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

2005 RESEARCH VESSEL PROGRAMME

PROGRAMME: RV CEFAS ENDEAVOUR: CRUISE 07/05

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DURATION: 5th May – 18th May 2005

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 North West Riff (Dogger Bank) & The Hills.

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 North West Riff & The Hills.

3. To search for fish tagged during cruise END 03/05

4. To use fishing survey methods (Bongo net) to estimate the abundance and distribution of plankton on the sandeel fishing grounds on the North West Riff & The Hills.

5. Sampling for potential fecundity in pre-spawning mackerel.

PLAN: (all times are British Summer Time)

Narrative

Endeavour sailed at 09:00 on Friday 6th May 2005 and steamed to The Hills (~54° 25’ N, 1° 00’ E). Surveying for sandeels and their predators

commenced at 10pm the same evening. Surveying took place over established grids on the Hills and the North West Riff. Fisheries acoustics were operated during a morning shift (0500hrs-1100hrs). Trawling for predators took place between 1100hrs and 2000hrs. Dredging for sandeels began shortly after at 2200hrs, and was completed between 0400hrs and 0530hrs. The shift pattern operated continuously throughout the cruise, but was modified slightly on the 11th May in order to return a CTD controller to shore (requested by Liam Fernand). To achieve this aim, Endeavour steamed west from approximately 54° 06' N, 0° 42' E at 1430hrs to Bridlington, arriving 1730hrs, before heading back to the survey grid at 1900hrs to begin dredging for sandeels at approximately 2200hrs. Surveying of the study area was completed on 18th May at 0300hrs, whereupon Endeavour set a course for Lowestoft, arriving at 1700hrs.

Results

1. To use acoustic & fishing survey methods to estimate the abundance and distribution of sandeels on sandeel fishing grounds on the North-West Riff (Dogger Bank) & The Hills.

a) Acoustic methods

Sandeel schools were identified using the Simrad EK60. Classification of acoustic 'marks' into species was based on their vertical position, location with regards to bottom structure, shape and by comparing the 120 kHz and 38 kHz echograms. Due to absence of a swimbladder, sandeels show up stronger on the 120 kHz. This is in contrast to many other locally abundant species like clupeids and gadoids. The distribution and number of sandeels and other fish schools in mid-water in the study area could therefore be estimated relatively easily (Table 1, Figure 1).

Acoustic class	Grid 1	Grid 2
Sandeel	129	25
Clupeids	31	105
Unknown	4	259

Table 1. Number of schools recorded in the water column during daytime

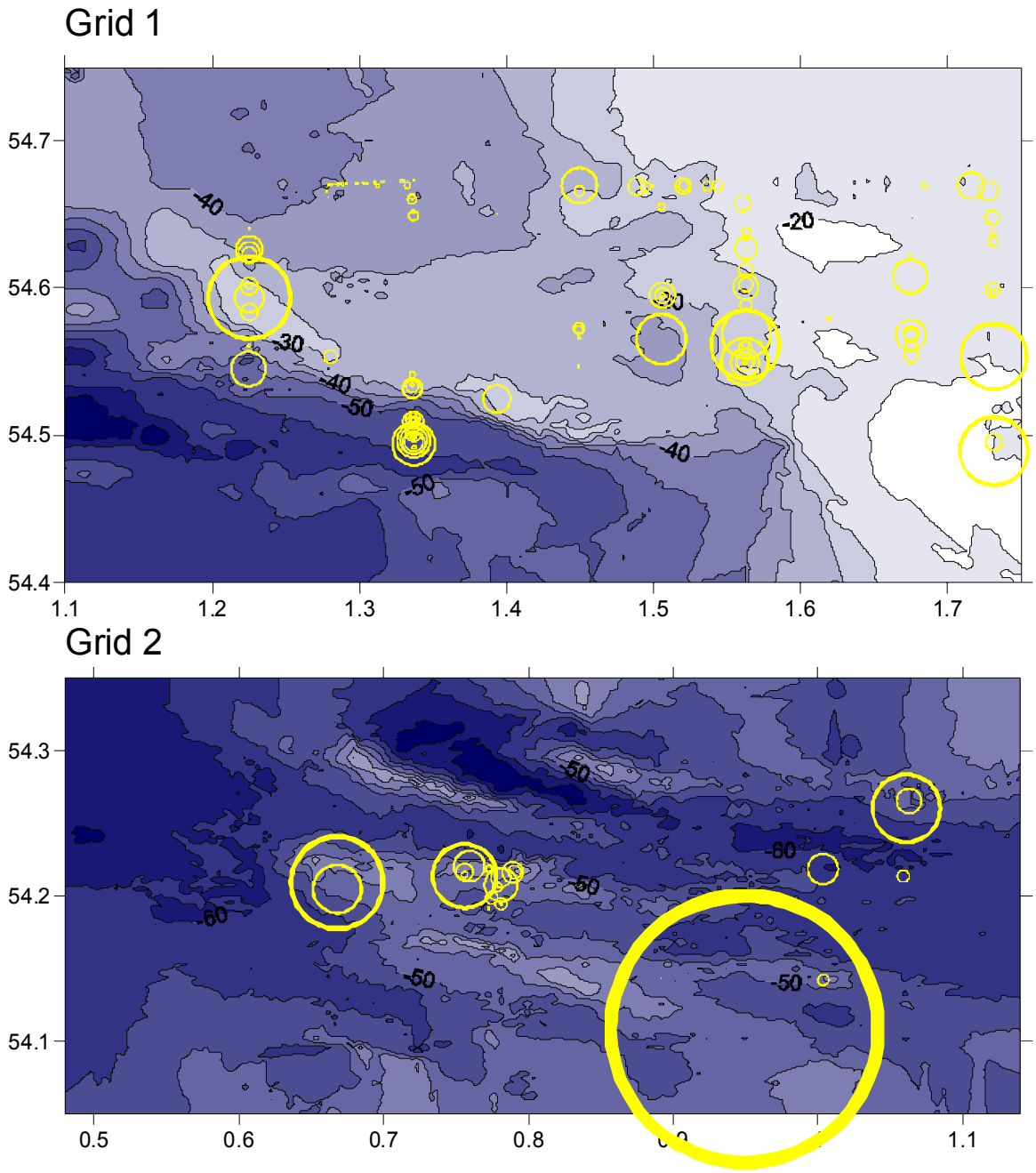


Figure 1. Sandeel schools overlayed on bathymetry. Size proportional to acoustic backscatter.

Five times more sand eels schools were recorded on Grid 1 than Grid 2. Applying standard methods, the biomass of sand eels on each grid was calculated using standard using the sand eel weight and and measured in situ target strength of -70.27 dB at 120kHz (Table 2). Biomass of sand eels on Grid 1 was almost 10 times that of Grid 2.

	Grid 1	Grid 2
Mean length (cm)	11.65	12.36
Mean Weight (g)	5.92	6.94
Biomass (t)	4,239	459

Table 2. Mean lengths, weights and biomass of sandeels. (Length-weight relationship: W=0.00000744L2.7196

In general, the acoustic 'picture' was hampered by poor weather conditions and we suspect that the values calculated above represent a considerable underestimate of sandeel density since many sandeels were likely to have remained buried in the sediment. Nonetheless, the comparison of relative densities between Grid 1 and Grid 2 remains valid.

Detailed data on sandeel schools were collected on an opportunistic basis using the Simrad SH-80 scanning sonar. We were able to record the movements several individual schools of sand eels as they passed close to the vessel (within a 500m radius) on Grid 1 Transect C (Figure 3). Unfortunately, technical problems and poor weather hampered further attempts to track schools. In addition, throughout the duration of the fisheries acoustics and Granton trawling shift, multi-beam acoustic data were collected using the Simrad EM3000 for later analysis of the detailed bathymetry and sediment.

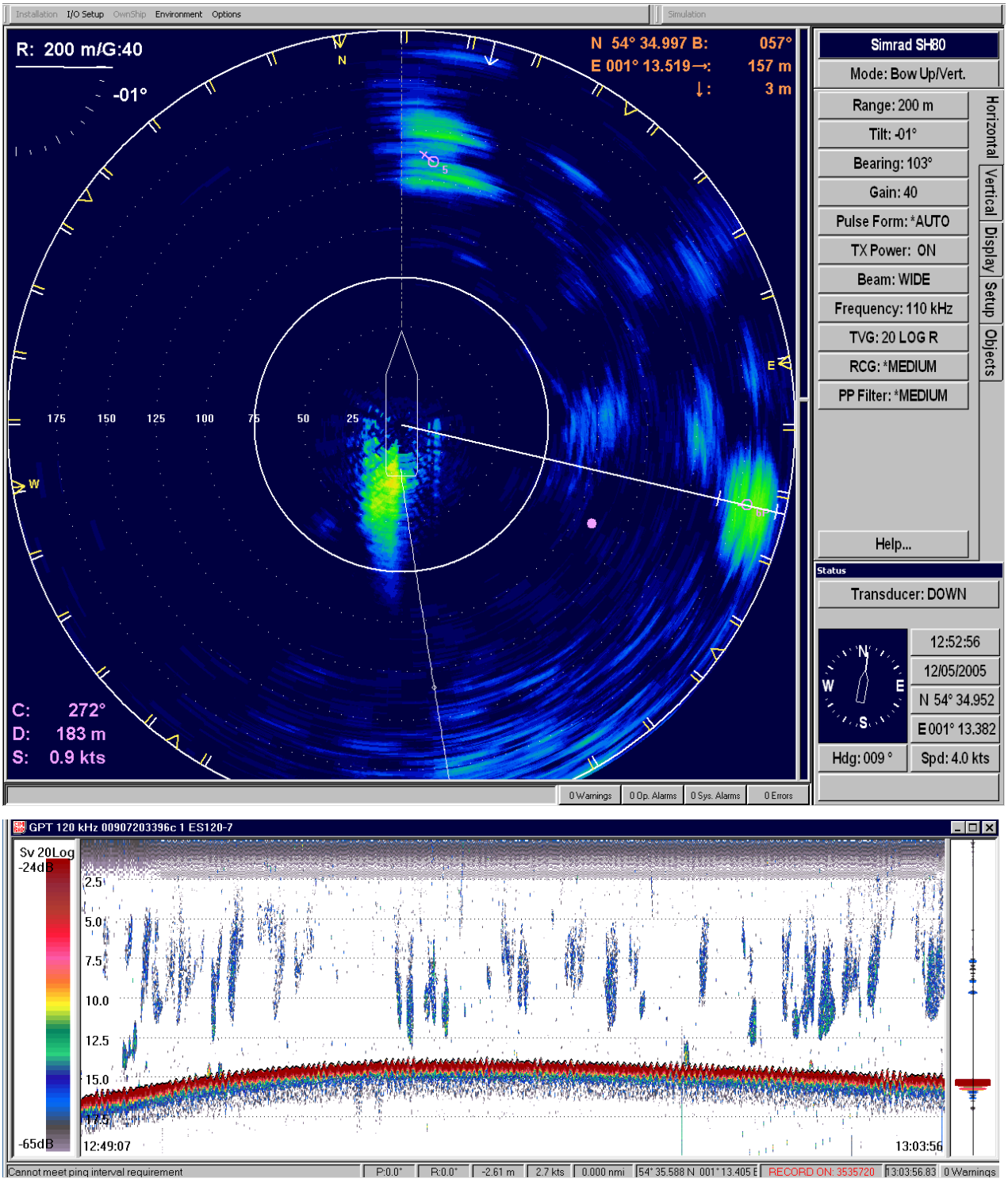


Figure 2. Sandeel schools being tracked using SH80 sonar. Bottom panel shows sand eel schools in the vicinity detected by the EK60 echo-sounder.

b) Dredge methods

Dredging for sandeels took place at 63 stations (three were repeats of stations at which it was suspected that the dredge was not fishing properly because of excessive heave). Sandeels were caught at 59 of the 63 stations, with a maximum catch of 440. Relative catch numbers and distribution is shown in Figure 3. Each night, otoliths were taken from up to five fish of each 0.5 cm length class. In total, 722 otolith samples were taken (approximately 60 pairs per night). The length-frequency of sandeels on the different survey grids is shown in Figure 4.

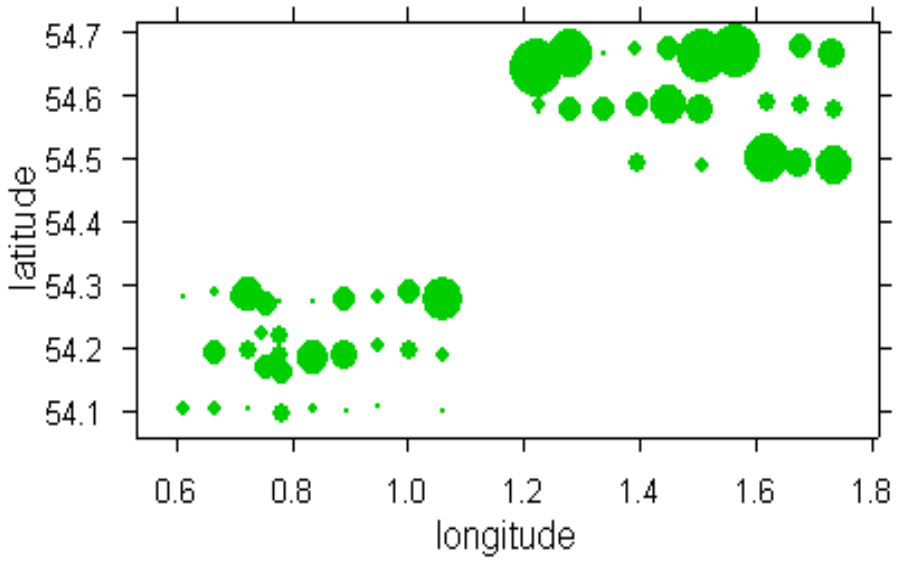


Figure 3. Plot of sandeel distribution (numbers)

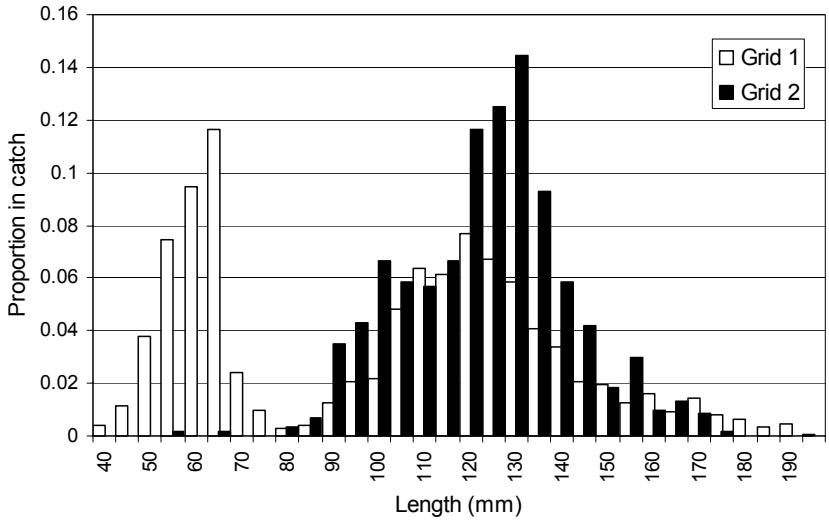


Figure 4 Plot of sandeel length frequencies.

2. To use fishing survey methods to estimate the abundance and distribution of predatory fish on the sandeel fishing grounds on the North West Riff & The Hills.

Trawl surveying for predatory fish was undertaken successfully at 60 stations. Over 40,000 fish were caught, weighing approximately 2.7 metric tonnes. Most abundant by number was dab (Limanda limanda), constituting over a third of the catch. By weight, whiting (Merlangius merlangus) constituted approximately 40% of the catch.

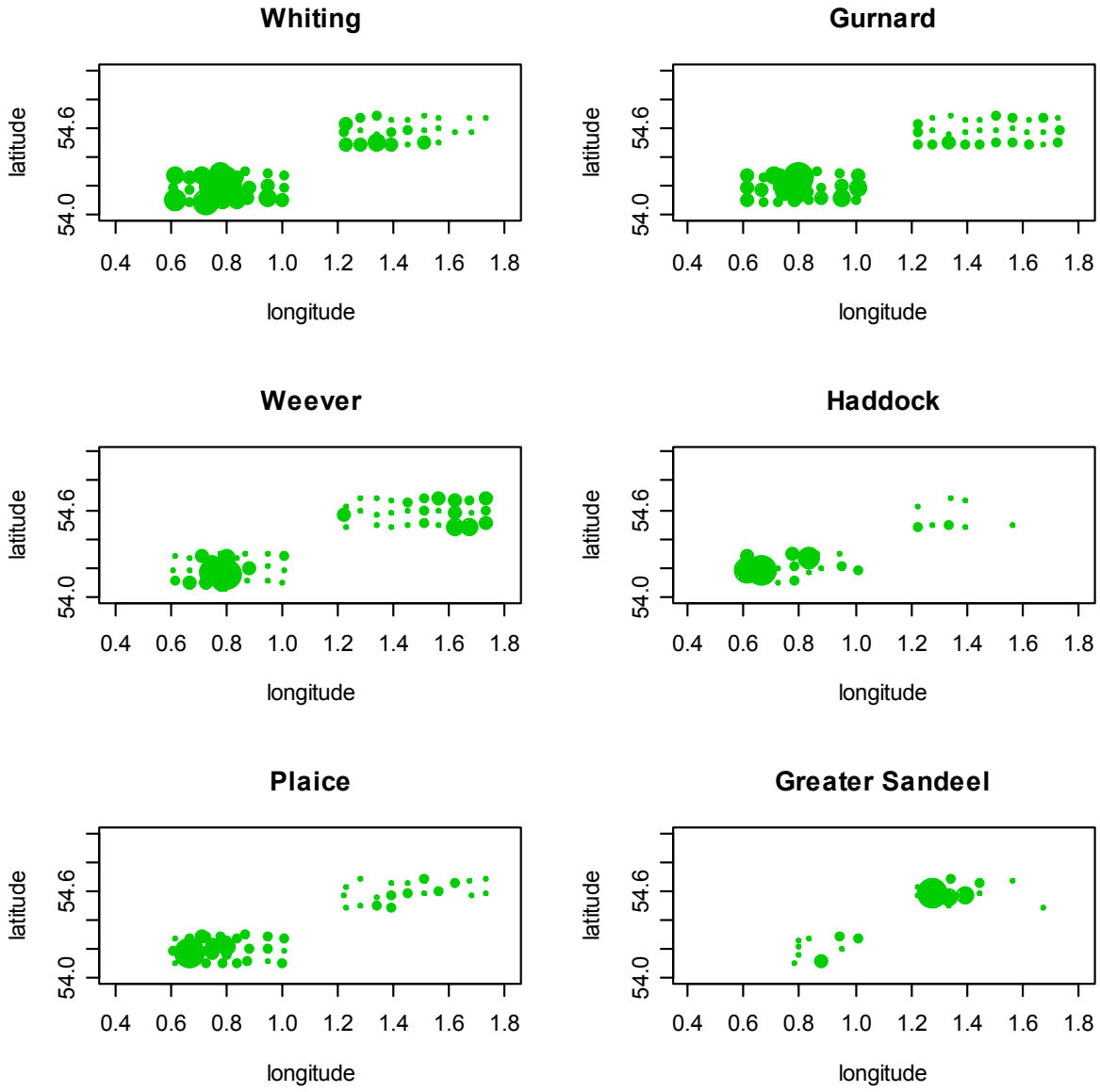


Figure 5. The relative abundance and distribution of the eight most common predatory fish species.

In addition to the stations on the survey grid, two additional trawls were performed along lines 1-C and 1-E. The trawls were 2hr duration, with the aim of testing the hypothesis that longer tow lengths would enable the capture of larger fish. To avoid unnecessarily large catches of small fish, the blinder was removed from the trawl; mesh size was then 100mm. Despite the length of the trawls, few fish were caught, suggesting that large fish are not abundant in the study area.

Analysis of the gut contents of predatory fish revealed that a greater proportion of predation on fish occurred on grid 1 (Figure 6 & 7; Table 3), where the majority of sandeels were found in the water column and in the sediment. Other significant prey items in the diets of the predatory fish sampled were pelagic and benthic crustaceans (gurnards and mackerel), bivalves (plaice) and echinoids (haddock). 389 muscle samples were taken from predatory fish for later isotopic analysis (Table 4)

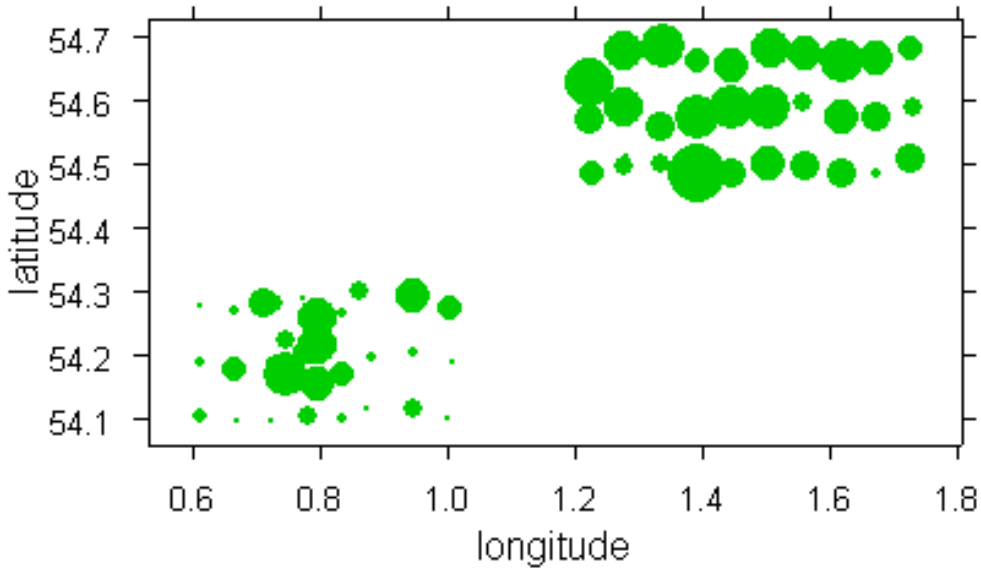


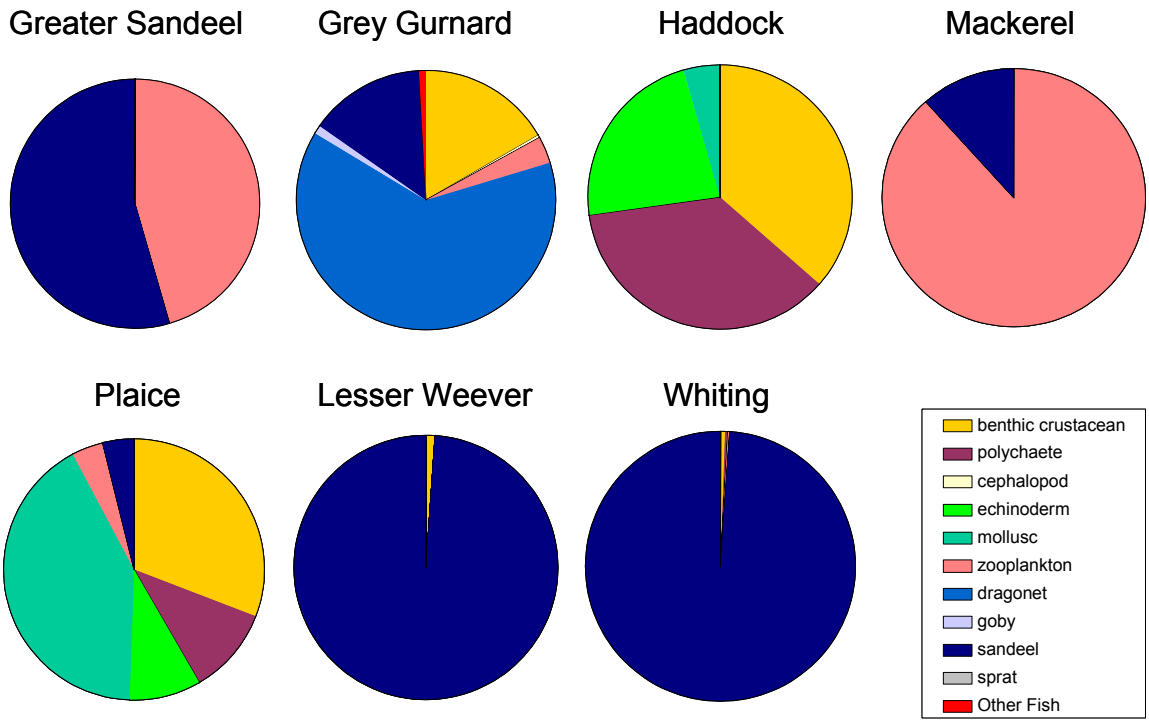
Figure 6. Incidence of predation on sandeels.

Species	Code	Grid 1			
		Number of empty stomachs	% of stomachs empty	Number of stomachs containing sandeel	% stomachs containing sandeel
Greater sandeel	GSE	29	50	19	33
Grey gurnard	GUG	86	24	45	13
Haddock	HAD	5	25	0	0
Mackerel	MAC	13	20	14	22
Plaice	PLE	5	11	1	2
Lesser weever	WEL	121	53	53	23
Whiting	WHG	97	31	101	33
Total		**356**		**233**	

Species	Code	Grid 2			
		Number of empty stomachs	% of stomachs empty	Number of stomachs containing sandeel	% stomachs containing sandeel
Greater sandeel	GSE	8	53	6	40
Grey gurnard	GUG	328	69	22	5
Haddock	HAD	9	10	1	1
Mackerel	MAC	11	15	1	1
Plaice	PLE	34	19	20	11
Lesser weever	WEL	166	69	17	7
Whiting	WHG	274	53	34	7
Total		**837**		**101**	

Table 3. Incidence of predation of sandeels

a. Grid 1 (% identifiable prey)



b. Grid 2 (% identifiable prey)

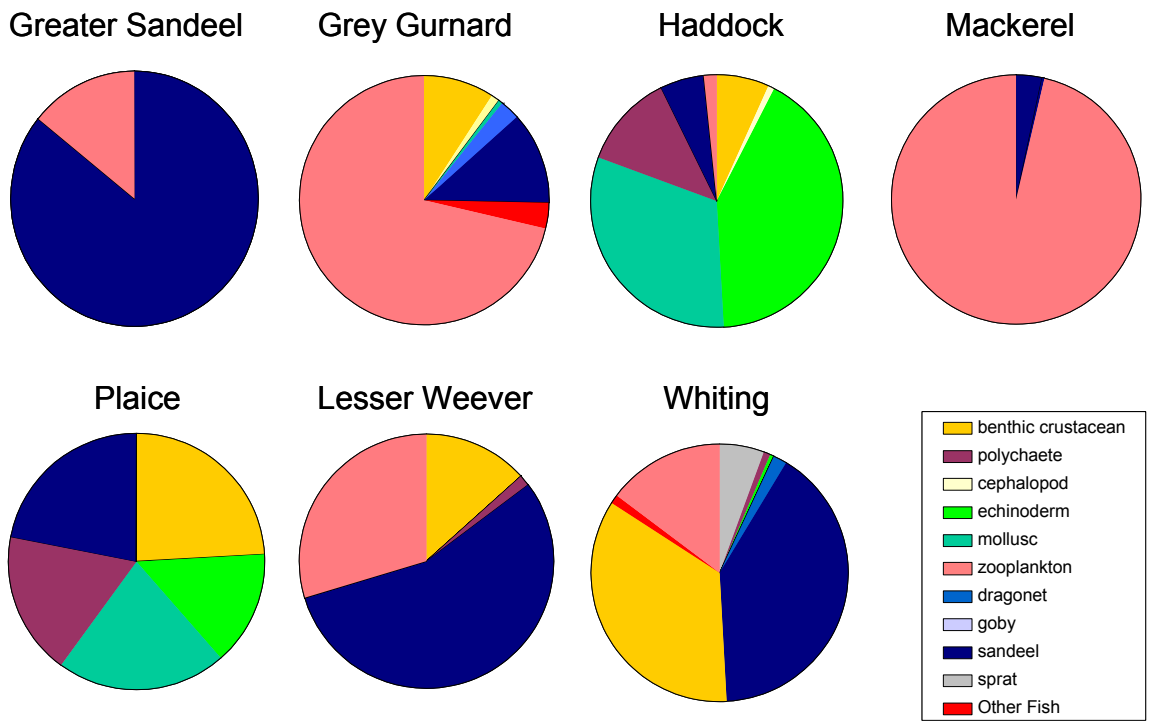


Figure 6. Proportion of prey in the diet of predatory fish in survey grids 1 & 2.

Species	Code	Grid 1		Grid 2		Total Number of stomachs
		Number of stomachs	Muscle samples	Number of stomachs	Muscle samples	
Brill	BLL	0	0	1	1	1
Bullrout	BRT	0	0	6	3	6
Cod	COD	0	0	1	0	1
Flounder	FLE	0	0	2	1	2
Greater Sandeel	GSE	58	20	15	4	73
Grey Gurnard	GUG	354	59	475	41	829
Red Gurnard	GUR	1	1	0	0	1
Haddock	HAD	20	11	91	15	111
Horse Mackerel	HOM	1	0	0	0	1
John Dory	JOD	0	0	1	0	1
Mackerel	MAC	64	20	73	16	137
L-R Dab	PLA	0	0	2	0	2
Plaice	PLE	45	19	181	22	226
Tub Gurnard	TUB	1	1	0	0	1
Lesser Weever	WEL	230	30	240	13	470
Whiting	WHG	309	42	517	58	826
Grand Total		**1083**	**203**	**1605**	**174**	**2688**

Table 4. Total number of stomach examined and muscle samples taken.

3. To search for fish tagged during cruise END 05/05

Despite trawling an area of 3,200,000 metres during the cruise in the areas where tagged fish were released in April 2005, no tagged fish were caught during the cruise.

4. To use standard methods (Bongo net) to estimate the abundance and distribution of plankton on the sandeel fishing grounds on the North West Riff & The Hills.

Plankton dips were undertaken successfully at 60 stations and samples stored in formaldehyde. In general, samples were thick with phyto- and zooplankton-

to be expected at this time of year (spring bloom). Samples will be worked up at the Lowestoft laboratory to determine plankton mass and composition.

5. Sampling for potential fecundity in pre-spawning mackerel.

Stage 3 mackerel ovaries were sampled on an opportunistic basis, as and when suitable fish were caught. 21 samples were taken towards a target of 50. Protocol was not difficult to follow, although photo-id of maturity stages would have been helpful. The failure to meet the target was surprising given results of trawling in the same location the previous year, when 140kg of mackerel were caught from 18 tows. In contrast, less than 80kg of mackerel were caught in 60 tows during the present cruise.

Distribution list:

Basic list + D. Righton (SIC), S. Mackinson (2IC), C. Stewart, J. Blanchard, G. Daskalov, K. Sullivan, S. Hetherington, C. Mills, J. Pinnegar, K. Lees (Reserve), Eastern Region and Northeastern Region Sea Fisheries District, Sea Fisheries Inspectorate.

The survey area.

The survey took place on the west side of the Dogger Bank, on and around the shoals of the North West Riff. Two survey grids (Figure A), each containing 48 stations, were sampled independently. Grid 2 (54 6.0 N, 0 36.708 E to 54 16.8 N, 1 0.186 E) on the Hills in a relatively unfished area, and Grid 2 (54 29.4 N, 1 13.489 E to 54 40.2, 1 43.884 E) on the south western edge of the Dogger bank, usually heavily fished by Danish sandeel vessels. Survey legs each 10.8 nm (20 km) long, spaced 1.9 nm apart (3.6 km) running north-south, with sampling stations space every 5.4 nm apart were defined for each grid. Grid legs were surveyed alternately (i.e, C, E, G, I), with Grid 2 being completed in full before surveying started on Grid 1.

The survey strategy and fish sampling.

Acoustic surveying for fish shoals was carried out using a split beam, dual frequency (38 & 120 kHz) scientific echosounder (EK60, Simrad) between 0500 h (just after dawn) and 1030h at speeds of between 5 and 7 kts depending on weather. Ten minutes prior each sampling station, observations of seabird numbers and activity was recorded. At each sampling station, CTD casts were taken in combination with plankton hauls made with a 0.5 m ring net (60 mpi) fitted with a flowmeter.

Following each acoustic survey, a trawl was carried out at each station between about 1030 h and 2000 h using a standard Granton trawl. Twenty minute trawls were carried out at each of the day's six stations. Catches were sorted by species, measured and counted. For larger catches, sub-samples were taken and total numbers were calculated by raising the total weight of the catch by the number in a weighed sub-sample.

The feeding habits of the most abundant predatory fish (whiting, haddock, cod, gurnard, weever, mackerel, plaice and greater sandeel)were investigated at each station. Five fish in each 5cm length class were taken from the total

catch and their gut contents identified and weighed. Muscle samples were taken from a sub-sample of the predators for isotopic analysis.

A dredge survey for sandeels was undertaken during hours of darkness (2200 to 0500). The survey was carried out using a 1.2 m sandeel dredge from 2100 h to about 0300 h each night. 10-minute tows were carried out at each dredge station. Sandeels were counted as whole fish or heads, heads were subsequently discarded and only whole fish measured or weighed. 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 and recording

All samples were recorded adhering to defined protocols. Fish lengths and weights were entered directly into a database using the CEFAS Electronic Data Collection system. Other data were entered in to a central database and quality controlled by subsequent independent checking.

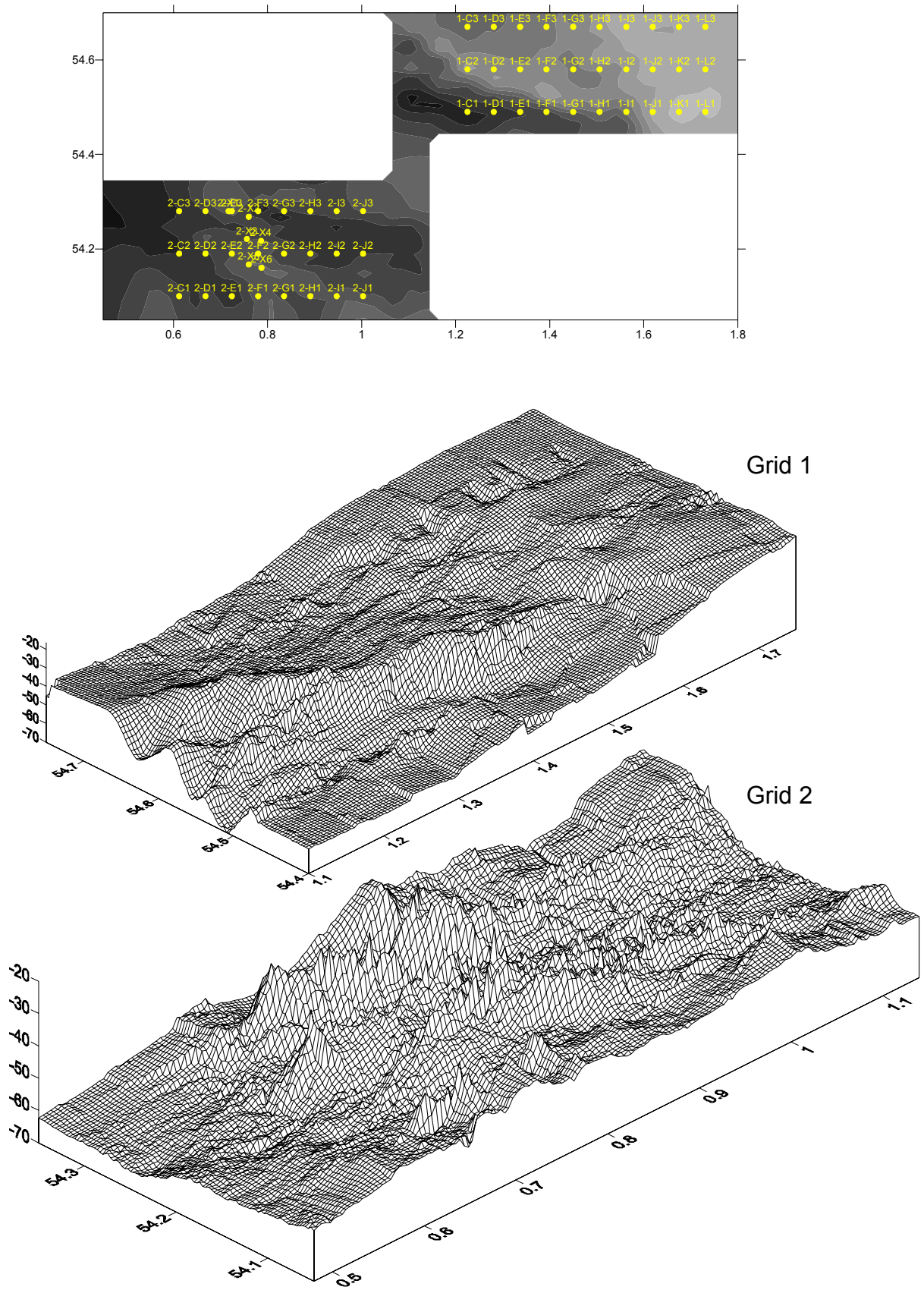


Figure A. The survey area, showing the location of the survey grids and their bathymetry.