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International Council for the
Exploration of the Sea

C.M.1987/B:1
Report of
Activities

FISH CAPTURE COMMITTEE

by

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1985



THÜNEN

Digitalization sponsored
by Thünen-Institut

BELGIUM

(Ir. G. Vanden Broucke)

In view of the need for energy-saving studies of the technical parameters of trawling gear, the development of new types of fishing gear and the introduction of new fishing methods was continued. On board the research vessel "Belgica" data were collected on the parameters determining the drag of bottom trawls by measuring the vertical opening and the tension in the warps and the legs.

Data were collected on a traction meter system for beam trawlers with the aim of enhancing the safety during fishing. This system was tested on board a beam trawler (900 hp).

For the coastal fishery, experiments with a semi-pelagic net were carried out along the Belgian coast. This net was equipped with a "Rock Hopper" groundgear.

To increase the catch rate of small beam trawlers, experiments were carried out with an electrified otter trawl for shrimps. The electric field strength in the front part of the net was studied. A comparative study of the selectivity of beam trawls equipped with square and diamond mesh codends was continued. The laboratory study on mesh shrinkage due to sediments was completed.

Various yarns and nettings were testing for knot strength, mesh strength, mesh size, shrinkage and elongation.

Scallop fishing was introduced into the Belgian sea-fishery.

CANADA
(P. Koeller)

Five organizations report development of commercial fishing gear. Federal Development Branch in New Foundland began a project to develop a trawl catch monitoring system intended to give the operator reliable, high-resolution, real-time information on catch quantity. The systems consists of a catch indicator, transducers to measure headline height and spread, otter board spread, trawl depth, water temperature, and associated shipboard receiving, processing and display equipment. It is intended as a major improvement over existing systems, with primary emphasis on reliability, cost effectiveness, data quality, information accessibility and display. The same organization reports development of an outboard motor powered pot/line hauler.

The Federal Fisheries Development Branch, Scotia-Fundy Region's trial of a new scallop rake continued in 1986. Two more versions were built and tested with encouraging results regarding rejection of rocks. The group also acquired the underwater "Mermaid Explorer" camera system. Trials resulted in excellent video recordings of both scallop rakes and otter trawls. The system will be used extensively in 1987 to document fish behaviour with various gear types. Evaluation of codend selectivity experiments conducted previously indicated significant differences in the ability of juvenile cod and haddock to escape from square mesh codends.

The Faculty of Engineering and Applied Science of Memorial University, Newfoundland, reports completion of a Master of Engineering thesis on trawl gear performance and net drag analysis, with application to small trawls and vessels. A procedure was developed to determine engineering performance which was used to compare vessel power and gear drag for small inshore trawls. The same study also involved towing tank drag measurements on small polythene nets, including an investigation of the relationship between mesh orientation and net drag to explain the reduced drag of square mesh vs diamond mesh nets.

The Province of New Brunswick's Technical Services group indicated successful trials with the following gear: a net drum and Mogere polyvalent doors for shrimp trawls; a "rock hopper" foot rope with Bison doors; a high lift trawl; a pair bottom trawl; and a Ball net hauler for longlining mackerel shark. A floating herring net was also tried, with results to be evaluated in 1987.

The Nova Scotia Department of Fisheries reported the following work: continued development of longlining gear for sharks, including trials with swordfish drums; evaluation of propeller nozzles, both alone and in combination with CPP on small (up to 55 ft) longliners; and trials with net storage reels on small draggers to determine positioning for greatest effectiveness.

In the area of fishing gear development for scientific purposes, the Pacific Region reports the development of a surface beam trawl. The gear is designed to sample the first 10 m of the water column for juvenile pink and chum salmon. It will be tested during 1987.

The Marine Ecology Laboratory, Bedford Institute of Oceanography, Dartmouth, used an underwater vehicle (BRUTIV) to identify and observe haddock in conjunction with its ECOLOG acoustic system. Acoustics recorded the presence of fish both day and night, while BRUTIV's video camera recorded fish only at night, apparently due to avoidance of the towed vehicle by day.

Acoustic research at MEL also included a study comparing their ECOLOG system with a Biosonics dual-beam system. The Biosonics algorithms rejected more than 99% of the fish targets observed, resulting in much higher variances around its estimated target strengths. Biases due to fish reflectivity appeared to be comparable in the two systems. A comparison of ECOLOG counting estimates of density with integration estimates suggested significant biases in the latter which is correlated with fish size.

Work continued at the Biological Station, St Andrews, New Brunswick on developing methods for estimating in situ herring target strength. Estimation from pulse counts and integration products proved impractical due to high fish densities. Initial work with a prototype high frequency sounder system showed that individual herring could be resolved, but the downward-looking sounder recorded few fish and high noise levels.

DENMARK
(H. Lassen)

1. The Danish Institute for Fisheries and Marine Research

Acoustic Surveys for Fish Stock Estimation

In 1986 the North Sea east of 70E, Skagerrak and Kattegat was surveyed in August-September.

Target Strength of fish

In-situ target strength estimation of fish was continued, using the SIMRAD split-beam echo-sounder ES400. The project was however delayed significantly because of technical troubles with the ES400 system. The system was enhanced by data collection where each peak identified is dumped separately, also by reading directly the signal amplitude, depth and the target angles. A peak selection program based on constancy of the target angles on the front of the peak was implemented and target strength data on small herring and blue whiting were collected using the latter technique.

Towed body

The towed body which is used as platform for the transducer was modified and now operates satisfactorily. It is possible to achieve a stable platform at about 11 knots except with wind and sea coming from aft. The noise level does not appear to have increased while source-level + voltage-response is about 1.5-2.0 dB below the hull-mounted transducer. The hull-mounted transducer is however susceptible to noise in bad weather and at speeds above 8-9 knots.

Frequency Response of Ensonified Fish

The laboratory studies were concluded. Measurements in the frequency domain 20-200 kHz on Roach and Perch (14-24 cm) showed as expected that the swimbladder is dominating the backscatter. The skeleton and flesh do contribute, but to an extent very dependent on the frequency. This causes large variations in target strength even when changing the frequency as little as 500 Hz, up to 24 dB. These variations are dependent on the orientation of the fish, its size and species. The experiments show that the scattering is a mixture of Rayleigh and geometrical scatter which results in an irregular TS-frequency dependence.

2. The Danish Institute of Fisheries Technology

Development of improved trawl designs

New large-mesh trawl designs with rope wings have been developed, model tested in the flume tank and introduced to the new class of high towing power "supertrawlers" based in Esbjerg. The designs

developed in close cooperation with net manufacturers and fishing skippers with finance assistance from the Fisheries Ministry.

The same procedure has also been used to develop improved single and twin-trawl systems for smaller vessels engaged in plaice fishing. Again the new net designs have given extremely encouraging fishing results. In addition a separator panel has been developed which can be inserted in the shrimp trawls used in the North Sea Fladen ground fishing. The panel is inserted well down the belly of the trawl and divides the trawl vertically into two parts, the upper leading to a codend designed for fish and the lower to one designed for shrimp. The separator panel has been tested at sea on board an Esbjerg trawler working a twin trawl system. Initially just one of the two trawls has been modified and both the upper and lower codends are in shrimp mesh sizes. Preliminary results given by the skipper are encouraging. The catch of shrimp is equal between the two trawls and most of fish bycatch and none of the shrimp catch is in the upper codend. The skipper is now leaving the upper codend open.

Trawl drag studies

The measurements of the drag of elliptical cones of netting taken in the flume tank last year have been analysed and compared with the predictions made by different hydrodynamic and empirical models. It was found that much better agreement between measurements and predictions was obtained if it was assumed that the drag of the netting bars is proportional to the sine squared of the angle between the water flow and the netting bar rather than the sine cubed as predicted by cross-flow theory. Furthermore it was found that the drag of the netting increased dramatically with the mesh opening making formulaes based on twine surface area alone virtually useless for many Danish net designs where the mesh opening is very different in different parts of the trawl.

Further work is now being done using large scale models to determine if the geometrical shape of trawls is changed significantly when energy-saving net sections with less resistance are inserted. This work has been sponsored by the Danish Energy Ministry.

Engineering performance of full-scale fishing gear

Measurements of the towing geometry have been obtained (using Scanmar sensors) for an anchor seine, traditional and improved put trawls and a herring pair trawl.

The abrasion of netting materials

An initial appraisal has been made of several different methods for simulating in the laboratory the processes which cause wear in netting materials. The worn material has been compared with

cooperation with 5 net and rope manufacturers and although there is a large variation in the strength of a given sample after the wear tests it has been decided to try and proceed further with the development of a representative method for testing and comparing the effects of wear on different materials. The work has been funded by the material manufacturers and the Teknologiradet.

Trawl to vessel acoustic links

Due to the interest from Danish electronic firms in the development of new trawl instrumentation an appraisal has been made of the problems associated with the transfer of data from fishing gear to the towing vessel using acoustic links. A mathematical model has been developed to simulate the sound paths under different hydrographical conditions and with different locations of the sender and receiver. The work has been made jointly with the Danish Institute for Marine Research and Aalborg University and has been sponsored by the Teknologiradet.

FINLAND (P. Suuronen)

Underwater observations were made of two Finnish midwater trawls, using a remote-controlled towed vehicle equipped with a low-light-level television camera. These observations were carried out in collaboration with the Institut für Fangtechnik (Hamburg) in July in the Aland Sea (ICES subdivision 29), on board the German research vessel "Solea".

In autumn the catches of Finnish trawlers consist mostly of small-sized Baltic herring. Preliminary studies were made of the effects of changing the mesh size in the front part of the trawl and the towing speed on the size distribution of the herring catch.

The diurnal activity and swimming depth of spring-spawning Baltic herring were followed with an echo-sounder in the vicinity of a herring trapnet in May and June in the south-western archipelago (ICES subdivision 29).

Testing has begun of the resistance of the different kinds of netting materials used in herring trapnets.

An acoustic survey was conducted in July-August in subdivisions 29-32. The species studied were Baltic herring and sprat. For calibrating the system, a standard target was used. The echoes were also recorded for further analysis.

FRANCE

(N. Diner et C. Nédélec)

Acoustique Pêche

L'activité en matière d'acoustique appliquée a la pêche et a la recherche halieutique a porté principalement sur le traitement des données acoustiques d'une part, l'acoustique en chalutage de fond d'autre part.

1 - Traitement des données acoustiques

- Traitement des données = la numérisation et le stockage sur disquette des données sondeur sont faits grace a un data-logger special. La visualisation des détections sur écran cathodique couleur ou sur papier sur imprimante couleur est possible. Les niveaux de couleurs, choisis par l'opérateur, permettent d'augmenter la qualité d'informations utilisables dans la représentation sur l'écran.
- Sondeur de pêche : une amélioration sensible de la compensation des pertes de propagation a été apportée a un sondeur de pêche classique, sans en grever trop le coût, ce qui lui donne pratiquement les performances d'un sondeur scientifique.

Etude du comportement des poissons : l'utilisation d'un sonar omnidirectionnel et celle d'un sondeur porté par un corps remorque divergent fortement écarte de la route du navire remorqueur permet une analyse quantitative des réactions d'évitement du poisson a l'approche du navire.

2 - Acoustique en chalutage de fond

Le plus gros problème rencontre est celui de la zone d'ombre au voisinage du fond qui bien souvent masque les détections ou altère la représentation de la topographie du fond. Les programmes de recherche inities sur les sondeurs large bande et multi-faisceau devraient permettre de résoudre ce problème par la mise au point de sondeurs de type nouveau pour la pêche. Nous travaillons d'autre part sur l'acquisition possible par acoustique de données sur la géométrie du train de pêche.

Techniques de capture

1 - Etude du comportement des espèces vis à vis de l'engin de capture

En dehors de l'étude du comportement par voie acoustique, déjà citée, la recherche de technique de visualisation adaptées aux différents engins a été poursuivie.

- La possibilité d'observer le chalut en action de pêche a été testée lors d'une campagne a bord du N/O CRYOS par la mise en oeuvre d'un engin remorque télépilote prêté par le Marine Laboratory d'Aberdeen.

Un projet de dispositif concentrateur de poisson instrumenté a été étudié, qui combinerait suivi acoustique et visualisation photographique des poissons attirés par le dispositif.

2 - Etude des engins

Chaluts

Le logiciel de trace de plans est maintenant opérationnel et commercialisé; il lui sera adjoint quelques compléments, mais l'effort principal va maintenant porter sur la conception assistée par ordinateur. Un contrat d'étude a été passé pour faire la modélisation physique et mathématique du chalut en pêche, et créer le logiciel permettant la représentation a trois dimensions du chalut en fonction de ses caractéristiques géométriques et des conditions de pêche. Une campagne a été faite sur le N/O GWEN DREZ pour des mesures de traînée du train de pêche en fonction du gréement et de la vitesse qui fourniront les premières valeurs expérimentales utilisées pour caler le modèle.

Une étude comparative a été faite sur maquettes pour analyser le fonctionnement des chaluts jumeaux et le comparer à celui d'un chalut unique de surface de fil comparable. Des mesures de tension des funés, des ouvertures horizontales et verticales, a différentes vitesses et avec différents gréements, ont été réalisées; elles seront comparées avec les résultats obtenus en vraie grandeur sur le N/O GWEN DREZ.

Filets maillants

- le programme défini en liaison avec les biologistes pour une étude de la sélectivité des tremails, doit se dérouler en 1987.
- Une adaptation à la pêche française au thon blanc de la technique de pêche aux filets dérivants utilisée dans certains pays étrangers a été réalisée. Le matériel, réalisé sur plans IFREMER par les Ets LE DREZEN, a été essayé à la fois sur le N/O PELAGIA et un bateau professionnel, puis sur deux bateaux professionnels. La pêche de nuit au filet dérivant a permis d'augmenter de 40% les captures des

bateaux; l'essai d'une pêche de jour, programmée en 1987 et menée en parallèle avec la pêche classique à la ligne, devrait permettre d'accroître encore le gain de productivité.

- L'étude sur la mécanisation de la pêche aux filets maillants a révélé les grandes difficultés d'une mécanisation totale à bord des petits bateaux; elle est maintenant orientée vers la mécanisation de la manutention du filet à bord, en laissant le démaillage du poisson en opération manuel

Dispositif concentrateur de poisson (DCP)

Une étude d'un DCP instrumenté (détection acoustique et photographie sous-marine) a été entreprise en liaison avec le Centre IFREMER et l'équipe ORSTOM Tahiti. Le but est de mieux comprendre le processus de concentration du poisson, dans le temps et dans l'espace, sous un radeau attracteur ancre.

Drague à coquillages

Le drague cribleuse et aspirante à palourdes roses a été testée en conditions opérationnelles en baie de Concarneau et dans le Golfe normano-breton. Son efficacité a été confirmée, mais son utilisation professionnelle ne sera envisageable que lorsque le marché de la chair de bivalves utilisée dans les plats cuisinés sera organisé.

La mise au point de la drague hydrodynamique (par effet Magnus) à coquilles Saint-Jacques sera poursuivie en 1987.

Amenagement du navire de pêche

L'étude de l'automatisation de la salle de travail des chalutiers industriels est effectivement démarrée; elle comprend l'agencement de la salle de travail et les automatismes à prévoir pour le tri, l'alimentation des machines à eviscérer et le conditionnement.

FEDERAL REPUBLIC OF GERMANY
(H. Mohr)

As in previous years investigations on energy saving fishing methods occupied a large sector of the research work done in the Federal Republic.

Due to the extraordinarily poor stocks of cod at present, in the Western Baltic as well as in the German Bight, experiments with gill and trammel nets for cod were stopped in preference for those to catch other species, which might at least partly replace cod in the commercial fishery. Thus, field work with herring gill nets was started in the Baltic in order to promote the selective capture of large-sized and, therefore, marketable individuals of this still abundant species. Because of the unfavourable length composition of traditional trawl and gill net catches, the herring prices paid are so low that this fish is not attractive to German fishermen. Also in the Baltic, experiments for catching flatfish were undertaken with gill and trammel nets which were modified with the aim of reducing the bycatch of rubbish (mainly jellyfish and seaweed). The latter seriously hampers or even prevents the use of these gears in summer and autumn.

In the North Sea differently coloured trammel nets for the capture of soles were tested. The best results were obtained from steel-grey and dark-green nets, whereas blue and light-brown ones yielded very poor catches. Because of the lack of recruitment in 1986 the most efficient mesh sizes for sole trammel nets were slightly larger than in the year before.

In the past, an electrified beamtrawl has been developed which meets all requirements of commercial deployment. Recent experiments have shown that the shape of the beamtrawls used hitherto is not adapted in the best way to the reactions of fish in the electrical field. The construction of the trawls has been improved accordingly.

A recently purchased low-light underwater TV camera was used successfully during trawling experiments in order to observe the function of flexible kites made of canvas. Video pictures were also recorded of rubber bobbins when crossing obstacles.

Interesting records could be made with regard to the behaviour of fish within the trawl and the process of mesh selection within the cod-end. Further investigations focussed on technical properties of the remote controlled towed vehicle (RCTV), the knowledge of which is a prerequisite for its safe handling.

As in previous years, selection experiments were carried out during the winter cod fisheries in the German Bight. The properties of a new type of polypropylene multifilament, recently introduced into the German deepsea fisheries, were investigated.

In the Baltic, square mesh selection experiments were undertaken during pelagic pair trawling for herring. The main purpose was to apply the well-known narrow selection range of square mesh cod-

ends. It is hoped by this means to increase the proportion of easily marketable fish sizes in the herring landings.

GERMAN DEMOCRATIC REPUBLIC

(W. Thiele)

In the GDR, fishing gear research and development involves three fields:

- deep sea fishing
- inshore fishing
- basic research on theoretical and experimental aspects.

Deep Sea Fishing

Hydrodynamic experiments concerning the net cones of pelagic trawls were carried out with models in a wind tunnel. The best versions were selected for full scale experiments and then tested during normal fishing. The result was that the number of fish caught in the meshes was reduced by around 50%.

Further work has since been done to develop computer programs for the design and verification of trawl nets. Material data and other information needed for the computer-aid design of trawls are presently being compiled in a data base.

New types of pelagic trawl with asymmetric side panels have been developed, tested and put into production for fishing near the sea bed. They have proved particularly useful in shallow waters for catching squid, hake and mackerel.

A new type of bottom trawl has been specially designed for use in deep waters. It requires 25% less netting material. Although the net opening has not been increased, it has much improved fish catching ability.

Work has continued on the use of jigging gear for squid fisheries. Investigations into the use of light for attracting fish have also yielded results.

Sea and Inshore Fishing

The main tasks in this sector are the continued development and application of energy-saving fishing methods that simultaneously preserve fish stocks. Hydraulically driven net haulers are being developed for herring, cod, and flatfish trap net fisheries. Work is also being done to improve weight lines and floats. In long-line fishing a fully mechanised system for small vessels with a capacity of approximately 5,000 hooks a day is being developed.

Basic Research

Further work was performed on finite element systems for the analysis of steady state and transient processes. The aim of these investigations was to find further applications of the method in fishing gear development.

A computer program for calculating the shape of, and the forces acting on, ground trap nets was written for the steady state. First results lead us to believe that the impressions conveyed by simpler methods regarding these types of fishing gear will have to be modified in some cases quite drastically.

The following programs have been written for transient state problems:

- calculation of the variation in shape of and load on net cages exposed to wave action; initial results confirming the validity of this procedure have been obtained;
- calculation of the path followed by a towed body behind the towing vessel which is moving through waves; this program has been successfully tested.

In addition, pilot experiments concerning the hydrodynamic properties of otter boards were carried out in a wind tunnel. First results indicate that our models of pelagic otter boards tended to oscillate naturally under certain circumstances. Major oscillations in force and moment were also recorded.

ICELAND (G. Thorsteinsson)

Following direct observations with an underwater TV camera on Nephrops and Nephrops trawls in 1985, experimental trawl designs were tested and observed in May 1986. The new trawl designs showed good performance and increased the catch rates by reduced towing resistance. This experiment consequently resulted in better rigging of commercial Nephrops trawls. A video film has been published to illustrate the most interesting results.

In July the behaviour of cod and some other bottom fish species in relation to bottom trawls was studied. A video film made about these observations was of great interest to the fishermen.

Further observations were made on other fishing gears (seine, dredge, trap) and animal behaviour in relation to those gears.

A video tape was produced about model tests of shrimp trawls in the flume tank in Hirtshals.

A new design of a scallop dredge with improved rock rejection for

less damage to the scallop has been well received in the scallop fishery.

The conversion of a 28 m long fishing vessel for black quahog hydraulic dredging was completed. Experimental fishing will begin early in 1987.

Measurements of fuel consumption of fishing vessels were continued and proposals of energy saving projects were presented.

Routine acoustic assessment surveys were carried out on the stocks of herring and capelin. Target strength measurements on herring were conducted with a split beam echosounder. However the values obtained are thought to be unreliable.

IRELAND
(J. P. Hillis)

Trial use of separator trawls with two separate cod-ends by commercial skippers under Department of Fisheries supervision was discontinued, due to the hazards associated with hauling the two cod-ends separately in poor weather. Some progress was achieved in designing single divided cod-ends to overcome this problem. Comparisons of Nephrops and whiting catches taken by standard Nephrops trawls of 60 mm and 70 mesh are reported in the "Report of Activities" of the Shellfish Committee.

An Bord Iascagh Mhara undertook a number of fishery development projects of which the following had a significant element of gear research.

1. Adaptation of double rig Nephrops trawling systems to deep water.
2. Development of pair seining to modify pair trawling techniques.
3. Development of simple traps for whelk fishing.

NETHERLANDS
(B. van Marlen)

General

Owing to the increased demand for contract research, many discussions were held with the Dutch fishery industries, especially the ship-yards, and maritime research institutes. Various project-proposals were made to raise funds via the "National Foundation for the Co-ordination of Maritime Research in the Netherlands" (CMO). Two ICES papers "Use of heavy fuels in the Dutch Fisheries" and "Application of energy-saving concepts in Dutch fishing cutter design and operation", have been written. Technical advice has been given for potential projects in the

developing countries. A 6-week mission to Tanzania was undertaken for work on fishing development.

Safety and working conditions

A prototype of a portable warp greaser was tested. Two advantages of this unit are the possibility of greasing potentials of different warp diameters and the exchange of units between fishing vessels. Attempts were made to commercialise the system. During 6 weeks on board the beamers GO 38 and GO 41 a test has been accompanied of a new greasing and preserving remedy "Break free". More noise level measurements have been done on board nine Dutch beamers. The results are similar to the 1985 tests. In co-operation with TPD-TNO (Institute for Ship-acoustics) systematic noise measurements have been done on board of representative 1500 kW and 220 kW beamers to find ways to reduce the noise levels.

Reducing energy costs

Due to low fuel prices and the small price-difference between light and heavy fuels, less attention has been paid to the use of heavier fuels (up to 380 mm²/s) (cSt.) on board Dutch beamers. Poor quality of bunked fuels was identified as a problem for Dutch fishing vessels. Discussions with fuel suppliers, engine manufacturers and skippers resulted in a Working Group to improve the fuel specifications used on board the Dutch fishing vessels with continuously varying diesel loads. Power and fuel consumption measurements have been made on board the 2200 kW beamer GO 26, one of the few Dutch beamers with a controllable pitch propeller. A useful manual was produced describing the procedure for power measurements and data analysis. Owing to calibration failures the recorded data only resulted in rough conclusions. On the GO26 experiments were also done with the fuel katalysor CP 3500. These experiments will be concluded in 1987. This katalysor should prevent carbon deposits in the engine and reduce the fuel consumption.

Design of fishing vessels

In view of the changing fishery conditions in the Dutch fisheries (TAC, quota, laying-up weeks) an optimised fishing vessel is much more needed. The study of energy-saving concepts design and operation, shows that in the Dutch cutter fleet, only those aspects had been applied which did not interfere too much with the daily fishing operations, such as the choice of the propulsion machinery, fuel oils and electrical power generation. With a careful reconsideration of energy-saving possibilities, a potential 15-25% fuel savings may be realised.

Electrical fishing

Modifications in the circuitry aimed at a higher reliability. Comparative trials were done on the RIVO system and one designed by a Mr van de Vis of Texel. Results were encouraging for the RIVO

system with higher sole catches, while the other system fell short in this respect. Both systems fail to match the conventional tickler chain gear catches of plaice however. It is hoped to complete commercial development soon. The catching efficiency of several components of the system, such as the electrodes and the net alone, was studied. Measurements were made on the energy transmission through the system, as it was felt that substantial losses took place that may be diminished.

Towed fishing gear

Sterntrawler skippers are seeking ways to increase the depth of their gear without a reduction in fishing speed. An initial idea of changing the door attitude toward the flow, in order to gain depth was tried on FRV "Tridens" in March with only minor success. Apparently bigger downward forces have to be applied either by weight or a hydrodynamic device to reach significantly greater depths.

Trials were conducted on the self-built rotor control unit for the underwater towed vehicle. The purchase of a new camera (SITOE-1223) enabled a far better picture quality. Recordings were made of a bobbin trawl giving useful information on the behaviour of measuring equipment on the net.

Four designs of beamtrawl nets were tested in the Hull Flume Tank at scale 1:4 and three designs of big meshed midwater pair trawls (scale 1 : 25). The beamtrawl nets were intended to be used with a rake type of stimulation, where the problem was to minimize the distance between the rake pins and the footrope without a loss in bottom contact. The aim with the midwater trawls was to find a net with similar vertical opening but bigger wingspread and to create a square aft part (4 equal panels), to avoid the problem of substantial meshing of fish. One of the gears tested featured simple taper ratios at the frame lines to cut the costs in production and to ease repair. This simpler cutting resulted in distortion of the meshes close to the frame lines with low stress in the bosom and high stress at the selvages. Apparently good trawl shapes can only be found with a frame line design not too different from the theoretically calculated one on the basis of equal load on the bars.

Extended trials were done in with two different beamtrawl nets used with the rake trawl used. One of the nets was constructed with four shark teeth, while the other was based on a round footrope. The reference gear had a conventional tickler chain. With both rake trawls, catches of sole, turbot and plaice were low in comparison with the conventional gear. Furthermore the expected decrease in towing resistance did not occur, while many of the fish became scratched by the pins. The rake trawl concept not an improvement on conventional gear and will not be investigated further.

Trials were done on commercial boats with German and Danish type

nets to identify the best rigging for fishing over sand-ridges. Good results were obtained. On some occasions the net got stuck in a ridge but never to such an extent that hauling-in was necessary.

Tests on a so-called "trouser net", with a considerably smaller twine area were done with the aim of developing low drag beamtrawls. The net consists of two small beamtrawl nets next to each other, attached to one footrope on one beam. The catching efficiency turned out to be promising with a slightly smaller drag. Handling both cod-ends simultaneously was no problem.

NORWAY (A Bjordal)

Fish Behaviour and Reaction

Studies of fish behaviour in relation to different light stimuli have continued. The investigations have shown that scattered layers of herring may be concentrated and guided by means of underwater light. By lowering the light underneath the school, the herring immediately ascended to the surface when the light was switched on.

The behaviour of herring in relation to vessel and gear in purse seine fisheries has been investigated.

The imaging sonar 675 kHz sonar, SIMRAD/MESOTECH Model 971, has been used as a trawl-sonde on a number of pelagic and bottom trawls. This can show (1) the three-dimensional shape of the trawl gear, from the doors to the cod-end, (2) the shape of the sand cloud, behind the doors, and (3) fish positions at the entrance and at different sections along the inside of the trawl gear. Such measurements, made both in daytime and at night are being used to quantify trawl effectiveness and to study trawl geometry.

Selective Fishing

Work to improve the size and species selectivity of shrimp and round fish trawls as well as size selectivity of Danish seines has been carried out.

Further studies were conducted to evaluate the selective performance of bottom trawls used in Norwegian demersal fish surveys. A modification of the radial escape section (RES) utilizing the filtering effect of the funnel meshes and the forward herding and upward escape reaction for fish, proved to increase loss of small shrimp and escape of fish through an

opening in front of the funnel entrance.

Size selectivity of square mesh and diamond codends have been compared both in roundfish trawls and Danish seines. Improved selectivity was proved, but heavier meshing of redfish in the square mesh reduces its usefulness in the Barents Sea. To avoid problems with emptying a big catch from square mesh, a codend composed of square mesh in the upper panel and diamond meshes in the lower was designed and tested. The selectivity of this design was poorer than that of the ordinary square mesh codend. Initial experiments with square mesh codends in Danish seines gave encouraging results.

The sampling trawl studies have proved length dependent escapment of cod under the fishline, and that the sweep length effects both the size and species composition of the catches. Relatively more small fish are caught with 40 metre sweeps than with 80 metre sweeps. Long sweeps, however, catch relatively more large fish.

Improvements of Fishing Gear and Methods

A new hook design (EZ-Baiter) has been tested in comparative longline fishing trials. This hook, which is a modified circle design adapted to mechanized longlining gave significantly higher catch rates for all main target species (cod, haddock, tusk and ling), when compared to traditional hooks. The development of a "tea bag" longline bait has been continued, (mince raw material in nylon gauze bags). Bait with herring as raw material has given comparable catch rates to traditional longline bait for tusk, ling and haddock. The development of a simple mechanized longline system is complete. The system, which is based on random baiting and storing of the line in tubs is already installed on several vessels from 30 to 50 feet long.

Mechanized net stacking systems are now in common use on most of the larger Norwegian purse seiners.

Development of new hauling and stacking systems for lead- and float lines on large purse seiners have continued. This will hopefully eliminate manual handling of the heavy lines.

Acoustics and Behaviour

Development of a multi-frequency echo sounding system for measuring the density and size composition of zooplankton in situ continues.

For theoretical determination of the target strengths of walleye pollock (Theragra chalcogramma) and roach (Rutilus rutilus), anatomical measurements have been completed.

The target strength of haddock (Melanogrammus aeglefinus) has been measured in situ with the SIMRAD split-beam echo sounder.

Vessel Technology - Marine Engineering

The research programme "Safety and Working Environment" was completed in 1986. The results have played an important role in preparing safety regulations and a for government safety regulations and a "Whitepaper" on Safety in the fishing fleet. A follow-up information project is now being prepared. The work on "Safety standards in the Fishing Fleet" will continue. This is a survey covering about 600 fishing vessels. Preliminary results indicate serious shortcomings in several sectors of the fleet.

The research activities on "Fuel Saving and Fuel Economy" were completed during 1986. The information and education project that formed part of the programme was completed also. An educational simulation programme about fuel saving, for use on personal computers, was made operational. The "Ecopilot", an industrial project for automatic optimization of main engine and c.p.-propeller control--was also concluded from the research point of view. A bow tank for pitch reduction on fishing vessels was model tested with encouraging results.

A project involving "Future"-research was commenced, with the aim of producing scenarios for the Norwegian fisheries of the future, with particular emphasis on the fishing fleet and vessel technology development. This work continues in 1987.

A pilot project on "Information Technology in the Fishing Fleet" was carried out with emphasis on information analysis and the scope for the use of information technology onboard.

In general, there is great interest in technology for processing at sea, and plans for research in adapting technology for use on board were prepared.

An analysis of damage, stability and safety on smaller fishing craft concluded that improvements can be gained simply by using watertight bulkheads and floating components in the rail.

PORTUGAL (A. Leite)

During 1986 the Department of Fishing Gear and Methods of the Instituto Nacional de Investigacao das Pescas, Portugal, was involved in the following work.

Fishing experiments on deep-sea species were conducted using PA MONO 2.5 horizontal and vertical long-lines. Successful detection and capture of the black scabbard fish Aphanopus carbo and deep-sea sharks on fishing grounds off Madeira Island. and the continental Portuguese coast, are reported.

Experiments on catching the deep-sea crab Geryon affinis were

conducted with traps on Gettysburg, Ormond and Lion Banks.

The Portuguese version of FAO Technical Paper No. 222 - "Definition and Classification of Fishing Gear Categories" was published, also the Portuguese version of the "Glossary of Fishing Gear" of the European Communities Commission.

Fishing charts of the Portuguese Coast and Madeira Island area have been prepared.

Other work arose in the resolution of fishing administration problems, mainly related to the establishment of new fishing activities inside the Portuguese EEZ.

SPAIN

(J. Bravo de Laguna)

Spanish activities have concentrated on acoustics applied to fisheries research. Three acoustic surveys were carried out, two along the Spanish coasts and a third one in the Eastern Central Atlantic (CECAF area). The vessel used was the R/V Cornide de Saavedra which is equipped with 38 kHz and 120 kHz echosounders and a digital echointegrator. Acoustic calibrations were done with standard copper spheres.

The cruise 'Saracus 861' was carried out in March along the Spanish north and northwestern coasts, between the Spanish-French and Spanish-Portuguese borders, ICES VIIIC and IXA statistical divisions, down to 500 m depth, along 2078 nautical miles of cruise tracks. The species caught were pilchard, anchovy and horse mackerel. These populations were mapped in the different areas and the biomass of the different age groups was estimated.

During the acoustic survey 'Pelagos 8608' the coastal pelagic fish populations of the West African coast along Togo, Benin, Ghana and Cote d'Ivoire were studied. This was part of a multiship survey with participation of Spanish, Norwegian, Mauritanian and Senegalese research vessels. An intercalibration exercise involving all the vessels was carried out during a mini-survey of an area located between the parallels of latitude 15N and 15 30'N.

Finally, in November the acoustic survey 'Saracus 862' was conducted again along the Spanish north and northwestern coasts, in ICES VIIIC and IXA statistical divisions, down to 500 m depth, along 2184 nautical miles where the species caught were pilchard, anchovy, and horse mackerel. These populations were mapped in the different areas and the biomass of the different age groups was estimated. Initial experiments were performed to determine the target strength of sardine and horse mackerel with a split beam echosounder.

SWEDEN
(O. Hagström)

Fish Behaviour

Behaviour studies of both marine and freshwater species have been carried out using telemetric instruments and underwater observations. Work on fish reactions to stationary gears such as gill nets and pound nets has continued.

Improvements of Fishing Gear and Methods

There are continuing projects to improve pelagic trawls for both pair and single boat fishing. The trawls are designed for catching herring, sprat and cod.

Fishing Vessels and Equipment

Several projects are in hand whose main objectives re to give better working conditions on board fishing vessels.

Acoustics

Routine surveys are carried out in the Skagerrak/Kattegat and in the Baltic areas. The target species are herring and sprat.

UNITED KINGDOM

1. ENGLAND AND WALES
(G. P. Arnold)

Developments with the Simrad QD echo-integrator and Apricot Xi microcomputer reported in 1986 have been consolidated and plots of biomass (t/km²) per nautical mile surveyed are produced routinely during acoustic survey cruises together with a preliminary assessment of abundance by species for each area surveyed. Improvements have included the adaptation of the Simrad EK400 bottom detector and digitiser to reduce the chance of 'bottom stop' operating on dense fish shoals and the production of a calibration spreadsheet designed to reduce time taken up with calibrations at sea.

Acoustic survey equipment installed on the new RV CORYSTES includes synchronized 38kHz and 120 kHz echo sounders and a 38 kHz split-beam target strength analyser with QD and QM echo-

integrators. There are in addition an SM600 long range sonar and the MAFF 300 kHz sector scanning sonar.

Two acoustic surveys were carried out during 1986 using a Simrad 38 kHz system. The first survey (20 August-3 September) was undertaken to estimate the biomass of spawning herring shoals off the north-east coast of England between the Humber (53°35'N) and the Farne Islands (55°45'N) and extending offshore to the western edge of the Dogger Bank (01°20'E). Two patches of fish were located. The major one was centred 9-10 miles off the coast between Whitby and Robin Hood's Bay, the smaller one 9-10 miles ENE from Flamborough Head. The biomass in these concentrations was estimated to be in the range 120-140,000 tonnes.

The second survey (2-17 December) investigated the distribution of pelagic species in the western English Channel between Portland Bill and the Lizard up to 20 miles off the coast. Sprat shoals were mainly concentrated towards the western side of Lyme Bay and biomass was provisionally estimated at 5,500 tonnes. Very few pelagic traces were recorded west of the Eddystone but several dense concentrations were found to the east, pilchard and small mackerel within 12 miles of the coast and horse mackerel further offshore.

2. SCOTLAND (P. Stewart)

Further comparative fishing experiments using small mesh covers confirmed that codends with fewer meshes round their circumference increase the 50% retention length for haddock and whiting. Observations of square and diamond mesh codend covers showed that there is slightly more clearance between codend and cover in the square mesh case. This may reduce the masking effect of conventional covers. Preliminary trials with a new design of vertically divided trawl (two nets on one headline) were performed to investigate the possibility of comparing two codends without using small mesh covers.

A new project has been started to study the effect on catch size of the factors which are thought to determine the efficiency of sampling gears. The major parameters to be measured will be towing speed, light level and gear geometry.

A proposed design for a small 600 hp version of the standard ICES Young Fish Sampling trawl was tested to make careful comparison of its geometry with that of the normal size (GOV chalut 36/47).

Engineering data were obtained on the relatively new Scottish pair seining method in which the gear is shot by one vessel, towed for a considerable time by both before the ropes are passed back to the first vessel for hauling. Vessels of about 250 hp were used.

A preliminary series of observations using television and

instrumentation were made on a 240 hp seine net vessel. More detailed information on the geometry of the ropes is now possible and a further trial is planned in 1987 with enhanced instrumentation for monitoring swept area.

Engineering trials on flat and vee-type otter boards have been concluded. The effects of ground friction and changes in wire attachment position have been measured with instrumentation and recorded on film over a range of speeds. One aim is to improve the matching of door size to net size.

A final series of measurements was made on the drag of different ground gears on hard and soft seabeds. The analysis of a large body of data on the drag of two panel demersal trawls has been started with the aim of developing a net drag formula. Different designs of these trawls may need to be considered separately.

The computer model of a trawl is being extended to include demersal nets and the wires ahead of the net. A theory of flow through nets is being developed and further work has been done on the drag coefficients of netting at small angles of attack.

Further experiments, using direct observation techniques, have been made to investigate the damage to commercial species of fish escaping from codends. A new study began to investigate fish behaviour to and performance of single vessel twin-trawls using different rigging arrangements and similar and dissimilar nets. Work on separator trawls continued to assess species separation and selection utilizing different mesh sizes in the upper and lower codends.

A three year study of swimming performance has established figures for maximum speed, minimum speed and endurance at intermediate speeds for mackerel (30-40 cm). The endurance for similar sized herring and saithe has also been measured. The results have been found to give explanations for the increase in tilt angle of mackerel when light level drops, and the changes in behaviour observed in the mouth of a trawl net.

Conclusions from the studies of fish reaction to trawls at night are that below certain light levels (10⁻⁷ lux) and with low levels of bioluminescence and deck lights off, haddock, whiting, cod, saithe and sandeels have been observed to show no reaction to the parts of the trawl until touched.

A pattern recognition test has been found successful in helping to show food preference in cod. This technique may be useful in speeding up tests selecting better synthetic baits and experiments are continuing.

The routine measurement of transducer beam patterns was continued on its bi-annual basis, showing no significant differences from earlier measurements. Beam pattern measurements on the Simrad Split Beam System were also carried out and indicated some software problems requiring solution before it can be used for

measurements at sea. Cage materials were measured to assess the best cages for species with very low target strengths. Experiments at 38 and 120 kHz were carried out on shrimp using a low reflectivity cage in cooperation with the Antarctic Survey. In addition, the same rig was used to continue measurements on the frequency response of caged fish from 27 to 54 kHz. Mackerel, herring, cod and saithe were investigated for frequency differences. In-situ measurements were continued using the Dual Beam System for herring in the Clyde and Minch in November and in the Orkney/Shetland area in July.

Acoustic surveys were carried out on the North Sea sprat, herring in the Clyde/Irish Sea, the Orkney/Shetland area and ICES area VIA.

U.S.S.R.
(A. A. Elizarov)

In the Barents Sea in 1986, gear research was conducted to substantiate the measures for rational exploitation of haddock stocks and to determine the catchability coefficients of bottom trawls. The following results were obtained:

- measurements of the selectivity of trawl codends made of polyamide netting with 100 to 140 mm mesh size intended for the haddock fishery in the Barents Sea;
- data on the catching efficiency of bottom trawls as a function of the net length in relation to catches of cod, haddock and plaice;
- preliminary data on the survival of haddock after escaping from the 120 mm mesh codends.

In the Baltic Sea and the Gulf of Riga, the selective properties of trawls having an inner mesh size in the codend of 28 mm made from 183 tex x 3 (polyamide A) twines, were investigated in relation to the fishery for mixed concentrations of herring and sprat by small trawlers. Diamond-shaped and square meshes were investigated. Quantities of meshed fish (mainly sprat) were observed. The number of meshed fishes increased with the increase of sprat by-catch. When the by-catch of sprat exceeded 30%, over 200 meshed fish were observed per square metre of netting.