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Exploratory Voyage for Blue Whiting
Arctic Privateer
March - April, 1975

A report produced jointly by W.F.A.
M.A.F.F. Torry Research Station,
M.A.F.F. Fisheries Laboratory, and
D.A.F.S. Marine Laboratory.

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S U M M A R Y

This report describes a voyage made in March-April 1975 on the stern freezer trawler ARCTIC PRIVATEER to catch blue whiting to the north-west of the British Isles. The voyage was a joint venture undertaken by the Ministry of Agriculture, Fisheries and Food, the Department of Agriculture and Fisheries for Scotland and the White Fish Authority.

For the first three weeks, fish could not be located in great quantities, and rough weather and various operational problems interrupted the search several times. Eventually, however, extremely dense concentrations of blue whiting were located, and the ARCTIC PRIVATEER rapidly caught her full capacity and returned to her home port with nearly 400 tons on board. This was achieved in a voyage of 41 days.

Having once located the fish in quantity, capture proved to be no problem and tows were limited to very short periods to avoid catching quantities too great to handle.

On the other hand, the problems of processing the fish on board, by the different methods tried, were found to be considerable and most of the fish was frozen whole.

Since the main objectives of the voyage were to establish catch rates for a typically-equipped British trawler, and to bring back a large quantity of blue whiting for processing trials and trade assessment ashore, the voyage can be counted as highly successful.

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R E F E R E N C E

1. Hatfield, M. and Wray T. 1974 Exploratory voyage for blue whiting, St. Benedict, March-April, 1974.
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EXPLORATORY VOYAGE FOR BLUE WHITING - ARCTIC PRIVATEER

1. INTRODUCTION

The stocks of blue whiting in the north-east Atlantic are large and at present virtually unexploited. Recent estimates of the size of the stock spawning west of Scotland lie between 5 and 15 million tons, and it is considered that an annual catch approaching half this amount could be taken without reducing the stock to unacceptably low levels. The blue whiting is therefore potentially capable of supporting a fishery of world importance.

Foreign vessels, notably Norwegian, Spanish and Russian, have been exploiting the stocks of blue whiting on a small scale since 1970.

The first commercial trials by a British vessel were in March-April, 1974, when the White Fish Authority (WFA) chartered the Hull freezer trawler ST. BENEDICT on behalf of the Ministry of Agriculture, Fisheries and Food (MAFF). The aim of that voyage was to bring back sufficient quantities of blue whiting to assess its potential for direct human consumption. Unfortunately, fish density was less than hoped for and only 67 tons of blue whiting was returned for processing and acceptability trials. Also, due to operational problems, there were only eight effective fishing days. This meant that the second objective of carrying out sufficient fishing to be able to advise the UK industry on problems which will be met in the detection and capture of blue whiting was not fully achieved.

To continue the commercially-orientated work started by the ST. BENEDICT, a further exploratory voyage was carried out in March-April, 1975 on the freezer trawler ARCTIC PRIVATEER. This report summarises the results of that voyage.

2. OBJECTIVES

The objectives of the voyage were:-

- (1) To gain more experience in the detection and capture of blue whiting.
- (2) To determine the catch rates achievable over a period of intensive fishing.
- (3) To obtain samples of fish, suitably preserved, for commercial assessment by the trade.
- (4) To enable further experimentation on processing, preservation, and marketing methods by both the M.A.F.F. Torry Research Station and the WFA.

3. STAFFING AND RESPONSIBILITIES

Overall management of the project was carried out by the WFA Industrial Development Unit on behalf of M.A.F.F. The vessel was commanded by Skipper W. Stockton and manned by a crew of 22 from British United Trawlers (BUT) who were under the direction of representatives from the WFA, MAFF and the Department of Agriculture, and Fisheries for Scotland (DAFS). The staff from these establishments and their respective duties were as follows:-

3.1. WFA Industrial Development Unit

J.L. Robertson	Senior Fisheries Development Officer	Officer in charge of voyage.
A. Smith	Master Fisherman	Adviser on fishing tactics and gear handling.
G. Cartwright	Senior Marine Engineer	To assist and advise Chief Engineer on the operation of propulsion machinery and work with Torry staff on various duties.

K. Hairsine	Electronics Engineer	Responsible for all electronic equipment (navigation and fishing aids).
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3.2. MAFF Torry Research Station

I. McDonald	Senior Scientific Officer	Responsible for advice and crew instruction on all aspects of fish handling, processing and stowage.
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W. A. Johnston	Senior Scientific Officer	To join the ship on the last ten days of the voyage to carry out a programme of research.
J. Smith	Senior Scientific Officer	
A. Thomson	Scientific Officer	

3.3. MAFF Lowestoft Fisheries Laboratory

J. Dann	Scientific Officer	Biological investigations and to advise on echo soundings and if necessary on fishing grounds.
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3.4. DAFS Aberdeen Marine Laboratory

J. Richards	Higher Scientific Officer	Biological investigations and to advise on echo soundings and if necessary on fishing grounds.
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4. VESSEL

The ARCTIC PRIVATEER (Figure 1) is a 70m (228 ft), 1860 kW (2500 hp) distant water stern freezer trawler, owned by the Ministry of Agriculture, Fisheries and Food. While awaiting conversion to a research vessel for Torry Research Station, she was lent to the WFA for this voyage under the overall direction of the Controller of Fisheries R & D. Full technical details of the vessel appear in Appendix 1.

5. FISHING GEAR

The ship carried various options of gear for the voyage, but only the following were used:-

(1) Engel 1600 x 20 cm pelagic trawl, lined with 24mm stretched mesh. 100m (55 fm) bridles were used with 750 kg (1650 lb) sinker weights, six F3 fender floats and 6m² (65 ft.²) Suberkrub trawl doors. Further details are shown in Figures 5 and 7.

(2) Engel 2000 x 20 cm pelagic trawl, lined with 24 mm stretched mesh. 100m (55 fm) bridles were used with 1000 kg (2200 lb) sinker weights, six F3 fender floats and 6m² (65 ft.²) Suberkrub trawl doors. Further details are shown in Figures 6 and 7.

6. VOYAGE NARRATIVE

The ARCTIC PRIVATEER left Hull at 0730 on Saturday, 15th March, proceeded northabout to grounds on the edge of the continental shelf to the west of the Shetlands and commenced fishing at position 60°19'N x 07°05'W on Monday, 17th March.

The next 11 days were spent in this general area. During this period the vessel had to be taken into Stornoway to replace a boiler feed pump pipe and take on fresh water. The fishing was very unproductive during this period and it was decided on the 28th March to search in a southerly direction and make for the Porcupine Bank area where blue whiting marks had been reported by the FRV CIROLANA. Before setting off, the ship put into East Loch Roag to exchange second engineers and the MAFF and DAFS Marine Laboratory representatives.

At approximately 0500 on the 3rd April on the passage south dense fish marks were observed at position 57°05'N x 09°33'W, west of Barra on the southern tip of the Hebrides. The marks proved to be blue whiting and the first tow through them yielded 500 baskets. The vessel fished close to this position for the remainder of the voyage, with a very high catch rate of blue whiting throughout the period.

It was originally planned that the last 10 days of the scheduled 50 day voyage would be devoted to experiments on fish preservation under the direction of Torry. However, due to the very heavy fishing it became clear that the vessel would be full within 40 days. The additional three Torry personnel were therefore flown to Barra where they were taken out by launch to join the vessel on Thursday 17th April. At this point Mr. Cartwright(WFA) and Mr. Richards (DAFS) left the vessel. The Torry experimental programme was completed by Tuesday, 22nd April, by which time the vessel was full to capacity.

Contact was maintained throughout the voyage with F.R.V.'s CIROLANA and EXPLORER, which were carrying out blue whiting survey work in the same general area, and information on fish marks and catches was exchanged.

The ARCTIC PRIVATEER left the fishing grounds at 1700 on the 22nd April and docked in St. Andrew's Dock, Hull on Thursday, 24th April. Due to a dispute by the landing labour there was a 14 day delay before the vessel was discharged. Approximately 400 tons of frozen fish were landed and put into cold storage in Hull.

7. RESULTS

7.1. Fish Detection and Location

As shown in Figure 8, the areas fished covered the edge of the Continental shelf from $60^{\circ}19'N \times 05^{\circ}12'W$ to $57^{\circ}00'N \times 09^{\circ}37'W$, in water depths of 255 to 1645m (140 to 900 fm). All fishing was pelagic.

The layer of marks identified as blue whiting varied in thickness from about 18 to 90m (10 to 50 fm), and was always located at 240 to 460m (130 to 250 fm) below the surface irrespective of water depth.

During the first 11 days of fishing the search was concentrated in the area to the west of the Orkney and Shetland Isles (i.e. from $60^{\circ}19'N \times 05^{\circ}12'W$ to $58^{\circ}12'N \times 09^{\circ}10'W$). This was the main area of operation for the ST. BENEDICT and foreign vessels fishing for blue whiting in 1974.

Although quite heavy marks were occasionally seen on the sonar and echo sounder they yielded very little, the best catch achieved during this period being 80 baskets for a 1 hour 9 minute tow. Typical sonar and netsonde traces obtained during this part of the voyage are shown in Figures 9 and 10.

Quite frequently two distinct layers of marks were seen, one at 180m (100 fm) and one at 370m (200 fm). Similar sets of marks were regularly seen on the ST. BENEDICT voyage in 1974 (Reference 1). On that voyage the lower layer was identified as blue whiting and yielded quite good catches, while the upper layer was identified as lantern fish (*Myctophum Tenisoni*), hatchet fish (*Sternoptychidae*) and other small species. On the ARCTIC PRIVATEER, however, although the lower layer was identified as blue whiting the catches achieved were very poor, and the upper layer was never positively identified.

On one occasion, south of Rosemary Bank, good marks were seen on the sonar, with the transducer set vertically, but on shooting the gear the marks did not appear on the Netsonde until the gain control was increased from its normal setting of $4\frac{1}{2}$ to 8. On hauling, the catch was seen to consist, not of blue whiting, but of considerable quantities of jellyfish.

At sunset during this first period (about 2030) the marks broke up rapidly and had completely disappeared within about 15 minutes. Provided fish were present in the area concerned, the marks returned to consolidate at 370 to 440m (200 to 240 fm) at about 0600.

During the second part of the voyage, fishing was concentrated in a very small area to the west of the Hebrides (i.e. from $57^{\circ}32'N$ x $09^{\circ}10'W$ to $57^{\circ}00'N$ x $09^{\circ}37'W$), where dense concentrations of blue whiting were found.

During the day, in this area, the marks appeared as a single layer about 18m (10 fm) in thickness, usually at a depth of about 370m (200 fm), but occasionally going as deep as 460m (250 fm) at mid-day. At no time were two layers of marks seen. The best catch achieved during daylight was 1000 baskets for a 30 minute tow. Typical sonar and Netsonde traces obtained during the day are shown in Figures 11 and 12.

At night the blue whiting ascended to about 260 to 290m (140 to 160 fm), and the layer of marks expanded in thickness to about 90m (50 fm). At no time did the marks completely disperse during the night, and for the most part were very much in evidence. The best catch achieved during the night was 400 baskets for a 1 hour 25 minute tow, carried out between 21.55 and 23.20. Typical sonar and Netsonde traces obtained during the night are shown in Figures 13 and 14.

7.2. Method of Capture

After location of the fish as described in 7.1., the pelagic trawl was shot and towed above a contour. In the northern area during the first 11 days of fishing the blue whiting were found to be quite lively and on several occasions were seen on the Netsonde to dive below the net.

In the southern area during the last 20 days fishing, no difficulty was experienced in catching blue whiting. If the fish attempted to take avoiding action, this was not apparent on the Netsonde and was ineffective.

Throughout the voyage fishing was conducted with and against the tide and wind, with no appreciable differences in catch rates. On several occasions the weather conditions were not very satisfactory for pelagic fishing (winds of Force 6 and above) and during these periods it was normal to tow before the wind. This enabled greater control to be maintained over the vessel and gear during hauling.

7.3. Use of Fishing Gear

7.3.1. Gear Handling

During the early part of the voyage the ramp was well out of the water, and consequently it proved impossible to heave any bag of over approximately 500 baskets up the ramp. On three separate occasions the main gilson wire parted when trying to heave a large bag aboard. However, after about 200 tons of fish had been caught and the ramp had settled further into the water, larger catches were taken on board without any great difficulty. During the last 20 days of the voyage, when fishing was heavy, it was normal practice to try to limit each catch to 200-300 baskets so that handling was easier and the fish were not crushed when heaving aboard.

Turn-round of the Engel pelagic trawl was a task which took a minimum time of 1 hour 20 minutes with 915m (500 fm) of warp out and seven men on deck including the mate. Of course, the handling time was often greater for large catches or when gear problems were encountered. The use of a net drum would have resulted in faster handling times using fewer men, and also reduced much of the physical effort in handling the net.

The Engel 1600 x 20cm trawl was used for the first few tows of the voyage, but was then damaged due to bad weather and later repaired.

Engel 2000 x 20cm trawls were used for the remainder of the voyage without any problem in attaining sufficient towing speed (up to four knots); the above comments on handling also apply to this trawl size.

The first Engel 2000 x 20cm trawl was split by a pinnacle soon afterwards, and the second 2000 x 20cm trawl was used for all of the productive fishing period, with very little damage. Trawl damage in general was very light by commercial standards.

7.3.2. Trawl Manoeuvring

Generally 20 lengths of warp (910m or 500 fm) were paid out for fishing at a depth of 370m (200 fm); i.e. a ratio of 2.5:1. With this ratio the Engel 2000 x 20 cm trawl could be towed at about 2 to 2.5 knots; higher speed made the trawl rise, while lower speed made it sink. Rapid manoeuvring of the net was very simple with the available propulsion power of 1860 kW (2500 hp).

Net mouth opening at 2.5 knots was found to be:-

1600 x 20 cm trawl

22m (12 fm) with 750 kg (1650 lb) weights per side

2000 x 20 cm trawl

25m (14 fm) with 1000 kg (2200 lb) weights per side

7.4. Use of Fish Finding Equipment

7.4.1 Sounders

The Kelvin Hughes MS44 sounder gave satisfactory performance in detecting blue whiting, but suffered from the obvious limitation in

searching for pelagic fish, that its depth display at any particular range setting is limited. It was therefore used in combination with the sonar (see below), the range setting of the MS44 being selected by reference to the sonar. A typical MS44 trace obtained during the day is shown in Figure 15.

As on the ST. BENEDICT the most effective tool in fish finding was the Elac Super Lodar sonar with the transducer set vertically. This equipment gave excellent definition of the blue whiting layer, when present, at any depth encountered. With the sonar set to the 'search' mode, and the transducer at any appreciable angle above vertical, blue whiting were never visible either on the trace or on the oscilloscope.

7.4.2 Netsonde

This equipment consisted of:-

Elac LAZ 71 fishfinder display unit

One Elac NES3 transducer

Two Elac NES4 transducers

1800m (1000 fm) of cable

Elac electric self-tensioning winch

The Elac NES4 transducer, with upward and downward-looking transducer heads, was used throughout the voyage and performed well. Headline, fish and footrope definition was excellent. However, problems were encountered with the transducer cable resulting in loss of signal to the display unit on several occasions. The original cable appeared to have deteriorated and was easily fractured, especially during rough weather. The first 915m (500 fm) of cable was eventually renewed and few problems were encountered thereafter.

7.5. Catch (Refer to Tables 1 and 2)

During the first 11 days of fishing catches of blue whiting were low. This was partly because of rough weather but mainly due to the absence of fish in the areas searched. During this first period 22 tows were completed in a total fishing time of 47 hours 50 minutes (i.e. from 'all square' to 'knock out') for an estimated total of 443.5 baskets. This gave a mean catch rate of less than 10 baskets per hour.

During the last 20 days of the trip catches were much higher. During this latter period 63 tows were completed in a total fishing time of 31 hours and 12 minutes for an estimated total of 17,380 baskets. This gave a mean catch rate of 557 baskets per hour.

At times the fish marks were so dense that the length of time the net was towed through them was limited to three or four minutes. This yielded sufficient fish to process (fillet or freeze whole) in grade 1 condition. The aim during this period, therefore, was to limit the towing time to take on board between 200 and 300 baskets per haul.

However, this aim was not always achieved and there were times when unmanageably high catches were obtained. On these occasions it was found impossible to haul the cod-end aboard and the net had to be cut as shown in Figure 3 to release a quantity of fish before the bag could be hauled up the ramp.

Overall, 85 tows were carried out in a total fishing time of 79 hours 2 minutes for an estimated total of 17,823 baskets. This gave a mean catch rate for the whole voyage of 225 baskets per hour.

The total weight of fish landed was 399.71 tonnes, graded as follows (for explanation of grades see paragraph 7.6.4.):-

Grade 1 (blocks)	322.84 tonnes
Grade 3 (blocks)	58.57 tonnes
Commercial Nobbed (blocks)	.68 tonnes
Cages Loose Fish	11.95 tonnes
Torry Samples	5.67 tonnes

Nearly all of the catch was of blue whiting but during the first part of the voyage some greater silver smelt were taken.

7.6. Processing

7.6.1 Factory Layout (Refer to Figure 16)

The equipment installed in the gutting space was hired from Boyd Line Ltd., Hull. The conveyors (2), (3), (6), (8) and (9), the Arenco machine (5), machine feeding hopper (4) and fillet hopper (7)

had previously been installed aboard the ARCTIC RAIDER for herring fishing. There were, therefore, few alterations needed to enable the equipment to be installed aboard the sister ship ARCTIC PRIVATEER.

The fish were dropped into pound (1) via a hydraulically-operated hatch on deck. Water jets at the back of the pounds made the bulk of the fish fluid enough to be regulated through a vertical sliding door to elevator (2). From this the fish could be diverted via a two-way gate to the Torry roller grader (13) or onto athwartships conveyor (3). From the latter they were either directed to Arenco machine hopper (4) or onto conveyor (8) and so to conveyor (9), where they were dropped onto conveyor (10) and fed to the 20-station vertical plate freezers (11), or directed to an offal screw conveyor (16) and dumped overboard.

The fillets from Arenco machine (5) were flumed down a chute to elevator (6) and up into hopper (7). The offal from the machine was flumed into chute (15) and pumped overboard. From hopper (7) the fillets were boxed and pushed through a slot in the bulkhead onto the frozen block conveyor and so on to the plate freezers (11).

The frozen blocks or boxes of fillets were discharged from freezers (11) onto a belt conveyor at deck level, under fish conveyor (10) and transported to a chute in hatch (12), then slid down into the cold store. A chute in the cold store directed the frozen blocks to the required part of the store.

7.6.2 Grading

As shown in Figure 16, a roller type grader was installed for the voyage. Various versions of the roller grader have been built at Torry for both round and flat fish. The version built for blue whiting has four rollers, intended to give sufficient throughput to meet factory and freezing demands on board the ARCTIC PRIVATEER. Unfortunately there was no opportunity to carry out full-scale trials on this grader before the voyage, and problems with the feed and distribution to the rollers were anticipated. This has been a source of trouble with this type of

grader in the past and another method employing a conveyor to distribute the fish onto the rollers was tried but without success. For the main part of the voyage the grader had to be by-passed. Fortunately the fish caught were nearly all over the grade 1 length requirement and only a small permissible quantity of small fish were frozen in any grade 1 block.

7.6.3 Filleting and Nobbing

The Arenco CIS/CIF machine is designed for filleting and/or nobbing herring, pilchard and medium-sized mackerel. Trials on filleting and belly cleaning blue whiting are being carried out by Arenco but no claim has been made to date that the machine can handle these fish efficiently. It was intended that, if possible, 50 tons of fillets would be produced on the voyage, together with a small quantity of nobbed and belly cleaned fish.

The F.60 fish feed pockets were removed from the CIS machine in the WFA Industrial Development workshop before the voyage and F.90 pockets were fitted instead. A special attachment was purchased from Arenco to convert the CIF filleting part of the machine for belly cleaning the nobbed fish. This was brought over and fitted by an Arenco representative from Sweden. To do this conversion the filleting knives had to be removed. Nobbing and belly cleaning was tried with thawed-out blue whiting from the ST. BENEDICT voyage and produced encouraging results.

The machine was then converted back to filleting and again when tried with the thawed-out fish produced a satisfactory result. Various alterations had to be made to the settings when fresh fish were later put through the machine. The fillets produced were acceptable but care had to be taken to select the correct size of fish to feed to the machine. The F.90 pockets were too wide for most of the fish and there was a tendency at the gut extracting rollers after the heading knives to throw the fish off line. This resulted in fish being presented to the filleting stage in the wrong position, i.e. on their side instead of belly down. In Figure 17 three fillets on the left have been correctly positioned and the two on the right wrongly positioned. There were also many fillets with the black belly flap skin attached as can be seen in Figures 17 and 18.

Overall, the machine turned out an article of acceptable appearance. There was, however, a tendency for a small piece of bone to be left in the thick part of the fillet. Various adjustments were made to correct this, without success. An example of this fault can be seen in Figure 18 on the second fillet from the right; the piece of bone is shown up by the dotted line.

The main problem was that fish incorrectly positioned at the beginning of the filleting stage could be thrown out of the carrier belts and jam the machine. Occasionally the belts were even forced into the knives by an accumulation of jammed fish. This was the reason why only a small quantity of fillets was produced, as time was lost in clearing the machine of jammed fish. The crew feeding the machine did their best but were often confused by the fact that even though the fish were the required length some were of a thin cylindrical shape and apart from producing an inferior fillet, this shape of fish frequently became dis-orientated in the machine and jammed it.

The belly cleaning attachment was fitted during the latter part of the voyage. The same problems arose as with the filleting, but the design of the belly cleaning attachment made it even more difficult to clear jammed fish when nobbing than when filleting. For this reason only a small experimental quantity of nobbed and belly cleaned fish was produced. Approximately one ton of nobbed fish without belly cleaning was produced for commercial distribution. Figure 19 illustrates the best performance of the machine. The random sample shown compares one nobbed only fish with nobbed and belly cleaned fish.

As stated previously, when the machine was tried in dock with a few selected fish the result was encouraging. However when hundreds of fish are being fed in by four or five operators, one carelessly positioned or wrongly sized fish can be the cause of a jam resulting in many damaged fish or fillets. The number of times the machine jammed during the last year's herring voyage was few compared with the stoppages when machining blue whiting.

Modifications could possibly be made to the CIF/CIS to improve this situation. A more detailed report on the performance of the machine will be prepared by Torry in due course, followed by discussions with Arengo. It is important that some suitable machine be made available to process these fish at sea, as the appearance of the fillets that were produced were far superior to any cut from the thawed-out whole fish in the past.

7.6.4 Fish Quality and Labelling

Experimental work in recent years has shown that blue whiting has a tendency to go soft quickly. There are various conditions that contribute to rapid spoilage, the main ones being:-

- (1) The length of time the fish are towed after being caught.
- (2) The quantity of fish caught and the pressure exerted on the fish while hauling.
- (3) The temperature in the pounds.
- (4) The length of time the fish are laying in the pound before freezing.

The conditions during the voyage on the ARCTIC PRIVATEER were favourable in many respects. There was strict supervision of the fish at all stages, from catching until stowage of the frozen blocks in the ship's cold store.

It was intended to classify the fish into three grades. Table 3 shows the quantities, grades and total blocks frozen. They were labelled as follows:-

- Grade 1 : First quality and over 27cm (10.6 in)
Grade 2 : First quality and under 27 cm (10.6 in)
Grade 3 : All small fish under 22cm (8.6 in) and all fish that have softened or are of poor quality.

The fillets produced on the voyage were all from grade 1 quality fish.

The fish caught throughout the voyage were nearly all over 28cm (11 in) in length and consequently there were no grade 2 blocks processed. The quantity of fish caught was regulated to produce first quality blocks. If the fish had been in the pounds for three hours and longer a careful watch was kept on the quality thereafter, and if there was any sign of deterioration the blocks were labelled grade 3.

Most of the blocks frozen were classified as grade 1 quality and the reasons for this are as follows:-

- (1) During the main part of the voyage when the bulk of the catch was frozen, the fish marks were so dense that the towing time had to be limited. This resulted in a fresh and lively catch.
- (2) If too many fish were caught in any given haul a large quantity was dumped or, if frozen, was classified as grade 3. With large catches pressure exerted on the fish caused some damage when hauling.
- (3) The fish were sorted at various points along the line, although when freezing whole fish a small percentage of damaged fish did get through.
- (4) The temperatures encountered during the voyage were fortunately fairly low. It was only during the last eight days of fishing that the ambient temperature during the day reached 13°C.
- (5) Due to regulating the catch rate, the time the fish were in the pounds was reduced to give a permissible delay.

7.6.5 Block Dimensions and Weight

The whole fish were frozen in 20-station vertical plate freezers. Aluminium tee piece vertical dividers were used to make 100mm (4 in) thick x 500mm (20 in) x 500mm (20 in) blocks weighing approximately 25 kg (55 lb). During discussions between the WFA and commercial firms interested in buying the fish, the latter stated that they would prefer 50mm (2 in) thick blocks. Trials using longitudinal dividers to make 50mm blocks had previously been carried out by Torry without success. Similar dividers with various plastic dipped coatings were again tried during this voyage, but again proved to be unsuccessful for commercial operation. Block thickness therefore had to be maintained at 100mm.

The fillets were frozen in cardboard cartons 100mm (4 in) thick x 500mm (20 in) x 250mm (10 in), four boxes to a freezer plate.

7.6.6 Cold Storage

Due to the fact that the vessel had been laid up for an extended period it took approximately six days to reduce the cold store temperature to -25°C . It was not possible during the fishing period to reduce the temperature to below -27.5°C . It was only after the store was full and battened down that the temperature dropped to -30°C . The hold compressor was run continuously throughout the period the vessel was in dock awaiting discharge.

7.7. Catch Composition

Samples for biological examination were taken from 40 of the hauls made during the voyage; of these seven were taken in the area around 60°N , 07°W and the remainder from the area to the west of Barra (approximately $57^{\circ}15'\text{N}$, $09^{\circ}15'\text{W}$). A basket of fish (200 - 300 fish) was measured from all hauls sampled and from some of these hauls selected fish were examined to determine sex, maturation stage, and age.

The fish caught ranged in length from 17 to 45cm (6.69 to 17.72 in), and in age from 2 - 14 years. The length distribution of the fish measured was unimodal, the mode occurring at 31 cm (12.20 in) (Figure 20). The mean lengths of fish from the different hauls varied between 29 and 33cm (11.42 and 12.99 in) with the exception of one haul in which only two baskets were caught and the sample may not have been representative). The mean length of fish taken in the first few hauls to the west of Barra was higher than in later hauls in that area. This could be related to changes in the proportions of the sexes in the catch. The ratio of males to females changed from more than 1:4 in the first few hauls to 1:1 in the later hauls. Since females attain a greater length at age than males (Figure 20) and the females contained a greater proportion of older fish (Figure 21) the mean length of the fish in the first hauls was somewhat greater. The 1968 year class (7 years old) was the most abundant one in the catches of both male and female blue whiting.

The proportion of immature fish in the catches was very low (less than 5%). The fish caught in March in the more northerly area were mostly in a prespawning condition (less than 1% spent). In April, to the west of Barra, the fish were predominantly spent (more than 80%) while the remainder were prespawning with relatively few fish in spawning condition.

The shoals had a tendency to disperse in the late evening. This is reflected in the low average catch rate of 850 baskets per hour in the period 1800 - 2400 GMT, compared to the morning period (0600 - 1200 hours) when catch rates averaged 1760 baskets per hour. The change in catch rate with time of day is shown in Figure 22.

8. DISCUSSION

During the voyage on the ST. BENEDICT in March-April, 1974 the quantity of blue whiting caught was 67 tons in 17 days, which was much less than envisaged. This was partly due to curtailment of the voyage, and partly due to scarcity of fish in the areas tried up to the time of termination. The quantity of blue whiting caught by the ARCTIC PRIVATEER on this voyage was approximately 400 tons. This was accomplished in 41 days and the vessel was able to return home full earlier than expected.

The area searched during the first 11 days of fishing was the same as the previous year on the ST. BENEDICT, and catches were even lower. This was fully compensated for in the second half of the voyage when dense concentrations of blue whiting were found in the area west of the Hebrides.

The marks seen on the echo sounder and sonar during the first 11 days of fishing were generally similar to those observed on the ST. BENEDICT, i.e. two layers of marks, one at 180m (100 fm) and one at 370m (200 fm), and they always disappeared at night. During the last 20 days however, there was only a single layer of marks. This was dense during the day and did not disappear at night; in fact some very good catches were taken during the hours of darkness.

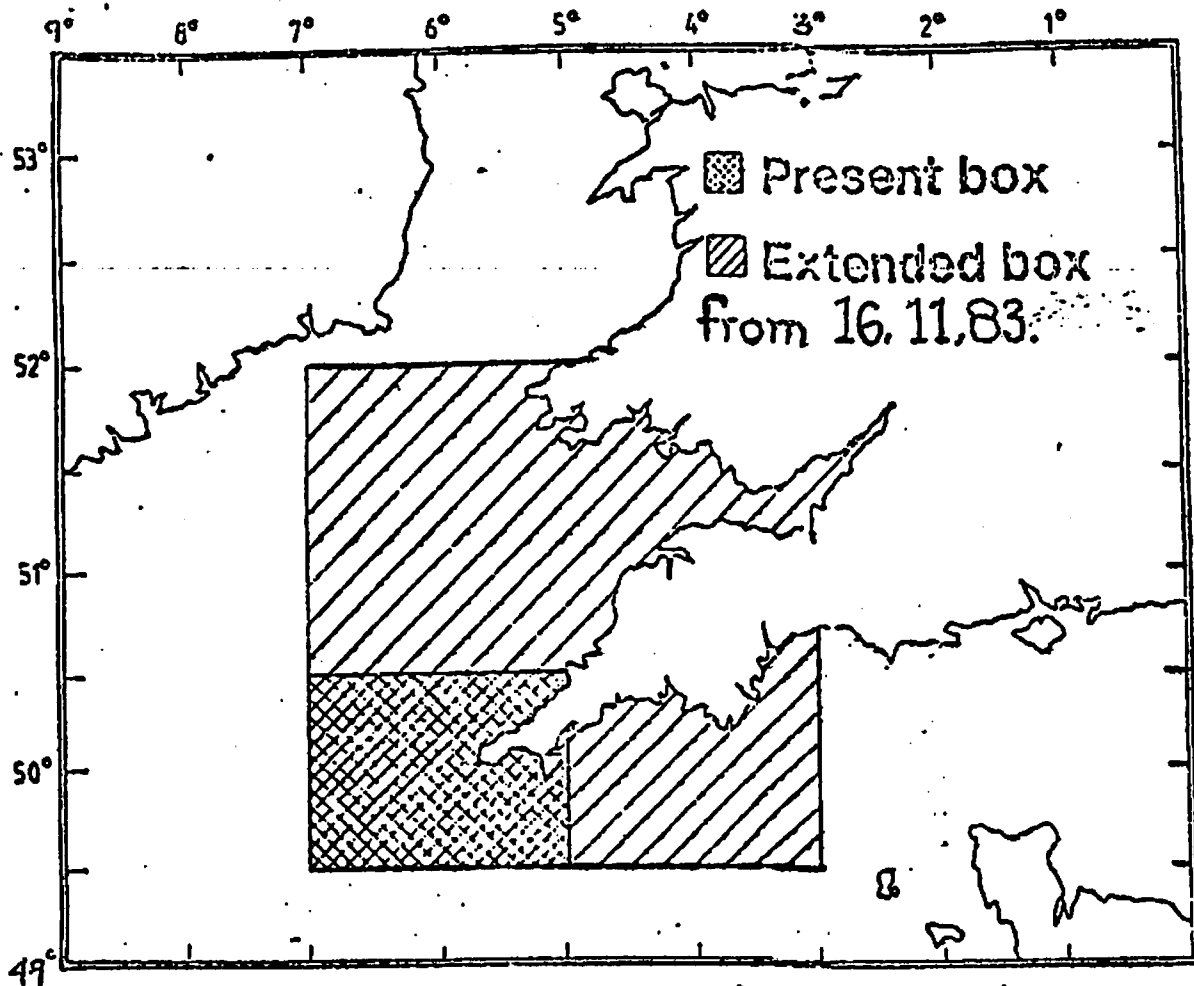
It was clear that, having once discovered the area of dense fish marks, there was no real difficulty in catching the fish. The ability of the fish to dive under the net (as reported from the previous ST. BENEDICT voyage, Reference 1) was not a problem, presumably because of the denseness of the shoal; fishing was frequently carried out near the bottom, which also appeared to help in this matter.

Although some gear handling problems were encountered during the early part of the voyage, this was generally satisfactory. However, it would have been facilitated had a net drum been available.

Perhaps the greatest problem encountered was in not being able to haul and process very large catches. During the second part of the trip it was possible to catch blue whiting in almost unlimited quantities, and consequently it was very frustrating having to limit the catches to suit the processing capability of the vessel.

9. CONCLUSIONS

Blue whiting were found in dense shoals on the edge of the continental shelf between latitudes $57^{\circ}00'N$ and $57^{\circ}40'N$ (Figure 8). The total catch of approximately 400 tons was achieved in 41 days and all the specified voyage objectives were met. However, the freezing 'bottleneck' was a serious disadvantage and this contributes to the conclusion that catching blue whiting by freezer trawlers as currently equipped for freezing whole fish at sea, is unlikely to be a commercial proposition.



S.W. ENGLAND. MACKEREL "BOX"
 IN WHICH. ONLY VESSELS USING BOTTOM.
 TRAWLS., DANISH SEINE-NETS. OR SIMILAR NETS
 TOWED ON THE BOTTOM, LINES, TRAMMEL NETS
 (OR SIMILAR) AND HAVING MESH SIZES
 OF AT LEAST 60 M.M. ARE ALLOWED TO
 FISH.

THIS ORDER VIRTUALLY. ELIMINATES
 PURSE SEINE NET - RING NET AND
 PELAGIC TRAWL NET FISHING IN THE
 S.W. MACKEREL FISHERY.

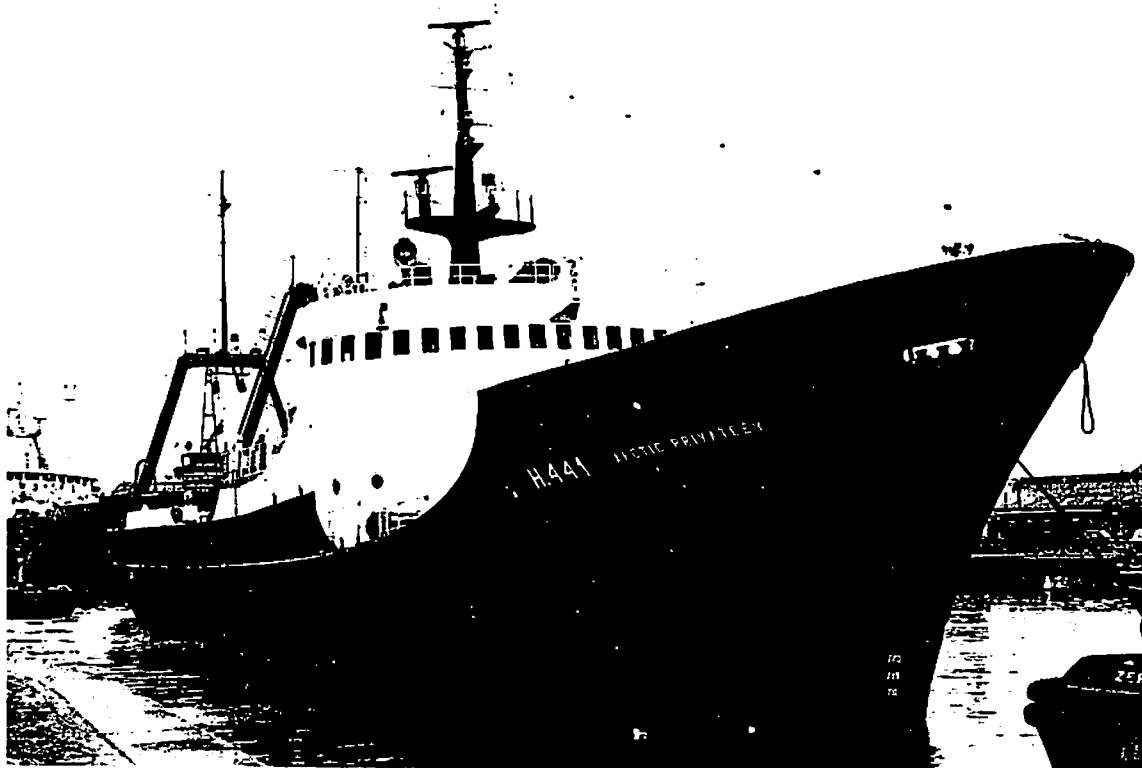


Figure 1. Arctic Privateer

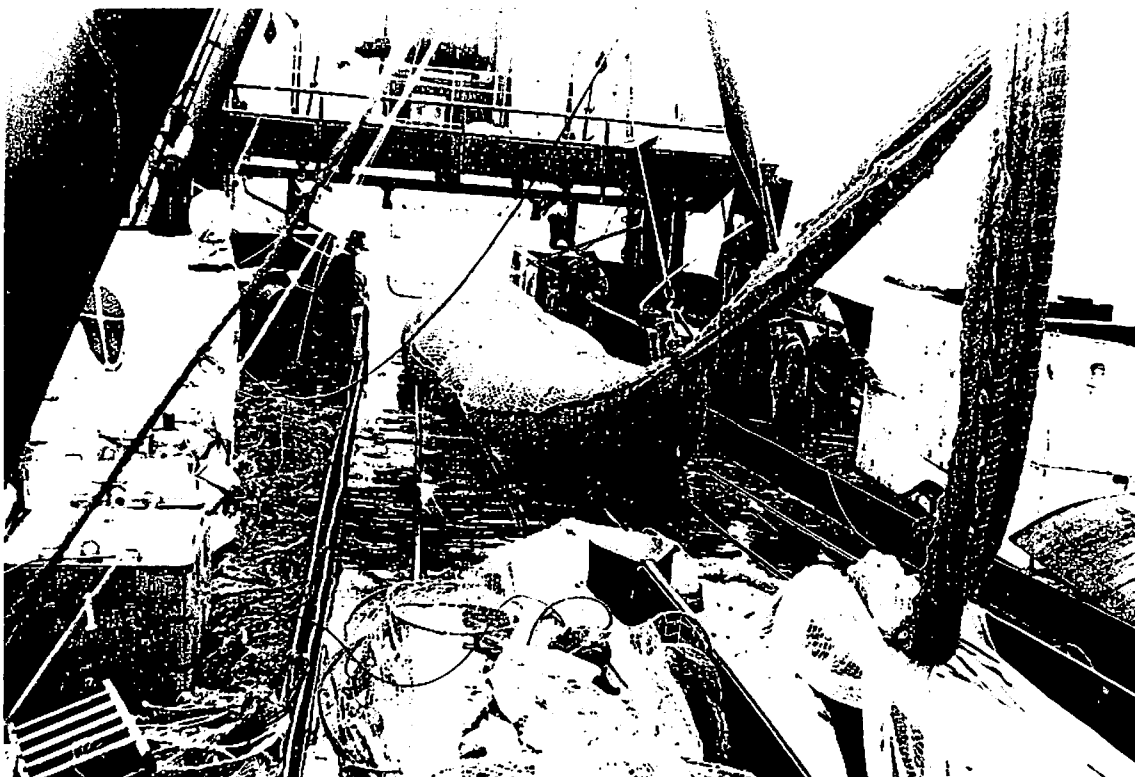


Figure 2. A haul of Blue Whiting is brought aboard

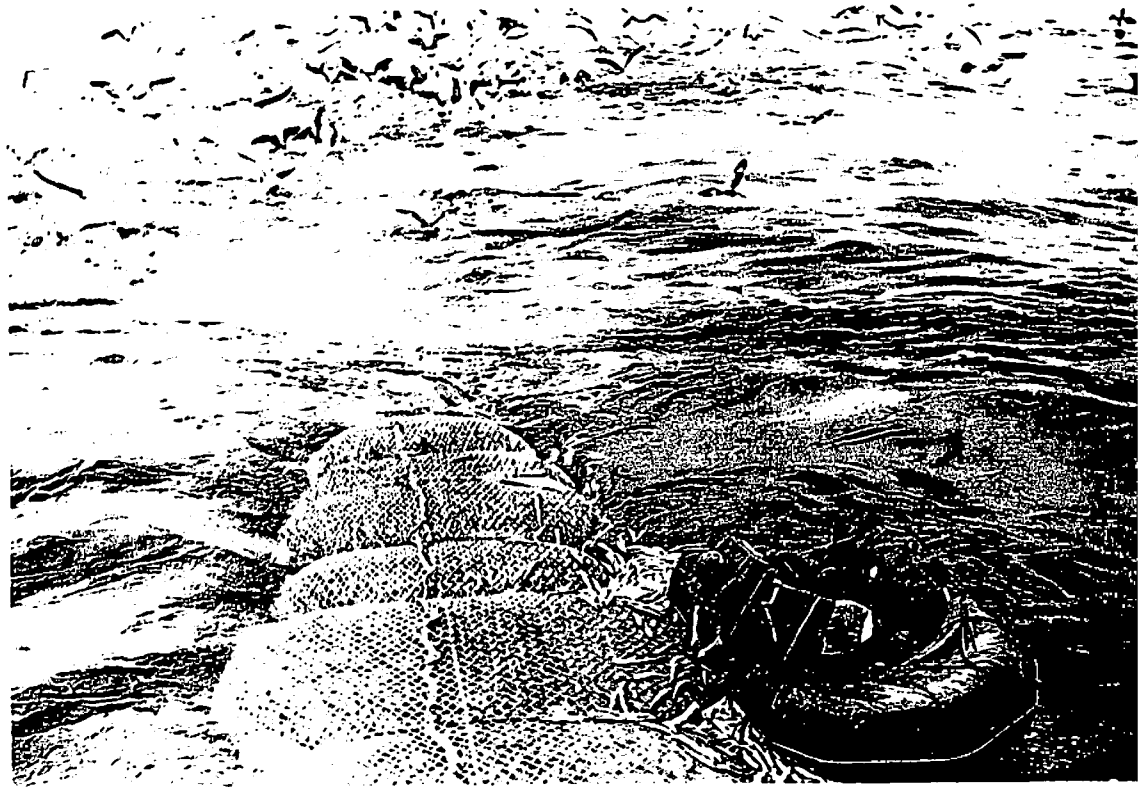


Figure 3. Part of a large catch of Blue Whiting being released

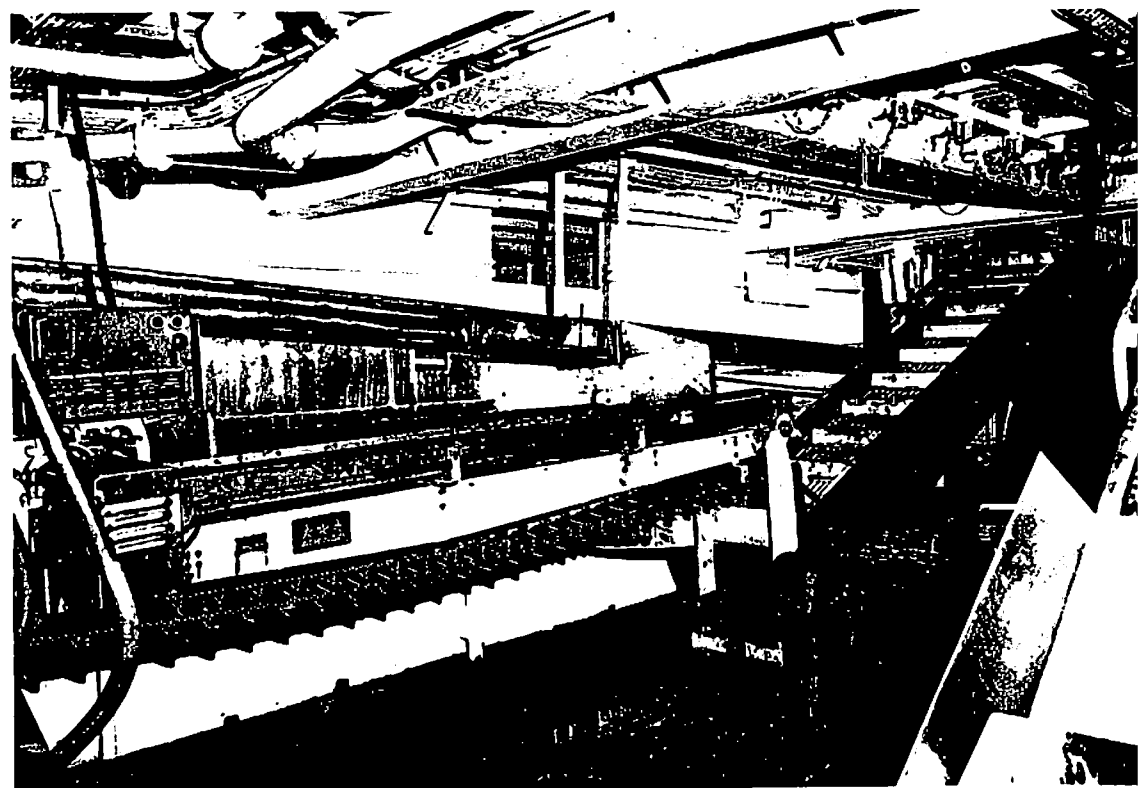


Figure 4. View of the Factory Deck

Figure 5. Engel 1600 x 20cm Pelagic Trawl

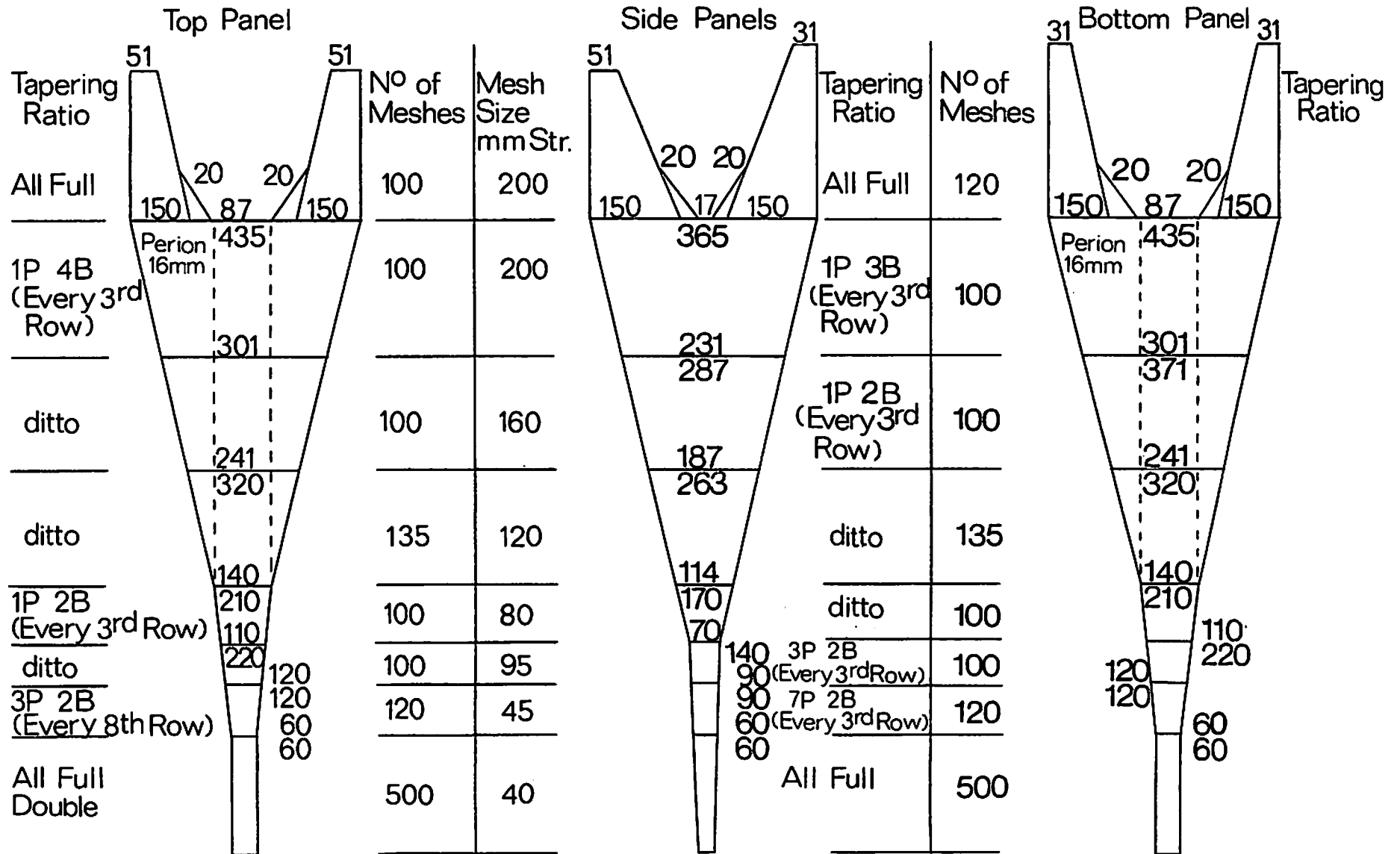


Figure 6. Engel 2000 x 20cm Pelagic Trawl

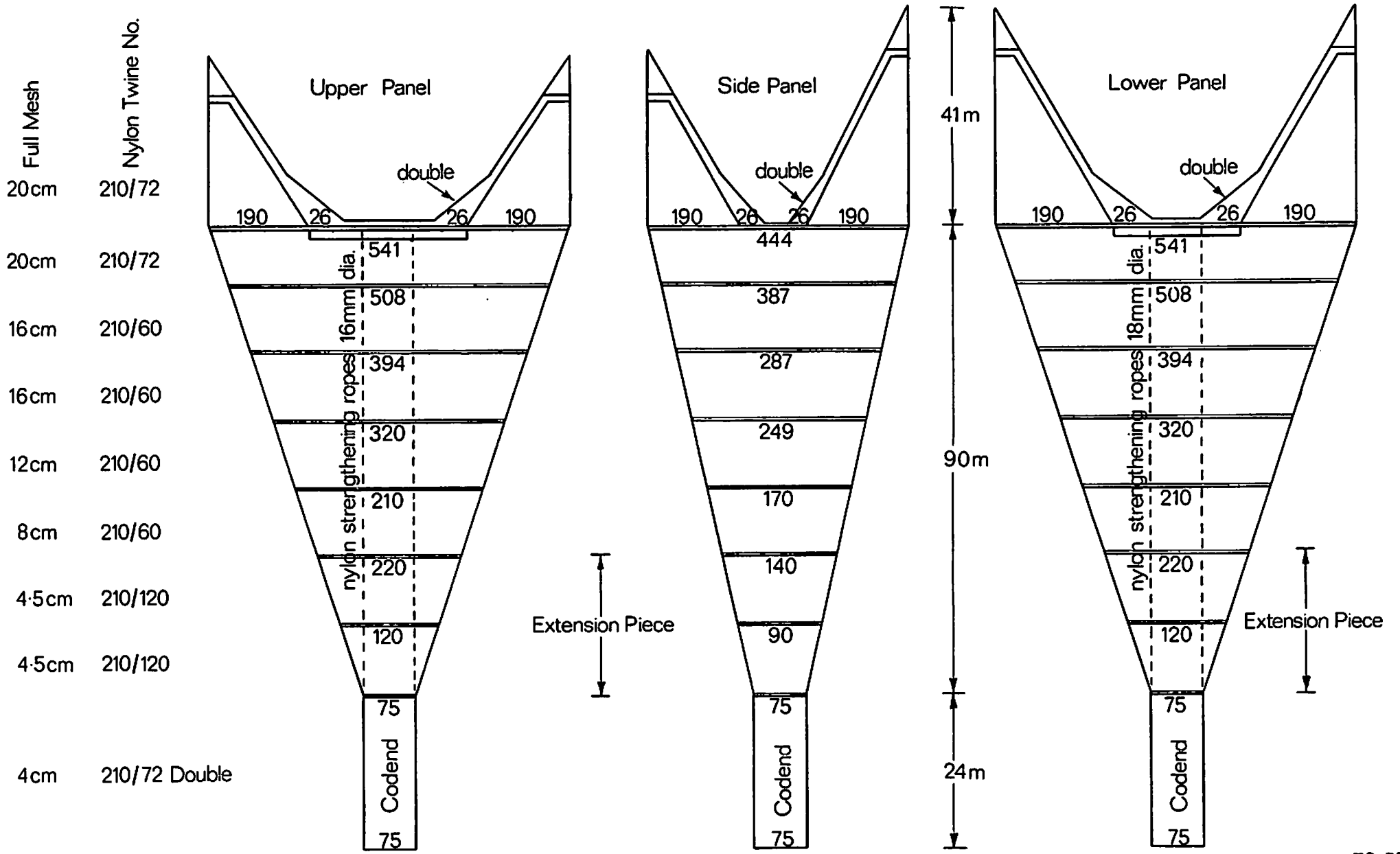
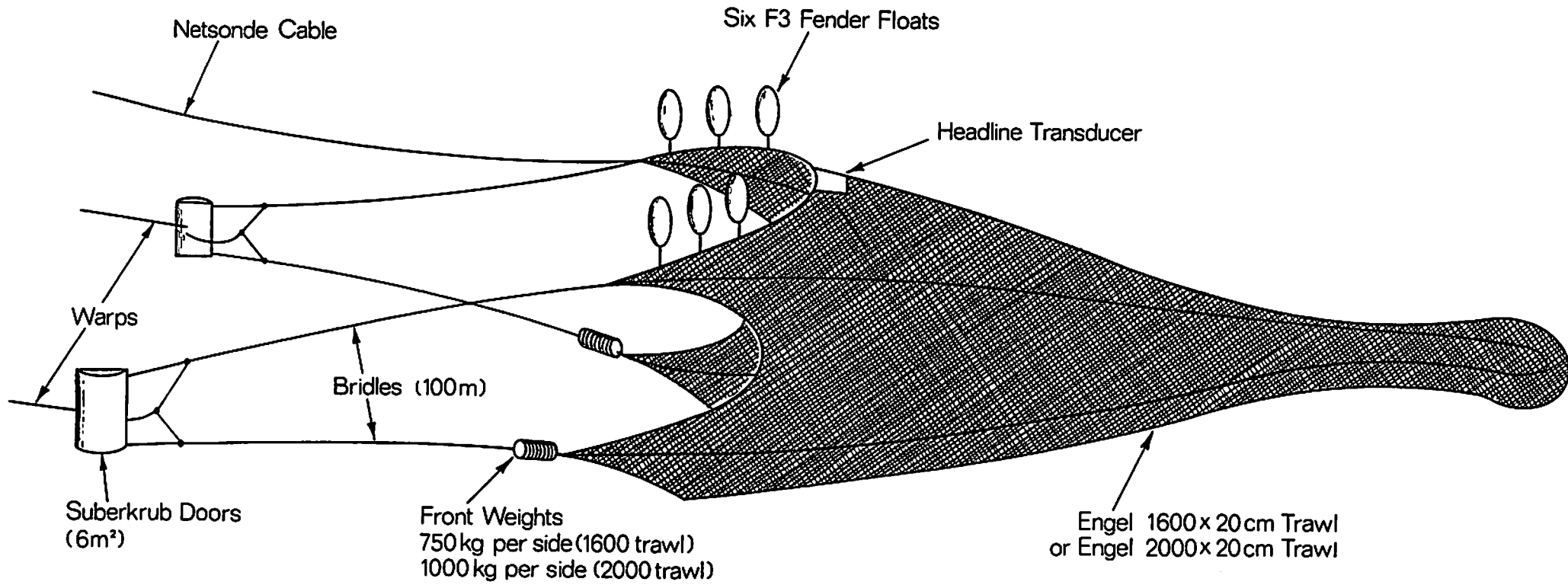


Figure 7. Trawl Rigging



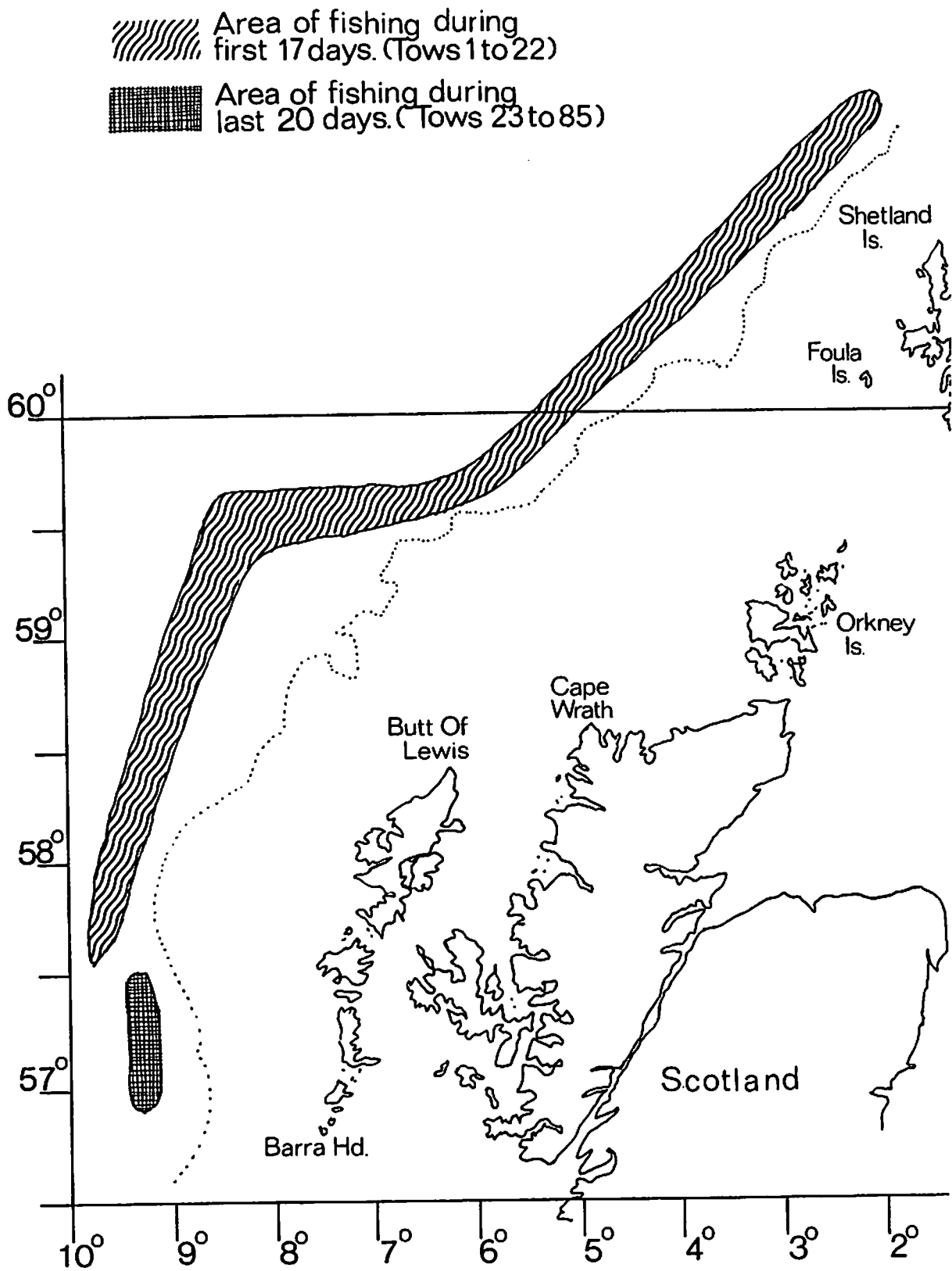


Figure 8. Location of Tows



Figure 9 Sonar Trace from First Part of Voyage - Daylight Tow



Figure 10 Netsonde Trace from First Part of Voyage - Daylight Tow

Ships Hull

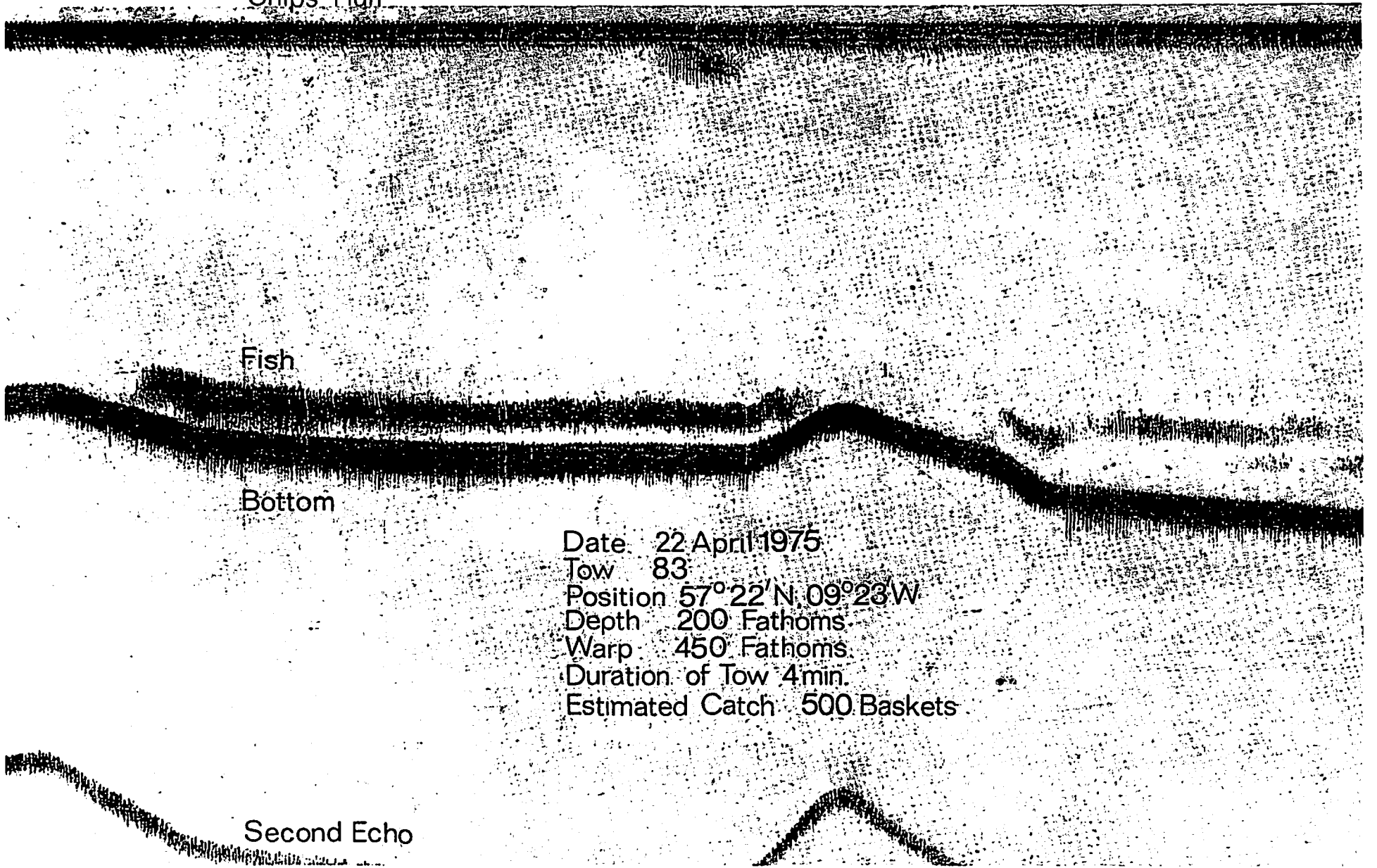
Fish

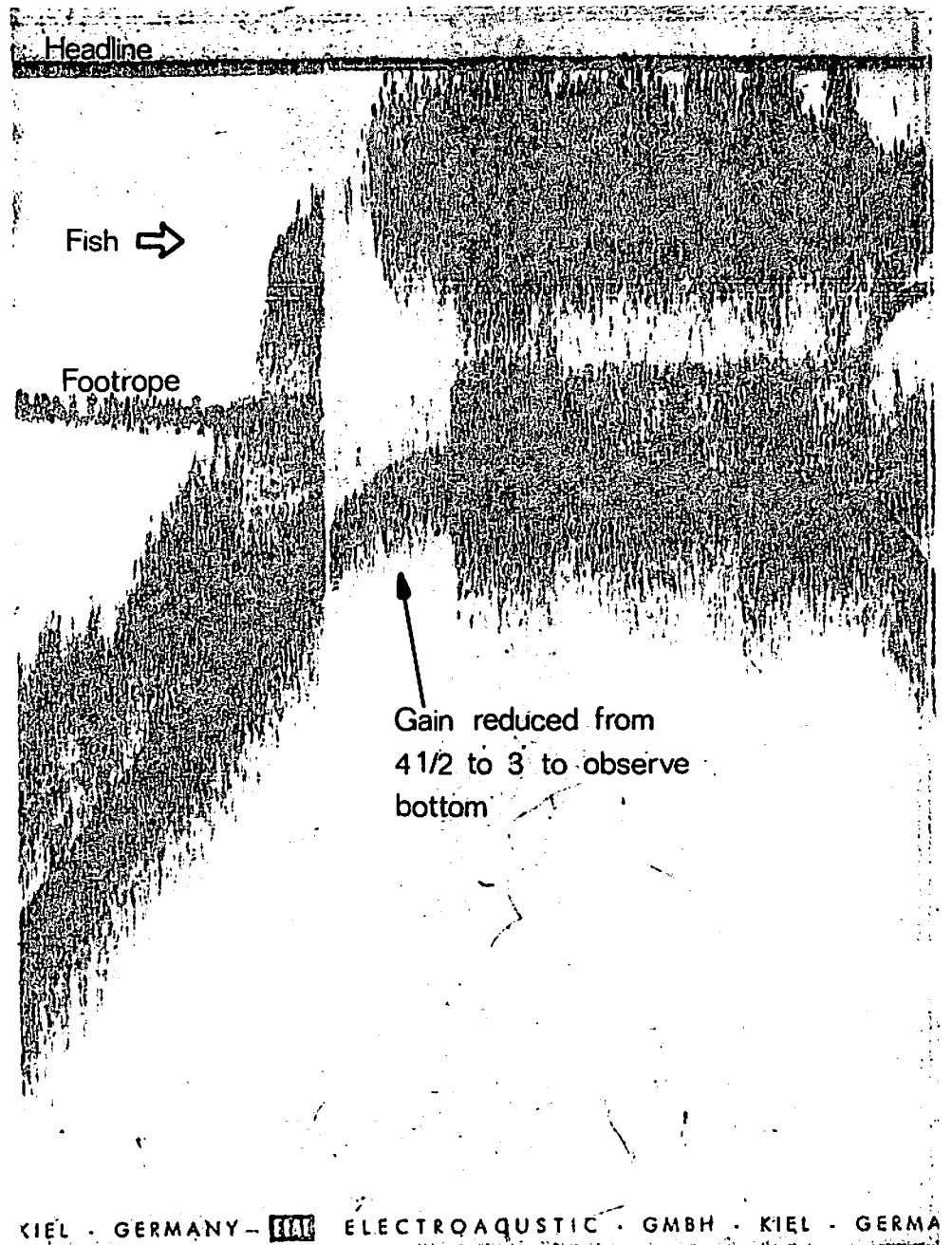
Bottom

Date: 22 April 1975
Tow 83
Position 57°22'N, 09°23'W
Depth 200 Fathoms
Warp 450 Fathoms
Duration of Tow 4 min.
Estimated Catch 500 Baskets

Second Echo

Figure 11 Sonar Trace from Second Part of Voyage - Daylight Tow





Date: 22 April 1975

Tow: 83

Position: 57° 22' N, 09° 23' W

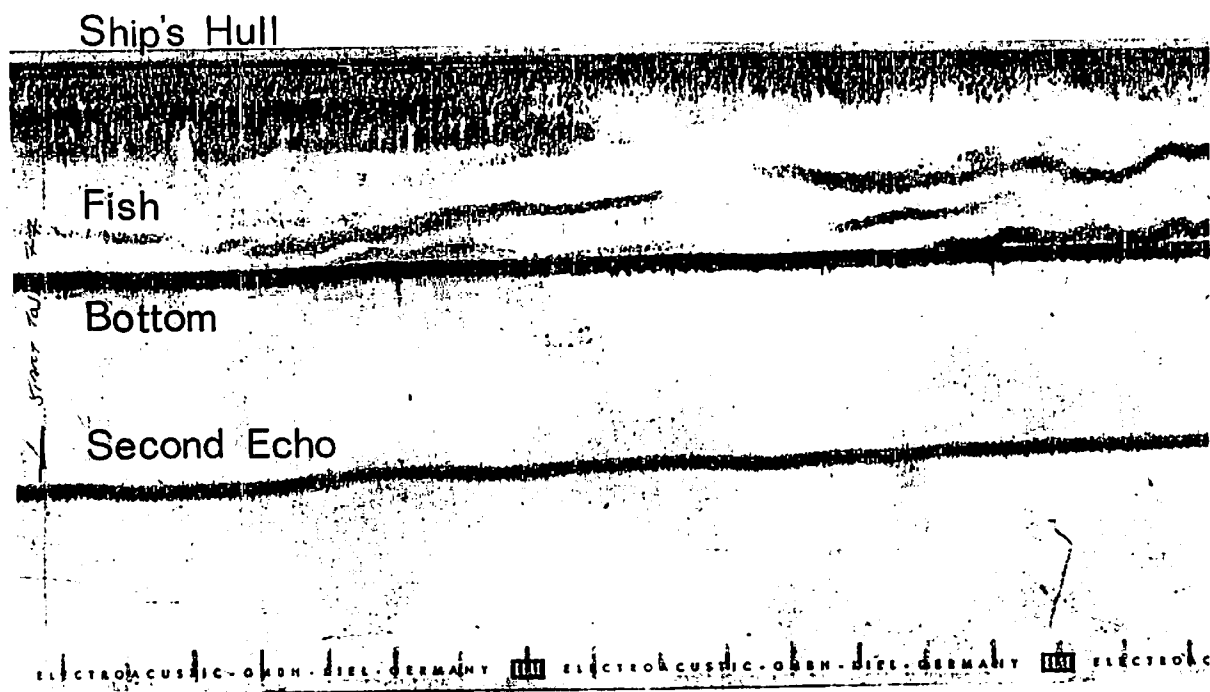
Depth: 200 Fathoms

Warp: 450 Fathoms

Duration: 4 min.

Estimated Catch: 500 Baskets

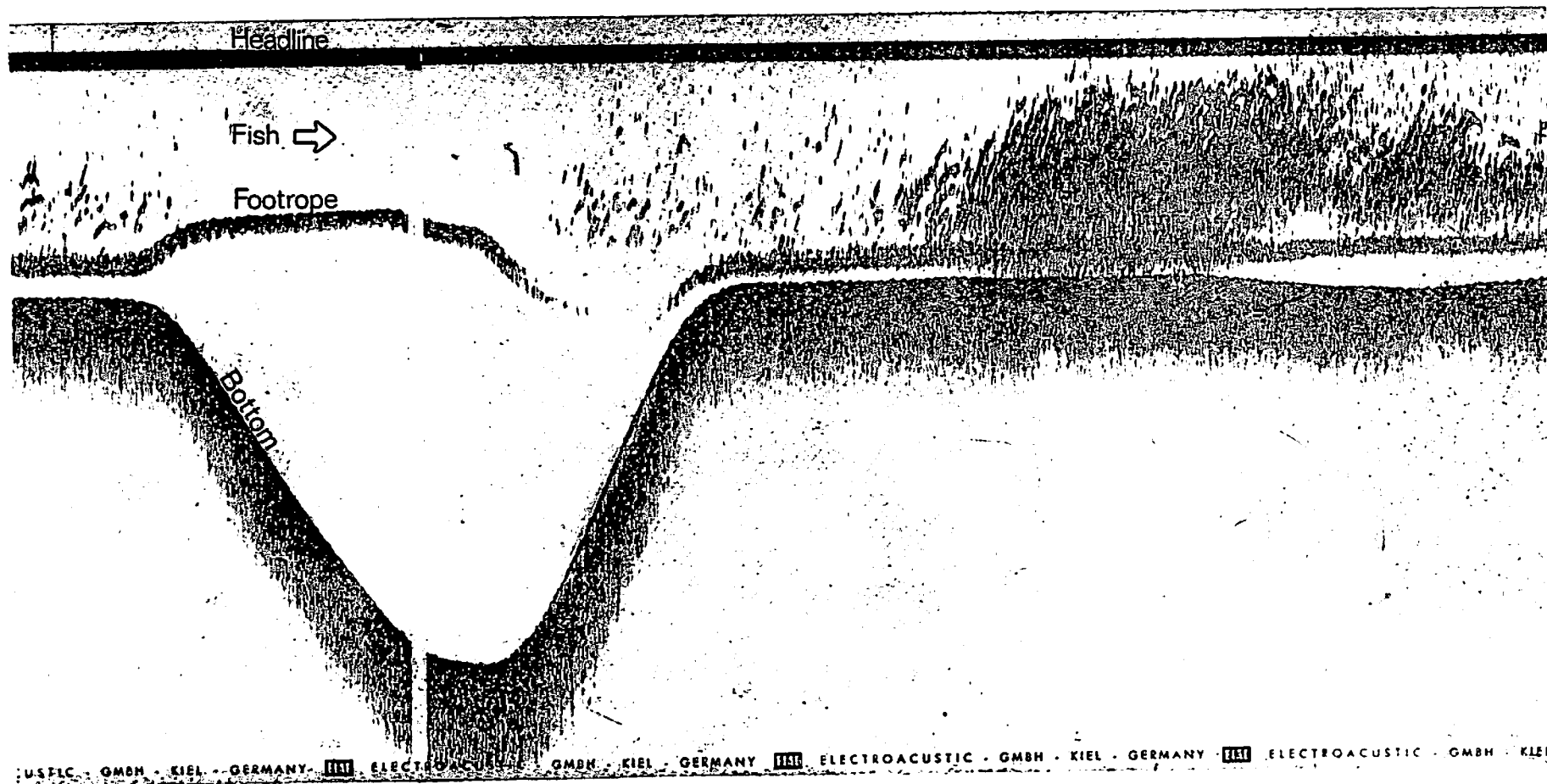
Figure 12 Netsonde Trace from Second Part of Voyage - Davlight Tow



Date 20 April 1975
 Tow 77
 Position $57^{\circ}32'N, 09^{\circ}23'W$
 Depth 180 Fathoms
 Warp 425 Fathoms
 Duration of Tow 1hr 25min.
 Estimated Catch 400 Baskets

Figure 13 Sonar Trace from Second Part of
 Voyage - Night Tow

Figure 14 Netsonde Trace from Second Part of Vavanya - Ninth Tow



Date: 20 April 1975
Tow: 77
Position: 57°32'N, 09°23'W

Warp: 425 Fathoms
Duration of Tow: 1 hour 25 min
Estimated Catch: 400 Baskets

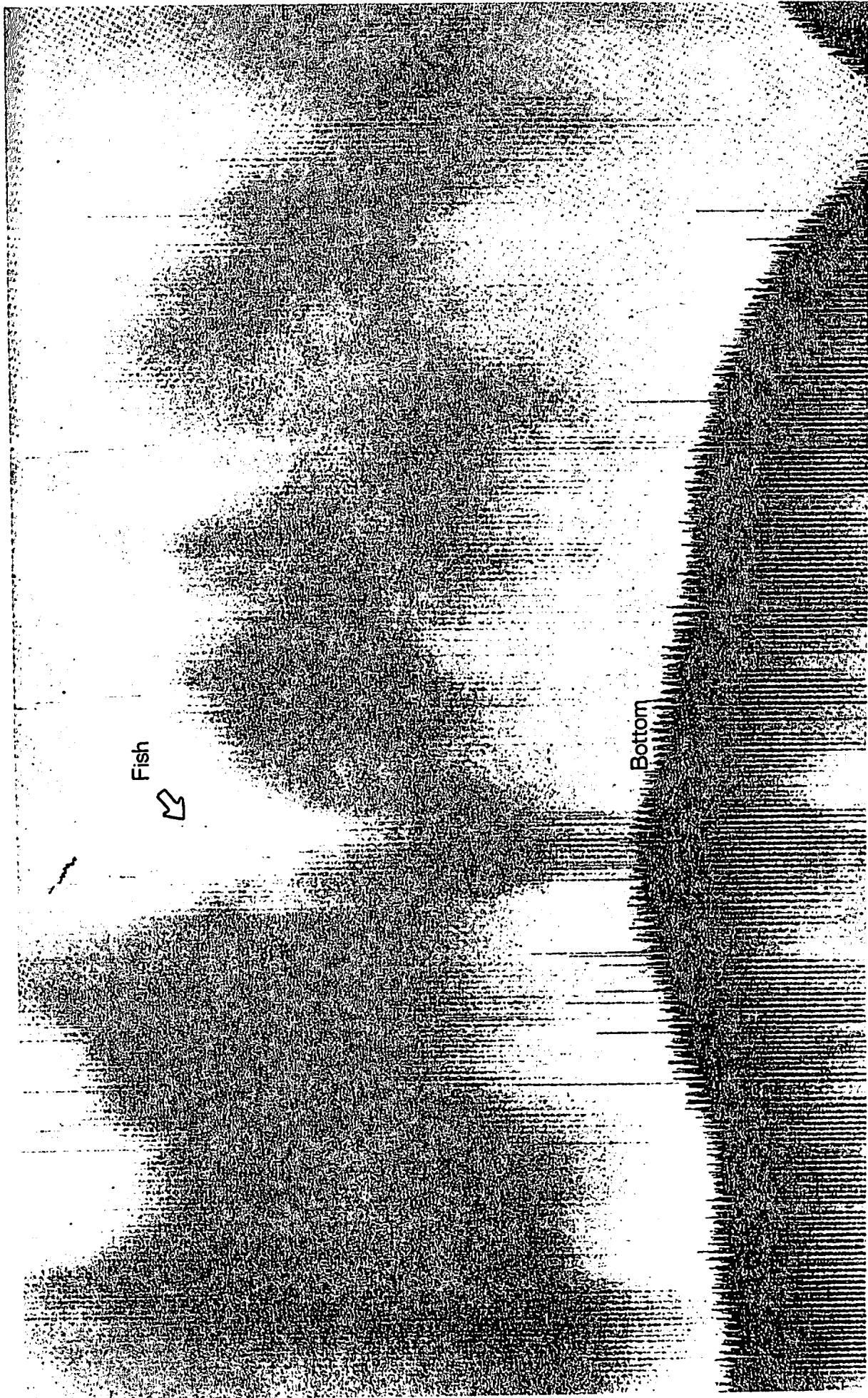
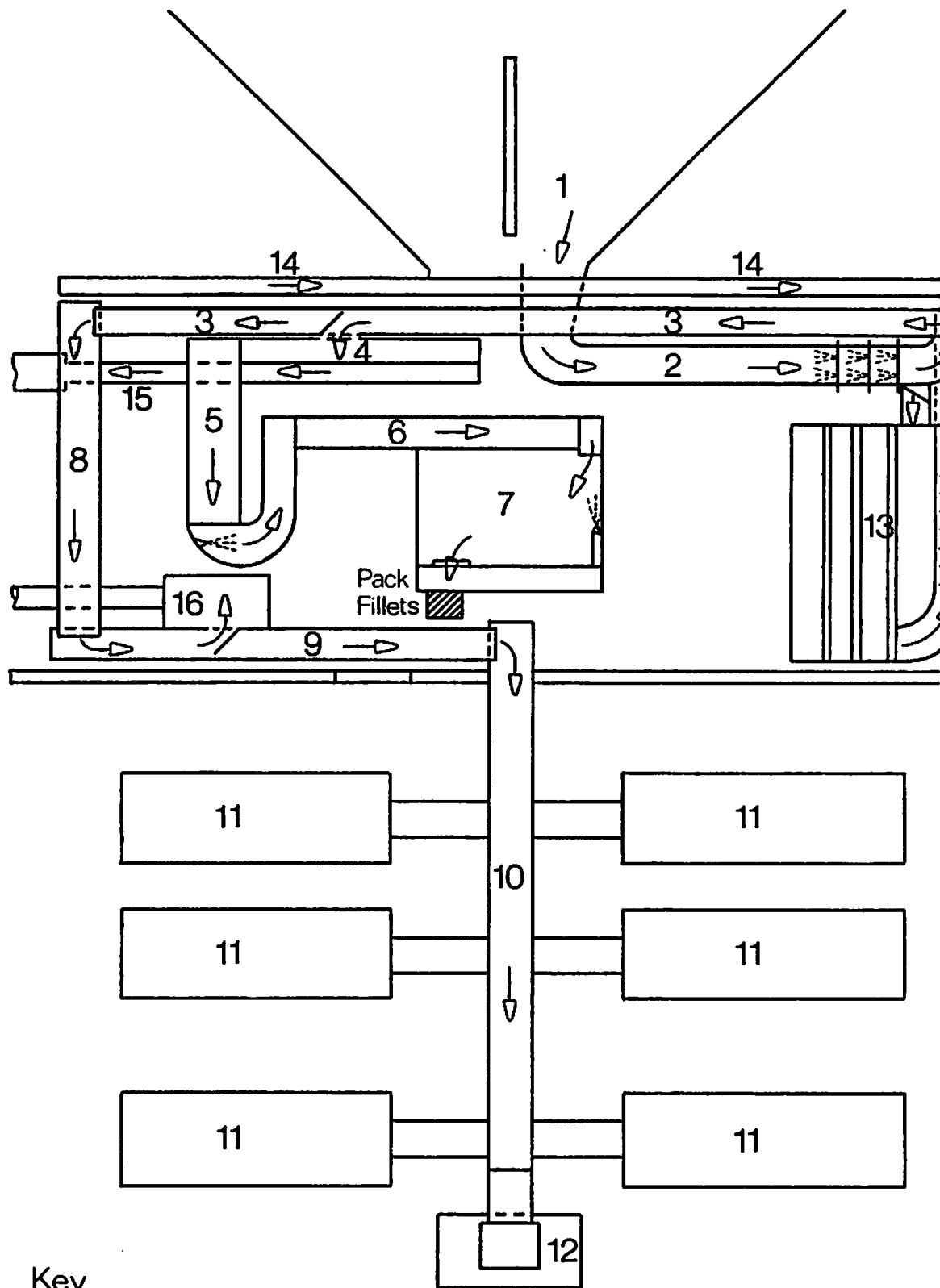


Figure 15 MS 44 Trace from Second Part of
Voyage - Daylight Tow



Key

- | | |
|--------------------------|----------------------------|
| 1 Fish Pound | 9 Conveyor |
| 2 Conveyor Elevator | 10 Conveyor |
| 3 Conveyor | 11 Vertical Plate Freezers |
| 4 Machine Feeding Hopper | 12 Cold Store Hatch |
| 5 Arenco Machine | 13 Torry Roller Grader |
| 6 Conveyor | 14 Offal Chute |
| 7 Fillet Hopper | 15 Chute |
| 8 Conveyor | 16 Offal Screw Conveyor |

Figure 16 Layout of Factory Deck

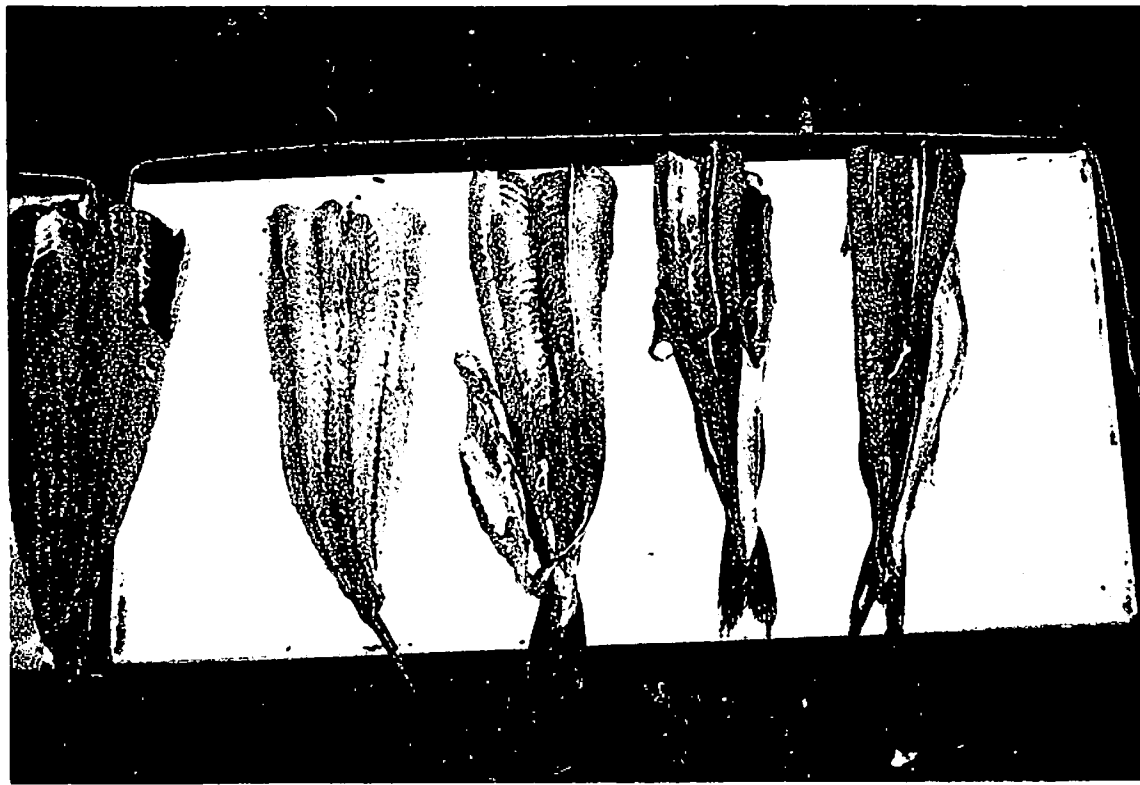


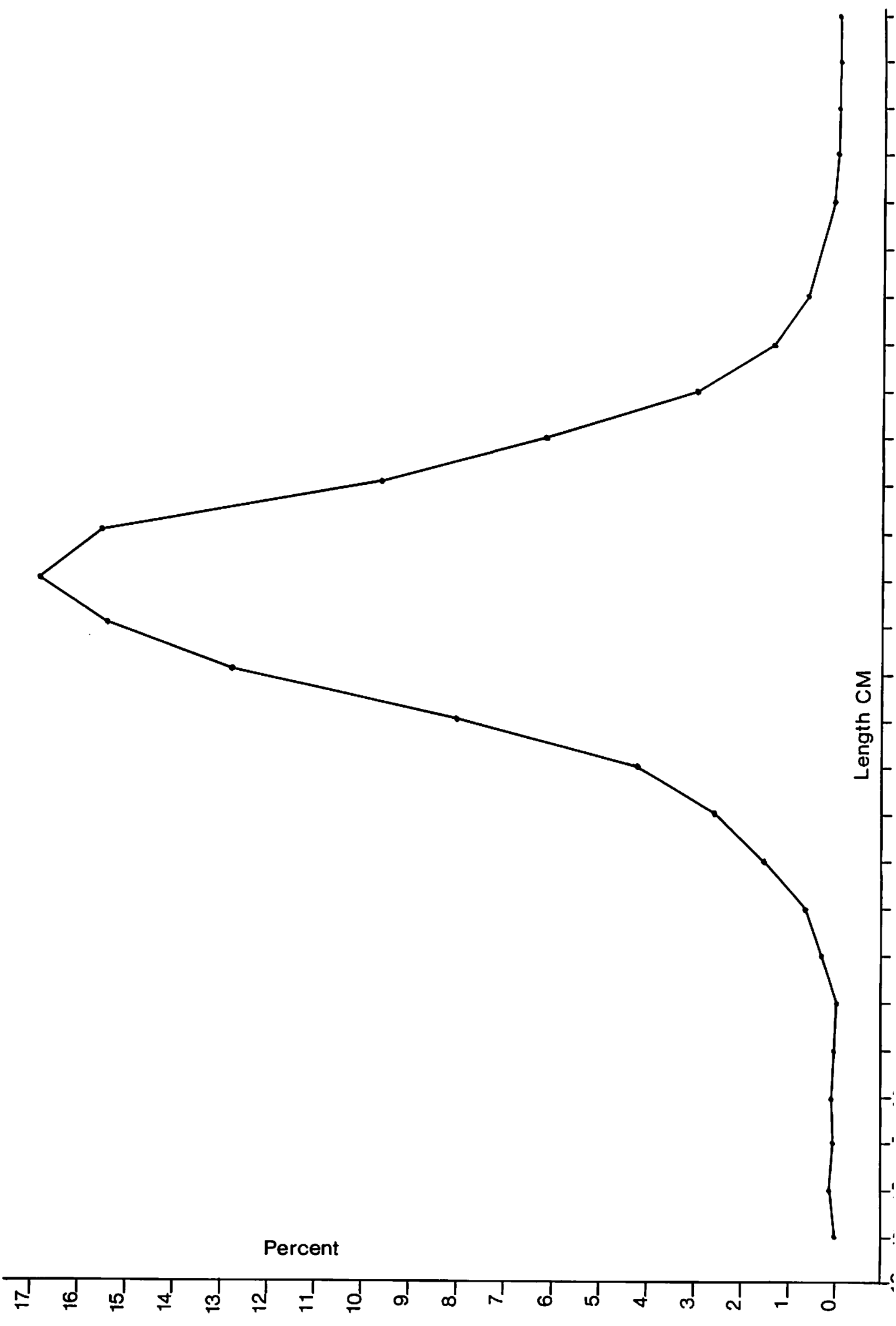
Figure 17 Machine-produced Fillets (1)



Figure 18 Machine-produced Fillets (2)



Figure 19 Nobbed and Belly Cleaned Fish



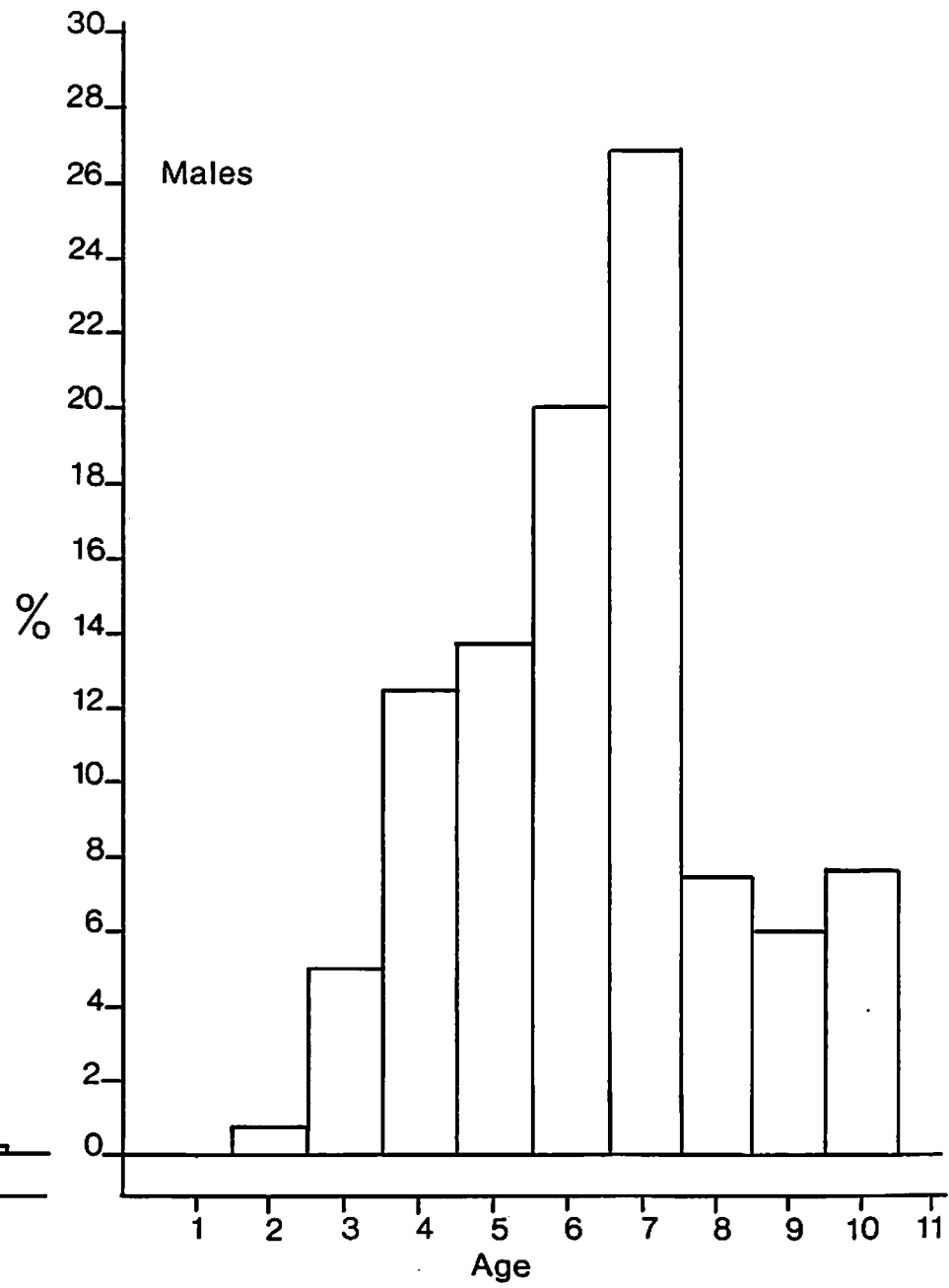
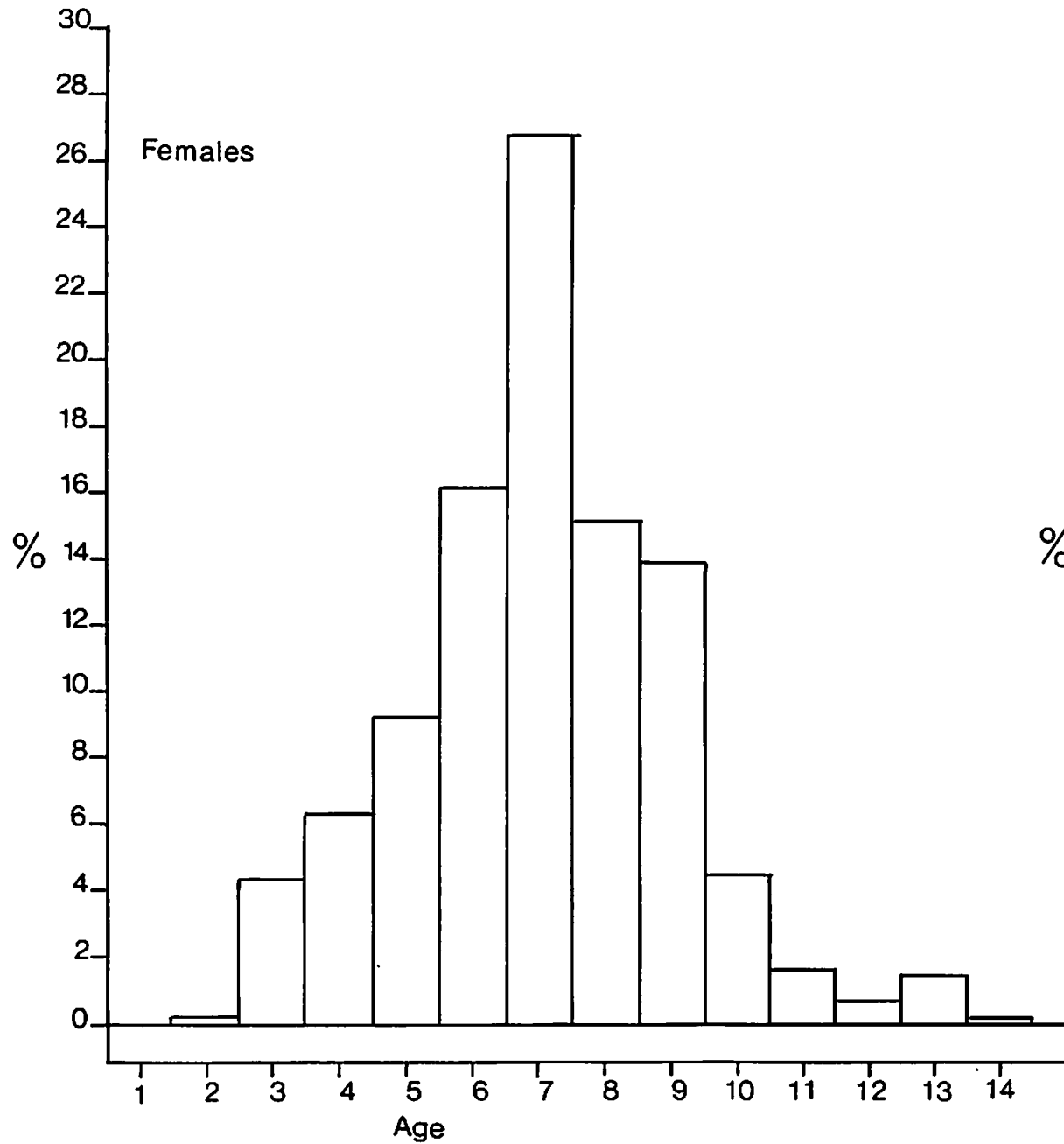
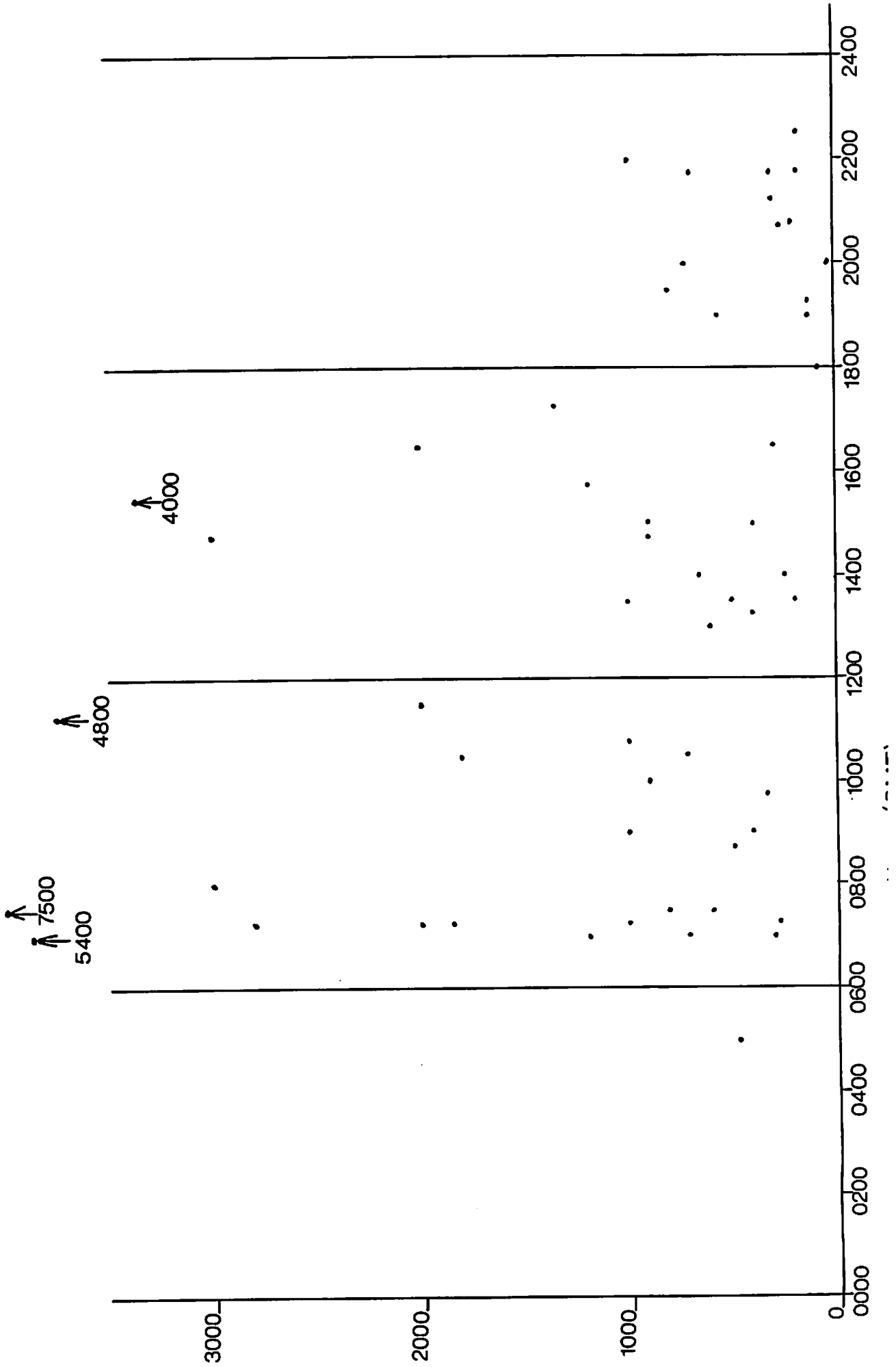


Figure 21 The Percentage Age Composition of Blue Whiting



Catch Rate (Baskets Hour)

Table 1 Trawling Log

(30 BASKETS TO TON APPROX.)

DATE	TOW	LAT. N	LONG. W	TRUE COURSE	WEATHER	DEPTH	FISHING DEPTH	WARD IN. FATHOM	TIME ALL SQUARE	TIME ANCHOR OUT	FISHING TIME	ESTIMATED BASKETS	BASKETS PER HOUR	N° OF BLDGS WHOLE FISH	N° OF BONES FILLETS	TYPE OF TRAWL	REMARKS		
17-3-75	1	60°-19'	07°-05'	200°	E 2-3	FATHOMS 615-640 280-300	FATHOMS 200-50	4-50	15:15	19:00	3-45	-	-	-	-	1600 20CM	SHAKE DOWN TOW TO FAMILIARISE THE CREW. ALL FLOATS BURST W/3 FENDER FLOATS LINED ON TRAWL		
18-3-75	2	60°-02'	06°-55'	090°	E 2-3	SHOALEDED 240	220-240	4-50	0715	0930	1-15	70-80	60	50	9	-	-	FOUL DOORS NET DAMAGED CHANGED OVER TO 2000	
18-3-75	3	60°-03'	06°-46'	260°	E 2-3	300	220-240	4-50	1135	1300	1-25	-	-	-	-	-	-	ADDED 200 KILOWT EACH SIDE 2 EXTRA CHAINS ON FOOTROPE	
18-3-75	4	60°-03'	06°-53'	290°	E 2-3	300	210-250	4-50	1655	1912	2-17	-	-	-	-	-	2000 20CM	GOOD MARKS FISH TIGHT ON BOTTOM	
19-3-75	5	60°-01'	06°-54'	270°	E 3-4	240-260	200-220	4-25	0730	08:58	1-28	50	35	20	25	-	-	ADDED 200 KILOWT PER SIDE FISH MIXED GRADE 3	
19-3-75	6	60°-02'	07°-00'	135°	E 3-4	230-260	220-230	4-25-490	1020	1330	3-10	60-70	30	0	90	-	-	VERY GOOD TRALE	
19-3-75	7	60°-03'	06°-50'	090°	E 3-4	240-260	130-220	4-50	1745	1930	1-45	30	17	20	0	-	-	ADDED 200 KILOW PER SIDE FISH MIXED GRADE 3	
						STEAMING TO STORINGWAY													DEPART STORINGWAY 22 APRIL AT 0600
23-3-75	8	60°-05'	07°-03'	090°+170	W/NW 6/7 OCC 8	180-280	170-240	500	0750	1235	4-45	14	3	11	0	-	-	ELAC CABLE DAMAGED GRADE 3	
23-3-75	9	60°-00'	06°-49'	275°	W/NW 6/7 OCC 8	200-240	200	475	1444	1520	0-36	2	4	0	1	-	-	ELAC CABLE DAMAGED LOST SIGNAL	
24-3-75	10	60°-09'	07°-25'	120°	N/WAN 6/7	300	200	525	0758	0825	0-27	1	2	0	0	-	-	ELAC CABLE DAMAGED LOST SIGNAL	
24-3-75	11	60°-07'	07°-17'	130°	N/WAN 6/7	280-300	240	525	1021	1130	1-05	80	70	40	32	-	-	PROBLEM WITH NETSONDE WINCH - PARTED SLIDSTONE	
24-3-75	12	60°-08'	07°-24'	ABORTIVE HULL		ELAC CABLE PARTED ON SHOOTING DAMAGED IN SEVERAL PLACES													
25-3-75	13	60°-15'	07°-25'	170°-210	NW 6	360-480	200-240	550	0735	0900	1-25	0	0	0	0	-	-	HERVED OFF 300 FATHOM CABLE TO CHECK	
25-3-75	14	60°-08'	07°-08'	310°	NW 6	280-420	230-240	450-475	1108	1323	2-15	25	10	0	34	-	-	NO FOOTROPE SIGNAL PARTED SLIDSTONE ON HULL	
25-3-75	15	60°-09'	07°-23'	145°	NW 6	240-300	200-230	525	1440	1830	3-50	70	20	13	34	-	-	GOOD MARKS ON SONAR NOTHING ON TRANSDUCER	
						WEATHER NORTHERLY FORCE 8/9 RUNNING SOUTHERLY ALONG CONTINENTAL SHELF LOOKING FOR MARKS													
27-3-75	16	58°-12'	09°-38'	190°	NORTHERLY 5	260-400	200-220	550	1205	1520	3-15	0	0	0	0	-	-	NET BADLY DAMAGED	
						REPORTS OF GOOD MARKS FROM EXPLORER SW 'ROSEMARY BANK' STEAMING TO 59°-00'N 8°-15'W													
28-3-75						LAID WITH WEATHER NW 10													
29-3-75																			
30-3-75	17	59°-52'	09°-10'	290°	NW 4-5	900+	210-230	500	0833	1112	2-39	0	0	0	0	-	-	2000 20CM	
31-3-75	18	60°-07'	07°-15'	130°	NW 2-3	260-340	220-240	450/500	0740	1100	3-20	1/2	0	0	0	-	-	FEW MARKS ON SONAR NOTHING IN TRANSDUCER	
31-3-75	19	60°-00'	06°-25'	130° 300	NW 3-4	280	220	400/500	315	1615	3-00	3	1	0	4	-	-	FEW MARKS	
1-4-75	20	59°-53'	05°-46'	060°	W 6	380/400	220-240	500	0735	1035	3-00	0	0	0	0	-	-	GOOD TRACES ON SONAR NOTHING ON NETSONDE	
1-4-75	21	60°-02'	05°-12'	060°	NW 4	220/300	220	450	1415	1705	2-50	18	6	12	0	-	-	SMALL FISH ALL GRADE 3	
1-4-75	22	58°-47'	07°-47'	060°	NORTHERLY 3-4	200	180-200	400	1017	1235	2-18	0	0	0	0	-	-	STEAMING SLY ALONG CONTINENTAL SHELF LOOKING FOR MARKS	
						FOUND MARKS IN POSITION 57°05' N 09°33' W MARKS ALL TIGHT ON BOTTOM NO LANTERN FISH AT 100 FATHOMS													
1-4-75	23	57°-05'	09°-33'	160°	NE 4-5	210-240	200-210	500	0845	0957	1-12	500	500	119	0	-	-	ESTIMATE 200 BASKETS LOST GRADE 1 FISH	
1-4-75	24	57°-11'	09°-33'	160°	NE 4	210-240	200-210	500	330	1500	1-30	300	200	118	0	-	-	COMPRESSOR TROUBLE ONLY 3 FREEZERS WORKING	
1-4-75	25	57°-11'	09°-34'			NET DAMAGED ON SHOOTING TENDING ALL NIGHT													
1-4-75	26	57°-15'	09°-33'	165°	NE 3/4	220-240	200-210	500	0710	0850	1-40	450	270		56	-	-	GOOD MARKS ON NETSONDE DURING LAST 15 MIN ONLY	

Table 1 Trawling Log (cont'd)

TIME	TOW	LAT N	LONG W	TRUE COURSE	WEATHER	DEPTH	FISHING DEPTH	WARP IN FATHOMS	TIME ELAPSED	TIME KNOWN	FISHING TIME	ESTIMATED BASKETS PER HOUR	BASKETS PER HOUR	% OF BASKETS WHOLE FISH	% OF BASKETS FILLETS	TYPE OF TRAWL	REMARKS	
4-75	27	57° 15'	09° 33'	170°	NE x 3	210-240	200-210	500	1330	1405	0-35	550	920	368		200 x 20 CM	RUBBER BOAT LAUNCH AND COD END CUT 30084	
4-75	28	57° 08'	09° 37'	180°	NE x 3	220-240	200-210	500	1535	1548	0-13	500	1100					
4-75	29	57° 15'	09° 32'	150-180°	NE x 4	220-240	200-210	500	0725	0755	0-20	400	800					
4-75	30	57° 13'	09° 30'	170°	NE x 3	220-240	200-220	500	334	1348	0-14	250	900	382	114	3		GRADE 1 / GRADE 3
4-75	31	57° 15'	09° 31'	165°	NE 2/3	210-220	200	500	1900	2000	1-00	200	200				TRACE DISPERSING DURING NIGHT	
4-75	32	57° 18'	09° 30'	180°	NW 3/4	200-220	210-200	500	0725	0815	0-40	400	600				FISH BEGINNING TO CONCENTRATE DURING T	
4-75	33	57° 16'	09° 25'	170°	WNW 4	200	?	500	1300	1345	0-15	70	-	353	140	28		ELAC PROBLEM GEN. NO. 4584 B1M HANDED E
4-75	34	57° 14'	09° 26'	160°	WNW 4	210-230	200-215	500	1500	1540	0-40	600	900				ELAC FAILED - NET ALLOWED TO SETTLE	
4-75	35	57° 14'	09° 30'	175°	NW 5	210-230	?	500	1910	1942	0-32	100	200					
4-75				No	FISHING			GALES										
4-75				No	FISHING			GALES										
4-75	36	57° 10'	09° 27'	340°	WNW 6	210-230	200-220	475	0945	0955	0-10	60	360				ELAC CABLE PART AFTER 5 MIN	
4-75	37	57° 18'	09° 27'	160°	W 4/5	210-230	190-200	500	1305	1322	0-17	170	600					
4-75	38	57° 18'	09° 28'	170°	NW 4/5	220-230	210	500	1623	1700	0-37	180	300	288		6		FISH MARKS DUR. LAST 20 MIN ONLY
4-75	39	57° 14'	09° 24'	170°	NW 3	180-220	190	500-425	1800	2035	2-35	200	80					
4-75	40	57° 08'	09° 12'	160°	SW 3	170-190	160-180	400	2145	2210	0-25	350	800					
4-75	41	57° 09'	09° 14'	160°	W 6	150-170	140-160	350	0715	0745	0-30	200	2000	287	292			COD END SPLIT 1 500 BASKETS LET C
4-75	42	57° 06'	09° 12'	160°	WNW 6	140-150	115-140	325	2208	2219	0-11	180	1000					
4-75	43	57° 09'	09° 20'	160°	WNW 4	200-210	200-170	450	0715	0719	0-4	350	5200					
4-75	44	57° 03'	09° 12'	150°	SW 4/5	240-250	220	500	1310	1323	0-13	250	1200	570	10			
4-75	45	57° 01'	09° 15'	290°	SW 5	200-215	190-205	450	1415	1456	0-11	150	800					
4-75				No	FISHING TODAY			AT OBAN										GRADE 1 / GRADE 3
3-4-75	46	57° 07'	09° 12'	345°	SW 4/5	200-190	190-180	400	0705	0720	0-15	180	720					ONLY 4 MIN ACT IN FISH MARK
3-4-75	47	57° 01'	09° 16'	320°	SW 4/5	200-185	190-180	400	1033	1048	0-15	180	720					VERY SPOTTY FISH MARKS
3-4-75	48	57° 01'	09° 22'	335°	SW 4	230	220	450	1409	1456	0-45	180	240	4891				
3-4-75	49	57° 07'	09° 12'	340°	SW 3/4	230-180	200-170	450	1904	2006	1-02	120	120					
3-4-75	50	57° 08'	09° 12'	160°	SW 5/6	160-150	150	300	2145	2245	1-00	180	180					NET SHOT AT 06 CLEAR FOUR RESHOT 083
4-4-75	51	57° 07'	09° 13'	330°	S 2/3	160-200	160-190	350-400	0900	0950	0-50	400+	500	440	0			
4-4-75	52	57° 06'	09° 17'	340°	S 2/3	245	235	500	1400	1413	0-13	150	700					
5-4-75	53	57° 00'	09° 08'	320°	VAR 1	180-200	160-190	400	0705	0714	0-09	200	1300					
5-4-75	54	57° 04'	09° 20'	160°	VAR 1	195-210	200	450	1025	1034	0-09	300	1900	380				FISH DURING LA FEW MINUTES ONLY
5-4-75	55	57° 08'	09° 12'	170°	VAR 1	220	190-200	500	1715	1735	0-20	450	1350	380	60			

Table 1 Trawling Log (cont'd)

DATE	TOW	LA-N	LONG.W	TRUE COURSE	WEATHER	DEPTH	FISHING DEPTH	WARP TO FATHOM	TIME ALL TIME	SOURCE	TIME FISHING	TIME KNOCK OUT	FISHING TIME	ESTIMATED BASKETS	BASKETS PER HOUR	N° OF BLOKS	N° OF BOWS	TYPE OF TROUL	REMARKS
15-4-75	56	57° 06'	09° 10'	350°	FAK1	130	350	2145	2155	0 12	60	300	2000	300	2000			2000	GEAR SHOT 0638 FEA (CABLE RIPPED KNOT 08)
16-4-75	57	57° 06'	09° 10'	440°	FAK1	200	450	1805	0813	0 08	400	3000	2000	400	3000				CABLE RIPPED KNOT 08
16-4-75	58	57° 04'	09° 5'	340°	VARI	210	500	1111	1114	0 03	250	5000	2000	250	5000				300 BASKETS DUMPED FROM RAMP
16-4-75	59	57° 12'	09° 12'	170°	53	230	500	1545	1554	0 09	170	1200	2000	170	1200				
16-4-75	60	57° 06'	09° 12'	350°	55	220	450	1902	1938	0 36	350	600	2000	350	600				
17-4-75	61	57° 08'	09° 12'	160°	55	210-220	450	2040	2155	1 15	300	240	2000	300	240				
17-4-75	62	57° 04'	09° 15'	330°	SW4	200	450	0711	0722	0 11	750	4000	2000	750	4000				
17-4-75	63	57° 10'	09° 16'	340°	SE3	200-210	400	2045	2152	0 47	180	220	2000	180	220				GOOD MARKS
17-4-75	64	57° 13'	09° 17'	160°	54	180-185	450	2235	2335	1 00	180	180	2000	180	180				NO TACKLES SEEN
17-4-75	65	57° 05'	09° 14'	340°	SW4	200-210	500	CABLE PARTED	ABORTIVE HULL	40	—	—	—	—	—				NO REMAINS ON NETS
18-4-75	66	57° 06'	09° 14'	340°	SW5	200-210	450	0955	1007	0 12	140	700	2000	140	700				VERY HEAVY SWELL
18-4-75	67	57° 08'	09° 13'	340°	SW5	200-210	450	1125	1135	0 10	330	2000	2000	330	2000				
18-4-75	68	57° 05'	09° 14'	340°	55	200	450	1912	2030	1 18	150	115	2000	150	115				HEAVY BARK ELAC
18-4-75	69	57° 14'	09° 16'	340°	56/7	200	450	—	—	—	—	—	—	—	—				CABLE PARTED
19-4-75	70	57° 05'	09° 14'	340°	SW4/5	210	450	0715	0730	0 15	250	1000	2000	250	1000				
19-4-75	71	57° 15'	09° 15'	340°	SW5	210	450	1040	1055	0 15	250	1000	2000	250	1000				
19-4-75	72	57° 17'	09° 18'	340°	SW5	210	450	1455	1525	0 30	200	400	2000	200	400				
19-4-75	73	57° 24'	09° 21'	340°	SW4	210-218	425	1926	2006	0 30	400	800	2000	400	800				
20-4-75	74	57° 20'	09° 19'	160°	SW5/6	200	450	073	0723	0 10	300	1800	2000	300	1800				
20-4-75	75	57° 16'	09° 16'	340°	SW4	190-220	475	1315	1400	0 45	300	400	2000	300	400				1525 MINUTE BARK
20-4-75	76	57° 26'	09° 25'	350°	SW3/3	190	400	2005	2020	0 15	180	720	2000	180	720				
20-4-75	77	57° 32'	09° 25'	170	52	180	425	2155	2320	1 25	400+	300	2000	400+	300				NIGHT TOW MARK
20-4-75	78	57° 19'	09° 19'	350	SE3	190	425	0708	0728	0 20	100	300	2000	100	300				CONCENTRING TOGETHER
20-4-75	79	57° 22'	09° 19'	350	SE3	190	450	0836	0851	0 15	250	1000	2000	250	1000				MARKS STILL NOT COME TOGETHER
21-4-75	80	57° 28'	09° 22'	350	53	200	450	133	1333	0 20	400	1200	2000	400	1200				
21-4-75	81	57° 30'	09° 22'	350	E2	205	450	2035	2130	1 17	30	20	2000	30	20				NO MARKS DURING NIGHT VIBRANT HOOKS
22-4-75	82	57° 24'	09° 23'	170	LT ARES	185	400	0510	0525	0 15	120	480	2000	120	480				MARKS COMMENCED CONCERNING 0500
22-4-75	83	57° 22'	09° 23'	170	—	200	450	0737	0741	0 04	500	7500	2000	500	7500				PLACED SPRICE ON FINE CABLE
22-4-75	84	57° 22'	09° 23'	170	—	220	500	1441	1445	0 04	200	3000	2000	200	3000				DELAY IN SHOOT
22-4-75	85	57° 20'	09° 20'	340	NW 2/3	215	500	1622	1628	0 06	200	2000	2000	200	2000				LEFT ON DECK 15 REQUIRED TO BASKETS DUMP

LAND DODGING FOR NIGHT SOUTHERLY 8

460%
543/156
382/196
476/0
397/113
336/294
490/40 26

FULL LIT
LAST FEW MIN ONLY
MARKS LATE IN (M)
CONCENTRING TOGETHER
MARKS STILL NOT COME TOGETHER
NO MARKS DURING NIGHT VIBRANT HOOKS
MARKS COMMENCED CONCERNING 0500
PLACED SPRICE ON FINE CABLE
DELAY IN SHOOT
LEFT ON DECK 15 REQUIRED TO BASKETS DUMP