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Mapping seabed biotopes at Hastings Shingle Bank, eastern English Channel. Part 1. Assessment using sidescan sonar

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A multi-technique approach was used to map the spatial distribution of seabed biotopes (i.e. physical habitats and their associated benthic assemblages) in the vicinity of Hastings Shingle Bank in the eastern English Channel, part of which is licensed for the extraction of marine aggregates for the construction industry. An area of seabed, approximately 12×4 km in size, was surveyed using a high-resolution sidescan sonar system, and a mosaic of the output was produced, covering 100% of the survey area. The area was then divided into acoustically distinct regions based on the sidescan sonar data, and the benthic communities and sediment types within each of the regions were ground-truthed using a Hamon grab fitted with a video camera, and using a heavy duty 2-m beam trawl. Additional information concerning the seabed was obtained through the application of video and photographic techniques. Sediments within the survey area ranged from cobbles and coarse gravels on the Shingle Bank, to various grades of sands to the north and south. Analysis of faunal data revealed the presence of statistically distinct biological assemblages within each acoustic region. Using all available data, four discrete biotopes were identified and their spatial distribution mapped across the survey area.

INTRODUCTION

There are many sonar devices currently on the market which can be used to map various seabed properties (e.g. sediment type, topography, surface texture). These acoustic systems can generally be divided into the following categories: (a) broad-acoustic beam (swath) systems such as sidescan sonar; (b) single beam acoustic ground discrimination systems (AGDS) such as RoxAnn and QTC-View; (c) multiple beam swath bathymetric systems; and (d) multiple beam (interferometric) sidescan sonar systems (Kenny et al., 2000). Recent improvements in many of these acoustic systems in the 1990s, in particular with swath and multibeam systems as a result of increased digital processing power offered by modern computers, have led to very high resolution and affordable systems entering the market place. This development is reflected in the number of recent investigations which have used acoustic techniques as a means to infer the biological status of the seabed (e.g. Magorrian et al. (1995) and Greenstreet et al. (1997) using RoxAnn systems; Wildish & Fader (1998) and Tuck et al. (1998) using sidescan sonar; Kostylev et al. (2001) using multibeam bathymetry). Although the outcomes of these studies are, in general, encouraging, the approaches have not yet reached the stage of uncritical, routine application. However, these developments are offering the opportunity for researchers to move away from a process of inference around a matrix of spot samples into the realm of spatially continuous mapping using spot sampling for ground-truthing. For this reason the use of acoustic techniques to assist in mapping the geographical distribution of biotopes (e.g. physical habitats and associated biological communities) can be seen to have many potential advantages, including the prospect of 100% coverage of the seabed as resources allow or priorities dictate.

The choice as to which acoustic system should be used depends on a number of factors: (1) which properties of the seabed are to be measured (e.g. bathymetry, surface texture, sediment type); (2) the area of seabed to be covered; (3) whether or not 100% coverage is required from the system; (4) the cost of the system. Whilst many of the acoustic techniques have been proven to effectively map the surface geology of the seabed, the extent to which they can be used for mapping the spatial distribution of biotopes is still unclear.

The work described in this paper formed part of a wider study, funded by the UK Department for Environment, Food and Rural Affairs (Defra), which aimed to evaluate the utility of a number of acoustic systems for mapping seabed biotopes in areas of coarse substrates. In this paper, high-resolution sidescan sonar is used to map seabed biotopes at relatively fine scales at a site in the eastern English Channel adopting an integrated approach similar to that described in Brown et al. (2002), and the results describe the spatial distribution of biotopes within this region.

MATERIALS AND METHODS

Sidescan sonar survey

The survey site crossed Hastings Shingle Bank in the eastern English Channel, covering an area of approximately 12×4 km (Figure 1). A sidescan sonar

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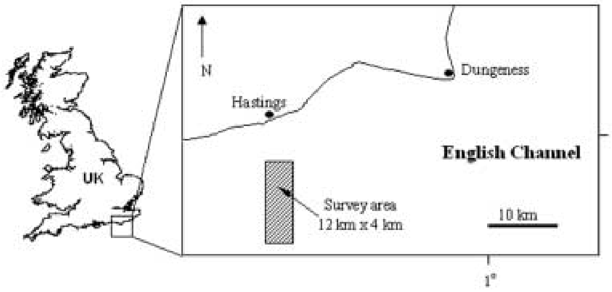

Figure 1. Geographical location of the survey area.

survey of the site was carried out in July 1999 using a Datasonics SIS1500 digital chirps sidescan sonar with a Triton Isis logging system. Delphmap post-processing software was used to mosaic the imagery and classify texturally different regions. The system was operated on a 400 m swath range, and survey lines were spaced at 400 m intervals in a north–south orientation in order to ensonify 100% of the survey area. Vessel position was provided by the Veripos differential global positioning system (DGPS) and towed sensor position calculated by vessel heading, towcable layback and towfish depth, all of which were logged in real time by the Isis system. A drop-camera frame fitted with an under-water video camera and light was deployed at 12 stations across the survey area in order to provide visual ground-truth data to aid interpretation of the sidescan sonar data set.

Seabed features (rippled substrata, rough uneven topography, dredged tracks etc.) and an indication of the sediment type (soft or hard sediments) could be identified from the sidescan sonar backscatter, and the presence of these features/characteristics was confirmed through the underwater video data collected at the ground-truth stations. The survey area was divided into four acoustically distinct regions based on information derived from the sidescan mosaic and the underwater video data. These regions formed the basis for the design of subsequent biological and sedimentological surveys.

Benthic survey

The design of the biological and ground-truthing survey was structured around the four acoustically distinct regions identified from the output of the sidescan sonar survey. The main sampling tool was a 0.1 m^2 Hamon grab fitted with a video camera and light. This was the preferred type of sampling gear due to its ability to collect samples on coarse, unconsolidated sediments. The grab was fitted with a video camera in order to record an image of the seabed adjacent to the collection bucket of the grab, thus providing information about the undisturbed surface of the substrate at each sampling station. Sampling stations were randomly positioned within each of the four acoustic regions, and the number of stations within each region was linked to the size of the area (Figure 2).

A total of 16 Hamon grab samples was collected from across the study area in October 1999. Following estimation of the total volume of each grab sample, a 500 ml sub-sample was removed for laboratory particle size analysis. The remaining sample was washed over 5 mm and 1 mm square mesh sieves to remove excess sediment.

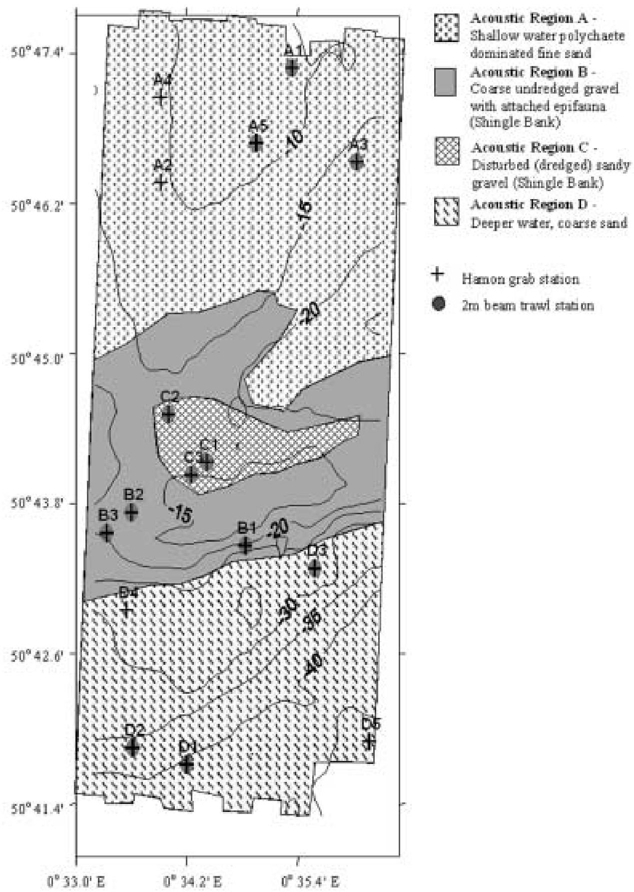

Figure 2. Plot of the survey area showing the four acoustically distinct regions (A, B, C and D) determined from the sidescan sonar data, and locations of the sampling stations.

The retained macrofauna were fixed in 4–6% formaldehyde solution (diluted with seawater) for laboratory identification and enumeration.

A 2 m beam trawl survey was also conducted in order to characterize the epifauna (July/August 2000). A modified 2 m beam trawl, with a heavy-duty steel beam, chain mat and a 4 mm knotless mesh liner fitted inside the net was deployed at selected sampling stations within each of the acoustically distinct regions. The beam trawl was deployed from the stern ramp of the research vessel using a warp length of three times the water depth. Each tow covered a fixed distance of 120 m across the seabed, which was determined using Sextant software linked to the ship's DGPS. The speed of the ship and the deployment time were also recorded. On retrieval of the trawl each sample was washed over a 5-mm square mesh sieve and macrofaunal species were identified and enumerated at sea. Colonial species were recorded as either present or absent. Any specimens that could not be identified at sea were fixed in formaldehyde solution and returned to the laboratory for identification.

A drop-camera frame fitted with a video camera and lights was deployed at a number of stations to obtain additional, visual, qualitative ground-truth data from each of the acoustic regions. The camera system was suspended above the surface of the seabed (no greater than 2 m from the seabed) as the vessel was allowed to drift. Deployments were made around slack water when current speeds were at their lowest in order to achieve good quality video footage.

In the laboratory, Hamon grab samples were first washed with freshwater over a 1-mm square mesh sieve in a fume cupboard to remove the excess formaldehyde solution. Samples were then sorted and the specimens placed in jars or Petri dishes containing a preservative mixture of 70% methanol, 10% glycerol and 20% tap-water. Specimens were identified to species level, as far as possible, using standard taxonomic keys. The number of individuals of each species was recorded, and colonial species were recorded as present or absent. For each positive identification a representative specimen was retained in order to establish a reference collection.

The sediment sub-samples from each grab station were analysed for their particle size distributions. Samples were first wet sieved on a 500 micron stainless steel test sieve, using a sieve shaker. The sediment fraction less than 500 microns, along with water from the wet sieving, was allowed to settle in a bucket for 48 hours. Excess water was then removed using a vacuum pump and the fraction was washed into a sterile Petri dish, frozen for 12 h and freeze dried. The weight of the sediment was also recorded. A sub-sample of the <500 micron freeze dried fraction was then analysed on a laser sizer. The >500 micron fraction was washed from the test sieve into a foil tray and oven dried at $\sim 90°C$ for 24 hours. It was then dry sieved for 10 min on a range of stainless steel test sieves at half phi intervals, down to 1 phi. The sediment on each sieve was weighed to 0.01 g and the results recorded. The results from these analyses were combined to give the full particle size distribution. The mean and sorting values were then calculated.

Data processing

Total number of individuals (excluding colonial species) and total number of species were calculated from both the Hamon grab and beam trawl surveys as summary measures of benthic assemblages within each acoustic region. Associations between benthic assemblages and acoustic regions were examined using multivariate statistical methods. Analysis was conducted on the entire dataset excluding colonial taxa. Sample and species associations across the survey area were assessed by non-metric multi-dimensional scaling (MDS) ordination using the Bray–Curtis similarity measure on 4th root transformed data using the software package PRIMER (Clarke & Warwick, 1994). Rare species (i.e. with fewer than three individuals recorded throughout the survey area) were removed from the analysis in order to reduce the variability caused by these infrequently occurring species. Removing these species was also necessary to conform to certain limitations in the total number of species which can be used during certain tests within the PRIMER software (e.g. SIMPER—see below). The majority of species collected during the beam trawl surveys were epifaunal species. Statistical analysis was therefore conducted on all taxa excluding colonial organisms using identical statistical methods as above on 4th root transformed data.

Analysis of similarities (ANOSIM, Clarke, 1993) was performed to test the significance of differences in macrofauna assemblage composition between samples. The nature of the groupings identified in the MDS ordinations were explored further by applying the similarity percentages program (SIMPER) to determine the contribution of individual species to the average dissimilarity between samples.

A correlation-based principal components analysis (PCA) was applied to ordinate results from the sediment particle size analysis. Prior to analysis, environmental variables were converted to approximate normality using a log $(1+N)$ transformation. Analysis of similarities (ANOSIM, Clarke, 1993) was performed on particle size data to test the significance of differences in particle size composition between acoustic regions.

RESULTS

Acoustic data interpretation

This survey site crossed Hastings Shingle Bank, parts of which have been licensed for some years for the commercial extraction of marine aggregates for the construction industry. The survey therefore had the additional benefit of allowing an evaluation of the success of the techniques in identifying any consequences of man-made perturbations at the seabed. The structure of the bank was clearly discernible from the sidescan mosaic. Examination of these data revealed the presence of four acoustically distinct regions (labelled A, B, C and D) within the survey area (Figure 2). The Shingle Bank could be divided into two regions which, following ground-truthing with the underwater video camera, related to areas of coarse gravel (Region B) and of dense dredge tracks in coarse gravel infilled with sand and silt (Region C). The regions to the north and south of the Shingle Bank both appeared from the sidescan record to consist of rippled sand. However, ground-truthing revealed that the inshore region consisted of fine–medium rippled sand at water depths of less than 20 m (Region A), whereas the offshore region was predominantly slightly gravelly rippled sand at water depths greater than 20 m (Region D). Boundaries between adjacent regions were clearly defined, and the substrata within Regions A, B and D tended to be homogeneous in their distribution. Examples from the sidescan record and images taken from the underwater video footage of each acoustically distinct region are illustrated in Figure 3.

Sediment characteristics and environmental variables

Examination of the grab samples on deck, and *in situ* study of the undisturbed seabed surface by the video camera attached to the side of the grab, confirmed the interpretations from the acoustic data. Results from the particle size analysis of grab samples, used in conjunction with information derived from the sidescan sonar mosaic and video footage, provided a clear understanding of the physical habitat characteristics within each acoustic region.

Samples collected from the Shingle Bank (Regions B and C) had a much higher percentage of coarse material than samples collected from regions to the north and south of the bank (A and D), which consisted mainly of sand. This is reflected in the PCA ordination by the separation of A and D from B and C (Figure 4). The particle size

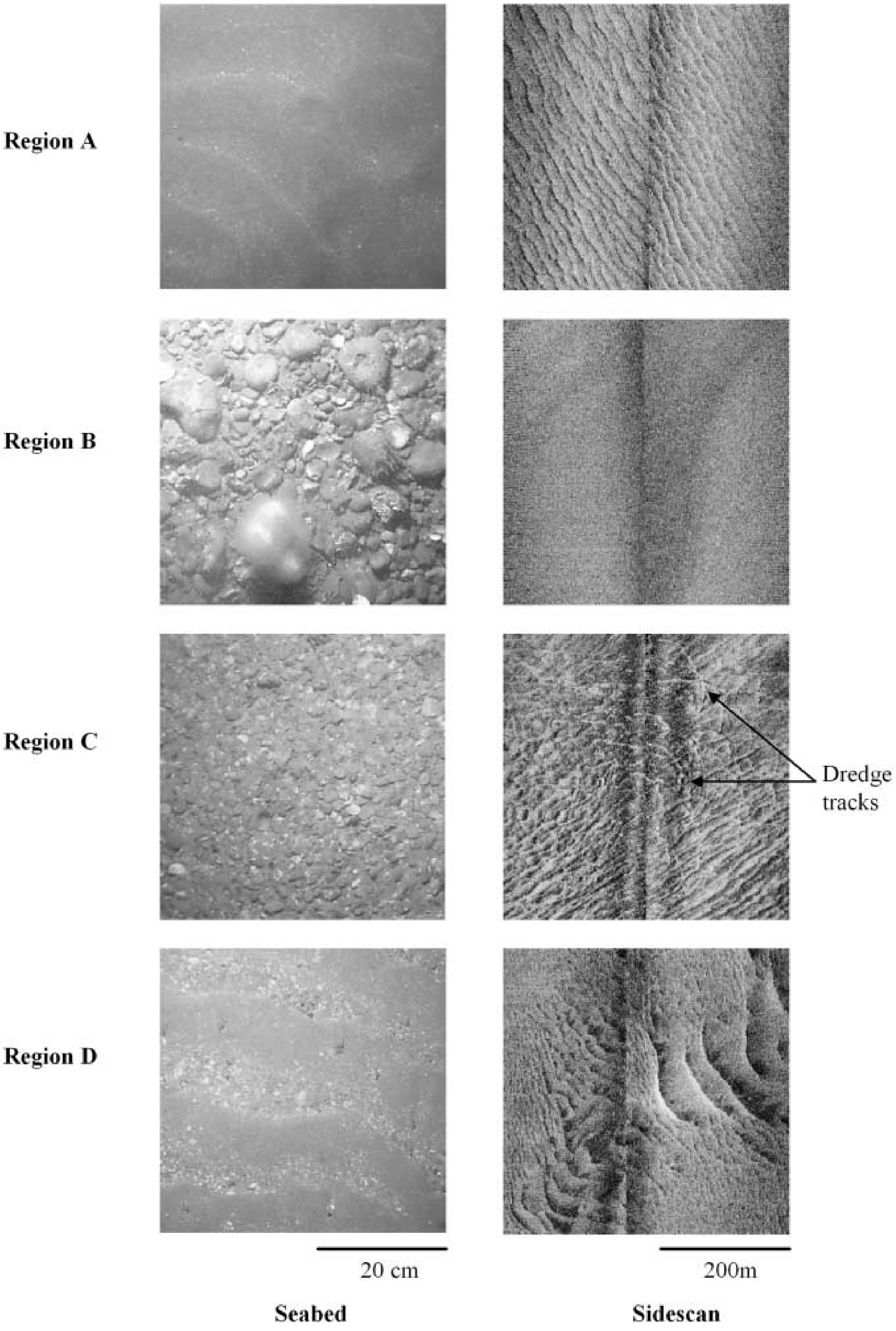

Figure 3. Examples of sidescan sonar images from the acoustically distinct regions with corresponding images of the seabed collected using the underwater video. Region A, inshore fine–medium sand <20 m; Region B, cobbles and gravel with attached epifauna—undredged Shingle Bank; Region C, disturbed gravel—dredged Shingle Bank; Region D, slightly gravelly rippled sand >20 m.

distributions of samples from within Regions A and D were also more consistent, as depicted by the tight clustering of samples in the PCA ordination (Figure 4). In contrast there was a much higher degree of particle size variability between replicate samples collected from Regions B and C, as depicted by the much wider spread of samples from these regions in the PCA ordination (Figure 4). Analysis of similarities results (Clark 1993) for

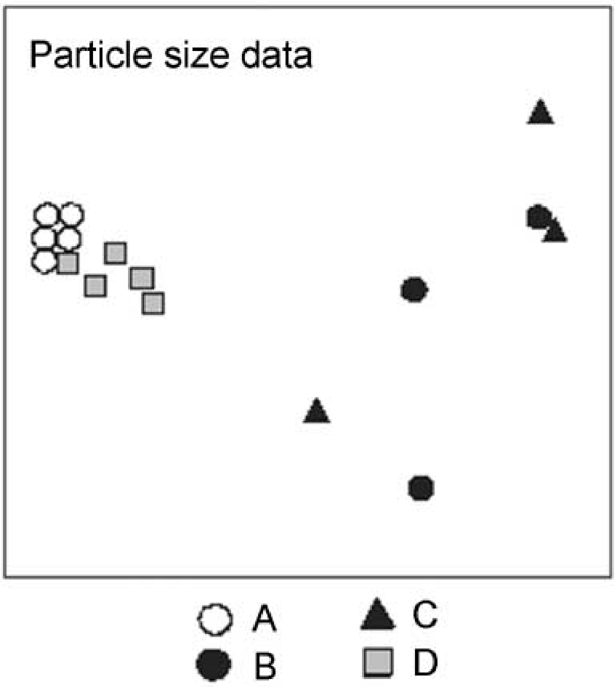

Figure 4. The PCA ordination of particle size (mean diameter in mm, sorting coefficient, % gravel, % sand and % silt/clay) distributions.

Table 1. *Summary of means and standard deviation for the numbers of species and numbers of individuals (colonial species not included in the number of individuals) from within each acoustic region from the Hamon grab and beam trawl surveys.*

	Hamon grab		2 m beam trawl	
	Mean no. taxa	Mean no. individuals	Mean no. taxa	Mean no. individuals
Region A	15(±8.2)	82(±60.1)	21(±2.3)	183(±34.0)
Region B	50(±6.4)	132(±12.9)	34(±4.0)	255(±103.6)
Region C	21(±12.7)	34(±23.1)	31(±2.3)	184(±7.6)
Region D	22(±5.4)	38(±12.5)	26(±6.1)	268(±139.0)

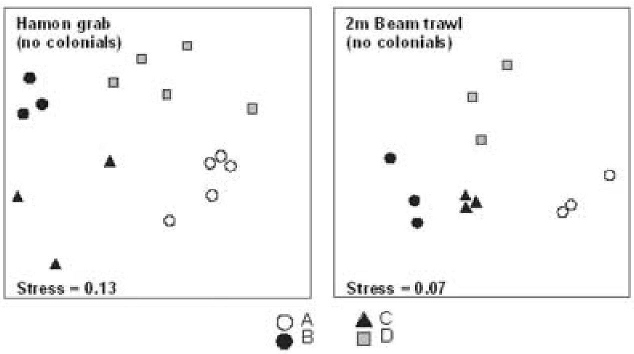

Figure 5. The MDS plots for macrofaunal assemblages from the Hamon grab and beam trawl surveys. All taxa except colonials included; data were 4th root transformed.

particle size data between samples from the four acoustic regions revealed that all regions were statistically distinct from one another, with the exception of Regions B and C. However, in terms of seabed morphology, Region C was visually and acoustically distinct from Region B, and dense dredge tracks were clearly visible on the sidescan sonar record within this region (Figure 3).

Biological data interpretation

A total of 172 taxa was identified from the 16 Hamon grab samples collected from across the survey area. There was a high degree of variability in the mean number of taxa between regions, with the undredged Shingle Bank (Region B) supporting a higher number of taxa than the dredged Bank or surrounding sandy regions (Table 1). Similarly, the undredged Shingle Bank (Region B) also supported the highest number of individuals. A total of 91 taxa was identified from the beam trawl survey. Patterns were similar to the Hamon grab data set, with the undredged Shingle Bank (Region B) supporting the highest number of individuals and taxa compared with the other regions (Table 1). Mean numbers of individuals and taxa were not markedly lower in the vicinity of the dredging (Region C) compared with the undredged Shingle Bank. However, the figures do not reflect the abundance of colonial organisms such as the soft coral *Alcyonium digitatum* and the bryozoan *Flustra foliacea*, which were notably much more abundant in Region B than Region C.

Grouping of replicate samples from each acoustic region from both the Hamon grab and beam trawl surveys is clearly visible (Figure 5). Analysis of similarities revealed that there were significant differences in macrofaunal assemblage structure between all acoustic regions, with the exception of Regions C and B from the beam trawl data.

Biotopes

The community groupings were explored further using SIMPER. Results revealed that the average similarity between replicate samples collected within an acoustic region was relatively low, particularly for the Hamon grab data, and that characterizing species from each acoustic region identified from the Hamon grab survey were unsurprisingly very different from those identified from the beam trawl survey (Tables 2 & 3).

Biotope A: *Shallow water, polychaete dominated fine sand*

The inshore area of the site (Region A), consisting of shelly sand in which polychaete tubes were visible on the underwater video footage, was identified as a discrete biotope. The species composition was characterized by polychaete worms such as *Spiophanes bombyx*, *Magelona johnstoni*, *Nephtys cirrosa* and *Aphrodita aculeata*. Burrowing amphipods of the genus *Bathyporeia* were present as was the sand goby *Pomatoschistus minutus*.

Biotope B: *Coarse gravel with attached epifauna*

Region B was the undredged region of Hastings Shingle Bank. There was an abundance of attached epifauna: in particular, the soft coral, *Alcyonium digitatum*, and the bryozoan *Flustra foliacea* distinguished this biotope from

Table 2. *Results from SIMPER analysis of Hamon grab data (all taxa excluding colonial species, 4th root transformed), listing the main characterizing species from each acoustically distinct region. Average abundance, similarity percentage, and cumulative similarity percentage for each species and the overall average similarity between replicate samples from within each region are listed.*

Acoustic region		Average abundance	%	Cumulative %	Average similarity
A	*Spiophanes bombyx*	18.2	25.0	25.0	
	Magelona johnstoni	20.8	23.6	48.6	42.3%
	Nephtys cirrosa	2.4	17.6	66.3	
	Bathyporeia gracilis	10.2	16.0	82.3	
B	*Pomatoceros triqueter*	17.7	10.6	10.6	
	Ascidiacea	11.7	8.5	19.1	
	Echinocyamus pusillus	5.0	7.7	26.8	
	Lumbrineris gracilis	5.0	7.6	34.4	43.6%
	Aonides paucibranchiata	2.7	6.5	41.0	
	Caulleriella alata	2.3	6.5	47.5	
	Scalibregma inflatum	2.0	5.8	53.4	
	Glycea lapidum	2.0	5.8	59.2	
	Poecilochaetus serpens	1.7	5.5	64.7	
	Syllis (Type B)	1.0	5.5	70.2	
C	*Caulleriella alata*	4.3	55.9	55.9	16.5%
	Scolelepis squamata	1.3	18.8	74.7	
	Ampelisca spinipes	2.7	13.7	88.4	
D	*Lumbrineris gracilis*	3.4	22.8	22.8	
	Nephtys cirrosa	2.6	13.4	36.2	27.2%
	Spisula elliptica	1.6	11.0	47.3	
	Eurydice pulchra	0.8	10.7	58.0	

Table 3. *Results from SIMPER analysis of beam trawl data (all taxa excluding colonial species, 4th root transformed), listing the main characterizing species from each acoustically distinct region. Average abundance, similarity percentage, and cumulative similarity percentage for each species and the overall average similarity between replicate samples from within each region are listed.*

Acoustic region		Average abundance	%	Cumulative %	Average similarity
A	*Pomatoschistus minutus*	54.3	13.3	13.3	
	Pagurus bernhardus	25.7	11.6	24.9	
	Aphrodita aculeata	21.0	11.2	36.1	66.4%
	Pontophilus sp.	14.0	10.8	46.9	
	Hinia sp.	15.7	9.4	56.3	
	Buglossidium luteum	11.7	8.5	64.8	
	Callionymus sp.	4.7	7.7	72.5	
	Echiichthys sp.	4.7	7.1	79.6	
B	*Psammechinus miliaris*	101.0	10.9	10.9	
	Pagurus bernhardus	27.0	10.4	21.2	
	Ophiura albida	19.3	8.8	30.0	
	Buccinum sp.	7.3	7.2	37.2	56.2%
	Macropodia sp.	5.7	6.4	43.7	
	Nudibranchia	13.3	6.2	49.8	
	Chlamys sp.	4.3	5.9	55.7	
	Pisidia sp.	6.7	5.9	61.6	
	Pomatoschistus minutus	2.7	5.7	67.3	
	Metridium senile	4.3	5.2	72.5	
C	*Pagurus bernhardus*	31.3	9.2	9.2	
	Hinia sp.	20.0	8.1	17.3	
	Pomatoschistus minutus	21.0	7.5	24.8	68.4%
	Chlamys sp.	8.7	6.9	31.7	
	Macropodia sp.	8.0	6.4	38.1	
	Galathea sp.	7.0	6.4	44.5	
	Liocarcinus sp.	11.7	6.4	50.9	
	Buccinum sp.	6.3	6.2	57.1	
D	*Pagurus bernhardus*	66.3	16.62	16.6	
	Ophiura albida	85.7	14.44	31.1	
	Liocarcinus sp.	14.0	10.61	41.7	52.5%
	Ophiura ophiura	25.3	10.27	51.9	
	Crangon allmanni	14.3	7.87	59.8	
	Pomatoschistus minutus	4.7	7.84	67.6	
	Macropodia sp.	4.7	7.61	75.2	

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the others found within the study area. Other characterizing species included the sea urchin *Psammechinus miliaris*, the sea anemone *Metridium senile*, the hydroid *Sertularia* sp., the serpulid polychaete *Pomatoceros triqueter* and the encrusting bryozoan *Schizomavella* sp.

Biotope C: *Disturbed (dredged) sandy gravel*

Region C was the dredged area in the middle of the Shingle Bank, surrounded by Region B. The gravel within this region was sandier and therefore less coarse than that of Region B, and there were fewer sightings of large epifaunal species on the underwater camera footage from this area. This was confirmed by a marked absence of many of the sessile epifaunal species in the grab and trawl data that were abundant in biotope B. Whelks of the genus *Hinia* sp. were one of the characterizing species of biotope C.

Biotope D: *Deeper water, coarse sand with* Ophiura ophiura

The sediment within Region D was mainly sand with low proportions of gravel in some areas, and the particle size distribution was similar to that of Region A. However, the biotic component of this region was distinctly different, with fewer polychaete species, although the polychaete worms *Nephtys cirrosa* and *Spiophanes bombyx* were present as they were in Region A. The brittle stars *Ophiura albida* and *Ophiura ophiura* were identified as characterizing species from this habitat.

DISCUSSION

The Hastings Shingle Bank and surrounding seabed have been well studied for a number of years due to the interest in the site for aggregate extraction (Shelton & Rolfe, 1972; Kenny, 1998). The location has also been sampled as part of broader-scale benthic surveys in the English Channel (Holme & Wilson 1985; Sanvicente-Anorve et al., 1996). In the current study, four biotopes were identified from an area 12×4 km which encompassed the Shingle Bank and parallels can be drawn between these and assemblage types described in the past.

The undredged region of the Shingle Bank was dominated by the soft coral, *Alcyonium digitatum* and the bryozoan *Flustra foliacea* attached to coarse deposits of cobbles, pebbles and gravel. These two characterizing species, amongst others, have been reported in this vicinity in previous surveys (Shelton & Rolfe, 1972). Holme & Wilson (1985) describe several epifaunal assemblages from the central region of the English Channel which show a degree of similarity to those found at the Hastings study site. They document three sub-types of an assemblage (Type B) associated with hard surfaces of rock, cobbles and pebbles which are subjected to varying degrees of tidal scour by sand and periodic smothering, namely:

- Subtype B-1 'Well developed faunal assemblage with *Polycarpa violacea* assemblage' (Holme & Wilson 1985). This is described as a relatively stable, rich and varied fauna associated with pebbles, cobbles and rock outcrops, affected periodically by sand scour.
- Subtype B-2 'Impoverished *Polycarpa violacea–Flustra foliacea* assemblage' (Holme & Wilson 1985). This assemblage is found on similar hard substrates as subtype B-1, but is subjected to considerable sand scour and periodic submergence by thin layers of sand.
- Subtype B-3 'Impoverished *Balanus–Pomatoceros* assemblage' (Holme & Wilson 1985). This assemblage is characteristic of hard substrates subjected to severe scour and deep submergence by sand or gravel. The fauna is therefore restricted to fast-growing colonizers which can rapidly settle and establish themselves in the short periods when conditions are favourable.

The undredged region appears similar in terms of fauna and physical habitat to subtype B-1 and B-2. The dredged Shingle Bank (Biotope C), which consists of a sandier substrate, and dredge tracks in-filled with sand, shows similarity to the subtype B-3. Kenny (1998) draws similar comparisons between the assemblages reported by Holme & Wilson (1985) and those he identified within the region of Hastings Shingle Bank during an environmental survey of the areas licensed for aggregate extraction. Shelton & Rolfe (1972) describe a rich fauna on the Shingle Bank but did not identify any impoverished regions. This can be explained by the fact that trailer dredging for aggregates did not begin 'in earnest' at the licensed sites until 1988, and it is likely that the rich fauna found on the undredged Shingle Bank (Biotope B) originally extended over the entire area of the Bank.

Studies by Shelton & Rolfe (1972) and Kenny (1998) also report the presence of sandier deposits to the north and south of the Shingle Bank, in agreement with the current study. However, these previous studies focused their survey effort within the immediate vicinity of the Shingle Bank, or extended surveys in a south-west–north-east direction parallel with the prevailing tidal currents. There is limited previous data regarding the benthic fauna to the north and south of the bank.

Habitat boundaries between acoustically distinct regions within the study site were relatively clear. Moreover, the acoustic regions themselves appeared to coincide with discrete assemblages identified by ground-truthing. However, similar studies attempting to map the spatial distribution of habitats and assemblages elsewhere have indicated that a close association between the two does not always exist (Basford et al., 1989; Dewarumez et al., 1992; Brown et al., 2002). This concept of discrete communities vs continua is discussed by Brown et al. (2002), and the study site described in the current study appears to fall into the latter category, displaying very distinct faunal differences which appear to coincide with clearly discernible habitat boundaries.

Other factors, such as sediment characteristics, are thought to have a greater influence on assemblage structure at more localized scales, such as those encountered in the current study (Eleftheriou & Basford, 1989; Seiderer & Newell, 1999). Substratum types can often show discontinuities across a region which may give rise to distinct boundaries between neighbouring assemblages. The use of sidescan sonar in the current study enabled such boundaries to be identified and mapped. Designing subsequent biological surveys around the acoustically distinct regions determined from the sidescan sonar data made it possible to test whether discrete assemblages existed within these boundaries. However, the lack of clearly definable boundaries between adjacent habitats can cause major problems when attempting to produce high-resolution seabed maps due to difficulties in determining where demarcation lines should be drawn.

The mapping approach also proved very successful in identifying anthropogenic disturbance at the seabed from aggregate dredging. Dredging tracks were clearly identifiable from the sidescan data, and an impoverished fauna was recorded from within the disturbed area compared with that from the surrounding undisturbed gravel bank.

The survey approach adopted in the current study, using a combination of sidescan sonar, video, grab and trawl, has led to a detailed understanding of the spatial distribution of habitats and assemblages within the region. The use of a swath acoustic system such as sidescan sonar allows 100% coverage of the survey area to be achieved. This in turn increases the accuracy at which habitat boundaries can be drawn across the area, which ultimately increases the confidence of the final biotope map when compared with other mapping approaches.

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