

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

2003 RESEARCH VESSEL PROGRAMME

REPORT: RV CORYSTES: CRUISE 06/03

| | | |
|--------|-------------------|----------------------------|
| STAFF: | JD Metcalfe (SIC) | S Hetherington (1-11 June) |
| | C Burt | C Stewart |
| | O Heffernan | J Blanchard |
| | J van der Kooij | S Mackinson |

DURATION: 1 - 16 June

LOCALITY: North Sea

AIMS:

1. To use acoustic & 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 (Bongo net) to estimate the abundance and distribution of plankton on the sandeel fishing grounds on the western Dogger Bank.
3. 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.
4. To carry out a shipboard experiment to determine gut evacuation rates of sandeels.

NARRATIVE: (All times are British Summer Time)

CORYSTES sailed at 2115 h on Sunday 1st June and steamed overnight to the sandeel fishing grounds on the south-western end of the Dogger Bank (North West Riff). A systematic survey for sandeels (Aim 1), plankton (Aim 2) and of sandeel predators (Aim 3) commenced at 0918 h the following day (2nd June) and, apart from two breaks on 4th and 11th June to exchange crew and scientific staff at Bridlington, continued until 0900 h on 12th June. Having completed the survey, the rest of the day (12th June), was spent fishing for sandeels and testing modifications to the semi-pelagic trawl along the northern end of survey line E (see Appendix). Fishing for sandeels, and testing modifications to the semi-pelagic trawl continued the following day (13th June) along the southern side of the South West Patch and North West Riff.

The following two days (14th & 15th June) were spent carrying out an acoustic search for sandeels, firstly along the eastern edge of the Dogger Bank, then to the west and south of the Dogger bank. Fishing with the semi-pelagic trawl to identify the composition of acoustic targets was carried out on 3 occasions, on the last of which however, the trawl sustained substantial damage to the belly and one wing.

CORYSTES subsequently steamed to the north-western end of the Indefatigable Bank to an area known as the "Hurdy Gurdy" (53° 36.93'N, 02° 11.18'E), arriving on station at 2325 h on the 15th June. The following day was spent rod and line fishing for cod. Twelve small (25-51 cm) cod were caught, 6 of which were large enough to be tagged with data storage tags. These fish were subsequently released at 1510 h

at 53° 36.91'N 02° 11.18'E and CORYSTES then set sail for Lowestoft, docking at 2335 h on the 16th 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 each year in June between 2000, and 2002. The survey grid is located on the North West Riff, at the south western end of the Dogger Bank. 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 along each leg in a single 24 h period, with the complete grid being surveyed over nine days, weather permitting. However, in contrast to the previous surveys, all but the first two lines (A and C) commenced with the trawl survey at about 1100 h and finished with the acoustic survey the following morning.
 - 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 1100 h each day between 2nd and 11th June using the Simrad EK 500 dual frequency (38 & 120 kHz), split beam echo sounder with echo integration. Comparatively few (129) sandeel shoals were identified (Fig 1a) and, based on volume back scattering, the sandeel biomass in the survey area was estimated to be 1,802 t.

During the acoustic survey, plankton samples and CTD casts were made at 6 stations located at regular intervals along each leg. Plankton hauls were taken with a 0.5 m ring net (60 mpi).

During the survey many of the mornings were overcast, while frequently the afternoons were sunny. It was noted that in the afternoons, while the predator survey was in progress, sandeel shoals appeared to be more abundant than they had been during the morning. It is possible therefore that weather, particularly the intensity of ambient daylight, may affect the timing of emergence and abundance of sandeel shoals in the water column.
 - ii. 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 the 2nd and 12th June. The dredge was towed for 10 minutes each plankton/dredge station, with one transect (i.e. 6 stations) being surveyed each night. Sandeel catches ranged from 0 to 3125 fish per tow, and 9019 sandeels were taken in total over the 54 stations surveyed (Fig 1b). All fish were counted and samples measured. The length-frequency data are presented in Fig. 2a together with the length-frequency data for sandeels caught in dredges during the April cruise (Fig. 2b). Otoliths samples for age/length determinations (5 otoliths per 0.5 cm size class) were taken on 5 occasion (total: 238 fish).
 - iii. To estimate the distribution and relative abundance of sandeel predators, a **trawl survey** was carried out along each leg between about 1100 h and 1800 h between the 2nd and 12th June using a standard Granton trawl with a 12 mm mesh liner. Twenty minute trawls were carried out at the 54 plankton/dredge stations. 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 (cod, whiting, haddock & gurnard, Table 1) with 1,414 stomachs being sampled in total. The 54 trawls yielded a total of 31,041 fish from 25 species of which 72% (by number) were dabs and 4.3% were whiting, only 23 (0.07% of the total catch by number) cod were caught. The spatial distribution and abundance of these 4 sandeel predator species is presented in Fig. 3a, while the spatial distribution and abundance of these 4 sandeel predator species that had sandeels in their stomachs is presented in Fig. 3b. As an additional aim, tissue samples from several hundred sandeel predators (cod, whiting, haddock & gurnard) were taken for subsequent stable isotope analysis.

2. *Fishing for sandeels* using a semi-pelagic trawl was attempted during the day on 7 occasions, between 12th and 13th June. Fishing was carried out along banks in, or close to, the survey area that are established commercial sandeel fishing locations. However, an insufficient number of live sandeels were caught and shipboard experiments to determine gut evacuation rates of sandeels (Aim 4) could therefore not be carried out.
3. *Additional acoustic surveying for sandeels* was carried out during daylight hours on the 14th & 15th June. The 14th June was spent surveying along the eastern edge of the Dogger Bank from 54° 24.0'N, 02° 25.97'E to 55° 20.66'N, 03° 59.69'E. The 15th June was spent surveying to the west and south of the Dogger bank, from 54° 20.0'N, 00° 51.0'E via 54° 10.0'N, 00° 43.0'E; 53° 51.4'N, 00° 48.6'E; 53° 39.2'N, 00° 54.2'E; 53° 35.6'N, 01° 10.0'E; 53° 42.6'N, 01° 40.0'E to 53° 35.8'N, 01° 55.4'E.

During the survey some small sandeel shoals (confirmed by fishing with the semi-pelagic trawl) were located on the bank north of the Pickerill gas field along a line from 53° 39.2'N, 00° 54.2'E to 53° 35.6'N, 01° 10.0'E.

JD Metcalfe
16 June 2003

SEEN IN DRAFT: M Jones, (Master)
B Salter, (Senior Fishing Mate)

INITIALLED: ECEP

DISTRIBUTION:

| | | | |
|--------------|-------------|--|-----------------|
| Basic list + | O Heffernan | S Mackinson | J van der Kooij |
| | C Burt | S Hetherington | J Blanchard |
| | C Stewart | Clerk, Eastern Sea Fisheries Committee | |

Figures

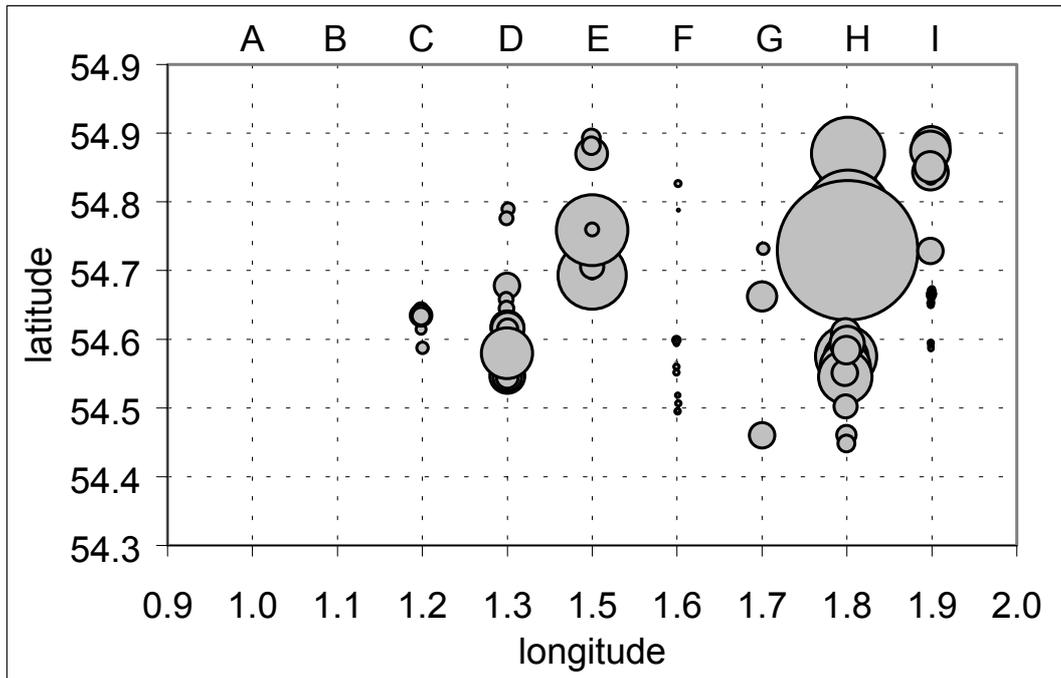


Figure 1a. The distribution and relative size of sandeel shoals in mid-water by day in the survey area as revealed using the Simrad EK500 dual frequency, split beam echo sounder. Identification of sandeel shoals was subjective and based on the difference in target strength between 38 and 120 kHz, shoal shape and shoal position in the water column. Symbol size is proportional to the relative size of the shoals based on acoustic backscatter (S_A) values (NASC m^2/nm^2). Number of shoals = 129.

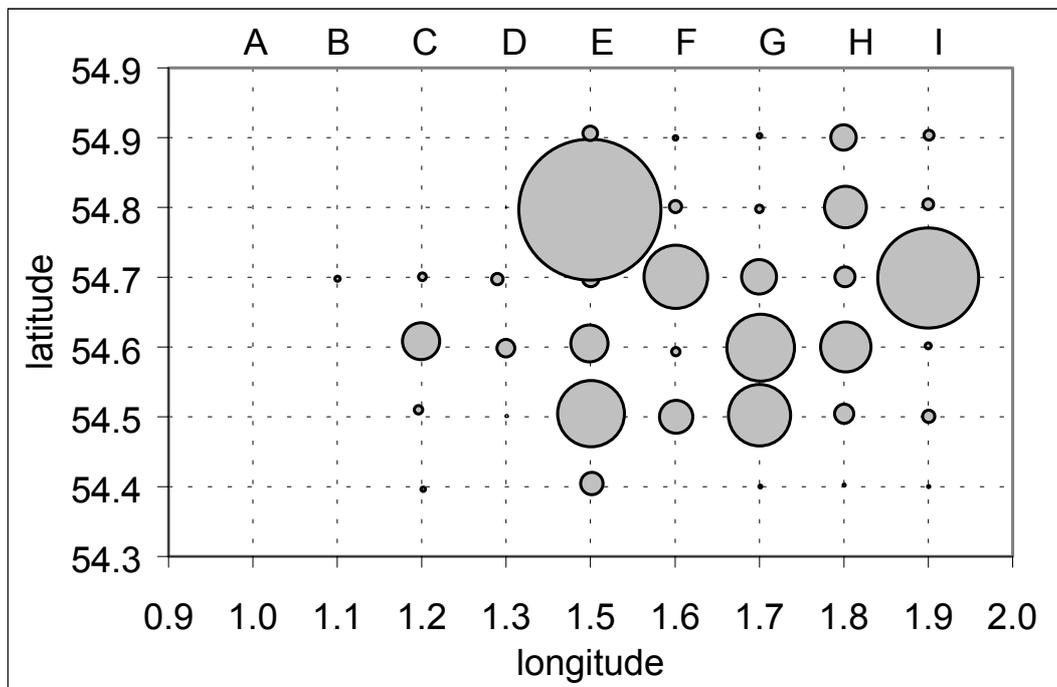


Figure 1b. The distribution and relative abundance of sandeels in the sediment at night in the survey area as revealed using a 1.2 m sandeel dredge. Symbol size is proportional to the relative density.

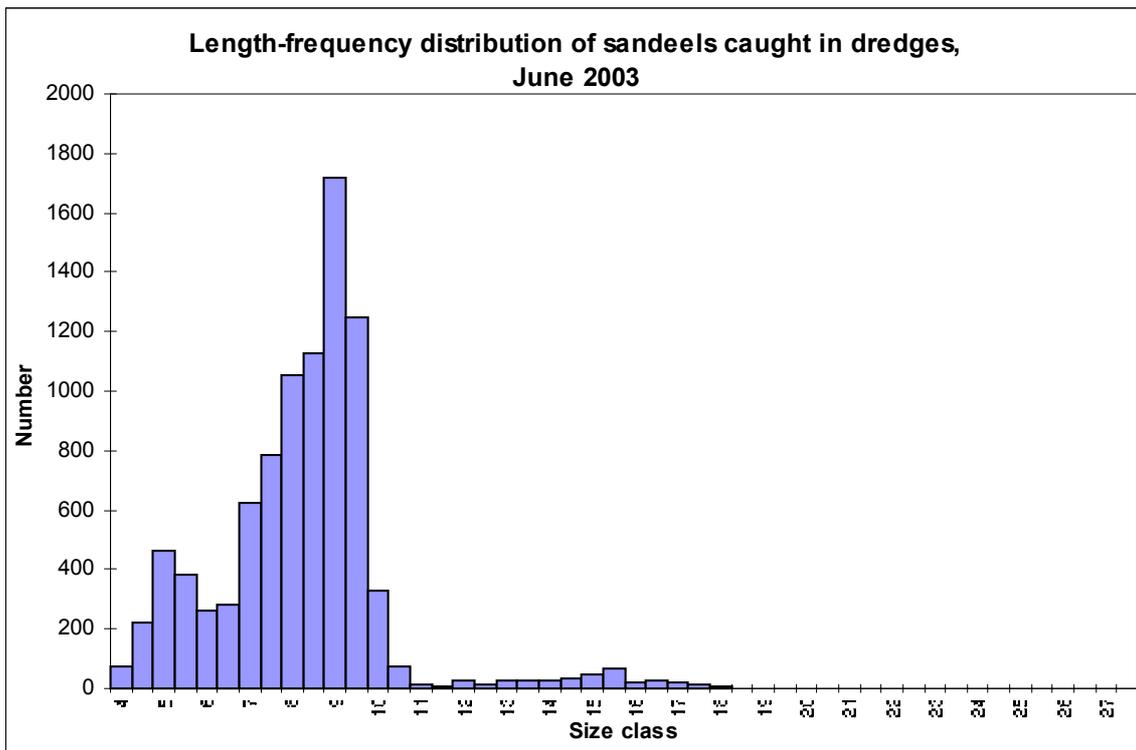
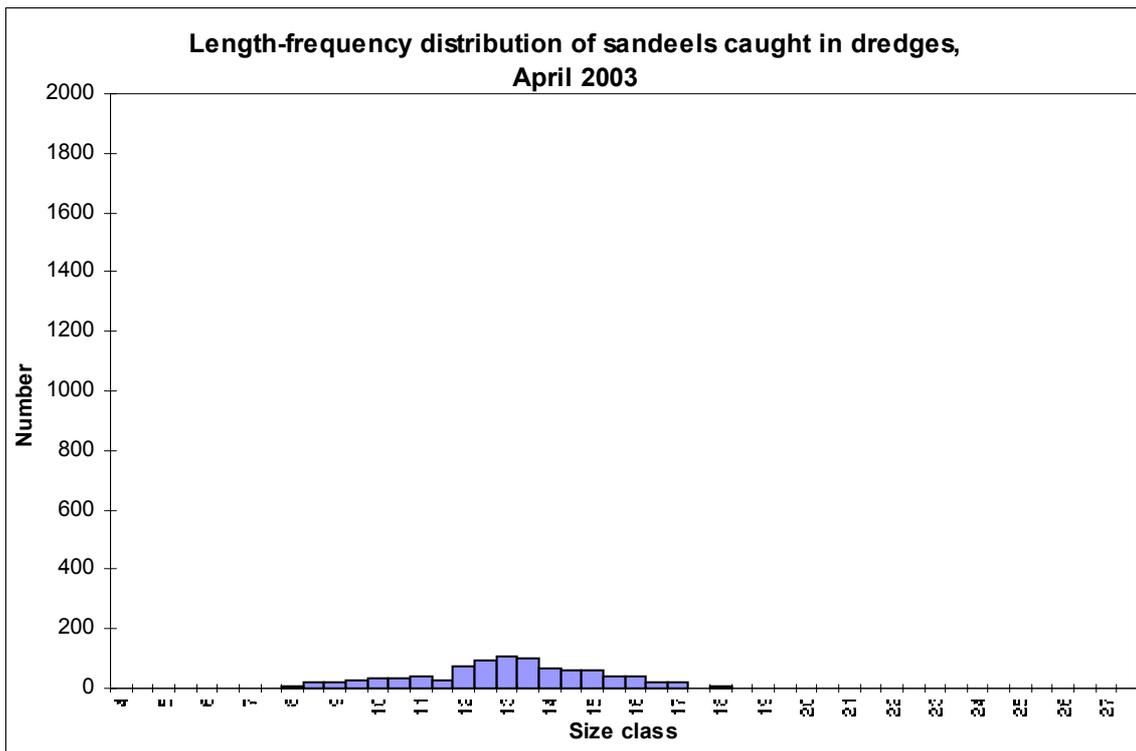


Figure 2. Length-frequency distribution of sandeels caught in dredge hauls in April (upper panel) and June (lower panel) sandeel surveys in 2003.

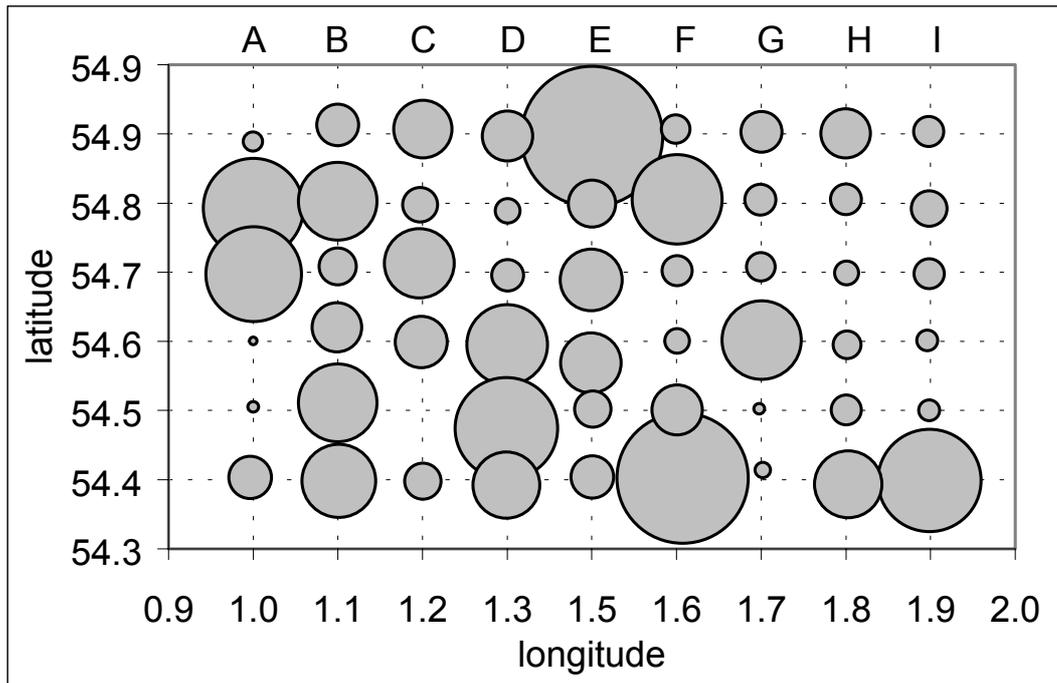


Figure 3a. The pooled distribution and relative abundance of the four main sandeel predators (whiting, haddock, gurnard and cod). Symbol size is proportional to the relative density.

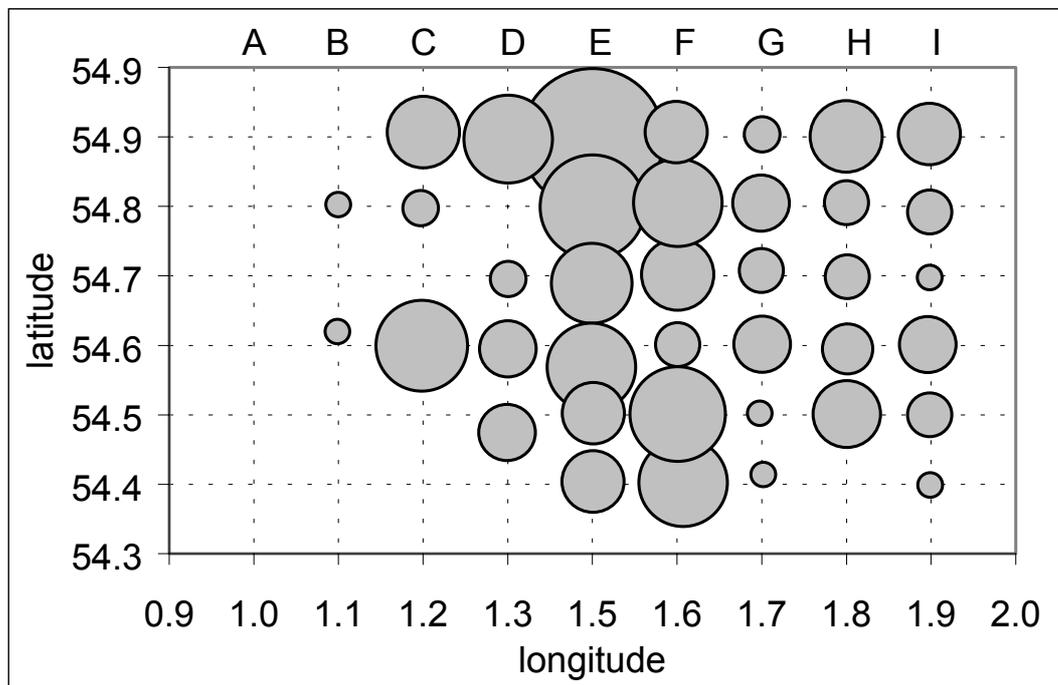


Figure 3b. The pooled distribution and relative abundance of the four main sandeel predators (whiting, haddock, gurnard and cod) that had sandeels in their stomachs. Symbol size is proportional to the relative density.

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-four 20-minute trawls.

| Species | Number | % of total catch | stomachs sampled | % eating sandeels |
|---|---------------|-------------------------|-------------------------|--------------------------|
| Dab (<i>Limanda limanda</i>) | 22,358 | 72.04% | 0 | 0% |
| Lesser Weaver (<i>Echiichthys vipera</i>) | 4,086 | 13.16% | 0 | 0% |
| Whiting (<i>Merlangius merlangus</i>) | 1,336 | 4.30% | 510 | 13% |
| Grey Gurnard (<i>Eutriglia gurnardus</i>) | 882 | 2.84% | 643 | 28% |
| Sprat (<i>Sprattus sprattus</i>) | 793 | 2.55% | 0 | 0% |
| Haddock (<i>Melanogrammus aeglefinus</i>) | 489 | 1.58% | 238 | 1% |
| Solenette (<i>Buglossidium luteum</i>) | 439 | 1.41% | 0 | 0% |
| Plaice (<i>Pleuronectes platessa</i>) | 190 | 0.61% | 0 | 0% |
| Lemon sole (<i>Microstomus kitt</i>) | 100 | 0.32% | 1 | 0% |
| Dragonet (<i>Callionymus lyra</i>) | 93 | 0.30% | 0 | 0% |
| Sandeel (<i>Ammodytes marinus</i>) | 73 | 0.24% | 0 | 0% |
| Smooth Sandeel (<i>G. semisquamatus</i>) | 50 | 0.16% | 0 | 0% |
| Scaldfish (<i>Arnogossus laterna</i>) | 43 | 0.14% | 0 | 0% |
| Poor cod (<i>Trisopterus minutus</i>) | 29 | 0.09% | 0 | 0% |
| Cod (<i>Gadus morhua</i>) | 23 | 0.07% | 21 | 10% |
| Greater Sandeel (<i>Hyperoplus lanceolatus</i>) | 12 | 0.04% | 0 | 0% |
| Herring (<i>Clupea harengus</i>) | 11 | 0.04% | 0 | 0% |
| Long rough Dab (<i>Hippoglossoides platessoides</i>) | 9 | 0.03% | 0 | 0% |
| Rays (<i>Raja sp.</i>) | 9 | 0.03% | 0 | 0% |
| Red mullet (<i>Mullus surmuletus</i>) | 9 | 0.03% | 0 | 0% |
| Bull-rout (<i>Myoxocephalus scorpius</i>) | 3 | 0.01% | 0 | 0% |
| Starry smooth hound | 2 | 0.01% | 0 | 0% |
| Mackerel (<i>Scomber scomber</i>) | 1 | 0.00% | 1 | 0% |
| Spurdog (<i>Squalus acanthias</i>) | 1 | 0.00% | 0 | 0% |
| Lesser spotted dogfish (<i>Scyliorhinus canicula</i>) | 1 | 0.00% | 0 | 0% |
| Total | 31041 | | 1414 | |

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Release of tagged fish (times are BST)

Tagged fish were released at sea on one occasion during the cruise.

Six cod were tagged internally with StarOddi data storage tags and externally with a yellow flag tags. The fish were caught, tagged and released on 16th June. Release details are as follows:

Release date and time: 16th June 2003, 1510 h
Release location: 53° 36.91'N 02° 11.18'E

| DST N° | Flag tag N° | Fish length (cm) |
|---------------|--------------------|-------------------------|
| 235 | EO 10314 | 48 |
| 227 | EO 10315 | 45 |
| 232 | EO 10316 | 48 |
| 233 | EO 10317 | 51 |
| 229 | EO 10318 | 46 |
| 219 | EO 10319 | 38 |

JD Metcalfe (SIC)
16 June 2003

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/trawl stations were located, 5.4' (10 km) apart, along each leg and numbered 1 to 6 from north to south.

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 early to mid June) 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 station.

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 12 mm mesh liner. Trawl surveys were carried out along each leg between about 1200 h and 1900 h. The trawl was towed at 4 kts for 20 minutes through each trawl station.

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 0330 h the following day. The dredge was towed for approximately 10 minutes at 3 to 4 kt through each 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. However, in contrast to the previous surveys, all but the first two lines (A and C) commenced with the trawl survey at about 1100 h and finished with the acoustic survey the following morning.

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 the 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 and gurnard) and classified as: empty, containing sandeels, or containing non-sandeel food.

Small tissue samples from the dorsal muscle were taken from whiting, haddock and gurnard for subsequent analysis for stable isotopes.

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