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Report of Activities

FISH CAPTURE COMMITTEE

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by

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BELGIUM

(Ir G Vanden Broucke)

In the field of fuel-saving studies, commercial fishing gear has been adapted and new types of fishing nets have been designed to reduce the energy consumption.

The application of a variation of the "Rock-Hopper" gear, rigged on a semi-pelagic net for the inshore fishery on roundfish, has been considered.

Comparative fishing experiments have been carried out with beam trawls using a combination of a chain mat and flip-up ropes, towed from a 1200 hp beam trawler.

For the purpose of reducing the drag of the gear, further experiments have been carried out with electrified beam trawls. An underwater pulse generator has been designed for use on the coastal fishery. Work has been done on the cable winch required in electric fishing. In this case the cable has four internal conductors.

In order to increase safety on board beam trawlers, a new overload protection system was tested on board a 900 hp vessel. The system automatically releases the towing cable if a preset overload occurs in one of the warps, or if a given load difference between the two warps is detected, or in the event of a sudden, well-defined increase in load.

On a fishing vessel of 500 hp, experiments were carried out to test a semi-pelagic net as a bottom pair-trawl for roundfish. A four panel-trawl for demersal fishing has been studied on the research vessel "Belgica".

Research on the selectivity of the beam trawl used in coastal fisheries for sole was begun. Diamond and square codend meshes were tested using both the parallel haul and the covered codend methods.

A laboratory has been developed to test the shrinkage of netting under tension due to the igress of sand between the twine fibres.

CANADA

(P Koeller)

Fishing Gear Selectivity

Comparative fishing trials were carried out by the Fisheries Development Branch (FDB) of the federal Department of Fisheries and Oceans (DFO), Scotia Fundy Region, to document the benefits of square mesh codends for groundfish stock management. Mesh sizes used were 121 mm square, 130 mm square and 130 mm diamond. Initially these trials were to use codend covers, but inspection with an underwater camera (Mermaid Explorer) showed that the covers were collapsing the codend and inhibiting escapement. Consequently, a trouser trawl was employed with square mesh on one side and diamond mesh on the other. A total of 51 valid sets were made. Results show that an equivalent size square mesh releases about 50% more cod and haddock <40 cm in length while yielding 50% larger retention lengths. For Yellowtail flounder and American plaice the diamond mesh had improved escapement of immature fish.

The importance of location in lobster traps of escape devices for sublegal size lobsters was studied by DFO's Gulf Region. Trials with several trap models indicated that the presence of an auxiliary escape device in the second chamber of standard 3-chamber commercial parlor traps does not enhance escape.

A tangle net used commercially in Europe for catching spider crab (Maia sp.) was successfully tried for catching snow crab (Chionoecetes opilio) by DFO's Gulf Region. The tangle net catches mating pairs and allows for research on seasonality of mating in deep living populations of snow crab. Mating pairs are not usually caught in standard commercial traps.

The catchability of lobster and crabs by baited traps was studied by DFO's Biological Sciences Branch, Scotia Fundy Region with a view to developing catchability coefficients which can be used in biomass estimates for stock assessments. Catch rates were compared to density estimates measured in two habitat types (with and without kelp cover) by divers. Catchability coefficients increased greatly with size of lobsters and did not differ between habitats for either lobster or crabs.

DFO's Biological Science Branch, Newfoundland Region continued field experiments on selectivity of Diamond 9 midwater trawls used in collection of capelin samples during acoustic surveys. Escapement of capelin is being estimated by attaching trawl bags made of 12.7 mm mesh nylon to the outside of the trawl at various locations.

Fish Behaviour and Underwater Observations

Trials with a flapper used in conjunction with a square mesh section of a standard 130 mm diamond mesh codend were conducted by FDB, Scotia Fundy. Camera observations showed that the flapper encouraged fish to seek early escapement through the relatively small square mesh section.

Mermaid Explorer was also used successfully to observe inshore scallop rakes and pair trawls, and to search for illegal lobster traps on the bottom. National Sea Products Ltd employed this camera system on board an offshore trawler to determine the effect of reduced trawling speed on fish capture. There was no visual evidence to suggest that fish escapement increases when trawling speed was reduced from 4 to 3.5 knots. DFO's Quebec Region also used an underwater video camera to study the efficiency of the Digby scallop drag, and in scallop stock assessments.

Commercial Fishing Gear Development

The Nova Scotia Department of Fisheries continued work with a controllable pitch propeller system in a propeller nozzle. The test vessel will be equipped with a fuel monitor and an evaluation will be conducted in the spring of 1988. An inshore vessel was equipped to drag for mussels to determine if a commercial venture can be established to supply mussel seed for commercial growers. A contract was awarded to the Technical University of Nova Scotia for a hydrostatic analysis of the area's well known Cape Island style inshore fishing boats. The group also provided funding for trials of a marine hydraulic crane for use in lobster fishing. Safer working conditions and more efficient handling of the gear were the major benefits.

The New Brunswick Department of Fisheries developed a bottom trawl with a high selectivity for flatfish. The net is fished without floats for flatfish. Satisfactory results were also obtained for cod when floats were added. Trials with gear which is easily adjustable to fish for either cod or flounder are continuing.

The Faculty of Applied Science, Memorial University of Newfoundland designed a system to harvest mussels under ice. The University also considered the use of hydraulic scale models in the design of floating fish cages used in aquaculture.

Under Sea Ice Studies

DFO's Central and Arctic Region tested a prototype acoustically-triggered underwater camera for photographing targets detected under landfast sea ice. The Region has been using hydroacoustics for several years to examine Arctic cod behaviour, distribution and abundance beneath sea ice. This camera will provide a mean for verification in addition to more traditional approaches, such as vertical gill nets. Initial tests in Chitty Lake, North West Territories, were successful and development of a deep-water version (to 200 m) continues. DFO's Quebec Region is currently analysing data from winter groundfish surveys to study the interaction between ice coverage and catch size.

Acoustics and Stock Assessments

Acoustic surveys have been conducted on southern Gulf of St Lawrence (Baie de Chaleur and Sydney Bight) herring each fall since 1984. These surveys have followed randomly determined zigzag transects. Biomass estimates are based on the assumption that herring schools are randomly distributed within coastal strata. In 1987 an additional survey was conducted concurrently on a second vessel using the design employed during the Scotia Fundy Region's annual winter survey of Chedabucto Bay herring. In this alternate design herring aggregations located through

contact with local purse seine fishermen are intensively mapped by repeated crisscross transects. Results from the two survey types are being compared and evaluated.

A BIOSONICS acoustic system has been purchased by DFO's Quebec Region for use in shrimp resource assessment surveys.

Several papers were published by DFO's Scotia Fundy Region documenting improvements in acoustic fish size discrimination. They show the joint effect of perspective and position in the beam on the target strength of fish and calculate appropriate corrections for the significant bias present in existing methods. These corrections have also been incorporated into new equipment from BIOSONICS (USA) and SIMRAD (Norway) as well as the Canadian company (SEASTAR) which has undertaken to commercialise the ECOLOG system developed at the Bedford Institute of Oceanography.

DFO's Newfoundland Region conducted six offshore surveys for cod, capelin and redfish using the HYDAS single-beam system. The region is currently developing and conducting trials with the HYDAS-2-dual-beam system.

Trawl Monitoring

DFO's Biological Sciences in Newfoundland completed trials on SCANMAR's trawl monitoring package to be used on demersal biomass surveys. The package includes height, depth, temperature, and spread sensors. Software was written to log the data onto computer tapes. The equipment will be used on all bottom surveys of the Grand Bank in 1988 and the data will be incorporated into estimates of minimum trawlable biomass for stock assessment. Scotia Fundy Region also purchased the system for the same purpose, and to determine net configuration and depth during juvenile fish midwater trawl surveys.

FEDERAL REPUBLIC OF GERMANY

(E Dahm, K Lange)

Energy-saving fishing methods have been one of the main research subjects of the Institute for Fishing Technology. They have been supplemented by special investigations on trawls used for stock assessment purposes and on the environmental effects of different beam trawl types.

Cod stocks in the German inshore waters of North Sea and Baltic are still in a poor condition. Trials intended to substitute catches of other species have continued. The situation is especially serious in the Western Baltic. Due to its brackish nature, the Baltic is lacking in fish species of commercial interest. Herring, second in importance there, can for obvious economic reasons only substitute for cod to a very limited extent. Good prices are obtained only for large herrings. Gear research concentrated on the improvement of gillnets capable of exploiting this part of the stock. Under normal conditions, the diameter of the monofilament twine greatly influenced the catch. Nets with 0.15 mm twine sometimes caught three times more than those with 0.28 mm. However, during the spawning time when the herring fishery is most productive twine diameters seemed to be of minor importance. This finding is of considerable economical relevance because nets with thicker twine can be used much longer.

Pair trawling, another important fishing technique for Baltic herring, was also investigated, especially the influence of codend mesh shape (diamond/square) on the catch selection. Square meshes showed a sharp selection of herring with a narrow selection range, confirming results from experiments with other species.

Another alternative for cod, the flounder, is only of local importance during the summer months when it can be sold directly to restaurants or tourists. The flatfish fishery is often severely hampered by jellyfish. In such a situation gillnets of multimono twine and half the height of the conventional nets made of twisted twine are more effective than traditional ones.

Fishing boats from the Baltic exceeding 16 m length may overcome the present lack of cod by fishing for turbot in the Southern North Sea. This was suggested by exploratory fishing voyages carried out over several years as well as a quasi-commercial fishery which began in 1987. The main season for turbot lasts from the beginning of May to mid-July and gillnetting may be continued by switching effort to cod in August.

A further possibility for large enough boats is gillnetting for sole. Success in this fishery has led to four new fishing boats in East Frisia being commissioned as combination beam trawlers/gillnetters.

Relatively unexploited sources of good quality fish are the numerous wrecks lying in the German Bight. However, there is a high risk of net damage when fishing above or near these underwater obstacles. In 1987 the catch rates were increased by using sonar to search for and approach the wrecks. Additional experience was gained about the optimum construction of the gillnets necessary for this fishery. It

was found that the catches obtained with 2.5 m high nets were the same as those obtained from traditional nets (4 m height). Damage could be considerably reduced by including weak points in the lead line.

Pilot trials were also performed with a special wreck longline. As with the gillnets, exact positioning of the gear and limitation of damage by including weak points greatly improve the efficiency of this fishing method. The catch rate per hook has been most encouraging.

Underwater television has become an important tool for research at the Institute for Fishing Technology. For the first time the behaviour of soles in front of an electrified beam trawl has been observed directly. Standard otter trawls used for stock assessment purposes have been investigated, especially the influence of rigging on the geometry of the net, the bottom contact of the groundrope and the fish behaviour.

From observations of codends used for selection experiments, it was discovered that the escape of small fish is influenced considerably by the rigging of the small mesh codend cover. In the forward part of the codend where the cover is lying closely to the codend netting, no fish could pass through. However, when the cover was lifted by floats from the upper panel of the codend, then the fish could pass through the codend meshes into the cover.

To study the effects of beam trawls on the seabed and benthos, TV observations have been made on different types of this gear. It has been found that there is little or no harmful effect on the seabed when using relatively light gear such as the brown shrimp beam trawl or the type used in the German sole fishery. Heavy beam trawls, however, flatten all bottom structures. Even on a hard sandy bottom, they dig out animals like the sand dollar which lives in an average depth of 15-20 cm. The tracks of such a gear appear highly attractive to predatory fishes living nearby, probably because they can feed on damaged or unprotected bottom dwellers. But it is not known what happens when such an area is repeatedly fished, nor how soon recovery would take. Investigation of these questions should contribute to the newly established ICES research programme in this field.

To check the influence of camber on the lift and drag of V-shaped otterboards, wind tunnel tests were performed at the Institute of Naval Architecture, University of Hamburg. A camber of 13% of the chord length increased the lift coefficient by the factor 2.4 compared to an uncambered door when the board was close to a bottom plate. The factor reduced to 1.4 when the board was positioned in the centre of the flow without bottom influence.

Errors in processing fish length and weight data could be considerably reduced by use of an electronic measuring board. Such a device has been developed in the Institute. It works by connection to a small commercially available computer. Data recorded via the measuring board switches are displayed on the computer screen and stored on diskettes. Thus it is possible either to examine the data immediately at sea or to bring them ashore for later processing in the Institute. A prototype has been tested successfully on research ships, and arrangements are being made for commercial production.

FINLAND

(P Suuronen)

The behaviour of Baltic herring in the vicinity of and inside midwater and bottom trawls was studied in the Archipelago Sea and Gulf of Finland with an echo-sounder in a small motorised boat moving above the gear.

The escape of herring through the upper belly panels of a pelagic herring trawl was studied in autumn by attaching small meshed bags to different parts of the belly to catch the escaping fish.

The effect of the towing speed on the size distribution of the herring catch was studied in the Gulf of Finland, during the autumn.

The diurnal activity and swimming depth of spring-spawning Baltic herring were followed with an echo-sounder in the vicinity of a herring trapnet leader in May and June in the southwestern archipelago of Finland.

Testing of the resistance to water flow of the different kinds of netting material used in herring trapnets was continued in collaboration with the Institut fur Fangtechnik (Hamburg).

An acoustic survey was conducted in July-August in ICES sub-divisions 29-32. The target species were Baltic herring and sprat.

FRANCE

(G Massart)

ACOUSTIQUE PECHE

Etude de matériel

Comme les années précédentes, l'activité en matière d'acoustique sous-marine a porté sur les applications à la pêche mais aussi à la recherche halieutique :

- un sondeur de pêche classique à 4 fréquences a été modifié pour lui adjoindre un dispositif TVG numérique et pouvoir appeler chaque fréquence par clavier. Cela permet de disposer d'un sondeur scientifique à 4 fréquences et de faible coût ;
- la visualisation couleur sur un écran de micro-ordinateur type PC est maintenant au point avec la possibilité de sortie sur imprimante couleur ;
- les programmes de recherche sur les sondeurs large bande et multifaisceaux continuent ;
- une première expérience de détection planctonique a été effectuée. On a pour cela utilisé comparativement 6 fréquences différentes comprises entre 28 et 200 kHz ;
- dans le cadre de l'écho-intégration, l'étude des réactions d'évitement des poissons à l'approche du navire est poursuivie. On essaie en particulier de quantifier l'influence du phénomène sur les évaluations acoustiques de stock ;
- enfin, dans un autre domaine, l'acquisition par voie acoustique de données sur la géométrie du train de pêche est étudiée.

Etude du comportement des espèces

- L'observation des réactions d'évitement des bancs de poissons au moyen d'un sonar omnidirectionnel porté par le chalutier et d'un sondeur vertical porté par un corps remorqué largement écarté du sillage du navire par un divergent a été poursuivie dans le but de corréler les réactions d'évitement aux espèces rencontrées, à la période (dans la journée et dans l'année) et au lieu de ces observations.

- Le projet de dispositif concentrateur de poissons instrumenté, étudié en 1986, a été retardé ; l'étude n'a été achevée qu'en 1987 et la réalisation n'en est qu'amorcée. Le système comportant à la fois un suivi du comportement des poissons par voie acoustique et une visualisation photographique des espèces devrait être opérationnel à Tahiti en 1988.

TECHNIQUES ET ENGINS DE CAPTURE

Chaluts et chalutage

- L'étude sur les chaluts jumeaux, commencée en 1986 par des essais sur maquettes en bassin d' essais s'est poursuivie par des essais à la mer qui ont permis d'affiner les moyens de dimensionner les chaluts jumeaux (ouverture verticale, surface de fil, effort de remorquage).

- Un chalut à 3 ailes a été étudié, à la fois en bassin sur maquette et à la mer. Les résultats (gain en ouverture verticale et choix des gréements) ont permis un transfert presqu'immédiat aux professionnels.

- Le programme d'étude sur la conception des chaluts assistée par ordinateur se poursuit avec la modélisation de formes de filets encore simples (à symétrie axiale) pour lesquelles existe une bonne corrélation entre formes obtenues par le calcul et formes observées en bassin.

- L'utilisation du chalut pélagique pour la capture du germon a été tentée par des professionnels avec la collaboration de l'IFREMER. Les résultats obtenus sont très encourageants et motivent le démarrage de l'étude d'un chalut spécifique.

Panneaux

Des panneaux roulant sur le fond, imaginés par un industriel installé à Lorient, ont été testés en bassin et essayés en mer. Les premiers résultats font apparaître un écartement comparable et un effort de traction inférieur à ce que l'on obtient avec des panneaux classiques de surface équivalente.

Par ailleurs, dans le cadre du Projet HALIOS (projet EUREKA de chalutier franco-hispano-islandais), plusieurs propositions d'études ont été faites :

- pour des divergents souples,
- pour des divergents à flottabilité positive,
- pour un système de blocage à poste des panneaux classiques.

Filets droits

- Une étude sur la sélectivité des trémails à soles a été entreprise et sera achevée en 1988.

Manutention des filets maillants à bord des petits bateaux

- Après les difficultés relatées précédemment sur la difficulté de mécaniser la totalité des opérations de mise en oeuvre des filets droits à bord des petits bateaux (moins de 12 mètres), le travail entrepris a permis d'aboutir à des propositions d'aménagement de plans de pont et d'emploi d'apparaux facilitant la manutention et le stockage des filets à bord.
- Dans le cadre des essais de pêche du germon aux filets dérivants (voir compte-rendu d'activité de 1986), les travaux ont été poursuivis pour déterminer l'influence du maillage sur la taille des captures et le rendement de la pêche, la profondeur optimale d'immersion et la possibilité de pêcher de jour.

Dragues à coquillages

Des difficultés techniques retardent la mise au point de la drague hydrodynamique (à effet Magnus) à coquilles Saint-Jacques.

Par contre, une nouvelle génération de drague cribleuse rotative, aspirante ou non, a été développée pour être mise en oeuvre par de petits bateaux, éviter l'engorgement de la drague et simplifier le tri à bord.

Palangres

Une campagne de pêche à la palangre profonde sur les côtes françaises de la Méditerranée à l'Est de Marseille a été réalisée mais a donné des résultats décevants à la fois pour des problèmes pratiques (conditions météo, choix des appâts) et de faible disponibilité des ressources visées.

NAVIRES DE PECHE

- Une étude visant à définir les points communs entre les besoins des pêcheurs armant des bateaux de moins de 25 mètres pour en rationaliser la construction est actuellement en cours.

- L'étude de la salle de travail d'un chalutier industriel permettant la rationalisation et la mécanisation du travail des captures est achevée.

  A métier pratiqué comparable et captures identiques, sa prise en compte devrait permettre une réduction substantielle des effectifs affectés au travail du poisson.

- Dans le but de répondre aux besoins des pêcheurs de pays peu industrialisés, les plans, caractéristiques, apparaux et aménagements de thoniers senneurs de taille moyenne ou petite ont été étudiés et doivent aboutir à un dossier de construction d'un navire de 40 mètres et d'un navire de 27 mètres.

- L'étude des conditions de travail et de la sécurité à bord des bateaux de pêche artisanale de 12 à 18 mètres a été réalisée par l'I.U.T. de Lorient avec le concours de l'IFREMER.

GERMAN DEMOCRATIC REPUBLIC

(Professor H Stengel)

Deep Sea Fishery

Engineering trials on various midwater trawls have been carried out in a wind tunnel leading to a net with an opening height more than 100 m. Prototypes were tested on a 2500 kw trawler. They had an opening height up to 115 m at a trawling speed of 5 knots.

Using a remote-controlled vehicle fitted with an underwater TV camera, fish behaviour in the vicinity of midwater trawls was investigated. The observations were carried out on the fishing grounds of Namibia between October 1987 and March 1988. Useful observations were made on horse mackerel, especially during hauling the trawl. The observations were recorded on video tape.

A new cutting method for demersal trawls was introduced. The cutting is carried out not along the lestridge but along the middle axis of the net panels. Using this method the net material consumption was reduced by 25%. The catchability was improved also.

Sea and Coastal Fishery

In 1987 work has continued on the development of energy-saving fish catching procedures, in the course of which the fish stock is protected as much as possible. Research work has been done particularly in the field of set gillnet fishing, line trawling and Danish seining. In the field of set gillnet fishing, work on the development of a hydraulically driven net lifter has ended, contributing to the almost complete mechanisation of set gillnet fishing in the GDR.

The work on the development of a float adapted to the requirements of mechanisation in set gillnet fishing will end in 1988. Several types of set gillnet constructions and types of netting materials for catching cod and flatfish have been investigated with respect to their catching efficiency. In the GDR, very little longlining is done commercially.

However, because line fishing proved to be a good alternative for cod fishing compared to the highly energy-consuming trawl, further work has been done on a mechanised longline system. The intention is to create a system for smaller fishing ships without having to separate snood lines and hooks from the main line - this refers to a daily consumption of approximately 5000 to 6000 hooks. In 1987, initial tests have been successfully carried out on a partly mechanised system which functions according to this principle.

For selective catching of flatfishes and conserving the fish stock, investigations regarding the introduction of Danish seining have begun. Initial trials have been carried out with cutters of 12 and 17 m length. Various headline combinations and net constructions have been tested and the hauling procedure has been varied. Other work has focussed on the anchoring method for catching flatfish and freshwater fish within the three-mile zone.

Basic Investigations

Investigations on the stability of otter boards have continued. The problems of small disturbances have been solved.

The damping coefficients and hydrodynamical mass moments of inertia for the Suberkrub otter board have been determined experimentally. The programme SKIT has been developed to calculate the otter board performance in the trawl system.

Research has continued on a mathematical model for the design and calculation of net cages. Here the method for calculating discrete towing systems has been applied. The shape of the net cages and the load acting on them in a seaway and in non-uniform flow have been investigated.

ICELAND

(G Thorsteinsson)

The difference in selectivity of cod between square mesh and diamond mesh codends was studied by the twin codend method. As expected the selectivity of the square mesh codend was better than that of the diamond mesh section but this difference decreased when the catches were in excess of two metric tons per trawling hour. In the case of haddock, the square mesh codend released too many of the large fish.

In July, observations on modified bottom trawl designs were made by TV. Poor visibility limited the results obtained. Experimental hydraulic dredging on black quahog started in March. The results were good and some commercial fishing has started. The on fuel consumption project was completed.

Routine acoustic assessment surveys were carried out on the stock of herring and capelin. Acoustic measurements of the behaviour and reaction of herring to a research vessel during echo-surveying, were carried out. The fish reacted to strong light stimuli, such as the working lights on deck. No significant change in echo intensity was observed when only the sailing lights were on. Preparations have been made in order to sample all available information from the ES400 split-beam echo-sounder for target strength measurements.

IRELAND

(J P Hillis)

The separator prawn trawl experiment was continued, using a single codend of potential cross-section area approximately 1.8 times greater than normal equipped with a separator panel of corresponding diameter throughout its entire length, and separate cod-lines for the upper and lower sections. All mesh was of 70 mm size throughout. Two skippers were given the gear to use and record results, and they were consulted over the design of the gear prior to construction. One requested a panel extending forward to the "choker" or "lazy deckie" rope half way along the body of the net, the other accepted a separator panel restricted to the codend. The boat with the half body separator panel obtained, after some initial difficulties and installing four strops 50 cm long stretched from the leading edge of the separator panel to the under surface of the trawl vertically beneath, separation of approximately 90% weight of Nephrops in the lower codend and 80% of whiting in the upper. The boat with a separator panel in the codend only obtained proportions in the range of 70-90% Nephrops in the lower and 65-90% whiting in the upper codend. Results with a dual-purpose trawl equipped with this codend did not appear to differ from those using a Nephrops trawl.

NETHERLANDS

(B van Marlen)

General

Many discussions were held with the Dutch fishery industries and maritime research institutes/universities in order to stimulate contract research. Various project proposals for this purpose have been elaborated. Attention has also been given to fishery policy orientated projects, particularly on survey-nets and selectivity. Technical advice was given on ad hoc problems (fuel quality, engine damages), on proposed projects in developing countries and to the Dutch navy concerning new deck layout and gear handling arrangements for future mine sweepers.

An experiment was done to look for shellfish in deeper water using commercially available sonar equipment, but with negative results (report TO 87-01).

Ships Acoustics (RIVO/TPD-TNO)

The systematic noise level research studies on board representative 2000 and 300 hp beamers were completed. A three-part report has been prepared describing the noise measurement results, noise sources and sound-transfer paths with, in part III, a description of the dominant noise contributions and major noise control measures. The RIVO noise readings up to 1987 of 20 beamers have been given in an ICES paper. The results show that almost all the 20 fishing vessels exceed the IMO and Dutch Shipping Inspectorate noise limit references (merchant marine) by 10-15 dB(A).

Systematic Hull-form Model Tank Tests (RIVO/MARIN)

Preliminary to model tank tests, a computer prediction model (FISPOW) was developed to predict the resistance and propulsion of 30-70 m fishing vessels. Under RIVO-chairmanship, various fishing vessel designers and yards contributed to this co-operative project, while the model was made by MARIN. By means of this model, Dutch ship designers can optimise the hull-form and appendages (coefficients, bulb) with regard to the fishing and steaming speed.

Ergonomic Bridge Layout Design

In cooperation with the Technical University of Delft and IZF-TNO, RIVO made a CMO proposal for ergonomic bridge layout design. Up to now no optimising studies have been made in this field, while an increasing number of beamers are involved in North Sea collisions. This is caused partly by the much increased number of vessels, but the traditional bridge layout with redundancy and mismatching of electronic aids also contributes.

Reducing Energy Costs

In 1987, much attention was given to the reduced quality of fuel. This problem resulted in engine damage and a higher use of lubricating oil. In cooperation with engine builders, oil companies, ship owners and insurance companies it was decided to research the causes of these problems.

RIVO has tested a fuel additive, the fuel catalyser of CP 3500, on a beamer with a 2000 kW engine. The results gave a cleansing improvement of about 30% and a fuel saving of 3-4%. The tests ran for 2600 running hours.

Safety and Working Conditions

There is yet no efficient machine for peeling Dutch shrimps. There is a demand, however, to avoid the difficulties of hand-peeling. At the request of industry, RIVO began tests with a pressure/vacuum system which removes the body skin. The first results have been hopeful.

The development of a portable fishing line greaser has been completed. The prototype has been taken over by trade and industry.

For fresh fish handling on beamers, proposals have been made for containers to be used instead of fish boxes in order to improve working conditions, the fish quality and to reduce handling costs during the auction.

Projects in Developing Countries

Visits were made to Western Africa, Senegal and Mauretania. In Mauretania, economic, technical and operational aspects of the industrial fisheries were evaluated. This project was carried out in cooperation with LEI and resulted in the building and delivery of 10 new ships.

Two visits were made to Senegal at the request of FMO (Netherlands Development Finance Company), to value four existing fishing vessels and to study the technical possibilities of those ships. A new company "Nouvelle Chalucap" has been set up with the four existing ships and four new ones to be built in 1988, RIVO will supervise the new buildings.

Techno-economic Research

Methods of calculating the economic performance of fishing boat designs have been reported (TO 87-02). Of particular importance are the time value of money and the concept of discounting future cash flows to the present. The choice of design criteria depends on whether future revenues and costs are predictable or not.

An example of the decision to invest in a system for electrical stimulation of flatfish has been worked out. Acceptable pay-back periods may be achieved when revenues can be raised by several percent, for instance from an improvement in fish quality leading to higher fish price or a shift to species of higher commercial value. Fuel-oil consumption is less important at present prices. An analysis of the economic performance of 10 freezer trawlers is in progress. The aim is

to build a detailed simulation model of trawling operations. A study has been undertaken to describe the variability of catches using statistics of real fishing data.

Direct Observation on Fishing Gear

An observation cruise has been carried out on "Tridens" during the summer, involving commercial bottom trawls and midwater big-mesh trawls. The practical use of the remote observation vehicle (ROV) has been demonstrated to skippers and net designers. Unique shots were taken around and inside the big-mesh trawl GM2 showing good correspondence between its geometry and model observations done earlier. Tests on the GOV-trawl indicated that its performance should be monitored during surveys. Adjustments to the pan and tilt of the ROV unit will be necessary to be able to follow individual fish during capture. Further modifications will include a hydraulic power unit, self-propelling facilities, and the use of an umbilical cable for towing and signal transmission.

Deep-water Midwater Gear

Several rigging configurations were tested allowing midwater trawls to reach greater depths, including:-
- backstrop V-arrangement in front of and behind the doors
- additional weights on the doors and on the lower wing-ends
- depressors instead of weights
- pony-doors on the lower wing-ends
- small and large depressor plates, mounted on the doors.

The simplest and most effective way to improve the fishing depth is to add weight. The vessel's lifting devices or handling difficulties will limit the approach. Depressor plates give a lighter though bulkier construction, but at trawling speeds these plates may generate considerable downward forces. Problems may arise with door stability as the dynamic equilibrium of forces is drastically altered. Possibly a combination of both effects in a newly designed door will lead to the best results.

Beam Trawls for Pandalus borealis

Beam trawls with mesh sizes of 24 mm and 30 mm (full mesh) have been tested to appraise the effect changing the minimum mesh size to 30 mm. The 30 mm net showed 35% decrease in catches over 16 hauls, although the amount of commercial sized prawns did not fall dramatically. It was concluded, that commercially attractive catch rates can be obtained with the 30 mm codends.

Electric Fishing

The RIVO electric fishing system has been simplified to create a more robust device. It is hoped to attract private investment to develop the equipment up into a commercial product. A system supplied by a private firm was tested simultaneously with the RIVO-system on FRV "Isis" and later on the commercial vessel GO-65. Sole catches could be improved by 30%, whereas plaice catches fell short by 50% and turbot by 15%. The introduction in the Dutch beam trawl fleet is not possible as a consequence of a ban on electric fishing by the Dutch Government.

Beam Twin-trawls

Another way to reduce the drag of beam trawls is to reduce their total twine area. This may be done by splitting the nets into two smaller nets or one net with two separate and shorter codends. A reduction in twine area of 50% gave a drag reduction of 10%. Such net designs did not result in lower catches.

The by-catch of cod in the Dutch beam trawl fishery is a matter of great concern owing to the mortality of young fish. Modifications in headline mounting of beam trawls have been tested. Due to the tendency of cod to dive when nets approach, the by-catch did indeed decrease and so did the net drag.

Multifoil Depressor Otterboard

A biplane otterboard was designed and tested in the Hull Flume Tank with discouraging results at first due to instability and not knowing the optimum warp and backstrop attachment points. Next, a bigger model was constructed and tested in the larger Hirtshals tank. The range of possible attachment points was increased and now a stable configuration could be found. Compared to a Suberkrub door of equal total surface area and weight, it was clear that a bigger spreading force can be achieved with a biplane while its diving capacity was similar.

Fishing Net Model Studies

Separator panels in midwater trawls can be beneficial when a distinct separation of, for instance, horse mackerel and herring can be obtained. Prior to full scale tests, a separator panel was mounted in a model of big meshes trawl GM-2 to analyse the impact on its drag and geometry. The force distribution along the frame lines was altered dramatically, with the side frame lines pulled in a V-shape. An improvement was achieved by attaching a third bridle from the front of the separator panel to the upper bridle. A new design of a midwater pair trawl was tested successfully.

NORWAY

(A Bjordal)

Fish Behaviour and Reactions to Fishing Gear

The behaviour of cod, saithe and haddock - particularly in relation to selective devices in trawls was studied by using a remote controlled TV-vehicle. The same method was used to evaluate the effect of gear type and sweep lengths on a demersal sampling trawl. Size and species composition of catches by demersal trawl and pelagic trawl operated on bottom were compared. Effects of trawl selectivity are also being investigated and quantified through use of a high frequency scanning sonar.

Further investigations on fish reaction to different light stimuli has shown that scattered layers of both feeding and spawning herring may be concentrated and guided by use of over - and/or underwater light.

Studies of herring behaviour in relation to vessel and gear in purse seining have shown how to predict the movement of herring schools during the catching process. Trials have shown that both herring and mackerel are herded by large (150 mm stretched) meshes in the last part of purse seines. The observations were done with a SIMRAD FS3300 sonar which proved to be a very good tool for observation of school behaviour and net geometry.

Underwater observations of longline gear in the field have comprised studies of hooking behaviour (tusk) and bait predation by different species.

Selective Fishing

The work on selective fishing has included:-

- fishing trials with separating panels in new types of shrimp trawls.
- funnel arrangements in the belly of shrimp trawls to improve size selectivity of shrimp. This arrangement gave better results than selection by the codend alone.
- experiments with square mesh in the codend on shrimp trawls.
- development of a codfish trawl with combined square/diamond meshes in the codend and increased wing mesh size.
- in bottom trawl observations, cod and haddock have been observed to swim at different heights above the bottom.
- effect on selectivity of codend of material (PA and PE); round straps and length of panels in 2-panel codends were observed by TV during comparative fishing trials using a modified trouser-codend method. The selectivity of PA and PE codends was similar, while the 50% roundstrap experiments gave inconclusive results. A shorter upper panel in two-panel codends had an adverse effect on selectivity.

- in longline experiments, artificial bait caught larger cod compared with natural bait. This seems to be a consequence of the larger size of artificial baits.

Improvements of Fishing Gear and Methods

Significant catch improvements are obtained in mechanised longlining using swivel connected snoods and a more effective hook type. A new artificial bait has been tested with promising results for cod and tusk. Preliminary studies indicate that bait predation by sea birds might have a severe negative effect on the catching power of longlines.

Full scale trials with collapsible fish traps have given promising results for tusk (Brosme brosme).

Development of high opening bottom trawls has continued. Various commercial gears have been tested on rough grounds. Danish seine operation has been observed by underwater TV.

Sinking speed experiments have been conducted on purse seine with different gear parameters. The sinking speed was maintained using less lead weight together with a larger mesh size.

Acoustics and Fish Behaviour

The split-beam echo-sounder continues to be used in determinations of the in situ target strengths of fish. By using this together with an echo-counting technique, the effective sampling volume of the echo-sounder beam has been measured.

In another study using direct in situ measurements of target strength, combination of these with modelling calculations based on the swimbladder morphometry (of walleye pollack) has allowed inference of the orientation distribution of fish during their acoustic observation.

A multi-frequency acoustic system to measure plankton, to determine both density and size of individual organisms, has been tested at sea for the first time. Further tests are planned.

The effect of vertical migration in fish target strength and sound absorption in high fish densities has been investigated.

Other Relevant Activities

In a project aimed at exploring the feasibility of using wild cod fry as seed fish in aquaculture, 0-group NE-Arctic cod in August-September were found concentrated in shallow waters occurring in small, nearbottom schools which could be easily located with a commercial echo-sounder. Aimed fishing with a small mesh Danish seine produced catches up to 20 000 fish per haul. This suggests also that for such small fish, random (ie not aimed) survey fishing may give misleading results.

Work on textiles used in fishing gear construction has continued, including fishing experiments with different twine types in cod gillnets in the Lofoten fishery and more basic studies of textile twine properties and their applications in fishing nets.

PORTUGAL

(A M Leite)

During 1987 the Department of Fishing Gear and Methods of the National Institute of Fisheries Research of Portugal was involved in the following work:

a) Study of fishing prospects on deep-sea species using vertical and horizontal drifting longlines in the area of Madeira Island and along the Portuguese coast.

b) Fishing trials with surface drifting longlines for large pelagic migrating species along the Portuguese coast.

c) Preparation of fishing charts of the Portuguese coast and Madeira.

d) Exploratory fishing inside the Portuguese EEZ.

UNITED KINGDOM

1 England and Wales

(G P Arnold)

Acoustics work has concentrated on improvements to the acoustic tank facility. A new anechoic lining allows hydrophone calibration from 10 kHz to 350 kHz with an accuracy of $\pm$ 0.2 dB. Complete system calibration (SL + SRT) in the frequency range 14.5 kHz to 320 kHz is possible with the same accuracy.

An acoustic tag has been designed to telemeter the tilt angle of free-swimming fish and construction is under way using hybrid micro-electronic techniques.

An acoustic survey using a Simrad 38 kHz system was undertaken off the north east coast of England from 28 August to 6 September to estimate the biomass of spawning "Banks" herring. The survey covered an area extending from 53°58'N to 54°42'N and a distance of 15-20 miles off the coast. A small patch of spawning herring was located 9-10 miles north east of Flamborough Head early in the cruise but the main spawning concentrations, which were located further north, did not develop until the end of the survey. The biomass was estimated at 120-140,000 tonnes, similar to that recorded in 1986.

Preliminary selectivity experiments for mackerel were carried out in the western English Channel in February 1987 using 70 and 80 mm square-mesh codends attached to an otherwise unmodified commercial pelagic trawl, fished by a chartered vessel working on its usual grounds. Selection was observed at all catch-rates (0.8-37 tonnes h^{-1}), but variation in selectivity between hauls was high.

2 Scotland

(P Stewart)

Discard experiments have been conducted on prawn trawls to compare catches from codends of different design - with a short extension, with fewer meshes round the circumference (narrow), with square mesh and with longitudinal ropes along the codend. Compared to a standard commercial codend significant reductions in discards of small Nephrops were found with all except the narrow codend. Observations of the codends of seine nets with and without covers showed that codend selection could cease completely when the cover or codend contained large quantities of small fish which masked the codend meshes.

A preliminary study using mathematical simulation of the influence of codend shape on selectivity was able to demonstrate typical features of real selection curves. The technique may be used to investigate the effect on selectivity of design features. A theoretical investigation was conducted into the usefulness of the alternate haul method of estimating selection parameters. A comparison was made between the catches obtained in the two sides of a vertically divided trawl. In almost all of the 24 hauls there was no significant difference between the quantity and distribution of the cathces in the two codends. The technique is being tested as a possible alternative to the covered codend method for selectivity measurements.

Two cruises were undertaken to investigate the effect of environmental factors on the catch of fish sampling gears. Further cruises are planned to assess the significance of the variation of catch with seabed type as well as trawl geometry, towing speed and parameters defining visibility.

The study of damage to fish escaping from codends was continued. Scale damage and survival rates for fish subsequently kept in cages on the seabed were carefully monitored over periods of up to 52 days. Control fish caught by barbless hooks on handlines all survived.

Further trials to measure the performance of a 200 hp seine net were conducted. Tensions and geometry were measured to determine swept area and gear drag throughout the haul. More film of commercial pair trawls was obtained.

Diving observations were made on a twin trawl using a two warp system. Fish behaviour and the catch in the two sides of the gear were recorded. Even small differences in the two nets due eg to temporary mending caused noticeable differences in catch between the two sides.

The use of separator panels in fish/prawn trawls has now been taken up by a significant number of boats in NE Scotland. 85 mm mesh is used in the upper net and 70 mm mesh in the lower net resulting in major reductions in the discard of small white fish.

The computer model of a trawl is being developed further to improve representation of the construction of the net and to reduce convergence times. Preliminary measurements of the flow in codends and idealised

trawls were made to improve understanding of the flow in nets both for the model work and for studies of the basic factors affecting selectivity.

The investigation of food preferences in cod in relation to line fishing bait selection has continued. The effect of previous feeding history on food preference is currently being studied using a multiple choice experiment with cod.

Acoustic surveys were carried out on herring in the Clyde/Irish Sea, in the Orkney/Shetland area and ICES area VIa. In support of this work, transducer beam patterns were measured at 38 and 120 kHz. During one cruise a dual beam system was used to obtain in situ target strength measurements on herring.

The dual beam system was also used at the Loch Duich site to investigate the relationship between the target strength of caged single fish and tilt angle, measured by a stereo camera.

Further work on the frequency dependence of fish target strength was conducted. Measurements were made on four species using a swept within pulse signal in the range 27 to 54 kHz. It was found possible to distinguish between species from the echoes to a high degree of accuracy.

Side scan sonar at 200 kHz was used to survey an artificial reef colonised by lobsters (Homarus).

USSR

(S Studenetsky)

Experimental investigations on the selectivity of bottom trawls and the survival of escaping fish were carried out while the speed of trawling varied between 3.2 and 3.7 knots. The following results were obtained:-

-selectivity data for trawl codends made of polyamide netting with 100 to 142 mm mesh size in relation to catches of cod and haddock in the Kopytov and Bear Island areas and in the area of the joint USSR/Norwegian fishery;

-data on the differentiated (by length) efficiency of bottom and commercial trawls in relation to cod, haddock, plaice and beaked redfish;

-data on the catchability of shrimp by trawl.

In the Baltic Sea, investigations of the selective properties of trawl codends made in hexagonal mesh, in herring fishing by bottom trawls towed by 300 hp vessels, were carried out. The inside stretched mesh sizes were 34.2 and 37.0 mm. 51 experimental hauls were conducted. The selectivity coefficients varied from 3.42 to 3.84 and the selectivity range from 3.17 to 3.39 cm.