International Council for the Exploration of the Sea

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Report of Activities

FISH CAPTURE COMMITTEE

by

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1985

BELGIUM

(G. Vanden Broucke)

Within the framework of an energy-saving project, different possibilities were studied. Research was carried out to reduce the hydrodynamic resistance of trawls by adapting the technical parameters influencing the drag. These parameters were: the diameter of the netting yarns, the mesh size and the cutting rate.

As regards the rigging of the fishing gear new types of otter boards were introduced.

For the beam trawlers a warp tension meter was designed in order to enhance the safety in the case of overloading on one of the beams.

For the shrimp fishery experiments were carried out with an electrified beam net. The aim was to create an electrified field in the front part of the net.

On the research vessel "Belgica" a series of measurements to study the geometrical configuration of a bottom trawl (vertical and horizontal net opening) were carried out.

Research on netting materials and normalization was continued in co-operation with netting manufacturers and within the

framework of the different projects carried out by the Research Station.

As in the past the netting yarns used in Belgium are made of polyethylene (66%) and polyamide (33%).

Future work

- Studies on fuel saving.
- Electrical fishing for shrimp and flatfish.
- Selectivity experiments with square meshes.
- A rock-hopper experiment for the coastal fishery.
- Experiments on laboratory scale to measure the electrical field distribution between electrodes fed by pulsegenerators.

CANADA

(P.J.G. Carrothers)

Six organizations report innovation in fishing gear, usually the introduction of established gears in new applications. The Federal Development Branch in Newfoundland reports mounting a longtime sheave with brake on the vessel to hold the monofilament mainline as required for removing fish and baiting hooks while under-running moored gear to avoid having to hold this relatively sharp line by hand. They report completion of two Nordco longline systems, one a simple manual system for inshore and the other automated for larger vessels. They also had two projects to determine the feasibility and viability of harvesting redfish with near-shore otter trawlers for the high-quality food market; daily landings of boxed, uniced fish was preferred. The Newfoundland provincial goverment now reports that 2-mm, plied, Kevlar, trawl twine was found too fine, even though it was as strong as the 4-mm polyethylene twine normally used. Federal Development in Halifax report that braided, knotless netting in a square-mesh codend experienced no mesh

distortion and less abrasion, and yielded better selectivity than did netting previously used. A prototype of their new scallop rake design indicated reduced drag and improved rock rejection for less damage to the scallops while maintaining catch rate. A six-month trial of a prototype, dual-purpose (Schottish seine or otter trawl) system, with fully powered hauling and stowage reels, on a 29-m commercial vessel was completely successful. Change-over between gears at sea required less than 20 minutes. Pair shrimp trawling with 14-m vessels showed improved catching efficiency and reduced drag when using pony doors in conjunction with only a 5/1 warp scope ratio. Work on longline systems continues, with emphasis on light attraction. The Nova Scotia provincial government reports ongoing experimentation with artificial baits for longline gear and for lobster traps and with spring-loaded scallop rakes for small, inshore vessels. Aluminum net reels on inshore draggers under 14 m have been shown to make gear handling easier and safer. The New Brunswick provincial government reports technical and financial assistance to the commercial fishery in trying available, more sophisticated trawl doors, with plans for further assistance with trawl doors, net drums, high-lift trawls and rock-hopper footropes. Federal Development in Vancouver are adapting the Nordco longline gang-baiter to local conditions using circle hooks. Also in technical innovation, they report a twin beam trawl sampling system for juvenile salmon, herring, plankton, etc. from surface to seabed, and a jet-pump system under development for sampling juvenile crabs and prawns. The Federal Research Branch in Newfoundland report progress with their Multiple Opening and Closing Sampling System (MOCSSY) for capturing larval fish and other plankton. A depth-stratified survey has been carried out and further, planned, epuipment developments include a more powerful stepping motor, improved power supply, a second digital flow meter and a light meter.

In relation to trawl survey methods for fish-stock assessment purposes, Federal Research in Newfoundland reports continuing work to evaluate the influence of currents and tides on catch results, involving continuous fishing at selected sites with simultaneous measurement of physical oceanographic data (current speed and direction, bottom temperature and light level). Unfortunately, sea time was reduced by vessel problems to 1/6 of that intended, but enough information was obtained to improve experimental procedures for next year. Federal Development in Newfoundland report two exploratory surveys to determine feasibility of new, commercial fisheries. Federal Research in the Gulf of St. Lawrence reports an electronic survey data logging system involving a digital balance (compensated for ship motion) and measuring board for individual fish, trawling data (including water temperature at the trawl), navigational data, catch weight and count, and manually entered biological data. Data were displayed to assist planning and were edited during the survey, thus reducing errors and eliminating post-survey data transcription, verification and manual entry.

Four organizations report selectivity studies. The Newfoundland provincial government confirms that a square-mesh codend fished from a 20-m vessel released more under-size cod than did a diamond-mesh codend of the same mesh size. Federal Development in Vancouver also report plans for evaluating and demonstrating square-mesh codends, including twisted, knotless netting. Their study on the effect of variation in mesh size and hanging ratio in salmon gillnets has been reported and they propose to evaluate the selection of monotwist core gillnets for chinook salmon. Federal Research in the Gulf of St. Lawrence identifies a selectivity study with herring gillnets involving four mesh sizes, four colours and two fibre types, reported in detail to CAFSAC. Federal Research in Quebec report a theoretical selectivity study of the effect of escape-vent size in lobster traps.

An analytical approach to trawl studies, involving computer processing of engineering data, is reported at three locations. A graduate student at Memorial University of Newfoundland is approaching the problem of matching trawls to trawlers by conducting towing tank tests to estimate netting drag at various angles and speeds and by a numerical analysis of field data to predict warp shape and drag. Staff at the Technical University of Nova Scotia are looking into the potential of finite element techniques for mathematical trawl modelling. Federal Research on the Pacific reports work in the flume tank at the University of British Columbia, which is instrumented for engineering studies rather than for gear demonstrations, and an interactive computer program for trawl design including 3-dimensional graphic displays.

Concerning underwater observation of fish and gear in situ, Federal Research in Newfoundland reports trials into the suitability of photographic and video monitoring systems on the manouverable, towed vehicle MANTA for snow crab surveys as a means for biomass estimates. Water turbidity and camera failure frustrated success in this first effort. With Federal support, the Marine Sciences Research Laboratory of Memorial University of Newfoundland has installed a fixed hydrophone array in Conception Bay to track cod carrying ultrasonic transmitters for a study of their behaviour in relation to measured environmental conditions. In another study, depths and

temperatures at which cod tend to concentrate during migration and individual preferences for depth and temperature in inshore areas, particularly around cod traps, were monitored by tracking five cod carrying acoustic tags. Interference by ship noise was detrimental to tracking. Federal Development in Halifax report acquisition of an underwater, video, remote-controlled vehicle which is being used in the refinement of low-resistance towed fishing gear. Federal Research in the Gulf of St. Lawrence report using a television camera mounted on a sledge rake and coupled to a stereoscopic photographic camera for bio-estimates of snow crab. Counts are obtained from the video recordings and sizes are determined from the photographs, while contour maps are obtained automatically using special software. Federal Research in Quebec report trials with still, underwater photography to assess densities of snow crab and scallops. They also report a magnetic tagging program to assess stock size and other parameters for management of the snow crab resource in the St. Lawrence estuary.

Federal Research in Newfoundland report increasing use of hydroacoustics for fish abundance estimates. It is well established for capelin and confidence is growing for redfish, particularly considering that trawl estimates are adversely affected by contageous distribution and diel movements of the fish. Equipment reliability is improving. Methodologies have also been developed to obtain, for the first time, quantitative biomass estimates of herring from acoustic/purse-seine surveys. To further this initiative, development of a transceiver for a new, modified, dual-beam system for measuring fish target strength in situ was commenced. An underwater towed vehicle and oceanographic towing cable are being acquired for this system. The Marine Ecology Laboratory in Dartmouth report a source of significant bias which must affect interpretation of data in both counting and integration techniques and which is seen to influence variability in target strength observations. It is possible to identify the distorting effects with the dual-beam ECOLOG, and a method of field calibration has been developed with this information which yields close agreement between the results of acoustic and trawl surveys. Federal Research in St. Andrews reports that randomized or systematic area surveys of herring give poor abundance estimates. Instead, replicate coverage of known concentrations is required, and survey lines should be run only to search for aggregations or where they have been repeatedly delineated. Attempts to determine spatial distribution and orientation of herring by stereo photography from a towed vehicle for validation of acoustic results indicated that measured fish-number density decreased as the fourth power of the range. This obviously incorrect relation is attributed to the light intensity from the camera flash and the area of the fish image both decreasing as the square of the range. This limiting factor seems to hold even at short ranges and true fish densities are not observed by this method at any range. Federal Research at Nanaimo report routine hydroacoustic enumeration of juvenile salmon in lakes, integration and counting techniques for Pacific salmon in major inlets and evaluation of hydroacoustic possibility to predict salmon escapement to the spawning grounds. Winter, offshore herring distributions were monitored acoustically and sampled by trawling for biological information and to study problems associated with quantitative estimates.

Federal Development in Halifax report the successful testing of a prototype, segmented, plastic, propellor nozzle which has aroused considerable commercial interest. Federal Development in Vancouver report a computer modelling program for fishing vessels and their operation to seek opportunities for energy conservation and a model-testing program for fishing vessel hulls to reduce hull resistance, both at the University of British Columbia. They also report preparation of pilot, three-dimensional, Loran C, fishing charts with promising results and further pilot work and system development on the Atlantic Coast; and they report development of computer software for displaying predicted tidal current data, including a tracking component which is used for search and rescue and will likely be useful in fishing operations.

DENMARK

(H. Lassen)

Trawl Door Design

Systematic tests have been made in the Flume Tank of 1:4 and 1:5 scale models of vee doors of 6,4 m^2. The effect on spreading force and drag have been measured when alterations are made to the towing chains, angle of attack, angle of heel, angle of vee, aspect ratio, cambering and the fitting of slots. The results were reported to the Working Group meeting in Tromsø.

Netting Resistance

Tests have been made in the Flume Tank of the resistance of elliptical cones of full scale netting. The netting sample is 6 m long, towed from a frame 4 m x 2,5 m, and is made fast to an elliptical hoop at the downstream end which is tensioned. The effects of material type, construction, twine diameter, mesh size, cutting rate and mesh opening have been studied and formulae derived for determining the resistance of such a section of netting. It was found that mesh opening and cutting rate/angle of attack were important parameters. The resistance of cones of square mesh netting were also measured and found to be very high.

Basic Net Design Principles

A program of systematic tests has been initiated in the Flume Tank to determine the effect upon a trawls towing resistance and the opening of the meshes in different parts of the trawl when changes are made to the distribution of strain in the net mouth. These changes are effected by altering the shaping of the net panels, the hanging of the netting on the frame ropes or the relative strain taken by the different towing bridles.

Computer Aided Net Design

A project has been started which is aimed at producing net drawings, design help, accurate net drag predictions and matching of net size to door size and vessel towing power. The computer programs are to be used by the Danish trawl manufacturers and the starting point has been the Gifford Technology/Marine Laboratory CAD net package. Design techniques are to be changed to Danish commercial practice and the results of the previous projects input to give more accurate net drag predictions.

Selectivity Studies

A separator panel for sorting fish in to a separate codend in North Sea Shrimp Trawls has been designed in conjunction with the Marine Laboratory, Aberdeen. The design was finalised using a 1:3,3 scale model in the Flume Tank. The trawl was then tested full scale at sea by the Marine Laboratory aboard a commercial vessel during the summer.

Netting Material Studies

Studies within this new field of research for the institute have begun with the measurement of twine diameter and breaking strain of the commonly used commercial products. Comparison has been made between samples from spools of untreated twine and from finished netting.

Twin Trawl Systems

Substantial numbers of boats trawling for nephrops have adopted the twin trawl/3 wire system first used successfully in 1984. In addition in 1985 a twin trawl system requiring only 2 towing wires was developed in the Flume Tank, tested at sea with instruments to check the spread of the gear and then introduced to the commercial fleet with extremely good fishing results. The use of double trawl systems has also proved to be successful for flatfish (plaice and witches).

Trawls for Vessels of High Towing Power

Several new trawlers have been built within the last year which have towing power well above that traditionally available for shrimp and sandeel fishing. The institute has worked closely with the industry making a lot of detailed design studies and model tests in the Flume Tank in order to dimension the trawls correctly.

Siamese Trawls

A new design of nephrops trawl has been developed with a net manufacturer in the Flume Tank and used successfully at sea. The bosom of the footrope is made much wider than usual by in fact making 2 bosoms and a short centre wing which is towed off rubber disc legs functioning like a tickler chain.

Pelagic trawls

The standard pelagic trawls (FOTÖ model 80 and 84) used by R/V G.O.Sars, R/V Argos and R/V Dana were tested in the flumetank at the Danish Fishery Technology Institute. Model 84 were found to be the better and this trawl has become the standard trawl for surveying pelagic fish stock.

Acoustic methods

A towed body system carrying a split-beam acoustic transducer and low precision CTD-system were developed in cooperation with the Danish Maritime Institute. The towed body has a hydrofoil which produces a drag away from the research vessel. The body is

usually towed in 3-5 m depth with a speed up to 12 knots. On average about 11 knots have been achieved compared to the previous average integration speed of 8 knots. This has been possible due to the reduced noiselevel compared to the hull mounted transducer. Its weight is about 200 kg incl. transducer.

The SIMRAD ES400 split-beam system was installed on the R/V Dana in July. The system was tested by calibration and during cruises. It has still not been functioning properly.

The eastern part of the North Sea was surveyed for 0-group herring in July 1985 on a trial basis. It appears that hydroacoustical surveys are quite feasible in this area at this time of the year.

Stock estimates comperable those obtained by other methods (multispecies VPA, IYFS, VPA) were found.

The Bornholm Deep in the Baltic was surveyed for cod in March 1985. The analysis of these data are still underway.

The shallow western part of Kattegat were surveyed for herring and sprat in August-September. Also these data are still not analysed.

The annual joint Swedish-Danish hydroacoustic survey for herring in Skagerrak, Kattegat and western Baltic was conducted in August-September and reported to ACFM in November as usual.

The study of the target strength frequency dependence was continued in collaboration with the Danish Technical University. There is no results yet to report.

FAROES

(H. í Jakupsstovu)

During 1985 the Fisheries laboratory of the Faroes has conducted the following activities of interest for the Fish Capture Committee of ICES.

In February a salmon longliner was used for experimental fishery for atlantic salmon within the Fishery zone of The Faroe Islands. The fishing stations were distributed throughout the entire zone. For each longline set a number of biological parameters were recorded, together with surface temperatures and positions at beginning and of set and beginning and end of haulback.
In addition, during the survey, two salmon tagged with acoustic tags were tracked for 12 and 18 hours respectively.

The blue whiting spawning stock was assessed acoustically in April during a suvey with the Faroese research vessel *Magnus Heinason*. In august the same vessel participated in the ICES coordinated blue whiting survey in the Norwegian sea.

Since the late seventies pair trawling has been of increasing importance as a fishing method in faroese waters. In June 1985 pairtrawling experiments were conducted with two pair trawlers over deep waters around the Faroes. The aim of the experiment was to

test the method at depths not fished previously by Faroese pair trawlers, to compare the catch rates against coventional single boat trawling at the same depths, and to measure the oil consumption of pairtrawling with depth. On limited fishing grounds pair trawling is space demanding and occasionally conflicts arise between pair and single boat trawlers due to this. During the experiment pair trawling with otter boards was tryed successfully. The distance between the vessels was reduced significantly using otterboards compared to without.

In 1986 the following activities are planned.

The tracking experiments on atlantic salmon were continued in February. One specimen was followed nearly 6 days.

The acoustic assessment surveys with *R/V Magnus Heinason* in April and August will be continued.

In May-June an experimental fishery on redfish is planned over the Mid Atlantic Ridge south west of Iceland.

Experiments on automatic baiting and handling of monofilament longlines are also planned in 1986.

FINLAND

(P. Suuronen)

The experiment concerning the possibility to increase the mesh size of the leader net of the Baltic herring trapnet in the Archipelago Sea and Gulf of Finland were continued. A comparative fishing trial with a pelagic trawl with very large meshes (8 m bar length) in the front part of the trawl was carried out in September in the Bothnian Sea in order to test the suitability of such a trawl for the Baltic herring fishery.

Acoustic survey was conducted in July-August in sub-divisions 29-32. Target species were Baltic herring and sprat. For the system calibration a standard target was used. The echoes were also recorded for further analysis.

FRANCE

(C. NEDELEC et N. DINER)

TECHNOLOGIE DE LA PECHE

Engins et méthodes de pêche

L'observation du fonctionnement des chaluts a été poursuivie à l'occasion de la campagne de la "Thalassa" en septembre 1985. On s'est attaché en particulier à la mesure des paramètres des chaluts de fond à grande ouverture verticale avec acquisition et traitement informatisé des données à bord. Un essai préliminaire d'un équipement remorqué et télécommandé de visualisation TV (système OCEAN ROVER de Seametrix) du fonctionnement du chalut et du comportement a été effectué.

L'étude de la senne coulissante (à petits pélagiques) a été commencée sur la base d'une description et d'une évaluation des méthodes existantes en Bretagne-Sud. Cette étude sera complétée par des essais sur maquettes et des mesures en mer, visant à la réduction du coût des sennes, à une plus grande facilité de manoeuvre et à une amélioration de l'efficacité.

Le développement des chaluts jumeaux a été entrepris en collaboration avec un fabricant de filets. A la suite d'essais sur maquettes au bassin de Lorient, une expérimentation en mer, en vraie

grandeur, a été effectuée à bord du nouveau bateau de recherche "Gwen-Drez" (24 m) en novembre 1985. Les premiers résultats, en pêche commerciale, confirment l'intérêt de cette technique qui permet d'obtenir une augmentation de 30 à 40 % du rendement en espèces démersales.

La drague cribleuse pour coquillages enfouis a été essayée en juillet sur un bateau professionnel de Granville. La manutention de la drague et des tuyaux d'aspiration sur un bateau de 12 m n'a posé aucun problème, et le fonctionnement de la drague a été parfois extrêmement satisfaisant. Des inconvénients ayant été rencontrés sur certains types de fonds, une mise au point complémentaire est prévue en 1986.

L'équipement des bassins d'essais de Boulogne et Lorient en appareils de mesure (courantomètre, capteurs de tension) et en matériel de visualisation (caméra TV) a été complété. Par ailleurs, l'étude du projet de nouveau bassin de Boulogne a été poursuivie. La réalisation de ce moyen d'essai amélioré est prévue dans le cadre du projet de Centre National de la Mer.

Le tracé informatisé des plans de chaluts a fait l'objet du développement d'un logiciel avec le concours du Centre National de la Mer de Boulogne. Ce logiciel comporte essentiellement un programme de tracés de plans, l'établissement d'un fichier de plans et des extensions de programmes concernant les calculs de poids et de surface de fils, les devis de fabrication et les modifications de pièces.

L'étude de l'amélioration des conditions de travail et de la sécurité à bord des bateaux de pêche, entreprise en collaboration avec l'IUT de Lorient * a été poursuivie. les observations effectuées sur des navires professionnels (19 à 26 m et 33 à 35 m de longueur) comportent des observations sur l'équipement de pont et la manoeuvre des engins de pêche.

Pêches expérimentales et exploratoires

Des essais de pêches aux palangres pour squales ou merlu, et des chalutages profonds avec de nouveaux types de chaluts à crevettes ont été réalisés en Méditerranée.

Mécanisation du tri

En relation avec l'étude d'un nouveau type de chalutier de pêche fraiche industrielle, nous avons participé au développement d'une balance électronique permettant la pesée du poisson à bord, ainsi qu'à la réflexion sur la conception d'une salle de tri automatisée.

Assistance technique. Diffusion des connaissances. Coopération.

Ce programme de routine groupe l'ensemble des activités sur le transfert des connaissances. Son exécution régulière apparait indispensable pour assurer la liaison entre la profession, l'administration et la recherche.

* IUT = Institut Universitaire de technologie

Comme les années précédentes, les actions ont porté sur l'information directe, les travaux de bureau d'étude, les démonstrations en mer et aux bassins d'essais, les avis sur les aspects techniques de la réglementation et les services consultatifs (avis à l'Administration et expertises diverses).

Dans le cadre des actions au titre de la coopération, on notera la formation de plusieurs stagiaires étrangers, un échange de chercheurs avec l'Institut de recherche sur les pêches du Portugal et l'organisation d'un stage de formation en technologie de la pêche à Lisbonne (en liaison avec l'INIP).

ACOUSTIQUE PECHE

Améliorations de la technique d'écho-intégration et de ses applications pour l'exploitation des stocks

Un logiciel d'exploitation des données a été mis au point sur micro-ordinateur pour le calcul des stocks par espèce avec (évaluation d'une variance "identification") en poids et en nombre, le calcul du taux d'efficacité des chaluts et le tracé des routes suivies.

La mise au point d'une technique de détermination des index de réflexion in situ a été entreprise.

La technique d'identification des espèces par classifieur d'écho a été poursuivie en travaillant sur l'influence des seuils de prise en compte par l'écho-intégrateur.

Acoustique et comportement

Des données préliminaires intéressantes ont été obtenues grâce au sonar omnidirectionnel lors des campagnes de la "Thalassa" : HEID 84 et EIGAS 85. En particulier des réactions d'évitement très nettes ont été mises en évidence.

Le comportement jour-nuit des détections a été étudié. Il ne semble pas constant et l'on a observé des variations dont l'analyse est actuellement en cours.

Une expérimentation, en octobre, a mis en évidence la possibilité de travailler avec un corps remorqué divergent qui, support d'une base acoustique, permettra, d'une part, de mieux quantifier les évitements des bancs à l'approche du navire en prospection à 10 nds et, d'autre part, de cerner plus précisément le comportement des espèces, navire en pêche, dans une zone comprise entre le chalut et le navire lui-même.

GERMAN DEMOCRATIC REPUBLIC

(W. Thiele)

Development work has been carried out in both deep seas and inshore fisheries in accordance with GDR fishing patterns.

Deep-sea fisheries

Improved trawl nets were taken in use in the shrimp fisheries at depths between 400 and 600 m in the south-western Indian Ocean. The new trawl designs and the use of trawling outriggers led to higher catches and reduced the fuel consumption.

Pelagic trawls which are better suited to the specific conditions of the fishing grounds and the fish species have been developed for use on fishing grounds in the North, Mid, and South Atlantic. A trawl net, with asymmetric side panels for squid and mackeral fisheries has been developed, as well as a trawl with a very large square spread (up to 80 x 80 m) for catching schools of fish spread over a large area. All pelagic trawl nets have been fitted with a novel pocket/standard section, which improves their hydrodynamic qualities. This has led to a considerable reduction in the number of fish which are meshed. The new design was tested both in a wind tunnel and a flume tank. A new cutting pattern has been developed for ground trawl nets reducing the amount of materials needed by 25%. The catching performance of this net is comparable with that of conventional nets.
Rope pulleys with a high surface hardness (58 HRC) have been taken in use to reduce wear on the trawl warps. As a result, the service life of trawl warps has increased by more than 10% and that of the rope pulleys by more than 500%.

Following very positive results obtained in shrimp trawling in 1984, a second similarly equipped factory trawler/processing ship of older design was brought into operation in 1985. Conventional lamps, drift anchor, jigging equipment and stability sails were used.

Inshore fisheries

The GDR fishing industry also found it necessary to replace traditional inshore trawls with new trawls with lower hydrodynamic resistance.
Thus, new herring trawls have been developed, tested and taken in use in the inshore fisheries. Numerous tests have shown that these trawls get good catches with a 20% lower resistance than rope trawls. In connection with flatfish fisheries, selective tests were performed with flatfish trawls some of which had square meshes in the after end of the net. The first results are availavle. In the field of trawl equipment, comparative measurements (position and drag) have been made for small trawl boards in commercial use.

Passive fishing methods are becoming increasingly important due to the lower fuel consumption in relation to catch. As most fishing methods of this kind are traditionally labour-intensive and therefore not very efficient, the GDR has begun to mechanize gill net fishing. The first step in this direction was the development of hydraulically driven hauling equipment.
Apart from such development in technology, the catching efficiency and utility of various new designs of gill nets used for catching cod and flatfish were investigated. These investigations will be continued.

Another fishing method which is efficient in terms of energy and preserves stocks is long-line fishing for Baltic cod. Both monofil and multifil long-lines have been successfully used in tests. Further preliminary tests are planned for 1986 to promote the development of a mechanized long-line system.

It will only be possible to improve fishing equipment in the future if it is used in conjunction with efficient technology allowing the equipment to be observed while in use and all relevant parameters of the fishing equipment to be measured. For this reason, a towed controllable underwater observation system for use in shallow water (max. depth 100 m) and an underwater system for observing stationary fishing equipment (pots, gill nets etc.) are among the equipment being developed at present.

Basic research

The study or mechanics of flexible net design has been the centre of attention in the field of basic fishery research. The main aim of these studies is to quantify theoretically the relationship between shape and stress in this type of net. As the results of these studies, a digital computer program has been developed, which makes it possible to calculate accurately the geometry and strengths of pelagic rope trawl nets in different situations and fitted with different equipment. Studies of the dynamic processes taking place in trawls were begun and the first results are now available.

FEDERAL REPUBLIC OF GERMANY

(H. Bohl)

Since 1980 a good deal of the gear technological research and development work done in the Federal Republic is aimed at the introduction and promotion of energy saving fishing methods. In 1985, activities were concentrated on fishing tests with gill and trammel nets, longlines, Danish seines, electrified beam trawls and modified types of otter trawls.

The experiments carried out with bottom-set gill and trammel nets in the western Baltic were hampered by the fact that the cod year class 1983 was very poor. Under these conditions small-meshed gill nets (53 - 55 mm bar length) failed completely, whilst trammel nets with lints of 60 - 70 mm bar length proved most effective in fishing the wide range of length classes occurring on the fishing grounds. Trammel nets with a height of 0,60 m instead of the usual height of 1,20 m were shown to be unsuitable for catching Baltic cod. The use of 1,80 m high trammel nets could also not be recommended because the clearing of the gear took too much time.

In the German Bight the sole fishery with trammel nets was further intensified. For the first time not only cutters from the Baltic but also some vessels from the East Frisian coast participated in this lucrative fishery. In this case, nets of only 0,60 m in height caught about the same amount of fish as higher ones, but they were much easier and quicker to disentangle and to clear than the standard gear.

Attempts to employ gill and trammel netters in the winterly cod campaign in the German Bight failed due to the severe ice conditions in January/February and due to the lack of recruits (year class 1984) in November/December 1985. However, good catches of large-sized cod could be obtained from gill net fishing experiments carried out at wrecks during October in the German Bight.

An exploratory gill net fishery for turbot which was conducted during May in the southwestern North Sea, led also to very promising results.

In the field of longlining, the tests of an imported automatic system suitable for larger vessels as well as the development of an own semi-mechanized version constructed for smaller fishing craft were continued. Research on bait acceptance was carried on.

In continuation of the experiments with Danish seines, in 1985 only a single chartered vessel operated off the Danish west coast. The catches obtained were, on average, not very encouraging because the IVb plaice and sole stocks are overexploited.

For the same reason, in 1985 no progress could be made in the promotion of electrified beam trawling.

As to the design of fuel saving otter trawls, full-scale experiments carried out aboard FRV "Walther Herwig" with a commercial midwater trawl have shown that the warp load can be reduced by about 20% by amending the cutting rates of certain net sections.

In spring 1985, a remote controlled towed vehicle (RCTV) was purchased from a Scottish manufacturer. This vehicle was equipped with a low light level underwater TV camera bought one year earlier. In close cooperation with the Marine Laboratory Aberdeen, the system could be successfully tested aboard FRV "Solea". First video recordings of bottom trawls revealed interesting details of the gear in action and of the fish behaviour during the process of capture.

The echo integration system especially developed for the purpose of Antarctic krill research was modified in order to improve both quality and availability of acoustic data. The new version of the system proved its value on the occasion of an acoustic krill stock assessment conducted with FRV "Walther Herwig" and RV "Polarstern" in the area between Bellingshausen Sea and Elephant Island.

The bottom trawl selection experiments carried out annually since December 1982 in the winterly cod fishery of the German Bight, were also continued in December 1985. In these experiments the selectivity of the gear was obviously not influenced by the duration of tow.

ICELAND

(G. Thorsteinsson)

In cooperation between private companies and the Marine Research Institute the behaviour of Nephrops against a bottom trawl was observed with an underwater TV camera. Attempts will be made to use the results to increase the catchability of conventional Nephrops trawls for the 1986 season. On the same occation the behaviour of different fish species against two designs of 4 seam trawls was observed under different conditions. Videotapes on the most interesting results of the cruise are available.

Comparative selectivity experiments with different cod-end mesh sizes were conducted on haddock.

Fishing experiments on crabs have resulted in commercial fisheries on some places. Experimental fishing on basking shark started in 1985 and will be continued in 1986.

During four weeks in August-September the MRI with the 23 m long research vessel Dröfn has searched for demersal fish species and shrimp with many different fishing gear in the Skjöldungen and Angmagssalik fjords (E-Greenland) for Greenlandic authorities. The catches with demersal fishing gear proved to be very poor whereas interesting salmon catches were taken in the Skjöldungen fjord with drifting and stationary floating gill nets.

A new design of a scallop dredge improved rock rejection for less damage to the scallops while maintaining catch rates.

Mesh breaking load tests were exceptionally numerous in 1985 especially on hexagonal purse seine netting which made a good appearance in the capelin fishery.

Preliminary trials with split beam echosounders were carried out. Further testing is necessary in 1986. The developement of a method for measuring the equivalent beam angels of hull

mounted transducers was completed. Further investigations of the reliability of this method is planned with split beam echosounders.

Routine acoustic assessment surveys were carried out on the stocks of herring and capelin. Additionally Iceland participated in the ICES acoustic survey on blue whiting.

Measurements on fuel consumption of different vessel types were continued. The results have been presented in fishery magazines and on a video-tape as well. Many Icelandic vessels have had new propellers and propulsion systems installed, and this has led to significant reduction of fuel comsumption.

Due to interest to utilize the black quahog stock design work on a suitable vessel construction for a possible black quahog fishery has started.

IRELAND

(J.P. Hillis)

During the late summer, two commercial trawlers had their trawls equipped with separator panels in the aft half only, leading to upper and lower cod-ends, while a third boat had its trawl equipped with upper and lower cod-ends only. In contrast to the 1983 experiments no diagonal baffles to direct fish upwards were used. The mesh sizes of the attached parts were 60mm throughout. The boats were asked to fish in their usual fashion, with observers aboard to

record catch landings and discards in the upper and lower cod-ends. Results were encouraging, with over 90% of Nephrops being taken in the lower cod-end in every case and over 85% of whiting in the upper cod-end with the exception of one boat where it was initially 67% but rose to 89% after modification to increase the diameter of the cod-ends to allow freer flow of the catch. With both species, the landed catch showed a slightly higher degree of separation than the discards. In general, the skippers expressed themselves pleased with the working of the gear, but one considered that there could be an increased hazard in the use of two cod-ends during bad weather and suggested that one cod-end with separator panel might constitute a safer version of the gear for commercial use.

NETHERLANDS

(B. van Marlen)

Electric sea fishing

A workshop has been held on the 25th of January at RIVO, IJmuiden with representatives of Belgium, W.Germany, United Kingdom and The Netherlands. Technical details were exchanged. It was felt that each participating country should try to develop and commercialise its own system and exchange information on a regular basis.
This suggestion has been supported by a formal ICES recommendation, made by the Fishing Technology and Fish Behaviour Working Group meeting in Tromso, Norway, May 1985.
A report of the meeting is given in CM 1985/B:37 of the ICES.

Three experimental cruises were conducted by FRV ISIS during 1985 on electrofishing. Tests done in May/June showed an percentage increase of total sole catches of + 117% at 700 V and 20 Hz in comparison with the conventional gear. A slight tendency of catches per square meter to decrease with speed was found for the 72 hauls included, but there was a great scatter in the results. During this period no significant problems were encountered with the electrode endurance as reported in 1984 with similar voltages. A steel wire braid on the copper electrode improves its lifespan considerably.
A five week trip in November/December was committed to a comparison of two different systems on one boat, namely the systems developed by RIVO and by the Institut für Fangtechnik (IFF) of Hamburg, W.Germany. With all testing, installation and travel time included, two weeks of comparative fishing remained. The results were rather discouraging for the Dutch system concerning reliability of the system. Many components were troublesome such as the winch, feeding cable and connecting cables between the beam and the electrodes, while IFF's system performed well in this respect.
The Dutch pulser itself did not malfunction however. The catch results were not firmly conclusive, due to to poor fishery, a small number of hauls, size and rigging differences between both gear, but it cannot be denied that sole and plaice catches of RIVO's system outnumbered those of IFF's system.
It should be born in mind that the design philosophies of both systems were different. RIVO's system has been developed to meet conventional gear catch rates at speeds over 4.5 knots, while the approach for IFF's system was to aim at maximum energy saving and good performance at speeds around 3.0 knots. Particularly this system was not towed at its optimum speed and further engineering of the net itself may raise its catch potential. On the other hand it may be a necessity to use the considerably high electrical power of RIVO's system to obtain good catch rates at higher speeds.
The attempts to commercialise the system will be given strong emphasis in the research programme of RIVO during 1986. The aim is to test a newly designed system with better reliability built

by the industry on the basis of now existing knowledge and to evaluate its economical potentials.

Safety sand working conditions

Generally safety problems can only adequately be handled by good contact between research personnel and the industry. Cases that worked well are the introduction of easier and safer fish landing techniques, now in use by five older vessels and usage of separate winch drums for the lazy decky instead of the main winch capstans supported and promoted by the Technical Research Department.

Preliminary studies indicate a possibly substantial decrease of hard physical labour during fish processing and storing on board by using fish containers instead of ice boxes. A necessary condition will be good quality of the landed fish, which stresses the need for investigation by a fish -processing research station.
The fish sorting machine installed on the UK 173 has been monitored by the Technical Research Department until June 1985, when the machine was dismantled and reInstalled in a fish processing plant on Urk. A gain in labour was not experienced as the crew found difficulties with hooking the fish on the conveyer system of the machine. The use of fixed weights as a reference to overcome dynamic problems, when measuring weight on a moving boat, worked very well however and further research using a system based on this method may very well follow.

Noise control

A brief survey of noise levels on board of eight different Dutch beam trawlers has been conducted. Measurements were done in the messroom, pantry, huts and on the bridge as well as in the machinery room during steaming and fishing operations.
The results were also compared to measurements done by other national and foreign institutes on beam trawlers and stern trawlers and related to recommendations drafted by the "International Maritime Organisation" and the Dutch Shipping Inspection, which apply to new sea trade vessels. As can be expected with relatively small and high powered boats, the noise levels exceed these standards in a lot of cases, except for the machinery rooms, when steaming and to a lesser degree while fishing. Pair trawling led to slightly lower noise levels than beam trawling.

Reduction of fuel costs

The research project on heavy fuels has reached its final phase during 1985. Looking back on the past years it can be regarded as advantageous to use heavy fuels in order to reduce fuel costs. The outcome, however, will always depend on the price difference between gasoil and heavy fuel. Difficulties were encountered in the beginning due to lack of experience in

handling the fuel and the use of relatively new engines.
The beam trawlers use a fuel with a viscosity of 180 mm^2/s (cSts) and stern trawlers turn to even heavier fuels of 360 mm^2/s (cSts). Generally a decrease in fuel consumption of some 7% could be obtained. A total net cost reduction of 18% resulted with the average price difference of 1985 and taking into account some additional costs on maintenance.

Measurements of fuel consumption and power on beam trawlers

During October and November 1985 two weeks were dedicated to measurements of fuel consumption, main engine and winch power, warp loads, speeds etc. on the beam trawler UK 173 with the aid of a new data-logger (FLUKE 2280-B) and the TRACOR-MARCON condition monitoring equipment, described in the annual report of 1984. These mesurements were conducted during steaming, shooting, hauling and fishing. Data has been recorded on magnetic tape and will be processed and analysed during 1986.

Improvement of towed fishing gear

Several projects run under this heading. Big meshes trawl GM3 of 4320 meshes circumference was tried out in comparative fishing experiments on FRV TRIDENS during two weeks in June and July with no escape of herring through the big mesh. The footrope needed some additional weight (120 kilo) to keep good bottom contact.
The size of this net requires full power of the vessel (appr. 1300 kW (1800 hp), a fact that limits further extensions in size on this boat.
Towards the end of the year the gear has been rent to a private shipowner and tried out on the stern trawler "Ariadne" SCH 303 with encouraging results. It has not left the company since and applications for even bigger nets of similar construction were directed towards the Technical Research Department.
In March 1985 co-operative research has been carried out on FRV TRIDENS on square mesh cod-ends and cod-end covers on bottom trawls, using the Marine Laboratory remotely controlled television equipment.
Details of these experiments were presented at the ICES working group meetings at Tromso, Norway, in May 1985 and are given in report CM 1985/B:34 of the Fish Capture Committee.
RIVO is now building up a system of its own on the basis of this vehicle, which will be operational during 1986. It can be regarded as an important tool in fishing gear research. Major conclusions of the trials are a favourable effect on small fish bycatch when cod-ends with square meshes are used and a good net shape with a junction rate of diamond to square mesh of 2 to 1, assuming both having similar bar lengths.

Model research has been done in S.F.I.A.'s Flume Tank of Hull, England in April 1985.
Three different nets were investigated:
. A 1 to 25th scale big meshes pair trawl for herring with a

maximum mesh size of 12.9 meters and a circumference of 3354 meshes of 20 cm.
The headline, footrope and sidelines were cut with simple taper rates to avoid a number of ropes of inequal length in order to ease manufacturing and repairing. The model tests showed no considerable distortion of the net shape. A full scale net has been made later in the year and fished succesfully on commercial pair trawlers. Several others are using similar nets now.

- A 1 to 4th scale beam trawlnet for electrofishing. The distance between the beam and the electrodes has been varied to appraise the effect on bottom contact and additionally the effect of the hanging of meshes in the sides upon the net shape has been determined.

- Finally a 1 to 40th scale model of a 5000 meshes midwater trawl, supplied by a net manufacturer, was studied to investigate its shape and performance.

Design of fishing vessels

The purchase of an APPLE IIe micro-computer with an existing software package for ship design calculations proved helpful advising the industry. Especially problems concerning stability and adding midship sections can be handled quicker and with better accuracy.
Close contact to the industry revealed common areas of interest, among which are:
- optimization studies on stern and small trawlers, emphasising fish processing and storage on board
- measurement of energy flows on commercial boats, eventually leading to energy saving concepts.

Future research programmes will be focussed on these topics.

NORWAY

(S. Olsen)

FISH BEHAVIOUR AND REACTION

Studies of reactions to light by saithe in a large net cage indicated clear colour preferences and greater attraction by subsurface than by surface lights.

The reaction of herring towards vessel and net has been studied in the coastal purse seine winter fishery and during summer in the North Sea. The winter herring is clearly more affected by vessel generated stimuli than the North Sea herring during summer.

Experiments have been started aimed at reducing construction costs, storage space and hydrodynamic resistance in purse seines by making parts of the seine of large-meshed webbing. Initial trials with small herring were positive.

Further detailed studies have been carried out of fish distribution and behaviour in relation to gillnet fishing in a local fjord. These studies also contribute to the input data required for the previously reported numerical model which simulates the interacting factors and processes in gillnet fishing. This project will be completed and fully reported in 1986.

Analysis of detailed statistics of the Lofoten spawning cod fishery confirms that the catching efficiency of the passive gears (gillnets, long lines) is a negative function of fishing effort (or gear density) and of fish density. These effects have a significant impact on the

economy of fishing and cannot be neglected in fisheries management and regulations.

SELECTIVE FISHING

The 1985 programme has included studies of selectivity, gear technology and fish behaviour in relation to trawl fishing for shrimp and round fish. Another feature has been the study of differential escapes from the trawl which has been a worrying factor in quantitative sampling for resource assessment.

Good progress has been made, particularly due to the use of new instruments and equipment for gear measurements, monitoring and direct observation by a remote controlled underwater TV system, "the Ocean Rover".

Experiments with a shrimp sorting system, incorporating small meshed funnels inside a very large meshed netting cylinder inserted in front of the codend, have given a 60-70 % release of cod and haddock above 20 cm and reduced catches of undersized shrimp.

Direct TV observation of a bottom trawl suggested that simply by lengthening the chains between bobbin groundrope and fishing line more cod could be released without much affecting haddock release, important for instance if the cod quota has been reached and the haddock quota not. The observations also showed that in the type of bottom trawl mostly used by Norwegian trawlers heavy escapement of cod occurs under the lower wings.

Initial experiments with trawl codends made of square meshes, monitored with the use of underwater TV, have confirmed the good selective properties of such codends.

Studies of quantitative sampling technique are being conducted in cooperation with the Institute of Marine Research. It is evident that many small cod escape below the fishing line of a trawl rigged with bobbins in the normal way. The sweep length of the sampling gear is

also affecting the length frequency distributions of cod and haddock.

IMPROVEMENTS OF FISHING GEAR AND METHODS

Longlining work has been aimed at developing alternative bait types and has been concentrated on producing a bait partly based on fish offal. Control of the stimuli leaching or dissipation rate has been a problem, and a method for testing this critical factor has been developed. Fishing trials in the fall of -85 gave very promising results, especially with regard to long line fishing for haddock.

Trials with new types of lines have given marked increases in the catch rate for bottom set long lines (40-70%). A new type of hook and swivel mounted gangions of monofilament are the most important reasons for this increase. This new type of long line is now being commercially applied with good results.

Further experiments with gangion floats in the bank line fishery gave no significant increase in catching efficiency.

A simple line mechanization system for small vessels has been developed and tested with good results. A new type of random baiter has been developed and during hauling the lines are coiled in tubs and the hooks stored on short magazines. Pilot trials of three to five systems will be carried out on commercial vessels in 1986.

On purse seining a system for hauling and stacking the net and leadline on larger boats has been developed and tested. The system consists of a Japanese "Ball-Roller" mounted on a small manouverable crane and it has greatly reduced the manpower requirement and the work hauling the heavy leadline.

Trials aimed at reducing the net tearing in purse seine and trawl have also been conducted.

ACOUSTICS AND BEHAVIOUR

A new method for monitoring fish behaviour in large holding pens has been developed. The system consists of simultaneous measurements of the integrated echo intensity in six separate cells along the axis of the pen by using six transducers mounted below the pen. The reaction of fish to various stimuli imposed in one of the cells is quantified by the change in frequency distribution of the echo intensity relative to the undisturbed situation. The method seems to be suitable for general fish behaviour studies, particularly concerning attraction and avoidance effects.

The equivalent beam angle of hull-mounted transducers was measured by a vessel-tilting procedure. The quantity has a first-order appearance in the basic acoustic equation for estimating fish density.

An acoustic method of quantifying the reaction of fish to imposed stimuli has been developed.

The tilt angle distribution of loosely schooling saithe has been photographically determined. This information is valuable for predicting target strength distributions when single-fish target strength functions of tilt angle are known.

Acoustic equipment and techniques used in the surveying of marine fish stocks were intercompared for application to fresh water fish.

Absorption of sound by dense aggregations or schools of herring may have been observed.

Use of a split-beam acho sounder (SIMRAD ES system) to measure the in situ target strengths of fish continues.

Theoretical computation of the target strengths of swimbladder bearing fish continues.

A draft of a guide for calibrating acoustic instruments used in

fish-density estimation has been prepared jointly with the Marine Laboratory, Aberdeen, and was distributed to participants in FAST Working Group meetings for review.

Work on an acoustic system for measuring plankton and larval fish densities continues.

VESSEL TECHNOLOGY - MARINE ENGINEERING

During 1985 considerable efforts have been made developing new generation trawlers, both for wet fish and freezing at sea. Direct gutting with bleeding in ice water has been a central laboursaving feature in these vessel designs.

Work has been carried out to clarify the detrimental effects of fisheries regulations on fishing vessel design and efficiency.

A handbook for fishermen on vessel design and procurement has been completed.

Work has continued on fishing vessel safety and working conditions, the work has included

- clarification of the causes of accidents
- development of measures for reducing accidents
- practical tests of various measures

An investigation into the safety standard of the fishing fleet is being conducted. A sample of 600 vessels has been drawn, and the field inspection work is almost completed.

In the field of energy saving, the information campaign has continued in 1985, with local courses, distribution of leaflets and video tapes.

The monitoring of the performance of a heavy fuel system on a large trawler continues, and will be reported in 1986.

Further model tests have been carried out to develop hull forms with

less resistance in a seaway. Fuel scale tests to confirm the results have complemented the model tests.

A fuel consumption simulator is being developed, the software will be implemented on standard personal computers.

POLAND

No report received.

PORTUGAL

(A.M. Leite)

During 1985 the Department of Fishing Gear and Methods of the Instituto Nacional de Investigacao das Pescas (INIP), Portugal, was involved in the following works:

- Prosecution of fishing essays dedicated to deep-seas species using PA MONO Ø 2,5 mm traditional longlines and vertical drifting longlines.
  In these experiments black scabbard fish (Aphanopus carbo) and deep-sea sharks were detected on Suzan Banc (Madeira sub-area) and in the areas of Espinho, Vila do Conde and Caminha (Continental sub-area), in addition to areas previously investigated.
- Publication in "Publicacoes a Vulso" do INIP of a Report concerning fishing gear for tuna fishing.
- Professionel formation of new technicians of the Department.
- Resolution of problems related to Fishery Administration.

SPAIN

(J. Bravo de Laguna)

Acoustic methods

As in previous years the Spanish Institute of Oceanography conducted two routine acoustic surveys to estimate the stock sizes of the most important coastal pelagic fish stocks. The acoustic equipment consisted of two Simrad EK 400 echo-sounders 38 and 120 KHZ and Simrad QD digital echointegrator. Acoustic calibration was done with standard copper spheres.

The survey "Saracus 1985" took place in August along the Spanish north and northwestern coasts with emphasis on pilchard, horse mackerel and blue whiting. The "Saracus" series has been conducted since 1981 as a part of a multi-disciplinary research project in co-operation with INIP (Portugal) on the pilchard fish stocks of ICES, statistical divisions VIIC-IXA. Biomass of different age groups was estimated by areas and subareas. Complementary calibrations done with fish in a net cage were not very successful.

During the acoustic survey "Mediterraneo 85" the coastal pelagic fish stocks of the Spanish mediterranean continental shelf from the Strait of Gibraltar to the Spanish-French border, including the Balearic Islands, were investigated. The distribution of anchovies, sardinellas, horse mackerels and some other pelagic fish species was chartered and their biomass estimated. Assessments of pilchard biomass were divided by age groups.

Longlines and traps

During June and July experiments on longlining for demersal species in vulcanic slopes and shelves around the Canary Islands were carried out by the Fishing Technological Center of Taliarte on the research vessel Taliarte. Three different

longline types were tested on 143 stations in 26 catching locations. Preliminary results indicate that the best results are obtained with a combination of vertical and horizontal lines. The longline experiments also included tests with different types of bait.

During the same cruise an experimental trap was tested in comparison with three conventional designs in a combined fish and deep sea shrimp fishery. The experimental gear outfished the older trap types by 38-120%.

SWEDEN

(O. Hagström)

Fish behaviour and reaction

Behaviour studies of both salt water and fresh water species has been carried out using telemetric methods and underwater observations. Work on fish reaction toward stationary gears as gill net and pond net has continued. Construction of new telemetric system has been started.

Selective fishing

Investigation has been carried out on selection and meshing of baltic cod in codends with 95 mm and 110 mm mesh size respectively. The work has been carried out on board commercial trawlers.

Improvements of fishing gear and methods

Projects are ongoing to improve pelagic trawls for both pair and single trawlers. The trawls are designed for catching herring/sprat and cod.

A comparative fishing with different types of Nephrops traps has been concluded. The main objectives were to optimize the catch per trap. Preliminary results indicated significant differences between traps. Minor alteration of the

rigging and entrances as well as lower centre of gravity appear to have made the differences non significant. A commercial fishery has started.

Fishing vessels and equipment

Projects with the main objectives to give better working conditions on board fishing vessels have started. Work on reducing fuel consumption are ongoing. Experiment with noise reduction on a new trawler is promising.

Acoustics

Routine surveys were carried out in Skagerrak, Kattegat and in the Baltic area.

Measurements of target strength of Clupeoides and cod in situ with split beam echo-sounders have started.

UNITED KINGDOM

1. ENGLAND

(G.P. Arnold)

The new underwater acoustics lab has been implemented which houses a test tank of internal dimensions 4.9m long x 3.0m wide x 3.5m deep. The tank, which can be filled with either filtered salt water or filtered, softened fresh water, can accommodate 2 transducers of up to 1 tonne in weight which can be suspended and rotated; frequencies down to 30kHz are possible. In the near future transducer rotation will be automated to enable automatic beam plotting.

Recently, a successful 4 week course in Practical Fisheries Acoustics was held at the Fisheries Laboratory, Lowestoft using the above test tank. A users workshop was also included and the advantages of having an acoustic tank of suitable dimensions were very apparent since it was possible to demonstrate practically the operating features of the acoustic survey equipment.

The acoustic survey equipment used by MAFF (Simrad QD) has been much improved by the purchase of a micro computer from British Antarctic Survey (BAS) which enables the QD echo integrator to be programmed remotely and the data stored directly on a floppy disc. Ship's position (lat/long) will also be recorded automatically at the end of each nautical mile surveyed. An Apricot Xi micro computer (10Mb hard disc, 256kb RAM) has been used on recent acoustic survey cruises to compare the Simrad QM and QD echo

integrators, validate data, and obtain an estimate of fish biomass. The spreadsheet programmes used were improved during CLIONE 15/85 and CIROLANA 1/86 to provide a layer by layer analysis of the data from the QD echo integrator, an average biomass per survey area, and plots of biomass (tonnes/km^2) per nautical mile surveyed. The programme incorporated species distribution and length/weight data from trawl samples. Work has commenced to enable the direct transfer (instead of the present manual entries) of data from the QM, QD and Racal-Decca position-fix to computer file for spreadsheet analysis. Also, new EPROMs have been purchased from Simrad to provide automatic control of the "minimum depth" facility presently available manually on the EK400. This is vital if the biomass of dense shoals close to a reef or shoaling seabed is to be estimated correctly.

MAFF's new vessel CORYSTES will be equipped to operate concurrently with 38kHz and 120 kHz EK400 acoustic survey equipment. Also an ES400 split-beam system will be available for target strength measurements and the 300kHz sector scanning sonar (presently on CLIONE) for the estimation of shoal distributions during survey cruises.

Four acoustic surveys have been carried out during 1985/6 using Simrad 38 kHz equipment. The first survey carried out during the first half of February 1985 investigated the distribution and abundance of spent herring in the Southern Bight of the North Sea and eastern English Channel. The second, undertaken from 14-28 August covered the north-east coast grounds from the Farne Islands to Flamborough Head to assess the stock of 'Banks' herring spawning in that region. The third survey from 6-20 December again covered the Southern Bight and eastern Channel to provide an assessment of spawning and spent 'Downs' herring. Results from these surveys have been reported to the ICES Herring Working Group. The fourth survey was undertaken in January 1986 to survey pelagic shoals in the English Channel. A large mixed shoal of mackerel and scad off Start Point was provisionally estimated to comprise 50,000 t mackerel and 20,000 t scad.

2. SCOTLAND

(D.N. MacLennan)

Progress has continued on the development of a computer model of a pelagic trawl. Convergence times for the calculation have been reduced. The results have confirmed that the degree of stretching of the netting on the frame ropes has an important effect on net shape. Work has begun on studying water flow in codends. In a flume tank the paths of small particles were tracked through the meshes by viewing a laser illuminated slice with a TV camera.

The performance of the ICES Young Fish Sampling (GOV) trawl was measured on FRV 'Scotia'. Data were collected on the performance of the gear using Polyvalent doors and the three types of permitted groundgear. Underwater TV observations were made using the Remote Controlled Towed Vehicle. It was seen that at 4 knots the lightest groundgear was lifting off the bottom. The net was not distorted like some of the flume tank models of the GOV trawl.

Performance measurements were made on a small size of demersal pair trawl, to extend the range of measurements. The sweeps were observed to be digging in deeply near the net and to leave the bottom not far from the net. Ground friction may be a significant component of gear drag. Analysis programmes have been developed from this data to predict wire shape.

A new series of measurements on otter board performance has been started using the improved instrumentation. The aim is to produce systematic series of measurements on common types of door. Initial work has demonstrated that the performance of Vee boards is sensitive to small changes in the rigging. Groundgear drag is also being investigated to quantify bottom friction forces in demersal trawls.

Further measurements have been made on the height of gill nets in a tideway, using manometers. Bottom current speed was also measured and height was found to vary significantly with speed.

A series of comparative fishing experiments was performed to investigate aspects of codend mesh selection. Further work was done, using small mesh covers, on the selectivity of square mesh codends, including experiments on Nephrops. The influence of codend dimensions on mesh selection was studied. It was found that, for a given mesh size, increasing the length of the extension piece, between net and codend, reduced the 50% length. Reducing the width of the codend increased the 50% length. These effects were thought to be due to changes in the degree of mesh opening in the codends.

Direct observation techniques continue to be used to investigate the damage to escaping fish and the possibility of separating species in the trawl. A final cruise completed a series of investigations on the light levels of fishery grounds and the reaction distances of fish in different net visibility. The Aultbea facility for the capture, handling and experimenting with mackerel has been used to study various aspects of their reaction ability including swimming performance, schooling behaviour and effect of light levels on behaviour.

A number of alternative experimental procedures for determining the effectiveness of manufactured baits are being compared. The nature and concentrations of stimuli necessary for bait acceptance are being studied in the aquarium using these techniques.

Experiments on caged fish at 38 and 120 kHz have concluded with measurements of sandeels and herring. In addition work has been carried out using the same rig to investigate the frequency response of caged fish using a newly developed wide band echo-sounder operating over the frequency range 27 to 54 kHz. The results from this have been very encouraging; striking differences have been discovered in the frequency response of cod and herring of the same size. In-situ target strength measurements have been conducted using dual beam equipment and measurements on herring obtained. Acoustic surveys of North Sea herring, Clyde herring, North Sea sprat, herring and mackerel to the west of Scotland have been carried out.

USA

(A.J. Kemmerer)

A summary follows of 1985 research related to fish finding and capture in four regions: northeast, southeast, southwest, and northwest. The summary is not comprehensive, but it does provide examples of current interests and activities.

Northeast

Gear research and development activities in the northeast have been very diversified and generally related to resource conservation. In Maine, a study of the effects of bottom dredges is taking place both to quantify the effects and to seek alternative fishing methods to reduce damage to bottom habitats. This is being done by setting aside an area where commercial dredging is prohibited. Different levels of fishing effort, with several types of dredges, are applied within the prohibited area. Besides the dredge studies, a separator trawl is being evaluated to reduce the incidental catch of juvenile groundfish in their shrimp fishery.

A significant effort is going into trawl-related training courses for fishermen at the Massachusetts Institute of Technology (MIT). Additionally, MIT has conducted tank tests of model trawlers with and without bulboas bows. The tests indicate that the bows can reduce running horsepower demands by about 20 percent. Other studies in Massachusetts concern the use of square meshes in the cod end of trawls to reduce captures of undersized cod, flounders, and other species, as well as a study of scallop dredges to improve size selectivity (i.e., reduce the mortality of small scallops).

Tank studies are underway at the University of Rhode Island of Norwegian BMV and Portuguese doors for bottom trawls. This is being done in conjunction with field studies of northeastern groundfish trawls to better quantify catch data from sampling trawls. And finally, studies of ghost gill nets are continuing with some of them involving submersible observations. Several ghost gill nets have been periodically observed for two years.

Southeast

The Trawl Efficiency Device (TED) continued to receive much of the gear research and development attention in the southeast. Part of the reason for this is a concern many conservation groups have about an apparent decline in the number of Kemp's Ridley sea turtles, an endangered species. These groups believe that the shrimp fleet, especially the fleet in the northern Gulf of Mexico, is one of the major sources of mortality for sea turtles. The TED, developed to eliminate sea turtle captures in shrimp trawls, has been strongly endorsed by the conservationists. With their support, a major technology transfer effort was undertaken to encourage shrimp fishermen to voluntarily adopt the TED. Voluntary adoption was believed possible because of the fishing benefits shown for the TED, such as reduced bottom trash and finfish in the catch. Several hundred TED's are now in use in the shrimp fishery and at least two modified versions of the device have been developed, which also are gaining acceptance. Whether or not a voluntary program will be permitted to continue or be replaced by regulations requiring TED's is uncertain.

Large-mesh bottom trawls, as a harvesting technique for coastal herrings in the Gulf of Mexico, are beginning to show promise. Initial trials last winter and spring produced mixed results partly because of difficulty in interpreting acoustic returns from fish and non-fish targets, and the apparent ease with which some of the fish were able to escape capture. Scuba observations during the summer in relatively shallow waters showed that fish would school into a trawl and often remain there until the speed of the net changed (such as during retrieval), at which time they would rapidly swim out of the mouth of the net. Other fish would swim back to the cod end of the trawl where they would remain in the relatively slack waters caused by the finer meshes in this portion of the trawl. Because of this slack water, the fish failed to tire even after several hours of trawling. These observations are being used to modify gear design, operation, and retrieval procedures for testing in 1986.

Because of fish escapement from trawls and an apparent inability to always correctly identify fish from acoustic returns, a towed submersible system capable of operating at speeds to six knots and to depths of 100 fathoms was procured. This system is equipped with pan and tilt, low-light-level television and film camera systems and has a positioning accuracy of about 10 cm. Initial trials with the system have shown it to have considerable promise for aiding in identifying acoustic targets and for gaining observations of fish and gear interactions.

Two exploratory fishing cruises conducted cooperatively with Japan in the northern Gulf of Mexico showed considerable potential for development of a Gulf butterfish fishery. These fish apparently concentrate during the fall and spring months along thermal gradients in waters 40 to 100 fathoms. This depth range is outside the normal trawling area of most shrimp trawlers. The fish appear to be susceptible to capture with large-mesh, high-opening bottom trawls. Initial estimates suggest an MSY of about 50,000 mt.

Continued work with bottom-longline fishing for deepwater grouper has shown that longlines are effective sampling tools. This research has been done using a manned submersible which permits direct assessment of grouper and tilefish through point and line-transect counts. The submersible observations in conjunction with bottom-longline sets were used for estimates of catchability coefficients, which were verified this past summer in a submersible study off Puerto Rico and the Virgin Islands.

Southwest

Experiments are being conducted to assess the benefits and feasibility of escape gaps in lobster pots for the Hawaiian fishery. Early trials with rectangular escape gaps (as used in other lobster fisheries) were successful with spiny lobster, resulting in significant decreases in the catch rate of sublegal lobster and, at some banks, an increase in the catch rate of legal lobster. A problem arises, however, in that the slipper lobster in recent years has come to comprise about 50 percent of the catch, and slipper lobster catch rates decrease dramatically in traps with escape gaps. Past research investigated moving the gaps to different areas on the trap but without notable success. More recently, circular and square escape vents are being examined to develop optimal configurations of escape gaps for both species.

Fisheries for deep bottom fish in the Hawaiian Archipelago and in much of the Pacific basin use handlines or hydraulic gurdies. The use of the "kali pole" type longline gear is being evaluated. To date, the use of these poles in this fishery may not be profitable due to aggregation of the target species. For resource assessment purposes, however, the gear is being used for both this fishery and for the seamount groundfish fishery in the central north Pacific.

Anchored Fish Aggregating Devices (FAD's) are the most significant new technology in Hawaiian fisheries for tuna and other pelagic species. FAD's were introduced to Hawaii by NMFS and are now installed and maintained by the State of Hawaii. The impact of FAD's on tuna behavior and exploitation is being studied by tracking the movements of tunas outfitted with pressure-sensitive ultrasonic transmitters. Horizontal and vertical components of movement are plotted as a function of time and mapped against FAD location, bathymetry, temperature distribution and other features of the tuna's environment. Results to date suggest that yellowfin tuna learn the location of FAD's and incorporate FAD's in their daily movement patterns, venturing away from FAD's at night and returning to them during daylight. Tracking of bigeye tuna and mahimahi also is underway.

Northwest and Alaska

A mesh-size selection study for cod ends of the Aberdeen high-rise rockfish trawl was conducted along the west coast of Washington, Oregon, and California. A trawl fishery in these areas targets on a mix of up to 8 to 10 rockfish (Sebastes) species that are managed by harvest quotas and trip limits. Cod ends made of 3-1/2", 5", and 6" mesh webbing and 3" square mesh webbing were evaluated. Preliminary findings show that each species has a different selection curve and, because the coastal distribution and species abundance is quite variable, selection of an optimum mesh size that would reduce the constraints of species-trip-limits regulations is unlikely. Additional work is expected in 1987 and 1988.

Hydroacoustic surveys are conducted annually of stocks of Pacific hake or walleye pollock in the northeastern Pacific ocean. These stocks primarily inhabit the midwater and are predominately single-species fisheries. To improve the accuracy of the biomass estimates derived from echo integration techniques, split beam/dual beam methodology, hardware, and software has been developed to measure target strength in situ. Preliminary results will be available in 1986.

Extensive bottom-trawl surveys are conducted in the Bering Sea and Gulf of Alaska, and on the west coast of Washington, Oregon, and California. Biomass estimates are derived for the mix of groundfish and crabs sampled during the surveys. In 1985, a net mensuration system was acquired to monitor the net opening and area swept by standard survey trawls. Computer software was developed so that data readout from an acoustic link could be summarized and fed into an onboard computer data logger for each trawl station. Beginning in 1986, the system will be used on all NMFS trawl surveys to improve the accuracy of area-swept calculations.

A reference collection for fishing gear material has been established. The purpose of the collection is to aid in the identification of derelict fishing gear recovered at sea or along the coastal beaches. This collection was assembled in response to the interest in marine debris and entanglement issues.

USSR

(S.A. Studenetsky)

During 1985 studies were conducted to substantiate measures for the rational exploitation of the cod and haddock stocks in the Barents and Norwegian Seas and of redfish in the Irminger Sea. The main objectives were to evaluate the catchability coefficients of bottom trawls and determine the efficiency of the bottom long line fishery in the North-East Atlantic. The most important results were:

- Data on selectivity of PA trawl codends of 102-128 mm mesh opening for cod and haddock in the Barents and Norwegian Seas and of 104-140 mm mesh opening for redfish in the Irminger Sea.
- Preliminary data on the survival rate of haddock escaping through 110 mm trawl codend.
- Estimates of the efficiancy of the bottom longlining for wolffishes, cod and halibut in the North-East Atlantic.