Final Report

Programme 17: Squid Fishery English Channel

Prepared by

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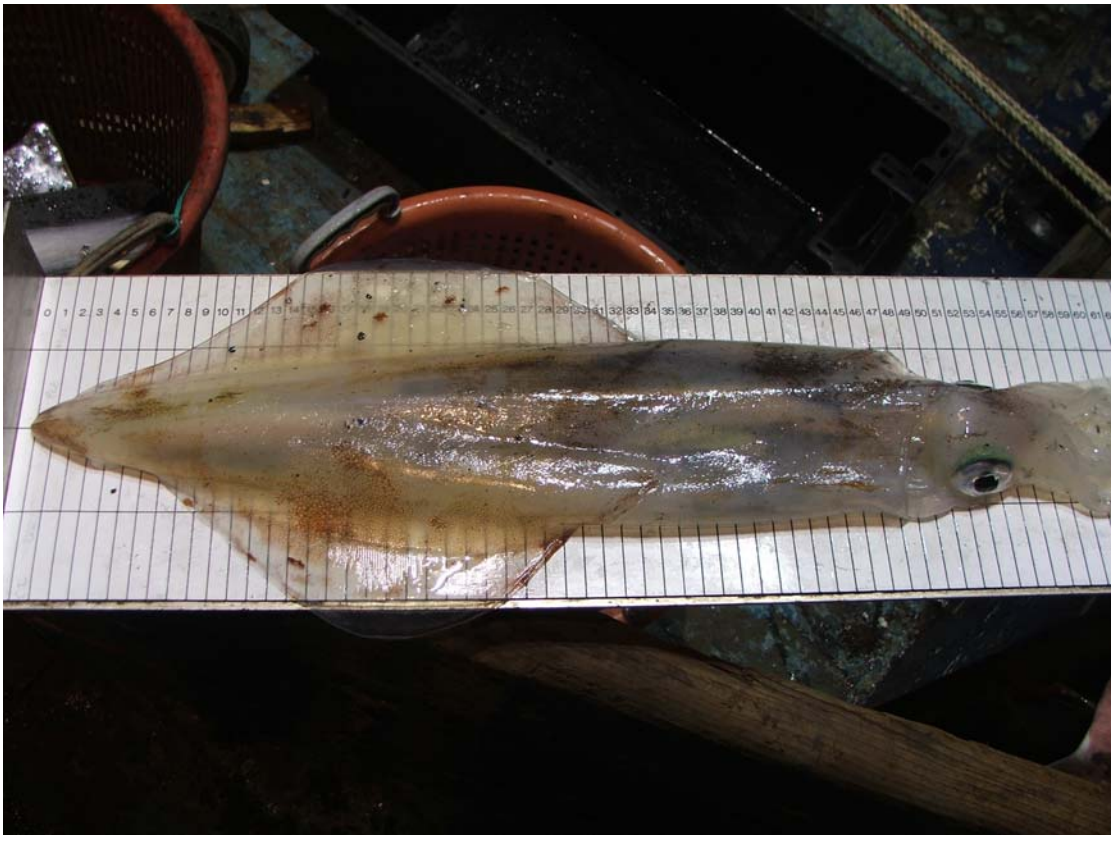


February 2008

SUMMARY

The FV "Valhalla", Skipper David Warwick, was chartered in December 2006 and January 2007 to undertake a squid survey in the English Channel using jigging, a fishing method that has the potential of having little impact on recovery species and on the environment.
A total of 75 jigging stations was completed. Squid catches consisted mainly of *Loligo vulgaris* and *Loligo forbesi* (European Northern squid). Fishing with lights appeared to be an effective method of catching *L. vulgaris.*

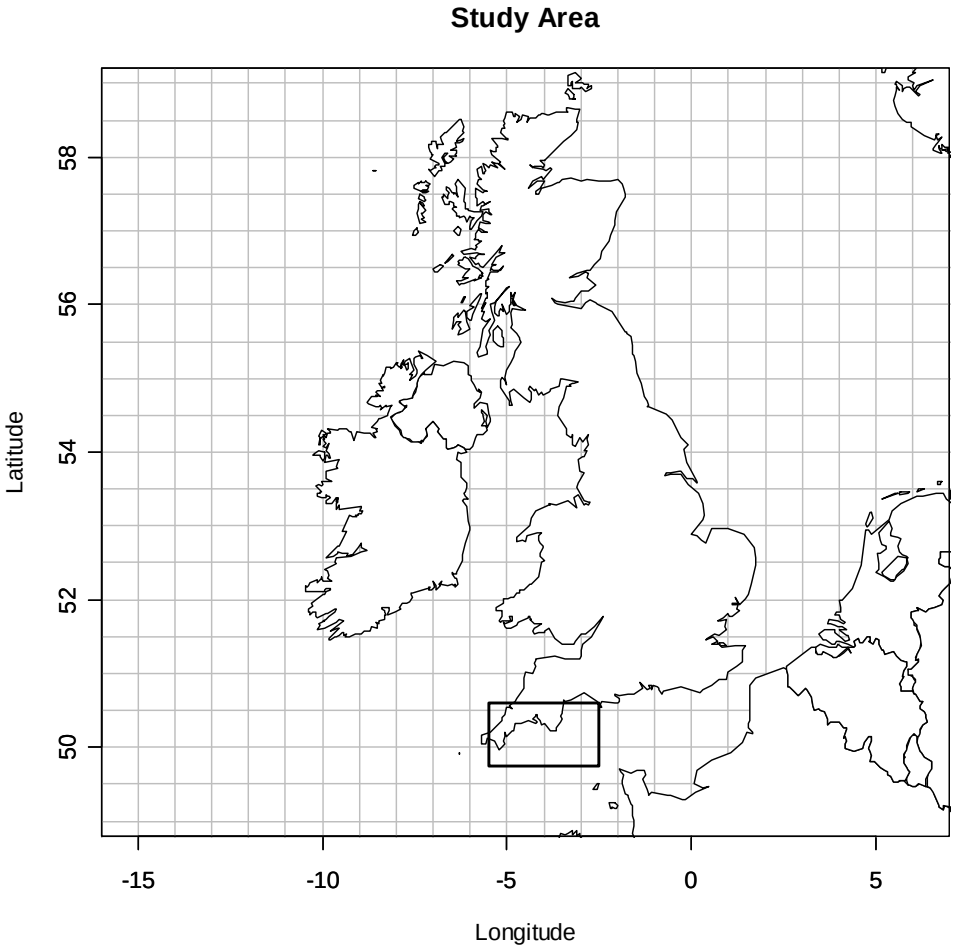


Figure 1. Squid fishery English Channel. UK and Ireland chart; the rectangle in the Southwest indicates the survey area.

Introduction

The Fisheries Science Partnership (FSP) was established in 2003 to build relationships between fishermen and scientists, and to involve fishermen in the co-commissioning of science. The FSP is funded by the UK's Department for Environment, Food and Rural Affairs (Defra). Ten projects were carried out during 2003/04, and a further ten in 2004/05, comprising a mixture of time-series surveys, fishing gear selectivity studies and examination of spatial patterns of catch compositions. Reports for FSP projects already completed are available on the FSP page of the Cefas web site (www.cefas.co.uk).

A further three years of the FSP programme were funded by Defra with effect from 2005/06. Industry proposals for FSP projects have typically been developed at a port/regional level, refined and agreed with Cefas and approved by the FSP Steering Group. Charter vessels are selected through an open tendering procedure, and are given dispensations from the relevant quota and effort controls and to fish in non-UK waters where appropriate.

This report presents the results of FSP 2006/07 Programme 21, a jigging survey of squid off the English Channel. The survey, on board the chartered vessel FV Valhalla, was planned to take place during the fourth quarter of 2006 to coincide with the period when squid are being caught in commercially viable quantities in this area. A first trip took place from 6 to 20 December 2006 and a second trip took place from 6 to 15 January 2007. Weather conditions were extremely bad and only 14 days of fishing out of 20 days of survey were conducted. Therefore, completion of the survey was delayed until late summer – early autumn of 2007. However, examination of the species composition of commercial catches in October 2007 suggested a poor season for *L. vulgaris*, which was viewed as an indication that jigging with lights was most likely to be unsuccessful. The survey was cancelled on this basis.

This survey represents one of two surveys, which aimed at developing jigging as an alternative low-impact method to catch squid. The second survey looked at squid distribution and catches in the North East Coast of England and is reported separately.

Objectives

To undertake a survey to map squid catches and to record catch and by-catch rates in the English Channel, using lures, jigs, gurdies (if appropriate) and illumination.

The detailed operational plan for the survey was discussed and agreed at a meeting between Cefas and the skipper on 24 November 2006. A copy of the operational plan is given as Appendix 1.

The cruise narrative prepared by Cefas seagoing staff is reproduced as Appendix 2.

Methods

Vessel and gear

The Valhalla, a 16.5m (registered) stern trawler, was identified to conduct the survey. Her trawling gear (nets and doors etc.) were removed and a combined generator and light rig, of the kind often seen illuminating road works or construction sites, was lifted onto the stern. This rig provided 4kw of metal halide light on a 7 m telescopic pole. The generator ran on diesel and provided the most cost-effective way of achieving temporary metal halide light of the type used by commercial jig fisheries elsewhere in the world.

Handlines containing 35 fathoms of 40 kg monofilament, a 2/0 swivel and a 1.5 fathom dropper of 24 kg mono were made up with two to three squid jigs attached at 1

m intervals approximately 1m above a lead weight. Several fishing rods and reels were also provided.

Survey design

The survey was designed to cover the distribution of squid within the area of operation specified. The initial plan was to allocate 15 days to jigging in the Western Channel, where squid catches were known to be high, and 5 days to jigging in the Eastern Channel. Fishing was to take place potentially over a 24-h period. Given the poor weather conditions for jigging, the Valhalla also undertook some commercial trawling for squid to seek areas of concentrations.

Sorting and processing the catch

The squid catches and other commercial species were quantified as accurately as possible. Standard Cefas methods for sorting and measuring squid catches at sea were carried out. The catch was mainly squid.

The observer collected samples of squid for sex and maturity determination, and recorded the cruise reference, tow number, species, and length. These were to be spread out over the entire area. Collections were made across the length range to avoid oversampling of large or small specimens in different areas.

Data analysis

Catch rates were calculated as numbers per hour spent on jig drifts to standardise for the effects on catch of variable drift times. Squid were identified to species level. Identification was either performed on board the vessel or, if that was not possible, a sample was frozen to be identified back at the laboratory.

Results

Fishing stations

Details of position, date and time, along with total numbers of squid caught are given in Appendix 3 for the jig stations and for the commercial trawls conducted. Figures 2a and 2b show the position of the drifts made by the vessel. In all 75 drifts were carried out, 69 in December 2006 and the rest in January 2007.

Distribution patterns

Plots of the distribution of *L. vulgaris* and *L. forbesi* are shown in Figures 3 and 4. The charts should not be interpreted as a representation of the distribution of those species in the survey area because the jig stations were placed in locations where good squid catches were expected. Rather, the charts are indicative of the catch rates, by species, at the locations fished during the survey. Squid were only caught at 7 stations. Both species were caught inshore, and *L. vulgaris* was caught offshore as well.

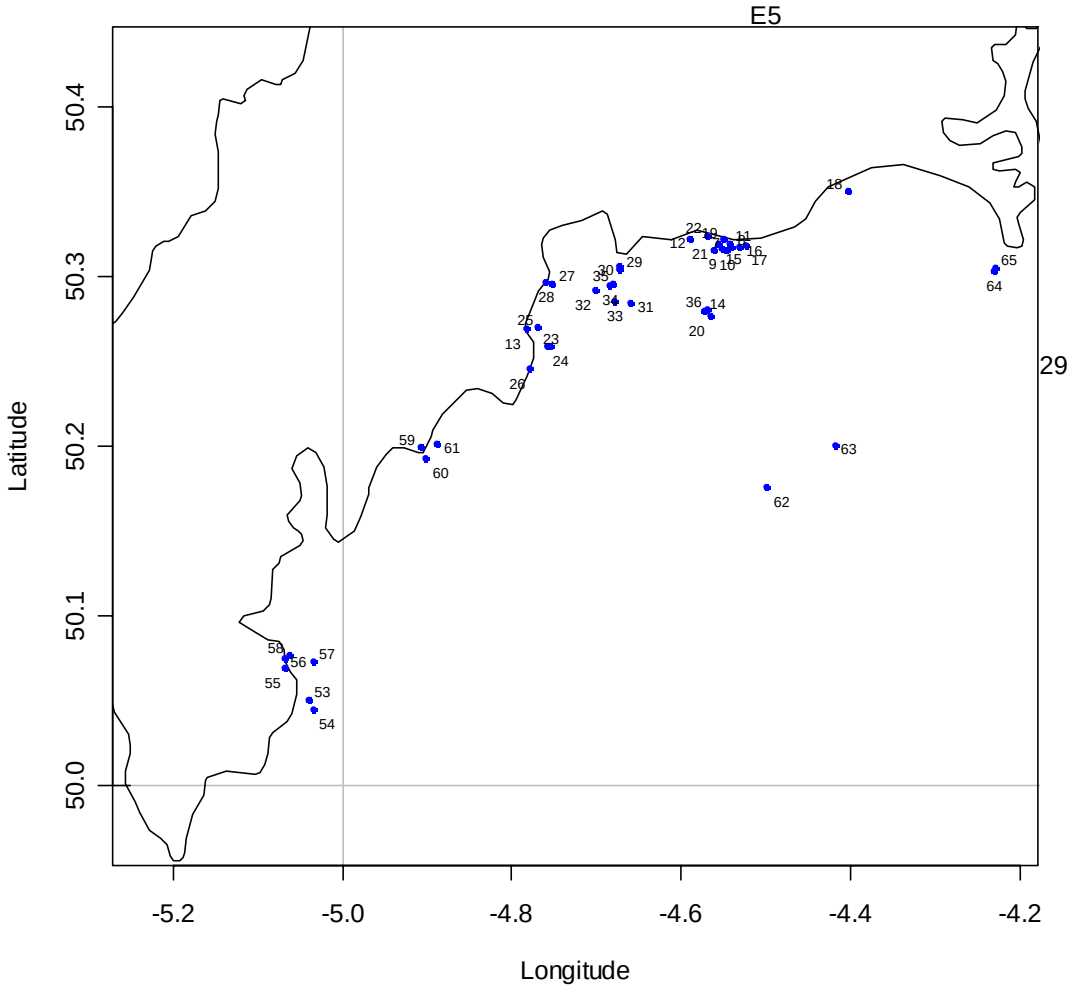


Figure 2 a). Squid fishery English Channel. Position of the jig stations situated west of longitude 4.2 E.

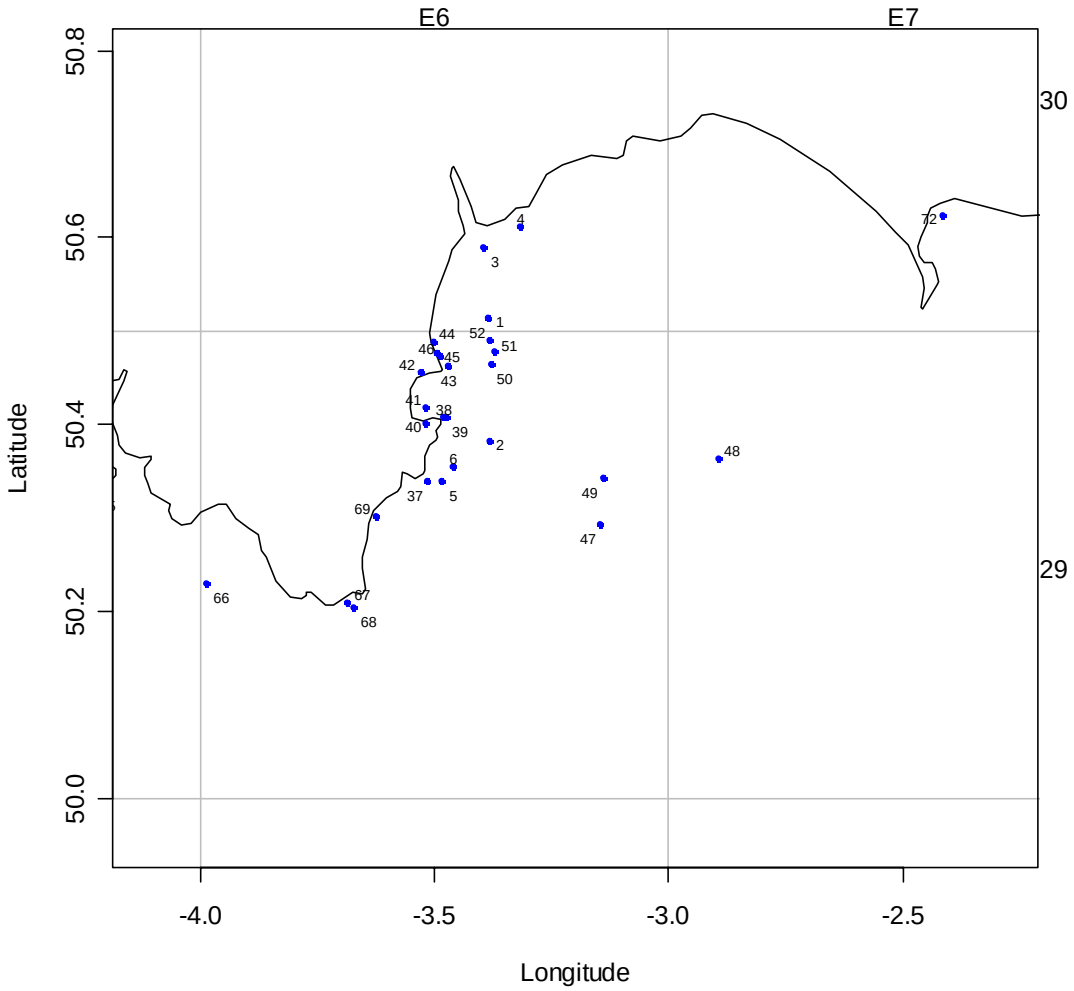


Figure 2 b). Squid fishery English Channel. Position of the jig stations situated east of longitude 4 E.

Catch compositions

Jig catches consisted almost entirely of squid, the exception being 3 mackerel.

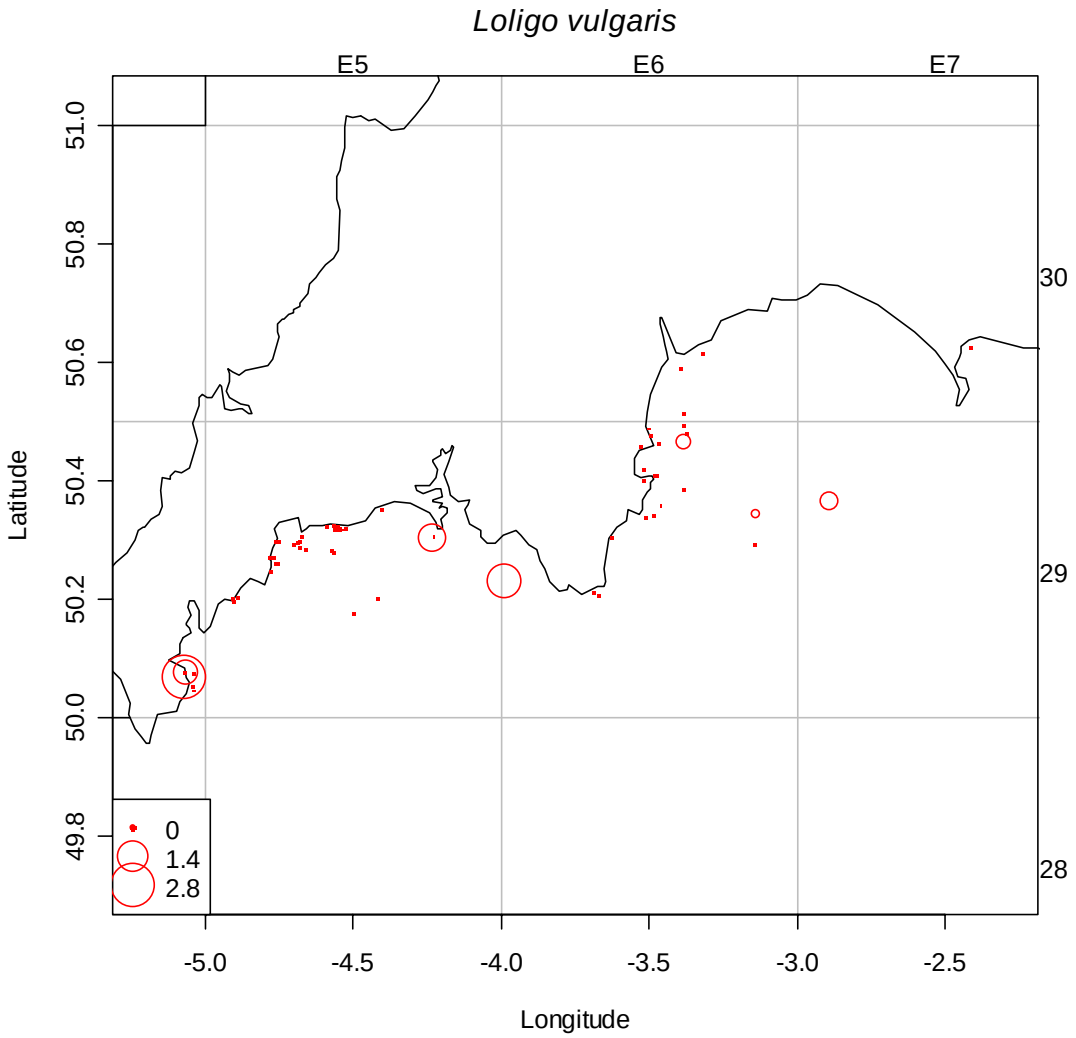


Figure 3. Squid fishery English Channel. Abundance of *Loligo vulgaris* by station, expressed in numbers per hour jig drift.

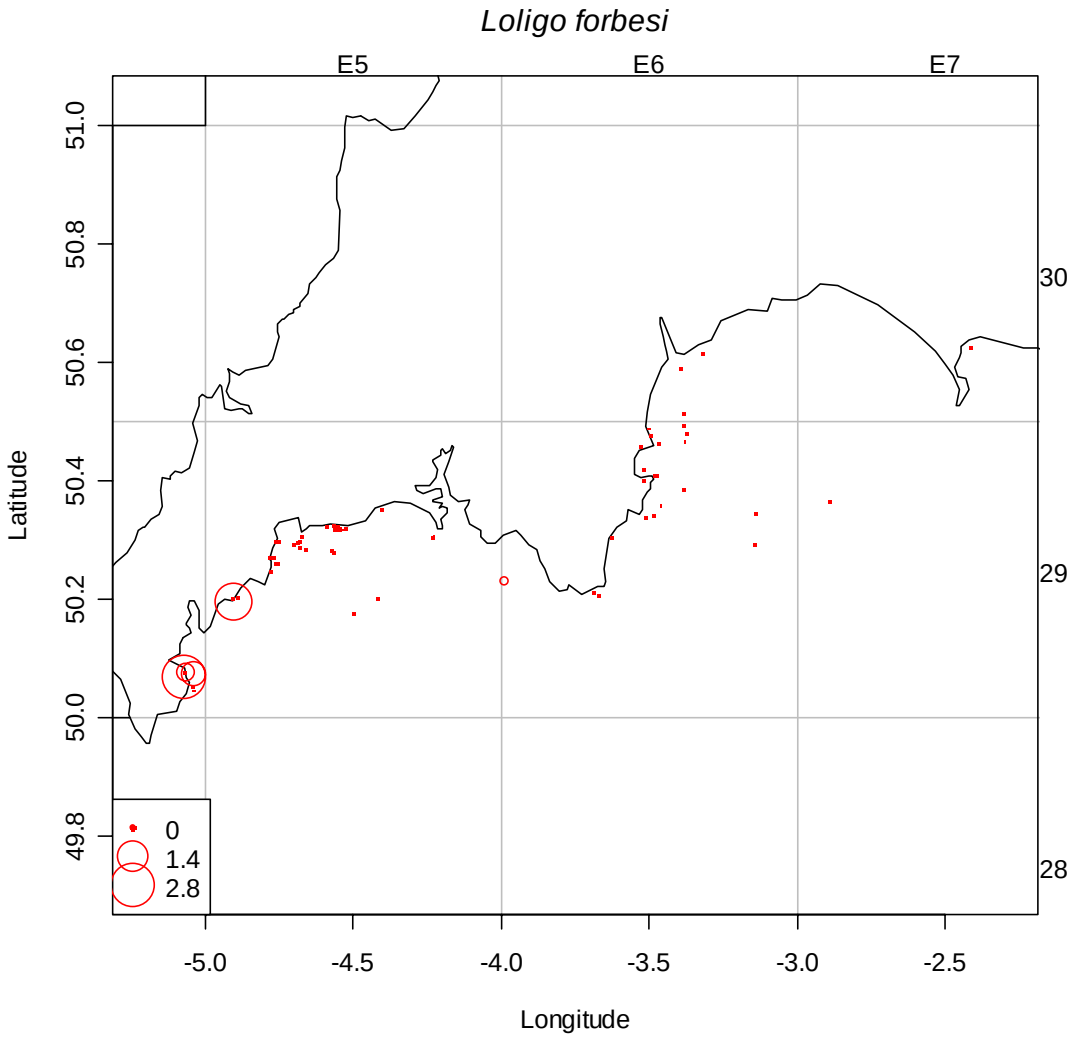


Figure 4. Squid fishery English Channel. Abundance of *Loligo forbesi* by station expressed in numbers per hour jig drift.

Length compositions

The mantle length distribution of *L. vulgaris* was wide, although the majority of individuals were < 300 mm peaking at 240 mm (Figure 5). The distribution of *L. forbesi* was practically uniform, with a range between 250 and 500 mm (Figure 6).

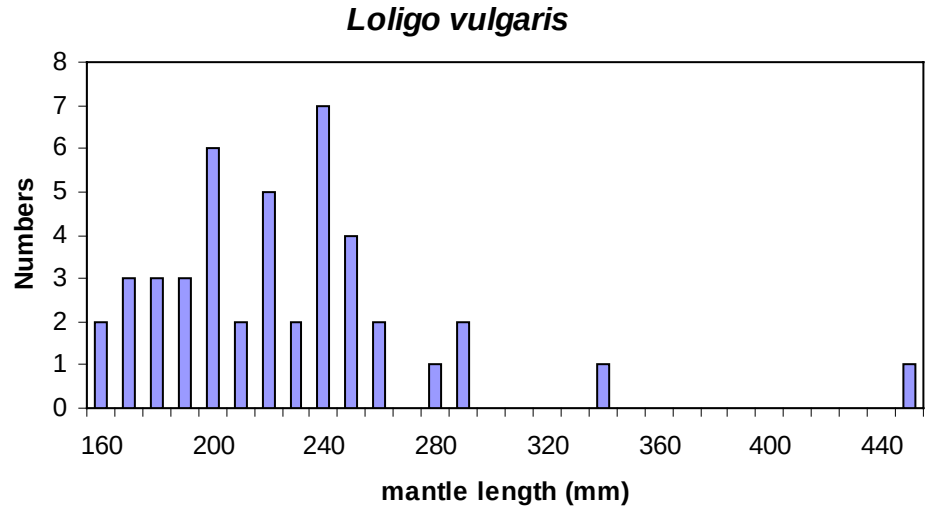


Figure 5. Squid fishery English Channel. Length frequency distribution of all *Loligo vulgaris* caught.

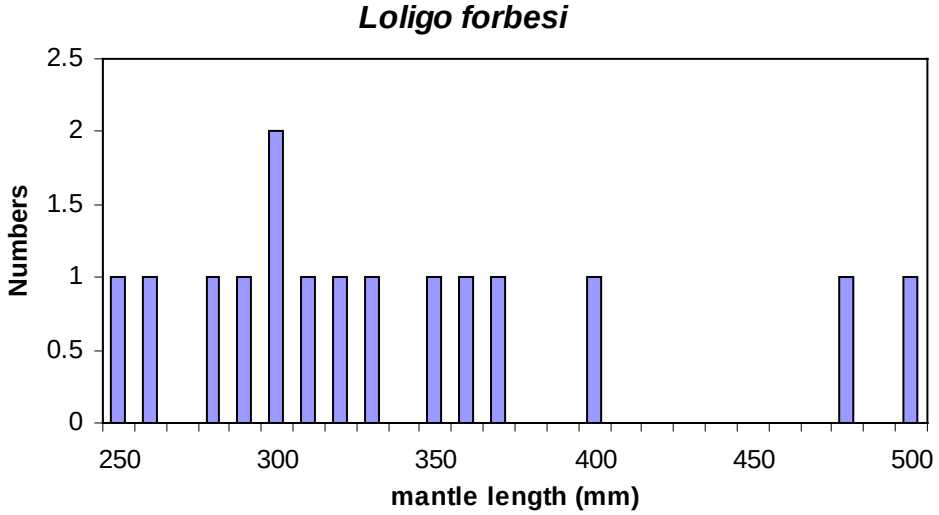


Figure 6. Squid fishery English Channel. Length frequency distribution of all northern squid (*Loligo forbesi*) caught.

Discussion

The weather was the main limitation on the success of this survey. December and January saw multiple Atlantic fronts one after the other tracking across the UK. Strong winds resulted in little water clarity, which undermined the efficacy of the jigs. Prolonged periods of bad weather, increased swell size and high levels of turbidity could well disturb squid aggregations having a detrimental effect on jigging. The same effect of poor water clarity has been observed in South African chokka squid *Loligo vulgaris reynaudii* (Roberts and Sauer 1994).

Loligo forbesi was mainly caught in daylight or dark/daylight (gloomy) catches, very rarely in full darkness, whereas *Loligo vulgar*is was caught by day and night. Squid caught under lights were nearly always *L. vulgaris*.

No single jig type stood out as being more effective than any other, but the commercial Japanese “jelly” jigs, especially when tied “in line”, were probably least effective. Interestingly these are the jigs most often used by commercial jig fishermen in the southwest. The most effective method was that of handlining and doing so with several lines at once, this created a “curtain” of jigs that induced interest from passing squid. However, the technique is not easy to master and its success is highly dependent on the orientation of the vessel to wind and tide.

Although two stations yielded good catches (commercial quantities) the catches were generally very poor. That combined with bad weather conditions meant curtailing the survey short of 5 days on 15 February, awaiting more favourable conditions in late summer /early autumn. The survey was finally cancelled in October 2007 given a poor squid season in the southwest, particularly for *L. vulgaris*, the squid species that appeared to be caught more successfully with lights. Some trawls were conducted in January for “ground-truthing” purposes. Substantial quantities of squid were caught in all five hauls, suggesting that adverse weather conditions and not a lack of availability were likely to be the cause of the generally poor jig catches.

In summary, although the species composition and catches of squid in the survey area indicate that a directed squid fishery in the southwest could possible, the combination of poor weather and poor water clarity likely dictates that a future jig fishery using lights to attract squid is not a realistic possibility. That there will be occasions in some years where jigging using lights will be feasible and possibly lucrative is not questioned, but a permanent / seasonal jig fishery under those conditions is not likely to justify the investment required.

References

Roberts, M.J. and W. H. H. Sauer 1994. Environment: the key to understanding the South African chokka squid (*Loligo vulgaris reynaudii*) life cycle and fishery? *Antarctic Science* 6(2): 249-258.

SQUID FISHERY ENGLISH CHANNEL: December 2006

Detailed Operation Plan (as agreed 24 November 2006)

VESSEL

"Valhalla". (skipper Mr David Warwick)

OBSERVER

Jonathan Ashworth (CEFAS)

OBJECTIVE
To undertake a survey to map out squid catches and record catch and by-catch rates in the English Channel using lures, jigs, gurdies (if appropriate) and illumination.

FISHING GEAR
Jigging equipment.

AREA OF OPERATION and TOW POSITIONS

The survey will be conducted in the English Channel with fishing operations being carried out between latitudes 49^{o} - 51^{o} N and longitudes 1^{o} E - 6^{o} W (see map in Annex 1). The survey will be conducted entirely within British fisheries limits.

PERIOD OF SURVEY

The survey is to take place during November - December 2006 if at all possible. The plan is to start in the evening of the 4th of December 2006 (weather permitting). The named Skipper and vessel will undertake a jigging survey for a total number of 20 days. Of those, 15 days will be allocated to jigging in the Western Channel, where squid catches are known to be higher, and 5 days to jigging in the Eastern Channel. The intention is to start the survey in the Western Channel. The time at sea may be divided into shorter periods with a break between each period. The vessel needs to be available for up to a maximum of 35 days, to account for the possibility of time lost due to steaming, bad weather and vessel availability.

FISHING ACTIVITIES

- Fishing will be required potentially over a 24 hour period. The vessel must adequately cover the distribution of the target species within the area of operation specified.
- The typical working time for the observer on deck will be 12-14 hours per day, and the observer must have a sufficient period of sleep (minimum 7 hours per day).

- All fishing operations will form part of the survey and must be sampled by the observer as per the sampling requirements. No commercial fishing will take place outside of the survey.

SORTING AND RECORDING THE CATCH

It is important that the squid catches and other commercial species are quantified as accurately as possible. The crew will be required to assist in sorting the catch as required by the observer and preparing any fish for sale. Standard CEFAS methods for sorting and measuring squid catches at sea will be carried out. The entire catch should be available to the observer for sampling, and none discarded without being recorded. The catch is expected to consist mainly of squid.

The observer will collect samples of squid for sex and maturity determination, and record the cruise reference, tow number, species, and length. These are to be spread out over the entire area. Collections should be made across the length range at each tow to avoid over-sampling of large or small specimens in different areas. An effort should be made to freeze any squid specimen that could not be identified at the species level.

DATA TO BE RECORDED BY SKIPPER

The observer will provide recording sheets on which the skipper will record the following details for each drift:

Date
Station number
Start and end fishing times
Positions (latitude and longitude)
Other relevant information (e.g. tidal state, weather conditions)

The skipper should provide full details of the gear and rigging. At the end of the survey, the skipper should provide an electronic copy of the fishing station positions from the plotter.

DATA TO BE RECORDED BY OBSERVER

The observer must ensure that all catch composition, length frequencies and raising factors are fully and correctly entered on the recording sheets, and that all bridge log sheets and biological sampling sheets are collated at the end of each sampling day. Any significant deviations from the survey plan should be reported to CEFAS by the observer.

CRUISE REPORT

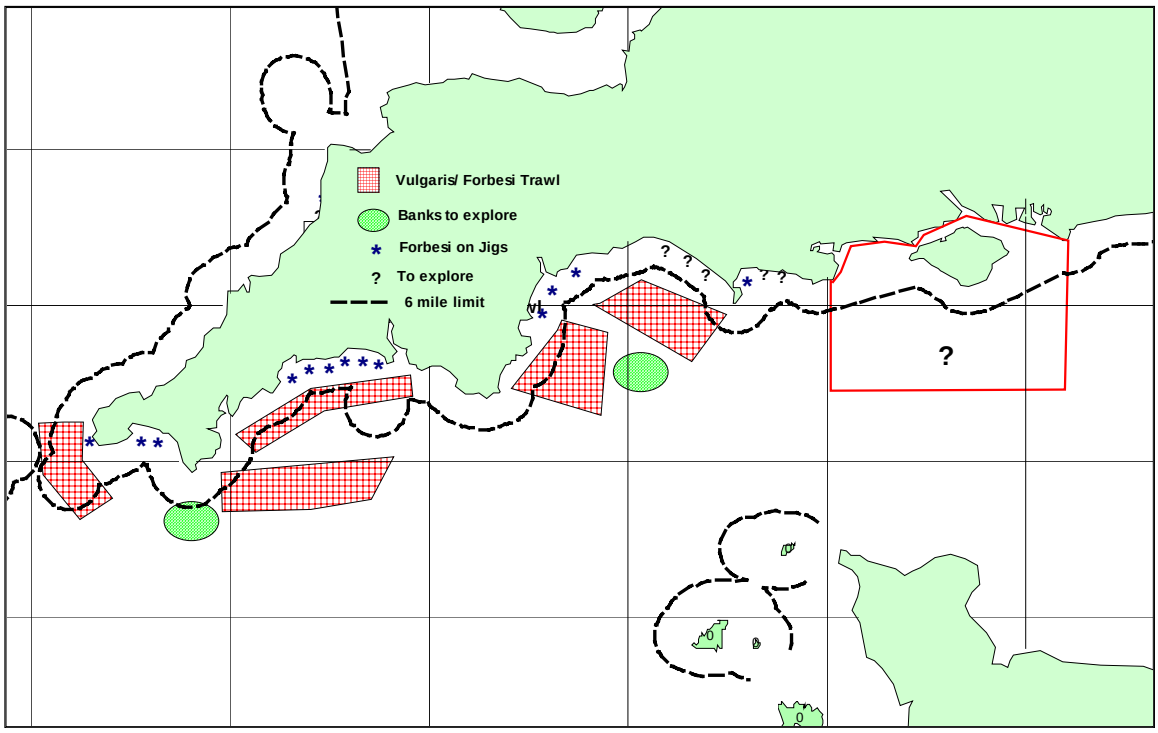
The observers will maintain a diary of activities, including an electronic copy where possible, and a draft cruise report in standard CEFAS format will be prepared for submission to CEFAS immediately after the cruise. The cruise narrative should be written at sea and read and agreed by the skipper (report will bear the sentence “seen in draft by skipper”).

Signed:

…….. (skipper) …….(date)

……(CEFAS) …….(date)

Annex 1: Map of the area within which the survey will take place. Areas where squid (*Loligo vulgaris and L. forbesi*) are caught commercially by either jig or trawl are indicated. Areas to be explored during the survey are indicated by a question mark (?).



Appendix 2: Squid Fishery, English Channel. **Cruise narrative**

CRUISE REPORT (seen in draft by skipper)

VESSEL
"Valhalla". (Skipper Mr David Warwick)

OBSERVER
Jonathan Ashworth (CEFAS)

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PREPARATION
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Hand lines containing 35fathoms of 40kg monofilament a 2/0 swivel and a 1.5fathoms dropper of 24kg mono were made up with two to three squid jigs attached at 1m intervals approximately 1m above a lead weight.
As no one knew what to expect several fishing rods and reels were also provided.

PART 1 (December 6th – 20th)
Day 1
The Valhalla sailed from Brixham in the early hours of Wednesday 6th of December and steamed a short distance to conduct a trial drift to the North of Torbay. Tide was approaching springs and the wind was strong Westerly. All elements of the preparation for the survey seemed to be ok. The light rig provided a much brighter and whiter light than one would expect from normal deck lights and by increasing or decreasing the height of the telescopic arm it was possible to change the characteristics of the light and shadow configuration beneath the vessel.
It was found very early on that sustained hand lining in temperatures of 2degrees and below in a stiff breeze when nothing is being caught proved next to impossible and to this end everyone was thankful of the fishing rods. It was decided to use rods for exploration and to change to hand lines if squid were encountered in any quantity
Several drifts were conducted in towards the Exe estuary in shallow but very turbid water. Visibility was obviously going to be an issue and because of this it was decided to steam several miles south to conduct drifts in the deeper (and hopefully clearer) water off Dartmouth. No squid were encountered on any of the drifts on this first day, furthermore it was decided due to the water conditions and weather forecast (SW 6-8 inc 9-10 soon) to postpone any other jigging until conditions improved.
One of the biggest problems of the whole survey would prove to be getting weather, water and tide conditions suitable to allow the jigs to work effectively.

After three days of storm force SW winds the forecast seemed to offer a window of fine weather with a more northerly set to the wind creating an opportunity for greater clarity of

water and better sea conditions. On the strength of this forecast it was decided to steam west to survey areas of known squid ground around Looe, Mevagissey and Fowey.

Day 2 & 3

First drift of the day was conducted very close to the shore in strong to gale force NW winds and although the water clarity was improved it was still milky. This drift resulted in one squid (*L.Vulgaris*) caught under lights at first light. Several other drifts were conducted in the same area without success, then a large squid (*L. Forbesii*) of 36cm was caught 9 drifts later and a third squid (*L. Vulgaris*) was caught on the following drift and that accounted for all of the squid caught that day. In total 19 drifts were conducted between Looe and the Dodman point over a 24 hour period in water from 5 to 29 fathoms and no other squid were encountered, the weather also deteriorated as the forecast NW winds backed into the SW and increased to gale force again. Several drifts were conducted tight into the land in poor conditions without success and in view of the deteriorating weather and forecast the Valhalla sought shelter in Mevagissey.

Day 4

After lying alongside the wall in Mevagissey for 36hrs the weather showed signs of improvement and the survey was picked up in Par bay over ground around Black Hd. recommended to us by fishermen in Mevagissey. No success in Par bay after several drifts prompted a move to ground to the south of Fowey where we were approached by local fishermen as they awaited the tide change before hauling Bass nets. The skipper of the "……" suggested we try an area he called the "outer ground" a little further south of our current position. He explained that when he targeted squid this area often produced fish in marginal/turbid conditions where nowhere else would. We conducted one drift over this ground catching one squid (*L. Forbesii*) of 48cm within 10mins, however, 2 more drifts of over an hour each proved fruitless. Considering the clarity of the water it was decided to tie alongside in Mevagissey for the evening and to return to "the outer ground" for early morning. That night the forecast gave SW gales for the next 5 days effectively closing down any opportunity to explore the area further.

Day 5

We sailed from Mevagissey at 04:30 on the 12th and were on station by 05:30. The first drift (1.5hrs) provided a flurry of activity that lasted for 5minutes with two lines retrieving parts of squid tentacles, 1 squid landed (*L. Forbesii*) of 33cm and several squid lost either on the retrieve or at the boat. A second drift of similar length produced nothing, weather conditions were by this time deteriorating rapidly and so a decision was made to try a couple of deeper marks as we steamed for Brixham, however by the time we had reached the first mark, "Owen rock", the drift speed was over 1knot and sea conditions had deteriorated enough to make any effective jigging virtually impossible. The Valhalla proceeded to steam for Brixham arriving at about 19:30.

Day 6

The following morning a decision was made to explore inshore marks around Torbay.
The first drift was conducted across hard ground less than a mile from the mouth of the river Dart. On arrival it became apparent that the weather conditions were poorer than anticipated and the water clarity was too poor for the jigs to work effectively, nevertheless a short drift was conducted and no squid were encountered. We then decided to steam into the shelter of Torbay and spent the rest of the day conducting drifts around this area, no squid was encountered on any of the drifts and so towards the end of the day several drifts were conducted to the north of Torbay on hard ground around Babbacombe and Hopes nose, from information gleaned from trawler skippers we were aware of large squid being caught on previous days just 3 miles further off, however, weather conditions would not allow us to get out and explore these areas . Again no squid were encountered. At this point it was decided in light of the atrocious weather forecast and poor water clarity to curtail any more jigging until weather conditions improved sufficiently to allow several clear days. At this point a total of 6 days had been spent away for 5 days of survey time.

(NB. All of the local fishermen we have talked to, before and since embarking on this survey, have said pretty much the same thing: -
"The weather conditions we are experiencing will make successful jigging very difficult to achieve as the clarity of the water will decrease the efficacy of the jigs. The turbid conditions will also disrupt and break up squid aggregations as they move away from hard and rough seabeds to avoid harm."
"Recent years have seen a noticeable decline in squid caught to jigs on the inshore marks. Many believe this is as a result of trawling effort on inshore grounds."
"General belief is that we are too late in the year for this Southern Cornish inshore fishery."
"Squid are very elusive and difficult to predict").

Day 7

The forecast from 16/12/06 was for moderate West or North West winds set to decrease over a 5 to 6 day period. The Valhalla sailed from Brixham at 0400 on the Saturday morning to be on station around the "TV" wreck before first light. Due to the fine forecast it was decided to explore the deeper water fishery in Lyme bay, an area where squid catches from the trawler fleet were on average around 250 to 350kg/day.
The first drift (4.27hrs long at an average speed of 0.73knots) produced 2 tentacles! The second drift (5.27hrs long at an average speed of 0.83knots) produced 3 squid (L. Vulgaris) and one tentacle in a flurry of activity approximately half way through the drift, the drift was continued into full dark with the lights illuminated from 16:30 but no more squid were encountered. A decision was made to anchor for the night in an attempt to allow the lights to have more effect. Anchor was dropped close to the "TV" wreck at 19:45 in 53metres of water and the Valhalla remained at anchor for 12.33hrs during which time no squid were encountered until just before dawn when several "chances" were missed on the hand lines and 1 squid was caught (*L. Vulgaris*) again this happened in a flurry of activity in a short period of time.

(NB. Consistent retrieve rate is essential to successful jigging, retrieve too slowly or in a jerky manner and the squid will escape the jag, retrieve too quickly especially in a heavy swell and it is possible to pull the tentacles off the squid. In deep water and especially when experiencing heavy swells maintaining a constant retrieval is very difficult as the pitch and roll of the vessel is almost impossible to address.
Another problem encountered was one of tide, in 50 to 60 metres of water and a strong tidal flow the amount of lead required to hold bottom was such that it became very difficult to detect any squid takes, one way of addressing this whilst at anchor was to use lighter lead weights and "cast" the hand lines up-tide however as the tide turned the vessel would not always lie favourably to the anchor making hand lining in this fashion often quite difficult).

Day 8

After dawn the Valhalla lifted anchor and steamed to inshore grounds where the water was a little shallower and tidal flow less intense, this was ground that we had been unable to access earlier in the month because of the weather. The first drift (2.7hrs at an average speed of 0.38knots) produced 2 squid (*L. Vulgaris*) on the same line but one escaped. The second drift (2.85hrs at an average speed of 0.32knots) produced nothing. Anchor was dropped close to a wreck known as the "Coal boat" the hope was that the lights might draw feed fish from the wreck thus attracting squid. The Valhalla remained at anchor 2.53hrs during which time one squid was missed on a rod line.

(NB. An unusual phenomenon was observed whilst at this station. Possibly as a result of the lights a number of polycheate worms were witnessed swimming strongly and freely on the surface. On closer inspection these looked to be a species of ragworm (*Nereis spp*.), several were scooped from the water using a basket but they broke up on closer inspection revealing what appeared to be a milt/sperm like substance. Tides were at spring but the moon was in its new phase, was this phenomena caused by our lights fooling the worms into believing it was a full moon?).

A confirmed forecast for more prolonged settled weather meant we could now look further a field and so a decision was made to steam into Brixham, top up on fuel and re-victual the vessel so that we could then steam to the West and explore ground around the Lizard and Lands End. The Valhalla steamed from Brixham at 21:00 bound for the Mannacles reef near Falmouth.

Day 9

The first drift was conducted in full dark with the lights on and produced no squid, however, one jag was attacked as it was returned to the boat covered in ink. The second drift was conducted with no squid. On the third drift 8 squid were caught and 4 missed (4 *L. Vulgaris* and 4 *L. Forbesii*). Two more drifts were conducted, one in the same area and one across a small reef known as the "Wrigglers" where one squid was caught.

Anchor was dropped just before last light in close proximity to the area we had had most success through the day. Under light we observed more feedfish beneath the boat than at any other station to date. Although Garfish (*Belone belone*) had been a common sight for the duration of the survey at this station they were seen to be feeding on Sprats (*Sprattus (clupea) sprattus*), as were Mackerel (*Scomber scombrus*), also several Sea Bass (*Dicentrarchus labrax*) were observed throughout the night, often chasing small mackerel.

Three squid were caught very shortly after dropping the anchor creating some excitement aboard. At times it was difficult to get the jags through the mackerel shoals and although only one Mackerel was brought to the boat this in no way was indicative of how many mackerel picked up the jags. Mackerel were used to bait a jag and this was deployed to see if it was effective, to everyone's surprise very shortly afterwards a large cuttlefish was brought to the boat but fell off as it was attacking the bait but not entangled in the jags.

Catches of squid at this station were the best encountered so far, in the first instance and as night fell several squid were caught of which most were L. Forbesii, however once any trace of light had left the sky catches became purely L. Vulgaris. Hand lines out fished the rods and at times achieved almost commercial catch rates, however, these flurries of squid could not be sustained and at no time did it seem possible to "work" the squid to the boat. The last of the squid were caught before 02:00 and nothing was caught after this time. At 04:32 the anchor was lifted and the vessel steamed to Gull Rock in St Veryan Bay yet another area recommended to us by local fishermen.

Day 10

Three drifts were conducted in St Veryan Bay one inside the Gull rock in full dark with no squid and two outside from dawn onwards. On the second drift 2 squid were caught (L. Forbesii) in close proximity to each other, the third drift resulted in two very large squid hooked, again in close proximity to each other but lost before they could be brought to the boat. Another drift was conducted over the same ground but nothing to show for it.

Several telephone calls to trawler skippers and inshore fishermen in Newlyn and Sennen suggested that recent poor weather and high seas had driven squid away from the inshore marks and so we decided not to waste any time exploring these western most areas. Instead it was decided to steam a little way east to explore offshore reefs we had been unable to search effectively earlier in the survey due to the same poor weather.

The first drift was conducted over "Hatt" rock but tide and wind were unfavourable and so it was decided to steam to another reef known as the "Brentons". Here we dropped anchor for 2.25hrs, no squid. Picked up the anchor and steamed into Rame head to the West of Plymouth sound where 2 squid (*L. Vulgaris*) were caught in quick succession, another drift over the same area produced no squid but 2 Mackerel. Both Mackerel and pilchards were observed beneath the boat attracted by the lights.

Vessel then steamed east again to drop anchor on ground known as the "East Rutts" an area exclusively set aside for static gear fishing with pots.

Moral aboard the boat was at low ebb at this point as most felt that as we steamed east we were steaming away from squid. To everyone's surprise this station produced some of the best catch rates to date. Interestingly very few squid fell to rods (only 3), however one person using 3 hand lines with 2 jags on each accounted for 14 squid (all L. Vulgaris) in a period of about 1.5hrs, missing more than 10 chances. Only two L. Forbesii were caught at this station,

one early in the session and the other just before dawn. The catch rates here were the closest to catch rates observed in South Africa. A Hagfish (*Myxine glutinosa*) was observed swimming past the boat on this station, Colin Warwick believed that these fish were often found around static gear zones, attracted by the bait in the pots.

Day 11

After sunrise on the 20/12/06 and after several hours without a sign of squid the Valhalla picked up the anchor and steamed to the east of Prawle point where two drifts were conducted both without success, although a small Pollack fell to a jag on the first drift. The vessel then steamed round Start point and conducted one drift just to the north of the Skerries bank NTZ, again no squid.

With the proximity of the Christmas break and problems with sorting out logistics at such a time, arrangements were made to have a crane alongside the quay in Brixham to get the light rig ashore and so we curtailed the rest of the survey until after Christmas.

Part 2 (Jan 06th-Feb 15th)

After the Christmas break the Valhalla was on standby for fine weather from the 6th. However, the weather during the early part of January was atrocious with Atlantic front after front sweeping across the English Channel delivering severe gale and storm force winds in seemingly unbroken pattern. By the 15th of January a window of weather looked as though it might present itself as a ridge of high pressure pushed up from the south.

Day 12

The Valhalla steamed from Brixham at 18:00 on the 14/01/07 bound for the Isle of Wight (IOW) where we intended starting the Eastern Channel element of the survey. Weather on the steam to the IOW was reasonable but on arrival off St Catherine's Point the forecast was Southerly 6-7 occ8 not what we had expected from previous forecasts. We conducted one drift over rough ground off St Catherine's Point (ICES Division VIId, sub rectangle 30E8), however, the drift speed was over 1knot and the sea state was beginning to deteriorate, the water was extremely milky in colour, all in all not ideal conditions for squid jigging. A telephone conversation with a contact in Cowes on the I.O.W suggested several sites worth looking at and so we moved slightly further west to an area of ground south of Freshwater bay. A drift was conducted in this area, again no squid were encountered, the weather by this time had increased to a southerly 7 and given the forecast (now SW 6-9) it was decided to run for Weymouth bay where we hoped to be able to explore one or two wrecks tight in to the shore, areas we had been told squid are often caught. On arrival in Weymouth bay we conducted one long drift of over 2 hrs, which skirted both wrecks, no squid were encountered and by this time a television weather chart had been seen which made it quite clear that the weather was closing down any jigging opportunities for some time to come. At this time a decision was made to curtail all jigging activity until a settled period of fine weather could be reasonably guaranteed, at which point the Valhalla steamed back to Brixham, the light rig was craned from the boat and the skipper and crew put the trawls and doors back aboard, so that they might take advantage of any temporary break in the weather.

Poor weather continued to blight the survey throughout January; indeed, the Valhalla managed to achieve only 4 trawling days in the next 21/2 weeks. During this time it became apparent that a slightly different approach to the survey might enable a more efficient coverage of the ground. Negotiations were made to allow the Valhalla to carry a trawl so that marginal survey days could be spent trawling commercially and the jigging survey could then be conducted when conditions allowed. One issue would of course be the inability to carry both trawl and lights but it was felt that the efficacy of the lights needed to be tested anyway, to this end permission was granted for the Valhalla to carry commercial trawl gear instead of the light rig.

Day 13

The Valhalla sailed from Brixham at 05:00 on the Friday morning and shot her trawl by the "TV" wreck towing with the tide in an easterly direction. After three hours the trawl was

hauled for an estimated 50kg of squid of which most was *L.Vulgaris* many of which were females that had been successfully mated or males with obvious signs of hectocotilization. The second tow of the day, for a similar duration, produced an estimated 56kg of squid and although this haul was not sampled the species composition was similar to the first. The third haul was very disappointing as the skipper fully expected this to be the best haul of the day; only an estimated 12kg of squid was caught. In all the abundance of squid seemed to be approximately 60% less than was being caught by the trawlers before Christmas.
We now had to steam for approximately 2hrs to get back to ground where squid had been more abundant in the trawl. On arrival on the more productive ground the anchor was dropped and jigging commenced.
The wind freshened to an Easterly 5-6 throughout the night and although the clarity of the water was good the motion of the boat and the way she lay to anchor against the wind and the tide made hand line jigging difficult and uncomfortable. The tide at its strongest was running at 1.4knots and this caused the same sort of problems experienced in other areas of deepwater. Although the anchor was deployed the action of tide and wind meant that the vessel dragged its anchor most of the night at an average speed of 0.5knots. Not one squid was encountered over 11hrs of jigging.
Day 14
Given the conditions of wind and tide on the first night it was decided to try laying anchor on slightly shallower ground on the Saturday night. The Valhalla conducted two tows of 3.5hrs each on similar ground to the previous day catching in total an estimated 60kg of mixed squid (squid catch composition consisted of mainly *L.Vulgaris* with occasional *L.Forbesi* present). The Valhalla steamed into slightly shallower water and deployed the anchor very close to the 25m contour. Less wind and less tide meant that the vessel held her anchor throughout the night but at the same awkward angle for hand lining as had been experienced on the previous night. At this station, 13hrs of jigging produced no squid or indeed any sign of squid.
Day 15
The Valhalla shot the trawl on inside Lemon sole grounds. One tow was conducted the catch from which was insufficient to pay the diesel. A decision was made to steam to an inshore reef between Lyme Regis and Beer head from which squid was known to have been caught on jigs in the past. The Valhalla dropped anchor at 15:45 in light winds and clear skies. After 2hrs jigging with rods and hand lines 2 takes were encountered on the hand lines, one escaped on the retrieve but left ink all over the jag and the second fell off at the surface. No other squid were encountered on this station and in all over 12 hrs jigging was conducted over this mark.
Due to personal commitments it was not possible to conduct any further days on the survey and the Valhalla steamed back to Brixham. It was decided to contact the survey co-ordinator in an attempt to negotiate a deferral of the remaining days to late summer early autumn, when it is hoped conditions would be more favourable. The weather took another turn for the worse on the 7th February and remained too poor to conduct effective jigging for over a week. At present 14 days of the survey have been conducted for 15 days away from port.

SUMMARY

Trip 1 (December 6th – 20th):

Valhalla sailed from Brixham in the early hours of Wednesday 6th of December and steamed a short distance to conduct a trial drift to the North of Torbay. After three days of storm force SW winds fine weather was forecast so, the vessel steamed west to survey areas of known squid grounds around Looe, Mevagissey and Fowey where some squid were caught in subsequent days.
The best squid catches were achieved in two occasions: one at the Mannacles reef near Falmouth and the other in a ground known as the “East Rutts”, east of Plymouth. In the first instance catches of squid were initially dominated by *L. forbesi* but once it got dark catches consisted of *L. vulgaris*. At the “East Rutts”, an area set aside for

static gear, the best catch rates were achieved during night hours with a predominance of *L. vulgaris*. The vessel returned to Brixham on 20th December.

Trip 2 (January 6th – February 15th):
The vessel was on standby for fine weather from the 6th January but could only sail on the 14th January. Although several drifts were attempted on the first day no squid was caught. The weather soon deteriorated, water turbidity was high and a decision was made to stop jigging until weather conditions improved. Permission to trawl was granted and a number of tows that caught squid were conducted. Those suggested that squid abundance had decreased considerably compared to the period prior to Christmas. Jigging was subsequently conducted on productive grounds, based on results from the vessel's tows or information from other fishers, but no squid were caught. The Valhalla steamed back to Brixham and given prevailing bad weather conditions the remaining survey days were deferred until late summer or early autumn.

Getting weather, water and tide conditions suitable for the jigs to work effectively proved difficult during this survey. Fishermen in the South West already target *L. forbesi* successfully however, the survey did not succeed in identifying optimum fishing conditions and localities. Catches of *L.forbesi* were very low at night and under lights.

Gear loss was considerable during the first trip but decreased in the 2nd trip as more "anchoring", as opposed to drifting, took place. No jig was particularly more effective than the others, although the commercial Japanese "jelly" jigs, especially when tied "in line", were probably least effective for *L.vulgaris*. Interestingly these are the jigs most often used by commercial jig fishermen in the South West to catch *L.forbesi*. The most effective method was that of hand lining with several lines at once, creating a "curtain" of jigs that appeared to attract squid. However, the technique is not easy to master and its success is very dependent on the orientation of the vessel to wind and tide.

Appendix 3. Squid fishery English Channel. Jig station details and catch numbers per station for main commercial species.

Station	RECTAN	Start latitude	Start longitude		End latitude	End longitude		Date	Time	Duration (Mins)	*Loligo vulgaris*	MACKEREL	*Loligo forbesi*
1	30E6	50.28	3.26	W	50.3	3.23	W	6-Dec-2006	6:30	150	0	0	0
2	30E6	50.32	3.24	W	50.22	3.22	W	6-Dec-2006	9:16	0	0	0	0
3	30E6	50.35	3.24	W	50.35	3.23	W	6-Dec-2006	10:33	43	0	0	0
4	30E6	50.37	3.19	W	50.36	3.19	W	6-Dec-2006	11:41	37	0	0	0
5	29E6	50.21	3.28	W	50.2	3.28	W	6-Dec-2006	14:15	120	0	0	0
6	29E6	50.28	3.28	W	50.21	3.27	W	6-Dec-2006	16:15	0	0	0	0
7	29E5	50.19	4.33	W	50.18	4.32	W	9-Dec-2006	5:10	52	0	0	0
8	29E5	50.19	4.33	W	50.19	4.32	W	9-Dec-2006	6:08	74	0	0	0
9	29E5	50.19	4.33	W	50.18	4.33	W	9-Dec-2006	7:30	70	0	0	0
10	29E5	50.19	4.33	W	50.18	4.32	W	9-Dec-2006	8:44	50	0	0	0
11	29E5	50.19	4.32	W	50.19	4.32	W	9-Dec-2006	9:40	35	0	0	0
12	29E5	50.19	4.35	W	50.19	4.35	W	9-Dec-2006	10:48	43	0	0	0
13	29E5	50.16	4.46	W	50.16	4.46	W	9-Dec-2006	11:48	13	0	0	0
14	29E5	50.16	4.34	W	50.16	4.34	W	9-Dec-2006	12:05	12	0	0	0
15	29E5	50.19	4.33	W	50.19	4.33	W	9-Dec-2006	12:50	36	0	0	0
16	29E5	50.19	4.31	W	50.19	4.31	W	9-Dec-2006	13:34	62	0	0	0
17	29E5	50.19	4.31	W	50.19	4.31	W	9-Dec-2006	14:43	60	0	0	0
18	29E5	50.21	4.24	W	50.21	4.24	W	9-Dec-2006	16:21	120	0	0	0
19	29E5	50.19	4.33	W	50.19	4.32	W	9-Dec-2006	19:12	50	0	0	0
20	29E5	50.16	4.34	W	50.16	4.33	W	9-Dec-2006	20:31	46	0	0	0
21	29E5	50.19	4.34	W	50.18	4.33	W	9-Dec-2006	21:59	53	0	0	0
22	29E5	50.19	4.34	W	50.19	4.34	W	9-Dec-2006	23:02	46	0	0	0
23	29E5	50.15	4.45	W	50.15	4.45	W	10-Dec-2006	5:47	16	0	0	0
24	29E5	50.14	4.46	W	50.15	4.45	W	10-Dec-2006	6:15	62	0	0	0
25	29E5	50.15	4.46	W	50.16	4.46	W	10-Dec-2006	7:24	61	0	0	0
26	29E5	50.14	4.46	W	50.14	4.46	W	10-Dec-2006	9:28	41	0	0	0
27	29E5	50.17	4.45	W	50.17	4.45	W	11-Dec-2006	11:12	131	0	0	0
28	29E5	50.17	4.45	W	50.17	4.45	W	11-Dec-2006	13:30	52	0	0	0
29	29E5	50.18	4.45	W	50.18	4.4	W	11-Dec-2006	14:31	33	0	0	0
30	29E5	50.18	4.4	W	50.18	4.4	W	11-Dec-2006	15:29	34	0	0	0
31	29E5	50.16	4.39	W	50.17	4.39	W	11-Dec-2006	16:16	58	0	0	0
32	29E5	50.17	4.42	W	50.17	4.41	W	11-Dec-2006	17:35	56	0	0	0
33	29E5	50.16	4.41	W	50.17	4.4	W	11-Dec-2006	18:40	80	0	0	0
34	29E5	50.16	4.41	W	50.17	4.4	W	12-Dec-2006	5:37	90	0	0	0
35	29E5	50.16	4.41	W	50.17	4.4	W	12-Dec-2006	7:15	95	0	0	0
36	29E5	50.16	4.34	W	50.16	4.34	W	12-Dec-2006	9:52	20	0	0	0
37	29E6	50.2	3.31	W	50.2	3.3	W	13-Dec-2006	5:33	72	0	0	0
38	29E6	50.24	3.29	W	50.24	3.28	W	13-Dec-2006	7:22	30	0	0	0
39	29E6	50.24	3.29	W	50.24	3.28	W	13-Dec-2006	7:58	46	0	0	0
40	29E6	50.24	3.31	W	50.24	3.31	W	13-Dec-2006	9:23	31	0	0	0
41	29E6	50.24	3.32	W	50.25	3.31	W	13-Dec-2006	10:01	123	0	0	0
42	29E6	50.27	3.32	W	50.27	3.31	W	13-Dec-2006	12:24	37	0	0	0
43	29E6	50.26	3.29	W	50.27	3.28	W	13-Dec-2006	13:17	39	0	0	0
44	29E6	50.28	3.3	W	50.29	3.3	W	13-Dec-2006	14:14	45	0	0	0
45	29E6	50.28	3.29	W	50.28	3.29	W	13-Dec-2006	15:10	41	0	0	0
46	29E6	50.28	3.29	W	50.28	3.29	W	13-Dec-2006	15:56	72	0	0	0
47	29E6	50.2	3.07	W	50.17	3.08	W	16-Dec-2006	6:17	256	0	0	0
48	29E7	50.21	2.59	W	50.21	2.53	W	16-Dec-2006	11:30	376	3	0	0
49	29E6	50.2	3.08	W	50.2	3.08	W	16-Dec-2006	19:45	740	1	0	0
50	29E6	50.28	3.23	W	50.27	3.22	W	17-Dec-2006	9:38	162	1	0	0
51	29E6	50.29	3.23	W	50.28	3.22	W	17-Dec-2006	12:31	171	0	0	0
52	29E6	50.29	3.22	W	50.29	3.22	W	17-Dec-2006	15:48	152	0	0	0
53	29E4	50.03	5.02	W	50.02	5.02	W	18-Dec-2006	5:53	52	0	0	0
54	29E4	50.03	5.02	W	50.02	5.02	W	18-Dec-2006	7:00	86	0	0	0
55	29E4	50.05	5.04	W	50.04	5.04	W	18-Dec-2006	7:00	86	4	0	4
56	29E4	50.04	5.03	W	50.04	5.04	W	18-Dec-2006	12:56	73	0	0	0
57	29E4	50.04	5.01	W	50.04	5.02	W	18-Dec-2006	14:27	68	0	0	1
58	29E4	50.04	5.03	W	50.04	5.03	W	18-Dec-2006	16:18	734	14	1	7
59	29E5	50.11	4.53	W	50.11	4.54	W	19-Dec-2006	6:09	46	0	0	0
60	29E5	50.11	4.53	W	50.11	4.54	W	19-Dec-2006	7:04	56	0	0	2
61	29E5	50.12	4.52	W	50.12	4.53	W	19-Dec-2006	8:12	50	0	0	0
62	29E5	50.1	4.28	W	50.1	4.29	W	19-Dec-2006	11:16	35	0	0	0
63	29E5	50.11	4.25	W	50.12	4.25	W	19-Dec-2006	12:15	135	0	0	0
64	29E5	50.18	4.13	W	50.18	4.13	W	19-Dec-2006	16:22	99	2	0	0
65	29E5	50.18	4.11	W	50.18	4.13	W	19-Dec-2006	18:40	97	0	2	0
66	29E6	50.13	3.59	W	50.13	3.59	W	19-Dec-2006	21:50	640	19	0	1
67	29E6	50.12	3.39	W	50.12	3.41	W	20-Dec-2006	10:14	1497	0	0	0
68	29E6	50.12	3.39	W	50.12	3.4	W	20-Dec-2006	11:25	37	0	0	0
69	29E6	50.18	3.36	W	50.18	3.37	W	20-Dec-2006	13:14	41	0	0	0
70	30E8	50.33	1.19	W	50.35	1.21	W	15-Jan-2007	7:27	146	0	0	0
71	30E8	50.35	1.3	W	50.37	1.3	W	15-Jan-2007	10:50	137	0	0	0
72	30E7	50.36	2.25	W	50.37	2.24	W	15-Jan-2007	17:52	129	0	0	0

Appendix 3. Squid Fishery, English Channel. Jig station details and catch numbers per station for main commercial species. (Continue).

Station	RECTAN	Start latitude	Start longitude		End latitude	End longitude		Date	Time	Duration (Mins)	*Loligo vulgaris*	MACKEREL	*Loligo forbesi*
73	29E7	50.21	2.56	W	50.19	3.05	W	2-Feb-2007	20:30	670	0	0	0
74	30E6	50.32	3.15	W	50.32	3.15	W	3-Feb-2007	19:00	780	0	0	0
75	30E7	50.41	2.58	W	50.41	2.58	W	4-Feb-2007	15:45	745	0	0	0

Appendix 3. Squid fishery English Channel. Tow details and catch numbers per tow for main commercial species of the commercial tows conducted.

Station	RECTAN	Shot latitude	Shot longitude		Haul latitude	Haul longitude		Shot date	Shot time	Duration (Mins)	*Alloteuthis subulata*	*Loligo vulgaris*	*Loligo forbesi*	WHITING	LEMON SOLE	PLAICE (EUROPEAN)
1	29E6	50.17	3.17	W	50.18	3.05	W	2/2/2007	07:45	180	8	172	0	736	19	80
3	29E7	50.22	2.55	W	50.22	2.43	W	2/2/2007	14:45	180	0	17	1	1160	8	49
4	29E7	50.19	3.08	W	50.22	2.53	W	2/3/2007	09:05	210	0	214	0	425	33	49
5	29E6	50.22	2.53	W	50.19	3.1	W	2/3/2007	13:05	205	0	220	20	405	25	38
6	29E6	50.32	3.14	W	50.27	3.12	W	2/4/2007	08:30	240	2	53	7	153	59	31