the yield per recruit and spawning stock biomass per recruit for groundfish in the Northwest Atlantic Ocean. (ongoing, abstract available)

5. Effects of Selectivity of 5.5 and 6.0 mesh square and diamond mesh codends on the percent maximum spawning potential of yellowtail flounder and Atlantic cod or New England commercial bottom trawls. (nearly complete, preliminary report available)

6. Use of traps by juvenile lobsters in New England waters. (ongoing)

7. Development of a species selective bottom trawl to reduce bycatch of juvenile groundfish in the small mesh whiting fishery. (ongoing)

   Reduction of cetacean bycatch in the swordfish drift net fishery. (proposed project, proposal available)

Alaska Fisheries Science Center
Conservation Engineering Project
Craig Rose, NMFS
7600 Sand Point Way NE.
Seattle, WA 98115 USA

1992 fishing gear research activities by the Alaska Fisheries Science Center Conservation Engineering Project in 1992 has been the use of video and sonar to observe fish behavior in relation to a number of trawl modifications designed to separate groundfish species. This has been done in cooperation with the International Pacific Halibut Commission and several regional gear manufacturers. Modifications tested during a cruise in August included rigid grids in the intermediate and the top panel of the codend, a horizontal pattern of loose lines across the intermediate, a horizontal panel across the trawl mouth and patterns of glow twine woven into the sides of the intermediate. This cruise also provided a platform for a test by the University of Washington's Fisheries Research Institute of the use of small underwater cages to evaluate the survival of discarded fish. Project staff have also provided video observation capabilities for two similar cruises sponsored by the Canadian Department of Fisheries and Oceans and the Alaska Fisheries Development Foundation.

Monitoring and analysis of trawl shape variation during groundfish surveys have continued. A series of simulations was run and used to evaluate the range of effects that this variation could have on survey results by altering the area swept by the trawl. As with several studies using data from specific surveys, the simulations demonstrated now assuming

constant trawl width produced biases which varied with fish depth distribution. An experiment is planned for 1993 to test for differences in survey trawl catchability due to differences in trawl width.

University of Washington
School of Fisheries
Fisheries Research Institute, WH-10
Seattle, WA 98195

Ellen Pikitch, Principal Investigator

West Coast Trawl Codend Mesh Size Study: Final manuscripts are in preparation that will describe both short- and long-term effects of potential changes in codend mesh size or shape on the U.S. west coast groundfish trawl fishery (e.g., catch rates, discard rates, selection curves, modeling of potential long-term responses). Six codend types (four diamond and two square mesh codends) were tested during three years of field work on board commercial trawl vessels operating under production conditions. A randomized block design was employed using the alternate haul method.

North Pacific Bycatch Survival Study: A pilot study was completed during 1992 off Kodiak Island, Alaska, to test a sea bed cage method for estimating post-capture survival of trawl-caught and released Pacific halibut (Hippoglossus stenolepis). The 1992 field season demonstrated that the sea bed cage method is a useful and efficient means for determining relative survival of discarded halibut that has considerable advantages over other methods. We developed a model which predicted the fate (live or dead) of individual halibut with high accuracy. While we have demonstrated the utility of the sea bed cage methodology for estimating relative survival of discarded halibut, further experiments will be carried out during 1993 and 1994 in order to obtain estimates of absolute survival and to predict survival for a wide variety of fishing and handling practices used in commercial fishing.

Trawl Codend Mesh Size and Shape Investigations to Reduce Catch and Discard of Undersized Pollock. The study is supported by the Saltonstall-Kennedy Grant Program to the Alaska Fisheries Development Foundation. Participants include the Fisheries Research Institute of the University of Washington in Seattle, Washington, and the University of Alaska's Fishery Industrial Technology Center in Kodiak, Alaska. We will utilize a randomized-block alternate-haul experimental design to evaluate the impact of different codend mesh sizes and configurations (square and diamond) on small fish discard rates, usable fish production rates, size-specific fishing mortality, and fishing revenues in the Bering Sea pollock fisheries. The experimental codends will be rotated in random sequences among three to five catcher vessels. Catches taken with those codends will be transferred

to a mothership, where biologists will sample the catches for species and size composition. Commercial vessels and gear will be employed and all efforts will be made to simulate production commercial fishing practices.

Massachusetts Division of Marine Fisheries
18 Route 6A, Sandwich, MA 02563 USA

H. Arnold Carr

Marfish Gauge Report: In 1991, MDMF had 20 mesh measuring devices built that functioned in a manner similar to the ICES mesh gauge. The device is expressly designed to measure webbing in nets commonly used in the otter trawl fisheries. To determine the accuracy and precision of this device, and others currently used by fisheries and law enforcement personnel, a series of comparative tests were undertaken. Four instruments were tested: two pistol type devices and two wedge measuring gauges. Preliminary testing showed that differences in mesh sizes observed between gauges could be attributed to two distinct factors: operators with differing techniques for gauges affected by operator and dissimilarities in gauge operating principles and designs.

A synopsis of the work follows:

When use of a gauge is not controlled for technique dependent gauges, measurements of the same twine with the same type gauge are expected to yield different mean mesh sizes with differing confidence intervals.

Even when operator techniques are controlled to minimize differences in measurements between the four tested gauges, the expected mean mesh measurements for the same twine would, in most instances, be expected to be significantly different.

For double mesh twine a large sample size may be necessary to increase precision of the measurements. Additionally, careful placement of the gauge in the correct position on the knot must be maintained for all gauges.

Measurements of random samples within the same twine with the same gauge type are not expected to be significantly different, provided sample size is large enough to reduce sample variance to a level where means can be compared accurately.

Survival of Juvenile Cod and American Plaice in the Northwestern Atlantic Trawl Fishery: Four cruises were completed to assess survival of the on-deck discard and the survival of cod (Gadus morhua) and American Plaice (Hippoglossoides platessoides) that escape from the codend. The first two cruises only investigated discard survival. Two subsequent cruises have evaluated discard survival and escapee

survival. Two more cruises are scheduled to look at longer term survival and the possible application of reducing the high mortality of deck discard, especially during periods of warmer air temperature.

Whiting Separator Trawl Study: The economic importance of the small mesh whiting or silver hake (Merluccius bilinearis) fishery in New England and resultant substantial catches of regulated groundfish species has prompted an investigation into the use of horizontal separator trawl similar to the one investigated by the DAFS Aberdeen Marine Laboratory in the Nephrops fishery. A trawl net, constructed with a horizontal panel beginning just above the sweep, was examined for its ability to separate fish bycatch from the small mesh whiting fishery. The panel was set at three different heights and the resulting catch was assessed to determine the degree of separation of whiting from flounder, dabs, hake, and other groundfish. Results encourage construction of a trawl that incorporates a sweep that lays off the bottom during the tow. Massachusetts, with assistance from the University of Rhode Island, is continuing research on a commercial trawl that will probably be mandatory within two years.

Fish Behavior and Gear Selectivity Workshop MTS'92

A three-day workshop in October included presentations of papers from gear researchers from the United States and Canada. Bob van Marlen participated as an invited speaker and added considerable depth to discussions at the workshop.

The Plenary Session concluded with three statements or resolutions.

1. Whereas conservation engineering is identified as one means to reduce bycatch, improve selectivity, and diminish the adverse impact of fishing gear on marine resources and the environment; and whereas federal, state, and private scientists and engineers are now responding to an increase in conservation engineering questions by planning and undertaking appropriate investigations; and whereas there is a recognized need to standardize these investigations and ensure that they are undertaken with a high degree of validity; therefore, be it resolved that a workshop be convened next fall to review and refine acceptable methodology and standards in gear selectivity and fish behavior investigations.

2. Whereas conservation engineering is a valuable part of effective fishery management; and whereas supportive technology has advanced in recent years which allows conservation engineering investigations to be undertaken with greater efficiency and understanding; therefore, be it resolved that the discipline of conservation engineering be incorporated into the process of establishing or amending Federal Management Plans (FMPs).

3. Whereas the role of conservation engineering in the management of living marine resources may not be explicitly understood and requires an improved definition; and whereas the elements necessary to successfully address conservation engineering problems should be properly and adequately identified; therefore, be it resolved that the ASMFC Conservation Engineering Committee write a paper on Conservation Engineering to place it in proper perspective.