

**DEPARTMENT FOR ENVIRONMENT, FOOD AND RURAL AFFAIRS
CEFAS, LOWESTOFT LABORATORY, SUFFOLK, ENGLAND**

2002 RESEARCH VESSEL PROGRAMME

REPORT: RV CORYSTES: CRUISE 06/02

STAFF:	JD Metcalfe (SIC)	RP Flatt
	K Turner	S Mackinson
	S Freeman	DA Righton
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	MO Eagle (PT)	C Firmin (PT)

DURATION: 28 May – 12 June

LOCALITY: North Sea

AIMS:

1. To use acoustic and fishing survey methods to estimate the abundance and distribution of sandeels on sandeel fishing grounds on the western Dogger Bank.
2. To use fishing survey methods to estimate the abundance and distribution of predatory fish feeding on sandeels on the sandeel fishing grounds on the western Dogger Bank..
3. To use QTC View to describe seabed sediment type in relation to sandeel distribution and abundance.
4. To carry out a shipboard experiment to determine gut evacuation rates of sandeels.
5. To recover, service and re-deploy the CEFAS data transmitting sonar buoy on the Indefatigable Bank.
6. To catch and tag cod with coded acoustic pingers and release them in the vicinity of the CEFAS data transmitting sonar buoy on the Indefatigable Bank in order to monitor their subsequent residence within the area.

NARRATIVE: (All times are British Summer Time)

CORYSTES sailed at 1040 h on Tuesday 28 May and proceeded to the sandeel fishing grounds on the south western end of the Dogger Bank (North West Riff). A systematic survey for sandeels (Aim1), sandeel predators (Aim 2) and of the sea bed sediment (Aim 3) commenced at 0430 h the following day (29 May) and continued uninterrupted until 0244 h on 7 June. The rest of the day (7 June) was spent fishing for sandeels, but insufficient numbers of live fish were caught in a single haul to carry out a gut evacuation experiment (Aim 4), and at 1630 h CORYSTES departed the sandeel fishing grounds and steamed overnight for Bridlington. Scientific staff were exchanged the following day (8 June). Overnight, CORYSTES returned to the sandeel

fishing grounds and recommenced fishing for sandeels along the 30 m contour on the southern edge of the North West Riff between plankton/dredge stations B3 and E5 at 0620 h the following morning (9 June). Fishing for sandeels continued until 1355h when sufficient numbers of live fish were caught for a trial gut evacuation experiment. CORYSTES continued to survey for sandeels in the area until 1815 h and then steamed to the north-western end of the Indefatigable Bank (the "Hurdy Gurdy" at 53° 36.93'N 02° 11.18'E). CORYSTES arrived on station at 0500 h the following day (10 June) and at 0530 h commenced an acoustic survey of the area (5 x 4 nm, from 53° 34.00'N, 02° 07.92'E to 53° 39.00N, 02° 14.67'E) in order to determine the distribution and abundance of sandeels in the vicinity of the "Hurdy Gurdy". The survey continued until about 1200 h and subsequently CORYSTES anchored on the Hurdy Gurdy. The rest of the day was spent fishing for cod by rod and line.

During the evening of 10 June, while working on the ship's compass, the 3rd engineer spotted a distant light flashing with a pattern identical to that of the sonar buoy that had been deployed on 9 April from COR 02/02. Subsequently, a target was identified on the ship's radar about 2.5 nm to the south east of the ship's position. The following morning (11 June), CORYSTES weighed anchor and went to investigate the source of the signal and discovered the sonar buoy at 53° 35.59'N, 02° 14.48'E. The buoy was recovered at 0942 h and CORYSTES returned to anchor on the Hurdy Gurdy. The rest of the day was spent line fishing for cod, preparing the replacement data transmitting sonar buoy, and tagging cod with coded acoustic pingers. A replacement sonar buoy was subsequently deployed at 1639 h at 53° 37.05'N 02° 11.21'E and brief trials with a coded acoustic pinger deployed over the side of the ship indicated that the sonar buoy was working satisfactorily.

The following morning was spent carrying out range trials with a coded acoustic pinger deployed from the sea-rider. Subsequently, nine cod tagged with coded acoustic pingers, and a control pinger (code 27) deployed on static gear (chain anchor, ~ 2.5 m for rope and a trawl float), were deployed at 1150 h at 53° 37.01'N 02° 11.19'E. CORYSTES then set sail for Lowestoft and docked at 2039 h on 12 June.

RESULTS:

1. *Estimation of the abundance and distribution of sandeels, and sandeel predators, on sandeel fishing grounds on the western Dogger Bank.* This was a repeat of the surveys carried out in May/June in 2000 and 2001. The survey grid is located on the North West Riff, at the south western end of the Dogger Bank (Fig. 1). The grid consists of 9 legs, each 27 nm (49.22 km) long, running north-south from 54° 51'N to 54° 24'N. East-west, the legs ran 6.75' (7.24 km) apart from 01° 00'E to 01° 54'E. Six plankton/dredge stations are located 5.4' (10 km) apart along each leg (see Appendix I). The survey strategy allows acoustic, trawl and dredge surveys to be performed successively along each leg in a single 24 h period, with the complete grid being surveyed over nine days, weather permitting.
 - i. *Acoustic survey* methods were used to estimate the distribution and abundance of sandeels in mid-water in the study area (see Appendix I for a detailed account of the survey strategy). The survey was carried out from 0500 h to about 1200 h each day between 28 May and 7 June using the Simrad EK 500 dual frequency (38 & 120 kHz), split beam echo sounder

with echo integration. Good echo signals were obtained and 538 sandeel schools were identified (Fig 2). By combining the EK500 echo sounder output with the Quester Tangent Corporation (QTC View) seabed classification system, acoustic surveys of the sea bed sediment were carried out simultaneously. During the acoustic survey, plankton samples and CTD casts were made at regular intervals along the survey grid. Plankton hauls were taken with a 0.5 m ring net (60 mpi).

- ii. To estimate the distribution and abundance of sandeel predators, a *trawl survey* was carried out along each leg between about 1200 h and 2000 h using a standard Granton trawl with a 6 mm mesh liner. Twenty minute trawls were carried out at 52 of the 54 plankton/dredge stations (station 4 on leg E, and station 4 on leg D, could not be trawled because of the presence of seabed obstructions). Catches were sorted by species and either counted directly (catches < 200 fish), or numbers were calculated by raising the total weight of the catch by the number in a weighed sub-sample. Stomach contents were examined in 20 (fewer in smaller catches) individuals of each major sandeel predator species (Table 1). The species to be gut-sampled (cod, whiting, haddock, gurnard, plaice etc.) had previously been identified from preliminary sampling undertaken during COR02/02. The 52 trawls yielded a total of 31,632 fish from 26 species of which 71% (by number) were dabs and 10.2% were whiting. Only 63 (0.2% of the total catch by number) cod were caught, and most of these appeared from their length to be 1-group fish. Although cod had the highest incidence of sandeels in their stomachs, (36.7%), whiting (13.5% having sandeels in the stomachs) was the major sandeel predator by virtue of its comparatively higher abundance. The spatial distribution and abundance of these sandeel predators in relation to the distribution and abundance of sandeels as revealed by dredge survey is presented in Fig.3. A more detailed analysis of these data will be carried out subsequently.
 - iii. A *dredge survey* for sandeels buried in the seabed was carried out using a 1.2 m sandeel dredge from 2200 h to about 0330 h each night between 28 May and 7 June. Six 10-minute tows were carried out at each plankton/dredge station, with one transect being surveyed each night (total of 54 stations, Fig.1). Sandeel catches ranged from 0 to 820 fish per tow, and 3291 sandeels were taken in total. All fish were counted and, where catches were < 200 fish, measured. Where catches were well in excess of 200 sandeels, a sub-sample of about 200 fish were measured. Otoliths samples for age/length determinations (5 otoliths per 0.5 cm size class) were taken on 7 occasions (total: 376 fish). Sandeel length-frequency data is presented in Fig. 4.
2. *Description of sediment type in relation to sandeel distribution and abundance using QTC View.* The Quester Tangent Corporation (QTC View) system in unsupervised mode was used in conjunction with the EK500 echo sounder (see 4 above) from 0500 h to about 1400 h each day between 28 May and 7 June April. This arrangements allowed the seabed sediment in the study area to be surveyed while simultaneously measuring the distribution and abundance of sandeels in the water column. The data will subsequently be used in a detailed analysis of the relation between the spatial distribution sandeels and sediment characteristics.

3. Fishing for sandeels using a semi-pelagic trawl was carried between about 1000 h and 1500 h on 7 June and again on 9 June between 0620 h and 1355h. On 7 June, insufficient live fish were caught in a single haul to carry out an experiment to determine gut evacuation rates. However, on 9 June several hundred fish were caught at 1355 h at 54° 31.88'N, 01° 18.51'E and a trial experiment was undertaken. Live sandeels were held in a 2 m deck tank containing fresh, filtered, seawater. Sandeels were sampled (10 fish per sample) every hour from 1420 h on 9 June until 1320 h on 10 June. Fish were killed by overdose of anaesthetic and immediately frozen. Sandeel samples were returned to the Laboratory for subsequent analysis of gut contents.
4. *Cod tagging with coded acoustic tags:* Fishing for cod by rod and line took place on 10 & 11 June on the Hurdy Gurdy. Over 90 young cod (26 –49.5 cm) were caught, 9 of which were tagged internally with 76 kHz coded acoustic pingers (Lotek, 55 x 16 mm) and externally with yellow flag tags. The fish were held in a 2 m deck tank overnight following surgery and released the following day in the vicinity where they had been caught.
5. The sonar buoy originally deployed on 9 April from COR 02/02 was successfully recovered. Although no damage was immediately apparent, further inspection revealed that the Orbcomm arial had sustained damage, and this had allowed sea water to infiltrate the transmitter unit causing it to fail. It is not clear how the damage had been sustained, or how the mooring had moved 2.5 nm from its original deployment position.

A replacement CEFAS data transmitting sonar buoy was successfully deployed on the "Hurdy Gurdy" at 1639 h on 11 June at 53° 37.05'N 02° 11.21'E. Trials with coded acoustic pingers deployed from the sea rider indicated that the sonar buoy was working satisfactorily but that tag signals were only detected out to a range of at about 200 m. A control pinger (code 27) was deployed on static gear about 70 m from the sonar buoy. Subsequently, information from the Laboratory in the days after deployment indicated that the sonar buoy continued to transmit daily until 18th June, but only one transmission (on 17th June) contained tag data. This transmission indicated that 5 of the nine tagged fish were detected during the previous day, in addition to the control pinger.

JD Metcalfe
12 June 2002

SEEN IN DRAFT: A Reading, (Master)
B Salter, (Senior Fishing Mate)

INITIALLED:

[Handwritten initials]
w.c. 27/6.

DISTRIBUTION:

Basic list +	DA Righton	C Stewart
MO Eagle	RP Flatt	S Mackinson
K Turner	S Freeman	R Taylor
C Firmin	Clerk, Eastern Sea Fisheries Committee	

FIGURE CAPTIONS:

Figure 1. The sandeel survey grid situated on the North West Riff.

Figure 2. The distribution of sandeel shoals in mid-water by day in the survey area as revealed using the Simrad EK 500 dual frequency, split beam echo sounder. Identification of sandeel shoals was subjective and based on the difference in target strength between 38 and 120 kHz, shoal shape, and shoal position in the water column. Symbol size is proportional to the relative size of the shoals based on the acoustic back-scatter (S_a) values ($\text{NASC m}^2/\text{nm}^2$).

Figure 3. The distribution and abundance of sandeels in the sediment by night in the survey area (as revealed using a 1.2 m sandeel dredge)) and the distribution of A: the five main sandeel predators (whiting, haddock, gurnard, plaice and cod) and B: the distribution of the five main sandeel predators which had sandeels in their stomachs. Symbol size is proportional to the relative density.

Figure 4. Length-frequency distribution of sandeels caught in dredge hauls.

Fig. 1

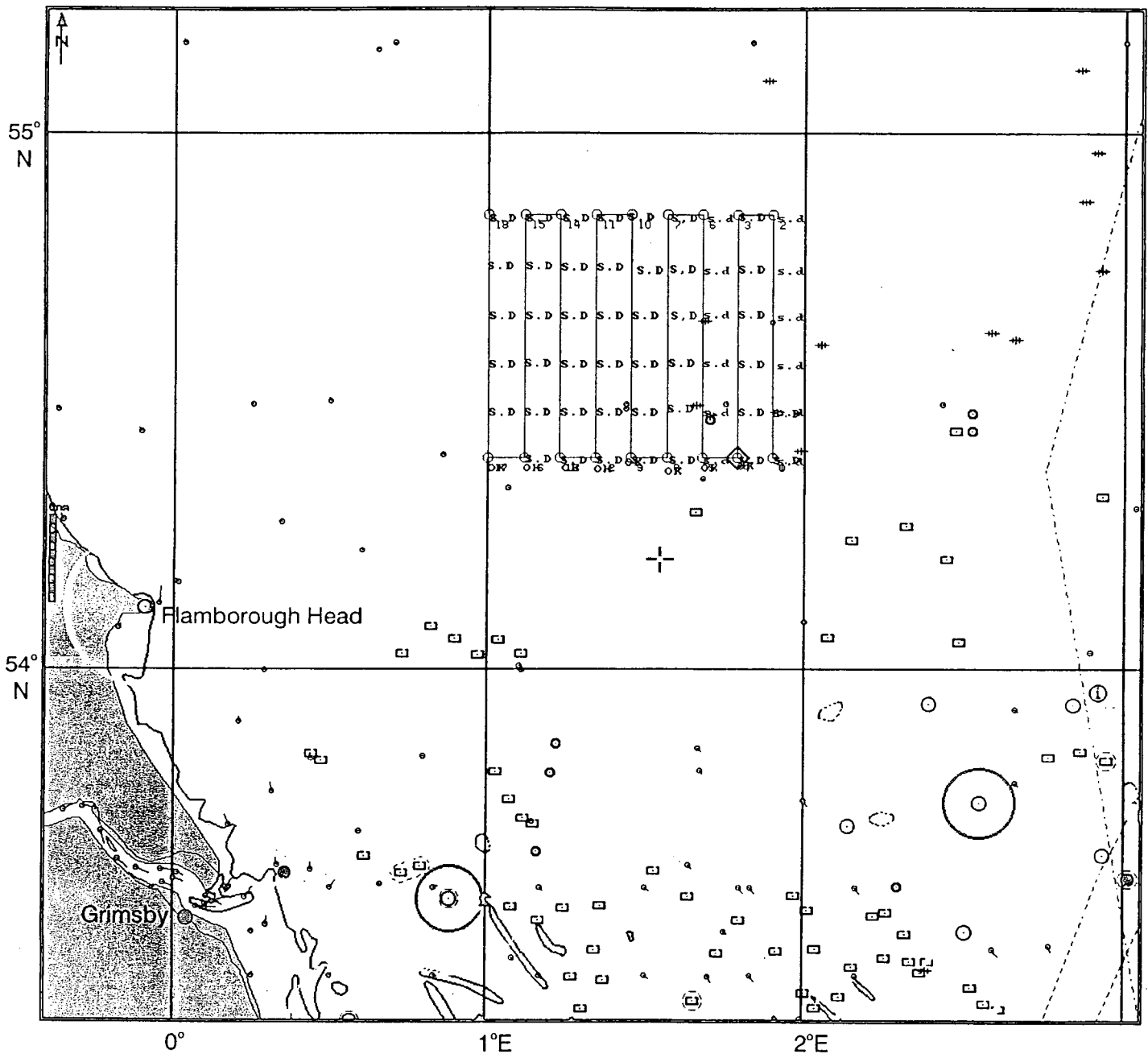


Fig. 2.

Number of schools = 538

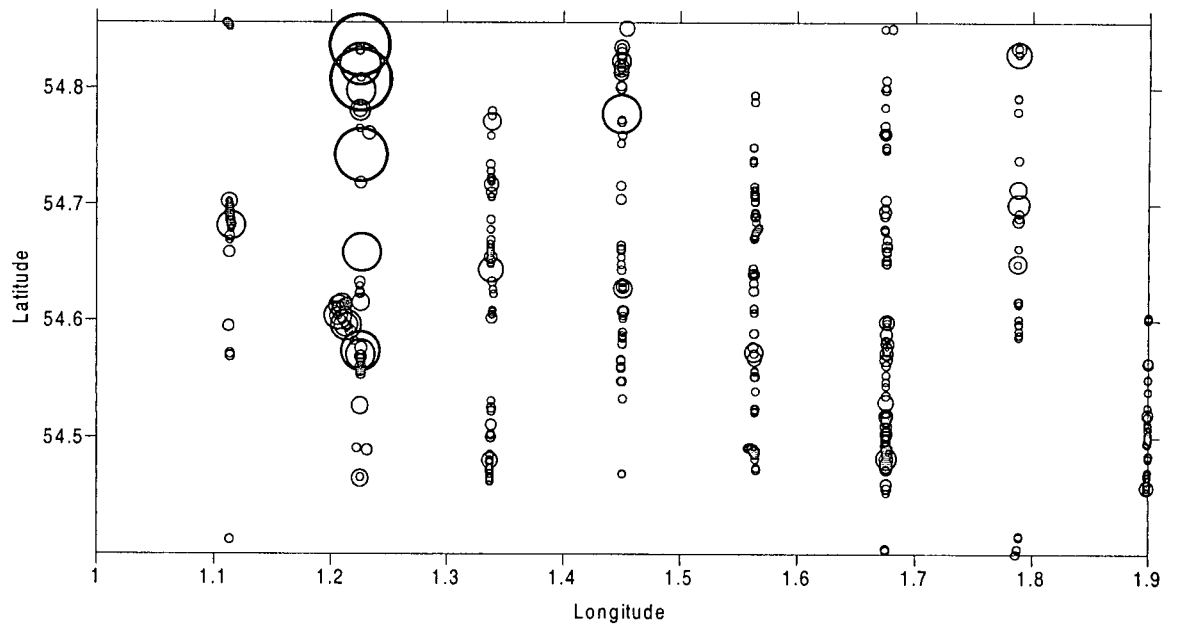
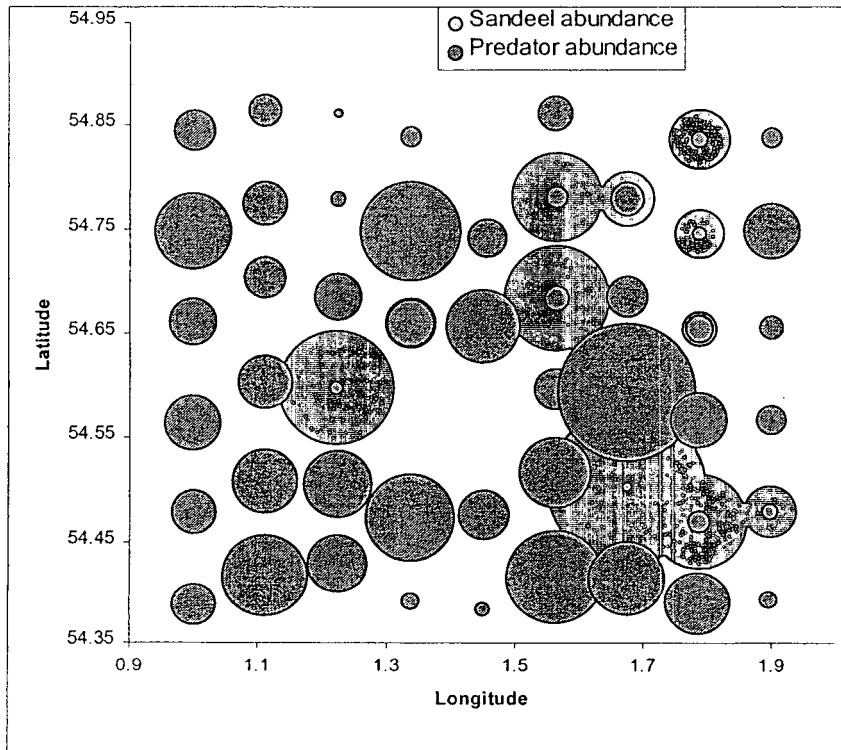


Fig. 3

A.



B.

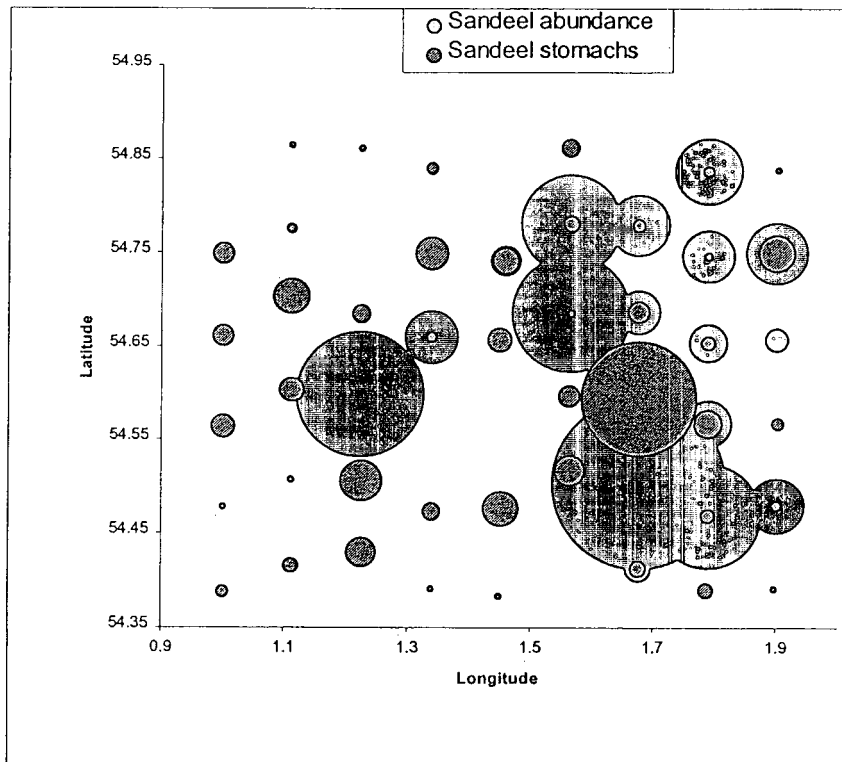


Fig. 4

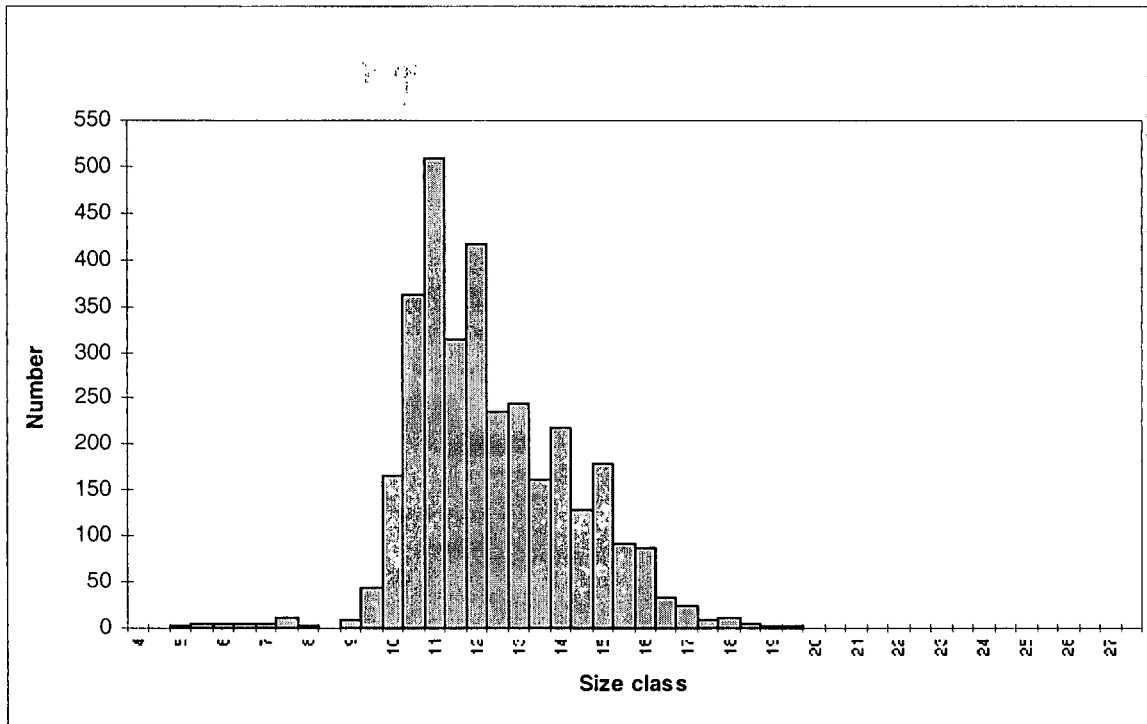


Table 1. Results of Granton trawl survey for sandeel predators on the North West Riff. Numbers of fish caught and stomachs sampled over during fifty-two 20-minute trawls. The species to be gut-sampled had previously been identified from preliminary sampling undertaken during COR02/02.

Species	Number of fish	% of total catch	Number of stomachs sampled	% eating sandeels
Dab (<i>Limanda limanda</i>)	22,428	70.9%		
Whiting (<i>Merlangius merlangus</i>)	3,238	10.2%	733	13.5%
Lesser Weaver (<i>Echiichthys vipera</i>)	2,372	7.5%	5	1.0%
Sprat (<i>Sprattus sprattus</i>)	1,071	3.4%		
Haddock (<i>Melanogrammus aeglefinus</i>)	677	2.1%	338	6.8%
Grey Gurnard (<i>Eutriglia gurnardus</i>)	530	1.7%	412	22.3%
Poor cod (<i>Trisopterus minutus</i>)	211	0.7%	29	0.0%
Herring (<i>Clupea harengus</i>)	184	0.6%	14	0.0%
Solenette (<i>Buglossidium luteum</i>)	162	0.5%		
Plaice (<i>Pleuronectes platessa</i>)	161	0.5%	140	10.7%
Mackerel (<i>Scomber scomber</i>)	125	0.4%	11	0.0%
Smooth Sandeel (<i>Gymnamnodytes semisquamatus</i>)	90	0.3%	5	0.0%
Lemon sole (<i>Microstomus kitt</i>)	82	0.3%	46	0.0%
Cod (<i>Gadus morhua</i>)	63	0.2%	30	36.7%
Sandeel (<i>Ammodytes marinus</i>)	58	0.2%	1	0.0%
Long rough Dab (<i>Hippoglossoides platessoides</i>)	50	0.2%	1	0.0%
Dragonet (<i>Callionymus lyra</i>)	39	0.1%		
Greater Sandeel (<i>Hyperoplus lanceolatus</i>)	37	0.1%	28	60.7%
Scaldfish (<i>Arnogossus laterna</i>)	28	0.1%		
Rays (<i>Raja sp.</i>)	14	0.04%	1	0.0%
Red mullet (<i>Mullus surmuletus</i>)	7	0.02%	6	0.0%
Monkfish (<i>Lophius piscatorius</i>)	2	0.01%		
Topknot (<i>Phrynorhombus sp.</i>)	1	0.00%		
Starry smoothhound (<i>Mustelus asterias</i>)	1	0.00%		
Spurdog (<i>Squalus acanthias</i>)	1	0.00%		
Pogge (<i>Agonus cataphactus</i>)	1	0.00%		
Total	31632		1800	

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RV CORYSTES: CRUISE 6/02

Release of tagged fish (times are BST)

Tagged fish were released at sea on 2 occasions during the cruise.

One cod, which was caught in the Granton trawl on 29 May was tagged internally with a Mk3 electronic data storage tag (DST) and externally with a yellow flag tag. The fish was tagged on 30 May and released on 1 June. Release details are as follows:

Release date and time: 1 June 2002, 1041 h
Release location: 54° 20.24'N 01° 40.00'E

Cod:		
DST	Flag tag N°	Fish length (cm)
3342	EO 10136	48

A further nine cod were tagged internally with Lotek acoustic pingers and externally with a yellow flag tag. The fish were caught on the 10 & 11 June, tagged on 11 June and released on 12 June. Fin samples were taken from each fish and preserved in alcohol for subsequent genetic analysis at the Marine Laboratory, Aberdeen. Release details are as follows:

Release date and time: 12 June 2002, 1150 h
Release location: 53° 37.01'N 02° 11.19'E

Pinger code	Flag tag N°	Fish length (cm)	Fin sample N°
17	EO 10138	43.5	2
56	EO 10139	37	3
51	EO 10140	49.5	1
2	EO 10141	39	4
43	EO 10142	37	5
39	EO 10143	37	6
30	EO 10144	39	7
15	EO 10145	36.5	8
1	EO 10146	36.5	9

JD Metcalfe (SIC)
12 June 2002

Appendix I

SANDEEL SURVEY

The survey area.

The survey grid was located on the North West Riff, at the south western end of the Dogger Bank. The grid consisted of 9 legs, each 27 nm (49.22 km) long, running north-south from 54° 51'N to 54° 24'N. East-west, the legs ran 6.75' (7.24 km) apart from 01° 00'E to 01° 54'E. Each leg was labelled (A to I) from the west, and 6 plankton/dredge stations were located, 5.4' (10 km) apart, along each leg and numbered 1 to 6 from north to south (Fig. 2).

The survey strategy.

Grid legs were surveyed alternately, starting from the west (i.e. in order: A, C, E, G, I then B, D, F, H) with the grid area being covered twice during the survey period. Acoustic surveying for fish shoals was carried out using a split beam, dual frequency (38 & 120 kHz) scientific echosounder (EK500, Simrad) between 0500 h (just after dawn in late May) and about 1200h at speeds of between 5 and 7 kts depending on weather. Plankton hauls were taken with a 0.5 m ring net (200 mpi) at each plankton/dredge station. By combining the EK500 echo sounder output with the Qester Tangent Sea-view (QTC) seabed classification system, acoustic surveys of the sea bed sediment could be carried out at the same time.

Following each acoustic survey, the grid leg was surveyed for potential sandeel predators (particularly cod, whiting, haddock, gurnard etc.) using a standard Granton trawl with a 6 mm mesh liner. Trawl surveys were carried out along each leg between about 1200 h and 2000 h. The trawl was towed at 3.5 kts for 20 minutes through each plankton/dredge station between.

Subsequently, the grid leg was surveyed for sandeels using a 1.2 m scallop dredge specifically modified to catch sandeels buried in the sediment. Dredge surveys were carried out along each leg between 2200 h and about 0400 h the following day. The dredge was towed for approximately 10 minutes at 3-4 kt through each plankton/dredge station. Accurate estimates of the duration of each tow were obtained from a temperature and depth recording data storage tag, programmed to record data every 10 s, attached to the head of the dredge.

Weather permitting, this survey strategy allowed acoustic, trawl and dredge surveys to be performed along each leg in a single 24 h period.

Processing catches from sandeel dredges.

Sandeels were counted as whole fish or heads, heads were subsequently discarded and only whole fish measured or weighed.

- i. *Small catches (< 200 whole fish).* All fish were counted and measured (to the nearest 5 mm below, i.e. 12.3 mm = 12 mm and 12.8 mm = 12.5 mm).
- ii. *Moderate catches (200 - 1000 whole fish).* The catch was counted and a sample of approximately 200 fish measured. Otoliths were taken from 5 fish from each 5 mm size class.

- iii. *Large catches (>1000 whole fish)*. The catch was weighed and a sub-sample (2-3 kg) was weighed and counted. Approximately 200 of these fish were measured and otoliths taken from 5 fish from each 5 mm size class. The sub-sample weight was subsequently used to raise to total weight of the catch to total numbers of fish.

Other species were either counted directly (small catches), or numbers were calculated by raising the total weight of the catch by the number in a weighed sub-sample. A note was also made of the typical benthic fauna associated with the catch in the dredge.

Processing catches from Granton Trawls

Fish were sorted by species and either counted directly (small catches), or numbers were calculated by raising the total weight of the catch by the number in a weighed sub-sample. Stomach contents were examined in 20 (fewer in smaller catches) individuals of each major sandeel predator species (cod, whiting, haddock, gurnard, plaice) and classified as: empty, regurgitated (i.e. empty but flaccid), containing sandeels, or containing non-sandeel food.

Plankton samples were preserved in 4% buffered formalin and stored for later analysis.