Eastern IFCA
Inshore Fisheries and Conservation Authority

RESEARCH REPORT
2015

Shark By-Watch UK 2 Field Study: The Wash Skate and Ray Fishery

Habitat mapping report

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Shark By-Watch

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Introduction

Shark By-Watch UK Project Overview

Shark By-Watch UK is a Cefas led project which was set up in order to improve knowledge of shark's, skate's and ray's in terms of commercial fishing activity. The project is funded by the European Fisheries Fund (EFF) along with contributions from partner organisations across the UK including the IFCA's.

The initial stage of the project looked at ways of determining where elasmobranchs are caught and the methods used to catch them, whether they are caught as target or non-target species and whether or not they survive when caught as by-catch. Such knowledge will help to improve understanding of the requirements needed to effectively manage sustainable fisheries for sharks, skates and rays and will contribute to the reform of the Common Fisheries Policy (CFP).

This project is now in its second phase and consists of three field studies looking at fisheries around the UK. These include:

1. Bristol Channel Skate & Ray Fishery
2. The Wash Skate and Ray Fishery
3. Thames Estuary Thornback Ray Fishery

The field studies will be used to collect biological data on skates and ray, identify habitat preferences and to measure extent of spatial abundance, juvenile nursery grounds and stock residency.

Eastern IFCA's involvement

Eastern IFCA were approached by Cefas to assist with the project by conducting habitat mapping within The Wash as part of The Wash Skate and Ray Fishery field study. Obtaining such data should help to identify possible areas that may act as suitable habitat for Skates and Rays. By understanding the distribution of such habitats along with data obtained from fisher-led self-sampling surveys it is hoped that we will gain a better understanding of the spatial abundance and stocks of skate and ray off the Norfolk and Lincolnshire coast and thus better inform management solutions.

This report will show the various stages in the habitat mapping process including under water video surveys, Side Scan sonar surveys and ground truthing using a Day grab.

Materials and methods

Study area

The study was conducted within The Wash on the east coast of England (Figure 1). The Wash is both a Special Area of Conservation and a European Marine Site and is one of the most important marine areas in the United Kingdom and European North Sea. The Wash includes extensive areas of mud and sand flats and has one of the largest expanses of sublittoral sandbanks and the second-largest area of intertidal flats in the UK supporting a diverse range of communities (Natural England 2005).

The Wash is a dynamic environment, water entering the Wash from offshore brings with it approximately 6.8×10^6 tonnes of suspended sediment annually much of which is deposited as the current speed decreases approaching the bay thus forming the intertidal mud and sand flats. Sediment is then later mobilized as strong wave action and tidal current activity constantly rework the sea bed (Ke *et al,* 1996).

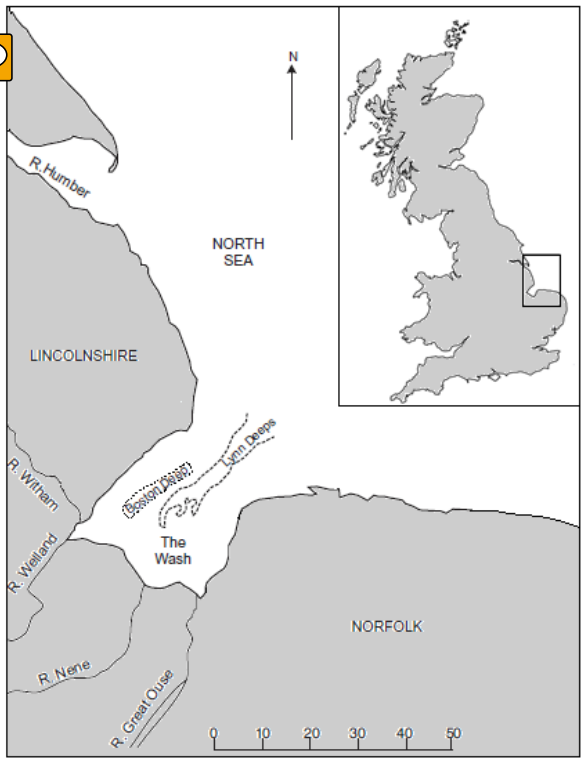
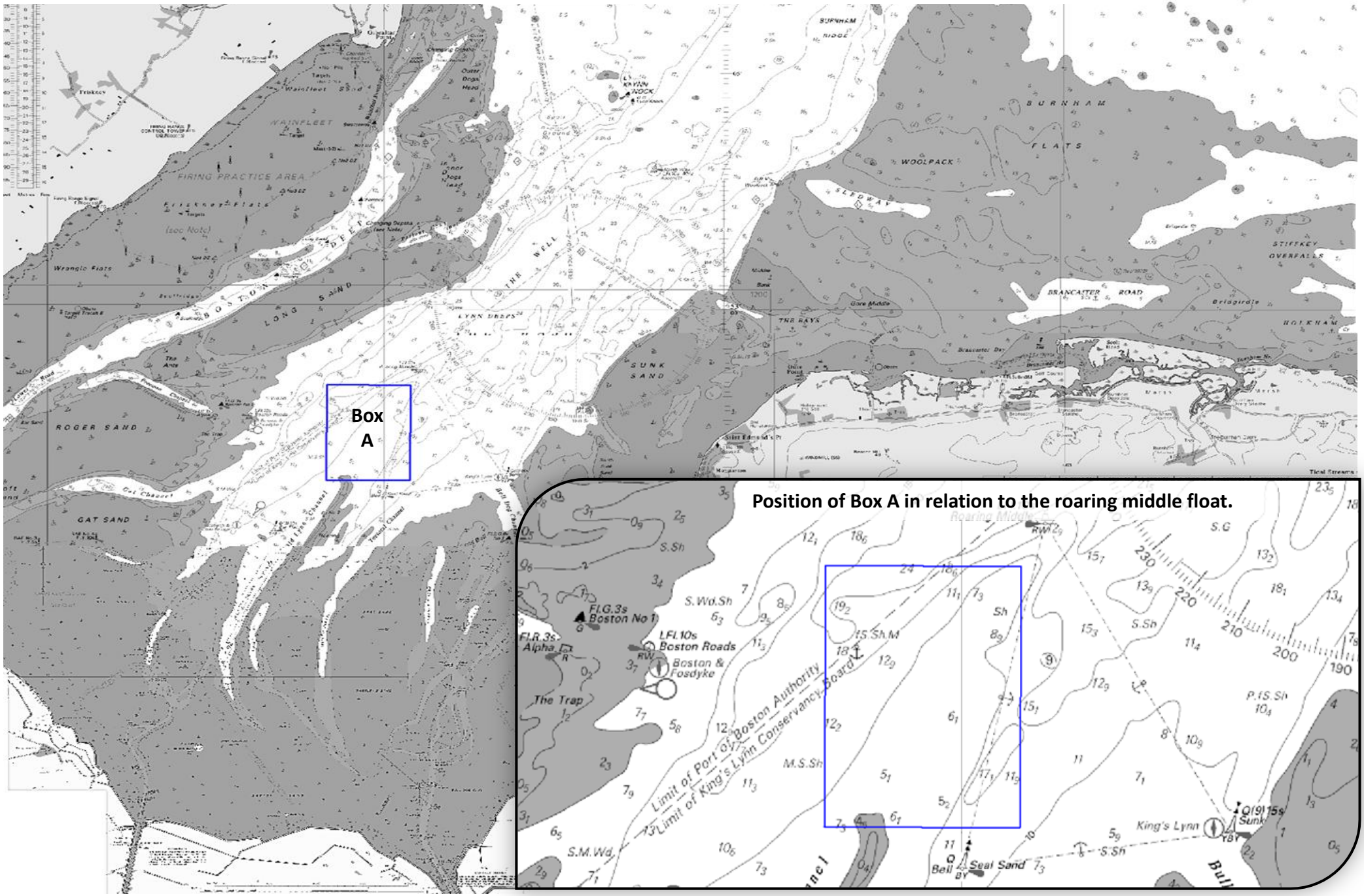


Figure 1. The Wash embayment in relation to the east coast of England.

The study site consisted of a 10.23 sq Km area located over the Lynn deeps close to the Roaring Middle (Box A in Figure 2). The Lynn Deeps form a deep trough through the centre of the Wash known as the Well with a maximum water depth of around 40m. Water enters the Wash from The North Sea through this depression as a strong flood-tide and flows back out along the margins through the Boston Deeps (Ke et al,1996). Commercial fishing operates in this area. Currently the main activity is potting targeting whelks and crustaceans however historic records show that this area has supported a significant fishery for flat fish, skates, rays and pink shrimp.

Figure 2 Map showing the location of survey Box A within the Wash embayment



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Sonar Acquisition using Edgetech 4200MP

An Edgetech 4200 MP side scan sonar was used to acquire acoustic imagery (figure 3). The sonar system has a horizontal beam width of 0.28° at 300 kHz and a Vertical beam width of 50° and was towed behind the vessel at a speed between 4 and 8 knots. The tow vehicle was maintained at a height of 10 meters from the sea bed giving total swath coverage of 120m.

18 survey lines spaced at 150m intervals were surveyed within box A giving 100% coverage of the seabed within the survey area. The lines ran south west to north east following the depth contours. The data was captured using Discover 4200MP, a Side Scan Sonar Digital Data Acquisition program which produces XTF File's (extended Triton Format). These were then exported to Triton Perspective, a Side Scan Processing and Interpretation Software package used to produce geo-registered side-scan mosaics.

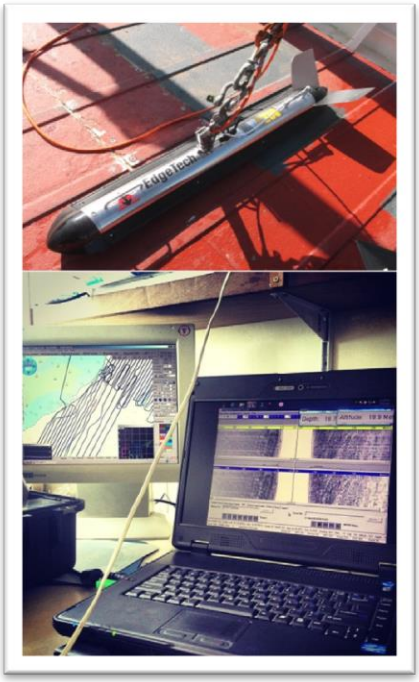

Figure 3 (Above) Side scan sonar tow vehicle (Below) Side scan acquisition software.

Ground-truthing

Video Survey

A camera sled was used with a GoPro camera mounted to the frame, to acquire underwater videos in order to support the sonar imagery (figure 4). 16 stations within box A were sampled (Figure 5). At each station the Camera sled was lowered to the sea bed and the imagery was viewed, via a live feed so that visible features could be noted down. The sled was bounced three times in order to capture footage from all angles.

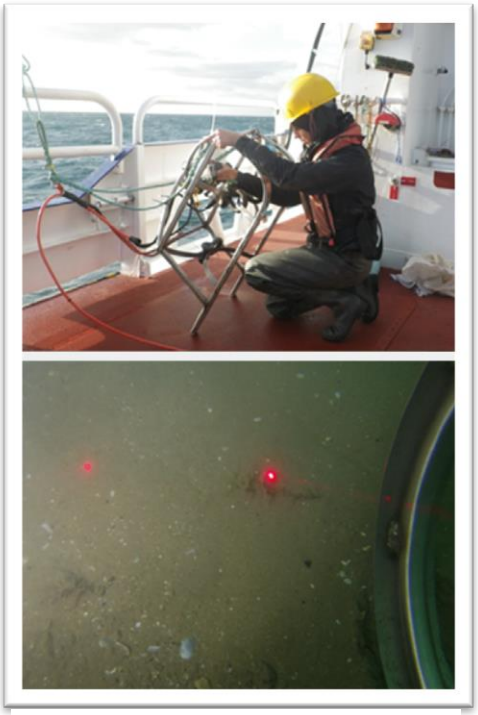

Figure 4 (Above) Camera sled pre deployment. (Below) Camera sledge on the sea bed.

Day grab survey

A 0.1m^2 day grab was also deployed via the A frame at the stern of the vessel at each of the sampling stations (Figure 6). At each deployment the position was taken along with sampling time, and notes were made on the sediment composition and biota. Photographs were also taken of the grab sample.

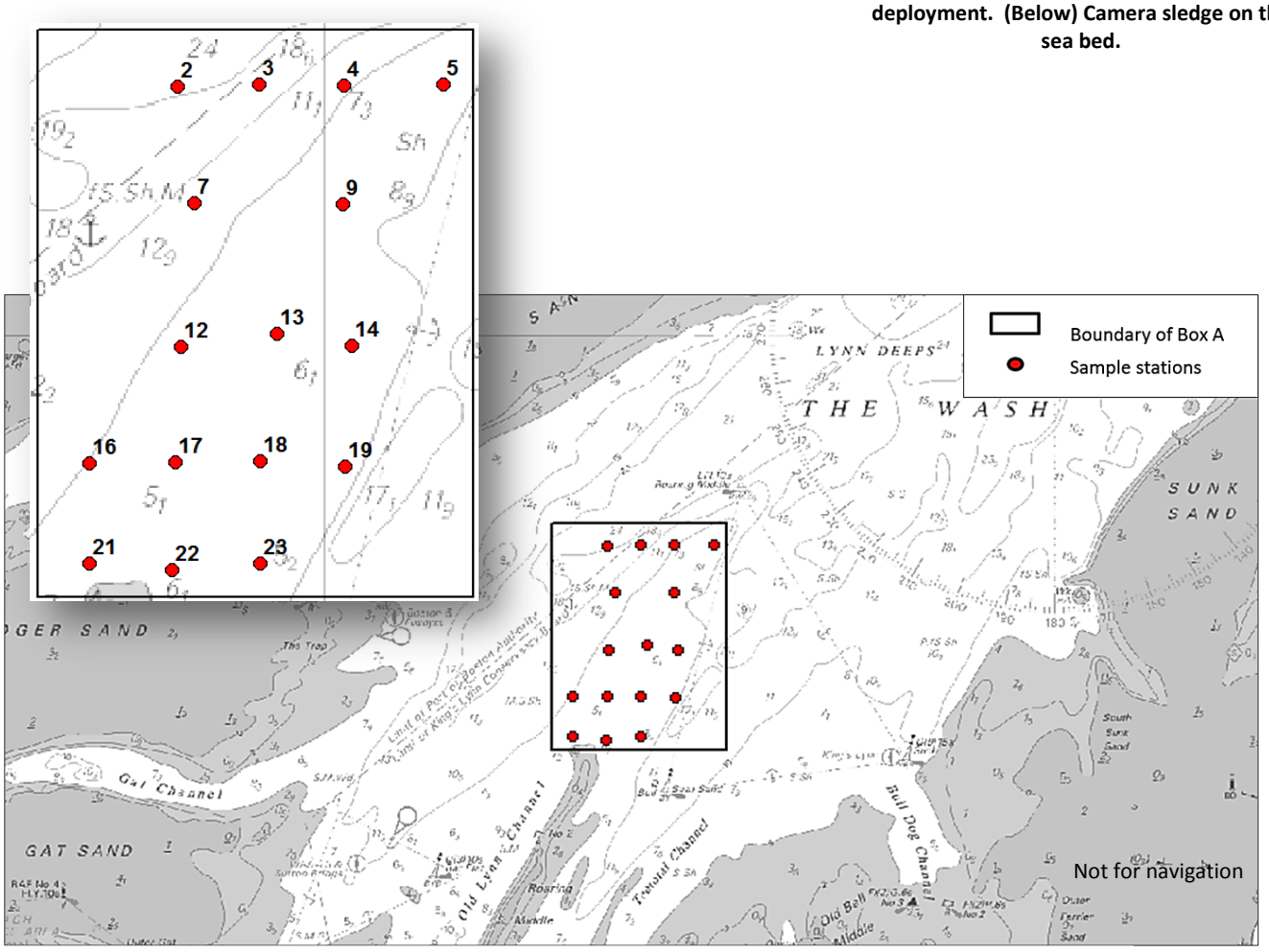

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Figure 5 Chart showing the position of sampling stations within box A (insert) Numbered sample stations.

Analysis of seafloor substrata

Visual characterization of the bottom sediment was made by estimating the percentage of the different sediment types within the grab sample. The classification system used is shown in figure 7. Additional information was recorded of the percentage by volume of other features in the sample including shell, fragments of sabellaria and flora.

Percentage of each sediment type within the Grab sample	%
Silt	
Fine	
Medium	
Coarse	
Gravel	
Pebble	
Cobble	
Total	100%

Figure 7 Sampling sheet for sediment composition.

Figure 6 (Above) Deployment of the Day grab and (Below) Day grab containing sediment sample.

Results

Of a total of 7 sea days allocated for the project it was only possible to go to sea on three of these days due to poor weather. Two of these days were spent side scanning using the *Edgetech 4200MP* during which we covered 70 linear km of sonar survey lines aboard R.V Three Counties covering a total area of 10.23 square Km. The remaining day was used to conduct ground-truthing video surveys and to obtain grab samples. 15 grabs were made within Box A and were accompanied by video images taken at the same location. Table 1 below summarises the survey effort.

Table 1. Survey effort statistics for Survey Box A.

Date	Survey area	Survey Lines completed	Distance covered (Km)	Grab samples completed	Video surveys completed	Time spent surveying (h:m)	Time spent steaming to locations (h:m)
21st October 2015	Box A	6	19.89	0	0	02:17	07:43
22nd October 2015	Box A	0	53.9	16	16	06:15	03:45
4th November 2015	Box A	12	0	0	0	05:26	03:33
	Total	18	73.79	16	16	13:18	15:01

Sediment characteristics

Analysis of the grab samples along with video footage of the undisturbed sea-bed enabled sediment characteristics in the acoustic region to be determined. A range of habitat types were identified including Sand, Mixed sediment, coarse sediment with shell and muddy sand. Table 2 and figure 8 show the results of the sediment analysis performed on the Day grab samples at each sample site.

Table 2. Sediment composition data from Day grab samples collected at each sample station

Grab Id	% Silt	% Fine	% Medium	% Coarse	% Gravel	5% Pebble	% Cobble
2	5	75	10	10	0	0	0
3	20	0	20	50	10	0	0
4	20	0	40	30	10	0	0
5	5	0	40	50	5	0	0
7	0	20	70	0	10	0	0
9	10	0	50	30	10	0	0
12	10	20	70	0	0	0	0
13	0	20	0	70	10	0	0
14	5	0	40	50	5	0	0
16	0	10	90	0	0	0	0
17	5	80	15	0	0	0	0
18	20	70	0	0	10	0	0
19	10	0	0	80	10	0	0
21	0	1	99	0	0	0	0
22	10	0	50	40	0	0	0
23	10	70	5	5	10	0	0

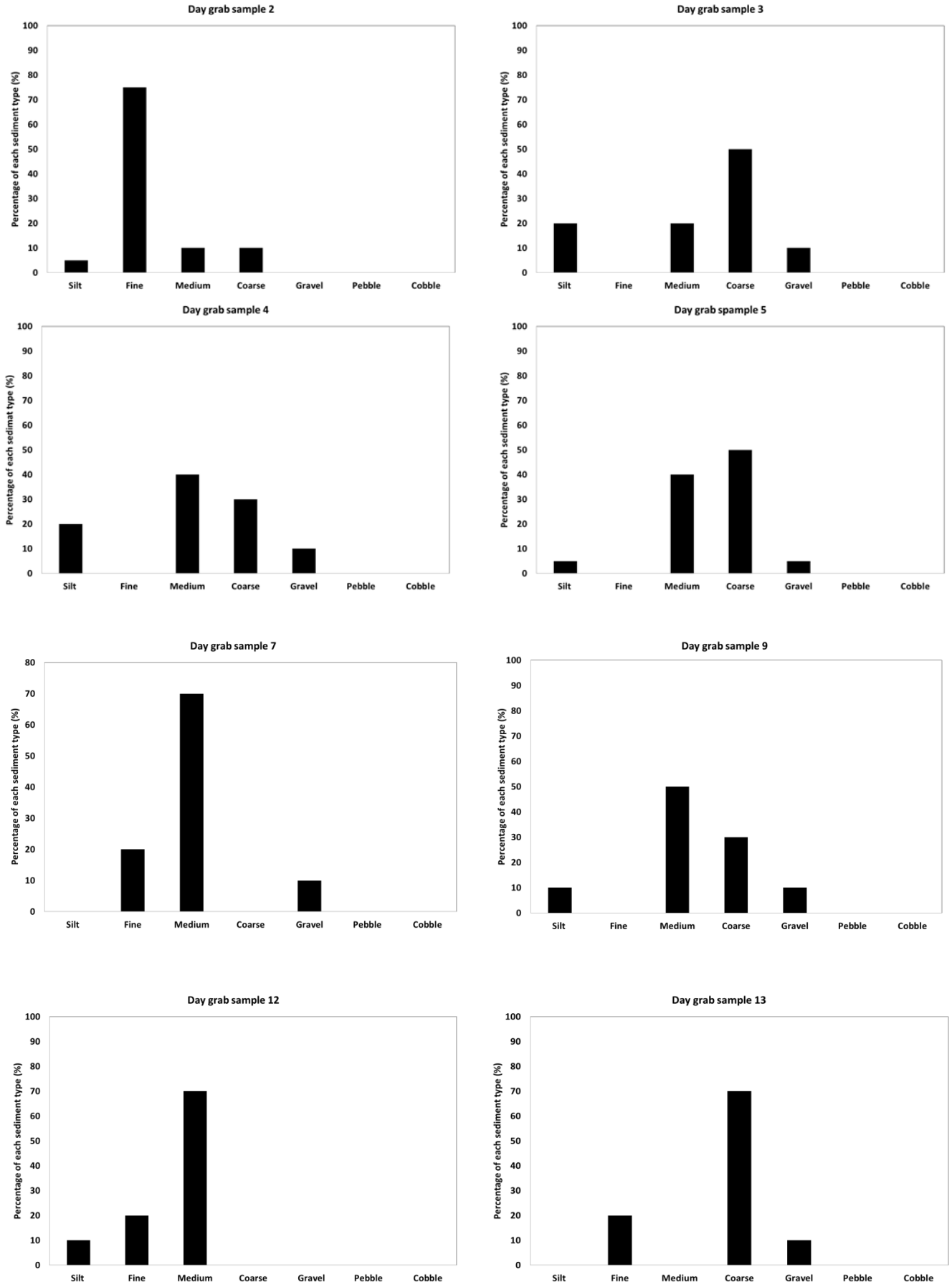

Figure 8. Bar graphs displaying the sediment composition at each sample site.

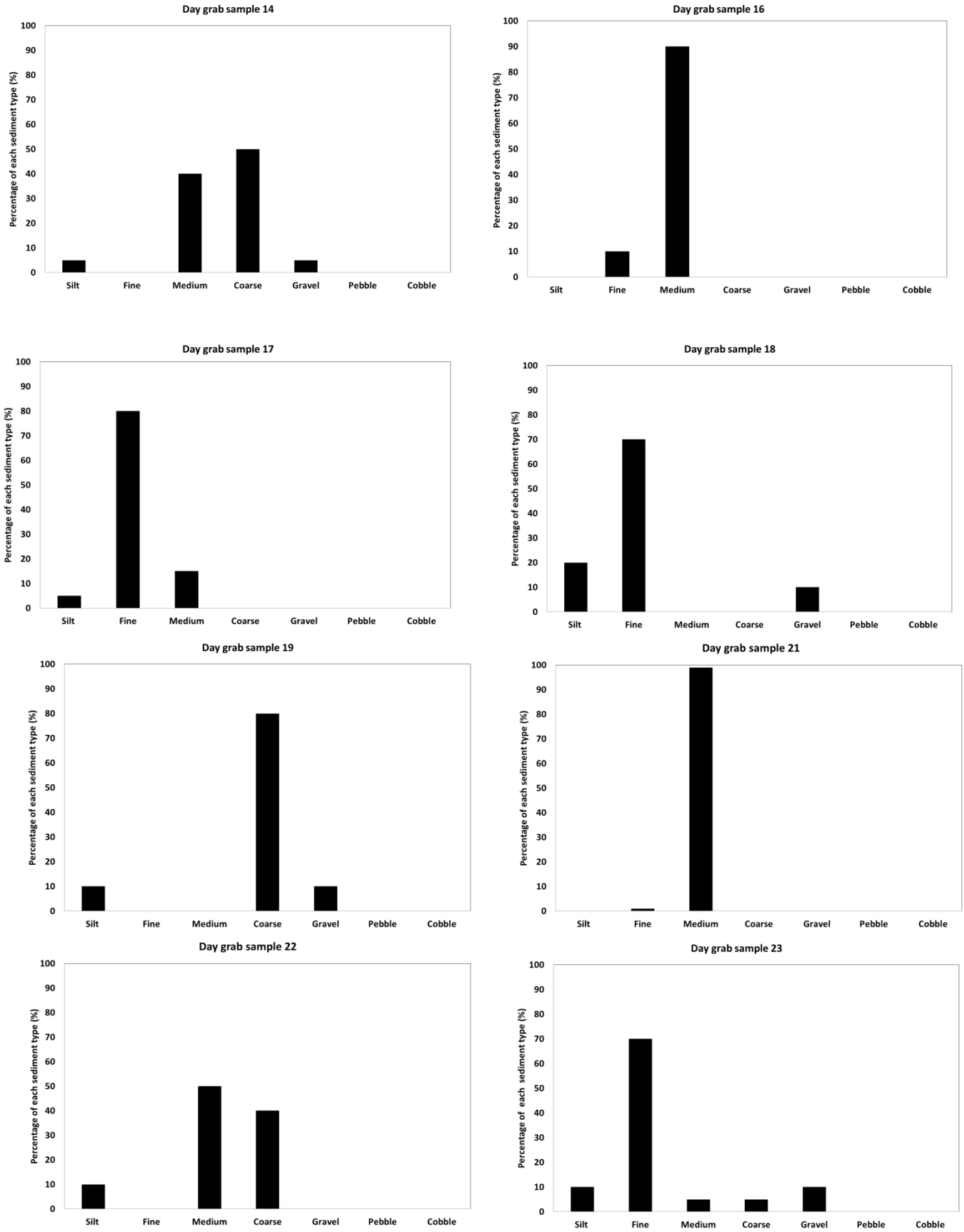

Figure 8. Continued

General classification of sediment types

In general the eastern portion of the survey block contained coarse sediment with gravel whilst the western portion of the survey block contained medium to fine sediment. Figure 9 provides a visual representation of the location of the sample stations. The coloured pies represent the major sediment component of the grab sample at each sample location and the dotted lines divide up the sample stations in accordance to their broad scale sediment type. This enables the division of the east and west portion of the survey bloc to be visualised.

Analysis of sediment composition using principle component analysis

An ordination of the sediment composition of each grab samples is illustrated in figure 10. The distance between the points reflects the dissimilarity between the compositions of grab samples at different sample sites. Closer points indicate more similar sediment composition where as more distant points have more different sediment compositions.
Grab samples 2, 17, 18 and 23 show a clear separation from the rest of the samples and cluster together at the top of the ordination plot. The sediment compositions of these four grab samples are similar to each other but differ significantly from all other grab samples. Grab samples at these sample stations tended to consist of finer sediment (See images 12 to 15 of figure 11). The remaining grab samples cluster at the bottom of the ordination plot and form two, less distinct groups. To the left of the ordination are samples 3, 4, 9, 13, 15 and 19. These grab samples consist of coarse sediment or gravel, (See image 1to 6 of figure 11). The cluster to the right, samples 7, 12, 16, 21 and 22 are formed of medium sediment. Less distinction is visible between medium and coarse sediments (see images 7 to 11 of figure 11).

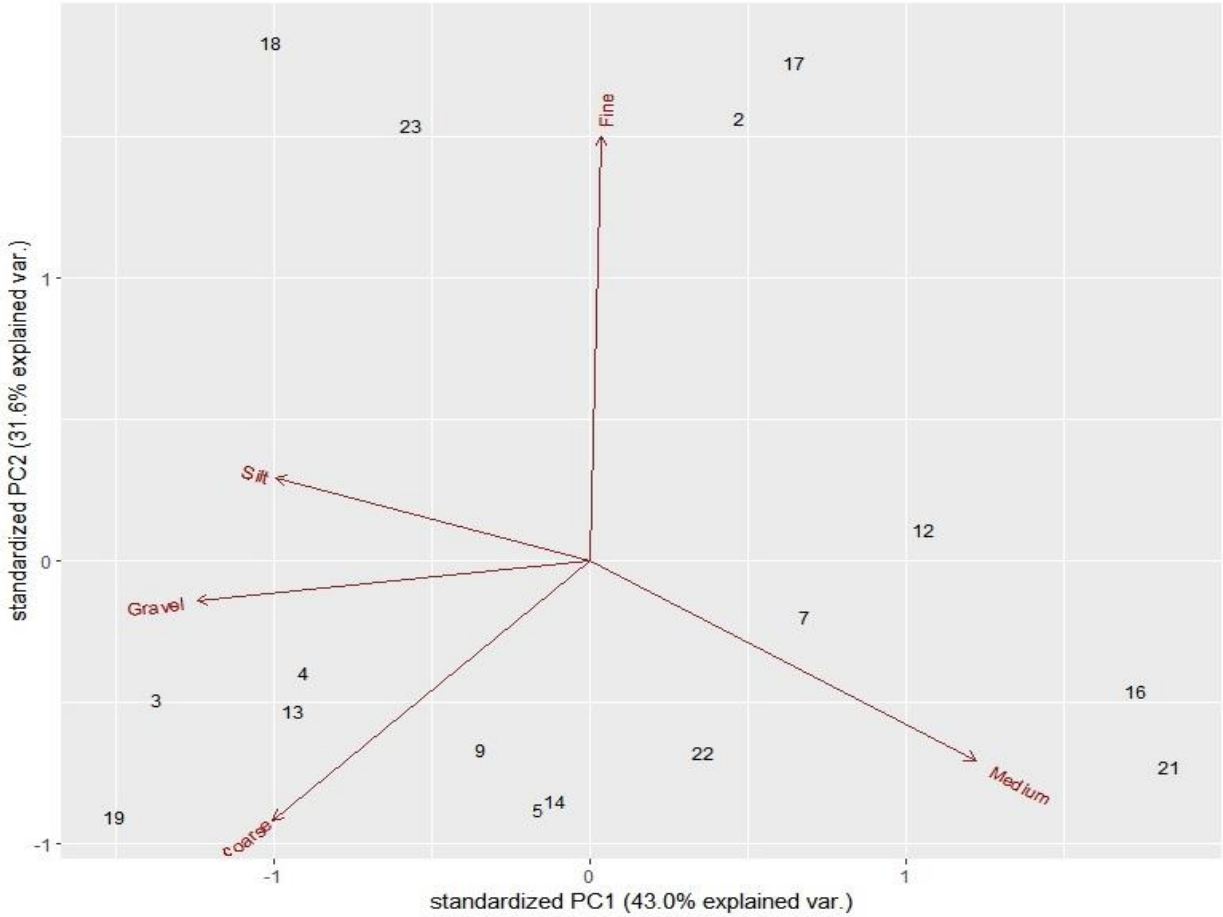

Figure 10 . PCA ordination of sediment composition distributions

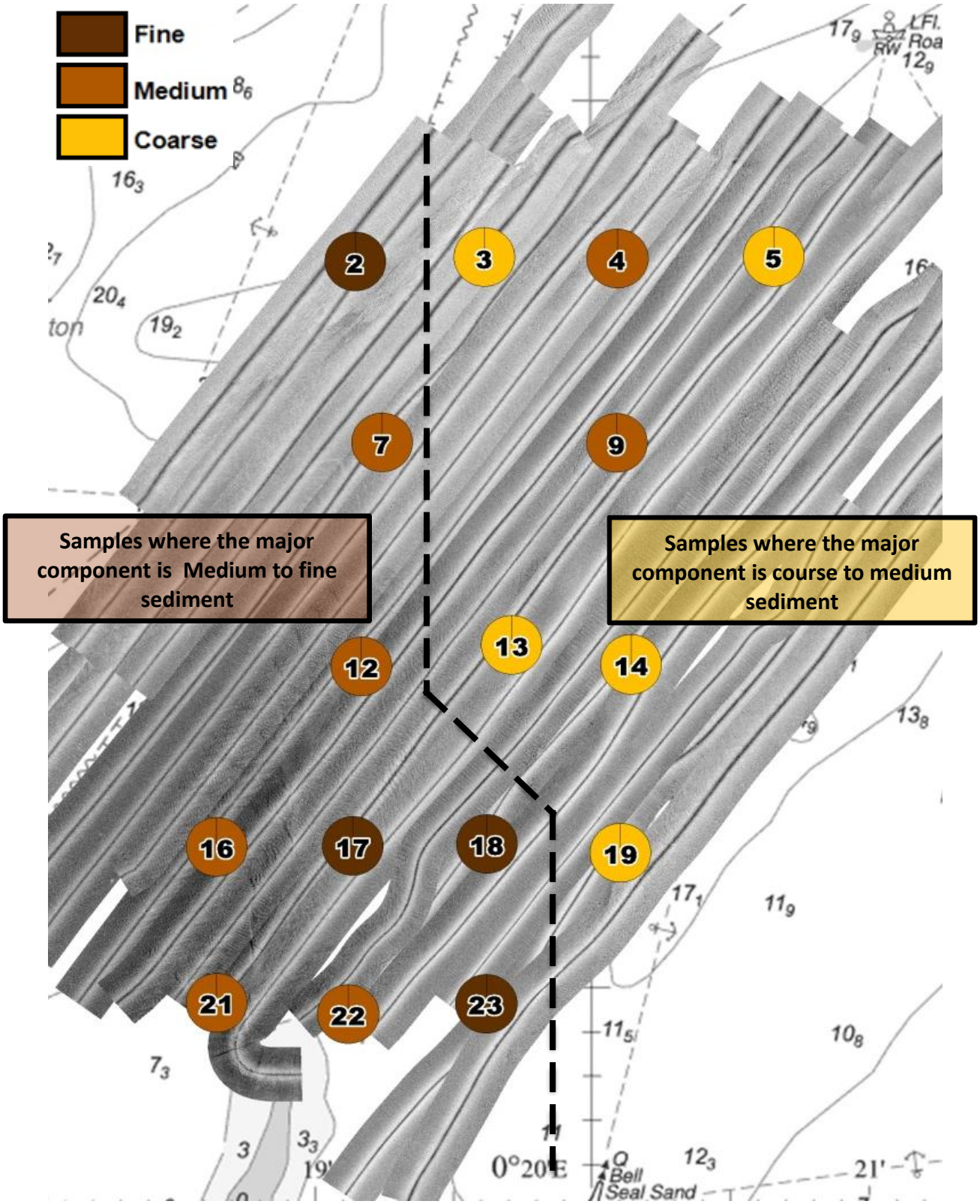

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Figure 9. Side scan sonar mosaic overlaid with pies representing the major sediment component of each grab samples. Dotted lines indicate separation of grab sites according major sediment type. To the left of the dotted line are sites containing medium to fine sediment. To the right of the dotted line are sites containing coarse sediment and gravel.

Image 1. Sample station 3

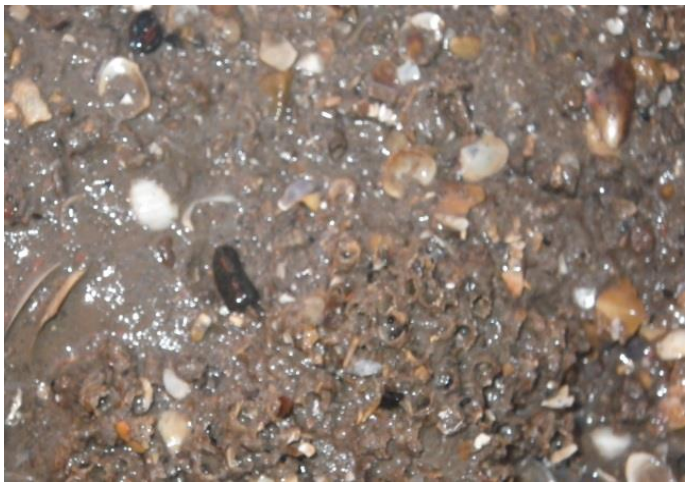

Image 2. Sample station 4

Image 3. Sample station 9

Image 4. Sample station 13

Image 5. Sample station 14

Image 6. Sample station 19

Figure 11. Images of Day grab samples.

Image 7. Sample station 7

Image 8. Sample station 12

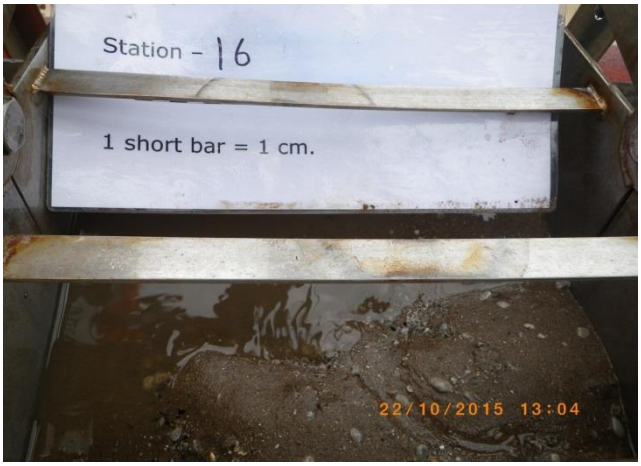

Image 9. Sample station 16

Image 10. Sample station 21

Image 11. Sample station 22

Figure 11. Continued

Image 12. Sample station 2

Image 13. Sample station 17

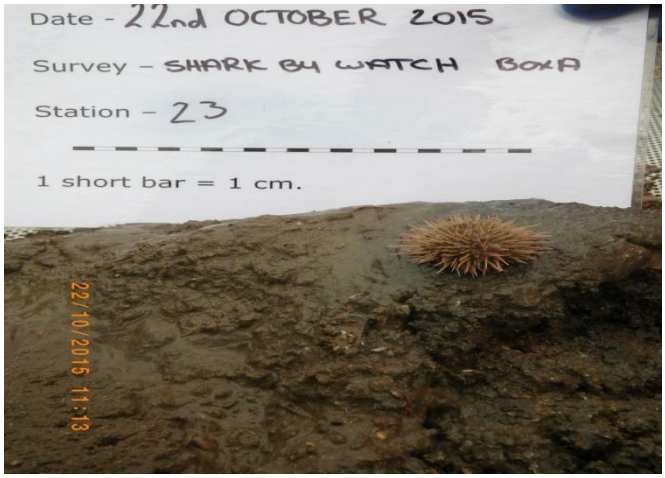

Image 14. Sample station 23

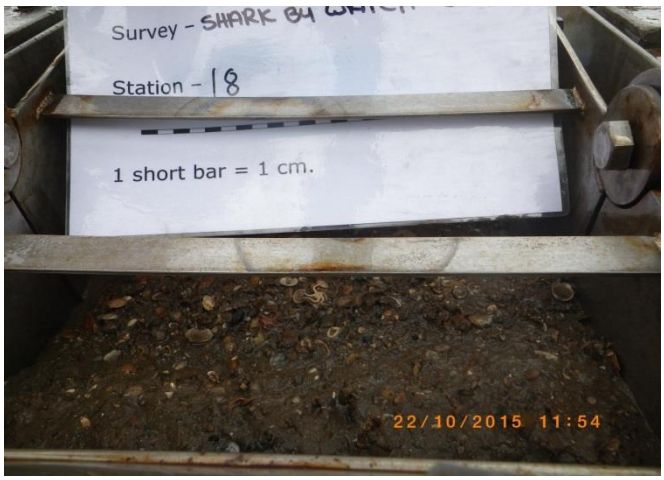

Image 15. Sample station 18

Figure 11. Continued

Physical description of the sites based on Sonar Acquisition

Side scan sonar data along with the analysis of video footage enabled the identification of differences in the distribution of sediments across the survey area. Acoustically distinct regions are suggested and are displayed in the mosaic of the side scan sonar images in figure 12 . In overview the survey area displayed a transition from medium/course sediment at the northern end of the survey area to an expanse of sand waves along the western edge and down into the south west corner.

The lower south west portion of the survey box consisted of mobile sand with vast areas of sand waves and sand ripples (See image 1 and 2 of figure 13). The sand waves extend up the western edge of the box. The central area of the box consists of homogeneous cover of medium to coarse sediment (See image 3 and 6 of figure 13) with patches of mixed and coarse sediment within.

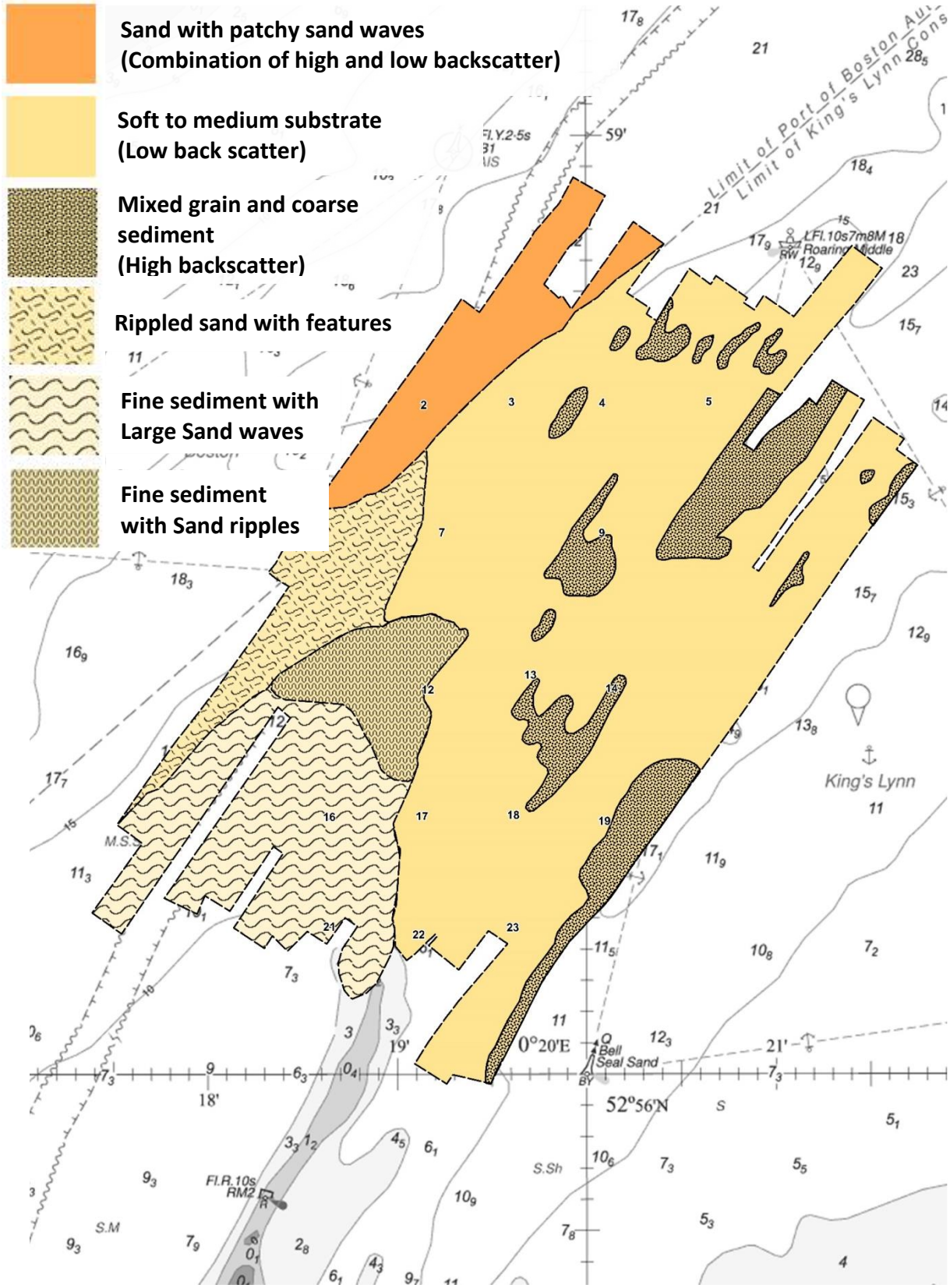

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Figure 12. Side Scan sonar interpretation showing suggested sediment types

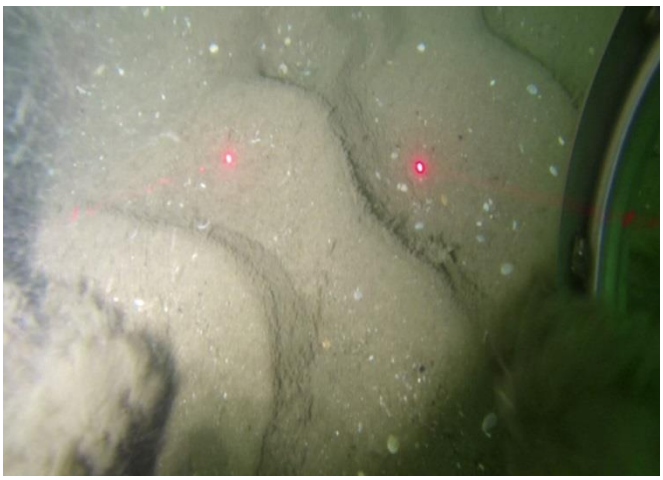


Image 1. Sample station 16

Image 2. Side scan sonar image of Sample station 16

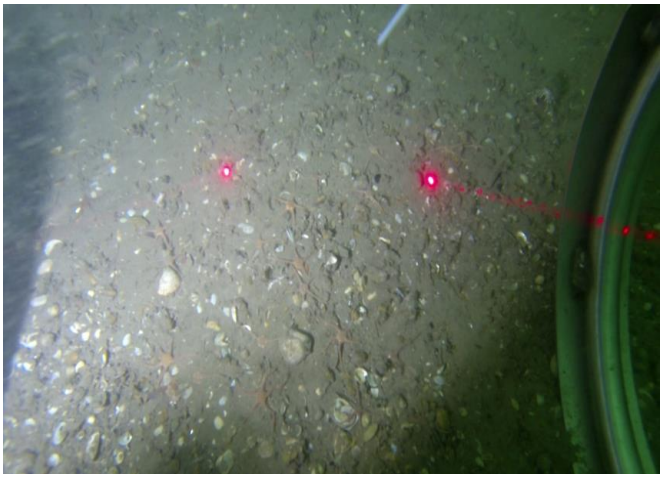


Image 3. Sample station 18

Image 4. Side scan sonar image of Sample station 18

Image 5. Sample station 14

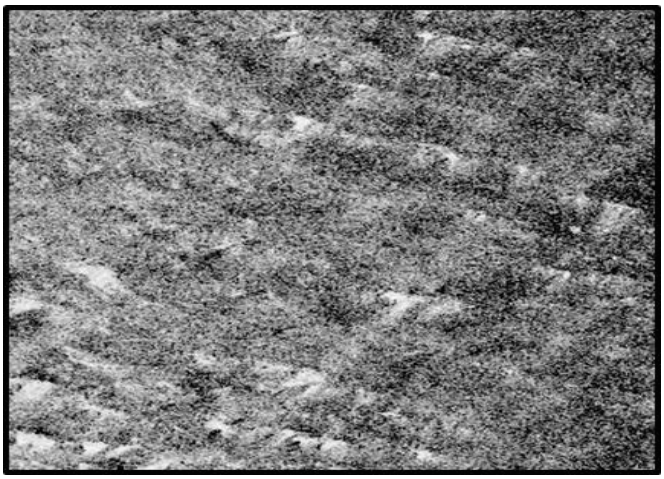


Image 6. Side scan sonar image of Sample station 14

Figure 13. Side Scan sonar interpretation showing suggested sediment types

Discussion

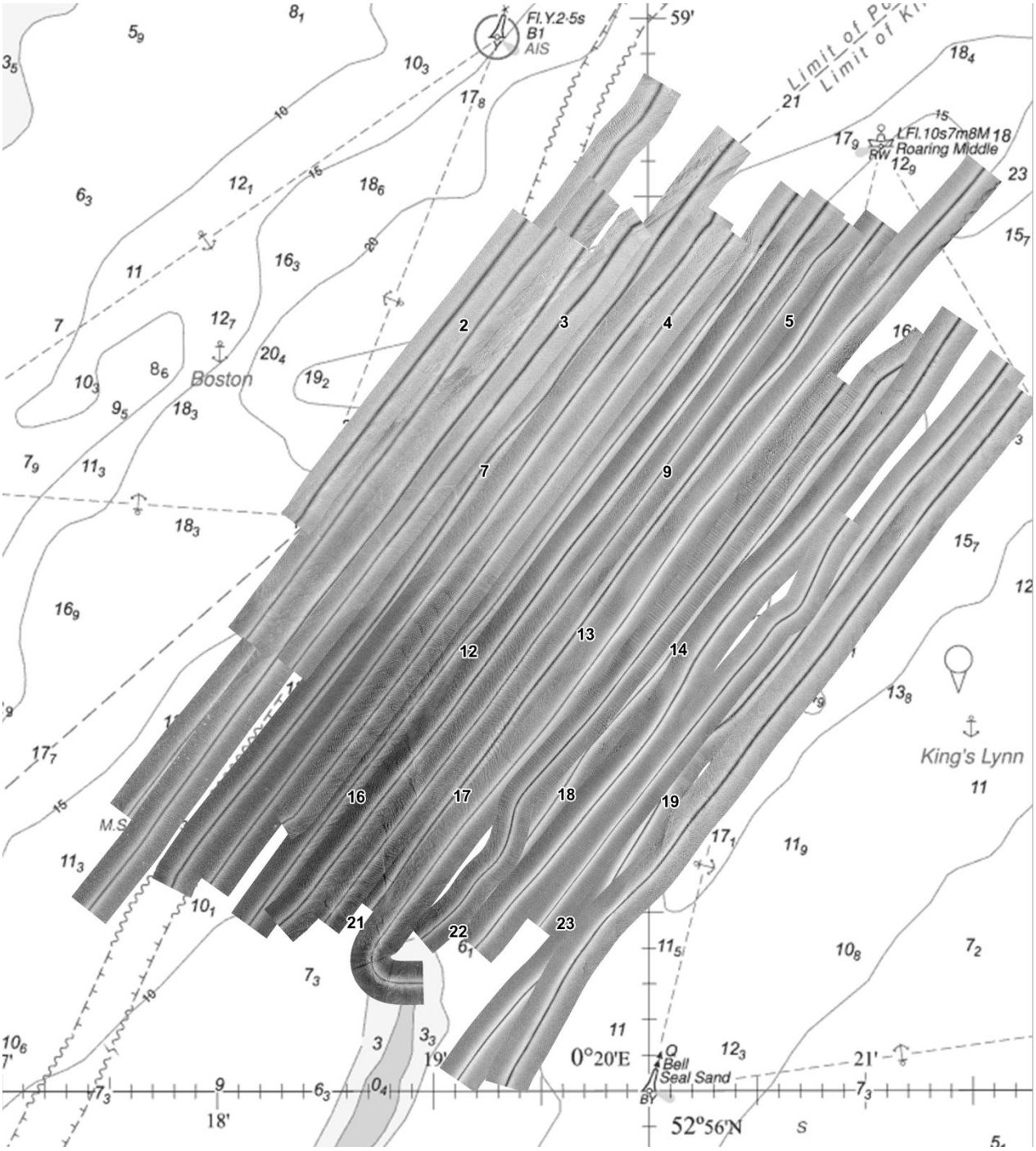
The three survey days enabled us to gain sufficient data to suggest the habitat type and sediment composition within the surveyed area. The habitat mapping using the side scan sonar provide complete coverage of the survey box and enabled us to produce a mosaic from the side scan sonar images and identify acoustically distinct regions.

Ideally the acoustic data should be processed prior to ground truthing to inform the sampling strategy however due to weather constraints, this was not possible and so 16 stations were positioned to evenly cover the survey box. This meant that some of the regions that were highlighted as being acoustically distinct following analysis of the side scan data may not have had ground truthing data. This may limit the interpretation of the side scan sonar images as there is no supporting groundtruthing data.

The ground truthing was successful. Camera images captured from the sea bed supported the sediment samples obtained using the Day grab and enabled the habitat type to be determined. The PCA of this data was used to group sites according to their sediment composition.

Further survey work was planned in order to extend this survey area however survey work had to be called off due to bad weather.

Appendix



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This Image shows the side scan sonar mosaic of the survey lines carried out in box A.

References

Ke, X., Evans, G., & Collins, M. B. (1996). Hydrodynamics and sediment dynamics of the Wash embayment, Eastern England. Sedimentology, 43, 157.

Lart, W. (2014). Overview of the evolution of the assessment and management of the Northern European skate and ray fishery. No. SR674) Seafish.

Natural England. (2005). The Wash and North Norfolk coast SAC UK0017075.

Natural England. (2015). The wash SPA: Site information (draft) Natural England.