

SEA FISH INDUSTRY AUTHORITY  
Industrial Development Unit

SQUID JIGGING TRIALS ABOARD F.R.V. G.A.REAY

Internal Report No. 1126

November 1983  
P. Neve

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SUMMARY

Squid fishing trials involving the use of bottom and midwater trawls, and hand and automatic jigging techniques with light attraction were conducted at various locations between the north east coast of Scotland and the Faroe Islands during September/October 1983.

Squid were taken in both the bottom and midwater trawls and, as on previous occasions, it was demonstrated that squid, in this case Todarodes sagittatus, can be attracted to lights during darkness and subsequently caught on jigged lures. However, the apparent absence of any appreciable quantities of squid in the areas fished calls into question the viability of a directed squid fishery.

The paucity of information known about squid, particularly such aspects as behaviour, and migration in relation to their environment is discussed and a suggestion is put forward for an international symposium to discuss all aspects of the squid fishery.

1        INTRODUCTION

The Sea Fish Industry Authority were invited to participate in a squid fishing cruise aboard the Fisheries Research Vessel G.A. REAY in collaboration with personnel from Marine Laboratory, Aberdeen (DAFS) and Torry Research Station (TRS). The objectives of the cruise programme were to obtain, on behalf of TRS, samples of the "hard squid" Todarodes sagittatus for iced, frozen and chilled sea water storage trials and subsequent analysis. In addition, small quantities of various white fish species from North Sea, Shetland and Faroese grounds were required by other TRS cruise personnel for chemical analysis.

Apart from the need to obtain white fish samples from other grounds it was intended to concentrate squid fishing activities in the Faroe Islands region where reasonable quantities of Todarodes had been caught during the 1982 visit to this area. It was proposed to use bottom and midwater trawling methods for catching squid during the day and to utilise hand and mechanical jigging techniques, in conjunction with light attraction, at night. Since it had not proved possible to obtain a suitable sea anchor for the vessel, an essential requisite for open water squid jigging, it was proposed to limit jigging operations to sheltered waters such as those afforded by the Faroese fiords.

This report describes the results obtained by trawling and jigging for squid. The effectiveness of each method is assessed and suggestions are put forward for further investigatory work.

2      TRIALS PERSONNEL

The scientific staff on this voyage consisted of the following.

G. Stroud (Scientist in charge)	TRS
E. Dalgarno	TRS
A. Thomson	TRS
G. Howard	DAFS
P. Neve	SFIA

3        TRIALS VESSEL

The G.A. REAY is the former 70m Hull freezer trawler ARCTIC PRIVATEER which has been modified for research purposes. The factory deck has been provided with a chill store while the freezing deck has been equipped with vertical and horizontal plate freezers, an air blast freezer and a laboratory area.

#### 4 TRIALS EQUIPMENT

The vessel was equipped with both bottom and midwater trawling gear, hand and automatic jigging machines and these are described in more detail below.

##### 4.1 Bottom Trawl

The bottom trawl used on this trip was a 105 ft. headline high lift Portuguese trawl with cut-away lower wings. The trawl doors were BMV 4m<sup>2</sup> oval, slotted type. The trawl was fished either with a dan leno rig or a split bridle rig to obtain maximum headline height. Initially, the groundrope was fitted with 60 ft. of rubber discs in the bosom section in order to improve ground contact but this resulted in torn bellies during the initial tows and the rubber discs were replaced with an equal length of steel bobbins which alleviated this problem.

##### 4.2 Midwater Trawl

An Engel 800 x 20cm midwater trawl was supplied on loan from MAFF (Lowestoft) since it was desired to tow at speeds in excess of 5 knots. It was considered that the G.A.Reay's own midwater trawls were too large for this purpose. The Engel 800 x 20 cm is a rectangular trawl with a headline length of 140 ft. The trawl is designed to give a mouth opening of 16 x 13m at three and three-quarter to four knots with toe end weights of 100kg/side and 3.25m<sup>2</sup> Suberkrub doors. In practice the G.A.Reay's own 6m<sup>2</sup> doors were used.

##### 4.3 Jigging Equipment

The jigging equipment consisted of a hand jigging machine supplied by DAFS, two automatic jigging machines supplied by SFIA and a lighting array supplied jointly by SFIA and TRS.

###### 4.3.1 Hand Jigging Machine

This machine was constructed by DAFS but is similar in design to the commercially produced KEMERS jigging machine. The latter are, however, designed to be driven by a remote motor. It consists of a simple hand-cranked drum, which holds the monofilament line and lures, connected to a retractable outboard

chute and idler roller. The machine was fastened to the port side rail of the working deck as shown in Fig.1. The lures consisted of five hard-bodied, long-hooked, orange jigs spaced at approximately 30cm intervals. A lead sinker weight was attached terminally and two battery operated underwater lamps completed the rig. These lights were identical in design to those used aboard ARCTIC HUNTER (See Ref.1) and were mounted immediately preceding and following the lure section of the line. During operation the jigs were allowed to freewheel out while the speed of retrieval was generally governed to match that of the automatic machines.

#### 4.3.2 Automatic Jigging Machines

Two Uematsu automatic jigging machines were fitted along the port side rail of the working deck as shown in App.1. A full description of these machines and their operation is given in Reference 1 and need not be repeated. The lines were each fitted with 30 jigs in various combinations of both hard and soft-bodied forms in a variety of colours. On one occasion a chemical type underwater light\*, which had been provided by the sales agent as a sample for commercial assessment, was attached to one of the lines but, apart from this, no underwater illumination was used with these jigs.

#### 4.3.3 Lighting Array

The lighting array consisted of six 1.5 Kw 220V A.C. bulbs fitted with lamp covers and suspended above the jigging machinery on a wire strop as shown in App.1. Initially, the forward end of the supporting wire was attached to a stanchion welded to the ships rail but, after one night's operation, it was found that the light/shadow interface (see Ref.1 for description) could be more accurately controlled by attaching the wire to the ship's boat davit since this could be manoeuvred outboard as required by means of a hand crank. The lighting array was taken down after each night's jigging operations in order to reduce the possibility of breaking the bulbs in rough weather.

\*Supplied by Maritime Facilities Company (UK) Ltd., PO Box 12, Stroud, Glos. GL5 2QA.



5 TRIALS NARRATIVE

September 27th

Vessel departed Aberdeen. Bottom trawl prepared for use. One tow conducted off Tod Head. Vessel proceeded to Turbot Bank and completed one tow during the night.

September 28th

Minor engine repairs carried out. One further tow conducted at Turbot Bank. Vessel proceeded to Bosies Bank and carried out a further tow. Vessel then steamed north.

September 29th

One tow completed east of Orkney. Vessel steamed north and conducted two tows off the east coast of Shetland. Vessel steamed north to Faroe.

September 30th

Vessel completed one tow at Fuglo Bank and proceeded to Funding Fiord for jigging operations.

October 1st

Vessel completed one tow at Fuglo Bank. Due to weather constraints vessel proceeded to Mulen, on the north coast of Faroe, for jigging operations.

October 2nd

Vessel completed two tows north of Faroe and proceeded to Funding Fiord for jigging operations.

October 4th

Vessel completed two tows north of Faroe and proceeded to Arne Fiord for jigging operations.

October 5th

Vessel steamed to Thorshaven where discussions were held with local fisheries staff. Vessel then steamed south to Fanny Bank.

October 6th

Bottom trawl stowed and midwater trawl prepared for use. One tow completed at Fanny Bank. Vessel steamed south-west to Wyvell-Thompson Ridge area.

October 7th

Two tows with the midwater trawl were carried out. Vessel then steamed east towards Shetland. Midwater trawl stowed and bottom trawl prepared for use.

October 8th

Vessel completed one tow south of Foula and a further tow west of Fitful Head. Vessel then proceeded to Papa Sound for jigging operations.

October 9th

Vessel conducted one tow south of Foula and proceeded to Scalloway Deeps for jigging operations.

October 10th

Vessel steamed to Orkney where one tow was completed and then steamed to the Moray Firth where a further tow was conducted south of Wick.

October 11th

Vessel completed one tow in the Moray Firth and proceeded to anchorage off Peterhead.

October 12th

Vessel arrived at Aberdeen.

## 6 RESULTS

### 6.1 Trawling

A total of about 3 baskets of squid (95 kg approximately) were caught by combined trawling operations. A total of 21 tows representing about 70 hours fishing time were completed with the bottom trawl and 3 tows representing about 9 hours fishing time were conducted with the midwater trawl. Trials with the latter had to be curtailed because of a fault in the headline transducer cable winch. Further details are shown in Appendix 2.

The predominant species of squid caught was Todarodes sagittatus ("hard" squid). Fishermen often refer to this species as red squid to distinguish it from Loligo forbesi which is known as white squid. These names are based on the differing body coloration of the two types. Loligo was only caught on the Shetland, Orkney and North Sea fishing grounds while Todarodes was not taken south of Orkney which may reflect a different pattern of distribution for the two species. One specimen of an unidentified ommastrephid (oceanic type) squid was caught in the midwater trawl of Faroe.

The largest individual catch of squid was 24 individuals (half basket approximately) taken with the bottom trawl off Faroe but, generally, catches were much lower and, occasionally, zero. The first haul of each day produced the highest catches of squid which repeats the pattern established during the G.A. Reay's 1982 squid fishing cruise. On the Faroese grounds, even in the Fiords, jellyfish were present in large numbers and produced heavy marks detectable on the echosounder. Often the codend contained as many jellyfish as whitefish.

The midwater trawl yielded very few squid even though a mouth opening of 8 fm and a towing speed of 5-6 knots were maintained. The bulk of the catch consisted of small quantities of myctophids, blue whiting, and red fish.

The individual size of *Todarodes* caught was generally in the range 20-30 cm mantle length, although one larger individual of 40 cm mantle length was taken from deeper water in the midwater trawl. The *Loligo* squid were of a similar size although the penultimate haul with the bottom trawl yielded about 30 very small juvenile specimens.

## 6.2 Jigging

A total of 7 nights were spent jigging for squid, (5 nights at Faroe and 2 nights at Shetland) mostly during the hours of darkness. Further details are shown in Appendix 2.

A total of 10 squid were caught on the automatic machines and 1 squid by hand. These squid were all *Todarodes* of 20-25cm mantle length and were all taken in Arne Fiord or Funding Fiord at Faroe. (See Appendix 4).

No squid were either seen or caught at Shetland or Mulen (Faroe). Catches were generally taken during the first few hours of darkness, no squid were seen or caught during daylight jigging operations.

At Faroe the lighting array attracted large quantities of juvenile fish which could be seen swimming repeatedly in and out of the illuminated area of sea. Generally, squid were attracted soon after the lights had been switched on and often attacked the lines immediately. Besides the 10 squid actually caught, several were hooked but managed to shake free before they could be brought aboard. In some cases squid were observed to attack the lines from up to 2 metres distance but to withdraw at the last moment. It was also noticeable that as jigging progressed through the evening catch rates tended to decline even though squid could be seen swimming in the area.

The use of "rubby dubby" (crushed mackerel suspended in a netting bag over the ship's side) was tried on several occasions at Faroe but its effectiveness as an additional attractant is difficult to assess because of the small numbers of squid observed. Never more than seven individuals were seen at any one time.

For similar reasons the effectiveness of the underwater lamps cannot be fully assessed. Both the chemical light and the battery operated lights could be seen from the ships side at a depth of several fathoms. However, the chemical light emitted a yellow-green glow compared with the harsher yellow-white radiation of the battery type.

Lure preference is difficult to assess from the small number of squid caught. However, no squid were hooked on the soft bodied jigs whereas orange, red and green hard bodied lures all caught squid.

During the final nights jigging at Faroe three of the lighting array bulbs blew which, in the absence of spare bulbs, effectively reduced the illumination to half power for the remainder of the trip. Failure of these bulbs was attributed to water ingress between the bulb holder and the lamp covers which had all been constructed at TRS from sheet metal. The other three bulbs were enclosed in purpose-built watertight rubber housings and these continued to function without fault.

The automatic jigging machines performed without major faults during the whole trip. Occasionally, an overwind of one revolution during retrieval caused the terminal weights to fall inboard of the idler rollers but this was remedied by increasing the length of line between the weight and the final lure.

Some tangling of the lines between adjacent machines took place in strong currents unless both machines were adjusted to haul and release simultaneously. At Mulen and Shetland the lines tended to stream under the boat due to strong currents. Apart from the incorrect positioning of the lines relative to the light/shadow

zones thus caused, there was also the possibility of parting the line due to chaffing against the vessel's hull. It should be noted that this problem was exacerbated by the fact that the ship was anchored. Under drifting conditions in the open sea currents would not be expected to be a serious constraint to fishing, especially if drift due to windage was reduced by the use of a sea anchor.

7        DISCUSSION

Compared with the results of G.A. Reay's 1982 squid voyage when over 5 tonnes of squid were caught, principally by bottom trawling, catches this year were very poor indeed. Discussions with Faroese fishermen and Mr. S. H. Jakupsstovu, Director of the Faroese Fisheries Institute, indicated that 1983 had been a bad year for squid fishing. Mr. Jakupsstovu held the view that *Todarodes* migrate along the Faroese/Shetland trench with some of the stock swimming north to Faroe and some swimming on to Norway. This year he suggested that, as had been the case with blue whiting, the migration path had taken place further east than normal with the result that the bulk of the stock had moved towards Norway via Shetland and had largely by-passed the Faroese coast. He reported that heavy catches of squid had been made recently by Norwegian fishermen. He further suggested that if squid appear in Faroese Fiords during June/July then a good local fishery can be expected but if, as had happened this year, the squid did not arrive until August then a poor fishery was likely.

The Faroese utilise squid only for longline bait but such is the demand that Canadian frozen squid, although reported to be of poorer quality for bait purposes, is imported to make up any shortfall in local supplies. The Faroese inshore fishermen catch squid in the Fiords on simple handlines equipped with hard bodied, long hooked jigs either during daylight or after dusk using simple paraffin lamps for light attraction. According to Mr. Jakupsstovu the Fisheries Institute chartered a commercial vessel for several months early in 1982 for squid fishing and equipped it with automatic jigging machines and a powerful lighting array. This project resulted from successful hand jigging attempts from one of their research vessels the previous winter. However the commercial vessel caught very few squid and the project was abandoned. Squid are apparently sometimes caught during the period January - March and can be detected on the

echosounder as a layer at 150 fm above the blue whiting shoals which are migrating southwards at a depth of 200 fm at this time. The squid are typically large individuals (40+ cm mantle length) and can be caught on jigs during the day and also at night using light attraction.

The reasons for the apparent low population density of squid this year compared with 1982 can only be guessed at since there is insufficient information known about their behaviour and distribution. Since squid typically have a short life cycle of only 1-2 years a poor year class recruitment to the fishery would not account for low population density unless large scale mortality occurred in the previous year's breeding stock or during larval and early juvenile stages of development. The movements and distribution of squid are more likely to be related to hydrographic/oceanographic conditions of which very little is known in relation to squid. Squid occurred in both Arne Fiord and Funding Fiords which are closed at one end whereas squid were not seen off the coast at Mulen. Large numbers of juvenile fish were present in the Fiords and these may attract the squid which are active predators. There may also be a predator-prey relationship between *Todarodes* and blue whiting and although this is merely conjecture, it might be important in connection with any future directed fishery for squid.

The presence of large numbers of jellyfish on the Faroese grounds may have influenced catch rates since, from experience, many fishermen argue that catches of white fish decrease significantly if jellyfish are present.

It is generally believed that squid disperse in midwater during darkness and congregate near the sea bed towards dawn and, for this reason, the first daily tows with the bottom trawl were arranged to coincide with the dawn period. Catches to some extent bear out this theory as hauls subsequent to the first always yielded fewer squid.



During the first haul the echosounder revealed a steady downward movement of several layers of marks. These could not be identified with certainty but probably consisted of jellyfish and myctophids rather than squid. The large number of jellyfish, which would be expected to have a similar target strength, would in any case tend to mask out any squid marks.

The midwater trawl trials demonstrated that squid can be caught by this method but would only be viable if the squid were in sufficient concentrations. As mentioned previously this might occur during blue whiting migrations.

As in previous SFIA jigging trials the technique has been shown to work successfully but viability is dependant on sufficient quantities of squid being present. Aboard the G.A. Reay during the 1982 visit to Arne Fiord about half a basket of squid was taken on 1 hand line of jigs during the space of about half an hour. At that time several dozen individual squid could be seen swimming on the surface of the Fiord water in the illumination cast by the ship's deck lights and it is based on these results that it was decided to try automatic jigging this year. However, the maximum number of squid seen on the surface during this trip was only seven individuals.

During jigging operations it was interesting to observe the behaviour of the squid. As mentioned previously the lures were attacked almost immediately if squid were present. As jigging progressed attacks decreased. In some cases the squid were seen to follow the lines down through the water but retreat from them as the lines were retrieved. Several attacks on the lines were not followed through, as if the squid suddenly realised that the lure was not an edible fish. At other times continuous jigging seemed to have an adverse effect on catch rates and jigging was continued intermittently over five minute periods. It is possible that the regular and continuous pattern of jig movement through the water may not have been attractive and indeed, may have had the opposite effect.

During the final nights jigging at Arne Fiord illumination experiments were carried out, since seven squid could be seen swimming in the outer periphery of the illuminated zone but would not venture near the lines even when the failure of three bulbs due to rain water ingress reduced the effective illumination to half power. When the three remaining lights were extinguished the seven squid congregated under the stern ramp lights and could not be attracted back to the jigging area when the lighting array was re-illuminated. Certainly the squid were attracted by the lights but even though large numbers of small fish were also present no predatory attacks on them by squid were recorded. Since the squid did not appear to be actively feeding it might be argued that squid strike at lures out of annoyance in the same way that a salmon migrating upstream is believed to strike at a fisherman's fly.

The squid fishery in both the U.K. and Faroese waters, appears, from the available evidence, to be very unpredictable. On the other hand the Norwegian Fishery for *Todarodes* has expanded markedly in the last few years with catches of over 10,000 tonnes being recorded in 1982. This has led to widescale adoption of jigging machines and light attraction systems by the Fiord fishermen. It seems likely that the Norwegians could teach us more about the *Todarodes* fishery and it has been suggested by TRS that a squid seminar could usefully be arranged in the U.K. at which various interested parties would be invited to participate. It is envisaged that this would encompass catching, handling, processing and marketing of squid.

The author suggests that this forum might usefully be held at Hull and include representatives from Faroe and, particularly Norway and also a squid cookery demonstration by our home economist team in conjunction with TRS.

Clearly some means of pooling all the available information on squid is required before any large scale directed fishery for this species can be contemplated.

8        CONCLUSIONS

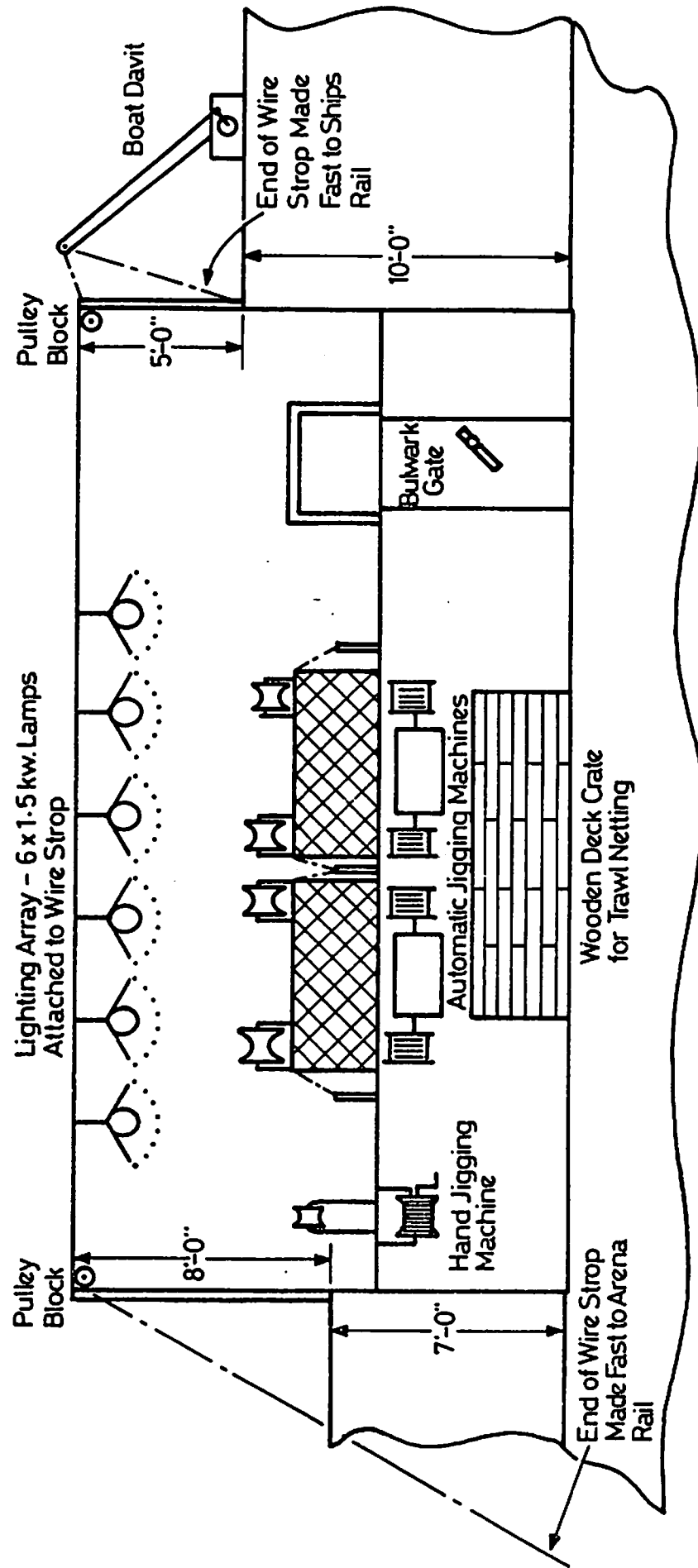
- 1        Todarodes squid can be caught by jigging techniques in Faroese waters but the catch rates obtained do not indicate the likelihood of developing a large scale fishery. The possibility of using this technique in U.K. waters, notably Shetland, remains to be investigated.
- 2        Todarodes squid can be caught by midwater trawl but a directed fishery would depend on locating suitable concentrations.
- 3        Insufficient information is known about squid particularly distribution and behaviour patterns and it is suggested that a joint approach to this problem by interested nations would assist all member countries. It is suggested that a seminar would be useful in this respect and would also include discussions on the catching, handling, processing and marketing of squid.

9

REFERENCES

1

White Fish Authority Field Report No. 450 Squid Jigging  
Trials Aboard ARCTIC HUNTER - 1976.



Arrangement of Jigging Equipment Along Portside Rail of FRV G.A. Reay

## APPENDIX 2

## TRAWLING LOG

<u>DATE</u>	<u>TRAWL TYPE</u>	<u>FISHING PERIOD</u>	<u>FISHING AREA</u>	<u>WEATHER</u>	<u>CATCH/COMMENTS</u>
Sept 27	Bottom	1640-1940	Tod Head		12-15 Baskets mixed fish
	Bottom	2345-0300	Turbot Bank		2 loligo squid 10 Baskets mixed fish No Squid
Sept 28	Bottom	0715-1015	Turbot Bank		
	Bottom	1530-1830	Bosies Bank		
Sept 29	Bottom	0000-0300	E of Orkneys		
	Bottom	1015-1315	E of Shetland		15-20 Baskets mixed fish
	Bottom	1400-1700	E of Shetland		
Sept 30	Bottom		Fuglo Bank		
Oct 1	Bottom	0515-0905	Fuglo Bank	SE 7/8 62°26'N 05°27'W	15-20 Baskets mixed fish (a few Todarodes squid) Net damaged along selvedge
Oct 2	Bottom	0545-0825	N of Faroes 62°33'N 07°27'W	S4	15 Baskets mixed fish Half basket Todarodes squid
		0940-1340	62°33'N 06°47'W	S4	15 baskets mixed fish (a few Todarodes squid) Heavy amounts of jellyfish near seabed
Oct 3	Bottom	0400-0820	N of Faroes 62°36'N 06°57'W	SSE6	25 Baskets haddocks and jellyfish
		0925-1155	N of Faroes 62°36'N 07°35'W	SSE6	(a few Todarodes squid) 5 Baskets red fish and haddocks (no squid)
Oct 4	Bottom	0405-0815	N of Faroes 62°31'N 07°35'W	S4	20-25 Baskets fish mostly haddock (half basket)
		1040-1335	NE Faroes 62°33'N 06°15'N	S4	Todarodes squid) 5 Baskets mixed fish (a few Todarodes squid)
Oct 6	MW	0415-0600	62°30'N NE Faroes 05°00'W		
Oct 7	MW	0735-1030	Fanny Bank 60°00'N 06°01'W	W6-7	1 Todarodes
	MW	1645 1930	Wyvell Thompson Ridge 60°07'N 07°30'W	W6-7	1 unidentified squid
Oct 8	Bottom	0840-1140	S of Foula 60°05'N 02°05'W	S5	20-25 Baskets mixed fish A few Todarodes squid
	Bottom	1340-1640	W of Fitful Head 59°50.5'N 01°29'N	V3	12 Baskets mixed fish A few Loligo squid
Oct 9	Bottom	0515-0815	S of Foula 60°04'N 02°05'N	SE2-3	20-25 Baskets fish (mainly mackerel) 12 Todarodes and 1 Loligo squid
Oct 10	Bottom	1440-1705	E of Orkneys 59°10'N 01°50'W	SW8	2 Todarodes
	Bottom	2230-0320	S of Wick 58°20'N 03°05'W	SW8	4-5 Baskets mixed fish 2 Loligo and 30 juvenile squid
Oct 11	Bottom	0615-0930	Moray Firth 58°00'N 03°30'W	W8	5 Baskets mixed fish no squid

APPENDIX 3  
JIGGING LOG

<u>DATE</u>	<u>MACHINE TYPE</u>	<u>FISHING TIME</u>	<u>FISHING AREA</u>	<u>CATCH</u>	<u>WEATHER</u>	<u>COMMENTS</u>
Sept 30	A A H	1930-2000 2030-2230 " "	Funding Fiord-Faroes	4 Todarodes + 1 hooked/lost No squid	Choppy Water surface	Light/shadow interface position incorrect
Oct 1	A	1800-2300 intermittent operation	Mulen Faroes	No squid	Strong current	Lights moved further many small fish attracted outboard but no squid jigs swept under boat - operation suspended
Oct 2	A  H	0800-2400  intermittent	Arne Fiord Faroes	5 Todarodes  1 Todarodes	Wind increased choppy seas	Two squid struck and missed lures - mackerel ground bait
Oct 3	  H	1800-2300  intermittent	Funding Fiord Faroes	No squid		Many small fish attracted but no squid seen
Oct 4 Oct 5	A H	1800-0500 intermittent	Arne Fiord Faroes	1 squid	calm/ heavy int. rain	Three bulbs shorted out. A group of 7 squid stayed in periphery of light all night but did not strike
Oct 8	A	1800-2300	Papa Sound Shetland	No squid	Var 3	Water very clear No squid seen
Oct 9 Oct 10	A H	1030-2400 intermittent	Scalloway Deeps Shetland	No squid	SE2-3 increasing 8-9	No squid seen and current very strong

A = Automatic  
H = Hand

