



**FISH CAPTURE COMMITTEE**

**1991**

**by**

**S. Olsen**

## BELGIUM

(R. Fonteyne)

During the past year major attention was paid to three topics:

- gear research,
- selectivity research and
- the environmental impacts of trawling.

### 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, semi-pelagic and high opening bottom trawls and pair 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 of different net designs for the coastal sole beam trawl fishery were compared. A two panel beam trawl with reduced tickler chain weight yielded the same sole catches as the traditional beam trawl provided with side panels, but only when used on soft grounds. On hard grounds the gear was less efficient. Further comparative fishing experiments were carried with a new type of ground rope for shrimp beam trawls.

First trials were made with the newly acquired SCANMAR equipment. The technical parameters of two one-boat semi-pelagic trawls were measured. The system proved to be reliable even under difficult working conditions. The system is now available for skippers who want to control or adjust their gears.

### Selectivity studies

A study on codend selectivity for sole in the coastal beam trawl fishery was completed. Of all codend parameters investigated (mesh size, netting material, mesh shape (diamond versus square) and codend length) only the mesh size had a significant influence on the selection parameters for sole. Contrary to the results obtained with roundfishes, no influence of the mesh shape on the selectivity could be shown for sole. It is therefore assumed that square meshes could be used to improve species selectivity of beam trawls.

The first two phases of the EC "FAR" research project "Improved selectivity in the North Sea Fishery - Beam Trawling" were completed. This project is carried out in collaboration with the Netherlands Institute for Fishery

Investigations (Ymuiden) and Seafish Technology (Hull). The aim of the project is 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. Apart from a detailed literature search on the subject, a comprehensive inquiry on the technical aspects of beam trawling has been carried out. Alternative "round" beam trawls (for use with chain mats) with a square mesh top panel, a reduced top panel, shortened lastridge ropes, a lowered headline or with a square mesh top panel codend were designed. Models of these trawls were constructed and tested in the Seafish flume tank. The designs considered by the other partners in the project involve the use of separator panels, a square mesh window in the bottom panel and large diamond and hexagonal meshes in the top panel. The next phases of the project include the observation of the full scale gears at sea and catch comparisons.

The study on the methodology of selectivity experiments was finished. The experiments examined sole and dab caught by beam trawls. Due to the absence of masking effects, as occurs with the covered codend method, the results obtained with the twin trawl method are more reliable. The application of a new statistical model, developed by Canadian researchers, made it possible to bypass the problems usually encountered when analyzing data from twin trawl 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 started. This project is carried out in collaboration with institutes from the Netherlands, Germany and the UK. The Fisheries Research Station will concentrate on the technical aspects of the environmental impact of beam trawling. Measurements will include the pressure of the gear on the bottom, trawl marks on different bottom types and survival of animals that escaped through the codend meshes and of discarded animals.

#### Other activities.

The study of the shrinking of netting materials was continued. Test were conducted on the shrinkage due to sediment absorption in function of the tension on the netting material.

The inventory of net plans and rigging of gears in use in Belgium was continued. The data base of wrecks and obstacles on fishing grounds visited by Belgian trawlers was completed.

## CANADA

(P. Koeller)

### N.W. Atlantic Fisheries Centre, St. John's, Newfoundland

#### Gear/fish behaviour, selectivity:

Engineering sea trials of the standard groundfish survey trawl (Engel 145 High Lift) were carried out using SCANMAR acoustic sensors to measure trawl geometry and net speed at predetermined depths using varying scope ratios and towing speeds. Considerable variation in net parameters, bottom contact, and door stability was directly related to tow direction in the reciprocal tow method (paired tows with and against currents). Six groundfish survey cruises were conducted using SCANMAR, with data logged on a PC. These data will be analyzed and compared to the experimental data from the sea-trials.

Two exploratory deep-water surveys were conducted (in cooperation with the Marine Institute) for Greenland halibut, in depths from 1000 to 1700 meters off the continental shelf from the Grand Bank to Davis Strait, using a FURUNO CN10A net sounder to measure trawl performance. Trawl sink rate and the degree of bottom contact varied with depth, warp length, and overall trawl weight; this necessitated many changes in the standardized methods developed for shallower water surveys.

Experimental fishing trials were conducted to study the effect of tow duration on the selectivity of the standard groundfish survey trawl. Tow durations of 5, 15, and 30 minute were made at eight stations for cod and American plaice. At one station, a 24-hour experiment was conducted with six replicate sets at 5, 15, and 30 minutes duration to estimate the combined effect of diel variation and tow duration on size and species selectivity. Preliminary analysis indicated that shorter tows have higher CPUE (catch-per-minute) than longer tows regardless of time of day. A Survey Trawl Reference Manual was also completed which includes specifications for the four survey trawls and a comprehensive set of ACAD drawings to internationally recognized standards.

#### Acoustics:

The group conducted six offshore acoustic surveys in 1991 comprised of three capelin biomass surveys, one redfish biomass survey, and two cod surveys, one a winter biomass survey of NAFO Division 2J3KL cod, the other a research oriented survey to assess the distribution and abundance of 2J3KL cod during the spring onshore migration. No inshore acoustic surveys were conducted in 1991.

Studies were conducted on herring and cod to assess target strength variability and the relationship between target strength and condition factor. Studies on fish counting techniques for cod were also undertaken in 1991.

A workshop under the Northern Cod Science Program was held in August, 1991 to examine the feasibility of acoustic surveys in NAFO Division 2J3KL cod. The workshop recommended a move from 49kHz to 38 kHz to standardize with researchers in other countries carrying out gadoid acoustic surveys. A report was prepared to delineate procurement options for the 38kHz technology for offshore acoustic research and surveys.

Acoustic system development included the design of a gimbaled frame to accommodate a variety of towed body/transducer combinations for standard target calibrations.

#### Marine Institute, St. John's, Newfoundland

Gear/fish behaviour, selectivity:

In addition to offshore halibut surveys completed cooperatively with DFO and reported above, two 65' Inshore trawlers were equipped to fish for halibut in water depths between 700 and 1200 meters. Although some problems were experienced with the fishing gear both vessels managed to find fish and achieve commercial catch rates (1500 - 4000 kg per 5 hour tow).

A 3-year project to improve hook and line technologies in SW Newfoundland was initiated. The project includes the evaluation of high speed fishing vessels to increase the operational range of the fleet, fishing trials on jigging reels, low cost automated longline systems, rigging of lines, fish behaviour experiments and workshops for fishermen.

Observation on cod behaviour around a Japanese Style cod trap were made using underwater video and scanning sonar, to compare fishing performance and selectivity of this style and the modified Newfoundland trap observed in 1990. UWV was also used to observe cod behaviour around baited hooks with different types of bait and in relation to environmental factors such as temperature and current. A bibliography of fish behaviour in relation to fishing gears is being compiled and will be updated.

Other projects undertaken included: evaluation of a shrimp separator; trawl gear video; DFO groundfish survey technicians course; cod trap workshops; sea trials to evaluate performance of various fishing gear, and numerous consultation with fisherman.

#### DFO Fisheries and Habitat Management, St. John's, Newfoundland

A number of studies were carried out under the Atlantic Fisheries Adjustment Program. A cod trap (Newfoundland and Japanese type) mesh selectivity study was completed to determine a mesh size that would decrease the catch of immature fish. Additional work is required to explained variations in the results. A feather hook selectivity study was carried out to determine the relationship between the size of hook and the size of cod caught. Poor catches resulted in inconclusive results. Two commercial gillnet fishing vessels were contracted to compare catches of 5 and 5.5 inch mesh gillnets. Very little difference between the two mesh sizes were observed. Three 10 day selectivity trips were carried out on an offshore (51m) stern trawler to determine the selectivity characteristics of an otter trawl with lacestage ropes decreased by 15 and 20%, 130mm square vs 145 mm diamond mesh codends, and an otter trawl with a Sort-X system installed in the extension. Results are available on request. A traditional shrimp trawl was equipped with a Nordmore Grate and a retainer bag over the grate to capture escaping fish and shrimp. Initial results suggest that jellyfish blocking the grate can occasionally cause selectivity problems, and that approximately 5% of the shrimp (the largest in the catch) are lost to the retainer.

#### Maurice Lamontagne Institute, Mt. Joli, Quebec

Gear/Fish Behaviour, Selectivity:

A selectivity study of Danish seines and bottom trawls used by the cod fleet in the Gulf of St. Lawrence was undertaken, results to be reported in 1992. The performance of the Nordmore grid

for separating fish from northern shrimp in shrimp trawls was estimated and found excellent. A semi-pelagic shrimp trawl was also tested for ability to reduce finfish by-catch. The results showed a strong reduction of flatfish and juvenile fish in the catch. A sorting trawl for cod and plaice was also tried. A mechanism for timed release of snow crabs caught in lost traps was investigated.

Acoustics:

An acoustic cruise was conducted during May-June in Cabot Strait to study the summer migration of mackerel in the Gulf of St. Lawrence. A second cruise was completed in August in the northern Gulf of St. Lawrence on the aggregation dynamics of zooplankton, pelagic fish and whales in the region. A third cruise during November was directed towards estimation of herring on the west coast of Newfoundland. Systems used included a dual-beam Biosonics 103 (38 & 120 kHz), a single-beam Datasonics (120 kHz) coupled with the HDPS-9001 of Femto Electronics and, recently, a split-beam Simrad EK-500 (38 & 120 kHz).

St. Andrews Biological Station, St. Andrews, New Brunswick

Gear/fish behaviour, selectivity:

SCANMAR gear continues to be deployed routinely on standard groundfish surveys, with sensors deployed on almost all sets. Gear spread, height and speed are being measured and logged on a PC. The information is placed on an ORACLE database and made available to gear researchers and assessment scientists for examination of extraordinary sets, swept area calculations, etc.

Acoustics:

Acoustic surveys of NAFO Div. 4WX herring in January 1991, December, 1991 and January, 1992 found only about one tenth the quantity from previous years. A drastic decline in stock size is only one possible explanation, others being changes in behaviour or in winter distribution. New survey methods are needed to elucidate this problem. The potential usefulness of a dual beam acoustic system is being tested during the regular groundfish bottom trawl surveys on the Scotian Shelf. Exploratory work on cod off Sydney Bight in January, 1991 showed good correlation between trawl catches and acoustic integrations during the tows.

Bedford Institute of Oceanography, Dartmouth, Nova Scotia

Gear/fish behaviour, selectivity:

SCANMAR measurements and data availability as per report for St. Andrews.

Acoustics:

A 4-frequency acoustic backscattering system was deployed in September 1991 on a 12 day multi-disciplinary zooplankton survey in the Gulf of Maine and the adjacent Scotian Shelf. Acoustics delineated centimetre-sized crustaceans and assisted direct BIONESS (multi-net) sampling. Intense siphonophore scattering hampered acoustics in some regions. Laboratory development of an 8-frequency deep towed sonar (1-50 MHz) has progressed with initial sea trials scheduled for August 1992.

DFO Fisheries and Habitat Management, Halifax, Nova Scotia

Gear/fish behaviour, selectivity:

Experiments with rigid grates in a shrimp trawl were concluded and the concept was adopted by the fishing industry. Work with cod/haddock separator panels continued. Although as much as 90 percent of the haddock and 60 of the cod were separated into the top and bottom sections, respectively, results to date are inconclusive and further trials are planned during 1992. Hook size studies in the swordfish and groundfish (cod & haddock) fisheries were completed, the latter in conjunction with a trawler to compare selectivities of the two fishing methods. Work was initiated on "ghost" gillnets, to quantify the problem in terms of amounts of fish lost and number of ghost nets, using UWV and sidescan sonar.

Gulf Fisheries Centre, Moncton, New Brunswick

Acoustics:

A herring acoustic survey was conducted in Chaleur Bay and Sydney Bight using a SIMRAD EY200 transceiver and 120-25 transducer. Herring observed in Chaleur Bay were generally in narrow bands parallel to shore while loosely aggregated schools were found at Sydney Bight.

Gear/fish behaviour, selectivity:

Measurement of gear geometry and speed with SCANMAR sensors continued on standard groundfish trawl surveys. Size selectivity of cod and plaice in trawls were conducted to determine the best mesh size for optimize yields and reduced capture of undersized fish.

Freshwater Institute, Winnipeg

Acoustics:

A hydroacoustic study of northern shrimp (*Pandalus borealis*) diel vertical migration was executed off Labrador. The acoustic data were groundtruthed with a remote controlled opening/closing Tucker-type plankton trawl and a commercial shrimp trawl. Shrimp were observed to migrate upward after sunset to the lower limit of the thermocline. They descended rather quickly to the bottom at dawn. Nocturnal migration decreased the vulnerability of the shrimp resource to bottom trawls. Acoustic studies of Arctic cod (*Boreogadus saida*) schooling behaviour and predation by marine mammals and sea birds in Lancaster Sound (Canadian Arctic archipelago) were completed. Arctic cod distribution was highly contagious and fish densities in the schools occasionally exceeded 100 m<sup>-3</sup>.

Sault Ste. Marie Laboratory, Sault Ste. Marie, Ontario

Acoustics:

Fisheries acoustics surveys were conducted in the spring to quantify the biomass of fish migrating from tributaries into Thunder Bay and Thunder Bay Harbour, Lake Superior. Results are under analysis.

Pacific Biological Station, Nanaimo, British Columbia

gear/fish behaviour, selectivity:

A trawl system capable of opening and closing at depth was developed for sampling sockeye in lakes. Estimates using the closing system more than doubled sockeye abundance estimates made with a continuously open trawl.

The first major survey using the new Bernard-Sigmund beam trawls was successfully completed in July. The gear was developed for sampling juvenile salmon, herring and other pelagic species in surface waters of the continental shelf and open waters in the North Pacific. The trawl design incorporates a paired surface configuration which can be fished simultaneously and continuously for 24 hours a day at speeds of up to four knots, in sustained winds up to 30 knots and sea heights up to six metres.

As part of a program to test the feasibility of reducing incidental catch and total mortality of chinook salmon in seine fisheries, three seine mesh sizes used in the commercial fishery were tested to define the relationship between salmon body size and retention in the seine.

#### Acoustics:

A new technique was developed to determine zooplankton abundance in large oligotrophic lakes. The system is capable of rapid acquisition and processing of large quantities of data for detailed determination of zooplankton production. When coupled with direct biological sampling, the technique provides improved information on zooplankton distribution in sockeye nursery lakes. It was used to expand coverage and enhance stock assessment information.

Hydroacoustic and trawl sonar equipment was used to examine the diel behaviour of rockfish (*Sebastes*) concentrations and their behaviour around the mouths of midwater and bottom trawls. It appears that the fishing vessel rather than the trawl may be the major factor influencing fish movements in response to fishing.

A Graphic Information System (GIS) was used to analyze digital echograms for fish schools and develop a school species index.

The fifth in a series of hydroacoustic cruises to estimate total herring biomass in two areas of major winter concentration was conducted. Night-time experimental hydroacoustic surveys to determine distribution and relative abundance of juvenile herring in the Strait of Georgia were conducted in October, 1990. A hydroacoustic survey of offshore Pacific hake distribution and abundance from the Canada/Washington border to Queen Charlotte Sound was completed. Hydroacoustic surveys were completed at three lakes in the Stikine/Taku watershed to determine survival of sockeye salmon fry outplanted from an Alaskan hatchery.



## DENMARK

The Danish hydroacoustic work has two main lines: monitoring surveys for fish stock assessment and research work for improving the use of the acoustical survey data.

### Monitoring surveys.

In 1991 Denmark participated in two ICES-coordinated surveys.

In July - August R/V DANA surveyed the eastern North Sea, Skagerrak and Kattegat in the joint survey for the pelagic fish species of the region.

In October Denmark participated in a German-Danish cruise with the German R/V SOLEA in the western Baltic and the Belt Sea for herring and sprat.

### Research work.

In May a research project was started with the object of using image processing and pattern recognition techniques in order to extract more information from the acoustical signals, especially using three-dimensional structures for classifying disperse layers of fish.

In September R/V DANA made a cruise in which an attempt was made to study the distribution of fish (based on single fish echoes) in front of a trawl in relation to the selectivity of the trawl. Data were also collected for the above-mentioned project.

## **Codend selectivity studies**

**Contact person David Wileman**

The EEC has contracted DIFTA to update a review made in 1988 of the data available on the codend selectivity in the North Sea fisheries. All available measurements are collected together and average selection factors and selection ranges calculated for different fish species and fishing methods.

## **Selectivity in Danish and Scottish seines**

**Contact person Thomas Moth-Poulsen**

This ongoing EEC FAR project is carried out in partnership with SFIA in Hull. The Danish research so far comprises 35 hauls in 1991 testing a standard 40 mm diamond mesh codend against one fitted with two 90 mm square mesh panels using the alternate hauls technique. These trials revealed a significantly better release of undersized haddock without loss of marketable fish in the square mesh panel codend. Significant improvements were not proved for other species.

24 other hauls were made in April 92 using 100 mm codends, 90 mm square mesh panels and the hooped covered codend method. These seem to reveal very asymmetrical and steep selectivity curves for the Danish seine fishery. These trials are to continue in June 92.

## **Development of species selective trawls**

**Contact persons David Wileman and Klaus Lehmann**

This EEC FAR project is in partnership with the Marine Laboratory, Aberdeen and aims at separating whiting, haddock and herring in Norway pout trawls. Use of a horizontal separator panel towing up to 1 m behind the footrope and up to 2 m above it has been tested at sea on FRV 'Clupea'. No acceptable species separation for haddock and whiting could be achieved. The intention was to separate the pout into the lower codend and divert haddock/whiting/herring to the upper codend. Performance of the trawl was assessed by a remote controlled towed vehicle (RCTV) observing the fish behaviour. The RCTV observations confirmed that the height at which fish entered the trawl was highly variable with large amounts of pout often going directly into the upper codend. Attempts will now be made to separate species in the aft part of the belly using square mesh panels or grids.

DIFTA has taken part in field work in a joint Nordic Council funded project in partnership with laboratories in Norway, Sweden, Greenland, Iceland and Faroe Iceland. The aim of the project is to develop a sorting device which can reduce the catch of under marketable size shrimp and bycatch of fish species. Trawls with grid have been tested in commercial the fishery and the trawl geometry and fish behaviour to the grid have been observed by RCTV.

### **Set Bag net**

**Contact person: Ulrik Jes Hansen.**

DIFTA has been investigating the use of set bag nets in Bangla Desh. During a study tour in 1991 information was collected on the design and operation of this trawl-like static gear. The intention is to perform tests with models of set bag nets in the flume tank in order to gain detailed knowledge of their geometry and then improve their selectivity. efficiency. The gear as it is used today is catching too many undersized shrimps and fish in the coastal zone of Bangla Desh.

### **Trawl door studies**

**Contact persons: Lars Høgh Knudsen and Kurt Hansen**

The EEC FAR Project carried out in partnership with SFIA, England and IFREMER, France was continued. Further flume tank tests were performed on models of five commercial doors. A total of ten otterboard models have been fully tested in the DIFTA Flume Tank during this project and in addition cross tests have been performed on models tested by the other partners. Full scale trials carried out by IFREMER were analyzed. The project will be completed in 1992.

### **Model/Full scale correlation**

**Contact person: Kurt Hansen**

DIFTA has in cooperation with RIVO and SOAFD Marine Laboratory initiated an analysis of the scaling formulae used when estimating full scale performance of trawls from flume tank tests.

The work is funded partly from the EEC FAR programme.

The aim of the project is to develop new scaling rules specially for the scaling of the speed when performing flume tank tests. The work will continue in 1992 and 1993.

### **Computer assisted trawl simulation**

**Contact persons: Lars Høgh Knudsen and Kurt Hansen**

Work on the EEC FAR Project CATS was initiated in the beginning of 1991. The project 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. Two trawl models have been tested in the DIFTA Flume Tank and comparisons have been made with results from computer simulations. An interface program was developed to generate numerical models using CADTRAWL drawing files as input. The project will continue during 1992 and 1993.

## THE FAROE ISLANDS

(Jan Arge Jacobsen)

### FISH TECHNOLOGY

The Norwegian sorting grid system (Sort-X) developed primarily for Atlantic cod and haddock has been tested on Saithe in Faroese waters in 1991. Two surveys were conducted, one in September and one in November. Preliminary results indicate a more smoothed and steeper selection ogive for saithe as compared to a normal trawl, resulting in a greater escapement of the small and undersized saithe. However, the differences were not as clear as expected from comparable results on cod and haddock in the Barents Sea.

A survey on the relationship between the acoustic area backscattering of demersal fish in the bottom layer at a trawlstation and the catch was done in October 1991. Preliminary results show poor correlation of trawl catch with total echo abundance at each station, this is thought to be due to varying amounts of norway pout present in the acoustic readings, but not caught in the bottom trawl. Further analysis of the data are planned and the results will be reported to ICES.

In December a heavy rockhopper ground gear was tested against a standard rubber gear around the Faroe Islands. The absence of cod and bad weather limited the survey resulting in few comparable tows. Further study of the two ground gears is planned in 1992.

### ACOUSTICS

Three blue whiting surveys have been made in 1991. The first in January south off the Faroes and in international waters west of the British Isles, very limited amount of blue whiting were observed during the survey. The second survey covered the southern part of Faroese EEZ of postspawning blue whiting on its way northwards. The third survey covered the area north off the Faroes in the Norwegian Sea in August, where the 1989 year class dominated totally. These results were reported to ICES in 1991.

An acoustic survey on herring in Faroes waters in June yielded no reliable acoustic estimate due to very shallow distribution of the herring schools, but the area of distribution could be determined and areas of high and low density could be located in the Faroese EEZ during the survey.

FINLAND  
(P. Suuronen)

In May-June and October-November 1991 trials were carried out in the Archipelago Sea (ICES SD 29N) to study the size selection and survival of young Baltic herring when a rigid grating grid is used in the front part of the codend extension of a pelagic herring trawl. During the survival tests, the escaping fish were captured into a hooped netting cage, which was released from the trawl when enough fish were caught, and left at the depth of capture. After a predetermined period, dead and live fish were counted and measured.

Survival experiments on vendace (the most important commercial fish species in Finnish lake fishery) were made in Lake Juojärvi and in Lake Oulujärvi in summer 1991 when fish were escaping through the codends of pelagic vendace trawls. The survival trials were made with the same capture and monitoring method as used in the herring survival study.

Trials for developing and constructing a species selective trapnet (setnet) for whitefish were completed. A prohibiting net in front of the wings of the trapnet prevents the salmon from entering the trap. This enables trap net fishery of whitefish during the spawning migration of the salmon.

Testing of the effectiveness, selectivity and durability of the different types of gillnet materials (bar length 50 mm) used in the pike-perch fishery continued in the Archipelago Sea in spring and autumn.

Trials on leading feeding herring schools into a floating, modified poundnet with the help of underwater lamps were conducted in the Archipelago Sea in October-December. The behaviour of herring schools in and around the poundnet was monitored by a sonar and gillnets.

The study of the effects of cold winter conditions on the physical properties of netting materials continued. First results will be published in the Journal of the Textile Institute.

A combined hydroacoustic-trawl survey was conducted in August in the northern Baltic Proper (SD 29), in the Bothnian Sea (SD 30) and in the Gulf of Finland (SD 32). The species studied were Baltic herring and sprat. A total of 1450 nautical miles was echointegrated with a Simrad EK-500 echosounder and 33 hauls with a Larsen-type pelagic herring trawl were made.

## FRANCE

### 1 - Amélioration des techniques de capture

#### 1.1 - Amélioration des chaluts et de leurs appareils

##### 1.1.1 - Conception des chaluts assistés par ordinateur

Menée en collaboration avec le Danish Maritime Institute (DMI) et le Danish Institute for Fisheries Technology and Aquaculture (DIFTA) dans le cadre du programme FAR, cette étude a d'ores et déjà permis de représenter d'une façon satisfaisante un chalut pélagique et un chalut de fond. Le travail en cours vise maintenant à diminuer les temps de calcul nécessaires pour déterminer la forme du chalut en fonctionnement.

##### 1.1.2 - Etude des panneaux de chalut

Menée en collaboration avec le DIFTA et le Sea Fish Industry Authority (Grande-Bretagne), cette étude nous a permis de comparer les performances à la mer de différents types de panneaux. Les essais en bassin sur un nombre important de types de panneaux menés en France à Lorient et à Boulogne font encore apparaître des écarts par rapport aux résultats obtenus à Hirtshals et à Hull qu'il reste à expliquer (peut-être par les caractéristiques mêmes des bassins) pour résoudre les problèmes d'intercalibration qui persistent.

##### 1.1.3 - Chalutage profond

###### a - En Méditerranée :

Poursuite des travaux pour la capture d'Aristeus Antennatus, recherche des lieux de pêche et du chalut le mieux adapté.

Résultats décevants de la campagne organisée en mars 1991, ressource en crevettes absente.

## b - En Atlantique Nord Est

En collaboration avec les professionnels, les conditions de capture d'espèces jusqu'alors peu pêchées dans cette zone ont été étudiées (cartographie, identification d'espèces, étude d'engins et de gréement).

Ces travaux sont couverts par la confidentialité accordée aux partenaires professionnels de l'IFREMER.

### 1.1.4 - Sélectivité des chaluts

Une campagne a été faite en novembre 1991 dans le Nord du Golfe de Gascogne pour étudier l'efficacité d'un panneau à mailles carrées pour permettre l'échappement des jeunes merlus dans une pêcherie langoustines/merlus. Le travail doit se poursuivre en 1992, mais les premiers résultats semblent très favorables.

### 1.1.5 - Instrumentation et équipement des chaluts

Des essais sont en cours pour valider la conception de différents systèmes :

- Capteur d'effort immergé, autonome, à mémoire, pour mesurer les efforts dans les funes, bras et autres éléments du gréement du chalut (but visé : capteur relativement bon marché sans exigence de transmission acoustique des données).
- Capteur autonome à mémoire permettant le contrôle a posteriori de l'angle d'attaque des panneaux de chaluts.
- Système télécommandé de fermeture du cul de chalut pour sélectionner la capture correspondant à une détection donnée.

## 1.2 - Analyse des facteurs d'efficacité des thoniers senneurs

L'étude entreprise en 1990 pour comparer l'efficacité du gréement californien et du gréement scandinave pour la capture des thonidés à la senne coulissante est achevée. Ses conclusions, actuellement analysées par les armateurs français, montrent l'intérêt de possibles transferts de technologie.

## 1.3 - Filets maillants

Pour faire face aux critiques concernant la capture accidentelle de dauphins par les filets maillants dérivants utilisés pour la pêche au germon dans le Golfe de Gascogne, l'IFREMER et les professionnels ont essayé divers montages des filets en immergeant plus ou moins la ralingue supérieure. Dans tous les cas, les captures de dauphins ont été extrêmement peu nombreuses.

## 1.4 - Machines de ramassage

1.4.1 - La machine à récolter les coquillages enfouis à l'étude en 1990 est maintenant opérationnelle. Le sédiment est fouillé en avant de la machine par des jets d'eau, les coquillages mis en suspension sont entraînés dans la partie supérieure de la ramasseuse par un courant d'eau créé par des cylindres tournants, puis ramenés en surface par une vis sans fin quand la profondeur d'eau est faible (une aspiration pourrait remplacer la vis sans fin si la profondeur d'eau l'exigeait).

1.4.2 - Une variante de ce système a été développée pour la coupe des algues, une barre de coupe sectionnant les algues entraînées par le courant d'eau créé par les cylindres tournants, ces algues étant ensuite aspirées, par air lift, jusque sur le bateau qui les collecte.

### 1.4.5 - Mise en service du bassin d'essais de chaluts de Boulogne/Mer

Ce bassin à circulation d'eau large de 4 m, profond de 2,3 m où l'eau peut circuler jusqu'à 2 mètres par seconde a une zone de travail de 18 m de long, le long de laquelle un vitrage de 8 m permet l'observation des modèles en essai. Le fond mobile, maintenant classique dans les bassins de ce type, a pour particularité d'être assez aisément démontable, ce qui rendra la maintenance du bassin plus facile.

## 2 - Etudes sur l'aménagement des navires

### 2.1 - Réflexions sur le pont de pêche des chalutiers

Après avoir analysé les problèmes d'ergonomie et de sécurité du travail sur le pont de pêche des chalutiers de 25 mètres, une étude comparable est en cours pour les chalutiers de 50 mètres sur lesquels les dangers viennent moins de problèmes d'encombrement et de conflits d'occupation de l'espace que de la taille et du poids des appareils ainsi que des efforts exercés par les engins de manoeuvre.

### 2.2 - Machine à trier le poisson par analyse d'image

Les études entreprises sur le tri automatique du poisson à bord des chalutiers pratiquant le chalutage de fond en Manche et en Atlantique Nord étant devenues sans objet du fait de l'interdiction par la CEE de l'embarquement de telles trieuses, l'effort a été reporté sur le développement d'une machine à trier les petits poissons pélagiques à bord des chalutiers opérant en Méditerranée. Le but de l'opération est de diminuer les rejets inévitables en cas de capture importante à cause du temps exigé par le tri de ces petits poissons dont des quantités notables sont avariées avant d'avoir pu être triées. Une maquette de trieuse séparant anchois, sardines et maquereaux commence actuellement ses essais.



### 2.3 - Renouvellement de la flotte océanographique française

L'IFREMER étudie actuellement le remplacement de deux navires de recherche halieutique, le N/O THALASSA (61 m de long) et le ROSELYS II (20 m, opérant en Méditerranée).

Le remplaçant de THALASSA sera un chalutier pêche arrière de 72 m équipé pour faire également des travaux océanographiques ; le remplaçant du ROSELYS II sera un catamaran de 28 m équipé pour le chalutage, adaptable pour la mise en oeuvre d'autres techniques de pêche et également à même de permettre des opérations océanographiques.

Le suivi des études menées par les chantiers de construction de ces navires est assuré pour partie par les technologistes des pêches de l'IFREMER.

## 3 - Acoustique sous-marine appliquée à la pêche

### 3.1 - Etudes menées par l'IFREMER

#### 3.1.1 - Echo-intégration, identification des détections

Le logiciel MOVIES B étudié pour individualiser les bancs de poissons et permettre l'écho-intégration par bancs est complété par un système qui définit pour chaque banc un certain nombre de critères géométriques et énergétiques.

Des recherches sont en cours pour trouver le système le plus fiable pour identifier l'espèce constituant le banc à partir de l'analyse de ces critères.

Le projet BIOMASS, mené dans le cadre du programme FAR avec des partenaires universitaires français, le Marine Laboratory d'Aberdeen et le Marine Biology Laboratory d'Iraklion en Crète intègre une partie de ces résultats.

#### 3.1.2 Développements de nouveaux sondeurs

- Les travaux sur le sondeur large bande se poursuivent.
- Le sondeur multifaisceaux pour la pêche développé dans le cadre du projet HALIOS (programme EUREKA) a été testé en mer à plusieurs reprises et ses résultats sont très prometteurs, même s'il demeure quelques problèmes de visualisation.
- Le sondeur numérique développé conjointement par IFREMER et la Société MICREL est maintenant en phase d'essai sur des navires professionnels et de recherche halieutique où sa souplesse d'emploi et les facilités apportées par le traitement numérique du signal sont très appréciées.

Une campagne effectuée sur le N/O THALASSA a été consacrée à l'essai de ces différents sondeurs.

L'algorithme de détermination de la nature des fonds sous-marins à partir de signaux émis par des sondeurs standard est maintenant au point.

### 3.1.3 - Qualité acoustique des navires de pêche

Le remplacement du N/O THALASSA très âgé et particulièrement bruyant, le souci de se doter d'un navire permettant de faire des recherches sur la pêche à grande profondeur (avec la discrétion acoustique que cela suppose pour ne pas affaiblir les performances des sondeurs) a amené l'IFREMER à étudier les causes de bruits rayonnés par les navires ainsi que les solutions retenues dans les autres pays ayant récemment lancé des navires de recherche pour rendre ceux-ci suffisamment silencieux. Le souci de maintenir le coût de construction à un niveau raisonnable rend ce problème particulièrement ardu...

### 3.1.4.- Evaluation acoustique de stocks

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

Une deuxième campagne s'est déroulée en octobre dans le golfe de Gascogne pour déterminer l'abondance et la distribution des ressources pélagiques potentiellement utilisables pour des produits transformés type surimi.

## 3.2- Etudes menées par l'ORSTOM

La coopération avec le Vénézuéla, Cuba et le Mexique, se poursuit. Il y a eu récemment une campagne d'écho-intégration sur le mérou dans le Yucatan. Des études sur l'influence du bateau dans l'évitement des poissons ont encore été menées cette année en Martinique et au Vénézuéla.

Au Sénégal, outre les campagnes d'évaluation classiques, les travaux s'orientent vers les problèmes de détection sur petits fonds.

Un programme d'évaluation de petits pélagiques se met en place en Mer de Java.

A Tahiti, outre les campagnes de marquage et des études de comportement, on étudie par écho-intégration l'évolution des agrégations produites par les DCP.

Des études sont en cours à Brest sur les discriminations entre échos de poissons et échos de masses planctoniques, au moyen d'expérimentations multifréquentielles.

Un groupe de travail francophone, dont le thème était : "L'occupation de l'espace par les populations d'organismes marins : description et impact sur les évaluations acoustiques", s'est réuni en mai 1991 à Thonon-les-Bains ; il est ouvert à toute personne souhaitant y participer et se réunira de nouveau en mai 92.

## GERMANY

(E. Dahm, U. Richter)

a) Institute for Fishing Technology, Hamburg

### Energy saving methods

Negative environmental effects of fishing gear receive more and more public attention as the recent international discussion on driftnets has shown. A general ban of a special fishing method not taking into consideration the actual damage done by that method under given local conditions is the easiest way to solve the political problem but not in the interest of the fishing industry. There is on the other hand a lack of reliable scientific data on the subject which might help to find adequate solutions. The collection of such data will be the central task in a program taken up by the Institute in 1991.

A first review of the passive gear fisheries of Germany revealed no special risk of unwanted bycatch for the area of the North Sea. Neither the sole nor the plaice fisheries carried out with set nets produce any considerable bycatch of mammals or birds because they are done in areas or seasons where fishery and birds or mammals are not present at the same time.

Due to their low numbers bycatch of mammals does also play no role worth mentioning in the German set fisheries in the Baltic. However, a certain concern is caused by sea birds. Especially ducks may get into nets and drown at certain places and certain times of the year. Several cruises with chartered vessels and a research vessel have been undertaken in the last months of 1991 to spot places of common occurrence of fishes and migrating sea birds. So far only a limited number of birds were caught in the nets and first hypotheses could be set up concerning the areas of maximum risk. They have to be validated by a number of follow-up cruises in the next years to provide the fishery management with the scientific background necessary for the possibly pending regulatory measures.

Besides of that, the Institute continued its search for alternatives to the dwindling cod fishery as well in the Baltic as in the Southern North Sea. In the eastern part of the German fishing zone, in the Baltic, the fishery for turbot, flounder, pike-perch and pike may offer opportunities. First test fishings were rather encouraging. However, prices are still inadequate and marketing of the new species e. g. flounder has to be considerably improved.

In the North Sea, the valuable fishery for sole with gill nets suffers from being confined by quota and seasonal availability. First attempts to extend the season by participation in the setnet fishery for plaice gave rather good results. The half-sized trammel nets with only one armouring mesh developed by the Institute proved to be especially useful in this context. However, the number of meshes in the lint has to be enlarged to prevent loss of the more active larger plaice.

Preparations for a detailed study of bycatch in salmon driftnets in the Baltic are in progress. Preliminary results have been obtained by participation of members of the Institute in commercial fishing cruises.

### Investigations with trawls

Recent research has shown that bottom trawls lose a considerable part of the fishes herded between the wings by escapement beneath the groundrope and over the headline. Small bagnets attached at the headline allow as well a quantitative assessment of these losses as when fastened on the groundrope and running beneath of it and after the roller gear. Because of the evident importance of such results for the assessment work, this methodology was applied at a standard bottom trawl used for stock assessment purposes. The experiments carried out so far show as well a species as a size selectivity. Some species as *Callionymus* or *Trigla* never appear in the catches of this trawl. From other species (*Gadus*, *Melanogrammus*, *Merlangius* and also from several flatfishes) especially the young agegroups escape to a large extent between the rollers of the groundgear. These results throw some doubt up on the validity of assessments of the 0-Group if e. g. abundance indices are based on catches with this trawl.

The methodological work on determination of the shape of a trawl in action by means of underwater video was continued. A special test device was constructed to define the optical and electrical depiction errors and successfully tested at sea.

Research and development work on otterboards was continued by sea trials on a new construction of cambered V-doors. The doors performed with equal efficiency as flat boards of 4.5 m<sup>2</sup> though having only a surface of 2.4 m<sup>2</sup>.

Small trapeziform sail kites worked also very well during sea trials. Though having each only 0.56 m<sup>2</sup> surface, two sail kites improved the opening height of a codhopper bottom trawl from 5 to 6 m. It is essential to give them some initial lift at the forward edge. This is done by putting small floats into a pocket sewed alongside this part of the device.

### Selection experiments

Selectivity research results compiled so far from the area of the North Sea contain little or no data on the selectivity of bottom trawls for saithe. In 1991 the Institute succeeded in contributing to fill this gap. During two cruises in the Norwegian part of the North Sea selectivity data for saithe could be collected by different techniques (covered codend and divided trawl) and for two mesh shapes in the codend (diamond and square meshes). In contrary to research results on other gadoid fishes these experiments resulted in remarkably high selection factors. The reason for this may lie in the fact that the saithe well known as a fast and enduring swimmer tires to a much lower extent than other representatives of the same family. However, a reduction of the se-

lective properties related to an increase of the filling of the codend as stated during the experiments is well in accordance with observations on some other gadoid fishes.

A remarkable increase in knowledge could also be achieved during a cruise to Greenlandic waters. The few data available on the selectivity of bottom trawls towards cod and redfish in this area could be confirmed and complemented and new data on the selective properties of square meshes gathered. An important finding of the cruise is that square meshes of the same size as diamond meshes show a considerably smaller selectivity range and, thus, a sharper selection. They also let pass a greater number of bigger fishes. The introduction of a certain mesh shape as a management tool should therefore be carefully deliberated.

A possible field of application for square meshes seems also to open in the beam trawl fishery for brown shrimp. Preliminary results of the first trials show a decrease of the unwanted bycatch of undersized brown shrimp and fish and especially a remarkable reduction of the number of gilled undersized sole.

#### Material investigations

The collection of data on the change of the mesh opening of netting material stored in a net shed was continued.

In a Finnish-German project on the setnet fishery for pike-perch the Institute deals with the questions of degradation of material during use and choice of the most appropriate material.

#### b) Institute for Deep Sea Fisheries and Fish Processing, Rostock

A new type of bottom trawl for the catch of cod and flatfishes based on innovative principles of construction (central lestridge) was developed and introduced into the commercial fishery on request of fishing enterprises of Mecklenburg-Vorpommern. A software package for design and calculation of towed trawling systems facilitating the task of such construction work was created. It includes graphics software for the production of net and rig drawings.

Standard bottom trawls for assessment purposes of eel and young fish stocks were introduced for the fishery biology department.

Extensive bycatch investigations were carried out in the commercial eel fishery east of Rügen and Usedom.

The work on the development of a fully mechanized longline apparatus for smaller fishing vessels was continued. The hydraulic propulsion of the prototype main winch was improved and technical trials were carried out aboard the R.V. "Clupea". Further on a working model of a combined piece-or-whole-fish-baiter was built and tested.

c) University of Rostock

Different research projects concerning engineering aspects of fishing gear were either continued or completed. The following tasks were treated with prime priority:

- Investigations on the relation between the accuracy of experimentally acquired input data and the results of calculations concerning simulation models of fishing gear.
- New theoretical and experimental investigation on shape and strain of heavy flexible ropes in currents.
- Research on a laterally displaced trawl for the catch of pelagic fishes living near to the surface (continuation).
- Development of a mathematical simulation model for the calculation of set nets in currents.

## ICELAND

(G. Thorsteinsson, P. Reynisson)

Some experiments on the selectivity of shrimp trawls were conducted. In May a square mesh codend was tried in comparison with usual diamond codend on a commercial vessel in the offshore fishery. The results were positive and resulted in a regulation obliging the boats to use square mesh codends in larger parts of the offshore fishing grounds. (The square mesh codends have been used in the inshore fishery for more than three years.)

In June the influence of using bigger mesh size in the bellies of shrimp trawls was examined. This method to release undersized shrimp is rather effective. This method is used on many boats in the offshore fishery. No official regulation was made however.

In June the influence of a separator grid was tested in the offshore shrimp fishery. In spite of good results to release small redfish no recommendation has been sent to the Ministry of fishery on its use.

The selectivity of shrimp trawls in general has been a subject of Scandinavian cooperation for two years. One cruise was carried out in Icelandic waters in September dealing mainly with square mesh codends and separation grids. In addition to this, interesting video observations were made on the trawls and the behaviour of the shrimp and some fish species.

In May some new types of Nephrops trawls were tested and observed with an underwater TV camera. The new trawl designs proved well and all of them were taken into commercial use after the experiments. Especially the twin trawl design has been successful.

Several routine acoustic surveys were carried out on the stocks of capelin and herring in Icelandic waters in autumn and winter. The results were used for management purposes.

In June a three week acoustic survey on redfish in the Greenland sea was carried out. Conditions in the uppermost 350 meters proved to be excellent, for acoustic abundance estimation as well as target strength measurements. A similar survey is planned in the period June-July 1992, in cooperation with Russian scientists.

An acoustic survey on zooplankton was planned in 1991. This survey was to be an extension of the short pilot surveys in 1989 and 1990. Due to circumstances this was not possible, but two short surveys along these same lines are planned in 1992.



New acoustic equipment (EK 500 echo sounders and BI 500 post processing systems) were installed on board two of our research vessels, Árni Friðriksson and Bjarni Sæmundsson. The echo sounders are working at 38,120 and 200 kHz and 12,38 and 120 kHz respectively.

## IRELAND

(J. P. Hillis)

An experiment to determine escapement of whiting from a 70 mm square mesh panel on the top sheet of a dual purpose (whitefish and Nephrops) trawl by fishing with a 30 mm mesh cover fitted over it was conducted by Bord Iascaigh Mhara (Irish Sea Fisheries Board) was carried out during the spring. Results showed that whiting escaping through the square mesh panel and retained in this cover outnumbered those in the cod-end by about 1.74 to 1, and that their mean length was 16.5 cm as opposed to 25.9 cm for those in the cod-end.

In the summer, an experiment was carried out to assess the escapement of whiting through a similarly placed square mesh panel of 80mm mesh on the top sheet of a Nephrops trawl. This gave similar but less clear-cut results ascribed to the selection characteristics of the Nephrops and the greater propensity for it to accumulate shell, weed and such debris than the dual purpose trawl.

## THE NETHERLANDS

### General :

Within the scope of the Community Research Programme (FAR/DG XIV, 3rd call) 5 technical research proposals were sent in to Brussels. Only one was accepted : "Improved species and size selectivity of midwater trawls (TE 3 613, NL, UK, D)". Bilateral coöperative research contracts have been signed between RIVO-SEAFISH (UK) and RIVO-IFREMER (France). To consolidate and exchange European research activities on safety and working conditions onboard fishing vessels close coöperation took place between RIVO, SEAFISH, LSCTPM (France), Marintek (Norway) and Lindholmen (Sweden).

In the framework of EC-programme TEMPUS a revised application was sent in. The participants are RIVO, University of Agriculture (Szczecin, Poland), University of Rostock (Germany) and the Humberside International Fisheries Institute wit SEAFISH (Hull, UK).

In april 1991 the ICES FTFB and FAST working Group meetings were held in Ancona, Italy. Much emphasis was given on the selectivity of fishing gears (e.g. square meshes) and standardisation of survey nets. This was reported to the Atlantic Committee for Fisheries management ACFM as well as discussed extensively at the 79th Statutory Meeting in La Rochelle, France.

Besides many requests and brief advices, no projects in developing countries have been carried out.

### Safety and working conditions :

As follow up of the research project "Safety and working conditions in the beamtrawl fisheries (1988-1990)", a safety group started under chairmanship of the Dutch shipping Inspectorate. The other participants are besides RIVO, representatives of the fisheries sector and fishery schools. The Group aims at investigating the feasibility of the RIVO-TU Delft safety solutions, resulting in recommendations for authorities to draft rules concerning safe working onboard beamtrawlers.

Also some subsidies have been forwarded to introduce 5 local engineering solutions to minimize disability risks : winchhead elimination, safety gilson wire, remotely controlled lazy-decky pin, reducing the codend swing and a beam catcher. Although the funding has not been realised yet, the remotely controlled lazy-decky pins have been successfully installed on the beamer UK 104, initiated by a fatal accident and payed by the skipper himself. The other solutions have not exceeded the engineering phase.

The first phase of the EG project UP 1.67 "Integrated quality assurance of chilled fresh fish at sea (D, NL, UK)" has been finished with a report and transfer of knowledge to the industry. In the second phase of this EG-project, UP 2.537, the onshore developed equipment for freshfish handling will be adapted for sea trials.

The aim of this project is to define a system to handle fish by which the overall quality of plaice can be improved before filleting. Therefore the plaice must be graded and weighed onboard, either with aid of RIVO's fisheye system (by means of structured light and image analysis) or with aid of TNO's grading device, using infra red sensors and separate volume measuring. For onboard gutting of the plaice two prototypes were developed, the TNO-LEBA option and the RIVO-TU Delft option (plaice unit 2000). Parts of the unit 2000 are patent pending.

The differences are the dimensions and chosen methods of weighing, washing and grading. The RIVO-TU Delft unit is the most compact one, suitable to install more units above the hand sorting table.

During the sea trials also some changes in the routing of the freshfish in the fish hold will be introduced. Besides improvement of the working conditions, icing and storage are better controlled and fishboxes or containers carry a barcode with data on the contents and graded plaice quality for auction and retailers use.

#### **Engineroom systems :**

At the Ministries; request RIVO investigates the possibilities to limit the main engine output for the 300 hp beamers and some fraud resistant power measuring system for onboard use. Discussions were held with the industry, engine manufacturers and fisheries organizations.

As a sub project of the beamer 2000 research : safety integrated redesign, the environmental impact of machinery installations has been analysed.

The following emissions are of relevance: exhaust gases of machinery installations, HFCK's (R22, refrigerating) and Halon 1301 (fire extinguishing).

Compared with land based diesel engines exhaust rates on fishing vessels of NOx and SO2 are a factor 3 - 5 higher, although there are no rules or recommendations yet concerning the HFCK and Halon emissions, and the impact is marginal compared to the merchant marine fleet. For newbuildings Halon will be banned in the near future, to avoid further deterioration of the ozon layer.

#### **Beamer 2000**

In 1991 the safety integrated redesign of a beamtrawler has been finished. Starting from a conceptual redesign of a 2000 hp beamer, the project has developed into the "Beamer 2000" project, an umbrella project that stands for several related activities in sub-projects such as reducing the safety, workload and environmental drawbacks of the beamtrawl fisheries. Except improving the quality of the working areas, also the quality of the fresh fish and the quality of the marine environment has been focused on. With more or less overlapping technical solutions integrated improvements can be realised.

Recommendations for the fishdeck layout, wheelhouse layout and the engineroom layout has been worked out upto the predesign phase and much emphasis has been given in the knowledge transfer to the fishing sector via lectures and publications in weekly fisheries magazines.

From the designing point of view the project has been taken over by the industry, where various skippers and shipyards are competing one another with the detailed drawings and specifications of "Beamer 2000". The prospect is that in 1992 the first beamer 2000 will be launched.

Detail engineering is continuing on the plaice unit 2000, low noise propellers, low noise and "green" diesel engines, accommodation 2000 and the beamtrawl gear 2000 (safe handling, selectivity, marine environment).

#### **ROV development :**

At the invitation of "Institute für Fangtechnik" (Germany) reference measurements have been carried out onboard FRV Hamburg "SOLEA". The aim was to compare the performances of an electrically driven (original Belfour ROV) and the hydraulically driven (RIVO's adapted ROV) rotors. Last mentioned modification has been applied for the ROV developed in cooperation with the private company Seatec as a part of a EC project "Eureka". By means of new rotor configurations the magnus efficiency has been improved and the scope of the ROV in depth and side way displacement has been improved. Also the ROV platform gained better video output possibilities and more freedom for additional sensors.

#### **Ecological impact of bottomgears :**

Research on the impact of bottom gears on Benthic organisms has been continued this year at national level (RIVO, NIOZ, DNZ, RGD, DIHO) as well as at on

international level. Three topics were investigated : to what depth does commercial beamtrawling disturb the sediment, what is the survival rate for Benthos and fish after being caught, have years of beamtrawling had a significant effect on the benthic system ? The results will be published in 1992.

In the framework of the EC FAR programme the proposal MA 2.549 "Environmental impact of bottom gears on benthic fauna in relation to natural resources management and protection of the North sea" has been granted and started in 1991. Except beamtrawling, also other types of bottom gear will be investigated. The participants are besides the Netherlands (RIVO, NIOZ, DIHO), Fisheries Research Station (Ostend, Belgium) (FRS), Institute für Meereskunde and Alfred Wegener (Germany).

EC-project TE 1.154 NL DK UK "Fishing gear model and full scale relationship (RIVO 199)" was continued in 1991. A 5600 meshes circumference trawl was selected as the prototype and models derived from this net. Bar lengths of the front part were measured and samples of mesh sizes in the aft part were taken. Models at scales 1/25, 1/35 en 1/40 were designed and built by DIFTA, Hirtshals. Net openings and drag were measured in the flume tank for selected parameters of the rigging, as given in the table below (full-scale equivalent values).

Parameter	Full scale equivalent value
Bridle weights	1360kg - 1870kg (in air)
Towing speed	2.5 - 6.0kn (4 or 5 different speeds)
Bridle length	153m
Backstop length	4m (including load cells)
Extension	5m
Door spread	150m - 165m - 180m
Type and size of doors	7m <sup>2</sup> and 8m <sup>2</sup> Süberkrüb 8-9m <sup>2</sup> Dangren

An extended literature study was undertaken and the idea was raised to investigate the relation between the drag coefficient of a complete net and the Reynolds Number for a range of model scales. Froude scaling does not lead to the correct towing speed, and it is hoped to achieve a better quantitative relationship at least for one net design. Trials at sea were scheduled in March-April this year, but had to be postponed due to other research priorities chosen for this year's research vessel programme. They will be done in the spring of 1993.

#### Project 201 Single-door trawl.

Results of model studies in the Flume Tank of DIFTA, Hirtshals are given in report TO: 90-701 "Modelonderzoek aan schuin achter het schip gesleepte pelagische vistuigen GM2 en P-168" (In Dutch). The major conclusion of this study is that it is possible to tow trawls of design used by the Dutch sterntrawler fleet substantially out of the wake of the vessel with an acceptable net geometry.

In developing more selective fishing gears, work on selective trawls has been given high priority in 1991 and various research projects undertaken of which some were partly financed by the EC.

EC-project TE 2.554 NL B UK "Improved selectivity of fishing gears in the North Sea fishery - Beam trawling (RIVO Project 230)" was continued in 1991. Participants in this project are the Netherlands Institute for Fisheries Research (RIVO-DLO) of IJmuiden, The Netherlands, The Fisheries Research Station of Ostend (FRS), Belgium and the Sea Fish Industry Authority of Hull (SEAFISH), United Kingdom. An extended literature study and fleet inventory formed the start of the project.

A range of potentially feasible ideas was selected and scale models produced to be tested in the flume tank of SEAFISH at Hull. A 12m V-shaped beam trawl design rigged with tickler chains was taken as representative for the Dutch beamtrawls in use and 9-10m chain mat arrangements were chosen for the English and Belgium fleets. The following configurations were tested at scale 1/5 in October and November 1991.

Configuration
Oblique separator panel
Big meshes in square
Square mesh top panel
Hexagonal meshes in the square
Square mesh window in the lower panel
Lowered headline attachment
Shortened selvage ropes
Square mesh top part of the cod-end
Reduced top panel (cut away)

After evaluation of the models the next items were chosen for direct observation at full-scale at sea.

Item:	Big meshes in square	Square mesh top panel	Hexagonal meshes in the square	Lowered headline attachment	Reduced top panel
RVZ		X		X	X
RIVO	X		X	X	

A final selection will take place after observation and if necessary improvements in the rigging. A first set of observations on the 12m beam trawls will be done from FRV "TRIDENS" in March 1992. A chartered boat will operate from Ostend and the ROV-system from FRV "ISIS" to observe the smaller gears in May 1992.

#### Project 239 - EC 1991/2 "Separation of Cod and Whiting in Bottom Pair Trawls"

Research on this topic was continued and financially supported by the EC. Experiments were done in two periods February-March and March-April 1991 on standard and modified pair trawls with the objective to reduce the by-catch of cod while maintaining the catches of whiting. The gears were operated from two commercial trawlers, namely the KW-137 and KW-173, while direct observations using a remotely operated television vehicle were done from FRV "ISIS", during the first period. The modifications tried out aimed at creating larger openings near the footrope of the trawl, through which cod are offered escape opportunities prior to capture. This concept has been proven to work and various modifications of the rigging were tested. The second experimental period was used to investigate the effectiveness of a horizontal separator panel in the same trawl. These experiments were carried out onboard FRV "ISIS" and were meant to supply additional information on typical behavioural differences between cod and whiting. The results prove, that cod show indeed the tendency to seek escape paths underneath the footrope and in the lower parts of the gear, while whiting do not exhibit a similar escape behaviour. Conclusively the research carried out indicated, that cod can be offered escape opportunities in lower parts of the gear, by altering the rigging of the trawl or adding a separator panel. The penalty could be a certain loss in whiting catches. The optimum rigging had not yet been identified, but the idea of creating larger escape openings near the footrope by extending the connecting chains seemed to work well and enable to some extent a more directed whiting

fishery and a reduction in cod by-catches. More experiments were recommended in order to draw definite conclusions concerning the optimum rigging.

The EC accepted a research proposal called "**Improved species and size selectivity of midwater trawls (TE 3.613)**" in which the next organizations will cooperate: SEAFISH Hull (UK), SOAFD - Marine Laboratory Aberdeen (UK), 'BFAF - Institut für Fangtechnik' Hamburg (D) and the Netherlands Institute for Fisheries Research RIVO-DLO (NL). The project is still in the contract phase. The aim is to improve the species and size selectivity of midwater trawls used in Community waters, thus reducing the by-catch and discarding of non-target species in a mixed fishery and the discards of juvenile fish in a single species fishery. RIVO-DLO is coordinator, Marine Laboratory will conduct experiments on fish behaviour in a water tank, SEAFISH will conduct model studies on experimental gear designs in their flume tank, and both RIVO-DLO and BFAF-IFF will do direct observation using their RCTV-systems and carry out comparative fishing trials at sea on their research vessels. All participants will be engaged in summarising the findings and presenting them to their national fishing industries. A first set of sea trials is scheduled to take place on FRV "SOLEA" in August-September 1992.

#### **Informatics :**

The computer program FishEye™ that was developed for the EC-project "**Integrated quality assurance of chilled fresh fish at sea**" was improved considerably. The program is now able to grade sole, plaice, whiting, dab, cod and lemon-sole with an accuracy of about 98%.

For the automatic analysis of otoliths much work was done in extracting the age-information along the lines of growth within the otolith..

The automatic sorting and counting of fish-eggs in plankton samples was developed quite promising. A special flow system was developed to get a constant speed of the plankton samples in the vision area of the camera.

NORWAY  
(Å. Bjordal)

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 Institute, Trondheim (3)

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

### FISH BEHAVIOUR AND REACTION TO FISHING GEAR

The effect on natural distribution of wild fish (saithe) from fish farm activities has been studied by conventional tagging methods and by telemetric tracking (1, in cooperation with Marine Laboratory, Aberdeen). Behaviour of wrasses has been studied for development of more efficient and gentle capture techniques (1).

Analysis of catch data indicates strong effect from seismic activity on the behaviour of fish and catch rates in longline and trawl fishing (1). Reactions of fish to recorded vessel noise has been studied on penned cod (1).

Vertical migration of shrimp has been studied by towing a steel frame with sampling bags at intervals up to 8 m above the bottom. The results show that a standard sampling trawl has rather poor sampling efficiency compared with the frame method (2).

### SELECTIVE FISHING AND SURVIVAL AFTER ESCAPEMENT

Further experiments with fixed sorting grids in fish trawls have shown that this technique has a clear potential for improving the size selection. Data were obtained on cod, haddock, redfish and Greenland halibut, with bar spacing in the grids of 40, 50 and 55 mm (2, 1).



The work on grid sorting system in shrimp trawls has been continued, partly as joint Nordic project with testing of several grid designs versus different sizes of diamond and square meshes (1).

Selection experiments with seine net showed that 50% of the escapement (of cod and haddock) takes place after the fish bag has reached the surface during hauling. Introductory trials with sorting grids in seine net were conducted (1).

Experiments with a plastic body on longline hooks gave improved size selection for haddock, but not for tusk and ling (1).

Further experiments with survival of fish after escapement from trawls indicate low mortality for both cod and haddock, haddock, however, was more vulnerable to scale loss (1). Simulated net bursts indicate significant mortality of herring that escapes after purse seine bursts (1).

## IMPROVEMENT OF FISHING GEAR AND METHODS

Experiments with liquid bait extracts in Norway lobster pots, indicated improvement of catch rate and size selection compared with natural bait (1).

In comparative fishing trials in the longline fishery for haddock, the EZ-baiter hook gave equal catch rates to the Wide Gap hook. Monofilament gangions did not give improved catch rates of tusk and ling (1).

There is now considerable interest in keeping fish alive after capture, both for buffer storage and for ongrowing in pens. For this purpose, gentle capture techniques are required. The work has so far included development of large scale fyke-nets and adaption of seine nets for gentler handling and improved survival (1).

A simple ball roller system is developed for easier handling of sea cage nets (1).

Work to improve sampling trawls was continued including trawl geometry under different conditions, comparison of bobbins and rock-hopper gear (2). Further, a 1-door trawl for sampling close to the surface has been developed (1).

## HYDROACOUSTICS

The acoustic systems EK500 and BI500 have been used on vessels of the Institute of Marine Research for about 1000 survey days in 1991.

A development project on sonar biomass estimation was based on the use of existing sonar hardware (the SIMRAD SA-950) with improved data access. Further data interfacing on the SIMRAD SR-240 omni sonar have been made (1).

Development on the towed body concept was continued with final goal to install EK500 components in the towed body and transfer digital data by optical cable to the vessel. Successful testing and calibration on the ES38D, pressure stable split beam transducer have been made to 400 m. Experiments with resolving dense layers of fish at depth for in situ TS measurements have been conducted (1).

The first version of the mapping/charting module for BI500 is now being tested. Further work will include more advanced tools and geographical software routines for display and analysis of survey data (1).

Software using the detected single fish and connected angular data to track single fish in real time has been developed. Up to 32 fish can be tracked simultaneously, and data on fish "size", swimming speed, direction, vertical and horizontal movement are displayed and stored for further statistical analysis (1).

A larger relational database to handle all scientific data is now being modelled. The database, Ingres V 6.3, will be operational in April -92, served by two HP 9000/mod750. The BI500

database, used during data collection at sea, will be modified so that the tools developed for processing ashore, also could be used on board the vessels (1).

A system for performing "dry measurements" on the EK500 has been developed, simulating the input from a split beam transducer with four independent quadrants. Since time, Amplitude, Phase and Frequency can be set with high precision, the preliminary name for the instrument is TAPP. Initial tests have been successful (1).

Acoustical data to be analyzed by geostatistical methods were sampled on an experimental fjord survey (1).

Multifrequency EK-500 data have been sampled on several surveys for different reasons, like investigating target strength differences, attenuation differences and also for discrimination between plankton and fish (1).

In 1991, a project was commenced for further elucidation of harmful impacts from seismics on eggs, larvae and juveniles from different species. This also included sound pressure and acceleration measurements of the very sound near-field around air guns (1).

## FISHING VESSEL TECHNOLOGY

Two textbooks (in Norwegian) are now in their finishing stage, one on fishing vessel safety and one on working conditions onboard fishing vessels. A data bank on personal accidents in the Norwegian fishing fleet is continuously being updated and extended (3).

The survey on energy consumption in the Indian fishing fleet is now finished. A survey on air pollution from the fleet and plants of the Norwegian fishing industry has also been completed. An energy-saving system for steering a trawler by means of hydraulically changing the position of the trawl blocks has been developed (3).

Ship-to-ship and ship-to-shore data communication via the Inmarsat C satellite has been further tested by fishing, research and coast guard vessels in the Barents Sea. The system is now operating satisfactorily to the north of Spitsbergen. Special software and antenna systems has been developed (3).

Catamaran fishing vessels are met with increasing interest. Feasibility studies for various fisheries have been carried out. An investigation of safety in extreme wave conditions has been conducted (3).

A purse seiner/seine netter has recently been relaunched after extensive modifications, including new systems for loading, holding and unloading the live fish which are now being tested (3).

RUSSIA

(Pinro, Murmansk)

Experimental investigations on selectivity of bottom trawls have been carried out during 1991. The following data have been obtained:

- data on selectivity of bottom trawls rigged with the "Troll-X" system relative to cod and haddock in the southern Barents Sea;
- data on cod and haddock escapement through a trawl bag during hauling and retrieval of the trawl at different speed;
- data on contact of cod and haddock with the sorting grid during escapement through the trawl bag in the shrimp fishery.

## SWEDEN

(L-E. Palmén)

During 1991 one hydroacoustic survey were carried out on herring and sticklebacks covering the Gulf of Bothnia. The study was done within a major program for the Gulf of Bothnia during 1991 between Sweden and Finland. The herring was registered by a 38 KHz echosounder with a hull mounted transducer and the stickleback by a 200 KHz echosounder with a transducer mounted in a towed body.

A mesh experiment were carried out on board a commercial nephrop trawler with a twin trawl one with 60 mm square mesh and the other with 70 mm diamond mesh in the codends. The results showed a considerable increase in the L50 from 26.4 mm to 40.1 mm for the trawl with 60 mm square mesh. Statistical significant difference in the selection range could not be proven between the trawl types.

A so called "Micro trawl" characterized by a long square and two codends has been tested in the cod fishery. The codends are divided almost up to the square which consequently gives a good waterflow and a trawlspeed of up to 3.2 knots. The trawls size are 660 meshes with 120 mm stretch mesh and an opening of 2.9-3.2 m. Experience so far tells that the catches are bigger and the catchability for undersized fish are lower. Two codends has also shown to be practical in the case that the trawl is demolished one still have 50% of the catch left.

A shrimp trawl called "Grenadier trawl" has been developed to separate fish and shrimps because of the hard scales of species like Grenadiers and Silver smelts are affecting the quality of the shrimps. There have been an gusset sewed in the side-panel of the trawl to get an opening of 18-22 m. Using two codends above each other and a separation panel inside the trawl to split the catches have given results of 92-95% shrimps in the lower codend. One problem so far are dogfish that are captured in the separation panel.

A new project with rolling trawl doors have been initiated. At first they are going to used in the small scaled fishery.

SPAIN  
(Eduardo Balguerías)

INSTITUTO ESPAÑOL DE OCEANOGRAFIA (IEO)

ACOUSTICS

Contact persons: Carmela Porteiro, Pablo Carrera and Rogelio Abad

Two acoustics surveys were conducted by the IEO in the Spanish continental shelf:

1- PELACUS 0391 was carried out onboard *R/V Cornide de Saavedra* from 16/03/91 to 11/04/91. Its main objective was to assess both the sardine and the blue whiting stocks occurring in Spanish waters. The cruise covered the Spanish Atlantic and Cantabrian continental shelf down to 1000 meters depth.

A total of 2765 nautical miles were sailed following a zig-zag track. The working area was divided into seven geographic zones and different depth strata for calculation purposes.

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

Hydrographic parameters were recorded in 61 stations and 22 pelagic hauls were conducted for species identification.

2- The ECOMED 91 cruise was planned to assess the stocks of sardine and anchovy occurring in the Mediterranean Sea from Punta Europa (Gibraltar Strait) to Sete (Gulf of Lion). From 21/10/91 to 21/11/91, an area of 14352 squared nautical miles was surveyed by the *R/V Cornide de Saavedra*. This area was divided into 14 sectors and 3 depth strata for calculation purposes. Transects were done following a zig-zag track.

Acoustics signals from a Simrad echosounder EK-500 split beam 38 kHz were integrated over one nautical mile intervals.

Species were identified from catches of 32 pelagic hauls.

## SELECTIVITY STUDIES

Contact person: Antonio Celso Fariña

Studies on bottom trawl selectivity for hake, blue whiting, horse mackerel, megrim, anglerfish and nephrops were completed onboard *F/V Riazor* from 27/05/91 to 13/06/91. Different gears provided with diamond and square mesh codends and mesh sizes of 40, 65 and 80 mm were compared according to the alternate fishing method.

Experiments were conducted in the NW Spanish coast along 60 hauls carried out at 130 and 200 meters depth completing 5 hauls per type of gear, mesh size and depth stratum.



U.K.

(G.P. Arnold)

Fisheries Laboratory, Lowestoft, England

*Effect of noise on RV catch rates.* A carefully designed statistically balanced experiment was undertaken with RV "Corystes" in the North Sea to investigate the effects of underwater noise on fish catch rates. The ship produces very low levels of underwater noise but the propulsion system generates a narrow band 300 Hz tone (plus harmonics) which is transmitted through the propeller. Transmission to the water can be eliminated by the use of chokes. More than 200 tows were made in February and March with a beam trawl and an otter trawl at both a shallow water and a deep water location. For each gear the effects of chokes in and out, direction of tow (with or against tide) and light or dark, were investigated with quadruple replicated half-hour tows in random order. Ancillary factors such as wind speed and direction, speed through the water and speed over the ground, were also recorded. The catches included haddock, whiting, Norway pout, plaice, sole and dabs. A preliminary analysis of the results indicates a small but non-significant effect of ship's noise but strong and significant effects of day and night and possibly other factors for some species.

*Acoustic tag development.* Work has continued to develop a miniature pressure sensitive telemetry tag to operate down to 100 m with an accuracy of  $\pm 0.5$  m. Following the successful trials of a data storage tag reported last year, the design of a miniature version has been completed and an order placed with a commercial company for the manufacture of a pre-production run of 10 tags. A patent application has been lodged in respect of the data storage tag.

U.K.  
(Scotland)

### Cod-end selection methods

A new design of cover has been tested using rigid rings to hold the cover off the cod-end and prevent masking of the cod-end meshes. This technique may be suitable for seine net and pair trawl selection trials. Identical twin trawls were used to compare the selectivity of two identical cod-ends, one with the traditional cover and the other with the new design. Haddock and whiting were caught. Two standard 90 mm diamond mesh cod-ends were used for eight hauls and two similar cod-ends with 90 mm square mesh windows were used for ten hauls. In all cases the 50% retention lengths were larger when the new ringed cover was used. The values given below were obtained from selection curves drawn through the combined data for all valid hauls made with each cod-end.

Cod-end	Cover design	Haddock		Whiting	
		L50	SR	L50	SR
Standard 90 mm diamond mesh cod-end	Traditional	22.9	8.5	28.8	6.8
	Ringed design	27.0	6.4	29.8	5.3
Same but with 90 mm square mesh window	Traditional	27.2	7.0	32.6	7.3
	Ringed design	29.1	7.4	35.6	7.3

### Selectivity

Using the new design of cover mentioned earlier, selectivity parameters were obtained for a range of cod-end designs on pair trawls. The preliminary results are tabulated for haddock.

Mesh size mm	Meshes round	50% retention length cm
90	80	29.5
90	120	22.5
90	150	17.0
100	70	32.1
100	100	32.4
100	130	25.8

Mesh size mm	Meshes round	50% retention length cm
110	80	37.2
110	100	33.0
110	120	29.4

An instrument to measure short distances accurately is being developed for trials in 1992. It will be used to measure the diameter of the cod-end mouth during fishing.

A mathematical model of cod-end shape and loading is being developed to help in the study of the dependence of selectivity on cod-end geometry and other factors.

During one cruise cod-ends made of new materials having a semi-rigid mesh shape were filmed to assess the practicalities of its use over large areas of the cod-end without the problems sometimes found with square mesh netting.

### Separator trawls

Model and full-scale trials have been done for an EC funded project to develop a trawl which separates human consumption species from Norway pout. The design, using a horizontal separator panel, was intended to divert small haddock and whiting to the upper compartment and Norway pout and other species into the lower one. Poor water clarity may have contributed to the inconclusive results. The design and positioning of the separator were varied. It was possible to divert 60 to 80% of all three species either into the upper or lower compartment by changing the height of the panel or the position of the panel leading edge relative to the footrope. No clear separation of pout from human consumption species was possible.

### Grids

A sorting grid suitable for improving selectivity of small haddock and whiting on Scottish trawlers was tested. A rigid grid was placed so that it covered the entrance to the upper of two cod-ends. The 1 x 0.5 m grid could be slanted forwards at varying angles and was formed of 22 mm bars whose spacing could be altered. A 0.5 x 0.7 m rigid vent was attached immediately ahead of the lower end of the grid and an inclined canvas sheet led the fish from the belly netting up to the vent and grid. The aim was that the small fish should pass through the grid into the upper cod-end but the larger fish should find their way down through the vent into the lower cod-end. The results for a bar spacing of 40 mm at a 45° slope for three size ranges of fish show that the concept has potential and further improvement may be possible.

### Sampling trawls

Further data have been collected in the series of trials to determine the factors affecting trawl catches during stock assessment surveys. A report was prepared using data from the preliminary analysis carried out in 1990 and presented at the 1991 Statutory Meeting.

## **Fishing effort**

Trials to measure the swept areas of some new gears having enhanced performance have been undertaken. Engineering data and underwater observations on a twin crown Nephrops trawl will be reported. A study comparing volumes swept by the principal Scottish demersal gears has been completed.

## **Physical modelling**

An EC funded project to improve the modelling procedures for use in flume tanks for instance has continued. "Small model" trials have been conducted in the Hirtshals tank. The results suggested that models scaled at constant Froude Number do not provide accurate drag estimates for the full-scale net. The inadequate modelling of elasticity and stiffness of twines and ropes may also contribute significantly to inaccuracies in model geometry.

## **Fish behaviour**

The study of fish behaviour in cod-ends continued to address the practical problems encountered in making cod-ends more precise selective devices. Further sea trials were undertaken to investigate the use of visual patterns in the cod-end as a means of inducing more consistent escape behaviour. Fish response was found to vary with time of year and it is thought that fish swimming performance and condition factor may impose limits on escape responses. Other experiments and observations have indicated that the more important variables which may affect escape behaviour are light intensity, local flow velocity and water temperature.

Observations on the reactions of schooling fish to netting barriers were made in the aquarium. Fish (mackerel and haddock) were shown to penetrate some netting twines more readily than others. Mackerel have also been shown to penetrate vertical bars of twine more readily than horizontally orientated ones for each of the twines under test.

Some work was done in collaboration with SFIA, Hull on the release of small cod through square mesh windows in cod-ends. It was observed that cod, like most other round fish, are not inclined to escape through the lower panels of cod-ends.

## Acoustics

Surveys of herring were carried out 1) in the ICES area VIa and 2) in Orkney Shetland and Buchan areas in July 1991. The latter survey was in conjunction with Norwegian Danish and Dutch fisheries research laboratories. During the VIa survey data was collected in individual sample format for each transmission and with 0.5m depth definition at 38 and 120kHz. For the Orkney Shetland area data was recorded on Sun from EK500 echosounder at 38kHz.

Work on the automatic extraction of shoals has developed the system has been transferred to Sun computer system. The echo sounder output is treated as an image and loaded into a Sun based system using Imaging Technology high speed image processing cards. Image processing techniques involving smoothing, edge enhancement, multiple binary thresholds, erosion and dilation are used to isolate and define the locations and shapes of fish shoals and the seabed from the image. Timing is dominated by data recovery and the association of adjacent pixels into connected objects. Typical image recovery and processing is less than 20 seconds for 512 acoustic transmissions. The objective of the work is to aid extraction of shoal statistics to assist with understanding of stock distribution and species recognition.

Work on survey design methods has continued using a series of simulations to investigate the precision of estimates with different survey methods. 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.

U.S.A.

Fisheries Acoustics Science and Technology Issues

Alaska Fisheries Science Center, Seattle, Washington

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 AND 1992, 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 and 1992 including shelf waters of the eastern Bering Sea. Annual surveys of the Gulf of Alaska spawning stock in the Gulf of Alaska have continued through 1992. Target strength studies of fish using the split beam technique continue and standard sphere calibration has become 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 fifth in a series of triennial surveys (summer) of pollock in the Bering Sea was completed in 1991. The sixth triennial survey of Pacific whiting off the west coast of the U.S. is scheduled for the summer of 1992.

Southwest Fisheries Center, La Jolla, California

Bio-acoustic technology is used in a study of predator/prey interactions in the antarctic marine ecosystem. The predators are chinstrap penguins and southern fur seals breeding in the vicinity of Elephant Island, off the northern tip of the Antarctic Peninsula; their principal prey is antarctic krill (*Euphausia superba*). Aspects of the foraging ecology and reproductive success of seals and penguins are studied at selected breeding sites. Complementary shipboard observations are used to describe within and between season variations in the distributions of krill, zooplankton, phytoplankton, and water types. During the 1992 field season, a Simrad EK500 echo sounder was used by the Antarctic Ecosystem Research Group at the National Marine Fisheries Service's Southwest Fisheries Science Center to map the distribution of krill. A 120 kHz split-beam transducer was deployed on a dead-weight towed body, and communicated with the echo sounder via 50 m of armored towing cable, a set of slip rings on a towing winch, and 75 m of shielded deck cable. The echo sounder was connected via ethernet to a UNIX workstation for post-processing and archiving of acoustic data. For the purposes of generating distribution maps and abundance estimates, volume backscattering attributed to krill was integrated over the 10 m to 250 m depth range and averaged over 1 nmi transect intervals. These values were gridded and contoured to produce distribution maps. Abundance was estimated by converting area backscattering strength to krill

biomass density using a new formulation for krill target strength from Miller [Biomass Newsletter 13(2):6] and treating the mean density on each transect as an independent estimate of the mean density over the survey area. Volume backscattering measurements are currently being analyzed at higher resolutions to describe the dominant horizontal and vertical scales of krill aggregation patterns. The system was also used to 1) collect target strength measurements on both individual and aggregated krill; 2) direct simultaneous high-resolution net sampling; and 3) conduct fine-scale mapping of a krill aggregation over a 48-hour period.

#### Southeast Fisheries Center, Pascagoula, Mississippi

The Southeast Fisheries Center (SEFC) group continues to develop fisheries acoustic surveys for small pelagics in the Gulf of Mexico. A single survey was scheduled for the fall of 1991, but was canceled due to vessel problems. In June, 1992, the Center plans to use acoustics to assess the performance of video equipment used to survey reef fish at sites currently sampled with a video camera and trap. Acoustics will be used to estimate the abundance of fish over the survey site. In July and August, 1992, plans are in place to estimate the acoustic backscattering cross-sections of small pelagic and other species held in a cage. The work will be a joint effort with the Florida Department of Natural Resources (DNR). A fisheries acoustic/rawl survey is also scheduled in October. Florida DNR conducts surveys for Spanish sardine (Sardinella aurita), scaled sardine (Harengula jaguana) and Atlantic thread herring (Opisthonema oglinum) along the coast near Tampa Bay, Florida in depths ranging between 5 and 14 m. Vessel avoidance has not been a problem.

#### GLOBAL Ocean ECosystems Dynamics Program (GLOBEC)

IOC and SCOR have formally approved the formation of a Scientific Steering Committee to establish and coordinate an international GLOBEC program. There are four major focus areas: 1) fundamental process studies; 2) retrospective analyses of existing data with new tools; 3) numerical modeling and 4) advanced sampling systems. ICES is co-sponsoring International GLOBEC and, in particular, acoustic survey data from the area included in the ICES Cod and Climate project form a data base that may benefit from retrospective scrutiny. There are numerous examples of possible new acoustic technology that may be applicable to International GLOBEC. One of these is the development of acoustic (and other) instrumentation which can be used in ship-of-opportunity sampling programs to complement such direct sampling as is done in the continuous plankton recorder (CPR) program.

The U.S. GLOBEC Scientific Steering Committee continues to successfully encourage U.S. funding agencies to sponsor development of new acoustical technology, including moored acoustic systems for quantitative measurement of zooplankton, micronekton and fish larvae size and abundance in relation to the

physical environment. A strong recommendation to integrate complementary acoustical and optical measurements into advanced ocean sampling systems has evolved from conferences on both acoustical and optical technology development for GLOBEC science programs.



## Fishing Technology and Fish Behavior Issues

### National Marine Fisheries Service, Northeast Region

Catch comparison experiments with a Nordmore Grate in the Gulf of Maine shrimp fishery have concluded with favorable results with regard to by-catch reduction and shrimp retention. Grates manufactured from ultra high molecular weight polyethylene (UHMWPE) and with 0.75 and 1.00 inch bar spacing were evaluated. No evidence of size selectivity of shrimp was noted with the spacings tested. Grates manufactured from UHMWPE were found to be more acceptable to the industry than grates fabricated from aluminum, as they could be handled on net reels. These results have prompted managers to require vessels fishing for northern shrimp to equip their trawls with this device as of April 1,

A study is to be conducted with the cooperation of New England fisheries industry leaders, vessel owners, the University of Rhode Island, Massachusetts Division of Marine Fisheries, and the National Marine Fisheries Service. The prime objectives of this project are to develop fish size selection curves for 5.5 inch square and diamond mesh and 6 inch square and diamond mesh shapes for yellowtail flounder and Atlantic cod. Also planned is to compare statistically L25, L50, L75, Selection Range and Selection Factors for the eight selection curves developed. The experimental design follows a paired-alternate tow method, comparing a small mesh codend (control) with an experimental codend. All testing is to be performed on a commercial fishing vessel and tows will be of commercial length.

### University of Rhode Island Fisheries Program

Survival studies on fish escaping through codend meshes were conducted and analyzed. Fish were held in underwater pens after passing through the meshes of a towed codend simulation apparatus. High survival rates occurred, with 100% survival in many treatments. While no survival differences were noted by mesh shape, some fish were found to escape more quickly from square mesh codends.

Studies of fish behavior in and around commercial trawls are being conducted using a self-contained low-light camera with a separate 8 mm recording unit and battery pack in an underwater housing.

## Massachusetts Division of Marine Fisheries

The MDMF and the New England Aquarium have completed the first year of an investigation on trawler discarded juvenile groundfish. Two cruises were made to assess the survival of the deck discard of cod (Gadus morhua) and American plaice (Hippoglossoides platessoides). Survival rates were determined by placing the "discarded" fish in large cages and returning them to the tow depth for about 24 hours. The first cruise, in early June 1991, resulted in overall survival rates of 264 cod at 12% and 209 plaice at 44%. Over all survival rates for the second cruise, in late April 1992, 51% for 115 cod and 66% for 178 plaice. Cod and plaice blood samples were taken from another subset of fish and analyzed for hematocrit, protein, lactate, chloride, glucose, sodium, potassium, total osmolality and cortisol. Lactate concentrations increased dramatically as time on deck increased, but did not vary with length of tow. Cortisol concentrations were elevated above the control values in all fish, regardless of length of tow or time on deck.

A second series of two cruises will assess the survival of discarded fish and fish that escape from the cod end. The same species are the subjects. The first cruise was just completed in early June 1992. The discard methodology was the same as the previous year. A detachable cod end cover was constructed and deployed to catch the escapees. The cover, turned cage after its release, remained on the bottom for 24 hours. An ROV was used to survey the entrapped fish just after the cover was released and just prior to retrieval of the cover/cage. An initial review of the data show a high survival rate of the escaped fish and a much lower survival rate of the discarded fish.

MDMF has also been investigating the reduction of bycatch. The small mesh trawl fishery for whiting (Merluccius bilinearis) usually has considerable bycatch of groundfish. The goal of this experiment was to gather preliminary data on the behavior of whiting and bycatch species relative to capture by an otter trawl and to design an otter trawl for the directed whiting fishery which will selectively fish for whiting, substantially reducing the amount of groundfish and small whiting. A net with a horizontal panel was experimentally fished from a chartered commercial trawler. The panel height was changed to assess changes in the catch of whiting and bycatch species. The results lead the researchers to believe that a trawl net can be designed to significant reduce the bycatch when fishing for whiting. The net will be converted for commercial use and used to assess the commercial application of this method.

### MIT Center for Fisheries Engineering Research

The Center continues to make the facilities of the David Taylor Research Center available for fisheries gear research and instruction. These include a 22 foot wide circulating water channel, a 52 foot wide towing basin and a 360 by 240 foot wave tank. These facilities continue to be improved to suit a wider range of fisheries research needs.

Two types of in-situ observation systems are being developed. The TUGOS, a towed vehicle for observations of trawls has seen further improvements. Modifications to the vehicle's shape are planned to increase its performance and to reduce the chances of entanglement. The Center is also working with MIT's Underwater Vehicles Laboratory on developing the techniques and hardware for the use of autonomous underwater vehicles (AUV's) in fisheries research.

### University of Washington, Fisheries Research Institute

The fourth Phase of the West Coast groundfish trawl codend mesh size study is using the field data and models developed during earlier phases to predict the short- and long- run effects of changes in codend mesh sizes and shapes.

Field work consisted of sending two observers along with sampling gear and detachable codends onboard groundfish trawl vessels fishing off the U.S. West coast. Four codends of different mesh sizes or mesh shapes were towed during each trip following a randomized complete block design. Variation in catch value, total weight, utilized weight, discarded weight, and gilled weight, are being analyzed to assess the short-term impacts of codend changes. Selectivity parameters obtained from analysis of length frequency data will be applied to single and multispecies models to assess long-term impacts of changes in codend mesh size or shape.

Future research plans include a study to estimate the survival of discarded Pacific halibut and king crab (Paralithoides sp.) in Bering Sea trawl fisheries.

### University of Georgia

The development of devices to reduce fish take in shrimp trawls is being pursued. This includes looking at the modification of turtle excluder devices (TEDs) as well as newly designed Bycatch Reduction Devices (BRDs).

Shrimp trawls made of LCPF materials (Spectra) are being tested for improvements in fuel efficiency by comparison towing with nets of traditional materials.

### University of North Carolina

Development of Bycatch Reduction Devices (BRD's) for shrimp trawls is being pursued with flume tank testing, divers, trawl cameras, test drags and testing in the fishery. The test tows indicate a 42% reduction in finfish bycatch with no shrimp loss.

Research on a skimmer trawl, a shallow water net held open by poles attached to the boat, found it to be extremely effective at catching white shrimp, with a 40% reduction in finfish bycatch.

### Texas A&M University

While continuing work on TEDs the major focus has become the design and testing of BRDs. Bycatch reduction by TEDs has been monitored during commercial shrimp trawling. One TED (Morrison) was found to exclude 40 to 50% of the fish bycatch. Data is also being collected on bycatch reductions while using a BRD installed behind a TED.

Improvements in energy efficiency of 10 to 15 %, concurrent with shrimp production increases of 15%, were found when using shrimp trawl constructed of Spectra webbing.

### NMFS, Alaska Fisheries Science Center International Pacific Halibut Commission

To facilitate the development of more selective fishing gear, a trawl mounted video system was developed to observe fish behavior in the vicinity of various components of a bottom trawl. This system was used during two cruises in 1991. Pacific halibut (Hippoglossus stenolepis), Pacific cod (Gadus macrocephalus) and various small flatfish were the primary species observed. These fish were viewed in front of the footrope, passing through the intermediate and reacting to several modifications added to the trawl. Behavioral differences which might be exploited to separate small flatfish from cod and large (>50 cm) halibut included; less time spent in front of the footrope, lower height while passing over the footrope and a tendency to remain close to the bottom panel throughout the trawl. No such clear differences were noted between cod and large halibut.