FALKLAND ISLANDS FISHERIES DEPARTMENT

THE FEASIBILITY OF BOTTOM LONGLINING INSIDE THE F.I.C.Z.

GLEDHILL

Price £5

THE FEASIBILITY OF BOTTOM LONGLINING INSIDE THE F.I.C.Z.

An Experimental Study Performed by the Jigger/Longliner Koei Maru No.30

Falkland Islands
Fisheries Department

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CONTENTS

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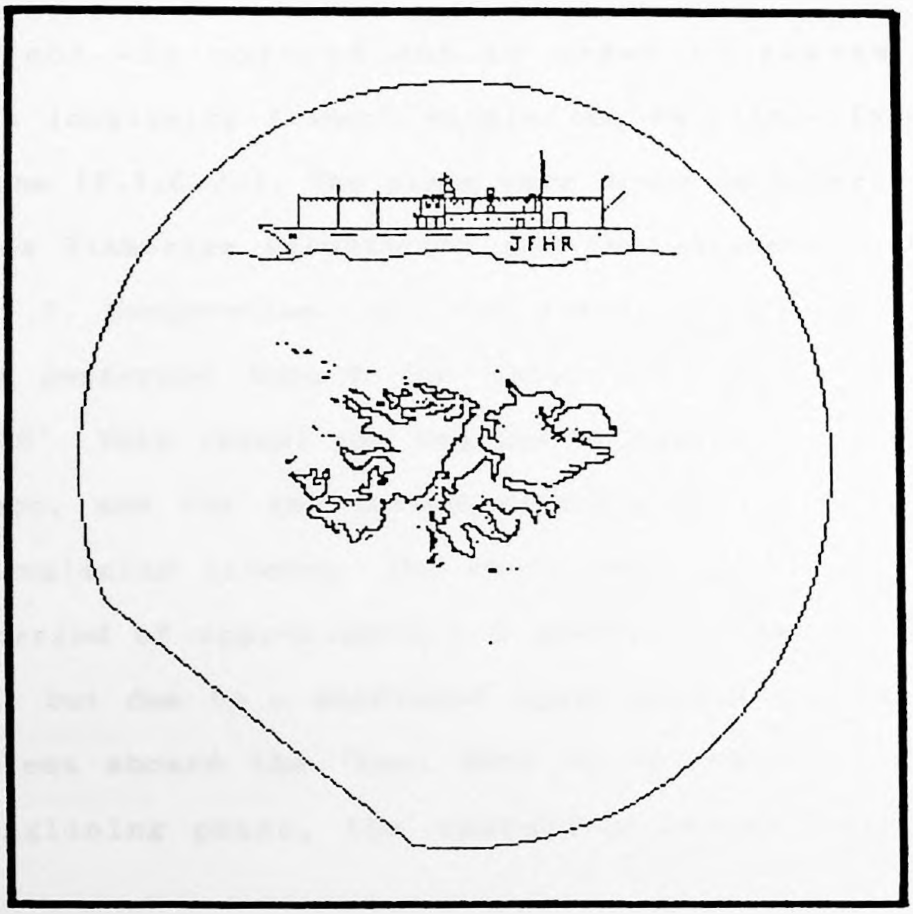
SUMMARY

An experimental bottom longline fishing programme was carried out by the Japanese jigger/longliner 'Koei Maru No.30' during the 1988 fishing season. From March 9th to May 22nd the vessel was jigging commercially for *Illex* squid inside the F.I.C.Z.. Her catches of squid were reasonably good, averaging some 18.38 tonnes of processed *Illex* per operational day. Details of the catches, methods of fishing and some aspects of the population structure taken from regular samples are discussed. The commercial success of the squid phase was to financially assist the experimental bottom longlining operation.

The experimental bottom longlining began on June 15th and continued until September 1st, during which time 57 days were spent fishing. The days were divided up into target fishing days and random sampling days. The target species were kingclip, ray, hake and toothfish. Catches were generally poorer than expected and the impact of the product on the Japanese market was not good with the exception of kingclip which compared favourably with the New Zealand product. A number of problems arose which reduced the potential catches, notably the difficulty of fishing in the best fishing grounds due to the presence of trawlers. Most of the zone was sampled between the operational limits of 150 to 450 metres depth. The longlining proved to be very effective at targeting for kingclip and ray in particular, but unfortunately ray, the most abundant catch (70% by weight), is not a viable product in Japan. Analysis of the catches is shown in some detail.

Expenditure on the project far outweighed the revenue from sales of fish, and as far as the 'Koei Maru' was concerned, the project was not a success. Purpose-built longliners fitted with autolining equipment and smaller crews would possibly be more efficient. While there is potential for longlining inside the F.I.C.Z., it is not a feasible alternative to, or compatible with trawling for finfish at the present time.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CHAPTER 1. INTRODUCTION

1.1 THE OBJECTIVES

This project was carried out in order to assess the potential for a longlining fishery within the Falklands Interim Conservation Zone (F.I.C.Z.). The plans were drawn up between the Falkland Islands Fisheries Directorate and the Japanese fishing association K.S.J. Corporation. All the research work and data collection was performed aboard the Japanese jigger/longliner 'Koei Maru No.30'. This vessel was awarded a jigging licence for the Illex season, and for the period directly following it an experimental longlining licence. The whole project was expected to run for a period of approximately 8 months, commencing on March 1st 1988, but due to a shortened squid season and various practical problems aboard the 'Koei Maru No.30' which occurred during the longlining phase, the operation lasted only six months.

1.2 THE ILLEX JIGGING PHASE

There are two main species of squid which are commercially fished inside the F.I.C.Z.; Illex argentinus (Argentine shortfin squid) and Loligo gahi (Patagonian squid). Loligo is the smaller of the two species and is popular with the European market, it is therefore largely fished by the Polish and Spanish nations. Loligo is most effectively caught by trawlers which tend to use a fairly fine mesh, it is very rarely caught in any volume by jiggers. Illex on the other hand is favoured by the Oriental nations, although caught by others, and is targeted by jigging vessels and a few jigger/trawlers. Jigging appears to be the most popular and efficient method of capture for this species. A third squid species, Martialia hyadeshi (black squid) is an occasional visitor to the zone, and although very few were caught during the 1988 season, it contributed significantly to the total catch for the 1986 season. Martialia is of a similar size and general appearance to Illex and is also caught by jigging vessels.

Whilst jigging during the 1988 season, the 'Koei Maru No.30' caught Illex and a very small amount of Loligo (so little as to be negligible), but no Martialia at all.

The jigging phase in the zone began on March 9th 1988 and continued until May 21st 1988, during which time the vessel transhipped in Berkeley Sound twice, and spent a period of five days outside the zone. The total pre-processed catch of Illex for this phase was 1576.79 tonnes, which represents an average daily catch of 26.28 tonnes of squid. The fishing methods, catches and other relevant material will be discussed in detail in chapter 2.

1.3 THE LONGLINING PHASE

After the jigging was completed, the 'Koei Maru' dismantled her jigging equipment and stored it away on the Stanley floating port complex F.I.P.A.S.S. (Falklands Interim Port And Storage System) before steaming for Montevideo to undergo alterations for longlining. The longlining began on June 15th 1988 and continued until September 1st when the vessel left the zone, bound for Japan. The target species were Kingclip (Genypterus blacodes) and Toothfish (Dissostichus eleginoides), although other species were also kept.

Observations were made of the technique and methods involved in this style of bottom longlining, as well as varied and detailed data collection. All the information collected will be discussed in chapter 3 of this report.

1.4 THE KOEI MARU No.30

The 'Koei Maru No.30' was completed in 1987 and launched in October of that year. She is designed primarily as a squid jigger but incorporates some unique adaptations not usually associated with such vessels. These features include a large door in the starboard side of the ship, roughly one metre above the water line, through which the longline is winched, and a conveyer belt stretching from the factory to a line preparation and deployment hold towards the rear of the ship. These adaptations are discussed further in chapter 3.

Specifications of the 'Koei Maru No.30' are listed below.

1. Gross Tonnage: 1095 tons
2. Net Tonnage: 328 tons
3. Overall Length: 69.5 metres
4. Beam: 10.8 metres
5. Draft: 6.93 metres
6. B.H.P.: 2100

Fishing Restriction Category 2 - Limited to cuttlefish drift net fishery, squid pole and line and cod-fish longline fishery.

Certificate of vessel's nationality:

Official Number 130159   Koei Maru No.30   JFHR

Kind of vessel: Motor ship

Port of registry: Shiogama, Miyagi-Ken

Material of hull: Steel

Type of engines: Oil engine, one

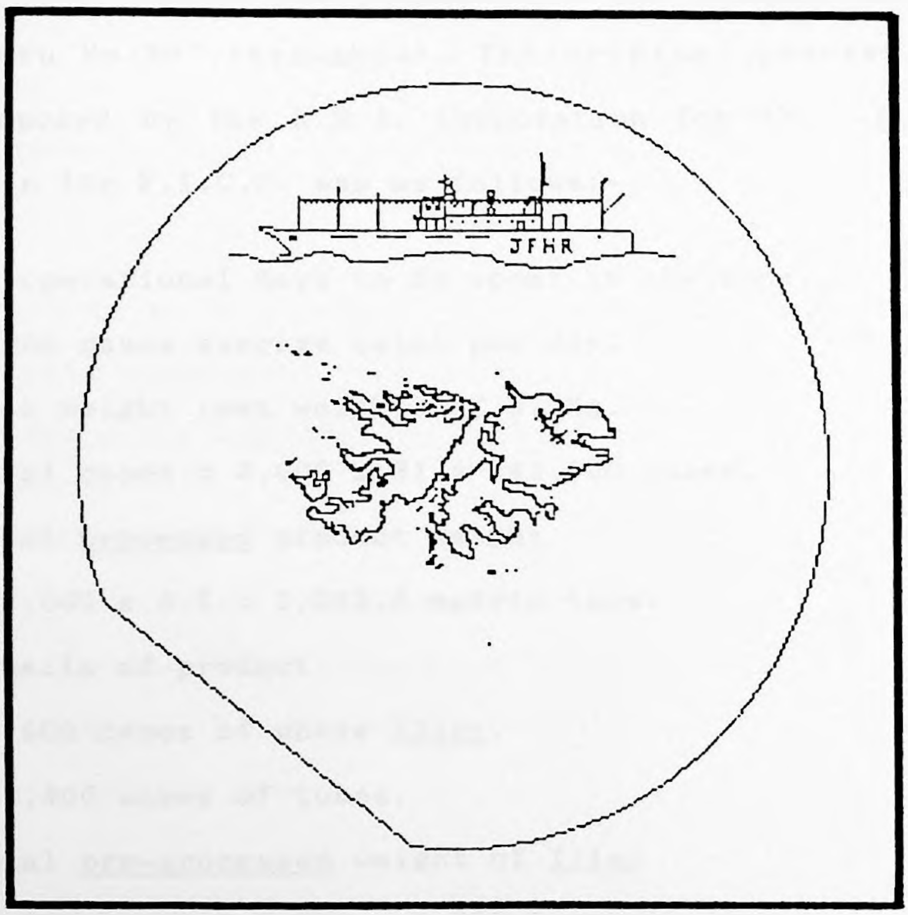
Kind of propellers: Screw propeller, one

Where built: Ishinomaki, Miyagi-Ken

Name of builders: Hitachi Zosen, Sakai Jukogyo, Kabushiki Kaisha, Murakami Zosensho

Date of launch: October 1987

The 'Koei Maru' is a comfortable modern fishing boat which caters for a crew of up to 26, including two onboard scientific observers. During the jigging operation there were 21 crew members and one scientist. A further two crew members joined the ship in Montevideo for the longlining phase, which increased the total company to 24. There was a scientist on board throughout the six month period, except for short spells when the 'Koei Maru' was transhipping in Berkeley Sound, or fishing outside the zone.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CHAPTER 2 THE SQUID JIGGING OPERATION

2.1 INTRODUCTION

This phase of the project was a fully commercial exercise which was under the control and judgement of the fishing master of the 'Koei Maru No.30' throughout. The original pre-season schedule as proposed by the K.S.J. Corporation for the Illex operations within the F.I.C.Z. was as follows:-

1. 81 operational days to be spent in the zone.
2. 3,000 cases average catch per day.
3. Case weight (wet weight) of 8.5Kg.
4. Total cases = 3,000 x 81 = 243,000 cases.
5. Total processed product weight

   243,000 x 8.5 = 2,065.5 metric tons.
6. Details of product

   48,600 cases of whole Illex.

   194,400 cases of tubes.
7. Total pre-processed weight of Illex

   43,600 cases @ 8.5Kg = 370.6 metric tons +

   194,400 cases @ 8.5Kg x 1.8 (conversion factor for tubes) = 2,974.32 metric tons

   Total pre-processed weight = 3,344.92 metric tons.

This plan was not strictly adhered to for a number of reasons; primarily due to the drastic fall in the market price of Illex, caused by large frozen warehouse stocks in Japan and high catches during the 1988 season. This had the effect of curtailing the jigging season prematurely, and many Japanese vessels had left the zone before the end of May. The 'Koei Maru No.30' ceased jigging operations on May 21st 1988.

The <u>Illex</u> is sold as a product in two forms; Whole squid and squid tubes. Tubed squid have had viscera and tentacles removed, leaving a cleaned fleshy mantle tube which commands a higher market price. A conversion factor is used to estimate the total (whole squid) weight of a squid from the tube weight. A factor of 2.0 is most commonly found for <u>Illex</u> tubes, but the 'Koei Maru' used 1.8. An example of how conversion factors (C.F.) work is shown below:-

> If 5,000 kilos of <u>Illex</u> tubes are reported
> then this represents (1.8 (C.F.)x 5,000) =
> 9,000 kilos of unprocessed (whole) squid.

It is the unprocessed weights of any fish or squid species caught in the F.I.C.Z. which is reported by the fishing vessels as 'total catch' to the Fisheries Department and therefore a complete understanding of conversion factors is necessary in order to calculate this figure.

2.2 METHODS

(I) DECK EQUIPMENT

Lamps - The first and most obvious feature of a jigger at work is the intensity of the lights which surround the deck and light up the night sky. The bright light is used to attract the squid, which are positively phototactic, towards the fishing boat. Positioning of the light source around the vessel and the shadow cast on the water by the ship's side has become a highly developed science, and the angle at which the light hits the water and illuminates the lures can have a dramatic effect on the catch rate.

The 'Koei Maru' is equipped with two rows of 80 lights, one row on each side, strung at a height of about 4 metres above the main deck, one metre in from the gunwales. Each 2Kw lamp is kept for two years and then replaced at a cost equivalent to $270 U.S. each. All the lights are controlled from the bridge, and can be operated in eight separate sections.

Jigs - The jigs are brightly coloured lures composed of a flexible plastic stem, at the lower end of which are two rings of metal barbless hooks. The unit is held together by a steel rod which runs through its entire length, and has a loop at the top and bottom for line attachment. Each jig is about 12cm long and designed to entangle the clubs and tentacles of the 'attacking' squid on the hook arrangement. Occasionally foul-hooking occurs but tends to happen only in very dense shoals of Illex. There are a great variety of different jig designs, but they all conform to the same general shape. The 'Koei Maru' used one variety of jig in four colours; green, orange, light blue and transparent. These were selected on two criteria, their previously proven effectiveness and their low cost.

Lines - All modern jigging lines are made of monofilament nylon. The maximum length of each line on the 'Koei Maru' was approximately 200 metres, of which the operational depth never exceeded 100 metres, and was most commonly between 30 to 50 metres. The bottom jigs are situated 5 metres above the sinker and the remainder sequentially dispersed at one metre intervals along the line. Numbers of jigs per line varied throughout the fishing period from 16 to 20. At the top of the jig trace is a brass swivel which is tied to the main line. During fishing, spare traces are kept on deck ready to replace lines which are lost with great regularity especially in heavy swells and when catch rates are very high. There are 100 lines on the 'Koei Maru' which work in pairs, each pair driven by a single jigging machine.

Jigging machines - These fully automated machines have a central power and control unit which operates two winding drums. In order to reduce tangling of lines the drums are either side of the central console about 1.5 metres apart. The drums are not round but elliptical (in section) to simulate a jigging motion of the lures in the water. The machines are designed to absorb the pitching and rolling movements of the vessel thereby avoiding breakage of lines under shock loads. Operating depths and winching speeds can be programmed into the control unit, and skilful use of the machines can drastically improve catch rates. Once started, the machines unwind the line to the predetermined depth and then reverse the direction. Should tangles appear, the machines will automatically halt, enabling repairs to be carried out. There were 50 machines spaced at intervals of 2 metres around the deck of the 'Koei Maru'.

Booms - As it unwinds, each line passes along a boom and over a leading roller, before dropping into the sea. The boom has a metal framework and is filled in with plastic mesh, has an incline towards the deck and guides the squid, which become detached from the jigs as they pass over the roller, into a trough. Extending the line away from the side of the vessel helps to maximise the use of light and shadows, and improve catch rates. There were two different boom lengths on the 'Koei Maru'; the shorter and more effective booms (according to the Bosun) were 2.5 metres long and the longer ones were 4 metres. These were alternately placed in pairs around the vessel, each pair allocated to one machine. The reason for having two different boom lengths is to avoid tangling of lines, and to maximise use of space around the ship (by alternating long and short booms), even if this is at the expense of using the longer, less effective booms.

The trough - Having been caught and flipped off the jig by the leading roller, the Illex slide down the boom and into a trough which extends all the way round the bulwark. During high catch rates the trough will fill and frequently overflow onto the deck. Towards the forward third of the ship is the factory, which lies below the open fishing deck. Pipes in the trough lead the squid into the factory pounds and water pumped into the trough help the squid on their way.

The parachute anchor - Early jigging vessels used to anchor in fishing grounds, but this proved to be inefficient because in strong currents squid shoals would be swept passed the ship. To overcome this problem and allow the ship to drift with the shoals, the sea anchor was developed, and the parachute variety is used on the 'Koei Maru'. Deployment of this huge underwater parachute appears at first inspection to be a laborious and awkward task but actually only takes a crew of 6 men roughly 4 minutes to deploy, and 6 minutes to retrieve. Once on deck there is a certain amount of preparation involved to make the anchor ready again for deployment.

(II) FACTORY EQUIPMENT

Squid pounds - Pipes direct the squid from the deck troughs into the pounds, where the inflow can be controlled by shutting off the pipes. When the pounds, of which there were two on this ship, one to port and one to starboard, are filled with Illex, crew members set to work filling plastic trays or cases with hand-graded squid. Each case contained 8.5 Kgs of squid, which was carefully weighed on a balance. These cases were allocated categories according to the number of pieces per box in the following ranges:- (see over)

No of Pieces per box

1-10	21-25	36-40
11-15	26-30	41-45
16-20	31-35	46-50 ... etc.

Whole Illex were most commonly found in the 21-30 pieces per box range, while tubed squid largely occupied a range of 36-60 pieces.

Tubing - This procedure has been mentioned earlier in the report, and began 15 days after entering the F.I.C.Z., once the planned weight of whole Illex had been taken. In order to remove the viscera and tentacles from the mantle, a special hand tool is employed. This tool is made of strong wire extending 25cm or so from a wooden base or handle. The wire is doubled back on itself and has a sharpened kink or indented 'V' at the end. It is this 'V' end which cuts through the connective tissue when the implement is forced inside the dorsal cavity of a squid, and frees the unrequired material from the mantle.

Tubes fetch a higher market price and considerably reduce the rate of filling valuable hold space, but involve a certain amount of arduous labour; crew members on the 'Koei Maru' managed to tube somewhere between 16 and 25 squid per minute per man.

Freezing plant - Having been packed, the cases of Illex were stowed in the factory until the Ice Master gave instructions to begin freezing. A conveyer belt transports the cases into the freezing plant which consists of eight units which together are capable of freezing in excess of 5,800 trays of squid at one time. After freezing, the blocks are removed from the trays and stowed in the freezing holds of which there were four on the 'Koei Maru'.

(III) THE WORKING DAY

Illex jigging is essentially a night-time activity, although the working day begins before sunset and continues long after sunrise. The following timetable outlines a typical working day for the 'Koei Maru':-

TIME	ACTIVITY
18:00	Standby : Alarm bell is sounded to wake the crew.
18:15	Sea anchor deployed : Having steamed during the day to the desired location, the first requirement is to set the parachute anchor.
18:30	Start jigging machines : Often only the short boom machines will be started at this stage until a shoal of *Illex* is encountered, at which point all the machines are initiated.
18:30	Freezers are emptied : Under the supervision of the ice master the catch of the previous night is cleared out of the freezing plant, each frozen block is removed from it's tray and then stored away in a freezing hold. Depending on the previous catch, this operation can take anything up to 2 hours.
19:30	Begin processing squid : Size selection, tubing and packing continue all night for as long as the *Illex* keep coming aboard.
21:30	First meal : 'Breakfast' is taken in three shifts.
03:00	Second meal : 'Lunch' also in three shifts.
06:00	Stop jigging machines : The catch rate tends to drop dramatically at dawn, and it is rarely worth jigging for *Illex* during the day.
10:30	Work ends : If the catch has been poor then work on deck and in the factory may end earlier.

TIME	ACTIVITY
10:45	Sea anchor retrieval : Vessel may steam to new fishing area.
11:00	Final meal.
12:00	Shift ends and day watch of 2 crew members begins.

Typically there will be four or five crew members working on the fishing deck, attending the machines and washing squid into the factory, while in the factory itself there will be some 12 crew attending to packing, tubing or freezing. The Fishing Master remains in the bridge throughout the fishing operation, but the Captain and Radio Operator will be found working under the same conditions as the rest of the crew. Frequently the Fishing Master will not be satisfied with the catch rate and give the order to move on to a new area. His decision to move will often be influenced by conversations with other Fishing Masters from the same Company on the VHF radio. There is a great deal of co-operation between "allied" fishing vessels and on a number of occasions the 'Koei Maru' tied up behind a jigger which was being deluged with squid to share and maximise the catch, the favour was usually reciprocated.

(IV) SAMPLING PROGRAMME

Of the 70 days spent jigging inside the F.I.C.Z., a scientist was on board for a total of 51. During this time 88 stations or samples were taken, usually two per night, but sometimes when catches were low only one or no stations at all were taken. A diary of the Illex phase is shown overleaf:-

DATE	OPERATION
09/03/88	Koei Maru No.30 entered the F.I.C.Z. for the first time.
13/03/88	First trans-shipment in Berkeley Sound.
15/03/88	Scientist joined the ship in Berkeley Sound.
16/03/88	Fishing resumed.
01/04/88	First and only fishing day was lost to bad weather.
10/04/88	Second trans-shipment in Berkeley Sound. The scientist was ferried to Stanley.
14/04/88	The scientist rejoined the vessel.
15/04/88	Fishing resumed.
11/05/88	Scientist was picked up at sea by the patrol ship 'Falklands Desire' and returned to Stanley.
15/05/88	The 'Koei Maru' steamed north, out of the zone in search of remaining <u>Illex</u> shoals.
20/05/88	The ship returned to fish inside the zone.
22/05/88	Jigging phase completed, steamed for Berkeley Sound.
23/05/88	Third trans-shipment in Berkeley Sound.
25/05/88	The vessel came alongside the floating port facility F.I.P.A.S.S. to remove superfluous jigging machinery which was not required for the longlining phase.
26/05/88	Vessel left Stanley for Montevideo, Uruguay.

All the data collected was of a standard nature for the "observer programme"; namely length, weight, sex and maturity data for each <u>Illex</u> sampled. In addition to the usual data, two other aspects of jigging were examined; firstly, the variation of <u>Illex</u> catch rates for individual jigging machines, and the differences between machines with long and short booms, and secondly the accuracy of the "standard" conversion factor which was used throughout the season.

The "boom counts" involved a total of six machines (12 booms), two with short and four with long booms, which could be observed clearly from the bridge. Most of the counts involved only two machines (labelled A and B) and were taken periodically during March and April. A count was a record of the number of squid caught by a machine (2 lines) and also the number of squid lost, over the course of 10 line hauls. The date, time and position of the ship also were recorded for each count. Towards the end of the jigging phase the sampled squid, which were previously dumped because they were not acceptable for the Japanese market, were cleaned of the visceral material and tentacles and kept for the crew. This procedure prompted the use of these same squid in an assessment of the accuracy of the conversion factor. Whole <u>Illex</u> were weighed, and then stripped of the viscera including the gills and pen, and the mantles (opened, flattened tubes) reweighed. Subtraction of the mantle weights from the whole weights gave the weight of the viscera and tentacles. From these figures the conversion factor is easily worked out as follows:-

CONVERSION FACTOR = TOTAL WEIGHT / TUBE WEIGHT.

The conversion factor was estimated at five different stations and found to be considerably different from that which was in use on the 'Koei Maru'.

Results of the data collected during the jigging phase are shown in section 2.3.

2.3 RESULTS

(I) ILLEX CATCH

The total processed *Illex* catch for 60 days of active fishing inside the F.I.C.Z. was 1,102.952 tonnes, which represents an average catch of 18.38 tonnes per jigging day. Table 1 shows how the catch was divided up between whole and tubed squid and compares the actual catch data with the proposed planned catch.

TABLE 1

	JIGGING PLAN	ACTUAL DATA
No. of operational days spent jigging inside the F.I.C.Z	81	61*
Total processed catch (tonnes)	2065.5	1102.9
Processed catch per operational day (tonnes)	25.5	18.1
Total processed weight of whole *Illex* (tonnes)	413.1	510.6**
Total processed weight of tubed *Illex* (tonnes)	1652.4	592.3
Total unprocessed weight of *Illex* caught (tonnes)	3387.4	1576.8

* = Includes one day lost to gales.

** = This figure includes 50.24 tonnes of whole *Illex* which was kept as bait for the longlining project.

From the figures in Table 1 it can be seen that the actual unprocessed catch of Illex fell short of the planned catch by 1810.6 tonnes and that this all came out of the proposed tubed squid catch. It appears that the plans may have been a little optimistic, since the time spent in the zone and the average daily catch were considerably less than forecast.

A total of eleven days were spent trans-shipping in, or steaming to and from Berkeley Sound; three in March, five in April and three in May. Added to these non-fishing days, there was one day, April 1st, which was lost due to bad weather.

The maximum catch for a single day was 50248 kilos, achieved on April 15th in only seven hours of fishing. The minimum catch (when there was a catch) was 720 kilos, and occurred towards the end of the period on May 10th. This large variation in catches indicates the patchiness of the Illex shoals.

Table 2, overleaf, shows various catch information broken down by month, i.e. for March, April and May. The total catches by day are also drawn up for each of the three months in Figures 1,2 and 3.

Close examination of the catches in April Figure 2 show that for several of the nights, a maximum catch is reached at about 37000 kilos, an amount which was dictated by the Fishing Master. The reason for this is that it represents the maximum amount of Illex that can be shipped and tubed without it spoiling; the crew were unable to efficiently process much more than this in one evening. This phenomenon only occurred after tubing began on March 26th, since tubed squid require much more processing and packing work than whole squid.

TABLE 2

CATCH INFORMATION	MARCH	APRIL	MAY
Jigging days	20	24	16
Trans-shipping days	3	5	3
Total processed catch (tonnes)	549.8	428.5	124.6
Average processed catch per operational day (tonnes)	27.5	17.8	7.8
Maximum catch (tonnes)	47.3	50.2	45.3
Minimum catch (tonnes)	14.9	6.5	0.7
Total processed weight of whole *Illex* (tonnes)	460.4	50.2	0.0
Total processed weight of tubed *Illex* (tonnes)	89.4	378.3	124.6
Total unprocessed catch (tonnes)	621.3	731.1	224.3
Average unprocessed catch per operational day (tonnes)	31.1	30.5	14.0

The large catch shown in Figure 2 on April 15th was not tubed but kept whole as bait for the longlining project. That evening the 'Koei Maru' linked up with another Japanese jigger, the 'Shunyo Maru No.178', from the start of fishing, a practice which became more common as the season progressed and the squid shoals became more difficult to locate. 'Linking-up' in such a fashion was arranged by mutual agreement of the two Fishing Masters involved. It is done when a vessel encounters a shoal too large for it to cope with, and so calls other jiggers in the vicinity, who might be having a poor catch, to share its good fortune. No more than two vessels were involved, and the link-up would be reciprocated, often within a few days. Usually catches on such occasions were high for both vessels, although not always. Linking-up is likely to have some effect on the levels of fishing effort, but it would be difficult to measure. The 'Koei Maru' linked-up at least seven times during the jigging phase.

FIGURE 1

The total pre-processed catch of _Illex_ (kilos) caught each day during March 1988 by the 'Koei Maru No 30'. Trans-shipping occurred in Berkeley Sound on the 13th-15th.

FIG.1 TOTAL CATCH OF ILLEX
FOR THE KOEI MARU No.30 – MARCH 1988

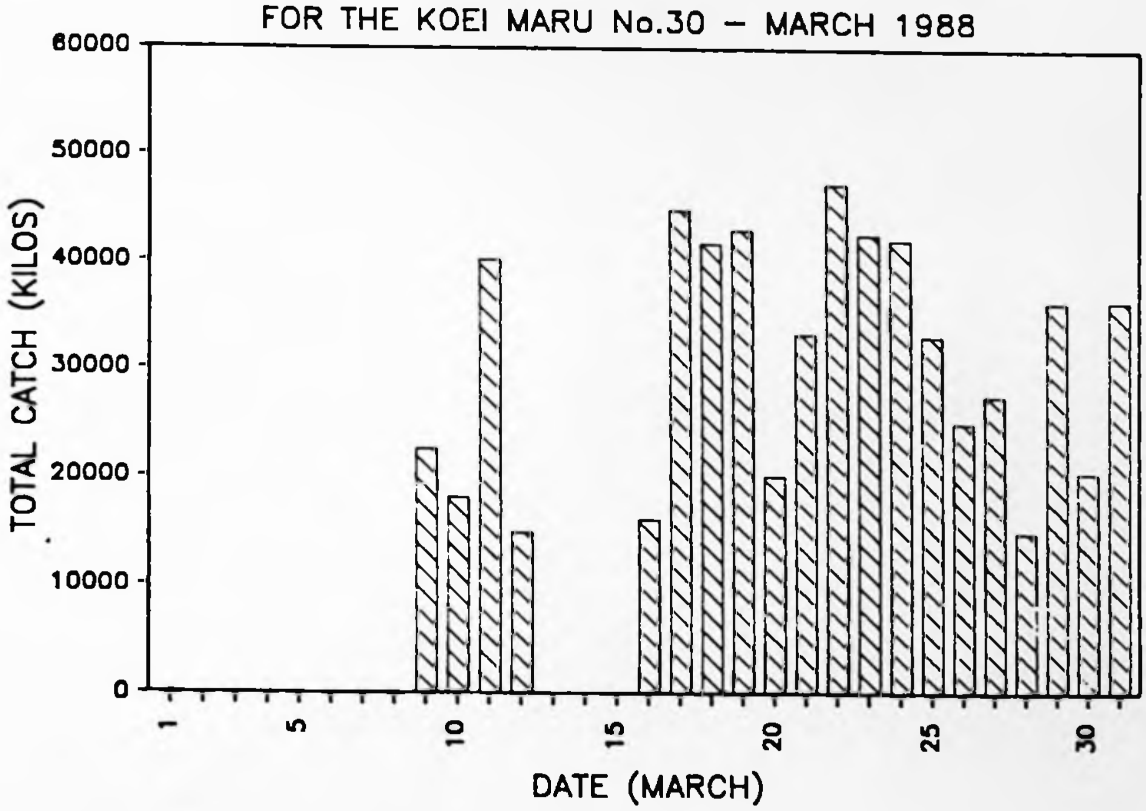


FIGURE 2

The total pre-processed catch of *Illex* (kilos) caught each day during April 1988 by the 'Koei Maru No 30'. Trans-shipping occurred in Berkeley Sound on the 10th - 14th, and there was no fishing, due to gales, on the 1st.

FIG.2 TOTAL CATCH OF ILLEX
FOR THE KOEI MARU No.30 – APRIL 1988

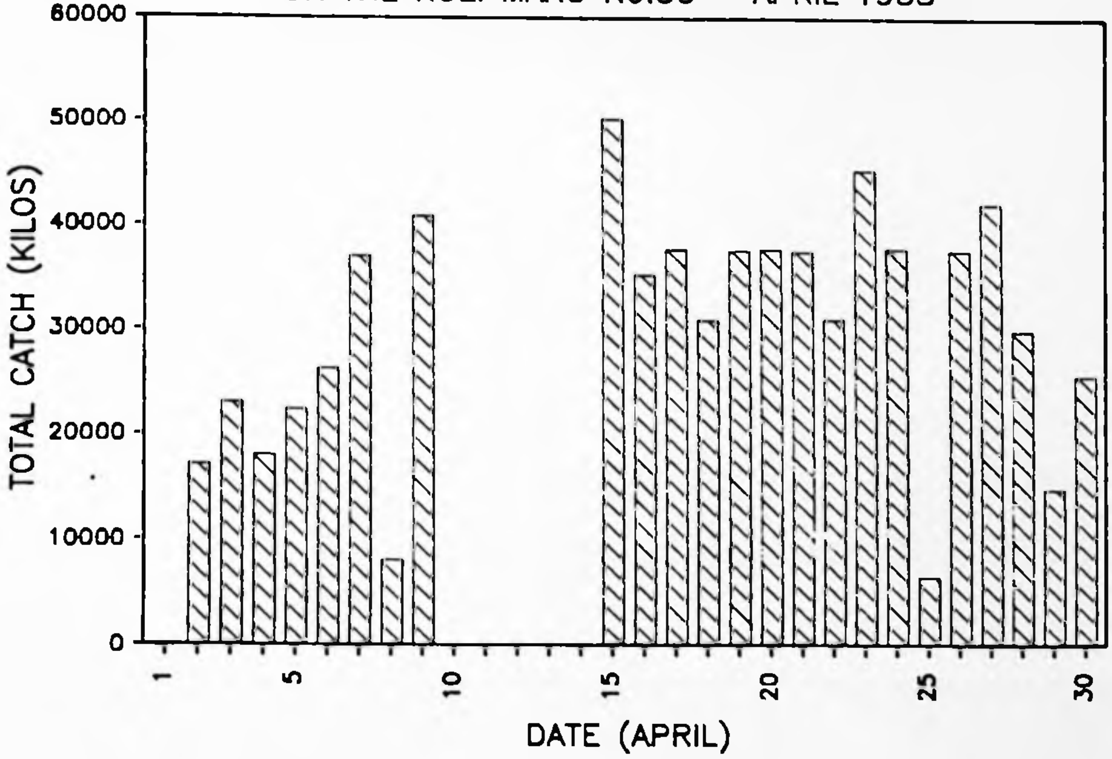
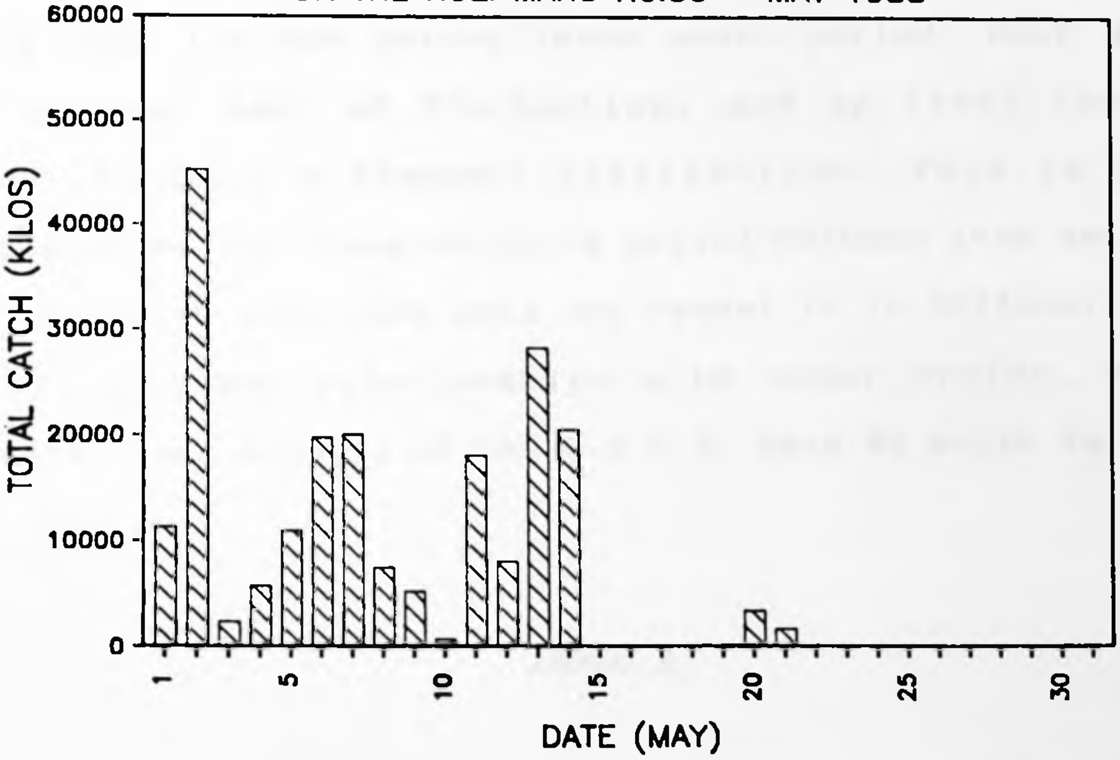


FIGURE 3

The total pre-processed catch of _Illex_ (kilos) caught each day during May 1988 by the 'Koei Maru No 30'. Trans-shipping occurred in Berkeley Sound on the 22nd - 24th, and between the 15th and 19th, the vessel left the zone in persuit of larger catches.

FIG.3 TOTAL CATCH OF ILLEX
FOR THE KOEI MARU No.30 – MAY 1988



(II) CATCH PER UNIT EFFORT

C.P.U.E. is expressed as the catch per hour spent jigging, it is a simple relationship, but effective in providing some indication of the fishing effort. Other variables could be taken into account such as number of lines, number of jigs, quality and quantity of light from the bulbs, and so on, but these can be difficult to monitor, and so are better left out.

Figure 4 is a plot of the C.P.U.E. expressed as tonnes per jigging hour for the entire three month period. Once again it shows a great deal of fluctuation, and on first inspection appears to show a bimodal distribution. This is in fact accentuated by the trans-shipping period between 10th and 14th of April, and with data from only one vessel it is difficult to try and interpret any relationships with lunar cycles, or stock movements. Some details of the C.P.U.E. data by month is shown in Table 3 below.

TABLE 3

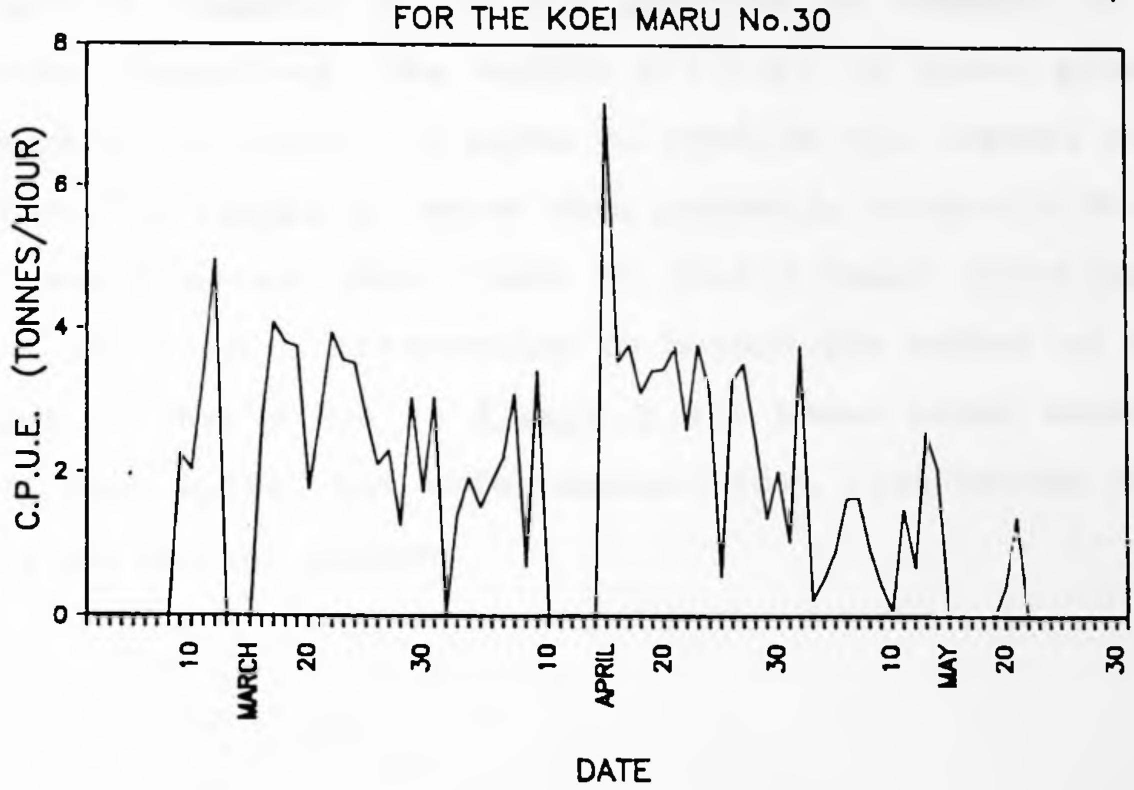
C.P.U.E.* DETAIL	MARCH	APRIL	MAY
Average CPUE	2.93	2.79	1.24
Average hours per day spent jigging	10:51	11.20	11.03
Maximum CPUE	4.96	7.18	3.77
Minimum CPUE	1.71	0.55	0.06

* = C.P.U.E. expressed as tonnes of *Illex* per jigging hour.

FIGURE 4

Daily Catch Per Unit Effort in tonnes of *Illex* caught per hour aboard the 'Koei Maru No.30' during March, April and May 1988. Plot does not include a C.P.U.E. for when the vessel was fishing outside the zone (May 15th - 19th).

FIG.4 ILLEX C.P.U.E. (MARCH – MAY 1988)
FOR THE KOEI MARU No.30



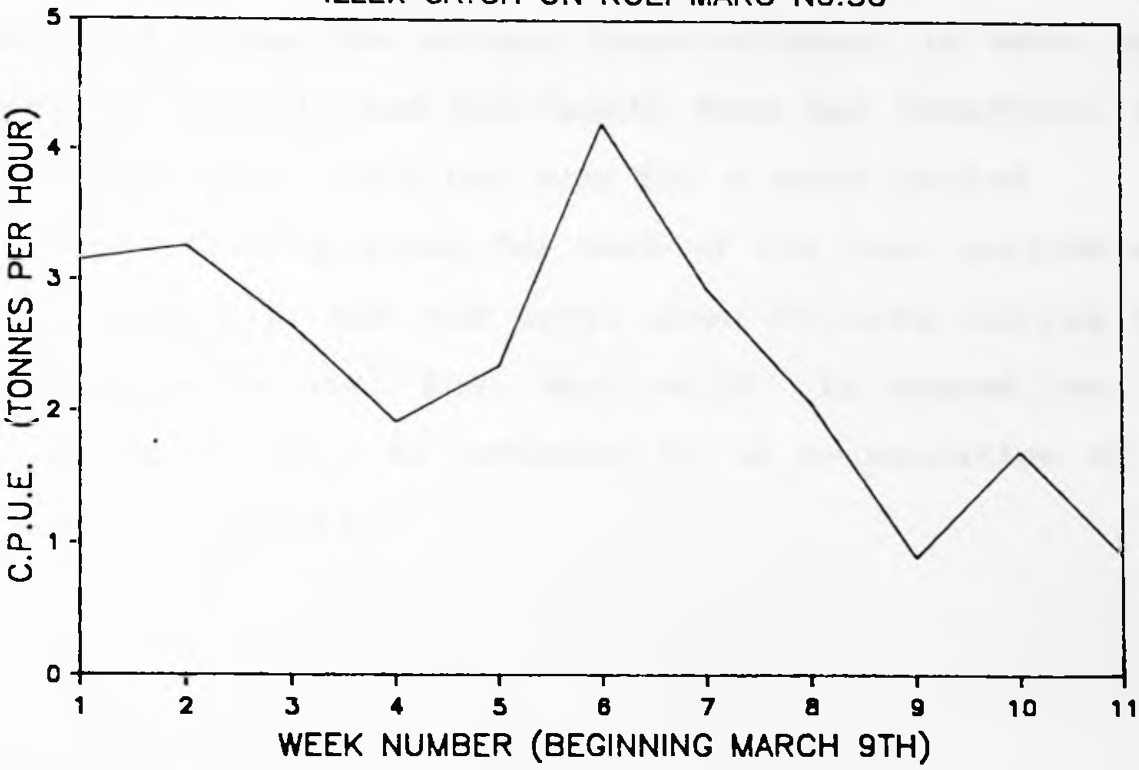
The data in Table 3 serves to reiterate the variable nature of jigging catches, it also gives some indication of how the C.P.U.E. declines in May, despite continuing to exert high effort. If the C.P.U.E. data is expressed in weekly terms, then some of the variation within the week is smoothed out to give a clearer graphical representation of what is happening overall. It must be emphasised once again that without data from a whole fleet of jiggers, it is not possible to comment on the squid stocks themselves. The weekly C.P.U.E. is shown graphically in figure 5 overleaf. It seems to confirm the bimodal distribution noticed in Figure 4, which then gradually drops off from week six to week nine and then rises to form a small third peak at week ten. It would be interesting to assess the effect of the moon on *Illex* catches since in Figure 5 all three peaks occurred during full moon weeks, but unfortunately this lies beyond the scope of this particular project.

FIGURE 5

The weekly C.P.U.E. (tonnes per hour) of *Illex* caught by the 'Koei Maru No.30'. Week 1 began on March 9th, the first day of fishing in the F.I.C.Z., and week 11 began on May 18th.

FIG.5 WEEKLY CATCH PER UNIT EFFORT

ILLEX CATCH ON KOEI MARU No.30



(III) FISHING AREAS

As mentioned in the introduction, the choice of *Illex* fishing areas was entirely at the discretion of the Fishing Master. For presentation purposes, the whole jigging period has been divided into four distinct sections; The first from March 9th-12th, when the vessel first entered the F.I.C.Z. but had no scientist on board; the second from March 16th to April 10th, a period between two trans-shipments; the third from April 15th to May 11th, from the second trans-shipment to when the scientist left the vessel; and the fourth from May 12th-21st, during which time the vessel left the zone for a short period.

The fishing areas for each of the four periods are shown in in Charts 1-4, and the total area covered during the jigging operations by the 'Koei Maru No.30' is mapped out on Chart 5. These charts will be referred to in presentation of the length-frequency results.

<u>CHART 1</u>

A chart showing the jigging areas fished by the 'Koei Maru' inside the F.I.C.Z. prior to there being a scientist aboard.

A = 9th-11th March

B = 12th March

FALKLANDS INTERIM CONSERVATION ZONE

This Chart is Illustrative, NOT Definitive

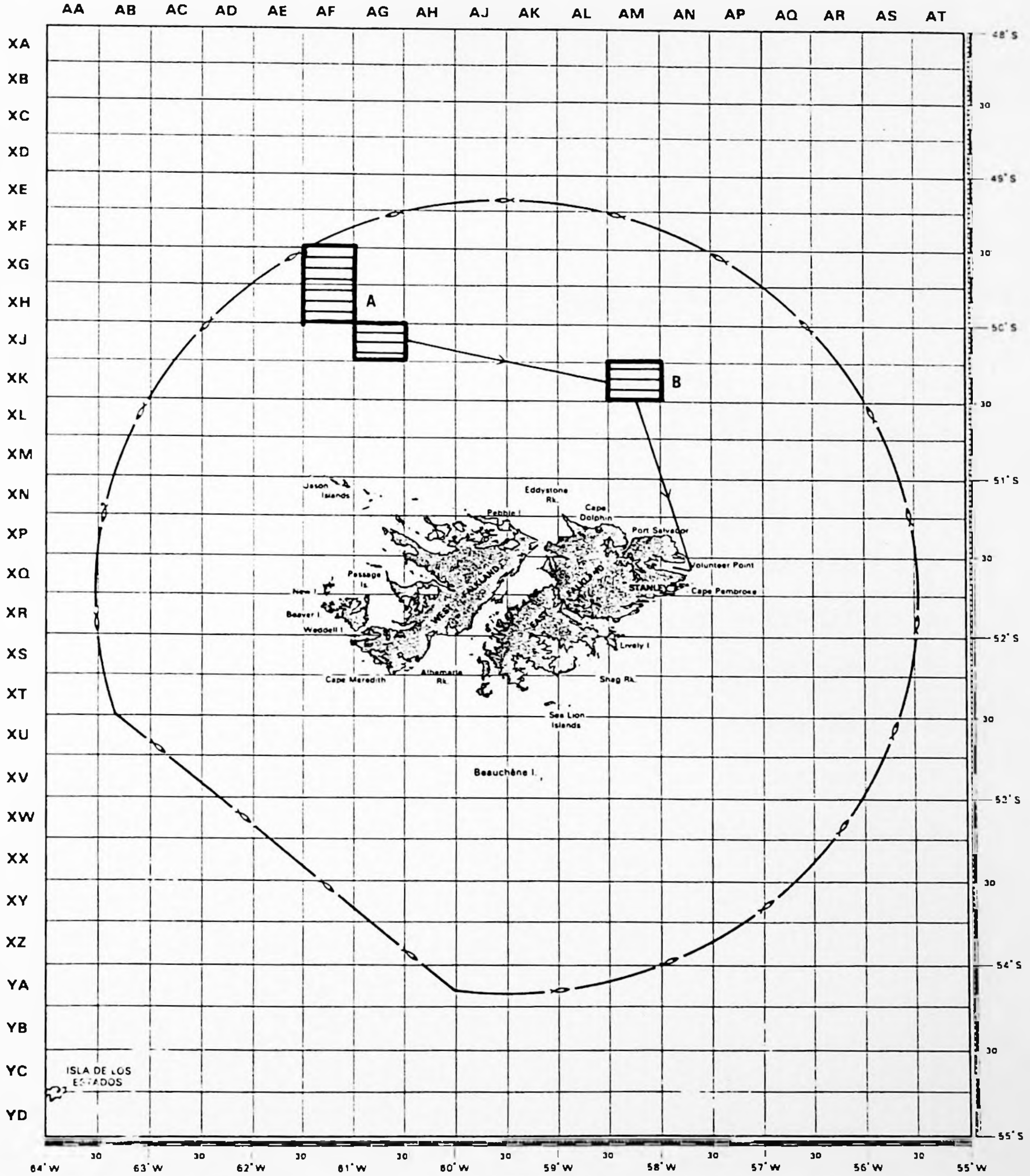


CHART 2

A chart showing the jigging areas fished by the 'Koei Maru' inside the F.I.C.Z. between the first and second trans-shipments.

A = 16th March	1 station
B = 17th-28th March	23 stations
C = 29th March - 6th April	15 stations
D = 7th April	2 stations
C = 8th April	1 station
E = 9th-10th April	3 stations

FALKLANDS INTERIM CONSERVATION ZONE

This Chart is Illustrative, NOT Definitive

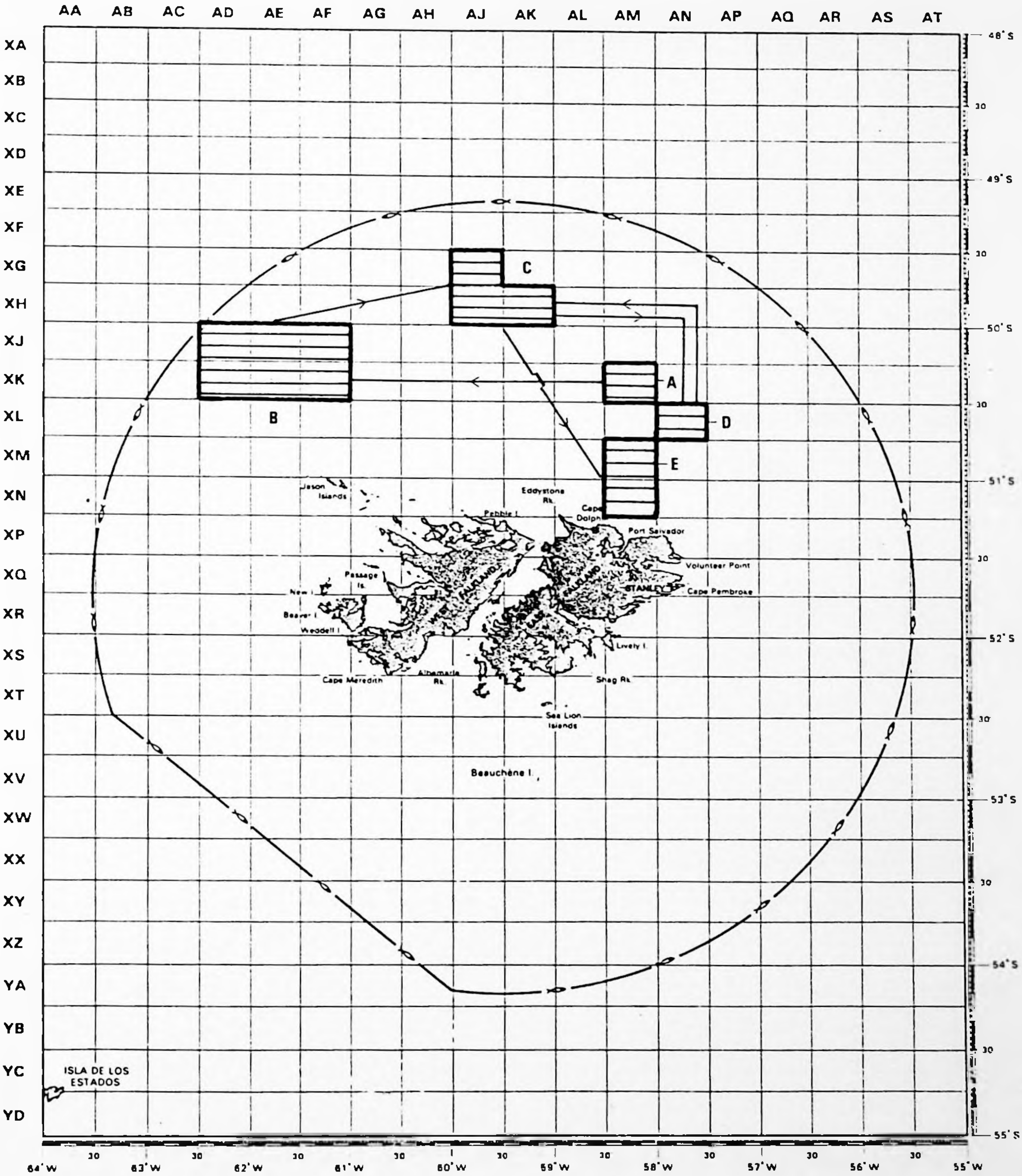


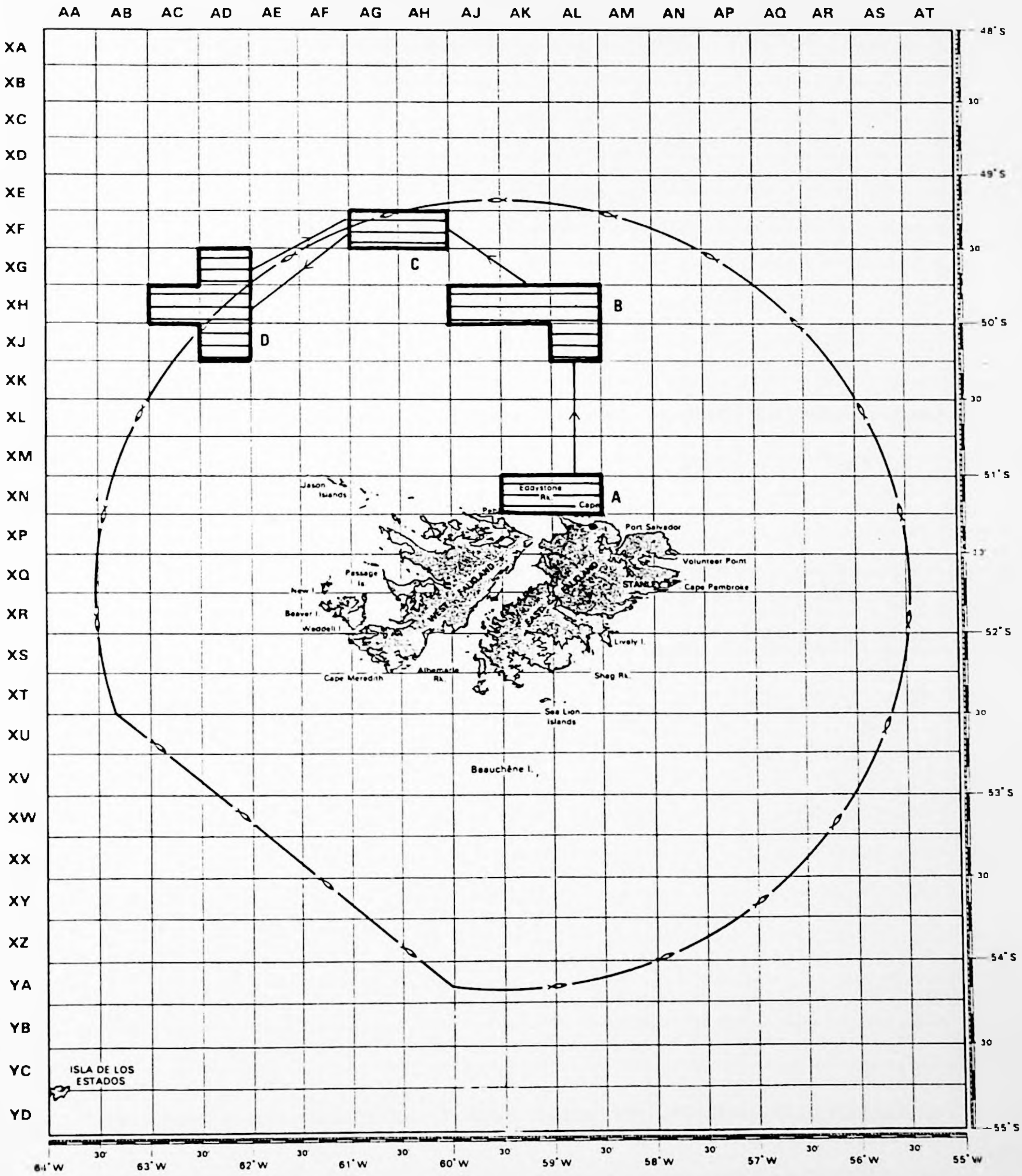
CHART 3

A chart showing the jigging areas fished by the 'Koei Maru' inside the F.I.C.Z. between the second trans-shipment and the recovery of the scientist by the 'Falklands Desire' patrol ship.

A = 15th-22nd April	16 stations
B = 23rd April - 3rd May	18 stations
C = 4th May	2 stations
D = 5th May	2 stations
C = 6th May	1 station
D = 7th-8th May	2 stations
C = 9th-10th May	1 station
D = 11th May	1 station

FALKLANDS INTERIM CONSERVATION ZONE

This Chart is Illustrative, NOT Definitive



Produced by Cartographic Unit LAWS ADAS MAFF

Based on part of Admiralty Chart No. 2505 with the permission of the Controller of Her Majesty's Stationery Office and the Hydrographer of the Royal Navy

<u>CHART 4</u>

A chart showing the jigging areas fished by the 'Koei Maru' after the scientist left the vessel until the end of the jigging phase.

A = 12th-14th May

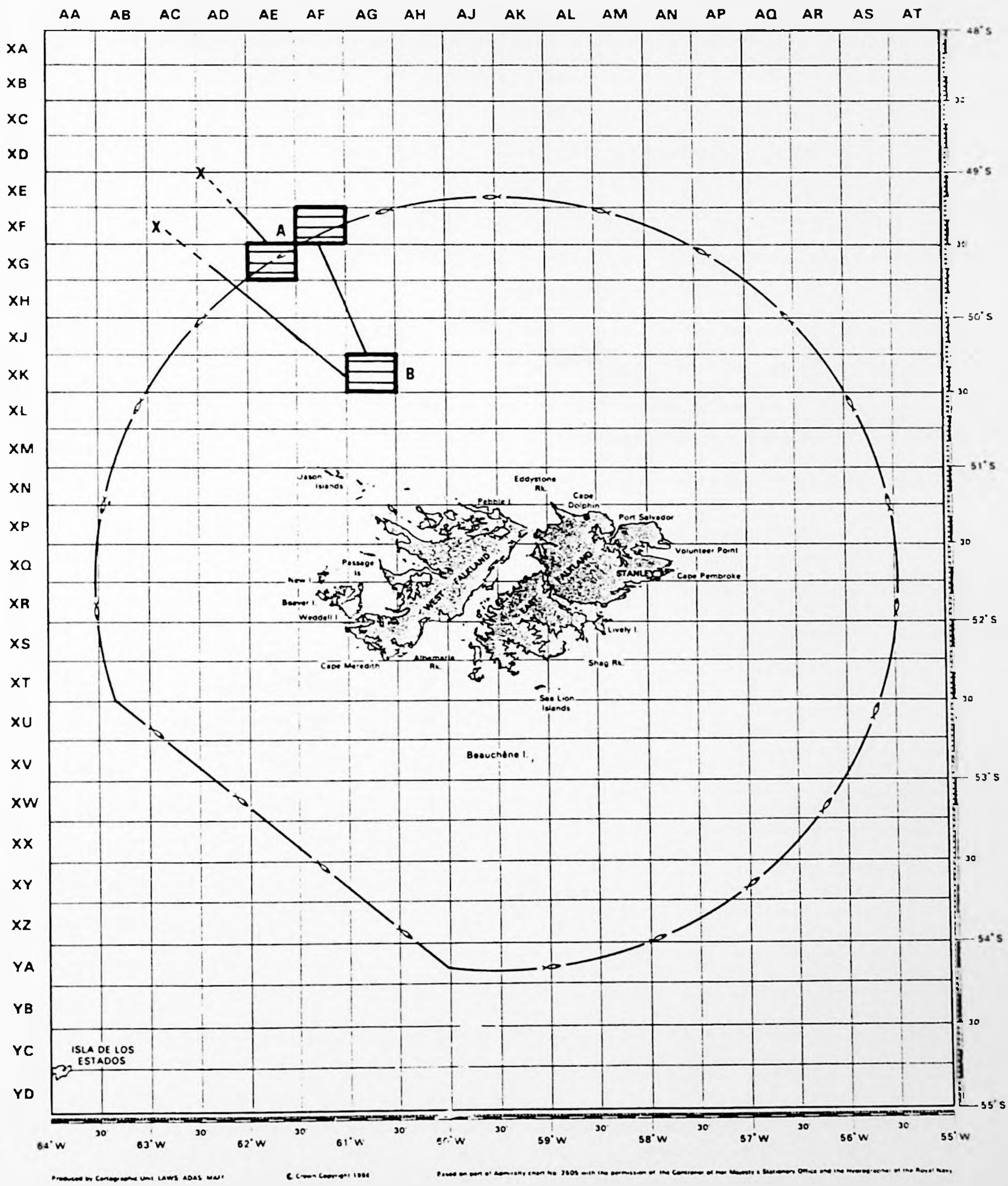
X = 15th-19th May (Outside Zone)

B = 20th May

A = 21st May

FALKLANDS INTERIM CONSERVATION ZONE

This Chart is Illustrative, NOT Definitive



Produced by Cartographic Unit LAWS ADAS MAFF

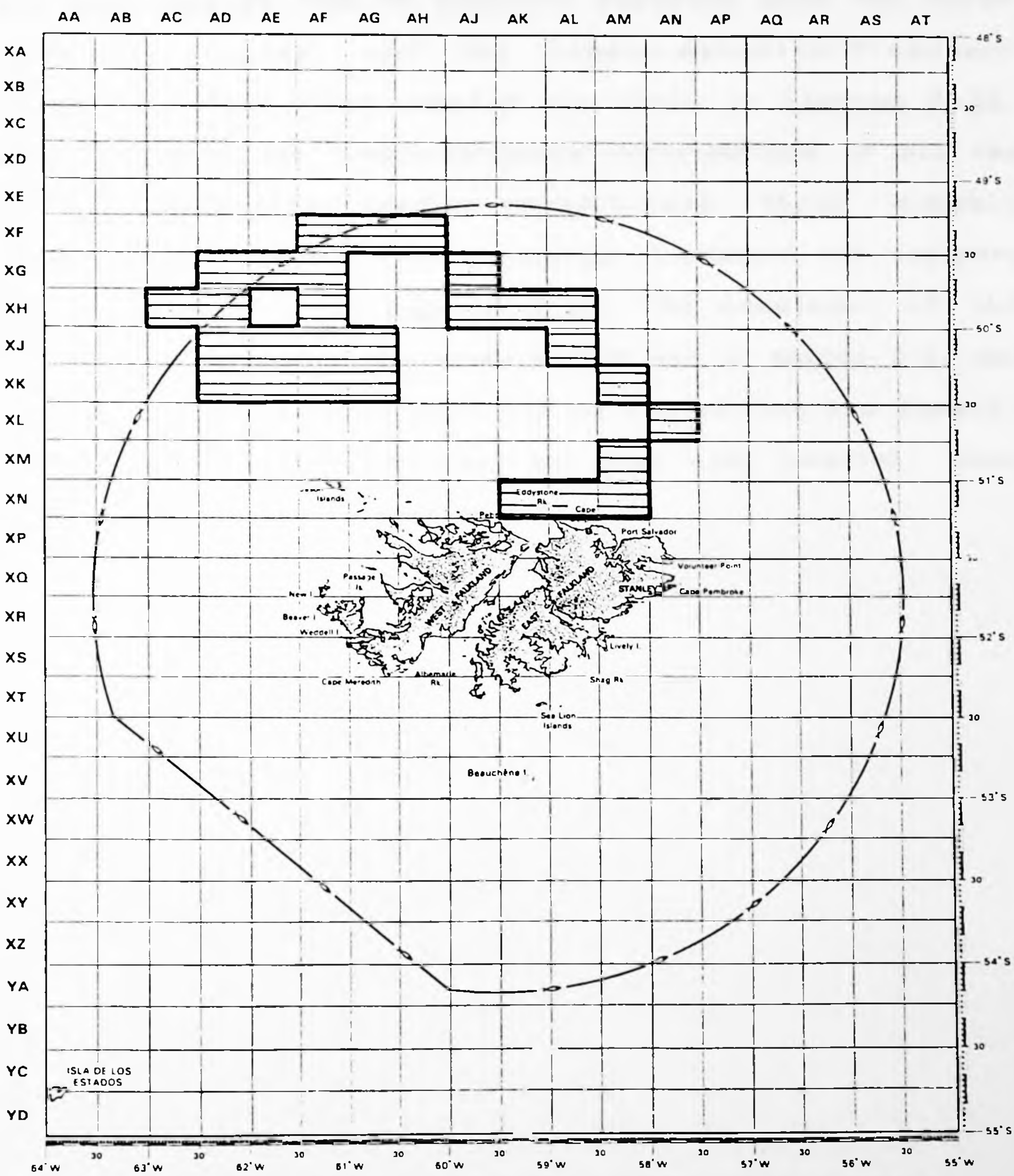
Based on part of Admiralty chart No. 2505 with the permission of the Controller of Her Majesty's Stationery Office and the Hydrographer of the Royal Navy

CHART 5

A chart showing the total area covered during the jigging phase inside the F.I.C.Z. by the 'Koei Maru' between March 9th and 21st May.

FALKLANDS INTERIM CONSERVATION ZONE

This Chart is Illustrative, NOT Definitive



(IV) LENGTH-FREQUENCY AND MATURITY RESULTS

Each squid that was sampled was measured (dorsal mantle length), sexed and its maturity assessed on a scale of 1 to 6 according to the 'Lipinski Universal Scale'. A total of 6957 Illex were sampled from 88 separate stations over the three months of jigging, and the length-maturity-frequency distributions from these samples are shown in Figures 6-22. Figures 6-7 show the length-frequency distributions of all the female and male Illex sampled respectively. Three monthly distributions of length with percentage frequency for separate sexes are presented in Figures 8-13. The remainder of the distributions relate to the areas marked out in Charts 2-3, and serve to demonstrate the variation in sex ratios and length-frequencies, not only with time, but also with location. These figures are discussed in section 2.4.

FIGURE 6

A length-frequency distribution of all the female *Illex* sampled throughout the jigging phase on the 'Koei Maru No.30'. The distribution is split into its constituent maturities.

FIGURE 7

As FIGURE 6, except the distribution is of males.

FIG.6 LENGTH–FREQUENCY DISTRIBUTION

FEMALE ILLEX SAMPLED FROM MARCH – MAY 1988

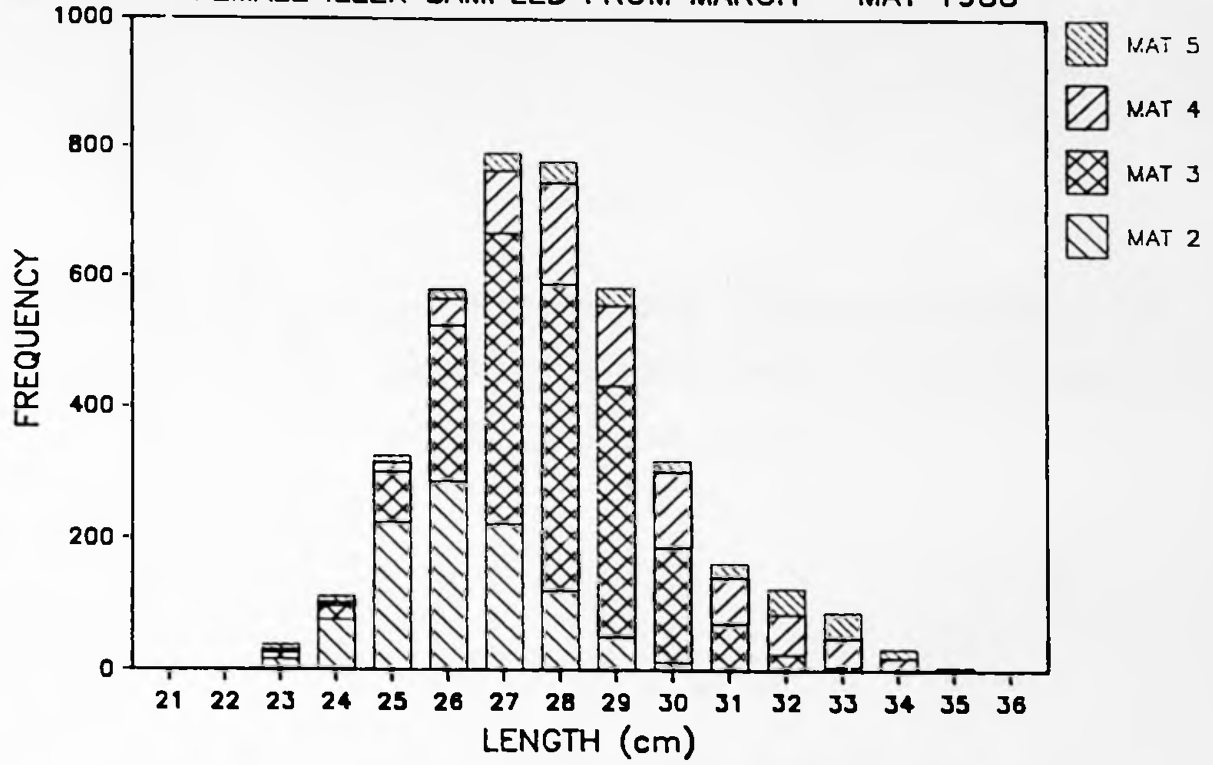


FIG.7 LENGTH–FREQUENCY DISTRIBUTION

MALE ILLEX SAMPLED FROM MARCH – MAY 1988

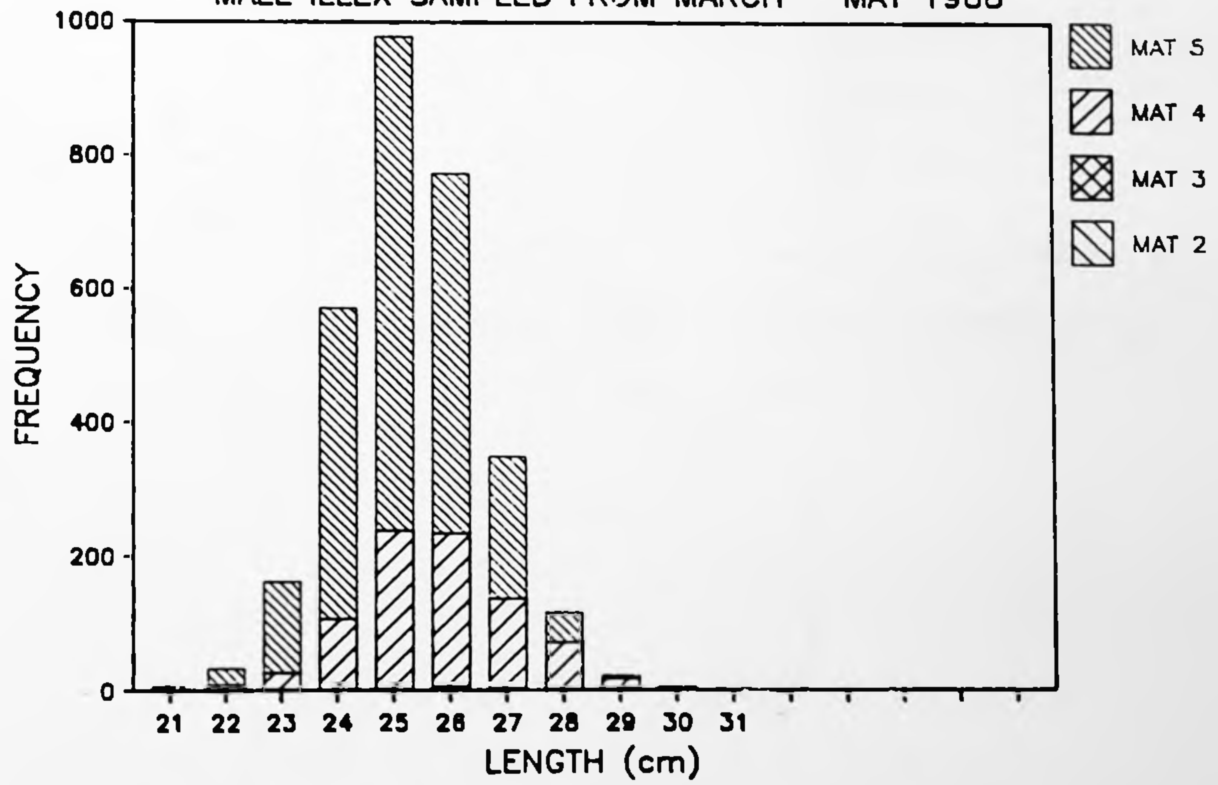


FIGURE 8

A length-frequency (percentage) distribution with maturity for female *Illex* sampled in March 1988.

Mean length = 26.46cm

FIGURE 9

A length-frequency (percentage) distribution with maturity for male *Illex* sampled in March 1988.

Mean length = 24.77cm

FIG.8 LENGTH-FREQUENCY DISTRIBUTION
FEMALE ILLEX, MARCH 1988, N=1345

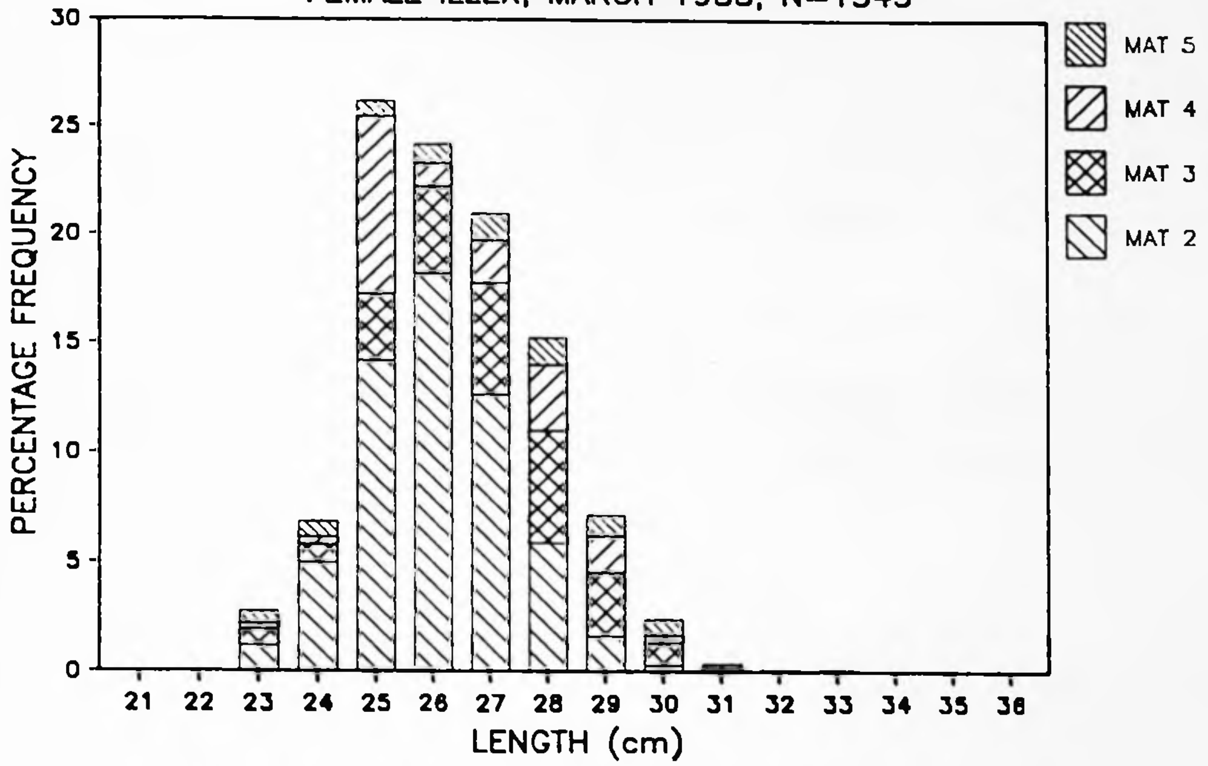


FIG.9 LENGTH-FREQUENCY DISTRIBUTION
MALE ILLEX, MARCH 1988, N=1189

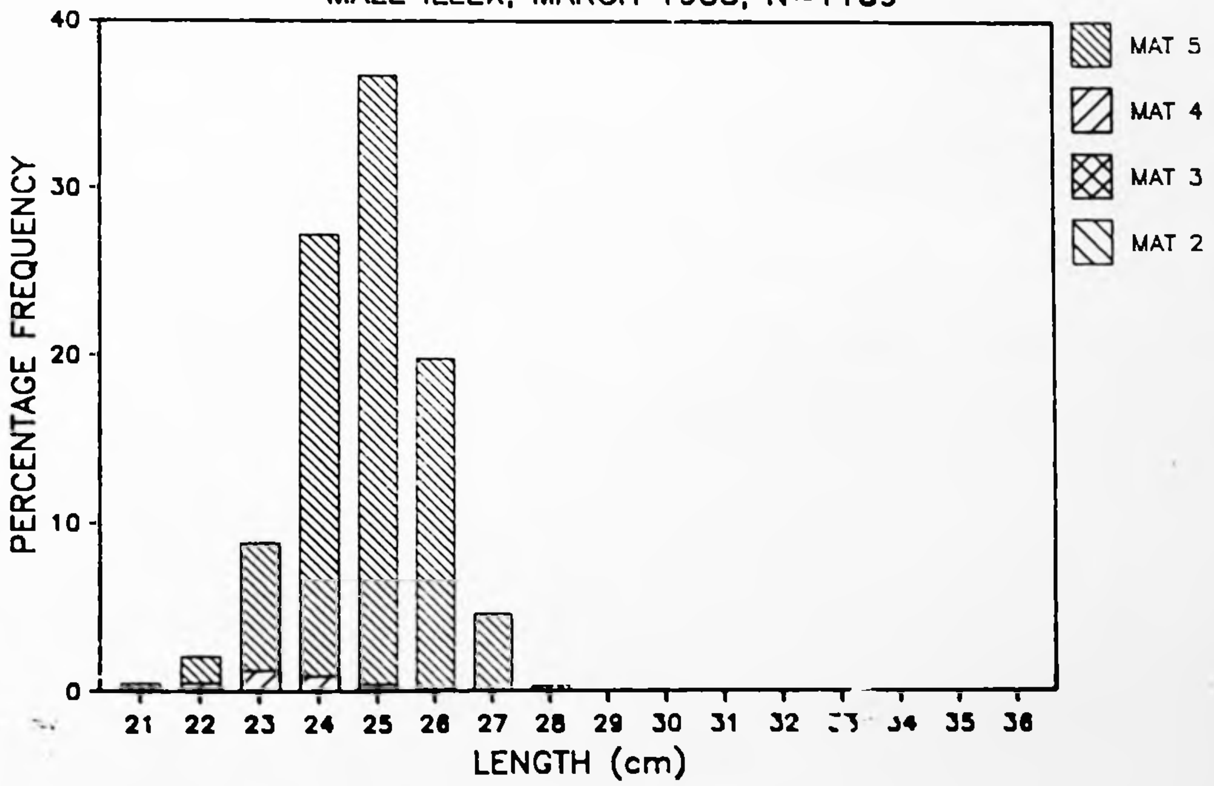


FIGURE 10

A length-frequency (percentage) distribution with maturity for female *Illex* sampled in April 1988.

Mean length = 27.94cm

FIGURE 11

A length-frequency (percentage) distribution with maturity for male *Illex* sampled in April 1988.

Mean length = 25.48cm

FIG.10 LENGTH-FREQUENCY DISTRIBUTION

FEMALE ILLEX, APRIL 1988, N=1978

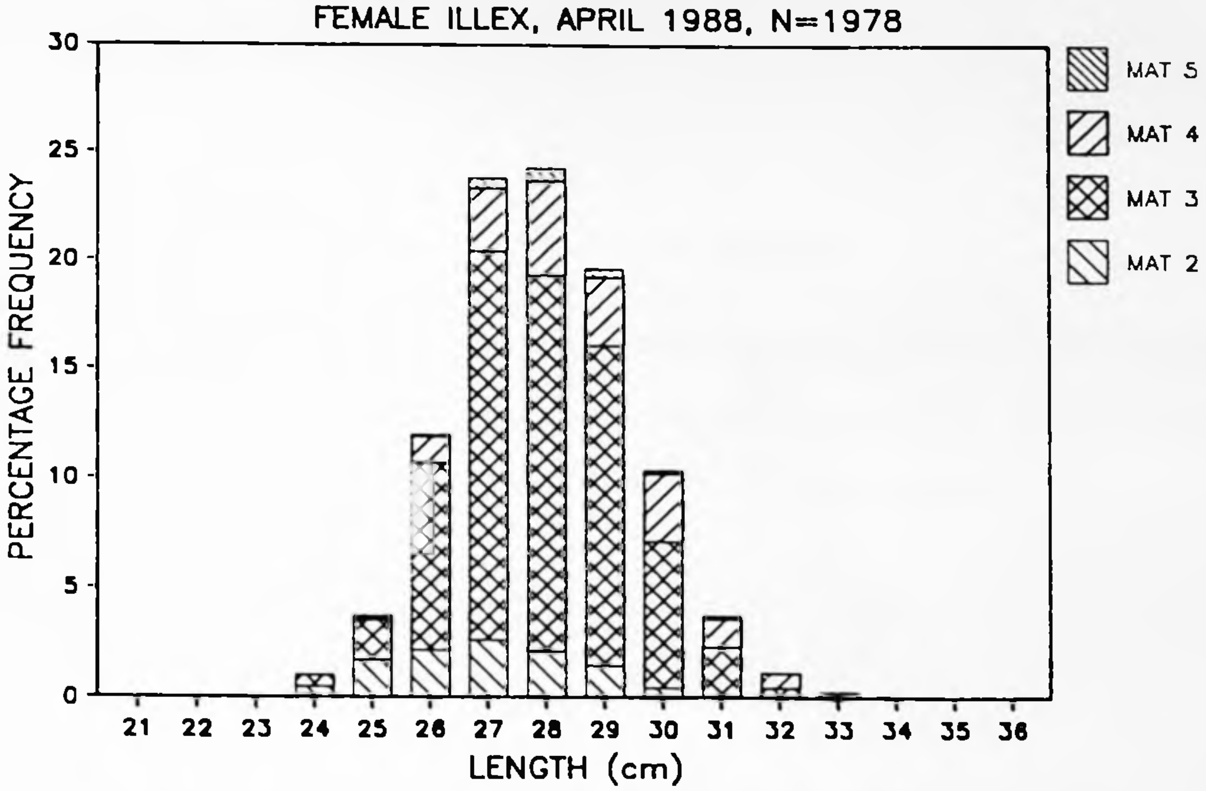


FIG.11 LENGTH-FREQUENCY DISTRIBUTION

MALE ILLEX, APRIL 1988, N=1513

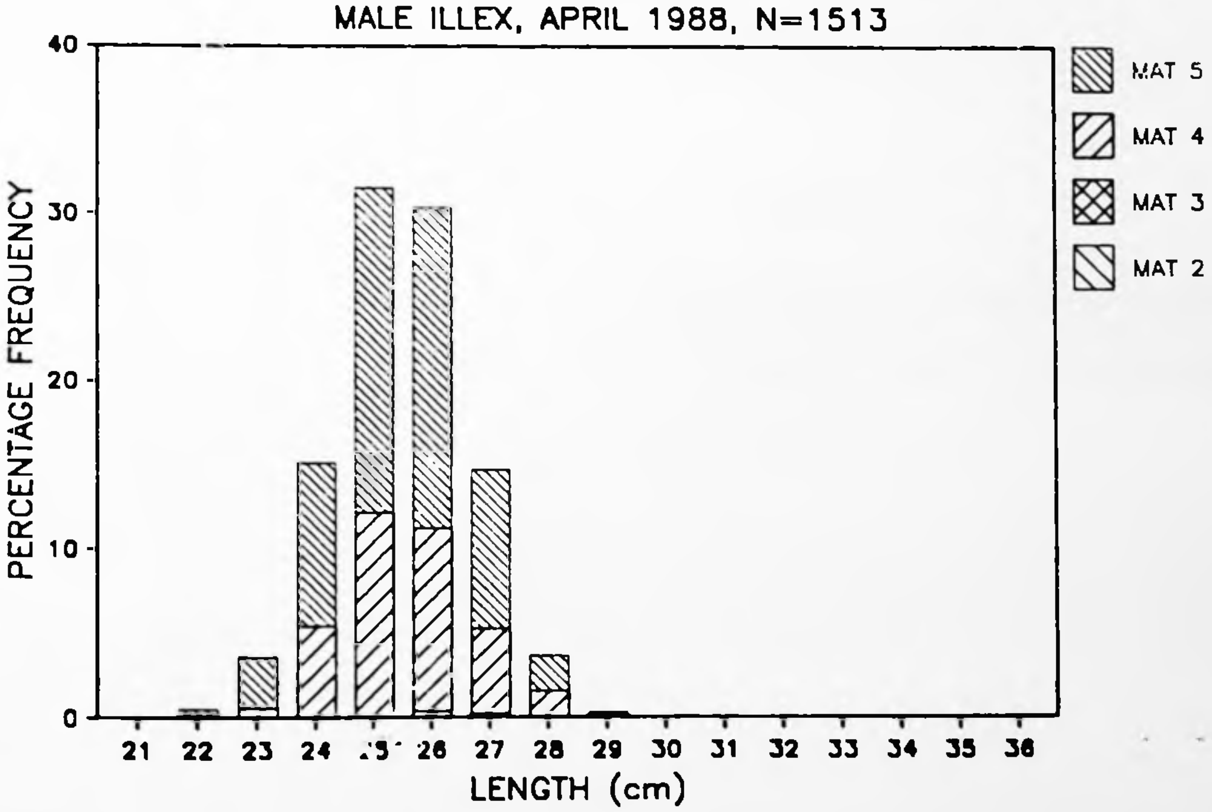


FIGURE 12

A length-frequency (percentage) distribution with maturity for female *Illex* sampled in May 1988.

Mean length = 30.40cm

FIGURE 13

A length-frequency (percentage) distribution with maturity for male *Illex* sampled in May 1988.

Mean length = 26.49cm

FIG.12 LENGTH–FREQUENCY DISTRIBUTION

FEMALE ILLEX, MAY 1988, N=623

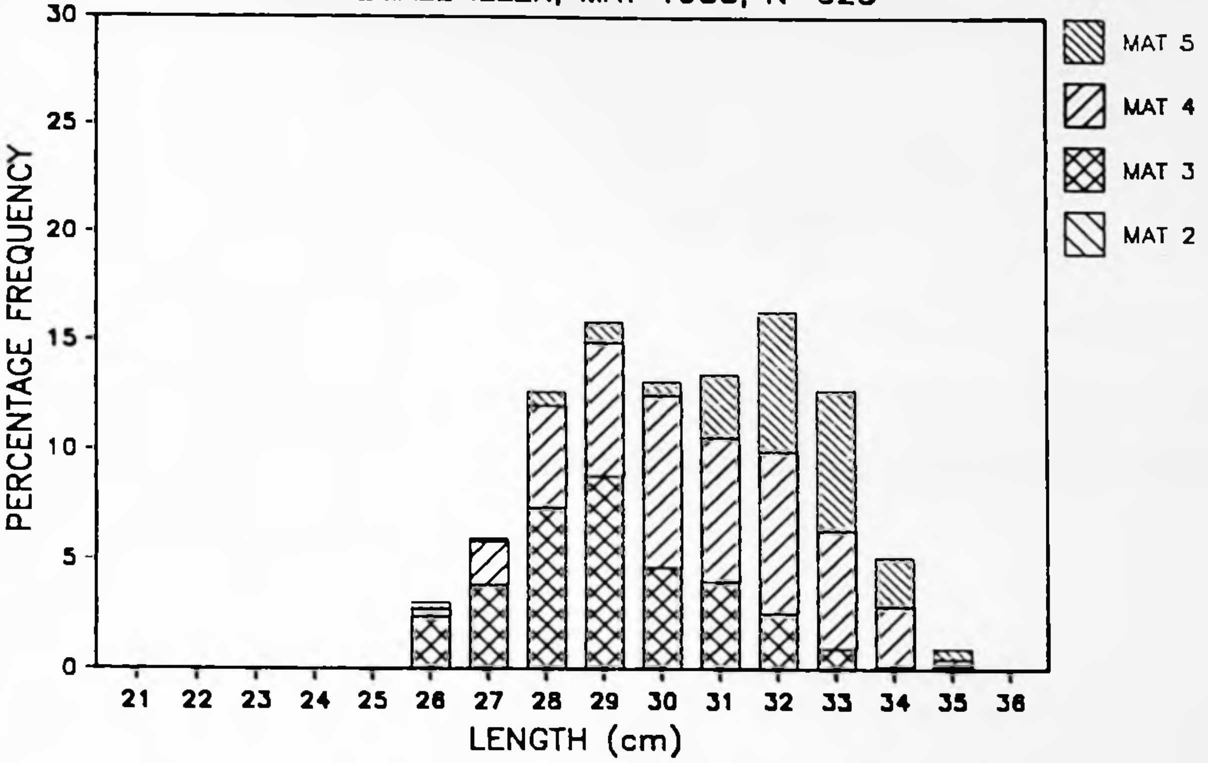


FIG.13 LENGTH–FREQUENCY DISTRIBUTION

MALE ILLEX, MAY 1988, N=309

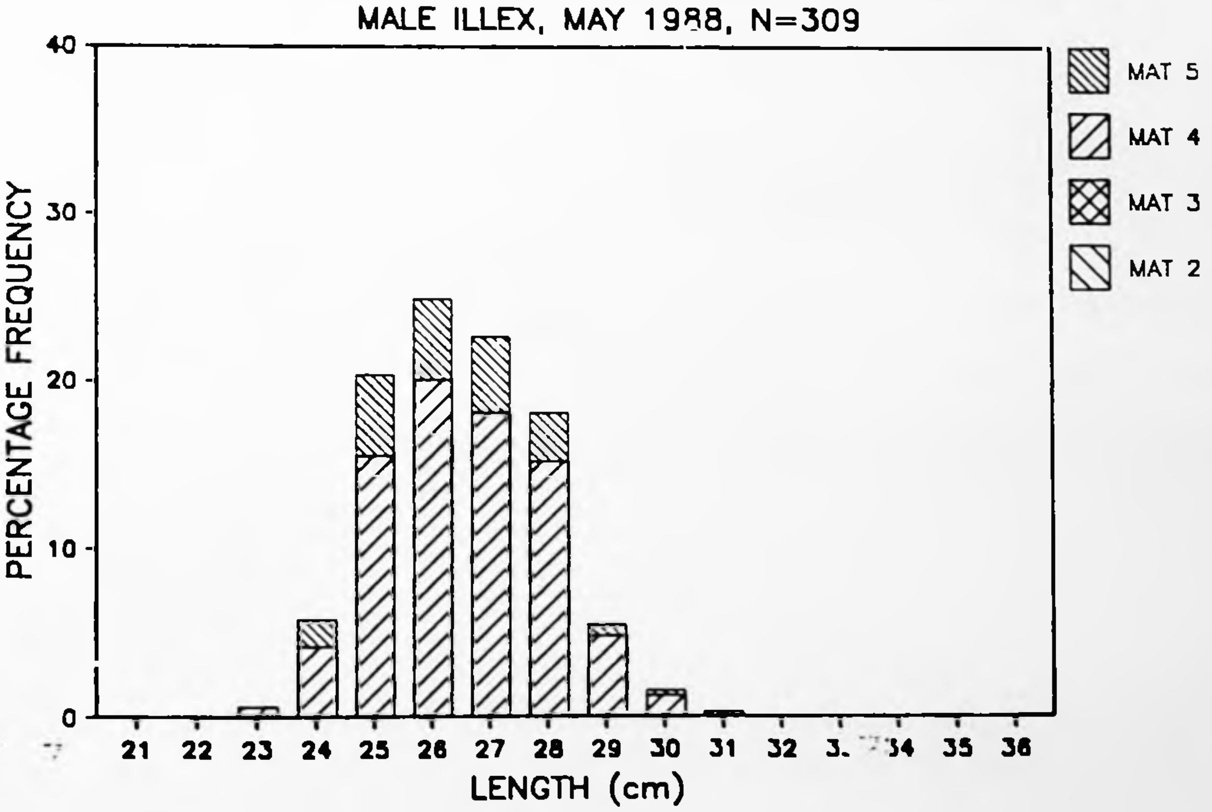


FIGURE 14

A length-frequency (percentage) distribution for male and female Illex sampled by the 'Koei Maru No.30' from area A in Chart 2. 58 squid were sampled.

FIGURE 15

A length-frequency (percentage) distribution for male and female Illex sampled by the 'Koei Maru No.30' from area B in Chart 2. 1958 squid were sampled.

FIG.14 LENGTH–FREQUENCY DISTRIBUTION

ILLEX, CHART 2–AREA A, N=85 (1 STATION)

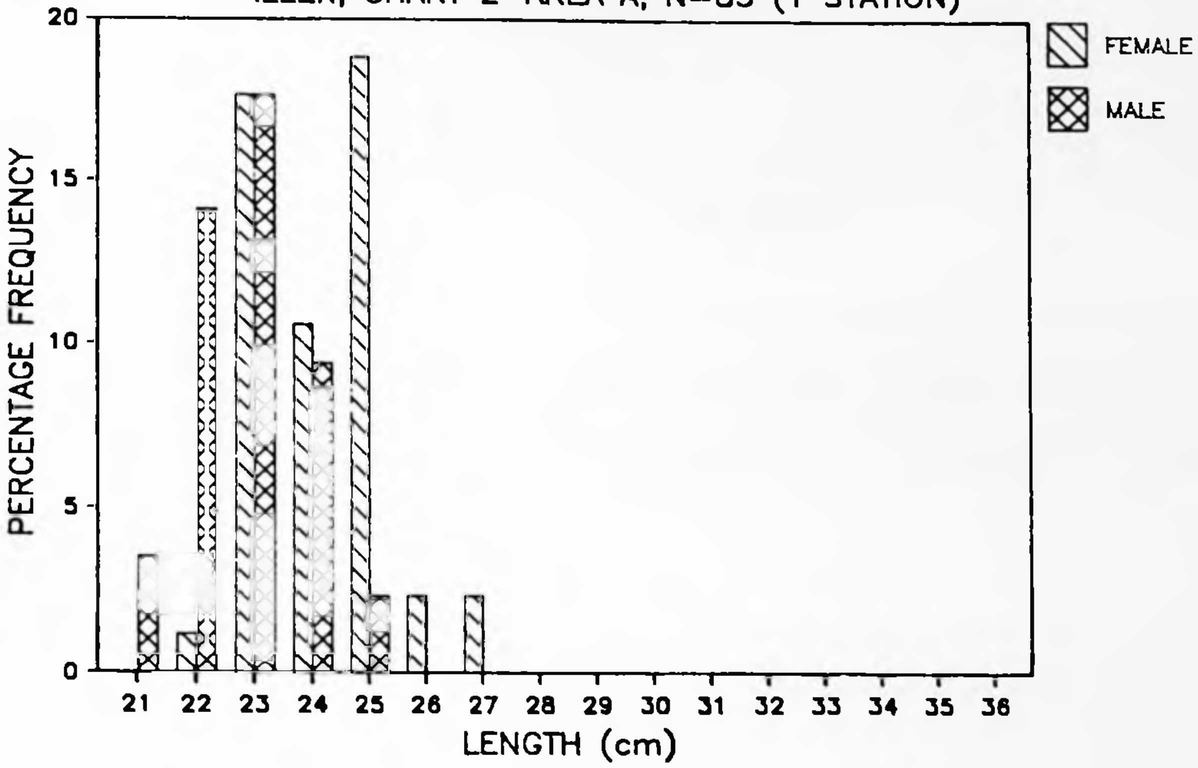


FIG.15 LENGTH–FREQUENCY DISTRIBUTION

ILLEX, CHART 2–AREA B, N=1958 (23 STATIONS)

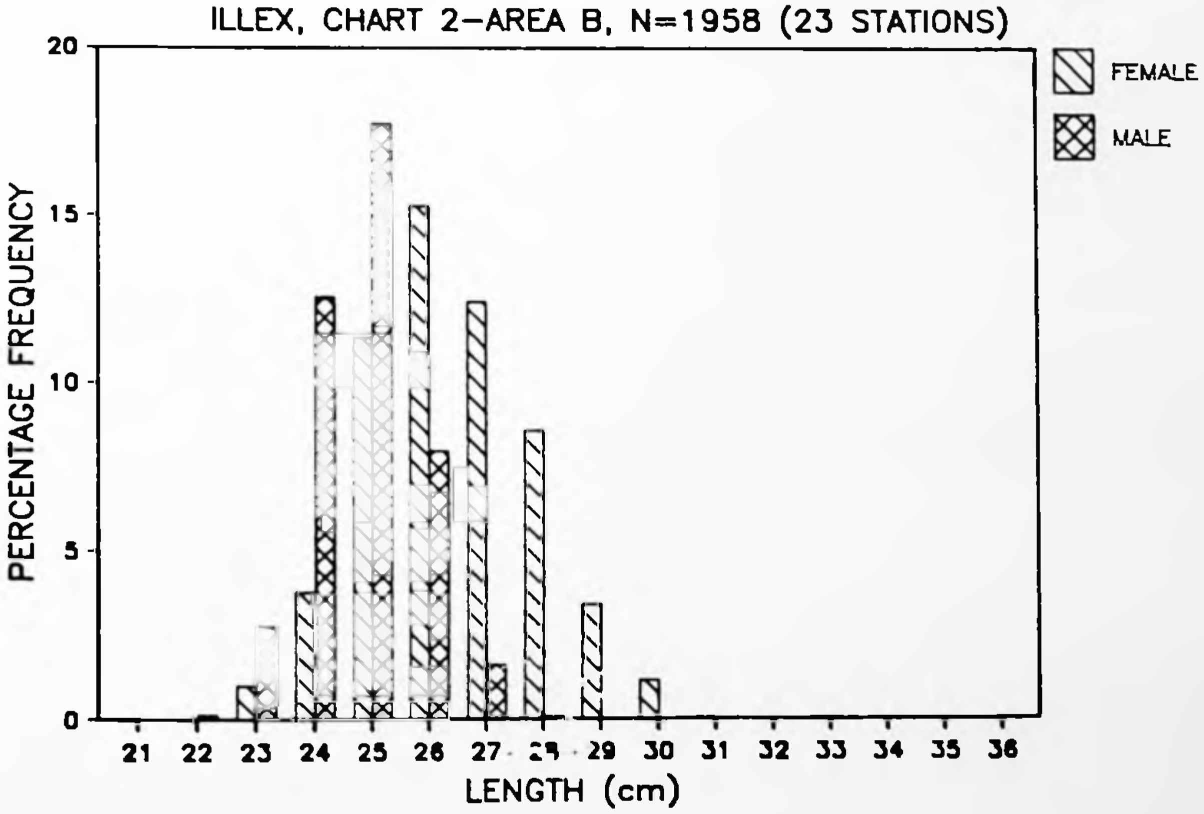


FIGURE 16

A length-frequency (percentage) distribution for male and female Illex sampled by the 'Koei Maru No.30' from area C in Chart 2. 1239 squid were sampled.

FIGURE 17

A length-frequency (percentage) distribution for male and female Illex sampled by the 'Koei Maru No.30' from area D in Chart 2. 176 squid were sampled.

FIG.16 LENGTH-FREQUENCY DISTRIBUTION

ILLEX, CHART 2-AREA C, N=1239 (16 STATIONS)

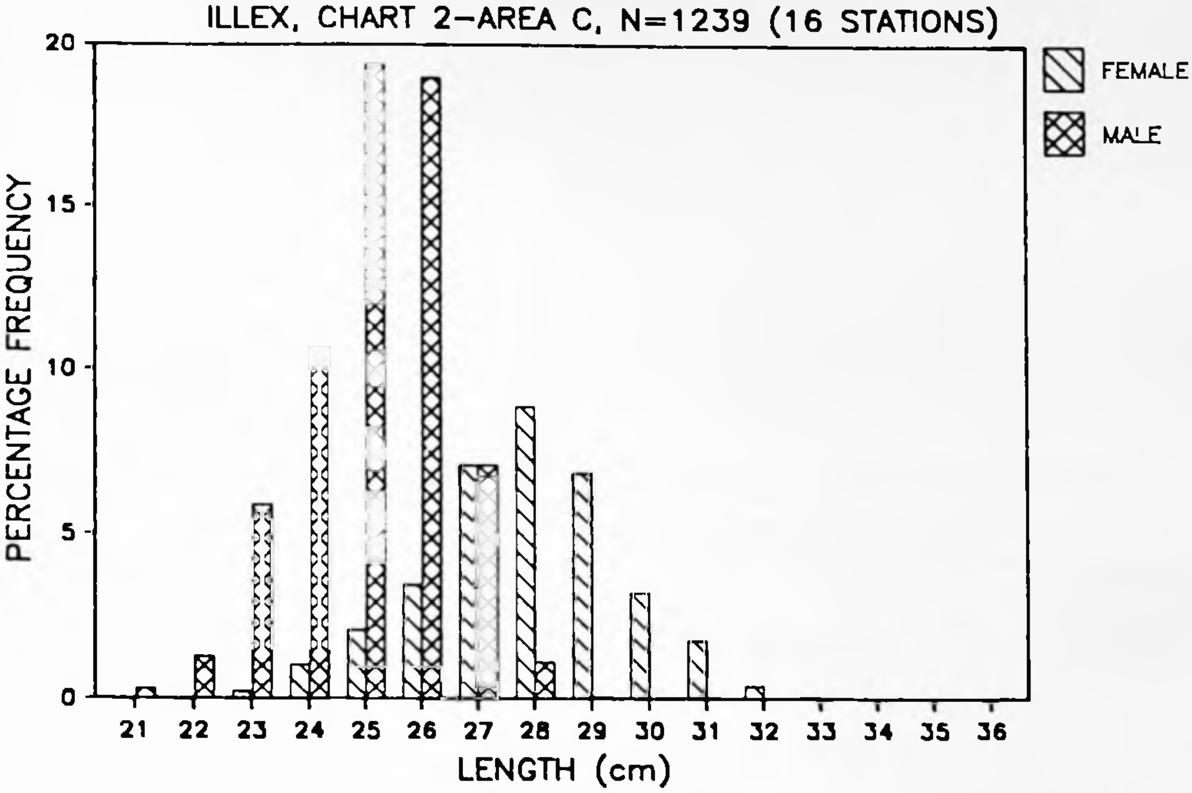


FIG.17 LENGTH-FREQUENCY DISTRIBUTION

ILLEX, CHART 2-AREA D, N=176 (2 STATIONS)

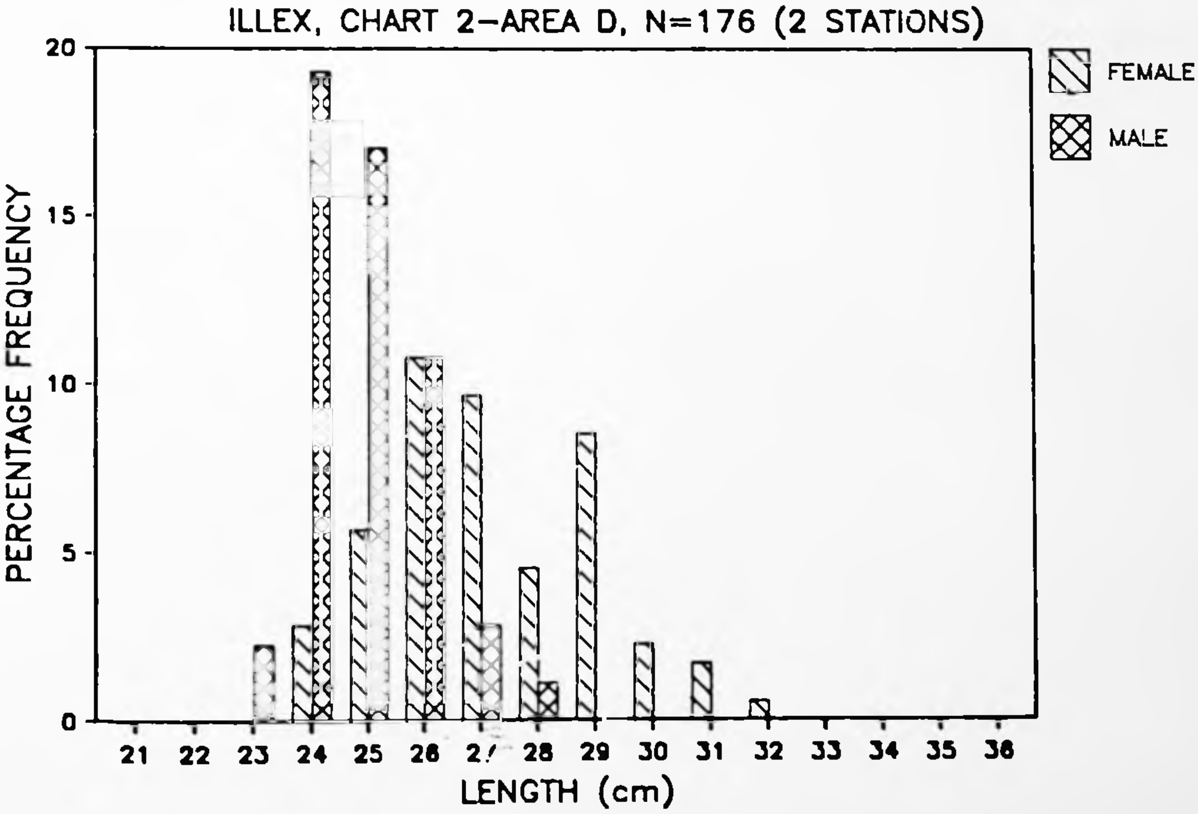


FIGURE 18

A length-frequency (percentage) distribution for male and female Illex sampled by the 'Koei Maru No.30' from area E in Chart 2. 220 squid were sampled.

FIG.18 LENGTH–FREQUENCY DISTRIBUTION

ILLEX, CHART 2–AREA E, N=220 (3 STATIONS)

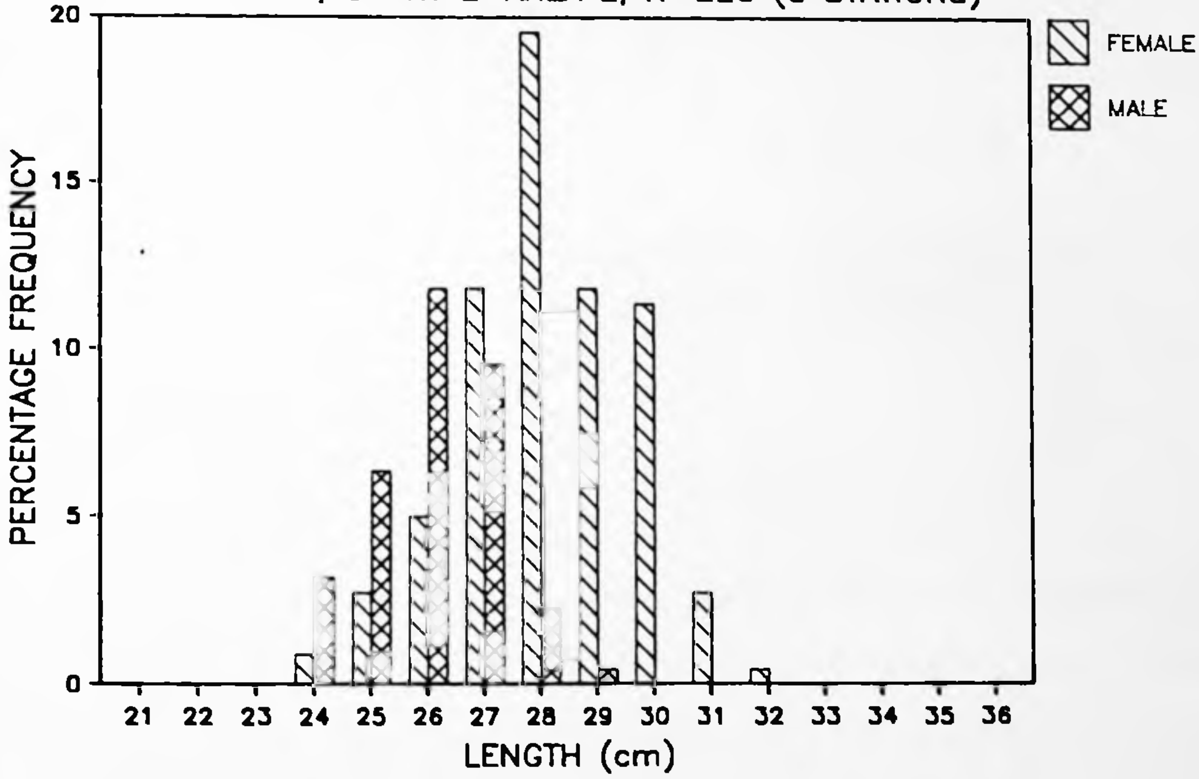


FIGURE 19

A length-frequency (percentage) distribution for male and female Illex sampled by the 'Koei Maru No.30' from area A in Chart 3. 1297 squid were sampled.

FIGURE 20

A length-frequency (percentage) distribution for male and female Illex sampled by the 'Koei Maru No.30' from area B in Chart 3. 1365 squid were sampled.

FIG.19 LENGTH-FREQUENCY DISTRIBUTION

ILLEX, CHART 3-AREA A, N=1297 (16 STATIONS)

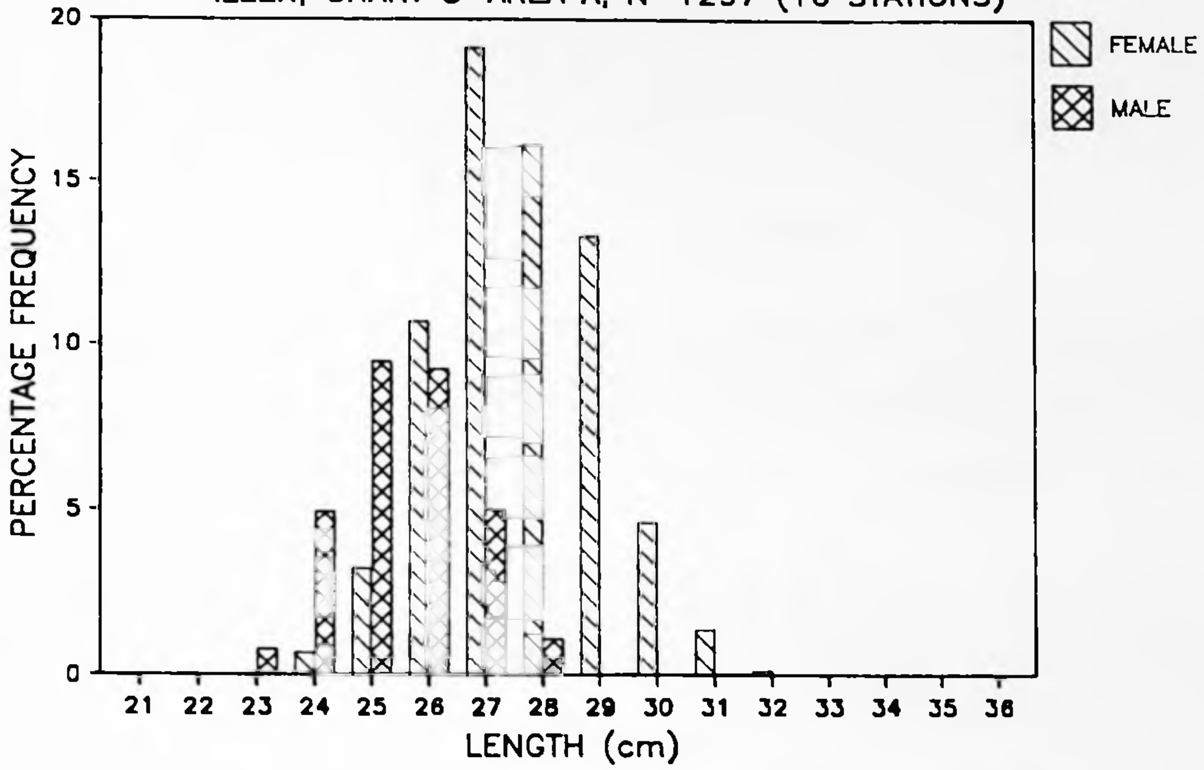


FIG.20 LENGTH-FREQUENCY DISTRIBUTION

ILLEX, CHART 3-AREA B, N=1365 (18 STATIONS)

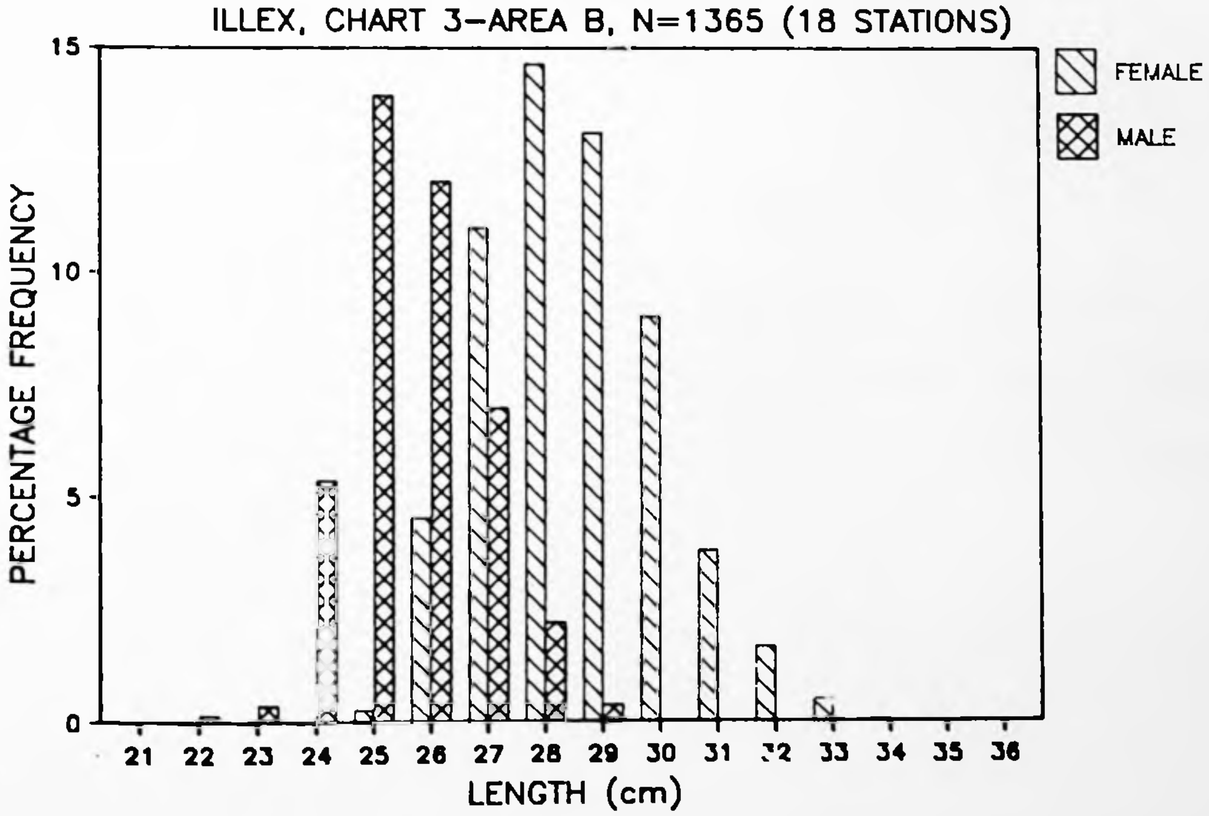


FIGURE 21

A length-frequency (percentage) distribution for male and female *Illex* sampled by the 'Koei Maru No.30' from area C in Chart 3. 279 squid were sampled.

FIGURE 22

A length-frequency (percentage) distribution for male and female *Illex* sampled by the 'Koei Maru No.30' from area D in Chart 3. 338 squid were sampled.

FIG.21 LENGTH-FREQUENCY DISTRIBUTION

ILLEX, CHART 3-AREA C, N=279 (4 STATIONS)

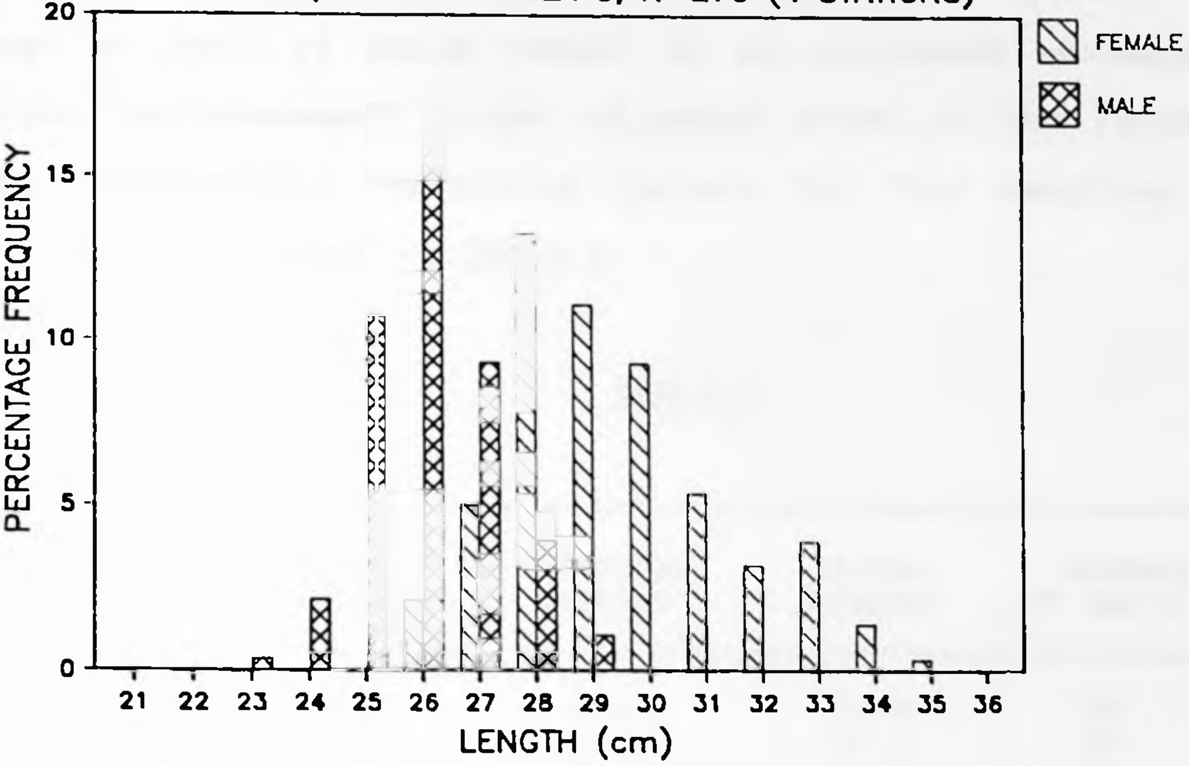
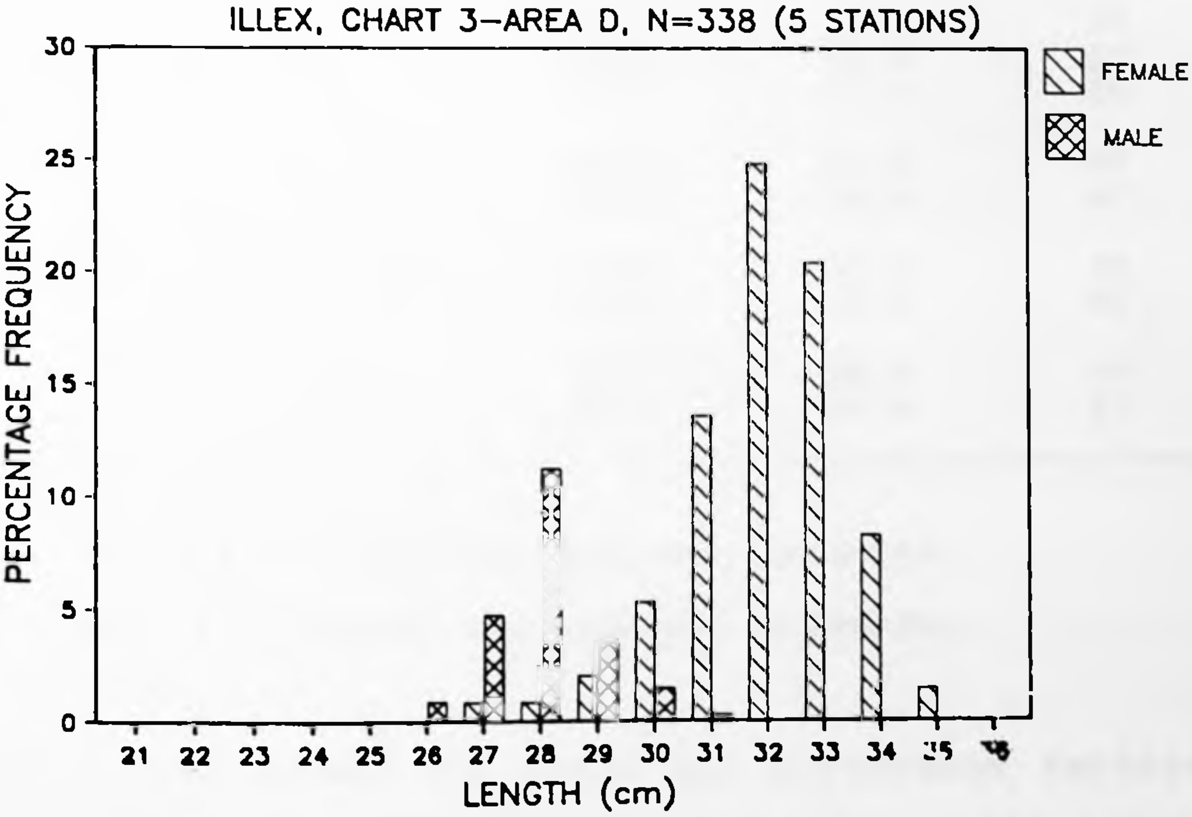


FIG.22 LENGTH-FREQUENCY DISTRIBUTION

ILLEX, CHART 3-AREA D, N=338 (5 STATIONS)



(V) CONVERSION FACTOR EXAMINATION

As mentioned earlier, the conversion factor for squid tubes on the 'Koei Maru' was 1.8. If this proved in any way to be too high or low, it could result in an incorrect estimate of the total pre-processed weight of squid given in the catch report. The experimental conversion factors for five sampling dates in May 1988 are shown in Table 4.

TABLE 4

DATE	TUBE WEIGHT	VISCERA* WEIGHT	TOTAL WEIGHT	NUMBER OF SQUID	C.F
06/05/88	10.5	12.0	22.5	20	2.14
06/05/88	14.5	17.0	31.5	25	2.17
06/05/88	14.0	16.0	30.0	27	2.14
07/05/88	13.5	18.5	32.0	20	2.37
07/05/88	14.5	19.0	33.5	20	2.31
07/05/88	20.0	27.0	47.0	28	2.35
08/05/88	23.0	28.0	51.0	30	2.22
08/05/88	30.0	38.5	68.5	42	2.28
09/05/88	14.5	18.0	32.5	30	2.24
09/05/88	17.0	22.0	39.0	35	2.29
11/05/88	29.0	39.0	68.0	39	2.34
11/05/88	21.0	29.0	50.0	31	2.38

* = Viscera includes head and tentacles.

NB. All weights are measured in pounds.

Having worked out these new conversion factors, it is possible to look at discrepancies between the reported pre-processed catch totals using a C.F. of 1.8, and the recalculated totals using the new C.F's. <u>Table 5</u> displays the original and recalculated catch totals of <u>Illex</u> caught on the 'Koei Maru' for five days in May 1988.

TABLE 5

DATE	TUBE WEIGHT (t)	REPORTED CATCH (t)	NEW C.F.	RECALCULATED CATCH (t)
06/05/88	10.99	19.785	2.15	23.63
07/05/88	11.16	20.088	2.34	26.11
08/05/88	4.17	7.516	2.25	9.39
09/05/88	2.92	5.256	2.27	6.63
11/05/88	10.06	18.115	2.36	23.75

During the five days in May which were examined, the reported catch total was between 19 and 30 percent less than the estimated catch total (using the C.F's. in <u>Table 5</u>). Implications of this will be discussed in part 2.4.

(VI) ILLEX COUNTS

Throughout the jigging period squid were counted as they came on board on six different jigging machines. Counts were concentrated on two machines; one with a double long boom (A) and the other with a double short boom (B). Each count consisted of ten line hauls, and included a separate count of squid which were dropped back into the sea. <u>Table 6</u> compares the squid counts for the machines A and B on 14 occasions.

TABLE 6

DATE	TIME	MACHINE	NUMBER OF JIGS	ILLEX CAUGHT	ILLEX DROPPED
01/04/88	22:10	A	40	61	0
		B	40	107	0
03/04/88	04:45	A	40	4	0
		B	40	2	0
	23:00	A	40	5	0
		B	40	13	0
04/04/88	02:45	A	40	49	2
		B	40	74	0
05/04/88	03:45	A	40	18	1
		B	40	48	0
	22:00	A	40	15	1
		B	40	61	1
14/04/88	21:45	A	28	115	3
		B	40	231	10
	22:00	A	40	162	2
		B	40	186	8
17/04/88	20:30	A	30	104	1
		B	30	69	4
18/04/88	23:00	A	30	2	0
		B	30	2	0
19/04/88	22:00	A	30	27	0
		B	30	36	0
21/04/88	23:00	A	30	71	3
		B	30	97	1
22/04/88	20:00	A	30	96	4
		B	30	138	3
29/04/88	05:00	A	30	2	0
		B	30	3	0

'A' refers to the long boom machine.

'B' refers to the short boom machine.

The following results are produced using Wilcoxon's signed-ranks test for two groups (ie. A and B) arranged as paired observations. The calculations are shown in <u>Table 7</u> below:-

<u>TABLE 7</u>

SAMPLE No.	SQUID CAUGHT PER JIG OVER 10 HAULS MACHINE A	MACHINE B
1	0.1525	0.2675
2	0.0100	0.0050
3	0.0125	0.0325
4	0.1225	0.1850
5	0.0450	0.1200
6	0.0375	0.1525
7	0.4107	0.5775
8	0.4050	0.4650
9	0.3467	0.2300
10	0.0067	0.0067
11	0.0900	0.1200
12	0.2367	0.3233
13	0.3200	0.4600
14	0.0067	0.0100

2 -ve RANKS (B<A)
11 +ve RANKS (B>A)
1 TIE (B=A)

TOTAL 14

Z = -2.2713 2-TAILED P = 0.0231

This result and others presented in this section are discussed in Chapter 2.4.

2.4 DISCUSSION OF THE ILLEX PHASE

Catches of *Illex* during the 1988 season were very good for all nations who participated in the fishery, the Japanese, and the 'Koei Maru NO.30' in particular, were no exception. Unfortunately the market price for *Illex* in Japan was not as high as in previous years, and so the value of the catch was perhaps a little disappointing.

Efficiency of the jigging machines was badly affected by poor weather conditions and ironically when the catch rates were exceptionally high. In both cases lines became entangled and were subsequently lost if left unattended for any length of time. At times up to 30% of the lines were simultaneously out of operation. During heavy swells, the Fishing Master would leave only the short boom machines switched on until the vessel encountered a shoal of *Illex*, so as to reduce the likelihood of tangling. Generally speaking the weather did not present too much of a problem, and although heavy swells reduced the efficiency of the machines, it only meant that once a shoal of squid was encountered it would take marginally longer than usual to fill the pounds. Only one day was entirely lost to bad weather, and served as a most welcome "holiday" for the ship's crew.

Catch per unit effort was highly variable from one day to the next, but when smoothed out into a weekly average (see Figure 5), showed some 'cyclic' pattern, peaking every four weeks. Crew members frequently mentioned the possibility of *Illex* behaviour being related to the lunar cycle. The results of

C.P.U.E. from the 'Koei Maru' would certainly suggest such a relationship, but a great deal more research would have to be carried out in order to prove anything. An extraordinarily high C.P.U.E. was achieved on April 15th, when over seven tonnes of Illex was being caught every hour. Several times during the squid period, the 'Koei Maru No.30' was the most successful jigger in the K.S.J. Corporation fleet, but she had the advantage of being one of the most modern vessels in the Zone this year.

All the fishing grounds were selected by the Fishing Master who was regularly in contact with several other Fishing Masters in the fleet. There appears to be a great amount of mutual assistance granted within the fleet, but very little indeed between fleets belonging to different corporations, as would be expected. It was often difficult, as an observer, to determine the exact reasons behind the Fishing Master's decision to move from one area to another, when at first glance the catch appeared to be more than satisfactory. On one such occasion it transpired that although the catch in one area had been good in terms of tonnage, the Illex were on the small side and therefore less attractive for sale on the market. The whole area fished by the 'Koei Maru' is shown in Chart 5, and probably reflects fairly closely the movements of the whole fleet.

As would be expected, the mean length of sampled Illex increased with time, in females from 26.46cm in March to 30.40cm in May; mean length of males increased from 24.77cm to 26.49cm. For this species of squid, the females are larger than the males, which is in marked contrast with loligo, the other main commercial species of squid in the zone.

By examining Figures 14-22 with reference to Charts 2 and 3 it can be observed that the length-frequencies, and perhaps more obviously the sex ratios, vary from area to area. Perhaps the best example of this is shown by the contrast of Figure 21 with Figure 22, which depict two areas which were sampled over the same two-week period, but which produced very different results.

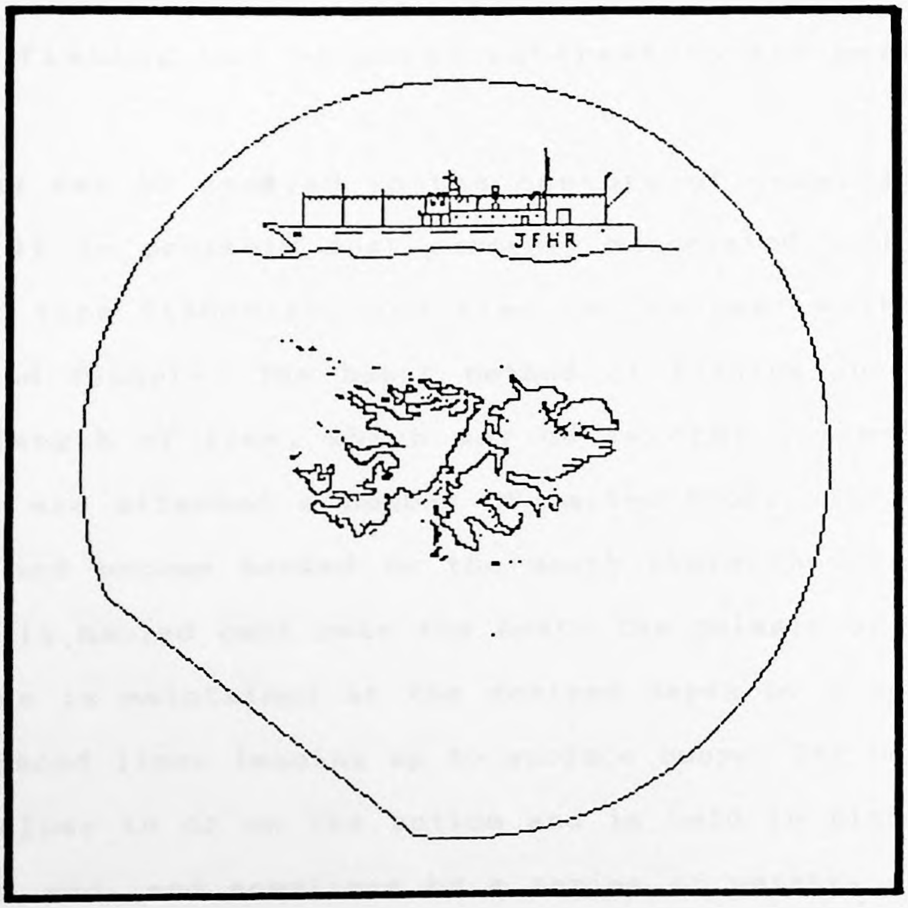
Maturity is seen to increase quite markedly in female *Illex* as the fishing period progressed. The female maturities ranged from II to V, the majority of squid in March being II's and III's, but by May IV's and V's. The male squid were almost entirely made up of IV's and V's and varied only slightly through the season. Too much attention should not be paid to the differing ratios of male IV's and V's by month, since both stages are very similar and may have been incorrectly assessed during sampling. Male IV's often took on the appearance of V's because they had been squashed in the sampling basket, and the spermatophores released into the mantle cavity.

The small amount of work carried out on the conversion factors served to highlight a possible area for revision. The work on this was performed at the latter end of the period when most of the *Illex* were in breeding condition, and hence a large amount of the discarded viscera was gonadal material. It may be that earlier in the season, proportionally less of the total squid weight is composed of gonads, which would possibly confirm a conversion factor of 1.8 as a sensible one. As it stands, the 'Koei Maru No.30' probably under-estimated her total pre-processed catch for the jigging phase, a problem which if multiplied up through the whole jigging fleet could represent a huge biomass of unreported catch. It could be that a 'sliding scale' of conversion factors should be applied as the season progressed in order to compensate for the increase in viscera weight derived from gonad development. This could be an area for further work, and obviously requires more than the five days of observations made during this study.

Catch rates for two separate machines were shown to be significantly different, the short-boom machine being the more efficient than the long-boom, which confirms the comments made by members of the Japanese crew. Once again the volume of work carried out was relatively restricted.

In summary then, the jigging phase of the project was a commercial success, although not as much as was hoped for by the K.S.J. Corporation. The opportunity for several other aspects of jigging to be examined was made possible by having a scientist on board a single ship for extended periods.

The longlining phase which followed the jigging was to be subsidised by the profits made from the Illex, should it have run into financial problems. The following chapter discusses the experimental longlining in the F.I.C.Z. and is followed by an analysis of the costs incurred and profits made from catches for both phases of the fishing.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CHAPTER 3 THE BOTTOM LONGLINING PHASE

3.1 INTRODUCTION

There has been no longline fishing inside the F.I.C.Z. since it was established in February 1987, and therefore this experimental fishing was of great interest to all parties concerned.

Longlining can be applied to the capture of demersal or pelagic fish. It is probably most commonly associated with its involvement in tuna fisheries, and also in the past with the Newfoundland cod fishery. The basic method of fishing involves laying out a length of line, which may be several kilometres long, to which are attached a number of baited hooks. The fish take the bait and become hooked by the mouth where they remain until the line is hauled back onto the boat. The pelagic or sub-surface longline is maintained at the desired depth by a series of regularly spaced lines leading up to surface buoys. The bottom longline lies close to or on the bottom and is held in place by anchors at each end, and sometimes by a series of weights along the length of the line. Spacing of hooks for pelagic species ranges from 30 to 100 metres, and for demersal species from 1 to 3 metres. The 'Koei Maru No.30' was involved only in demersal bottom longlining. In recent years longlining has become highly automated and many of the traditional methods abandoned in favour of mechanisation. The 'Koei Maru No.30' however employed a labour intensive and 'low-tech' style of fishing which is used by only a few Japanese vessels.

(1) THE OBJECTIVES

The main objective was to examine the potential for bottom longlining inside the F.I.C.Z., both in terms of commercial and practical viability. The introduction of a new method of fishing which is effective at targeting for under-exploited species is likely to be welcomed by both the Falkland Islands fishery and the fishing companies involved. There are a number of advantages associated with longlining over other more established methods some of which are as follows; the target species is usually a high value fish and is often caught live and landed in excellent condition; target species may include those which cannot be exploited on a large scale using other fishing methods; longlining can be carried out over a wide range of depths and over a variety of different bottom conditions with a minimum of gear alterations; the method is suitable for almost any size or type of vessel that can operate in the area being worked, provided enough workspace is available aft for setting operations, this means that conversions from other types of vessel (i.e. jiggers) are possible and usually fairly minor.

Another aspect of the project was (assuming successful) to suggest that a number of jiggers, after the end of the Illex fishing, convert for longlining and remain in the zone for extended periods, with a view to fishing in the South Atlantic for a whole year, and cutting the costs of sailing to and from the Orient.

From the scientific research point of view, the project produced data of a hitherto unknown kind inside the F.I.C.Z.; for example target species, catch rates, relationships between catch and temperature, soak time, depth etc. It also provided an insight into the methods used for this type of fishing, and the advantages and disadvantages over other fishing vessels in the context of the Falkland Islands fishery.

The K.S.J. Corporation listed its objectives in a letter proposing the project, as follows:-

"We firmly believe that the longline feasibility fishing operation will effectively encourage to help:

1) To contribute for Falkland Islands fishing development.

2) To grasp the potential marine resources and its species.

3) To have an assessment on the catches in the Japanese fish market.

4) To contribute for Falkland Islands fisheries benefit in the future."

(II) THE PLAN

A proposal for the bottom longline feasibility project was made to the Fisheries Directorate by the K.S.J. Corporation. Much of their proposed catch requirements came from data compiled during a similar experimental fishery carried out by the 'Koei Maru No.10' in Argentinian waters during 1987. Some 120 operational days were agreed upon by both parties as the period for fishing, of which 60 were commercial targeting days under the control of the Fishing Master and 60 were experimental days under the supervision of the Fisheries Scientist on board who was in consultation with the Fisheries Directorate. The 120 days were shortened to 80 due to a number of unforeseen circumstances and practical problems.

The two target species planned by K.S.J. before fishing commenced were toothfish (Dissostichus eleginoides) and mullet (Eleginops maclovinus). This was completely revised once fishing began, and in fact mullet played virtually no part in the exercise at all.

The longline fishing was due to begin on the 11th July 1988, but since the jigging phase had been shortened, longlining actually began on the 15th June. The programme of planned events and catches is shown below:-

1. 120 operational days to be spent in the zone.
2. 60 days target fishing, and 60 experimental sampling.
3. Average daily catch of processed fish = 5 tonnes.
4. Total processed weight of fish = 120 x 5
   = 600 tonnes.
5. Details of product:
   200 tonnes of toothfish @ 280 Yen per Kilo
   = Y56,000,000
   200 tonnes of mullet @ 280 Yen per kilo
   = Y56,000,000
   200 tonnes of others @ 80 Yen per Kilo
   = Y16,000,000

   Total predicted value of fish = Y128,000,000.

Most of the original planned schedule can be ignored since it bears little resemblance to the eventual catches. It appears that the K.S.J. Corporation plan for the longlining phase was possibly not as well researched as it could have been, given the data which was collated from the 'Koei Maru No.10' in 1987. It must be assumed therefore that at the time of making the proposals, the Argentine experimental results had not been made available to K.S.J..

The target species were in fact Toothfish, Kingclip (Genypterus blacodes), Hake (Merluccius australis and M. hubbsi) and Ray species. All of the fish were processed; the Kingclip were headed, gutted and tailed, as were the Hake and Toothfish; Only the 'wings' of the Ray were kept. The Fishing Master explained that the fish were relatively unknown on the Japanese market, and would sell better if they were headed and tailed than if they were whole.

The details of the materials and methods used during the longlining phase are discussed in the following section.

3.2 METHODS AND MATERIALS

According to her Fishing Master, there are only about 20 fishing vessels in Japan which practice the same method of bottom longlining as the 'Koei Maru No.30'. It is a style which uses a minimum of automated machinery and an array of both modern and traditional tools. Although the ship was built as a dual purpose jigger/longliner, there were still a number of alterations, mainly to the factory area, which had to be effected before she could begin longlining. Montevideo was the port selected for the refitting programme.

(I) THE REFIT IN MONTEVIDEO

The 'Koei Maru' left Stanley on May 26th and steamed at 10 knots, skirting around the Argentine E.E.Z., towards Montevideo, Uruguay; the vessel docked at about midday on the 30th May. During the voyage the crew dismantled the squid pounds, conveyer belts and work benches in the factory, creating an empty workspace in which to set up the new equipment. Various longlining accessories, which had previously been stowed away in the ship's holds, were gathered together so that preparation for the longlining could begin. A total of 11 days were spent in Montevideo for the conversions, after which the ship steamed back towards the F.I.C.Z..

Two new crew members, who had been flown out from Japan, joined the vessel in Montevideo. They were well acquainted with bottom longlining on the Patagonian shelf, having crewed on the 'Koei Maru No.10' the previous year, and instructed the regular crew in longlining techniques.

The conversions and installations of equipment can be summarised as follows:-

1. The installation of a line hauler (gurdy) on the stern deck, to be used for the retrieval of marker buoys.

2. Complete stripping of the aft freezer hold (hold No.4) for conversion into the line deployment and repair area. Installation of a boiler to heat the hold and dry the lines. Storage pens built for weights and prepared lines.

3. Removal of all jigging machine stands on the starboard deck, to provide a clear gangway along the working side.

4. Re-design of the factory to accommodate a central conveyer, a fishing platform, a line hauler for the main longline, an elevator leading to the pound (monkey pen), a heading and gutting work station including a circular saw, a washing pound, and an elevator leading to the sorting and packing station. In addition, the bulkhead above the fishing platform was cut away and attached to a hydraulic lift apparatus, in order to create headroom for the fishermen during fishing operations; the bulkhead could be raised open or closed as desired.

5. The placement of spotlights in strategic positions to light up deployment and hauling operations during dark hours.

A Uruguayan workforce was involved with most of the cutting and welding jobs, but the carpentry and fitting of equipment was carried out almost exclusively by crew members. There was a substantial amount of line preparation which had to be completed before fishing began, such as tying hooks to trace lines etc. which kept the crew busy for most of the port call. The description of gear and its preparation is given below.

(II) BOTTOM LONGLINING GEAR

The functional unit of the bottom longlining gear consisted of a groundline, gangions (snoods) and hooks, made up into 75 metre sections (baskets).

Hook and Gangion - The hooks used were all of a standard size and type, the dimensions of which are shown in Figure 23.

The hooks were attached to the groundline by a length of three-ply string, known as the 'gangion' (or snood, or gangline, or ganging). Every hook was painstakingly tied to the gangion by hand, a task which was carried out by all members of the crew throughout the longlining period. Each gangion was 1.2 metres long and was spaced apart on the groundline at between 1.6 and 2.0 metre intervals. Snap-on gangions, which are now commonly used in bottom longlining, were not employed; instead, each gangion had to be manually tied on to the groundline, a tedious and time-consuming practice.

The Groundline - The groundline can be described as the "backbone" of the longline, from which the gangions branch. The longline was made up of sections of groundline, called 'baskets', which are tied end to end. A basket can be described as a 75

FIGURE 23

The dimensions and general form of the bottom longline hooks used on the Koei Maru No.30.

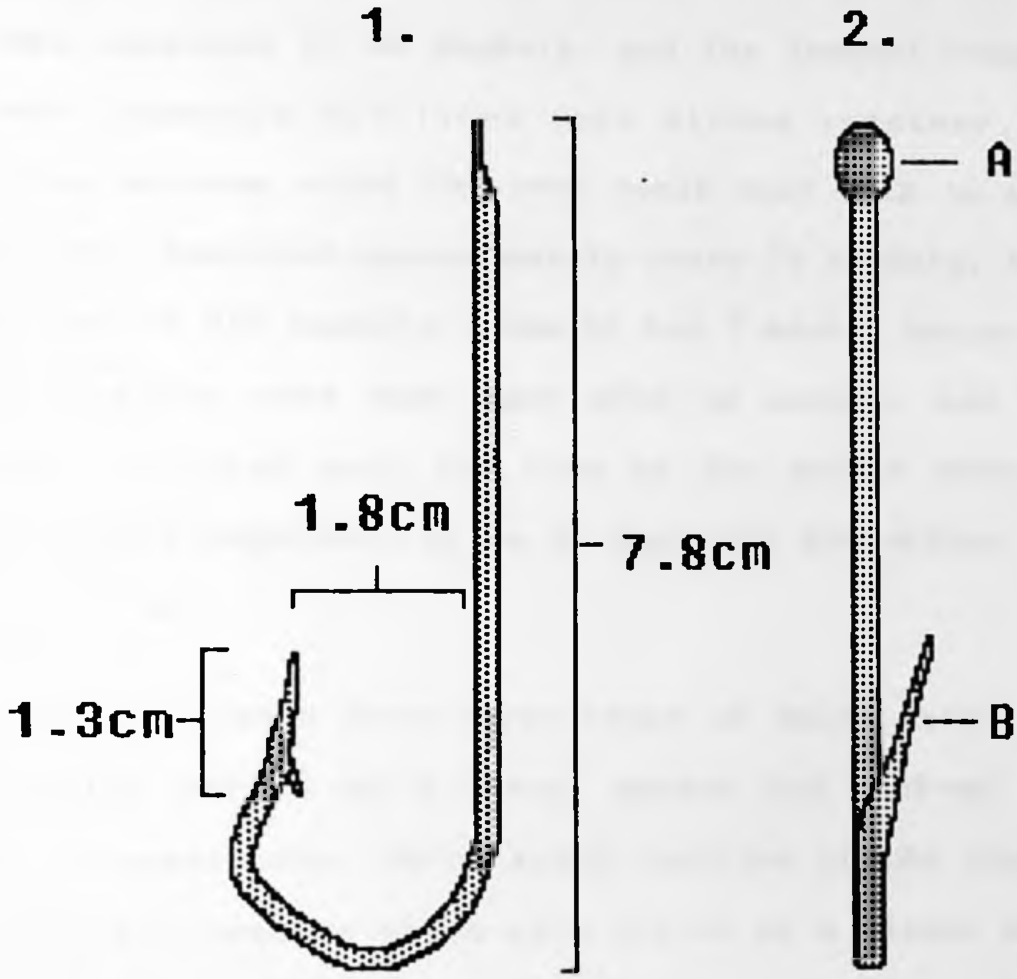


FIGURE 23.

metre length of groundline carrying 38 hooks. The baskets (lines) are stored, neatly coiled, on plastic trays with reed piping round the edges into which the hook points were embedded (see Figure 24).

The Longline - The shortest line used during the longlining operations was composed of 60 baskets, and the longest comprised some 540. Most commonly 510 lines were strung together, this being about the maximum which the crew could deal with in a day. Marker buoys were deployed approximately every 75 baskets, thus a longline made up of 510 baskets normally had 7 marker buoys. Both ends of the longline were made fast with an anchor, and small stone weights were tied onto the line at the points where the baskets were joined together, so as to keep the groundline on or close to the bottom.

Marker Buoys - There were three types of buoys used; large red floats, which served as a visual marker and pick-up buoy; smaller radio transmitters, which aided location of the longline at night; and light beacons which also served as a visual marker during the dark hours. The large red floats were attached by a long rope to the groundline, and at the terminal ends of the longline to the anchor line. The signal buoys were attached to the red floats.

The arrangement of the longline gear used by the 'Koei Maru No.30' is depicted in Figures 25 and 26.

FIGURE 24

A diagram showing the arrangement of the basket (section of line bearing 38 hooks) on the deployment tray.

A = Reed piping rim into which the hooks are embedded.

B = Plastic base of the tray.

C = The groundline.

D = A branching gangion or snood.

E = Hook.

F = Hooks arranged in order around the reed piping.

FIGURE 24

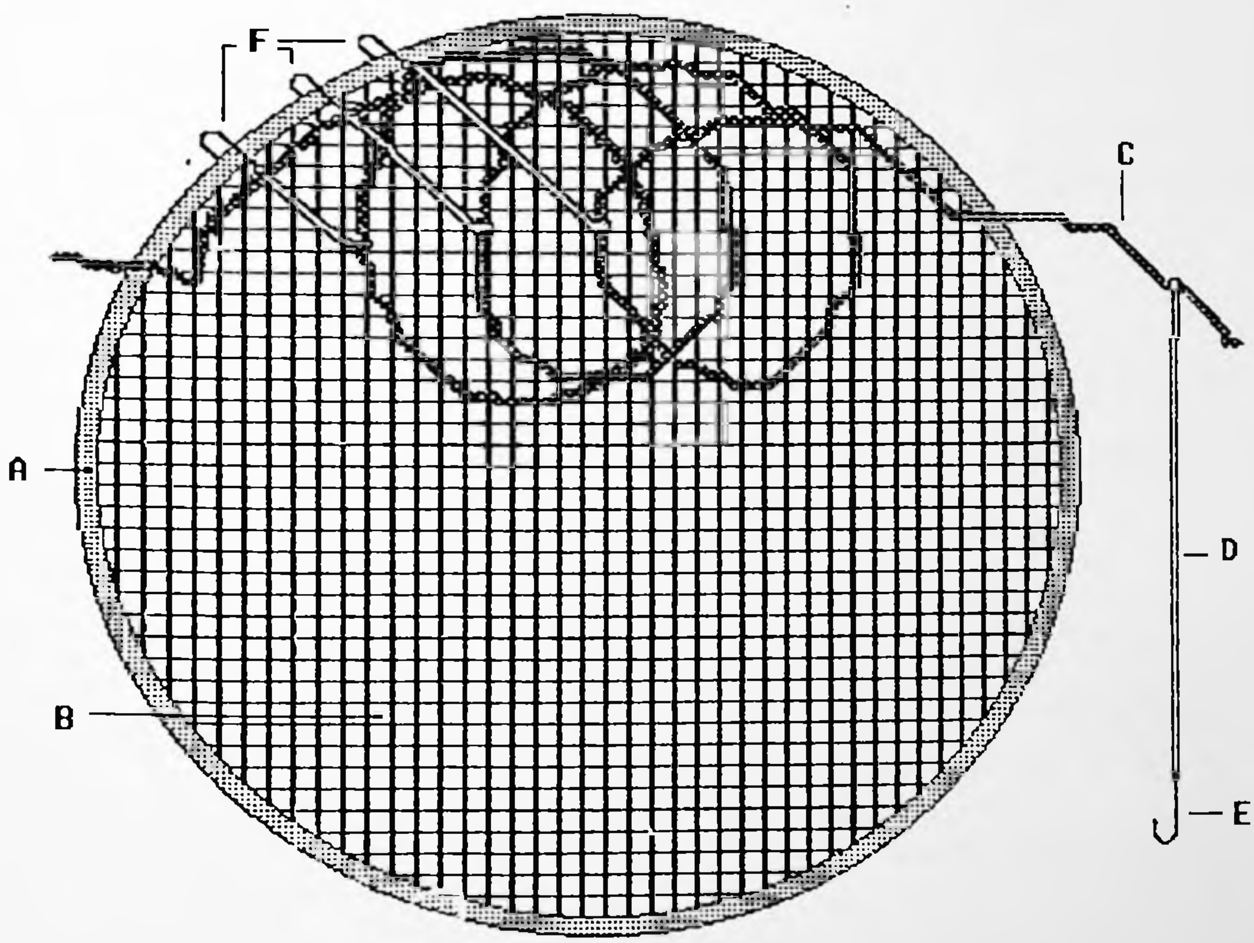


FIGURE 25

The layout of the bottom longline.

(Not drawn to scale).

A = Large pick-up floats.

B = Radio transmitter buoy.

C = Light beacon buoy.

D = Anchor line.

E = Terminal Anchor.

F = Stone weights.

G = One basket of line, bearing 38 hooks and a stone weight at each end.

FIGURE 26

A section of longline showing distances between hooks and the gangion length.

A = Gangion.

B = Baited hook.

C = Stone weight held in a rope net and attached to the groundline at the meeting point of two sequential baskets.

FIG 25

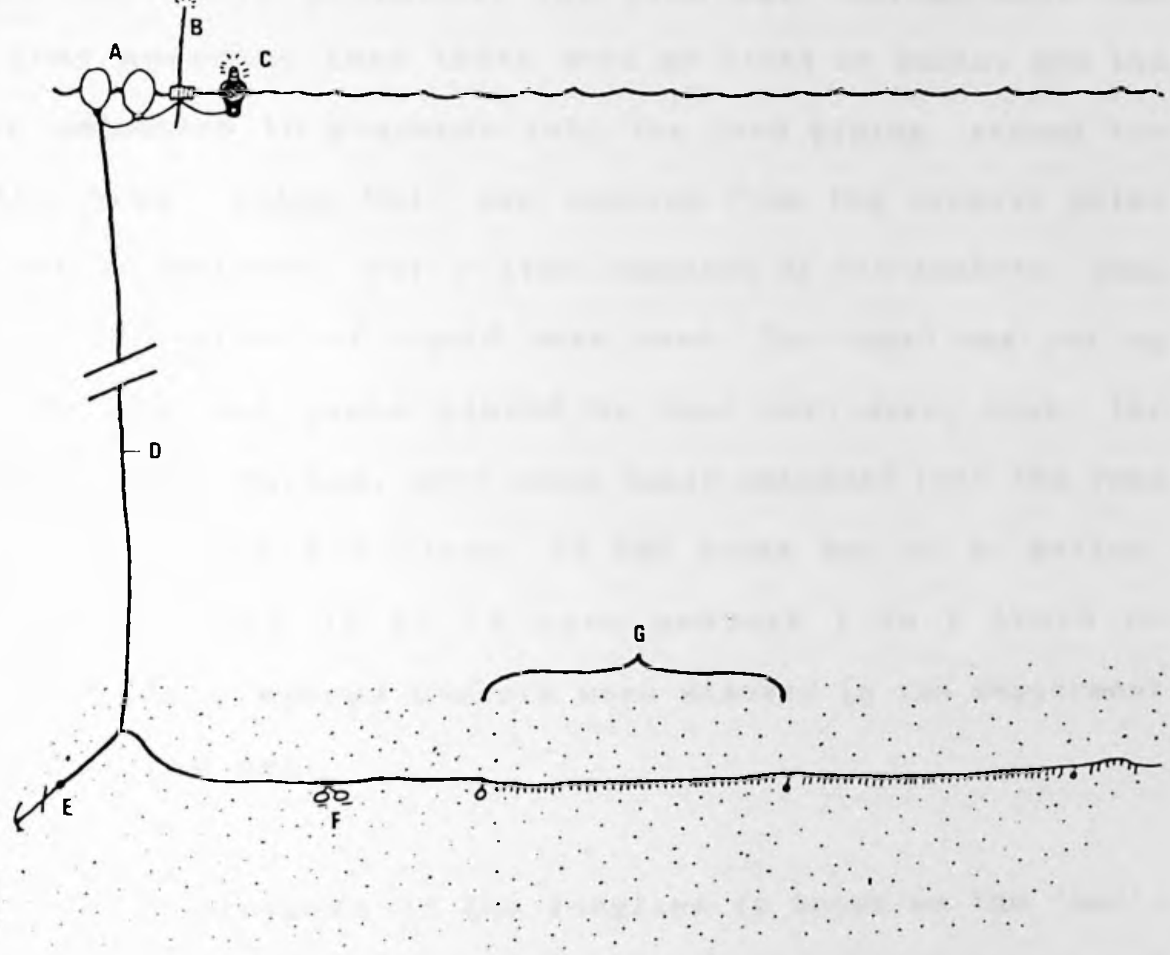
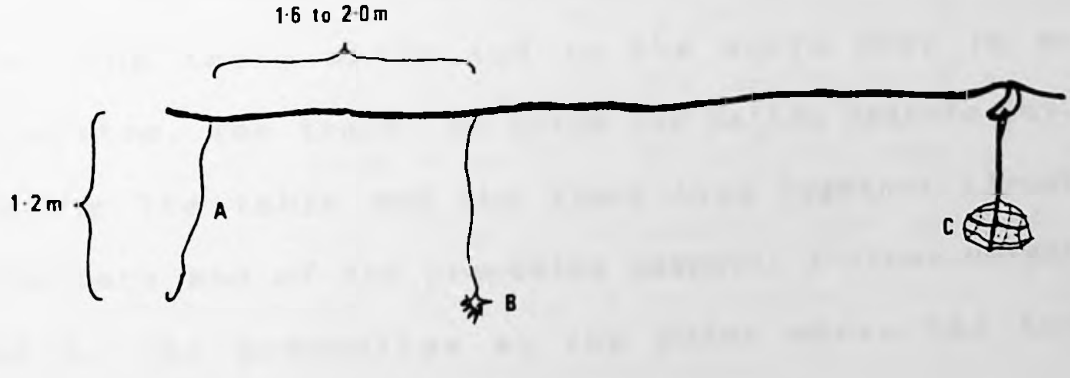


FIG 26



(III) LONGLINING METHODS

Preparation of the lines - Before the set could begin, every basket was carefully prepared. The line was coiled onto the plastic tray ensuring that there were no kinks or knots, and the hooks were embedded in sequence into the reed piping around the edge of the tray. *Illex* bait was removed from the freezer holds and left out to defrost. For a line composed of 510 baskets, some 60 cases or 510 kilos of squid were used. The squid was cut up into pieces, and one piece placed by hand onto every hook; the hooks, having been baited, were once again embedded into the reed piping. For a set of 510 lines, 19,380 hooks had to be baited. Baiting usually took 12 to 14 crew members 1 to 2 hours to complete. All the prepared baskets were stacked in the deployment hold ready for the set.

The set - Deployment of the longline is known as the 'set'. The vessel headed into wind for the set, and steamed at a speed of approximately 7 knots. The line was shot through a stern door which opened from the deployment hold. The set was initiated by a signal from the Fishing Master on the bridge and began with dropping the terminal marker buoys and anchor, which were attached to the beginning of the groundline. The longline was prepared on a long table which led to the stern door in an assembly-line system. The trays, on which the baited baskets lay, were passed along the table and the lines tied together (front end tied to the back end of the preceding basket). A stone weight was then tied to the groundline at the point where the two baskets were joined. At the end of the assembly-line the hooks were freed from the reed piping and the line was allowed to uncoil and pass out through the stern door. The marker buoys, which were prepared on the deck above the deployment hold, were attached to the groundline by a long rope which was handed down to the stern door from the gunwale. When the buoy rope passed out of the stern door, (attached to the groundline), the buoys with several hundreds of metres of rope were released over the side of the vessel.

Using this system of deployment meant that the line was being assembled only 4 or 5 baskets ahead of being shot and there was little room for error. For a longline of 510 lines, the set usually took in the order of two and a quarter hours. Figure 27 shows the arrangement of the deployment hold and assembly line.

At the end of the set, the vessel turned about and returned to the start position in preparation for the haul.

The haul - Like the set, the haul was usually made into wind. The longline start position was located using the radio buoy and the flashing beacon. As soon as the buoys were close by, the cargo door on the starboard side of the factory was hydraulically opened. The buoys were retrieved into the factory from the sea, and the anchor line lifted; attached to the anchor line was the groundline. The groundline was hauled by a power driven wheel, the gurdy, over a roller, set at the base of the cargo door opening, and into plastic collection tubs positioned behind the gurdy. The speed of hauling was controlled by the roller man who was responsible for gaffing the fish as they

FIGURE 27

A diagrammatic representation of the deployment hold (hold 4) during the set.

A = Prepared baskets on trays stacked together.

B = Crew man responsible for carrying baskets to the assembly table.

C = Two baskets tied together, end to end.

D = The Bosun checks the knots and counts the baskets as they pass along the table.

E = Stone weights stored in a pen.

F = Crew member ties on stone weights at the junction where two baskets are tied.

G = The hooks are pushed away from the reed edge, and the line uncoils in a controlled fashion.

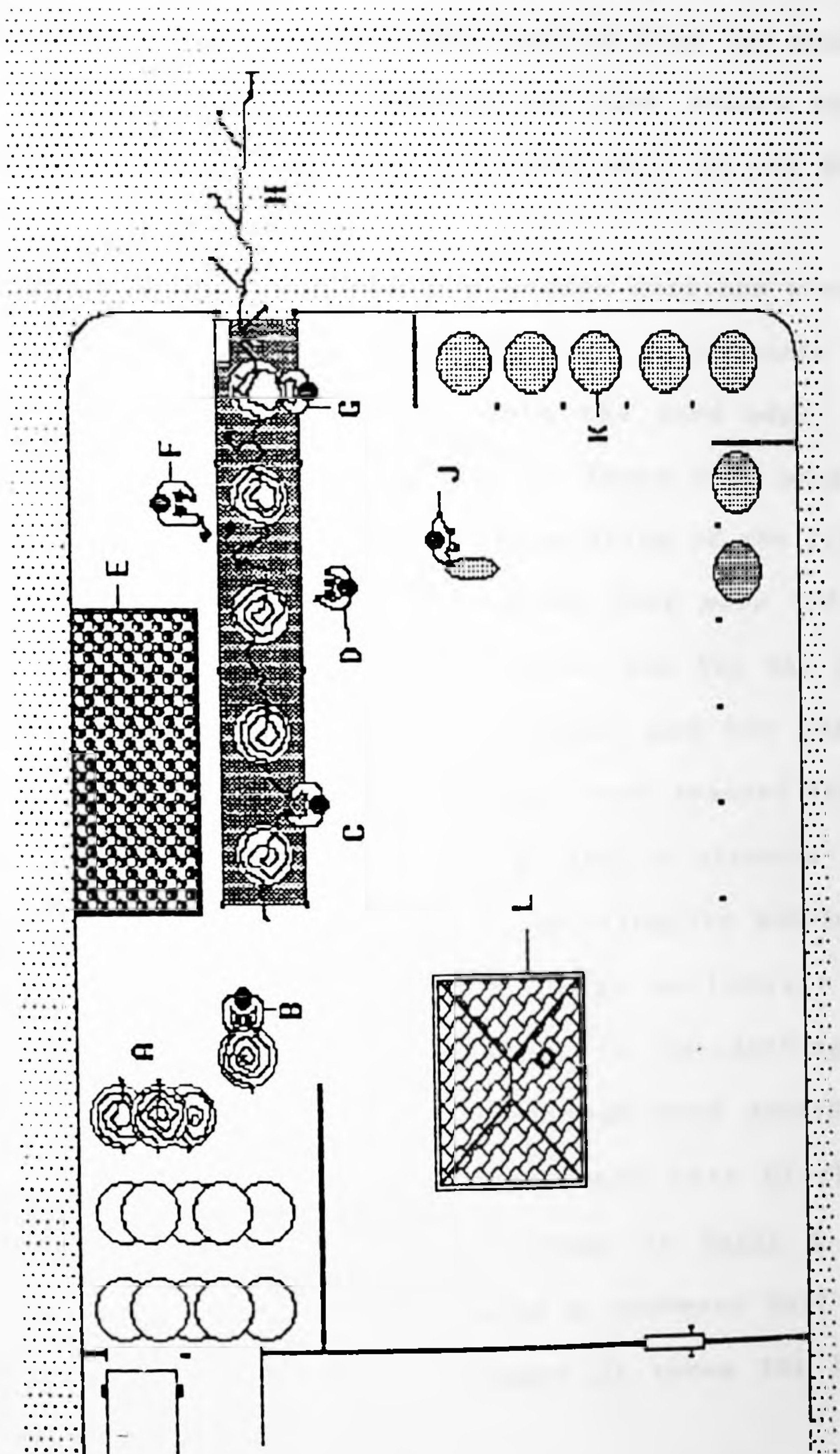
H = The line shoots out of the stern door and into the sea.

J = Crew man carries the empty trays to storage pens.

K = Stored trays.

L = Boiler which drys out the lines when they are brought into hold 4 for repairs.

FIG. 27



surfaced and tearing them away from the groundline. As the line passed over the gurdy the coiler man packed the line neatly into the collection tubs. When the stone weights came up, they were assisted over the gurdy and then untied from the groundline. Each tub was filled with two baskets of line before being sent aft with the stone weights on a conveyer belt to the deployment and line-repair hold.

In the repair hold all the broken gangions were removed and replaced with new ones. The lines were coiled onto the trays as before and the hooks embedded into the reed edge. The finished baskets were stacked and dried out. There were usually 12 or 13 crew working on the repair and preparation of the lines.

After the fish had been landed they were lifted into the pound or 'monkey pen' by an elevator. For the ray species, only the wings were passed into the pound, and the remains thrown directly back into the sea. The fish were removed from the monkey pen and were headed, tailed and gutted. A circular saw was used to remove the heads and tails of the kingclip and toothfish. The processed fish were washed in a large salt-water tank before being transferred, via an elevator, to the sorting and packing bench. The kingclip, hake and toothfish were sorted by size and placed into freezer trays to be frozen into blocks. The size categories for each species are shown in Table 8. Having been packed, the trays were loaded onto a conveyer belt which passed them into the freezer hold. Figure 28 shows the layout of the factory deck during the haul.

After the last basket was hauled, and the anchor and buoys landed, the cargo door was closed and the factory cleaned up. The

FIGURE 28

A diagrammatic representation of the factory hold during the hauling operation.

A = Longline rising out of the water.

B = Roller man, gaffs the fish as they appear. A second roller man with a longer gaff collects any dropped fish.

C = Line hauler, or gurdy.

D = Coiler man, coils the baskets into collection tubs.

E = Crew man untangles knots which occasionally occur in the groundline, and removes the stone weights.

F = Skate wings are removed, and all target fish are put into the elevator.

G = Conveyer to the line repair hold.

H = Fish elevator.

J = Fish pound (monkey pen).

K = Fish headed, tailed and gutted.

L = Salt-water fish cleaning tank.

M = Waste drain.

N = Fish conveyer from cleaning tank to sorting and packing bench.

P = Sorting and packing bench.

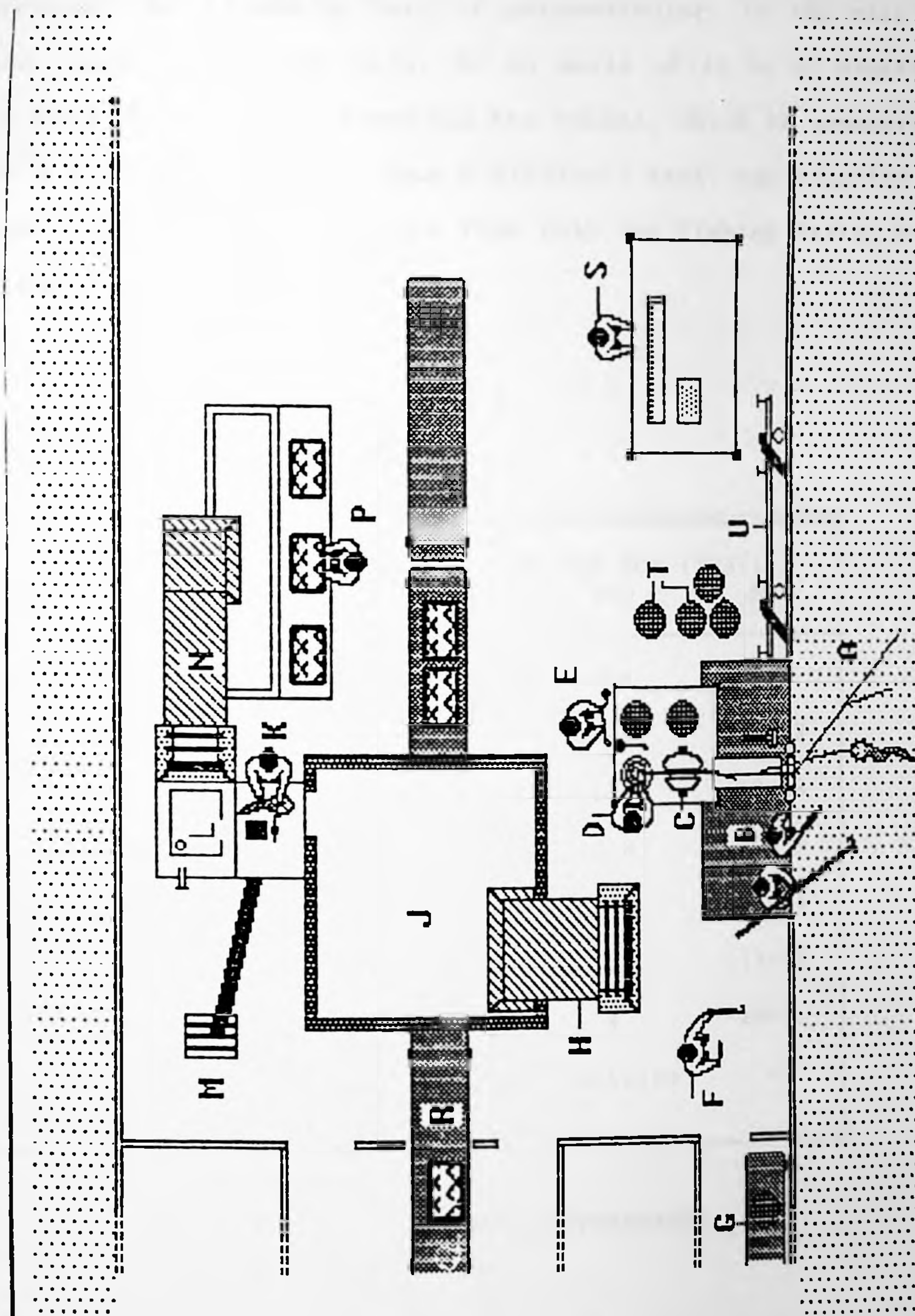
R = Conveyer to freezer hold.

S = Scientist and the sampling bench.

T = Empty collection tubs.

U = Cargo door (in open position).

FIG. 28



vessel then steamed to a new fishing ground. During the haul, the ship steamed at one or two knots and always kept the longline to the starboard side. Ideally the line entered the factory perpendicular, or slightly fore of perpendicular, to the ship's side, and rose out of the water at an angle of 45 to 65 degrees with the water's surface. Steering the vessel, which is unusually long for a bottom longliner, was a difficult task, and required a great deal of skill and patience from both the Fishing Master and the Captain.

TABLE 8

SIZE CODE	PIECES PER BOX (TRAY) KIN	TOO	HAK
SS	34+	34+	68+
S	33-17	33-17	67-49
M	16-11	16-11	48-28
L	10-8	10-8	27-19
2L	7-6	7-6	18-14
3L	5	5	13-11
4L	4	4	10-7
5L*	5 kilos	5 kilos	-

* = Individual fish weight. (Processed).

(IV) SAMPLING METHODS

The sampling programme - The sampling programme was worked out on the basis that of the 120 days planned 60 were set aside for target fishing and 60 for random sampling. This original assumption had to be revised when it became clear that less time was to be spent fishing than expected. For purposes of the survey, the F.I.C.Z. was divided up into 4 areas; NE, SE, SW and NW. Each area was then subdivided into water depth ranges. The depths which longlining could operate ranged from roughly 150 metres up to a maximum of 500 metres, and so the depth categories decided upon were: less than 150 metres, 150 - 250 metres, 250 - 500 metres and over 500 metres (see Figure 29). A number of days were deducted from the 60 in anticipation of poor weather conditions, and the remainder were divided up to enable maximum coverage of each quarter according to the 'fishable' area of each. It was hoped that fishing could occur in all depths between 150 and 500 metres. The planned allocation of sampling days was as follows:-

1. Zone I	(NW)	-	12 days
2. Zone II	(NE)	-	15 days
3. Zone III	(SE)	-	11 days
4. Zone IV	(SW)	-	12 days
5. Bad weather		-	10 days
	Total	-	60 days

The actual coverage is discussed in the results section.

FIGURE 29

A chart showing the four zones outlined for the random sampling of the F.I.C.Z.. The area which could be fished lay between the depth of 150 and 500 metres, anything shallower or deeper (dark shading) was ignored for purposes of the sampling.

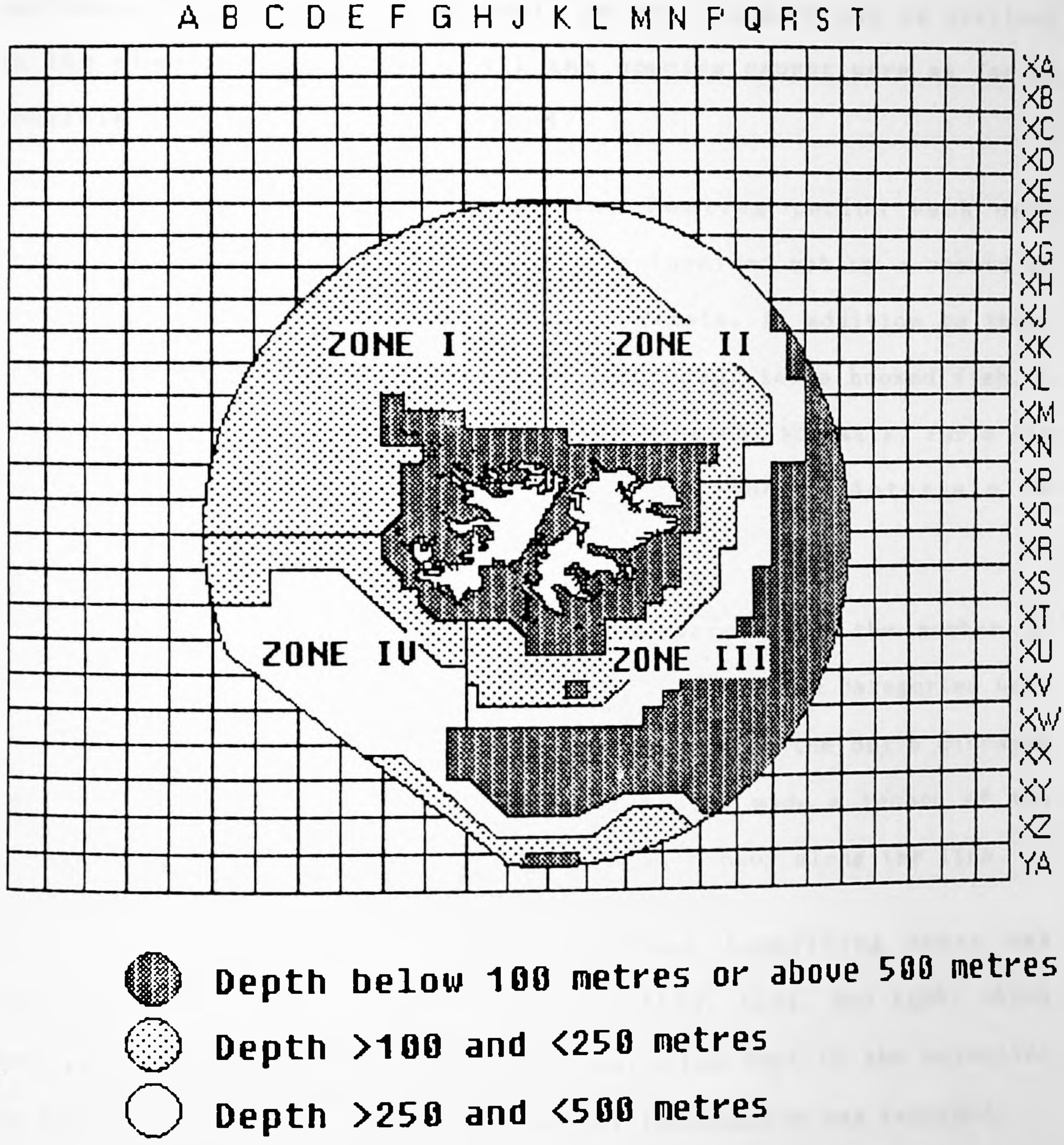

A B C D E F G H J K L M N P Q R S T
XA
XB
XC
XD
XE
XF
XG
XH
XJ
XK
XL
XM
XN
XP
XQ
XR
XS
XT
XU
XV
XW
XX
XY
XZ
YA
ZONE I
ZONE II
ZONE III
ZONE IV
Depth below 100 metres or above 500 metres
Depth >100 and <250 metres
Depth >250 and <500 metres

FIGURE 29.

Biological sampling - Throughout the longlining period samples of fish were taken, mostly Hake (Merluccius hubbsi) and Red cod (Salilota australis), for length, sex and maturity analysis. The samples were dealt in the standard way as outlined in the observer programme. All the species caught were as far as possible identified and recorded.

Fish counts - Throughout the hauling period each day, several fish counts were made. These involved making a record of every fish caught over a number of baskets. In addition to this, the state of the gangion was also recorded, ie. a hooked fish, a baited hook, a bare hook or a broken gangion. Normally, for a 510 basket longline, seven counts were made at intervals of approximately one and a half hours.

Catch records - At the end of every haul, the number of cases of each species and the frequencies of size categories were recorded. In addition estimates of weights of the day's discards were made and recorded. The Fishing Master made a record of the frequency of Kingclip caught between each buoy along the line.

All the data gathered during the longlining phase was recorded on data sheets LLS1, LLS2, LLS3, LLS4, and LLS5, which are shown in the Appendix. A log was also kept by the scientist on board, in which additional useful information was recorded.

The results of the longlining phase are presented in the following section.

3.3 RESULTS

The planned schedule for the longlining phase had to be shortened from 120 days to 80 days, due to a number of practical complications. Although this reduced the time available for a longlining survey of the F.I.C.Z., it did not impair the sampling programme too badly. A diary of events during the longlining phase is shown below:-

DATE	OPERATION
26/05/88	Left Stanley and steamed for Montevideo, with a scientist on board.
30/05/88	Arrived and docked in Montevideo.
31/05/88	Began conversion work on the vessel.
10/06/88	Completed conversion work.
11/06/88	Departed Montevideo.
15/06/88	Re-entered the F.I.C.Z. and prepared to begin fishing, (Station 1), gales prevented fishing.
15/07/88	Returned to Stanley for a meeting to discuss continuing plans for the fishing; changed scientists.
16/07/88	Left Stanley to resume fishing.
17/07/88	Resumed fishing (Station 33).
03/08/88	Changed scientists at sea.
17/08/88	Returned to Stanley for further meetings with K.S.J. Corporation and the Falkland Islands Fisheries Directorate concerning the remaining time to be spent fishing.
20/08/88	Left Stanley to resume fishing.
21/08/88	Resumed fishing (Station 68).
27/08/88	Changed Scientists in Stanley.
01/09/88	Returned finally to Stanley, to collect jigging equipment etc. Left for Japan.

Every day spent inside the zone was allocated a station number, regardless of whether or not fishing occurred. On one day, 31st August, two lines were set in a day, and therefore there were two stations on that day. A total of 79 days and 80 stations were spent longlining in the F.I.C.Z. between 15th June and 1st September 1988. A breakdown of how and where the days were spent is shown below:-

57 DAYS SPENT LONGLINING (58 STATIONS)
15 DAYS LOST DUE TO GALES (15 STATIONS)
7 DAYS IN STANLEY (7 STATIONS)
79 DAYS TOTAL (80 STATIONS)

23 STATIONS OF TARGET FISHING
35 STATIONS OF RANDOM FISHING

47 STATIONS FISHING AT DEPTHS LESS THAN 250 METRES
11 STATIONS FISHING AT DEPTHS GREATER THAN 250 METRES

ZONE I - 11 DAYS OF GALES
- 8 DAYS OF RANDOM FISHING
- 22 DAYS OF TARGET FISHING

ZONE II - 1 DAY OF GALES
- 11 DAYS OF RANDOM FISHING *
- 1 DAY OF TARGET FISHING

ZONE III - 1 DAY OF GALES
- 8 DAYS OF RANDOM FISHING

ZONE IV - 2 DAYS OF GALES
- 8 DAYS OF RANDOM FISHING

* = 12 STATIONS, ONE DAY HAD TWO STATIONS.

The stations were numbered in chronological order and have been drawn out in their relative positions in <u>CHARTS</u> 6 - 9. Both the start and end position of every longline have been marked on the charts as well as the station number.

CHART 6

Map of Zone I in the north west of the F.I.C.Z.. The circles represent the starting position of the set, and the line the direction and approximate distance of the longline. Squares show days which were lost to gales, and the numbers represent the station numbers.

GALES - 11 DAYS (12;22;23;37;40;42;43;48;49;52;53)

RANDOM - 8 DAYS (10;11;13;14;54;56;62;71)

TARGET - 22 DAYS (15;16;17;18;19;20;21;24;25;26;27;28;
29;30;38;39;41;50;51;57;58;61)

Random days were recognised as the first day in any new area, target days as repetition in an area at the express wish of the fishing master.

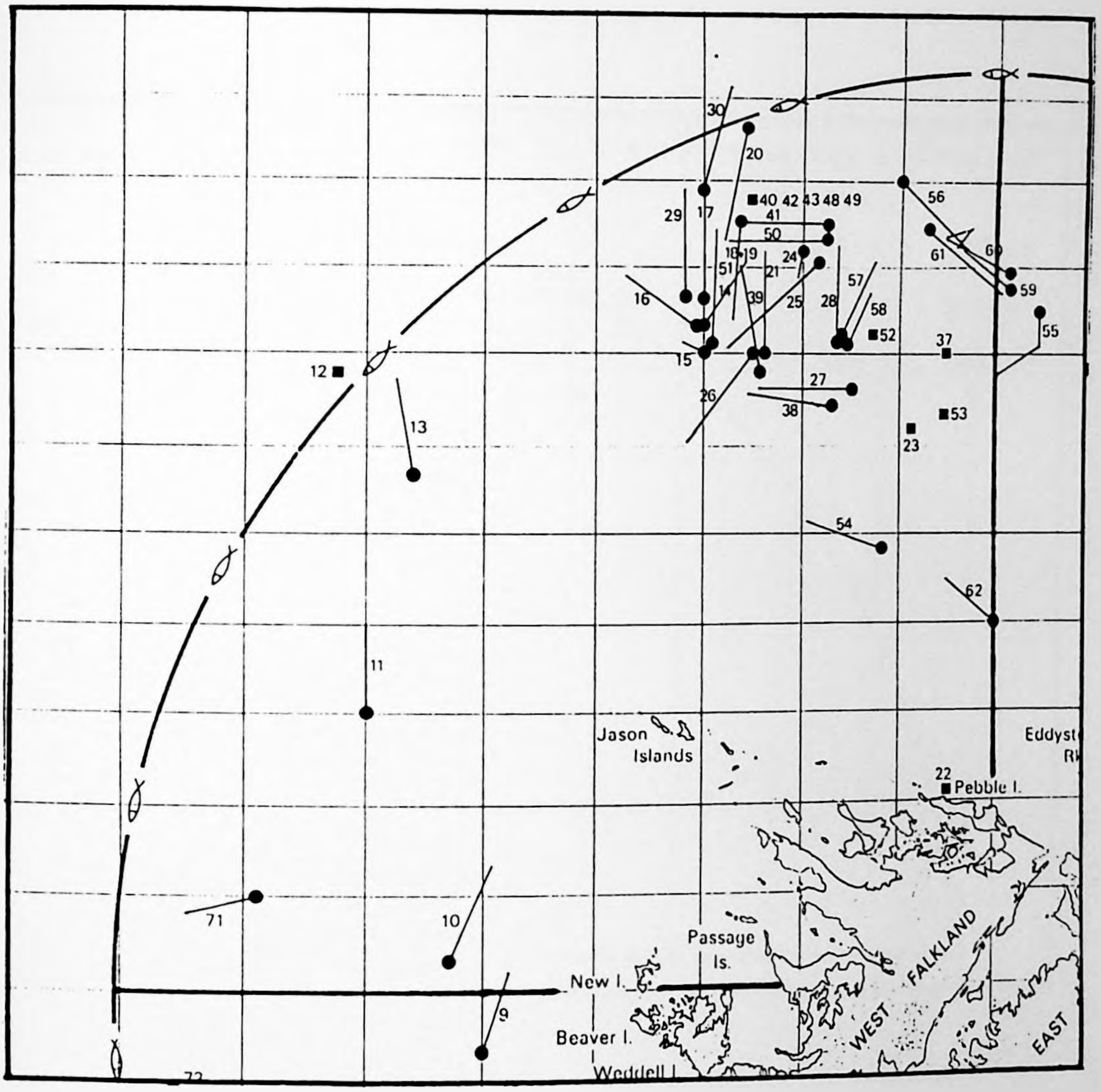

30
20
40 42 43 48 49
41
50
29
17
18 19
51
21
24
56
61
60
59
16
14
39
25
28
57
58
52
55
37
15
12
13
26
27
38
53
23
54
62
11
Jason
Islands
Eddyst
22
Pebble I.
71
10
Passage
Is.
New I.
9
Beaver I.
Weddell I.
WEST
FALKLAND
EAST

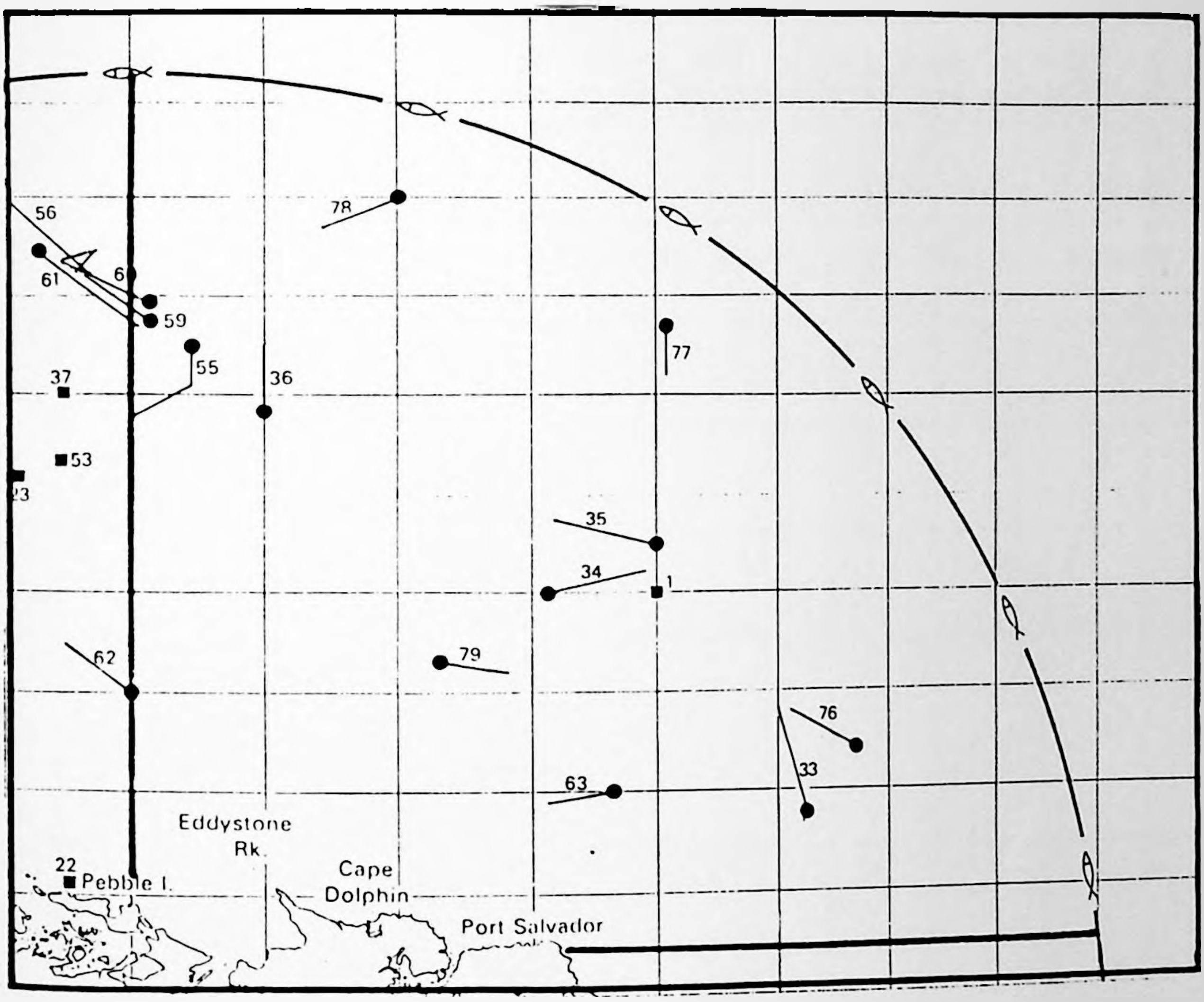
CHART 7

Map of Zone 11 in the north east of the F.I.C.Z.. The symbols are as explained in chart 6.

GALES - 1 DAY (1)

RANDOM - 11 DAYS (33;34;35;36;55;59;63;76;77;78;79)

TARGET - 1 DAY (60)



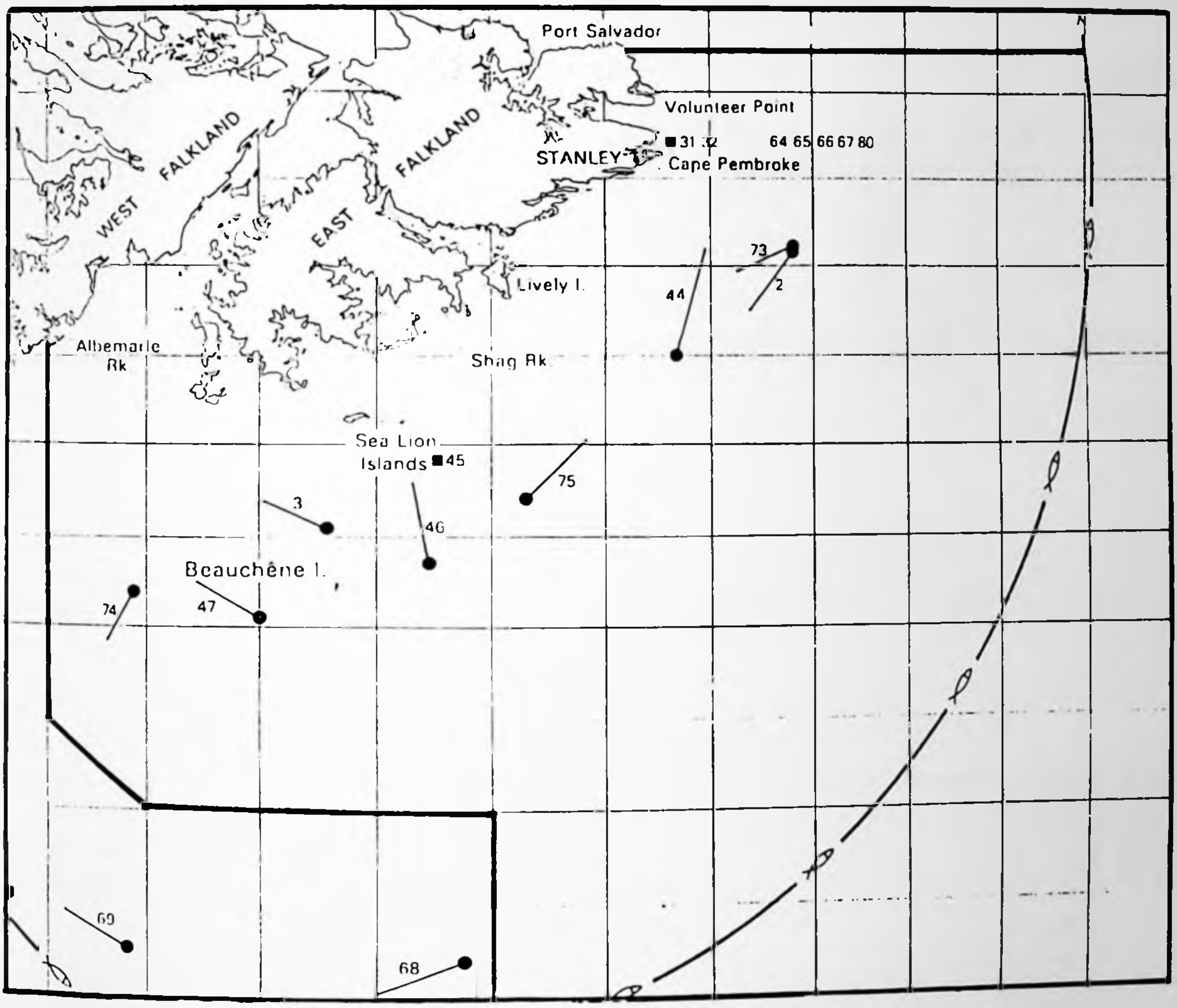
56
78
61
60
59
55
37
36
77
53
23
35
34
1
79
62
76
33
63
Eddystone Rk.
22
Pebble I.
Cape Dolphin
Port Salvador

CHART 8

Map of Zone III in the south east of the F.I.C.Z.. The symbols are as explained in chart 6.

GALES - 1 DAY (45)

RANDOM - 8 DAYS (2;3;44;46;47;73;74;75)



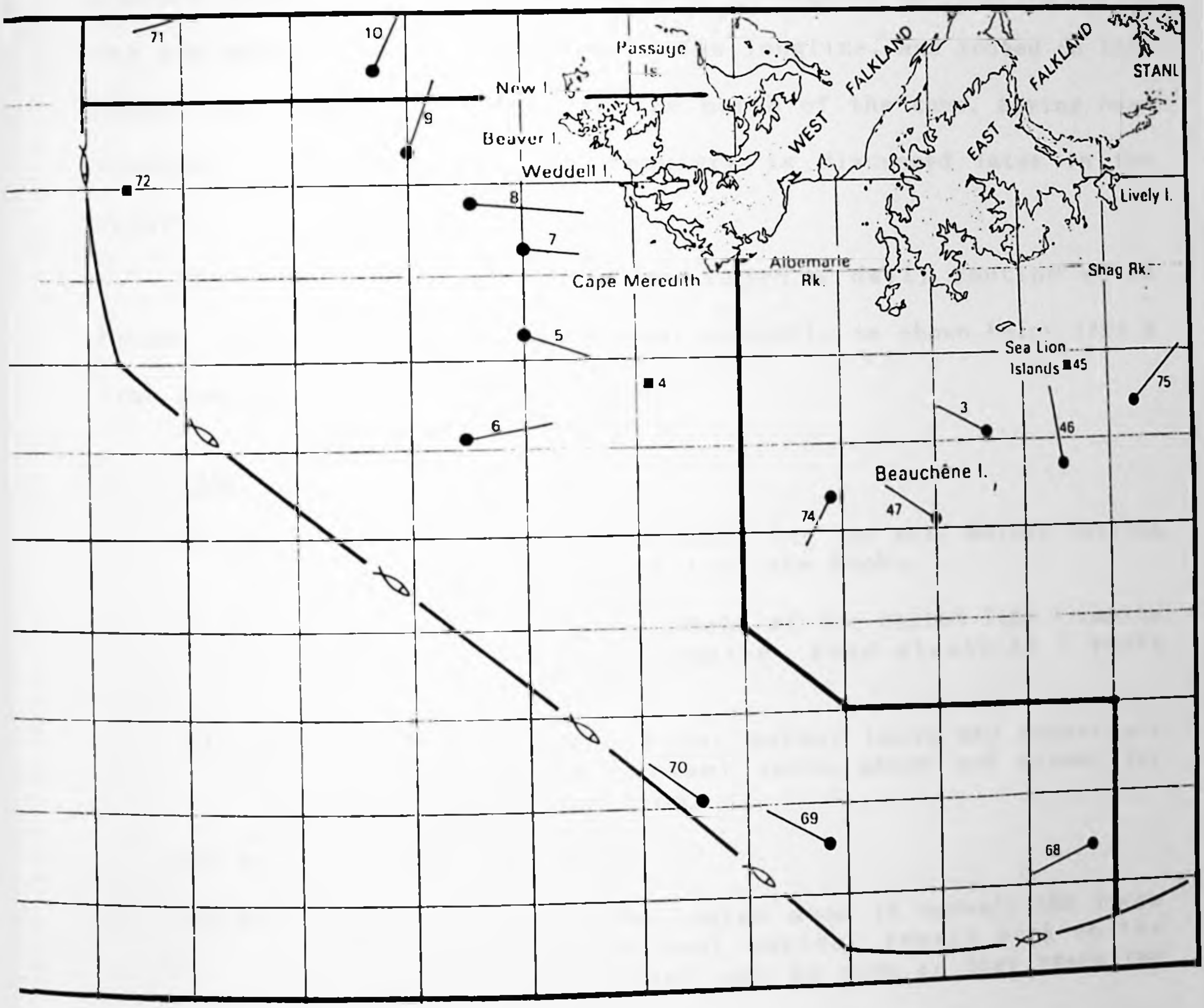
Port Salvador
WEST FALKLAND
EAST FALKLAND
Volunteer Point
STANLEY
Cape Pembroke
64 65 66 67 80
73
2
44
Lively I.
Albemarle Rk
Shag Rk
Sea Lion Islands
45
75
3
46
Beauchene I.
74
47
69
68

CHART 9

Map of Zone IV in the south west of the F.I.C.Z.. The symbols are as explained in chart 6.

GALES - 2 DAYS (4;72)

RANDOM - 8 DAYS (5;6;7;8;9;68;69;70)


71
10
Passage Is.
New I.
9
Beaver I.
Weddell I.
72
8
7
Cape Meredith
Albemarle Rk.
WEST FALKLAND
EAST FALKLAND
STANL
Lively I.
Shag Rk.
5
4
Sea Lion Islands
45
75
6
3
46
Beauchêne I.
74
47
70
69
68

The optimum number of baskets used to make up the longline was 510, although it took several days of fishing before the crew became experienced enough to cope with such a quantity. As few as 60 baskets were used on one occasion, but this was due to abandoning the operation during the set owing to deteriorating weather conditions. A major concern throughout the fishing period was the proximity of trawlers to the longline, and indeed on 12th August 105 lines were lost in the north of the zone, having been trawled. The conflict with trawlers is discussed later in the report.

The longlining quickly developed a daily routine which became fairly standard. A typical schedule is shown below (for a line composed of 510 baskets):-

TIME	ACTIVITY
00:30	Standby : Crew prepare for the set, mainly cutting squid bait and baiting the hooks.
02:10	Set start : Deployment of the baited line from the deployment hold begins, ship steams at 7 knots into wind.
04:20	End set : The final marker buoys and anchor are released. The vessel turns about and steams for the start position.
04:30	Breakfast.
05:50	Start haul : The cargo door is opened, the buoys lifted and the haul begins. repair work on the baskets is carried out as soon as they reach the repair hold.
06:30	Hook count : The scientist performs the first of six or seven hook counts and assessments, these are repeated every one to two hours during the haul.
10:30	Lunch.

SCHEDULE (Continued)

TIME	ACTIVITY
16:10	End haul : the last line and anchor come into the factory. The cargo door is closed and the factory cleaned up. The vessel steams to the next fishing area.
17:00	line repairs and preparations for the next day are completed.
17:30	Final meal.

(1) CATCH RESULTS

It became apparent, before fishing began, that the target species for bottom longlining would not include mullet, as forecast in the K.S.J. Corporation proposals. At the start of fishing the target species were toothfish (Dissostichus eleginoides) and kingclip (Genypterus blacodes). Because the catches were poorer than expected, ray sp. were added to the target species on June 21st and hake (Merluccius hubbsi) on June 30th. All other species caught were discarded or kept for consumption by the crew. A list of the species caught during longlining is shown below and overleaf:-

PISCES

MYXINIFORMES	
MYXINIDAE	Myxine Sp. (Hagfish)
OSTEICHTHYES	
GADIFORMES	
MORIDAE	Salilota australis (Red cod)
MERLUCCIIDAE	Macruronus magellanicus (Hoki) Merluccius australis (Patagonian hake) Merluccius hubbsi (Argentine hake)
MACROURIDAE	Coryphaenoides holotrachys (Grenadero)
OPHIDIIFORMES	
OPHIDIIDAE	Genypterus blacodes (Kingclip)
SCORPAENIFORMES	
SCORPAENIDAE	Sebastes oculatus
PSYCHROLUTIDAE	Neophrynichthys marmoratus
PERCIFORMES	
BOVICHTHYIDAE	Cottoperca gobio
NOTOTHENIIDAE	Patagonotothen Spp. Eleginops maclovinus (Mullet) Dissostichus eleginoides (toothfish)

PISCES

CHONDRYCHTHYES
SQUALIFORMES
SQUALIDAE — Various spiny dogfish Spp.

RAJIFORMES
RAJIDAE — _Raja_ Spp.
Bathyraja Spp.

Other species caught included octopus and scallops.

The weight of the processed catch sold in Japan for all of the target species is detailed in Table 9.

Conversion factors, to estimate the total pre-processed catch weight for each species, were worked out on board and determined as follows; Kingclip = 2.0, Toothfish = 1.9, Hake = 2.0, and Ray Spp.(pair of wings) = 2.5. Estimates also had to be made for any discarded fish, and were calculated using a daily average hooking rate (percentage) multiplied by an average weight for that day (taken from a sample); It must be emphasised that the estimates can only act as a rough guide to the tonnage of dumped fish.

From Table 9 it becomes immediately obvious that ray and kingclip were the two most successful target species, in terms of weight. Each of the target species commands a different price on the Japanese market and so the most successful species by catch may not necessarily provide the best financial returns. The economic aspects of the fishing will be reviewed later in the report.

TABLE 9

ITEM	SIZE CATEGORY	No.OF CASES	WEIGHT (kg)
KINGCLIP (BLOCK FROZEN)	SS	8	149
	S	374	7226
	M	439	8640
	L	564	11879
	2L	489	10868
	3L	368	7842
	4L	24	482
	5L	219	1340
KINGCLIP (INDIVIDUAL QUICK FROZEN IQF)	SS	5	65
	S	12	161
	L	15	258
	2L	23	401
	3L	27	510
TOOTHFISH (BLOCK FROZEN)	M	12	212
	L	9	167
	2L	7	129
	3L	5	100
TOOTHFISH (IQF)		5	81
RAY Spp.		2991	48177
HAKE (BLOCK FROZEN)	L	90	1928
	2L	74	1552
	3L	22	439
HAKE (IQF)	M	89	1806
		11	241

It is interesting to note that there are a number of discrepancies between the number of cases of fish reported by K.S.J. (displayed in Table 9), and the number counted on board by the scientists. The largest of these is for block frozen kingclip in the L size category; K.S.J reported sales of 564 cases, the scientists counted 849 cases frozen, a difference of 285 cases of fish. Table 10 shows the differences between the total number of cases of each species sold (as reported by K.S.J.) compared with the total number of cases caught and frozen on board the 'Koei Maru No.30' as reported by the scientists and thirdly as reported by the fishing log. It is not known how these discrepancies have arisen, but they are within acceptable limits.

TABLE 10

SPECIES	TOTAL SALES BY CASE (KSJ)	TOTAL CATCH REPORTED BY SCIENTIST	TOTAL CATCH REPORTED IN FISHING LOG
KINGCLIP	2567	2543*	2571
TOOTHFISH	38	43	45
RAY	2991	2838	2862
HAKE	286	267	267
TOTAL	5882	5691	5745

* = 5L fish not included, but included in sales report

NB all the sales reports include the IQF fish. These were not reported on the vessel by either the scientist or in the ship's fishing log.

The total catches of all the major species encountered during the longlining period are shown in Table 11.

TABLE 11

	SPECIES					
	KINGCLIP	TOOTHFISH	HAKE	RED COD	RAY	GRENADIER
DISCARDS	-	-	2767	52483	267040	27214
PROCESSED	49821	689	5966	-	48177	-
PRE -PROCESSED	99642	1309	11932	-	120442	-
TOTAL (INCLUDING DISCARDS)	99642	1309	14699	52483	387482	27214

NB all figures are in kilograms.
Processed fish are multiplied by their conversion factors to give the pre-processed weights.

Some of the above catch totals are presented in Figures 30 and 31.

Although some 52 tonnes of red cod and 27 tonnes of grenadier were caught, neither was considered to be suitable for the Japanese market and so were dumped. Surprisingly, a large amount of ray was also dumped, of which a fair amount was of marketable size.

The 23 target stations were considered as the commercial fishing period, and have been separated out from the other sampling stations to assess various catch statistics. These results ignore days lost to bad weather, even if they occurred in the target fishing areas.

FIGURE 30a

The total processed catches landed and sold in Japan, as reported by the K.S.J. Corporation. The two major landings were of kingclip and ray at 49 tonnes and 48 tonnes respectively. Only a very small amount of hake and toothfish were processed, and no red cod or grenadier were processed at all.

FIGURE 30b

The proportions of the longline processed catch expressed as a percentage. It is useful to note and then compare with figure 31b (total catch including discards) the proportions of kingclip (48%) and ray (46%).

FIG 30 a. PROCESSED CATCH (kilos)
OF SPECIES CAUGHT BY THE KOEI MARU No.30

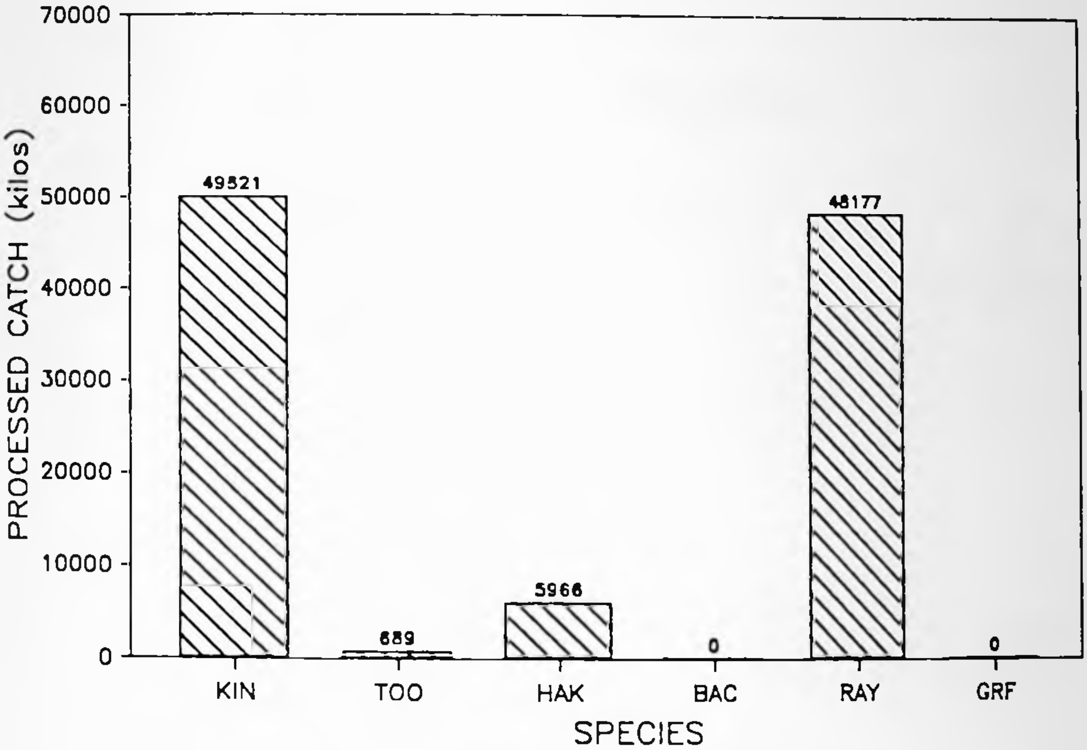


FIG 30 b. PROCESSED CATCH (kilos)
PROPORTIONAL PIE CHART

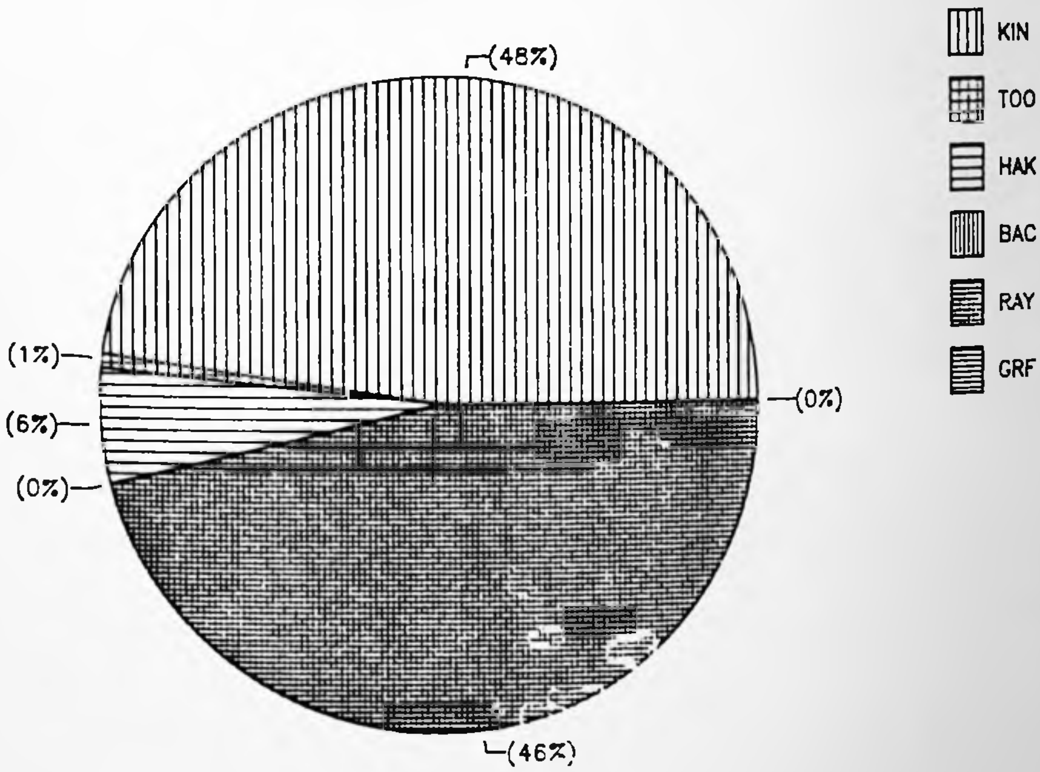


FIGURE 31a

The estimated total catch including discards (in kilos) of each species caught during the experimental bottom longlining.

FIGURE 31b

The proportions of total longline catch, including discards. Ray Spp. dominate the distribution at 66% with kingclip providing only 17% of the total catch by weight. Red cod, which was dumped by the Koei Maru, made up some 9% of the total catch.

FIG 31 a. TOTAL CATCH (kilos)
INCLUDING DISCARDS

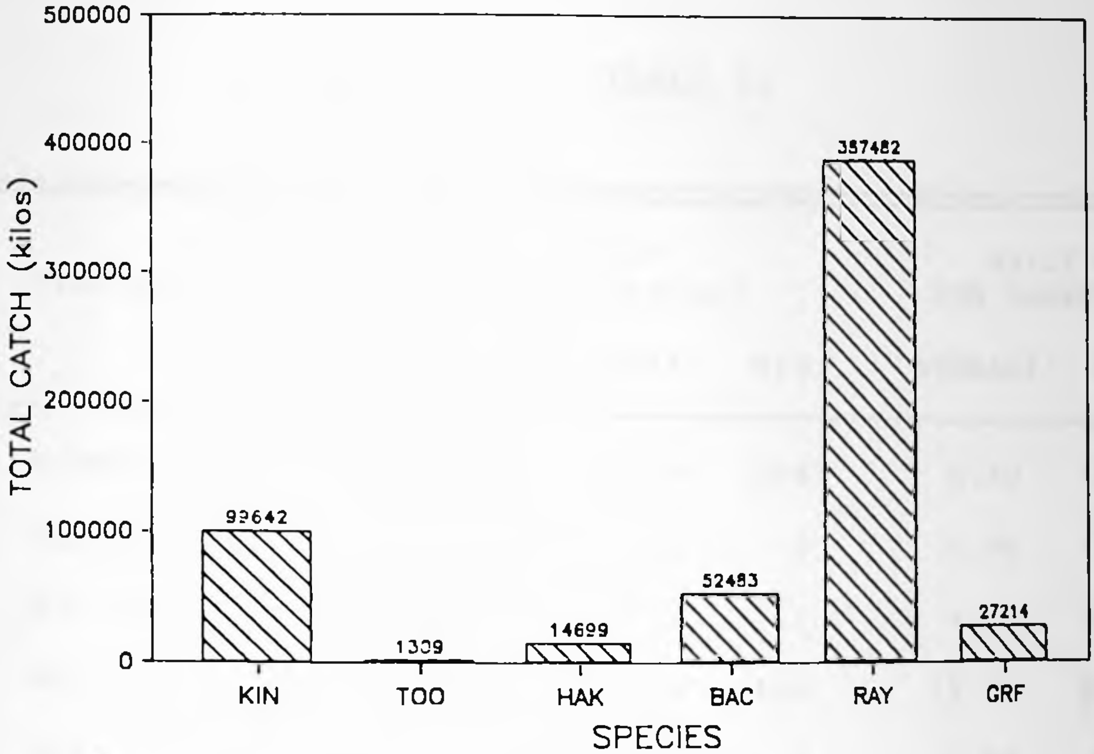


FIG 31 b. TOTAL CATCH (kilos)
PROPORTIONAL PIE CHART

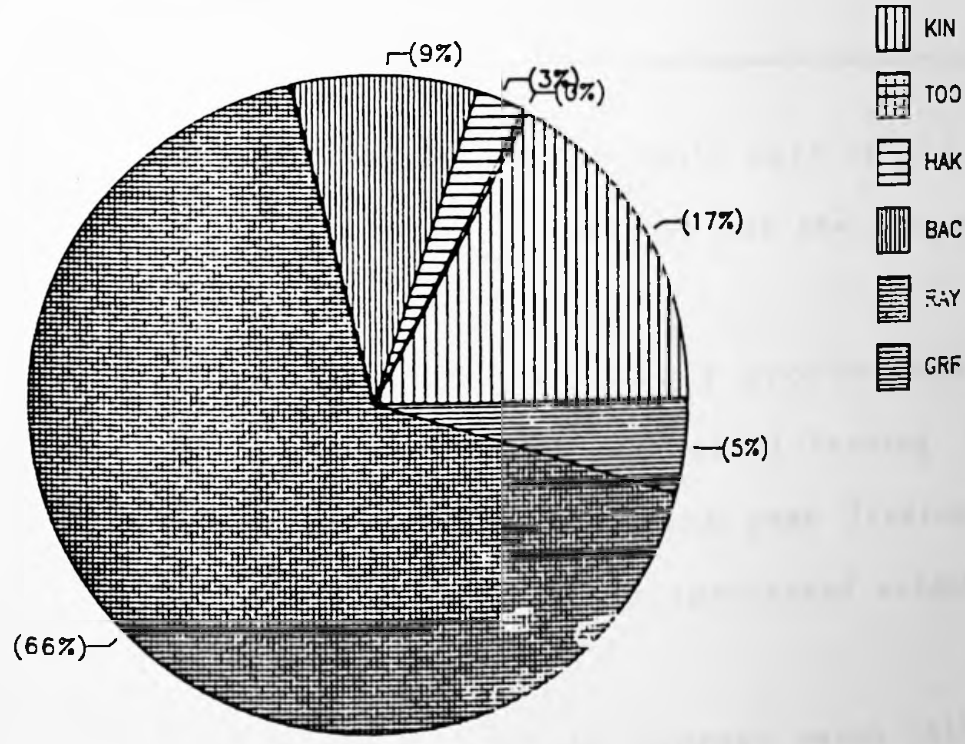


Table 12, below, shows the average, maximum and minimum daily catches of fish during the 23 target fishing days, expressed in kilos and kilos per basket (38 hook stretch of line).

TABLE 12

SPECIES	DAILY CATCH (Kilos)			DAILY CATCH PER BASKET (Kilos)		
	AVERAGE	MAX	MIN	AVERAGE	MAX	MIN
KINGCLIP	3680	7420	258	8.40	15.71	3.63
TOOTHFISH	30	228	0	0.06	0.46	0.00
RAY (KEPT)	2324	4887	42	4.85	9.58	0.70
RAY (DISCARDED)	5957	12619	420	12.69	24.74	4.15
HAKE	410	1160	0	0.86	2.27	0.00
RED COD (DISCARDED)	952	3872	0	1.97	7.59	0.00

It is interesting to note that roughly half of all the fish caught, by weight, was discarded. Possibly not the most efficient approach to fishing.

Figure 32 shows the average daily processed and pre-processed catches during the 23 days of target fishing. From the figure it is possible to see that during peak fishing only 2 tonnes of kingclip, and 1 tonne of ray (processed weights) were being caught per day.

Figure 33 is a plot showing the average catch (kilos) per basket for the target stations. The figures represent the pre-processed, but not the dumped weights of fish. An average of 8.4

FIGURE 32

The mean daily catch over 23 target days for kingclip (KIN), ray (RAY), red cod (BAC), hake (HAK) and toothfish (TOO). Both the pre-processed and the processed weights in kilos are shown.

FIGURE 33

The average daily catch (kilos) per basket, by species, for the target fishing stations. Since there are 38 hooks per basket, this could be interpreted as a unit of effort for catch per unit effort estimations.

FIG 32. AVERAGE DAILY CATCH
DURING THE 23 TARGET LONGLINING DAYS

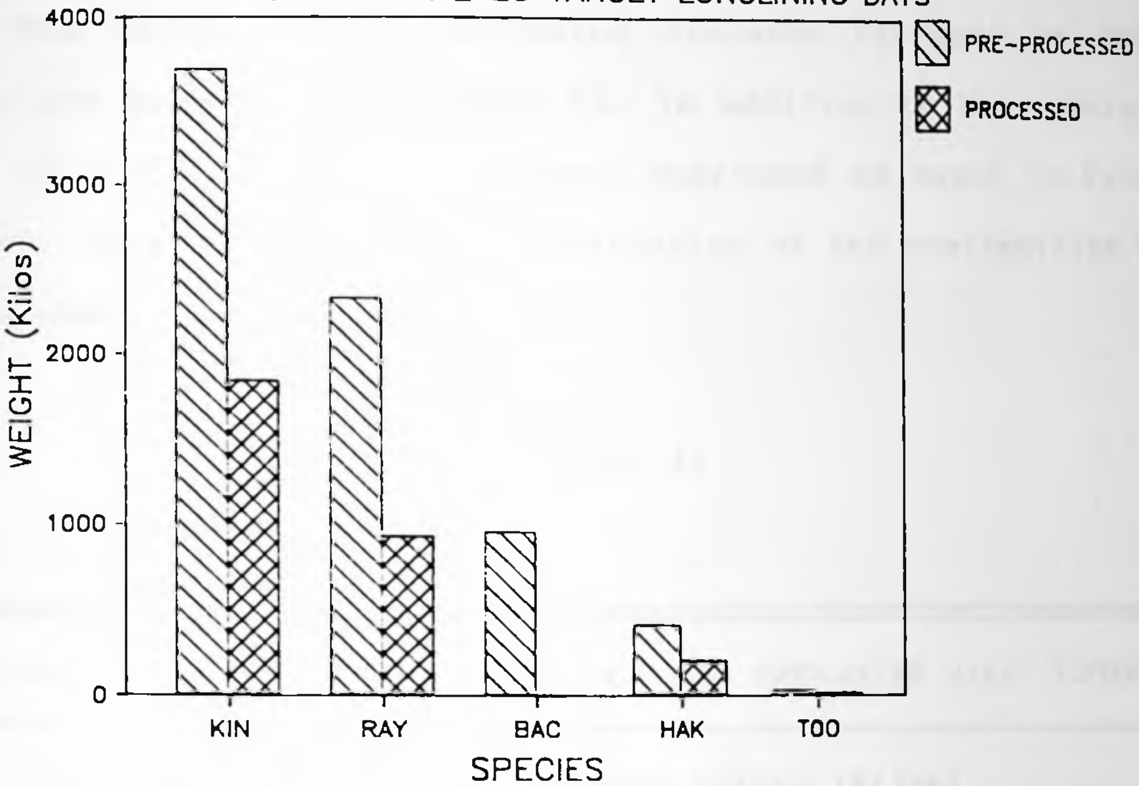
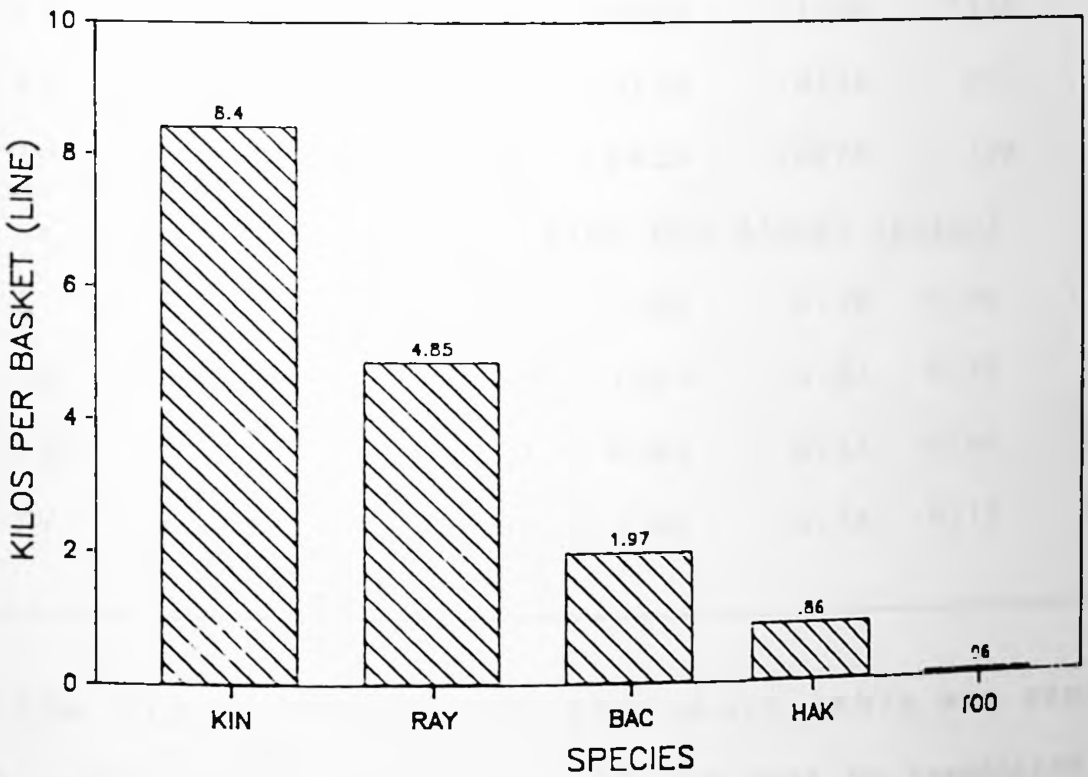


FIG 33. AVERAGE DAILY CATCH PER BASKET
DURING TARGET LONGLINING (BASKET = 38 HOOKS)



kilos of kingclip were caught per basket or 38 hooks, which works out to 0.22 kilos per hook.

The catch totals including discards for each of the four zones are presented in Table 13. In addition to the totals, some form of C.P.U.E. is also shown, expressed as catch in kilos per basket. This gives a better indication of the availability of the resources in each of the zones.

TABLE 13

ZONE	RAY	KINGCLIP	RED COD	GRENADIER	HAKE	TOOTHFISH
			CATCH TOTALS (Kilos)			
I	229914	90063	34906	0	10554	608
II	55169	17974	6020	1000	1720	456
III	43365	685	2128	8136	805	76
IV	59094	6227	9429	18078	408	494
			CATCH PER BASKET (Kilos)			
I	17.51	6.86	2.66	0.00	0.80	0.05
II	11.34	3.69	1.24	0.21	0.35	0.09
III	13.18	0.21	0.65	2.47	0.24	0.02
IV	18.07	1.90	2.88	5.53	0.12	0.15

The figures shown in the above table are represented graphically in Figures 34 and 35. It must be remembered that the quantities are estimated due to the presence of discards.

FIGURE 34

Total catches, including discards, (kilos) for the six most common species caught during the bottom longlining phase. The species catches are divided up by zone.

NB. More time was spent fishing in zone I than in the other three zones.

FIGURE 35

Catch per basket (kilos) by species for zones I to IV. The catch per basket can be considered to be a C.P.U.E.. The most dramatic variations with zone can be seen in kingclip and grenadier.

FIG 34. TOTAL CATCHES INCLUDING DISCARDS
OF BOTTOM LONGLINE SPECIES FOR ZONES I TO IV

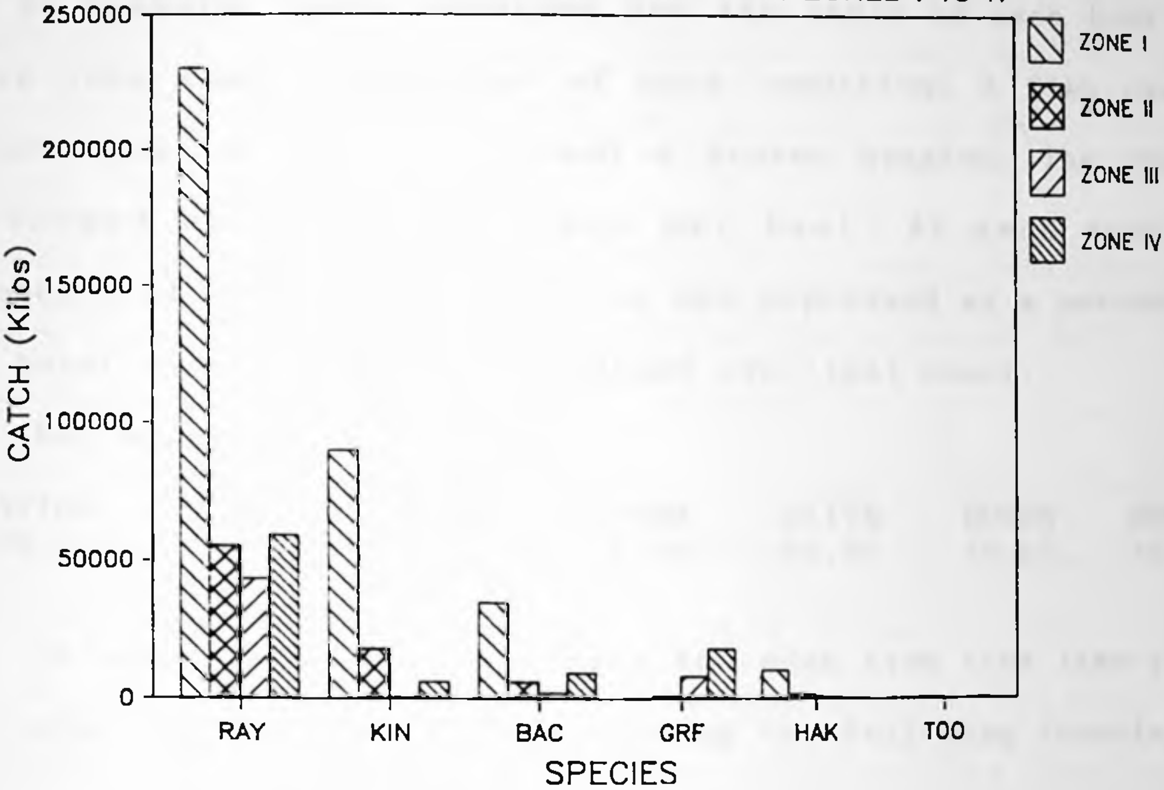
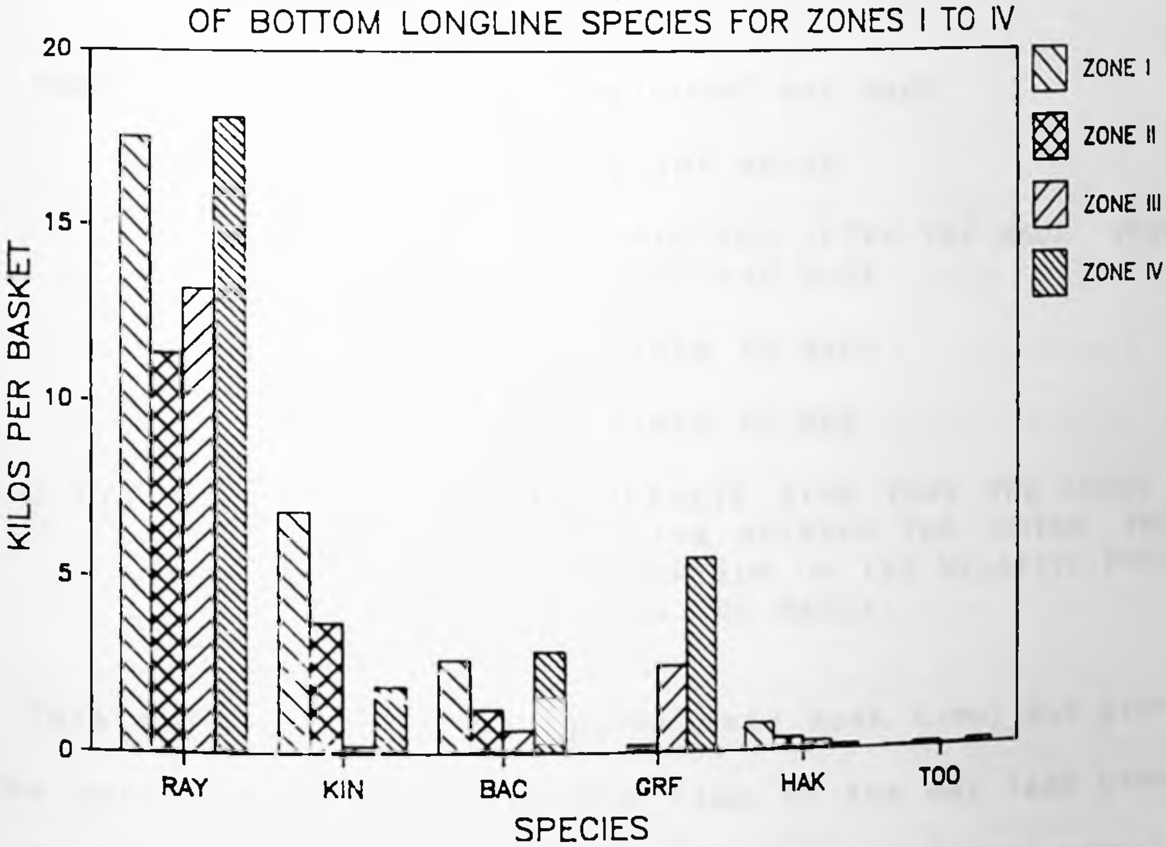


FIG 35. CATCH (Kilos) PER BASKET
OF BOTTOM LONGLINE SPECIES FOR ZONES I TO IV



(II) HOOK COUNTS

During every station a number of lines, somewhere between 4 and 10 baskets, were examined and the state of each hook noted. There were four categories of hook condition; a fish caught, a baited hook, a bare hook, and a broken gangion. The count was performed up to eight times per haul. At each count, the frequency of each hook condition was expressed as a percentage of the total number of hooks examined over that count.

For example:-

STATION	TIME OF COUNT	FISH%	BAIT%	HOOK%	BROKEN%
26	06:00	12.00	60.00	10.67	17.33

It was possible to estimate the soak time (the time spent in the water) for each hook count using the following formula:-

$$\text{SOAK TIME} = (X - (S + (C/T * L)))$$

WHERE:

X = THE TIME THE COUNT WAS MADE

S = THE TIME THE SET BEGAN

C = THE No OF MINUTES AFTER THE HAUL START AT WHICH THE COUNT WAS MADE

T = TOTAL TIME TAKEN TO HAUL

L = TOTAL TIME TAKEN TO SET

(C/T * L) = THE APPROXIMATE TIME THAT THE COUNT SAMPLE LENGTH OF LINE ENTERED THE WATER (WORKED OUT AS A PROPORTION OF ITS RELATIVE POSITION IN TIME DURING THE HAUL).

This formula gives an approximate soak time, but given that it was not possible to mark the line in any way (and hence know exactly when a stretch of line entered and left the water) it is the best estimate available.

In order to observe whether there was any relationship between each of the four hook conditions (fish, bait, bare or broken gangion) with increasing soak time, Figures 36 - 39 were drawn up. A simple linear regression was applied to each distribution, but gave very poor results, and showed that there were no linear relationships.

From Figure 36 it is difficult to establish very much at all. It is possible that the fish are being caught after a short soak time and then remaining attached on the line until it is hauled, but this cannot be proved. It appears that a majority of the hook occupation by fish lies between 0 and 30 percent.

The percentage of hooks with bait tended to remain below the 20% mark, but with short soak times reached as high as 76% (Figure 37). The decline of baited hooks with soak time was presumably due to bait loss and robbing by fish, to fish capture and to broken gangions.

The spread of bare hooks is fairly large, but it does show that the loss of bait and bait robbing is highly variable and shows no particular trends with soak time (Figure 38).

Figure 39 shows that broken gangions do not appear to vary with soak time, but are very much concentrated below the 30% level.

Several plots were drawn up to examine the change in frequency of hooked fish with depth throughout the whole of the F.I.C.Z.. The daily mean, worked out from the count samples, of the five most frequently caught species, expressed as a percentage, was plotted against the mean depth of the longline

FIGURE 36

The percentage of hooks which were hauled with fish (all species) at each counting sample plotted against estimated soak time (minutes) for that sample.

FIGURE 37

The percentage of hooks which were hauled with *Illex* bait attached at each counting sample plotted against estimated soak time (minutes) for that sample.

FIG 36. AN X–Y PLOT SHOWING
PERCENT OF HOOKS WITH FISH AGAINST SOAK TIME (mins)

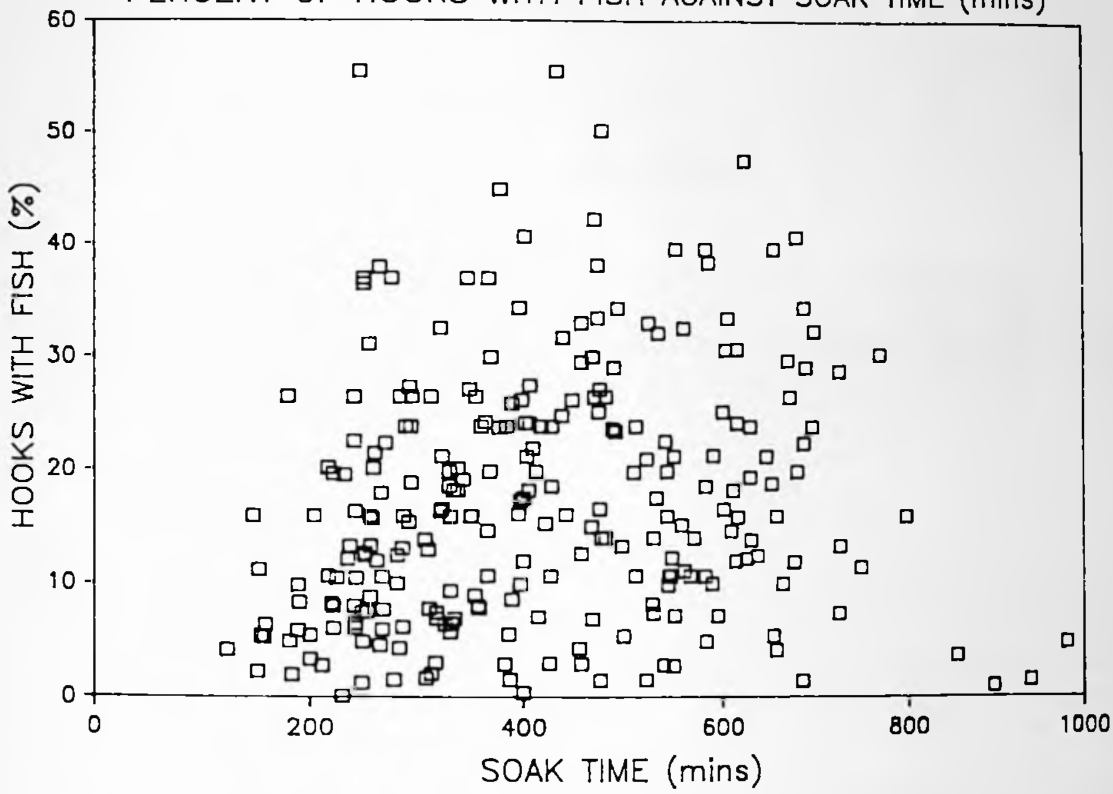


FIG 37. AN X–Y PLOT SHOWING
PERCENT OF HOOKS WITH BAIT AGAINST SOAK TIME (mins)

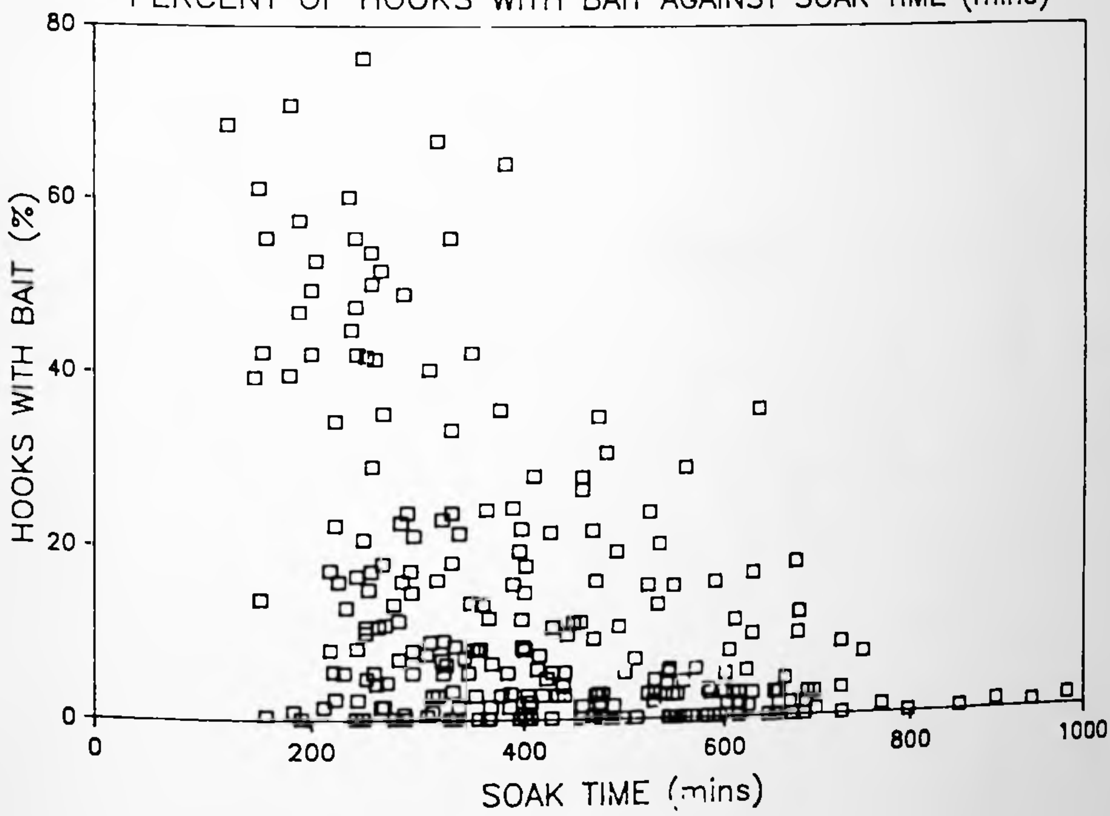


FIGURE 38

The percentage of hooks which were hauled without fish or bait but were still intact at each counting sample plotted against estimated soak time (minutes) for that sample.

FIGURE 39

The percentage of gangions which were hauled and in some fashion broken and without hooks at each counting sample plotted against estimated soak time (minutes) for that sample.

FIG 38. AN X-Y PLOT SHOWING
PERCENT OF BARE HOOKS AGAINST SOAK TIME (mins)

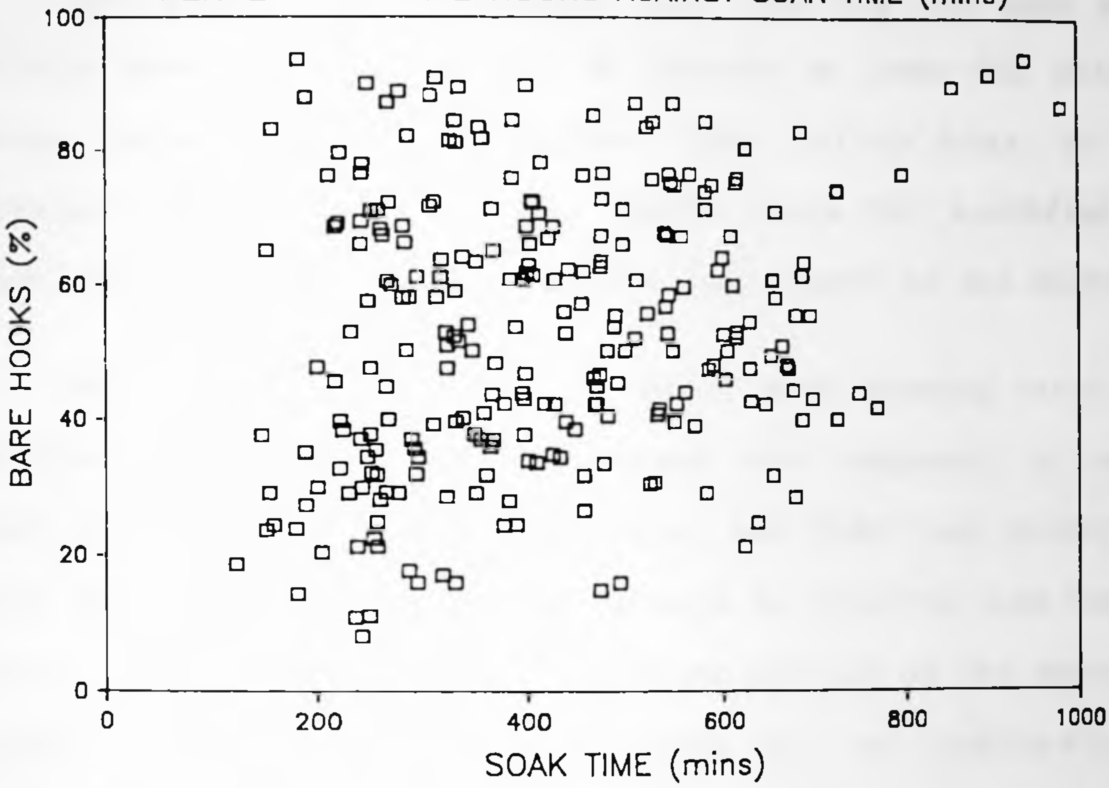
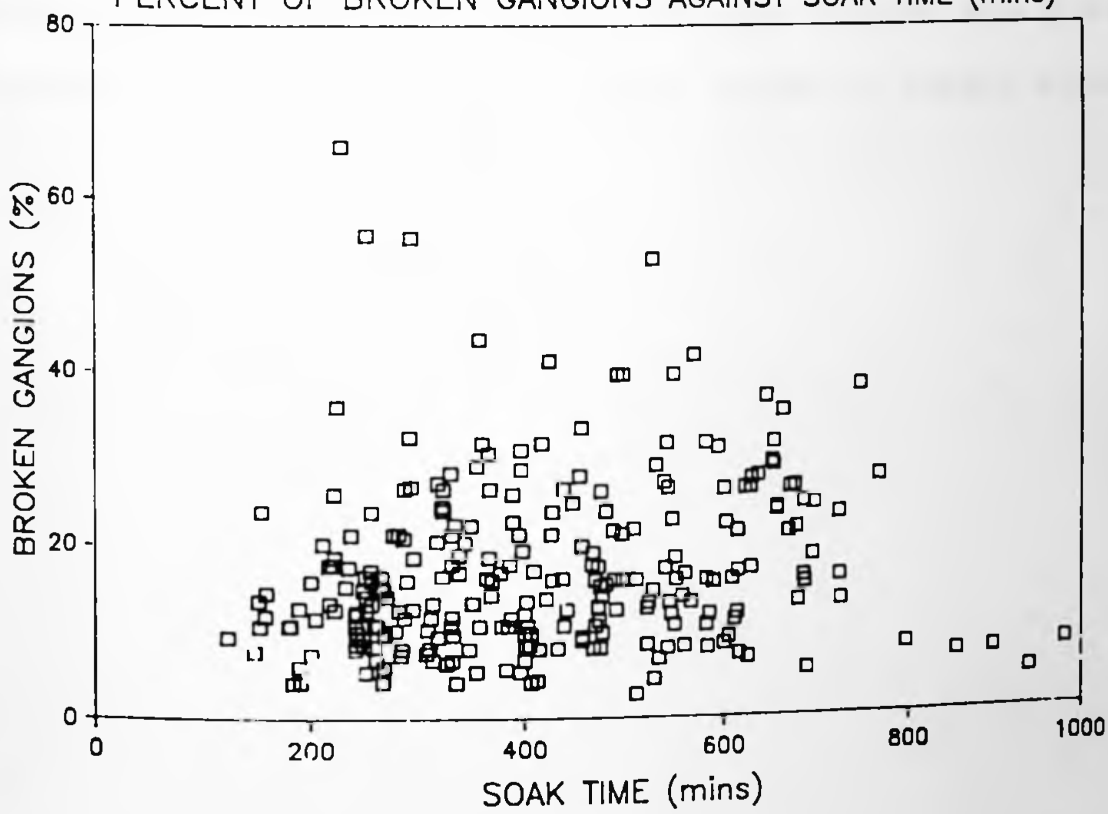


FIG 39. AN X-Y PLOT SHOWING
PERCENT OF BROKEN GANGIONS AGAINST SOAK TIME (mins)



for the day. These plots are shown in Figures 40 - 44, and Figure 45 is a plot of all the species with mean depth.

The plots for kingclip, ray, red cod and hake all exhibit fairly poor hooking rates at depths of over 220 metres, but a large range of hooking rates, some fairly high, at depths of between 150 and 220 metres. Catch rates for toothfish appear to show no trend other than fairly low counts at all depths.

When the mean of all the daily mean hooking rates for target stations and for random stations are compared, it can be seen that the targeting for kingclip and hake was pretty effective (see Figure 46). The figure should be treated with some caution, since the variance and standard deviations of the means were very large indeed. It serves just as an indication of the effectiveness of targeting and the difference it can make to hooking rates. The "others" in the figure are predominantly grenadiers, and were very rarely caught in target areas.

FIGURE 40

The daily mean of hooked kingclip, expressed as a percentage of all the hooks, plotted against the mean depth of the bottom longline for that day. The mean depth was taken as an average of the depth at the start and at the finish of the longline.

FIGURE 41

The daily mean of hooked ray, expressed as a percentage of all the hooks, plotted against the mean depth of the bottom longline for that day.

FIG 40. PLOT SHOWING
MEAN No HOOKS WITH KINCLIP (%) Vs MEAN DEPTH OF LINE

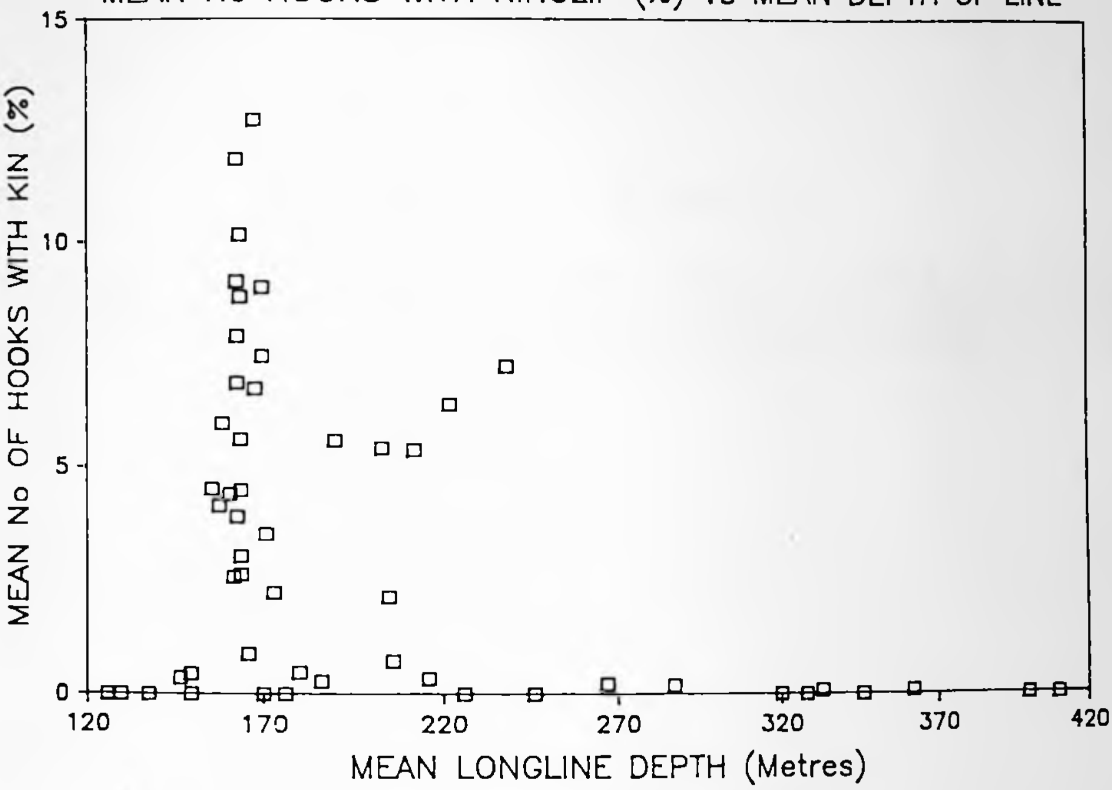


FIG 41. PLOT SHOWING
MEAN No HOOKS WITH RAY (%) Vs MEAN DEPTH OF LINE

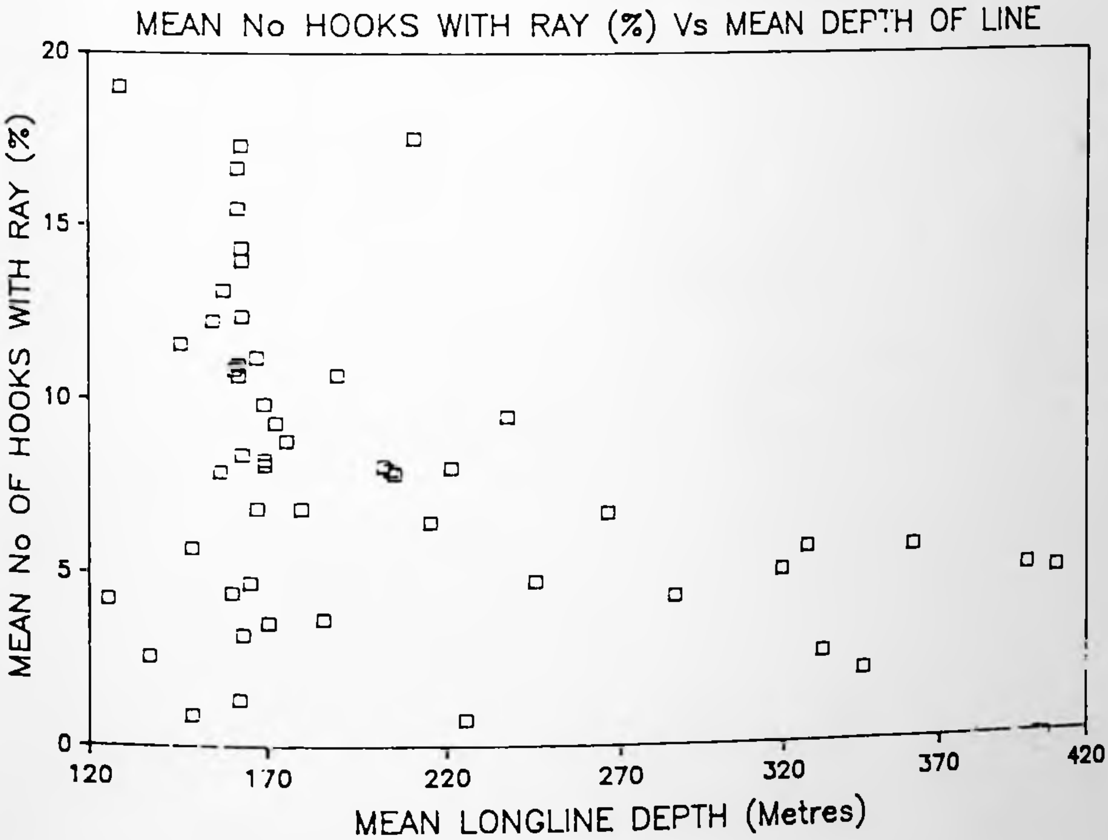


FIGURE 42

The daily mean of hooked red cod, expressed as a percentage of all the hooks, plotted against the mean depth of the bottom longline for that day.

FIGURE 43

The daily mean of hooked hake, expressed as a percentage of all the hooks, plotted against the mean depth of the bottom longline for that day.

FIG 42. PLOT SHOWING
MEAN No HOOKS WITH BAC (%) Vs MEAN DEPTH OF LINE

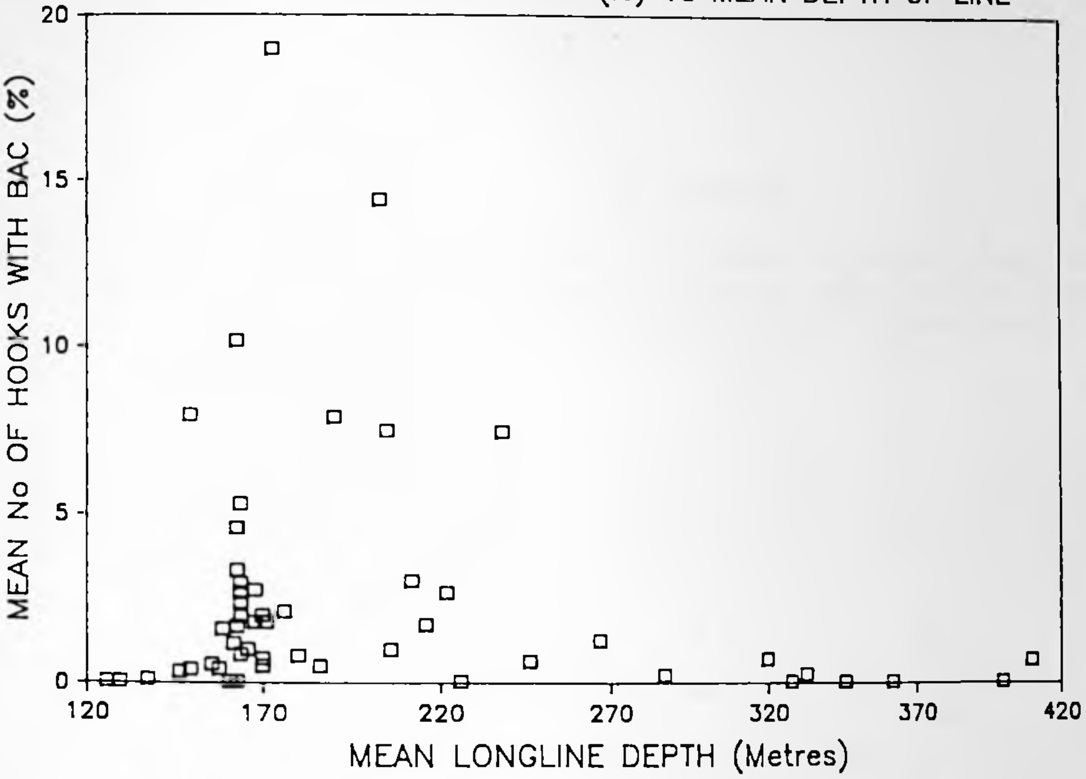


FIG 43. PLOT SHOWING
MEAN No HOOKS WITH HAKE (%) Vs MEAN DEPTH OF LINE

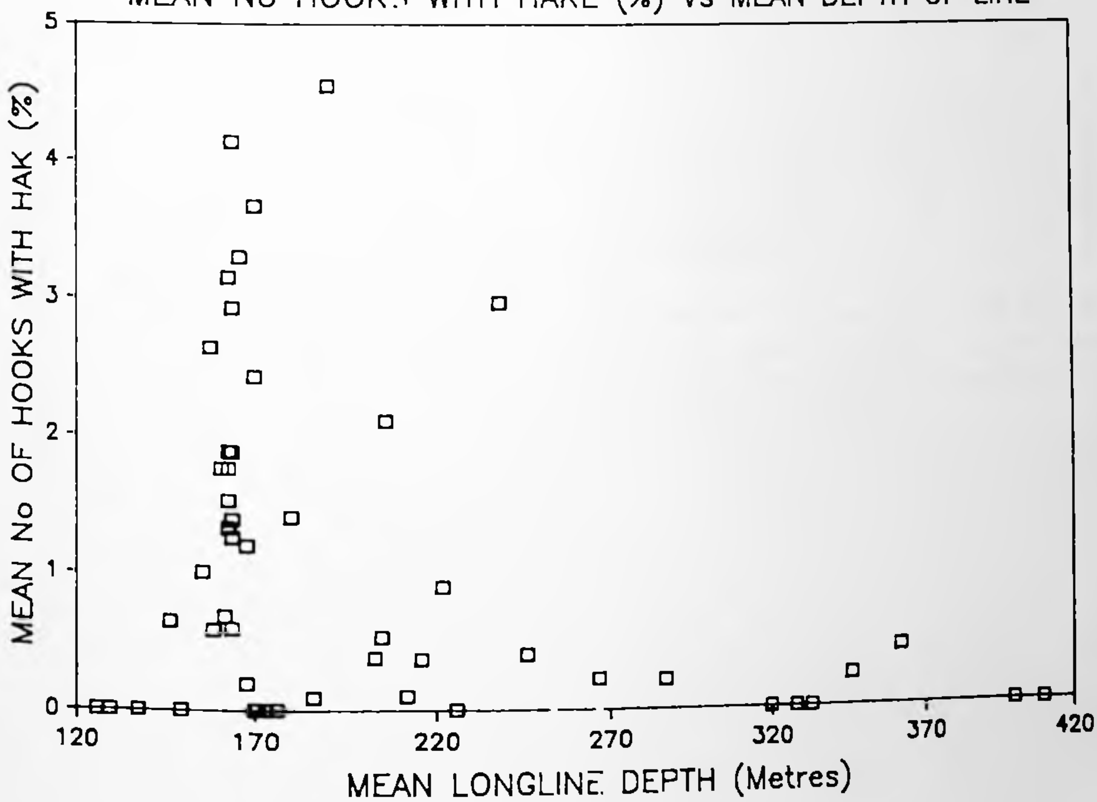


FIGURE 44

The daily mean of hooked toothfish, expressed as a percentage of all the hooks, plotted against the mean depth of the bottom longline for that day.

FIGURE 45

The daily mean of hooked fish (all species), expressed as a percentage of all the hooks, plotted against the mean depth of the bottom longline for that day.

FIG 44. PLOT SHOWING

MEAN No HOOKS WITH TOOTHFISH (%) Vs MEAN DEPTH OF LINE

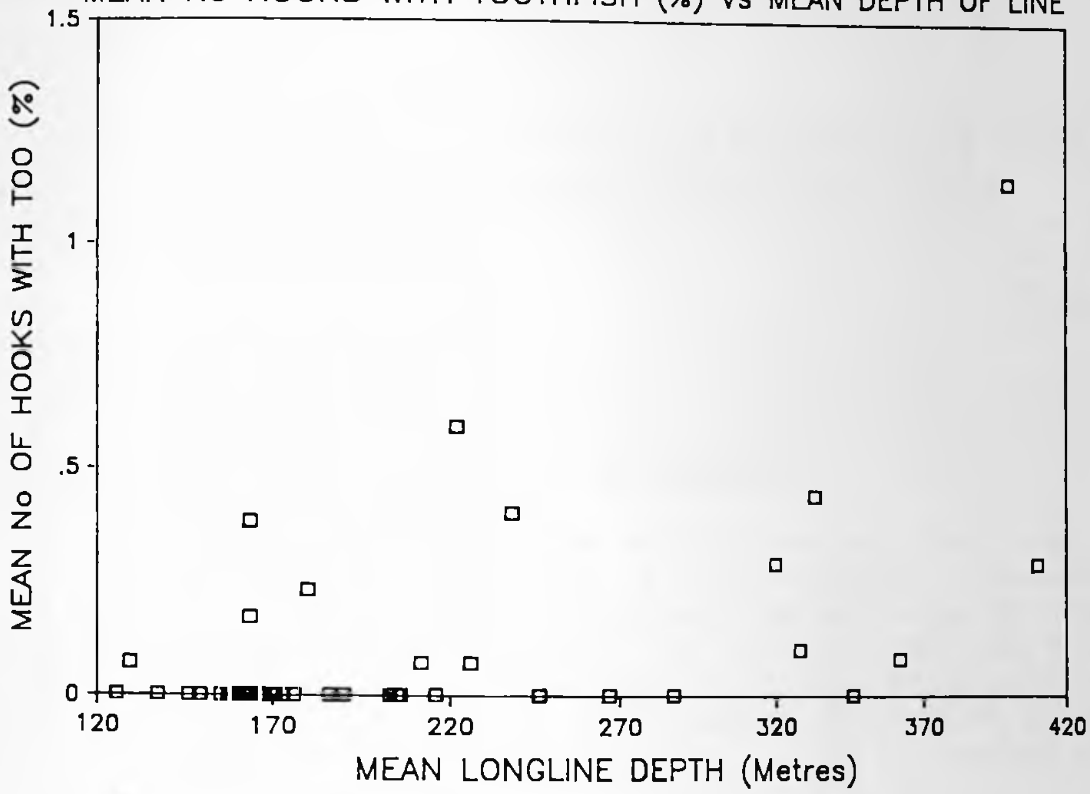


FIG 45. PLOT SHOWING

MEAN No HOOKS WITH FISH (%) Vs MEAN DEPTH OF LINE

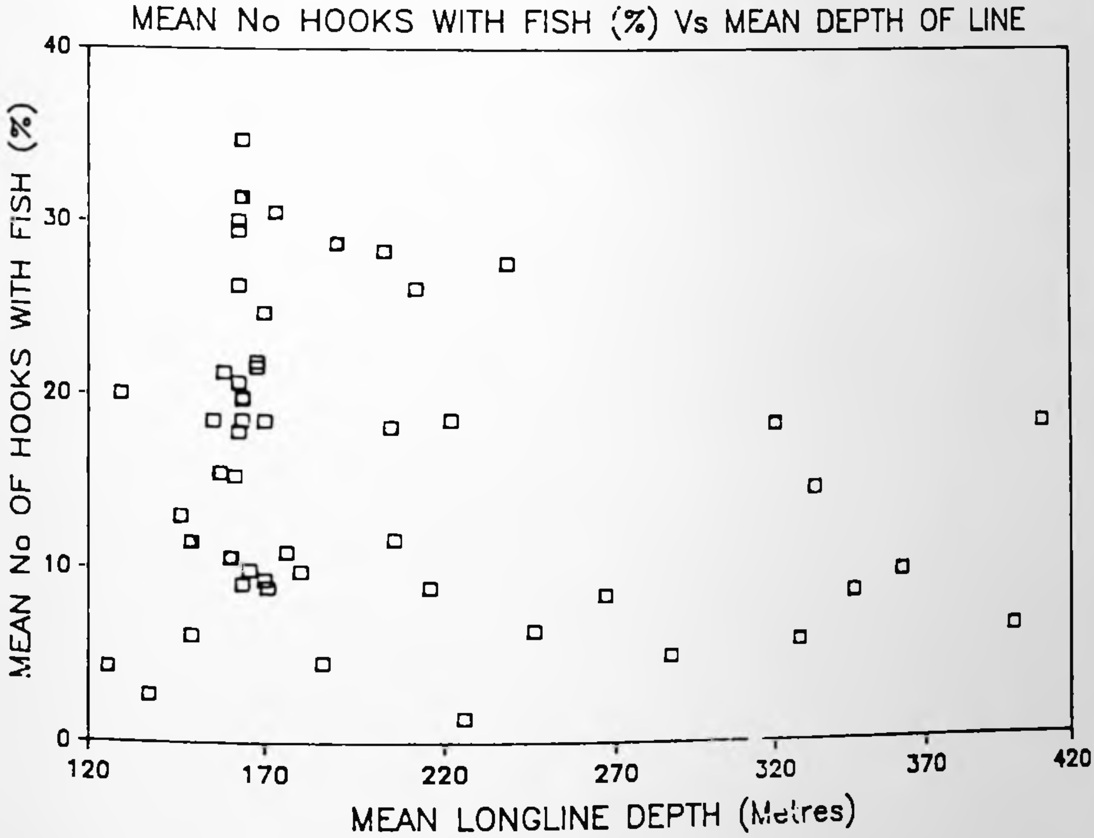
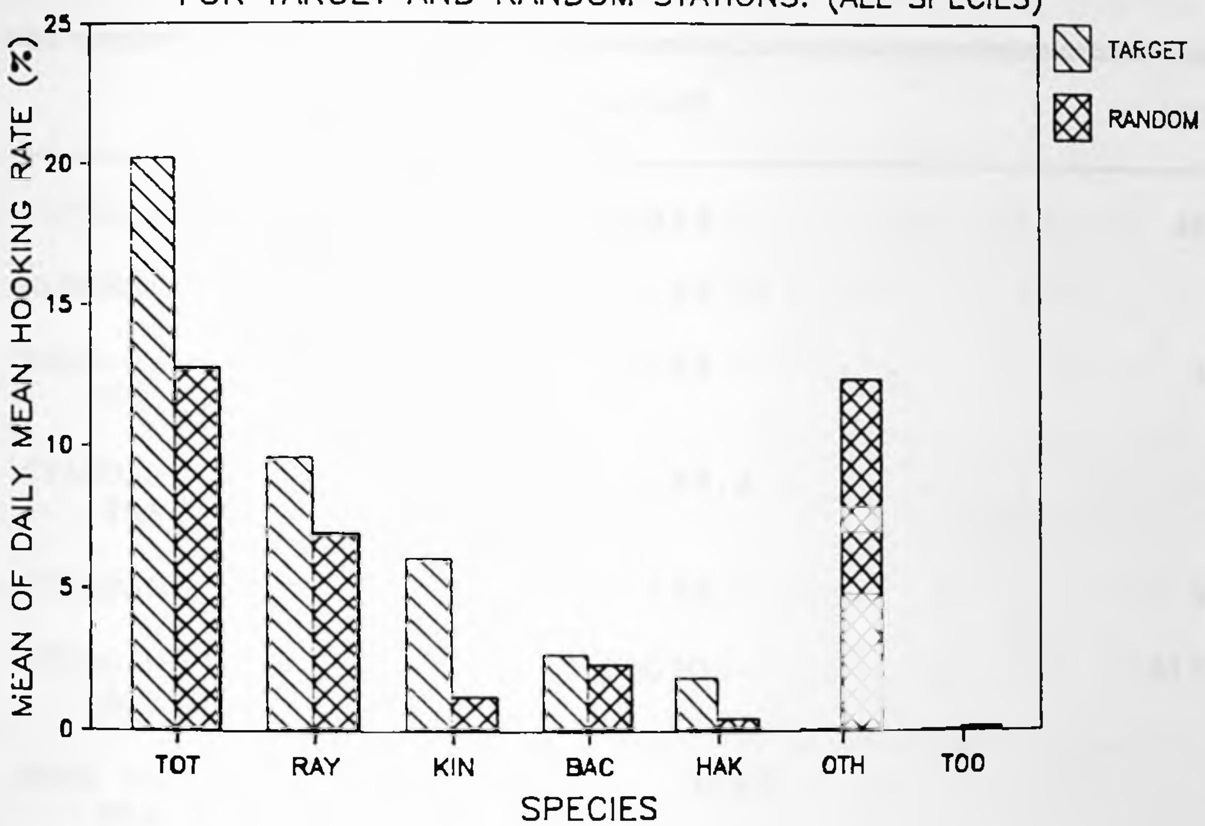


FIGURE 46

A bar chart comparing the means of the daily mean hooking rates, expressed as a percentage, by species, for targeted and random stations. The plot is drawn up to give an indication of the effectiveness of targeting. Although the variations and standard deviations were very large, the overlying trends are clearly shown.

FIG 46. MEAN OF DAILY MEAN HOOKING RATES
FOR TARGET AND RANDOM STATIONS. (ALL SPECIES)



The Fishing Master made a count of individual kingclip landed for 49 separate stations which totalled some 20,893 fish. Table 14 compares the individual kingclip catch statistics for targeted and random stations.

TABLE 14

	TARGET	RANDOM
TOTAL KINGCLIP	16823	4070
NUMBER OF STATIONS	22	27
MEAN No OF KINGCLIP PER STATION	765	151
STANDARD ERROR OF THE MEAN	83.4	64.3
STANDARD DEVIATION	391.1	334.3
TOTAL NUMBER OF BASKETS	10070	11215
MEAN No OF KINGCLIP PER BASKET	1.67	0.36

The above table shows very clearly that despite lower catches of kingclip than forecast, targeting was relatively successful.

The results presented in this section are discussed in Chapter 3.6.

3.4 THE K.S.J. CORPORATION REPORT

(1) INTRODUCTION

A report of the experimental bottom longline fishing operation on the 'Koei Maru No.30' compiled by the K.S.J. Corporation arrived at the Falkland Islands Government London Office on 11th November 1988. The report was transmitted by 'FAX' and is presented in it's entirety in the Appendix. Since the quality of the report was difficult to read due to the transmission and subsequent photocopying, some of the more important extracts have been re-typed and are shown on the following pages. The FAX contained two introductory pages, a page-long report from the Fishing Master of the 'Koei Maru', a three page section on the sales results and four pages listing the revenue and expenditure incurred during the whole fishing period in the F.I.C.Z..

THE FISHING MASTER'S REPORT

Experimental Longlining in the Falklands In 1988

KOEI MARU number 30

On June 16, 1988 KOEI MARU NO. 30 commenced fishing in the FICZ on the experimental longlining venture. Starting to the Southeast of the Falklands KOEI MARU then fished to the South, Southwest and West at seawater depths of about 150 to 200 meters, but there was no commercially viable fishing. Moreover, because of competition with trawlers fishing in this area we were unable to fish as had intended so we shifted to the area to the Northwest of the island where there were relatively few trawlers fishing. After arriving at this fishing ground there was a daily catch of kingclip of two metric tons per day and we continued fishing until the middle of July.

The weather becomes extremely rough during the middle of July and almost every day winds blow strongly (about 15 to 20 meters) from the West-Southwest so at this time we were unable to fish as had been we had hoped. Due to rough weather we were unable to fish on about one-third of the potential fishing days and even when fish was caught it was only in small amounts and was not sufficient to make the fishing commercially viable. Also the fish were small in all areas fished and the catch levels did not improve. I think that this is because the trawlers are fishing at the same depth of about 150 to 200 meters.

If the Falklands fishing grounds are divided into four equal parts there are relatively more fish in the Northwest sector and we fished longest in this area. Because water depth increases very rapidly to the East this area is not suitable even for longlining. Generally speaking the available fishing grounds were not suitable to longlining because of competition with the trawlers which were fishing at the same depth. The designation of different areas for trawling and for longlining could result in both resource conservation and a prolonging of the period during which these areas could be fished. The fishing ground will quickly be depleted if the current unrestricted fishing continues.

October 25, 1988

Masamitsu Chiba,
Fishing Master
NO. 30 KOEI MARU

Report on the Sales Results for the Catch of the NO.30 KOEI MARU Within the FICZ.

Sales Date: October 24, 1988

1. The Sales plan

We had expected that the bulk of the catch would be merluza negra (toothfish), but due to both the depth at which fishing occurred and the fishing season this species constituted less than one percent of the catch. Therefore our sales effort was shifted primarily to kingclip.

a. The main kingclip fishing grounds developed by Japanese trawlers are Southern Africa, New Zealand, Chile and Argentina. Thus since the establishment of 200 mile limits internationally the volume of kingclip coming into Japan, including imports, has been decreasing annually from over 6000 MT in 1983. In 1988 800 MT of imports and supplies from Chile and New Zealand combined to provide a total supply of only about 2000 MT. Thus we were confident we could sell under favourable conditions.

b. From the standpoint of quality, South African fish was the highest class of product but the volume is inconsistent so it is difficult to market this product. At present the New Zealand product is popular due to the pink colour of its skin. The reason for this is that companies specialising in slicing fish use this fish under the name of "amadai", (a kind of brim which is very popular in Japan). This species is used as raw material for slicing. Our product has a strong mix of pink and brown colour therefore it must be expected to have a lower reputation in the market than the New Zealand product.

c. Kingclip has been on the Japanese market for over 15 years, and it is primarily sold in Western Japan. The large fish is sold to processors for the production of fillets and the small and medium sizes are used for surimi type, kneaded fish production. This low oil content whitefish has no distinct flavours so it is suitable for use in a variety of dishes.

d. The fish produced on our vessel was very fresh and there was no separation of the flesh as is the case with trawl caught product and fish taken by other means. The market place highly evaluated these benefits of the longline fishing method.

2. Sales Results

Kingclip

As there is a stable supply of the New Zealand kingclip on the market the New Zealand product has become the standard against which the price is set. Also, the New Zealand product is ranked higher than that of the Southwest Atlantic.

The flesh of the kingclip sold by KOEI MARU was firm and undamaged as it was caught by longline and this fact was highly evaluated in the market. At present Southwest Atlantic kingclip is coming into Japan from Argentina , but this ranks below the NO.30 KOEI MARU product. Our product ranks first among the Southwest Atlantic kingclip, and its reputation was almost the same as the New Zealand product. We were satisfied with the price we received. However, we must also note that the low supply facilitated the strong price.

Comparative prices are as follows in yen per kg.

Size	NO. 30 KOEI MARU Southwest Atlantic product	New Zealand product
Large	370 - 340	400 - 350
Medium	300 - 250	300 - 200
Small	250 - 200	300 - 200
Mixed 3L - SS	355 - 150	

Rays (Kasupei)

The sales price in Japan is low. As the fishing ground is so far away, even if the species were available in volume it would not be an attractive item for the Japanese fishing vessels.

Other Species

The prices were fairly good, but the volume was too small. There are no prospects for a viable fishery targeting on these species.

October 31, 1988

Marukei, K.K.

Details of NO.30 KOEI MARU FICZ Bottomfish Sales

October 24, 1988

Item/size		Volume (Kgs)	Number of Cases	Price Yen/Kg	Yen Sales Amount
Kingclip	5L	1,340	219	370	495,800
(Block	4L	482	24	375	173,250
Frozen)	3L	7,842	368	355	2,783,910
	2L	10,868	489	340	3,695,120
	L	11,879	564	300	3,563,700
	M	8,640	439	250	2,160,000
	S	7,226	374	250	1,806,500
	SS	149	8	200	29,800
Individual	3L	510	27	355	161,050
Quick	2L	401	23	340	136,340
Frozen	L	258	15	250	64,500
(IQF)	S	161	12	200	32,200
	SS	65	5	150	9,750
Merluza	3L	100	5	650	65,000
negra	2L	129	7	650	83,850
(toothfish)	L	167	9	650	108,550
	M	212	12	650	137,800
IQF		81	5	650	52,650
Rays		48,177	2,991	140	6,744,780
Merluza	3L	439	22	230	100,970
(Hake)	2L	1,552	74	220	341,440
	L	1,928	90	220	424,160
IQF		241	11	150	36,150
IQF	3L	1,806	89	180	325,080
TOTAL		104,633	5,882		23,552,350

"K O E I   M A R U   N O. 3 0"

MARUKEI CORPORATION

REVENUE AND EXPENDITURE ON EXPERIMENTAL BOTTOM LONGLINING AND SQUID FISHING

1988,11.7

	SQUID JIGGING	LONGLINING	TOTAL
PERIOD	29 DEC-23 MAY 147 DAYS	24 MAY-20 OCT 150 DAYS	297 DAYS
PRICE OF FISH	319,852,484	23,552,350	343,404,534
COST OF FISHING			
CREW SALARY	79,388,600	22,212,600	101,601,100
FOODS	5,994,054	6,116,382	12,110,436
SEAMEN INS PRM	10,043,488	10,248,457	20,291,945
SALES COST	94,095,392	3,152,903	97,249,297
FUEL COST	35,117,747	15,948,747	51,086,494
REPAIR COST	13,363,600	13,636,400	27,000,000
CONSUMPTION COST	27,363,114	26,183,103	53,546,217
MISC.	38,828,540*	4,011,980	42,840,520
HULL INS PRM	3,881,000	3,980,250	7,841,250
DEPRECIATION	79,764,832	81,392,687	161,157,519
FISHING EXPENDITURE	387,841,367	186,863,411	574,704,778
PROFIT & LOSS	-67,988,883	-163,311,061	-231,299,944
ADMIN COST	18,342,000	18,717,000	37,059,000
INTEREST PAYABLE	13,215,000	13,485,000	26,700,000
SUB TOTAL	31,557,000	32,202,000	63,759,000
TOTAL COST	419,398,367	219,065,411	638,483,778
PROFIT AND LOSS	-99,545,883	-195,513,061	-295,058,944

* = NOT THE SAME AMOUNT AS ITEMISED IN DETAILS (SEE APPENDIX)

The revenue and expenditure sheet includes some fixed costs, which perhaps should not be included in such an evaluation, notably "Hull Insurance Premium" and "Depreciation".

Figure 47a is a pie chart which shows the proportion of revenue from sales of each species caught and landed during longlining phase. The relative revenues by species for block frozen and IQF fish is shown in Figure 47b.

All the results from Chapters 3.3 and 3.4 are discussed in Chapter 3.6.

FIGURE 47a

The proportion of sales revenue for each of the four species sold in Japan. The total revenue was 23,552,350 Japanese Yen.

FIGURE 47b

A plot showing the revenue in millions of Yen for each of the four bottom longline species. The totals have been divided into block frozen and IQF components.

FIG 47a. PIE CHART SHOWING THE SHARE OF SALES REVENUE FOR BOTTOM LONGLINING FISH

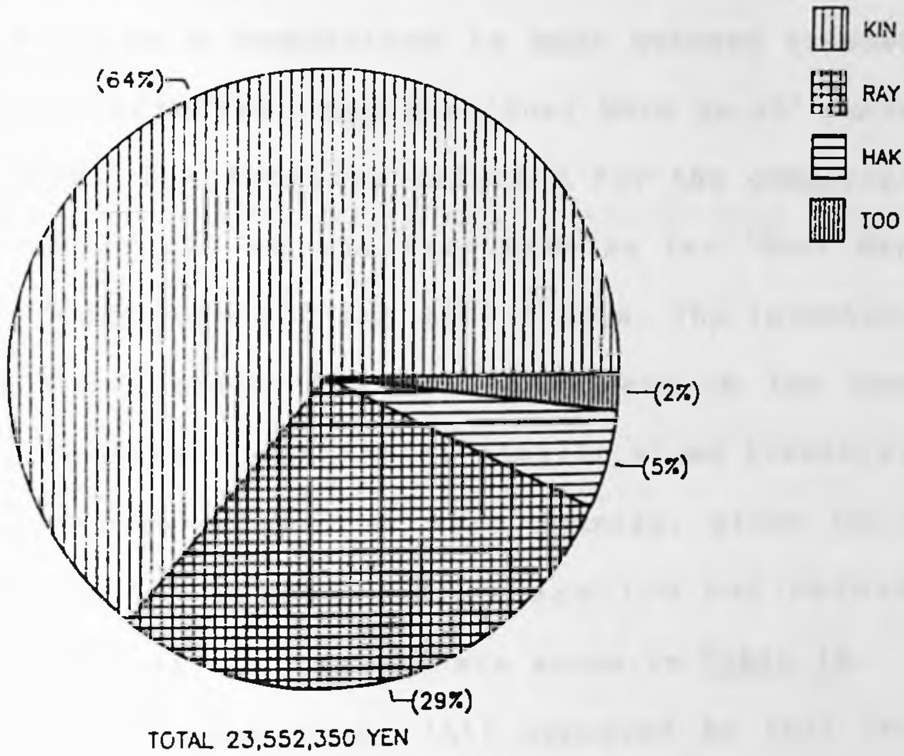
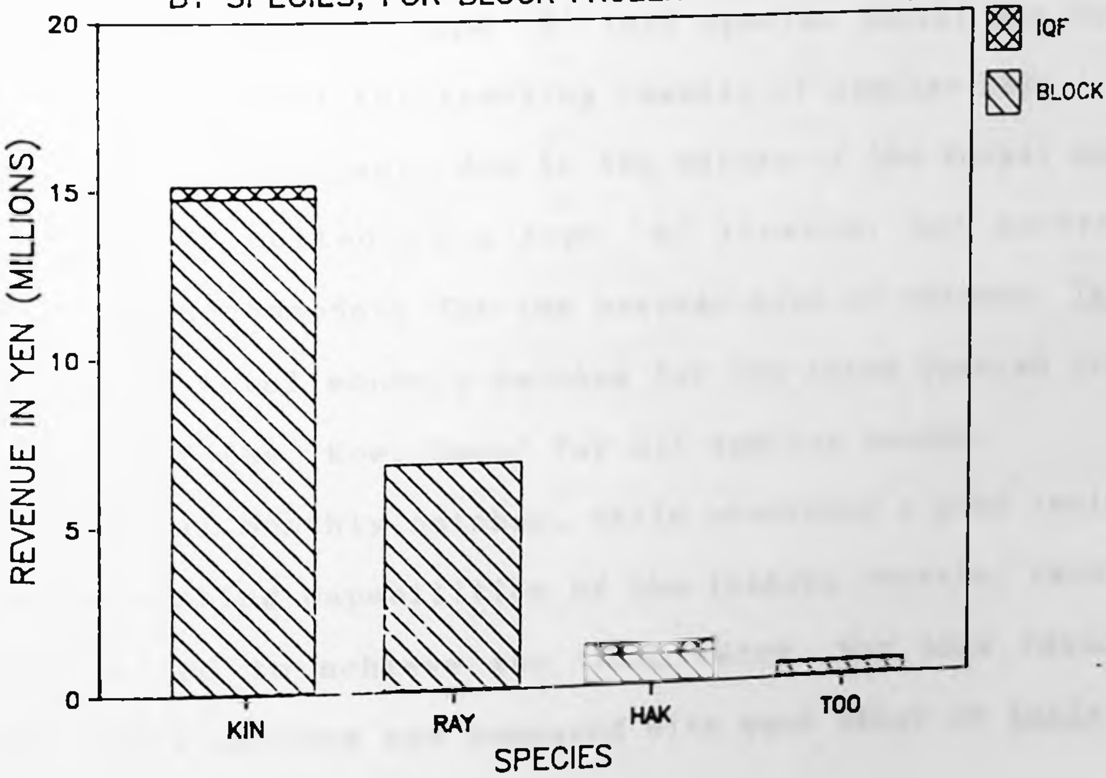


FIG 47b. THE REVENUE FROM BOTTOM LONGLINING BY SPECIES, FOR BLOCK FROZEN AND IQF FISH (YEN)



3.5 LICENCE FEES

In this section a comparison is made between trawlers with type 'A' licences (finfish) and the 'Koei Maru No.30' during it's 23 targeting days. The trawlers selected for the comparison were fishing in the F.I.C.Z. at the same time as the 'Koei Maru' and have a G.R.T. of between 900 and 1500 tonnes. The intention is to set a recommended licence fee for longliners in the zone with reference to comparative catches by similar sized trawlers.

All the trawlers looked at were Spanish, since the Polish trawlers were targeting for other species not relevant to longlining; details of the vessels are shown in Table 15.

The finfish licences (type 'A') appeared to fall into the £4,000 - £6,000 category (monthly average), which compared with £11,000 - £16,000 for type 'B' (all species north) and type 'C' (all species south) for trawling vessels of similar GRT.

A bottom longliner, due to the nature of the target species, would be most suited to a type 'A' licence, but accordingly adjusted to accommodate for the average size of catches. Table 16 compares the total monthly catches for the seven Spanish trawlers with those of the 'Koei Maru' for all species caught.

The total monthly catches, while providing a good indication of the harvesting capabilities of the fishing vessels, ignore the effort exerted to achieve the total catch. For this reason the average daily catches are compared with each other in Table 17.

TABLE 15

THE GRT, LICENCE FEE, MONTH AND NUMBER OF DAYS FISHED OF TRAWLERS WITH TYPE 'A' LICENCES AND THE KOEI MARU No.30

VESSEL	GRT (tonnes)	MONTH OF FISHING	DAYS FISHED	LICENCE FEE (per month)
No. 1	1297	JUNE	14	£4,712
No. 2	1071	JUNE	13	£4,214
No. 3	1359	JUNE	11	£4,946
No. 4	1425	JUNE	15	£5,168
No. 5	1091	JULY	23	£5,580
No. 6	1333	JULY	25	£5,193
No. 7	1095	JULY	22	£4,468
No. 7	1095	AUGUST	2	£4,468
KOEI MARU	1095	JUNE/JULY/AUG	23	EXPERIMENTAL

NB. Licence fees worked out as a monthly average (1988)

TABLE 16

THE TOTAL CATCHES (in tonnes) FOR SPANISH TRAWLERS AND THE KOEI MARU No.30, BY SPECIES

VESSEL	MONTH	HAKE	KINGCLIP	TOOTHFISH	RED COD	RAY	OTHERS
		SPECIES					
No.1	JUNE	249.1	6.7	0.0	25.4	0.0	0.0
No.2	JUNE	183.8	5.7	0.0	18.8	1.4	0.0
No.3	JUNE	423.0	7.3	0.0	29.0	5.8	0.0
No.4	JUNE	237.7	6.5	0.0	26.0	0.1	0.0
No.5	JULY	358.9	27.4	0.0	39.8	3.5	0.0
No.6	JULY	376.8	9.2	0.0	43.7	0.0	0.0
No.7	JULY	247.3	18.8	0.0	41.5	1.9	2.1
No.7	AUGUST	12.2	4.7	0.0	0.0	0.0	0.0
KOEI	JUNE	0.4	2.3	0.0	0.1	6.7	0.0
KOEI	JULY	6.6	59.6	0.3	14.5	141.7	0.0
KOEI	AUGUST	2.5	16.7	0.1	4.7	41.6	0.0

TABLE 17

THE AVERAGE DAILY CATCHES (in tonnes) FOR SPANISH TRAWLERS AND THE KOEI MARU No.30, BY SPECIES

VESSEL	MONTH	SPECIES					
		HAKE	KINGCLIP	TOOTHFISH	RED COD	RAY	OTHERS
No.1	JUNE	17.79	0.47	0.0	1.81	0.0	0.0
No.2	JUNE	14.14	0.44	0.0	1.45	0.11	0.0
No.3	JUNE	38.45	0.66	0.0	2.63	0.53	0.0
No.4	JUNE	15.85	0.43	0.0	1.73	0.008	0.0
No.5	JULY	15.60	1.19	0.0	1.73	0.15	0.0
No.6	JULY	15.07	0.37	0.0	1.75	0.0	0.0
No.7	JULY	11.24	0.85	0.0	1.89	0.08	0.09
No.7	AUGUST	6.10	2.35	0.0	0.00	0.0	0.0
KOEI	JUNE	0.20	1.20	0.0	0.05	3.40	0.0
KOEI	JULY	0.44	3.97	0.02	0.97	9.45	0.0
KOEI	AUGUST	0.41	2.78	0.02	0.78	6.93	0.0

Probably the best way of establishing a licence fee for a longliner of a similar size as the 'Koei Maru' from the trawling data, is to look at the ratio of licence fee to catch of target species. In the case of the Spanish trawlers, the target species was hake. The 'Koei Maru' targeted for kingclip and ray.

If the monthly licence fee is divided by the average daily catch by month (in tonnes) of the target species (hake), then the resultant figure represents the proportion of licence fee per tonne caught. When these figures for the seven Spanish trawlers are averaged, a mean of 356.2 is calculated. By multiplying this averaged ratio by the mean daily target catch from the 'Koei Maru' (kingclip and ray), an appropriate licence fee can be arrived at for each month. These are as follows:

MONTH		KINGCLIP		RAY		RATIO		SUGGESTED LICENCE FEE
JUNE	=	(1.20	+	3.40)	x	356.2	=	1638.6
JULY	=	(3.97	+	9.45)	x	356.2	=	4780.6
AUGUST	=	(2.78	+	6.93)	x	356.2	=	2471.4
						MEAN	=	2963.5

These calculations suggest that a licence fee of £2,963.5 per month would be appropriate, but it must be taken into consideration that hake will fetch a different market price to kingclip and ray, and also that longlined fish tends to command a higher market price than the same trawled species.

Further complications arise when setting a fee for vessels with a smaller or larger G.R.T. than the 'Koei Maru'. Unlike trawlers, the catching potential of longliners doesn't necessarily increase with increasing G.R.T.. There is also no easy way of establishing effort (i.e. number of jigging machines for jiggers), the closest being the number of hooks that can be deployed in a day (but very difficult to monitor).

As a starting point though, a bottom longlining licence fee should probably be set at a little less than that for a type 'A' licence. If however an exclusive longlining box were ever established inside the F.I.C.Z., then this may alter catches and correspondingly the licence fee would need reviewing.

3.5 DISCUSSION

The project as a whole can be considered successful, in as much as it served to prove that this particular style of longlining is probably not feasible inside the F.I.C.Z. at the present time. Problems of fishing conflicts with trawlers and marketing some of the products in Japan were the most obvious stumbling blocks for the operation. It became clear quite early on in the longlining phase that the target of five tonnes of kingclip (pre-processed) per day was not going to be reached; the target was established from the results obtained in 1987 by the 'Koei Maru No.10' longlining on the Argentine Patagonian shelf.

The 'Koei Maru No.30' was not the only longliner to fish inside the F.I.C.Z. during 1988. In late September and early October a Spanish bottom longliner, the 'Faro de Hercules' (callsign EAAC) spent a short period commercially fishing whilst on an experimental exploration of bottom longlining potential in the South Atlantic. The catches were consistently poor, as were the choice of fishing grounds, and consequently her visit to the Falklands was brief. There were a number of striking differences between the two longlining vessels, most notably that the 'Faro de Hercules' is a purpose built longliner fitted out with autolining equipment and that the bait being used was not squid but sardine. It is possible that the 'Faro de Hercules' would have been more successful if her exploratory trip to the zone had been planned in association with the Falkland Islands Fisheries Directorate, since, by the time she began fishing the location of the better longlining fishing grounds was known. Unfortunately no direct comparison between the two vessels could be made, due to a lack of on board sampling and minimal catch information from the 'Faro de Hercules'.

(I) BENEFITS OF THE EXPERIMENTAL BOTTOM LONGLINING

During the longlining phase it was possible to establish that it is an excellent method of targeting for ray and kingclip, and that the percentage of these two species in relation to the total catch was much higher than is found in trawled catches. The total hake catches were rather disappointing throughout the fishing period, for two main reasons; firstly, hake was not being preferentially targeted by the Fishing Master, as it has a low market value in Japan, and secondly none of the major hake grounds were fished due to the presence of numerous trawlers.

The yields of ray were exceptionally good in all areas of the zone, but this resource was once again not fully utilised by the 'Koei Maru' as it too has a very poor market value in Japan. The ray fishery would be much more attractive to European markets, in particular the British market, where 'skate' is becoming quite sought after. An additional attraction to ray is that it can be caught in areas where conflicts with trawlers would be minimal.

Longlining generally produces high quality, high value commodity due to the good condition of the fish upon capture. This was certainly the case of the 'Koei Maru' kingclip, as mentioned in the K.S.J. Corporation report, although they were careful to emphasise that the high value was also aided by the scarcity of the product.

As far as the sampling programme went, the experimental fishing provided some useful and interesting results. It has been possible to establish that much of the F.I.C.Z. is not suitable for this method of fishing and that certain depths are more productive than others. These points are discussed in more detail in a later section.

(II) PROBLEMS WITH THE BOTTOM LONGLINING PHASE

Unfortunately there were a large number of problems and these far outweighed the positive achievements of the exercise. The most important problem and the one with the most far reaching consequences for the future of longlining inside the F.I.C.Z. was that of conflicts with trawlers. At no time was the 'Koei Maru' able to fish when in the vicinity of trawlers without keeping a constant watch over the longline and calling up any vessel on the V.H.F. radio which was in danger of trawling over it. Despite the vigilant efforts made, 105 lines (baskets) from a total of 510 were trawled up on the 12th August in the north of the zone, at considerable cost in both gear and time spent attempting to recover the lines. The 'Faro de Hercules' also experienced a similar loss of bottom longline gear whilst fishing amongst a fleet of Polish trawlers off Cape Meredith. Due to this problem, the 'Koei Maru' was unable to fish in some of the more "attractive" fishing grounds, for example to the west of the zone on the 200 metre line, and had to settle for fishing grounds where catches were inevitably going to be poorer. This was the Fishing Master's most common complaint, and he mentions the problem in his report (shown earlier).

The weather had a fairly profound effect on the productivity of fishing, 15 days being lost to gales, and hauling conditions made hazardous on many occasions. On several days the number of lines set was reduced from the usual 510 because of deteriorating weather conditions. A problem peculiar to the 'Koei Maru No.30' was that the stern door, through which the line was deployed, was set too close to the water line and large amounts of water were shipped in a sea state of anything over force 5 (Beaufort scale). Water was also shipped in the factory deck through the cargo door whilst hauling and on a number of occasions crew members were completely swept over into the factory. Such occurrences would probably not happen on purpose-built longliners.

The Japanese market proved to be not very responsive to the South Atlantic bottom longline species, with the exception of kingclip and toothfish. One of the objectives of the project was to assess the impact of the product on the Japanese market, and it can probably be said to be poor. A European market would be more likely to give better results. Red cod provided the third largest catch, 9 percent by weight, but was discarded as a non-viable product. The Japanese response to ray was also very poor, and as the K.S.J. Corporation report states :

" Rays - The sales price in Japan is low. As the fishing ground is so far away, even if the species were available in volume it would not be an attractive item for the Japanese fishing vessels."

Although the toothfish commanded a high price in Japan, it is not caught in large enough quantities to become a viable product.

Catches even during the target periods were disappointingly low by comparison to trawlers (see Tables 16 and 17). Taking into consideration that the prime fishing grounds were not fished, due to the presence of trawlers, it is not surprising that the catches were low. It must be remembered that in order to compete with trawled fish, catches do not have to be as high as trawler catches, given the better price offered to longlined produce.

The costs and overheads for the 'Koei Maru' were unacceptably high, and it was far from ideal as a longliner. The vessel was large and the style of fishing very labour intensive. Extra costs were incurred with the refit in Montevideo, and the revenue from sales of fish could in no way recoup the losses of the venture. It may be that a purpose built bottom longliner would not have completed the fishing with such a deficit. While labelling the project as a commercial failure it must be emphasised that much of the time in the zone was spent sampling areas where catches were extremely low, and this compounded the financial problems of the 'Koei Maru'.

(III) THE SAMPLING PROGRAMME

The sampling programme covered most of the zone between the depths of 150 and 450 metres with four notable exceptions; the area east of Berkeley Sound, the area south of Cape Meredith, north and northwest of the Jason Islands and most importantly west of the zone along the 200 metre depth contour.

Figures 34 and 35 show the catches by area (the four sampling zones) and the C.P.U.E's expressed as kilos caught per basket. It shows clearly that certain species were caught in any quantity in only one or two zones (kingclip in the northern zones and grenadier in the south) and some **species** were fairly uniformly distributed (ray and red cod).

Examination of the hooking rates with increasing depth for each species showed fairly clearly that the optimum depth range for high hooking rates was between 150 and 200 metres for all the species except toothfish (Figures 40 - 45). Hooking rates throughout the sampling were highly variable, even over a period as short as one hour, but the overall trends were clear.

The soak time results were rather disappointing and didn't show very much at all. This could have been partly due to the method of estimation of soak times at each sample count, but it was the best estimation available, given the conditions at the time.

Although some length-frequency data was taken for red cod and hake, it was not used in this report since there was too little of it. It would have been interesting to compare the sizes and maturities of the longlined fish with trawled fish from the same period. From observations it appeared that although the longlining was extremely species specific, it was not size specific. Some extremely small kingclip (72 cm) were caught alongside large ones (142 cm). A large number of small notothenids were also caught at most stations as well as some very small ray. Unfortunately only the one standard size of hook was used, which prevented any work on the effect of hook size on fish size. The 'Faro de Hercules' was using very similar sized hooks to those of the 'Koei Maru'.

The <u>Illex</u> squid bait appeared to be very effective, and was an easily accessible bait for a squid jigger/longliner to use. The 'Faro de Hercules' used small sardines for bait. The zone could provide a healthy supply of both freshly frozen squid and patagonian herring (<u>Sprattus fuegensis</u>), although the latter is not always a reliable visitor to the zone, to be used as relatively cheap baits for bottom longlining.

IV JIGGER/BOTTOM LONGLINERS

One of the original objectives of this project was to examine the potential for squid jiggers to convert at the end of the <u>Illex</u> fishing period, to longliners, and see out the remainder of the year finfish fishing without having to return to their country of origin, potentially saving expenditure and costs of sailing home while at the same time increasing revenue from extra fish catches. This has been shown to be impractical and uneconomic. The experiences of the 'Koei Maru' highlight the dangers of becoming a 'Jack of all trades and master of none', in as much as longlining in the F.I.C.Z. is probably best left to the purpose built vessels.

(V) THE FUTURE OF BOTTOM LONGLINING INSIDE THE F.I.C.Z.

There is potential for a bottom longlining fishery to operate within the zone. Ray, kingclip and to some extent red cod have been shown to be good target species, and hake, which was not targeted by the 'Koei Maru' but occurs in huge numbers in the west of the zone, has a great deal of potential. Although there is potential for a bottom longline fishery, it may not be feasible to introduce it to the zone. The difficulties of initiating such a fishery are quite straight forward. Ideally the longliners would like to fish in areas where trawlers currently fish, but such a situation is not possible. Longliners have no obvious advantages over trawlers, so why upset the status quo with the introduction of designated 'longliner only' or 'trawler only' areas? If the main target species for a longliner was ray, then such conflicts could be avoided, and both styles fish within the zone. Any longlining which does occur will be much better suited to the European market, where 'skate' and hake are popular fish.

APPENDIX I

The following 5 pages (LLS1 - LLS5) are the data sheets which were used throughout the longlining phase for all data aquisition.

Bridge Data Sheet

LLSI

Date	Stn N^{o}	Time set start	Position set start	Time set finish	position set finish	Time haul start	Time haul finish	N^{o} of lines	Depth set st, fi	^{o}C set st fi	Wind dir. + speed Haul start.

ILS2

Date	Time	Haul start time	R	B	H	K	T	O	Fish total	Hook + Bait	Hook only	Broken gangion	Total No. gangions

R = RAY
B = BAC
H = HAK
K = KIN
T = TOO
O = OTHER

Date	Set time	Soak time (Range)	Haul time

Date	Species	SS	S	M	L	2L	3L	4L	5L	Total Cases

DAILY SUMMARY SHEET

LLS5

DATE	SET START POSITION	FISHING (Y/N)	RANDOM/ TARGET	COMMENTS

APPENDIX II

The following pages are a reduced photocopy of the complete K.S.J. Corporation FAX report of the experimental bottom longlining fishing operation carried out by the Koei Maru No.30.

Please pass to Kesser.

Mr Alastair Cameron
Deputy of Fisheries Director
Falkland Islands Government
London Office
29 Tufton Street
Westminster London
SW1P 3QL
United Kingdom

11 November 1988

Attention
Mr A Cameron

Re: Report of the experimental bottom long line fishing operation

KOEI MARU NO.30
===============

Attached, please find 10 pages of reports including this covering with respect to the captioned subject.

Could you please do not hesitate to contact us if any question you have.

Best regards
S. Kaneko

Mr Alastair Cameron
Deputy of Fisheries Director
Falkland Islands Government
London Ofice.
United Kingdom

11 November 1988

Attention Mr A. Cameron

Re: Report of the Experimental Bottom Long line Operation.

Enclosed, Please find the report on the experimental bottom long line operation performed by the fishing vessel KOEI MARU No.30 in Falkland Islands Fisheries Conservation and Management Zone 1988.

We mould very much appreciate if you could confirm your receipt of this report accordingly.

Best regards

S. Kaneko
K S J Corporation
Tokyo Japan

Experimental Longlining in the Falklands in 1988

KOEI MARU Number 30

une 16, 1988 KOEI MARU NO. 30 commenced fishing in the FICZ the experimental longlining venture. Starting to the least of the Falklands KOEI MARU then fished to the South, west and West at seawater depths of about 180 to 200 meters, here was no commercially viable fishing. Moreover, because ompetition with trawlers fishing in this area we were unable sh as had intended so we shifted to the area to the west of the island where there were relatively few trawlers ing. After arriving at this fishing ground there was a daily of kingclip of two metric tons per day and we continued ing until the middle of July.

weather becomes extremely rough during the middle of July and st every day winds blow strongly (about 15 to 20 meters) the West-Southwest so at this time we were unable to fish as been we had hoped. Due to rough weather we were unable to on about one-third of the potential fishing days and even fish was caught it was only in small amounts and was not icient to make the fishing commercially viable. Also the n were small in all areas fished and the catch levels did not rove. I think that this is because the trawlers are fishing the same depth of about 150 to 200 meters.

the Falklands fishing grounds are divided into four equal ts there are relatively more fish in the Northwest sector and fished longest in this area. Because water depth increases ry rapidly to the East this area is not suitable even for nglining. Generally speaking the available fishing grounds re not suitable to longlining because of competition with the awlers which were fishing at the same depth. The designation different areas for trawling and for longlining could result both resource conservation and a prolonging of the period uring which these areas could be fished. The fishing ground ill quickly be depleted if the current unrestricted fishing ontinues.

October 25, 1988

Masamitsu Chiba,
Fishing Master
NO. 30 KOEI MARU

Report on the Sales Results for the Catch of the NO. 30 KOEI MARU within the FIZC.

Sales Date: October 24, 1988

1. The Sales Plan

We had expected that the bulk of the catch would be merluza negra, but due to both the depth at which fishing occurred and the fishing season this species constituted less than one per cent of the catch. Therefore our sales effort was shifted primarily to kingclip.

a. The main kingclip fishing grounds developed by Japanese trawlers are Southern Africa, New Zealand, Chile and Argentina. Thus since the establishment of 200 mile limits internationally the volume of kingclip coming into Japan, including imports, has been decreasing annually from over 6,000 MT in 1983. In 1988 310 MT of imports and supplies from Chile and New Zealand combined to provide a total supply of only about 2,000 MT. Thus we were confident we could sell under favorable conditions.

b. From the standpoint of quality, South African fish was the highest class of product but the volume is inconsistant so it is difficult to market this product. At present the New Zealand product is popular due to the pink color of its skin. The reason for this is that is that companies specializing in slicing fish use this fish under the name of "amadai", (a kind of brim which is very popular in Japan). This species is used as raw material for slicing. Our product has a strong mix of pink and brown color therefore it must be expected to have a lower reputation in the market than the New Zealand product.

c. Kingclip has been on the Japanese market for over 15 years, and it is primarily sold in Western Japan. The large fish is sold to processors for the production of fillets and the small and medium sizes are used for surimi type, kneaded fish production. This low oil content whitefish has no distinct flavors so it is suitable for use in a variety of dishes.

d. The fish produced on our vessel was very fresh and there was no separation of the flesh as is the case with trawl caught product and fish taken by other means. The market place highly evaluated these benefits of the longline fishing method.

2. Sales Results

Kingclip

As there is a stable supply of the New Zealand kingclip on the market the New Zealand product has become the standard against which the price is set. Also, the New Zealand product is ranked higher than that of the Southwest Atlantic.

The flesh of the kingclip sold by KOEI MARU was firm and undamaged as it was caught by longline and this fact was highly evaluated in the market. At present Southwest Atlantic kingclip is coming into Japan from Argentina, but this ranks below the NO. 30 KOEI MARU product. Our product ranks first among the Southwest Atlantic kingclip, and its reputation was almost the same as the New Zealand product. We were satisfied with the price we received. However, we must also note that the low supply facilitated the strong price.

Comparitive prices are as follows in Yen per KG.

e	NO. 30 KOEI MARU Southwest Atlantic Product	New Zealand Product
·ge	370 - 340	400 - 350
dium	300 - 250	300 - 200
all	250 - 200	300 - 200
xed 3L - SS	355 - 150	

ays (Kasupei)

The sales price in Japan is low. As the fishing ground is so far away, even if the species were available in volume it would not be an attractive item for the Japanese fishing vessels.

Other Species

The prices were fairly good, but the volume was too small. There are no prospects for a viable fishery targeting on these species.

October 31, 1988

Maruei, K. K.

Details of NO. 30 KOEI MARU FICZ Bottomfish Sales

October 24, 1988

Item/Size		Volume (KGS)	Number Of Cases	Price ¥ / KG	¥ Sales Amount
Kingclip (Block frozen)	5L	1,340	219	370	495,800
	4L	462	24	375	173,250
	3L	7,842	368	355	2,783,910
"	2L	10,868	489	340	3,695,120
"	L	11,679	564	300	3,503,700
"	M	8,640	439	250	2,160,000
"	S	7,226	374	250	1,806,500
"	SS	149	8	200	29,800
Individual Quick Frozen (IQF)	3L	510	27	355	181,050
	2L	401	23	340	136,340
	L	258	15	250	64,500
	S	161	12	200	32,200
	SS	65	5	150	9,750
Merluza negra	3L	100	5	650	65,000
	2L	129	7	650	83,850
	L	167	8	650	108,550
	M	212	12	650	137,800
IQF		81	5	650	52,650
Rays		48,177	2,881	140	6,744,780
Merluza	3L	439	22	230	100,970
	2L	1,552	74	220	341,440
	L	1,928	80	220	424,160
IQF		241	11	150	36,150
IQF	M	1,806	89	180	325,080
TOTAL		104,633	5,882		23,552,350

"KOEI MARU NO. 50"

MARUKEI CORPORATION

REVENUE AND EXPENDITURE ON [illegible]ERIMENTAL BOTTOM LONG LINING AND SQUID FISHING

1988.11.7

	SQUID JIGGING	LONG LINING	TOTAL
PERIOD	29/DEC ~ 23/MAY 147 DAYS	24/MAY ~ 20/OCT 160 DAYS	29/DEC ~ 20/OCT 297 DAYS
FISH	319,852,484	23,552,350	343,404,834
FISHING			
SALARY	79,388,600	22,212,500	101,601,100
	5,994,054	6,116,382	12,110,436
N INSURANCE PREMIUM	10,043,488	10,248,457	20,291,945
S COST	94,096,392	3,152,905	97,249,297
COST	35,117,747	15,948,747	51,066,494
IR COST	13,363,600	13,636,400	27,000,000
SUMPTION COST	27,363,114	26,183,103	53,546,217
CELLANEOUS	38,828,540	4,011,980	42,840,520
L INSURANCE PREMIUM	3,881,000	3,960,250	7,841,250
PRECIATION	79,764,832	81,392,687	161,157,519
PENDITURE OF FISHING	387,841,367	186,863,411	574,704,778
PROFIT AND LOSS OF FISHING	-67,988,883	-163,311,061	-231,299,944
MINISTRATION COST	18,342,000	18,717,000	37,059,000
NTEREST PAYABLE	13,215,000	13,485,000	26,700,000
SUB TOTAL	31,557,000	32,202,000	63,759,000
TOTAL COST	419,398,367	219,065,411	638,463,778
PROFIT AND LOSS	-99,545,883	-195,513,061	-295,058,944

DETAILS OF REVENUE AND EXPENDITURE

		SQUID JIGGING		LONG LINING
PRICE OF FISH				
PRICE OF FISH BROUGHT BY REEFER	21/Jun	63,860,864		
	6/Jul	117,221,300		
	2/Aug	18,255,160		
PRICE OF FISH BROUGHT BY JIGGER	4/Nov	100,515,100		23,552,350
CREW SALARY				
SETTLEMENT DOCK WORKING FEE TRONSPORT, ACCOMODATION FEE	2/Nov	79,388,600		
MINIMUM GUARANTEE			2/Nov	22,212,500
FOODS				
TOTAL PAYMENT		12,110,436 (YEN)		
	147 Days / 297 Days	= 5,994,054	150 Days / 297 Days	= 6,116,382
SEAMEN INSURANCE PREMIUM				
'87.Dec ~ '88.Nov SEAMEN INSURANCE PREMIUM				15,017,279
MUTUAL FRATERNAL INSURANCE PREMIUM				1,887,404
MEDICAL FEE, MEDICAL EXAMINATION FEE, DRUG FEE, ETC				3,387,282
	147 Days / 297 Days	= 10,043,488	150 Days / 297 Days	= 10,248,467
SALES COST				
SALES COMMISSION				
STEVEDORING FEE	27/Jun	2,516,825		
COMMISSION		759,770		
TRNSPORT FEE		419,804		
STEVEDORING FEE		16,468,980		
SALES COMMISSION	30/Jun	2,267,880		
〃	6/Jul	3,516,540		
TRANSPORT FEE		880,106		
		35,576,160		

...ISSION	2/Aug	842,819	
		91,276	
		1,467,360	
...FEE			1,848,864
...SSION	4/Nov	8,016,483	108,985
		802,675	729,036
			676,220
		3,266,466	
...N FEE, ETC			9,162,905
...TOTAL		94,098,392	

...OST

	31/Dec	22,393,720	
	13/Jun	8,000,000 (FO)	6,000,000 (FO)
	6/Jul	5,319,800 (FO)	9,738,757 (FO)
	2/Aug	1,464,227	
	4/Nov		209,990
			15,948,747
TOTAL		36,117,747	

R COST

...PAIR FEE HAS NOT BEEN CHARGED YET. FOLLOWING IS LAST YEAR'S REPAIR FEE.

27,000,000 (YEN)

147 Days / 297 Days = 13,363,600

160 Days / 297 Days = 13,636,400

UMPTION FEE

JIGGING GEAR 9,620,800

OTHER HAS BEEN PAID

147 / 297 = 17,742,314

TOTAL 27,368,114

LONG LINE GEAR 8,076,700

35,846,717

147 / 297 = 18,104,403

28,183,103

MISCELLANEOUS

11/Apr	19,696,800
30/Jun	15,000,000

147 / 297 = 3,831,740

160 / 297 = 4,011,980

TOTAL PAYMENT 7,843,720

HULL INSURANCE PREMIUM

'87.12.6	OVERSEAS SALVAGE ASSOCIATION FEE	160,000.
〃 7	FISHING VESSEL INSURANCE FEE	7,691,260

147 / 297 = 3,881,000

160 / 297 = 3,960,250

DEPRECIATION

VESSLE	680,342,000 × 0.226 =	153,757,292
VESSLE GEAR	20,620,300 × 0.226 =	4,662,447
FISHING GEAR	16,107,800 × 0.226 =	2,737,760
TOTAL		161,157,519

147 / 297 = 79,764,832

160 / 297 = 81,392,687

ADMINISTRATION COST

FOLLOWING IS PROPOTION DIVISION OF MARUKEI'S ADMINISTRATION COST OF LAST YEN BY NUMBER OF TOTAL VESSLE

37,059,000 YEN

147 / 297 = 18,342,000

150 / 297 = 18,717,000

INTERESTPAYABLE

BUILDING FUND INTEREST

OTHER INTEREST

TOTAL 26,700,000

147 / 297 = 13,215,000

160 / 297 = 13,485,000

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