

# **FISHERIES SCIENCE PARTNERSHIP**

**Report on catches of saithe, cod and haddock in the  
northern North Sea by FV Farnella in autumn 2003**

**Fisheries Management Group  
CEFAS, Lowestoft  
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## **Introduction**

The DEFRA-funded Fisheries Science Partnership was established between DEFRA<sup>1</sup>, CEFAS<sup>2</sup> and NFFO<sup>3</sup> for the duration of financial year 2003/4. The objective was to enable the fishing industry to demonstrate the results of commercial fishing in a number of priority fishing areas nominated by the NFFO. Fishing vessels were chartered to fish commercially, usually under dispensation from the quota regulations, to obtain new data on the catch rate and size distribution of target species, and in some cases by-catch species. Ten projects were scheduled and completed. The charter of suitable fishing vessels was arranged by the NFFO, and work plans were developed between NFFO, CEFAS and the vessel skippers. CEFAS deployed sea-going staff to record raw data that were subsequently returned to the laboratory at Lowestoft for input and analysis.

CEFAS acknowledges the help of the NFFO and skippers during the conduct of these studies. The data and results are the intellectual property of the vessel skippers, CEFAS and NFFO.

1. Department of Environment, Food and Rural Affairs
2. Centre for Environment, Fisheries and Aquaculture Science
3. National Federation of Fishermen's Organisations

## **The North Sea saithe project**

This report presents the initial results of an FSP project carried out on the otter trawl fishery for saithe in the northern North Sea in autumn 2003. The project used two trips of a commercial stern trawler, the FV Farnella between 18 September and 5 October. The work plan involved otter trawling under dispensation from the quota regulations on grounds chosen by the vessel skippers in consultation with CEFAS.

Here we present

- Catch (as numbers and weight) per unit effort of saithe, cod, and haddock;
- Discarding as percent of catch by number;
- The distribution of numbers at length for these species;
- An analysis of the effects of towing time and depth on average length in the catch;
- Compositions of the catches for these three species.

Acoustic studies of fish distributions were also undertaken during this FSP survey. A preliminary summary will be found in Appendix 3. The intention is to calibrate the catch results presented in this report with measurements of acoustic energy at the corresponding fishing stations, then to estimate numbers between stations using only the measures of acoustic energy. This should permit an improved estimate of stock size in the area of the survey. The calibration and estimation processes form part of a research project that is likely to take several months before results can be made available.

## **Methods**

The FV Farnella (H135) is a steel stern trawler of 36 m reg. length, with a 1790 Kw engine.

The trawl used for the survey had a ground rope of approximately 36m, a 90mm square mesh panel and a cod end with 110mm mesh with double braided twine of 3mm. Trawling speeds averaged approximately 4.5 knots on both trips.

Total catches of all saithe, cod, and haddock were weighed and classified as 'discarded' or 'retained' according to advice from the fishing crew. Samples of these species from most hauls were also measured individually to obtain length frequency distributions. Otoliths were collected from 382 saithe and 22 cod but these samples have not yet been aged owing to other age-reading priorities. Comments about age-compositions in the text below are based on previous experience of length-at-age for the species concerned but, in the absence current local data, the comments are necessarily somewhat vague.

## Results

### *Data summary*

The position, date, and time of the hauls, along with weights and numbers of saithe, cod, and haddock caught are tabulated in Appendix 1. The catch data presented in the report are converted to weights (Kg) or numbers per hour of towing (catch per hr.) in the analyses below so as to diminish the effects on catch of variable tow times. Cruise reports prepared immediately after the FSP survey can be found as Appendix 2.

### *Fishing stations*

Trip codes, mesh sizes, dates, numbers of hauls, trawling depths, and average towing hours are summarised below in Table 1. Towing times varied between 0.5 and 7.5 hours. Locations of all stations (defined as midway between shooting and hauling positions), towing times, and approximate depth contours derived from recorded station depths are shown in Figure 1.

**Table 1.** Northern North Sea FSP trawl survey, 2003: details of fishing activities. SQMP=square mesh panel fitted as an escape device for small fish.

<b>Trip code</b>	<b>Vessel</b>	<b>Mesh mm</b>	<b>Dates in 2003</b>	<b>Hauls</b>	<b>Min depth m</b>	<b>Max depth m</b>	<b>Avge tow hrs</b>
Far 1/03	FV Farnella	110 + 90mm SQMP	18- 24 Sept	1- 24	97	281	3.4
Far 2/03	FV Farnella	110 + 90mm SQMP	26 Sept - 5 Oct	1 - 32	110	280	5.0

### *Results by species*

Data from both FARN 1/03 and FARN 2/03 are reported together below since the vessel and gear were the same on both trips.

### 1. Saithe - Figures 2a-g.

Saithe were present at all except 4 stations. Two localities, one NE of Shetland, the other further east toward Norway produced the largest numbers of fish - up to 6300 fish per hour. See fig. 2a. Fig. 2b indicates that moderate discarding, up to 14% of numbers caught, took place at two or three stations. At other stations, less than 2% was typical. The largest catches by weight, up to 4.38 tonnes per hour, were taken at easterly stations toward Norway but three other localities, including one on the southern boundary of the survey region, also yielded relatively large weights of saithe (fig. 2c).

The length frequency distribution for the entire catch of saithe from FARN 1 and 2/03 is shown in fig. 2d. This indicates that the bulk of the catch was made up of young fish between about 39 and 54 cm.

Saithe are fast-swimming, powerful fish and large individuals may be able to escape from short trawl tows that do not tire the fish sufficiently to force them to fall back into the net. To test this idea, the average (mean) length of all saithe caught by each tow was calculated and plotted against towing time in fig. 2e. The wide range of towing times used on the survey was ideal for this investigation. No clear relationship between towing time and average length can be seen. An increasing trend was fitted but not found to be statistically significant and is therefore not shown on the graph.

The possibility of a trend with depth was also investigated for saithe. Fig. 2f shows the average length in the catch plotted against the depth midway between shooting and hauling positions. In this case, a statistically significant linear trend was found indicating that larger individuals were more prevalent in the deeper water. Towing times did not vary systematically with depth, as may be seen from fig. 2g.

### 2. Cod - Fig. 3a-e.

Catches of cod were generally much fewer in number than those of saithe. The largest catch, 258 fish per hour, was taken at the southern extremity of the survey region. See fig. 3a. Two other localities, one east, and one west of Shetland, also yielded relatively large numbers of cod. 100% of the fish caught were discarded at two stations close to Shetland on the NE side. See fig. 3b. Elsewhere, discarding percentages were generally much lower. The total weights of the cod catches are shown in fig. 3c. The southernmost high yielding station gave 830 Kg per hour. Elsewhere the catches were quite uniformly low.

The length frequency distribution for all cod caught is shown in fig. 3d. There was a wide range of sizes corresponding to the presence of several age-groups. Few fish below the minimum landing size (35 cm) were caught.

Fig. 3e shows the results of investigating whether the size of cod caught increased with towing time, as done for saithe in fig. 2e. A statistically significant increasing trend was found.

### 3. Haddock - Fig. 4a-e.

Very substantial numbers of haddock were taken in two places. See fig. 4a. The highest yielding station was west of Shetland where more than 11 000 fish per hour were taken. Catches elsewhere were more moderate, mostly less than 100 fish per hour. 100% of fish caught were discarded at 4 stations. See fig. 4b. Elsewhere, discarding percentages were generally low. The total weights of haddock catches are shown in fig. 4c. The greatest weight of fish, 2.9 tonnes per hour, was taken just to the NE of Shetland.

The length frequency distribution for all haddock caught is shown in fig. 4d. Fish between 30 and 40 cm predominated but fish between 40 and 55 cm were also relatively numerous. This suggests that two or three year-classes were supporting the fishery for haddock.

There was no apparent relationship between the average length of haddock in the catch and the towing time. See fig. 4e.

### *Species composition of catches*

Species composition is of interest in relation to catch composition rules, and to concerns about the linkage between the catch of saithe and recovery species. Fig. 5 therefore makes paired comparisons between the number of saithe, cod, and haddock caught by the Farnella on trips 1/03 and 2/03. Each point in a panel of the figure represents the number of fish of a pair of species in one haul. In each row, the vertical location of a point is the number of fish of the species labelled in that row, whilst the horizontal location of a point in each panel is the number of fish of the species labelled in the appropriate column. The panels below the diagonal holding the names of the fish are a mirror image of those above.

If the nets selected strongly for one species to the exclusion of another, the points would tend to lie in vertical or horizontal strings, and if one species was strongly linked to another the points would tend to cluster round a 45° line. For Farnella, the results indicate that the largest catches of saithe did not include significant numbers of cod. Large numbers of haddock occurred in one large catch of saithe, and relatively large numbers of cod, about 100 per hour, occurred in a large catch of haddock. This suggests that saithe and cod tended not to be caught together on these trips, but that haddock may occur with either of those species.

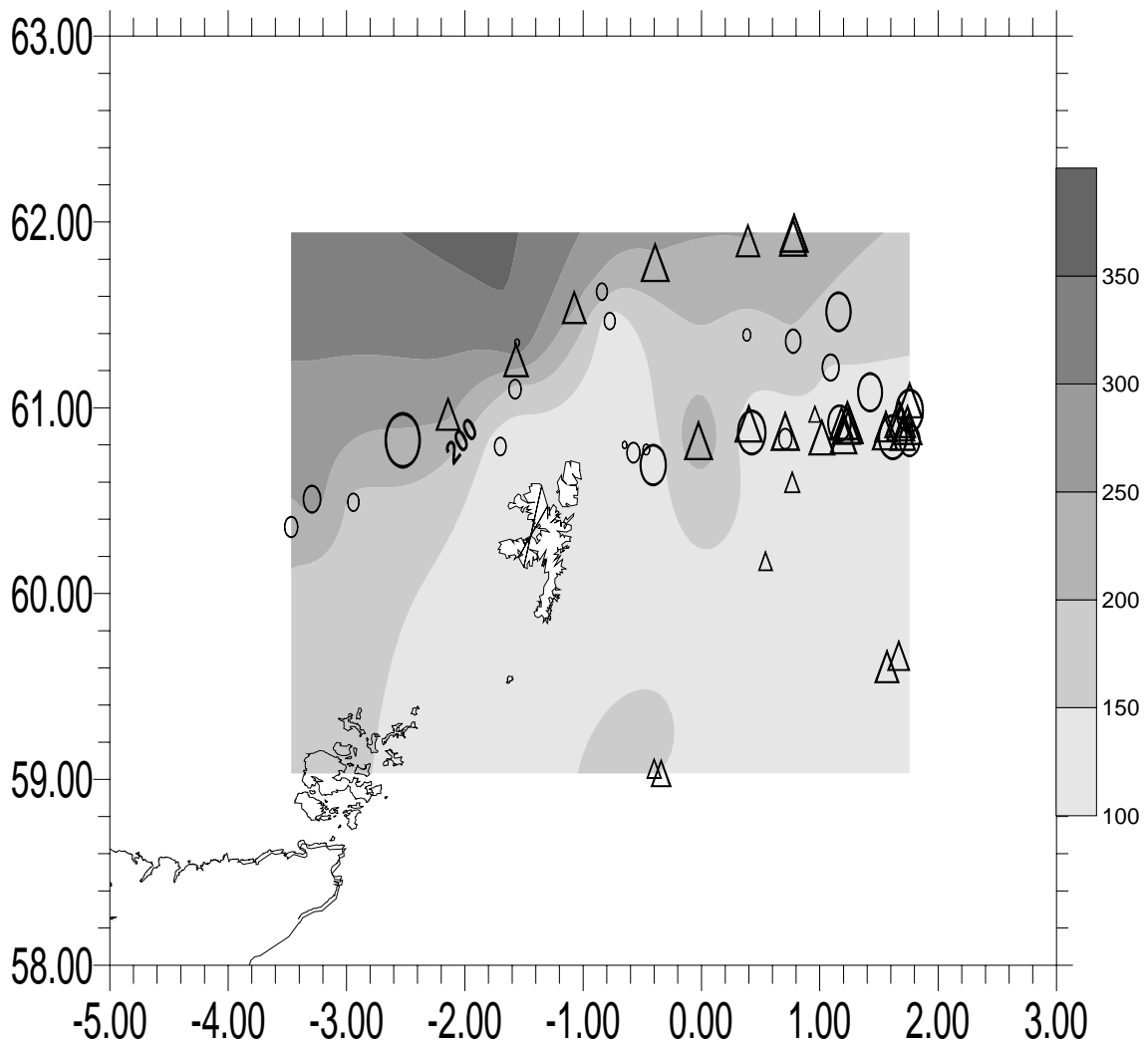
## **Summary and conclusions**

1. Saithe were present at most of the fishing stations, all of which were fished with a trawl fitted with a 90 mm square mesh escape panel and a 110 mm mesh codend. Catch rates ranged up to 6300 fish per hour, or 4.38 tonnes per hour. Discarding ranged from 0 to 14% of the catch in number, with less than 2% being typical of most catches. The bulk of the catch of both trips was made up of young fish between about 39 and 54 cm.
2. Cod were frequently caught but in much smaller numbers than saithe. The largest catch rate was 258 fish per hour, or 0.83 tonnes per hour. Discarding was generally low but there were two exceptional stations where 100% of the fish were discarded. Length distributions suggested a fairly wide spread of age-groups of cod in the catch. Few fish below the MLS were caught.
3. Moderate catches of haddock were taken at most stations except at two localities where very large catches occurred. The largest catch rate by number was 11 000 fish per hour, and the largest by weight was 2.9 tonnes per hour at a different station. Discarding percentages were generally low except at 4 stations where 100% of the fish caught were discarded. The bulk of the catch of both trips was made up of fish between about 30 and 40 cm but fish up to 55 cm were also common.

4. Longer tows may be better for catching large powerful fish. Statistical analysis found evidence for this effect for cod, but not for haddock, nor, surprisingly, for saithe. A tendency to catch larger saithe in deeper water was found.

5. Large catches of saithe usually did not include many cod but sometimes included large numbers of haddock. Large catches of haddock sometimes also included large numbers cod (relative to numbers of cod caught elsewhere).

**Fig. 1. Northern North Sea FSP survey, Sept. 2003:  
Station positions, tow times, and depth contours**

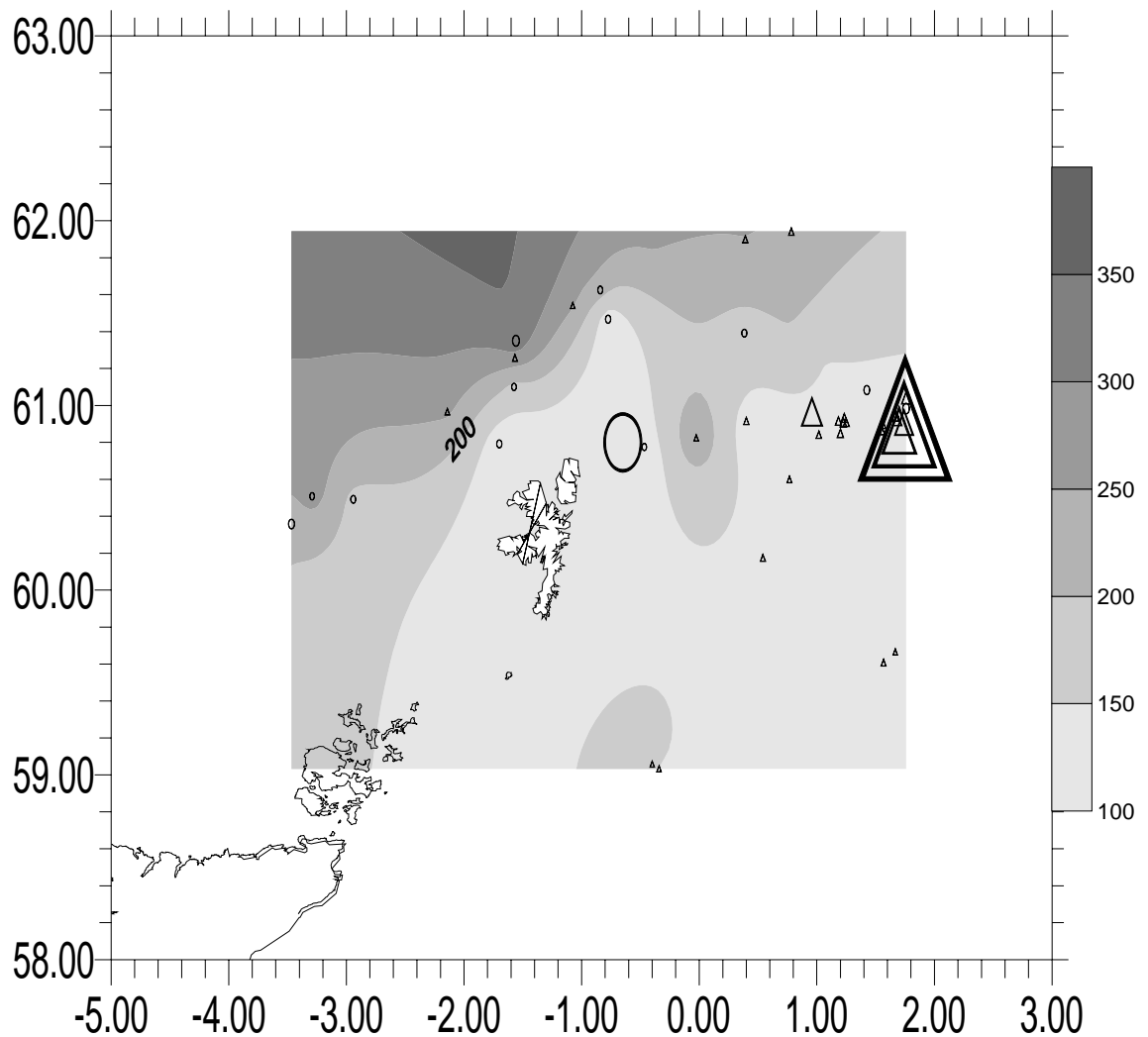


Circle = Farn 1/03

Triangle = Farn 2/03

Scaling: Largest symbol = 7.5 hours tow time

**Fig. 2a. Northern North Sea FSP survey, Sept. 2003:  
Saithe N per hr, and depth contours**

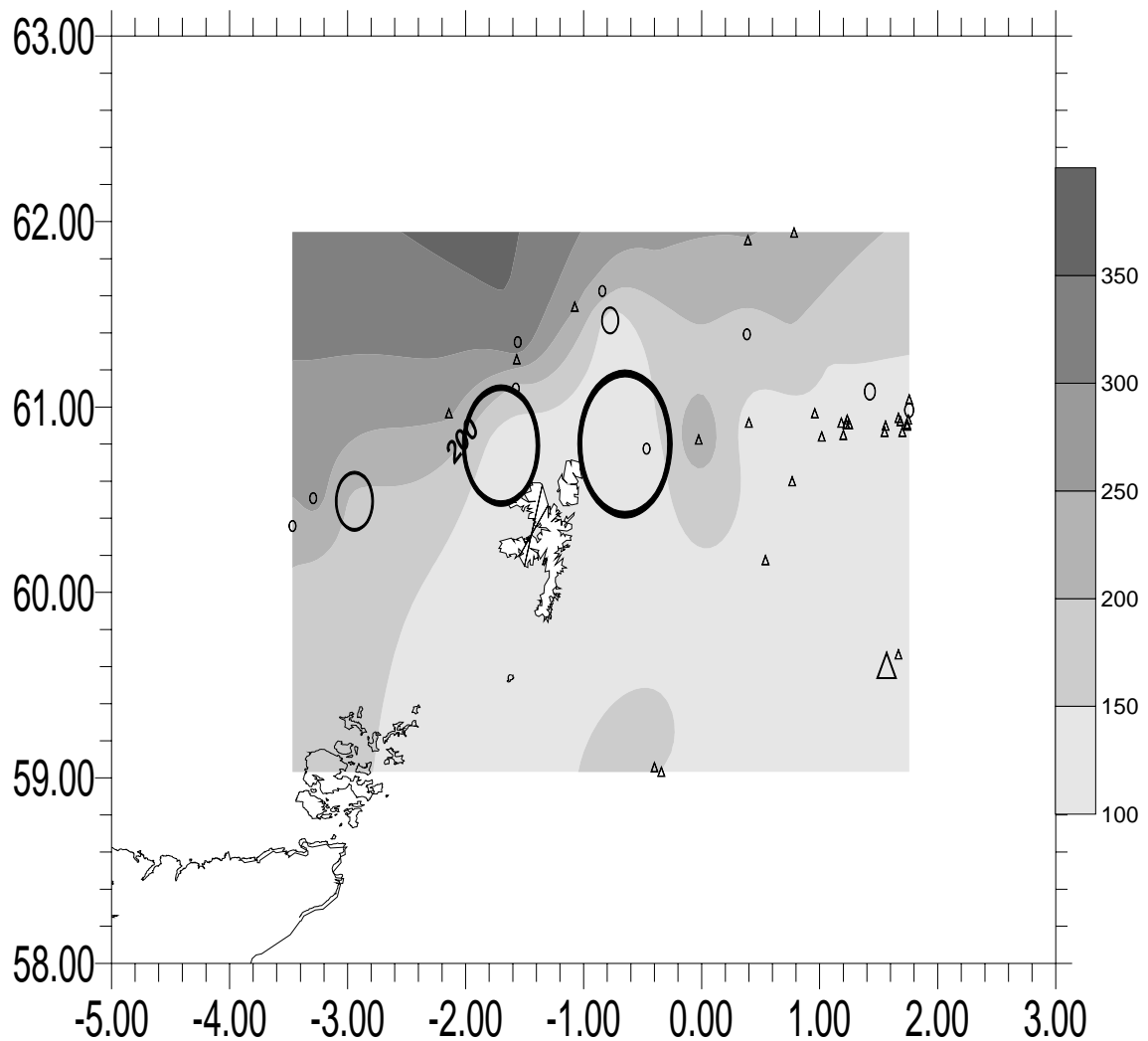


Circle = Farn 1/03

Triangle = Farn 2/03

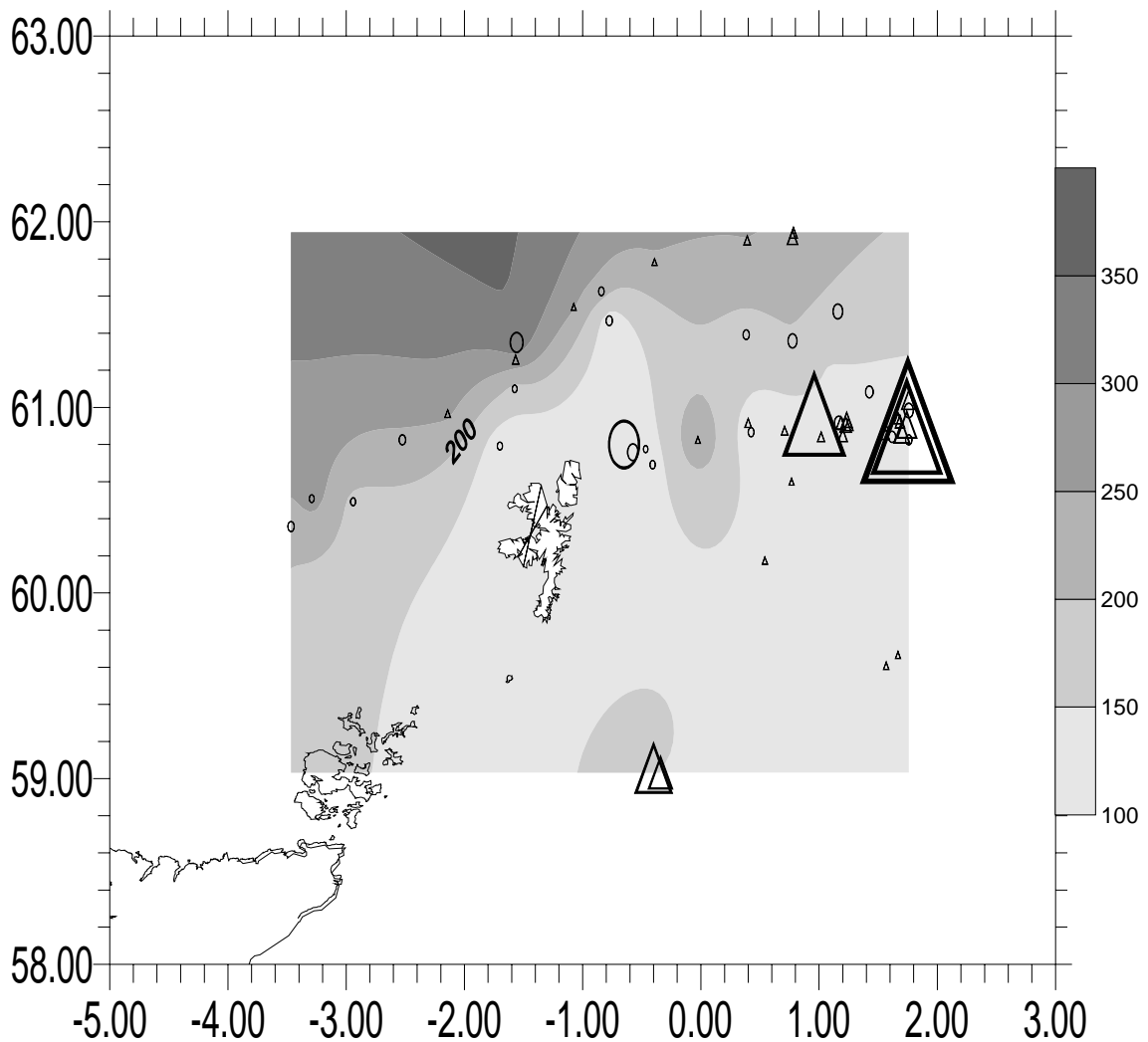
Scaling: Largest symbol = 6300 fish per hour

**Fig. 2b. Northern North Sea FSP survey, Sept. 2003:  
Saithe discard % by number, and depth contours**



Circle = Farn 1/03  
Triangle = Farn 2/03  
Scaling: Largest symbol = 14%

**Fig. 2c. Northern North Sea FSP survey, Sept. 2003:  
Saithe Kg per hr, and depth contours**

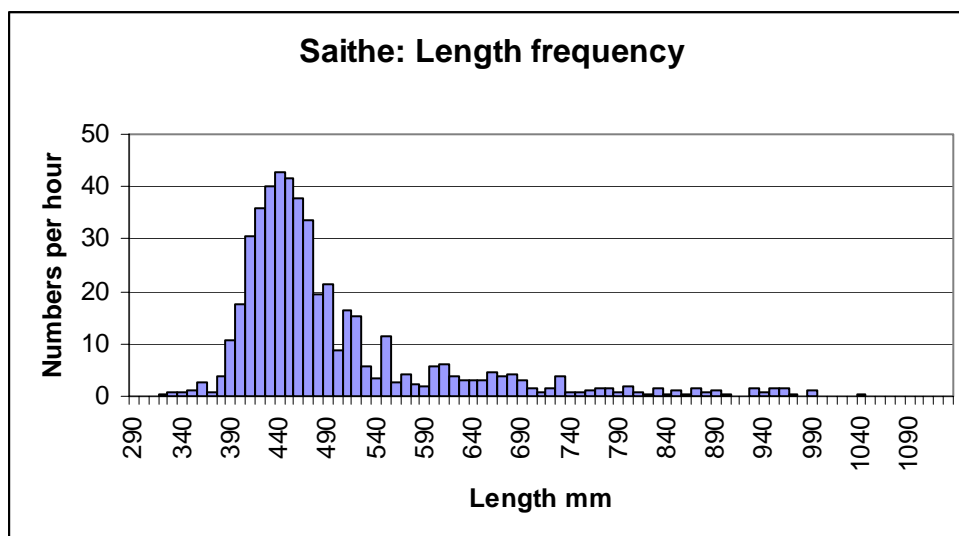


Circle = Farn 1/03

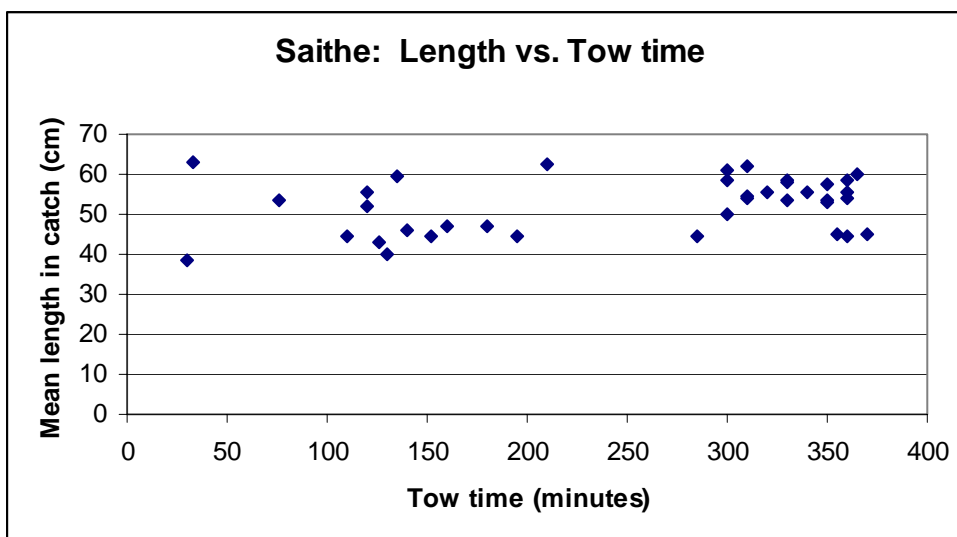
Triangle = Farn 2/03

Scaling: Largest symbol = 4381 Kg per hour

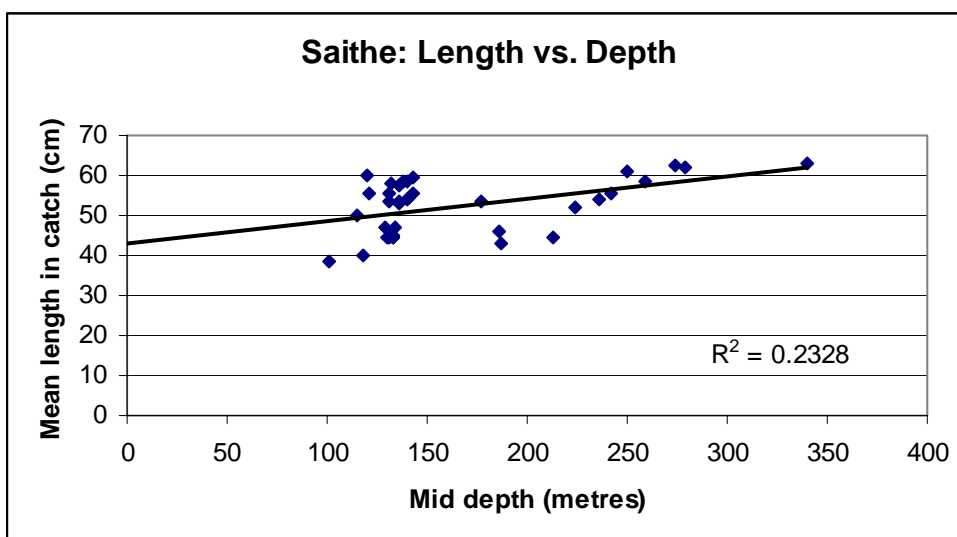
**Fig. 2d. Northern North Sea FSP trawl survey, Sept. 2003:**



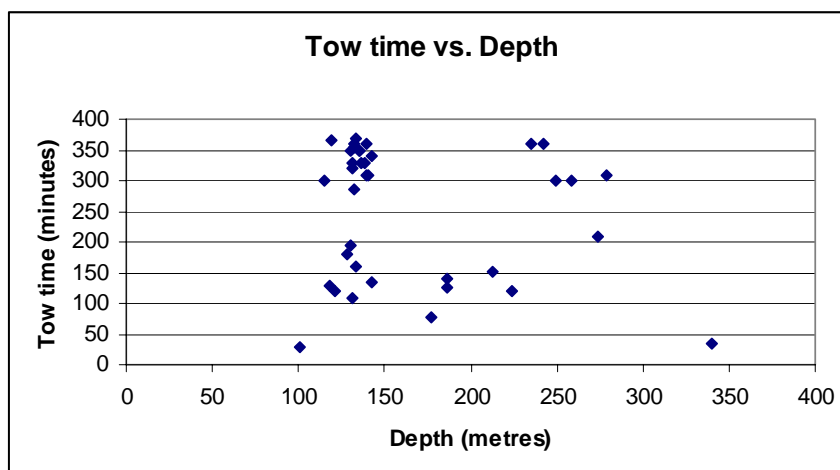
**Fig. 2e. Northern North Sea FSP trawl survey, Sept. 2003:**



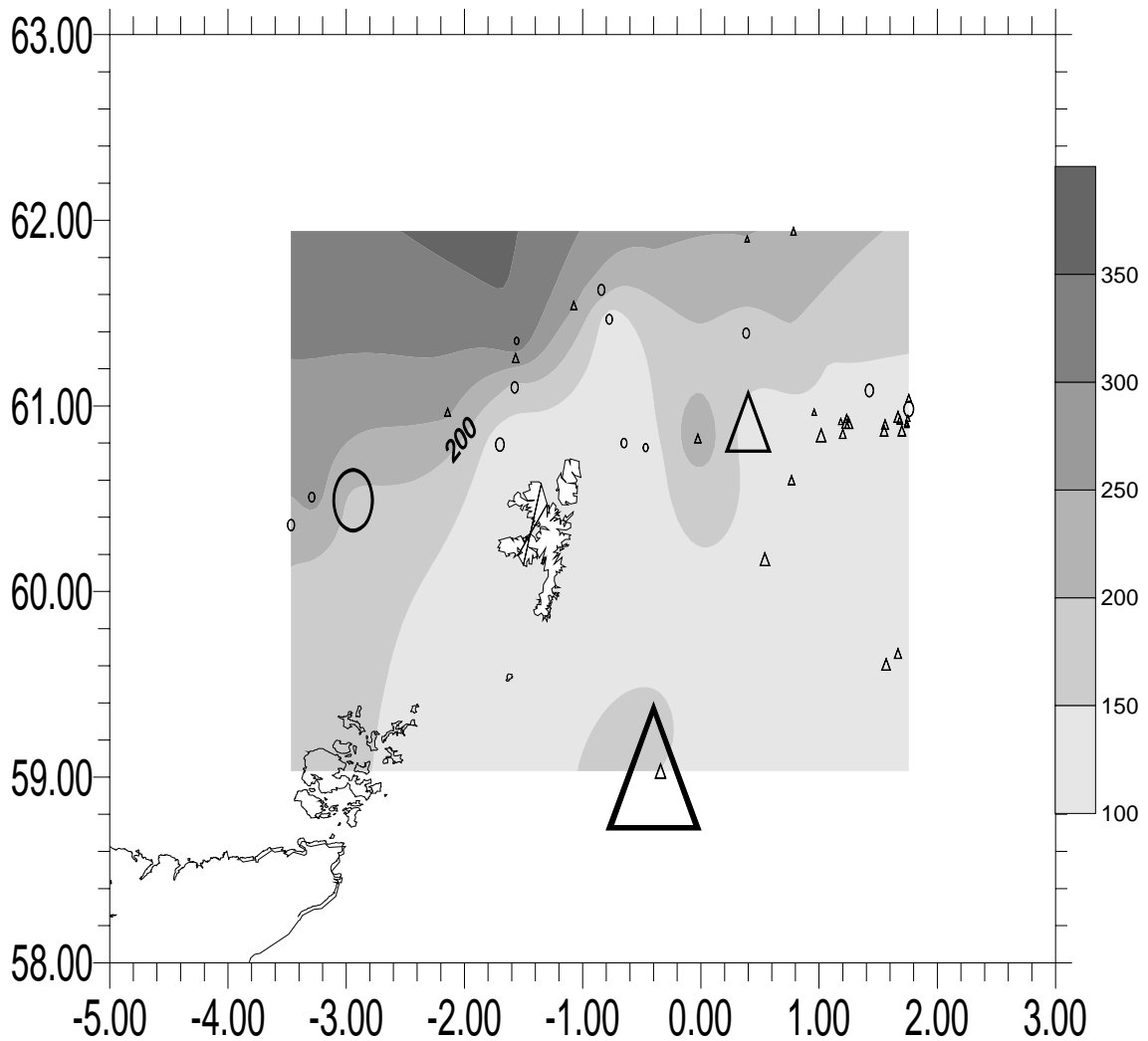
**Fig. 2f. Northern North Sea FSP trawl survey, Sept. 2003:**



**Fig. 2g. Northern North Sea FSP trawl survey, Sept. 2003:**



**Fig. 3a. Northern North Sea FSP survey, Sept. 2003:  
Cod N per hr, and depth contours**

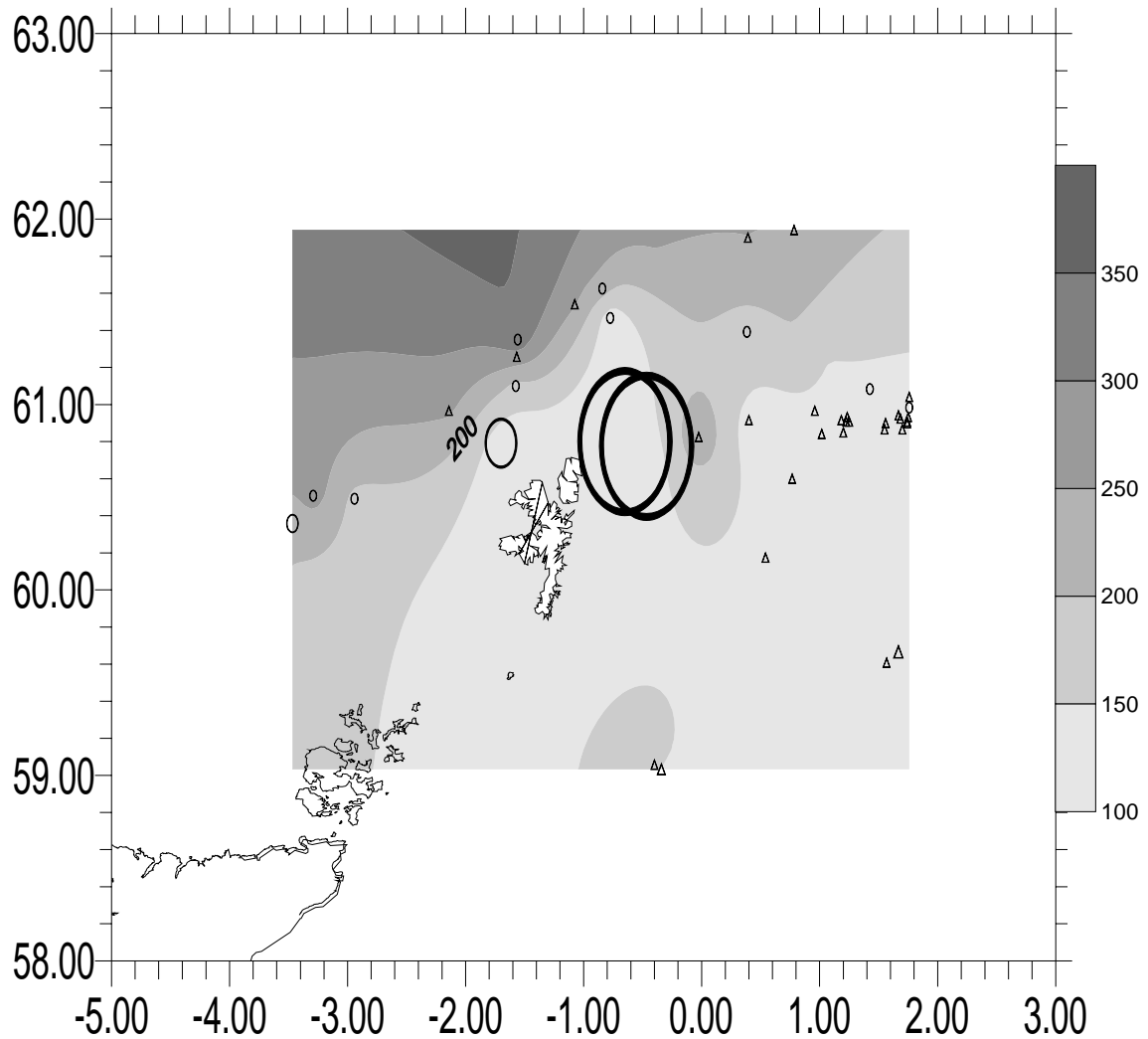


Circle = Farn 1/03

Triangle = Farn 2/03

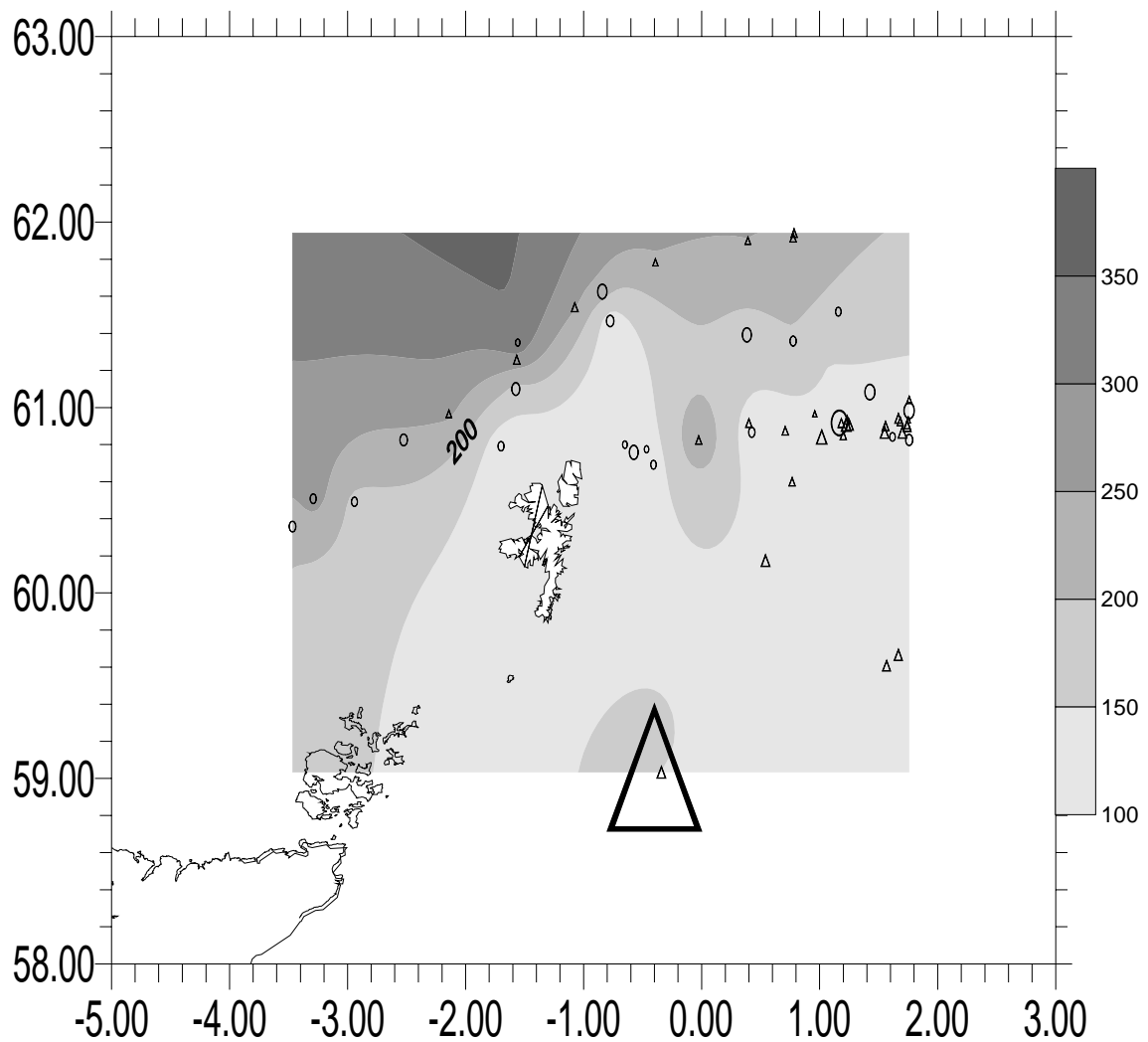
Scaling: Largest symbol = 258 fish per hour

**Fig. 3b. Northern North Sea FSP survey, Sept. 2003:  
Cod discard % by number, and depth contours**



Circle = Farn 1/03  
Triangle = Farn 2/03  
Scaling: Largest symbol = 100%

**Fig. 3c. Northern North Sea FSP survey, Sept. 2003:  
Cod Kg per hr, and depth contours**

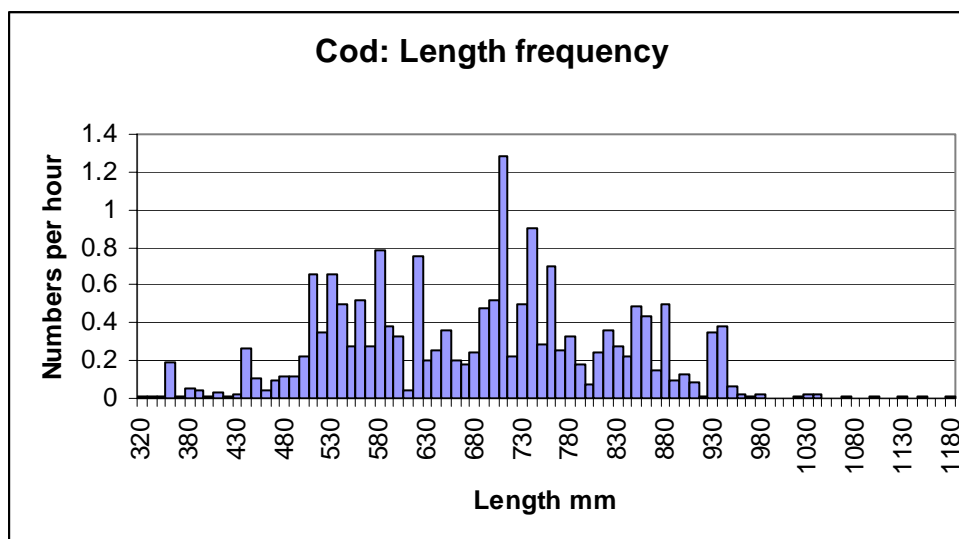


Circle = Farn 1/03

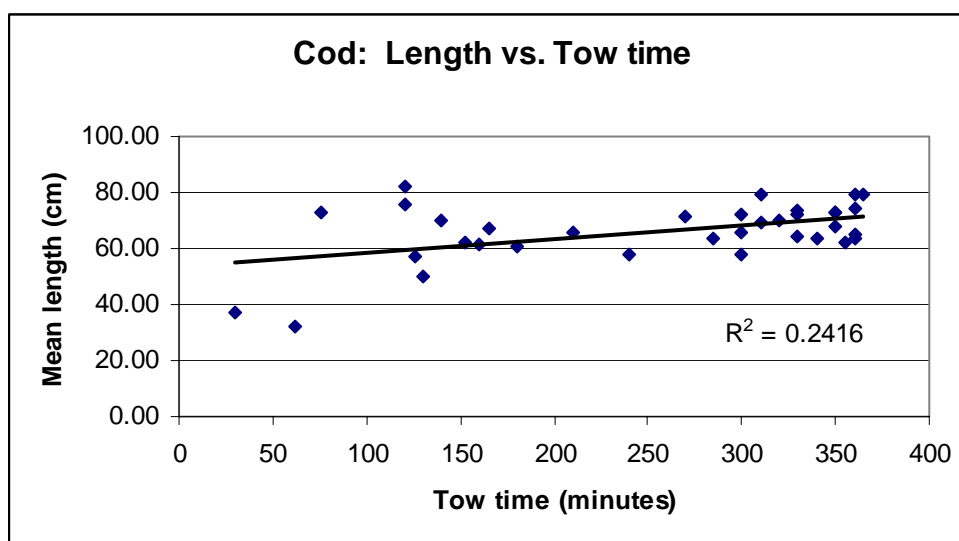
Triangle = Farn 2/03

Scaling: Largest symbol = 830 Kg per hour

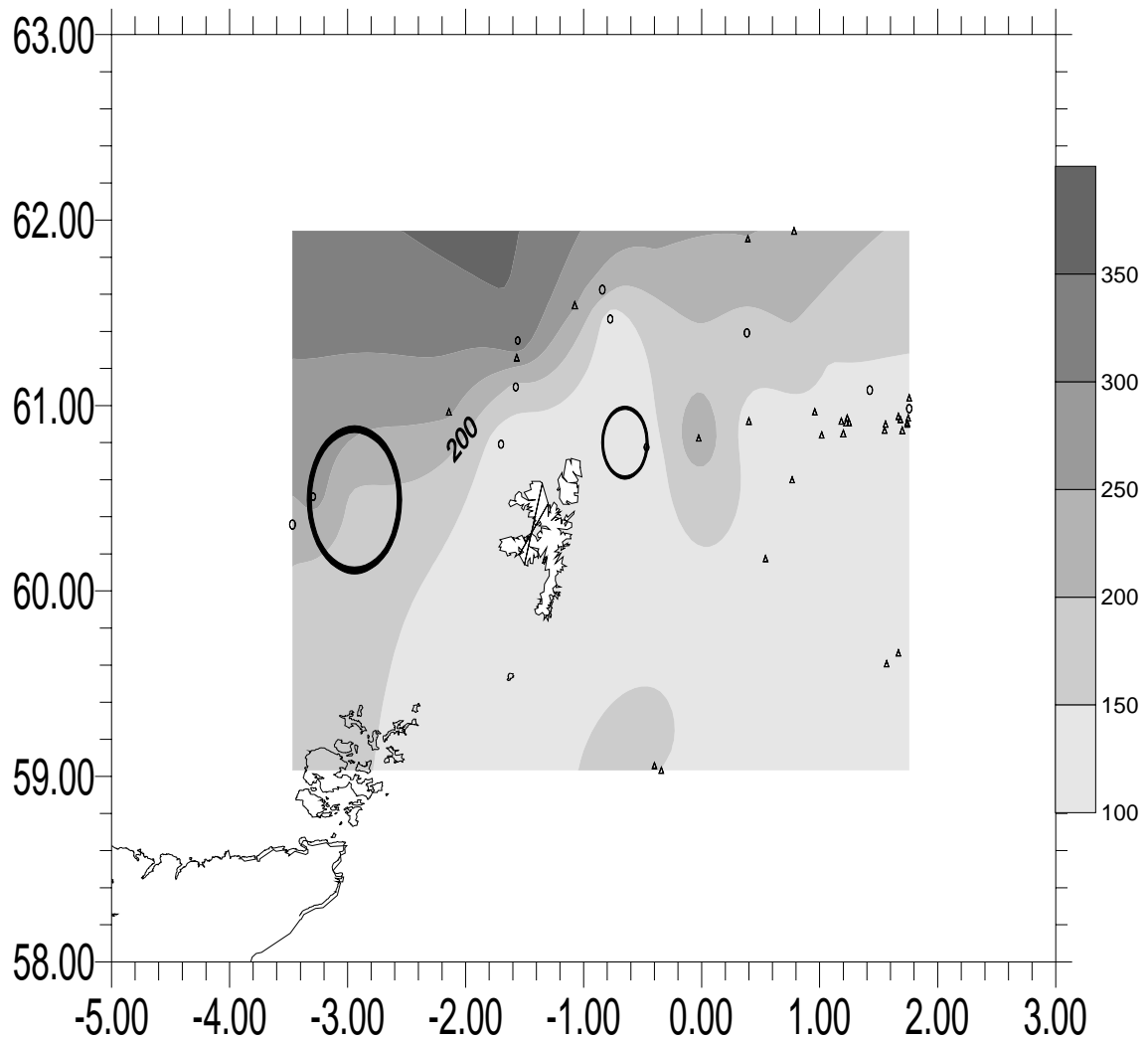
**Fig. 3d. Northern North Sea FSP trawl survey, Sept. 2003:**



**Fig. 3e. Northern North Sea FSP trawl survey, Sept. 2003:**



**Fig. 4a. Northern North Sea FSP survey, Sept. 2003:  
Haddock N per hr, and depth contours**

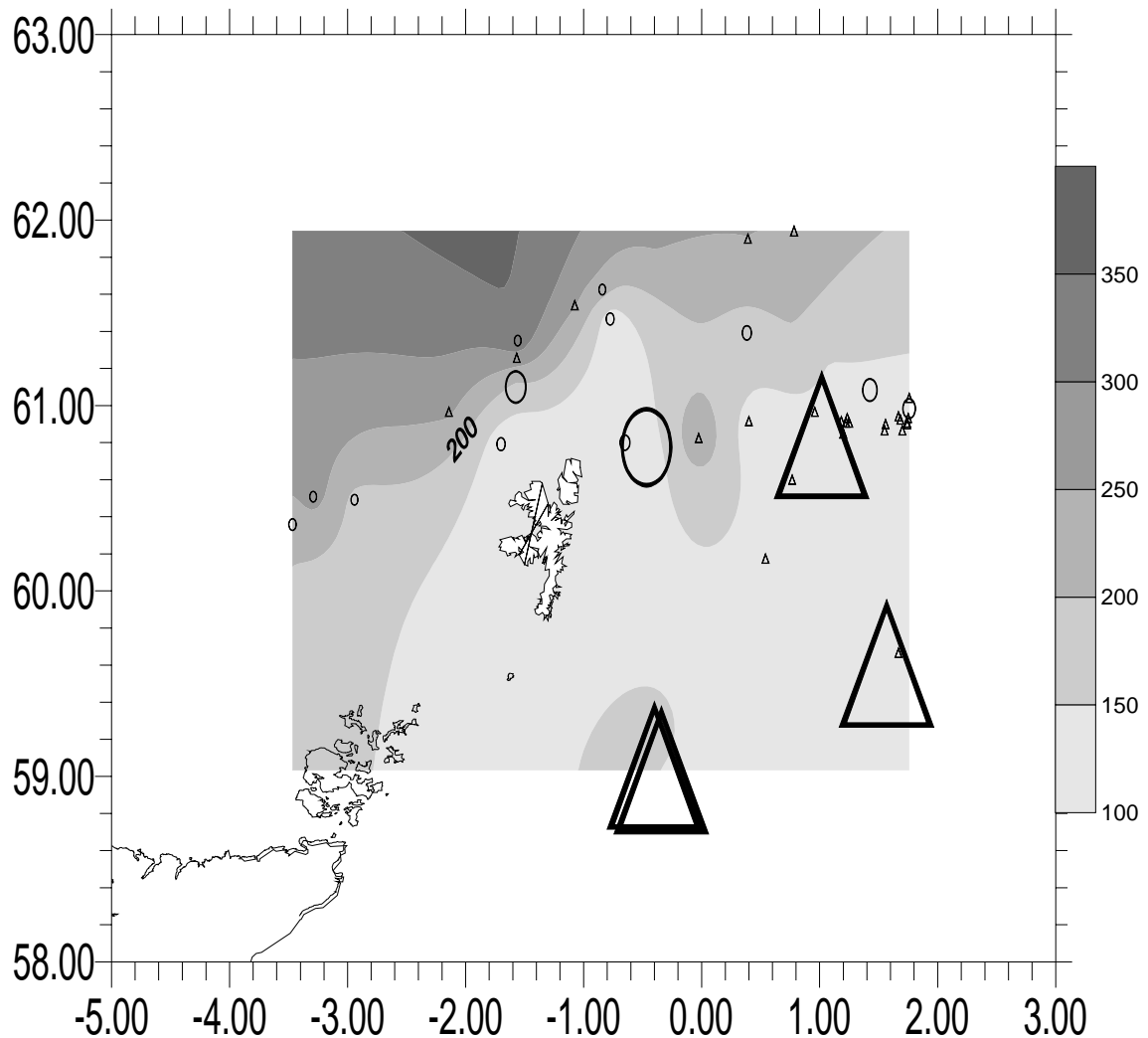


Circle = Farn 1/03

Triangle = Farn 2/03

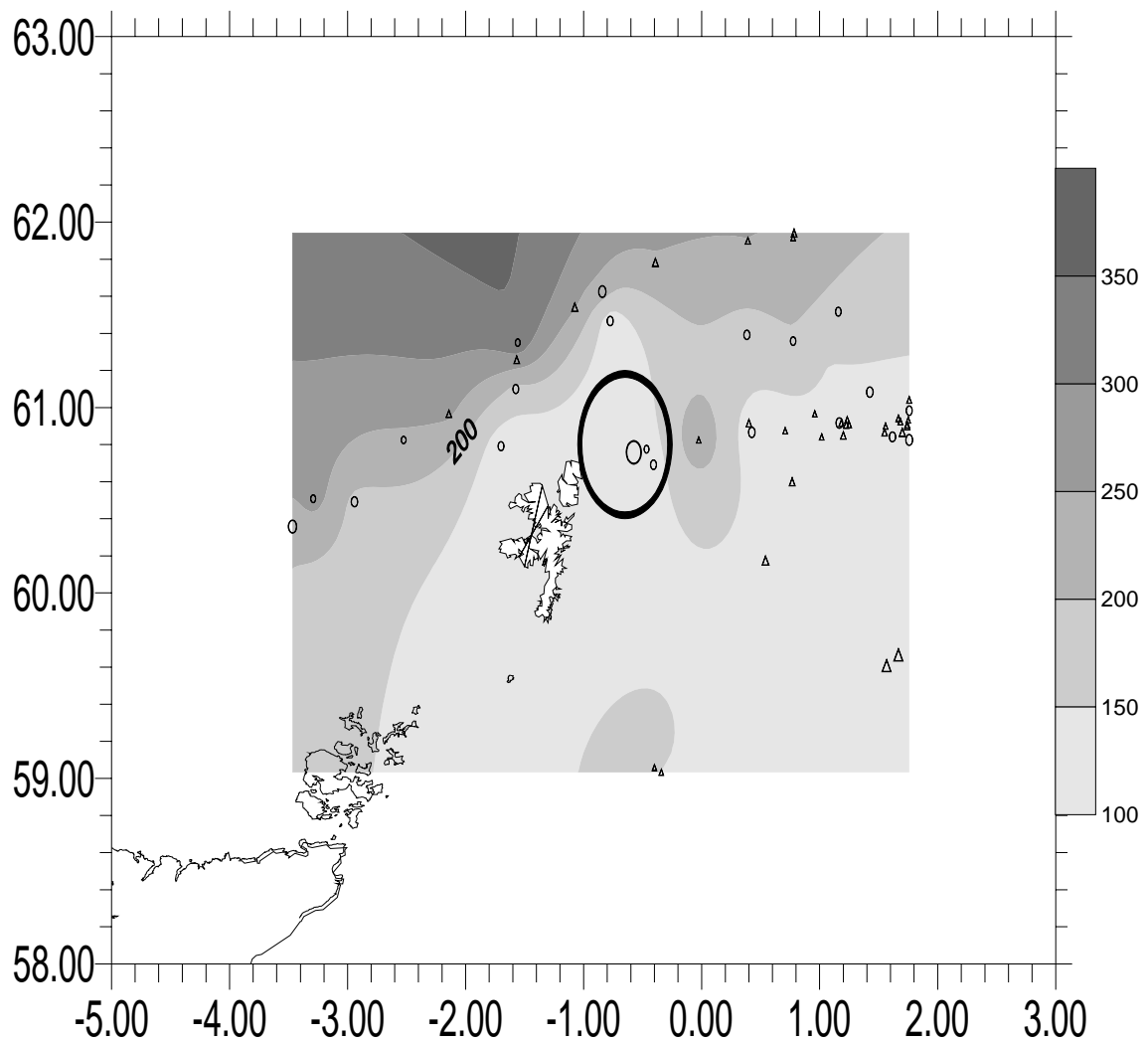
Scaling: Largest symbol = 11130 fish per hour

**Fig. 4b. Northern North Sea FSP survey, Sept. 2003:  
Haddock discard % by number, and depth contours**



Circle = Farn 1/03  
 Triangle = Farn 2/03  
 Scaling: Largest symbol = 100%

**Fig. 4c. Northern North Sea FSP survey, Sept. 2003:  
Haddock Kg per hr, and depth contours**

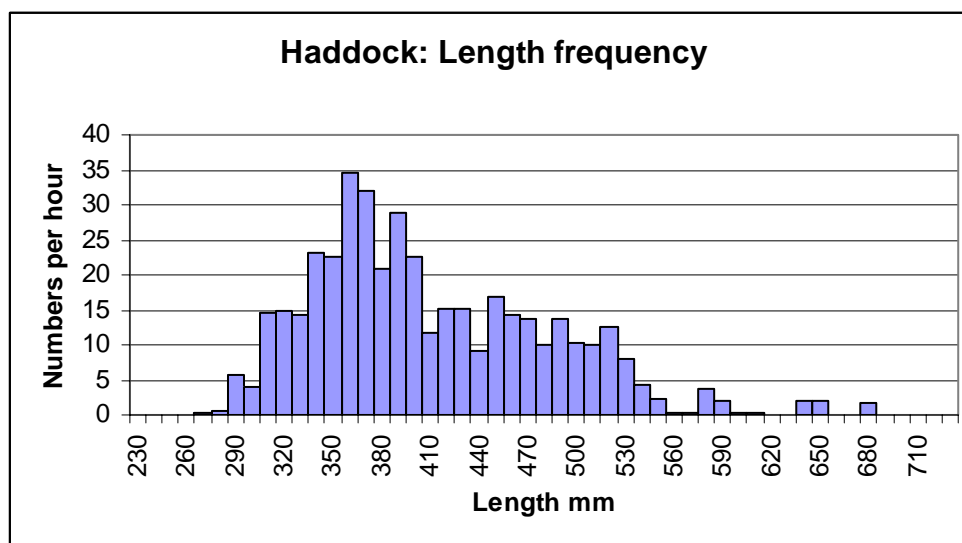


Circle = Farn 1/03

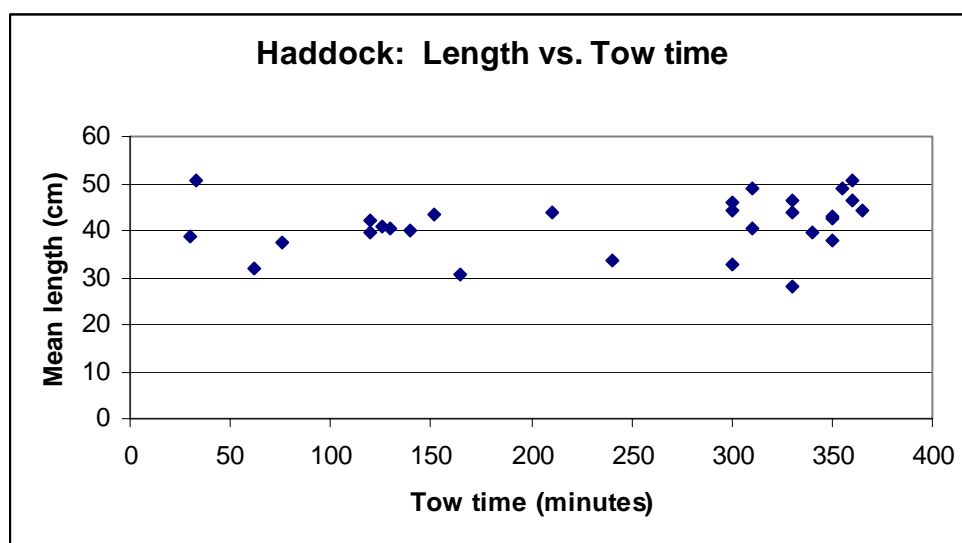
Triangle = Farn 2/03

Scaling: Largest symbol = 2908 Kg per hour

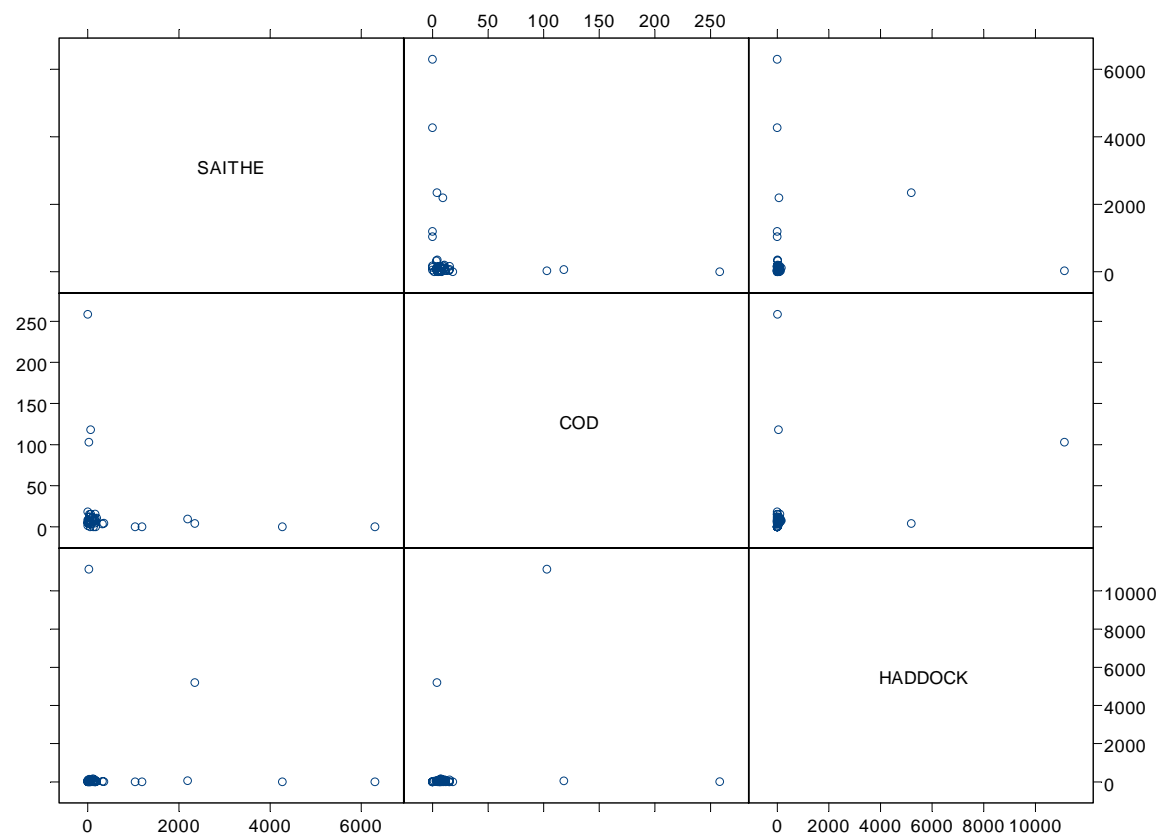
**Fig. 4d. Northern North Sea FSP trawl survey, Sept. 2003:**



**Fig. 4e. Northern North Sea FSP trawl survey, Sept. 2003:**



**Fig. 5. Northern North Sea FSP trawl survey, Sept. 2003: Numbers of individuals of saithe, cod, and haddock in catches of the FV Farnella.**





**APPENDIX 1: North Sea FSP saithe survey, autumn 2003: Station and catch details for 3 species of fish.**

**Selected abbreviations: POK\_Kg=catch weight of saithe in Kg, POK\_N=catch number of saithe.**

Cruise	Stn	Shot Lon	Shot Lat	Haul Lat	Haul Lon	Date shot	Time shot	Tow hrs	POK_Kg	POK_N	COD_Kg	COD_N	HAD_Kg	HAD_N
FARN 1/03	1	-3.4333	60.2833	60.4333	-3.5000	18-Sep-03	2:43	2.53	241	285	54	19	308	402
FARN 1/03	2	-3.4667	60.4333	60.5833	-3.1167	18-Sep-03	6:50	3.50	67	19	54	16	48	57
FARN 1/03	3	-3.0500	60.5333	60.4500	-2.8333	18-Sep-03	12:07	2.10	56	61	27	216	127	23368
FARN 1/03	4	-2.5167	60.8167	60.8333	-2.5333	18-Sep-03	16:57	7.55	749	na	212	na	47	na
FARN 1/03	5	-1.8333	60.7667	60.8167	-1.5667	19-Sep-03	6:30	2.17	58	81	29	25	85	118
FARN 1/03	6	-1.5500	61.0167	61.1833	-1.6000	19-Sep-03	11:00	2.33	40	35	80	18	102	154
FARN 1/03	7	-1.5333	61.3333	61.3667	-1.5833	19-Sep-03	16:45	0.55	227	95	0	0	5	5
FARN 1/03	8	-0.6667	60.8167	60.7833	-0.6333	19-Sep-03	23:30	0.50	649	1174	1	2	1454	2595
FARN 1/03	9	-0.6167	60.7833	60.7333	-0.5333	20-Sep-03	0:31	2.48	771	na	106	na	841	na
FARN 1/03	10	-0.4333	60.7000	60.6833	-0.3833	20-Sep-03	3:40	5.50	235	na	53	na	266	na
FARN 1/03	11	-0.4833	60.8000	60.7500	-0.4500	20-Sep-03	10:50	1.03	0	0	0	2	12	36
FARN 1/03	12	-0.7500	61.4000	61.5333	-0.8000	20-Sep-03	17:00	2.00	175	95	54	10	96	129
FARN 1/03	13	-0.8000	61.5667	61.6833	-0.8833	20-Sep-03	19:30	2.00	107	62	94	14	191	265
FARN 1/03	14	0.5167	60.8333	60.9000	0.3333	21-Sep-03	7:00	6.00	404	na	106	na	413	na
FARN 1/03	15	0.4000	61.3500	61.4333	0.3667	21-Sep-03	17:44	1.27	107	46	54	7	61	110
FARN 1/03	16	0.7667	61.6000	61.1167	0.7833	22-Sep-03	3:25	3.00	696	na	53	na	96	na
FARN 1/03	17	1.2000	61.6500	61.3833	1.1167	22-Sep-03	18:45	5.25	1338	na	53	na	191	na
FARN 1/03	19	1.1000	61.1000	61.0667	1.7500	23-Sep-03	6:25	5.17	807	485	268	55	354	587
FARN 1/03	20	1.7667	61.0667	60.9000	1.7500	23-Sep-03	12:10	5.83	1393	955	321	90	300	591
FARN 1/03	21	1.8333	60.8333	60.8167	1.6833	23-Sep-03	18:45	4.25	428	na	106	na	335	na
FARN 1/03	22	1.6333	60.8000	60.8833	1.6000	23-Sep-03	23:45	6.00	803	na	53	na	335	na
FARN 1/03	23	1.4833	61.0000	60.8333	0.8500	24-Sep-03	6:25	4.83	1017	na	531	na	335	na

**APPENDIX 1 continued: North Sea FSP saithe survey, autumn 2003: Station and catch details for 3 species of fish.**

**Selected abbreviations: POK\_Kg=catch weight of saithe in Kg, POK\_N=catch number of saithe.**

Cruise	Stn	Shot Lon	Shot Lat	Haul Lat	Haul Lon	Date shot	Time shot	Tow hrs	POK_Kg	POK_N	COD_Kg	COD_N	HAD_Kg	HAD_N
FARN 2/03	1	-0.5000	59.1167	59.0000	-0.3000	26-Sep-03	16:45	2.75	4444	0	2283	711	4	17
FARN 2/03	2	-0.3000	59.0000	59.0667	-0.3833	26-Sep-03	20:35	4.00	3909	0	159	73	1	3
FARN 2/03	3	1.5333	59.5667	59.6500	1.6000	27-Sep-03	6:15	5.00	269	199	159	60	720	3
FARN 2/03	4	1.6667	59.6667	59.6667	1.6667	27-Sep-03	11:45	4.50	160	0	159	37	671	0
FARN 2/03	5	0.5167	60.1667	60.1833	0.5667	27-Sep-03	20:35	2.67	107	100	106	40	192	0
FARN 2/03	6	0.7667	60.6000	60.6000	0.7667	28-Sep-03	1:40	3.00	107	114	53	20	143	0
FARN 2/03	7	1.1000	60.8333	60.8667	1.3000	28-Sep-03	6:20	5.67	1392	780	106	36	191	333
FARN 2/03	8	1.6500	60.8667	60.8667	1.7500	28-Sep-03	13:00	5.50	3159	12045	212	52	287	344
FARN 2/03	9	1.7333	60.8667	60.9333	1.7500	28-Sep-03	19:00	3.25	10620	13869	106	0	96	0
FARN 2/03	10	1.7500	60.9333	60.9333	1.7500	28-Sep-03	22:50	1.83	8032	11550	0	0	3	0
FARN 2/03	11	0.7000	61.9167	61.9667	0.8667	29-Sep-03	6:30	6.00	1071	447	106	20	287	311
FARN 2/03	12	0.7833	61.9333	61.9000	0.7667	29-Sep-03	13:15	5.83	1820	na	106	na	48	na
FARN 2/03	13	0.9500	60.9667	60.9667	0.9667	30-Sep-03	1:20	2.25	6426	2680	0	0	0	0
FARN 2/03	14	0.9500	60.9667	60.8500	1.5000	30-Sep-03	4:05	6.08	2142	1013	318	60	191	278
FARN 2/03	15	1.6000	60.8667	60.8667	1.5000	30-Sep-03	10:40	5.33	1699	886	212	52	143	0
FARN 2/03	16	1.5167	60.8500	60.9667	0.9833	30-Sep-03	16:30	5.83	1338	658	212	64	47	171
FARN 2/03	17	0.9667	60.9833	60.8833	1.5000	30-Sep-03	22:50	6.00	2034	987	106	28	96	0
FARN 2/03	18	1.4000	60.8500	60.8333	0.6333	01-Oct-03	5:30	5.50	749	383	318	84	0	2
FARN 2/03	19	0.5167	60.9167	60.9167	0.2833	01-Oct-03	11:40	5.83	642	360	106	689	205	272
FARN 2/03	20	-2.5667	60.8167	60.8333	2.5167	02-Oct-03	0:40	6.00	214	94	108	36	0	0
FARN 2/03	21	-2.4333	60.8500	61.0833	-1.8500	02-Oct-03	7:15	5.00	321	102	54	20	143	177
FARN 2/03	22	-1.8167	61.1167	61.4000	-1.3167	02-Oct-03	13:05	5.17	589	231	108	34	192	160
FARN 2/03	23	-1.2833	61.4000	61.6833	-0.8667	02-Oct-03	19:00	5.00	107	0	106	26	287	417
FARN 2/03	24	-0.7833	61.7000	61.8667	0.0000	03-Oct-03	0:40	6.00	214	na	54	na	335	na
FARN 2/03	25	0.0500	61.8833	61.9167	0.7333	03-Oct-03	7:25	5.00	589	257	54	0	96	0
FARN 2/03	26	1.7500	61.1667	60.9167	1.7667	03-Oct-03	17:15	5.50	2731	1768	53	19	95	104

**APPENDIX 1 continued: North Sea FSP saithe survey, autumn 2003: Station and catch details for 3 species of fish.**

**Selected abbreviations: POK\_Kg=catch weight of saithe in Kg, POK\_N=catch number of saithe.**

Cruise	Stn	Shot Lon	Shot Lat	Haul Lat	Haul Lon	Date shot	Time shot	Tow hrs	POK_Kg	POK_N	COD_Kg	COD_N	HAD_Kg	HAD_N
FARN 2/03	27	1.7667	60.9000	60.9167	1.7167	03-Oct-03	23:25	6.17	4766	6408	106	0	96	0
FARN 2/03	28	1.7333	60.9167	60.9333	1.6333	04-Oct-03	6:10	6.00	1553	2117	106	26	96	78
FARN 2/03	29	1.6500	60.9500	60.9333	1.6833	04-Oct-03	13:05	5.92	1124	1167	159	63	96	94
FARN 2/03	30	1.6667	60.9333	60.8667	1.4500	04-Oct-03	19:30	4.75	589	770	108	34	0	0
FARN 2/03	31	1.4000	60.8667	60.9667	0.9667	05-Oct-03	0:50	5.17	1231	660	108	0	46	0
FARN 2/03	32	0.9667	60.9333	60.8167	0.4500	05-Oct-03	6:30	6.00	642	na	108	na	46	na

## **APPENDIX 2: North Sea FSP saithe survey, autumn 2003: Cruise report 1 (excluding data shown in main report).**

**CENTRE FOR ENVIRONMENT, FISHERIES AND AQUACULTURE  
SCIENCE, LOWESTOFT LABORATORY, LOWESTOFT, SUFFOLK  
NR33 0HT.**

**REPORT:** FSP Saithe survey – FV Farnella 01/03

**STAFF:** Clive Satchell and Jeroen van der Kooij

**DURATION:** 16/09/2003 – 25/09/2003

**LOCATION:** Northern North Sea

### **AIMS:**

1. To conduct an acoustic survey of the area in order to investigate the potential for measuring the distribution of saithe (*Pollachius virens*).
2. To record the location, quantity and biological structure of catches taken from the acoustic survey.

**Narrative:** Mr Satchell, Mr van der Kooij and Dr Mackinson left Lowestoft for Grimsby on the afternoon of 14/09/03. On 15/09/03 staff joined the Farnella and sampling equipment was loaded aboard the vessel. Staff spent the day installing the acoustic logging computer and ensuring all software was compatible. At approximately 15:00 hrs Dr Mackinson left for the return journey to Lowestoft whilst Mr Satchell and Mr van der Kooij remained on board the vessel. At 16:30 a meeting took place between CEFAS staff members, Nigel Atkins of Marr Shipping LTD (Vessel owners), Dave Bevan of the NFFO and Judith Farrell of the FPO. Operational procedures of the forthcoming cruise were discussed and various points highlighted for further discussion. The Farnella crew arrived the following morning (16/09/03) at 8:00 and the vessel sailed at approximately 9:00 that day. After further discussions between CEFAS, Marr Shipping Ltd, and the skipper, it was agreed that the proposed survey would be conducted by a combination of sampling hauls from an acoustic grid and commercial type tows, taking into account the need for crew and staff rest periods. Survey work began on 17/09/03 at 19:30 and continued until the evening of the 23/09/03. Farnella docked at Scrabster on the morning of the 25/09/03 and staff arrived in Lowestoft that evening.

**Methods:** The area under scrutiny was the shelf edge north of Shetland, a region targeted by the international commercial saithe fisheries. Since fishing takes place both on the shelf itself as well as in the deeper waters north off the shelf, a cruise track was designed in zigzag formation crossing the shelf edge at right angles on each leg. This way the saithe “hotspots” would not be over-represented and the core of the fishing area would be covered.

Fisheries acoustic data were continuously collected at 38 kHz operating frequency using the SIMRAD ES60 Split beam Echosounder. Since no calibration was performed factory settings were maintained. The 38 kHz is considered to be the standard operating frequency for fisheries acoustic surveys. The initial plan was to identify shoals *in situ* and, where necessary,

shoot the demersal otter trawl in order to identify relationships between catch data and specific acoustic marks. However few significant marks indicating shoals of saithe were found throughout the survey and therefore sample tows were usually carried out in order to identify the composition of the general acoustic data, rather than that of a specific mark. The trawl used for the survey had a ground rope of approximately 36m, a 90mm square mesh panel and a cod end with 110mm mesh with double branded twine of 3mm.

**RESULTS:** The acoustic survey was completed in good time. As a result of local information the survey grid differed slightly from the proposed track. A total of 24 tows were completed during the survey. Length data were collected from sampled tows for all species, including both saleable and non-saleable by-catch. 10 tows conducted on the acoustic grid were sampled. 14 of the tows completed during the survey could be described as purely commercial type tows. 3 of the commercial tows were sampled by recording length measurements of all species, whilst species caught by weight was recorded for the other 11 tows. The duration of tows conducted on the acoustic grid varied between 30minutes and 2hrs 30minutes. The 3 commercial tows sampled had duration's of 3hrs 30minutes, 5hrs 10minutes and 5hrs 50minutes. Otoliths from 225 saithe and 22 cod were taken.

C. Satchell October 2003

## **APPENDIX 2: North Sea FSP saithe survey, autumn 2003: Cruise report 2 (exluding data shown in main report).**

**CENTRE FOR ENVIRONMENT, FISHERIES AND AQUACULTURE  
SCIENCE, LOWESTFOT LABORATORY, LOWESTOFT, SUFFOLK  
NR33 OHT.**

**REPORT:** FSP/2 Saithe survey – FV Farnella 01/03

**STAFF:** Kevin Sullivan

**DURATION:** 25/09/2003-06/10/2003

**LOCATION:** Northern North Sea

### **AIMS:**

1. To continue an acoustic survey of the area in order to investigate the potential for measuring the distribution of saithe (*Pollachius virens*).
2. To continue recording the location, quantity and biological structure of catches taken from Random Tows for targeting Saithe within the area .

**Narrative:** Mr Sullivan departed Lowestoft for Scrabster on the morning of 23/09/30. On 25/09/03 Mr Sullivan joined the Farnella at 0800hrs. A brief handover meeting took place with CEFAS staff Mr Satchell and Mr Van der Kooij who then departed for Lowestoft. A meeting with the skipper of Farnella John Musgrave confirmed that the Farnella would sail the following morning and start the second part of the Survey. On the morning of 26/10/03 Farnella sailed at 0800hrs. A discussion took place with the skipper as to how best conduct the fishing in the 2<sup>nd</sup> part of the survey, this resulted in an agreement to use the skippers knowledge to locate and target saithe whilst covering as much area as possible in the time available.

Fishing commenced at position 59.07.1N and 00.29.9 W using the Demersal otter Trawl. Acoustic data recording equipment was activated throughout the entire 2<sup>nd</sup> part with random checks to ensure that data was recording.

Fishing ceased at 1230hrs on the 05/10/03, the vessel then sailed to Scrabster docking at 0530hrs on Monday 06/10/03. CEFAS staff then departed for Lowestoft.

### **Results**

32 random tows for saithe were carried out data sheets for these being recorded.

157 otoliths from saithe were taken

Saithe fishing resulted in a total of 120 skips being landed along with 11 cod, 12 haddock, 3 ling 1 pollack and 1 monk skip.

Acoustic data was recorded through out.

K.SULLIVAN

9<sup>TH</sup> OCTOBER 2003

### **APPENDIX 3: North Sea FSP saithe survey, Sept. 2003:**

#### **Acoustics report for cruises 1 and 2.**

Jeroen van Der Kooij, CEFAS Lowestoft

High quality scientific data were successfully recorded using acoustic equipment on board a FV Farnella. As a result of anecdotal information the survey grid differed slightly from the proposed track (fig. 1). Because of the inability to calibrate the echo sounder on board of the fishing vessel, the acoustic data cannot provide absolute abundance information. However, the acoustic data in both parts of the trip were recorded on the same echo sounder, enabling us to look at the relative abundance differences between the two. The total integrated NASC (acoustic energy) of the first 10 m above the seabed has been abstracted for each 1 nautical mile in both surveys, displaying the relative fish densities throughout both tracks (fig. 1, scientific survey track and 2, commercial track). The average NASC per nautical mile of the scientific part of the survey was  $80.07 \text{ m}^2/\text{n.mi}^2$ , compared to  $99.01 \text{ m}^2/\text{n.mi}^2$  for the commercial part. Although no further statistics have been applied, the densities based on the acoustic data are 25% higher in the commercial part of the survey. The next step will be to link this information to the proportion of fish species caught in the nearest trawl. This will enable us to extrapolate species distribution and densities for the area and compare apparent differences between the scientific and commercial survey approaches.

The initial plan was to select acoustic saithe marks only and use these for distribution and density maps. However no clear saithe marks were observed in the echogram and as a result a more generalised approach had to be adopted. The total acoustic energy of the first 10m above the bottom was integrated for every 1 n.mi. Further steps to combine catch and acoustic data in this pilot study are:

- Sum catch data for every haul.
- Combine acoustic data for every haul.
- Find the proportions of each species in each catch by numbers or weight (or a calculated value incorporating numbers and weight).
- Partition the acoustic energy in every haul corresponding to the proportions of each species caught in the haul so that there is an acoustic value for every species in that haul.
- As above, allocate the acoustic energy between stations according to the proportion of species caught in the nearest trawl station.

The result will represent a species (e.g. saithe) distribution throughout the transect, but there are some important issues concerning interpretation of such data. E.g.

- This method assumes that “what we see” (in echogram) is “what we catch” (in trawl), which may not be the case because of the differences in selectivity of both fishing gear and acoustic equipment as well as fish behaviour (avoidance) with regards to fishing vessel and/or fishing gear.
- Because the acoustic species proportioning depends heavily on the catch data, the results will be quite similar to using catch data alone. There will be some differences in density (compared to catch), but due to the fact that the echo sounders are not calibrated, no absolute biomass can be calculated.

- Furthermore, because the hauls were very long (up to 6 hours), combining the species catch data will cause loss of important information. We simply don't know exactly when and where a specific species was caught in this 6-hour period.

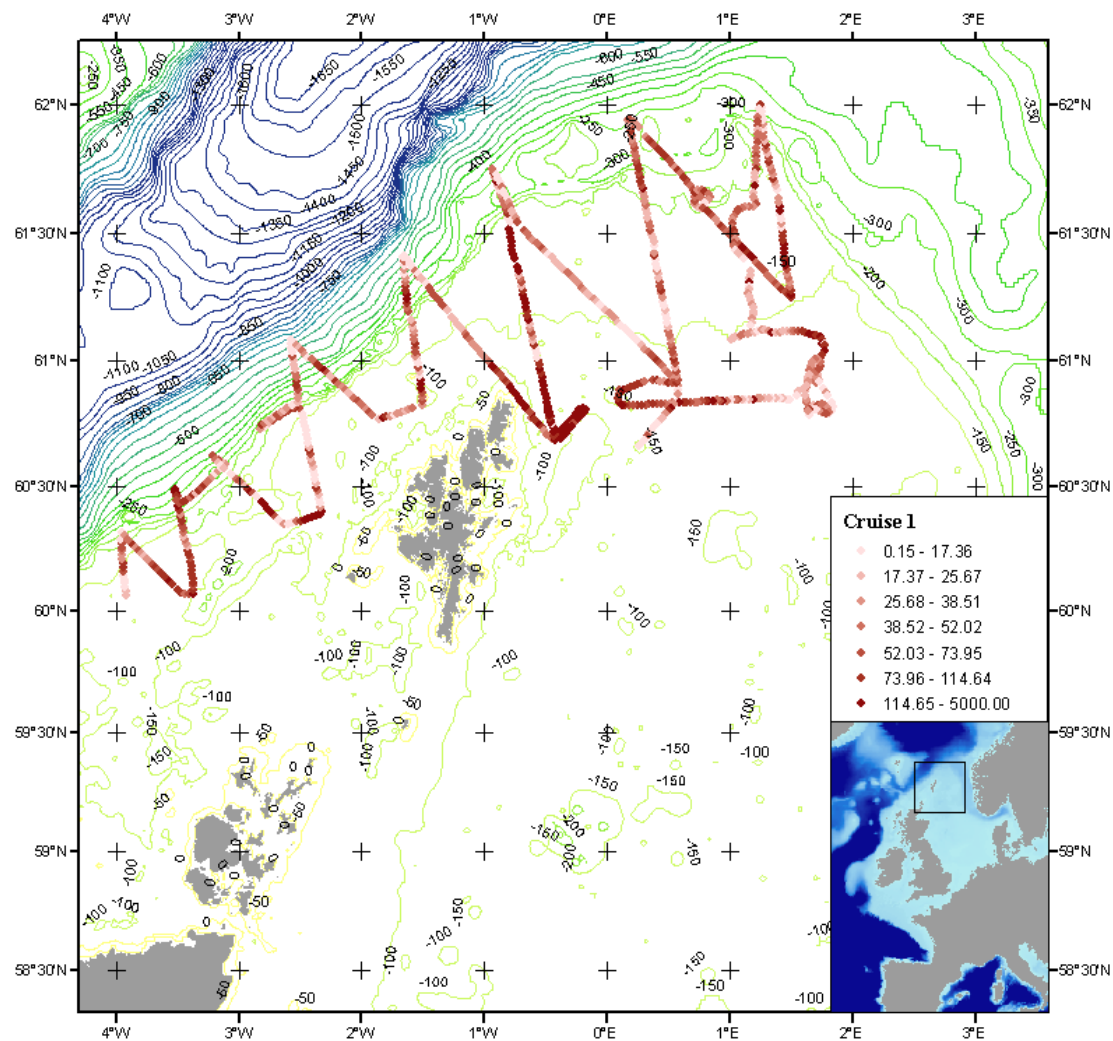


Figure 1. Acoustic survey track of the scientific part of the FSP Saithe survey on the FV Farnella using a SIMRAD ES60 split beam echo sounder at 38 kHz operating frequency. The legend indicates the pooled acoustic energy (NASC) per 1n.mi units.

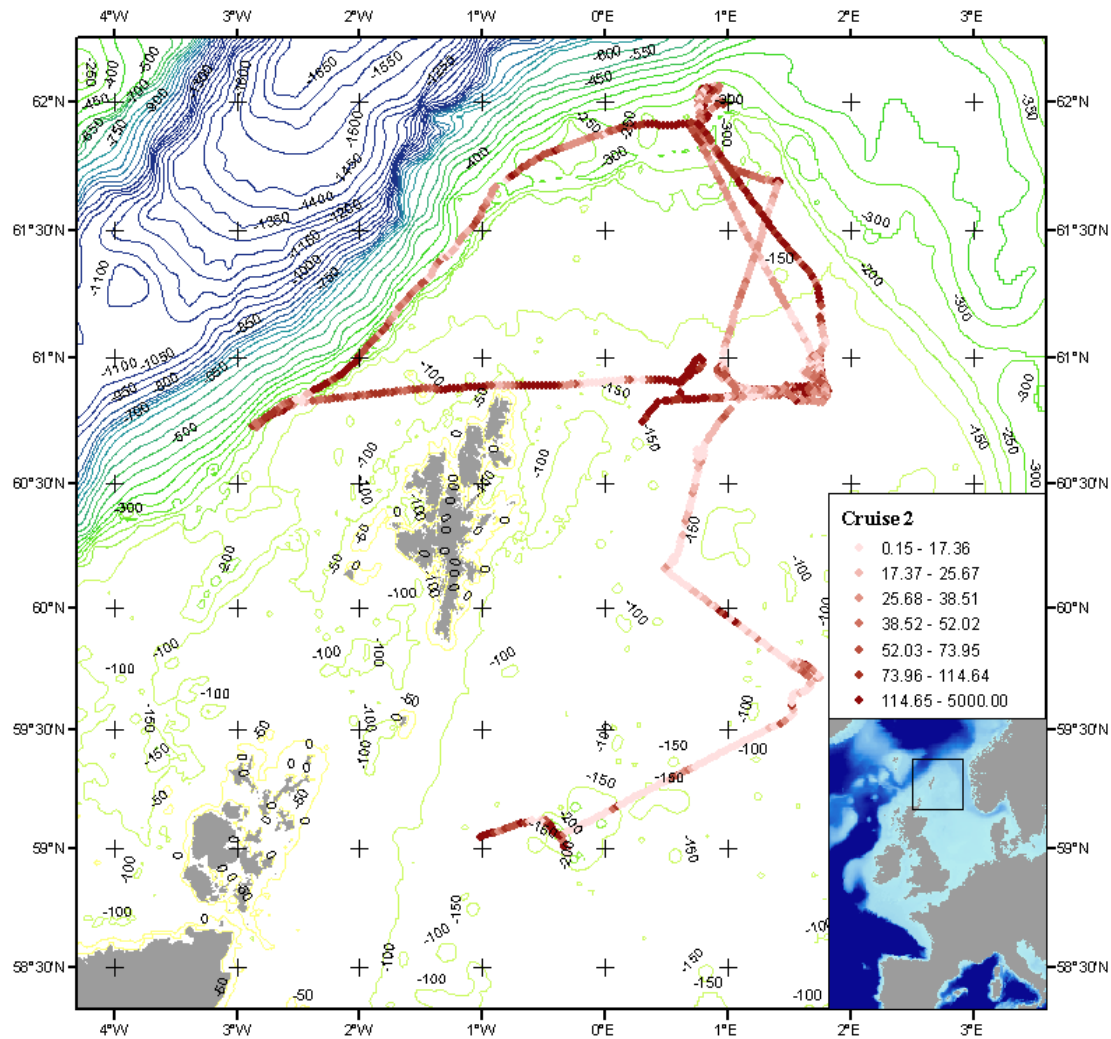


Figure 2. Acoustic survey track of the commercial part of the FSP Saithe survey on the FV Farnella using a SIMRAD ES60 split beam echo sounder at 38 kHz operating frequency. The legend indicates the pooled acoustic energy (NASC) per 1n.mi units.