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International Council for the
Exploration of the Sea

CM 1984/B: 3
Fish Capture Committee

REPORT OF THE WORKING GROUP ON FISHING
TECHNOLOGY AND FISH BEHAVIOUR

Convenor: D N MacLennan, DAFS Marine Laboratory, Aberdeen, Scotland
Rapporteur: P A M Stewart, DAFS Marine Laboratory, Aberdeen, Scotland
Meeting Place: Hirtshals, Denmark
Time: 30 April to 2 May 1984

This was the first meeting of the joint working group set up by Council Resolution 1983/2:3(1) which stated: "The Working Group on Research on Engineering Aspects of Fishing Gear, Vessels and Equipment and the Working Group on Reactions of Fish to Fishing Operations should be merged into a Fishing Technology and Fish Behaviour Working Group, which shall review and coordinate investigations of technologists and biologists on fishing gear/methods, fishing operations, behaviour of fish in relation to these operations and vessels".

The venue for the meeting and the special study topics were specified in the second part of the same Resolution: "The Working Group (Chairman: Mr D N MacLennan) should meet from 30 April - 2 May in Hirtshals (Denmark) and, in particular, consider:

- a) recent progress in the further development of Danish and pair seining, and
- b) factors influencing the performance of the ICES standard young fish trawl (GOV - trawl).

This report has not yet been approved by the International Council for the Exploration of the Sea. It has therefore at present the status of an internal document and does not represent an advice given on behalf of the Council. The proviso that it shall not be cited without the consent of the Council should be strictly observed.

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AGENDA

- 1 Progress Reports

- 2 Presentation of Papers and Verbal Contributions on the Special Subjects
 - 2.1 Model testing of the 36/47 GOV young fish sampling trawl. D A Wileman
 - 2.2 Variation of towing speed during survey cruises with the GOV trawl. P Stewart (verbal)
 - 2.3 Measurements of variability in bottom trawl performance during resource assessment surveys. C W West
 - 2.4 Developments in the Norwegian fisheries with the Danish seine. L Brunvoll
 - 2.5 Review of Danish seining in Iceland. G Thorsteinsson (verbal)
 - 2.6 Recent measurements on square mesh codend selectivity in seines and trawls. P Stewart (verbal)
 - 2.7 Selectivity in diamond mesh and square mesh codends - from experiments with Danish seines in north Norway. R Larsen

- 3 Presentation of Papers and Verbal Contributions on General Topics
 - 3.1 Performance tests on bottom trawls, 1982. R van Marlen
 - 3.2 Separator trawl experiments. C S Wardle (verbal)
 - 3.3 Selectivity of Nephrops trawls. P Hillis
 - 3.4 Appropriate knots for monofilament longline gear. E Dahm
 - 3.5 Dessin et conception des chaluts assistes par ordinateur. J-C Brabant
 - 3.6 Recent Norwegian work on longline mechanisation in the coastal fleet. R Skeide
 - 3.7 Observations on cod gill netting. W Dickson
 - 3.8 Gill net selectivity. P Stewart
 - 3.9 Flume tank experiments. B Scannel
 - 3.10 Escapement of capelin and polar cod through different parts of a pelagic trawl measured during an acoustic survey. R Larsen
 - 3.11 Visibility of netting underwater in relation to fish reaction to gear. C S Wardle (verbal)
 - 3.12 Reaction to fish to gear in the dark. C S Wardle (verbal)
 - 3.13 Comparison of catches and fuel consumption in single and pair boat trawling. A Olsen (verbal)

- 4 Recommendations

1 Progress Reports

The convenor requested, in his letter of invitation, that delegates should submit written progress reports on recent work on fishing technology and fish behaviour. Almost all participating countries submitted a report and these are included in this document. The convenor proposed also that the reports should not be presented verbally, as the time available was limited. During the morning session of the meeting on 1 May, time was allowed for questions and discussion on the reports.

BELGIUM

Work was continued on the study of technical parameters of trawling gear. The forces acting upon warps and bridles of a bottom trawl were measured in relation to speed. The effect of different riggings on the net opening of semi-pelagic trawls for cod and pelagic trawls for herring was studied by means of a netsonde. The latter experiments were carried out in close cooperation with the commercial fishery.

On board of a commercial beam trawler a new semi-pelagic trawl fishing with the warps passing through the boom sheaves was tested. On this occasion newly designed cambered and slotted otter boards were used.

Several projects were undertaken to investigate energy saving. The trials with gill and trammel nets fishing for cod on wrecks were continued. Although catch rates were good, the overall earning-capacity was rather low. This is due to the strong tidal currents on the Belgian coast during 14 days each month, which limits the number of fishing days. A comparative fuel consumption study between rectangular and three types of oval otter boards (Morgere, Hinriksson, flat wooden slotted door) was finished. The best results were obtained with the Hinriksson Poly-Ice boards used by a 600 hp stern trawler operating in Icelandic waters. The fuel saving amounted to 6% per fished mile. Both the Morgere and Hinriksson doors yielded better catches than the usual rectangular boards. Measurements on the fuel consumption of a 1000 hp beam trawler before and after the installation of a nozzle showed a saving of 8% when fishing.

With the aim of increasing catch rates in the daytime shrimp fishery, experiments were carried out with an electrified otter trawl. Unlike earlier experiments with an electrified otter trawl for flatfish, the results were rather disappointing. Due to the electrode array the non-commercial by-catch was too big, resulting in problems with the sorting of the catch. Adjustment of the rigging and electrode array should solve this problem.

Studies on netting materials mainly concerned with the effect of sand on mesh dimensions and the change of mesh size in relation to the drying time of the netting.

CANADA

1 For stock assessment and resource management:

Newfoundland is seeking a trawl for sampling juvenile flatfish. The Yankee 36 shrimp trawl appears to be selective and the Yankee 41-5 shrimp trawl is to be tried. In Quebec, the Yankee 36, Terra-Nova 1500 and Atlantic Western IIA trawls were compared for surveying shrimp. A modest program is underway to learn more about the effect of tidal currents on trawl selectivity. A micro-processor-controlled

closure trawl, actuated by temperature and pressure is being developed for selective sampling. Underwater TV on rakes is being tried for assessment of snow crab and scallop. Aerial surveys are being used and further developed for logging fishing effort on lobster (Homarus americanus) including electronic data logging and processing and prompt reporting of results for managing the fishery.

2 Hydroacoustic survey methods:

Development of procedures continues in St John's, Halifax, St Andrews and Nanaimo, all reporting improvements in hardware and software. Newfoundland is using the method for capelin biomass estimates and is developing a procedure for redfish, using a deep-towed body. Halifax has been comparing acoustic results with bottom trawl catches, noting numbers and size composition, and Nanaimo reports density comparisons of herring with purse-seine catches. St Andrews is studying the implications on acoustic results of the size and distribution of herring and of the echo characteristics of various schools, using in situ measurements of tilt-angle distributions and a rigorous calibration of the TVG function.

3 Gear selectivity and comparative fishing:

The study of square-mesh codends continues, both in St John's and in Halifax. St John's also reports continued study of mesh selectivity in cod traps to increase escapement of pre-recruits. Quebec reports a comparison between rectangular crab traps and the Japanese conical trap, favouring the former. In the Pacific, trials continue in an effort to encourage juvenile salmon to escape purse seines by attraction to coloured netting panels.

4 Fishing gear technology:

In the Pacific, visual observations of trawls using the towed vehicle MANTA have been coordinated with instrumented measurements, including fish reactions at the mouth and codend and including square-mesh codends. They also report studies of trawl-model resistance in a tow tank and a project to develop an inexpensive depth meter for purse seines. New Brunswick reports a successful "rock hopper" trawl for rough terrain. Newfoundland is experimenting with Kevlar, both in netting and in lines. The thesis study of aerofoil-shaped trawl-door models in a wind tunnel at the Technical University of Nova Scotia has been completed, including the effect of tips to increase stall angle.

5 Energy conservation:

On both the Atlantic and Pacific coasts, computer models are being developed to demonstrate energy-saving operating techniques to fishermen, using data bases derived from the respective fishing fleets. The effects of throttle usage and fuel warmers have been studied and both inshore and offshore vessels continue to be monitored for fuel consumption. The feasibility of retro-fitting propeller nozzles inexpensively and of using sail-assist are being studied. Low-energy fishing methods, particularly longlining, are receiving considerable attention, concerning both new techniques and new fisheries.

6 Fish quality:

Several projects involve new designs and applications of containers to improve fish-handling. New herring gill net haulers and shakers cause less damage to the fish. Underwater TV is being used to study the action of scallop rakers in the search for a design which will cause less damage to the animals, and a refrigerated hold and improved handling techniques have reduced crab mortality.

DENMARK

Energy Conservation

Research has as last year concentrated around the internordic project Oilfish. Three Danish institutes are participating in the following fields:-

- (I) Hull forms - Danish Ship Research Laboratory (SL). Model testing of trawlers with bulbous or radically different bow forms giving reduced resistance of 20-30%. Testing full scale of different types of hull paints.
- (II) Motors - Jutlands Institute of Technology (JTI). The oil consumption of 10 different diesel motors ranging from 58 kW to 735 kW has been measured and compared under towing, free running and full speed conditions. Means of recycling the waste heat from the cooling water and exhaust gases into accommo-heating or into mechanical energy by the use of a Stirling motor is being investigated.
- (III) Optimal propulsion system - Danish Ship Research Laboratory (SL). A design study computer program has been written which can calculate the oil consumption of a fishing vessel during a typical fishing trip. Parameters such as hull and gear resistance, propeller and motor characteristics can be optimised.
- (IV) Fishing gear - Danish Institute of Fisheries Technology (FTI). An analysis has been made of how much of the total resistance of 10 different types of trawl is due to the wires, trawl doors, netting, floats and footrope. The measurements have mainly been taken from model test results in the flume tank. Further tests were made on conical test samples of full scale netting to see if the large (60%) resistance of the netting could be reduced by the use of alternative materials. It was found that netting in braided polyethylene, twisted polythene and braided nylon of about 2,75 mm diameter had only marginally different resistance and that increases corresponded to increases in wet, knotted breaking load. A new form of knotless polyethylene netting was, however, found to have 16% less resistance with 50 mm knot to knot netting. Model tests of doors at different angles of attack and with or without slots were also undertaken to try and reduce their contribution (typically 20%).

Improvement of catch handling techniques

The Technological Laboratory has continued its work developing mechanised catch handling systems for various different types of trawler:

- (i) A four man system for sorting human consumption species from industrial fish, gutting the consumption fish and icing the industrial fish. This is used on board vessels of 230 tons/800 hp.
- (ii) A four man system for consumption fish which introduces CSW tanks as a buffer store and is used on boats of 170 tons/600 hp.
- (iii) A system for handling quickly consumption fish on board smaller 50 tons/350 hp vessels incorporating washing drums and a gutting machine.

- (iv) A system to improve the handling and quality of Nephrops on board trawlers of 20 tons. This incorporates a sorting bench, washing machine and 200 litres insulated CSW boxes to prevent blackening of the Nephrops and enables them to keep the catch on board for longer periods.

FTI has made an investigation of the relative efficiency of different systems for unloading catches of industrial fish. The most efficient system was found to be to hold the catch in tanks with a Vee formed bottom and to discharge with an air pump system.

Improvement of commercial trawl gear

FTI has continued its programme of testing trawls in the flume tank for net manufacturers and fishermen. The most important new developments have been the improvement in the hanging of large sandeel trawls, the use of very large meshes in the upper and sidepanels of pout trawls, the introduction of cambered vee doors and the development of double trawl systems for cod and Nephrops.

Gill nets

Tests have been made in the flume tank by FTI of trammel and tangle nets with different hanging ratios on the sole rope. It appears that the footrope will lift off the bottom in the slack downstream bight of the nets under strong tide conditions if the sole rope is made longer than the floatline but will hold the bottom if it is made the same length or shorter.

FAROE ISLANDS

In recent years many Faroese trawlers have changed to pair trawling with better economic results.

In order to find out where the saving takes place, there is installed on two pair trawlers and on one single boat trawler instruments measuring revolution, propeller setting, speed, oil consumption and wire tension during steaming, shooting, towing and hauling.

While we have some figures for the pair trawlers, unfortunately we have problems with the instruments on the single boat trawler.

These measurements will be continued.

In addition to the above, full scale measurements on the commonly used balloon trawl will be done, on both pair trawlers and the single boat trawler.

As part of this study, 1:10 scale tank trials on a model of the same trawl will be done. These trials will be carried out with the help of Mr W Dickson and some model design drawings and calculations have already been made.

During the seasonal fishery for blue ling we have carried out selectivity measurements using trawls with different mesh sizes. This work will be continued.

In near future we will purchase a remote controlled TV-vehicle. The cost and use of the vehicle will be shared with a trawl factory and a factory fishing and processing great scallops.

FEDERAL REPUBLIC OF GERMANY

In continuation of the activities in the years before the efforts of the Institut für Fangtechnik were mainly concentrated on fishing methods husbanding the resources. This includes as well research and development work in such fishing methods which consume less fuel than the so far most important trawling, as investigations on selective effects of these gears:

Investigations on set nets were continued. Experience of fishermen in the Baltic has shown that during late summer the commonly used trammelnets become unsuitable because of the occurrence of jelly fish in large quantities. Contrary to this, gill nets are scarcely hampered in catching roundfish. Large, 3.5 m high gill nets proved especially good catching efficiency for cod in the beginning of its spawning season. Multimono yarns again showed superior efficiency and ease of handling in comparison to monofilament or twisted yarns in this context.

Reduced pollution by weeds or jelly fish can also be reached by taking into account the activity patterns of the fishes sought for. If the nets are set only during the peak activity hours, the amount of catch will not be much affected but less spoilage encountered. In addition to this the mechanisation of a traditional device to enhance the activity of fishes is presently intended.

The sole fishery with set nets in the German Bight could in 1983 be continued with good success. This was partly due to a decrease of the used mesh size of 53 mm to 45 mm which brought an average gain of 100% in weight and at least of 50% by value. Nevertheless, in contrast to the commercial beam trawls, no undersized soles were caught. In the shallows of the East Frisian coast Grey Mulletts could be caught in commercially interesting quantities by special gill nets.

Work on longlines concentrated on the suitability of monofilament gear to live bait fishing in the Baltic and to the conditions found in the Southern North Sea. Whereas the trials in the Baltic resulted in a 60% catch increase compared to an equal number of hooks on conventional gear, those in the North Sea were severely hampered by strong tidal currents and predatory bottom living animals stealing the bait. The fact of the existence of a remarkable German longline fishery in the same area at the turn of the century nevertheless backs the decision to go on with the development of a line fishery especially adapted to the conditions there.

Reintroduction of Danish seining into the German cutter fleet was continued. Four cruises of FRV "Solea" were mainly devoted to the exploration of suitable fishing grounds in the Central and Southern North Sea. A chartered cutter operating from July to October under semi-commercial conditions took advantage from the findings of these cruises and achieved promising results.

Jigging machines were compared in two types in North Sea as well as in the Baltic. Good catches could so far only be made on wrecks in the German Bight which obviously attract large-sized cod at least temporarily.

The prototype of a pulse generator for electrified beam trawling which had been operated with success aboard FRV "Solea" but failed on a commercial trawler, was repaired and amended. Trials in the next future will show if a reliable and sound design is now available.

Trawl research was continued with the development of a mathematical model of the water flow inside and around the towed gear and with practical measurements of these values during a cruise of the FRV "Walther Herwig".

Fuel consumption under various gear conditions (trawl and set nets) was measured aboard a commercial cutter by means of a fuel meter.

For behavioural studies of marine and inland water fishes and of gear performance a low-lightlevel underwater TV camera was bought. First observations on the influence of tidal currents on gill nets were made near Heligoland.

A wreck finding instrument (Proton Magnetometer) which may be very helpful in the fishery on and around wrecks was tested and found useful.

Bottom trawl selection experiments on cod were carried out in December 1983 off the North and East Frisian coast.

The development of an own German echo-integration system was continued and tested in krill surveys during a cruise of RV "Polarstern" in the Antarctic.

First steps were made in a project to submerge artificial reefs in German coastal waters. Emphasis was laid on a construction which is easy to mount and to dismount. Three different types are designed.

A similar stage of completion is also to be reported from a project to influence fish behaviour by pressure impulses of high energy. An impulse-hydraulic system has been constructed which transforms a constant oilstream of 200 bar into pressure impulses of variable amplitudes, frequencies and envelopes. First tests of the equipment were encouraging.

FRANCE

Underwater observations

The different systems (sledge or glider) including a photo camera and developed in our Institute are working well. Pictures have been taken on the bottom down to 300 m.

A new camera developed for the identification of pelagic organisms has not yet run successfully as the shoals were too small.

Low light level TV camera has been used in order to observe the behaviour of molluscs around traps and of Nephrops stimulated by an electric fields.

A remote towed vehicle developed in the future pipe-line observations will be adapted for trawl observations with a TV camera.

A first trial will be made with the same type of vehicle but including divers.

Set nets

Gill nets and trammel nets are extending. They are made of twisted polyamide or multimonofilament.

Trammels for lobsters has been tested near Algiers.

Inshore fleets

In collaboration with the biologists an inventory of the inshore fleet has started in order to know the number of each type of boat, their characteristics and equipment. The knowledge of the fishing areas, type of fishing will help to know their fishing effort.

Long lining

Some problems have appeared in the finishing of automatic long line systems

Trawls

Industrial fleet is mostly for saithe fishing using a bottom trawl with ropes and pelagic doors.

Netdrums have been put on trawlers in order to modify the type of fishing more easily.

A study of the selectivity of GOV trawls has been made in the Mediterranean Seas. In the same area comparisons between different mesh sizes will start aboard commercial trawlers.

"Thalassa" has just made a cruise in order to test bottom and pelagic trawls.

Miscellaneous

In connection with the future Sea Center in Boulogne-sur-Mer, a new flume tank is under study however the financing is not yet decided.

We begin to use microcomputers and plotters to design and draw trawls.

Security aboard fishing vessels is under study in Lorient in cooperation with the University.

ICELAND

Stationary fishing gear

In the winter fishing season 1983 some new types of cod gill nets produced by an Icelandic factory were tested in commercial fishing. Very recently these experiments were continued. Many different types of nets and different floatlines were observed with an underwater TV camera mounted on a towed rotor controlled vehicle. Some cod were observed close to the net wall, swimming into the net and gilled. Observations on the behaviour of fish toward the gear are scarce so far.

Observations on different types of longline have started very recently. So far no observations on the behaviour of fish against baited hooks could be made.

Some trap designs have been tested to catch crabs and some other invertebrates which possibly can be used for human consumption.

Shrimp trawls

Numerous observations on different designs of shrimp trawls have been made in Isafjord Bay off the NW coast with the underwater TV camera already mentioned. The shape of different trawl types could be compared and the effect of various rig alterations became evident. These observations also include behaviour observations on shrimp and 0- and I-group fish species. Some fish species were seen escaping out of the codend and the aft part of the belly. Herring were seen to lose their scales in great numbers.

Selectivity

A short experiment was carried out with a selective Nephrops trawl, divided longitudinally. As more than 1/4 of the Nephrops was caught in the upper part of the trawl this trial was discontinued.

In the winter season 1984 some comparative fishing trials with Danish seines with 135 and 155 mm mesh size were conducted for catching haddock. A surprisingly high percentage of the haddock got gilled in the wings and the front part of the bally. The catch comparison showed the 155 mm mesh size to be far too big for haddock.

Material, standardization

Some work has been done on standardization of the bottom trawls used by the Icelandic research vessels in ground fish surveys (stock size estimation).

Some material testing - mainly breaking strength measurements - was carried out on netting and netting yarns. The ISO standards on netting technology are increasingly used by Icelandic netmakers.

Fuel consumption

The cooperation on fuel consumption of fishing vessels within Nordforsk was continued. The main result is that a considerable overall fuel reduction can be obtained. Consequently many vessel owners have already taken measures to reduce the fuel consumption of their boats. Among the projects dealt with the following are the most important:

Efficiency of propulsion machinery, effect of hull-fouling, use of waste heat, use of power from ashore when in harbour and the usefulness of fuel consumption recorders already used by one third of the Icelandic fishing fleet.

ITALY

During 1983 engineering tests were completed on four types of pelagic trawls which had different mesh sizes or ropes in the front part. They were:

- a) a standard 200 mm trawl as used in the Adriatic;
- b) a modified 200 mm trawl;
- c) an 800 mm trawl;
- d) a rope trawl.

These trawls were designed to have the same net mouth; and the aim of the tests was to compare their performances and fuel consumptions.

The same gear arrangement was used for all the trawls except for the following parameters: two warp lengths (100 m and 150 m) and two alternative points of attachment of bridles to doors were used in order to compare the trawl performances under variation of these parameters.

The 200 mm modified trawl produced results which were substantially similar to those of the standard 200 mm trawl: differences of about 3% were noted.

The comparison between the standard 200 mm trawl and the 800 mm trawl shows a reduction of 22% in the total warp loads measured on the vessel and a reduction of 30% in the total net loads measured ahead of the wing tips of the trawls.

The rope trawl has loads a little higher than the 800 m trawl. These differences can be partially modified if we consider the component of the forces in the tow direction instead of the total loads.

In any case the rope trawl had net openings much greater than the other trawls, especially in the vertical plane, in spite of the design. This fact was caused by the decision to use the same doors and the same bridle weights for all the trawls.

So the net loads per area of the rope trawl are about 50% of the 200 mm trawl and 24% of the 800 mm trawl, whereas the fuel consumption per area of the rope trawl is about 40% of the 200 mm trawl and about 33% of the 800 mm trawl.

The aim of the second part of this research project, financed by EEC, is the comparison of the fishing efficiencies of these trawls in relation to the Mediterranean fish species using the principle described by Mr Diner.

But in our case an electronic instrument was designed and constructed to connect a computer to an echosounder and to a netsonde in order to sample their echo-signals at a frequency of 5 kHz.

All the data received by the computer are stored on magnetic tape. The fish density in the water layer, sampled by the trawl, will be evaluated by means of these data and will be compared to the fish caught in each haul.

This instrument has just been tested at sea and the comparative fishing tests will begin next month.

NETHERLANDS

Electrical fishing

The development of an electrified beam trawl was continued. The last experiments in 1982 resulted in a great progress as the catches of the electrified beam trawl increased with about 50% compared with the year before. In 1983 a new pulse-generator has been designed by technicians of the Technical Research Department, which can meet the demand of higher electric fields for fishing in the daytime.

The experiments in 1984 will be used to collect sufficient data to be able to make a definite conclusion whether electric beam trawling is a good alternative for mechanical trawling. Also will be tried to solve the problem of electrode-corrosion.

Square mesh codends

Research on square mesh codend, similar to those investigated at the Marine Laboratory in Aberdeen, Scotland (J H B Robertson, CM 1983/B:25) indicated form stability problems when applying existing knotted netting, due to the different loads on the bars.

The use of knotless material seems to be of advantage from this point of view. Further research is needed.

Pelagic trawling

Comparative fishing trials on a pelagic net with very large diamond shaped meshes (2700 meshes circumference) showed a distinct herding effect by such a construction. Catches, compared with surrounding vessels of the commercial fleet, were quite promising.

The gear has been tried out on a commercial vessel, the "Alida" SCH 6 of fleet owner W v d Zwan for several weeks on mackerel and herring. The results were most forwarding and a stimulus for the development of larger pelagic nets based on the same concept.

As is usually the case, a 1/25 scale model was tested of a new design of 3600 meshes circumference, prior to full scale tests. The expectations from these tests are that the full scale net will have considerably less drag than comparable commercial nets in use. The aim is for 20-30% difference. The research programme for 1984 will include geometry and drag measurements and comparative fishing trials with this new gear.

Demersal trawling

An extended research programme on bottom trawl geometry and resistance has been carried out to complete the tests of 1982.

The nets tested will cover a wide range of trawls used in the Dutch fleet: loggernets, bobbin trawls and pair trawls. Data will be analysed throughout 1984 and reported with the 1982-trials.

Pair seining

Pair seining experiments were continued in 1983 on the UK 50 and UK 52 during six weeks. Details of the rigging and the hauling procedure were varied throughout the period. Finally the rigging used in previous years seemed to be the best.

The fuel oil consumption turned out to be 4000 litres per week on average, a substantial decrease compared to the amount of 12000 litres commonly used with such vessels when fishing beam trawls.

Species fished for were mostly plaice, while some roundfish have also been caught. The pair seining operation seems to be a suitable alternative when other fishing is low.

Fuel saving

Most beam trawlers in the Dutch fleet are heavily over powered ships, cruising at speeds higher than their economical speed.

In order to decrease the energy costs of this fishing method the wave making resistance of the trawlers may be reduced by a greater length. Preliminary calculations indicate room for improvement of the ship hulls. The costs of adding a midship section of some meters are comparable to the savings in energy costs over a lifetime period of the vessel. Further study has to be done to come to more definite recommendations. The fuel-oil consumption of auxiliary machinery will possibly be decreased by driving generators from the gear box or the propellor shaft directly instead of having self-driven generators. Detailed research will be done in the future.

Safety at sea

A report by Dr H B Lodewijks suggests that fishing operations are more accident prone than most land-based operations. Especially the weather conditions, resulting in motions of the vessels, the use of ropes and cables, the heavy loads on the materials in use and fatigue play an important role.

Safety is related to working conditions in general. Improvement of these conditions may be regarded as a first step to improve safety.

Research in this field has been case-orientated in 1983.

Catch handling

A study has been done on the use of refrigerated seawater for storage and transportation of plaice. Catch handling procedures can be enlightened with this application resulting in less strenuous work for crew members. Unloading of fish boxes with large wooden shelves turned out to be hazardous. A new method with a boom and a remote controlled winch has been developed and tried out on a commercial vessel (KW 221).

Results are promising and will be reported in detail in the next year. The problem of the safety of fishing operations, including gear handling procedures, cutting and storing of fish, unloading in the fish docks, will be studied in a more comprehensive way.

Use of heavy fuel oil

Three ships were added to the project concerning the use of heavier fuels, the UK 95, UK 253 and the GO 26.

The results of 9000 hours of operation of the vessel KW 137 using a blend with 20% heavy fuel were very promising.

Maintenance costs did not increase compared with the original fuel used, while the total fuel costs decreased by some 7%.

A fall-back in the overall quality of the fuel oil did not occur, as may be expected in the near future when new CIMAC-specifications will come in use. It is essential to apply the right lubricant.

A number of parameters such as temperature, pressure, viscosity, will be monitored and reported on questionnaires.

On the whole a total gross-saving of 17% in fuel costs has been obtained over 1983. Heavy fuels are now in use on some twenty vessels.

NORWAY

Hook and line

Further experiments with new hook designs have been conducted to develop more effective hooks that also are adaptable to mechanized longline systems.

To reduce the problem of bait predation, a new type of gangion float is developed. The performance of the floats was studied in a flume tank, and in the field by a remote operated TV-vehicle and their overall effects have been tested in experimental fishing. The floats give significantly lower bait loss and increased catch rates for ling.

A new type of longline (Quick Snap) were tested with good results - the main benefits being the swivel connected snoods and easier gear handling and repair.

Work on chemical stimuli and artificial bait has continued. (Results are being reported to the ABBA Working Group.)

Selectivity experiments suggest that the effects of hook size and shape are negligible, while bait size is important, particularly for the size of cod caught with longlines.

Several new systems for mechanised longlining have been tested, incorporating both precise baiting machines and random baiters. Full scale trials with a random baiting system were done during the winter season 1982/83, and in February 1984 the prototype of a new system for handling monofilament lines was tested.

Gill nets

A new float line for gill nets was tested at different depths.

Experiments were carried out in the gill net fishery for blue ling to study the effects of hanging ratio on catch rate and size selectivity.

Initial comparative studies of catch efficiency in longline, gill net and Danish seine started in 1983 were followed up in March 1984 with detailed echo surveys of a fjord in North Norway and comparative fishing trials with cod gill nets and trawl.

Experiments were started to evaluate the catch rate effect of baiting gill nets.

Further tests were carried out with the mechanical gill net handling system, operated for nets with different float lines.

Trawls

A double symmetrical shrimp trawl was designed and tested with regard to efficiency for shrimp and by-catch of undersized fish. Results were encouraging and a modified version was designed, and 1:5 and 1:10 models of this trawl were tested in the Hirtshals flume tank.

Experiments with modified versions of a vertical sorting panel in the aft belly of a shrimp trawl with regard to the loss of shrimp and the escapement of undersized fish were continued and finalised in 1983.

Initial trials were started in April 1984 with a prototype shrimp-fish separator to be installed between the body and codend of a shrimp trawl. The separator uses large square meshes to provide an escape path for fish, while funnels constructed of small mesh webbing keep the shrimp away from the big meshes and act as leading to guide the fish out of the trawl.

A high opening demersal/semi-pelagic trawl with 1600 mm meshes in the front belly and 400 mm meshes in the wings was tested in experimental fishing for blue whiting and silver smelt in the Norwegian Trench.

Mesh selection

Experiments to study mesh selection of cod and haddock in Danish seine were carried out in North Norway coastal waters. Selection factors comparable to those for trawl were estimated, possibly because of the traditional covered cod and technique applied.

Subsequent comparisons of standard and square mesh codends in Danish seine confirmed that the latter mesh configuration increases the slope of selection curve and reduce the variance.

Purse seines

A new improved power block for coastal purse seiners, which greatly reduces the problem of skewness during net hauling, has been successfully tested.

Net stacking systems for large purse seiners, with separate net winch have been installed on board approximately 50 Norwegian vessels.

The trials with air-filled floats for purse seines have continued. A few capelin nets have been fitted with such floats only, and tested with encouraging results.

The Institute of Fishery Technology Research has continued work on a numerical purse seine simulation model originally developed by NFMS, La Jolla, USA. The model is very general and will presumably also facilitate simulation of other types of gear (ie gill nets, longlines, etc).

Vessel technology

The programme of energy conservation has been continued at the same level of activity as in 1982.

A series of model tests on our 60' experimental vessel has resulted in a new bulb being added to the vessels. Fuel saving of 25-30% are reported when steaming.

A hydrostatic propulsion system has been installed in a 41 ft vessel, to investigate the suitability and fuel economy of such systems for propulsive duty.

A number of commercial fishing vessels have been fitted with new gear and propeller-systems and the resulting reductions in fuel consumption when steaming have been found to be in the order of 20-30%. A simulator for fuel usgae simulation has been developed as a teaching aid for correct utilization of engine and propeller, for use in training fishermen and skippers.

Work is continuing on an onboard information and decision-making system. The storage and retrieval system is now implemented on our computer system, and is being tested for function.

Fuel scale measurements of vessel resistance in a seaway has revealed that the present knowledge of speed loss and resistance increase is incomplete.

In 1984 considerable effort has been directed towards developing procedures and instrumentation for such measurements.

The activities on safety and working conditions have continued and a programme for improving safety and working conditions on the fishing vessels in a locality in Northern Norway is carried out in cooperation with the local health authorities. Various organisational and technological approaches are being tested.

UK, ENGLAND (SFIA)

Trawl developments

Double rig trawling, based on the American Gulf Coast shrimp trawler design, has been tested on a 23 m vessel. The trials concentrated on fishing for Nephrops in the Celtic Deeps. Catch rates were double those of single rigged trawlers in the same area ie 95 to 160 kg per four hour tow. The large catches created handling problems for the crew, indicating a need for mechanised grading and heading. The trials showed double rig trawling to be a practical technique for a UK fishery especially as an alternative to beam trawling.

Low drag trawl doors have been developed for smaller vessels of under 150 hp. Cambered doors and a novel design, called the "Heortness" door, have been tested. Care in rigging and shooting these doors must be exercised as they are less stable than the conventional flat door. The cambered door had least drag but the Hoertness door was more stable.

The development phase of the electrified trawling project has now been completed, with successful trials on a 26 m, 600 hp beam trawler. The equipment has been used on eight successive voyages and has demonstrated that for comparable catch rates to a conventional beam trawler, the trials vessel can reduce fuel consumption from 2000 to 1400 gal/week.

A Boris 520 prawn-fish trawl with a separator panel was tested under commercial conditions in the Silver Pits area. The separating panel proved to be effective in separating whiting from prawns, thus reducing damage to the whiting. The results were less conclusive for other demersal species because of low catch rates. The trawl required more towing power however; with the added panel.

A hard ground, high headline balloon trawl is being developed for vessels from 500 to 1700 hp. A model has been made of an existing gear with 170 ft headline and 121 ft groundline with rockhoppers. This is being progressively improved at the flume tank and full scale trials may take place.

Static fishing gear

More information is needed about the selectivity and catch efficiency of gill nets to enable fishermen to adapt to this method of fishing with some confidence. The capture efficiency of four different types of gill nets has been compared, in a wide range of tidal conditions when taking hake, cod, pollack and ling. The results show the method to be very selective compared with trawling. The catches, especially of cod, were concentrated in the lower quarters of the nets. Stiff netting was shown to be less effective in catching fish than soft walled netting.

The greater efficiency of monofilament longlines compared to twisted or braided lines has been demonstrated in Norway. To introduce the material in the UK, trials were carried out with 10 lines each 500 m long. Hauling and shooting

the gear were found to present no problems and some good catches were obtained of ling, conger, dogfish and cod. The rebaiting of hooks is likely to be a problem. To minimise labour for the crew, the best solution may be rebaiting ashore.

A braided twine tangle net of 200 mm mesh has been developed for the spider crab fishery in the eastern English Channel. This was successful and has extended the seasonal employment of vessels engaged in trammel netting for sole and plaice.

Squid jigging equipment was used to demonstrate that squid could be caught by light attraction and jigged lures. The absence of appreciable concentrations of squid however, reduced the value of the trials. More research is needed on the seasonal movements of squid as a basis for developing a squid fishery to the NW of the British Isles.

The Western Isles crab fishery could be improved by increasing the capture and survival rates for the brown and velvet crabs. The catch and escape rates of seven different types of creel, with variations in entrance design, are being investigated. The optimum soaking time is also being studied.

Fuel economy

The total power requirements of a Scottish seiner have been measured when free running and fishing. The vessel is of the latest type and is 24 m overall, with a 575 hp slow speed diesel engine, a cp propellor and a hydraulic winch, power block and rope reels. An audit of the power use will be of value to the industry.

UK, SCOTLAND

Gear modelling

The development of a mathematical model of a trawl has continued. Programming effort has concentrated on improving the rate of convergence of the calculation of net shape. To check the accuracy of the calculations, the shape of a pelagic trawl was measured in great detail. The Remote Control Underwater Vehicle (RCTV) was used to obtain measurements of the height, width and mesh angles in each panel of the net. It is planned also to use these data to investigate the accuracy of scale modelling. A relatively large scale model is to be built by the SFIA and measured in their flume tank. An offshoot of this work has been the development of a net drawing programme which simplifies the process of net design.

Equipment has been developed to measure the projected area of twines by an optical method. This is in accordance with the recommendations of the ICES working party on twine diameter measurement.

Investigation of gear drag

An investigation of the drag coefficients of cables and trawl warps was commenced. Data was collected on different types of warp during trials in Loch Ness. Particular attention was paid to measuring vibration. Analysis is still in progress. Further work is planned to complete the investigation.

Data is being collected on the drag of two panel trawls to derive equations predicting the drag of this type of net. This is part of a long-term programme of measurements aimed at collecting sufficient information on trawls to develop a general theory. The drag of various types of groundgear is being measured. A new comprehensive set of measurements on the performance of flat and vee type trawl doors is being collected.

Another series of measurements was made to investigate the performance of a demersal pair trawl. The spread of the sweeps was measured successfully on these trials, along with the net tensions and dimensions. The data will provide a useful comparison with single boat trawl performance.

Analysis of the data on codend drag has continued and is nearly complete. An empirical equation has been developed to predict codend drag. Investigation of water flow in codends is planned to clarify the basic processes which determine drag and influence fish reaction.

Variations in the towing speeds of standard survey gears have been investigated by calculating ship speed over the bottom from survey records. Significant differences between actual and planned speeds were found.

Selectivity

More comparative fishing experiments were carried out on trawls to compare the selectivity of square and diamond mesh codends. During these tests the main species caught were haddock and whiting. It was again found that the square mesh codends had smaller selection ranges than the diamond mesh codends. An experiment was then conducted with a Scottish seine net to investigate possible differences in codend selectivity. The 50% lengths found for haddock and whiting with 90 mm codends were 5 cm or more greater than those found with trawls. The square mesh selection ranges were again smaller than the diamond mesh. The results obtained in this project continue to suggest that the young fish mortality caused by present fishing methods could be reduced by the use of square mesh.

The EEC is presently drafting new regulations on codends and attachments. The detailed discussions on this matter have demonstrated the need for objective information on the restrictive effects of attachments. The RCTV was used to observe a wide range of these devices and on the same cruise, observations were made of codends with small mesh covers, as used in selectivity experiments. Video films have been compiled on these topics.

Several novel gears have been designed, with features derived from behavioural observations collected by laboratory staff. Further modifications were made to multi-level trawls in an attempt to separate haddock and whiting, but without notable success. A trawl has been constructed with a very large overhang on the square to restrict the escape route for haddock. Black and white netting of high contrast has been used to build a trawl. The aim is to see if a net designed to be as visible as possible herds fish more efficiently. No conclusive results have yet been obtained with these nets. Further work has been done on a two level trawl for separating Nephrops and fish, and experiment with small mesh covering panels have identified the places where Nephrops escape.

Set gear

Flume tank measurements on gill nets have been continued. Comprehensive measurements were made to investigate the parameters which affected net drag and headline height in a water flow. The important factors are twine area, buoyancy, twine solidity, water speed and twine type. Predictive equations have been derived from the data. It is planned to measure the drag and headline height of full sized nets in the sea.

The effect of twine type on the selectivity and capture efficiency of gill nets was studied in the cod fishery of Northeast Scotland. Nylon nets made from monofilament, multi-monofilament and twisted multi-filament twine were tested. Significant differences were found in the size selectivity and method of capture between the different types of twine.

Observation techniques

The remote controlled towed vehicle was used during nine cruises totalling 29 weeks on research ships and chartered commercial fishing boats. It has been found useful for many different investigations of towed trawls and to a lesser extent seabed survey work. It is routinely fitted with one TV camera, one 35 mm camera with 250 shots and a flash unit, red or white light for night work, a 300 kHz echo sounder and a netsonde unit.

The diver operated vehicle has been used during 20 weeks of research vessel and charter vessel cruises. This vehicle allows two divers to carry out short experiments and observations in and around towed trawls. Even though each diving scientist can spend only 40 minutes per day they can be much more selective in their observation and experimentation and can give a greater yield for certain types of observation.

Damage to escaping fish

Damage to fish escaping through the meshes of codends has been assessed by hand capture of these fish by divers as they emerge from the mesh. Square mesh escapes will be compared with the diamond escapes collected last year.

Mackerel swimming performance

Mackerel have been successfully transferred to the gantry tank at Aberdeen and a feeding school of 30 fish (30-40 cm) have been kept for nine months. Using the gantry and moving patterns projected into the tank a maximum cruising speed of 3.5 lengths per second has been found with an endurance of 3.5 hours. Faster speeds were maintained for shorter periods and in the tank at Loch Ewe (The Minch) a maximum burst speed of 15 lengths per second (5 ms^{-1}) was recorded. In trawls mackerel (30-40 cm) have been observed to swim on two occasions for periods in excess of 40 minutes at speeds near 3.5 knots (1.7 ms^{-1} , 4-5 BL s $^{-1}$) and then tire and become caught in the codend. In slower tows they have been seen to swim in small groups around the net and then out forwards of the mouth area. On one occasion two mackerel (35 cm) were observed feeding on sandeels while swimming forwards and out of a trawl towed at 2.8 knots (1.4 ms^{-1} ; 3-4 BL s $^{-1}$).

Hook and bait research

Previous work has shown that appropriate mechanical strength can be achieved in artificial baits. These baits can be made to attract fish to them but after mouthing the bait the fish rejects the bait and is not caught. Comparative fishing has shown that these artificial baits are less effective than the traditional natural baits. It appears that the fish are not stimulated into swallowing the artificial baits. A programme relating findings on the chemistry of swallowing of fish farm diets to the chemistry of baits is continuing in order to discover what makes the fish swallow the bait.

Salmon movements into the river mouth

A continuing programme recording the movements of salmon as they approach the river mouth showed that fish fitted with location transmitters were surprisingly clever at avoiding the fixed salmon traps used along the beaches near the river mouth. Salmon tracking and displacement work is to continue and will be further supported for the next three years by related experimental investigations into the orientation and navigation systems used by the salmon.

USA

In the northeast, experiments are being conducted with large-scale model trawls and smaller full-size gears at the David Taylor Model Basin, operated by NMFS, University of Rhode Island, and MIT.

In the southeast, a device originally developed as a means for ejecting sea turtles from shrimp trawls is being refined as a fish separator as well. Quite effective as a turtle excluder, good separation rates have been obtained in the daytime with some fish species, and modifications to improve the night-time fish separation rate are being tested.

In the northwest, efforts continue to further refine instrument systems for monitoring the performance of trawls during resource assessment surveys. Good results have been obtained with a prototype microprocessor-based system which stores all data internally. An acoustic link to the surface is being evaluated during field trials.

2 Papers and Verbal Contributions on the Special Subjects

2.1 Model testing of the 36/47 GOV young fish sampling trawl (D A Wileman)

A 1/10th scale model of the GOV trawl was constructed and tested in the Hirtshals flume tank. The aim was to identify the aspects of the rigging which most critically affected the net shape. The effect of varying bridle lengths and attachment, flotation, water speed, etc were investigated and a full report was presented. The report contains recommendations for the use of the gear. These were amplified and adopted by the Working Group (see section 4).

2.2 Variation of towing speed during survey cruises with the GOV trawl
(P Stewart - verbal)

Using existing survey data, the speed of the towing vessel over the bottom was calculated for each haul on four separate cruises. The speed was found to vary significantly between hauls and the median values to differ between cruises. The possible causes of these variations were considered: tidal effects, errors in Decca readings, speed log calibration errors, wind force and sea state. This will be the subject of a paper to ICES by Ferro and Rush.

2.3 Measurements of variability in bottom trawl performance during resource assessment surveys (C W West)

Observations using acoustic trawl instruments during resource assessment surveys have shown that trawl performance is quite variable in ways that can increase the variance of abundance estimates based on area swept techniques. The trawls responded to a number of factors present in the trawling situation, including minor changes in the rigging of the trawl or doors, towing speed, presence of a netsonde, depth of tow, scope ratio and bottom currents. Other factors that affected the area sampled during a tow include weather conditions, bottom composition and the procedures followed while setting and hauling the gear. The importance of using appropriate instrumentation during resource assessment trawl surveys is discussed.

2.4 Developments in Norwegian fisheries with Danish seine (L Brunvoll)

The seine net fishery for cod in northern Norway was described. The paper presented information on the types of vessel using seines, constructional aspects of the nets and the method of operation which is like fly-dragging. Catches of cod at Lofoten by different fishing methods were compared to show the importance of seining.

2.5 Review of Danish seining in Iceland (G Thorsteinsson)

The historical development of seining in Iceland was described. Variations on the technique, such as the use of wire ropes have been tried but difficulties were encountered; the wires tended to dig in too strongly. The selectivity of the seine was found to be similar to that of the trawl for plaice but better for cod. Attempts to conduct covered codend experiments on seines were unsuccessful; haddock were found meshed in the wings.

2.6 Recent measurements on square mesh codend selectivity in seines and trawls
(P Stewart - verbal)

The results of recent codend mesh selection experiments on seine nets were presented. The covered codend technique was used and data was obtained, principally on haddock, using both square and diamond mesh codends. The length selection ogives for the square mesh were steeper than those for the diamond mesh, as is the case for trawls. The 50% lengths for haddock and whiting in 90 mm codends were found to be about 5 cm greater in the seine. The selection ranges in the square mesh codends were lower than those in the diamond mesh. This will be the subject of a paper to ICES by Robertson.

2.7 Selectivity in diamond and square mesh codends - from experiments with Danish seines in north Norway (R B Larsen)

Thirty comparative hauls were carried out with two different codends. A diamond mesh and a square mesh codend, both of 110 mm mesh size, were attached to Danish seines constructed for north Norwegian waters. The square mesh codend retained proportionally fewer small and undersized cod and haddock than the diamond mesh codend. In the paper some of the results obtained are given.

3 Papers and Verbal Contributions on General Topics

3.1 Performance tests on bottom trawls, 1982 (R van Marlen)

Model and full scale measurements were reported on four different bottom trawls: two "logger-nets", a bobbin trawl and a balloon trawl. The effect on the gears of altering various parts of the rigging was investigated and the speed dependence of the parameters is presented in graphical form. Polyvalent doors were compared with Vee doors, and the usefulness of kites investigated.

3.2 Separator trawl experiments (C S Wardle - verbal)

Observations have been made on various aspects of Nephrops behaviour in trawls. The animals do not rise more than 1 m off the seabed when reacting in front of a gear. If they are out on the seabed when the gear approaches they may swim briefly, rise slightly and the groundgear passes under them. If they are in the burrow mouths, they retreat inside and are not caught. When sweeps or bridle wires scrape across the seabed, the Nephrops skip or roll over the wire and escape. This suggests that they will not be herded into the trawl mouth unless the sweep angle is small.

3.3 Selectivity of Nephrops trawls (P Hillis)

Nephrops can escape from many parts of a trawl other than the codend. Experiments were described which investigated escape from the trawl body by using small mesh panels to collect escaping Nephrops. Comparisons between trawls of different mesh size have been made and the problems were described. Codend selectivity and two level nets were also considered.

3.4 Appropriate knots for monofilament longline gear (E Dahm)

Several knots for fastening and connecting monofilament longlines were tested and compared. Surprisingly, old approved knots turned out to be either useless or unfavourable with regard to strength reduction. Recommendations are given for two especially appropriate knots for both purposes mentioned.

3.5 Dessin et conception des chaluts assistes par ordinateur (J-C Brabant)

To produce trawl drawings more quickly, a microcomputer and a plotter have been used. This makes it simple not only to make a quick selection but to automatically calculate changes to basic designs, and make other useful calculations such as twine area and net weight. The data can be coded in different ways. Specimen drawings were shown.

3.6 Recent Norwegian work on longline mechanisation in the coastal fleet
(R Skeide)

Systems suitable for use on small coastal vessels were described in detail. Random baiting has been tested successfully with squid and small mackerel as bait. The use of monofilament line in these systems was discussed.

3.7 Observations on cod gill netting (W Dickson)

Fishing experiments have been conducted in north Norway on the catching performance of gill nets. Effort has been directed at trying to relate the catch rates to the local fish density and movements, as determined by acoustic surveys, trawl sampling and landings. Estimates were made of the shoal densities and sampling areas of the nets.

3.8 Gill net selectivity (P Stewart)

A comparative fishing experiment was conducted to investigate the capture efficiency and selectivity of nets constructed from different types of twine: monofilament, multi-monofilament and twisted multi-filament nylon. The length, method of capture (gilled, tangled or snagged) and position in the net of each fish caught were recorded. There were significant differences between the test nets in the size range of the fish caught and the method of capture.

3.9 Flume tank experiments (B Scannel)

The limitations of scale models of nets for predicting full scale performance were described and the contradictions implicit in trying to keep the Reynolds and Froude numbers constant were stated. The errors introduced by present modelling techniques were listed and some improvements were proposed.

3.10 Escapement of capelin and polar cod through different parts of a pelagic trawl
(R B Larsen)

Fish escapement through different parts of a 1600 mm mesh pelagic trawl was studied. Two small meshed bags attached to different positions of the trawl were used to catch the escaping fish. The escapement of fish was found to be relatively higher in the belly part than in the front part of the trawl. The mean trawl efficiencies for 0-group and adult capeline, 0-group and adult polar cod were found to be 0.74, 0.7, 0.45 and 1.0 respectively.

3.11 Visibility of netting underwater in relation to fish reaction to gear
(C S Wardle - verbal)

Investigation into the underwater visibility of different netting and other gear materials has continued. The visual perception of fish and the visible range of trawls was described. Fish have limited angles of view and this has a bearing on their reaction to gear. The appearance of common twines and gear materials in green underwater light was demonstrated in photographs, which showed the importance of contrast relative to the background.

3.12 Reaction of fish to gear in the dark (C S Wardle - verbal)

Further efforts have been made to obtain evidence that fish cease to react to nets at low light levels. Normally the vertebrate species with the best dark adapted eyes cease to react at light levels below 10⁻⁷ lux. It has been found difficult, even at night in mid-winter to find fishing grounds where light levels are this low. Even when natural light levels are low enough, it is rare for bioluminescence to be absent and light from the fishing vessel may illuminate the gear. Taking account of these factors, a number of flash photographs have been taken on gear at night which show fish randomly ordered ahead of a trawl. This indicates an absence of visual reaction.

3.13 Comparison of catches and fuel consumption in single and pair boat trawling (A Olsen - verbal)

Information was presented on the performance of vessels which had transferred from single boat to pair trawling. Using bottom trawls, catches of cod, haddock and saithe were maintained at the same levels, but with reduced fuel consumption. Towing speeds appear to have reduced, although one vessel had increased catches for the same fuel consumption.

4 Recommendations

1 The Working Group, taking note of the new experiments reported, which confirm that square mesh codends have higher selection factors and shorter selection ranges than comparable codends of traditional diamond shaped meshes, recognising the great advantages of such selection facilities in resource management, recommends:

that more ICES member countries investigate the selection properties of square mesh codends, and in particular if, and to what extent, these are affected by catch size and by towing speed and duration.

2 The Working Group considers that the different rigs currently in use will cause significant changes in the geometry and fishing capability of the GOV trawl. It is recommended that member countries of ICES be encouraged to adopt similar practices when using the GOV trawl, in particular that:

a) The original French net specification should be followed as closely as practicable. The trawl may be constructed in polythene or nylon, and the twine diameters may be altered slightly, provided that the drag of the net (proportional to the twine area) does not change by more than 5%.

b) The trawl should always be used with a kite (0.85 m square) attached by strops of the lengths specified in the Manual (CM 1981/H:9) and additional floats on the headline such that the height of the headline centre, at a towing speed of 4 knots, is in the range 5.5 ± 0.5 m.

c) The weighting of the footrope as specified in the Manual should not be reduced unless problems are experienced through the gear coming fast on soft muddy ground.

d) All three bridles, inclusive of shackles, swivels, etc, must be precisely the same length and regularly checked.

e) The total length of the sweep system ie the sweeps plus all backstrops and extensions should be 60 m when fishing statistical squares up to 70 m deep and 110 m for squares over 70 m deep.

f) The trawl should be fished with the specified 4.5 m² polyvalent doors (3.1 m x 1.8 m). If another type of door is used, the size should be selected to ensure the same spreading force as that provided by the specified polyvalent doors.

It is further recommended that performance data for the GOV trawl should be published, based on full scale measurements (especially of the dependence of the headline height, wingend spread and door spread on towing speed) and that measurements should be made on the trawls used for surveys to demonstrate their compliance with the required specification.

3 The Working Group accepted an invitation from Prof K Olsen to meet in 1985 at the Institute of Fisheries, University of Tromso, and considered various topics for consideration as special subjects at that meeting. Consequently, the Working Group recommends that the next meeting should be in Tromso, from 20 to 22 May, 1985 and that it should consider, in particular:

a) Equipment and techniques for underwater observations of fish and fishing gear.

b) The general arrangement, deck lay-out and equipment of fishing vessels in relation to stationary fishing gear and methods.

4 Having regard to the importance of gear sampling efficiency in stock assessment and fisheries management, the Working Group recommends that a mini-symposium on this topic should be held at the 1986 Statutory Meeting to discuss the available knowledge, to assess the effect of variable gear efficiency on existing methods of stock assessment and to define the aspects of stock assessment work which might benefit from improved knowledge of gear efficiency.