

Gear and Behaviour Committee

by J.G. de Wit

1973

Belgium

(G. Vanden Broucke)

The investigations on the double beam trawls, consisting of a beam trawl and a second net on top of it, were continued. These investigations showed that an optimum net opening of the top net must be realized in order to increase the catching capacity; this may be obtained by an adaption of the taper ratio. Further experiments were carried out to this effect.

A bottom trawl of the beam trawl type was adapted to be used with otterboards instead of a beam on board a classical inshore side trawler. In comparison with earlier experiments on board a stern trawler, the adjustment consisted of an adaption of the rigging.

A second series of trials was made with semi-pelagic nets for the deep-sea fishery. The catching capacity was especially investigated in relation to the leg system.

A study of a one boat pelagic trawl was started. Mainly the rigging and the height of the net above the sea-bottom were investigated by means of echograms recorded by echosounders and/or sonars. It was observed that it is of great importance to determine the correct flotations and ballasting in relation to the height of the herring concentrations.

Experiments with a wireless netsounder were carried out for the herring fishery. The netsonde enabled the exact position of the net to be investigated.

With respect to the electrical fishery, the study on the practical possibilities of this fishery on a national and an international level was, first of all, further extended. Secondly, a series of comparative fishing experiments with a traditional and an electrified shrimp trawl was undertaken.

The behaviour of shrimps to electrical impulses was studied on a laboratory scale. Different impulse lengths, peak tensions and frequencies were introduced as variables.

As regards the fishery with artificial light, a preliminary programme was drawn up.

The behaviour of herring in relation to a pelagic pair trawl was investigated in connection with the mesh size in the front part of the net.

Via fishermen's log-sheets an analysis was made of sole and plaice catches by day and by night for various periods and various fishing grounds.

A second series of acoustic measurements was made of the F.R.V. "Hinders", especially as regards the different working conditions of the vessel.

The Treshev method was applied to the beam-trawl and bottom-trawl fisheries.

A study on the newly-designed security system for the beamtrawl fishery, obviating to a large extent the shortcomings of the customary slip-hook, was completed on board a middle-class multi beam-stern trawler.

A theoretical study on the conversion of side trawlers to multi-purpose vessels was started.

Research was carried out on the wear, on the degradation of yarns by marine bacteria and on the identification of synthetic fibres. A series of wear experiments was undertaken.

Within the framework of the international standardization of netting materials, collaboration was extended as regards working out draft recommendations e.g. on the measurement of mesh sizes, the drawing of fishing nets and the methods to assess the yarn elongation in a wet state.

A second series of experiments with the rinsing-and-sorting machine for shrimps was carried out. The objective of this research was twofold, viz. the examination of the protective effect of the machine on immature shrimps and flatfish, and the adjustment or the rebuilding of the machine in order to gain time in sorting the catch on board.

The study on landing the catch of trawlers was continued. The timings recorded during the landing of the catches from side trawlers and stern trawlers were analysed and the results will be used as a base to work out an improved working method.

Canada

(P.J.G. Carrothers)

New developments in Canadian fishing technology relate mostly to applications of powered net reels on multipurpose stern-ramp vessels. On a 52-m. vessel, three reels are employed on the main deck, which is divided into three, fore-and-aft gear-ways for very rapid change-over, or for continued operation during gear repair, with any triple combination of bottom, mid-water, or semi-pelagic trawl. On a 20-m. vessel, split, "waterfall", combination net-reel/trawl-winch are employed, with the main deck divided longitudinally into a central fish-pound and two lateral gear-ways, also for rapid changeover of gear.

The hinged ramp on the latter is lowered only while the cod-end is being hauled, otherwise it is raised to extend the fish-pound and serve as a wave trap. On both vessels, bottom and mid-water doors are immediately accessible, and their riggings are easily adapted to handle either a Danish-Scottish seine or a stern seine (with central bag-bunt and no purse line).

Conversion of a 36-m side trawler to stern trawling has involved a net reel on the boat deck and a roller across the stern. The main deck is sheltered, with a hatch to receive the full cod-end as it is lifted over the side, and it houses the trawl winch. A mid-water trawl is hauled onto the reel, whereas a bottom trawl is hauled onto the boat deck with wings on either side of the wheel-house. Both types of gear are carried and can be fished alternately with very short changeover time.

Two European fishing methods were tried successfully in Canada. A 43-m, 850 HP vessel was fitted in Holland for twin beam trawling and used primarily for flounder on Grand Bank, and the Norwegian automated long-line system was used on the Nova Scotia shelf. Considerable persistence and adaptations to local conditions were required for success, particularly with the long-line system.

Five other developments of interest, but of lesser significance or still in early stages, are 1) a small, Canadian-made, automatic winch for net-sonde on inshore vessels, 2) continued progress with active, rotating elevators on bottom and midwater trawls for depth control, 3) a wire stapler for rapid assembly and repair of nets, 4) hydraulic clam digger to extend the fishery into deeper waters, and 5) a high-lift, semi-pelagic trawl incorporating large forward meshes for increased trawl size.

Fishing gear research remains a token effort with emphasis on bottom trawls. The engineering study is in its "data extension" phase, aimed at deriving maximum quantitative information on trawl shapes and forces from experimental data already obtained for 22 different commercial, Canadian trawls and riggings. The fundamental study on netting hydrodynamics has extended existing screen theory to include conditions of low solidity and small angles of attack. Adaption of this theory to netting geometry should be fairly straight-forward. Application of membrane theory to integrate predicted fluid forces over trawl shapes is being investigated.

Reaction of groundfish to trawling operations is being approached in three ways. Analysis of gill-net catches with and without trawling noise shows that the noise increases the activity of cod and indicates, but does not prove statistically, that the cod are attracted to the noise. Automatic cameras on a towed, seabed-referencing vehicle are to be used to observe the behaviour of fish before and during approach of a trawler and trawl. The feasibility of using telemetering acoustic tags to indicate the movement of individual fish before and during approach of a trawler and trawl is also being studied.

Acoustic methods for groundfish inventory are receiving considerable attention. Development of sensing and logging hardware is well advanced.

Methods are being developed for interpreting the acoustic echos as numbers, species, and size of fish. A similar technique is used for preliminary surveys of herring abundance on the Canadian west coast, and the validity of using echogram target densities as a measure of juvenile sockeye densities during diel migration in fresh water was confirmed by digital acoustic counts and midwater trawl catches.

Efforts in underwater technology were directed primarily to three items of hardware for fisheries research. The EG&G underwater photographic systems were extensively modified for greater reliability and versatility, including a variety of external control and monitoring circuits of impedances up to 400 ohms. The towed, underwater, steerable, scuba sled was fitted with an echo sounder and servocontrols to hold the vehicle a pre-set distance above the sea-bed for unmanned benthic surveys. Further refinements to the system plus use during experiments on acoustic fishcounting and fish reaction to trawling are planned for 1974. A hydraulic sea-bed sampler, initially for use to 35 metres and potentially to 150 metres was designed and the prototype is under construction.

Denmark

(K. Popp Madsen)

No work carried out in 1973.

(P. Kannewarf)

No work carried out in 1973 in Greenland.

Federal Republic of Germany

(H. Bohl)

Fishing Gear and Apparatus

Recent gear research concerning midwater trawls showed that the mesh sizes in the anterior part of the net have little influence on the efficiency of the trawl. Although mesh lengths up to 120 cm are already applied, there is now a tendency to return to smaller meshes because of better handling of the gear. Most recently, trials were conducted with trawls in which the netting of the anterior part was replaced by a number of parallel-runningropes. By this it is possible to save net material and to reduce the towing resistance. Such a so-called "Tauwerk-Netz" could possibly be used not only in midwater but also on the bottom. The trials conducted up to now gave encouraging results.

As to net instrumentation, the Institut für Fangtechnik, Hamburg, is developing a digital data collecting and processing system based on the well-known multi-netsonde and some pullmeasuring-units. The data obtained will be processed by a computer.

More and more German trawlers change from wooden rectangular flat otter boards to oval cambered boards made of steel. A research program was initiated to find out the best size and rigging of these new boards in combination with several types of bottom trawls.

As in 1972, deep water trawling with respect to commercial application was carried out. At the eastern edge of the Great Bank of Newfoundland a 140'-bottom trawl could be operated in depths down to 2200 m. Solid plastic bobbins proved satisfactory, whilst the highly pressure-resistant floats used in this fishery imploded at depths of about 1350 m. In greater depths the vertical net opening was achieved by means of a wooden kite and two large-sized inflatable floats.

In compliance with C.Res.1972/5:7 further studies of the relationship between fish distribution and water temperature were conducted by means of a combined thermo- and net-sounder. The measurements of the time needed for gear handling aboard commercial trawlers and research vessels were also continued.

Echometric measurements were performed aboard FRV "Walther Herwig" in connection with an improved 250' high opening bottom trawl. The efficiency of this net was compared with that of 180' bottom trawls of commercial trawlers fishing on the same grounds.

Selectivity Experiments

Research on the influence of the elongation properties of polyamide netting yarns on the selectivity of bottom trawl codends was continued in April/May 1973. Despite severe ice conditions in the area of investigations (Gulf of St. Lawrence, ICNAF Div. 4 T), reliable cod selection factors could be established for two codends. One of these codends was made of the original Soviet CAPRON which has an elongation of 50.1% at the half wet knot breaking load. The other was made of the PA standard netting yarn (elongation 23.8%). The selection factors were found to be 3.36 for PA standard and 3.44 for CAPRON. These results indicate that the elongation of the netting yarn used is not a dominant causative agent for the selectivity differences observed between different net materials.

Net Materials

Now as before, the most important material for the manufacture of trawls is polyamide. Plaited polyethylene yarns are only sporadically used.

The commercial use of extra strong cod-end netting yarns (R 14000 - 18000 tex) decreased, whilst that of about R 9000 tex increased.

The cooperation with national and international bodies concerned with standardisation of net materials and testing methods was continued. Under discussion were the mounting and fixing of netting as well as general instructions for the drawing of fishing nets.

Electrical Fishing and Fish Behaviour

Preliminary experiments were conducted in brackish water of the Baltic. The investigations were carried out in large cages made of netting. Thus, electrical fields comparable to those in open water could be established. Voltage amplitude, current strength, pulse length and pulse frequency were varied. The reactions of different species of fish were observed directly and by means of underwater TV and camera. The experiments which were seriously handicapped by bad weather conditions, will be continued.

Noise Caused by Ship and Gear

Noise measurements of a 250'-bottom trawl were continued. In the region of the Skagerak comparative hauls were made on plane bottom in order to record the differences in noise performance by changing the bobbins (metal, plastic), otter boards and bridle lengths.

Research Vessels

The construction of the new fisheries research cutter "Solea" started in 1973. This stern trawler with additional deck equipment for beam trawling and electrical fishing will be commissioned in April 1974.

Finland

(V. Sjöblom)

No work carried out in 1973.

France

(M. Portier)

I - Chaluts -

Des essais ont été menés à bord de "La Pélagia", pour pêcher sur le fond avec des chaluts à 4 faces dont la relingue inférieure était protégée par un bourrelet lesté et un gréement dérivé de celui des chaluts pélagiques, c'est-à-dire comprenant deux longs bras et un lest important à la jonction du bras inférieur avec le bourrelet du chalut. Les panneaux divergents qui doivent être en permanence au-dessus du fond, pour assurer l'ouverture verticale du chalut, ont toutefois été spécialement étudiés pour éviter des avaries en cas de contact accidentel avec celui-ci.

L'utilisation d'un tel chalut et de son gréement, d'une façon que l'on peut qualifier de semi-benthique ou semi-pélagique, a permis la capture d'espèces typiquement démersales et aussi de poissons dits pélagiques qui se tenaient à proximité du fond. Les essais seront poursuivis et un intérêt particulier sera porté à l'influence de la posée du bourrelet sur le fond pour la capture de certaines espèces.

On a débuté l'étude en bassin d'un modèle de chalut de fond à 4 faces, dérivé de l'Atlantic Western Trawl, et dont le gréement très simple comporte uniquement deux entremises. Pour ce chalut, de caractère strictement benthique, les divergents sont des panneaux classiques rectangulaires, ovales plans ou ovales creux.

Dans le domaine des chaluts pélagiques, la taille maximum des mailles utilisées a été de 800 mm (maille étirée) mais les chaluts, à un seul bateau ou à deux bateaux, possédant des coupes très allongées se sont montrés particulièrement efficaces. Ils ont permis, dans certains cas d'augmenter de façon sensible la vitesse de chalutage.

Les culs de chalut ont été réalisés exclusivement en polyamide. Une étude a été entreprise pour tenter de déterminer le rapport existant entre la longueur de la maille étirée et les mesures effectuées d'une part avec la jauge plate et d'autre part avec la jauge ICES, pour différents maillages et diverses forces de fils.

Une section d'études des engins de pêche est en place depuis octobre 1972 au nouveau laboratoire de Lorient.

Au cours de 1973, le travail sur le chalut a été celui d'un bureau d'étude, prêt à répondre aux problèmes immédiats des professionnels et comportant notamment la mise au point de gréements.

II - Senne à thons -

Une étude de la senne à thon a débuté en janvier 1973. Il s'agit dans un premier temps de mesurer les performances des engins actuellement utilisés. Des enregistrements de la vitesse de plongée de la senne et de la profondeur à laquelle travaille la coulisse pendant les opérations de sennage, ont été réalisés lors des essais des nouveaux navires lancés pendant l'année.

Au laboratoire, un rapprochement a été effectué entre les enregistrements des performances et les plans détaillés des sennes.

En 1974, outre la poursuite des ces deux activités, est prévue une campagne d'étude de la sélectivité des poches en polyamide dans la pêche des langoustines du golfe de Gascogne.

III - Pêche électrique -

En 1973, l'Institut scientifique et technique des Pêches Maritimes a poursuivi ses recherches sur la pêche électrique en mer et a réalisé, grâce à un contrat passé avec le Centre national pour l'Exploitation des Océans, des études de comportement de poissons marins placés dans un champ électrique. Ces observations ont essentiellement porté sur des mullets (Mugil labrosus (RISSO)) et sur des sardines (Sardina pilchardus (WALBAUM)).

Le champ électrique était produit par un générateur impulsif qui délivrait des signaux rectangulaires.

Les seuils de taxie et de tétanie ont tout d'abord été mesurés dans un champ uniforme en fonction de la fréquence et de la durée des impulsions. Les effets de trains d'impulsions, réalisés à partir d'un stimulus à haute fréquence modulé par une fréquence plus basse ont également été testés. Ces expériences ont été effectuées en tenant compte de la température et de la salinité de l'eau ainsi que de l'espèce et de la longueur des poissons.

Ensuite, afin de se rapprocher des conditions réelles de pêche en vraie grandeur, le comportement des poissons a été observé, non plus dans un champ uniforme, mais dans un champ croissant. Les réactions des individus soumis à un champ électrique de valeur inférieure au seuil de taxie ont été observées et la qualité directionnelle des taxies dans un champ croissant a été étudiée en fonction des stimuli appliqués.

Mais ces séries d'expérimentations ont montré que le bac conçu pour ces essais n'était pas parfaitement adapté à ce type de travail; ces études doivent donc être complétées.

Les vitesses de nage des poissons en taxis ont également été mesurées et la fatigue qui en résultait a été appréciée pour différents stimuli. Certaines de ces expériences ont été effectuées en présence d'un stimulus photique afin de vérifier que ce dernier n'avait pas d'effet répulsif sur les individus qui pénétraient dans la zone fortement éclairée au proche voisinage de l'anode.

Le phénomène de tétanie a également été étudié en fonction des espèces et certaines particularités ont pu être observées.

Iceland

(G. Thorsteinsson)

Fishing experiments with high opening bottom trawls were successfully carried out in April, during the cod spawning season. Considering the results of the trials, these types of trawls can be expected to increase the catch per unit effort in many areas where the ground is not too rough. Nevertheless, the large trawlers do not yet use gear of this type. Because of increased interest in these trawlers, however, further experiments will have to be made.

Experiments with bigger bottom trawls of conventional design have shown most varying results depending on fish species and behaviour.

Selection experiments with prawn trawls by alternating tows with ordinary and increased meshsize trawls were carried out in May. The meshsize of the prawn trawls was enlarged on basis of the results of these experiments.

Further experiments were made with prawn sorting machines at sea. Good results were obtained as the survival rate of the undersized prawns was about 80%, if sorted immediately after catching. In commercial fishing big catches, bad weather and several other factors reduce the usefulness of these devices considerably.

Experiments made in autumn with midwater trawling for redfish west of Iceland were unsuccessful since no dense enough schools were found.

A few boats participated in experimental midwater trawling on blue whiting in May-June. After mid-May some good catches were taken west of the Faroe Islands. Later, in the post-spawning period, scattered fish occurrence resulted in poor catches.

In the 1974 program further trials with selective prawn trawls are planned in order to avoid the catch of undersized fish of economic importance.

Ireland

(J.P. Hillis)

No work carried out in 1973.

Netherlands

(J.G. de Wit)

Experiments on high-opening demersal trawls continued with a 90' (27,5 m) (headline) herring trawl with wedges. Mesh lengths in the forward parts of the trawl were 40 cm. The opening height was 10-11 m with three detachable kites connected to the headline. Later on this trawl was transformed and enlarged into a four-seam trawl of 104' (32 m) headline length (149' (45.5 m) groundrope).

The latter one was used on an undulating type of bottom in the Southern North Sea (peaks of 3.5 - 7.5 m) and without any substantial damage to the trawl. The opening height was 18-19 m when fishing for pelagic species, and about 14 m when fishing for demersal species. The towing resistance at a speed of 5.5 kn and at a depth of about 70 m amounts to 5.8 tons in each warp, and resulting in about 1150 h.p delivered by the propeller. After a light tickler chain was connected to the groundrope, this trawl succeeded to catch some flatfish, mainly plaice, as a bycatch. Research on this type of trawl will continue with a bigger one of 122' (37 m) headline, and also with different types of otterboards.

The collection and analysis of technical data on fishing vessel performance was continued on board trawlers of different sizes. The main objective of this study was to obtain more and accurate knowledge of the service conditions of fishing vessels. The study to design a simple method to calculate the propeller thrust for fishing effort measurements was finished and presented to the Gear and Behaviour Committee meeting, 1973. The Treshev Method for fishing effort measurements was applied to the beam trawl, being a fishing gear with a well-defined horizontal and vertical opening. The results of this study were presented to the Gear and Behaviour Committee meeting 1973.

Investigations on electrified beamtrawls for the shrimp- and sole fishery were continued. Comparative fishing experiments onboard a beamtrawler with two shrimp trawls, one of them being electrified, showed that in clear water and during day time considerable increases of the shrimp catches could be noted for the electrified trawl in spring and summer. In turbid water and when fishing at greater depths the catch increases were less but still notable (about 25%). The pulses were generated by a generator mounted to the beam and fed by a cable from the ship. The electrodes were also connected to the beam and ran in the towing direction of the fishing gear. The experiments will be continued in spring and summer 1974.

The electrified flat-fish beamtrawl is still in the design stage.

An electrified beam trawl was successfully used to sample eels in a qualitative way. The basic ideas used in designing this sampling gear were (a) to stimulate eels out of the bottom by means of electric pulses, (b) to lower the headline close to the bottom in order to avoid by-catch and (c) to fish in clear daylight and clear water, or in water with a low temperature, to make sure that eels are hidden in the bottom.

Complementary to rotating shrimp-sorting-machine the mechanical handling of shrimps became operational on board commercial shrimp trawlers. The content of the codend is dumped into a hopper with running seawater. The total catch is taken from this hopper by means of a conveyor belt and fed into the rotating sorting-machine. The sized fish and shrimps are retained and the by-catch passes over-board in a good condition.

A feasibility study to design an equivalent system for small trawlers, fishing for flatfish mainly, is in progress.

Enabling the flatfish beamtrawlers of about 1800 h.p to go multi-purpose has been hampered by the fact that trawlers of this category use warps of 32,5 mm diameter. This size is too heavy for demersal and pelagic trawling. To create the possibility for these relatively small trawlers, to use other fishing gears than beam-trawls only, a new type of winch was developed together with another way of rigging of the warps. This resulted in warps of 23.3 mm diameter and in sufficient capacity of the warp drums to make them multi-purpose.

Experiments to clean mussels internally from sand and silt in a vertical flow of water through a layer of mussels of about 1.5 m showed promising results. The experiments were conducted in a ship and will be continued.

Norway

(O. Nakken)

The investigations on methods to separate fish and prawn in prawn-trawling were continued. Experiments with sorting nets turned out to be more successful in the Canadian ("Kodiak" trawl) and old Norwegian type of prawn trawl ("Vingetrål") than in the large Norwegian type ("Sputnik"-trål).

The investigations on feedback control of schooling herring were continued. Different types of acoustic stimuli sources were developed and used.

During the summer of 1973 experimental studies on echo intensity as a function of fish density in fish schools were carried out on three species: saithe, sprat and mackerel. The observations show a linear relationship between echo intensity and fish density below a certain density level.

Fishing experiments with pelagic trawling for blue whiting were continued. With sufficient strong trawls and codends it was possible to catch up to 80 tons after 20 minutes of towing. An instrument which indicates to which degree the codend is filled was developed and tested. Trials were also made with a device which allows the codend to expand to a desired volume at a selected depth.

Poland

(Dr. W. Strzyzewski)

electivity studies in respect of cod and flat fish were continued in the Baltic in 1973.

Studies were carried out on codends made from polyamide twine, produced in Poland, from standard twine (Dutch, recommended by I.S.O.), and twine with more than 25% elongation (34.4%). The results obtained did not indicate any important differences.

Selectivity coefficients were from 3.22 to 3.25 in respect of cod. Analogical investigations with the same materials carried out in 1972, show a lower selectivity coefficient. This was most probably due to differing conditions of the cod. The 1972 selectivity studies, were on cod with more distended abdominal cavities in comparison to those of 1973.

The selectivity coefficient for flat fish was between 1.63 and 1.83.

During the investigations attention was paid to the influence of the twine's elongations on the selectivity. Due to insufficient material, final conclusions could not be reached.

The above data were published in C.M.1973/F:25. Investigations on the selectivity of individual parts of trawls were taken up. With this in mind, a vertical partition was inserted into the trawl, dividing it into two symmetrical parts. The mesh size of one part was larger than that of the other one. When sampling the catches, it was noted that this method might give the answer to the influence of the mesh size in different parts of the trawl on the selectivity of these parts. The investigations will be continued in 1974.

Investigations were carried out on fishing by means of electricity. These investigations will be continued in 1974.

Observations were commenced on fishing gear and the reaction of fish in the gear, by means of a one-man submarine. After trials, the prototype of a new submarine which can be used on board small fishing vessels, is under construction.

Portugal

(Comandante José de Ataíde, Dr. Bragança Gil)

Pendant l'année de 1973, l'Instituto de Tecnicas de Pesca a initié son activité quoyqu'en fonctionnant encore en des installations provisoires.

La construction du bateau de recherches de pêche a été continuée. Ce petit bateau est préparé pour la pêche à la seine tournant, le chalut pélagique et semi-pélagique et pour le chalut de fond. Il a été acheté au Canada par la Junta Nacional de Fomento das Pescas avec l'intention de commercer son activité pendant 1973, mais du aux plus diverses difficultés il n'est pas encore entré en activité.

Pendant juin-juillet on a fait, aux Açores, la campagne de la pêche au thon avec la collaboration technique et scientifique franco-portugaise. Dans cette campagne ont participé les bateaux de pêche professionnels des deux pays: le bateau du ISTPM "La Pelagia" et aussi un petit bateau portugais transformé en thonier pour essayer la pêche au germon à la traine suivant la technique de pêche des pêcheurs bretons.

Des bateaux de la Marine portugaise et un avion français, possédant un ART qui a été opéré par un technicien portugais, ont collaboré aussi dans la localisation des fronts thermiques de régions des Açores.

Spain

(O. Cendrero)

Experimental fishing using different types of shellfish traps, lobster nets and long lines were conducted in the Canary Islands area.

In the Mediterranean sardine fishery, some experiments with submerged artificial light and purse seining were carried out.

Sweden

(G. Otterlind)

No special activity is to be reported for 1973 and no greater changes as to gear construction and net material were noted.

United Kingdom

1. England (A.R. Margetts)

Measurements of the efficiency of a trawl by using sector-scanning sonar and acoustically tagged fish was continued, but severe weather at the time of the experiments seriously restricted the number of observations made. Results were broadly in accord with those obtained earlier.

The sector scanning sonar was used to observe the tracks left by double beam trawlers and to locate where telegraph cables crossing the southern North Sea were exposed on or clear of the sea bed.

In cooperation with Scotland an investigation was made of the feasibility of using the sector-scanning sonar to study the changing configuration of Danish seine warps as the gear was being hauled. The scanner is able to discriminate the ropes only when they are clear of the sea bed, but it was found that their positions could be followed by marking them at fixed intervals with acoustic transponding tags.

In deep water trawling at extreme depths it was impossible to judge during a tow whether the gear was on or off the bottom: a meter was therefore designed and built to measure headline height off the sea bed. The system effectively involves a miniature high frequency echosounder on the trawl measuring headline height and, closely linked with it, a transmitter sending in the general direction of the trawler related low frequency pulses with the time scale stretched. The distance between headline and sea bed is recorded as the distance between two lines on a weather chart or similar recorder. Trials and development of this were started.

Laboratory experiments were continued studying the reaction of fish to electromagnetic fields such as might possibly be involved in a fish navigation mechanism and studying the adaptation of fish to pressure changes.

Studies of the growth and development of fish skeletal muscle fibres in relation to performance were continued.

Multi-channel telemetry was developed to measure parameters such as heart rate and compass direction of a fish in the open sea.

Work continued to reduce even further the size of the Lowestoft acoustic fish tags; it is anticipated that these may be cylindrical, of 6 mm diameter and 30 mm length.

Pulse height recording of fish echoes was carried out with a 30 kHz echosounder and data collected separately from single fish and shoal signals. Emphasis was given to regular precise calibration of apparatus.

2. Scotland

(J.J. Foster)

Research undertaken at the Marine Laboratory during 1973 of interest to the Committee again included fish capture research and fish abundance estimation by acoustic methods. The former continued to be concerned with fishing gear technology and related fish behaviour studies aimed at identifying and measuring the main factors considered of importance in the fish capture process. The projects included :

a) Demersal trawls

Development work on the Laboratory's four panelled wide-opening demersal trawl in 1973 included introducing some minor modifications to the gear, engineering tests at sea and comparing it with traditional and modified commercial nets on FRS "Scotia". The modifications introduced to the gear included standardisation of mesh size in the forward parts to 140 mm, increasing the slack between the fishing lines and groundrope, simplifying baiting rates whilst lengthening belly and codend. The engineering tests demonstrated very satisfactory performance of the Laboratory's net and the near achievement of the 24 m net spread and 5.5m headline height design objectives. Full scale comparative fishing trials with these gears have yet to be undertaken but some very large hauls taken with the Laboratory's trawl indicate that it has a high fishing capacity.

The design criteria for the large opening trawl has been applied to the design of a smaller 4-panelled trawl which was tested on FRS "Mara" (200 HP) and studied by divers. Evidence recorded on ciné film and divers observations seem to support the hypothesis that less efficient otterboards sometimes generate denser mud clouds compared with more efficient otterboards. The location and the distance of the cloud track from the net as it passes may have an important influence on shepherding fish. Divers also observed some net tailoring flaws which are being corrected.

A short preliminary trial with a small pair of all metal cambered boards was satisfactorily conducted on a 120 HP commercial vessel, but a similar trial with larger all metal cambered boards on a 340 HP vessel was abortive and showed that redesign was necessary.

b) Pelagic trawling

The main effort in pelagic trawling involved further investigation of spinning cylinders to provide extra lift for the boards when raising the gear whilst fishing. A prototype cylinder driven by a commercially available 2 800 rpm deep water electric motor

powered from the ship through electric cored warps was fitted to each of "Explorers" pelagic boards. An increase of hydrodynamic board lift was achieved. Equipment is now being modified to increase further the board lift by using a larger diameter cylinder and gearing it down the cylinder to optimise lift/drag ratio, at a given power lower. The equipment will be tried on a smaller pair of pelagic boards with a smaller net.

c) Danish seine net.

Trials were made using "diverters" to delay closure of the Danish seine net and extend the fishing period during the fast haul. Also the effects on performance of alternative mesh sizes in the foreparts were investigated.

In collaboration with the Fisheries Laboratory, Lowestoft, preliminary studies were undertaken to investigate the feasibility of using the ARI sector scanner and transponding tags on the seine ropes to study rope configuration during the fishing operation.

d) Electrical fishing

Comparative fishing investigations were conducted using a 9 m beam trawl with a divided net and 2 codends and electrically independent port and starboard electrode arrays in front of the groundrope. Hauls were made with port and starboard electrode arrays switched off alternately. The results demonstrated that the electrical stimulus applied successfully increased catch rates of Nephrops.

Pilot trials to test the feasibility of applying electrical stimulus for catching flat fish gave encouraging results. The trials compared the effect on flat fish of towing a tickler chain in a catenary and a towed wire electrode array.

e) Effects of sound in fishing

Pair trawls and seine nets were worked over the hydrophone range and the noises generated by vessels and gears recorded. A comprehensive analysis involving separating out all contributing noises is under way.

Studies of the effects of sound on fish were continued at Loch Torridon. Considerable use was made of the Birmingham University sector scanner to provide continuous monitoring of fish reaction to sound. It was found that cod, saithe and dabs are attracted to low frequency sounds. These observations are supported by the results of sensitivity tests which were conducted in a specially designed acoustic tank.

f) Fish behaviour

Time-lapse cameras and acoustic tagging methods were used to confirm the dawn/dusk rhythm of the feeding activities of Nephrops. Some preliminary observations of related diurnal variation in catch rates of Nephrops have also been made.

The movement of fish carrying small transmitters has been tracked over a period of several hours in an enclosed sea loch and showed an interesting consistency of preferred area and depth.

New methods and improved systems have been developed for studying fish swimming speed and endurance. By conditioning fish to be attracted to feeding points and allowing them to swim freely between these points facilitates the measurement of burst swimming speeds. Television and camera systems were designed to allow accurate and continuous recording of these swimming activities. Analysis systems involving logging of all parameters and allowing automatic analysis of each picture frame were developed for eventual use on the computer.

Other work on swimming ability included shyness tests and comparing the results of laboratory and field swimming speeds and endurance tests with the results of investigations of the biochemistry of swimming.

g) Fish detection and abundance estimation

The prototype 400 channel echo integrator was modified and improved during the year and sea trials showed it to be a most useful instrument for routine use in surveys. A graph plotter was incorporated to give plots of integrated echo intensity against depth, and this proved most useful in rapid interpretation of the data. Trials of the high frequency echo counter were carried out on the artificial target range in Loch Ness with good results and it is hoped to carry out similar trials with the integrator in the near future.

U.S.A.

(K. A. Smith)

Direct sampling survey gear

Continued testing and mensuration activities using a recently designed modified high-opening Yankee No. 41 bottom trawl has indicated performance commensurate with expectations. The objective of this work is to develop a durable trawl that will take larger samples of demersal and pelagic fishes than are currently taken with the standard No. 36 Yankee. At present, the No. 36 Yankee is routinely used throughout ICNAF Supareas 4, 5 and Statistical Area 6 for conducting both spring and fall groundfish surveys.

Tests were conducted to evaluate the catch efficiency of the electric shrimp trawl system. During operations divers riding the trawl observed rock shrimp being shocked out of the bottom which answers a critical question concerning the burrowing habits of these shrimp. The use of the electric shrimp trawl system may be the answer to more precise daylight sampling of the partially buried Gulf of Mexico shrimp resource.

Testing of a series of nets for precise sampling of eggs, larvae and juveniles of anchovy and Pacific hake were conducted off the coast of Southern California. Devices tested and used are : 1-meter plankton net with 0.505, 0.333 and 0.165 mm meshes, a 6-foot Isaacs-Kidd trawl, a double warp midwater trawl, and a 16 foot otter trawl.

Direct observations and photography

The first series of tests of the RUFAS II (a Remote Underwater Fishery Assessment System designed to go as deep as 400 fathoms) vehicle were completed in tank tests. These tests indicated a good design was achieved. RUFAS II was later tested at sea and was

found to be an excellent system. The original RUFAS unit has been particularly useful for making counts of calico scallops off the east coast of Florida.

A towed underwater benthic sled (TUBS) designed for photographing benthic organisms on the hard and irregular bottom surfaces in ICNAF Subareas 4, 5 and Statistical Area 6 produced over 20 000 pictures of the ocean floor. The camera mounted on the sled was kept consistently in focus at a distance of one meter and produced excellent results.

Hydroacoustics

A significant amount of hydroacoustic system development, testing, and evaluation was conducted by U.S. National Marine Fisheries Service, universities and private companies. Many of these activities were reported at the ICES/FAO/ICNAF Symposium on Acoustic Methods in Fisheries Research, Bergen, Norway, June 1973. Twelve papers were presented describing United States activities.

The National Marine Fisheries Service acoustics system project intended to test the feasibility of using sound waves for fish location was completed. To acquire the empirical data required to verify the mathematical model developed by Massachusetts Institute of Technology (M.I.T.) a target array was placed in a 230 000 gallon (870m³) salt-water impoundment system. The target array was established through random selection process to simulate a fish school. Instruments selected and calibrated by M.I.T. were used to conduct the tests. Upon completion of the simulation tests, several hundred live specimens were placed in the tank for additional systems tests. All data were transmitted to M.I.T. for analysis.

Remote sensing

Field operations of the cooperative Earth Resources Technology Satellite (ERTS-1) utilising satellite photography, aircraft photography and shipboard data collected has been completed. A significant data bank was generated from the experiment, and preliminary results indicate definite correlations between sea clarity and the presence of schooling fish.

Low light-level image intensifier system field operations have been completed. The system was demonstrated to be effective in locating schooling fishes although certain operational limitations such as cloud cover, haze, inclement weather, sea state, turbidity and ambient light levels are all factors which must be taken into account.

A preliminary field evaluation was conducted on the Shadowgraph System (side scanning sonar) which was developed by the U.S. Navy. Test results indicate a potential fisheries application for the system; however, detailed data analysis has not as yet been completed.

Commercial fishing gear development

On the United States west coast, work was continued on the selective shrimp trawl. The objective was to increase the shrimp catch rates to a level that would be acceptable to commercial fishermen. Catch rates achieved were about 75% of what a standard trawl took and with very good by-catch separation.

A major effort to resolve the problem of porpoise mortalities associated with purse seining for yellowfin tuna resulted in a study of several preventive and remedial developments. These included the redesign of the seine, introduction of a torque-free purse wire, and the development of an indicator to detect direction and velocity of differential water currents. Remedial developments include a technique of using speed boats as tugs to hold the seine open when conditions would otherwise cause it to collapse. Results with all efforts have resulted in substantial reductions of porpoise mortalities.

The modified high-opening No. 41 Yankee trawl designed and built to National Marine Fisheries Service specifications, was introduced to the Southern New England fishing fleet. Some of the captains of commercial fishing vessels have reported significantly larger catches resulting from use of this trawl.

Indications that lobster pots, particularly those constructed of steel rods and mesh, and those coated with vinyl plastic, continue to fish for indefinite periods when lost on offshore grounds stimulated continued efforts to develop a mechanism for the release of lobsters from lost traps. Various bio- and chemo-degradable escape vents designed to open after specific periods of time have been tested and the data is currently being reviewed.

U.S.S.R.

(A. J. Treschev)

In 1973, preliminary technical and fishing tests of a large mesh midwater trawl for stern trawlers with a main engine power of 2 400 to 3 100 hp were conducted in the field of commercial fishing gear. Large mesh midwater trawls were elaborated for side trawlers with a main engine power of 800 hp, and more and large mesh bottom trawls for stern trawlers having a main engine power of 2 400 - 3 100 hp. Work on the determination of the resistance factor for trawl webbing of different assortments depending on the hanging and the angles of attack was continued.

Fish behaviour was studied during the cruises of the research vessels "Akademik Knipovich", "Tunets", "Odissey" and "Alaid". The objects of the investigations were cod, haddock, polar cod, grenadier, Atlantic herring and White Sea herring. Observations were conducted with the help of the hydrostate "Sever I" (40 submersions to a depth of 500 m), underwater cameras (200 submersions to a depth of 1 200 m), and of acoustic devices.

Preliminary data on distribution of fish and invertebrates in bottom and pelagic concentrations as well as in front of the trawl mouth were obtained. On the basis of these results, the methods of counting the commercial objects could be perfected.

The analysis of fishing intensity of the main fishing gears was made with the help of the swept volume method (SVM).

In the Baltic Sea the selectivity of the Baltic herring and the survival rate of this fish when escaping through the trawl meshes were investigated.

All the above-mentioned investigations will be continued in 1974.
