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Mapping the distribution of benthic biotopes around the Isle of Wight

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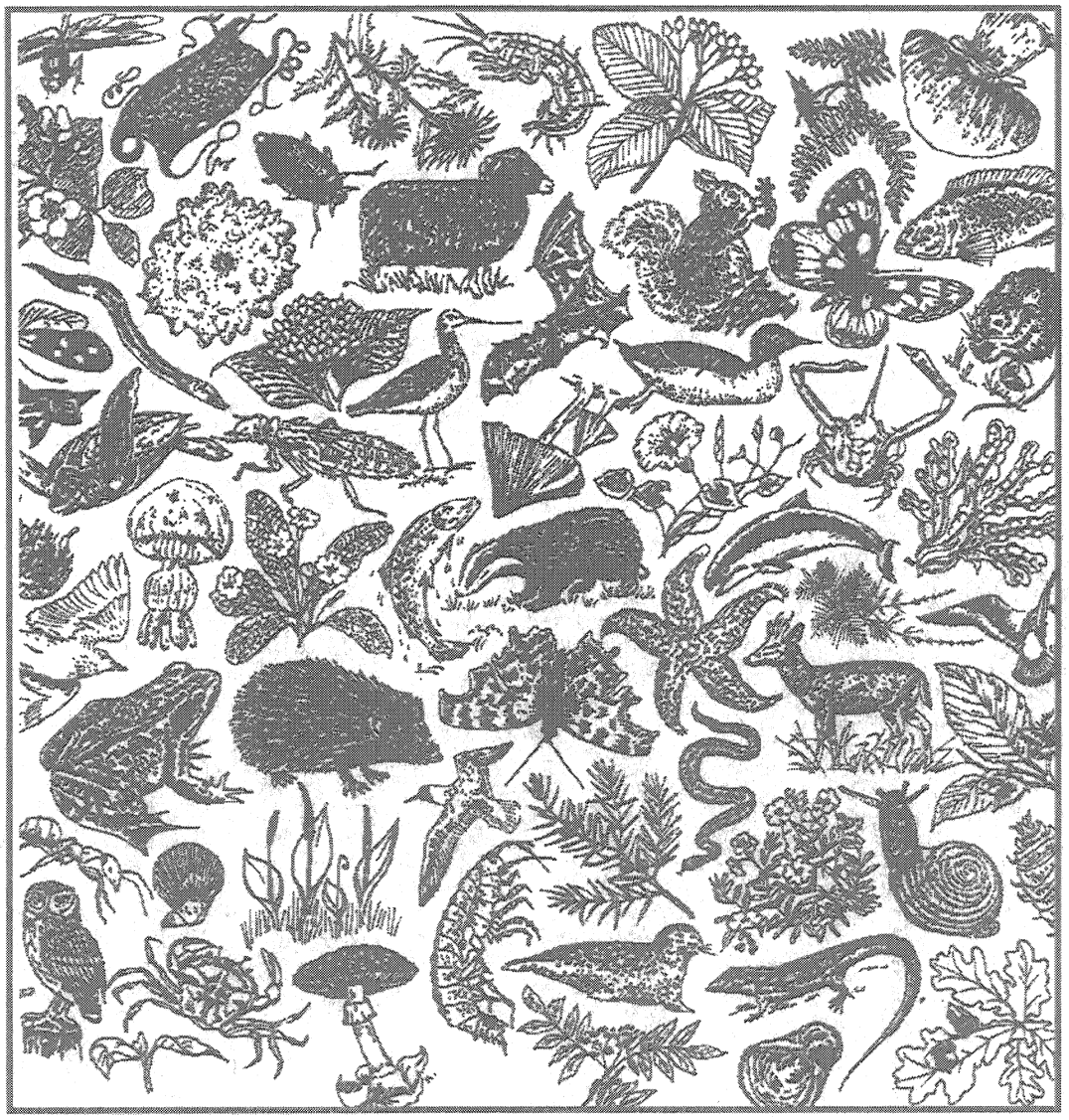

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Mapping the distribution of benthic biotopes around the Isle of Wight

Ian Sotheran & Bob Foster-Smith

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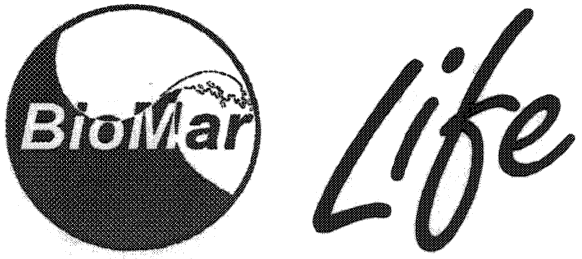

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January 1995

BioMar is 50% funded by the Commission of European Communities
under the LIFE programme

A collaborative study between English Nature and the BioMar programme

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Preface

The survey of the marine environment around the Isle of Wight has been undertaken as part of the BioMar Project which is funded by the European Community through the LIFE Programme. The BioMar Project partners are Trinity College (Dublin), The Office of Public Works (Irish Republic), The Joint Nature Conservation Committee, AIDE Environment (The Netherlands) and Newcastle University. One of the main aims of the BioMar Project is to devise a classification system for marine biotopes of the north-east Atlantic seaboard and to produce information on their range and distribution of in order to aid conservation assessment and the development of appropriate strategies for coastal zone management (CZM). The partners based at Newcastle University have the additional tasks of developing techniques for biotope mapping and applying them to specific management case studies in collaboration with other organisations.

English Nature provided a contribution to the BioMar project to cover the costs of the field survey and reporting for the present project.

Introduction

Management of the living resources and landscapes of the marine environment requires an inventory of these resources and their geographic location. Thus, mapping marine habitats (biotopes) forms a very useful basis for making decisions on the best approach for conserving the natural heritage of coastal waters. Therefore it is proposed that a baseline resource survey be conducted of the marine environment adjacent to a the south coast of the Isle of Wight from Bembridge to The Needles.

The survey was conducted using MV *Mary Lisa*, under the command of Mr. D. Burden, Portsmouth.

A baseline resource survey would have three objectives:

i Undertake a broad-scale acoustic survey to determine the major physical habitats present within the area together with their geographic distribution.

ii Ground truth the acoustic survey using a video system to match the biological features with the physical habitats.

iii Produce colour maps of the geographic distribution, and an inventory of the major biotopes within the survey area.

Survey area

Three areas were surveyed and are shown in Figure 1:

i The East coast of the Isle of Wight - the area included in the survey was from Bembridge to the North to St. Catherine's point to the south.

ii The south west coast of the Isle of Wight - the area surveyed extended from St. Catherine's point to the east, and concentrated on the Needles to the west.

Methods

BioMar at Newcastle University have been developing a survey protocol for mapping the seafloor using acoustic techniques validated by biological sampling with the data stored and analysed in a geographic information system (GIS).

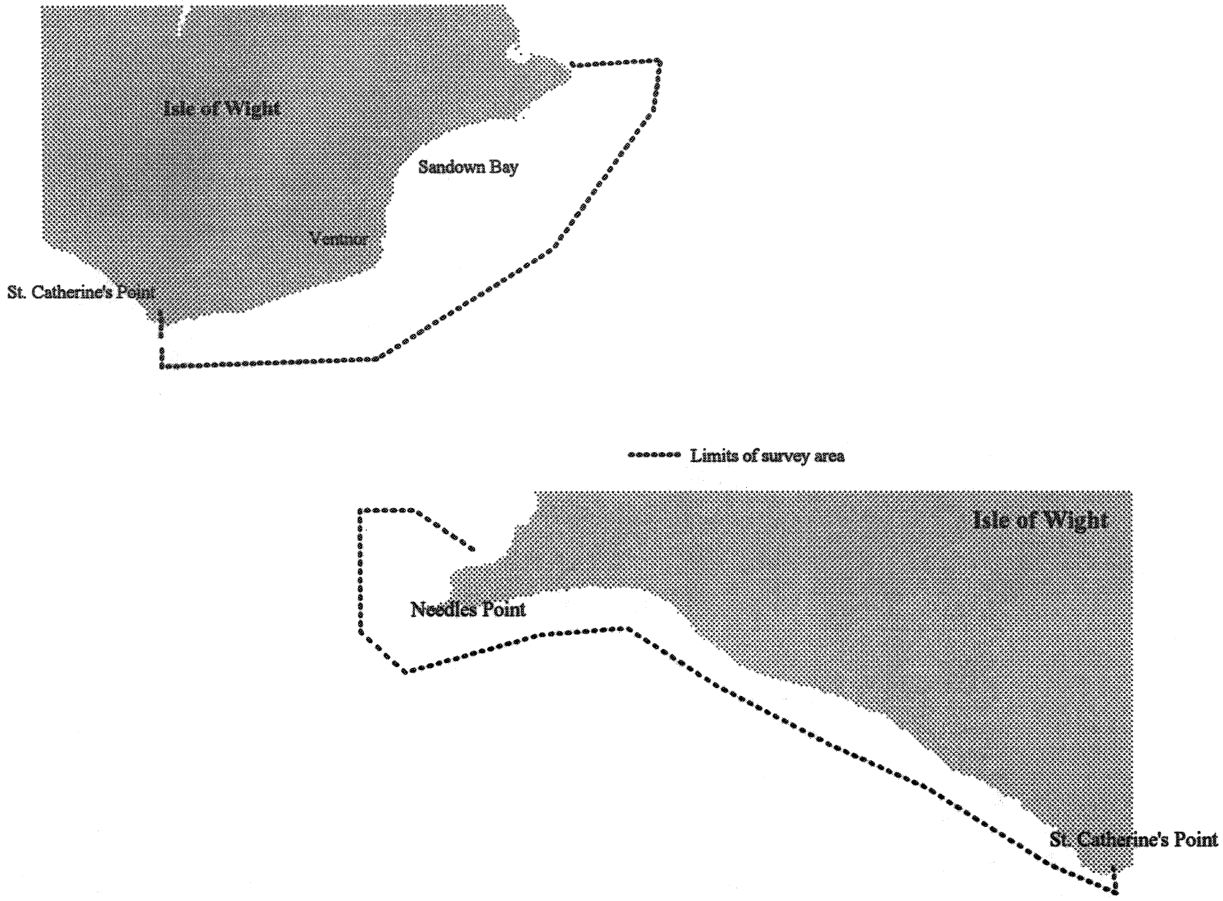


Figure 1 Location of survey areas

Acoustic surveying

Acoustic surveys of the sea-floor were undertaken using a *RoxAnn* processor which samples the return echo from a 200 kHz echo sounder; Chivers *et al* (1990)) provide a detailed description of this system. In addition to depth, *RoxAnn* generates two measurements derived from the first (E1) and second (E2) echoes which can be interpreted as measures of roughness and hardness of the sea floor respectively. Position was provided by a Global Positioning System (GPS) using a differential receiver which has a published accuracy of ± 15 m (Trimble™ GPS with Scorpio Marine™ differential receiver). *RoxAnn* data were saved at 5 sec time intervals on a laptop computer; the computer also supplies time and date for each data point. Whilst the boat travels along a set path, a continuous set of measurements (or track) of the physical nature of the sea-bed were recorded and displayed on the computer utilising *Microplot* navigation software (Figure 2).

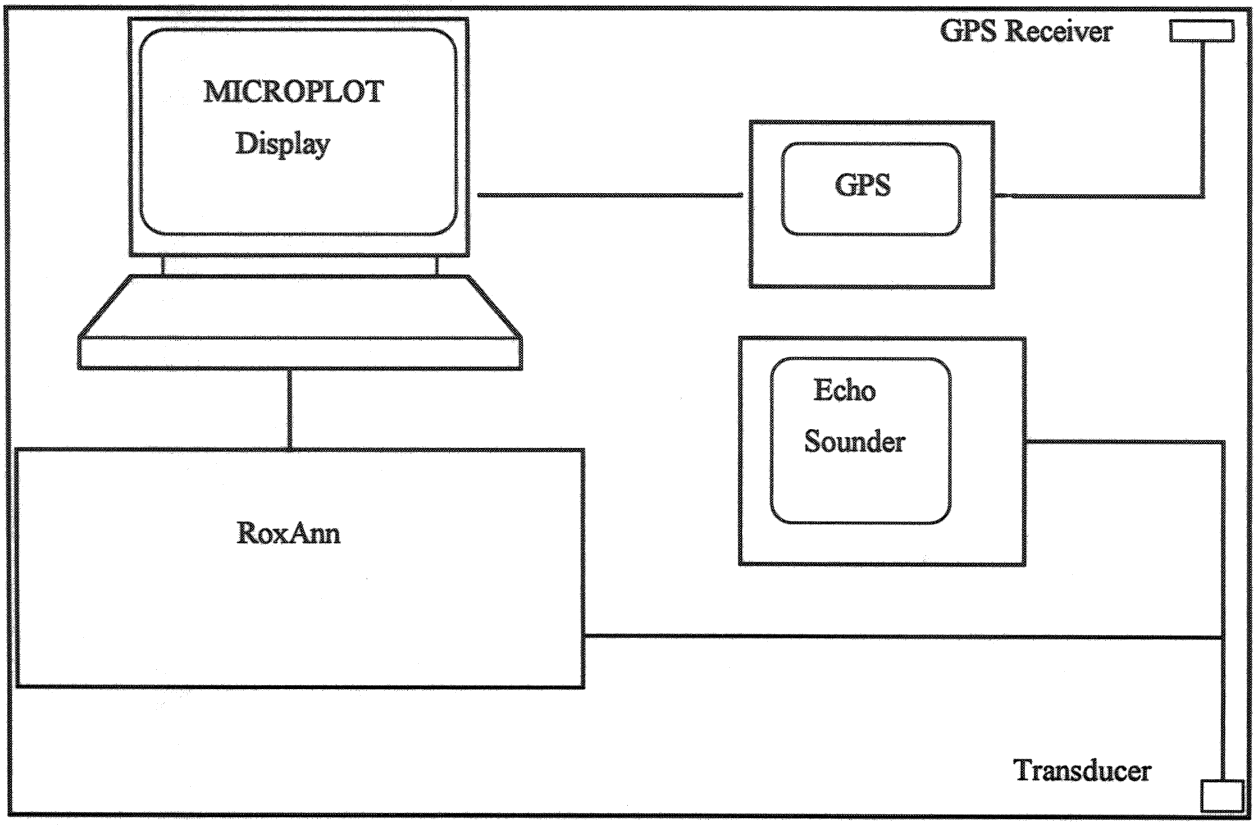


Figure 2 Schematic diagram of acoustic survey equipment

Microplot displays the track data on the computer screen superimposed if required on a map or chart of the coast. The track is coloured according to combinations of E1 and E2 or by depth.

Acoustic tracking

Information is obtained from a limited area under the survey vessel as it proceeds and a map of the acoustic properties of the sea floor is built up from a series of tracks: the closer the tracks are to each other, the more complete is the coverage. Nearshore coastal geology combined with coastal geomorphic processes generally produce a heterogeneous assemblage of physical habitats which results in the contagious distribution of associated natural assemblages. Further offshore where the seabed is predominantly sedimentary, there is generally less heterogeneity with large areas comprising similar sediment types. Consequently an adaptive survey strategy (Simmonds *et al*, 1992) was employed where the survey area was tracked at a broad level (0.5 km) and then heterogeneous areas, or areas of specific interest, were tracked in more detail (0.25 and 0.125 km spacing) to determine the spatial organisation of seabed characteristics.

Sampling

Acoustic mapping using the *RoxAnn* system provides data on the physical nature of the seabed - depth, smoothness/roughness and softness/hardness. These acoustic data have no biological meaning unless they are related to biological assemblages, or biotopes, determined from direct observations or samples of the sea-bed at predetermined point locations. In remote sensing terminology, the acoustic data must be validated with *in situ* biological sampling and, if possible with additional 'collateral data' such as seabed geology, tidal streams (Barrett & Curtis, 1992). *In situ* validation data may be existing sample data from previous investigations, although it is

preferable to collect new data the location of which can be accurately matched to acoustic tracks. New data can also validate existing data which may be valuable in dynamic environments subject to rapid change.

Biological data was collected using a towed video recorder and by grab sampling. A small remote video system using a standard Hi8 camcorder in a waterproof housing mounted into a small sledge was employed as the principle ground validation device. This system is connected by an umbilical to a monitor at the surface and can be towed along the sea floor as the boat drifts.

Data analysis

Preliminary analysis of acoustic data

Preliminary analyses are completed during the field survey both to select areas for more detailed tracking and to locate *in situ* samples. These analyses are completed within the software. Initially tracks were analysed to show small increments in the values of E1 (roughness), E2 (hardness) and depth by assigning colours to ranges of data. Basic contour maps were prepared for each variable by contouring equal-value points (isopleths) and then overlaying these maps produced a composite map which indicated areas with similar acoustic and bathymetric characteristics. During the field survey these maps were used to select sites for ground truthing: sites were selected to represent the range of E1, E2 and depth values indicated on the initial maps.

Analysis of ground-validation samples

Recordings from the camera were replayed for analysis and these records form the basis for the descriptions of the biotopes. Video recordings were analysed by a number of physical and biological characteristics where the terminology used for describing physical characteristics is that used by the Marine Nature Conservation Review of the Joint Nature Conservation Committee (Hiscock, 1990). For biological description emphasis is placed on recognising various life forms where the terms have been developed from *Seasearch* methods (Foster-Smith, 1992) for the *BioMar Project*. The biotopes present were then categorised according to a standard national classification system which is flexible enough to allow for local variation (Connor *et al,* In press). Whilst it is possible to distinguish some individual biotopes (and even to detect variations within a biotope type) using remote video, to achieve a consistent level of detail in the final biotope map it was necessary to group biotopes into generic biotope categories or life form groupings.

Matching acoustic data to biotopes

Matching biotopes to acoustic properties of the sea floor enables the distribution of biotope categories to be shown on a map. Initial matching was undertaken within *Microplot* by adjusting the boundaries of the map of acoustic/depth properties through editing the display of the acoustic data. These data were then exported from *Microplot* and post-processed using the spreadsheet *Excel* (Microsoft Ltd), the contouring program *Surfer for Windows* (Golden Software Ltd), and *Camris*.

Bathymetry

Acoustic track data were corrected to chart datum using tidal corrections calculated from the tidal prediction program using the simplified harmonic method produced by the UK Hydrographic Office (Anon, 1991). Corrections were applied hourly by taking the hour from 30 minutes before to 29' 50" after the hour: *i.e.* the correction for 12:00 would be applied to data from 11:30:00 to 12:29:59. These data were transferred to the contouring program *Surfer for Windows* to produce bathymetric maps for the survey areas. To convert the track data into a continuous coverage, it

was necessary to interpolate adjacent track data to calculate values for intermediate areas. Standard geo-statistical procedures were employed for the interpolations; a review of geo-statistics suggested that the procedure *krigging* was most suited to random data points (Rossi *et al.* 1992). *Surfer for Windows* provides a krigging algorithm to reduce the track data to a rectangular grid of data points for the survey area; a grid size of 100 m by 100 m was selected for the present project. A bathymetry map was produce for each survey area (Figures 6 & 7).

Results

The BioMar team from Newcastle University surveyed the Isle of Wight during the period 28th June to 2nd July, 1994. Two areas were surveyed:

i Bembridge point to St. Catherine's point (Figure 3).

ii Needles point to St. Catherine's point (Figure 4).

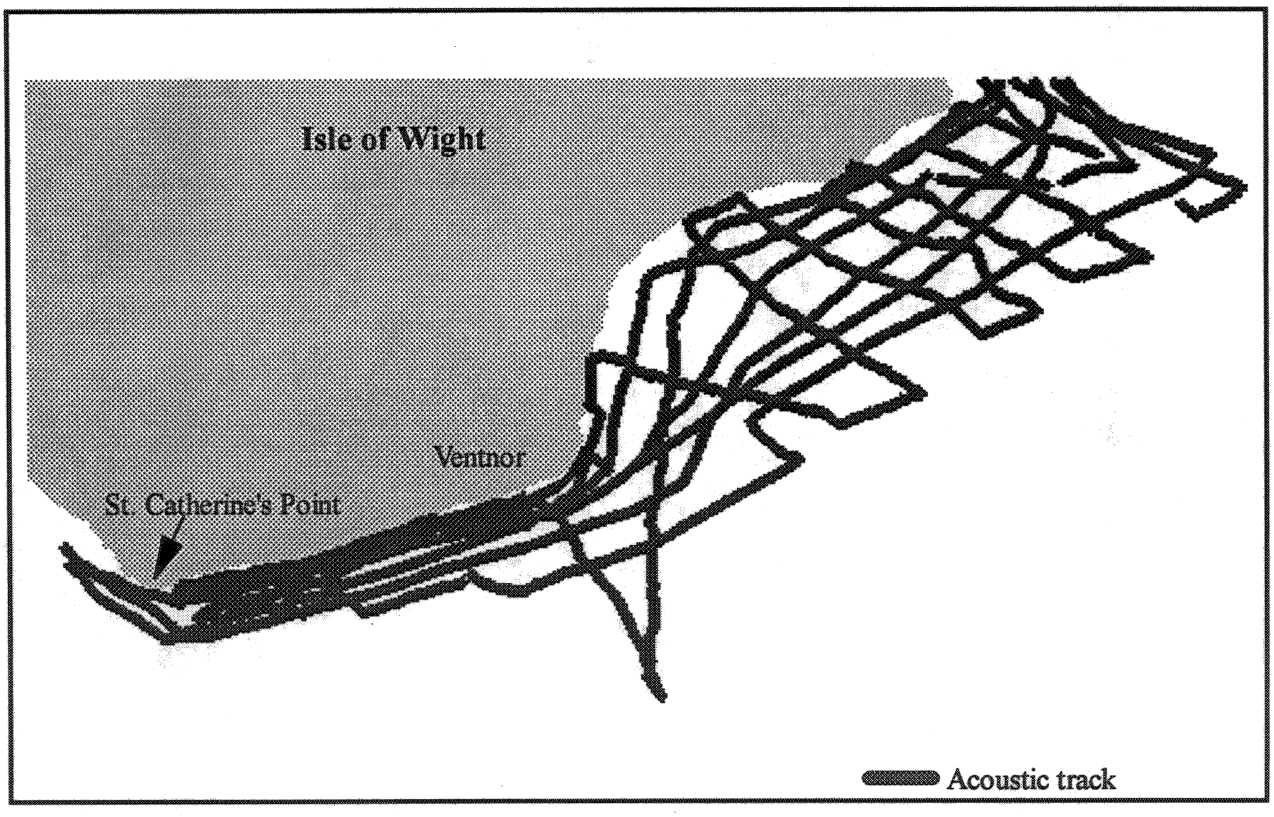


Figure 3 Location of the acoustic track between St. Catherine's point and Bembridge point.

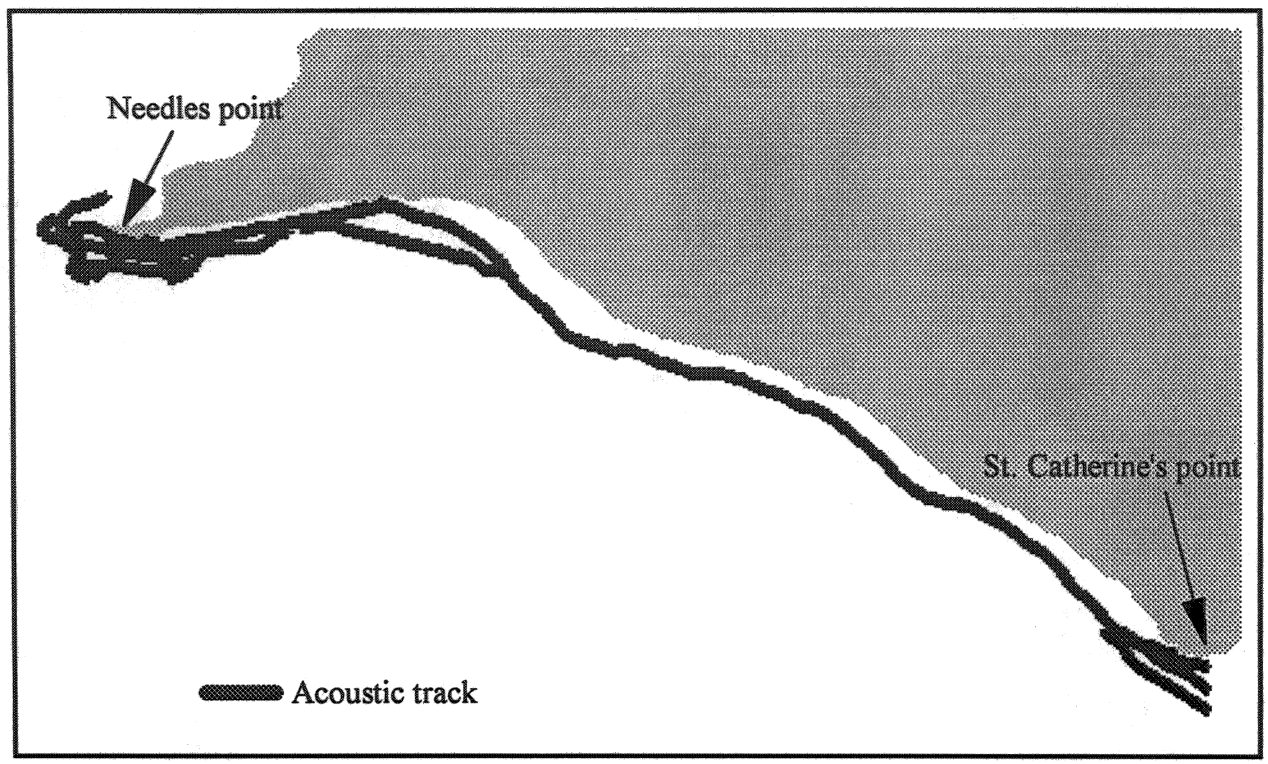


Figure 4 Location of the acoustic track between Needles point and St. Catherine's point.

From these areas, a total of 49 video samples were collected.

Figure 5 Bathymetry for the coast between Bembridge and St. Catherine's point.

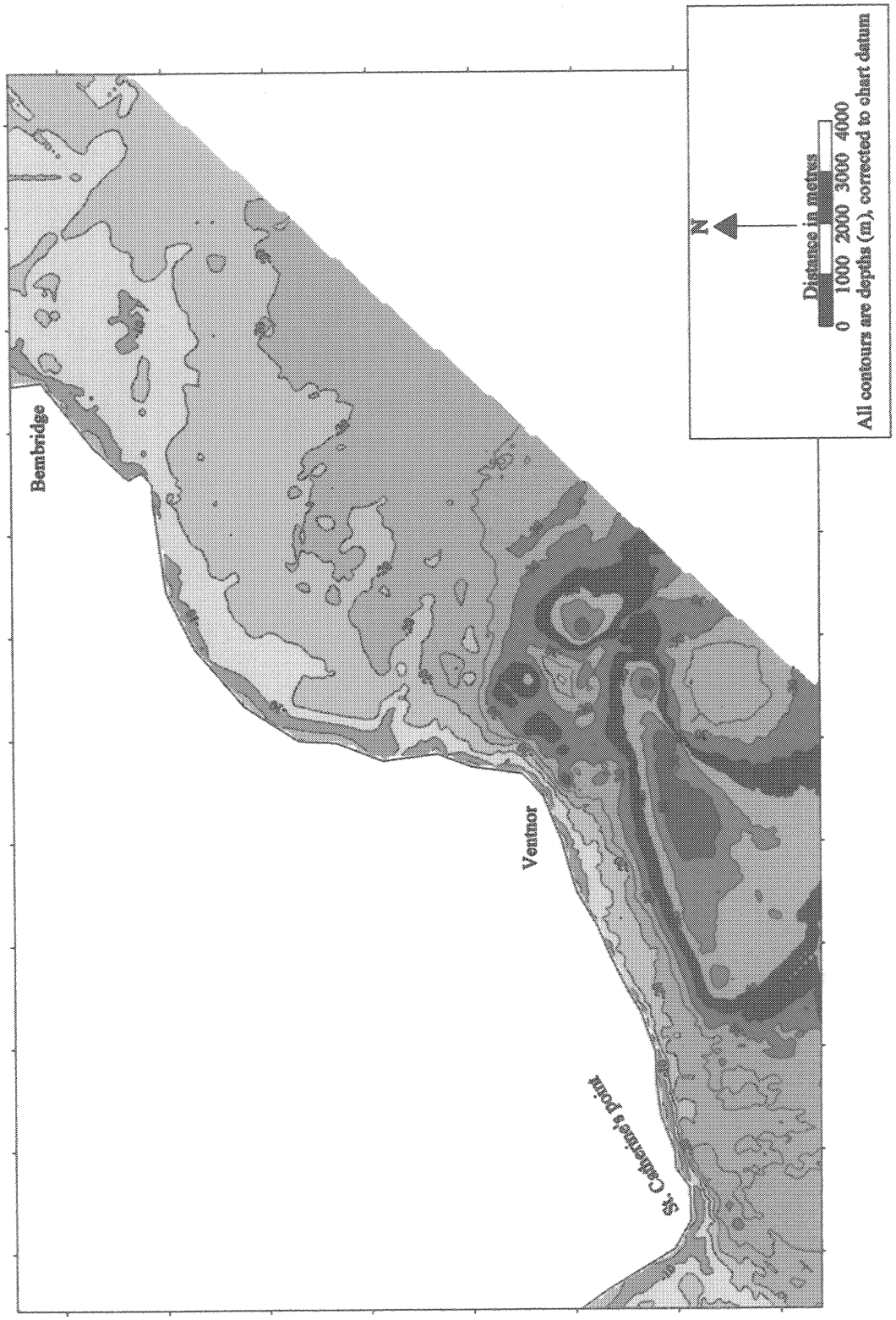
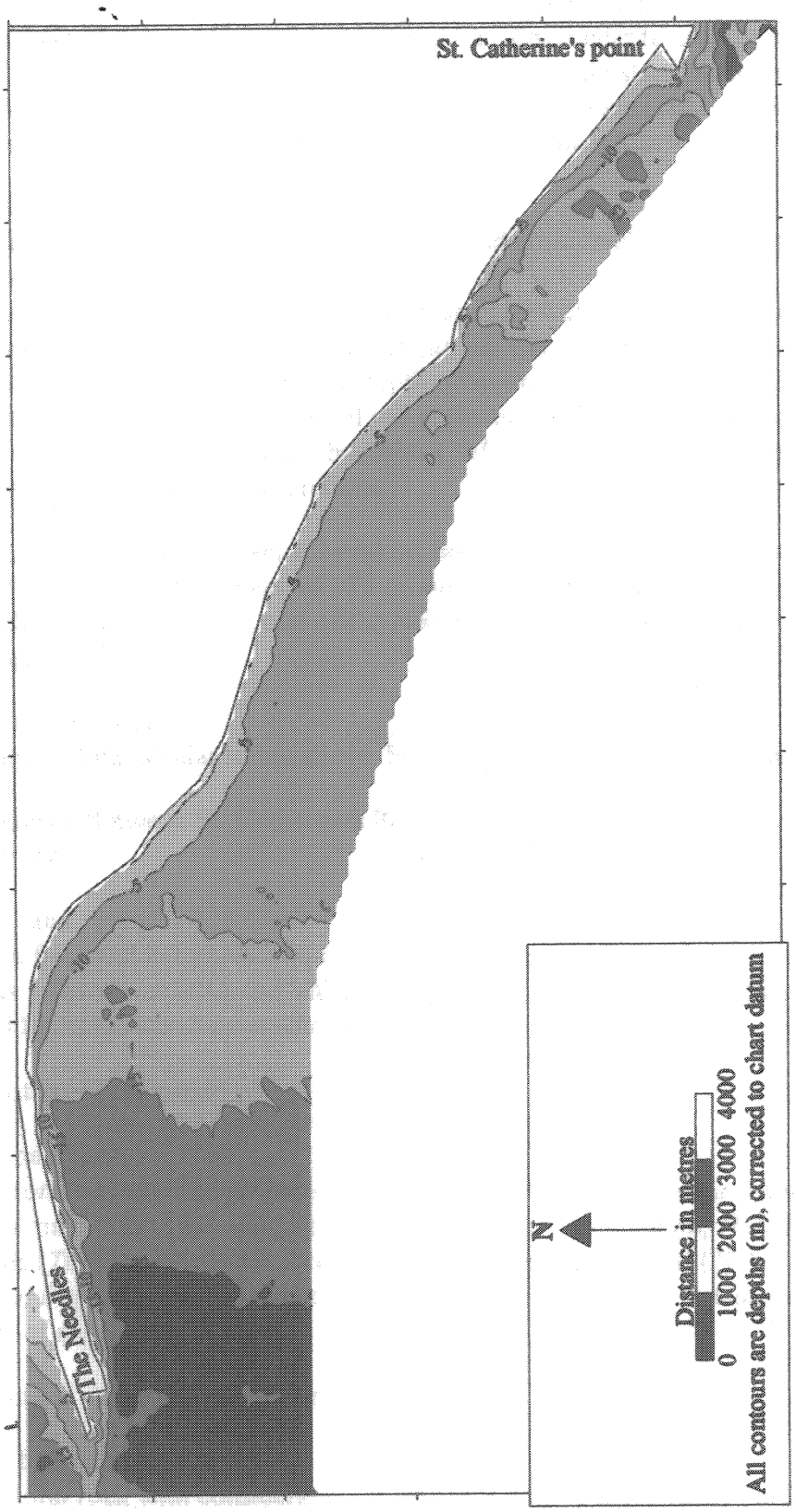


Figure 6 Bathymetry for the coast between St. Catherine's point and the Needles.



Distribution of biotopes

Following the analysis of the video samples and sediment samples, 11 biotope groups were identified (see below). Many of the biotopes are very similar to each other in species composition and reflect changes in silt influence or substratum type. Illustrations of many of these biotopes are to be found in the SEASEARCH publication for West Sussex (Irving, 1994). Spatial distributions of these biotopes for the survey area are shown in Figures 8 & 9.

1. Shallow reefs.
Bedrock and boulders with silty sand patches and considerable silt accretions over the rock surfaces.
Laminaria digitata was widespread in very shallow water and a dense turf or red algae (including *Plocamium cartilagineum, Deleseria sanguinea, Ceramium* spp.) richly overgrown with epifauna (*Electra pilosa*) extended down to a depth of approximately 10m. Vertical surfaces were densely overgrown with a short turf of mixed red algae and epifauna, including sponges (*Amphilectus fucorum, Halichondria panicea*), hydroids (*Tubularia larynx*), bryozoans (*Bugula turbinata*) mixed with considerable silt accretions.

Distribution: The predominant substratum east of St. Catherine's Point was of boulders, often very large. The Needles consisted of a pronounced bedrock reef with a very dense mixed turf and reduced silt influence whilst east of the Needles the bedrock was very broken with deep gullies and large boulders.

2. Boulders in sand.
A shallow habitat similar to the above, but with a sparse red algal turf and dense silt accretions.

Distribution: Between St. Catherine's Point and Ventnor, but probably widely distributed around shallow reefs.

3. Silty sand.
Medium fine sand in ripples with considerable evidence of organic material in troughs. No obvious infauna was observed, although *Arenicola marina* casts and holes that might have been created by *Echinocardium cordatum* were seen.

Distribution: Widespread.

4. Boulders in shell gravel.
Circalittoral boulders in locations were tidal currents might be enhanced with shelly gravel. A faunal turf, often quite rich, with sponges *Amphilectus fucorum, Halichondria panicea*), hydroids (*Tubularia indivisa, Nemertesia antennina*, sertularians (?) bryozoans (*Flustra foliacea, Bugula turbinata,* unidentified encrusting bryozoans), *Pomatoceros triqueter* and patches of encrusting corallines.

Distribution: Around St. Catherine's Point.

5. Silty bedrock/boulder.
Circalittoral rock with considerable silt influence with reduced faunal turf.

Distribution: Rock bordering silty sand.

6. Shallow cobble.
Lower infralittoral to circalittoral cobble/gravel and boulder with shelly sand and silt forming extensive level plains.
Rocks with Coralline crusts, *Pomatoceros triqueter* and a sparse faunal turf of hydroids, erect bryozoans (*Alcyonidium hirsuitum*) and *Urticina* spp..

Distribution: Probably extensive between Bembridge and Sandown and a restricted area next to the reef at the Needles.

7. Shelly gravel.
Extensive beds of shell (apparently *Mytilus edulis* and *Crepidula fornicata*) and rock gravel.
Community similar to '6' above, but a reduced epifauna.

Distribution: Probably intermingled with '6' and also extending to the south west towards Ventnor.

8. Deep reefs/boulder.
Level bedrock reefs (clay?) with boulder/pebbles in the circalittoral with silt influence.
A rich faunal turf of sponges, hydroids, bryozoans (including *Flustra foliacea* and *Alcyonidium hirsuitum*), *Urticina* spp. and (in some locations) signs of piddock holes in rock.

Distribution: Widespread. The rock around the Needles also supported a sparse growth of *Alcyonium digitatum.*

9. Cobble/rich turf.
Cobble and gravel forming an extensive level plain.
A rich turf, similar to '8' above. Although apparently similar, the acoustic signal was much harder and indicated a sharp boundary between biotopes '8' and '9'.

Distribution: Offshore from biotope '8' at Bembridge.

10. Deep boulder/bedrock.
Very large boulders stacked up on each other forming very impressive scenery in deep water (20-40m). Very silt influenced.
Encrusting sponges and bryozoans and a rich but short turf of hydroids and erect bryozoans (*Bugula turbinata*). Apparently rich in fish life.

Distribution: Deep water between St. Catherine's Point and Ventnor; possibly extending further to the south east. Rocks form impressive slopes into St. Catherine's Deep.

11. Deep mussel beds.
Sandy, shelly substratum with dense bed of *Mytlius edulis*. These were relatively small and clean, so giving the appearance of being recently settled.

Distribution: Deep water south of Ventnor (St. Catherine's Deep)

Figure 7 South east Isle of Wight Biotope Distribution.

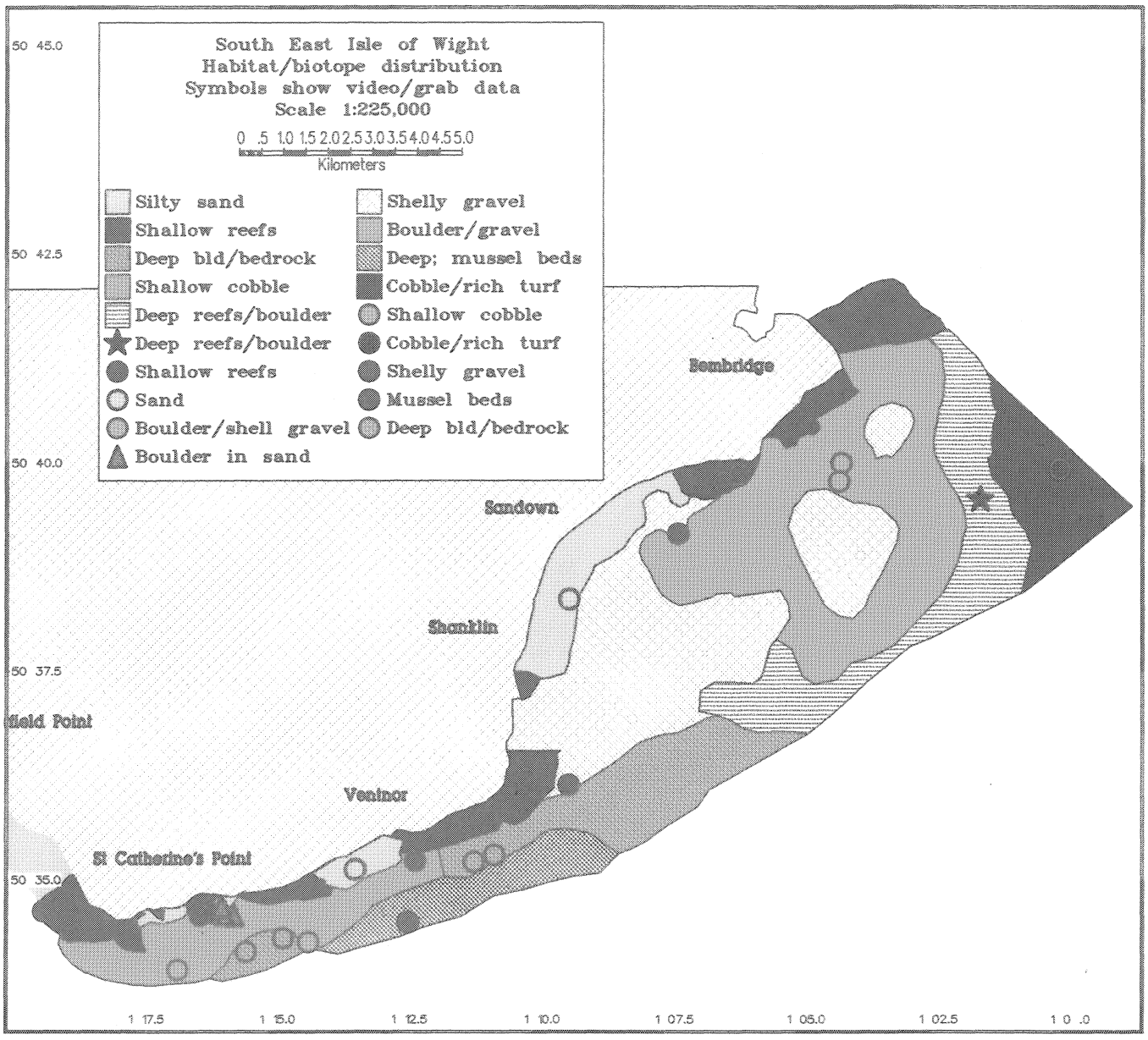
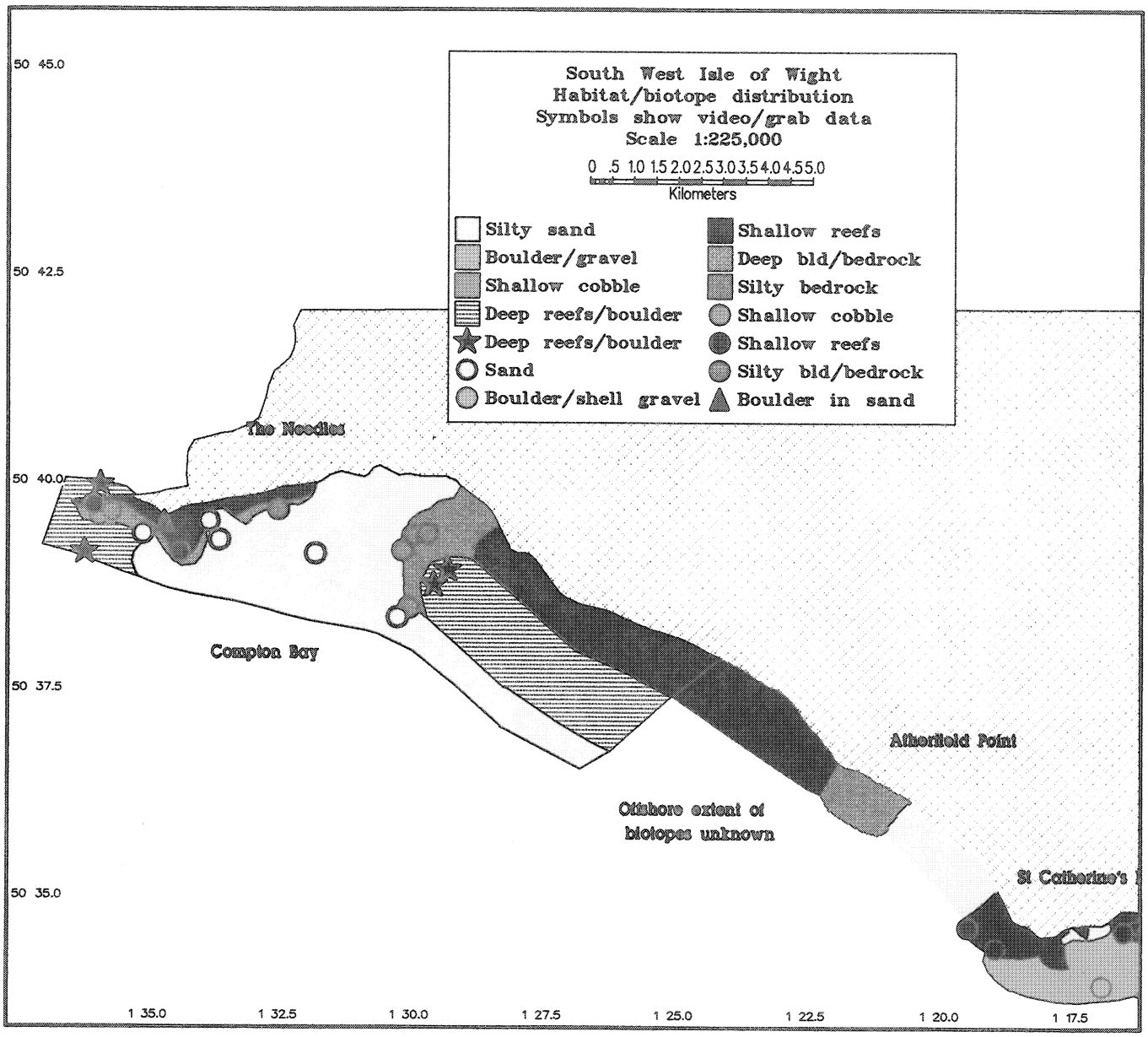


Figure 8 South west Isle of Wight Biotope Distribution.



Conclusions

The sediments within the survey area have been mapped by the BGS (Larminie, 1989) which indicate the area to be dominated by gravelly sand with a complex of more mud influenced gravel off Bembridge (Figure 9). A recent bulletin produced for SCOPAC and the Crown Estate (reference unknown; source EN) reports that the area is influenced by moderately mobile sediments with sediment transport directed eastwards along the southern coastline of the Isle of Wight until the confluence is reached with another sediment transport route from the Solent directed south and east. Clearly the area is highly influenced by mobile sediments, particularly of silt.

The BGS map of seabed sediments, however, makes very little reference to the rocky component of the substratum. Boulders (often spectacularly large) were abundant throughout the survey area and had a considerable influence over the biotopes represented.

The biotopes themselves were rather restricted in species composition with the same conspicuous species being found on a range of different substrata. There was, however, a general pattern to the offshore habitats of level cobble/gravel/shell plains between Bembridge and Ventnor giving way to boulder slopes around St. Catherine's Deep. The coast from St Catherine's Point to the Needles was of silty bedrock with current-swept cobbles at the Needles themselves.

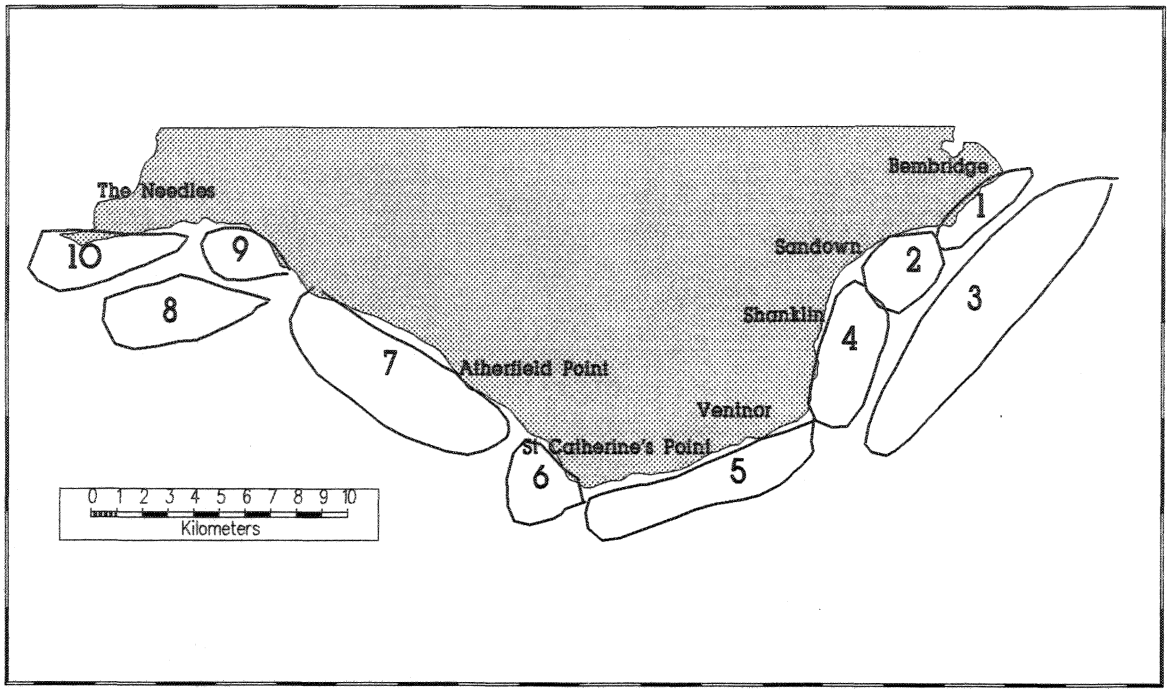
The general distribution of biotopes found during the survey agrees well with notes provided to EN by Ian Killeen, which has been reproduced below (Figure 10).

Figure 9. Distribution of seabed sediments (Larminie, 1989) ©National Environmental Research Council.

Reproduced from Britsh Geological Survey Chart.

1cm = 425m (~1:43500)

Figure 10. Anotated map of habitats (Killeen, *pers com*).



Reproduced with kind permission of Ian Killeen.

1. Shell, gravel, cobble etc.
2. Varied; shell gravel, sand, clay reef etc.
3. Cobble with *Dendrodoa* etc.; rich!
4. Sand, silt and mud. Rich for infaunal molluscs.
5. Mainly slabs of rocks of greensand. Impossible to grab, dredge. Potentially rich.
6. Sand, shingle, rather scoured with low species diversity.
7. Wealden reef, clays and has sandstone. Difficult to sample, relatively low diversity. Water is very turbid.
8. Shingle and shell gravel.
9. Small area of muddy sand. Rich for benthic infauna.
10. Cobble, chalk platform, gravel etc. Potentially rich.

BioMar Project: University of Newcastle

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