Kentish Flats
Wind Farm Development

Macrobenthic Ecology Study- 2007

Final Report
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EXECUTIVE SUMMARY

Kentish **F**lats **L**td (KFL) developed a Wind Farm within the outer Thames Estuary and offshore of north Kent. The site occupies an area of 10km^2 and lies approximately 8.5km north of Herne Bay. The scheme is in response to authoritative licensing of Wind Farm developments, which are necessary to fulfil government commitments to the increased exploitation of renewable energy resources.

As part of the application process for permission to develop the Kentish Flats site, a full **E**nvironmental **I**mpact **A**ssessment (EIA) was required. A baseline ecological survey was conducted prior to commencing the work in order to provide baseline data on the physical and biological conditions of the development site. A series of post construction benthic surveys are required as part of **F**ood and **E**nvironment **P**rotection **A**ct 1985 (FEPA) licence No. 31780/03/0 in order to detect if any changes have occurred within the benthic environment following commencement of work.

The 2007 macrobenthic ecology survey within Kentish Flats is the third in a series of studies following the development of the Wind Farm. The data generated from the survey were analysed and compared with those obtained from previous surveys, including the 2002 baseline study and the 2005 and 2006 post-construction studies. The aim was to investigate if any significant changes have occurred with respect to the physical characteristics and associated biological communities of the benthic environment that might be attributable to the construction or operation of the Kentish Flats Offshore Wind Farm.

Results from the 2007 survey showed that sand was the main sediment fraction across the survey area, with sorting coefficients ranging from very well-sorted to extremely poorly-sorted. A spatial pattern of sediment distribution was identified within the survey area. Specifically, the most offshore sites comprised homogeneous sediments, characterised by relatively well-sorted sands. These stations included the majority of sites within the secondary impact and the northern reference areas. These sites are the most exposed within the survey area and as such subjected to high variable hydrodynamic regimes. As a result, the habitats are more dynamic with greater sediment transport.

The more central stations within the survey area comprised more heterogeneous sediments, with higher percentages of gravel and mud. These sites comprised the majority of the stations within the development site, the southern reference area and selected sites within the scour assessment area. Samples from these stations showed higher levels of intra-samples variability, indicating heterogeneity of the sediment on a small scale. Finally, the most inshore sites comprised mixed sediment with the highest percentage of mud. These sites comprised the majority of stations within the cable corridor. These sites are the most sheltered within the survey area with little influence from wave action. Consequently, little sediment transport can take place and levels of mud accumulate increasing the sediment compactness.

Comparisons with previous years' surveys showed that this pattern of sediment distribution across the survey area has been maintained over time. Temporal variations of the sediment composition within the different areas were considered to be not significantly different, each area retaining a high degree of similarity of the sediment composition over time. Spatial variations between the different areas were significant and consistent over time.

Results of the macrobenthic analyses revealed a macrofauna broadly associated with the substrate type. As such the macrofauna distribution across the survey area also showed a pattern. Specifically, mobile sands, typical of the offshore sites (i.e. the majority of sites within the secondary impact and the northern reference areas) supported an impoverished macrofaunal community, characterised by more actively swimming crustacean amphipods and robust polychaetes worms which are characterised by flexible body structures and the ability of rapid burrowing if exposed to physical perturbation. These stations supported little epifauna represented by selected species of bryozoans.

The central part of the survey area hosted more stable and diverse communities including a high diversity of epifaunal species. This part of the survey area comprised the majority of sites within the development site, the southern reference area and selected samples from the scour assessment area and the cable corridor. This area extended inshore, gradually giving way to a community characterised by species typical of muddier sediments. This community was recorded at the most inshore part of the survey area which comprised sites within the cable corridor.

Large transitional areas were recorded between the offshore and the inshore communities, characterised by relatively diverse benthic communities associated with the sediment type and the degree of exposure. These transitional areas were generally characterised by less exposed and more stable sands, hosting a faunal community characterised by species typical of more compacted sands. These transitional areas comprised the more inshore stations within the secondary impact area and selected sites from the development site and the scour assessment area.

Comparisons with previous years' survey showed that this pattern of macrofauna distribution has been maintained overtime, however, temporal variations of the benthic communities were significant. Such differences were not considered to be associated with the construction or operation of the Kentish Flats Offshore Wind Farm, but rather with natural variability, which may include fluctuations in recruitment success, inter-species competition for space and food and seasonal patterns of disturbance such as storms, harsh winters and oxygen deficiencies.

The occurrence of the colonial epifauna within the survey area showed a similar pattern of distribution within the survey area with the highest number of species recorded within the central and more inshore sites. Similar pattern of epifaunal occurrence and distribution were recorded over time across the whole survey area as well as within each individual area.

Faunal assemblages from the trawl samples comprised a relatively wide array of species and higher taxa including fish, crustaceans, molluscs and echinoderms. Sessile epifauna included species of cnidarians, poriferans, bryozoans and ascidians. Nineteen species of fish were recorded across the survey area in 2007, of which six are commercially important. Similar trend of fauna distribution were recorded from the trawl samples in the different areas, with the crustaceans and the fish dominating the species diversity. With the exception of the reference area, the echinoderms dominated the abundance, whereas the crustaceans dominated both species diversity and abundance within the reference area.

The species composition of samples from the trawls showed little temporal fluctuations across the survey area. The most evident temporal trend was associated with a gradual decline of the mean number of fish species since the study begun, and a concomitant increase in the mean number of molluscs and, to a lesser extent, echinoderms. The mean crustaceans' species diversity showed very little fluctuations over time.

Temporal variations were evident in all areas and are not considered to be associated with the construction or operations of the Kentish Flats Offshore Wind Farm.

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ACRONYMS used in this document

ANOSIM	Analysis Of Similarity
BS	British Standards
CEFAS	Centre for Environment, Fisheries and Aquaculture
DEFRA	Department of Environment Food and Rural Affairs
DGPS	Differential Global Positioning System
EIA	Environmental Impact Assessment
FEPA	Food and Environment Protection Act
ISO	International Standards Organisation
KFL	Kentish Flats Limited
MCS	Marine Conservation Society
MDS	Multi Dimensional Scaling
MNCR	Marine Nature Conservation Review
PRIMER	Plymouth Routine In Multivariate Ecological Research
PSA	Particle Size Analysis
QC	Quality Control
SIMPER	Similarity Percentage analysis
SIMPROF	Similarity Profile analysis
UKAS	United Kingdom Accreditation Standards
WGS	World Geodetic System

GLOSSARY

Abundance	Number of animals present per unit area
Benthic	Associated with seabed environment
Benthos	Flora and fauna of the seabed
Biomass	Weight of animal flesh, excluding shells
Colonial	A colony of single-celled organisms
Colony	Several individual organisms of the same species living closely together for mutual benefit
Community	Collection of animals which consistently associate with a particular habitat type
Diversity	Variety of species of animals inhabiting a locality
Epifauna	Fauna living on top of the seabed (also referred to as epibenthos)
Epibenthic	Living on top of the seabed
Fines	Clay and silt component of rejected or overflowing dredge material released into the water column
Grab sample	Superficial seabed sample collected by use of a mechanical grab device
Macrofauna	Animals component of the benthos that are retained on a 1mm mesh sieve
Meiofauna	Small component of the benthos that are retained on a 63 mm mesh sieve
Taxon	Grouping of a scientific classification of organisms (pl = taxa)

1.0 Introduction

1.1 Background to the Study

Kentish Flats Ltd installed a Wind Farm within the outer Thames Estuary and offshore of north Kent. The site occupies an area of 10km^2 and lies approximately 8.5km north of Herne Bay.

The scheme is in response to authoritative licensing of wind farm developments, which are necessary to fulfil government commitments to the increased exploitation of renewable energy resources.

As part of the application process for permission to develop the Kentish Flats site, a full Environmental Impact Assessment was required. A baseline ecological survey was conducted prior to commencing the work in order to provide baseline data on the physical and biological conditions of the development site. The data set generated by the survey was accepted by **D**epartment of **E**nvironment **F**ood and **R**ural **A**ffairs (DEFRA) as an appropriate pre-construction data set. The subsequent FEPA licence No. 31780/03/0 required post construction benthic surveys which were conducted in 2005 (after the completion of the monopile foundations and finalisation of cable laying), 2006 (following the installation of the turbines) and 2007.

1.2 Objectives of the Benthic Survey

This study is the third in a series of post construction surveys which aim to assess the impacts of the Kentish Flats Wind Farm development on the physical conditions and associated biological communities within the development site and close environments. The task was achieved by comparing the data obtained during the 2007 survey to those of the 2002 baseline study (Emu Ltd, 2002a), the 2005 first post-construction study (Emu Ltd, 2006) and the 2006 second post-construction study (Emu Ltd, 2007).

Benthic samples were collected by means of a full sized Hamon Grab sampler, with subsequent analysis for macrofauna and sediment components, and by scientific 2m Beam trawl to provide qualitative data on epibenthos and fish species across the area.

The current study focused on macrofaunal communities only. Meiofauna and microflora were not considered and were excluded from the data analyses. Despite making up the majority proportion of the total biomass in marine environments, the ecology and dynamics of marine meio and micro communities are currently relatively poorly understood. As a consequence, their responses to certain activities and events are comparatively less predictable and difficult to interpret. Although some progress has been made towards the use of meiofauna as environmental indicators in recent years (Schratzberger *et al.*, 2000), the taxonomy of these types of organisms is complex especially at the higher levels of taxonomic penetration. Furthermore, field sampling and laboratory processing for meiofaunal components i.e. separation from the sediment matrix and fixation, would require further time consuming and costly procedures and would incur additional levels of control within both the field and laboratory protocols (Kennedy & Jacoby, 1997). Instead, macro communities, which are easily observable, measurable and well studied, are considered more practical as indicators of environmental conditions in the outer Thames Estuary and are more useful as measures of potential change due to the proposed activities at Kentish Flats.

2.0 Methods

2.1 Field methods

Emu Ltd undertook the field Hamon grab and Beam trawl sampling of the benthos and the subsequent laboratory processing of the sediment samples. All methods employed by Emu Ltd conformed to In-House operating procedures and/or **I**nternational **S**tandard **O**rganisation (ISO) 9001 control procedures where appropriate and are described below. The sediment particle size distribution analysis was undertaken at Emu Ltd's **U**nited **K**ingdom **A**ccreditation **S**tandards (UKAS) accredited laboratory.

Taxonomic analysis of the macrofaunal samples obtained by grab and trawl sampling was undertaken by Emu Ltd who are participants in the **N**ational **M**arine **B**iological **A**nalytical **Q**uality **C**ontrol **S**cheme (NMBAQC) scheme. This scheme is an independent, national **Q**uality **C**ontrol (QC) scheme designed to assess the quality of marine benthic taxonomy between laboratories in the UK. Emu Ltd have participated since 1996 and have consistently achieved >95% compliance with the scheme. The subsequent biomass analysis was completed at Emu Ltd's laboratory.

2.1.1 Survey Design

The survey design aimed to provide data on the spatial distribution of the benthic faunal communities across the area, in order to allow the comparison of results with the previous study as well as with future surveys at the same locations. This will enable any potential impacts arising from the Wind Farm development scheme at Kentish Flats to be assessed over time. Sample stations were positioned to include the area covered by a single tidal excursion from the boundaries of the development area, in this case up to a distance of approximately 8km to the west and 8km to the east, based on Admiralty Tidal Diamond D, Chart No. 1183. In addition, four reference stations were located approximately 5km north east and south east of the development site, away from potential impacts, in order to provide reference data for the purposes of the long term monitoring.

A total of 23 sample stations were visited in 2007, including those stations within the cable route corridor.

The sample station array is presented in Chart 2.1 and is based on the advice given by CEFAS in Annex I of the FEPA licence conditions as summarised below:

- **5** stations sampled within the proposed **Development Site (sites 3, 9, 14, 35 & 36)**
- **3** stations within the near-field area of the foundations (**Scour Assessment Area; sites 2, 6 & 10**)
- **8** stations sampled outside of the proposed development site along the tidal axis within a single tidal excursion (**Secondary Impact Area; sites 16, 18, 21, 29, 31, 38, 43 & 44**).
- **3** stations sampled along the **Cable Corridor (sites 40, 41 & 42)**
- **4** sites within **Reference** zones outside the tidal excursion from the development area **Sites 33, 45, 47 & 48**)

In addition to the grab sampling, 2m scientific Beam trawls were undertaken at 10 sites, both within the potentially impacted zone and adjacent areas. Beam trawl lines were positioned on the basis of the known distribution of sand bank and gravelly sand substrates, as identified by the baseline survey, such that adequate coverage of all habitat types was ensured. Trawl lines were also positioned within the proposed development site and along the proposed cable route corridor to ensure adequate coverage of the extents of the scheme. Chart 2.2 shows the location of the Beam trawl lines
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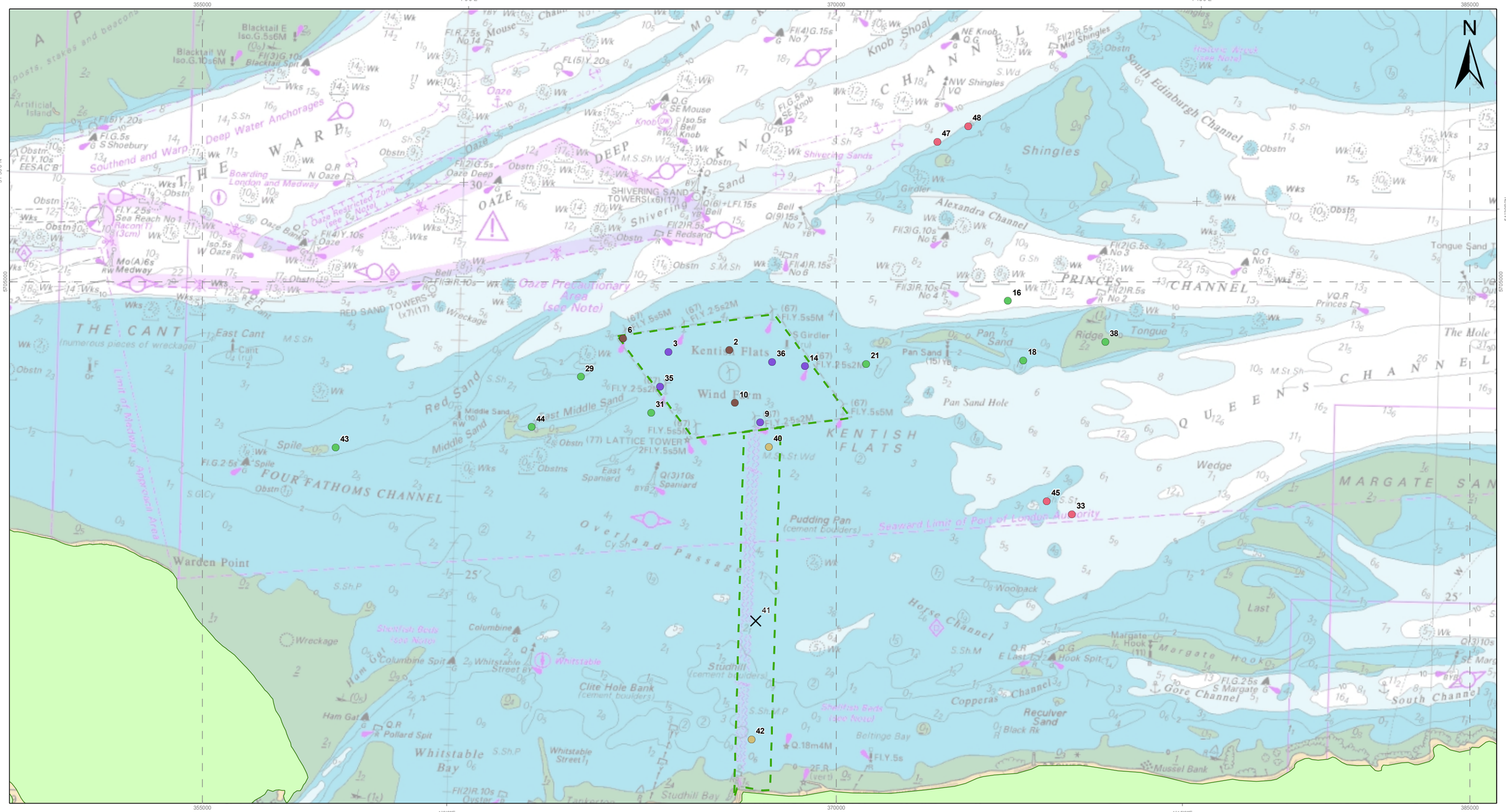

Location Plan

Legend

Kentish Flats Development Area & Cable Route (approx.)

Hamon Grab Sample Positions

Sample Area

- Cable Corridor
- Development Site
- Reference Area
- Scour Assessment Area
- Secondary Impact
- No Sample Taken

Scale Bar

0 1 2 4

Kilometres

Coordinate System

WGS84 UTM Zone 31 North

Notes

Depths	All depths are in metres below Chart Datum
Equipment	Hamon Grab
Caveat	© Crown Copyright and/or database rights. Reproduced by permission of the Controller of Her Majesty's Stationery Office and the UK Hydrographic Office (www.ukho.gov.uk). NOT TO BE USED FOR NAVIGATION

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EMU

Project Title

Kentish Flats Windfarm Development Macrobenthic Ecology Study 2007

Drawing Title

Grab Sampling Locations, Kentish Flats, 2007 Survey

Drawn By:	Checked By:	Chart No. 2.1		
RJM	SDG			
Job Number:	**Issued On:**	**Sheet Size:**	**Scale:**	**Rev:**
J/1/03/1033	13/06/08	A3	1:90,000	1

Map Document: (N:\1.03\1033 Kentish Flats Benthic 2007\GIS\3.Plots\Finals\2_1_GrabLocation.mxd)
10/06/2008 – 10:57:43

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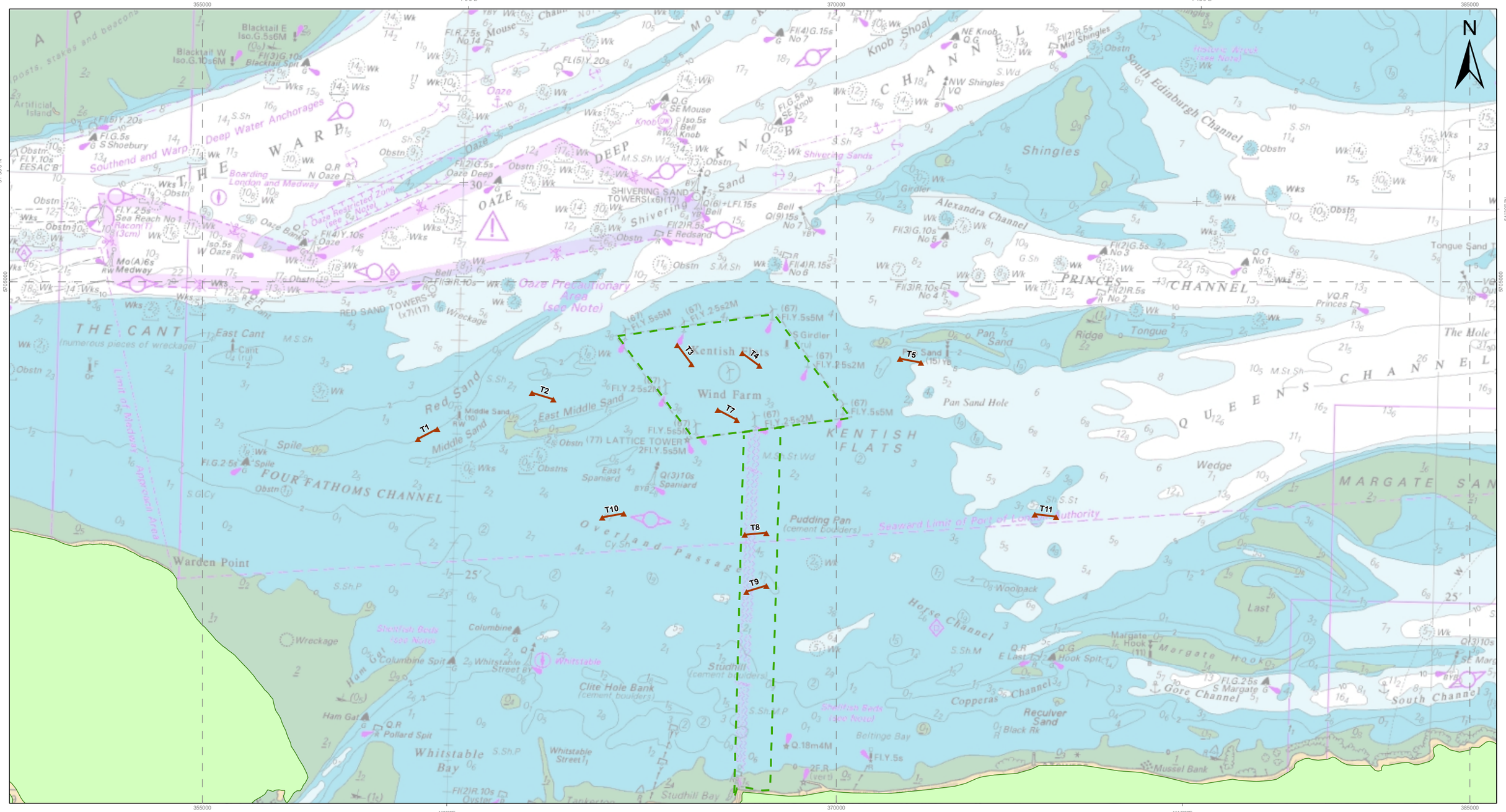
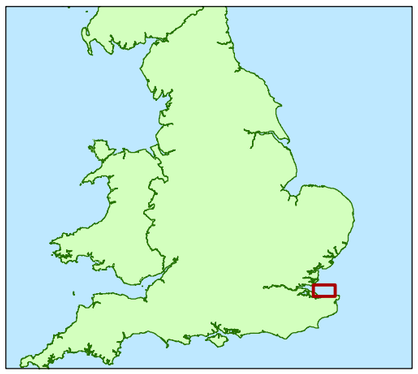


Location Plan



Legend

- Kentish Flats Development Area & Cable Route (approx.)
- Trawl Start and End Points
- Trawl Route

Scale Bar

0 1 2 4

Kilometres

Coordinate System

WGS84 UTM Zone 31 North

Notes

Depths	All depths are in metres below Chart Datum
Equipment	4m Beam Trawl
Caveat	© Crown Copyright and/or database rights. Reproduced by permission of the Controller of Her Majesty's Stationery Office and the UK Hydrographic Office (www.ukho.gov.uk). NOT TO BE USED FOR NAVIGATION

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Project Title

Kentish Flats Windfarm Development Macrobenthic Ecology Study 2007

Drawing Title

2m Beam Trawl Sampling Locations, Kentish Flats, 2007 Survey

Drawn By:	Checked By:	Chart No. 2.2		
RJM	SDG			
Job Number:	**Issued On:**	**Sheet Size:**	**Scale:**	**Rev:**
J/1/03/1033	13/06/08	A3	1:90,000	1

Map Document: (N:\1_03\1033 Kentish Flats Benthic 2007\GIS\3.Plots\Finals\2_2_Trawl_Locations.mxd)
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2.1.1.1 Site Positioning and Sampling

The survey was completed in two days, 22nd and 23rd May 2007, on board the vessel MV Arie Dirk. All field sampling methods employed were consistent with Emu Ltd Methods, Infaunal and Epifaunal Sampling Methods and Procedures (MET/05, Emu Ltd 2004a) and Emu Ltd Methods for Sediment Sampling and Processing (MET/06 Emu Ltd, 2006). Horizontal positioning was provided using Leica **D**ifferential **G**lobal **P**ositioning **S**ystem (DGPS) navigation equipment accurate to ± 5m. Sample station positions were recorded in **W**orld **G**eodetic **S**ystem (WGS)-84 every time the grab touched the seabed as indicated by the winch wire slackening. This was done by taking a manual fix within HYDROPro. All grabs were taken within 50 metres of the positions agreed prior to the survey. The fix number at the start and end of line position for each 2m Beam trawl deployment was noted once the trawl had reached the seabed (as evidenced by tension on the winch cable) and hauling had commenced. In addition, HYDROPro generated a series of continuous fixes every 5 seconds between the start and the end of the trawl record to record the track of each tow. The actual sample positions for each grab site and the start and end positions of each trawl line are presented in Appendix II.

2.1.2 Benthic Grab and Beam Trawl Surveys

Grab sampling was undertaken using a full size Hamon grab. However, the original $0.2m^2$ grab bucket had been split into two equal halves so that the actual area sampled is 2 x $0.1m^2$ (Figure 2.1). Upon recovery, two hoppers were placed carefully under the grab so that only half of the sample was collected for faunal analysis (equivalent to a conventional $0.1m^2$ sample), the other half being retained for full particle size analysis. The grab sampling locations for the current survey are presented on Chart 2.1. The positions for each grab sample, together with sample descriptions are presented in Appendix I.

Figure 2.1 Detail of Hamon Grab Bucket with Dividing Plate.

At each sampling station 3 replicates were collected in accordance with the Licence conditions. No samples were obtained at site 41, within the cable corridor, as the hard nature of the substrate at this location did not allow penetration of the grab into the sediment. Consequently, a total of 66 samples were obtained in 2007.

Beam trawl sampling was achieved using a heavily armoured 2 metre Lowestoft scientific Beam trawl. The trawl was fabricated from heavy galvanised steel, with the 5mm mesh net protected by heavy trawl chaffing net at the cod end, and by chain meshing running from the Beam (Figure 2.2). This meant that the trawl was capable of operating on the shelly, cobbly seabed that was known to exist in the area, and is the same design used successfully by CEFAS in similar conditions and in previous studies in the area

(Emu Ltd, 2002a). The cod end liner comprised 5mm knotless mesh. The Beam trawl was towed over a distance of 500 or 1000 metres depending on the nature of the seabed and the amount of material retained within the cod-end. The positions for the Beam trawl tows are presented in Chart 2.2.

A total of 10 Beam trawl tows were completed across the Kentish Flats study area in 2007. Notes on the start and finish positions, warp length and sample description are presented in Appendix II. Photographs of each Beam trawl sample are presented in Appendix IV.

Figure 2.2 Scientific Beam Trawl (2m) with Chain Armour.

2.1.2.1 Field Treatment of Grab Samples

Upon recovery of the Hamon grab, an assessment of sample volume (expressed as percentage fill) was made before the sample was released from the grab bucket into a plastic hopper. One half of the sample was retained for faunal analysis whilst the other half was placed in a labelled plastic bag for subsequent particle size analysis. Where replicate samples were taken, replicate particle size samples were also collected. The volume of sample taken for subsequent particle size analysis depended upon the nature of the sediment (as described in **B**ritish **S**tandards (BS) 1377, part two; 1990), but sample weight was generally between 500g and 2000g.

The faunal sample was photographed and notes on sediment characteristics and obvious fauna were made before being sieved on a 1mm mesh size sieve to remove the finer sediment fractions. The contents of the sieve were then transferred to a labelled 10 litre plastic bucket and the fauna fixed using 4% buffered saline formaldehyde solution. Samples were subsequently returned to Emu Ltd laboratories, Hayling Island, Hampshire.

2.1.2.2 Field Treatment of Beam Trawl Samples

Upon recovery, the Beam trawl was emptied by releasing the cod end into fish crates. All fauna were identified on site and the abundance estimated. Representative examples of the fauna were retained for subsequent laboratory analysis and confirmation of nomenclature, together with a small sub-sample of the sediment material, in order to examine the smaller fauna present. Beam trawl samples were fixed on site using 4% buffered saline formaldehyde solution. Fish length was measured and recorded.

2.2 Laboratory Methods

Samples were logged into the Emu Ltd wet-lab system. Each sample container, labelled with the job number, site and date, was assigned a unique **w**et-**l**ab (WL) number to identify it within the laboratory. Pre-printed waterproof paper labels were added to each sample container with specification of job number, job name, date, site and wet lab number.

2.2.1 Particle Size Distribution Analysis (PSA)

Particle **S**ize Distribution **A**nalysis (PSA) was undertaken at Emu Ltd's UKAS accredited Laboratory, employing Emu Ltd's In House Methods for the Determination of Particle Size Distribution (based on BS 1377, part 2, 1990) (MET/01, Emu Ltd 2005a) and Emu Ltd's In House Methods for the Determination of Particle Size Distribution by Malvern Microsizer Laser Diffraction (MET/02, Emu Ltd 2004b). The latter method was employed when the finer fraction of the sediment (<63 micron) comprised >5% of the sample. This method does not fall under UKAS accreditation. Sediment characteristics of the samples were subsequently classified using the **M**arine **N**ature **C**onservation **R**eview (MNCR) sediment nomenclature (Connor *et al.* 2004) which is based on the Wentworth Scale.

2.2.2 Macrobenthic Fauna Analyses of Grab Samples

Macrobenthic analysis of both grab and Beam trawl samples was undertaken by Emu Ltd, Marine Laboratories, Hayling Island. All procedures conformed to Emu Ltd's In-House Quality Control Methods for the Processing, Identification and Recording of Marine Macro-invertebrates, (MET/07, Emu Ltd 2004c).

Macrofaunal grab samples were re-sieved over a 1mm sieve to remove all remaining fine sediment and preservative. Fauna were sorted from the sediment by elutriation, with the sediment then sorted by hand under a binocular microscope to ensure no fauna remained. Residual sediment fractions were retained following sorting for future quality control auditing, as detailed in Emu Ltd's In-House Methods (MET/07, Emu Ltd 2004c).

Macroinvertebrates collected from the grab samples were identified to species level, where possible, and enumerated. All biological faunal material was subsequently stored in 70% Industrial Methylated Spirits. A faunal reference collection was prepared with individuals of all species identified retained. This will allow future checks on taxonomic classification to be made in assessing comparative monitoring data. Colonial epifauna were also identified to species level where possible and abundances estimated on a numerical scale ranging from 1 (lowest abundance) to 5 (highest abundance). Emu Ltd undertook QC checks on a representative number of whole samples, as well as the entire reference collection in compliance with internal analytical quality control criteria.

Species obtained from the Beam trawls were identified on site with representative specimens returned to the laboratory for confirmation of nomenclature. Epibenthic species from trawled samples were recorded at presence/absence level only.

2.2.2.1 Biomass Analysis of Grab Samples

Biomass analysis of the Hamon grab samples was also undertaken by Emu Ltd following identification and enumeration. The infauna from each sample was sorted into 5 groups (Annelida (Polychaeta and Oligochaeta), Crustacea, Mollusca, Echinodermata, and Others), and biomass analysis conducted using the wet blot method. Subsequently, the appropriate, standard corrections were applied to this data to provide equivalent dry weight biomass data (after Eleftheriou & Basford, 1989), as detailed in Emu Ltd's In-house Methods (MET/07, Emu Ltd 2004c). The conversion factors applied are given below:

- Annelida : 15.5%
- Crustacea : 22.5%
- Echinodermata : 8.0%
- Mollusca : 8.5%
- Others : 15.5%.

Epifauna were not submitted to the biomass analysis. Also, specimens submitted to the reference collection were not subjected to biomass analysis.

2.2.2.2 Macrobenthic Faunal Taxonomy

Macrofauna were identified to species level, where possible and enumerated. In case of doubtful identification, due to damage of the specimen or unresolved taxonomic problems, the best possible reliable taxonomic level was used. Uncertainties in identification are indicated by a question mark before the second epithet for a species (e.g. *Capitella* ?*capitata*) and before the generic name at genus level (?*Capitella*)

2.3 Data Analyses

The data set from the grab samples was investigated with the use of programs from the **P**lymouth **R**outine **I**n **M**ultivariate **E**cological **R**esearch (PRIMER) suite (Clarke & Warwick 2001 and Clarke & Gorley, 2006) using univariate and multivariate analyses.

Univariate analyses are used to extract features of communities which are not the function of specific taxa, i.e. these methods are species independent. They are not sensitive to spatio-temporal variations in species composition so that assemblages with no species in common can theoretically have equal values. Univariate analyses included Margalef's index of Richness, Pielou's Evenness index, the Shannon-Wiener Diversity index and Simpson's index of Dominance. Such univariate indices are useful in reducing large macrofaunal data sets to a single figure that may be used to compare a site's community structure.

The Margalef's index (*d*) is used to define species richness, but unlike the total number of species (S), which is largely dependent on the sample size, it also incorporates the total number of individuals (N) and is a measure of the number of species present for a given number of individuals.

Pielou's evenness index (*J*) expresses how evenly distributed the individuals are among the different species. In general, the higher the evenness the more balanced the sample is, as it indicates that the individuals are evenly distributed between the species recorded.

The Shannon-Wiener diversity (*H*) incorporates species richness and evenness as it expresses the number of species within a sample and the distribution of abundance across these species.

The Simpson index (λ) is a dominance index, in the sense that its largest values correspond to assemblages the total abundance of which is dominated by one or very few of the species present. It is related to the evenness so that the higher the dominance value, the lower the evenness.

In the initial stage multivariate analyses may involve transformation of data. Transformation is most commonly applied where the fauna is numerically dominated by a few species which may mask the underlying community composition. Transformation reduces the influence of these more dominant species, with transformation ranging in severity from no transformation to the reduction of all data to presence/absence only. If no transformation is applied to the data, greater emphasis is given to the most common species; a square root transformation allows the intermediate abundance species to play a role; finally, a 4th root transformation results in a down-weighting of the dominant species, taking into much greater account the lowest abundant species, and allowing the underlying community composition to be

assessed. An alternative transformation, with very similar effect to the 4th root, is the log transform, log(1+y). The latter transformations are effectively equivalent in focusing attention on patterns within the whole community, mixing contribution from both common and rare species (Clarke & Warwick 2001). In the present study, a 4th root transformation was applied.

The transformed data were then subjected to hierarchical agglomerative clustering, where similar samples are fused into larger and larger groups. This grouping is based on group-averaging or nearest neighbour sorting of a matrix of samples' similarities, using the Bray-Curtis similarity measure. The results are displayed in a tree-like dendrogram. The cluster analysis is best used in conjunction with **M**ulti **D**imensional **S**caling (MDS) or ordination analysis thus allowing a check on the 'goodness of fit' of the clusters produced by both types of analyses.

The MDS analysis uses the same similarity matrix as that used by the cluster analysis to produce an ordination of samples which is multidimensional. This attempts to construct a map of the samples in which the more similar two samples are in terms of species abundance (or biomass), the nearer they are on the map. The extent to which these relations can be adequately represented in a 2-dimensional map is expressed as the stress coefficient statistic, low values (<0.1) indicating a good ordination with no real prospect of misleading interpretation. The combination of clustering and ordination analysis can be a very effective way of checking the adequacy and mutual consistency of both representations.

The **Sim**ilarity **Prof**ile (SIMPROF) test was run in conjunction with cluster analysis. This test is a permutation test of the null hypothesis that a set of specified samples, which are not *a priori*, divided into groups do not differ from each other in multivariate structure and looks for statistically significant evidence of "true" clusters in samples, i.e. if the different station groupings interpreted from the cluster analysis are significantly different. The results are displayed by colour convention on the dendrogram: samples connected by red lines constitute a significant station group and cannot be differentiated.

Sediment data were also imported into PRIMER and 4th root transformed. The 4th root transformation was applied to the sediment data in order to reduce the degree of skewness displayed by the majority of the sediment fractions in all samples. The transformed data were then subjected to hierarchical clustering and ordination using Euclidean distance as the similarity measure as recommended by Clarke & Warwick (2001), for the analysis of environmental data.

Correlation-based **P**rincipal **C**omponent **A**nalysis (PCA) was performed on the sediment data, with regard to percentage (%) Gravel, % Sand and % Fines. The PCA is a method of identifying multidimensional patterns in data sets, highlighting similarities/differences within/between sets. Once these multidimensional patterns have been found the data are compressed by reducing the number of dimensions without loss of information. The results of a PCA are graphically represented by the Principal Component axes (PC) which are simply linear combination of the values for each variable (in this instance % gravel, % sand and % fines) and represent the perpendicular distance in a multidimensional space along which the variance of the variables are maximised. The degree to which a two-dimensional PCA succeeds in representing the full multidimensional information is seen in the percentage of the total variance expressed by the first two principal components. In general, a picture which accounts for as much as 70-75% of the original variation is likely to describe the overall structure rather well (Clarke & Warwick, 2001).

Following on from clustering and MDS, the faunal data were subjected to **Sim**ilarity **Per**centage Analysis (SIMPER), to establish species responsible for the similarity or dissimilarity of one sample against the other. In addition, SIMPER provides a ranked list of taxa which contributes most to the similarity/dissimilarity within/between the groups of samples identified by the multivariate analysis. The percentage dissimilarity between groups of samples, together with the ranked list of species per group can offer an assessment of faunal distinctiveness for each sample grouping.

A 1-way ANOSIM (**An**alysis **O**f **Sim**ilarity) was performed on the physical and biological data sets to assess spatial and temporal variations. The result of an ANOSIM test, referred to as sample statistic

"R", gives a single measure of the similarity (or difference) between any two samples, based on a large number (set at 9,999 in the present study) of permutations of the replicate samples. When the value of R approaches 0, differences between samples are small and can be considered insignificant. When R approaches ±1, the samples will contain communities that are significantly different and which may be associated with disturbance and chance that they fall outside of natural variability.

To carry out ANOSIM the grouping of samples must be made prior to seeing the data and the test is run on the assumption that there are no differences between the groups of samples (the "null hypothesis"). The test results are graphically represented as a histogram which plots the simulated distribution of the test statistic R under the null hypothesis of "no differences between samples". If the null hypothesis is true, the value of R from the test will fall within the simulated distribution (i.e. there are no differences between samples), conversely, if R falls outside the simulated distribution, there is evidence to reject the null hypothesis (i.e. there are large differences between samples) (Clarke & Warwick, 2001). ANOSIM test can be carried out on 2 or more pairs of samples. Where more pairs of samples are compared, the test result is a "*global R*", which indicates that there might be sample differences somewhere that might be worth examining further. Specific pairs of samples can then be compared (pairwise test).

Relationships between **Bio**logical and **Env**ironmental variables were tested employing the BIOENV analysis (also available within the PRIMER suite). BIOENV reveals those environmental variables which best match the observed grouping of faunal samples following the application of the Bray-Curtis similarity measure. Single and multiple combinations of variables can be input in order to assess those environmental factors which best fit the pattern of macrobenthic distribution. A ranked correlation using the Spearman method was applied.

Following on the BIOENV analysis, the **RELATE** test (or second BIO-ENV analysis) was performed on the data sets. RELATE is a permutation test of the null hypothesis of "no relationships between the biological (infauna data set) and the environmental matrices (sediment composition and depth)". The test results are graphically represented as a histogram of the simulated distribution of the test statistic Rho. If Rho falls outside the simulated distribution, the null hypothesis of no correlation between the matrices is rejected, i.e. the two matrices are correlated.

2.4 Map production

Both biological data and sediment characteristics were converted into digital format using **E**nvironmental **S**ystem **R**esearch **I**nstitute (ESRI) GIS package Arc View 9.1. This software allows plotting of a range of variables relative to the spatial distribution of the sampling sites. This enables spatial relationships in the data to be represented visually, and trends to be identified.

3.0 Results

3.1 Particle Size Distribution Analysis (PSA)

The results of the particle size distribution analysis are presented in Appendix V and include tabulated weight data for each whole phi mesh aperture, % fractional data and % cumulative data. Fractional histograms and cumulative charts have also been presented for each sediment sample.

Sediments across the survey area comprised predominantly sand, the sorting coefficient ranging from extremely poorly-sorted to very well-sorted. Levels of gravel and fines varied within the survey area and increased at the more inshore sites. Maxima levels of gravel were recorded at site 45 (within the reference area to the south east of the development area) and site 2 (within the scour assessment area), which accounted for a mean of 62.3% and 29.3%, respectively. The highest level of gravel in any one replicate was recorded in sample 45a (71.7%). Relatively high levels of gravel were also recorded at site 35 (within the development area), which accounted for a mean of 19.3%.

Maxima levels of fines were recorded at site 42 within the cable corridor which comprised a mean of 42.3%. The highest level of fine contents in any one replicate was recorded in sample 42b (57.8%). Relatively high levels of fines were also recorded at site 14 which accounted for a mean of 13.4%.

Results of the PSA distribution across the Kentish Flats survey area in 2007 are presented in Chart 3.1.

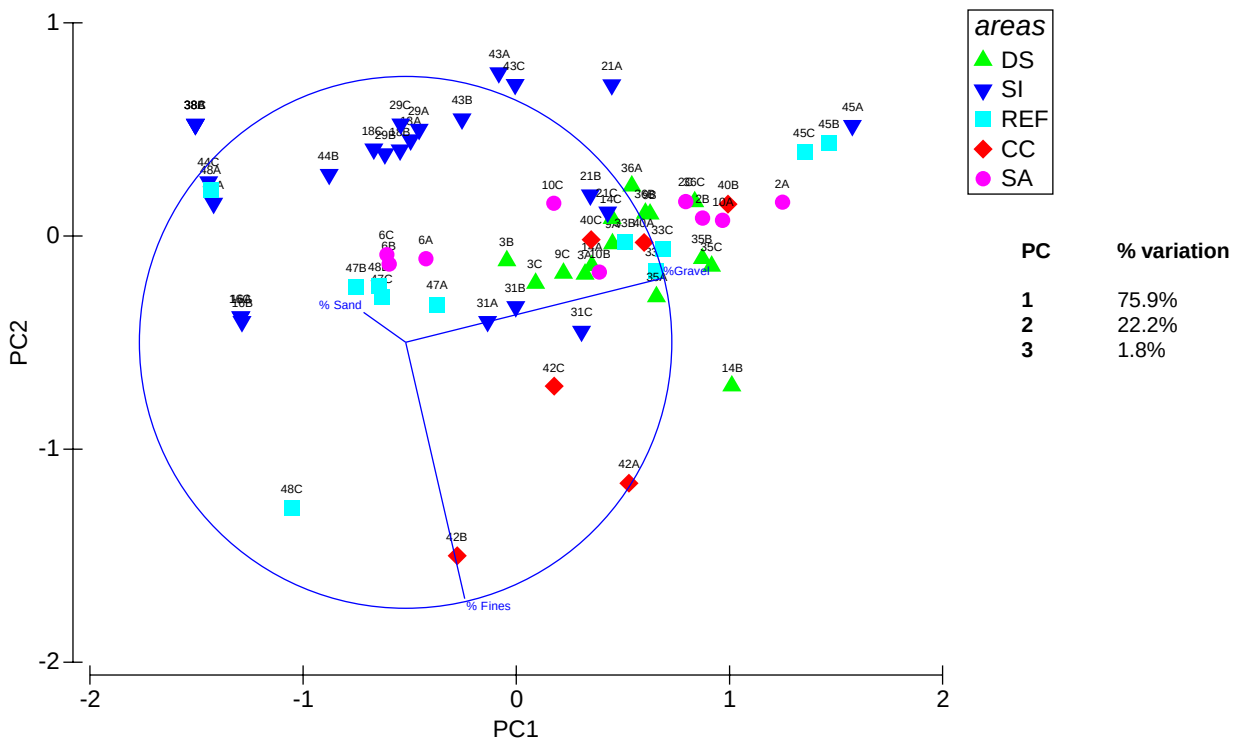
Several sediment samples from the same station showed relatively high degrees of variability, indicating that the sediments were locally patchy in nature. For example, at station 10 levels of gravel ranged from 5.9% (replicate 10c) to 27.4% (replicate 10a). At station 14 levels of sand ranged from 50.9% (replicate 14b) to 85% (replicate 14a). Finally, levels of fines at site 42 ranged from 21.3% (replicate 42c) to 57.8% (replicate 42b).

3.1.1 Multivariate Analysis of PSA Data

3.1.1.1 Principal Component Analysis (PCA)

Results of the PCA analysis (Figure 3.1) showed that the separation of stations along the primary ordination axis (PC1) was most influenced by the percentage of gravel.

The first two principal components explained over 98% of the variations, indicating that the 2-D ordination gives a good representation of the similarity of the sediment samples between stations, as illustrated in Figure 3.2. The Figure shows the values of percentage gravel, sand and silt/clay superimposed onto the PCA ordination as well as the sediment classification and sorting. In general, more heterogeneous sediment showed higher values of the sorting coefficient (very poorly-sorted to extremely poorly-sorted).



DS=Development Site; SI=Secondary Impact; SA=Scour Assessment; CC=Cable Corridor; REF=Reference

Figure 3.1 **Two-dimensional Representation of the Principal Component Analysis of Sediment Components from Grab Samples, Kentish Flats, 2007 survey**

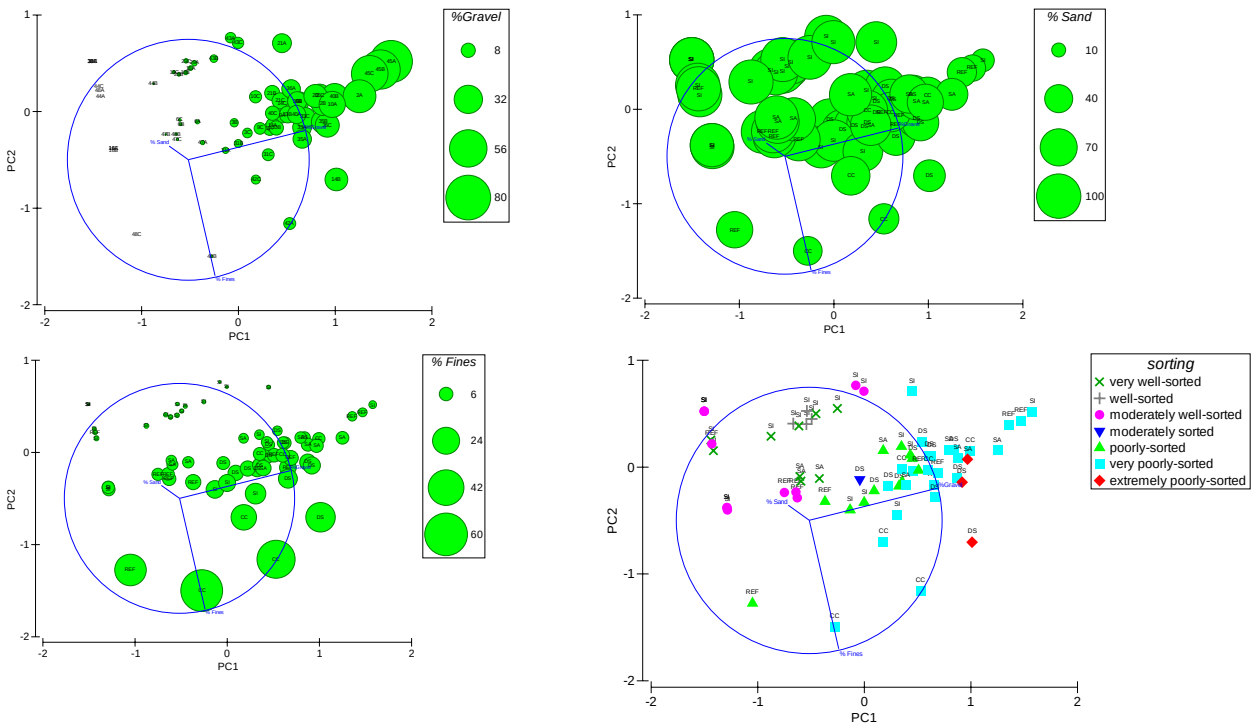


Figure 3.2 **Two-dimensional Representation of the Principal Component Analysis of Sediment Composition from Grab Samples, Kentish Flats, 2007 survey. Data with Superimposed Circles Proportional in Diameter to Values of Percentage Gravel, Sand, Fines and Sorting**

3.1.1.2 Hierarchical Agglomerative Clustering Analysis

Figure 3.3 shows the group average similarity sorting dendrogram and MDS for sediment samples following multivariate analysis. This analysis groups stations with similar particulate composition. Using Figure 3.3 eight groups of samples were identified and have been interpreted on the basis of broad sediment classification. Sediment characteristics within each group of samples identified by the multivariate analysis are summarised in Table 3.1 and illustrated in Figure 3.4. The latter shows the separation of the different groups of samples based on their sediment characteristics.

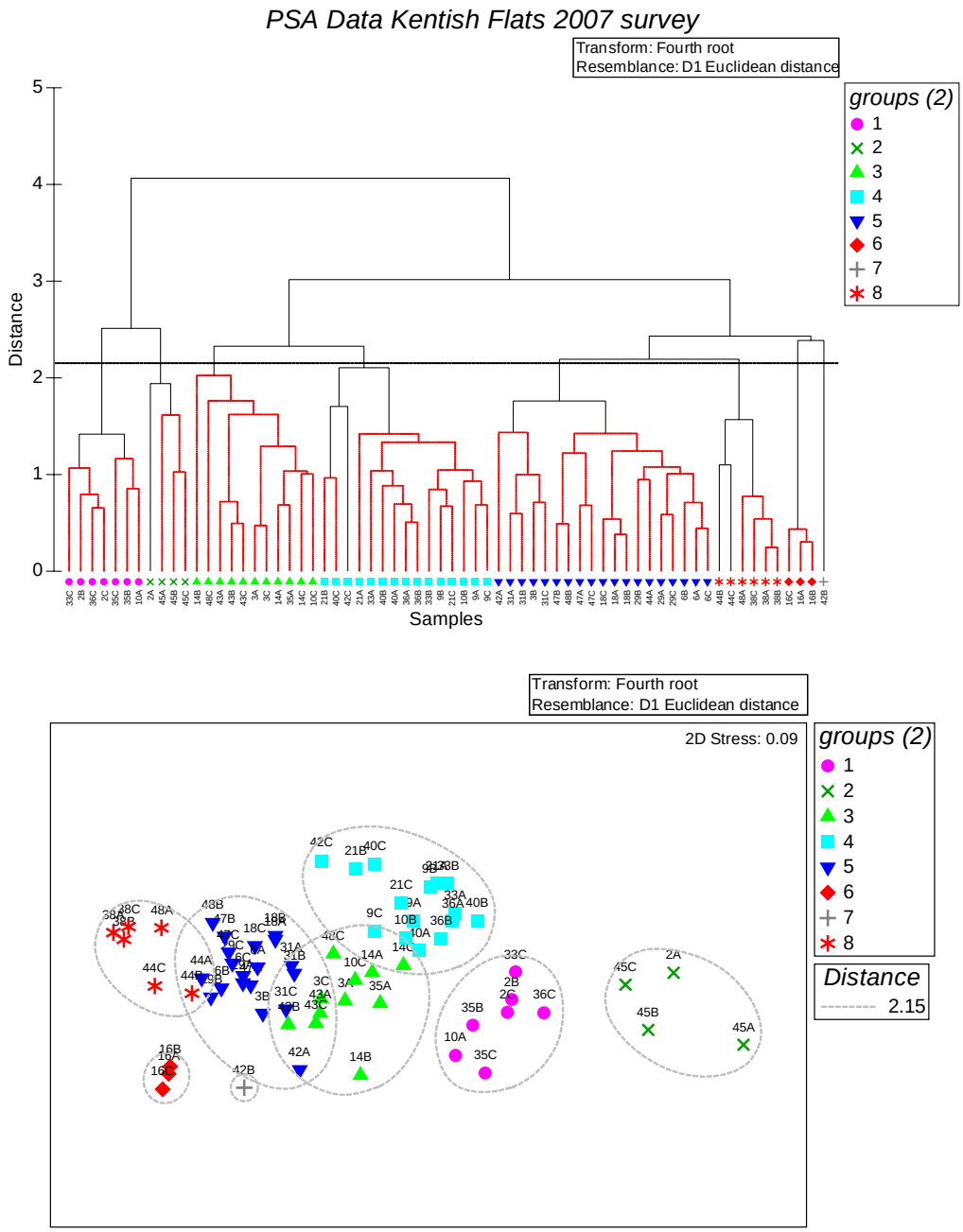


Figure 3.3 **Dendrogram (a) and Multi Dimensional Scaling (MDS) Plot (b) of Euclidean Distance Similarity Index of Major Sediment Components from Grab Samples, Kentish Flats, 2007 Survey**

Group	Samples	Mean % sediment component ± Standard Deviation			Description
		Gravel	Sand	Fines	
● 1	**33**(c); **35**(b,c); **36**(c)	22.2	71.1	6.6	Gravelly Sand, very poorly-sorted
× 2	**45**(a,b,c); **2**(a)	57.5	39.3	3.2	Sandy Gravel, very poorly-sorted
▲ 3	**3**(a,c); **14**(a,b,c); **35**(a); **43**(a,b,c); **44**(a); **48**(c); **10**(c)	6.7	84.5	8.8	Very Slightly Muddy & Gravelly Sand, poorly-sorted
■ 4	**9**(a,b,c); **21**(a,b,c); **33**(a,b); **36**(a,b,c); **40**(a,b,c); **10**(b)	12.1	81.6	6.4	Slightly Gravelly Sand, very poorly-sorted
▼ 5	**3**(b); **18**(a,b,c); **29**(a,b,c); **31**(a,b,c); **42**(a); **47(**a,b,c); **48**(a); **6**(a,b,c)	1.4	91.6	7.0	Very Slightly Muddy Sand, moderately well-sorted
◆ 6	**16**(a,b,c)	0.0	94.9	5.1	Sand. moderately well-sorted
+ 7	**42**(b)	0.2	42	57.8	Sandy Mud, very-poorly-sorted
✱ 8	**38**(a,b,c); **44**(b,c); **48**(a)	0.0	99.6	0.4	Sand well-sorted

Table 3.1 Summary of the Physical Characteristics of Groups of Samples Identified by the Multivariate Analysis, Kentish Flats, 2007 Survey

Group 1 comprised selected replicate samples from sites within the southern reference area and the development site. It was characterised by very poorly-sorted gravelly sand.

Group 2 comprised samples from site 45 within the southern reference area and one replicate from site 2 within the scour assessment area. It was characterised by very poorly-sorted sandy gravel

Group 3 comprised selected samples from the most offshore sites within the development site, the scour assessment area, the secondary impact and the northern reference areas. It was characterised by poorly-sorted coarse sand with small percentages of gravel and mud.

Group 4 comprised replicate samples from the most inshore sites within the development site, the scour assessment area and the secondary impact area, the most offshore sites within the cable corridor and selected samples from the southern reference area. It was characterised by very poorly-sorted sand with relatively high percentage of gravel.

Group 5 comprised samples from the majority of sites within the secondary impact area, the northern reference area and the most offshore site within the scour assessment area. It was characterised by moderately well-sorted sand with small percentage of mud.

Group 6 comprised replicate samples from site 16 within the secondary impact area to the north-west of the development site. It was characterised by moderately well-sorted sand.

Group 7 comprised a single replicate samples from site 42, the most inshore site within the cable corridor and comprised the highest percentage of mud, which was responsible for the separation of this

group.

Finally, **group 8** comprised selected replicates from the most offshore sites within the secondary impact and the northern reference areas. It was characterised by well-sorted sand.

Figure 3.4 shows the separations of the groups of samples based on the sediment classification and sorting and the percentage of the different sediment fractions responsible for the separation of the groups of samples, as identified by the SIMPER analysis.

The distribution of the group of samples identified by the multivariate analysis across the Kentish Flats survey area in 2007 is presented in Chart 3.2.

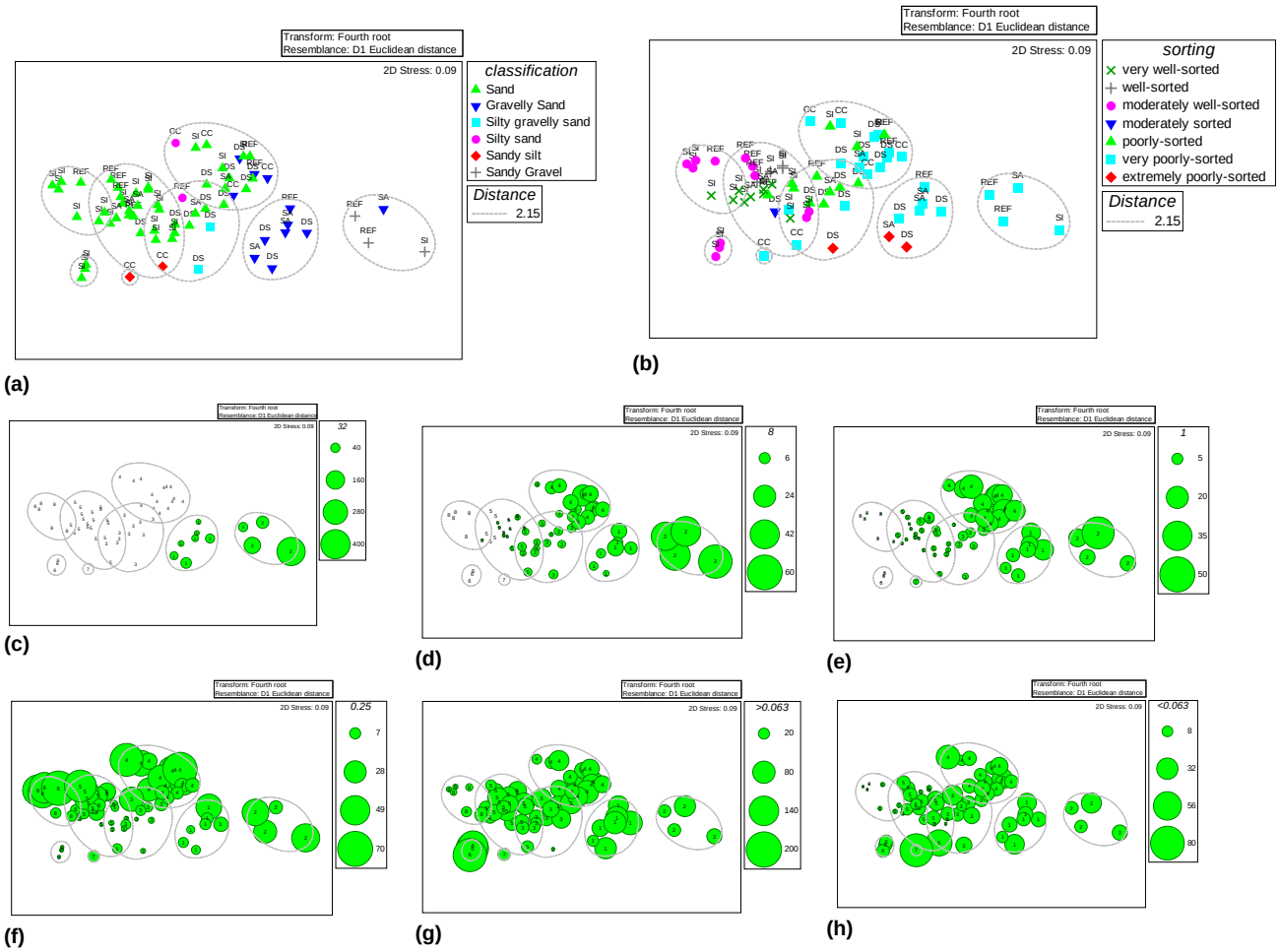


Figure 3.4 **Multi Dimensional Scaling (MDS) Plot of Euclidean Distance Similarity Index of Major Sediment Components from Grab Samples, Kentish Flats, 2007 survey. Data with Superimposed Sediment Classification (a) and Sorting (b) within the Different Areas and Circles Proportional in Diameter to the Values of Percentage Gravel (c, & d), coarse sand (e), medium sand (f), fine sand (g) and fines (h).**

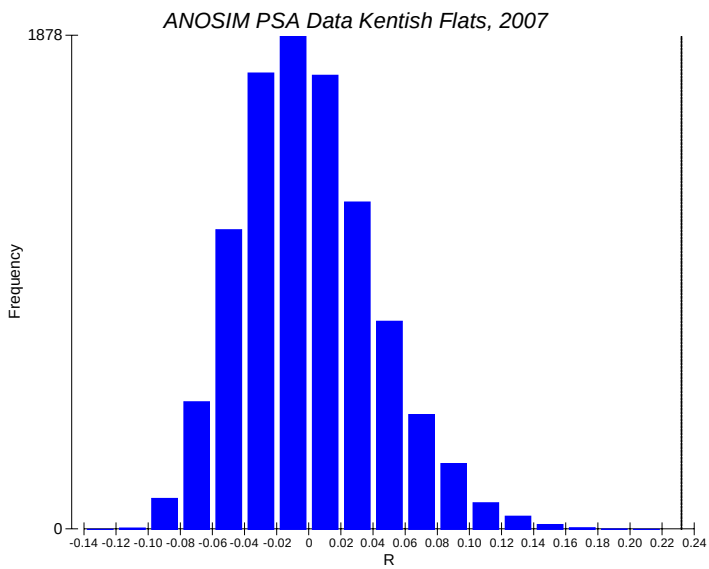
3.1.1.3 Analysis of Similarity (ANOSIM)

ANOSIM was applied to the PSA data to investigate whether samples within different areas collectively were significantly different. The resulting histogram plot (Figure 3.5) shows that, overall there were significant differences (significance level of sample statistic = 0.232) between the different areas within the Kentish Flats study site in 2007. Results of the pairwise test highlighted which areas showed the greatest difference (large values of R).

Results of the ANOSIM test showed that the largest differences were recorded between the secondary impact area and the cable corridor. Indeed both these areas exhibited large differences when compared to any other areas.

Sites within the secondary impact area were characterised by relatively homogeneous sediments and exhibited low spatial variability with respect to all three major sediment component, in comparison with the other areas (Figure 3.6). Sites within the cable corridor were characterised by heterogeneous sediments and showed large spatial variability particularly with respect to sand and fine contents.

Large differences were recorded between the reference area and the development site. Sediment composition of samples from sites within the reference area showed a high degree of heterogeneity, particularly at sites 33 and 45 to the south east of the development site. Overall, the reference area showed large differences when compared with sites within the development site and those within the secondary impact area, whereas differences with sites within the cable corridor and the scour assessment area were small in comparison.



Sample statistic (Global R) : 0.232
Significance level of sample statistic : 0.01%
Results of pair-wise test (number of possible permutation of each pairwise test: >>9,999)

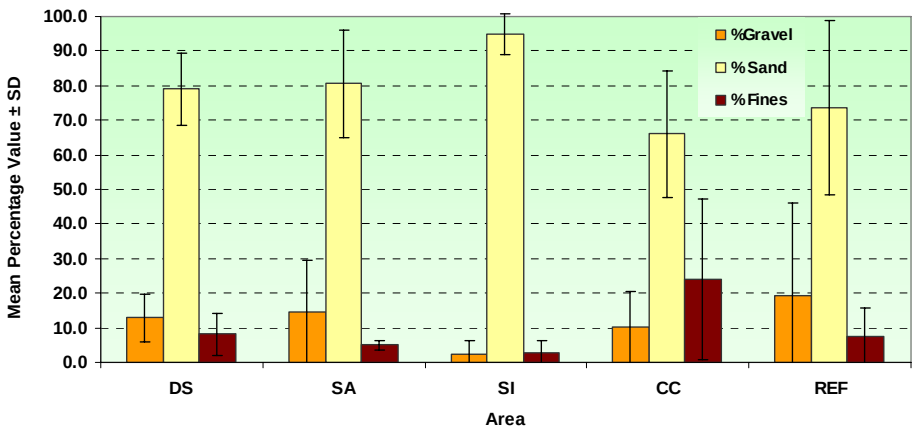
Areas	R statistic	Significance level
DS, SI	0.347	0.01%
DS, REF	0.262	0.3%
DS, CC	0.17	8.9%
DS, SA	0.134	5.4%
SI, REF	0.205	2.1%
SI, CC	0.354	0.7%
SI, SA	0.217	3.4%
REF, CC	0.041	26.6%
REF, SA	0.007	40.7%
CC, SA	0.117*	13.2%

* total number of permutations 5005.

DS= Development site; SA= Scour assessment; SI= Secondary impact; CC= Cable corridor; REF= Reference

Figure 3.5 ANOSIM of Sediment Components from Grab Samples, Kentish Flats, 2007 survey. Simulated Distribution (9,999 permutations) of the Test Statistic R under the Null Hypothesis of "No Differences Between Areas"

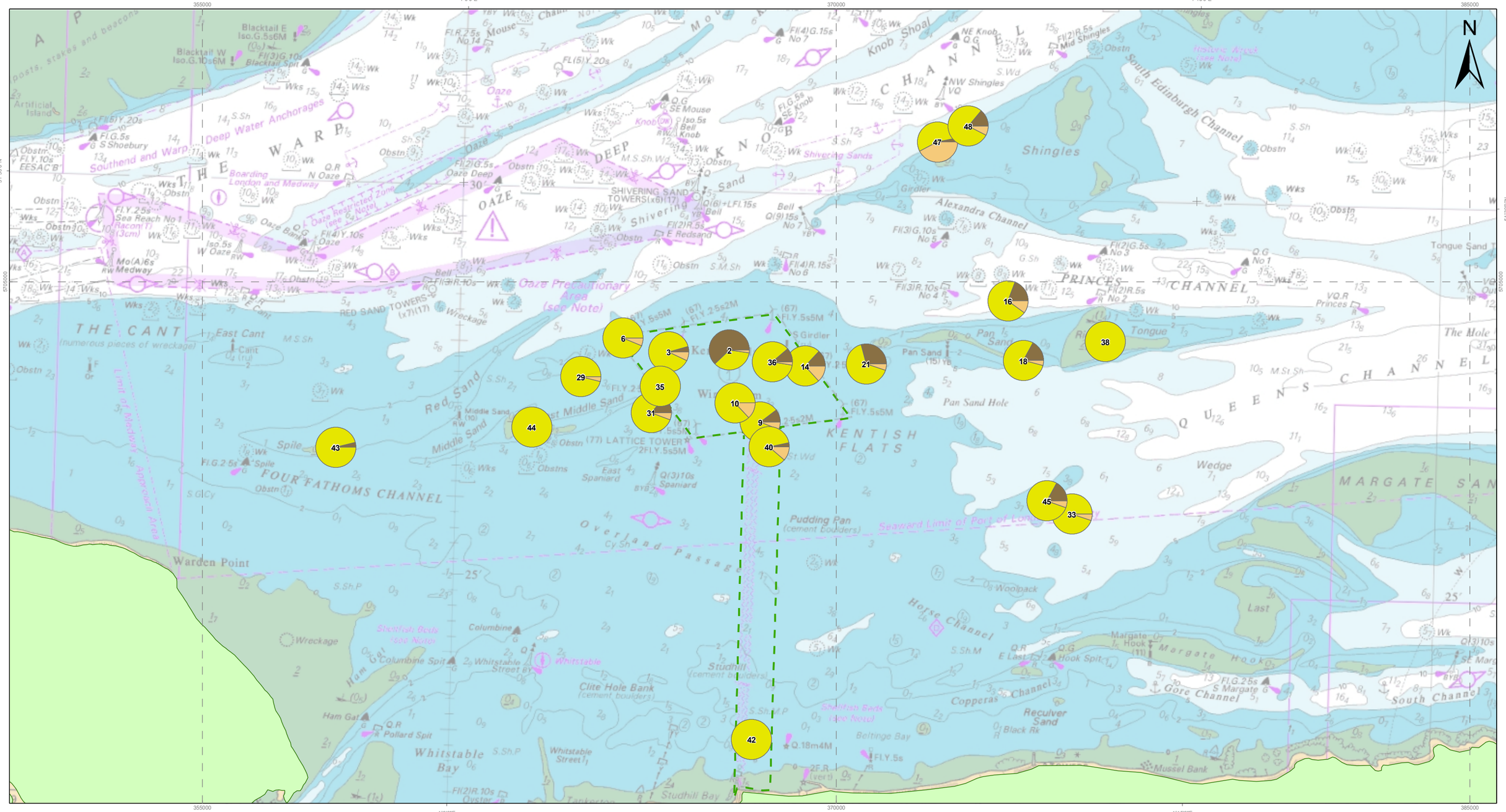
Figure 3.6 provides a summary of the principal sediment components within each area in 2007.



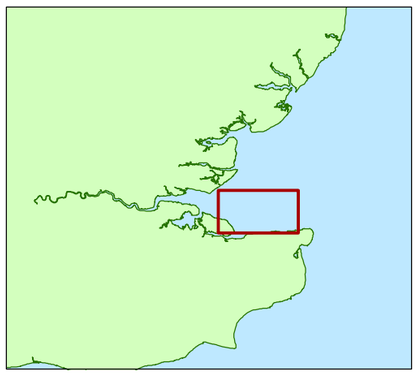
Area	Mean % sediment component			Sediment Description
	Gravel	Sand	Fines	
DS	12.8	79.0	8.2	gravely sand, very poorly-sorted
SA	14.5	80.5	5.0	slightly gravely sand, very poorly-sorted
SI	2.5	94.9	2.6	sand, moderately sorted
CC	10.0	65.9	24.0	slightly gravely silty sand, very poorly-sorted
REF	19.1	73.6	7.3	slightly silty gravely sand, very poorly-sorted

DS= Development site; SA= Scour assessment; SI= Secondary impact; CC= Cable corridor; REF= Reference

Figure 3.6 Particle Size Distribution of Main Sediment Fractions within Each Area, Kentish Flats, 2007 Survey



Location Plan



Legend

Kentish Flats Development Area & Cable Route (approx.)

Particle Size Distribution (%)

- Gravel
- Sand
- Silt

Scale Bar

0 1 2 4

Kilometres

Coordinate System

WGS84 UTM Zone 31 North

Notes

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Drawing Title

Particle Size Distribution of Main Sediment Fractions from Grab Samples, Kentish Flats, 2007 Survey

Drawn By:	Checked By:			
RJM	SDG	Chart No. 3.1		
Job Number:	Issued On:	Sheet Size:	Scale:	Rev:
J/1/03/1033	13/06/08	A3	1:90,000	1

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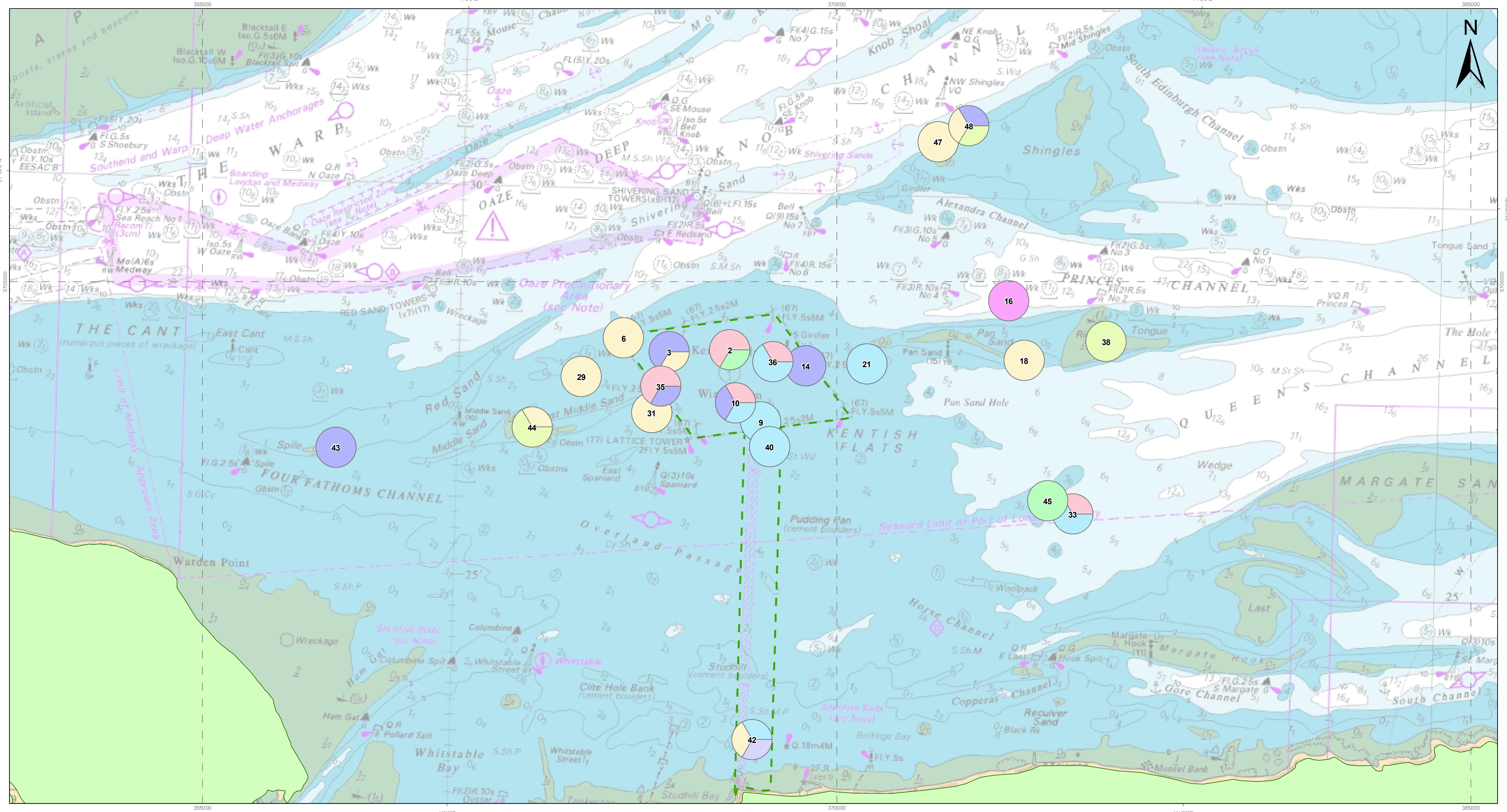

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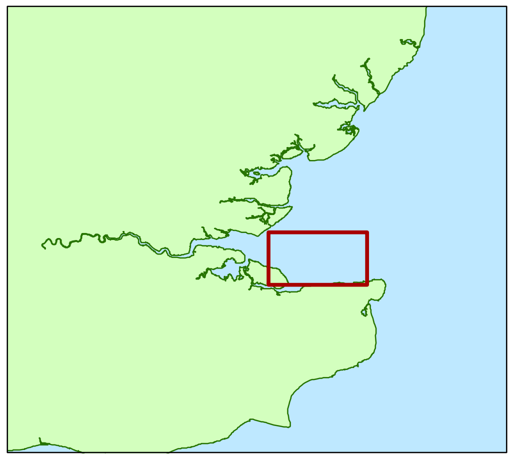

Legend

Kentish Flats Development Area & Cable Route (approx.)

Sediment Groups (2007)

- Group 1
- Group 2
- Group 3
- Group 4
- Group 5
- Group 6
- Group 7
- Group 8

Scale Bar

0 1 2 4
Kilometres

Coordinate System

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Kentish Flats Windfarm Development Macrobenthic Ecology Study 2007

Drawing Title

Sediment Groups Identified by the Multivariate Analysis of Grab Samples, Kentish Flats, 2007 Survey

Drawn By:	Checked By:	Chart No. 3.2		
RJM	SDG			
Job Number:	**Issued On:**	**Sheet Size:**	**Scale:**	**Rev:**
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3.2 Macrobenthic communities

A full species list of all organisms recorded within the survey area in 2007 and their abundance is presented in Appendices VI and IX for grab samples and Beam trawl samples, respectively.

The phyletic composition of the macrobenthic communities recorded by grab samples is presented in Table 3.2. The abundance of each taxon within the survey area is also presented. The abundance of the colonial epifaunal species is based on a numerical abundance scale with 1 representing the lowest abundance (defined as "species inconspicuous" within samples: 1-2 zooids per colony) and 5 representing the highest abundance (defined as "dominant" widespread on all hard surface within sample).

Taxonomic Group	**Number of species recorded within the survey area (**2007**)**	**Total abundance within survey area (**2007**)**
Porifera (sea sponges)	5	n/a
Cnidaria (Sea firs, sea anemones)	23 *(including 22 colonial species)*	120
Nemertea (Ribbon worms)	1	181
Nematoda (Round worms)	1	13
Entoprocta (Goblet worms)	1	n/a
Chaetognatha (Arrow worms)	1	2
Sipunculida (Peanut worms)	1	2
Annelida Polychaeta (Bristle worms) & Oligochaeta (Earthworms)	90 *(including 5 juveniles)*	1380 *(including 61 juveniles)*
Chelicerata (Sea spiders)	3	228
Crustacea (Shrimps, prawns, crabs)	50 *(including 4 juveniles)*	3005 *(including 8 juveniles)*
Collembola (Springtails)	1	1
Mollusca (Bivalves, chitons)	28 *(including 3 juveniles)*	256 *(including 61 juveniles)*
Bryozoa (Sea mats)	22	n/a
Phoronida (Horseshoe worms)	1	7
Echinodermata (Sea urchins, brittle stars, starfish)	8 *(including 2 juveniles)*	48 *(including 3 juveniles)*
Tunicata (Sea squirt)	8 *(including 2 colonial species)*	174
Pisces (Fish)	1 juvenile	1 juvenile
TOTAL	**245**	**5418**
Total infaunal species	**182***	**2377**
Total solitary epifaunal species	**10**	**3039**
Total colonial epifaunal species	**52**	**n/a**

* It does not include Chaetognatha

Table 3.2 Phyletic Composition of Grab Samples, Kentish Flats, 2007 Survey

A total of 245 species and higher taxa were recorded from the grab samples collected across the Kentish Flats survey area in 2007, including 182 infaunal species represented by 2,377 individuals.

Prior to any analysis being undertaken the faunal data set was subjected to some rationalisation. Specifically, a number of species and/or higher taxa were either removed from the data set or combined with another to avoid spurious enhancement of the species data. For example, taxa the identity of which was indeterminate (e.g. Crustacea, Copepoda, Ostracoda, Bivalvia, etc.) and therefore possibly belonged to one of the taxa already identified, were removed. Nematoda were removed as they are part of the meiofauna which was not included within the scope of the present study. Similarly planktonic species (Chaetognatha) were removed. Finally, all juvenile species were removed.

Of the original 245 species and higher taxa identified, 219 remained following the rationalisation procedure (including 9 solitary and 52 colonial epifaunal species). The 158 infaunal species were represented by 2,221 individuals whereas the 9 solitary epifaunal species accounted for 3,038 individuals.

Macrobenthic communities from the grab samples were analysed with respect to infauna and solitary epifauna (quantitative abundance for both).

Colonial epifaunal species (abundance estimated using the numerical scale) were removed from the species list prior to analyses being undertaken. These were dealt with separately and presented later in this section.

3.2.1 Enumerated Fauna (Infauna & Solitary Epifauna) from Grab Samples

Annelida were dominant in terms of species diversity (50.9%) followed by Crustacea (24.6%) and Mollusca (13.8%), other taxa (7.2%) and Echinodermata (3.6%). Annelida also comprised the largest bulk of the *infaunal* abundance, followed by other taxa (24.6%), Crustacea (10.8%), Mollusca (8%) and Echinodermata (1.9%).

Solitary epifaunal species comprised species of Actiniaria, the polychaete worm *Pomatoceros lamarcki*, the barnacle *Balanus crenatus* and ascidian species (e.g. *Polycarpa fibrosa*, *P. pomaria*, *Pyura squamulosa*). Of these, the ascidians were dominant in terms of species diversity, whereas *B. crenatus* was dominant in terms of abundance.

Within the annelids, the polychaetes *Spiophanes bombyx* and *Goniada maculata* were the most widespread within the survey area, occurring in 45% and 39% of the samples, respectively. *S. bombyx* was the second most abundant polychaete species together with *Euclymene oerstedii* and *Lanice conchilega*. Indeed these polychaetes were amongst the most abundant species within the survey area, together with *Notomastus* spp., *Nephtys cirrosa* and *Ophelia borealis*.

Within the crustaceans, *Bathyporeia elegans*, *Corystes cassivelaunus* and *Corophium crassicorne* were the most abundant and widespread species, whereas the bivalves *Abra alba*, *Mysella bidentata* and *Fabulina fabula* were the most abundant and widespread molluscs species within the Kentish Flats survey area in 2007.

Echinoderms comprised a small percentage of species diversity and abundance, with *Ophiothrix fragilis* being the most abundant species within the survey area in 2007.

Within the other taxa, Nemertea and the sea-spider *Nymphon brevirostre* were abundant and widespread within the survey area.

A list of the top ten most widespread infaunal and epifaunal species across the Kentish Flats survey area in 2007 is presented in Table 3.3. For each species the total numerical abundance within the survey area is given together with the highest density recorded in any one sample.

Species	MCS code	Frequency (% of samples)	Total abundance (no of individuals across survey area	Maximum density per sample (no individuals/0.1m^2)
Infaunal Species				
Spiophanes bombyx	P0794	45.5	115	15
NEMERTEA	G0001	43.9	181	32
Goniada maculata	P0271	39.4	39	5
Nephtys cirrosa	P0497	39.4	61	7
Notomastus spp.	P0920	37.9	72	9
Euclymene oerstedii	P0964	36.4	158	27
Lanice conchilega	P1195	34.8	80	15
Nymphon brevirostre	Q0005	31.8	164	46
Lumbrineris gracilis	P0579	28.8	39	8
Bathyporeia elegans	S0452	28.8	79	15
Solitary Epifauna				
Balanus crenatus	R0077	30.3	2735	661
Actiniaria	D0662	19.7	120	65
Pomatoceros lamarcki	P1340	12.1	9	2
Polycarpa fibrosa	ZD0112	7.6	105	62
Molgula manhattensis	ZD0151	6.1	9	4
Polycarpa pomaria	ZD0115	4.5	42	23
Pyura squamulosa	ZD0140	4.5	12	4
Styela clava	ZD0104	3.0	2	1
Dendrodoa grossularia	ZD0120	1.5	4	4

Table 3.3 Top Ten Most Frequently Occurring Faunal Species (Enumerated Fauna) across the Kentish Flats Survey Area, their Total Abundance and Maximum Density, 2007 survey

3.2.1.1 Univariate Analyses of Benthic Communities from Grab Samples (enumerated fauna)

Spatial variation of the biological features of the benthic communities across the Kentish Flats survey area are presented in Charts 3.3, 3.4, 3.5, 3.6, 3.7 and 3.8, for the distribution of the mean numbers of species, individuals, mean values of richness, evenness, diversity and dominance, respectively. Full results are presented in Appendix VII.

The mean number of species, expressed per m^2 showed a great degree of spatial variation across the survey area, ranging from a mean of 3.3 at site 48 within the secondary impact area to a mean of 40.7 at site 9 within the development site. Relatively high mean numbers of species were also recorded at site 33 within the southern reference area and 36 within the development site, whereas sites 38 and 3, within the secondary impact area and the development site, respectively, showed low mean numbers of species.

Faunal abundances, expressed as number of individuals per m^2 also varied greatly across the survey area in 2007, ranging from 4 at site 3 to 464 at site 45 within the southern reference area. Relatively high abundances were also recorded at sites 2 and 14 within the scour assessment area and the development site, respectively. Site 38 and 43, both within the secondary impact area hosted fairly low faunal abundances.

The mean value of the Margalef's index of richness (d) ranged from 1.3 at sites 48 and 38 within the secondary impact area to 8.5 at site 9. High values of richness were also recorded at sites 33 and 36.

The mean value of Pielou's evenness index (J) ranged from 0.23 at site 2 within the scour assessment area to 0.99 at site 3. The high value of evenness at site 3 was likely to be associated with the sparseness of fauna at this station which accounted for a mean of 4 species and a mean of 4.3 individuals. Sites 6 and 35 within the scour assessment area and the development site, respectively, also showed relatively high values of evenness.

Values of the Shannon-Wiener diversity (H) ranged from 0.6 at site 2 to 3.3 at site 9. High values of diversity were also recorded at sites 36 and 33, whereas sites 45 and 48 showed relatively low values. Mean values of the Simpson index (λ) ranged from 0.05 at site 9 to 0.8 at site 2. The high value of dominance index at site 2 was associated with a high abundance of the barnacle *Balanus crenatus*, which accounted alone for over 90% of the abundance at this site. Similarly the numerical dominance of this invertebrate at site 45 resulted in a high value of dominance at this station.

3.2.1.2 Biomass (infaunal species from grab samples)

Epifaunal species (colonial and solitary) were not subjected to biomass analysis. Similarly, voucher specimens retained for the reference collection were not subjected to biomass.

Spatial variations of infauna biomass across the survey area are presented in Chart 3.9. Raw data are presented in Appendix VIII.

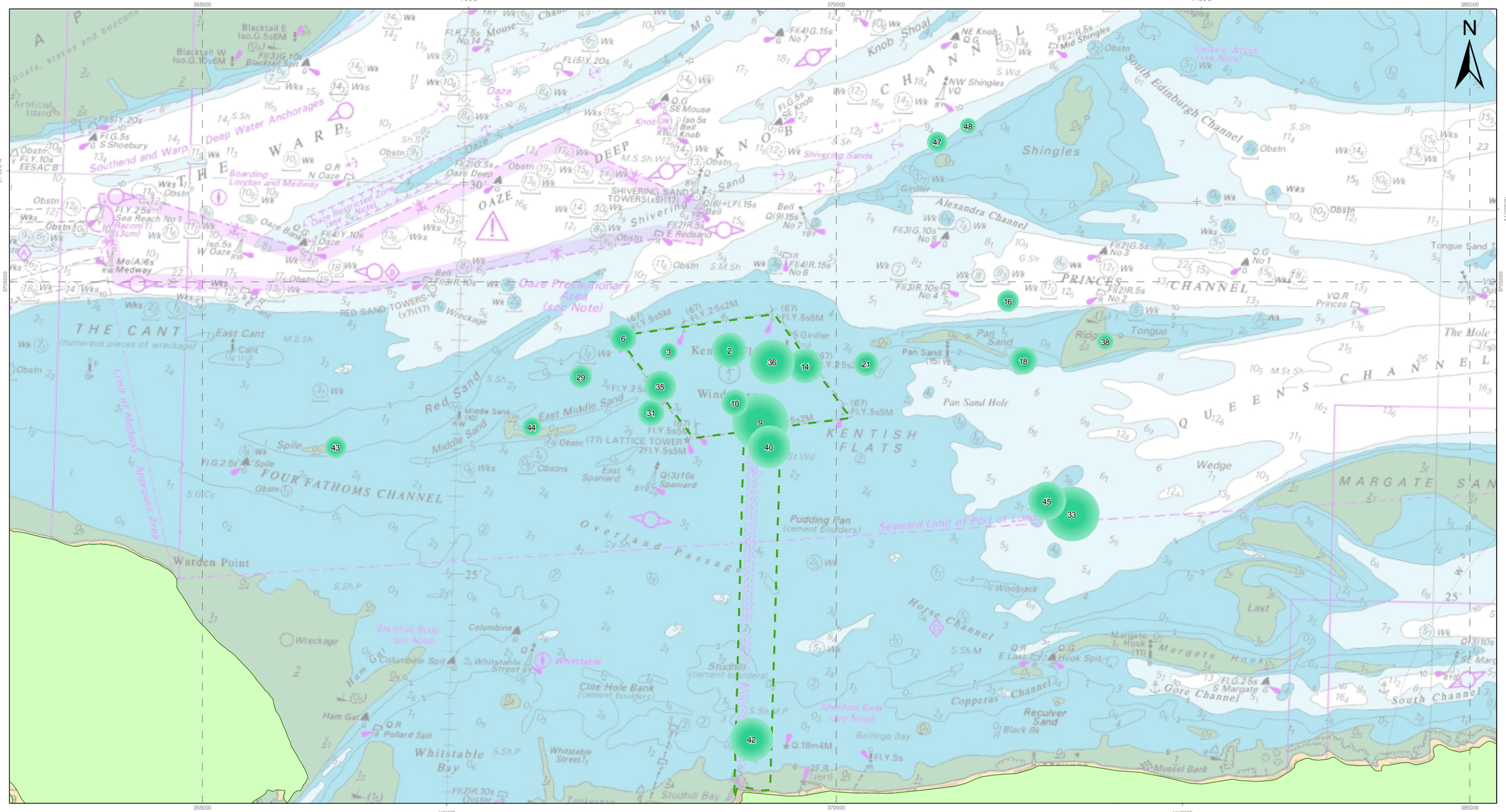
Echinoderms accounted for the largest biomass across the Kentish Flats survey area in 2007, followed by molluscs and annelids.

Infaunal biomass, expressed as AFDW g/0.1m^2 ranged from <0.01 at site 38 to 1 at site 31, both within the secondary impact area. Relatively high infaunal biomasses were also recorded at sites 43 and 44 within the secondary impact area and site 6 within the scour assessment area. Low values of infaunal biomass were recorded at sites 47, 10 and 3 within the northern reference area, the scour assessment area and the development site, respectively, and reflected low infaunal abundances.

The high values of infaunal biomass at sites 43, 44 and 6 did not correspond to high infaunal abundance. Analysis of the species list showed that echinoderms were primarily responsible for the high biomass at these sites which hosted the sea potato *Echinocardium cordatum,* a relatively large species which can reach up to 9cm in length.

Molluscs were responsible for the high infaunal biomass at site 31, although they were not numerically dominant. Analysis of the species list showed that site 31 hosted over 87% of the total abundance of the razor shell *Ensis arcuatus*, a large species which can reach up to 15cm in length.

The highest values of the annelids' biomass were recorded at sites 48 and 14 and were not associated with the annelids abundance at these sites but rather with the presence of robust polychaetes species (e.g. *Notomastus* spp).



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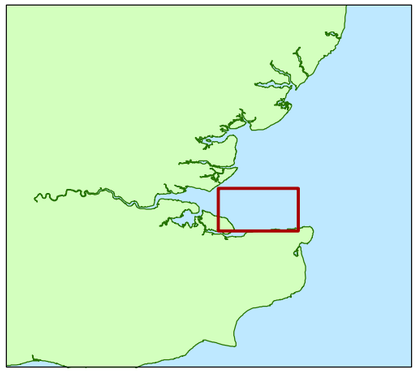

Legend

Kentish Flats Development Area & Cable Route (approx.)

Total Number of Species

= 24 species

Scale Bar

0 1 2 4

Kilometres

Coordinate System

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Notes

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Kentish Flats Windfarm Development Macrobenthic Ecology Study 2007

Drawing Title

Spatial Variations of the Mean Number of Species from Grab Samples, Kentish Flats, 2007 Survey

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RJM	SDG			
Job Number:	**Issued On:**	**Sheet Size:**	**Scale:**	**Rev:**
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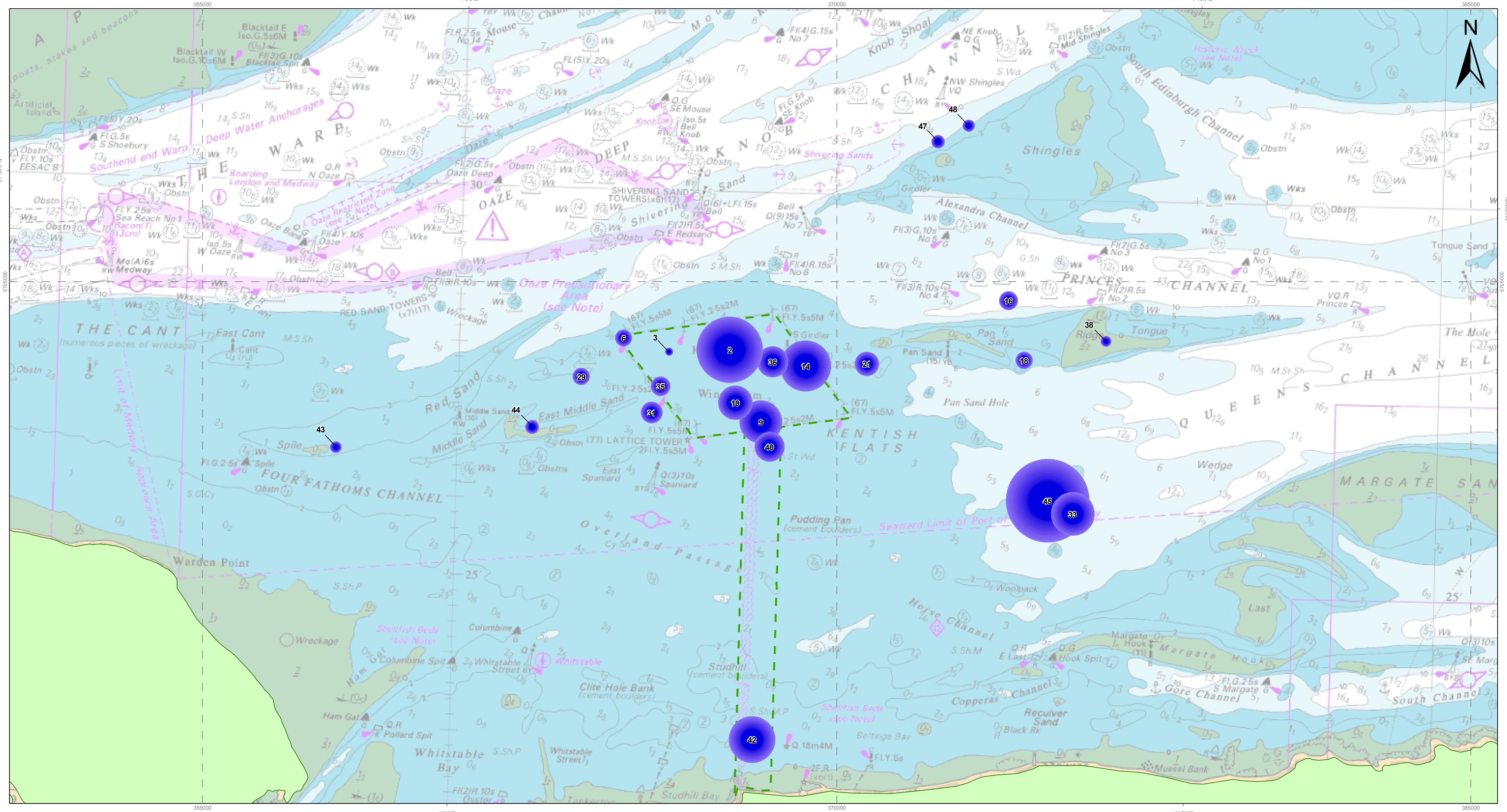

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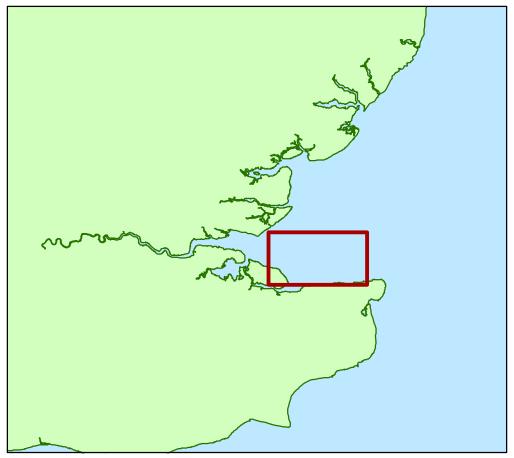

Legend

Kentish Flats Development Area & Cable Route (approx.)

Total Number of Individuals

= 120 individuals

Scale Bar

0 1 2 4

Kilometres

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Spatial Variations of the Mean Number of Individuals from Grab Samples, Kentish Flats, 2007 Survey

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RJM	SDG	**Chart No. 3.4**	

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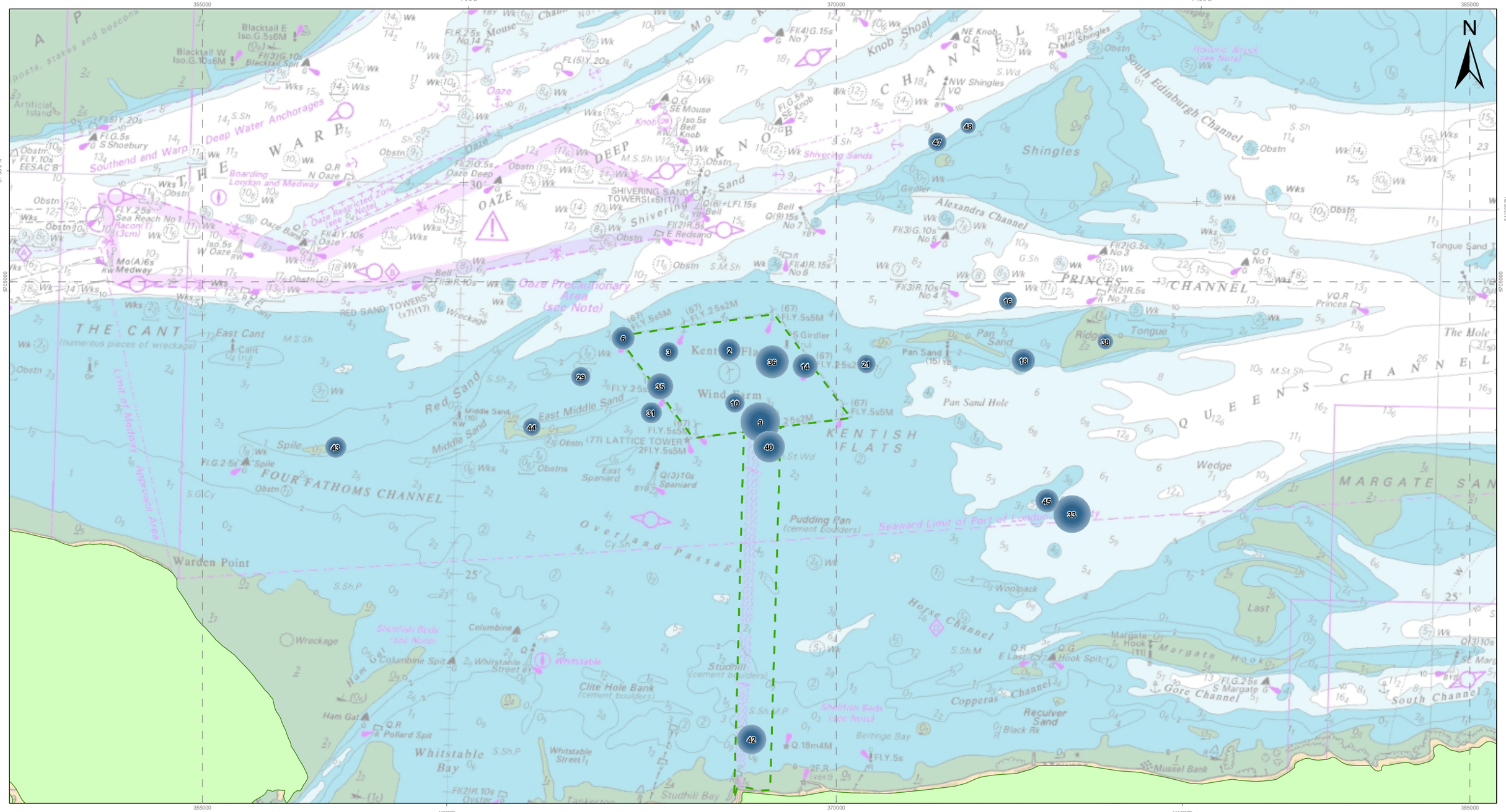

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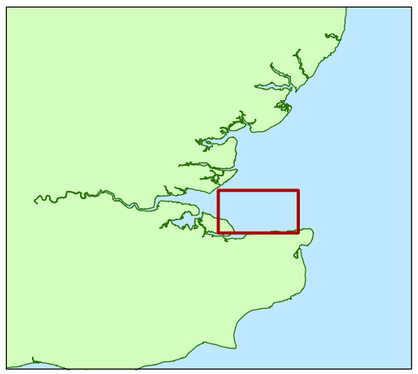

Legend

Kentish Flats Development Area & Cable Route (approx.)

Species Richness (*d*)

= 10

Scale Bar

0 1 2 4

Kilometres

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Kentish Flats Windfarm Development Macrobenthic Ecology Study 2007

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Spatial Variations of Species Richness (*d*), Kentish Flats, 2007 Survey

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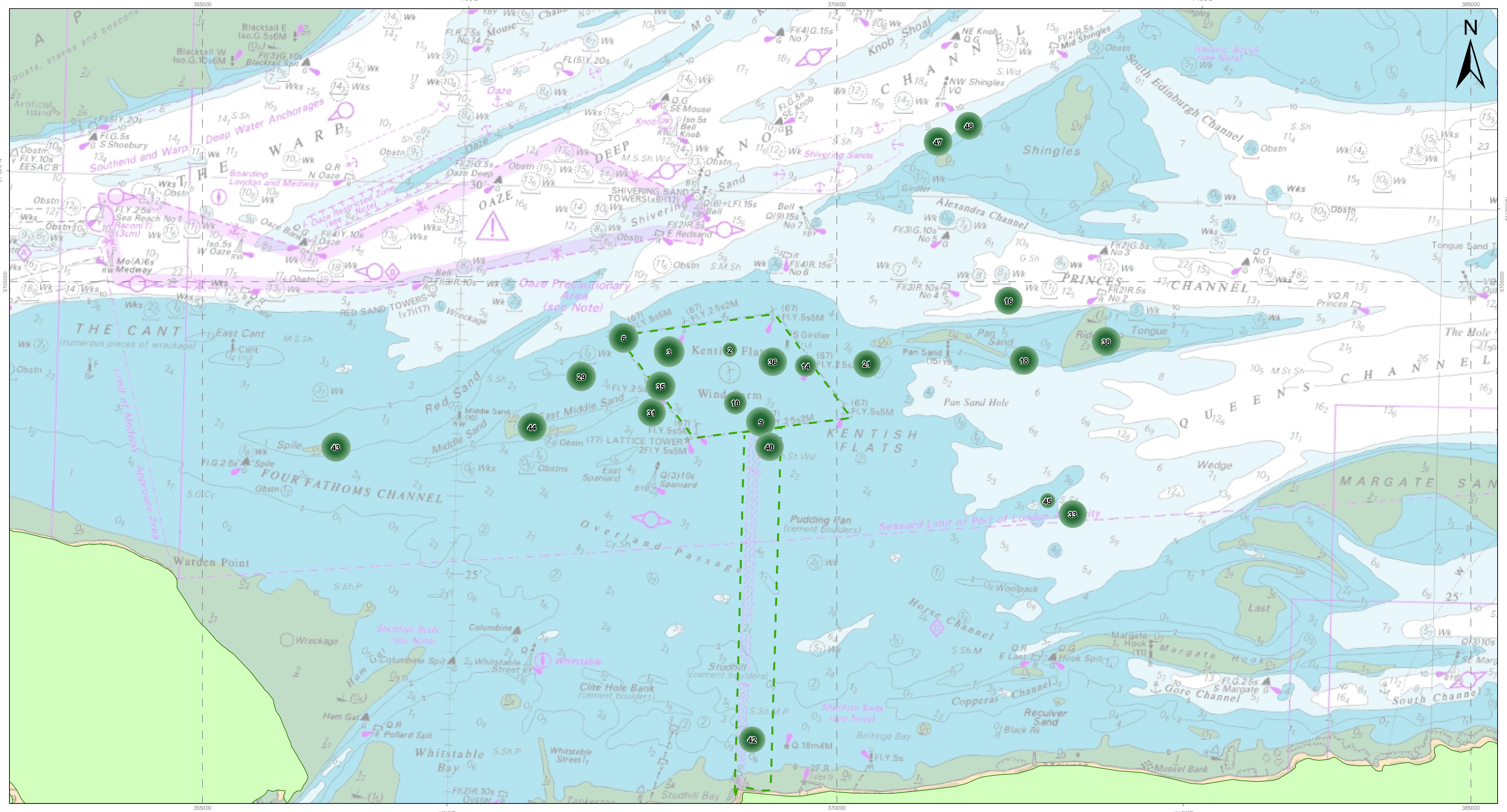

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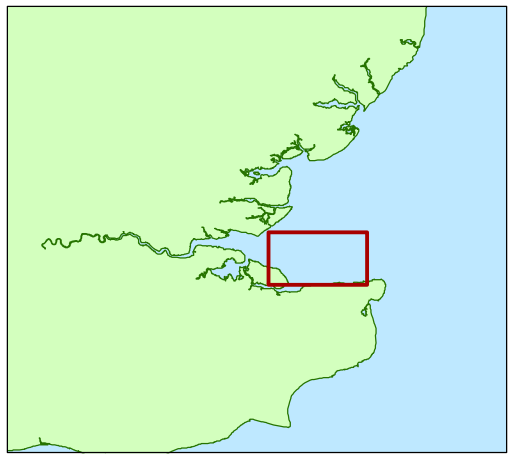

Legend

Kentish Flats Development Area & Cable Route (approx.)

Eveness Index (*J*)

= 2

Scale Bar

0 1 2 4

Kilometres

Coordinate System

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Drawing Title

Spatial Variations of Eveness Index (*J*), Kentish Flats, 2007 Survey

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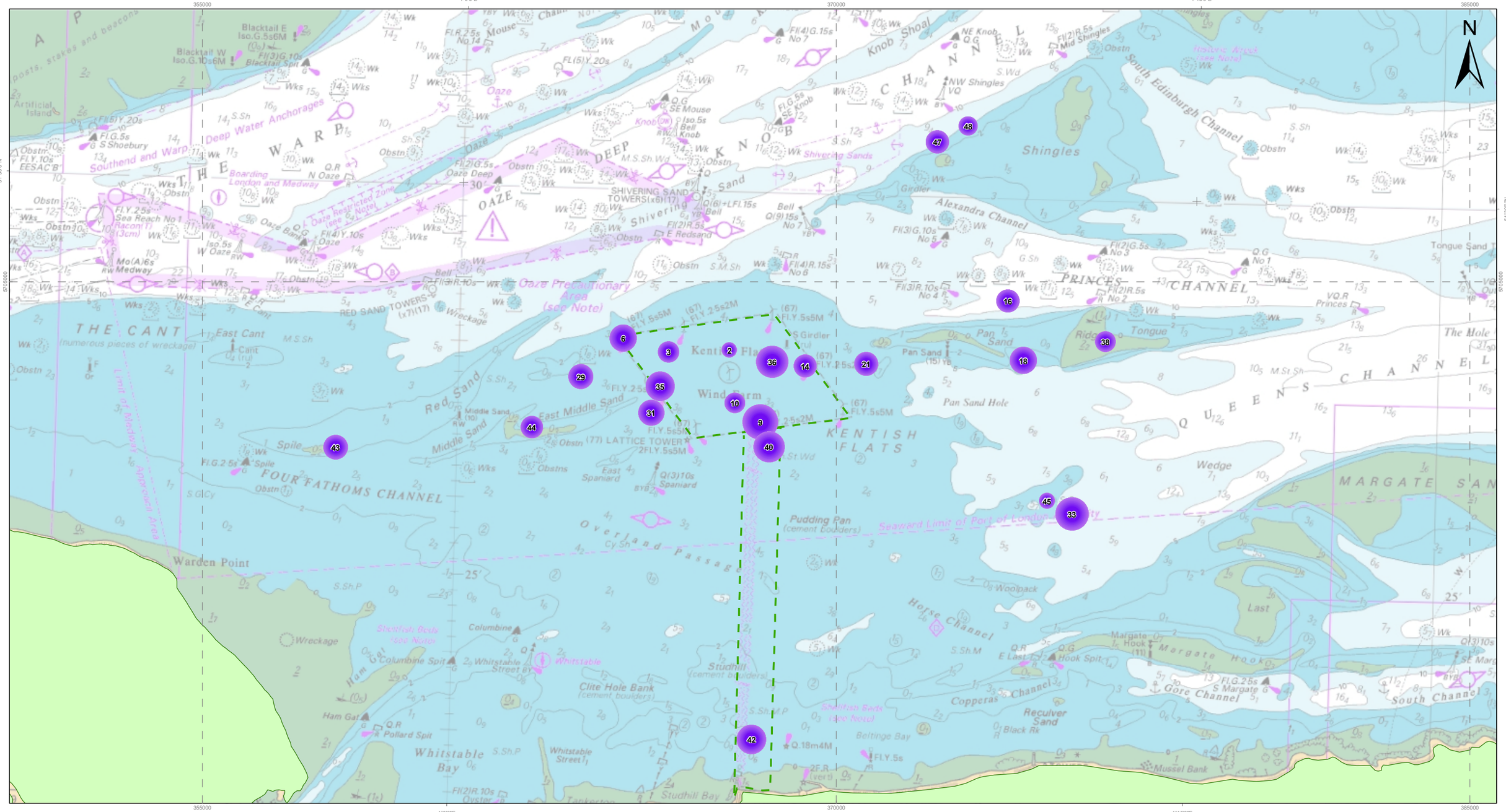

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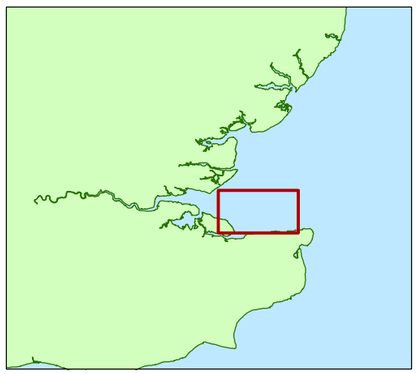

Legend

Kentish Flats Development Area & Cable Route (approx.)

Species Diversity (*H*)

= 5

Scale Bar

0 1 2 4

Kilometres

Coordinate System

WGS84 UTM Zone 31 North

Notes

Depths	All depths are in metres below Chart Datum
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EMU

Project Title

Kentish Flats Windfarm Development Macrobenthic Ecology Study 2007

Drawing Title

Spatial Variations of Species Diversity (*H*), Kentish Flats, 2007 Survey

Drawn By:	Checked By:	Chart No. 3.7		
RJM	SDG			
Job Number:	**Issued On:**	**Sheet Size:**	**Scale:**	**Rev:**
J/1/03/1033	13/06/08	A3	1:90,000	1

Map Document: (N:\1.03\1033 Kentish Flats Benthic 2007\GIS\3.Plots\Final\3_7_SV_Diversity.mxd)
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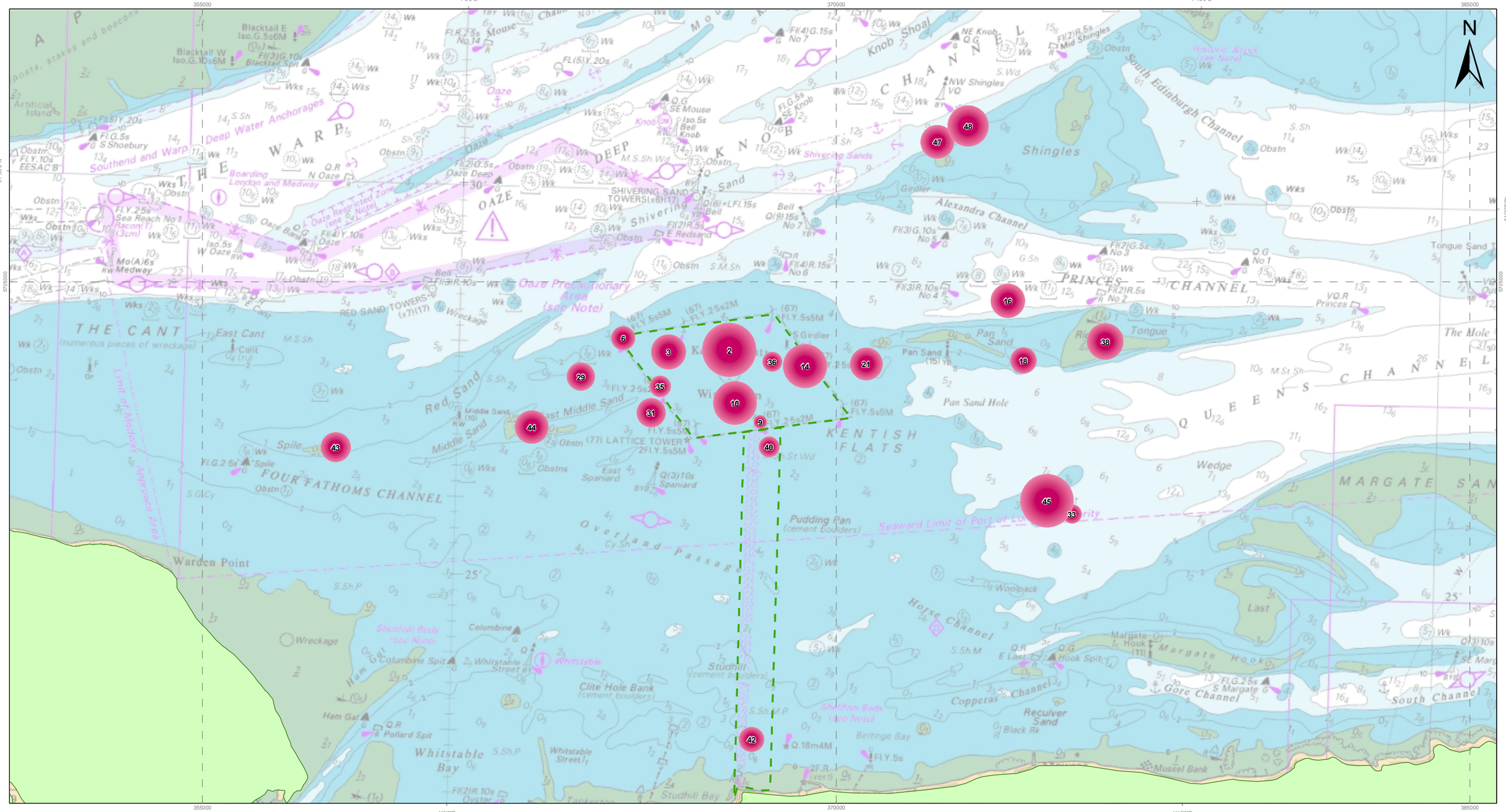
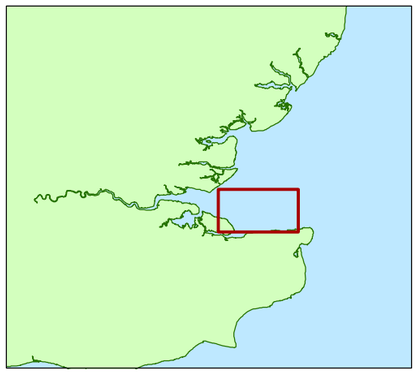
Commercial In Confidence



Location Plan



Legend

Kentish Flats Development Area & Cable Route (approx.)

Dominance Index (λ)

= 0.5

Scale Bar

0 1 2 4

Kilometres

Coordinate System

WGS84 UTM Zone 31 North

Notes

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Project Title

Kentish Flats Windfarm Development Macrobenthic Ecology Study 2007

Drawing Title

Spatial Variations of Dominance Index (λ), Kentish Flats, 2007 Survey

Drawn By:	Checked By:	Chart No. 3.8		
RJM	SDG			
Job Number:	**Issued On:**	**Sheet Size:**	**Scale:**	**Rev:**
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Map Document: (N:\1.03\1033 Kentish Flats Benthic 2007\GIS\3.Plots\Final\3_8_SV_Dominance.mxd)
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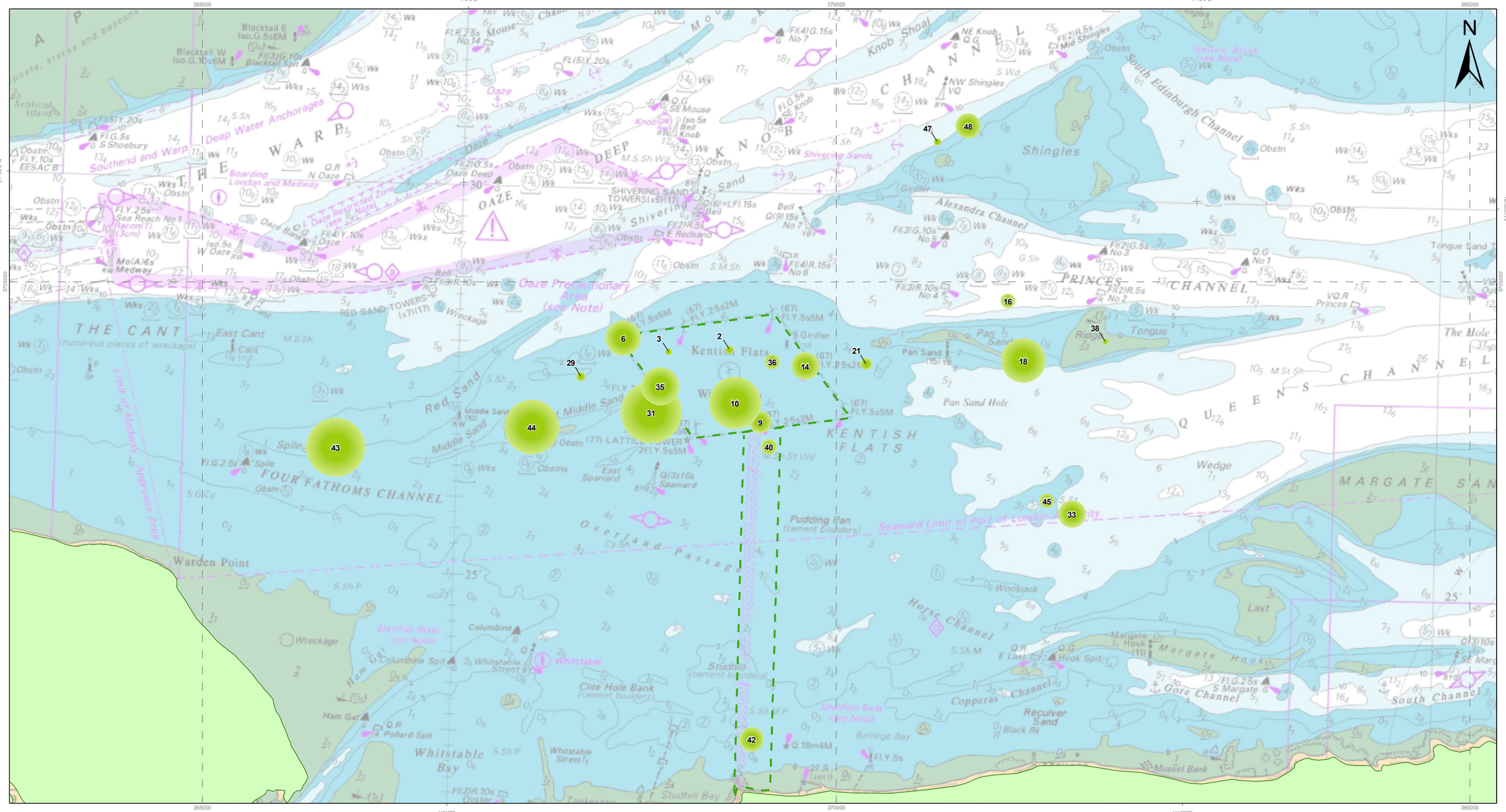
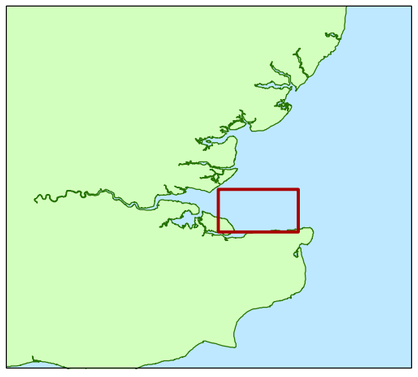
Commercial In Confidence



Location Plan



Legend

Kentish Flats Development Area & Cable Route (approx.)

Infaunal Biomass (gAFDW)

= 0.5

Scale Bar

0 1 2 4

Kilometres

Coordinate System

WGS84 UTM Zone 31 North

Notes

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Project Title

Kentish Flats Windfarm Development Macrobenthic Ecology Study 2007

Drawing Title

Spatial Variations of Infaunal Biomass from Grab Samples, Kentish Flats, 2007 Survey

Drawn By:	Checked By:	Chart No. 3.9		
RJM	SDG			
Job Number:	**Issued On:**	**Sheet Size:**	**Scale:**	**Rev:**
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Map Document: (N:\1.03\1033 Kentish Flats Benthic 2007\GIS\3.Plots\Final\3_9_SV_Biomass.mxd)
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Commercial In Confidence

3.2.1.3 Multivariate Analysis of Benthic Communities (Enumerated Fauna) from Grab Samples

Multivariate analysis was carried out to determine which groups of communities were present within the Kentish Flats survey area in 2007. The results of the similarity matrix, following a 4th root transformation are graphically represented in a dendrogram (Figure 3.7) and a multidimensional scaling plot (Figure 3.8).

Results of the Bray-Curtis Similarity matrix are presented in Table 3.4. The average similarity of replicates within each sampling site ranged from 6.54% (site 3) to 58.95% (site 16). The lowest level of similarity between any two replicate samples was 0% (replicates 3a and 3b), whereas the highest was 73.17% (replicates 16b and 16c).

Using Figures 3.7 and 3.8, eight groups of samples were identified. The groups of samples were subsequently analysed using Similarity Percentage Analysis (SIMPER), in order to determine which species were characteristic of the groups of samples and their contribution to the similarity within each group. Full results of the SIMPER analysis are reported in Appendix X. Table 3.5 shows the main characterising species of each group, together with their average abundance and frequency of occurrence within the group. These values refer to un-transformed data. The average similarity of each group is also shown, as well as the mean number of species and individuals. Top three species responsible for the separation of each group of samples are in bold.

	3a	3b
3b	0	
3c	19.6	0

	9a	9b
9b	46.55	
9c	48.85	43.84

	14a	14b
14b	25.4	
14c	32.52	41.1

	16a	16b
16b	58.35	
16c	45.32	73.17

	18a	18b
18b	38.8	
18c	36.88	69.39

	21a	21b
21b	62.43	
21c	35.87	44.4

	29a	29b
29b	48.09	
29c	42.45	40.93

	31a	31b
31b	54.25	
31c	59.28	58.38

	33a	33b
33b	62.8	
33c	49.76	48.33

	35a	35b
35b	53.43	
35c	27.77	43.94

	36a	36b
36b	53.95	
36c	52.09	45.38

	38a	38b
38b	54	
38c	45.98	32.71

	40a	40b
40b	53.2	
40c	34.38	41.73

	42a	42b
42b	52.89	
42c	44.01	46.4

	43a	43b
43b	64.63	
43c	47.52	49.05

	44a	44b
44b	69.33	
44c	41.05	35.53

	45a	45b
45a	52.13	
45b	57.66	51.13

	47a	47b
47b	68.31	
47c	36.08	65.94

	48a	48b
48b	46.51	
48c	26.76	53.3

	10a	10b
10b	62.25	
10c	31.19	48.72

	2a	2b
2b	36.4	
2c	24.63	43.49

	6a	6b
6b	55.21	
6c	51.79	35.06

Table 3.4 Small Scale Variability of Faunal Communities (Enumerated Fauna) from Grab Samples across the Kentish Flats Survey Area, 2007 Survey – Results of Bray-Curtis Similarity Matrix

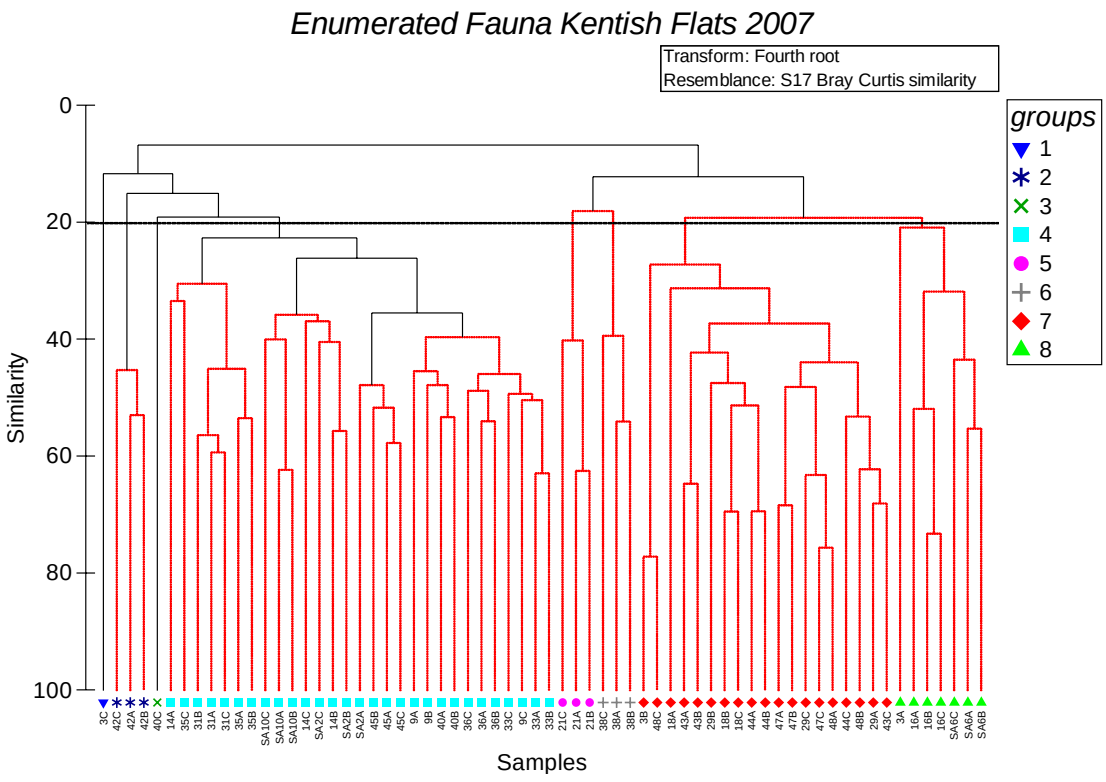


Figure 3.7 **Dendrogram of Bray-Curtis Similarity Index of Enumerated Fauna from Grab Samples, Kentish Flats, 2007 Survey**

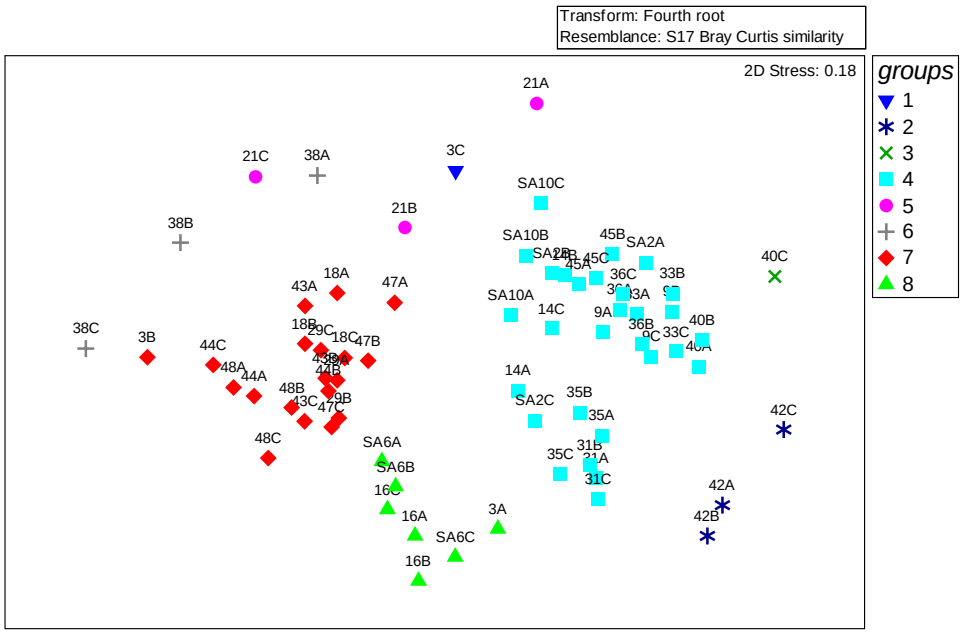


Figure 3.8 **Multi Dimensional Scaling (MDS) Plot of Bray-Curtis Similarity Index of Enumerated Fauna from Grab Samples, Kentish Flats, 2007 Survey**

Group	Samples and Sediment Characteristics Mean Number of Species & Individuals ± Standard Deviation	Species	Average Abundance	Frequency of occurrence (% of samples)
▼ 1 *Average Similarity* N/A	**3**c Total no of Species: 3 Total no of individuals: 3 Slightly silty **Sand**, poorly-sorted	*Goniada maculata* *Spiophanes bombyx* *Mysella bidentata*	1† 1† 1†	n/a n/a n/a
✱ 2 *Average Similarity* **47.77%**	**42**(a,b,c) Mean no of Species: 24 ± 2.6 Mean no of Individuals: 145 ± 48.6 **Silty Sand** very poorly-sorted	***ACTINIARIA*** ***Polycarpa fibrosa*** ***Polycarpa pomaria*** ***Ampharete baltica*** ***Abra alba*** *Euclymene oerstedii* *Molgula manhattensis* *Mediomastus fragilis* *Ophiothrix fragilis* *Pyura squamulosa*	35.3 34.3 14 6 3.7 4 2.7 6.7 6.7 3.7	100 100 100 100 100 100 100 67 67 67
✕ 3 *Average Similarity* N/A	**40**c Total no of Species: 13 Total no of Individuals: 28 Slightly Gravelly **Sand**, very poorly-sorted	***NEMERTEA*** ***Euclymene oerstedii*** ***Galathowenia oculata*** *Pholoe inornata* *Glycera tridactyla*	8 6 3 2 1	n/a n/a n/a n/a n/a
■ 4 *Average Similarity* **29.90%**	**9**(a,b,c); **14**(a,b,c); **31**(a,b,c); **33**(a,b,c); **35**(a,b,c); **36**(a,b,c); **40**(a,b); **45**(a,b,c); **2**(a,b,c); **10**(a,b,c). Mean no of Species: 20.3± 11.8 Mean no of Individuals: 148 ± 175 Slightly silty **Gravelly Sandy**, very poorly-sorted	***NEMERTEA*** ***Spiophanes bombyx*** ***Balanus crenatus*** ***Lanice conchilega*** *Euclymene oerstedii* *Nymphon brevirostre* *Notomastus spp.* *Goniada maculata* *Abra alba* *Caulleriella alata*	5.5 3.6 90.3 2.6 4.8 5.4 1.6 0.8 1 0.7	87 83 57 70 67 63 43 50 43 50
● 5 *Average Similarity* **47.57%**	**21**(a,b,c) Mean no of Species: 7.7 ± 3.8 Mean no of Individuals: 38.7 ± 27.2 Slightly gravelly **Sand**, very poorly-sorted	***Ophelia borealis*** ***Microphthalmus similis*** ***NEMERTEA*** *Nephtys cirrosa* *Polycirrus medusa* *Scoloplos armiger* *Travisia forbesii*	17.7 2.7 4.7 2.3 3.7 1.3 2.7	100 100 67 67 67 67 67
+ 6 *Average Similarity* **44.23%**	**38**(a,b,c) Mean no of Species: 3.7 ± 0.6 Mean no of Individuals: 7.7 ± 2.3 **Sand**, moderately well-sorted	***Urothoe brevicornis*** *Ophelia borealis* *Bathyporeia elegans*	3 1 2	100 67 67
◆ 7 *Average Similarity* **38.92%**	**3**b; **18**(a,b,c); **29**(a,b,c); **43**(a,b,c); **44**(a,b,c); **47**(a,b,c); **48**(a,b,c) Mean no of Species: 5.8 ± 2.6 Mean no of Individuals: 12.8 ± 8.3 **Sand**, moderately well-sorted.	***Nephtys cirrosa*** ***Bathyporeia elegans*** *Goniada maculata* *Magelona johnstoni* *Corystes cassivelaunus* *Notomastus* spp.	2.5 3.6 0.5 1.2 0.4 0.5	100 74 42 42 42 37
▲ 8 *Average Similarity* **34.76%**	**3**a; **16**(a,b,c); **6**(a,b,c) Mean no of Species: 7.4 ± 1.9 Mean no of Individuals: 18.9 ± 7.1 **Sand**, moderately well-sorted	***Fabulina fabula*** ***Nephtys hombergii*** *Corystes cassivelaunus* *Spio martinensis* *Notomastus* spp. *Abra alba*	33 14 0.9 1.6 1.6 0.4	86 86 71 57 43 29

† = total number of individuals

Table 3.5 Summary of Within Groups Similarity Following SIMPER Analysis of Enumerated Fauna from Grab Samples, Kentish Flats, 2007 Survey (Un-transformed Data). Species Responsible for the Separation of the Groups of Samples are in Bold. Solitary Epifauna in Blue

The distribution of the groups of samples across the Kentish Flats survey area, following multivariate analysis is presented in Chart 3.10

The eight groups of samples identified by the multivariate analysis comprised benthic communities largely associated with the sediment type.

Group 1 comprised a single replicate from site 3, within the development area, and was considerably different from other replicates from the same station to be grouped separately. Indeed, replicates from site 3 showed the lowest degree of similarity in 2007 (Table 3.4), and were characterized by low species diversity and abundance. Group 1 was characterized by very poorly-sorted sand with small percentages of silt (7.8%) and gravel (3.7%) and comprised a total of 3 species and individuals (Table 3.5).

Group 2 comprised replicate samples from site 42, within the cable corridor. It was characterised by silty sand, very poorly-sorted and hosted the highest mean species diversity and abundance. This group also hosted the highest number of solitary epifaunal species, e.g. Actiniaria, and the ascidians *Polycarpa fibrosa* and *Polycarpa pomaria,* which were by far the most abundant and widespread species within this group and were primarily responsible for its separation. Within the infauna, the polychaete *Ampharete baltica* and *Euclymene oerstedii* and the bivalve *Abra alba* were the most widespread and abundant species (Figure 3.9).

Group 3 comprised a single replicate from site 40 within the cable corridor and was characterised by very poorly-sorted sand with small percentage of silt (5.5%) and gravel (8.1). It hosted much lower species diversity (13 species) and abundance (28 individuals) compared to an average of 28 species and 75 individuals of the other two replicates from the same site.

Group 4 comprised the largest number of samples, including replicates from sites within the development area (9, 14, 35 and 36), the scour assessment area (2 and 10), the most inshore sites within the secondary impact area (31) and cable corridor (40) and the southern reference area (33 and 45). The group was characterised by gravelly sand, very poorly-sorted and hosted relatively high mean species diversity and abundance. The benthic community was dominated by the nemertean worms and annelids (e.g. *Lanice conchilega*, *Spiophanes bombyx* and *E. oerstedii*) which were primarily responsible for the separation of this group (Figure 3.9). Epifauna included species of ascidians, actiniarians and the barnacle *Balanus crenatus* which was numerically dominant, accounting alone for 62% of the group's faunal abundance.

Group 5 comprised samples from site 21, within the secondary impact area. It was characterised by poorly-sorted gravelly sand and hosted relatively low species diversity and abundance, represented by the polychaetes *Ophelia borealis* and *Microphthalmus similis* which were primarily responsible for the separation of this group of samples (Figure 3.9).

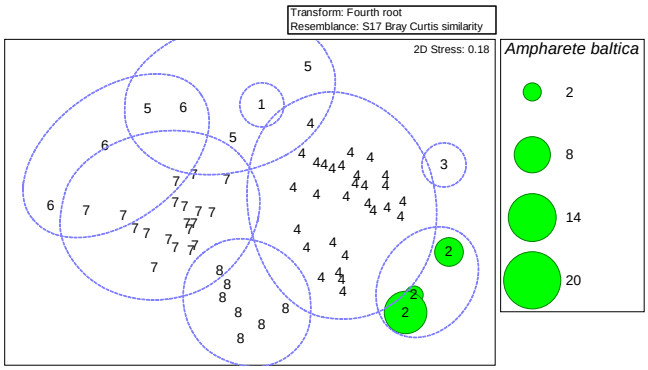
Group 6 comprised replicates from site 38, within the secondary impact area. It was characterised by moderately well sorted sand and hosted low species diversity and abundance, represented by the crustacean amphipods *Urothoe brevicornis* and *Bathyporeia elegans* and the polychaetes *O. borealis* which were primarily responsible for the separation of this group of samples (Figure 3.9).

Group 7 comprised a replicate sample from site 3 and the majority of samples from most offshore sites within the secondary impact area (18, 29, 43 and 44) and sites within the northern reference area (47 and 48). It was characterised by moderately well-sorted sand and hosted low species diversity and abundance. The faunal community was characterised by the polychaete *Nephtys cirrosa* and the crustacean amphipod *Bathyporeia elegans* which were primarily responsible for the separation of this group of samples (Figure 3.9).

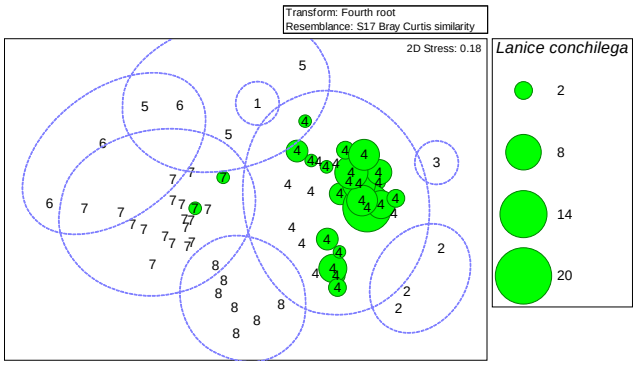
Group 8 comprised a replicate sample for site 3 and samples from site 16 and 6 within the secondary impact area and the scour assessment area, respectively. It was characterised by moderately well-

sorted sand and low species diversity and abundance. Numerically dominant species included the bivalve *Fabulina fabula* and the polychaete *Nepthys hombergii* which were primarily responsible for the separation of this group (Figure 3.9).

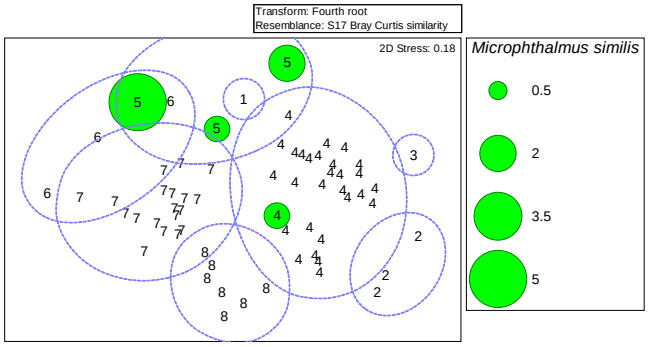
It is noteworthy that Groups 7 and 8 featured similar sediment composition and both hosted low species diversity and abundance, hence the results of the SIMPROF test (Figure 3.7). Main differences between the two groups were associated with the higher abundance of *F. fabula* and *N. hombergii* in group 8 and the higher abundance of *N. cirrosa* and *B. elegans* in group 7.



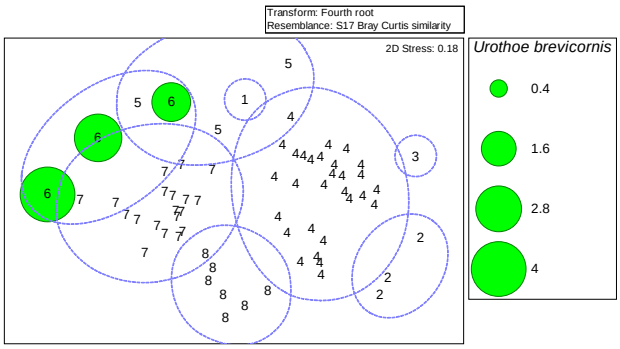
Abundance of *Ampharete baltica* in **Group 2**



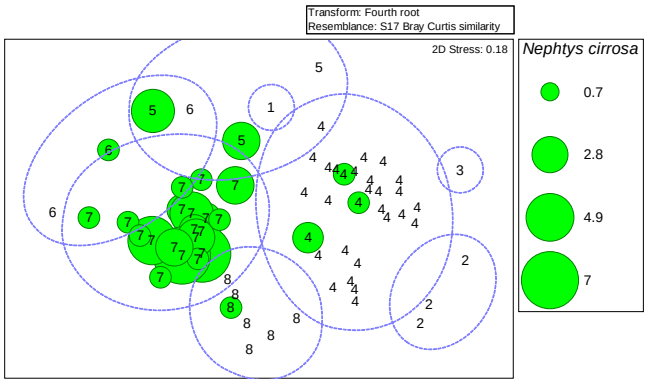
Abundance of *Lanice conchilega* in **Group 4**



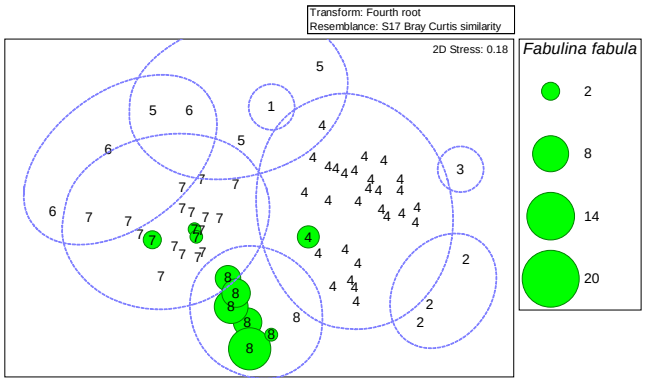
Abundance of in *Microphthalmus similis* in **Group 5**



Abundance of *Urothoe brevicornis* in **Group 6**



Abundance of *Nephtys cirrosa* in **Group 7**



Abundance of *Fabulina fabula* in **Group 8**

Figure 3.9 Multi Dimensional Scaling (MDS) Plots of Bray-Curtis Similarity Index of Enumerated Fauna from Grab Samples. Data with Superimposed Circles Proportional in Diameter to Values of Abundance of Species Responsible for the Separation of the Groups of Samples

3.2.1.4 BIOENV Analysis

In order to test relationships between physical and biological variables, the BIOENV statistical procedure was performed on the faunal and sediment data sets. BIOENV provides a ranked list of variables, or combination of variables, that best explains the community pattern as indicated by the similarity matrix. In the present study the sediment variables (percentage of sediment for various fractions) and depth were tested up to a maximum of 5 trial variables.

Results showed that the single variable which best explained the observed pattern of macro-infaunal distribution within the survey area was the 2mm sediment fraction (coarse sand) (ρ = 0.447). The combination of variables found to best explain the patterns within the macrofaunal distributions included percentage of coarse, medium and fine sands (2mm, 0.5mm and 0.125mm sediment fractions, respectively) and fines (<0.063mm sediment fraction) (ρ = 0.609).

Further analysis employing the RELATE test showed that there was a significant correlation between the observed distribution patterns of macro-fauna and sediment (Figures 3.10 and 3.11).

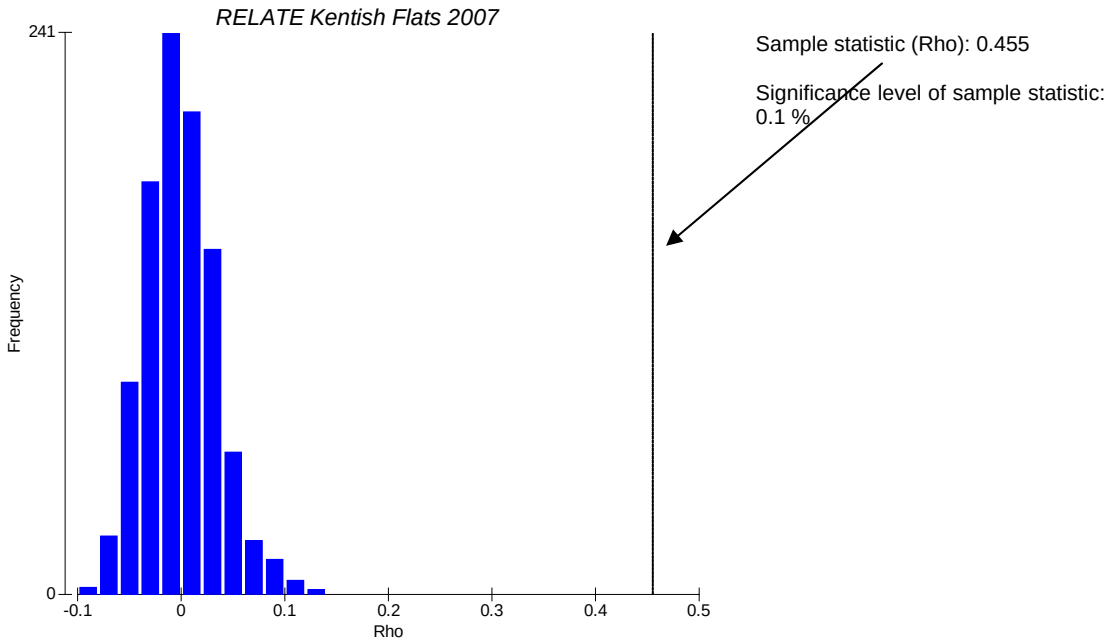
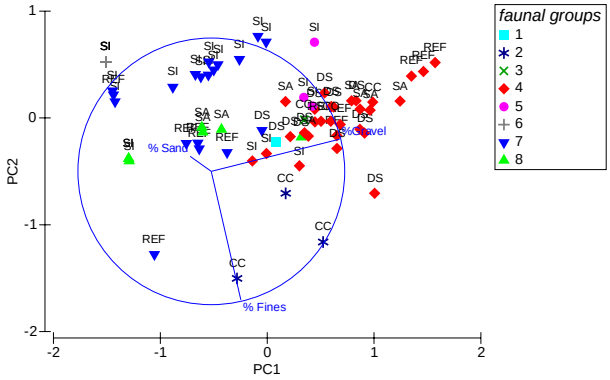
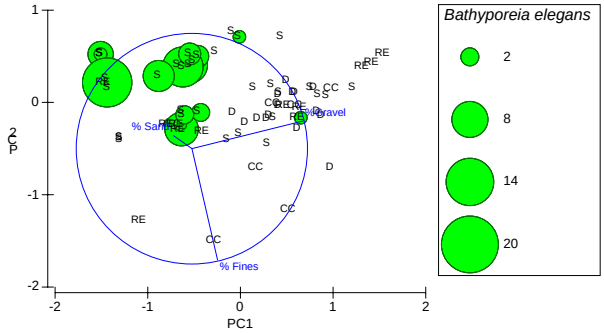
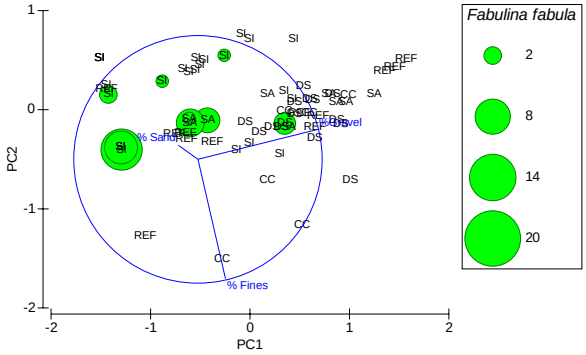


Figure 3.10 RELATE of Relationships Between Faunal Composition (Enumerated Fauna) and Sediment, Kentish Flats, 2007 survey. Simulated Distribution (999 permutations) of The Test Statistic Rho Under the Null Hypothesis of "No Relationships Between Faunal Distribution and Sediment Composition"

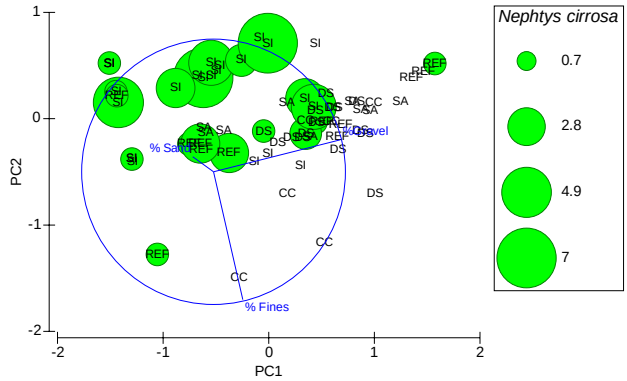




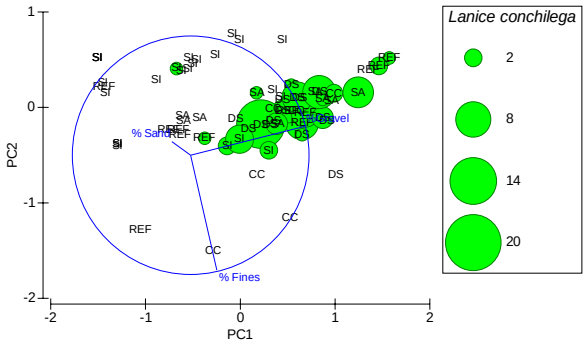
B. elegans in (very) well-sorted sandy sediments



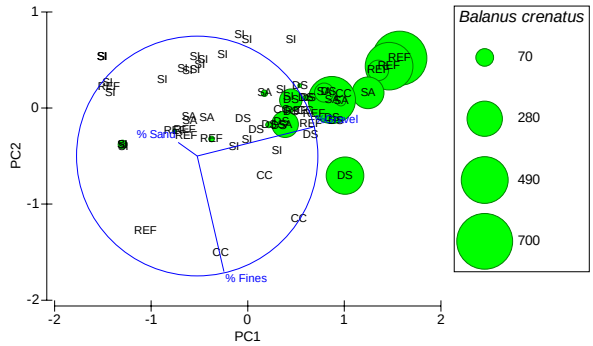
F. fabula in moderately-sorted sandy sediments



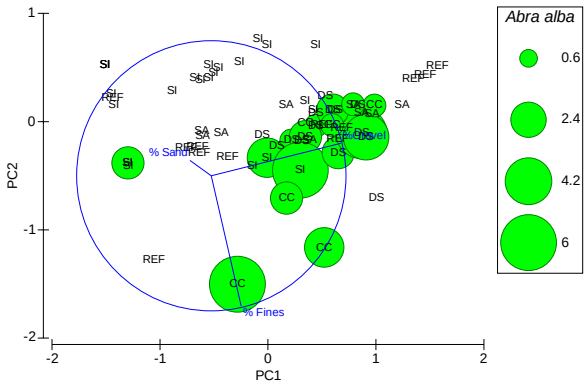
N. cirrosa in moderately (well)-sorted sandy sediments



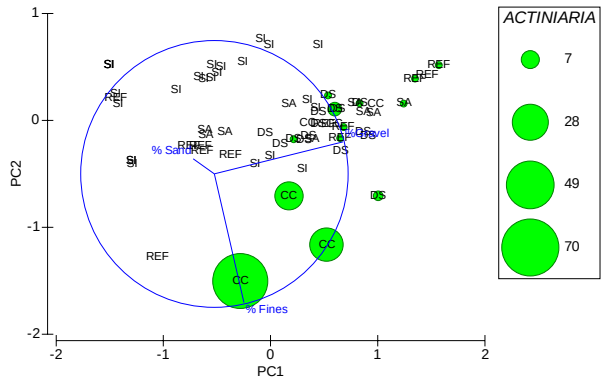
L. conchilega in poorly-sorted gravelly sandy sediments



B. crenatus in poorly-sorted gravelly sediments

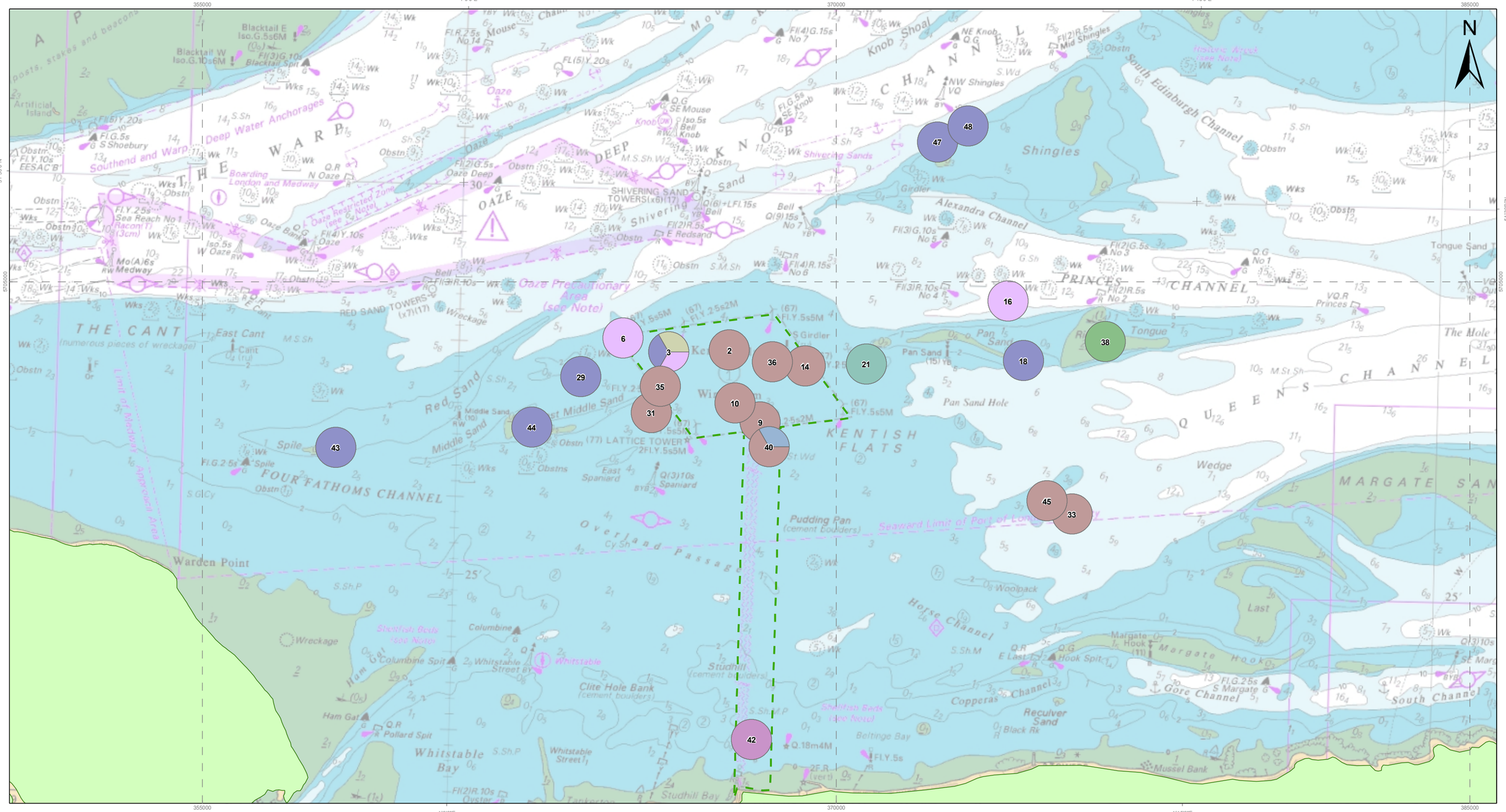


A. alba in very poorly-sorted mixed sediments

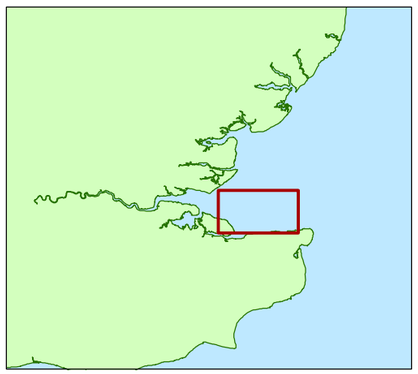


Actiniaria in (extremely) poorly-sorted muddy sediments

Figure 3.11 Two-dimensional Representation of the Principal Component Analysis of Sediment Composition from Grab samples. Data with Superimposed Groups of Samples Identified by the Clustering Analysis and Circles Proportional in Diameter to the Abundance of Species Characteristic of Different Sediments Types



Location Plan



Legend

Kentish Flats Development Area & Cable Route (approx.)

Faunal Groups (2007)

- Group 1
- Group 2
- Group 3
- Group 4
- Group 5
- Group 6
- Group 7
- Group 8

Scale Bar

0 1 2 4

Kilometres

Coordinate System

WGS84 UTM Zone 31 North

Notes

Depths	All depths are in metres below Chart Datum
Equipment	Hamon Grab
Caveat	© Crown Copyright and/or database rights. Reproduced by permission of the Controller of Her Majesty's Stationery Office and the UK Hydrographic Office (www.ukho.gov.uk). NOT TO BE USED FOR NAVIGATION

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Project Title

Kentish Flats Windfarm Development Macrobenthic Ecology Study 2007

Drawing Title

Faunal Groups Identified by the Multivariate Analysis, Kentish Flats, 2007 Survey

Drawn By:	Checked By:	Chart No.		
RJM	SDG	3.10		
Job Number:	**Issued On:**	**Sheet Size:**	**Scale:**	**Rev:**
J/1/03/1033	13/06/08	A3	1:90,000	1

Map Document: (N:\1.03\1033 Kentish Flats Benthic 2007\GIS\3.Plots\Final\3_10_Faunal_Groups.mxd)
10/06/2008 – 11:20:07

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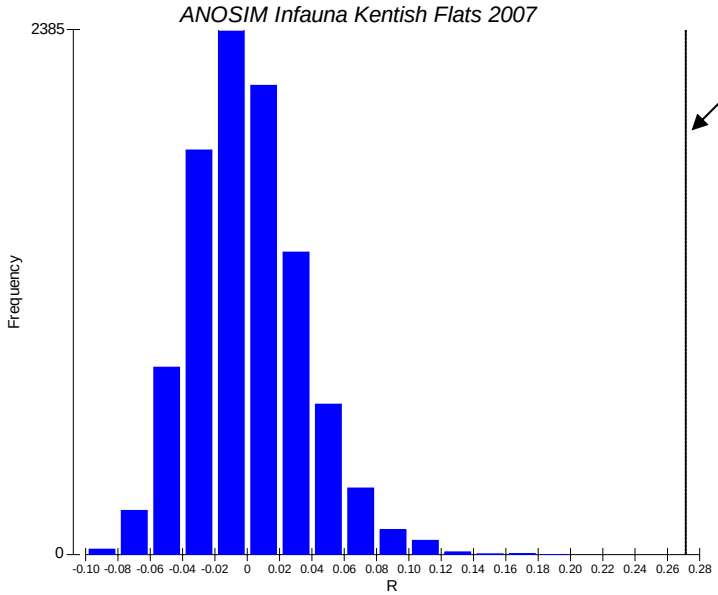
3.2.1.5 Analysis of Similarity (ANOSIM)

ANOSIM was applied to the enumerated fauna data set from the grab samples, with a view to investigating whether samples within different areas collectively were significantly different. Results (Figure 3.12) showed that, overall, there were significant spatial differences between the different sites within the Kentish Flats study area in 2007. Results of the pairwise test highlighted the areas which showed the greatest difference (large values of R)



Sample statistic (Global R) : 0.271
Significance level of sample statistic : 0.01%

R-Values derived from ANOSIM test (number of possible permutations for each pairwise >>9,999)

Areas	R statistic	Significance level %
DS, SI	0.396	0.01
DS, REF	0.12	4.1
DS, CC	0.255	4.2
DS, SA	0.145	4.8
SI, REF	0.136	3.4
SI, CC	0.564	0.01
SI, SA	0.259	0.4
REF, CC	0.362	0.6
REF, SA	0.185	3.2
CC, SA	0.633	0.02

DS=Development Site; SA= Scour assessment; SI= Secondary Impact; CC Cable Corridor; REF= Reference Area

Figure 3.12 ANOSIM of Enumerated Fauna from Grab Samples, Kentish Flats, 2007 Survey. Simulated Distribution (9,999 permutations) of the Test Statistic R Under the Null Hypothesis of "No Differences Between Areas"

The largest differences, based on the output of the ANOSIM test, were recorded between sites within the cable corridor and those within the scour assessment area and the secondary impact area. Indeed sites within the cable corridor showed large differences when compared to the majority of other areas (R >0.25). This is further illustrated in Figure 3.13 which shows the degree of separation of benthic communities from the different areas within Kentish Flats study area in 2007.

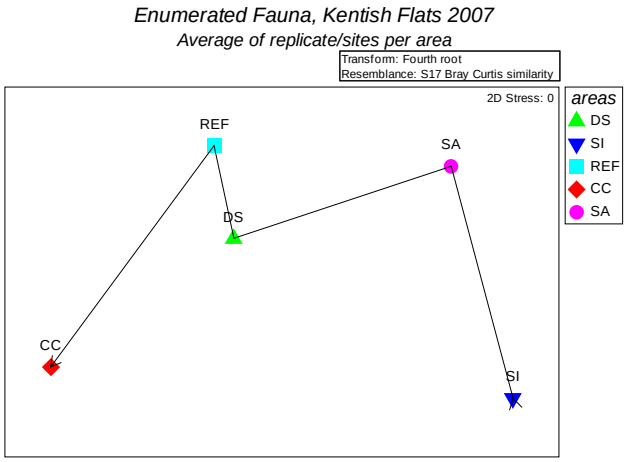


Figure 3.13 Multi Dimensional Scaling Plot of Bray Curtis Similarity Index of Enumerated Fauna from Grab Samples with Superimposed Trajectory Joining Points from the Most Offshore to the Most Inshore Stations, Kentish Flats, 2007 Survey

Characteristic species of the **cable corridor** included solitary epifaunal species (e.g. Actiniaria, *P. fibrosa*) and the polychaetes *Euclymene oerstedii*, *Pholoe inornata* and *Galathowenia oculata*, which were amongst the main species contributing to the difference between the cable corridor and the other areas. The bivalve *A. alba* was also abundant and fairly evenly distributed within the cable corridor.

Sites within the **scour assessment area** were characterised by very poorly-sorted gravelly sand and hosted a faunal community dominated by the polychaetes *Spiophanes bombyx*, *Notomastus* sp. and *Lanice conchilega* and the barnacle *Balanus crenatus*.

Sites within the **secondary impact area** were characterised by moderately well-sorted sand and comprised a faunal community dominated by the polychaetes *Nephtys cirrosa*, *Magelona johnstoni*, *Goniada maculata* and the crustacean amphipods *Bathyporeia elegans* and *Corystes cassivelaunus*.

Sites within the **development site** were characterised by very poorly-sorted slightly silty, gravelly sand and hosted a faunal community comprising polychaetes species such as *S. bombyx*, *Goniada maculata* and *Notomastus* spp., nemertean worms and the sea spider *N. brevirostre*. The faunal abundance was dominated by the barnacle *B. crenatus* although this species was not evenly distributed, occurring in <50% of the samples from this area. Sites within the development site showed the largest difference when compared with the sites within the secondary impact area, based on the ANOSIM output, and the smallest difference with sites within the reference area.

Sites within the **reference area** were characterised by very poorly-sorted slightly silty, gravelly sand, and hosted a faunal community of polychaetes (e.g. *Nephtys cirrosa Spio martinensis, Notomastus* spp.), crustacean amphipods (*Bathyporeia elegans*) and barnacles (*Balanus crenatus*).

A summary of the benthic faunal characteristics within each area is presented in Figures 3.14. The top five species responsible for the differences between areas based on the results of the SIMPER analysis is presented in Table 3.6. Average abundances and frequency of occurrence of each species within the areas refer to un-transformed data. Full results of the SIMPER analysis are presented in Appendix X

The species composition within each area showed a common trend with infaunal species diversity and abundance being dominated by the annelids (Figure 3.14). Crustaceans were the second most dominant group in terms of infaunal species composition in samples from the reference, the secondary impact and the scour assessment areas, whereas molluscs and echinoderms accounted from the second highest infaunal species diversity within the cable corridor and the development site, respectively. Other taxa accounted for the second highest infaunal abundance within the development site, the cable corridor and the reference area, whereas crustaceans were the second highest abundant infaunal taxon within the scour assessment area and the development site. Analysis of the species list showed that the high abundance of other taxa was associated with the occurrence of nemertean worms, the sea spiders *Nymphon brevirostre*, *Achelia echinata* and *Anoplodactylus petiolatus* and less frequently *Phoronis* sp.

Solitary epifauna accounted for relatively high species diversity in samples from sites within the development site and the cable corridor. At these sites they also comprised the largest faunal abundance together with samples from sites within the scour assessment area (Figure 3.14).

The highest value of faunal biomass was recorded from samples within the secondary impact and the scour assessment areas and was associated with the presence of large echinoderms such as *Echinocardium cordatum* and *Asteria rubens*. Molluscs were dominant in terms of biomass in samples from the development site, whereas annelids dominated the biomass in samples from the cable corridor and the reference area.

Mean values of univariate indices showed a common trend within all areas. Values of species richness and diversity reflected the variations in the mean number of species and individuals within each area and values of dominance were consistently lower than any other value.

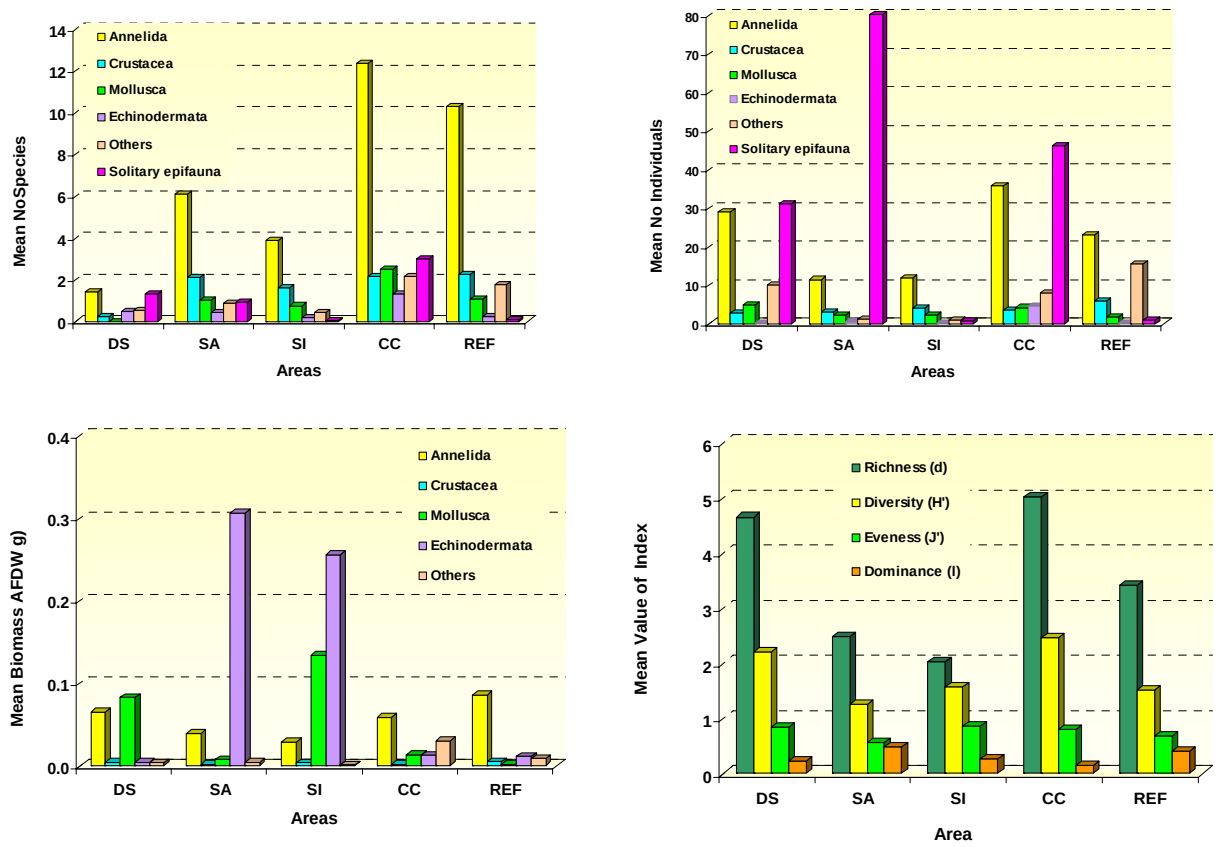


Figure 3.14 Spatial Variations of the Mean Numbers of Species, Individuals, Mean Values of Biomass and Univariate Indices of the Benthic Communities (Enumerated Fauna) from Grab Samples, Kentish Flats, 2007 survey

Areas	Species	Average abundance		Frequency of occurrence (% of samples)	
		DS	SI	DS	SI
DS & **SI** *Average dissimilarity* **89.92%**	*Spiophanes bombyx*	3.1	0.2	80	13
	Nephtys cirrosa	0.3	1.9	20	67
	Balanus crenatus	29.9	0.7	47	4
	NEMERTEA	4.5	0.8	80	21
	Bathyporeia elegans	0	2.1	0	50
		DS	REF	DS	REF
DS & **REF** *Average dissimilarity* **80.23%**	*Balanus crenatus*	29.9	106.3	47	50
	Spiophanes bombyx	3.1	3.4	80	50
	Nymphon brevirostre	2.7	9.3	67	58
	NEMERTEA	4.5	5.5	80	50
	Bathyporeia elegans	0	2.1	0	42

Table 3.6 Summary of Between Areas Dissimilarity Following SIMPER Analysis. (Un-transformed Data)

Areas	Species	Average abundance		Frequency of occurrence (% of samples)	
		DS	**CC**	**DS**	**CC**
DS & **CC** *Average dissimilarity* **81.52%**	*Polycarpa fibrosa*	0.1	17.3	7	67
	Euclymene oerstedii	3.1	6.8	47	100
	ACTINIARIA	0.6	17.7	33	50
	Galathowenia oculata	0.3	5.2	13	67
	NEMERTEA	4.5	3.3	80	50
		DS	**SA**	**DS**	**SA**
DS & **SA** *Average dissimilarity* **79.82%**	*Balanus crenatus*	29.9	110.4	47	67
	Notomastus spp.	2.1	2.2	47	67
	NEMERTEA	4.5	1.1	80	33
	Nymphon brevirostre	2.7	0.1	67	11
	Lanice conchilega	2.5	1.2	53	44
		SI	**REF**	**SI**	**REF**
SI & **REF** *Average dissimilarity* **83.82%**	*Balanus crenatus*	0.7	106.3	4	50
	Bathyporeia elegans	2.1	2.1	50	42
	Spio martinensis	0.6	0.7	21	33
	Nephtys cirrosa	1.9	0.9	69	58
	Notomastus spp.	0.5	0.4	25	33
		SI	**CC**	**SI**	**CC**
SI & **CC** *Average dissimilarity* **95.50%**	*Euclymene oerstedii*	1.6	6.8	13	67
	Polycarpa fibrosa	0	17.3	0	67
	ACTINIARIA	0	17.7	0	50
	Galathowenia oculata	0.04	5.2	4	67
	Pholoe inornata	0	1.8	0	83
		SI	**SA**	**SI**	**SA**
SI & **SA** *Average dissimilarity* **87.25%**	*Balanus crenatus*	0.7	110.4	4	67
	Spiophanes bombyx	0.2	2.1	13	78
	Nephtys cirrosa	1.9	0	67	0
	Notomastus spp.	0.5	2.2	25	67
	Bathyporeia elegans	2.1	0.4	50	22
		REF	**CC**	**REF**	**CC**
REF & **CC** *Average dissimilarity* **87.43%**	*Balanus crenatus*	106.3	0	50	0
	Polycarpa fibrosa	0	17.3	0	67
	Euclymene oerstedii	2.6	6.8	50	100
	ACTINIARIA	0.3	17.7	33	50
	Galathowenia oculata	0.4	5.2	17	67
		REF	**SA**	**REF**	**SA**
REF & **SA** *Average dissimilarity* 82.92%	*Balanus crenatus*	106.3	110.4	50	67
	Spiophanes bombyx	0.7	2.1	50	78
	Nephtys cirrosa	0.9	0	58	0
	Bathyporeia elegans	2.1	0.4	42	22
	Notomastus spp	0.4	2.2	33	67
		CC	**SA**	**CC**	**SA**
CC & **SA** *Average dissimilarity* 90.14%	*Balanus crenatus*	0	110.4	0	67
	Euclymene oerstedii	6.8	0.2	67	22
	Polycarpa fibrosa	17.3	0	67	0
	ACTINIARIA	17.7	0.1	50	11
	Galathowenia oculata	5.2	0	67	0

Table 3.6 cont **Summary of Between Areas Dissimilarity Following SIMPER Analysis. (Un-transformed Data)**

3.2.2 Colonial Epifauna from Grab Samples

Of the 66 samples collected by Hamon grab within the Kentish Flats survey area in 2007, 52 samples comprised colonial epifaunal species. These were represented by a total of 52 species and higher taxa, which included five species of Porifera (sea sponges), 22 species of Cnidaria (sea anemones, sea firs), one Entoprocta (goblet worms), 22 species of Bryozoa (sea mats) and two species of Tunicata (sea squirt).

Bryozoans and cnidarians accounted for the highest species diversity, the former also accounting for the highest frequency of occurrence in the samples and the highest cumulative abundance (scored on the numerical scale of 1 to 5).

Table 3.7 presents a summary of the top ten most widely distributed colonial epifaunal species within the survey area in 2007. The average cumulative abundance of each species is also shown together with the highest abundance in any one sample.

Species	**MCS code**	**Frequency of occurrence** (% of samples)	**Average abundance** (on the numerical scale of 1 to 5)	**Max Density** (on the numerical scale of 1 to 5)
Conopeum reticulum	Y0172	74	1.2	3
Aspidelectra melolontha	Y0182	58	0.7	3
Electra pilosa	Y0178	44	0.5	2
Electra monostachys	Y0177	42	0.6	3
Obelia dichotoma	D0519	33	0.5	3
Sertularia spp.	D0433	29	0.3	2
Alcyonidium mytili	Y0080	24	0.3	2
Hydrallmania falcata	D0424	21	0.3	3
Halecium spp.	D0390	20	0.2	1
Vesicularia spinosa	Y0131	18	0.3	3

Table 3.7 Top Ten most frequently occurring Epifaunal Species from Grab Samples across the Survey Area, Kentish Flats, 2007 survey

The highest species diversity of colonial epifauna was recorded at site 9 within the development site, whereas the lowest was recorded at sites 18 and 43 within the secondary impact area. Relatively high colonial epifaunal species diversity was recorded at sites 33 within the southern reference area and 42 within the cable corridor, whereas site 38 and 44 within the secondary impact area were devoid of colonial epifaunal species.

The distribution of colonial epifauna across the survey area is presented in Chart 3.11

The occurrence of colonial epifauna within the survey area was found to be associated with the sediment type. Specifically, sites characterised by heterogeneous sediments, particularly those with relatively large percentages of gravel hosted a greater number and variety of colonial epifaunal species. The more homogeneous sediments, with the highest percentage of sand, comprised little or no epifauna (Figure 3.15).

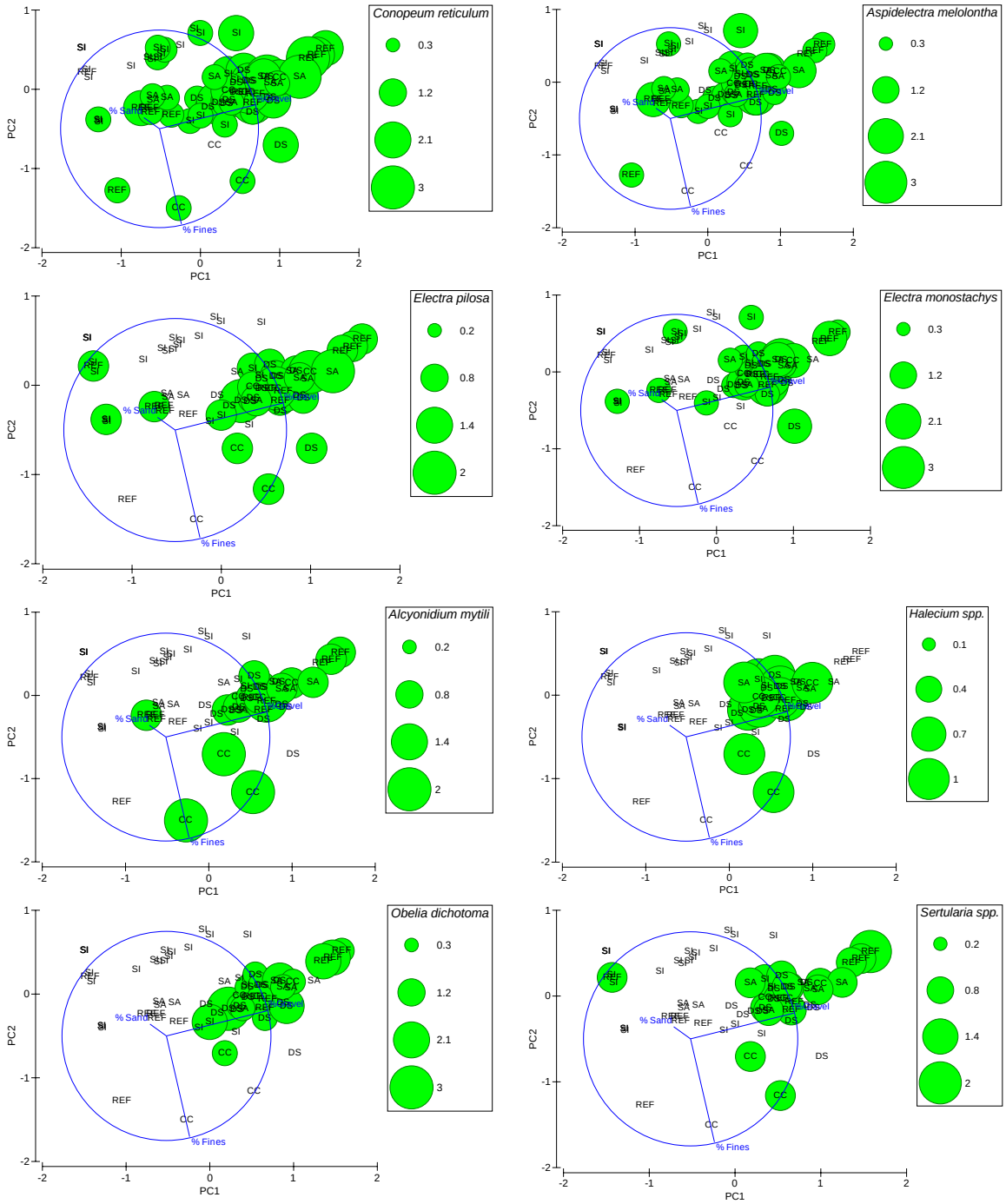
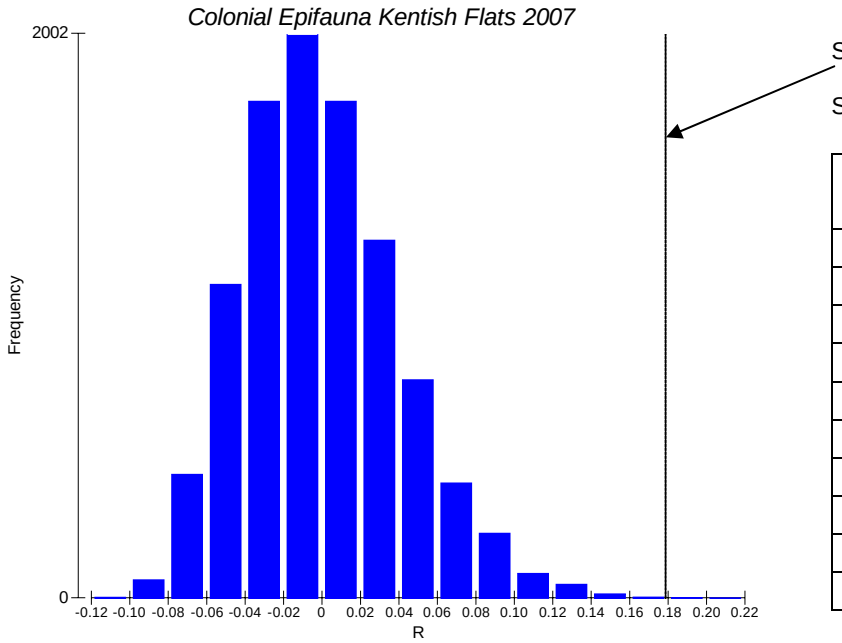


Figure 3.15 Two-dimensional Representation of the Principal Component Analysis of Sediment Composition from Grab Samples, Kentish Flats 2007. Data with Superimposed Circles Proportional in Diameter to the Abundance of Colonial Epifaunal Species

Overall, differences in the colonial epifaunal composition between the different areas were found to be significant (Figure 3.16). The largest difference, based on the output of the ANOSIM test was recorded between sites within the cable corridor and those within the secondary impact area, whereas the smallest were recorded between sites within the reference area and those within the scour assessment area. Relatively small differences of the colonial epifaunal composition were recorded between sites from the development site and the reference area.



Areas	R statistic	Significance level
DS - REF	0.208	0.6
DS - REF	0.032	24.9
DS - CC	0.41	0.3
DS - SA	0.052	23.2
SI – REF	0.178	1.4
SI - CC	0.573	0.1
SI - SA	0.016	36
REF - CC	0.168	7.9
REF - SA	-0.013	49
CC - SA	0.554	0.2

Figure 3.16 ANOSIM of Colonial Epifauna from Grab Samples, Kentish Flats, 2007. Simulated Distribution (9,999 permutations) of the Test Statistic R Under the Null Hypothesis of "No Differences Between Areas"

Similar trends of colonial epifaunal distribution were recorded in each area (Figure 3.17), with the bryozoans being dominant in terms of species diversity, followed by the cnidarians and the poriferans. Sites within the cable corridor hosted the highest mean number of colonial epifaunal species, whereas sites within the secondary impact area hosted the lowest number (Table 3.8), reflecting the sediment type characteristic of these areas, i.e. muddy, gravelly sand the former and predominantly sand the latter.

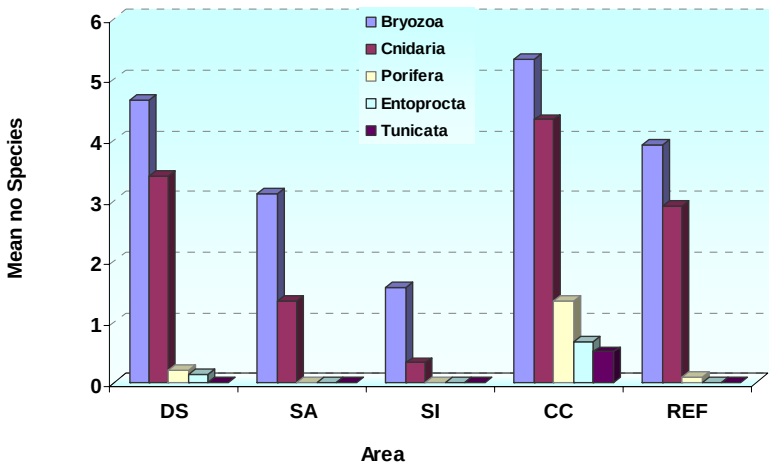
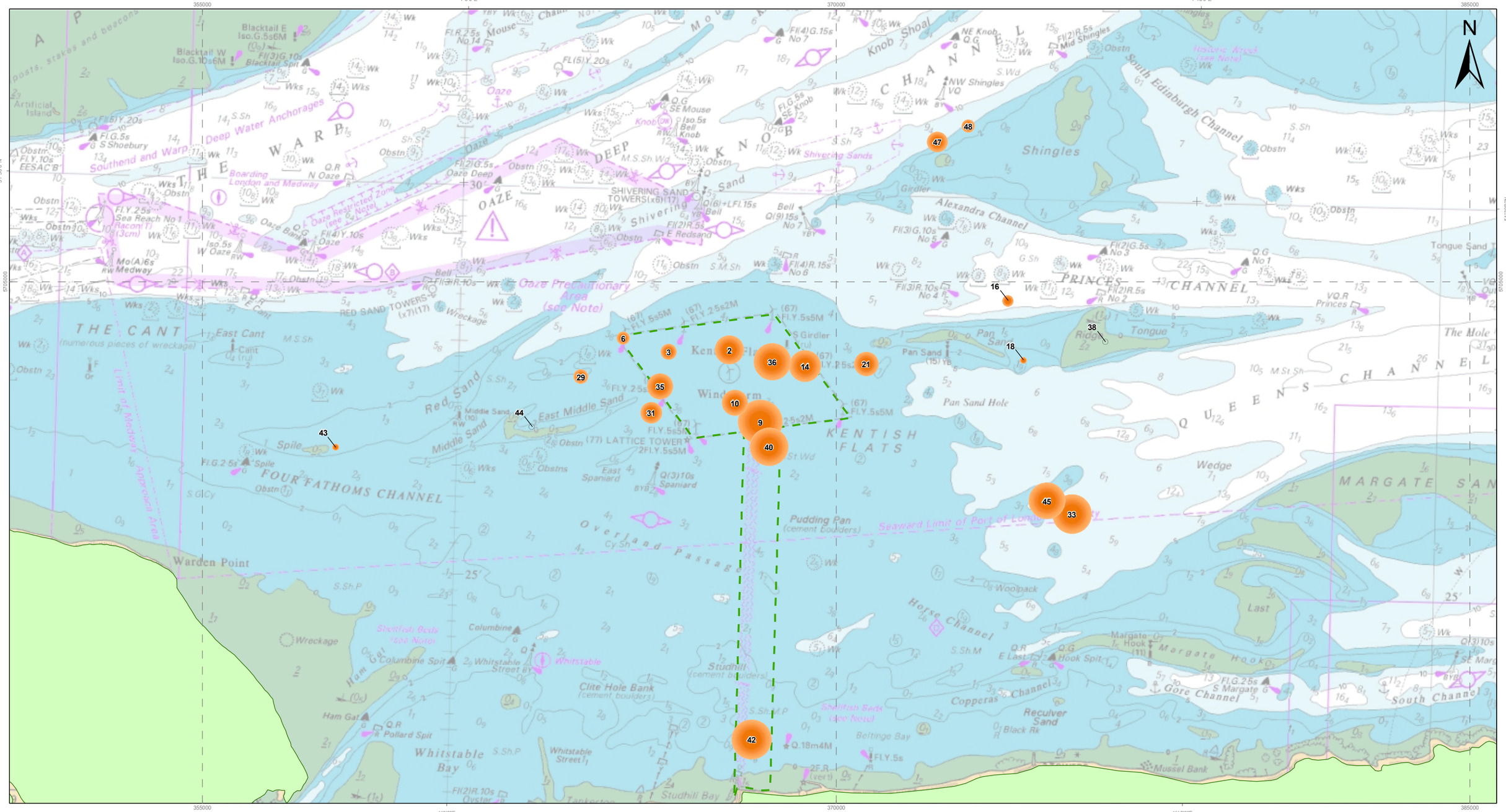


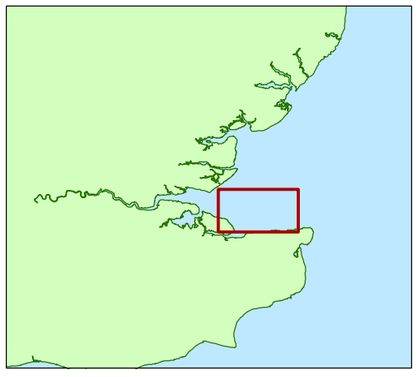
Figure 3.17 Mean Number of Species of Colonial Epifaunal Taxa Within Each Area, Kentish Flats, 2007 Survey

Area	Mean No Species ± SD	Top Five most widespread species	Frequency of occurrence (%samples within area)	Average abundance within area (on the numerical scale of 1 to 5)
DS	**8.4 ± 5.7**	*Conopeum reticulum*	100	1.9
		Aspidelectra melolontha	87	2.1
		Obelia dichotoma	73	1.9
		Electra pilosa	67	2.1
		Electra monostachys	67	2.0
SA	**4.4 ± 3**	*Conopeum reticulum*	89	1.2
		Aspidelectra melolontha	89	1.1
		Electra monostachys	44	0.6
		Sertularia spp.	44	0.4
		Electra pilosa	33	0.4
SI	**1.9 ± 2.9**	*Conopeum reticulum*	48	0.6
		Aspidelectra melolontha	32	0.5
		Electra monostachys	28	0.4
		Electra pilosa	16	0.2
		Sertularia spp.	8	0.1
CC	**12.2 ± 4.5**	*Halecium* spp.	83	1.5
		Conopeum reticulum	83	1.5
		Alcyonidium mytili	83	1.3
		Electra pilosa	83	1.2
		ENTOPROCTA	67	0.7
REF	**6.9 ± 5.2**	*Conopeum reticulum*	83	1.7
		Aspidelectra melolontha	67	1.0
		Electra pilosa	67	0.8
		Electra monostachys	50	1.0
		Sertularia spp	50	0.6

Table 3.8 Colonial Epifauna Species Composition within the Different Areas, Kentish Flats, 2007 survey



Location Plan



Legend

Kentish Flats Development Area & Cable Route (approx.)

Total Number of Colonial Epifauna Species

= 15

No Epifauna Present

Scale Bar

0 1 2 4

Kilometres

Coordinate System

WGS84 UTM Zone 31 North

Notes

Depths	All depths are in metres below Chart Datum
Equipment	Hamon Grab
Caveat	© Crown Copyright and/or database rights. Reproduced by permission of the Controller of Her Majesty's Stationery Office and the UK Hydrographic Office (www.ukho.gov.uk). NOT TO BE USED FOR NAVIGATION

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EMU

Project Title

Kentish Flats Windfarm Development Macrobenthic Ecology Study 2007

Drawing Title

Spatial Variations of the Number of Colonial Epifaunal Species from Grab Samples, Kentish Flats, 2007 Survey

Drawn By:	Checked By:	Chart No. 3.11		
RJM	SDG			
Job Number:	**Issued On:**	**Sheet Size:**	**Scale:**	**Rev:**
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Commercial In Confidence

3.2.3 Trawl Samples

Data on the fauna collected during the Beam trawl sampling are presented in Appendix IX. The start and end positions for each trawl are presented in Chart 2.2 and Appendix II. Ten Beam trawl samples were undertaken in 2007 within the Kentish Flats study area; the data generated are semi-quantitative.

A total of 83 species and higher taxa were recorded from the 10 beam trawl samples in 2007, including 23 crustaceans, 13 molluscs, 19 fish, 10 cnidarians, three poriferans, four bryozoans, five echinoderms and three ascidians. In addition, three other taxa were recorded including polychaete species, ctenophoran and nemertean. The phyletic composition of each beam trawl sample is presented in Table 3.9.

The total number of species per trawl sample ranged from 12 from trawl 2 within the secondary impact area to 36 in trawls 9 and 1 within the cable corridor and the secondary impact area, respectively.

The spatial distribution of the total number of species from trawl samples is presented in Chart 3.12.

	DS & SA			**CC**		**SI**				**REF**
Trawl site (nearest corresponding grab site)	**T3** (3)	**T4** (36)	**T7** (10)	**T8** (41)	**T9** (42)	**T1** (43)	**T2** (29)	**T5** (18)	**T10** (31)	**T11** (33)
Phylum	**Total number of species**									
Porifera (sea sponges)	0	0	0	1	3	0	0	0	0	0
Cnidaria (sea firs, sea anemones, soft corals)	2	6	3	2	2	4	4	0	1	5
Polychaeta (bristleworms)	1	1	1	1	0	1	1	1	1	1
Crustacea (amphipods, barnacles, crabs, shrimps)	5	10	8	8	14	9	11	2	7	9
Mollusca (whelks, scallops, clams)	6	5	2	7	5	7	7	2	8	2
Bryozoa (sea mats)	1	0	1	3	2	1	1	0	1	4
Echinodermata (brittlestars, sea urchins)	4	4	4	5	1	4	4	4	4	5
Tunicata (sea squirt)	1	1	1	2	2	0	0	0	1	1
Pisces (fish)	4	4	5	6	6	10	5	3	7	2
Ctenophora (comb jellies)	1	0	0	0	0	0	0	1	0	1
Nemertea (ribbon worms)	0	1	0	0	0	0	0	0	0	0
TOTAL	**25**	**31**	**25**	**35**	**35**	**36**	**33**	**12**	**30**	**29**

Table 3.9 Phyletic Composition of Beam Trawl Samples across the Survey Area, Kentish Flats, 2007 survey

Fish species

The 19 species of fish which were caught by the 2m beam trawl are presented in Table 3.10. Commercially important fish are indicated in bold. For each species the frequency of occurrence and the total abundance across the survey area are highlighted together with the maximum density recorded per any one trawl and the average size of each specimen across the entire survey area. measurements of individual specimens are presented in Appendix IX.

Species (common name)	**Frequency of occurrence** (% of samples)	**Total Abundance** (no. of individuals across survey area)	**Highest density per trawl**	**Average size (cm)**
Callionymus lyra (Dragonet)	80	69	31	11.3 (l)
***Solea solea* (Common (Dover) sole)**	**70**	**24**	**10**	**16.7 (l)**
***Pleuronectes platessa* (Plaice)**	**60**	**18**	**6**	**16.9 (l)**
Entelurus aequoreus (Snake pipefish)	50	5	2	n/a
***Limanda limanda* (Dab)**	**40**	**15**	**11**	**13.8 (l)**
***Raja clavata* (Thornback ray)**	**30**	**4**	**2**	**57.7(l) x 37.2(w)**
***Merlangius merlangus* (Whiting)**	**30**	**3**	**2**	**13.8 l)**
Hippocampus hippocampus (Short snouted seahorse)	30	3	2	n/a
Scyliorhinus canicula (Lesser spotted dogfish)	30	3	1	53 (l)
Gobidae (Gobies)	20	8	7	n/a
Belone belone (Garfish)	20	2	1	n/a
Trigla lucerna (Tub Gurnard)	20	2	1	19.5 (l)
***Microstomus kitt* (Lemon sole)**	**10**	**1**	**1**	**n/a**
Agonus cataphractus (Pogge)	10	3	3	7.7 (l)
Pipefish sp.	10	2	2	20 (l)
Echiichthys vipera (Lesser Weaver)	10	1	1	11 (l)
Pholis gunnellus (Gunnel)	10	1	1	n/a
Syngnathus acus (Greater pipefish)	10	1	1	11 (l)
SYGNATHIFORMES (sea horses, pipefish)	10	1	1	n/a

In **bold** are commercially important fish species. (l) = length; (w) = width

Table 3.10 Fish Species recorded by Beam Trawl Sampling, Kentish Flats, 2007 survey

A total of six commercially important fish were recorded across the survey area, including 24 Common Soles, 18 Plaices, 15 Dabs, 4 Thornback rays, 3 Whitings and one Lemon Sole. Of these, the Common Sole (*Solea solea*) was the most widespread, occurring in seven trawl samples, followed by the Plaice (*Pleuronectes platessa*) which was recorded in six trawl samples. The Dab (*Limanda limanda*) was recorded in four trawl samples whereas the Thornback ray (*Raja clavata*) and the Whiting (*Merlangius merlangus*) were recorded in three trawl samples. Finally, the Lemon Sole (*Microstomus kitt*) was recorded from a single trawl sample

Amongst the non-commercially important fish, the Dragonet (*Callionymus lyra*) showed the widest distribution, occurring in eight trawl samples. This species was also numerically dominant accounting for over 41% of the total fish abundance caught by beam trawling across the survey area in 2007. The snake pipefish *Entelurus aequoreus* occurred in 50% of the trawl samples, whereas the majority of the remaining species of non-commercially important fish occurred in no more than three trawl samples. These included the short snouted seahorse *Hippocampus hippocampus* and the lesser spotted dogfish *Scyliorhinus canicula.*

The occurrence of the commercially important fish across the survey area in 2007 is represented in Figure 3.18.

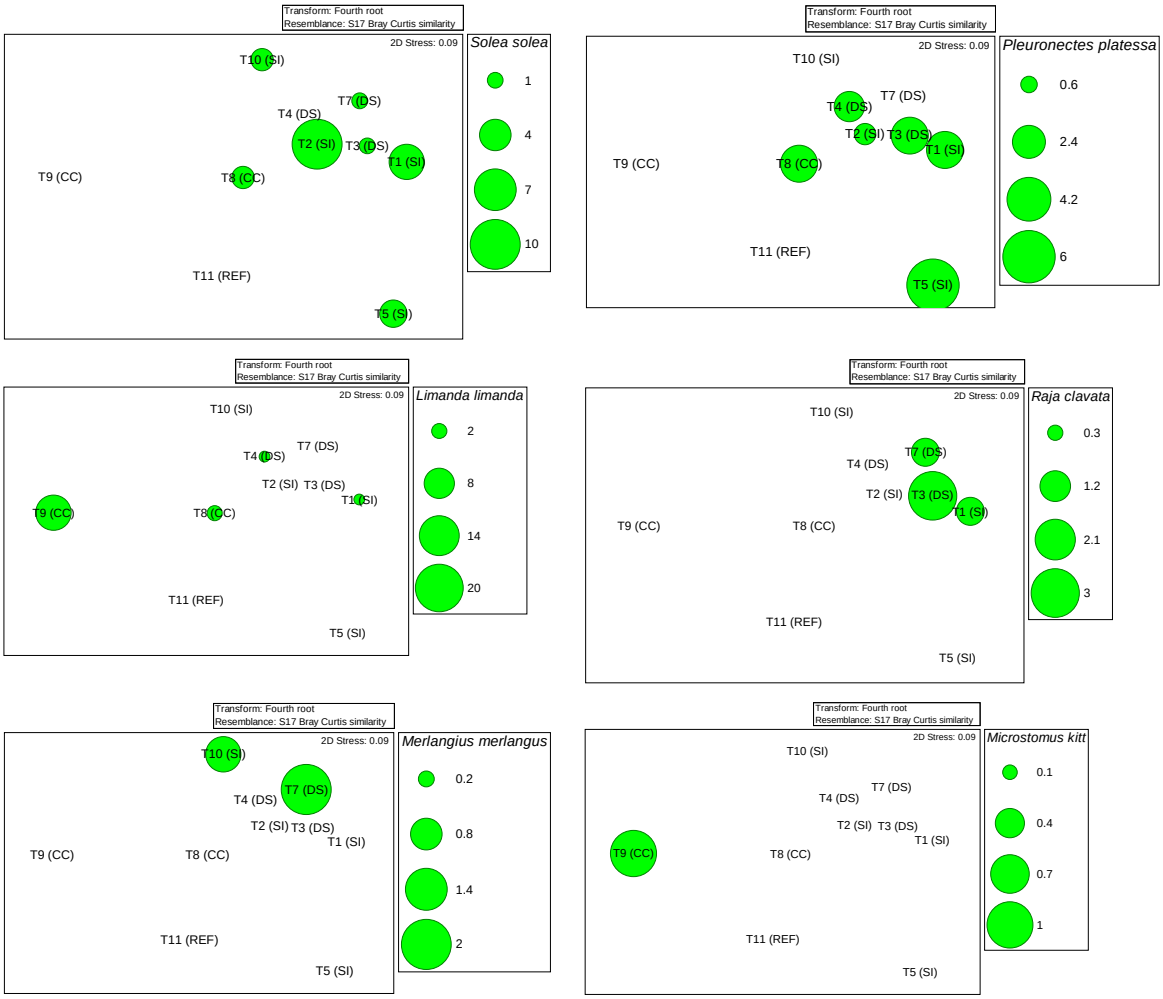


Figure 3.18 MDS Plots of Bray-Curtis Similarity Index of Faunal Species from Trawl Samples. Data with Superimposed Circles Proportional in Diameter to Values of Abundance of Commercially Important Fish, Kentish Flats, 2007 Survey

Epibenthic species

Echinoderms were widespread across the survey area and numerically dominant (Table 3.11). They comprised five species including starfish (*Asteria rubens*), green urchins (*Psammechinus miliaris*) and brittlestars (*Ophiotrix fralilis*, *Ophiura albida* and *O. ophiura*).

Crustaceans and molluscs were evenly distributed across the survey area and included (but were not limited to) typically mobile epibenthic scavengers such as crabs (*Pagurus bernhardus*, *Macropodia rostrata*), shrimps (*Crangon crangon*) and gastropod molluscs (*Buccinum undatum* and *Polinices pulchellus*).

Colonial epifaunal species (Cnidaria, Bryozoa and Tunicata) were also fairly evenly distributed within the trawl samples. Amongst the cnidarians, the hydroid *Hydrallmania falcata* was the most widespread occurring in eight trawl samples. Amongst the bryozoans, the hornwrack *Flustra foliacea* was recorded in seven trawl samples, together with the sea squirt *Styela clava*.

The most frequently occurring trawled epibenthic species (those occurring in at least 50% of the samples) are presented in Table 3.15. The total abundance of each species across the survey area and the highest number of species per any one trawl is also shown.

Species (common name)	**Frequency of occurrence** (% of samples)	**Total Abundance** (no. of individuals across survey area**)**	**Highest density per trawl**
Pagurus bernhardus (common hermit crab)	10	218	52
Ophiura ophiura (brittlestar)	9	3069	1526
Ophiura albida (brittlestar)	9	2743	1260
Asterias rubens (common starfish)	9	1802	409
Psammechinus miliaris (green sea urchin)	9	1289	515
Crangon crangon (brown shrimp)	9	180	40
Liocarcinus depurator (swimming crab)	9	67	23
Polinices pulchellus (necklace shell)	9	38	10
Macropodia rostrata (spider crab)	8	140	38
Hydrallmania falcata (hydroid)*	8	n/a	n/a
Styela clava (sea squirt)	7	377	352
Crepidula fornicata (slipper limpet)	7	79	21
Buccinum undatum (common whelk)	7	69	31
Hinia reticulata (netted dog whelk)	7	18	5
Flustra foliacea (hornwrack)*	7	n/a	n/a
Liocarcinus arcuatus (arch-fronted swimming crab)	6	19	5
Liocarcinus pusillus (swimming crab)	5	15	4
Metridium senile (plumose anemone)	5	11	6
Sepiola atlantica (little cuttlefish)	5	11	5
Hyas coarctatus (great spider crab)	5	6	2

*Species recorded as present (P)

Table 3.11 Epibenthic Macrofauna recorded by Beam Trawl Sampling, Kentish Flats, 2007 survey

Similar trends of macrofaunal distribution were recorded in the majority of the areas, with crustacean and fish accounting for the largest mean number of species, whereas echinoderms accounted for the largest abundance. Numerically dominant fish species from trawl samples obtained within the development site and the scour assessment area comprised *P. platessa*, *R. clavata* and *C. lyra*. The latter was numerically dominant in samples from all other areas but the reference, which comprised only two fish species, namely *E. aequoreus* and *S. acus*. The common sole (*S. solea*) and the dab (*L. limanda*) were numerically dominant in trawl samples from the secondary impact area and the cable corridor, respectively. Amongst the other taxa, the sea-squirt *S. clava* was numerically dominant in samples from all areas, together with the plumose anemone *M. senile* within the development site and the scour assessment area. A single beam trawl sample was undertaken within the reference area (T11) and comprised a fauna dominated by crustaceans in terms of both species diversity and abundance.

Summaries of the mean number of species and individuals from beam trawl samples within each area are presented in Figures 3.19 and 3.20

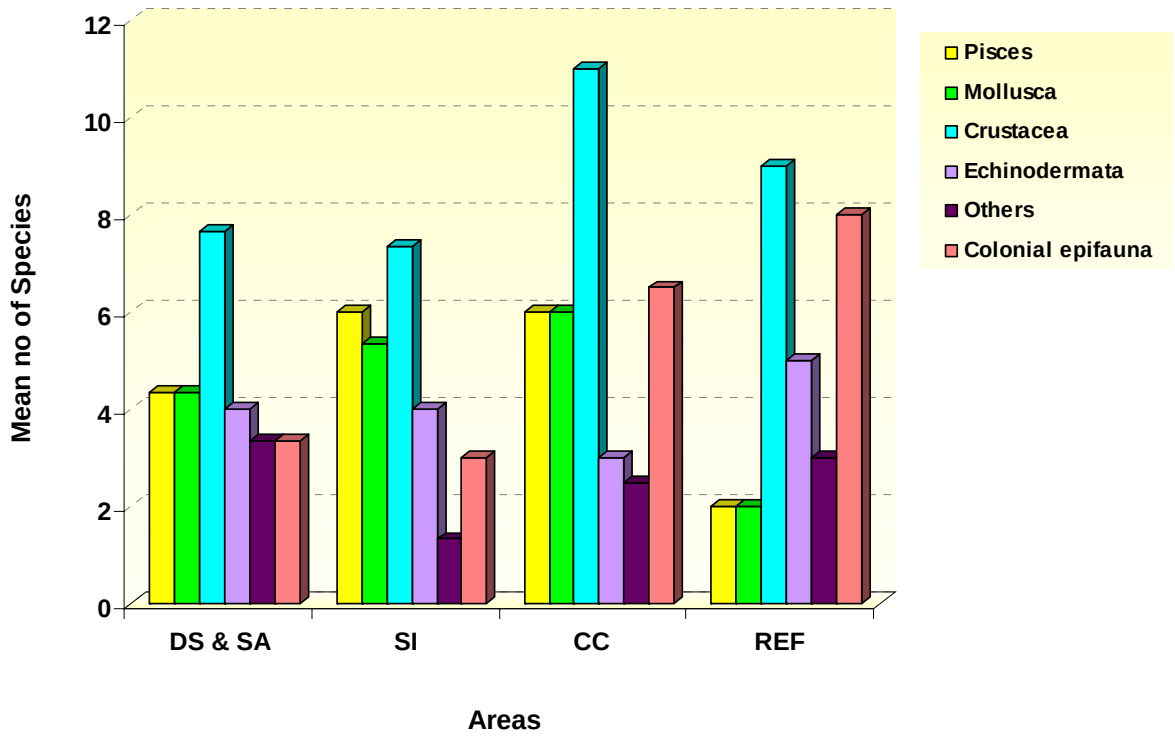


Figure 3.19 **Spatial Variations of the Mean Number of Species from Beam Trawl Samples, Kentish Flats, 2007 Survey**

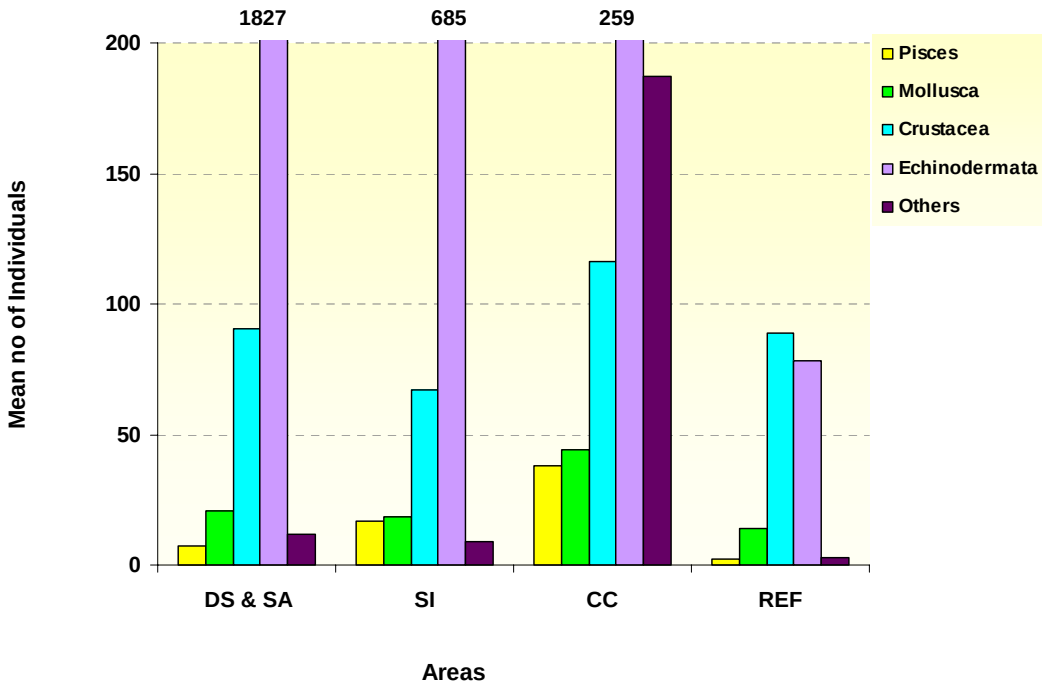
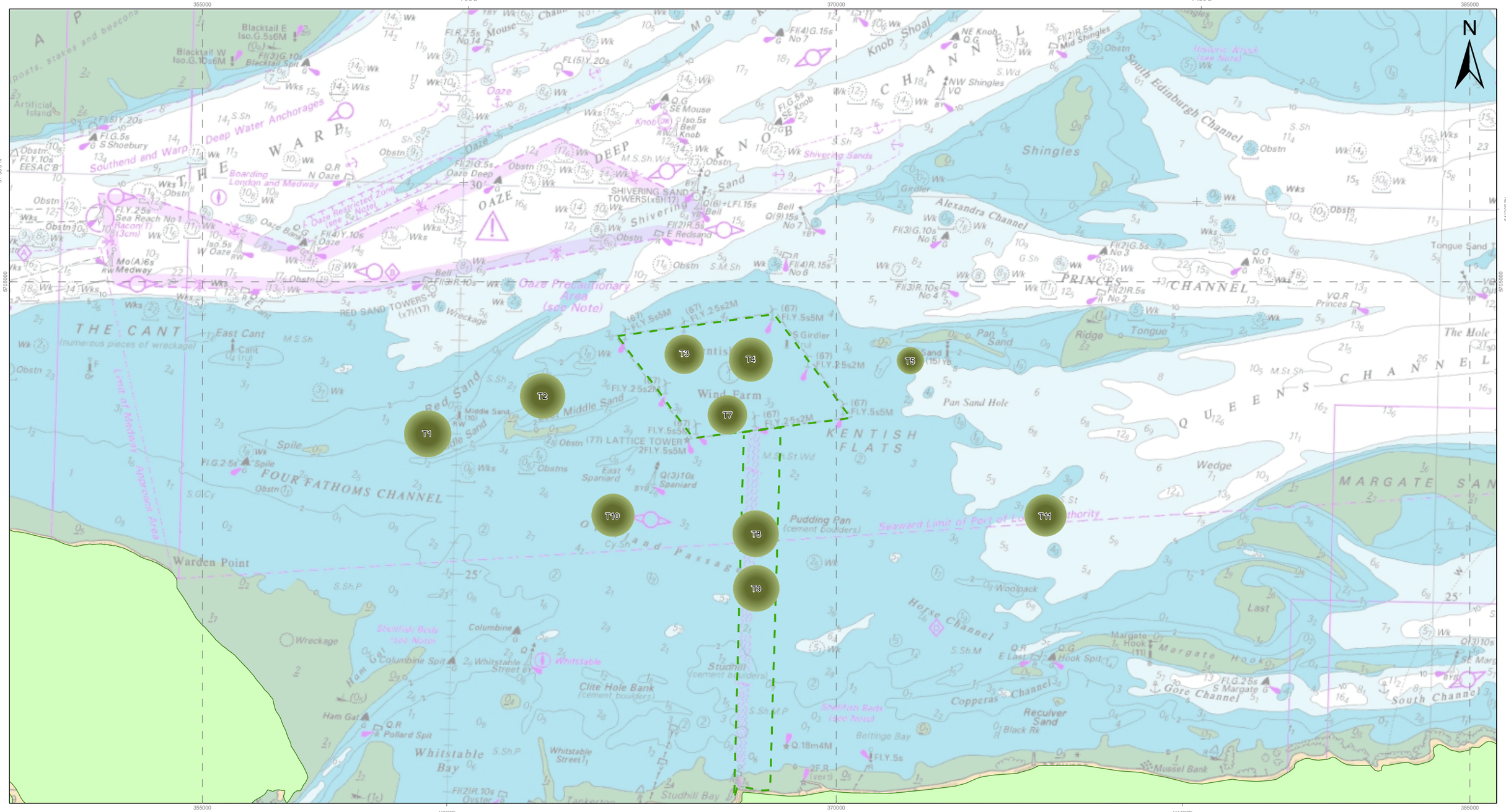
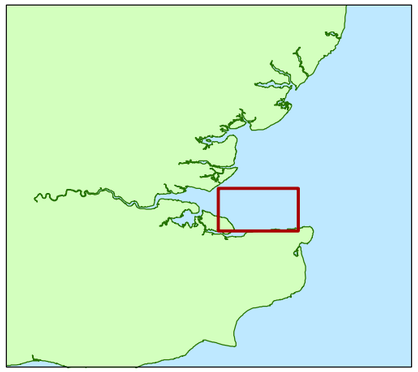


Figure 3.20 **Spatial Variations of the Mean Number of Individuals from Beam Trawl Samples, Kentish Flats, 2007 Survey**



Location Plan



Legend

Kentish Flats Development Area & Cable Route (approx.)

Total Number of Faunal Species

= 30

Scale Bar

0 1 2 4

Kilometres

Coordinate System

WGS84 UTM Zone 31 North

Notes

Depths	All depths are in metres below Chart Datum
Equipment	4m Beam Trawl
Caveat	© Crown Copyright and/or database rights. Reproduced by permission of the Controller of Her Majesty's Stationery Office and the UK Hydrographic Office (www.ukho.gov.uk). NOT TO BE USED FOR NAVIGATION

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EMU

Project Title

Kentish Flats Windfarm Development Macrobenthic Ecology Study 2007

Drawing Title

Spatial Variations of the Number of Faunal Species from Trawl Samples, Kentish Flats, 2007 Survey

Drawn By:	Checked By:	Chart No. 3.12		
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4.0 Discussion

4.1 2007 survey

4.1.1 Physical characteristics

Results of the 2007 survey showed that the survey area within Kentish Flats comprised mainly sand, the sorting coefficient of which ranged from very-well sorted to very poorly-sorted. Areas of mixed sediments were also recorded, particularly at the more inshore sites and comprised conspicuous percentages of gravel and fines. These sediments were usually very poorly-sorted.

An overall spatial pattern of sediment distribution was identified within the survey area in 2007. Specifically, samples from the more offshore sites were characterised by relatively well-sorted sand. Moving inshore within the survey area, the sediment became progressively more heterogeneous with samples accounting for conspicuous percentages of gravel and fines. At the most inshore sites sediments comprised the highest percentage of fines. A degree of small scale variability was recorded between replicate samples from the same sampling stations, particularly those within the more inshore areas of mixed sediments, indicating local heterogeneity of the sediment.

The sediment composition of samples from sites within the different areas (i.e. development site, scour assessment, secondary impact and reference areas) was found to be significantly different, with samples from sites within the cable corridor and the secondary impact areas exhibiting the largest difference. The majority of the sites within the secondary impact area lie within the most offshore area of the Kentish Flats, characterised by relatively homogeneous sands, whereas the sites within the cable corridor lie to the south of the development site, at the most inshore area, characterised by more heterogeneous mixed sediments.

Differences between samples from sites within the reference area and those from sites within the development site were also found to be significant. Indeed, samples from sites within the reference area showed large differences which reflected their position within the survey area. Specifically, the two offshore sites to the north east of the development site comprised relatively homogeneous sands, whereas the two more inshore sites to the south east of the development site comprised more heterogeneous sediment, typical of the more inshore part of the survey area including the development site.

4.1.2 Ecological communities

Results of the 2007 survey showed that the benthic communities sampled by Hamnon grab within Kentish Flats were diverse, comprising 219 species and higher taxa of invertebrates, including nine species of solitary epifauna and 52 species of colonial epifauna. Within the infauna, Annelida were dominant in terms of species diversity and abundance followed by Crustacea and Mollusca. Solitary epifaunal species comprised mainly barnacles, species of Actiniaria and ascidians, the latter being dominant in terms of species diversity. The biomass was dominated by the echinoderms, despite this taxon accounting for the lowest species diversity and abundance. The molluscs accounted for the second largest biomass across the survey area.

The benthic communities identified within the Kentish Flats study area in 2007 were found to be broadly associated with the sediment composition and as such showed an overall pattern of distribution. The offshore sites, characterised by homogeneous sand, hosted a benthic community dominated by crustacean amphipods (e.g. *Bathyporeia elegans*) and selected polychaetes worms (e.g. *Nephtys cirrosa*, *Goniada maculata*), which are typical colonisers of sediments subject to physical disturbance. These species are characterised by flexible body structures and are able of rapid burrowing if disturbed. The overall species diversity at these sites was lower compared to those of the

less exposed sites. In addition, samples from these stations contained little or no epifauna, represented mainly by species of bryozoans.

Moving inshore within the study area, the faunal assemblages gradually gave way to a community characterised by the bivalve *Fabulina fabula* and the polychaetes *Nepthys hombergii*. These species tend to occur in generally more compacted sands, with less sediment transport and often represent a transitional area between the more dynamic offshore and the relatively stable inshore sands (www.Marlin.ac.uk, 2007).

The central stations within the study area comprised a community characterised by the polychaetes *Lanice conchilega* and *Spiophanes bombyx*. These sites were more heterogeneous in the sediment composition and hosted a more diverse faunal community. The increased species diversity and abundance at these sites may be associated with the relatively stable nature of these stations and the heterogeneity of the sediment. The latter has provided a greater number of microhabitats including suitable substrate for epifaunal species such as the barnacle *Balanus crenatus*, which was abundant and widespread within the central zone of the study area. The high abundance of *S. bombyx* was, however, indicative of a certain degree of surface sediment disturbance.

Inshore stations were characterised by the bivalve *Abra alba* and the polychaetes *Mediomastus fragilis* and *Euclymene oerstedii*. Samples from these stations comprised the highest epifaunal species diversity and abundance, including solitary (e.g. actiniarians and ascidians) and colonial (e.g. cnidarians and bryozoans) species.

A relatively high degree of small scale variability was recorded between replicate samples from the same sampling station, indicating local variability of species assemblages, particularly at stations within the transitional areas of faunal communities.

The faunal communities within the different areas (i.e. development site, scour assessment, secondary impact and reference areas) were found to be significantly different, with the largest differences recorded between the cable corridor and the scour assessment and the cable corridor and secondary impact area. Such differences were associated with both species diversity and abundance, which reflected altogether two very different habitats at the two extremes of the survey area. Specifically, the majority of sites within the secondary impact area and, to a certain extent, those within the scour assessment area are located offshore, thus hosting dynamic habitats characterised by mobile sands and faunal species able to withstand such disturbance. At the other end, sites within the cable corridor are the most inshore characterised by mixed sediments hosting more stable communities, including large mollusc bivalves and epifauna.

Differences between the development site and the reference area were also found to be significant. Indeed, differences between the sites within the reference area were very large. Two major communities were identified within the reference area, one to include the most offshore sites to the north east of the development site and dominated by *N. cirrosa*, the other at the more inshore sites to the south east of the development site and dominated by *L. conchilega* and S. *bombyx*.

Average values of the univariate indices (i.e. species richness, diversity, evenness and dominance) showed a common trend in all areas with the dominance values consistently lower than any other index, indicating that species diversity and richness have remained fairly evenly distributed within the survey area. In 2007 samples from stations within the development site showed considerably higher values of species richness and diversity than those of the reference area. Indeed, these values were second highest after those of samples from stations within the cable corridor.

Colonial epifauna were diverse comprising 52 species and higher taxa of which the bryozoans dominated in terms of species diversity, followed by the cnidarians and the poriferans, the latter typical of the sites within the cable corridor. The distribution of the colonial epifauna was found to be

associated with the sediment characteristics as would be expected. Specifically, the majority of the most offshore sites, characterised by mobile sands, comprised no colonial epifauna, and when present they were represented mainly by species of bryozoans. The central and more inshore stations characterised by heterogeneous sediments supported more diverse colonial epifauna. Significant differences were recorded between the epifaunal communities of the different areas, with the stations within the cable corridor and those within the secondary impact area exhibiting the largest differences.

Faunal assemblages from the trawl samples comprised a relatively wide array of species and higher taxa including fish, crustaceans (e.g. crabs, shrimps), molluscs (e.g. limpets, whelks) and echinoderms (star fish, brittlestars, sea urchins). Sessile epifauna included species of cnidarians (sea firs, sea anemones), poriferans (sea sponges), bryozoans (sea mats) and ascidians (sea squirt). Nineteen species of fish were recorded across the survey area in 2007, of which six were commercially important species. The Dragonet and the Dover Sole were the most abundant and widely distributed fish. Similar trends of fauna distribution were recorded from the trawl samples in the different areas, with the crustaceans and the fish dominating the species diversity. The echinoderms, on the other hand, accounted for just seven species and dominated the abundance in the majority of the areas. Within the reference area, the crustaceans dominated in terms of both species diversity and abundance.

4.2 Comparative Study

The 2007 macrobenthic survey within the Kentish Flats study area is the third in a series of studies undertaken since the Wind Farm development was completed. Previous studies were conducted within the same area in 2005 (Emu Ltd, 2005b, Emu Ltd 2006), in 2006 (Emu Ltd, 2007) with a pre-construction survey completed in 2002 (Emu Ltd, 2002a, Emu Ltd 2002b). The latter provided baseline information on the sediment features and the biological characteristics of the benthic communities. The aim of the subsequent studies has been to ascertain the ecological status of the benthic communities post construction. These included year to year comparison of sediment and faunal composition with a view to identifying temporal changes which might be associated with the Wind Farm development.

Comparative analyses have been undertaken with respect to those sites which were sampled during each survey occasion. These included 23 locations, of which 5 within the Development area (sites 3, 9, 14, 35 and 36); 8 sites within the Secondary Impact Area (16, 18, 21, 29, 31, 38, 43 and 44); 3 within the Cable Corridor (sites 40, 41 and 42); 4 within the Reference Area (sites 33, 45, 47 and 48); 3 within the Scour Assessment Area (sites 2, 6 and 10). Samples were taken at these stations in 2005, in 2006 and in 2007, the latter with the exclusion of site 41 within the cable corridor. These stations were established in 2002 as part of the baseline study, however, some of them had to be repositioned during the subsequent 2005 survey, as the original ones coincided with the position of installed turbines. Stations which were repositioned beyond the 50m radius of those originally established in 2002 were excluded from the comparison with subsequent years. These included sites 2, 6 and 10 within the scour assessment area as well as two reference stations (47 and 48) to the north east of the development site which were established in 2005. These sites were, however, included in the comparison of 2007 with 2006 and 2005 data sets.

4.2.1 Temporal Variations of Sediment Composition from Grab Samples

The combined data set of the particle size distribution from all four survey occasions was subjected to multivariate analysis the outputs of which are presented in Figure 4.1 and summarised in Table 4.1. The Figures refer to the average of replicate samples within each site.

Using Figure 4.1, three major groups of samples were identified and separated on the basis of the principal sediment component.

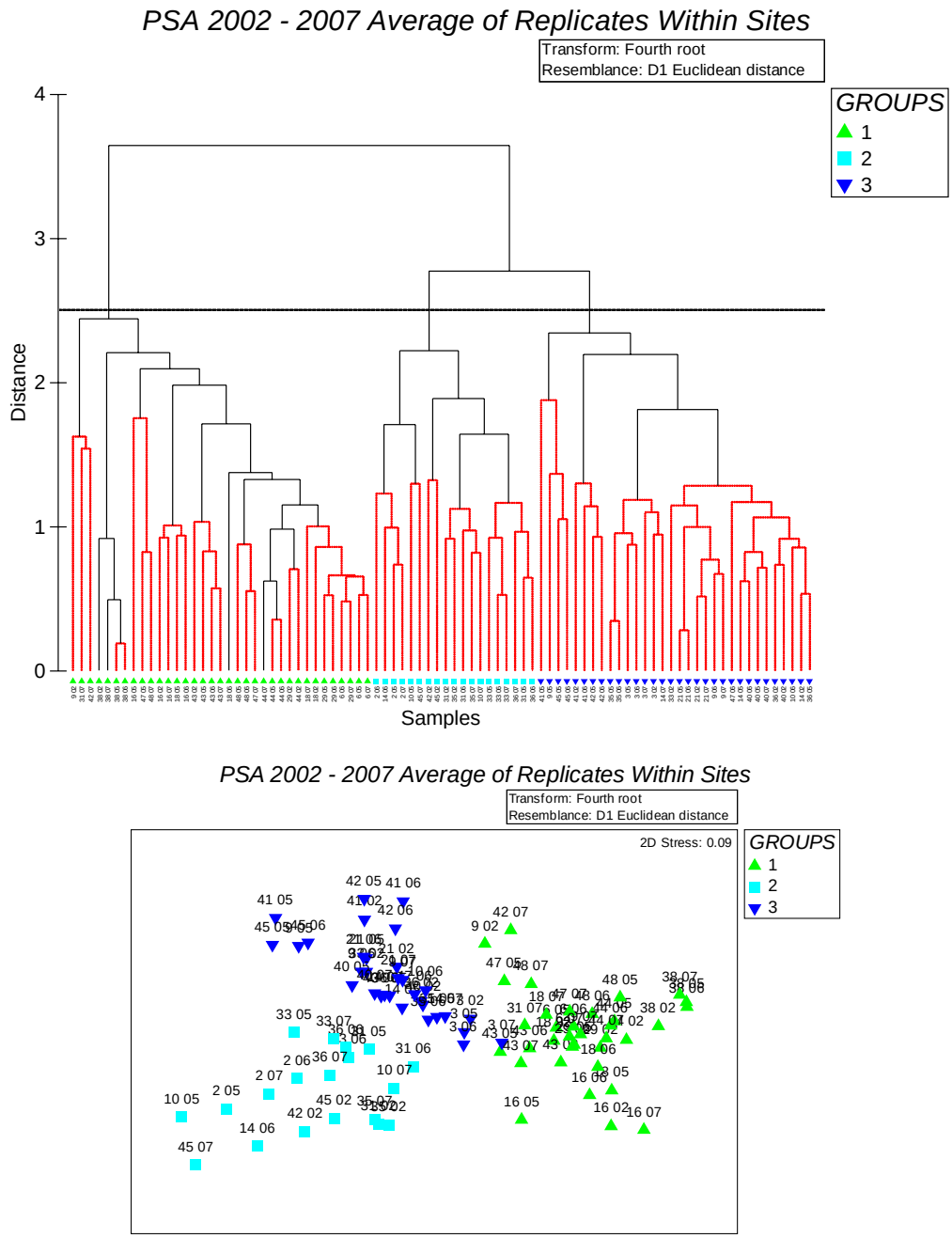


Figure 4.1 Dendrogram and MDS Plot of Euclidean Distance Similarity Index of Sediment Composition from Grab Samples, Kentish Flats. Combined data sets from 2002 - 2007 Surveys

Group	Site (Year)	Mean value variable ± SD			Sediment Classification & Sorting
		% Gravel	% Sand	% Fines	
▲ 1 Average similarity 82.21%	**6**(05,06,07); **9**(02); **16**(02,05,06,07); **18**(02,05,06,07); **29**(02,05,06,07); **31**(07); **38**(02,05,06,07); **42**(07); **43**(02,05,06,07); **44**(02,05,06,07); **47**(05,07); **48**(05,06,07)	1.2 ± 2.8	94.9 ± 8.3	3.8 ± 7.4	Sand, moderately well-sorted
■ 2 Average Similarity 89.64%	**2**(05,06,07); **10**(05,07); **14**(06); **31**(02,05,06); **33**(05,06,07); **35**(02,07); **36**(06,07); **42**(02); **45**(02,07)	22.8 ±13.7	68.2 ±17.2	9.0 ±9.4	Slightly silty Gravelly Sand, very poorly-sorted
▼ 3 Average Similarity 88.71%	**3**(02,05,06,07); **9**(05,06,07); **10**(06); **14**(02,05,07); **21**(02,05,06,07); **33**(02); **35**(05,06); **36**(02,05); **40**(02,05,06,07);**41**(02,05,06); **42**(05,06); **45**(05,06); **47**(06); **48**(06)	14.1 ± 8.4	75.9 ± 15.9	10.0 ± 12.4	Silty Gravelly Sand, very poorly-sorted

Table 4.1 Summary of Within Groups Similarity following SIMPER Analysis of Sediment Samples from Kentish Flats, 2002 - 2007 Surveys

Group 1 comprised the majority of samples from sites within the secondary impact area, the northern reference area and selected sites from the scour assessment area. It was characterised by moderately-well sorted sand.

Group 2 comprised the majority of samples from sites within the southern reference area, samples from selected sites within the development site and the scour assessment area and the most inshore sites within the secondary impact area. It was characterised by very poorly-sorted slightly silty gravelly sand.

Group 3 comprised the majority of samples from the development site, the cable corridor and the most inshore sites within the scour assessment area. It was characterised by very poorly-sorted silty gravelly sand.

Overall, the particle size distribution within the Kentish Flats survey area showed a common pattern between years. Specifically, the offshore sites, e.g. those within the secondary impact area and the northern reference area were characterised by relatively homogeneous sediment, comprising mainly sand (Figure 4.2b). The "central" sites of the survey area, e.g. those within the development area, the southern reference area and the scour assessment area were more heterogeneous comprising the highest percentage of gravel (Figure 4.2c). Finally, the most inshore sites, e.g. those within the cable corridor, comprised heterogeneous sediment with the highest percentage of fines (Figure 4.2d). The more heterogeneous sediments showed a higher degree of stability (very poorly-sorted (Figure 4.2e)) and variability within and between years.

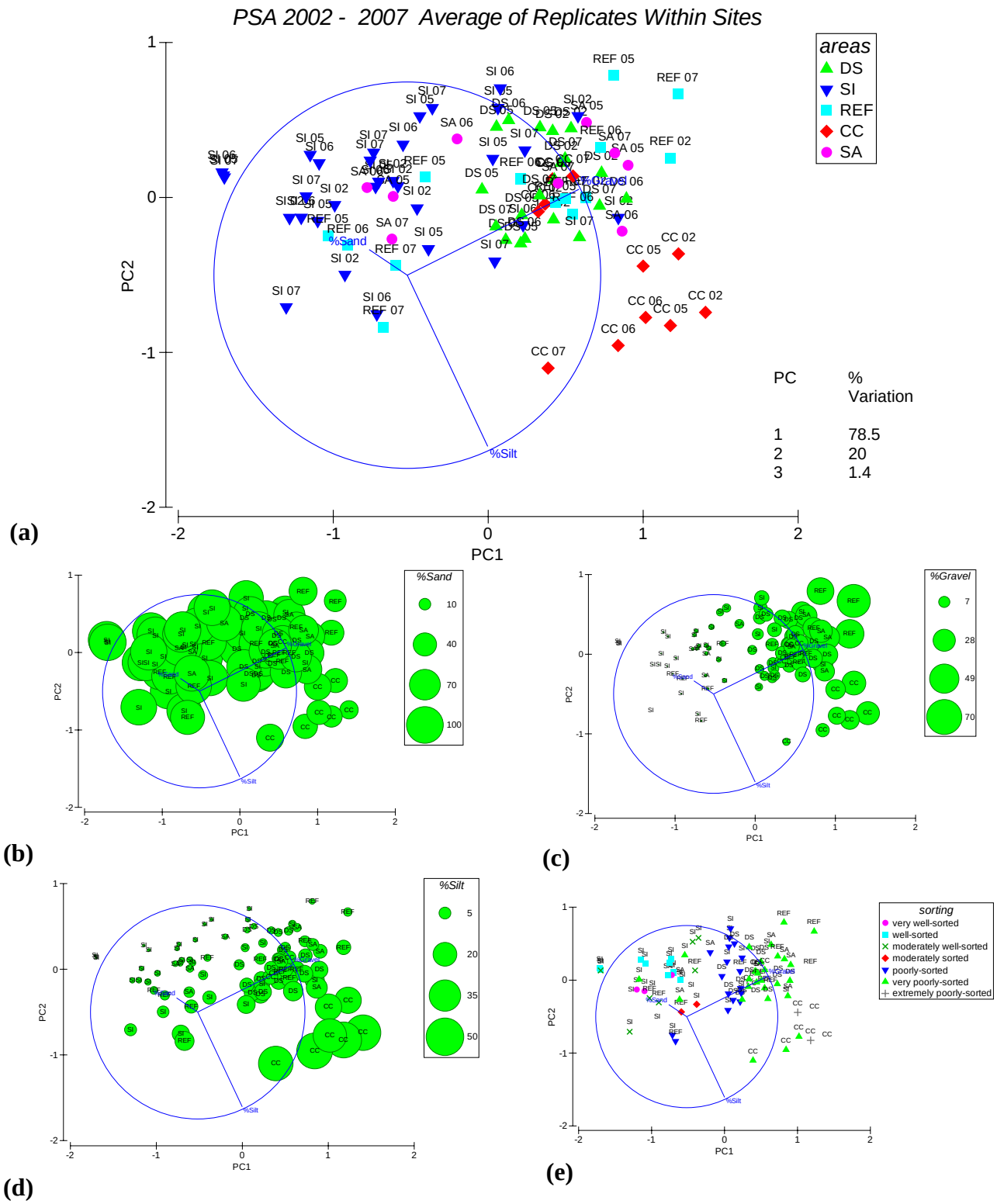


Figure 4.2 **Two-dimensional Representation of the Principal Component Analysis of Sediment Composition from Grab Samples, Kentish Flats 2002 – 2007 Surveys. Data with Superimposed Areas & Sediment Sorting (a), and Circles Proportional in Diameter to the Percentage of Gravel (b) & Silt/Fines (c). Data Refer to Average of Replicates within Sites**

Temporal variations of the sediment composition within the different areas are presented in Figure 4.3.

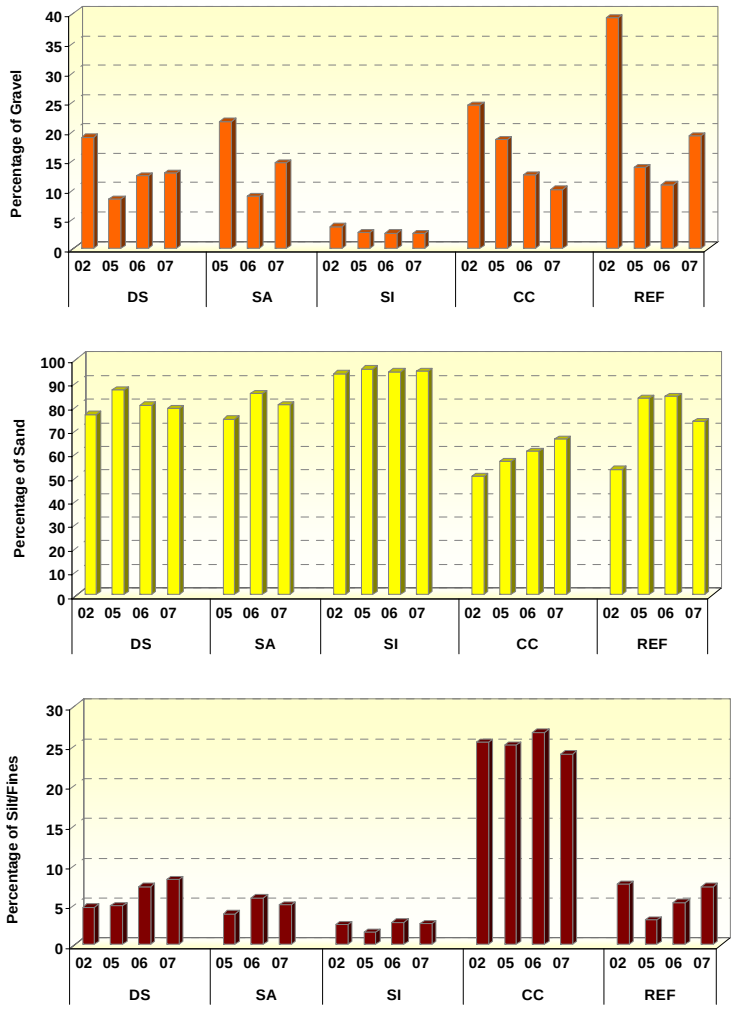


Figure 4.3 Temporal Variations of the Main Sediment Fraction Distribution within the different Areas, Kentish Flats, 2002 - 2007 Surveys

Each area has retained a similar sediment composition since the study began. Major differences were recorded over time from samples within the cable corridor which showed a consistent decline in the percentage of gravel. Similarly, samples from sites within the reference area showed overall, lower levels of gravel since the study begun. However, the decrease of gravel levels within the reference area may be an artefact of sampling. In fact, in 2002 samples were obtained only from sites 33 and 45 within the southern reference area, whereas during the subsequent years samples were also obtained from sites 47 and 48 within the northern reference area. The latter are located offshore to the north-westernmost boundary of the survey area and are characterised by homogeneous sand, whereas sites within the southern reference area are located more inshore and comprise heterogeneous sediment with relatively high percentages of gravel.

Other noteworthy temporal differences included an overall increase of the finer sediment fraction in samples from the development site. A summary of the temporal differences in the sediment composition within the Kentish Flats survey area is given in Table 4.2.

Area (site) no of replicate per site: 3 or otherwise specified	Year	Variable ± Standard Deviation			Sediment description
		% Gravel	% Sand	% Fines	
DS (3, 9, 14, 35 36)	2002*	18.9 ±7.3	76.4 ± 8.1	4.7 ± 3.1	Gravelly Sand, poorly-sorted
	2005	8.4 ± 5.2	86.8 ± 7.6	4.9 ± 6.9	Sand, poorly-sorted
	2006	12.3 ± 14.9	80.4 ± 14.7	7.3 ± 6.7	Slightly Gravelly Sand, very poorly-sorted
	2007	12.8 ± 6.9	79 ± 10.5	8.2 ± 6.1	Slightly Silty & Gravelly Sand, very poorly-sorted
SA (2, 6, 10)	2002	n/a	n/a	n/a	n/a
	2005	21.6 ± 23.4	74.5 ± 24.8	3.9 ± 5	Gravelly sand, very poorly-sorted
	2006	8.8 ± 9.8	85.3 ± 16.9	5.9 ± 7.6	Sand, poorly-sorted
	2007	14.5 ± 15	80.5 ± 15.6	5 ± 1.5	Silty Gravelly Sand, very poorly-sorted
SI (16, 18, 21, 31, 38, 43, 44)	2002	3.7 ± 8.3	93.8 ± 10.6	2.5 ± 3.2	Sand, well sorted
	2005	2.7 ± 3.9	95.7 ± 4.5	1.6 ± 2.4	Sand, moderately well sorted
	2006	2.6 ± 4.8	94.5 ± 6.4	2.8 ± 4.6	Sand, moderately sorted
	2007	2.5 ± 3.8	94.9 ± 5.7	2.6 ± 3.8	Sand, moderately sorted
CC (40, 41, 42)	2002	24.4 ± 15	50.2 ± 28.2	25.5 ± 22.2	Gravelly silty sand, poorly-sorted
	2005	18.5 ± 8	56.4 ± 21.4	25.1 ± 18.6	Gravelly silty sand, very poorly-sorted
	2006**	12.5 ± 8.7	60.8 ± 25.6	26.7 ± 25.6	Silty sand, very poorly-sorted
	2007***	10 ± 10.5	65.9 ± 18.2	24 ± 23.4	Slightly Gravelly, Silty sand, very poorly-sorted
REF (33, 45, 47, 48)	2002****	39.2 ± 19.4	53.2 ± 22.5	7.6 ± 4.5	Gravelly sand, very poorly-sorted
	2005	13.7 ± 17.2	83.2 ± 16.9	3.1 ± 4.9	Sand, very poorly-sorted
	2006	10.8 ± 14	84 ± 13.7	5.3 ± 4	Sand, poorly-sorted
	2007	19.1 ± 27	73.6 ± 25.3	7.3 ± 8.5	Slightly Silty, Gravelly Sand, very poorly-sorted

*Total replicate samples: 9 (sites 3, 9, 14, 35(a,b,c), 36(a,b,c)
**Total replicate samples: 7 (sites 40(a,b,c); 41(a); 42(a,b,c))
***Total replicate samples: 6 (sites 40(a,b,c) & 42(a,b,c))
****Total replicate samples: 4 (sites 35; 45(a,b,c))

Table 4.2 Temporal Variations of Sediment Composition of Different Areas within Kentish Flats, 2002 - 2007 Surveys

Sites within the secondary impact area exhibit the highest degree of similarity between years, as illustrated in (Figure 4.4) which shows the degree of temporal separation of all areas. Values of sediment fractions per year refer to average values from samples within each area. The Figure also shows fluctuations in the distance of samples from the development site and the reference area. The smaller distance recorded in 2002 between the two areas is likely to be associated with the relatively small reference area and the low number of samples therein collected during the baseline study.

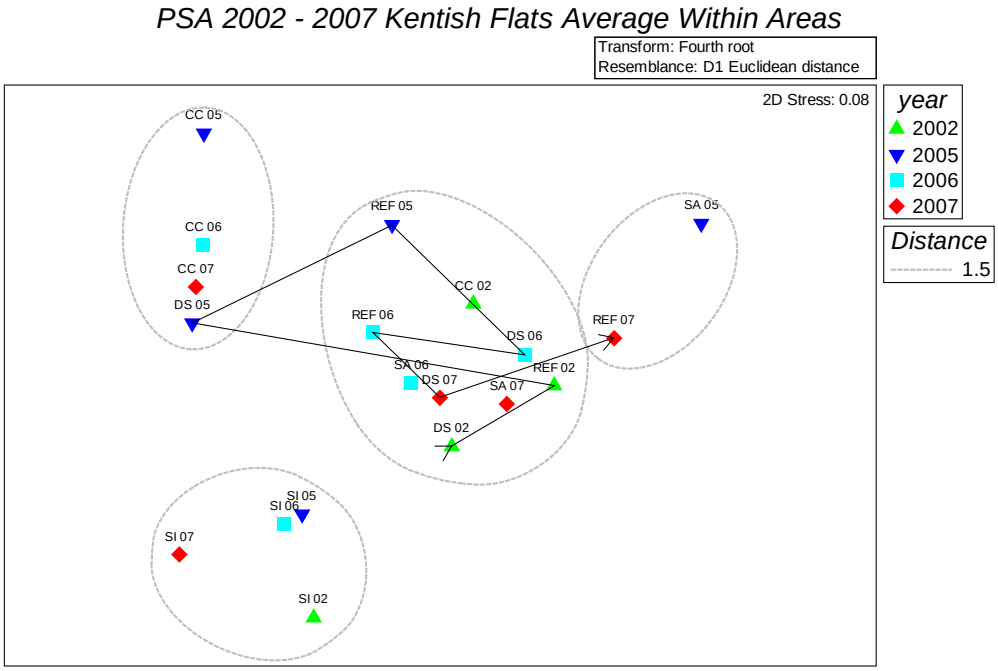


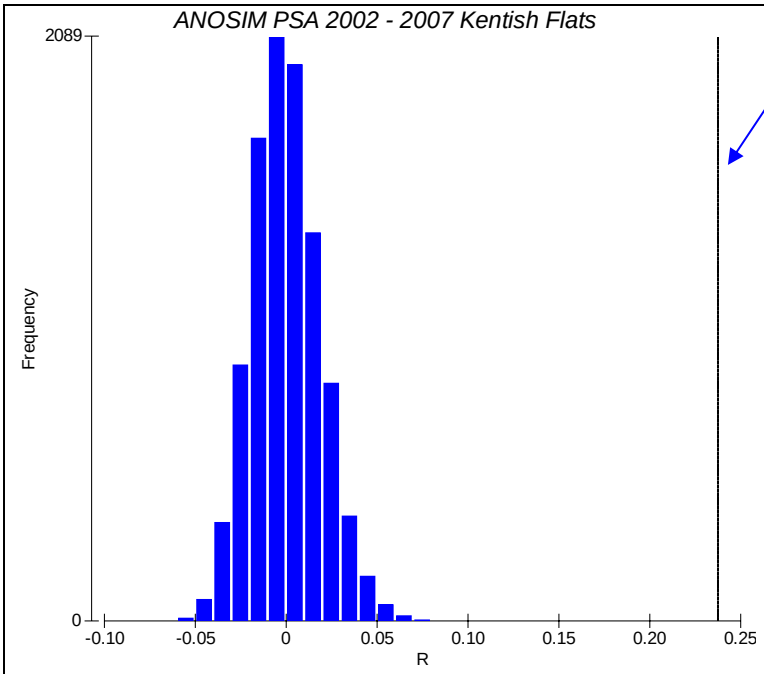
Figure 4.4 **Multi Dimensional Scaling MDS Plot of Euclidean Distance Similarity Index of Sediment Samples from Grab Samples, Kentish Flats, 2002 - 2007 Surveys. Average Values of Sediment Fractions within Each Area; Data with Superimposed Trajectory Joining the Development Site and the Reference Area in Order of Years**

4.2.1.1 Analysis of Similarity (ANOSIM)

ANOSIM was applied to the combined PSA data set in order to investigate whether temporal differences of the sediment composition within the different areas were significant. The resulting histogram (Figure 4.5) shows that, overall, there were significant differences. Results of the pairwise test, however, showed that the significant differences were associated primarily with natural spatial variability. The largest temporal differences were recorded between samples taken in 2007 and those taken in 2005 within the development site and the cable corridor. Analysis of the sediment samples showed that the temporal differences within the development site were associated with the percentage of sand and mud, the former being considerably lower, the latter higher in the samples from the 2007 survey (Table 4.3). Samples from the cable corridor in 2007 showed a considerably lower percentage of gravel compared to those of the 2005 survey. The pairwise test (Figure 4.5) also showed that spatial variations between the development site and the majority of other areas, including the reference area have, overall, decreased since the study began.

Further multivariate analyses were undertaken on samples within each area in order to illustrate the degree of temporal separation of each area as well as the degree of separation of individual sampling stations within each area. The outputs are presented in Figure 4.6. The Figure shows that each area has retained a high degree of similarity over time, with the majority of the individual stations sampled over time closely grouped together. This pattern was common to all areas, leading to the conclusion that the recorded temporal differences were not significant.

With regard to the reference area, two major groups of samples were identified by the multivariate analysis, one to include sites 47 and 48 at the north-easternmost boundary of the survey area and one to include sites 33 and 45 to the south east. Of these, site 33 showed the highest degree of temporal variability.



Sample statistic (Global R) = 0.238
Significance Level of sample statistic= 0.01%

TEMPORAL VARIATIONS			
Area	Year	Sample statistic R	Significance level
DS	2007-2002	0.008	39.3%
	2007-2005	0.095	3.3%
	2007-2006	0.053	10.1%
	2006-2002	-0.048	67.8%
	2006-2005	0.016	25.7%
	2005-2002	0.102	11.6%
SA	2007-2005	-0.01	42.7%
	2007-2006	-0.036	55.1%
	2006-2005	0.003	37.1%
SI	2007-2002	-0.015	54.3%
	2007-2005	0.002	36.7%
	2007-2006	-0.032	96.8%
	2006-2002	-0.039	71.2%
	2006-2005	-0.021	76.7%
	2005-2002	-0.043	78.6%
CC	2007-2002*	0.008	41.8%
	2007-2005*	0.219	4.4%
	2007-2006*	-0.013	44.2%
	2006-2002	-0.078	82.4%
	2006-2005	-0.023	51.3%
	2005-2002	0.066	15.8%
REF	2007-2002*	-0.016	45.7%
	2007-2005	-0.016	46.9%
	2007-2006	-0.024	56.9%
	2006-2002*	-0.029	55.5%
	2006-2005	-0.029	55.5%
	2005-2002*	0.02	40.5%

SPATIAL VARIATIONS				
Area	**Sample statistic R**			
	2007	**2006**	**2005**	**2002**
DS - SI	0.411	0.301	0.245	0.53
DS - SA	-0.134	0.034	0.34	n/a
DS - CC	0.17	0.041	0.365	0.142
DS - REF	0.254	0.141	0.276	0.123

R values derived from ANOSIM test (number of possible permutation of each pairwise test > 9,999 or otherwise specified)

* Number of permutations <9.999

DS= Development Site; SA= Scour Assessment; SI= Secondary Impact; CC= Cable corridor; REF= Reference Area

Figure 4.5 ANOSIM of Sediment Composition from Grab Samples, Kentish Flats, 2002 - 2007 Surveys. Simulated distribution (9,999 permutations) of the Test Statistic R Under the Null Hypothesis of "No Differences Between Years"

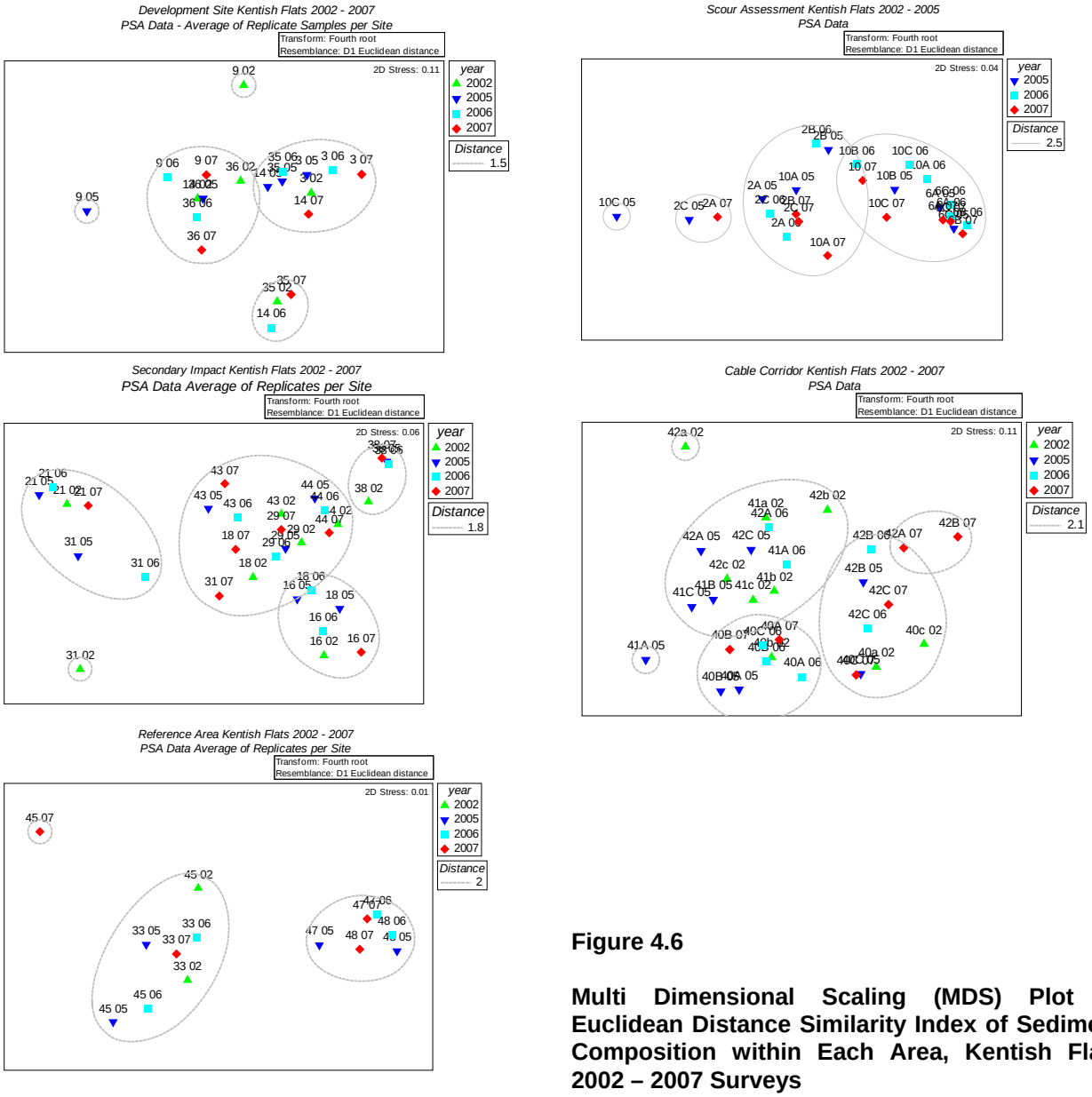


Figure 4.6

Multi Dimensional Scaling (MDS) Plot of Euclidean Distance Similarity Index of Sediment Composition within Each Area, Kentish Flats 2002 – 2007 Surveys

4.2.2 Temporal Variations of Faunal Benthic (Enumerated Fauna) Communities from Grab Samples

Prior to comparative analyses being undertaken, the combined data set (enumerated fauna) from all four survey occasions was further rationalised. Specifically, selected species were aggregated to the highest taxonomic level to which the identification was carried out in any one year. This process excluded potential artefacts of the taxonomic identification which might otherwise be mistaken as a temporal difference in species composition. The combined faunal data set was then subjected to multivariate analysis the outputs of which are presented in Figure 4.7. The Figure refers to the average of replicate samples within each site.

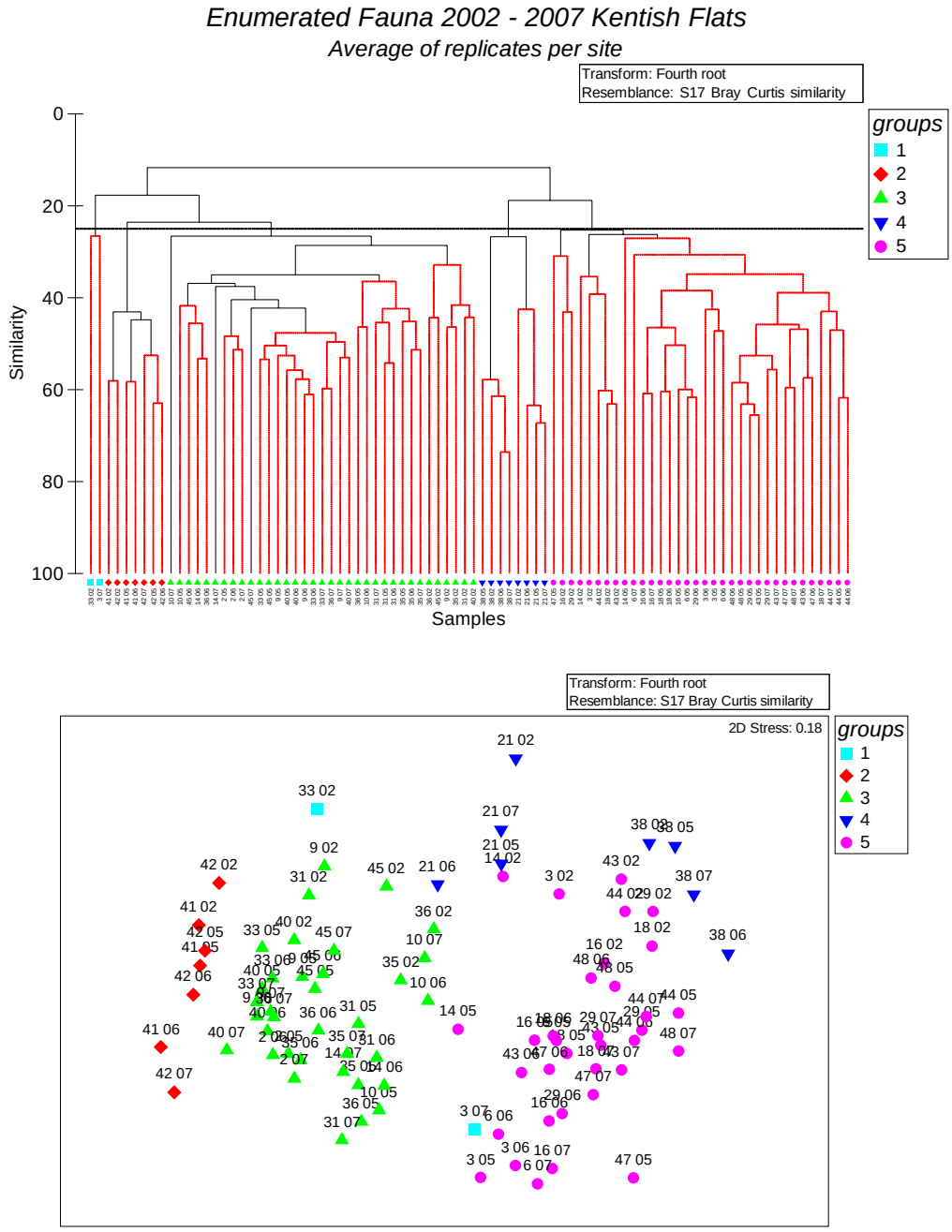


Figure 4.7 **Dendrogram of Bray-Curtis and Multi Dimensional Scaling (MDS) Plot of Bray-Curtis Similarity Index of Enumerated Fauna from Grab Samples, Kentish Flats. Combined data set from 2002 - 2007 Surveys**

Five groups of samples were identified by the multivariate analyses, the characteristics of which, as identified by the SIMPER analysis, are summarised in Table 4.3. Full results of the SIMPER analysis are presented in Appendix X.

Group	Samples (years) & Sediment Characteristics	Characterising Species (from SIMPER analysis 4th root transformation)
■ 1 Average Similarity 26.56%	**33**(02); **3**(07) **Sand**, poorly-sorted Mean no of species: 10.5 ± 0.7	*Goniada maculata* ***Nephtys caeca*** ***Mysella bidentata***
◆ 2 Average Similarity 46.85%	**41**(02,05,06); **42**(02,05,06,07) **Gravelly**, **Muddy Sand**, very poorly-sorted Mean no of species: 54 ± 10.3	**ACTINIARIA** ***Abra alba*** ***Mediomastus fragilis*** *Tubificoides benedii* ***Cirriformia tentaculata*** *Pholoe inornata* *Notomastus sp* *Molgula manhattensis* *Dendrodoa grossularia* *Lepidonotus squamatus* *Phoronis sp*
▲ 3 Average Similarity 35.36%	**10**(05,06,07); **45**(02,05,06,07); **14**(06,07); **36**(02,05,06,07); **2**(05,06,07); **33**(05,06,07); **9**(02,05,06,07); **40**(02,05,06,07); **31**(02,05,06,07); **35**(02,05,06,07) **Gravelly Sand**, very poorly-sorted Mean no of species: 36.7 ± 15.3	***Spiophanes bombyx*** **NEMERTEA** ***Lanice conchilega*** *Abra alba* *Goniada maculata* *Nymphon brevirostre* *Mysella bidentata* *Scoloplos armiger* *Anoplodactylus petiolatus*
▼ 4 Average Similarity 39.96%	**21**(02,05,06,07); **38**(02,05,06,07) **Sand**, poorly-sorted Mean no of species: 9.4 ± 4.7	***Ophelia borealis*** *Scoloplos armiger* *Nephtys cirrosa* ***Bathyporeia pelagica*** *Bathyporeia elegans* *Urothoe brevicornis* ***Polycirrus medusa***
● 5 Average Similarity 33.32%	**47**(05,06,07); **16**(02,05,06,07); **29**(02,05,06,07); **14**(02,05); **44**(02,05,06,07); **18**(02,05,06,07); **43**(02,05,07,06); **6**(05,06,07); **3**(02,05,06); **48**(05,06,07) **Sand**, moderately well-sorted Mean no of species: 10.6 ± 4.6	*Nephtys cirrosa* ***Bathyporeia elegans*** ***Magelona johnstoni*** *Notomastus* sp *Fabulina fabula* *Goniada maculata* *Abra alba* *Scoloplos armiger* *Spiophanes bombyx* *Spio martinensis*

Table 4.3 **Summary of Within Groups Similarity following SIMPER Analysis of Grab Samples from Kentish Flats, 2002 - 2007 survey.** Species responsible for the separation of the groups are in bold. Solitary sessile epifauna in blue

Group 1 comprised samples from site 33 within the southern reference area and site 3 within the development area from 2002 and 2007, respectively. These samples were characterised by low number of species compared to samples from the same stations collected in different years.

Group 2 comprised samples from the most inshore sites within the cable corridor. It was characterised by very poorly-sorted mixed sediments. It hosted the highest mean species diversity and abundance, including solitary epifaunal species. Characterising infaunal species included the bivalve *Abra alba*, and the annelids *Mediomastus fragilis* and *Tubificoides benedii*.

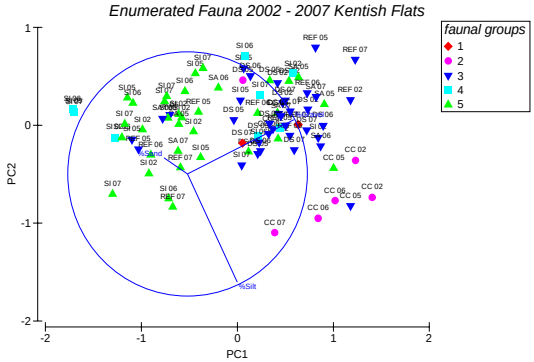
Group 3 comprised the majority of samples from sites within the development site, the southern reference area, the most inshore sites within the scour assessment area and the secondary impact area and the most offshore site within the cable corridor. It was characterised by very poorly-sorted gravelly sand and hosted the second highest species diversity and abundance. Characterising species included polychaetes worms (e.g. *Lanice conchilega*, *Spiophanes bombyx*), the bivalve *A. alba* and the barnacle *Balanus crenatus*.

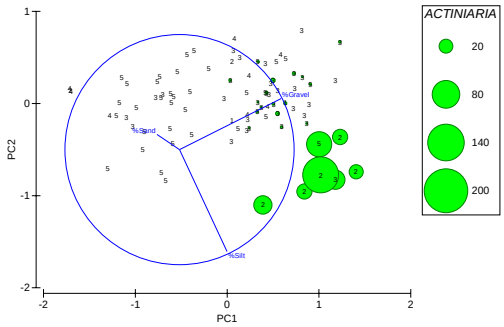
Group 4 comprised samples from two offshore sites within the secondary impact area and was characterised by poorly-sorted sand. Characterising species included the polychaete *Ophelia borealis* and crustacean amphipods (e.g. *Bathyporeia* spp).

Finally, **group 5** comprised samples from the most offshore sites within the secondary impact and the northern reference area. It was characterised by relatively mobile sand (moderately well-sorted) and included species such as *Nephtys cirrosa*, *B. elagans* and *M. johnstoni*.

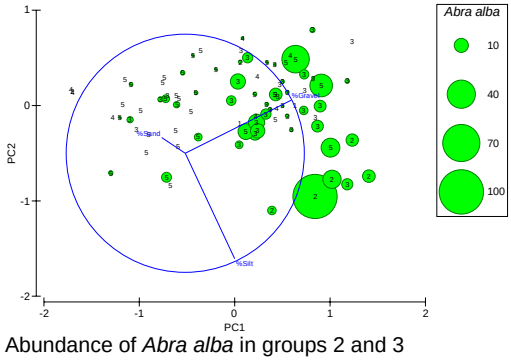
Chart 4.1 illustrates the habitats recorded within the Kentish Flats survey area over the four survey occasions as identified by the multivariate analysis.

Overall, the faunal characteristics of the groups of samples were found to be associated with the sediment characteristics, as illustrated in Figure 4.8. The figure shows the faunal groups identified by the multivariate analysis superimposed on the PCA of the sediment samples. All data refer to average of replicate samples per site. The Figure also shows the distribution of the main species responsible for the separation of the groups of samples.

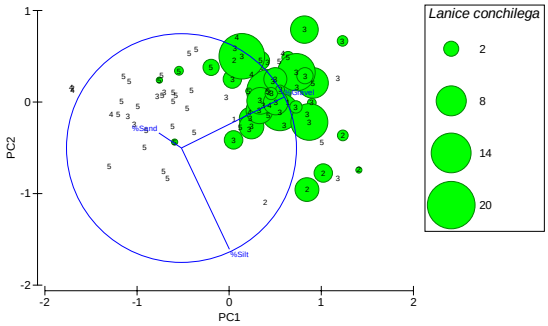




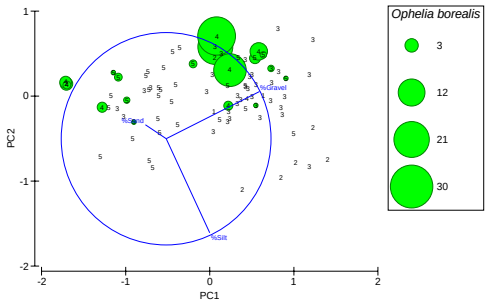
Abundance of Actiniaria in Group 2



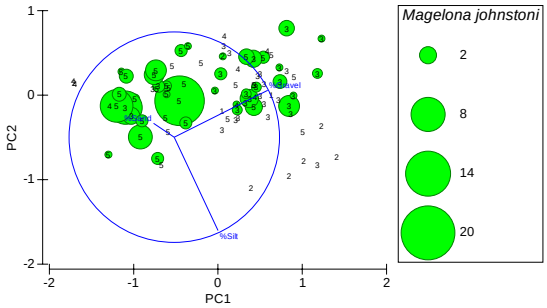
Abundance of *Abra alba* in groups 2 and 3



Abundance of *Lanice conchilega* in group 3

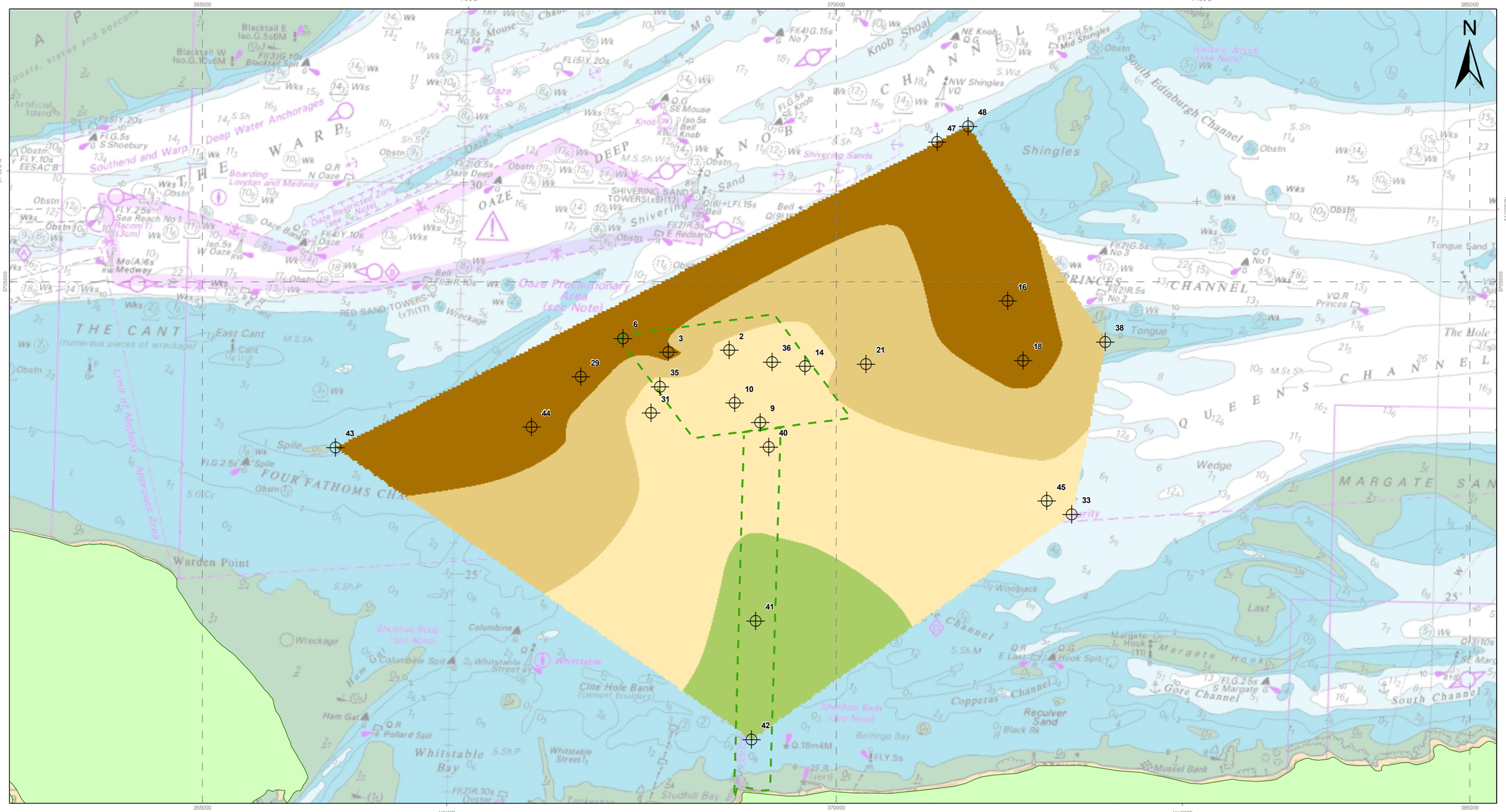


Abundance of *Ophelia borealis* in group 4

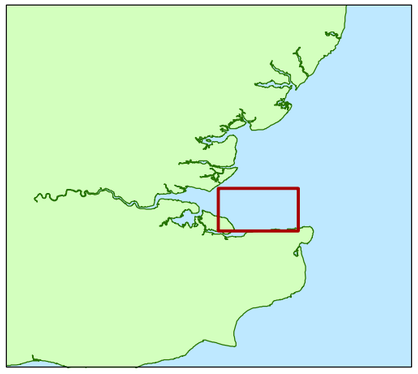


Abundance of *Magelona johnstonii* in group 5

Figure 4.8 MDS Plots of Bray-Curtis Similarity Index of Enumerated Fauna from Grab Samples. Data with Superimposed Circles Proportional in Diameter to Values of Abundance of Species Characteristic of Each Group of Samples



Location Plan



Legend

- Grab Sites
- Kentish Flats Development Area & Cable Route (approx.)

Habitat Regions

- Sand, Moderately Well Sorted
- Sand, Poorly Sorted
- Gravelly Sand, Very Poorly Sorted
- Gravelly Muddy Sand, Very Poorly Sorted

(Site 41 not sampled in 2007 survey)

Scale Bar

0 1 2 4

Kilometres

Coordinate System

WGS84 UTM Zone 31 North

Notes

Depths	All depths are in metres below Chart Datum
Equipment	Hamon Grab
Caveat	© Crown Copyright and/or database rights. Reproduced by permission of the Controller of Her Majesty's Stationery Office and the UK Hydrographic Office (www.ukho.gov.uk). NOT TO BE USED FOR NAVIGATION

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Project Title

Kentish Flats Windfarm Development Macrobenthic Ecology Study 2007

Drawing Title

Habitat Regions Based Upon Natural Neighbour Interpolation of Results of Multivariate Analysis

Drawn By:	Checked By:	Chart No. 4.1		
RJM	SDG			
Job Number:	**Issued On:**	**Sheet Size:**	**Scale:**	**Rev:**
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A summary of the temporal variations of the biological variables of the communities within Kentish Flats is presented in Figure 4.9.

A similar trend of macrofaunal composition was recorded during each year of survey, with the annelids dominating in terms of species diversity. Crustaceans and molluscs also accounted for a considerable bulk of the species diversity, whereas the echinoderms comprised only a small number of species.

One of the major temporal differences was associated with the abundance of the solitary sessile epifauna which showed a consistent increase over time with the highest value recorded in 2007. Analysis of the species list showed that species of Cirripedia, including *Balanus crenatus*, were primarily responsible for such an increase, comprising over 52% of the total faunal abundance in 2007. At this regard it is noteworthy that *B. crenatus* is typically opportunistic in nature and can vary in abundance over short periods in response to stress, e.g. scour, etc (www.Marlin.ac.uk, 2007).

The mean infaunal biomass across the survey showed considerable fluctuations between years and an overall pattern could not be identified. The mean biomass within the survey area in 2007 was dominated by the echinoderms and reflected the increase in the mean abundance of this taxon. The major difference with the 2006 biomass pattern was a decrease of the mollusc's biomass which reflected the lower abundance of this taxon within the survey area.

Mean values of the univariate indices across the survey area showed common trends over time with small temporal fluctuations.

Species which showed the greatest temporal variations of the mean abundance across the survey area included the polychaetes *Lanice conchilega* and *Scoloplos armiger*, the crustacean amphipod *Bathyporeia elegans*, the mollusc bivalve *Abra alba*, species of Nemertea and Actiniaria (Figure 4.10).

Temporal variations of the benthic communities were investigated within each area and the results are presented in Figure 4.11 to 4.13 for species diversity, abundance and biomass, respectively. Figure 4.14 summarises the temporal variations of the univariate indices within each area.

The Figures show a common trend with respect to species diversity, which was dominated by the annelids. This taxon was also dominant in terms of infaunal abundance within the majority of the areas along with the solitary epifauna. The latter only accounted for a small percentage of species diversity and abundance in samples from the secondary impact area.

The biomass showed different trends in different areas with larger temporal variations in comparison to those of species diversity and abundance, and a common pattern could not be extrapolated.

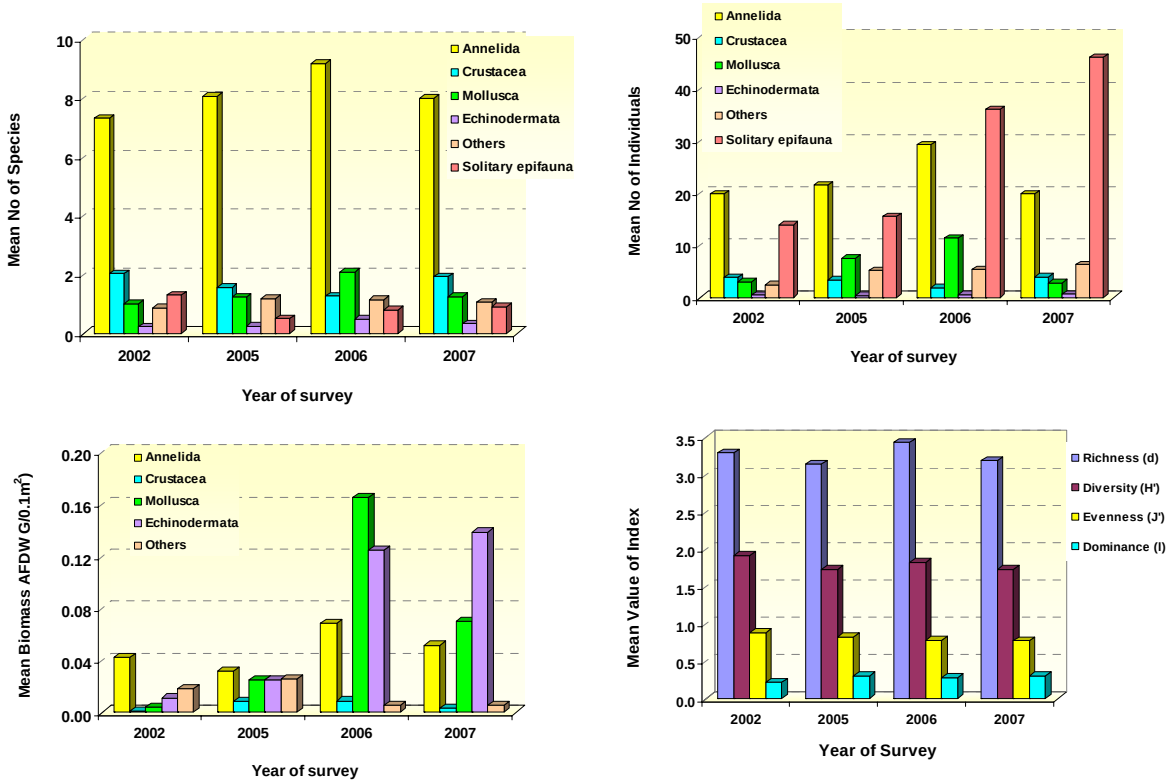


Figure 4.9 **Temporal Variations of the Biological Characteristics of Enumerated Fauna from Grab Samples within the Kentish Flats Survey Area, 2002 - 2007 Surveys**

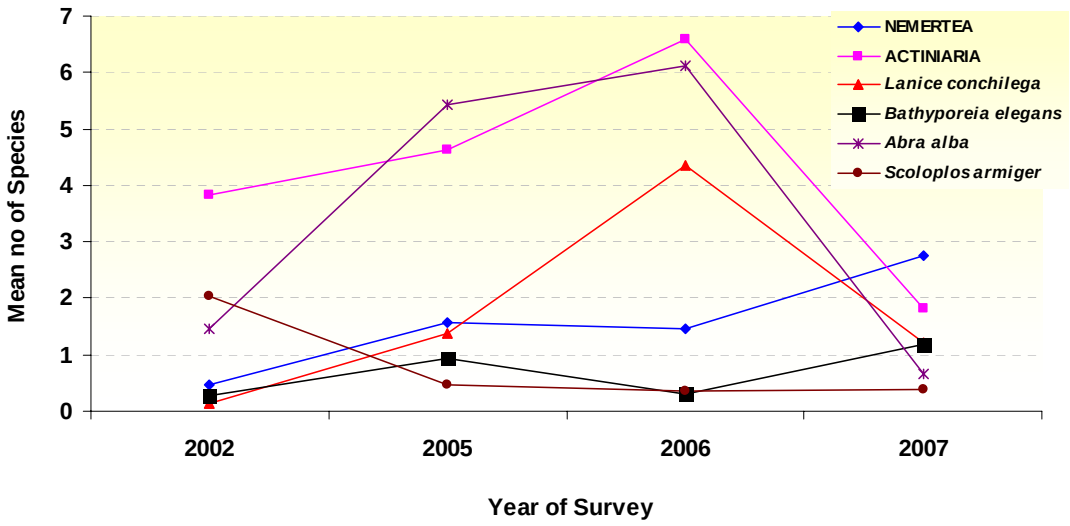


Figure 4.10 **Temporal Variations of the Abundance of Selected Species within Kentish Flats, 2002 – 2007 Surveys**

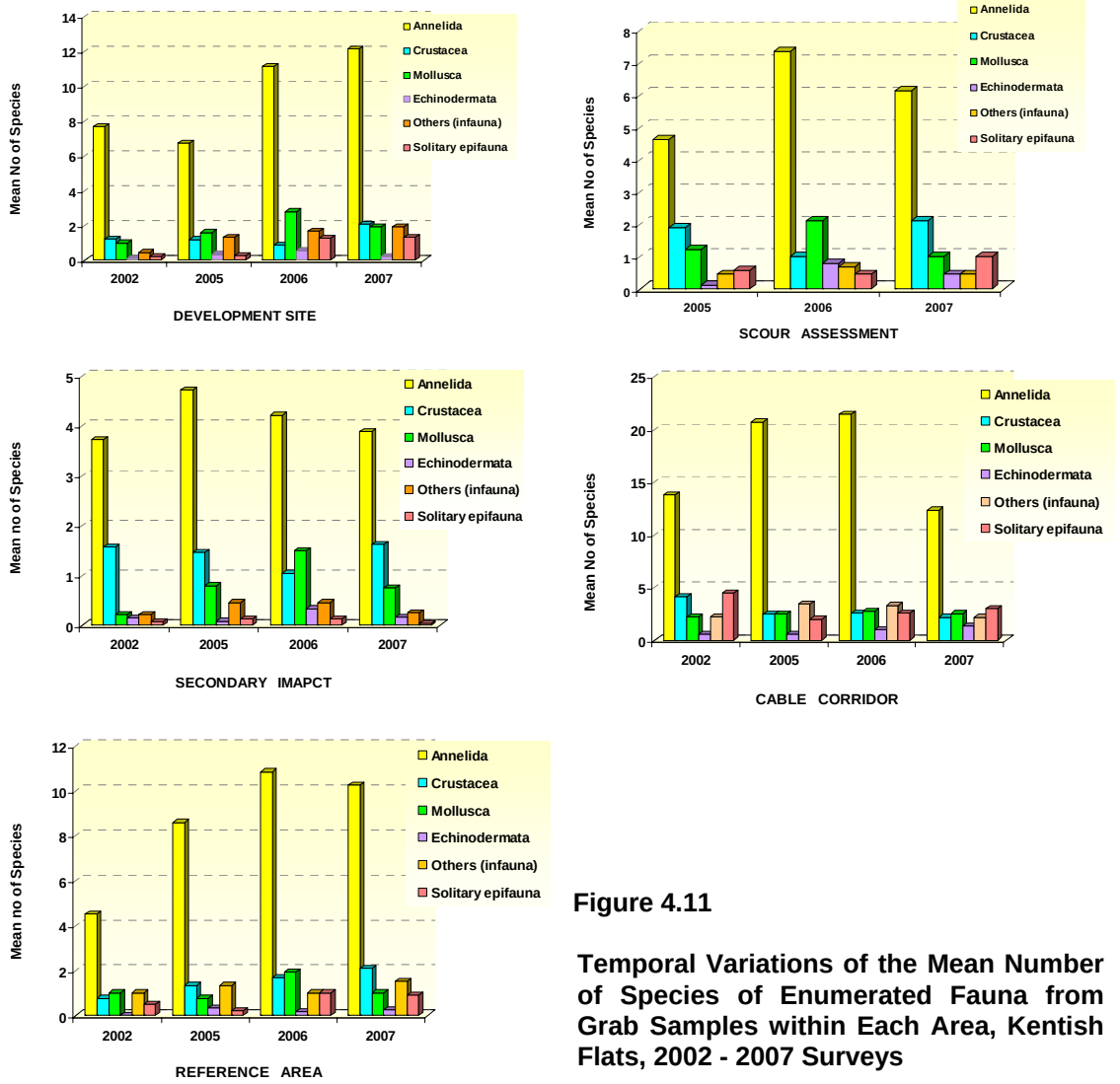
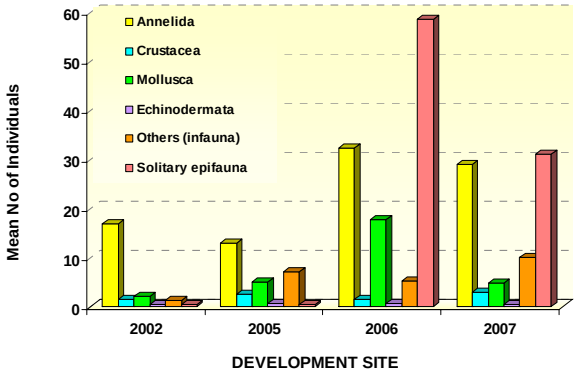
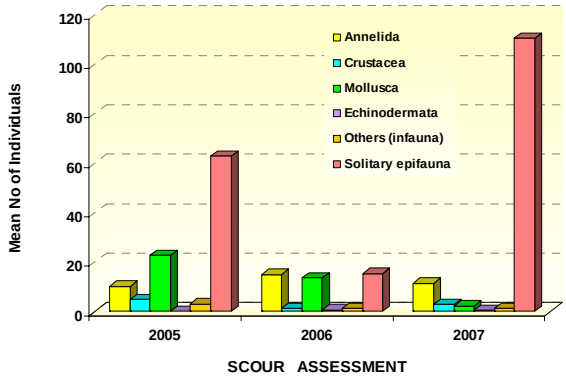
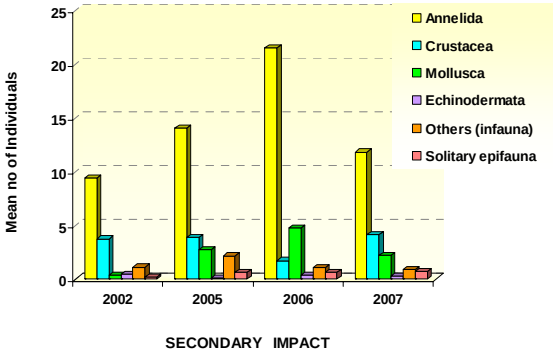


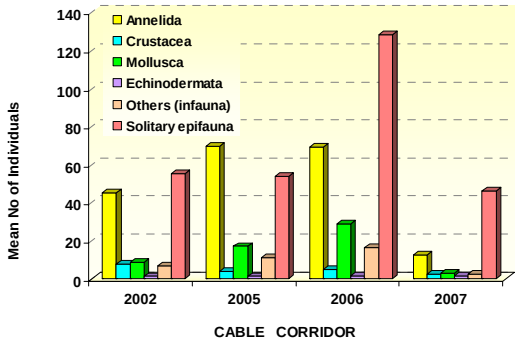
Figure 4.11

Temporal Variations of the Mean Number of Species of Enumerated Fauna from Grab Samples within Each Area, Kentish Flats, 2002 - 2007 Surveys









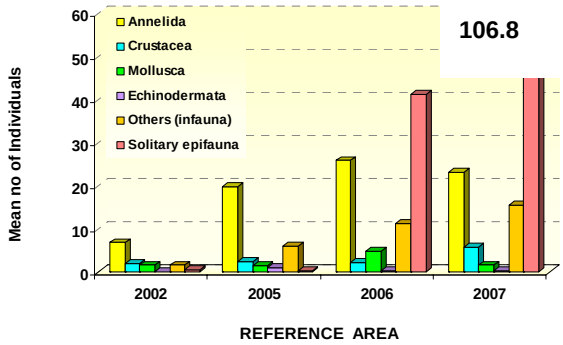


Figure 4.12

Temporal Variations of the Mean Abundance of Enumerated Fauna from Grab Samples within Each Area, Kentish Flats, 2002 - 2007 Surveys

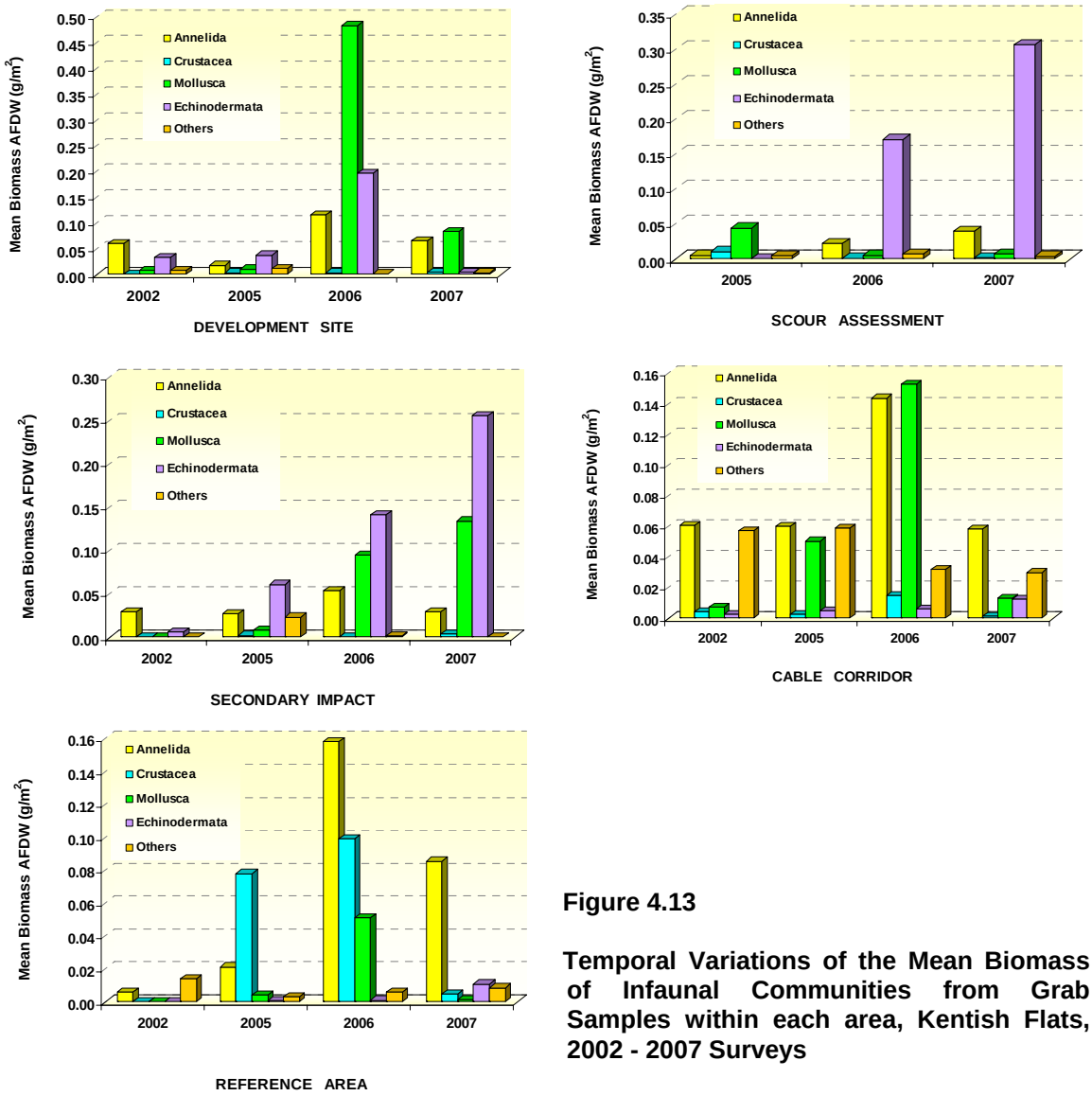


Figure 4.13

Temporal Variations of the Mean Biomass of Infaunal Communities from Grab Samples within each area, Kentish Flats, 2002 - 2007 Surveys

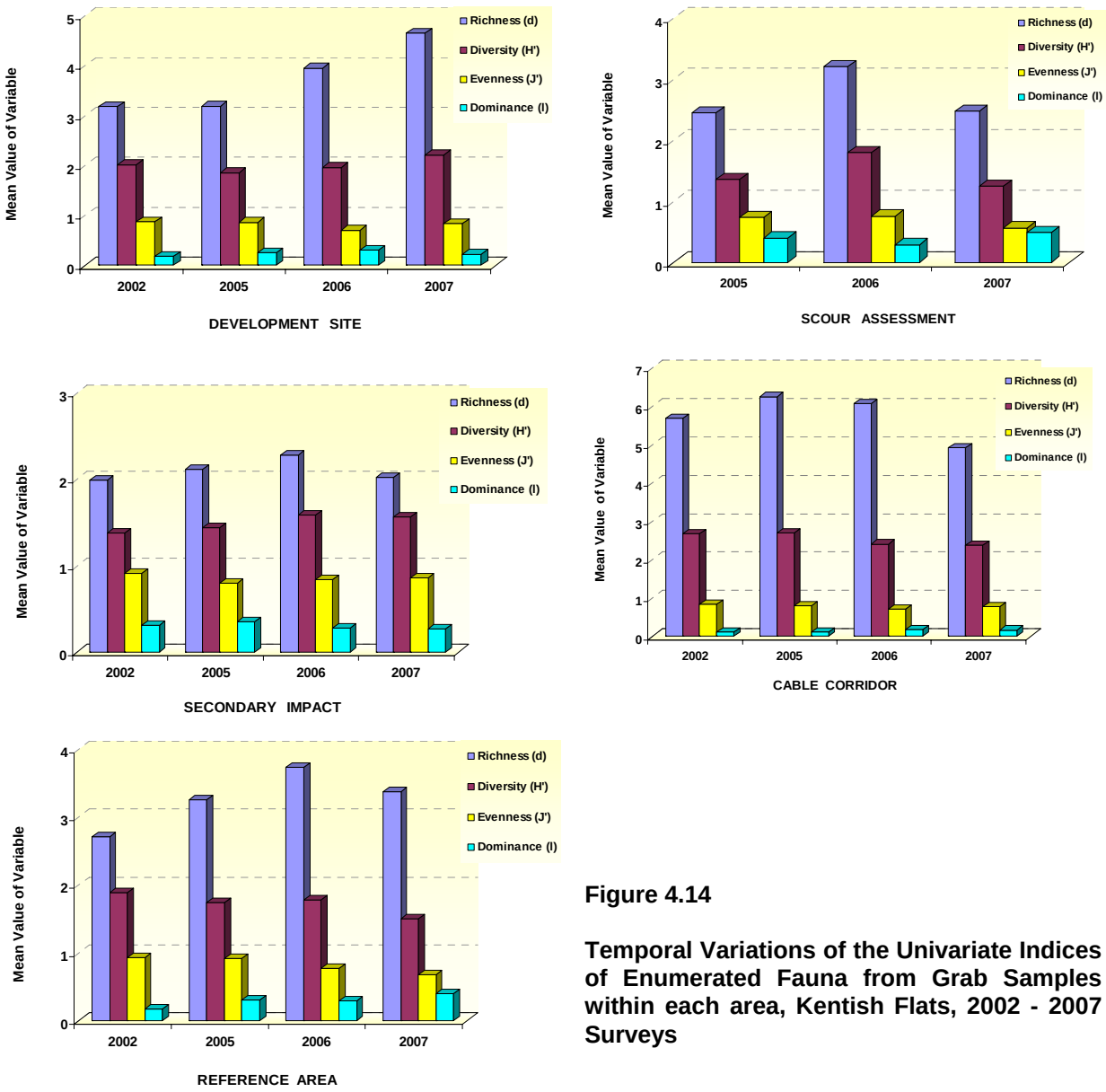


Figure 4.14

Temporal Variations of the Univariate Indices of Enumerated Fauna from Grab Samples within each area, Kentish Flats, 2002 - 2007 Surveys

Values of the univariate indices showed a similar temporal trend in all areas. Fluctuations of species richness and diversity values reflected those of the mean number of species and individuals within each area over time. Values of the evenness and the dominance indices remained relatively constant overtime indicating that the ecological equilibrium between species has been maintained since the study begun.

Results of the univariate indices were further analysed employing the multivariate analysis, the results of which are presented in Figure 4.15 and Figure 4.16.

Figure 4.15 shows the results of the Principal Component Analysis (PCA) undertaken on the univariate indices of Richness, Diversity and Evenness. The latter index showed a strong correlation with the dominance index which was not considered in the multivariate analysis.

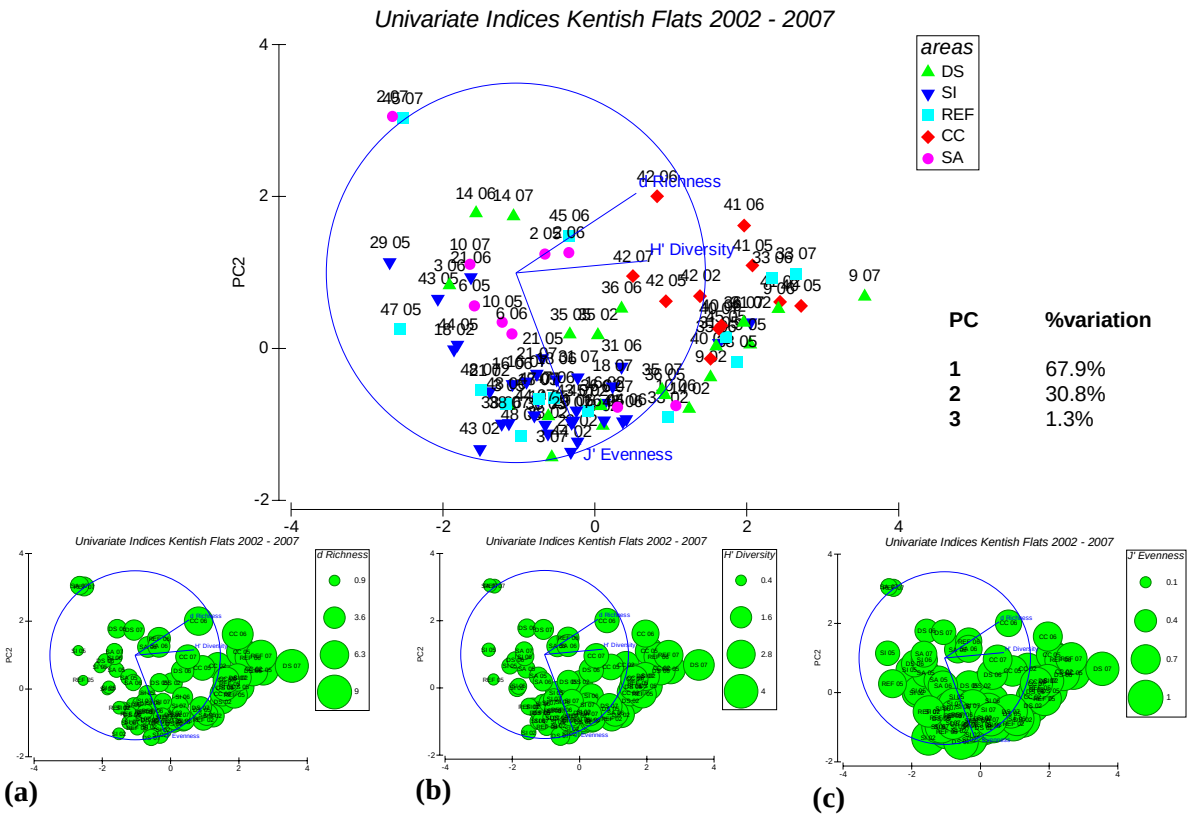


Figure 4.15 **Two Dimensional Representation of the Principal Component Analysis of Univariate Indices of the Benthic Communites (Enumerated Fauna) from Grab Samples, Kentish Flats 2002 – 2007 Surveys. Data with Superimposed Circles proportional in Diameter to the values of Richness (a) Diversity (b) and Evenness (c). Data Refer to Average of Replicates within Sites**

It can be seen that the majority of samples from sites within the cable corridor, the development site and the southern reference area showed high values of richness and diversity. The majority of samples from site within the secondary impact and the northern reference areas showed high values of evenness, associated with the relatively low number of species and individuals recorded at these stations.

Univariate indices of samples from the secondary impact area and the cable corridor showed the highest degree of similarity over time, expressed in this instance as the Euclidean distance. Univariate indices of samples from sites within the development site and the reference area in 2007 showed a lower degree of similarity compared to those of previous years (Figure 4.16). This was due to higher mean values of species richness and diversity recorded in samples from the development site in 2007 (Figure 4.14), particularly from site 9 (Figure 4.15). In addition, sites from the reference area in 2007, showed slightly lower mean values of the evenness compared to those from previous years (Figure 4.14). Analysis of the species list showed that this was associated with a numerically dominance of the barnacle *B. crenatus*, which accounted alone for 70% of the faunal abundance within the reference area in 2007.

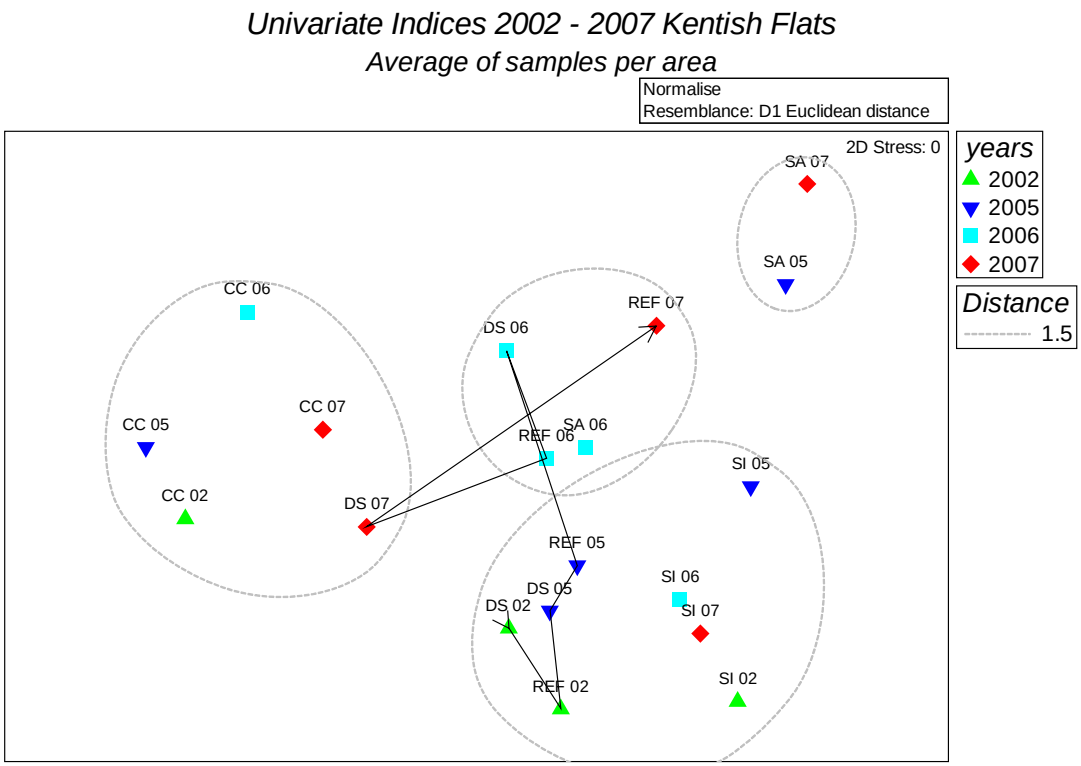
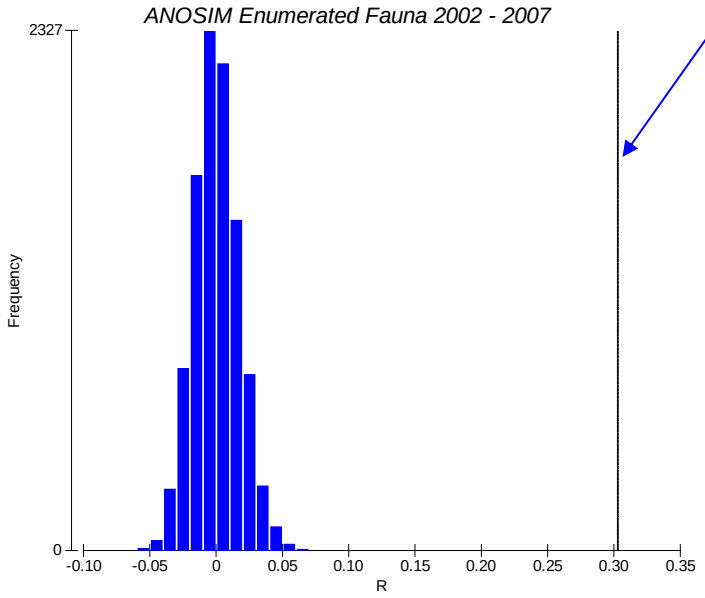


Figure 4.16 Multi Dimensional Scaling (MDS) Plot of Euclidean Distance Similarity Index of Univariate Indices of Benthic Communities (Enumerated Fauna) from Grab samples Kentish Flats 2002 – 2007. Data with Superimposed Trajectory Joining the Development Site and the Reference Areas in Order of Years. Values Refer to Average of Samples within Each Area

4.2.2.1 Analysis of Similarity (ANOSIM) of Benthic Communities (Enumerated Fauna)

ANOSIM was applied to the combined faunal data set in order to establish how significant the temporal variations of the benthic communities were and the results are presented in Figure 4.17. The Figure shows that overall there were significant spatial and temporal differences of the fauna composition of the different areas within Kentish Flats study area. Results of the pairwise test are also presented to highlight the areas which showed the greatest temporal difference (large values of R) as well as the spatial differences of the faunal communities of the development site and those of the other areas over time.

Sample statistic (Global R) = 0.303
Significance Level of sample statistic= 0.01%



TEMPORAL VARIATIONS			
Area	Year	Sample statistic R	Significance level
DS	2007-2002	0.392	0.06%
	2007-2005	0.148	0.8%
	2007-2006	0.074	4.6%
	2006-2002	0.575	0.01%
	2006-2005	0.147	1.7%
	2005-2002	0.216	1%
SA	2007-2005	0.248	1.1%
	2007-2006	0.037	27.2%
	2006-2005	0.074	17.4%
SI	2007-2002	0.117	4.1%
	2007-2005	0	43.7%
	2007-2006	0.056	5%
	2006-2002	0.25	0.01%
	2006-2005	0.023	17.7%
	2005-2002	0.067	11.3%
CC	2007-2002*	0.301	1.4%
	2007-2005*	0.302	1.8%
	2007-2006*	0.061	22%
	2006-2002	0.164	4.7%
	2006-2005	0.056	22.8%
	2005-2002	0.182	2.9%
REF	2007-2002*	0.389	0.7%
	2007-2005	0.036	19.1%
	2007-2006	0.001	35.7%
	2006-2002*	0.148	10.5%
	2006-2005	-0.005	43.7%
	2005-2002*	-0.097	70.8%

SPATIAL VARIATIONS				
Area	Sample statistic R			
	2007	2006	2005	2002
DS - SI	0.396	0.377	0.332	0.527
DS - SA	0.145	0.158	0.082	n/a
DS - CC	0.245	0.3	0.44	0.684
DS - REF	0.118	0.184	0.131	0.205

R values derived from ANOSIM test (number of possible permutation of each pairwise test > 9,999 or otherwise specified)
* Number of permutations <9.999

DS= Development Site; SA= Scour Assessment; SI= Secondary Impact; CC= Cable corridor; REF= Reference Area

Figure 4.17 ANOSIM of Enumerated Fauna from Grab Samples, Kentish Flats 2002 - 2007 Surveys. Simulated distribution (9,999 permutations) of the Test Statistic R under the Null Hypothesis of "No Differences Between Years"

Sites within the secondary impact area and those within the cable corridor exhibited the highest degree of similarity between years, as illustrated in Figure 4.18 which shows the degree of temporal separation of each area. Values of enumerated faunal abundance per year refer to average values of samples within each area. Sites within the reference area showed the lowest level of similarity. The Figure also shows that the degree of separation of the development site and the reference area has become smaller since the baseline study in 2002, which is in agreement with the ANOSIM test's results.

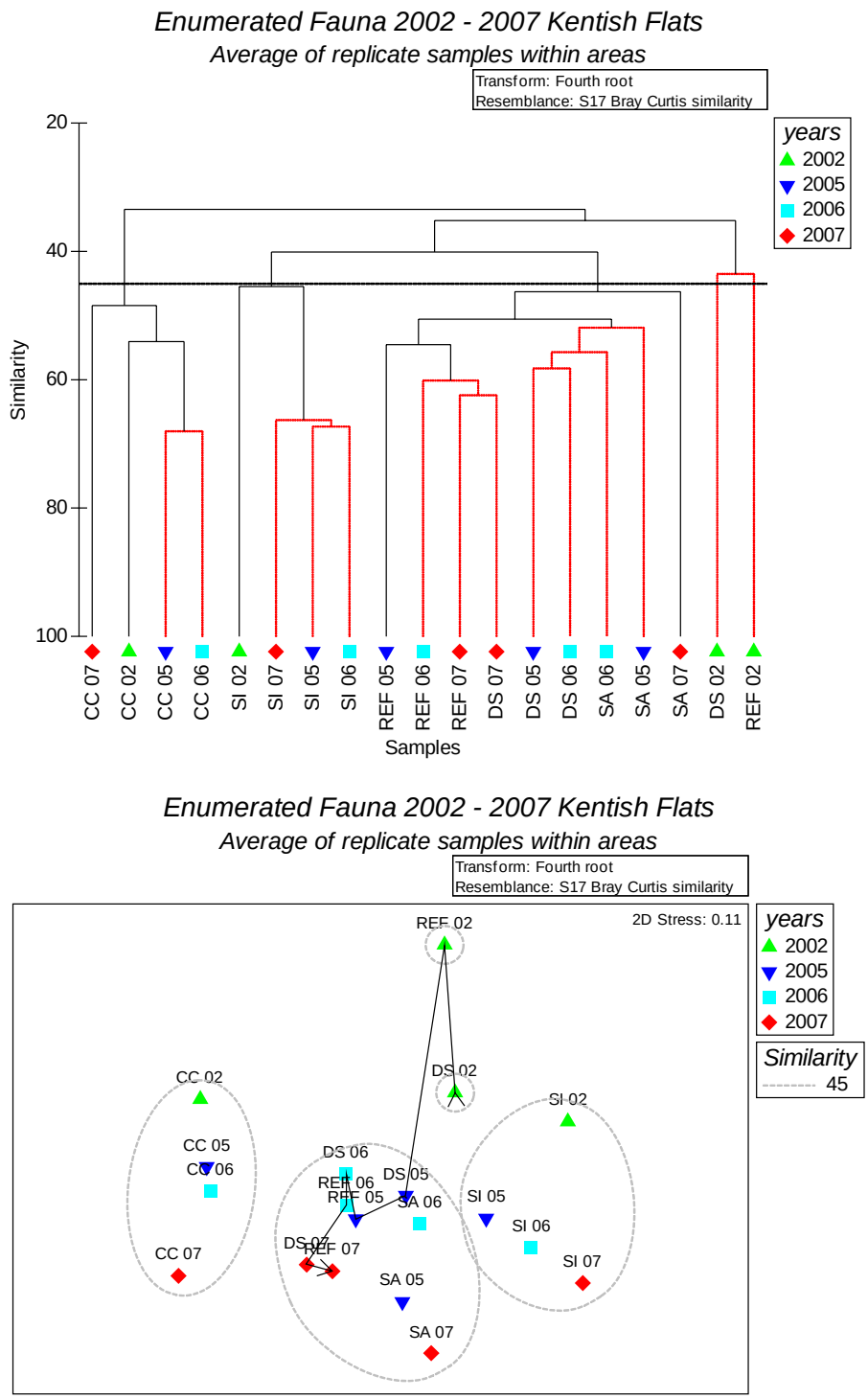
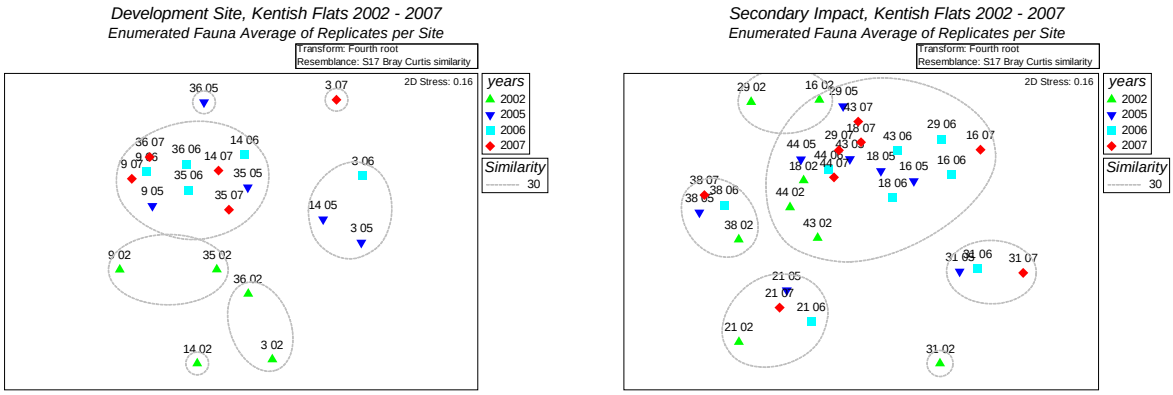


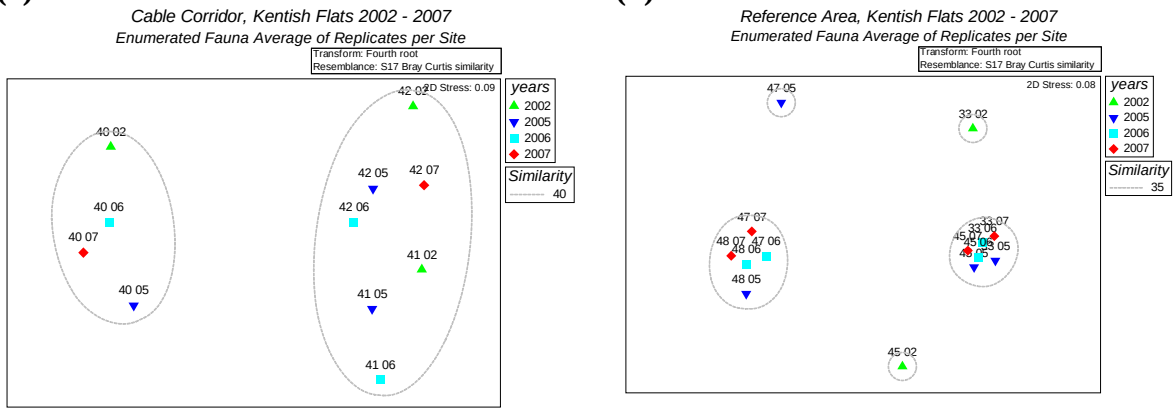
Figure 4.18 Dendrogram and Multi Dimensional Scaling (MDS) Plot of Bray-Curtis Similarity Index of Enumerated Fauna from Grab Samples, Kentish Flats, 2002 - 2007 Surveys. Average Values of Faunal Abundance within Each Area

Further multivariate analyses were undertaken on the benthic communities within each area the outputs of which are presented in Figure 4.19. The Figure shows that samples form sites within the different areas have retained relatively high degrees of similarity over time. The highest temporal variability was in general associated with those sites which showed high intra-sample variability, e.g. site 3 within the development site, site 29 within the secondary impact area and site 40 within the cable corridor. Sites within the reference showed two distinct groups, one comprising sites 45 and 33,

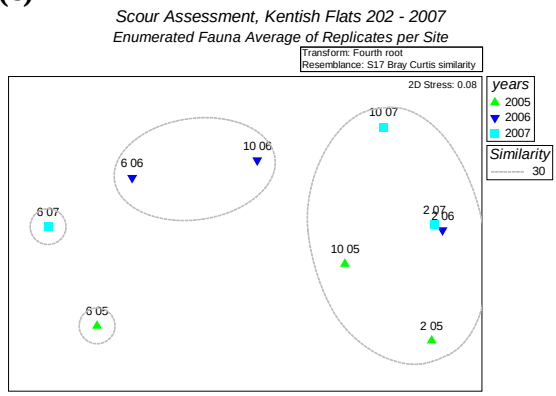
the other comprising sites 47 and 48. Great spatial variations were recorded between these two groups of samples, which were retained over time.



(a) **(b)**



(c) **(d)**



(e)

Figure 4.19

MDS of Bray Curtis Similarity Index of Enumerated Fauna from Grab Samples within Each Area, Kentish Flats 2002 – 2007 Survey

The SIMPER analysis was performed on the combined data set of the 2002 to the 2007 surveys in order to identify which species were primarily responsible for the temporal variations of each area. The results of the analysis are summarised in Tables 4.4 to 4.6 for the 2007 and 2002, the 2007 and 2005 and the 2007 and 2006 data sets, respectively. Full results of the analysis are presented in Appendix X.

Area & Year of Survey	Species	Average Abundance		Frequency of occurrence (% of samples)	
		2007	2002	2007	2002
Development site	*Magelona johnstoni*	0.1	1.4	6.7	77.8
2007 & **2002** surveys	*Scoloplos armiger*	0.4	2.2	26.7	77.8
	Cirripedia*	29.9	0	46.7	0
Average dissimilarity	NEMERTEA	4.5	0.3	80	20
82.78%	*Spiophanes bombyx*	3.1	6.2	80	100
Secondary Impact Area	*Scoloplos armiger*	0.17	1.6	8.3	78.6
2007 & **2002** surveys	*Bathyporeia elegans*	2.1	0.6	50	35.7
	Magelona johnstoni	1	2	37.5	42.9
Average dissimilarity	*Nephtys cirrosa*	1.9	1.3	66.7	71.4
80.75%	*Ophelia borealis*	2.3	0.9	20.8	35.7
Cable corridor	*Tubificoides benedii*	1.7	11.6	16.7	88.9
2007 & **2002** surveys	ACTINIARIA	17.7	15.2	50	66.7
	Galathowenia oculata	5.2	0.1	66.7	11.1
Average dissimilarity	Euclymeninae**	6.8	2.3	100	44.4
78.11%	*Scoloplos armiger*	0	2.9	0	77.8
Reference Area	Cirripedia	106	0	50	0
2007 & **2002** surveys	*Nephtys cirrosa*	0.92	0	58.3	0
	Spiophanes bombyx	3.4	1.8	50	50
Average dissimilarity	*Bathyporeia elegans*	2.1	0	41.7	0
90.04%	NEMERTEA	5.5	0.8	50	50

* Includes *Balanus crenatus* aggregated to higher taxa of Cirripedia
** Includes *Euclymene oerstedii* aggregated to higher taxa of Euclymeninae

Table 4.4 Summary of SIMPER analysis – Enumerated Fauna contributing most to the Dissimilarity of each Area between 2007 and 2002 Surveys, Kentish Flats. Un-transformed data.

Area & Year of Survey (2007 & 2005)	Species	Average Abundance		Frequency of occurrence (% of samples)	
		2007	2005	2007	2005
Development site	*Abra alba*	1.1	3.1	46.7	73.3
2007 & **2005** surveys	Cirripedia	29.9	0	46.7	0
	NEMERTEA	4.5	0.9	80	33.3
Average dissimilarity	*Nymphon brevirostre*	2.7	4	66.7	53.3
81.59%	*Spiophanes bombyx*	3.1	2.2	80	66.7
Scour Assessment Area	Cirripedia	110.4	62.4	66.7	22
2007 & **2005** surveys	*Abra alba*	0.1	22	11.1	66.7
	Spiophanes bombyx	2.1	0.9	77.8	33.3
Average dissimilarity	*Notomastus* sp.	2.2	0.4	66.7	3.3
86.73%	*Lanice conchilega*	1.2	3.2	44.4	44.4
Secondary Impact Area	*Bathyporeia elegans*	2.1	2.5	50	58.3
2007 & **2005** surveys	*Nephtys cirrosa*	1.9	1.9	66.7	58.3
	Magelona johnstoni	1	1.5	37.5	54.2
Average dissimilarity	*Ophelia borealis*	2.3	2.9	20.8	29.2
79.24%	*Abra alba*	0.5	2.1	16.7	37.5
Cable corridor	ACTINIARIA	17.7	34.9	50	66.7
2007 & **2005** surveys	*Polycarpa* spp†	24.3	0.33	66.7	22.2
	Eteone flava/longa *Mysella*	0	1.8	0	88.9
Average dissimilarity	*bidentata*	0.5	7.6	33.3	77.8
72.50%	*Mediomastus fragilis*	3.5	8.2	50	100
Reference Area	*Cirripedia*	106.3	0	50	0
2007 & **2005** surveys	*Bathyporeia elegans*	2.1	0.3	41.7	16.7
	Nephtys cirrosa	0.92	0.7	58.3	41.7
Average dissimilarity	*Nymphon brevirostre*	9.3	2.8	58.3	41.7
83.23%	*Spio martinensis*	0.7	<0.1	33.3	8.3

† Includes *P. fibrosa*, *P. pomaria* and *P gracilis* aggregated to genus level i.e. *Policarpa* spp.

Table 4.5 Summary of SIMPER analysis – Enumerated Fauna contributing most to the Dissimilarity of each Area between 2007 and 2005 Surveys, Kentish Flats. Un-transformed data

Area & Year of Survey	Species	Average Abundance		Frequency of occurrence (% of samples)	
		2007	2006	2007	2006
Development site	Cirripedia	29.9	57.5	46.7	66.7
2007& **2006** surveys	*Abra alba*	1.1	8.7	46.7	86.6
	Lanice conchilega	2.5	8.3	53.3	66.7
Average dissimilarity	*Notomastus sp.*	2.1	2.3	46.7	53.3
75.93%	*Spiophanes bombyx*	3.1	4.5	80	73.3
Scour Assessment Area	Cirripedia	110.4	15.3	66.7	33.3
2007 & **2006** surveys	*Lanice conchilega*	1.2	4.8	44.4	55.6
	Notomastus sp.	2.2	0.7	66.7	44.4
Average dissimilarity	*Fabulina fabula*	1.1	0.6	33.3	44.4
77.50%	*Abra alba*	0.1	2.9	11.1	44.4
Secondary Impact Area	*Abra alba*	0.5	3	16.7	58.3
2007& **2006** surveys	*Bathyporeia elegans*	2.1	0.7	50	33.3
	Nephtys cirrosa	1.9	1.3	66.7	66.7
Average dissimilarity	*Ophelia borealis*	2.3	3.4	20.8	33.3
79.68%	*Magelona johnstoni*	1	1.3	37.5	41.7
Cable corridor	ACTINIARIA	17.7	61.3	50	71.4
2007& **2006** surveys	*Molgula manhattensis*	1.3	62.9	50	51.1
	Polycarpa sp.	24.3	2.3	66.7	42.8
Average dissimilarity	*Lanice conchilega*	0.3	4.7	16.7	85.7
89.04%	*Abra alba*	2.2	23.7	83.3	100
Reference Area	Cirripedia	106.3	40.2	50	41.7
2007& **2006** surveys	*Bathyporeia elegans*	2.1	0.3	41.7	16.7
	Lanice conchilega	1.7	6.3	50	58.3
Average dissimilarity	*Nymphon brevirostre*	9.3	8.4	58.3	16.7
77.65%	*Spiophanes bombyx*	3.4	2.3	50	66.7

Table 4.6 Summary of SIMPER analysis – Enumerated Fauna contributing most to the Dissimilarity of each Area between 2007 and 2006 Surveys, Kentish Flats. Un-transformed data

Temporal variations of the benthic communities from sites within the **development area** were mainly associated with fluctuations in the abundance of the polychaetes worms *S. bombyx*, *S. armiger* and *L. conchilega*. Nemerteans and the bivalve *A. alba* also showed considerable variation over time (Figure 4.20a), together with species of Cirripedia. The greatest decline in abundance was recorded with respect to *A. alba*, the mean abundance of which within the development site was the second lowest recorded since the study begun. The mean abundance of *L. conchilega* also showed a conspicuous decline from 2006 reaching values comparable to those recorded in 2005. In comparison, *S. bombyx* and *S. armiger* showed less marked temporal variations and the overall mean abundance of both species decreased since the study begun. The mean abundance of nemertean worms showed a steady increase since the baseline study in 2002.

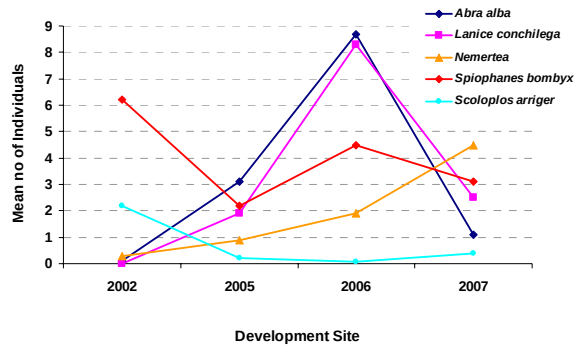
Temporal variations of the benthic communities from sites within the **secondary impact area** were mainly associated with fluctuations in the abundance of the polychaetes worms *N. cirrosa*, *O. borealis* and *M. johnstoni*, the bivalve *A. alba* and the crustacean amphipod *B. elegans*. Specifically, *A. alba* and *O. borealis* showed a decline of the mean abundance in 2007, following a steady increase in the previous two years (Figure 4.20b). *B. elegans* and *N. cirrosa* showed considerable fluctuations over time and overall, the mean abundance of both species in 2007 was higher than that recorded in 2006 and 2002. *M. johnstoni* showed a steady decrease since the 2002 baseline study.

Temporal variations of the benthic communities from sites within the **cable corridor** were associated with fluctuations in the abundance of infaunal and solitary epifaunal species. The former included polychaete worms (*M. fragilis*, *G. oculata*, *S. armiger* and *L. conchilega*) and the oligochete *T. benedii*. Considerable temporal fluctuations were recorded with the majority of these species (Figure 4.20c), with the exception of *S. armiger* and *G. oculata*, the former showing a steady decline since the study begun, the latter showing a steady increase. Solitary epifauna included species of Actiniaria and ascidians (e.g. *Polycarpa* spp., *M. manhattensis*). The mean abundance of the actiniarians showed a decline in 2007 following a steady increase during the previous 2 years, whereas *Polycarpa* spp

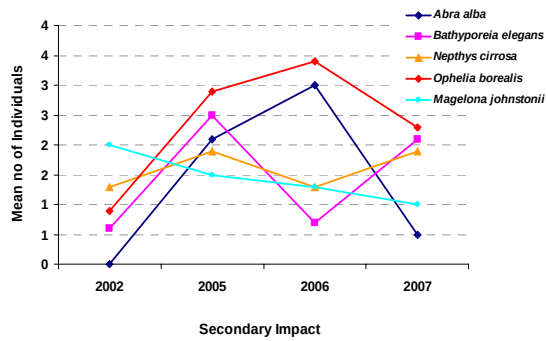
showed a sharp increase in 2007. It is noteworthy that in 2007 samples at site 41 could not be obtained due to the hard seabed sediment surface at this location. Samples taken at this site in 2005 and 2002 hosted over 50% of the mean abundance of Actiniaria sp within the cable corridor.

Temporal variations of the benthic communities from sites within the **scour assessment area** were associated with fluctuations in the mean abundance the polychaetes worms *L. conchilega*, *Notomastus* sp, and *S. bombyx* and the bivalve *A. alba* and *F. fabula*. The greatest variation was associated with a steady, significant decline of *A. alba* from 2005 (Figure 4.20d). *L. conchilega* showed a similar trend, although of a smaller magnitude. *Notomastus* sp and *F. fabula*, on the other hand, showed steady increase since 2005. Samples from site 41 showed the highest degree of temporal similarity, those from site 40 the lowest.

Temporal variations of the benthic communities from sites within the **reference area** were associated with fluctuations in the mean abundance of the polychaete worms *N. cirrosa*, *S. bombyx* and *L. conchilega*, the sea spider *N. brevirostre* and the crustacean amphipod *B. elegans* (Figure 4.20e). Species of Cirripedia also contributed greatly to the temporal variations within the reference area, exhibiting a sharp increase in the abundance since 2006.



(a)



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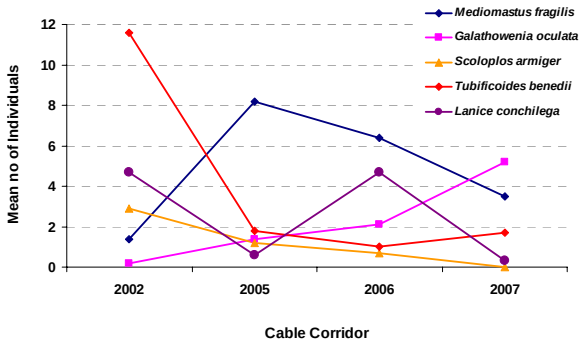

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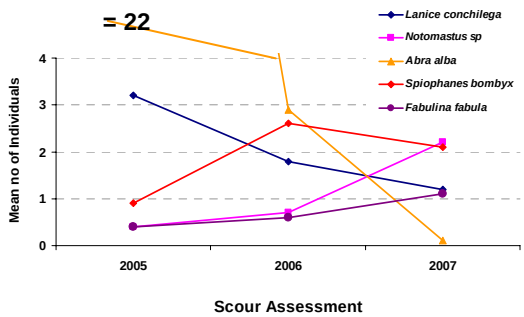
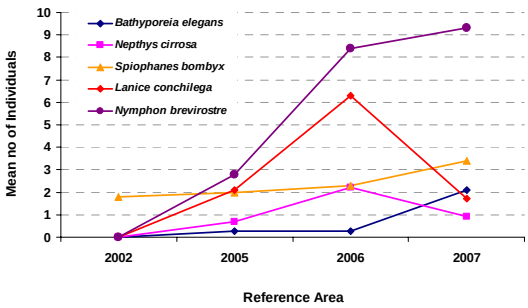


(d)



(e)

Figure 4.20

Temporal Variations of the Mean Abundance of the Top Five Faunal Species Responsible of the Temporal Variations within Each Area, Kentish Flats, 2002 – 2007 Surveys

Overall, the temporal differences recorded within the entire Kentish Flats survey area, as well as those recorded within each area, are most likely to be associated with natural variability rather than

anthropogenic activity. Results from a variety of environmental impact studies, suggests that the variability among samples collected from the impacted areas is likely to be much greater than that of samples collected from the control sites (Warwick & Clarke, 1993). Results of the current study showed no increased variability of samples collected in 2007 compared to those of the 2002 baseline study. Indeed, differences in the benthic communities of samples from the development site and those from the reference area in 2007 were smaller than those in 2002. In addition, the degree of the intra-sample variability was lower in 2007 than that in 2002, indicating higher degree of habitats stability. The abundance of species such as *L. conchilega* and *A. alba*, which were amongst those which showed the largest temporal variations in the abundance, may fluctuate between years owing to variations in recruitment success (www.Marlin.ac.uk, 2007). Moreover, random recruitment events of species such *as N. cirrosa* may be very important to the population size of other polychaetes present and may therefore create a degree of variation in community composition. Finally, temporal variations in species richness and abundance in general, may occur due to seasonal pattern of disturbance such as storms, harsh winters and oxygen deficiencies. Storms in particular, can cause severe substratum disturbance which can turn over the sediment and completely disrupt the community (www.Marlin.ac.uk, 2007). Similarly, changes in water temperature following harsh winters, can wipe out *L. conchilega* communities (Strasser & Pieloth, 2001) with significant effects on the overall species diversity, particularly in shallow waters.

4.2.3 Temporal Variations of Colonial Epifauna from Grab Samples

The combined data set of the epifaunal communities from the Kentish Flats study area over the four year period was subjected to multivariate analyses, the outputs of which are presented in Figure 4.21. The data refer to averages of replicates within sites. Samples which did not contain colonial epifauna were removed from the data set prior multivariate analyses being undertaken. These included the majority of samples from sites within the secondary impact area and those within the northern reference area.

Using Figure 4.21 five groups of samples were identified and found to be broadly associated with the sediment type (Figure 4.22 and Table 4.7).

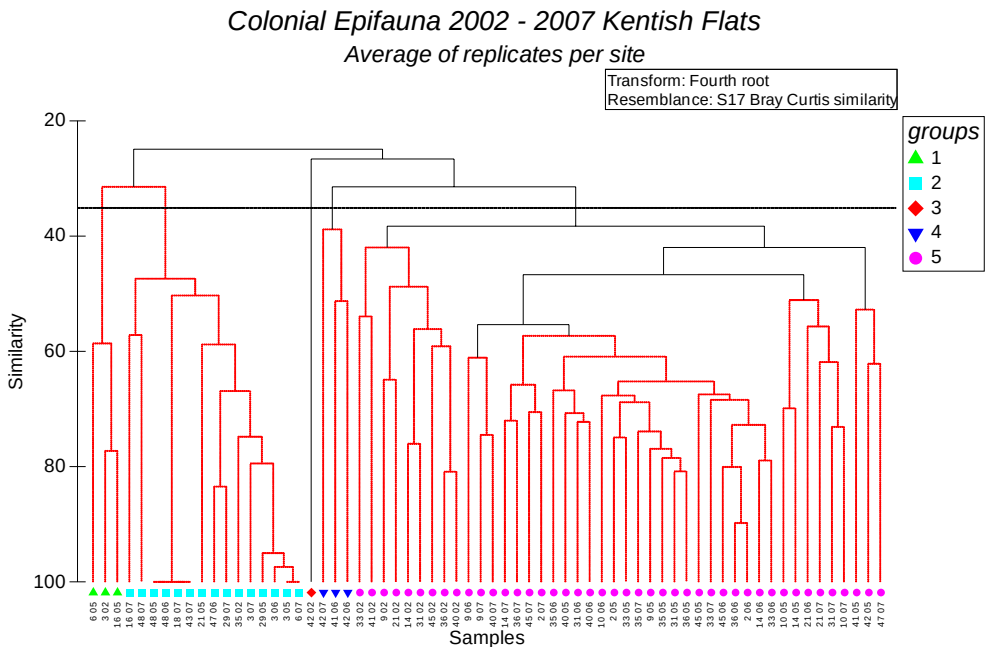
Group 1 comprised samples from selected stations within the development site, the scour assessment area and the secondary impact area. It was characterised by moderately well-sorted sand and hosted the lowest number of species, featuring *V. spinosa* and *C. reticulum*.

Group 2 comprised the majority of samples from the secondary impact area and from the most offshore stations within the development site and the scour assessment area. It was characterised by moderately-sorted sand and hosted a low number of species including *C. reticulum* and *A. melolontha.*

Group 3 comprised samples collected in 2002 from site 42 within the cable corridor, and was different enough to individually separate. It was characterised by very poorly-sorted gravelly and sandy silt and hosted a high number of species comprising species of bryozoans, cnidarians and poriferans.

Group 4 comprised the majority of samples from the most inshore sites within the cable corridor and was characterised by mixed sediments of gravel, sand and silt. It hosted the highest number of species of which *A. mytili, C. reticulum and E. pilosa* were the most frequently occurring.

Group 5 comprised the majority of samples from sites within the development site, the southern reference area, the most inshore sites within the secondary impact area and the scour assessment area and the most offshore site within the cable corridor. It was characterised by poorly-sorted gravelly sand and hosted a relatively high mean number of species of which *C. reticulum, E. monostachys and A. melolontha* were the most frequently occurring.



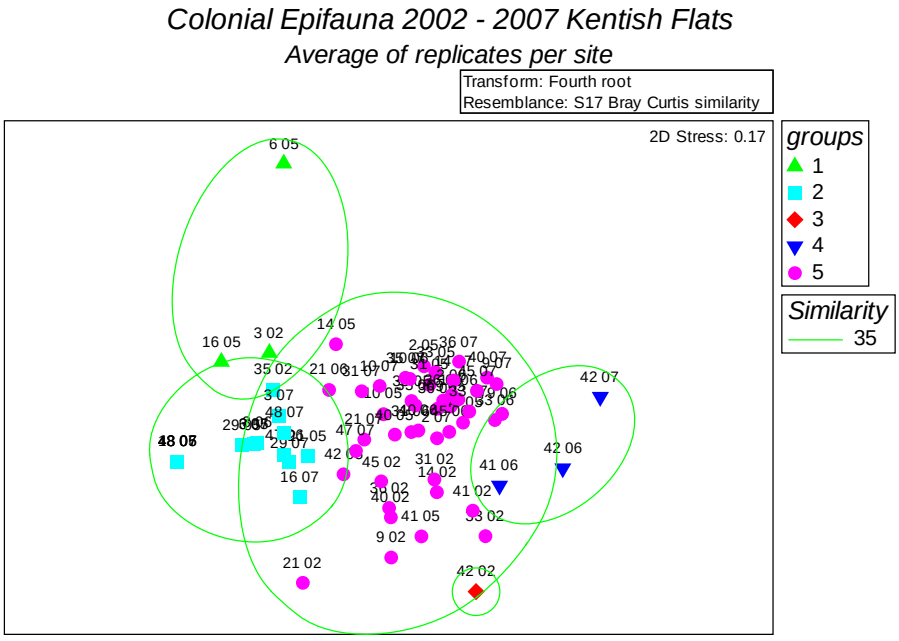
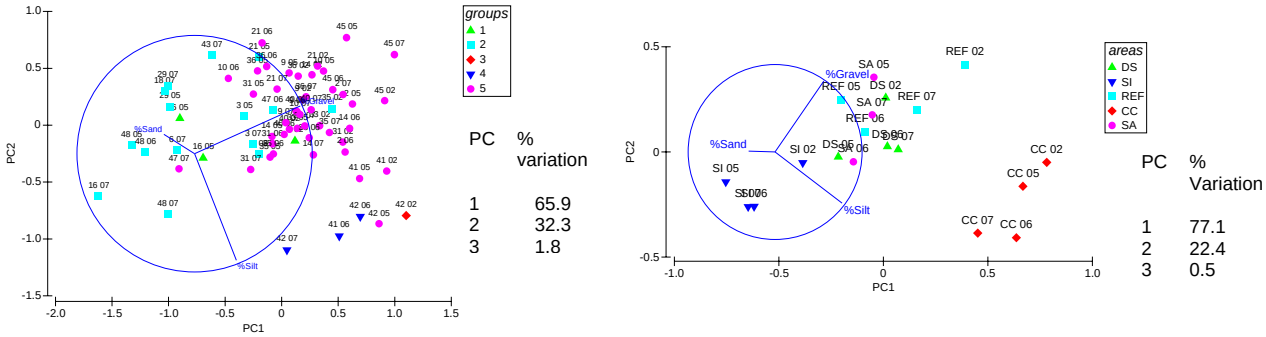


Figure 4.21 **Dendrogram and MDS plot of Bray Curtis Similarity Index of Colonial Epifauna from Grab Samples, Kentish Flats 2002 – 2007 Surveys. Values Refer to Average of Replicates per Site**

Group	Samples (years), Mean no of Species ± SD & Sediment Characteristics	Characterising Species (from SIMPER analysis 4th root transformation)
▲ 1 Average similarity 64.81%	**3**(02); **6**(05); **16**(05) Mean no of Species **1.7** ± 0.6 **Sand**, moderately well-sorted	***Vesicularia spinosa*** *Conopeum reticulum*
■ 2 Average similarity 60.24 %	**3**(06,07); **6**(07); **16**(07); **18**(07); **21**(05); **29**(05,07); **35**(02); **43**(07); **47**(06); **48**(05,06,07) Mean no of Species **2.4** ± 1.2 **Sand**, moderately-sorted	***Conopeum reticulum*** *Aspidelectra melolontha*
◆ 3 Average similarity N/A	**42**(02) Total no of Species **12** Gravelly Sandy **Silt**, very poorly-sorted	*Conopeum reticulum* ***Distomus variolosus*** ***Halichondria bowerbanki***
▼ 4 Average similarity 42.94%	**41**(06); **42**(06,07) Mean no of Species **19.3** ± 8.6 Slightly Gravelly **Sand** & **Silt** very poorly-sorted	***Alcyonidium mytili*** *Conopeum reticulum* ***Electra pilosa*** **ENTOPROCTA** *Bicellariella ciliata*
● 5 Average similarity 48.80%	**2**(05,06,07); **9**(02,05,06,07); **10**(05,06,07); **14**(02,05,06,07); **21**(02,06,07); **31**(02,05,06,07); **33**(02,05,06,07); **35**(05,06,07); **36**(02,05,06,07); **40**(02,05,06,07); **41**(02,05); **42**(05); **45**(02,05,06,07); **47**(07) Mean no of Species **11.7** ± 5.3 Gravelly **Sand**, poorly-sorted	*Conopeum reticulum* ***Electra monostachys*** ***Aspidelectra melolontha*** ***Electra pilosa*** *Vesicularia spinosa*

Table 4.7 **Summary of Within Groups Similarity following SIMPER Analysis of colonial epifauna from Grab Samples, Kentish Flats, 2007 survey. Species responsible for the separation of the groups are in bold.**

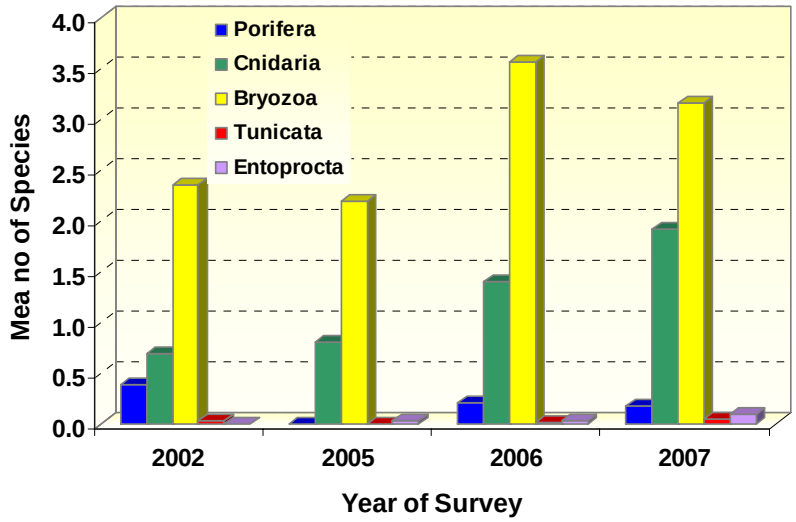


(a) Average of replicates per site

(b) Average of replicates per area

Figure 4.22 **Two Dimensional Representation of the Principal Component Analysis of Colonial Epifauna from Grab Samples, Kentish Flats 2002 – 2007 Surveys. Data with Superimposed Groups of Samples Identified by the Multivariate Analysis (a) and Areas (b)**

A summary of the temporal variations of the colonial epifauna within the Kentish Flats survey area is presented in Figure 4.23. The bryozoans accounted for the highest mean number of species during all four survey occasions followed by the cnidarians and the poriferans. Ascidians (Tunicata) and Entoprocta only accounted for a small number of species. Species composition retained a relatively high degree of similarity over time with *C. reticulum*, *E. monostachys* and *A. melolontha* being consistently amongst the most widespread species (Figure 4.23).



2002	2005	2006	2007
Conopeum reticulum	*Conopeum reticulum*	*Conopeum reticulum*	*Conopeum reticulum*
Electra monostachys	*Electra monostachys*	*Electra monostachys*	*Aspidelectra melolontha*
Aspidelectra melolontha	*Aspidelectra melolontha*	*Aspidelectra melolontha*	*Electra pilosa*
Cliona celata	*Vesicularia spinosa*	*Electra pilosa*	*Electra monostachys*
Penetrantia concharum	*Electra pilosa*	*Alcyonidium mytili*	*Conopeum reticulum*

Figure 4.23 Temporal Variations of the Mean Number of Colonial Epifaunal Species from Grab Samples and Top Five Most Widespread Species, Kentish Flats, 2002 - 2007 Surveys

Temporal variations of the colonial epifauna within each area are summarised in Figure 4.24.

Similar patterns of colonial epifaunal composition were recorded in each area, overtime, with the bryozoans being dominant in terms of species composition, followed by the cnidarians. Relatively high mean numbers of poriferans were recorded within the cable corridor. These included primarily the *Scypha ciliata* and *Cliona celata* and less frequently *Halichondria bowerbanki* and *Leucosolenia* sp.

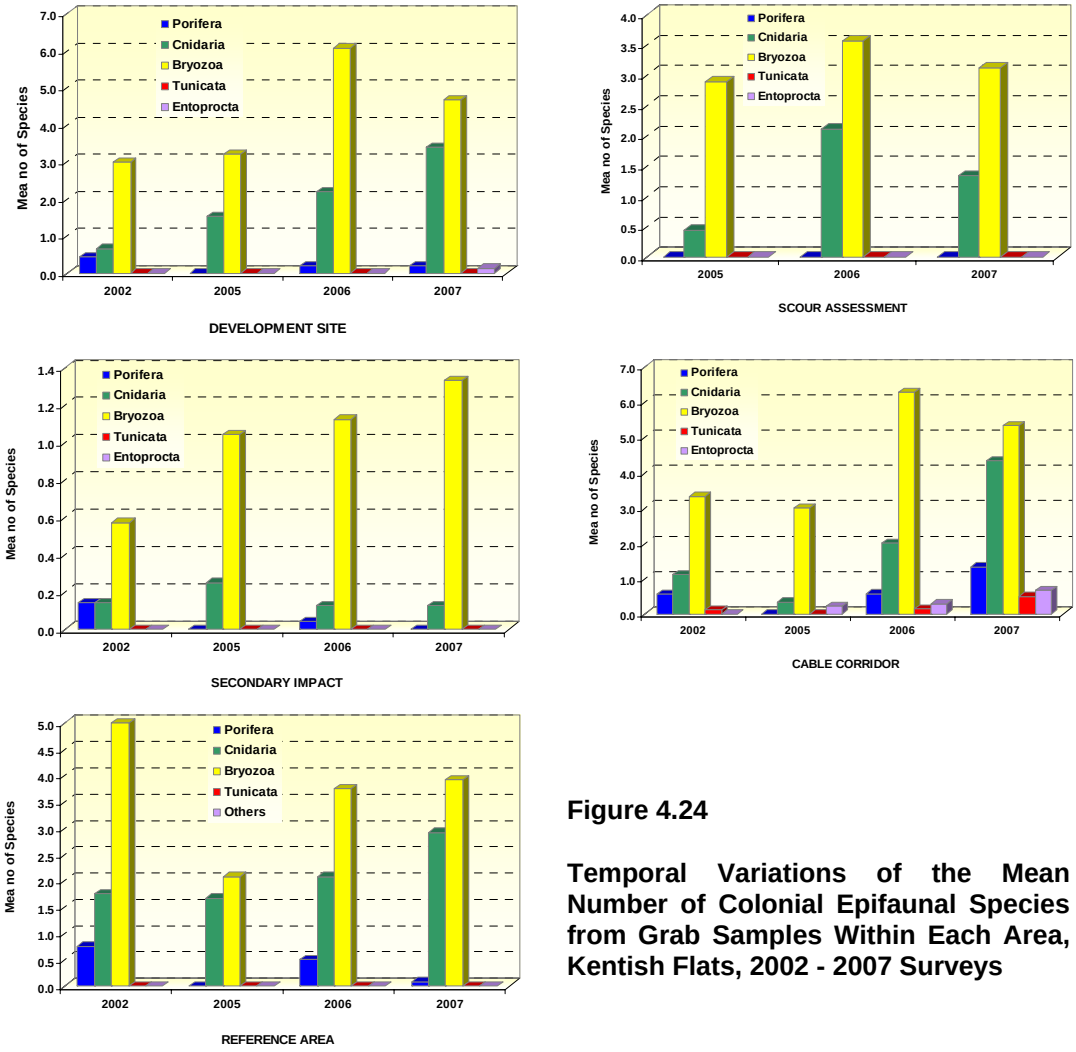


Figure 4.24

Temporal Variations of the Mean Number of Colonial Epifaunal Species from Grab Samples Within Each Area, Kentish Flats, 2002 - 2007 Surveys

4.2.4 Temporal Variations of Benthic Fauna from Beam Trawl sampling

Temporal variations of the benthic communities from the beam trawl samples were assessed with respect to the mean number of species and their frequency of occurrence within the survey area rather than the abundance, as this type of sampling provides semi-quantitative results. Prior to comparative analyses being undertaken, the combined data set (enumerated and colonial fauna) from all four beam trawl surveys was rationalised. Specifically, selected species were aggregated to the highest taxonomic level to which the identification was carried out in any one year to exclude potential differences in taxonomic discrepancy.

Temporal variations of the mean species diversity are presented in Figure 4.25. Overall, the mean number of species across the survey area showed little temporal fluctuations, the largest difference associated with the colonial epifauna which showed a peak in 2006. The most evident temporal trend, as illustrated in Figure 4.25, was associated with a gradual decline of the mean number of fish species since the study begun, and a concomitant increase in the mean number of molluscs and, to a lesser extent, echinoderms. The mean crustaceans' species diversity showed very little fluctuations over time.

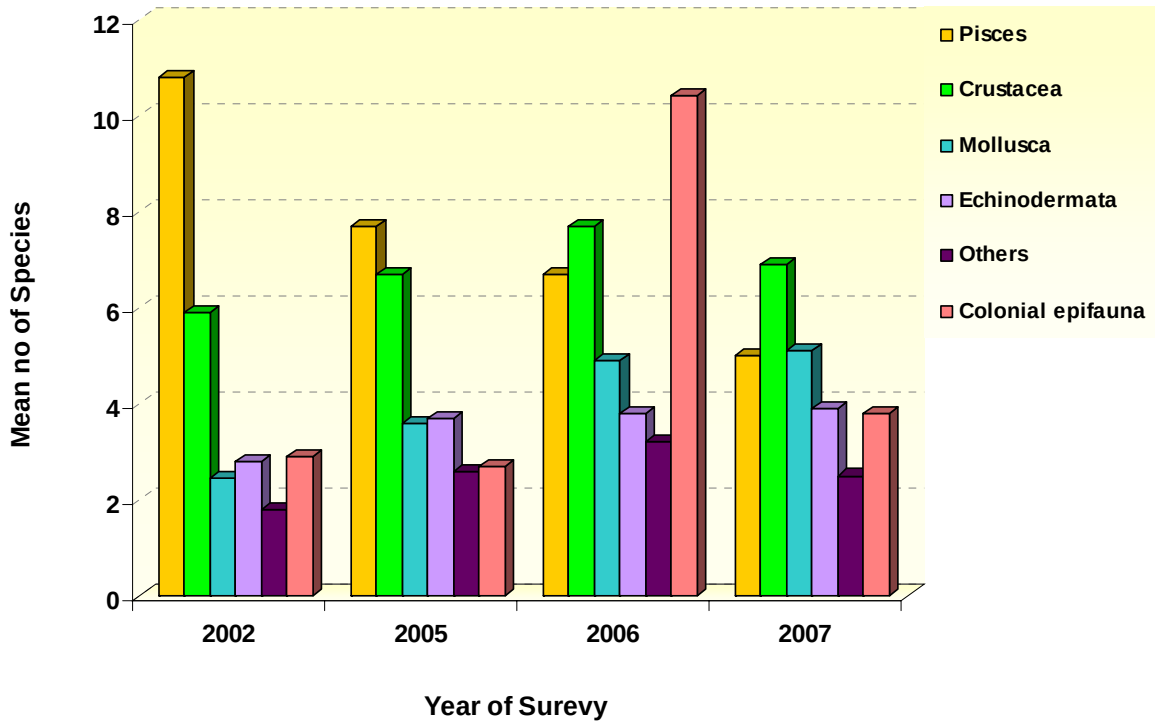


Figure 4.25 Temporal Variations of the Mean number of Species from Trawl Samples, Kentish Flats, 2002 - 2007 Surveys

The top five most widespread species in 2007 included the brown shrimp *Crangon crangon*, the crabs *Pagurus bernhardus* and *Liocarcinus* sp, the star fish *Asteria rubens* and the necklace shell *Polinices pulchellus*. With the exception of *P. pulchellus* the majority of these species were found to be fairly evenly distributed across the survey area in previous years' studies.

Temporal variations in species composition were further assessed employing the multivariate analyses on the combined fauna data set, the outputs of which are presented in Figure 4.26.
Overall, the faunal communities from the beam trawl samples from all survey occasions showed a relatively high degree of similarity (>35%), with the 2005 samples exhibiting the highest degree of

similarity and the 2002 samples the lowest. The 2007 samples showed the largest temporal dissimilarity with the 2002 baseline samples.

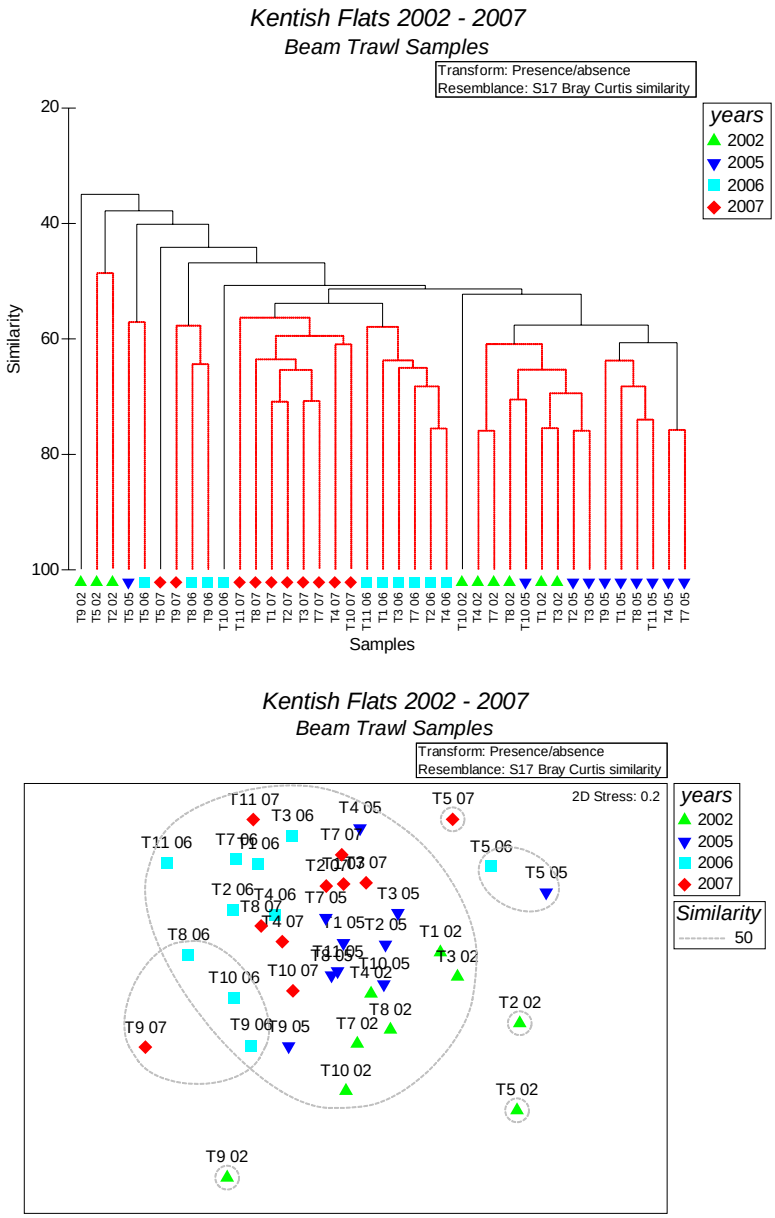


Figure 4.26 Dendrogran and Multi Dimensional Scaling plot of Bray-Curtis Similarity Index of Benthic Communities (Enumerated and Colonial Fauna) from Trawl samples, Kentish Flats, 2002 - 2007 Surveys

More detailed analyses were undertaken on the combined data set from the beam trawl samples with respect to fish and epibenthic species.

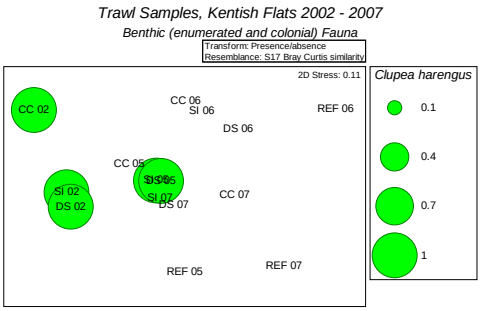
Fish species

Table 4.8 presents a summary of the fish species primarily responsible for the temporal differences, as outlined by the SIMPER analysis following transformation of data to presence/absence. The Table presents the top five species responsible for temporal variations between any two years (refer to Appendix X for full results of the analysis). The frequency of occurrence for each year is presented together with the average abundance of each species across the survey area. The latter has not been considered for the purposes of statistical analyses and is presented only for reference.

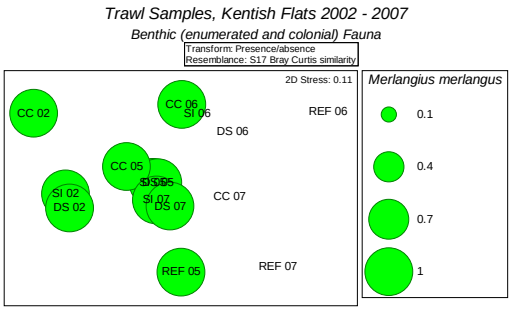
Amongst the commercially important fish, the herring (*C. harengus*) and the whiting (*M. merlangius*) showed the largest temporal variations, the former being absent in 2006 and 2007, the latter showing a considerably restricted distribution in 2007 and 2006 compared to those recorded in the previous years (Figure 4.27 (a) & (b)). Temporal variations of the dab (*L. limanda*), the plaice (*P. platessa)* and the sole (*S. solea*) were smaller in comparison and primarily associated with a more restricted distribution of this species in 2007 (Figure 4.27 (c) – (e)). The non-commercially important fish showed larger temporal variations, with the transparent goby (*A. minuta*) and the flounder (*P. flesus*) exhibiting the most conspicuous variations (Figure 4.27 (f) & (g)).

Species (common name)	**Frequency of occurrence (average abundance)** values refer to untransformed data			
	2002	**2005**	**2006**	**2007**
Aphia minuta (transparent goby)	0	0	70% (0.9)	0
Clupea harengus (herring)	**56% (0.7)**	**30% (0.6)**	**0**	**0**
Platichthys flesus (flounder)	56% (9.8)	0	10% (0.1)	0
Scyliorhinus canicula (lesser spotted dogfish)	0	60% (1.8)	20% (0.4)	30% (0.3)
Trisopterus luscus (bib/pouting)	56% (2.2)	60% (0.8)	30% (0.3)	0
Merlangius merlangus (whiting)	**100% (9.2)**	**90% (2.4)**	**10% (0.1)**	**20% (0.3)**
Limanda limanda (dab)	**100% (10.7)**	**60% (2.5)**	**60% (1)**	**40% (1.5)**
Agonus cataphractus (pogge)	78% (3.4)	70% (2.2)	40% (1.8)	10% (0.3)
Gobiidae (common goby)	78% (3.1)	80% (10.4)	100% (7.1)	20% (0.8)
Pleuronectes platessa (plaice)	**89% (5)**	**80% (1.3)**	**50% (1.2)**	**60% (1.8)**
Solea solea (Dover (common) Sole)	**78% (4.1)**	**80% (4.2)**	**70% (4.3)**	**70% (2.4)**

Table 4.8 Fish Species Responsible for Temporal Differences of the Benthic Communities from Beam Trawl Samples, Kentish Flats, 2002 - 2007 Surveys



(a)



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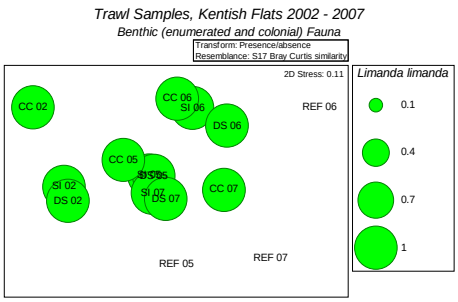
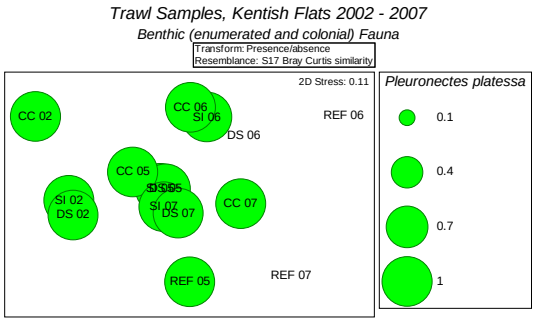
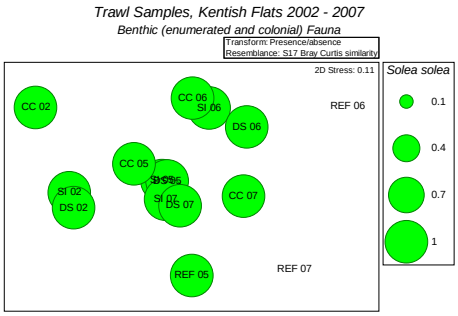


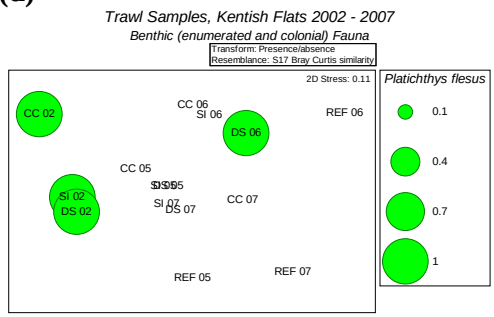
(c)



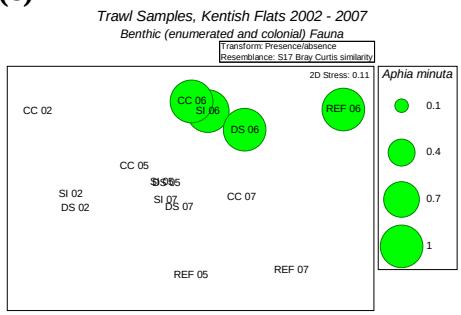
(d)



(e)



(f)



(g)

Figure 4.27

MDS Plots of Bray-Curtis Similarity Index of Faunal Composition from Trawl Samples, Kentish Flats, 2002 - 2007 Surveys. Data with Superimposed Circles Proportional in Diameter to Values of Abundance of the Commercially Important Fish Responsible for Temporal Variations (Data Refer to Average of Trawl Samples per Area per Each Year of Survey)

Epibenthic species

Temporal variations between the 2007 and the previous surveys were associated with the distribution of species such as *P. pulchellus*, *Hinia reticulata*, *Ophiura ophiura* and *Styela clava*. These species showed an increase of the frequency of occurrence within the survey area since the study begun. The colonial epifauna showed large temporal fluctuations, with species such as *Halecium* sp, *Clythia haemisphaerica* and *Electra pilosa* exhibiting the greatest oscillations between years. This can, however, be a consequence

of the sampling technique and the relatively low number of sites trawled rather than a true reflection of the species distributions across the survey area.

Table 4.9 presents a summary of the epibenthic species primarily responsible for the temporal differences, as outlined by the SIMPER analysis following transformation of data to presence absence. The Table presents the top five species responsible for temporal variations between any two years (refer to Appendix X for full results of the analysis). The frequency of occurrence for each year is presented together with the average abundance (where applicable) of each species across the survey area. The latter has not been considered for the purposes of statistical analyses and is presented only for reference.

Species	***MCS code***	**Frequency of occurrence** (average abundance)			
		2002	**2005**	**2006**	**2007**
Polinices pulchellus	W0491	0	30% (10.1)	30% (1.2)	90% (3.8)
Hinia reticulata	W0745	0	20% (0.9)	60% (2.8)	70% (1.8)
Ophiura ophiura	ZB0168	41% (0.6)	70% (111.9)	60% (102.3)	90% (306.9)
Styela clava	ZD0104	30%	50%	40%	70%
*Halecium*** sp†	D0390	11%	0	60%	0
Clythia haemisphaerica†	D0503	0	0	70%	0
Electra pilosa †	Y0178	11%	0	80%	10%
Hydrallmania falcata†	D0424	11%	90%	90%	80%
Sertularia argentea†	D0434	0	0	70%	40%
Alcyonidium diaphanum†	Y0076	0%	60%	50%	40%
Actiniaria	D0662	11% (0.2)	60% (4.4)	30% (0.5)	10% (0.1)
Pandalus montagui	S1377	56% (2.2)	40% (3.9)	90% (3.5)	50% (2.1)
Hyas coarctatus	S1519	33% (0.6)	70% (1.4)	70% (1.7)	50% (0.6)
*Macropodia** sp	S1529	4% (0.7)	90% (7.7)	90% (8.1)	80% (14)
Corystes cassivelanus	S1552	22% (0.8)	60% (3.1)	60% (2.5)	30% (4.2)

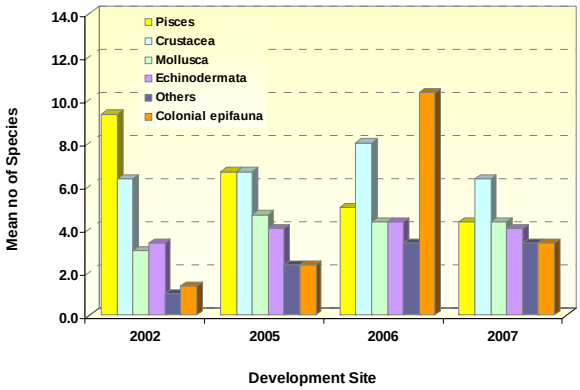
*Includes *Macropodia* sp, *M .rostrata* and *M. linaresi* aggregate to genus level
**Includes *Halcium* sp and *H. halecium* aggregate to genus level
†Species recorded as Present

Table 4.9 Epibenthic species responsible for temporal differences of benthic communities from trawl samples, Kentish Flats, 2002 - 2007 Surveys

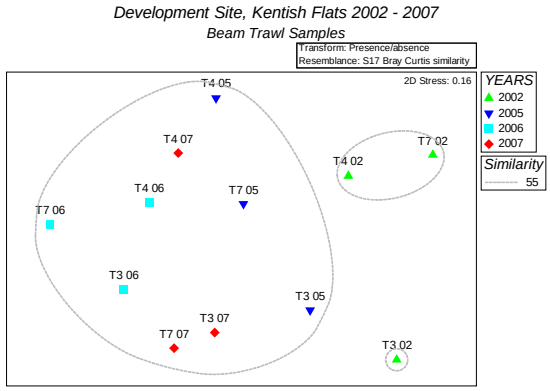
Temporal variations of the benthic communities from the trawl samples were investigated within each area and the results are presented in Figure 4.28

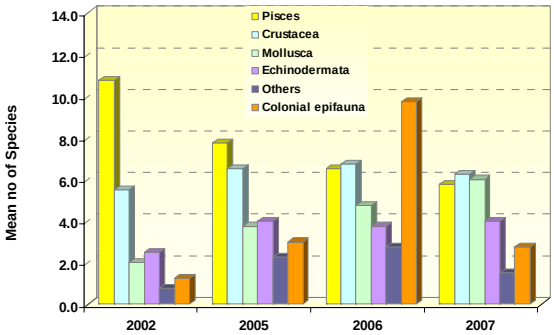
All areas showed a decline of the mean number of fish species since the study begun, the values in 2007 being nearly as half as those in 2002. The crustaceans and the molluscs showed small temporal variability with an overall increase of both taxa's species diversity in all areas since the study begun. Figure 4.28 also shows that the average similarity of beam trawl samples taken in 2007 was higher that that of the 2002 samples and this was a common feature to all areas.

With regard to the reference area, samples were obtained from a single sampling station, T11. In addition, and no samples were obtained in 2002, therefore temporal comparison within this area are limited and an overall pattern of temporal variability, as expressed by the MDS, could not be extrapolated.

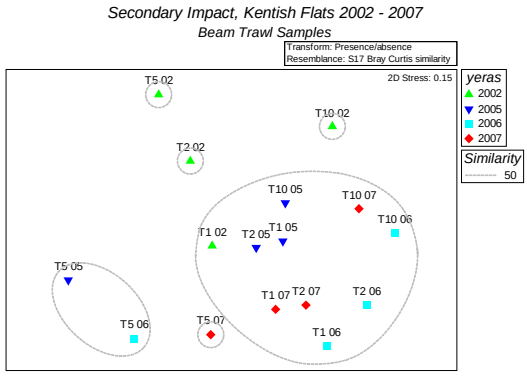


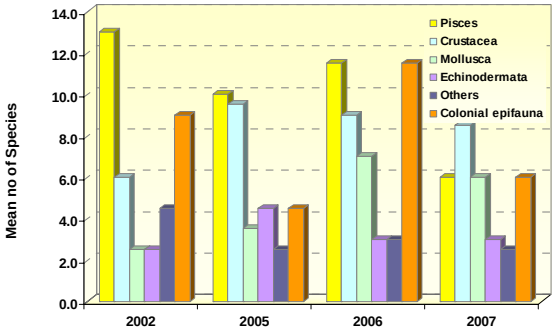
Development Site



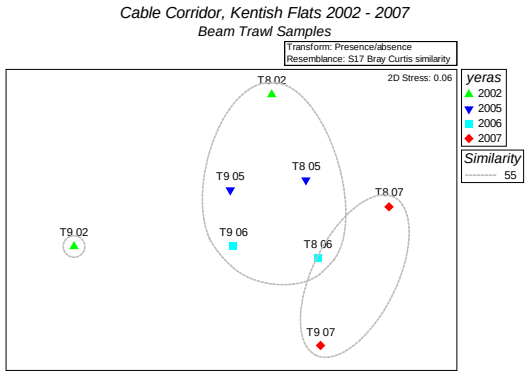


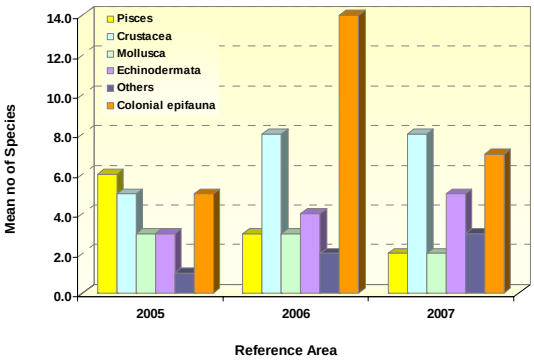
Secondary Impact





Cable Corridor





Reference Area

Phylum	Reference Area		
	2005	2006	2007
Pisces	6.0	3.0	2.0
Crustacea	5.0	8.0	8.0
Mollusca	3.0	3.0	2.0
Echinodermata	3.0	4.0	5.0
Others	1.0	2.0	3.0
Colonial epifauna	5.0	14.0	7.0

Figure 4.28 Temporal Variations of the Mean Number of Species of Major Benthic Community Phyla from Trawl Samples, 2002 - 2007 Surveys

5.0 Conclusions

The 2007 macrobenthic ecology survey was the third in a series of monitoring studies following the development of the Kentish Flats Offshore Wind Farm. The data generated from the survey were analysed and compared with those obtained from previous surveys, including the 2002 baseline study and the 2005 and 2006 post construction studies. The aim was to investigate if any significant changes have occurred with respect to the physical characteristics and associated biological communities of the benthic environment that might be attributable to the construction or operation of the Kentish Flats Offshore Wind Farm.

Results from the 2007 survey showed that the main sediment fraction across the survey area was sand, with sorting coefficients ranging from very well-sorted to very poorly-sorted. Overall, a spatial pattern of sediment distribution was identified within the survey area. Specifically, the most offshore sites were comprised of homogeneous sediments, characterised by relatively well-sorted sands. These stations included the majority of sites within the secondary impact and the northern reference areas. These sites are the most exposed within the survey area and as such subjected to high variable hydrodynamic regimes. As a result, the habitats are more dynamic with greater sediment transport.

The more central stations within the survey area comprised more heterogeneous sediments, with higher percentages of gravel and mud. These sites comprised the majority of the stations within the development site, the southern reference area and selected sites within the scour assessment area. Samples from these stations showed higher levels of intra-samples variability, indicating heterogeneity of the sediment also on a small scale. Finally, the most inshore sites comprised mixed sediment with the highest percentage of mud. These sites comprised the majority of stations within the cable corridor. These sites are the most sheltered within the survey area with little influence from tidal action. Consequently, relatively little sediment transport can take place and levels of mud accumulate increasing the sediment compactness.

Comparisons with previous years' surveys showed that this pattern of sediment distribution across the survey area has been maintained over time. Temporal variations of the sediment composition within the different areas were not considered to be significant, each area retaining a high degree of similarity of the sediment composition over time. Spatial variations between the different areas were significant and consistent over time. In conclusion, no changes to the physical nature of the seabed were evident from the benthic sampling programme that could be attributable to the construction or operation of the Kentish Flats Offshore Wind Farm.

Results of the macrobenthic faunal analyses revealed a macrofauna broadly associated with the substrate type. As such the macrofaunal distribution across the survey area also showed a pattern. Specifically, mobile sands, typical of the offshore sites (i.e. the majority of sites within the secondary impact and the northern reference areas) supported an impoverished macrofaunal community, characterised by more actively swimming crustacean amphipods (e.g. *Bathyporeia elegans*) and robust polychaetes worms (e.g. *Nephtys cirrosa*). These species are characterised by flexible body structures and are capable of rapid burrowing if exposed to physical perturbation. These stations supported little epifauna represented only by selected species of bryozoans.

The more central stations within the survey area comprised more diverse benthic communities, with large transitional areas associated with the sediment type and the degree of exposure. The transitional areas were generally characterised by less exposed and more stable sands, hosting a faunal community characterised by species such as *Fabulina fabula* and *Nephtys hombergii*. These species are typical of more compacted sands and extend over large transitional areas between the more offshore sandy sediment and the inshore muddy habitats and hence contained elements of both communities. These sites comprised the more inshore stations within the secondary impact area and selected sites from the development site and the scour assessment area.

The central part of the survey area hosted more stable communities characterised by species such as *Lanice conchilega* and *Spiophanes bombyx*. This part of the survey area comprised the majority of sites within the development site, the southern reference area and selected samples from the scour assessment area and the cable corridor. These stations were characterised by heterogeneous sediments and hosted higher species diversity and abundances including a high diversity of epifaunal species. This area extended inshore, gradually giving way to a community characterised by species such as *Abra alba* and *Euclymene oerstedii*. This last community was recorded at the most inshore part of the survey area which comprised sites within the cable corridor.

Comparisons with previous years' survey showed that this pattern of macrofaunal distribution has been maintained overtime, although some temporal variations of the benthic communities were considered significant. However, these temporal variations were not considered to be attributable to the construction or operation of the Kentish Flats Offshore Wind Farm, but rather with natural variability. For example, the abundance of species such as *L. conchilega* and *A. alba*, can fluctuate between years owing to variations in recruitment success. In addition, random recruitment events of species such as *N. cirrosa* may be very important to the population size of other polychaetes present and may therefore create a degree of variation in community composition. Finally, temporal variations in species richness and abundance in general, may occur due to seasonal pattern of disturbance such as storms, harsh winters and oxygen deficiencies. Storms in particular can cause severe substratum disturbance which can turn over the sediment and completely disrupt the community.

The occurrence of the colonial epifauna within the survey area was associated with the sediment characteristics and showed a spatial pattern of distribution within the survey area with the highest number of species recorded within the central and more inshore sites. Similar patterns of epifaunal occurrence and distribution were recorded over time across the whole survey area as well as within each individual area.

Faunal assemblages from the trawl samples comprised a relatively wide array of species and higher taxa including fish, crustaceans, molluscs and echinoderms. Sessile epifauna included species of cnidarians, poriferans, bryozoans and ascidians. Nineteen species of fish were recorded across the survey area in 2007, of which six were commercially important species. A similar trend of fauna distribution was recorded from the trawl samples in the different areas, with the crustaceans and the fish dominating the species diversity. With the exception of the reference area, the echinoderms dominated the abundance, whereas the crustaceans dominated both species diversity and abundance within the reference area.

The species composition of samples from the trawls showed little temporal fluctuations across the survey area showed. The most evident temporal trend was associated with a gradual decline of the mean number of fish species since the study begun, and a concomitant increase in the mean number of molluscs and, to a lesser extent, echinoderms. The mean crustaceans' species diversity showed very little fluctuations over time.

In conclusion, the benthic survey programme and associated data analysis has demonstrated patterns in the physical and biological environments of the seabed in and around the Kentish Flats Wind Farm site which have been compared to suitable reference sites. The study has recorded some natural variability in the biological communities within the survey area over the study period. However, no changes that might be attributable to the construction or operation of the Kentish Flats project are evident following the comparison and analyses of the benthic data collected over the period 2002 to 2007.

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7.0 AUDIT TRAIL

Title :. Kentish Flats Wind Farm Development Macrobenthic Ecology Study 2007			
Report No:	Report number 06/J/1/03/1033/0712 - Final		
Job No:	J/1/03/1033		
Client Name:	Kentish Flats Ltd c/o 54 Liss Road, Southsea, Hampshire, PO4 8AS		
Client Contact:	Mr Steve Bellew		
		Initials	**Date**
Project Manager:	Dr Nigel Thomas		
Data Analysis undertaken by:	Dr Stefania De Gregorio Mr Richard Marlow (GIS)		
Field work undertaken by:	Miss Jo Weir Miss Leigh Marsh Mr Jeremy Shottin		
Report written by:	Dr Stefania De Gregorio		
Report updated by:	Dr Stefania De Gregorio		
Report checked by:	Mr Paul English		
Report Authorised by:	Dr Nigel Thomas		

APPENDICES

(J/1/03/1033)

Appendix I

Grab Sampling Log

(J/1/03/1033)

APPENDIX I
GRAB SAMPLING LOG
KENTISH FLATS 2007
J/1/03/1033

Site No.	Replicate	Date	Wetlab Number	Time (BST)	Depth (BSL)	UTM WGS84 Z31N		Fauna (volume L)	PSA	*In-situ* sediment description	Sediment features (burrows, tubes, casts, smell)	Sediment anoxia (none, streaks, patches, layers, depth of layer)
						Eastings	Northings					
3	a	22/05/2007	WL019371	11:11	5.7	366033.80	5703337.33	6	Yes	Silty slightly shelly sand with some clay	None	Patches
	b		WL019372	11:13	5.7	366028.63	5703327.42	6	Yes	Silty slightly shelly sand with some clay	None	Patches
	c		WL019373	11:15	5.7	366023.16	5703339.91	5	Yes	Silty slightly shelly sand with some clay	None	Patches
9	a	22/05/2007	WL019374	08:13	7.3	368203.44	5701676.89	3	Yes	Silty shelly sand	None	None
	b		WL019375	08:15	7.3	368209.85	5701671.16	4	Yes	Silty shelly sand	None	None
	c		WL019376	08:18	7.3	368202.29	5701670.42	5	Yes	Silty shelly sand	None	None
14	a	22/05/2007	WL019377	12:27	5.6	369264.41	5703003.34	9	Yes	Silty sand	None	None
	b		WL019378	12:32	5.6	369276.44	5702999.88	5	Yes	Slighty shelly sand	None	None
	c		WL019379	12:42	5.6	369276.30	5702994.35	5	Yes	Shelly sand	None	None
16	a	22/05/2007	WL019380	14:29	15.2	374063.20	5704545.73	8	Yes	Fine sand	None	None
	b		WL019381	14:32	15.2	374070.14	5704538.14	8	Yes	Fine sand	None	None
	c		WL019382	14:36	15.2	374071.54	5704541.81	10	Yes	Fine sand	None	None
18	a	22/05/2007	WL019383	15:00	4.7	374430.61	5703134.66	8	Yes	Slightly shelly fine sand	None	None
	b		WL019384	15:02	4.7	374419.46	5703129.37	6	Yes	Slightly shelly fine sand	None	None
	c		WL019385	15:08	4.7	374425.59	5703131.08	5	Yes	Slightly shelly fine sand	None	None
21	a	22/05/2007	WL019386	12:53	6.0	370712.39	5703051.64	13	Yes	Shelly sand	None	None
	b		WL019387	12:55	6.0	370715.41	5703036.02	12	Yes	Shelly sand	None	None
	c		WL019388	12:57	6.0	370721.34	5703041.67	14	Yes	Shelly sand	None	None
29	a	22/05/2007	WL019389	10:27	4.8	363957.88	5702753.03	6	Yes	Slightly shelly sand	None	None
	b		WL019390	10:32	4.8	363959.09	5702760.06	8	Yes	Slightly shelly sand	None	None
	c		WL019391	10:37	4.8	363958.63	5702757.22	7	Yes	Slightly shelly sand	None	None
31	a	22/05/2007	WL019392	09:12	6.4	365623.96	5701898.29	4	Yes	Silty sand with *Ensis* shell	None	None
	b		WL019393	09:14	6.4	365622.55	5701900.18	4	Yes	Silty sand	None	None
	c		WL019394	09:16	6.4	365623.14	5701896.45	4	Yes	Silty sand	None	None
33	a	22/05/2007	WL019395	16:16	10.8	375582.16	5699497.61	10	Yes	Silty shelly sand overlying solid clay	None	None
	b		WL019396	16:19	10.8	375588.83	5699504.86	7	Yes	Silty shelly sand	None	None
	c		WL019397	16:24	10.8	375586.38	5699499.36	7	Yes	Silty shelly sand	None	Layer
35	a	22/05/2007	WL019398	10:04	6.0	365835.23	5702522.57	3	Yes	Silty shelly sand with some soft clay	None	None
	b		WL019399	10:09	6.0	365843.62	5702528.62	4	Yes	Silty shelly sand with some soft clay	None	None
	c		WL019400	09:53	6.0	365838.90	5702525.03	3	Yes	Silty shelly sand with some soft clay	None	Patches with clay
36	a	22/05/2007	WL019401	12:06	5.6	368486.20	5703101.29	8	Yes	Shelly sand	None	None
	b		WL019402	12:14	5.6	368476.73	5703097.83	7	Yes	Shelly silty sand	None	None
	c		WL019403	12:20	5.6	368485.96	5703093.88	7	Yes	Slightly silty shelly sand	None	None
38	a	22/05/2007	WL019404	15:25	2.8	376368.06	5703582.33	6	Yes	Clean fine sand	None	None
	b		WL019405	15:32	2.8	376368.42	5703577.53	3	Yes	Clean fine sand	None	None

APPENDIX I
GRAB SAMPLING LOG
KENTISH FLATS 2007
J/1/03/1033

Site No.	Replicate	Date	Wetlab Number	Time (BST)	Depth (BSL)	UTM WGS84 Z31N		Fauna (volume L)	PSA	*In-situ* sediment description	Sediment features (burrows, tubes, casts, smell)	Sediment anoxia (none, streaks, patches, layers, depth of layer)
						Eastings	Northings					
38	c	22/05/2007	WL019406	15:30	2.8	376356.51	5703571.96	4	Yes	Clean fine sand	None	None
40	a	22/05/2007	WL019407	07:45	7.6	368412.65	5701089.15	5	Yes	Silty shelly sand	None	None
	b		WL019408	07:48	7.6	368412.75	5701092.85	5	Yes	Silty shelly sand	None	None
	c		WL019409	07:57	7.6	368418.86	5701092.70	4	Yes	Silty shelly sand	None	None
41	a	22/05/2007	WL019410	16:58	7.7	368095.29	5696976.59	None	None	None	None	None
	b		WL019411	17:03	7.7	368095.65	5696991.38	None	None	None	None	None
	c		WL019412	17:07	7.7	368092.36	5696987.08	None	None	None	None	None
42	a	22/05/2007	WL019413	17:24	7.2	367997.63	5694160.18	4	Yes	Slightly gravelly shelly clay	None	None
	b		WL019414	17:27	7.2	367982.41	5694159.52	5	Yes	Gravelly clay	None	None
	c		WL019415	17:32	7.2	367995.08	5694145.41	6	Yes	Slightly gravelly sandy clay	None	None
43	a	22/05/2007	WL019416	08:06	4.1	358155.93	5701080.90	4	Yes	Shelly fine sand	None	None
	b		WL019417	08:10	4.1	358166.34	5701084.80	4	Yes	Shelly fine sand	None	None
	c		WL019418	08:15	4.1	358159.76	5701084.50	6	Yes	Shelly fine sand	None	None
44	a	22/05/2007	WL019419	07:33	5.6	362797.04	5701557.54	6	Yes	Fine sand	None	streaks
	b		WL019420	07:35	5.6	362802.45	5701554.43	6	Yes	Fine sand	None	streaks
	c		WL019421	07:37	5.6	362794.69	5701548.62	8	Yes	Fine sand	None	None
45	a	22/05/2007	WL019422	15:53	8.3	374987.40	5699811.92	2	Yes	Slightly silty shelly gravelly sand	None	None
	b		WL019423	16:04	8.3	374989.04	5699814.41	4	Yes	Slightly silty shelly gravelly sand	None	None
	c		WL019424	16:07	8.3	374996.01	5699814.96	2	Yes	Slightly silty shelly gravelly sand	None	None
47	a	22/05/2007	WL019425	13:33	8.8	372394.37	5708310.05	5	Yes	Anoxic sand	None	Whole sample
	b		WL019426	13:35	8.8	372393.65	5708321.44	7	Yes	Slightly shelly sand with small patch of sandy clay	None	Whole sample
	c		WL019427	13:37	8.8	372405.31	5708302.52	8	Yes	Sand	None	Whole sample
48	a	22/05/2007	WL019428	13:46	8.8	373121.50	5708686.85	14	Yes	Sand	None	None
	b		WL019429	13:50	8.8	373119.89	5708677.99	15	Yes	Sand	None	None
	c		WL019430	13:56	8.8	373123.64	5708682.37	14	Yes	Sand	None	None
2	a	22/05/2007	WL019431	11:43	5.6	367470.66	5703384.39	8	Yes	Silty sandy shell (Ostrea shells mainly)	None	None
	b		WL019432	11:49	5.6	367482.48	5703374.00	4	Yes	Silty shelly sand	None	None
	c		WL019433	11:51	5.6	367484.36	5703375.81	3	Yes	Silty shelly sand	None	None
6	a	22/05/2007	WL019434	10:56	5.9	364958.02	5703663.97	8	Yes	Slightly shelly sand	None	None
	b		WL019435	10:59	5.9	364960.87	5703661.03	8	Yes	Slightly shelly silty sand	None	None
	c		WL019436	10:50	5.9	364964.63	5703655.37	5	Yes	Slightly shelly sand	None	None
10	a	22/05/2007	WL019437	08:28	6.5	367602.18	5702130.68	4	Yes	Silty shelly sand	None	None
	b		WL019438	08:48	6.5	367591.10	5702117.48	4	Yes	Silty shelly sand	None	None
	c		WL019439	08:51	6.5	367605.40	5702132.67	4	Yes	Silty shelly sand	None	None

APPENDIX I
GRAB SAMPLING LOG
KENTISH FLATS 2007
J/1/03/1033

Site No.	Replicate	Anthropogenic features (includes: sewage derived material, other)	Conspicuous Fauna
3	a	None	None
	b	None	None
	c	None	None
9	a	None	None
	b	None	*Ophiura albida, Pisidia longicornis*
	c	None	None
14	a	None	None
	b	None	None
	c	None	None
16	a	None	None
	b	None	None
	c	None	None
18	a	None	*Echinocardium cordatum, Tapes* sp.
	b	None	None
	c	None	None
21	a	None	None
	b	None	None
	c	None	None
29	a	None	None
	b	None	None
	c	None	None
31	a	None	None
	b	None	None
	c	None	*Ensis* sp. Siphon only
33	a	None	None
	b	None	*Hydrallmania falcata*
	c	None	*Hyrallmania falcata, Sabellaria spinulosa* - moribund
35	a	None	None
	b	None	None
	c	None	*Hydrallmania falcata,* Sertularidae indet.
36	a	None	None
	b	None	None
	c	None	None
38	a	None	None
	b	None	None

APPENDIX I
GRAB SAMPLING LOG
KENTISH FLATS 2007
J/1/03/1033

Site No.	Replicate	Anthropogenic features (includes: sewage derived material, other)	Conspicuous Fauna
38	c	None	None
40	a	None	None
	b	None	None
	c	None	None
41	a	None	None
	b	None	None
	c	None	None
42	a	None	None
	b	None	None
	c	None	*Hydrallmania falcata*
43	a	None	None
	b	None	None
	c	None	*Echinocardium cordatum*
44	a	None	None
	b	None	None
	c	None	*Echinocardium cordatum*
45	a	None	Hydroids, *Urticina felina* , barnacles
	b	None	None
	c	None	None
47	a	None	None
	b	None	None
	c	None	None
48	a	None	None
	b	None	None
	c	None	None
2	a	None	*Asterias rubens*
	b	None	None
	c	None	None
6	a	None	None
	b	None	None
	c	None	*Echinocardium cordatum*
10	a	None	None
	b	None	None
	c	None	None

Appendix II

Beam Trawl Sampling Log

(J/1/03/1033)

APPENDIX II

Trawls positions Kentish Flats 2007 survey J/1/03/1033

Direction of Travel:
IC = Into Current WC = With Current AC = Across Current SW = Slack Water
Type of Gear = 2m Beam trawl with chains (green)

Date		Trawl						
Start Position (WGS84)		**End Position (WGS84)**		**Start/End Time (BST)**	**Start/End Depth (m)**	**Wire Out (m)**	**Direction & Speed (knots)**	**Sample**
Date 23/05/07 360561.80	5701513.08	**Trawl T1** 360104.18	5701281.07	08:51 - 08:59	6.2 - 5.0	20	IC - 1.8	T1
Date 23/05/07 363301.8	5702213.13	**Trawl T2** 362800.88	5702370.52	09:24 - 09:32	6.6 - 6.9	20	IC - 2.0	T2
Date 23/05/07 366234.65	5703506.18	**Trawl T3** 366576.28	5703052.78	11:41 - 11:48	5.8 - 5.7	20	slack water - 2.7	T3
Date 23/05/07 367779.9	5703302.19	**Trawl T4** 368179.46	5703004.94	12:53 - 13:00	6.0 - 5.7	20	IC - 2.3	T4
Date 23/05/07 371508.02	5703174.27	**Trawl T5** 372004.45	5703083.87	13:26 - 13:35	6.6 - 7.3	20	IC - 2.2	T5
Date 23/05/07 367650.61	5701725.5	**Trawl T 7** 367199.61	5701966.89	12:07 - 12:13	6.1 - 5.4	20	WC - 3	T7
Date 23/05/07 367836.48	5699007.25	**Trawl T8** 368351.40	5699053.31	14:57 - 15:05	7.1 - 7.6	25	IC - 2	T8
Date 23/05/07 367872.64	5697663.45	**Trawl T9** 368345.46	5697808.34	15:18 - 15:26	7.9 - 6.1	25	IC - 2	T9
Date 23/05/07 364972.47	5699514.35	**Trawl T10** 364462.92	5699420.98	10:02 - 10:10	7.1 - 6.7	20	IC - 2	T10
Date 23/05/07 374703.29	5699496.91	**Trawl T11** 375203.57	5699434.03	14:07 - 14:16	7.5 - 8.3	25	IC - 1.8	T11

Appendix III

Grab Samples Photo Log

(J/1/03/1033)

APPENDIX III
GRAB SAMPLES PHOTOS

Grab sample 40a

Grab sample 40b

Grab sample 40c

Grab sample 9a

Grab sample 9b

Grab sample 9c

APPENDIX III cont

Grab sample 10a

Grab sample 10b

Grab sample 10c

Grab sample 31a

Grab sample 31b

Grab sample 31c

APPENDIX III cont

Grab sample 35a

Grab sample 35b

Grab sample 35c

Grab sample 29a

Grab sample 29b

Grab sample 29c

APPENDIX III cont

Grab sample 6a

Grab sample 6b

Grab sample 6c

Grab sample 3a

Grab sample 3b

Grab sample 3c

APPENDIX III cont.

Grab sample 2a

Grab sample 2b

Grab sample 2c

Grab sample 36a

Grab sample 36b

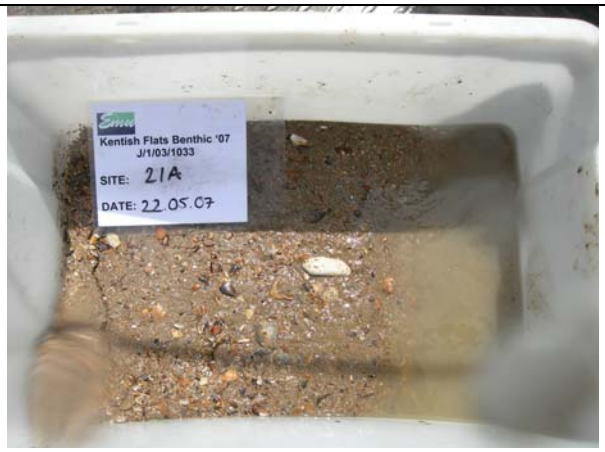
Grab sample 36c

APPENDIX III cont

Grab sample 14a

Grab sample 14b

Grab sample 14c

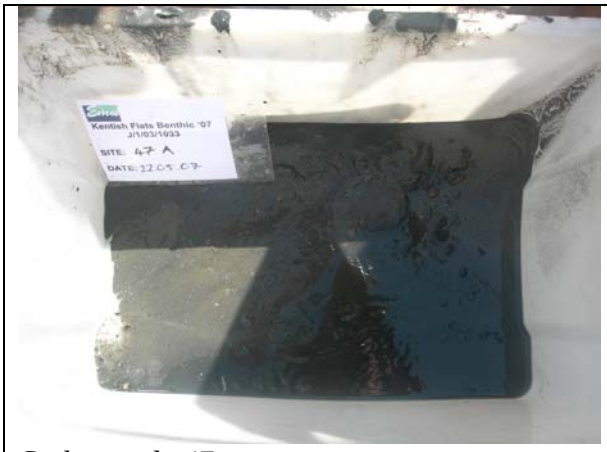


Grab sample 21a

Grab sample 21b

Grab sample 21c

APPENDIX III cont



Grab sample 47a

Grab sample 47b

Grab sample 47c

Grab sample 48a

Grab sample 48b

Grab sample 48c

APPENDIX III cont

Grab sample 16a

Grab sample 16b

Grab sample 16c

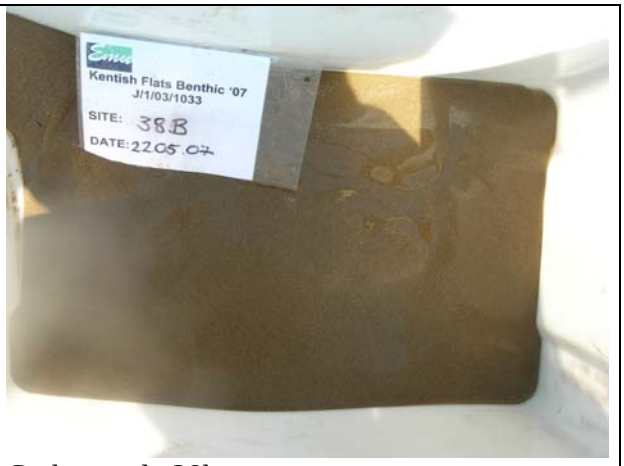
Grab sample 18a

Grab sample 18b

Grab sample 18c

APPENDIX III cont

Grab sample 38a



Grab sample 38b

Grab sample 38c

Grab sample 45a

Grab sample 45b

Grab sample 45c

APPENDIX III cont

Grab sample 33a

Grab sample 33b

Grab sample 33c

Grab sample 42 a

Grab sample 42b

Grab sample 42c

APPENDIX III cont

Grab sample 44a

Grab sample 44b

Grab sample 44c

Grab sample 43a

Grab sample 43b

Grab sample 43c

Appendix IV

Trawl Samples Photo Log

(J/1/03/1033)

APPENDIX IV

BEAM TRAWL SAMPLES PHOTO LOG

Trawl sample T1

Trawl sample T2

Trawl sample T3

Trawl sample T4

Trawl sample T5

Trawl sample T7

APPENDIX IV cont

BEAM TRAWL SAMPLES PHOTO LOG

Trawl sample T8	Photo not available Trawl sample T9
Trawl sample T10	Trawl sample T11

Appendix V

PSA Data

(J/1/03/1033)

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 2aSA (WL019431)

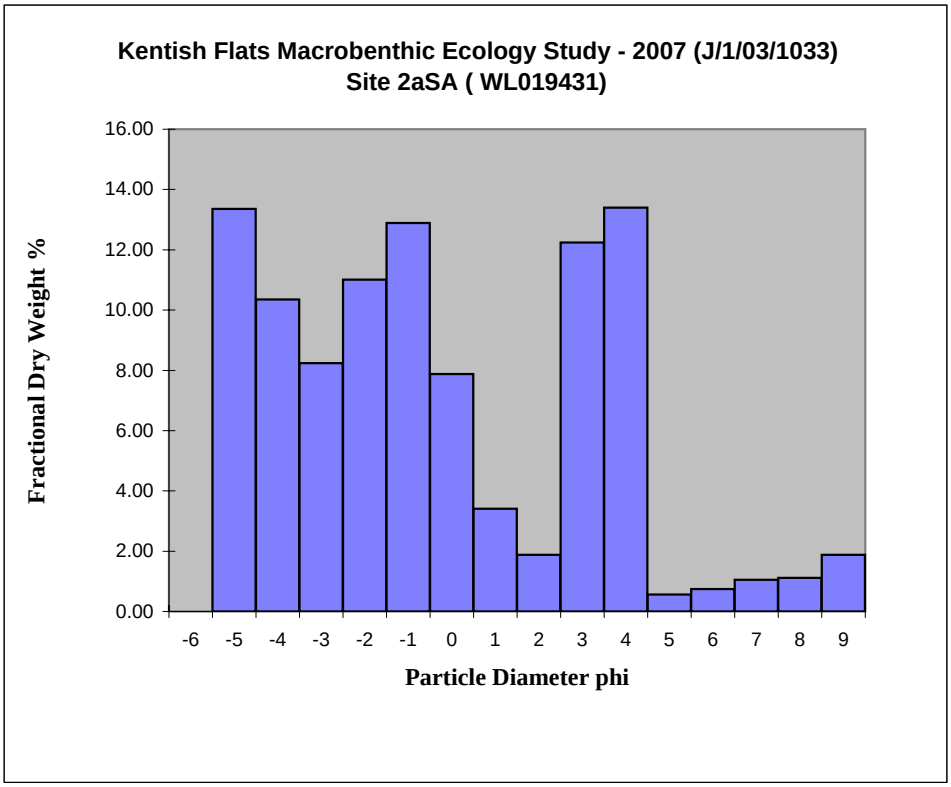
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	71.060	13.35	13.35
	16	-4.0	55.106	10.36	23.71
Gravel	8	-3.0	43.849	8.24	31.95
	4	-2.0	58.581	11.01	42.96
Coarse Sand	2	-1.0	68.576	12.89	55.84
	1	0.0	41.901	7.87	63.72
Medium Sand	0.5	1.0	18.142	3.41	67.13
	0.25	2.0	10.003	1.88	69.01
Fine Sand	0.125	3.0	65.128	12.24	81.25
	0.063	4.0	71.320	13.40	94.65
Silt	0.032	5.0	3.013	0.57	95.22
	0.0156	6.0	3.963	0.74	95.96
	0.0078	7.0	5.580	1.05	97.01
	0.0039	8.0	5.916	1.11	98.12
Clay	<0.0039	9.0	10.000	1.88	100.00
		Total Weight	532	100	

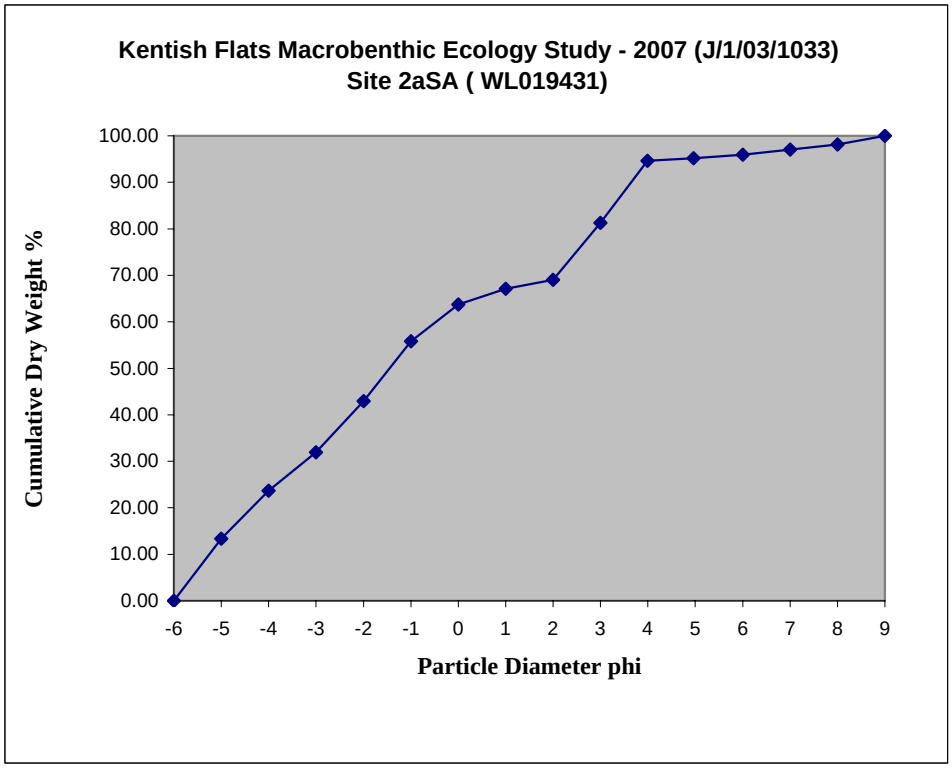
Mean mm	2.00
Md mm	2.74
Mean phi	-1.00
Md phi	-1.45
Sorting	3.72
Skq	0.11
Kurtosis	0.74

%Gravel	42.96
% Sand	51.69
% Fines	5.35

Gravelly Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 2aSA (WL019431)
Fractional Dry Weight %
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 2aSA (WL019431)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 2b SA (WL019432)

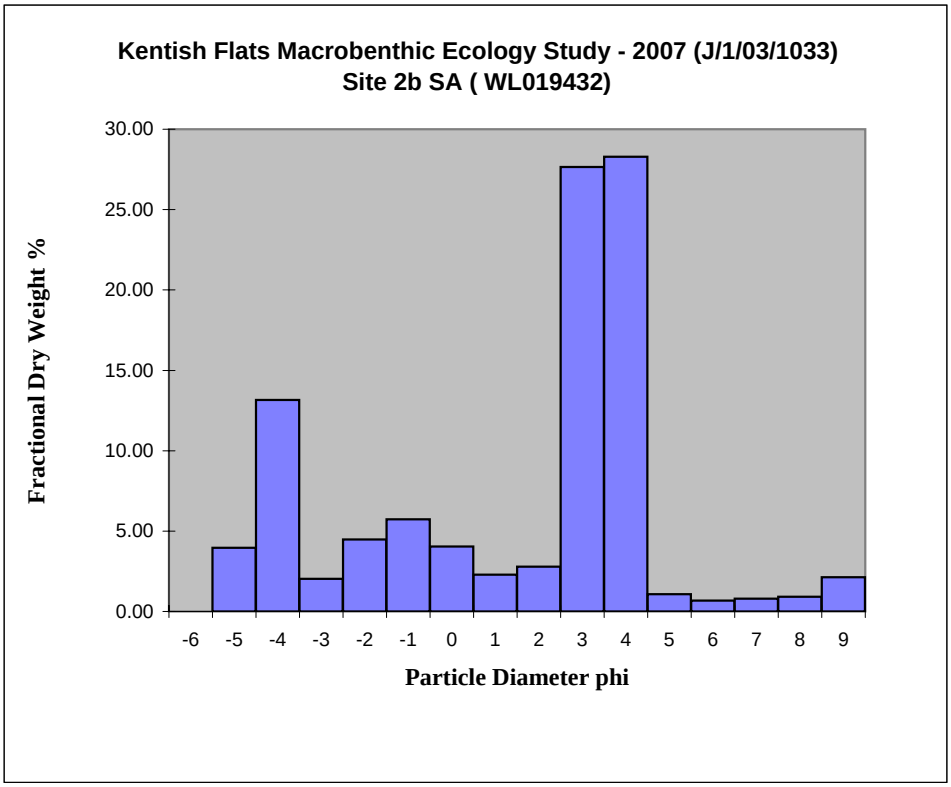
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage	
				Fractional	Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	11.041	3.97	3.97
	16	-4.0	36.628	13.17	17.14
Gravel	8	-3.0	5.638	2.03	19.16
	4	-2.0	12.465	4.48	23.64
Coarse Sand	2	-1.0	15.951	5.73	29.38
	1	0.0	11.245	4.04	33.42
Medium Sand	0.5	1.0	6.350	2.28	35.70
	0.25	2.0	7.730	2.78	38.48
Fine Sand	0.125	3.0	76.899	27.64	66.13
	0.063	4.0	78.693	28.29	94.42
Silt	0.032	5.0	2.975	1.07	95.49
	0.0156	6.0	1.878	0.68	96.16
	0.0078	7.0	2.212	0.80	96.96
	0.0039	8.0	2.540	0.91	97.87
Clay	<0.0039	9.0	5.922	2.13	100.00
		Total Weight	278	100	

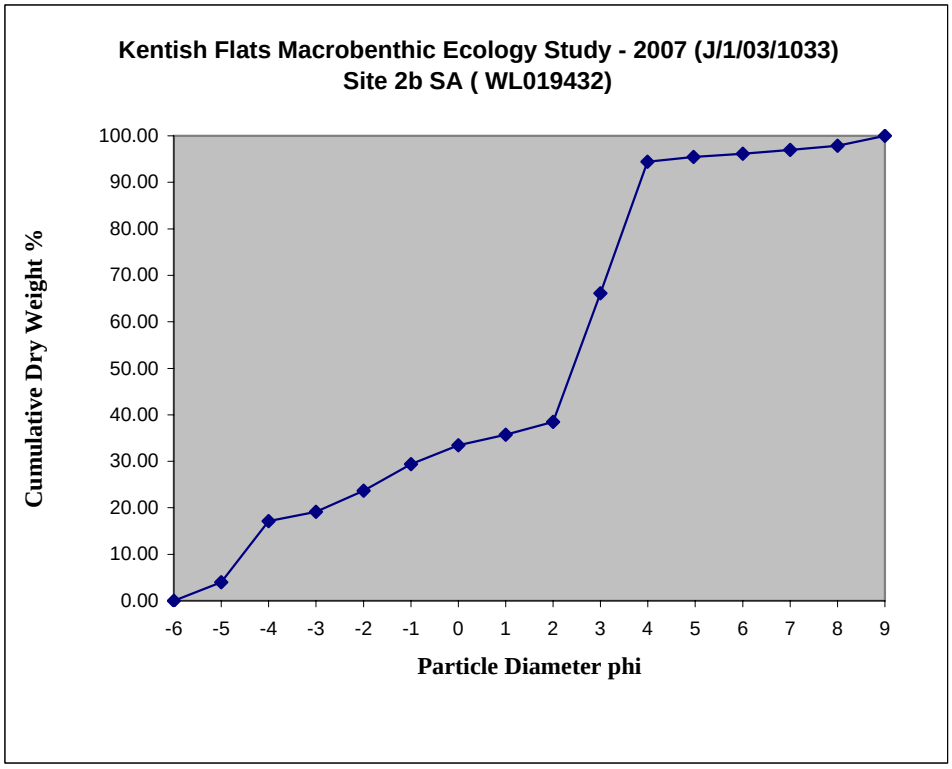
Mean mm	0.64
Md mm	0.19
Mean phi	0.65
Md phi	2.42
Sorting	3.36
Skq	-0.62
Kurtosis	0.76

%Gravel	23.64
% Sand	70.77
% Fines	5.58

Gravelly Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 2b SA (WL019432)
Fractional Dry Weight %
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 2b SA (WL019432)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 2c SA (WL019433)

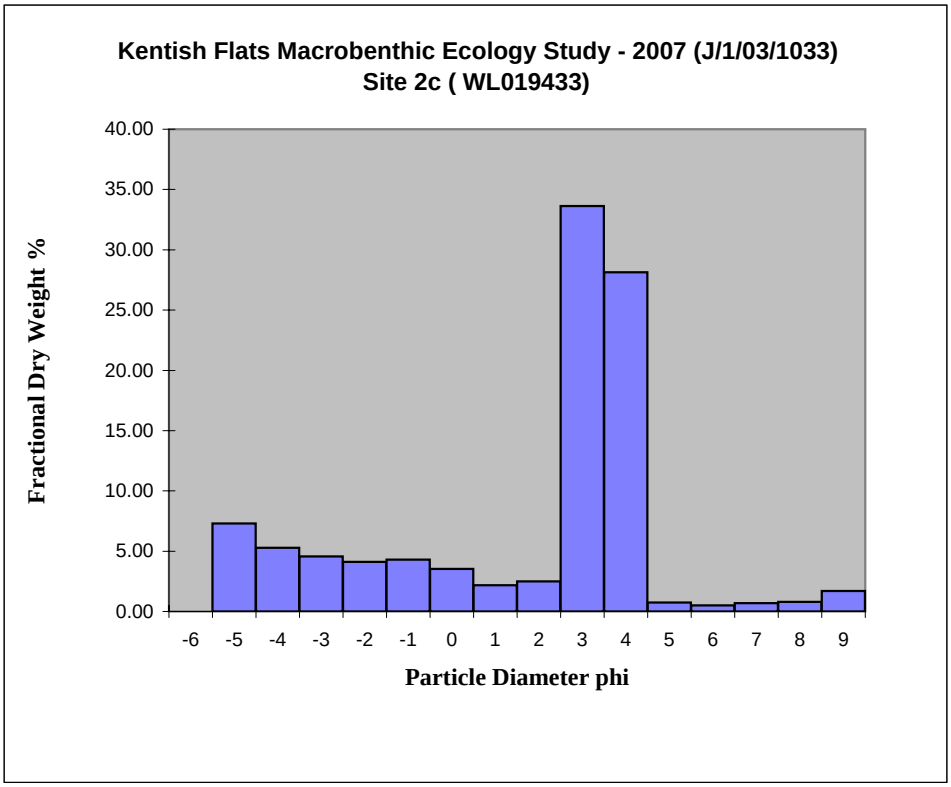
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage	
				Fractional	Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	20.696	7.30	7.30
	16	-4.0	14.930	5.27	12.57
Gravel	8	-3.0	12.972	4.58	17.15
	4	-2.0	11.667	4.12	21.27
Coarse Sand	2	-1.0	12.218	4.31	25.58
	1	0.0	10.015	3.53	29.12
Medium Sand	0.5	1.0	6.184	2.18	31.30
	0.25	2.0	7.067	2.49	33.79
Fine Sand	0.125	3.0	95.270	33.63	67.42
	0.063	4.0	79.720	28.14	95.56
Silt	0.032	5.0	2.088	0.74	96.29
	0.0156	6.0	1.401	0.49	96.79
	0.0078	7.0	1.968	0.69	97.48
	0.0039	8.0	2.290	0.81	98.29
Clay	<0.0039	9.0	4.844	1.71	100.00
		Total Weight	283	100	

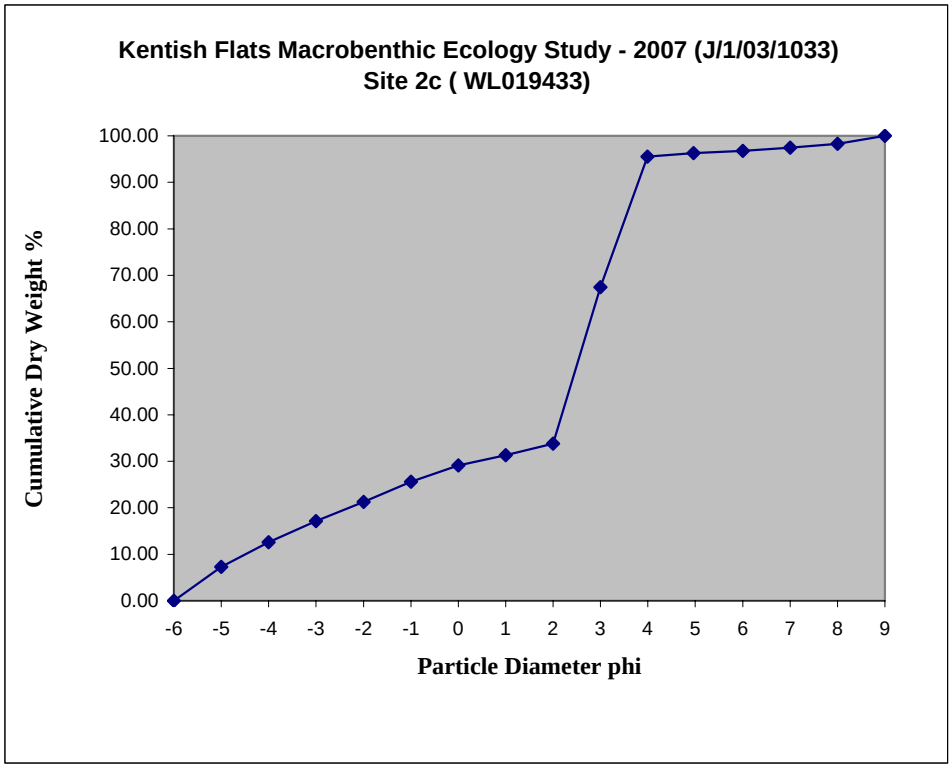
Mean mm	0.52
Md mm	0.18
Mean phi	0.94
Md phi	2.48
Sorting	3.21
Skq	-0.69
Kurtosis	0.92

%Gravel	21.27
% Sand	74.29
% Fines	4.44

Gravelly Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 2c (WL019433)
Fractional Dry Weight %
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 2c (WL019433)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 3a (WL019371)

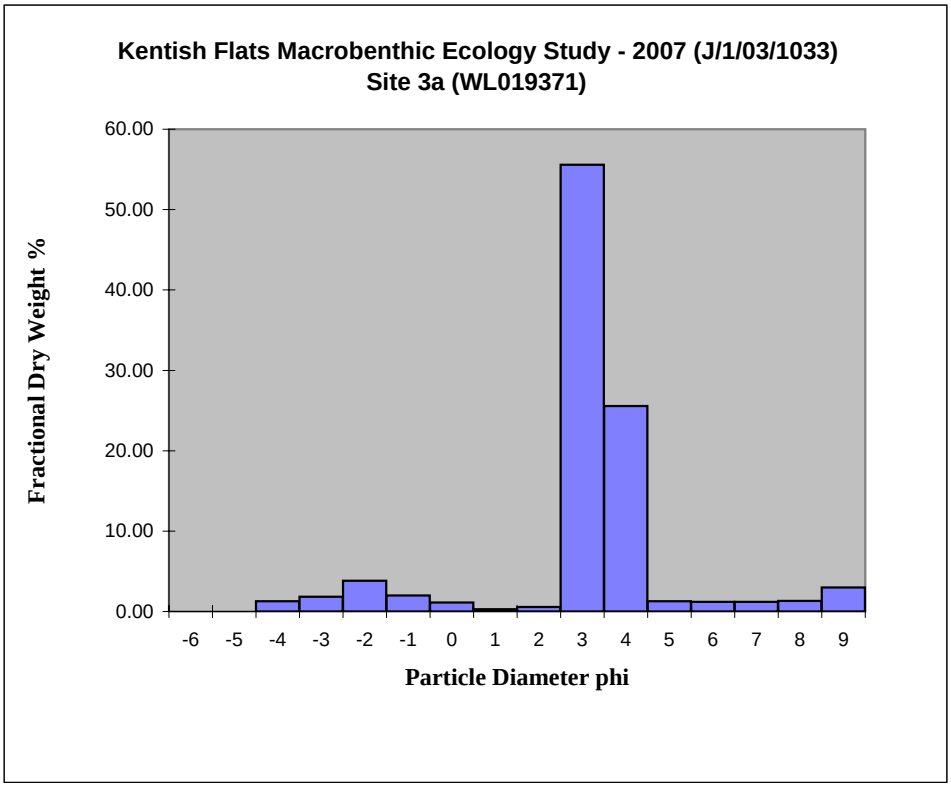
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage	
				Fractional	Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	2.000	1.27	1.27
Gravel	8	-3.0	2.855	1.82	3.09
	4	-2.0	6.020	3.83	6.93
Coarse Sand	2	-1.0	3.105	1.98	8.91
	1	0.0	1.775	1.13	10.04
Medium Sand	0.5	1.0	0.431	0.27	10.31
	0.25	2.0	0.889	0.57	10.88
Fine Sand	0.125	3.0	87.272	55.59	66.47
	0.063	4.0	40.137	25.57	92.04
Silt	0.032	5.0	2.023	1.29	93.33
	0.0156	6.0	1.852	1.18	94.51
	0.0078	7.0	1.883	1.20	95.71
	0.0039	8.0	2.042	1.30	97.01
Clay	<0.0039	9.0	4.696	2.99	100.00
		Total Weight	157	100	

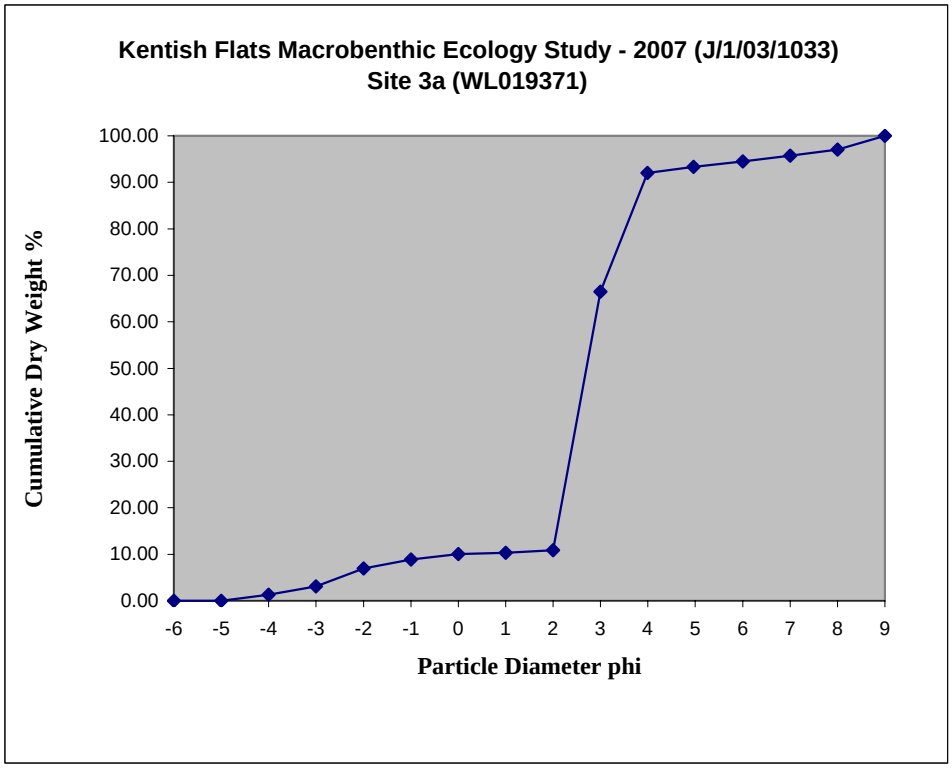
Mean mm	0.14
Md mm	0.15
Mean phi	2.82
Md phi	2.70
Sorting	1.75
Skq	0.03
Kurtosis	3.40

%Gravel	6.93
% Sand	85.11
% Fines	7.96

Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 3a (WL019371)
Fractional Dry Weight %
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 3a (WL019371)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 3b (WL019372)

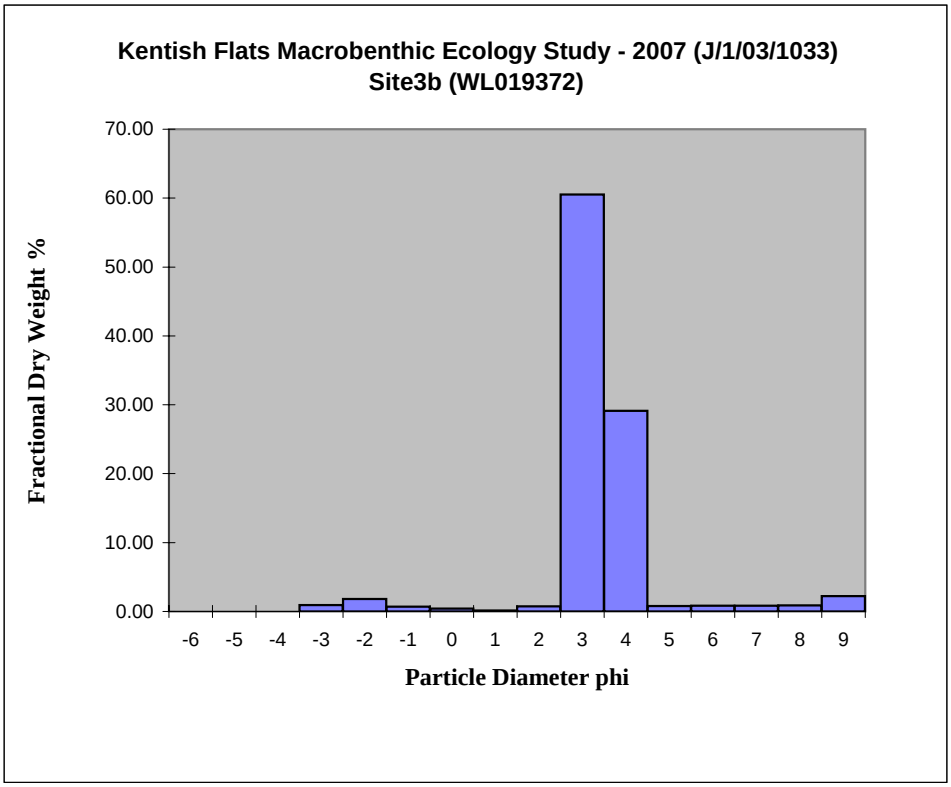
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	0.000	0.00	0.00
Gravel	8	-3.0	1.055	0.91	0.91
	4	-2.0	2.121	1.83	2.73
Coarse Sand	2	-1.0	0.834	0.72	3.45
	1	0.0	0.486	0.42	3.87
Medium Sand	0.5	1.0	0.175	0.15	4.02
	0.25	2.0	0.851	0.73	4.76
Fine Sand	0.125	3.0	70.311	60.55	65.30
	0.063	4.0	33.815	29.12	94.42
Silt	0.032	5.0	0.944	0.81	95.23
	0.0156	6.0	0.959	0.83	96.06
	0.0078	7.0	0.959	0.83	96.88
	0.0039	8.0	1.038	0.89	97.78
Clay	<0.0039	9.0	2.580	2.22	100.00
		Total Weight	116	100	

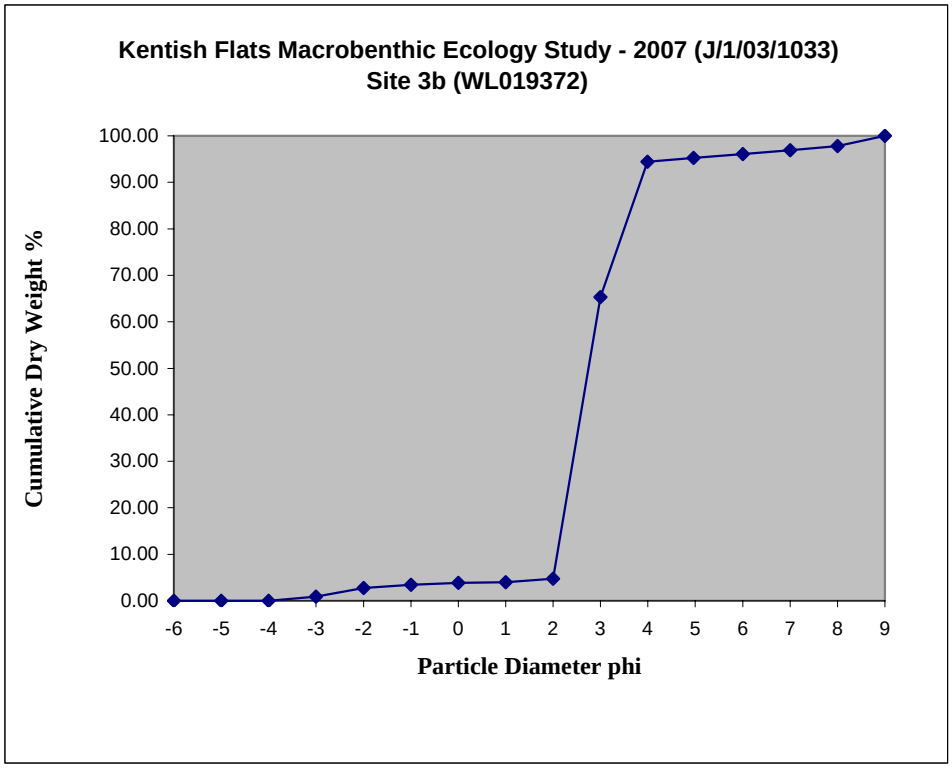
Mean mm	0.14
Md mm	0.15
Mean phi	2.86
Md phi	2.75
Sorting	0.77
Skq	0.34
Kurtosis	1.10

%Gravel	2.73
% Sand	91.69
% Fines	5.58

Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site3b (WL019372)
Fractional Dry Weight %
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 3b (WL019372)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 3c (WL019373)

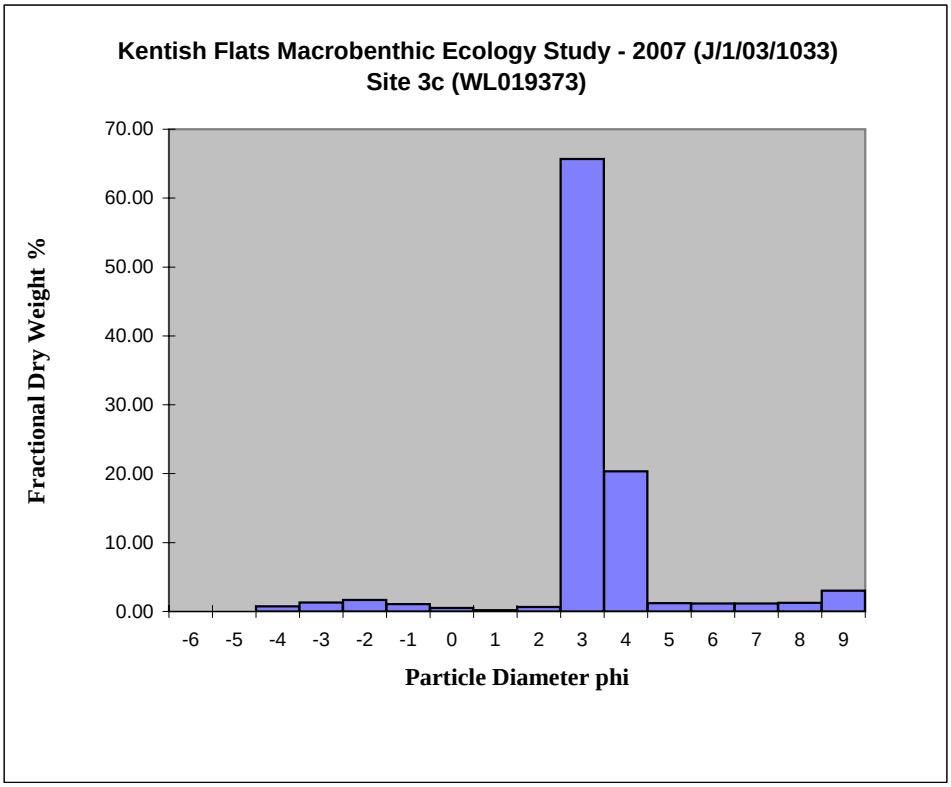
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	1.178	0.72	0.72
Gravel	8	-3.0	2.149	1.32	2.04
	4	-2.0	2.754	1.69	3.72
Coarse Sand	2	-1.0	1.709	1.05	4.77
	1	0.0	0.860	0.53	5.29
Medium Sand	0.5	1.0	0.331	0.20	5.50
	0.25	2.0	1.100	0.67	6.17
Fine Sand	0.125	3.0	107.317	65.67	71.84
	0.063	4.0	33.212	20.32	92.16
Silt	0.032	5.0	1.974	1.21	93.37
	0.0156	6.0	1.922	1.18	94.55
	0.0078	7.0	1.932	1.18	95.73
	0.0039	8.0	2.071	1.27	97.00
Clay	<0.0039	9.0	4.910	3.00	100.00
		Total Weight	163	100	

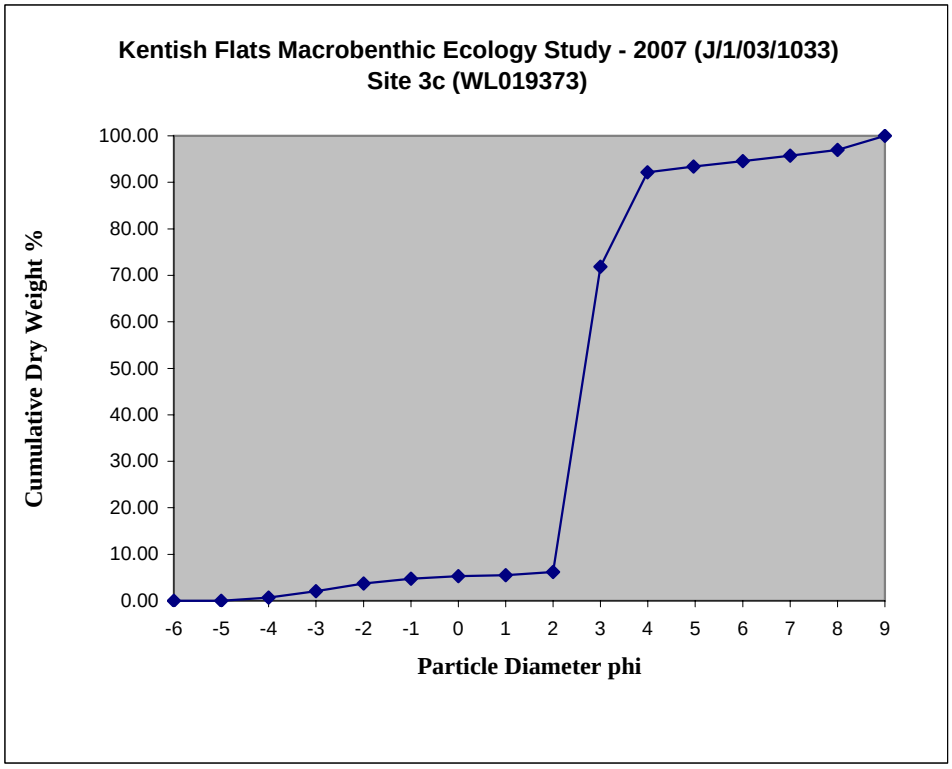
Mean mm	0.14
Md mm	0.16
Mean phi	2.80
Md phi	2.67
Sorting	1.41
Skq	0.18
Kurtosis	3.28

%Gravel	3.72
% Sand	88.44
% Fines	7.84

Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 3c (WL019373)
Fractional Dry Weight %
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 3c (WL019373)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

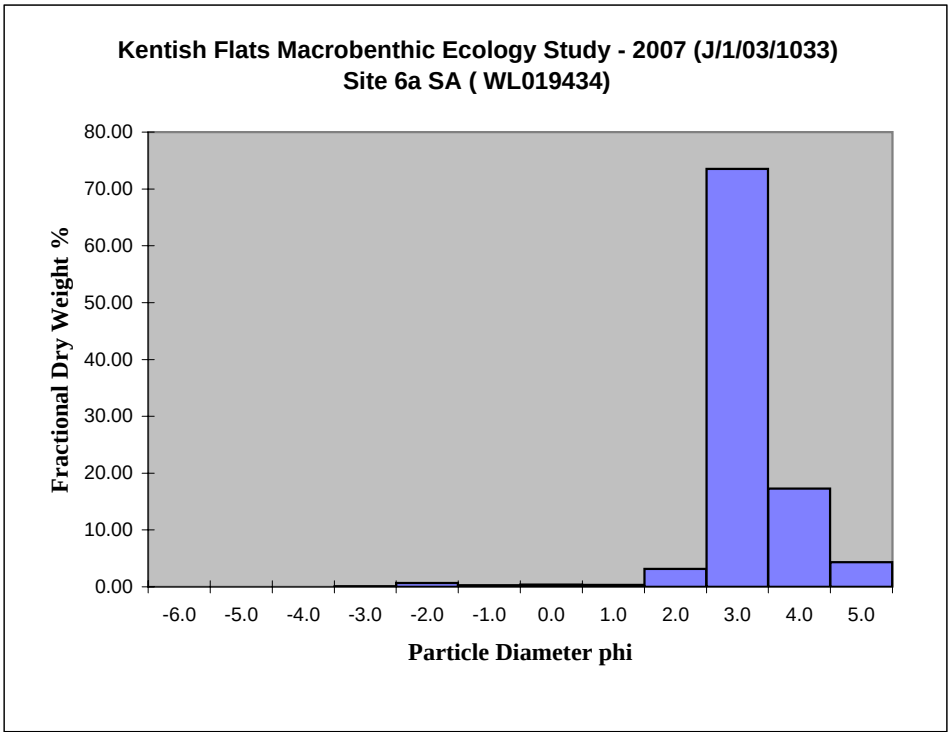
Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 6a SA (WL019434)

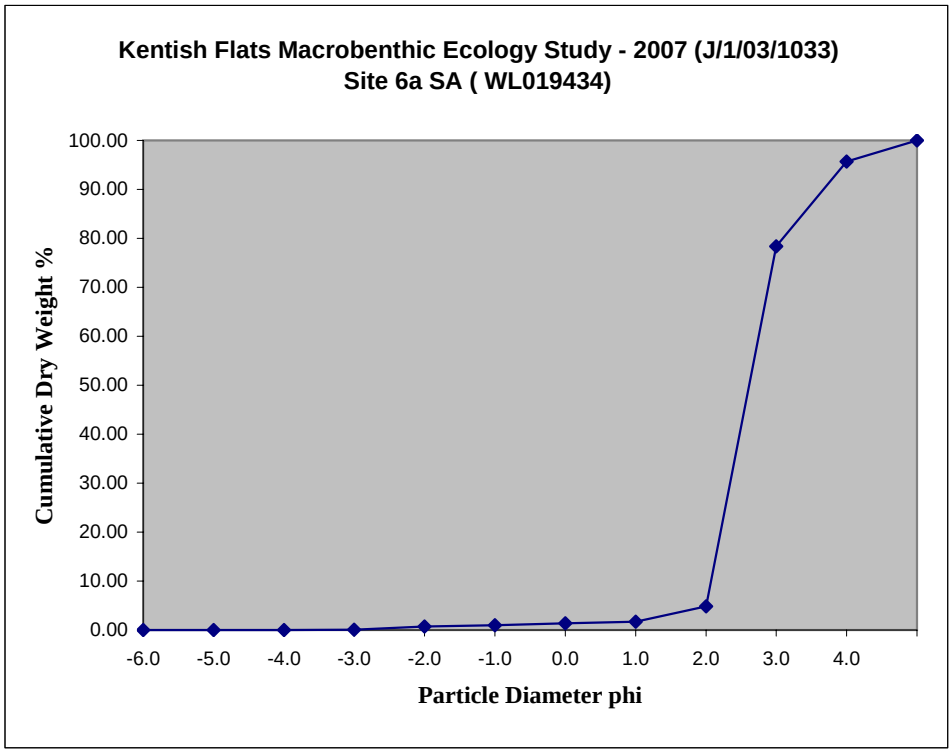
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	0.000	0.00	0.00
Gravel	8	-3.0	0.118	0.04	0.04
	4	-2.0	1.731	0.65	0.69
Coarse Sand	2	-1.0	0.823	0.31	1.00
	1	0.0	1.019	0.38	1.38
Medium Sand	0.5	1.0	0.829	0.31	1.69
	0.25	2.0	8.463	3.17	4.86
Fine Sand	0.125	3.0	196.203	73.51	78.37
	0.063	4.0	46.148	17.29	95.66
Silt/Clay	<0.063	5.0	11.579	4.34	100.00
		Total Weight	266.913	100.00	

Mean mm	0.17
Md mm	0.16
Mean phi	2.56
Md phi	2.61
Sorting	0.31
Skq	-0.37
Kurtosis	0.47

%Gravel	0.69
% Sand	94.97
% Fines	4.34

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 6a SA (WL019434)
Fractional Dry Weight %
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 6a SA (WL019434)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
Particle Diameter phi

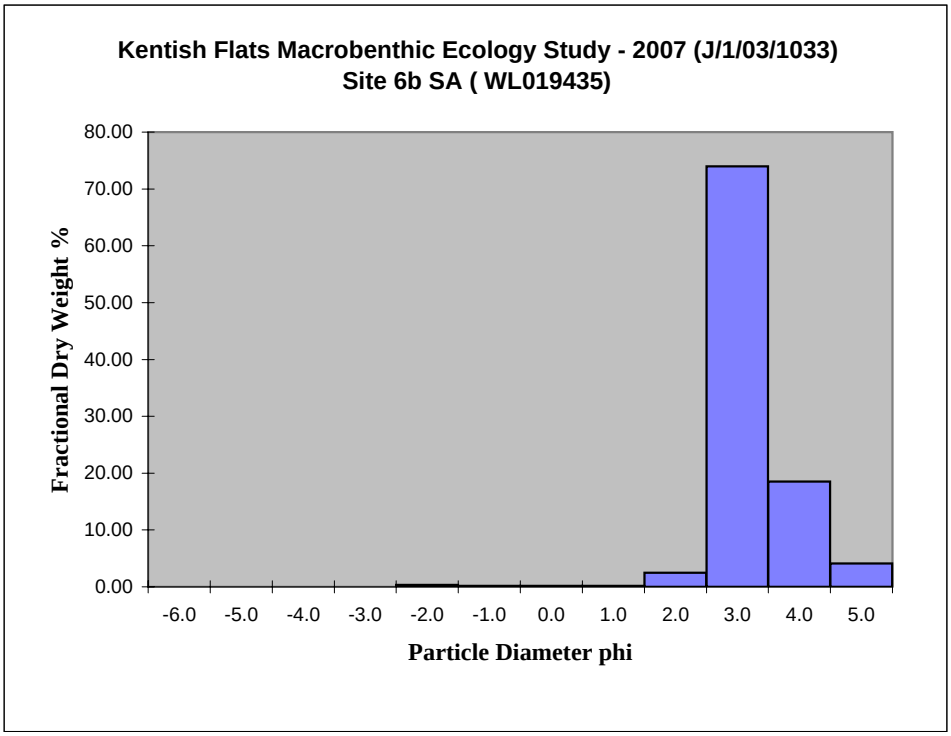
Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 6b SA (WL019435)

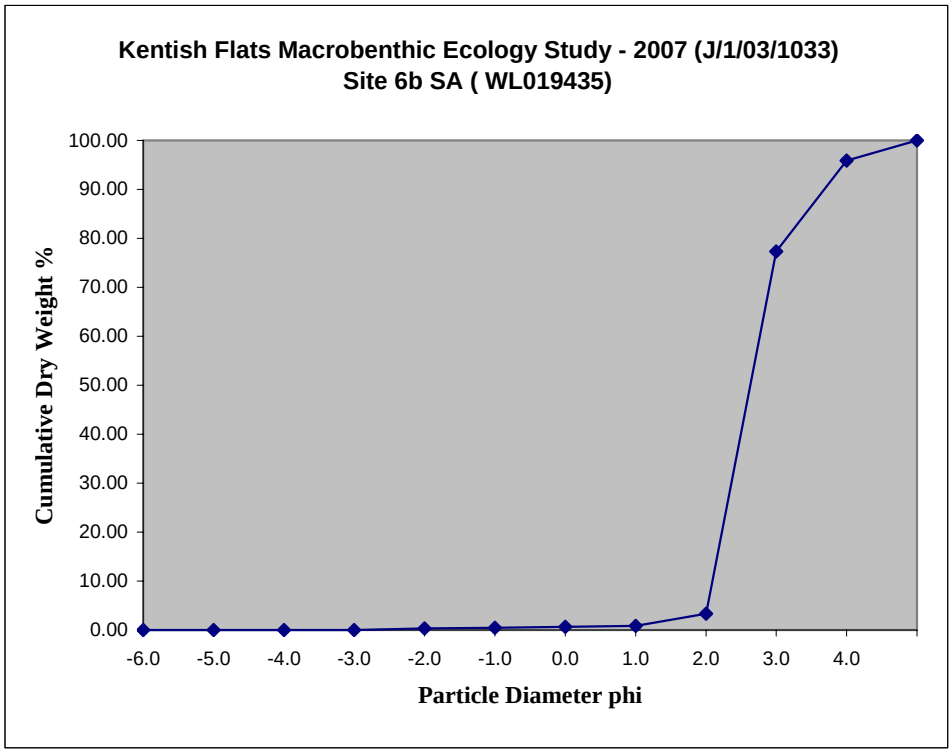
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	0.000	0.00	0.00
Gravel	8	-3.0	0.000	0.00	0.00
	4	-2.0	0.737	0.33	0.33
Coarse Sand	2	-1.0	0.346	0.16	0.49
	1	0.0	0.350	0.16	0.65
Medium Sand	0.5	1.0	0.389	0.18	0.82
	0.25	2.0	5.529	2.50	3.32
Fine Sand	0.125	3.0	163.827	74.00	77.32
	0.063	4.0	41.065	18.55	95.87
Silt/Clay	<0.063	5.0	9.141	4.13	100.00
		Total Weight	221.384	100.00	

Mean mm	0.17
Md mm	0.16
Mean phi	2.57
Md phi	2.63
Sorting	0.30
Skq	-0.43
Kurtosis	0.45

%Gravel	0.33
% Sand	95.54
% Fines	4.13

* Based on Connor *et al*, 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 6b SA (WL019435)
Fractional Dry Weight %
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 6b SA (WL019435)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
Particle Diameter phi

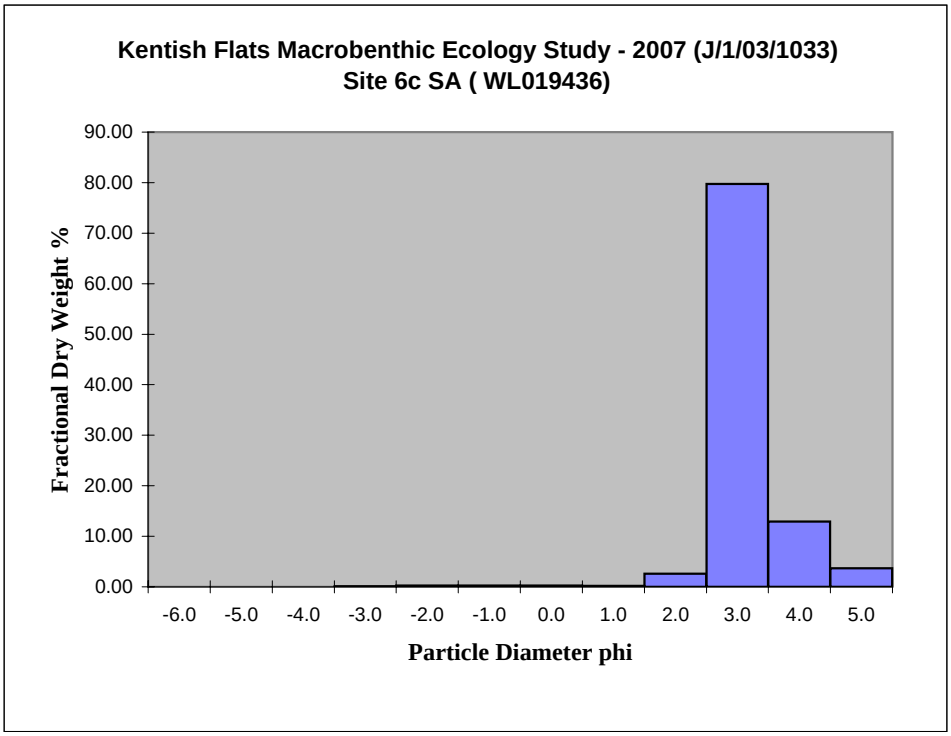
Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 6c SA (WL019436)

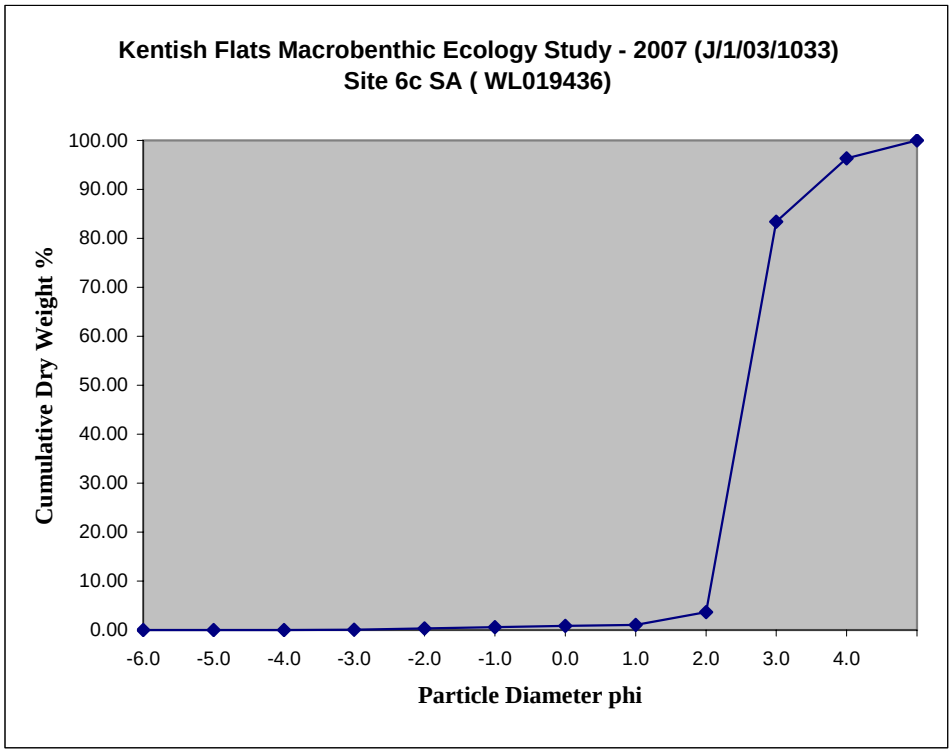
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	0.000	0.00	0.00
Gravel	8	-3.0	0.125	0.05	0.05
	4	-2.0	0.660	0.28	0.33
Coarse Sand	2	-1.0	0.576	0.24	0.58
	1	0.0	0.584	0.25	0.82
Medium Sand	0.5	1.0	0.509	0.22	1.04
	0.25	2.0	6.187	2.62	3.65
Fine Sand	0.125	3.0	188.669	79.76	83.42
	0.063	4.0	30.600	12.94	96.35
Silt/Clay	<0.063	5.0	8.623	3.65	100.00
		Total Weight	236.533	100.00	

Mean mm	0.17
Md mm	0.17
Mean phi	2.58
Md phi	2.58
Sorting	0.34
Skq	-0.18
Kurtosis	0.55

%Gravel	0.33
% Sand	96.02
% Fines	3.65

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 6c SA (WL019436)
Fractional Dry Weight %
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 6c SA (WL019436)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
Particle Diameter phi

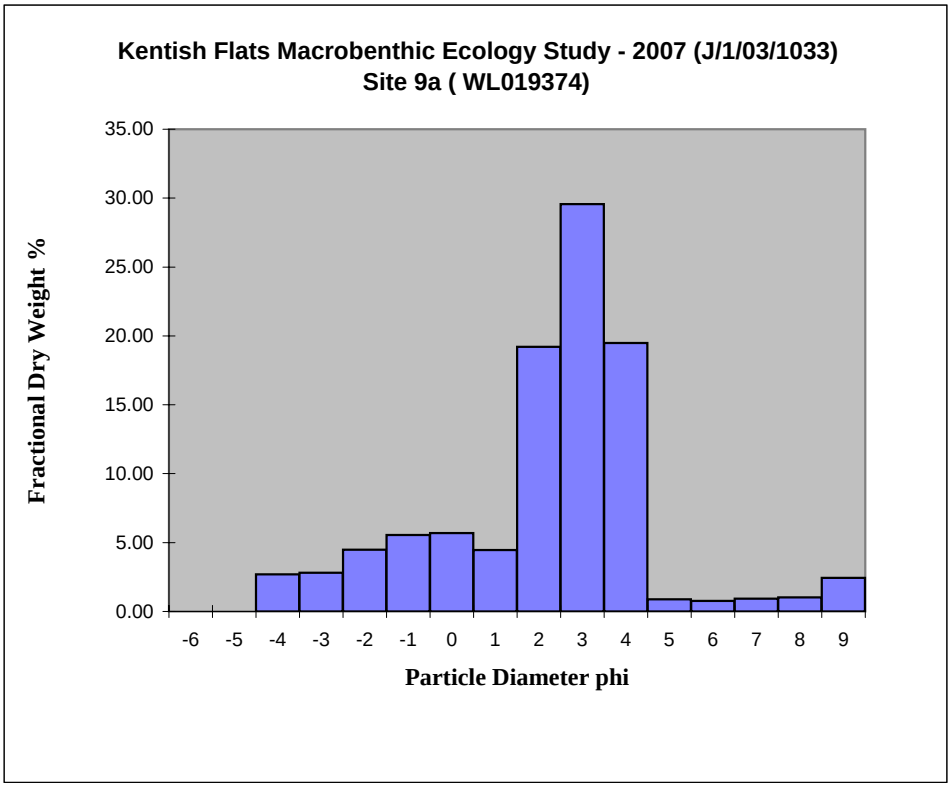
Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 9a (WL019374)

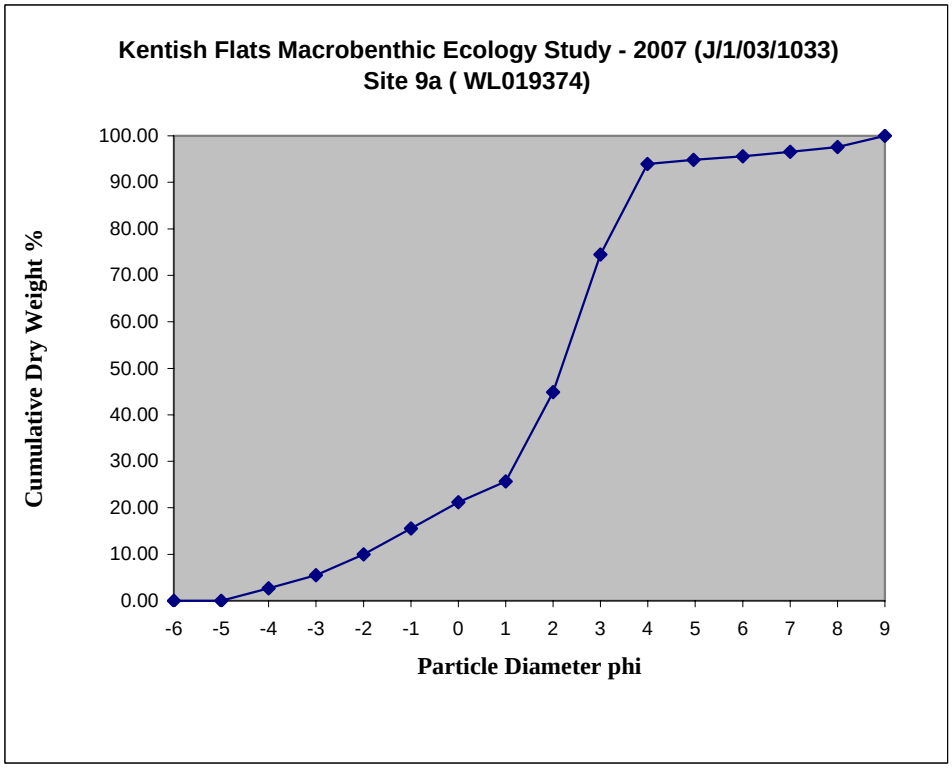
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	5.739	2.68	2.68
Gravel	8	-3.0	6.032	2.82	5.51
	4	-2.0	9.568	4.48	9.98
Coarse Sand	2	-1.0	11.857	5.55	15.53
	1	0.0	12.179	5.70	21.22
Medium Sand	0.5	1.0	9.534	4.46	25.68
	0.25	2.0	41.068	19.21	44.89
Fine Sand	0.125	3.0	63.200	29.56	74.45
	0.063	4.0	41.683	19.50	93.95
Silt	0.032	5.0	1.903	0.89	94.84
	0.0156	6.0	1.654	0.77	95.61
	0.0078	7.0	1.973	0.92	96.53
	0.0039	8.0	2.203	1.03	97.56
Clay	<0.0039	9.0	5.211	2.44	100.00
		Total Weight	214	100	

Mean mm	0.33
Md mm	0.22
Mean phi	1.58
Md phi	2.17
Sorting	2.37
Skq	-0.34
Kurtosis	1.57

%Gravel	9.98
% Sand	83.97
% Fines	6.05
	Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 9a (WL019374)
Fractional Dry Weight %
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 9a (WL019374)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 9b (WL019375)

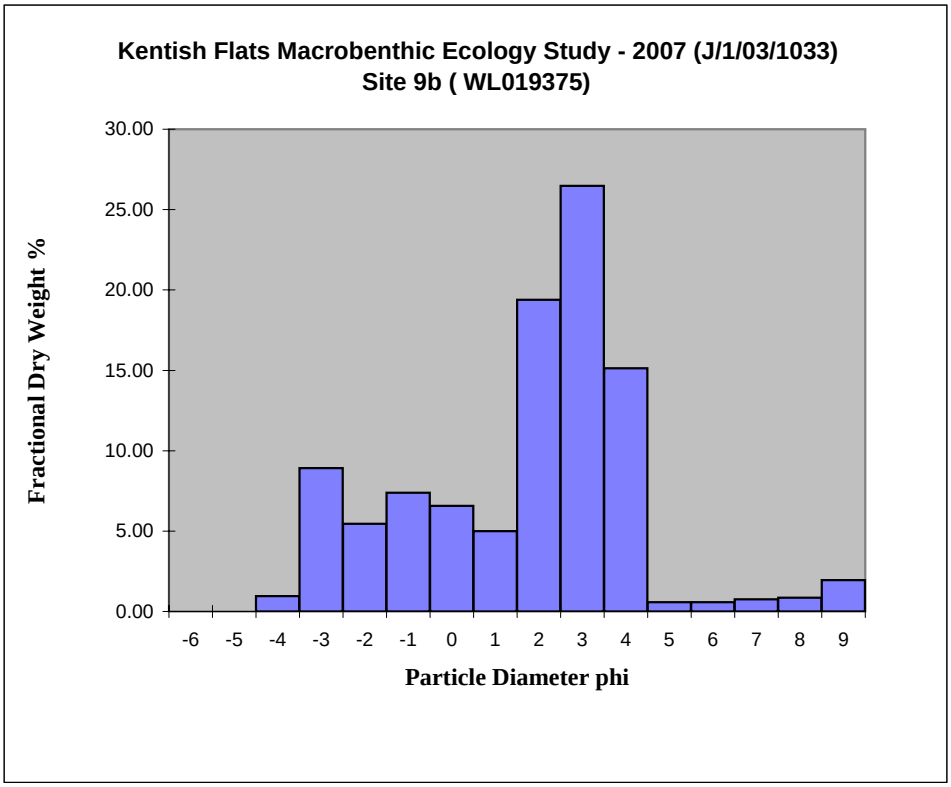
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage	
				Fractional	Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	2.411	0.95	0.95
Gravel	8	-3.0	22.684	8.92	9.87
	4	-2.0	13.885	5.46	15.33
Coarse Sand	2	-1.0	18.754	7.38	22.71
	1	0.0	16.723	6.58	29.29
Medium Sand	0.5	1.0	12.708	5.00	34.29
	0.25	2.0	49.284	19.39	53.67
Fine Sand	0.125	3.0	67.320	26.48	80.15
	0.063	4.0	38.441	15.12	95.27
Silt	0.032	5.0	1.471	0.58	95.85
	0.0156	6.0	1.471	0.58	96.43
	0.0078	7.0	1.908	0.75	97.18
	0.0039	8.0	2.197	0.86	98.05
Clay	<0.0039	9.0	4.970	1.95	100.00
		Total Weight	254	100	

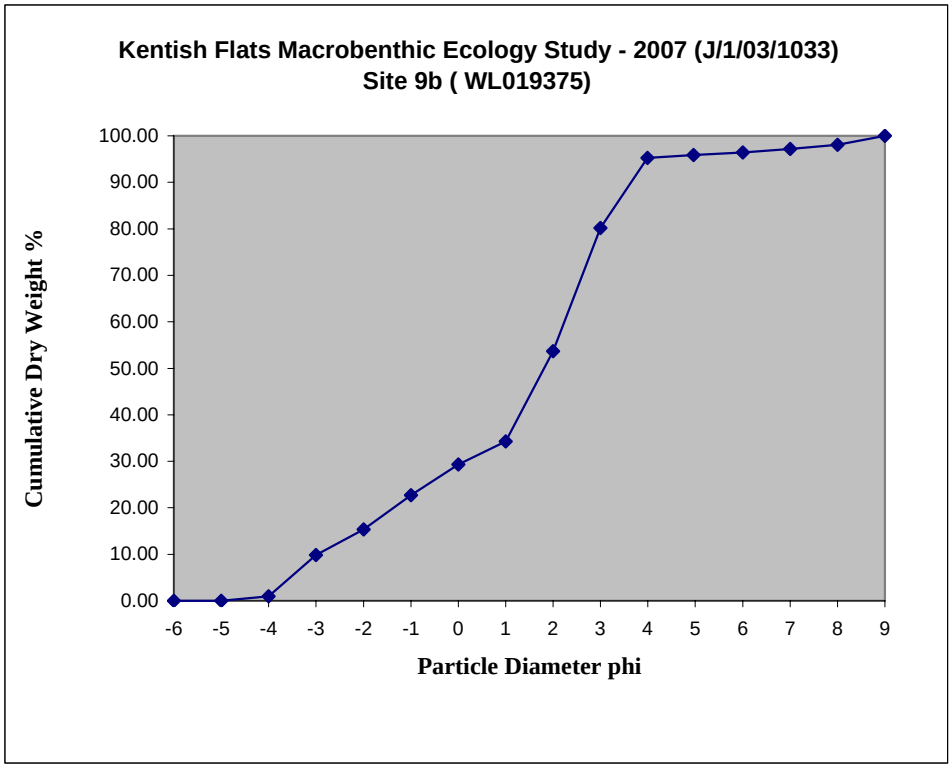
Mean mm	0.48
Md mm	0.29
Mean phi	1.05
Md phi	1.81
Sorting	2.43
Skq	-0.43
Kurtosis	0.89

%Gravel	15.33
% Sand	79.94
% Fines	4.73

Gravelly Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 9b (WL019375)
Fractional Dry Weight %
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 9b (WL019375)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 9c (WL019376)

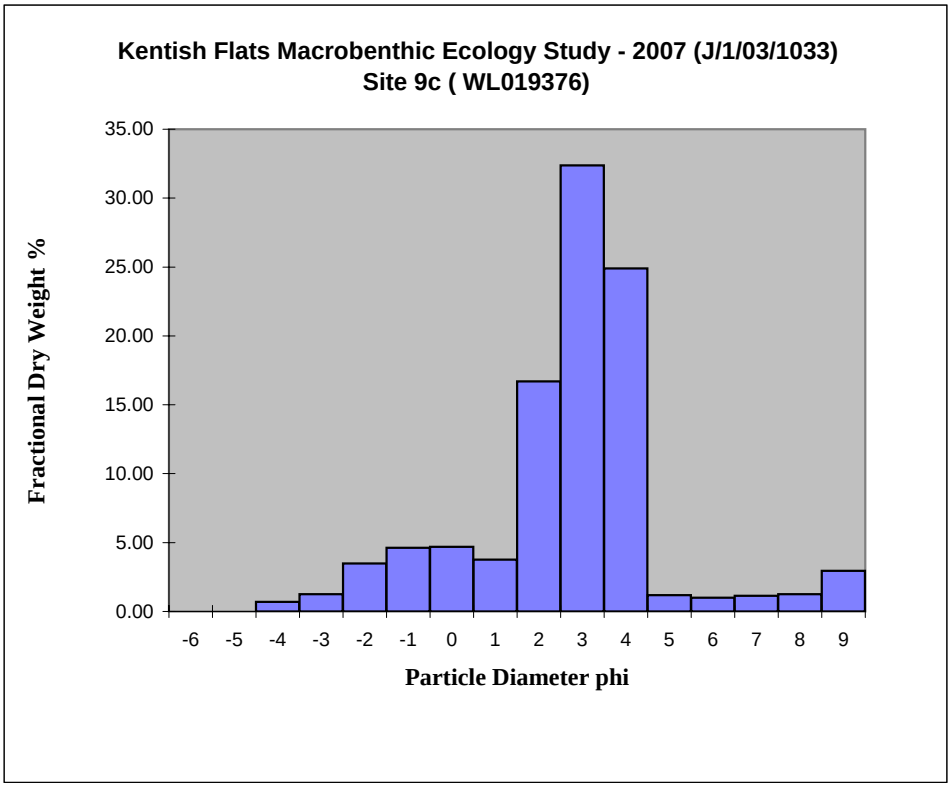
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	1.278	0.69	0.69
Gravel	8	-3.0	2.328	1.26	1.94
	4	-2.0	6.440	3.47	5.42
Coarse Sand	2	-1.0	8.548	4.61	10.03
	1	0.0	8.706	4.70	14.72
Medium Sand	0.5	1.0	6.987	3.77	18.49
	0.25	2.0	30.967	16.70	35.19
Fine Sand	0.125	3.0	60.046	32.38	67.58
	0.063	4.0	46.166	24.90	92.48
Silt	0.032	5.0	2.197	1.18	93.66
	0.0156	6.0	1.871	1.01	94.67
	0.0078	7.0	2.104	1.13	95.81
	0.0039	8.0	2.324	1.25	97.06
Clay	<0.0039	9.0	5.453	2.94	100.00
		Total Weight	185	100	

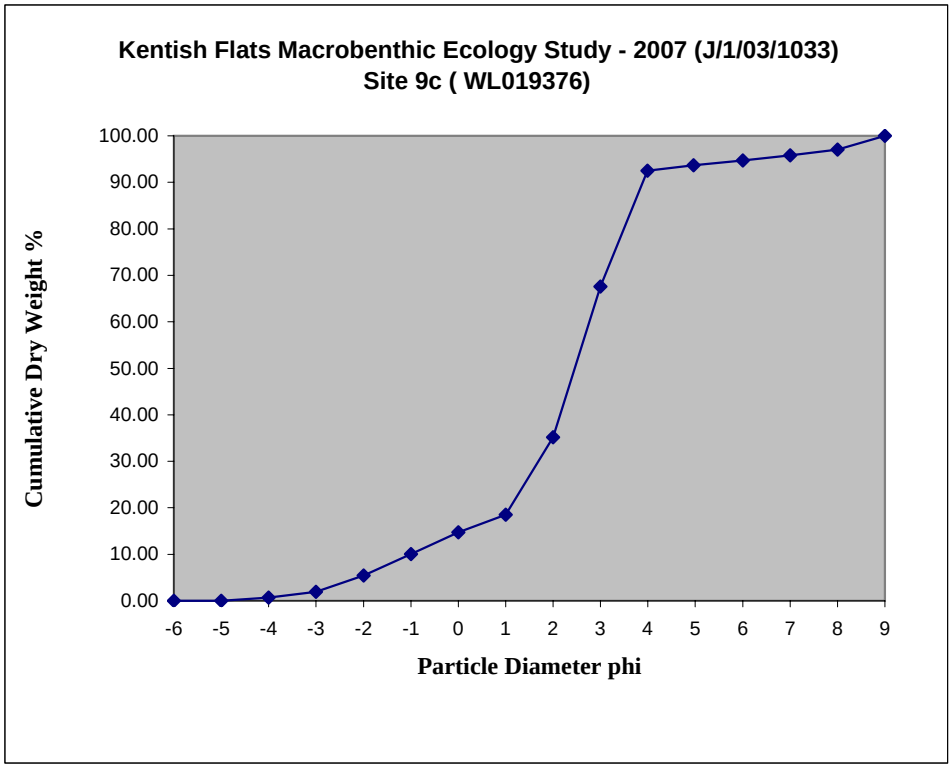
Mean mm	0.23
Md mm	0.18
Mean phi	2.15
Md phi	2.46
Sorting	2.10
Skq	-0.18
Kurtosis	1.81

%Gravel	5.42
% Sand	87.06
% Fines	7.52

Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 9c (WL019376)
Fractional Dry Weight %
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 9c (WL019376)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 10a SA (WL019437)

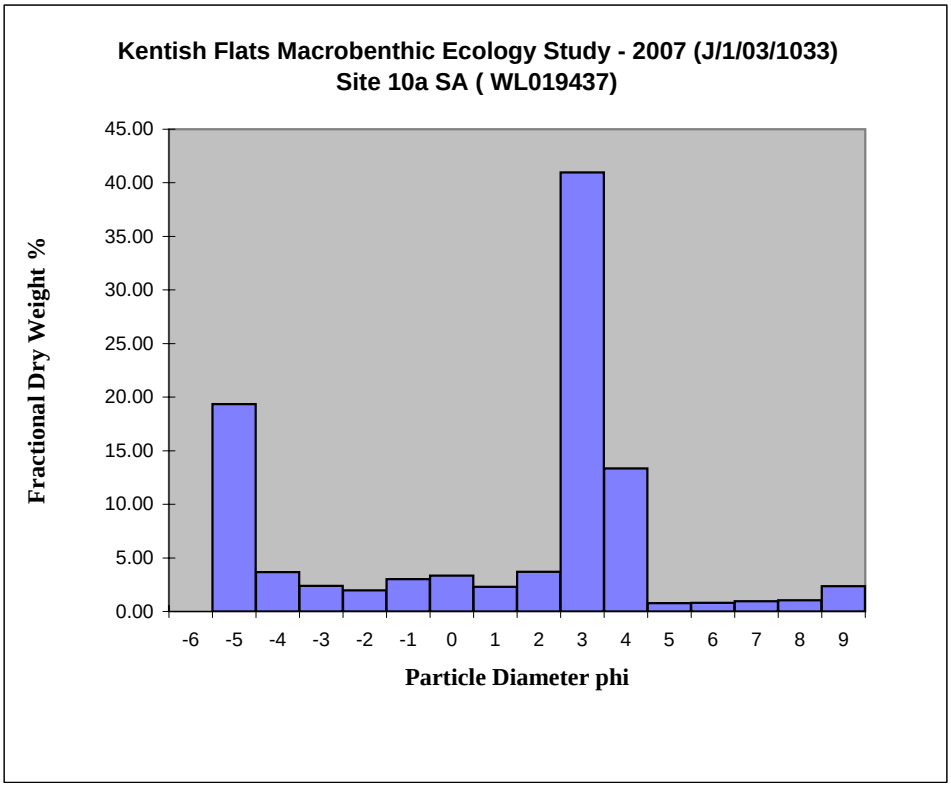
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	29.903	19.35	19.35
	16	-4.0	5.657	3.66	23.01
Gravel	8	-3.0	3.690	2.39	25.40
	4	-2.0	3.044	1.97	27.37
Coarse Sand	2	-1.0	4.642	3.00	30.37
	1	0.0	5.182	3.35	33.73
Medium Sand	0.5	1.0	3.544	2.29	36.02
	0.25	2.0	5.711	3.70	39.72
Fine Sand	0.125	3.0	63.291	40.96	80.68
	0.063	4.0	20.646	13.36	94.04
Silt	0.032	5.0	1.190	0.77	94.81
	0.0156	6.0	1.257	0.81	95.62
	0.0078	7.0	1.499	0.97	96.59
	0.0039	8.0	1.633	1.06	97.65
Clay	<0.0039	9.0	3.635	2.35	100.00
		Total Weight	155	100	

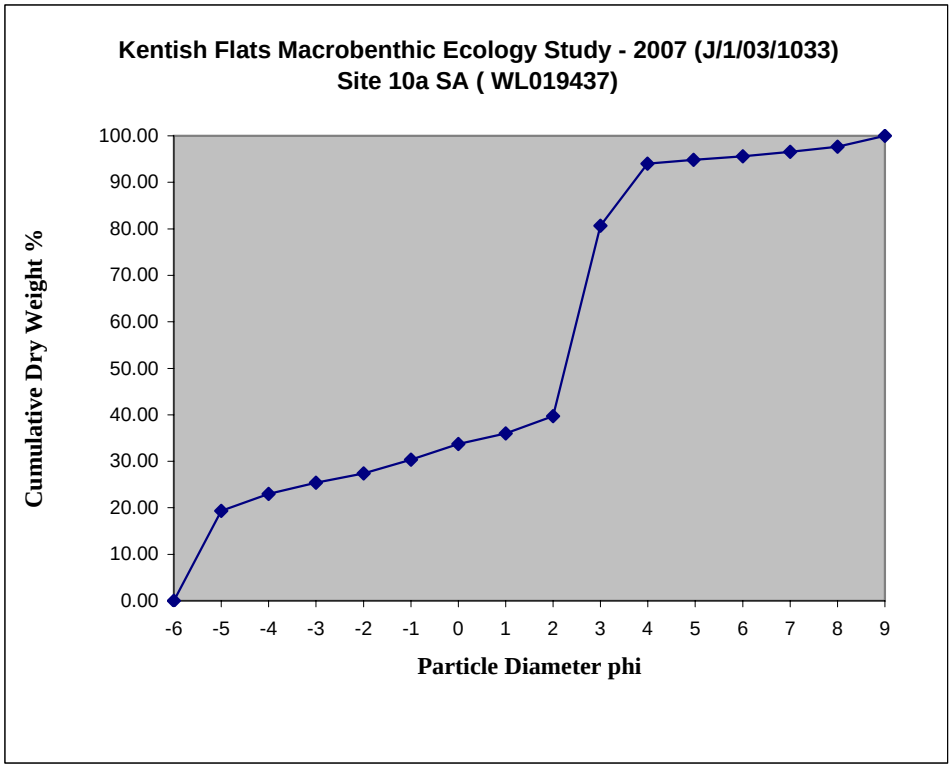
Mean mm	1.01
Md mm	0.21
Mean phi	-0.01
Md phi	2.25
Sorting	4.08
Skq	-0.65
Kurtosis	0.85

%Gravel	27.37
% Sand	66.67
% Fines	5.96

Gravelly Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 10a SA (WL019437)
Fractional Dry Weight %
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 10a SA (WL019437)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 10b SA (WL019438)

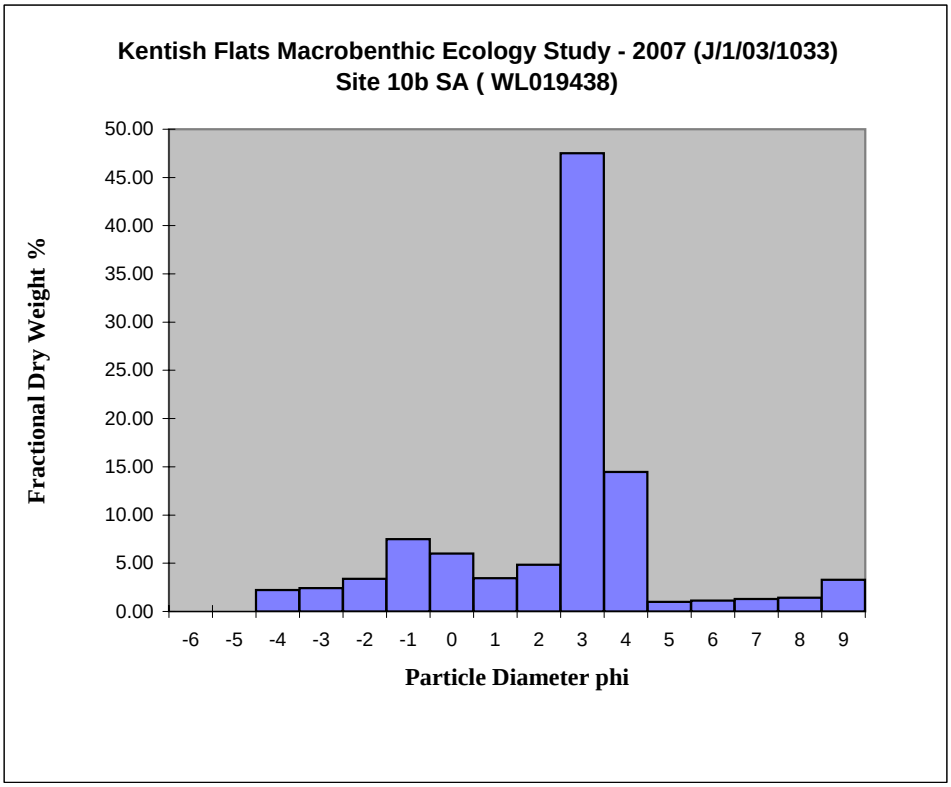
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage	
				Fractional	Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	5.037	2.24	2.24
Gravel	8	-3.0	5.478	2.43	4.67
	4	-2.0	7.652	3.40	8.07
Coarse Sand	2	-1.0	16.876	7.50	15.57
	1	0.0	13.539	6.01	21.58
Medium Sand	0.5	1.0	7.800	3.46	25.05
	0.25	2.0	10.930	4.86	29.90
Fine Sand	0.125	3.0	106.925	47.50	77.40
	0.063	4.0	32.600	14.48	91.88
Silt	0.032	5.0	2.234	0.99	92.87
	0.0156	6.0	2.529	1.12	94.00
	0.0078	7.0	2.893	1.29	95.28
	0.0039	8.0	3.196	1.42	96.70
Clay	<0.0039	9.0	7.423	3.30	100.00
		Total Weight	225	100	

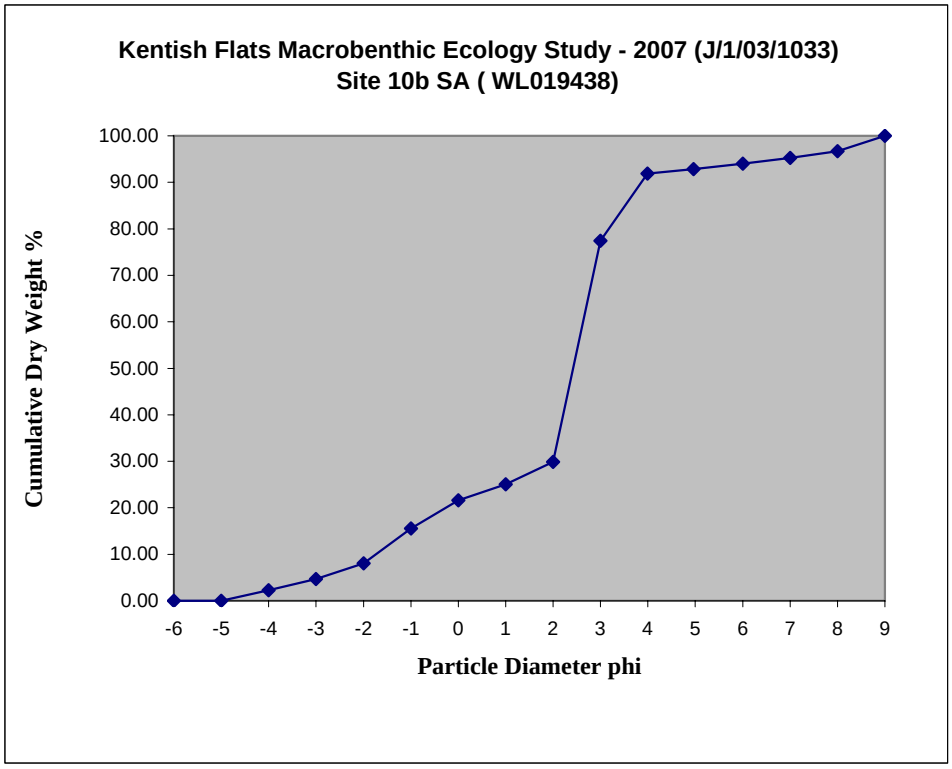
Mean mm	0.32
Md mm	0.19
Mean phi	1.65
Md phi	2.42
Sorting	2.56
Skq	-0.32
Kurtosis	2.02

%Gravel	8.07
% Sand	83.81
% Fines	8.12

Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 10b SA (WL019438)
Fractional Dry Weight %
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 10b SA (WL019438)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

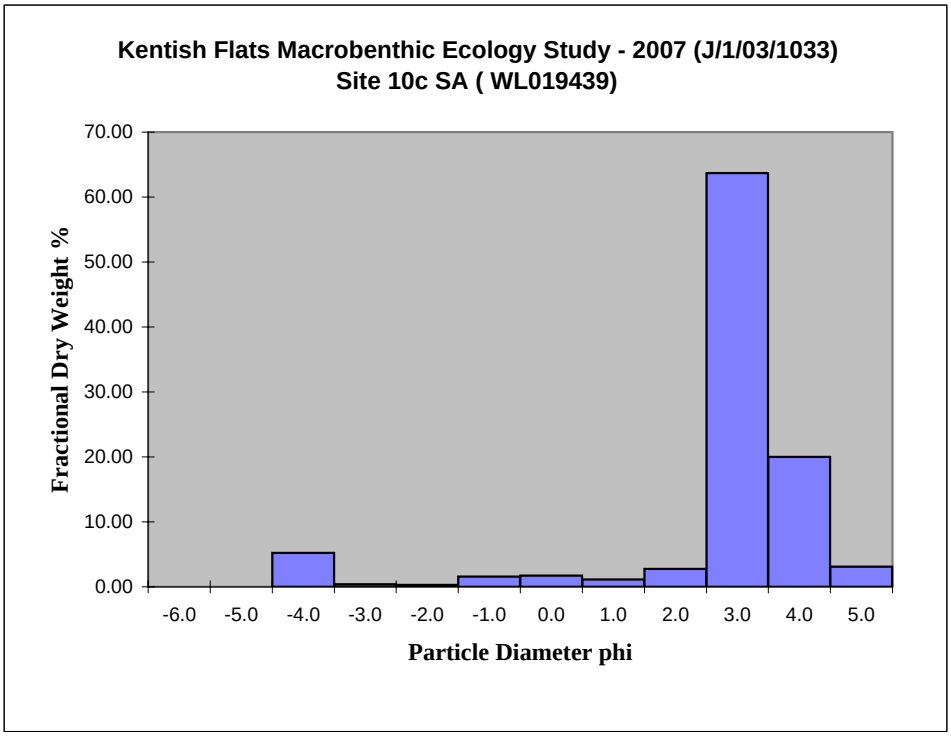
Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 10c SA (WL019439)

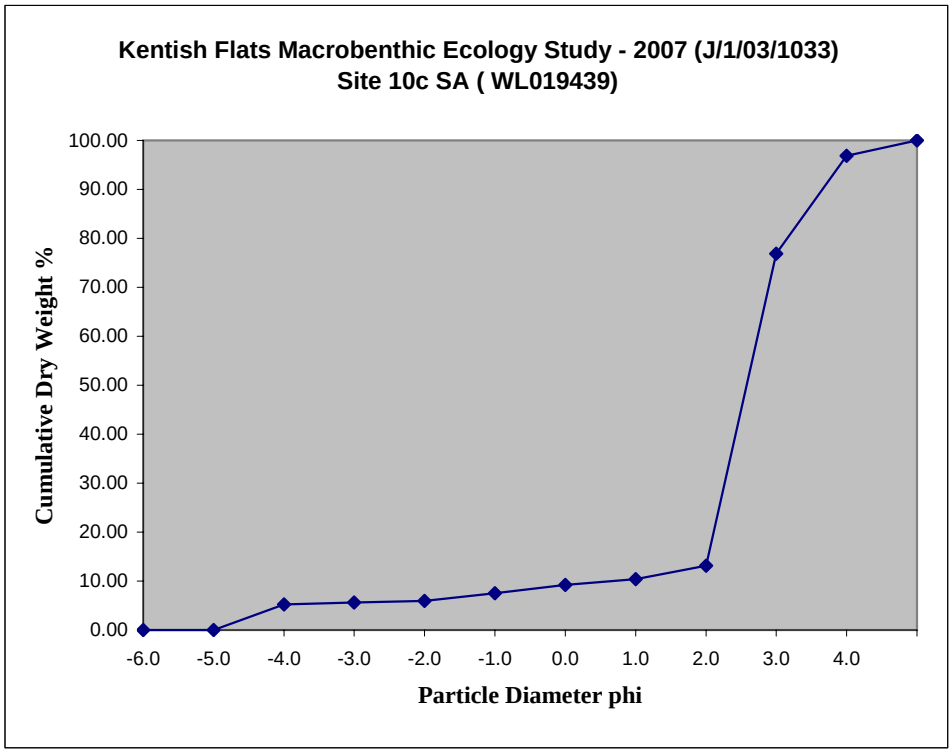
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	11.140	5.22	5.22
Gravel	8	-3.0	0.862	0.40	5.63
	4	-2.0	0.629	0.30	5.92
Coarse Sand	2	-1.0	3.394	1.59	7.52
	1	0.0	3.679	1.73	9.24
Medium Sand	0.5	1.0	2.449	1.15	10.39
	0.25	2.0	5.906	2.77	13.16
Fine Sand	0.125	3.0	135.817	63.70	76.86
	0.063	4.0	42.685	20.02	96.88
Silt/Clay	<0.063	5.0	6.652	3.12	100.00
		Total Weight	213.213	100.00	

Mean mm	0.18
Md mm	0.17
Mean phi	2.51
Md phi	2.58
Sorting	1.25
Skq	-0.59
Kurtosis	3.55

%Gravel	5.92
% Sand	90.96
% Fines	3.12

* Based on Connor *et al*, 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 10c SA (WL019439)
Fractional Dry Weight %
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 10c SA (WL019439)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 14a (WL019377)

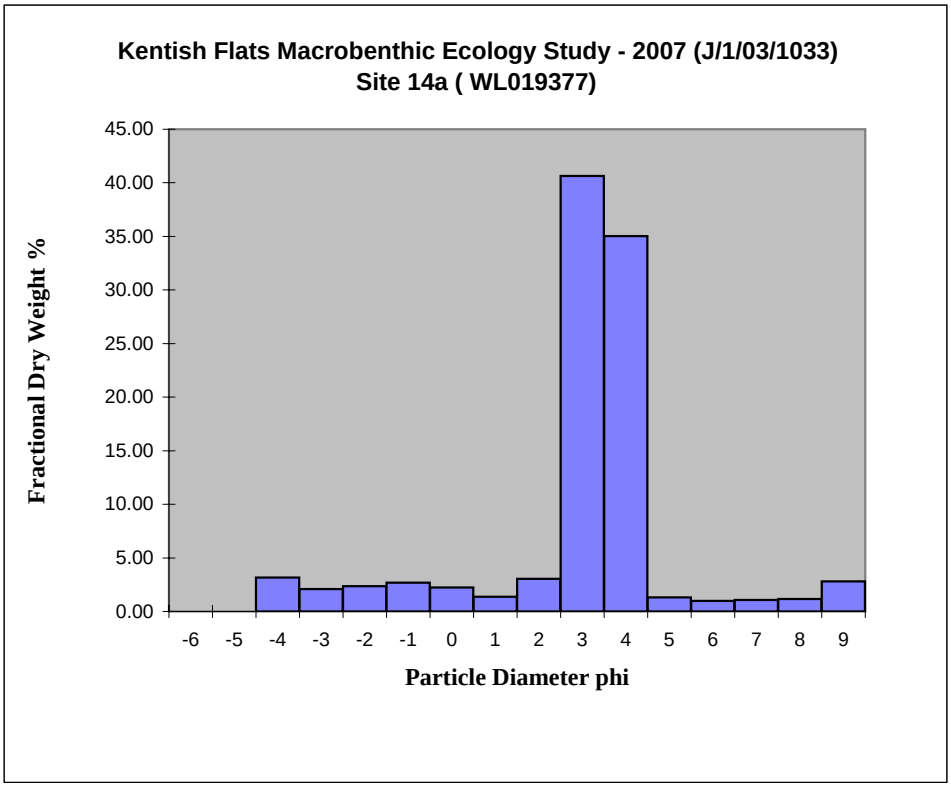
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage	
				Fractional	Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	5.553	3.17	3.17
Gravel	8	-3.0	3.655	2.09	5.26
	4	-2.0	4.130	2.36	7.62
Coarse Sand	2	-1.0	4.702	2.68	10.30
	1	0.0	3.935	2.25	12.55
Medium Sand	0.5	1.0	2.406	1.37	13.92
	0.25	2.0	5.334	3.05	16.97
Fine Sand	0.125	3.0	71.189	40.65	57.61
	0.063	4.0	61.350	35.03	92.64
Silt	0.032	5.0	2.322	1.33	93.97
	0.0156	6.0	1.714	0.98	94.94
	0.0078	7.0	1.904	1.09	96.03
	0.0039	8.0	2.039	1.16	97.20
Clay	<0.0039	9.0	4.911	2.80	100.00
		Total Weight	175	100	

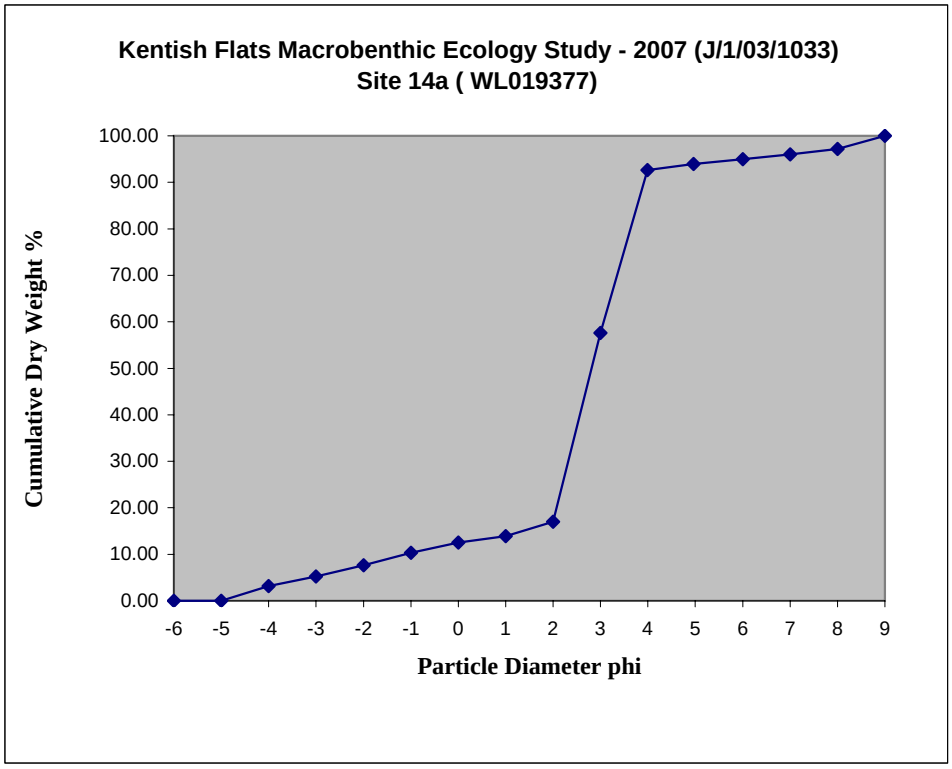
Mean mm	0.15
Md mm	0.14
Mean phi	2.75
Md phi	2.81
Sorting	1.91
Skq	-0.19
Kurtosis	2.91

%Gravel	7.62
% Sand	85.02
% Fines	7.36

Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 14a (WL019377)
Fractional Dry Weight %
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 14a (WL019377)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 14b (WL019378)

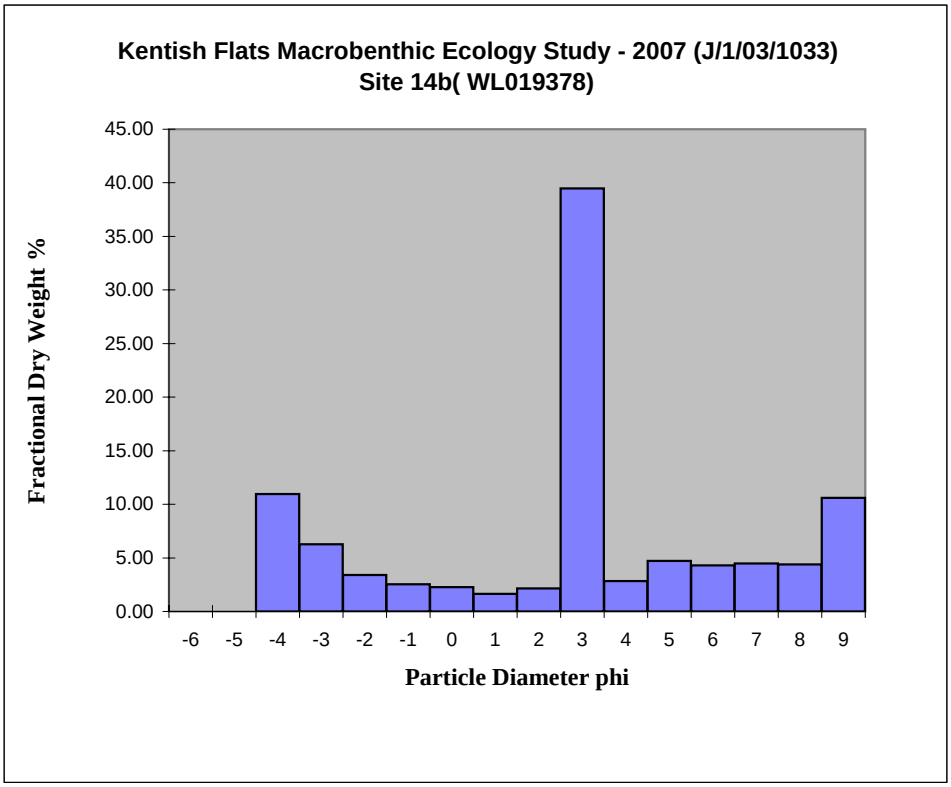
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage	
				Fractional	Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	7.044	10.95	10.95
Gravel	8	-3.0	4.040	6.28	17.23
	4	-2.0	2.198	3.42	20.65
Coarse Sand	2	-1.0	1.624	2.52	23.17
	1	0.0	1.459	2.27	25.44
Medium Sand	0.5	1.0	1.047	1.63	27.07
	0.25	2.0	1.387	2.16	29.22
Fine Sand	0.125	3.0	25.391	39.47	68.69
	0.063	4.0	1.819	2.83	71.52
Silt	0.032	5.0	3.032	4.71	76.23
	0.0156	6.0	2.771	4.31	80.54
	0.0078	7.0	2.878	4.47	85.01
	0.0039	8.0	2.815	4.38	89.39
Clay	<0.0039	9.0	6.826	10.61	100.00
		Total Weight	64	100	

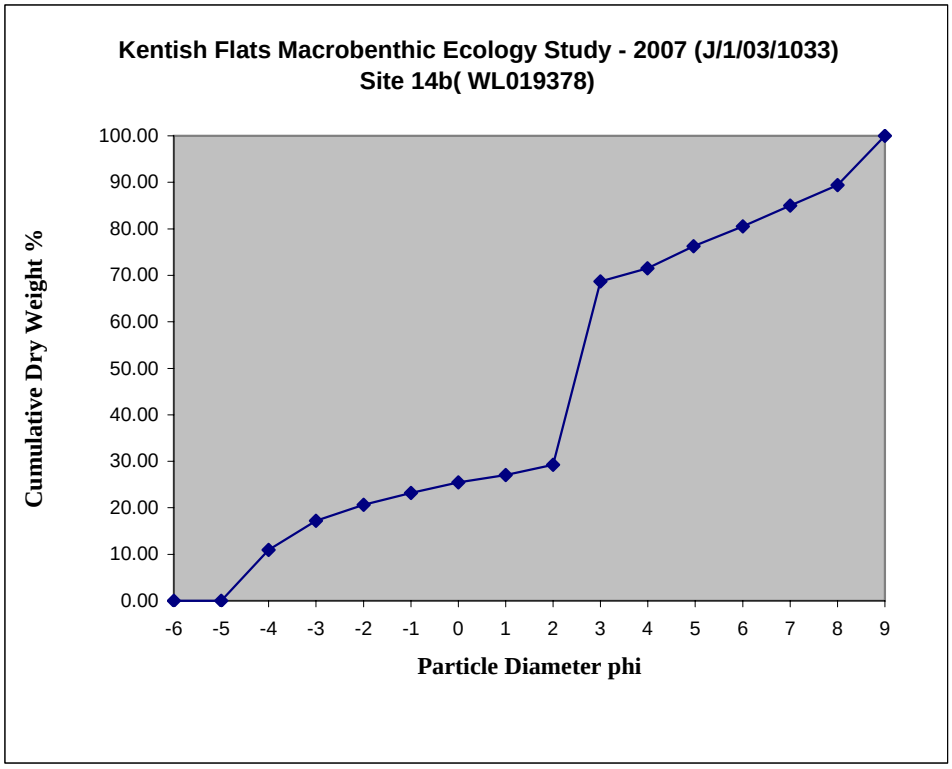
Mean mm	0.24
Md mm	0.17
Mean phi	2.04
Md phi	2.53
Sorting	4.38
Skq	-0.14
Kurtosis	1.04

%Gravel	20.65
% Sand	50.87
% Fines	28.48

Silty gravelly sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 14b(WL019378)
Fractional Dry Weight %
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 14b(WL019378)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 14c (WL019379)

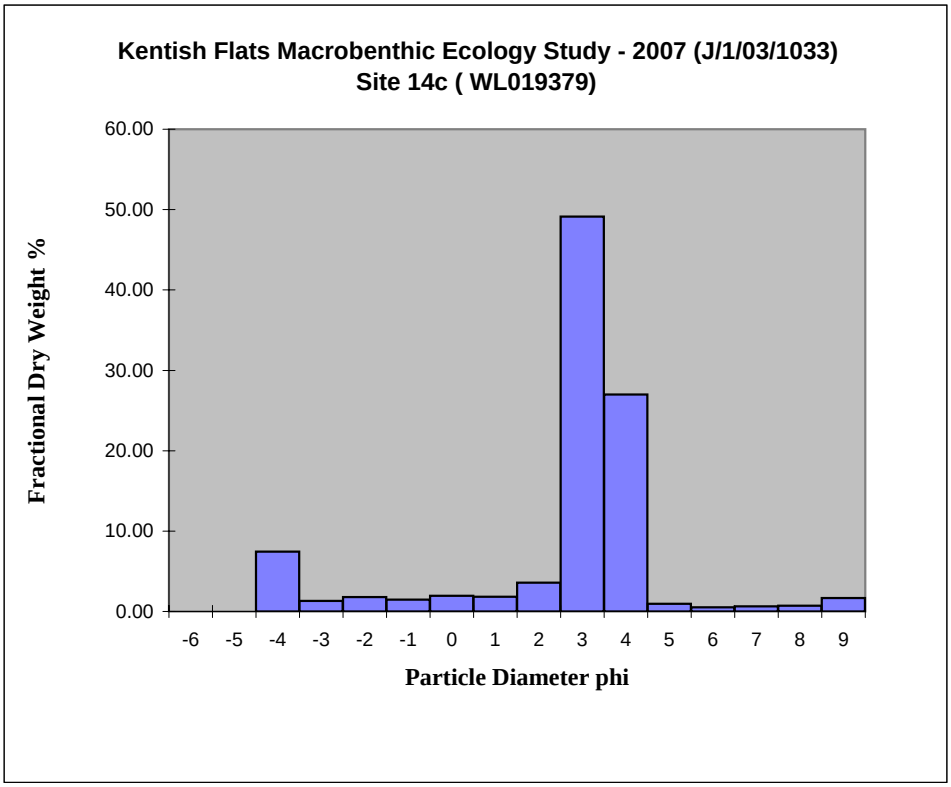
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage	
				Fractional	Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	20.817	7.45	7.45
Gravel	8	-3.0	3.725	1.33	8.78
	4	-2.0	5.038	1.80	10.59
Coarse Sand	2	-1.0	4.100	1.47	12.05
	1	0.0	5.411	1.94	13.99
Medium Sand	0.5	1.0	5.122	1.83	15.82
	0.25	2.0	10.057	3.60	19.42
Fine Sand	0.125	3.0	137.247	49.11	68.54
	0.063	4.0	75.422	26.99	95.53
Silt	0.032	5.0	2.625	0.94	96.47
	0.0156	6.0	1.490	0.53	97.00
	0.0078	7.0	1.735	0.62	97.62
	0.0039	8.0	1.969	0.70	98.32
Clay	<0.0039	9.0	4.684	1.68	100.00
		Total Weight	279	100	

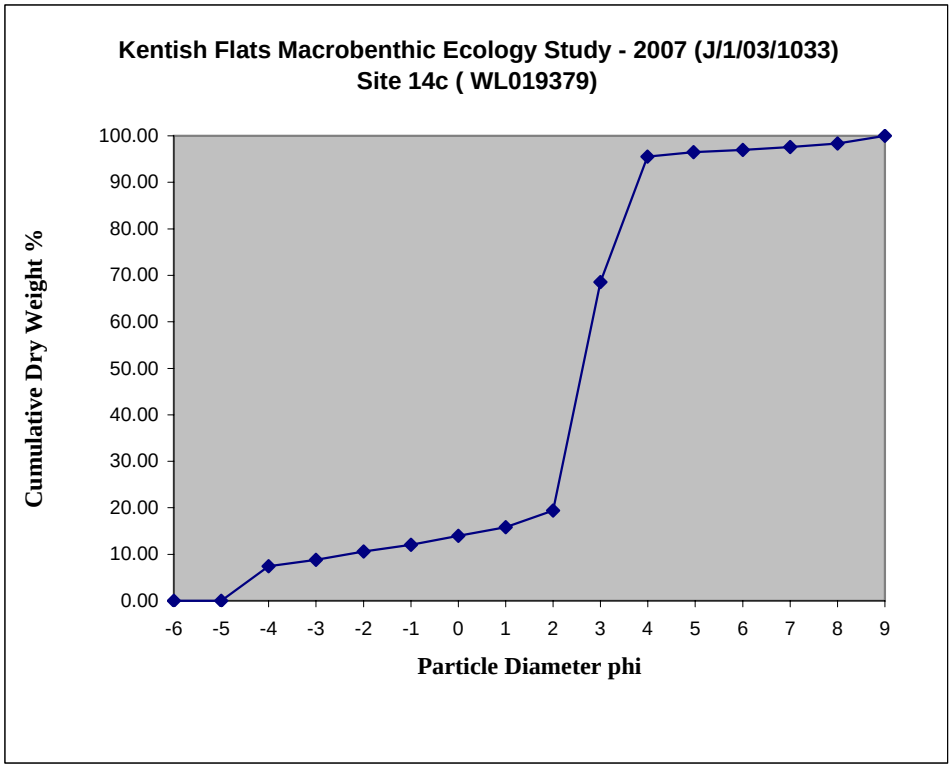
Mean mm	0.19
Md mm	0.16
Mean phi	2.41
Md phi	2.62
Sorting	1.89
Skq	-0.46
Kurtosis	3.03

%Gravel	10.59
% Sand	84.94
% Fines	4.47

Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 14c (WL019379)
Fractional Dry Weight %
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 14c (WL019379)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 16a (WL019380)

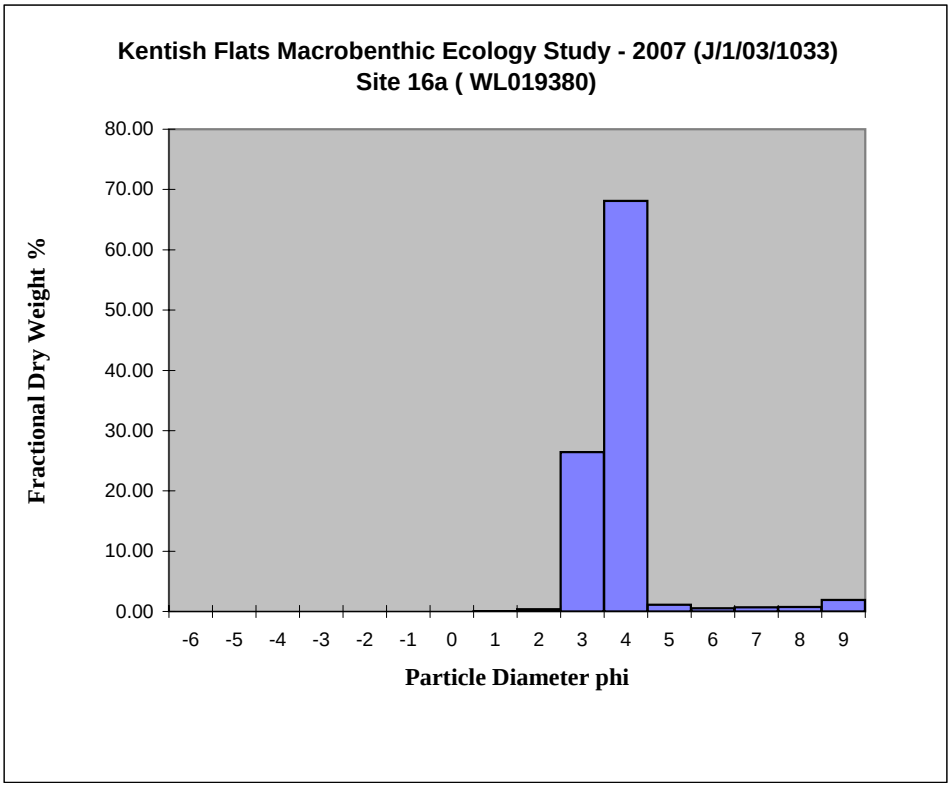
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage	
				Fractional	Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	0.000	0.00	0.00
Gravel	8	-3.0	0.000	0.00	0.00
	4	-2.0	0.000	0.00	0.00
Coarse Sand	2	-1.0	0.007	0.00	0.00
	1	0.0	0.025	0.01	0.01
Medium Sand	0.5	1.0	0.084	0.03	0.05
	0.25	2.0	0.933	0.38	0.43
Fine Sand	0.125	3.0	64.826	26.43	26.85
	0.063	4.0	167.072	68.11	94.96
Silt	0.032	5.0	2.793	1.14	96.10
	0.0156	6.0	1.260	0.51	96.62
	0.0078	7.0	1.710	0.70	97.31
	0.0039	8.0	1.887	0.77	98.08
Clay	<0.0039	9.0	4.703	1.92	100.00
		Total Weight	245	100	

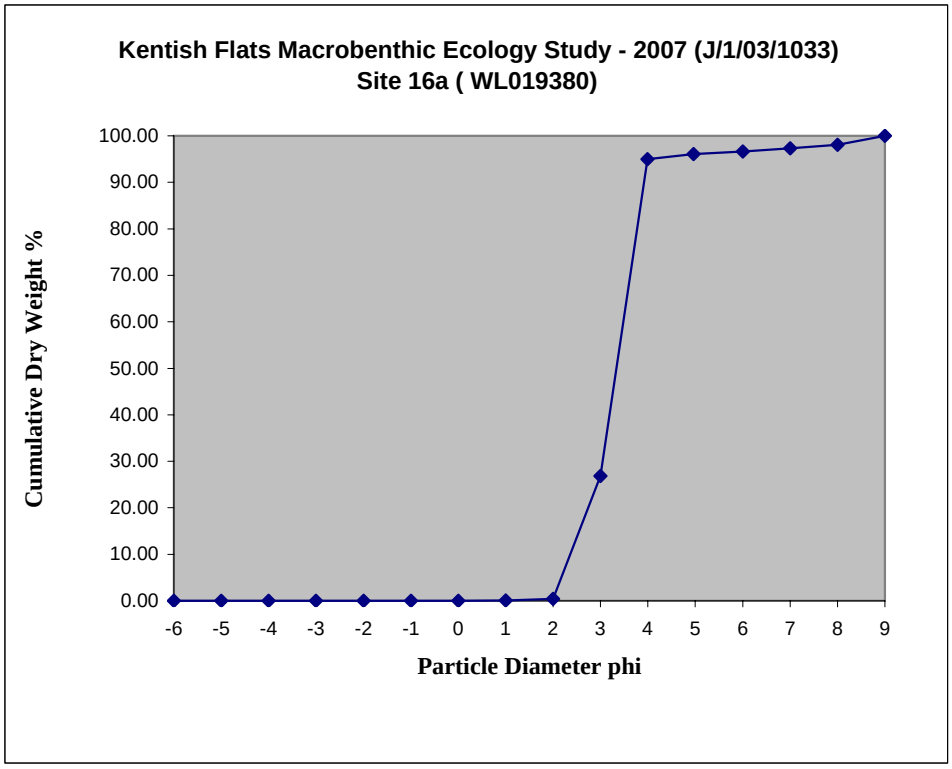
Mean mm	0.11
Md mm	0.10
Mean phi	3.25
Md phi	3.34
Sorting	0.59
Skq	-0.23
Kurtosis	0.98

%Gravel	0.00
% Sand	94.96
% Fines	5.04

Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 16a (WL019380)
Fractional Dry Weight %
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 16a (WL019380)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 16b (WL019381)

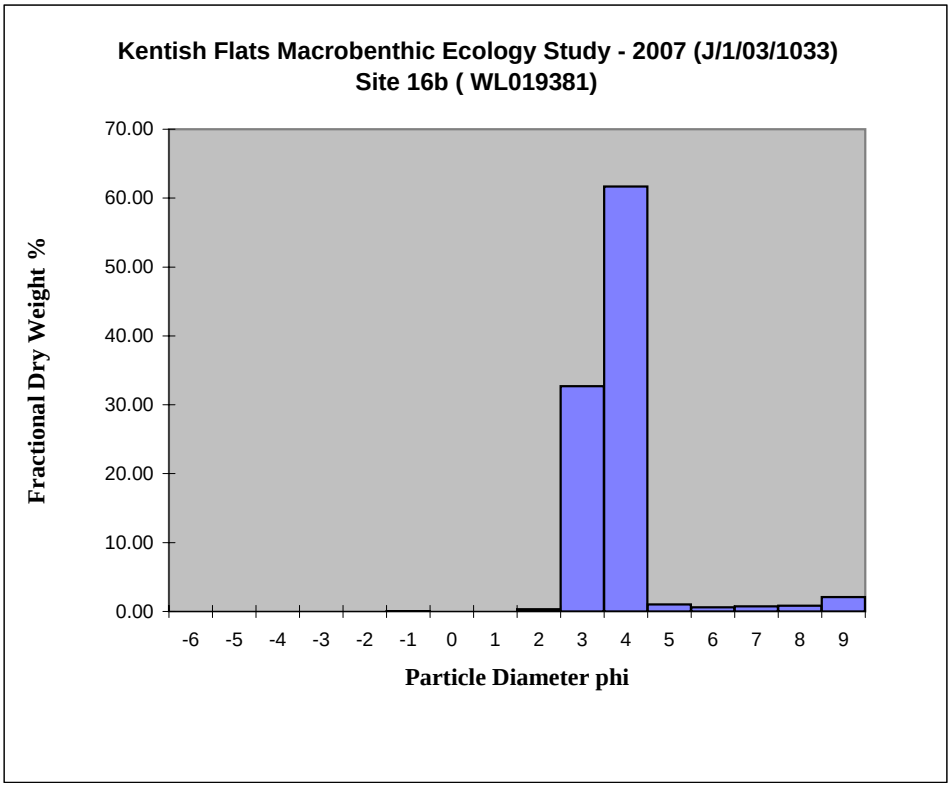
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	0.000	0.00	0.00
Gravel	8	-3.0	0.000	0.00	0.00
	4	-2.0	0.000	0.00	0.00
Coarse Sand	2	-1.0	0.054	0.02	0.02
	1	0.0	0.011	0.00	0.03
Medium Sand	0.5	1.0	0.045	0.02	0.05
	0.25	2.0	0.678	0.30	0.35
Fine Sand	0.125	3.0	72.678	32.68	33.04
	0.063	4.0	137.131	61.66	94.70
Silt	0.032	5.0	2.259	1.02	95.72
	0.0156	6.0	1.360	0.61	96.33
	0.0078	7.0	1.647	0.74	97.07
	0.0039	8.0	1.847	0.83	97.90
Clay	<0.0039	9.0	4.672	2.10	100.00
		Total Weight	222	100	

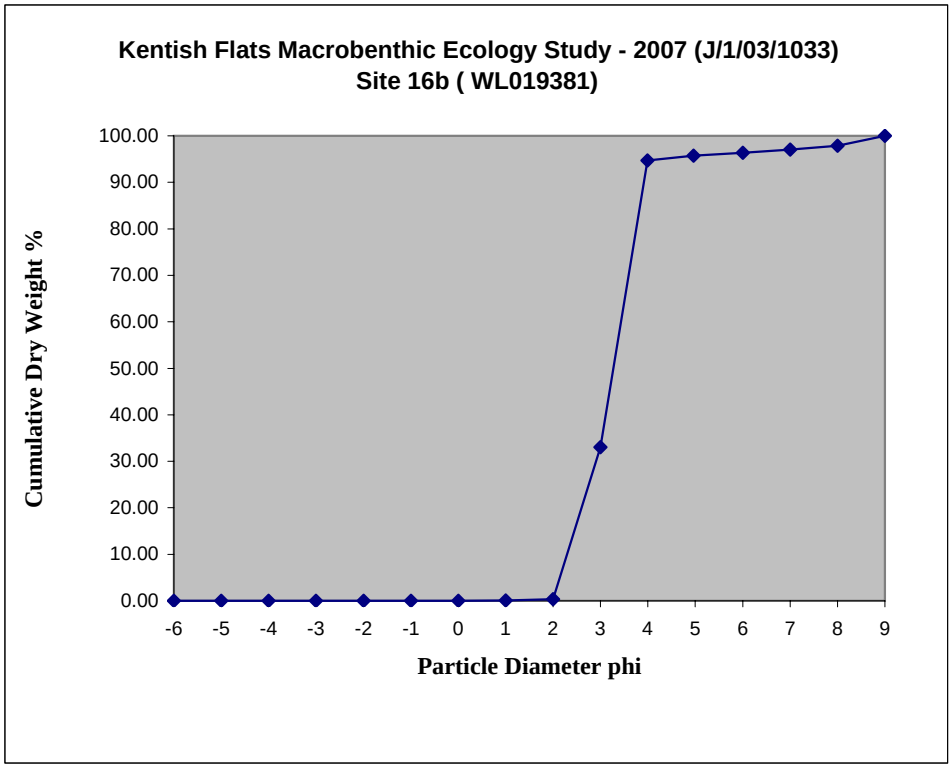
Mean mm	0.11
Md mm	0.10
Mean phi	3.19
Md phi	3.27
Sorting	0.66
Skq	-0.12
Kurtosis	0.95

%Gravel	0.00
% Sand	94.70
% Fines	5.30

Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 16b (WL019381)
Fractional Dry Weight %
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 16b (WL019381)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

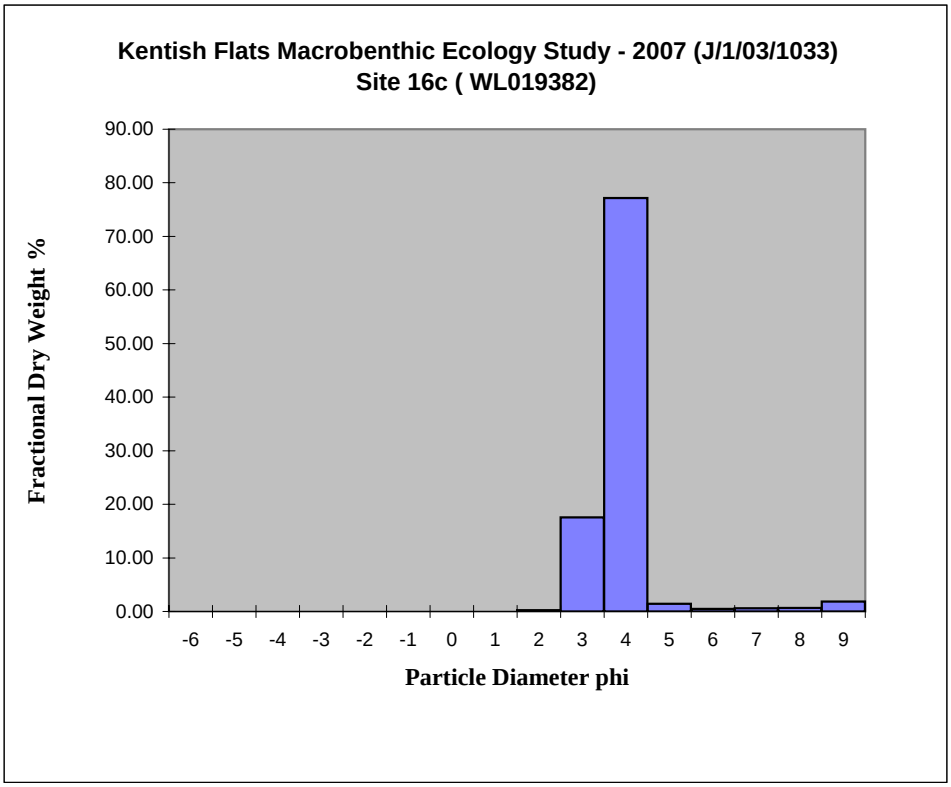
Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 16c (WL019382)

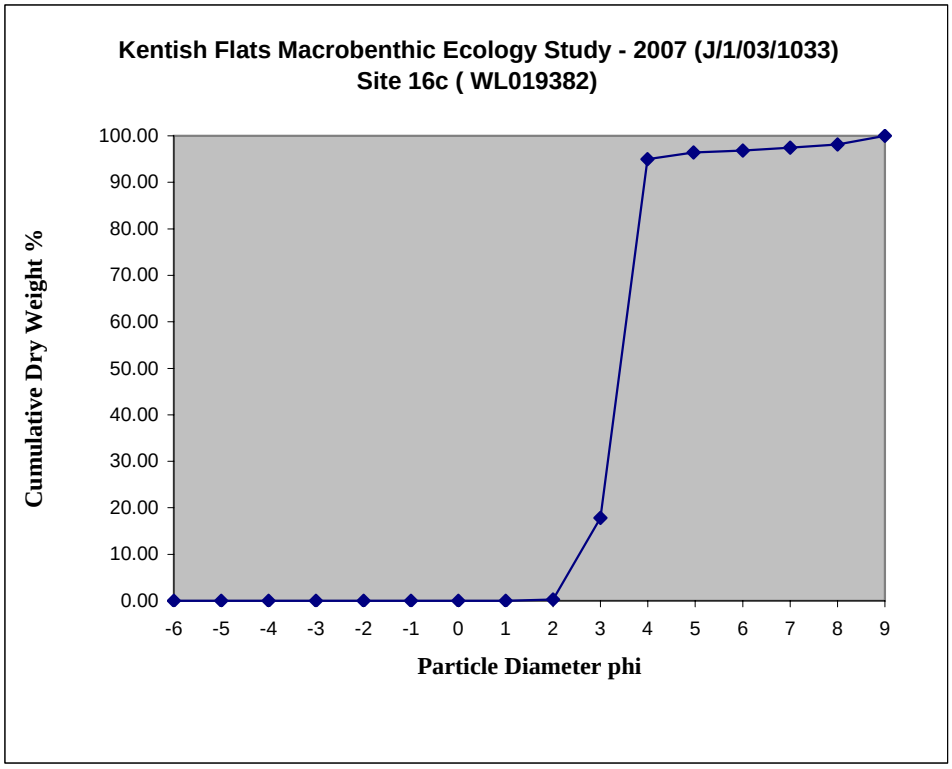
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	0.000	0.00	0.00
Gravel	8	-3.0	0.000	0.00	0.00
	4	-2.0	0.000	0.00	0.00
Coarse Sand	2	-1.0	0.011	0.00	0.00
	1	0.0	0.005	0.00	0.01
Medium Sand	0.5	1.0	0.056	0.02	0.03
	0.25	2.0	0.545	0.24	0.27
Fine Sand	0.125	3.0	40.341	17.53	17.80
	0.063	4.0	177.573	77.18	94.99
Silt	0.032	5.0	3.251	1.41	96.40
	0.0156	6.0	1.053	0.46	96.86
	0.0078	7.0	1.370	0.60	97.45
	0.0039	8.0	1.558	0.68	98.13
Clay	<0.0039	9.0	4.304	1.87	100.00
		Total Weight	230	100	

Mean mm	0.10
Md mm	0.09
Mean phi	3.39
Md phi	3.41
Sorting	0.50
Skq	-0.20
Kurtosis	1.11

%Gravel	0.00
% Sand	94.99
% Fines	5.01
	Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 16c (WL019382)
Fractional Dry Weight %
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 16c (WL019382)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 18a (WL019383)

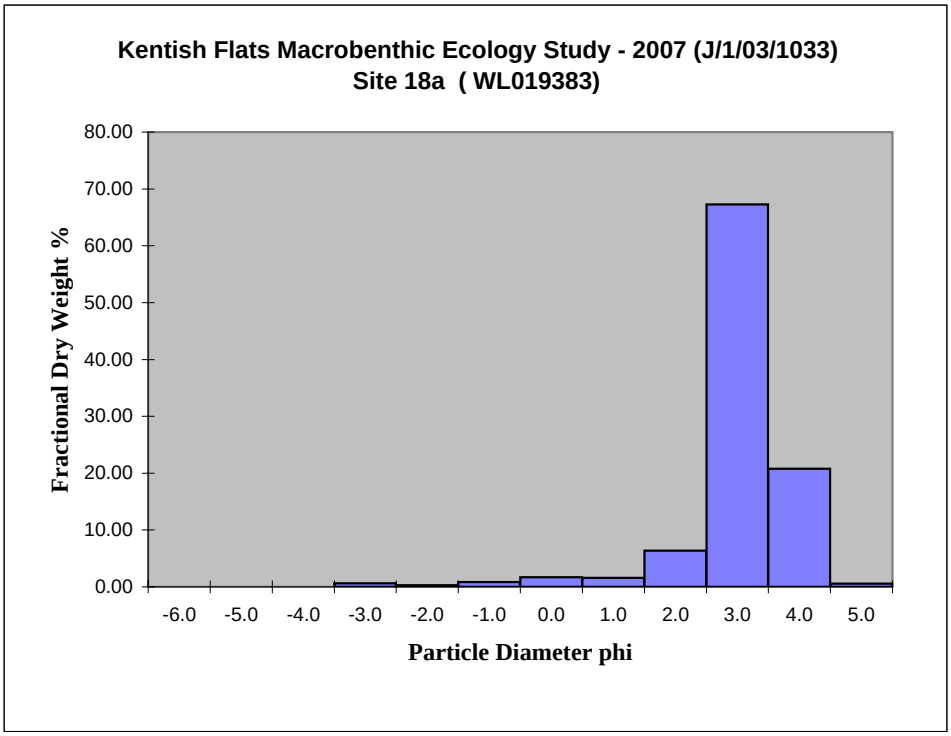
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	0.000	0.00	0.00
Gravel	8	-3.0	1.350	0.61	0.61
	4	-2.0	0.570	0.26	0.87
Coarse Sand	2	-1.0	1.841	0.84	1.71
	1	0.0	3.769	1.71	3.42
Medium Sand	0.5	1.0	3.497	1.59	5.01
	0.25	2.0	14.059	6.38	11.39
Fine Sand	0.125	3.0	148.147	67.26	78.65
	0.063	4.0	45.758	20.77	99.43
Silt/Clay	<0.063	5.0	1.266	0.57	100.00
		Total Weight	220.257	100.00	

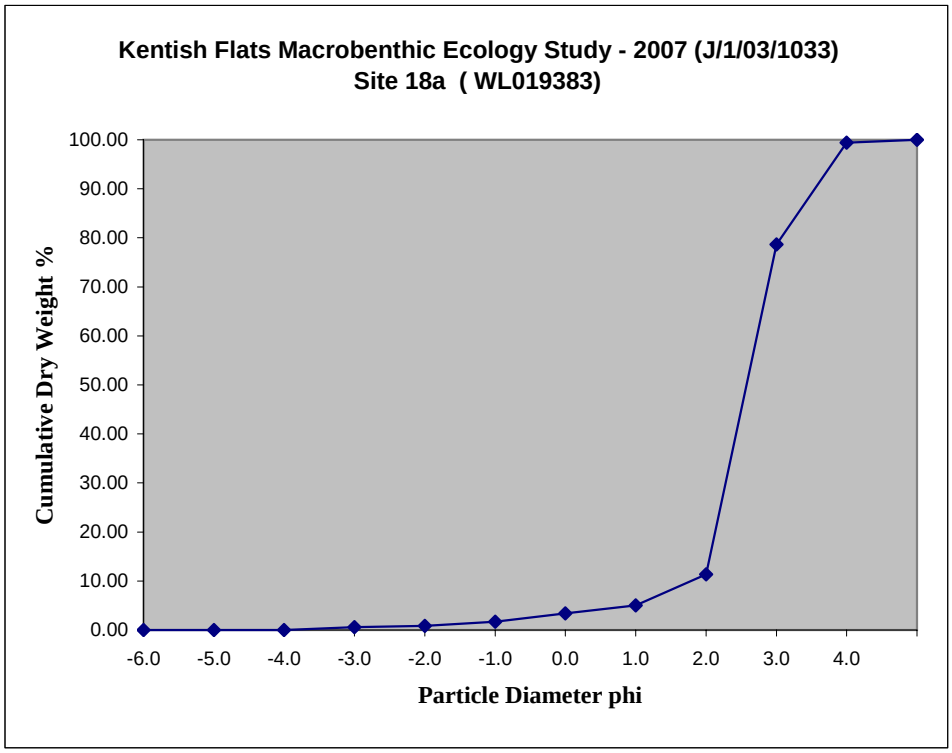
Mean mm	0.17
Md mm	0.17
Mean phi	2.52
Md phi	2.57
Sorting	0.49
Skq	-0.46
Kurtosis	0.99

%Gravel	0.87
% Sand	98.55
% Fines	0.57

Sand

* Based on Connor *et al*, 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 18a (WL019383)
Fractional Dry Weight %
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 18a (WL019383)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 18b (WL019384)

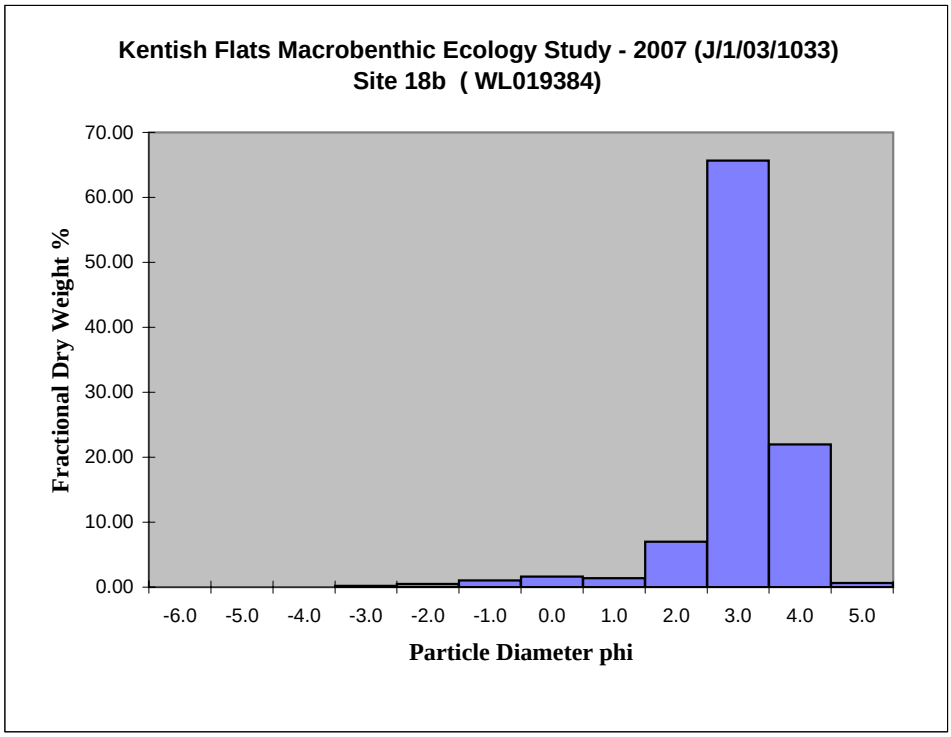
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage	
				Fractional	Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	0.000	0.00	0.00
Gravel	8	-3.0	0.438	0.18	0.18
	4	-2.0	1.206	0.49	0.67
Coarse Sand	2	-1.0	2.556	1.04	1.71
	1	0.0	4.036	1.65	3.36
Medium Sand	0.5	1.0	3.356	1.37	4.73
	0.25	2.0	17.125	6.99	11.72
Fine Sand	0.125	3.0	160.933	65.65	77.37
	0.063	4.0	53.854	21.97	99.34
Silt/Clay	<0.063	5.0	1.624	0.66	100.00
		Total Weight	245.128	100.00	

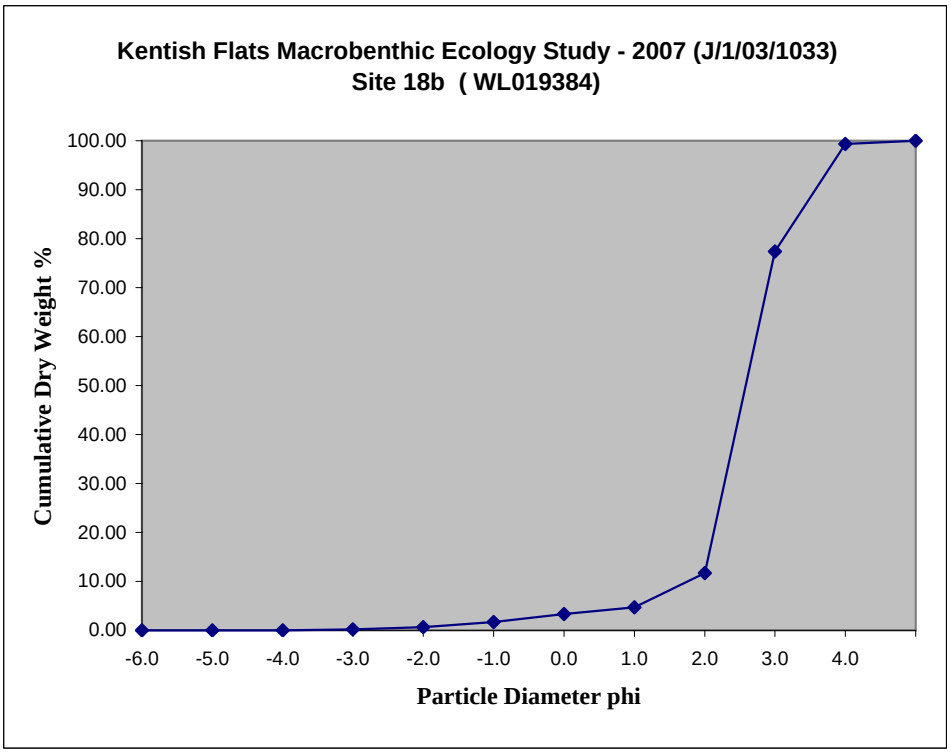
Mean mm	0.17
Md mm	0.17
Mean phi	2.52
Md phi	2.58
Sorting	0.47
Skq	-0.50
Kurtosis	0.93

%Gravel	0.67
% Sand	98.67
% Fines	0.66

Sand

* Based on Connor *et al*, 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 18b (WL019384)
Fractional Dry Weight %
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 18b (WL019384)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 18c (WL019385)

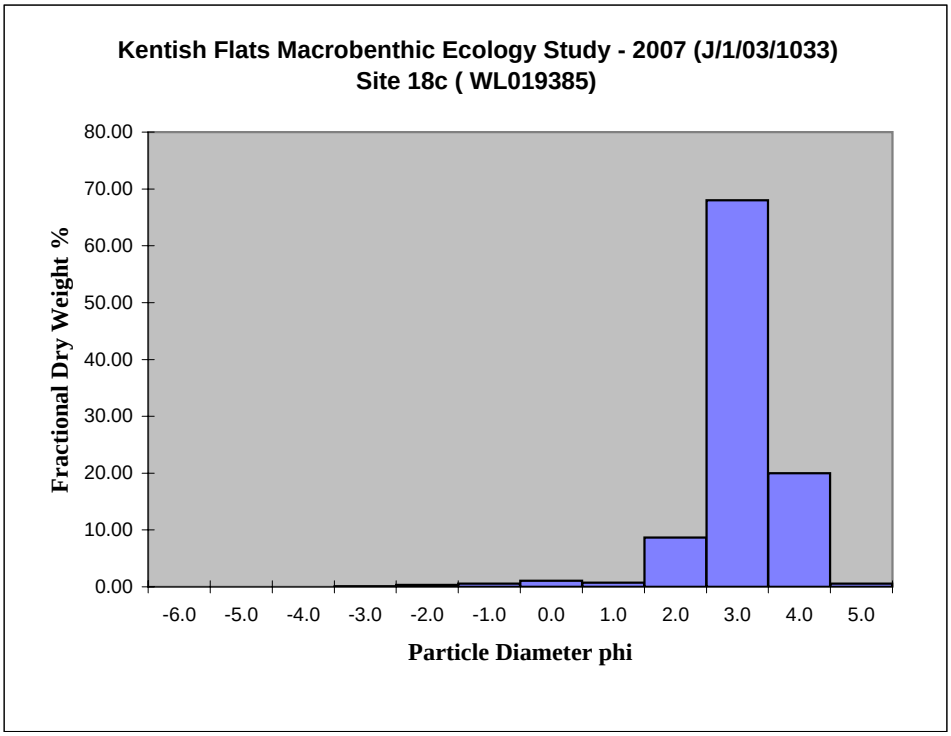
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	0.000	0.00	0.00
Gravel	8	-3.0	0.130	0.06	0.06
	4	-2.0	0.762	0.35	0.41
Coarse Sand	2	-1.0	1.205	0.55	0.96
	1	0.0	2.362	1.09	2.05
Medium Sand	0.5	1.0	1.547	0.71	2.76
	0.25	2.0	18.891	8.68	11.44
Fine Sand	0.125	3.0	148.075	68.03	79.46
	0.063	4.0	43.444	19.96	99.42
Silt/Clay	<0.063	5.0	1.261	0.58	100.00
		Total Weight	217.677	100.00	

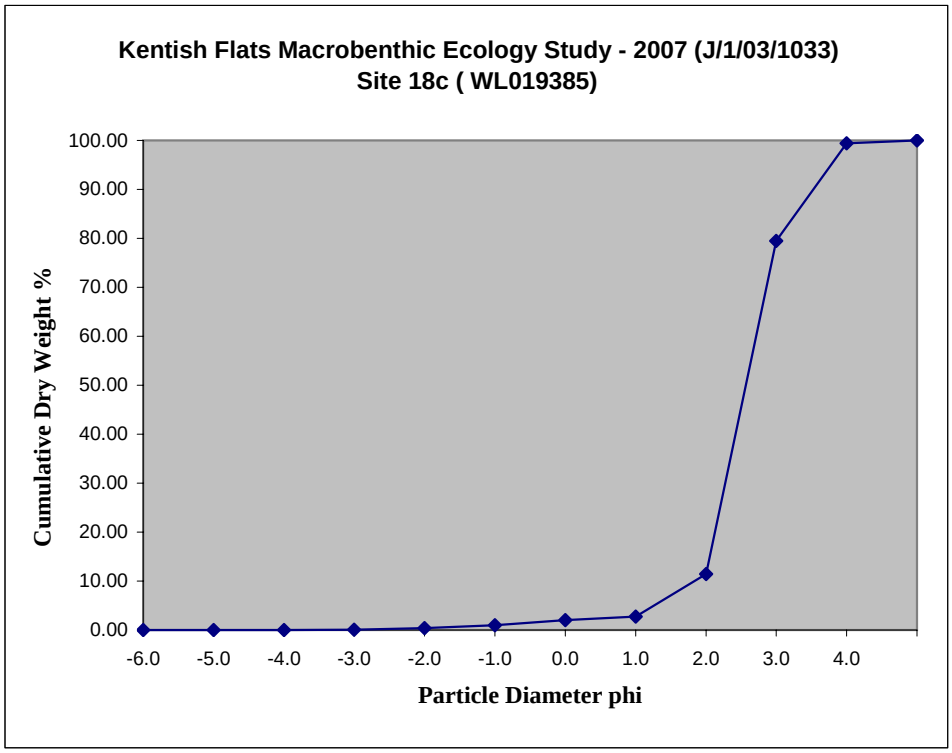
Mean mm	0.17
Md mm	0.17
Mean phi	2.53
Md phi	2.57
Sorting	0.45
Skq	-0.42
Kurtosis	0.86

%Gravel	0.41
% Sand	99.01
% Fines	0.58

Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 18c (WL019385)
Fractional Dry Weight %
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 18c (WL019385)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 21a (WL019386)

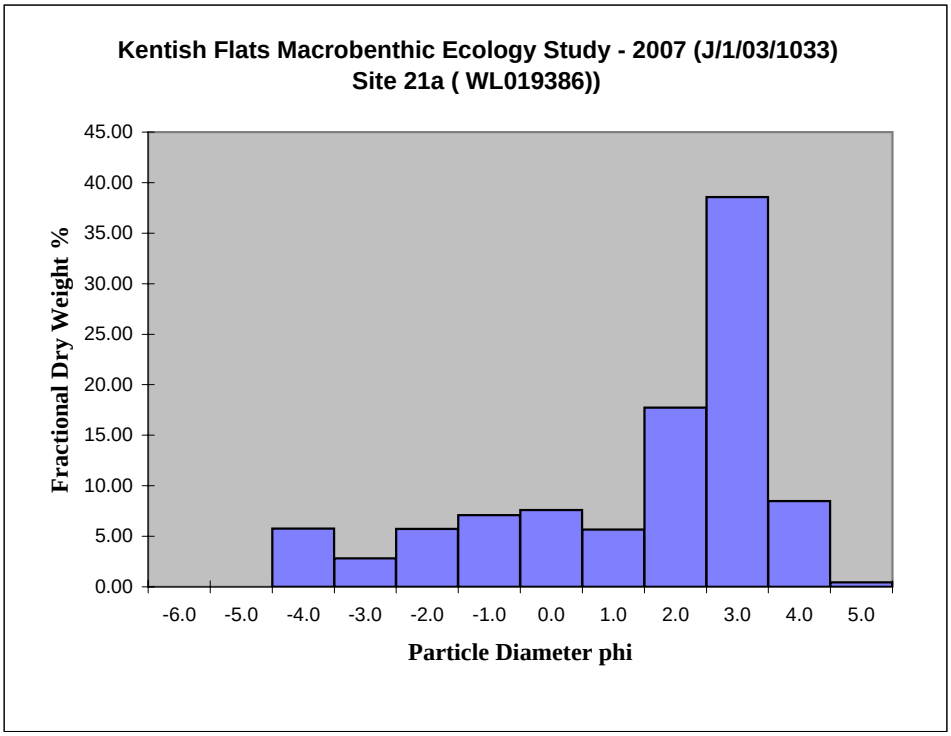
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	13.607	5.78	5.78
Gravel	8	-3.0	6.673	2.83	8.61
	4	-2.0	13.485	5.73	14.34
Coarse Sand	2	-1.0	16.737	7.11	21.45
	1	0.0	17.932	7.62	29.06
Medium Sand	0.5	1.0	13.371	5.68	34.74
	0.25	2.0	41.767	17.74	52.48
Fine Sand	0.125	3.0	90.855	38.58	91.06
	0.063	4.0	19.966	8.48	99.54
Silt/Clay	<0.063	5.0	1.080	0.46	100.00
		Total Weight	235.473	100.00	

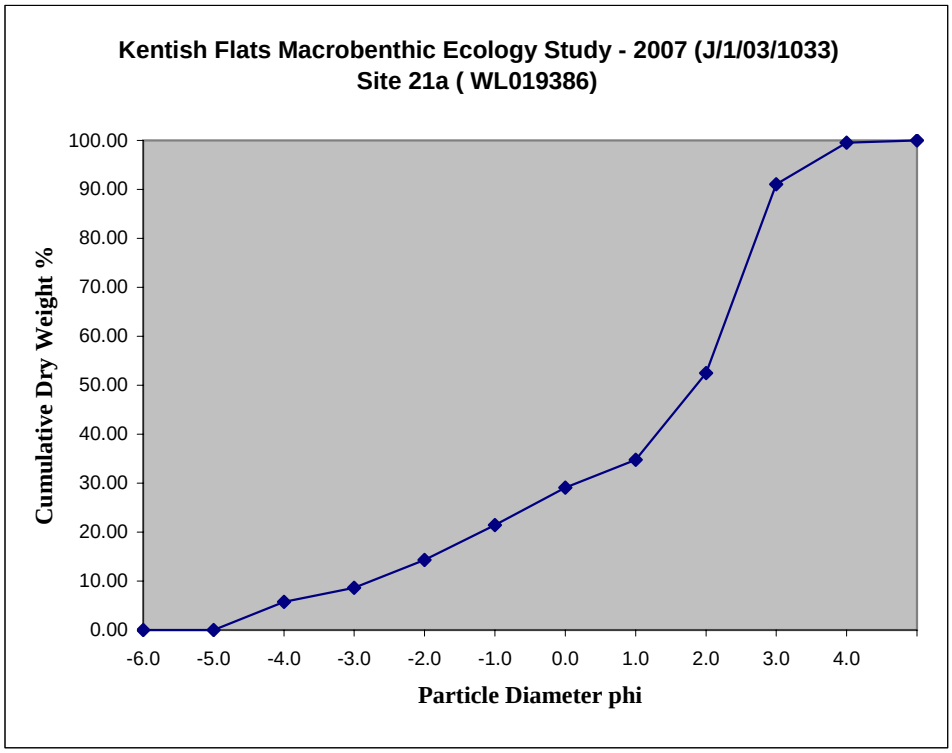
Mean mm	0.51
Md mm	0.28
Mean phi	0.97
Md phi	1.86
Sorting	2.22
Skq	-0.64
Kurtosis	0.93

%Gravel	14.34
% Sand	85.20
% Fines	0.46

Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 21a (WL019386))
Fractional Dry Weight %
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 21a (WL019386)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 21b (WL019387)

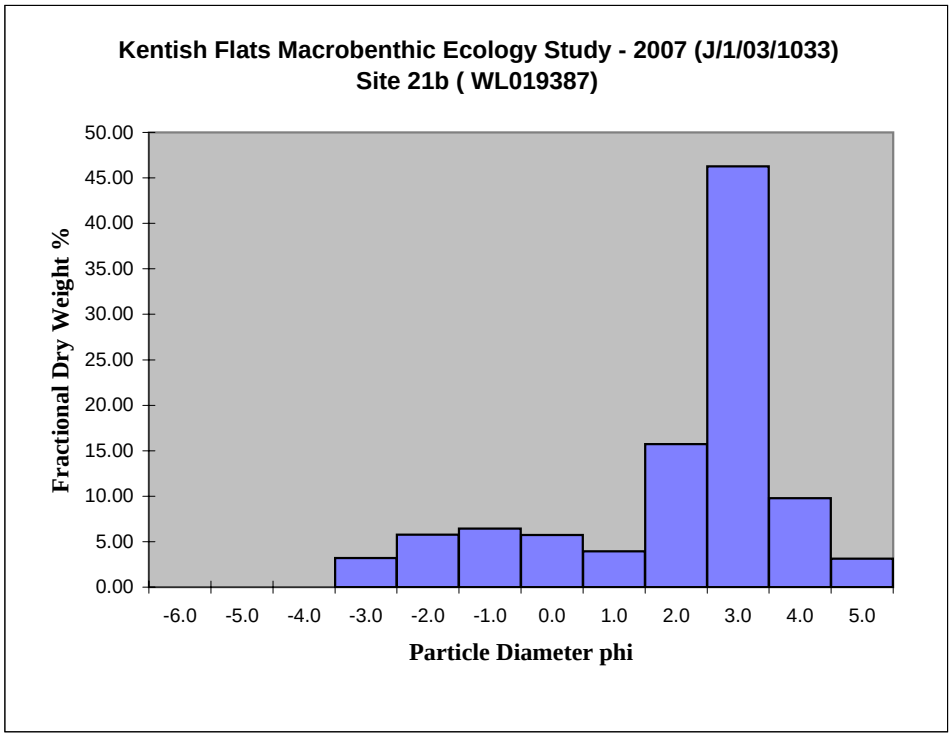
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	0.000	0.00	0.00
Gravel	8	-3.0	7.709	3.21	3.21
	4	-2.0	13.843	5.77	8.98
Coarse Sand	2	-1.0	15.428	6.43	15.41
	1	0.0	13.761	5.73	21.15
Medium Sand	0.5	1.0	9.478	3.95	25.10
	0.25	2.0	37.739	15.73	40.82
Fine Sand	0.125	3.0	111.045	46.28	87.10
	0.063	4.0	23.456	9.78	96.88
Silt/Clay	<0.063	5.0	7.497	3.12	100.00
		Total Weight	239.956	100.00	

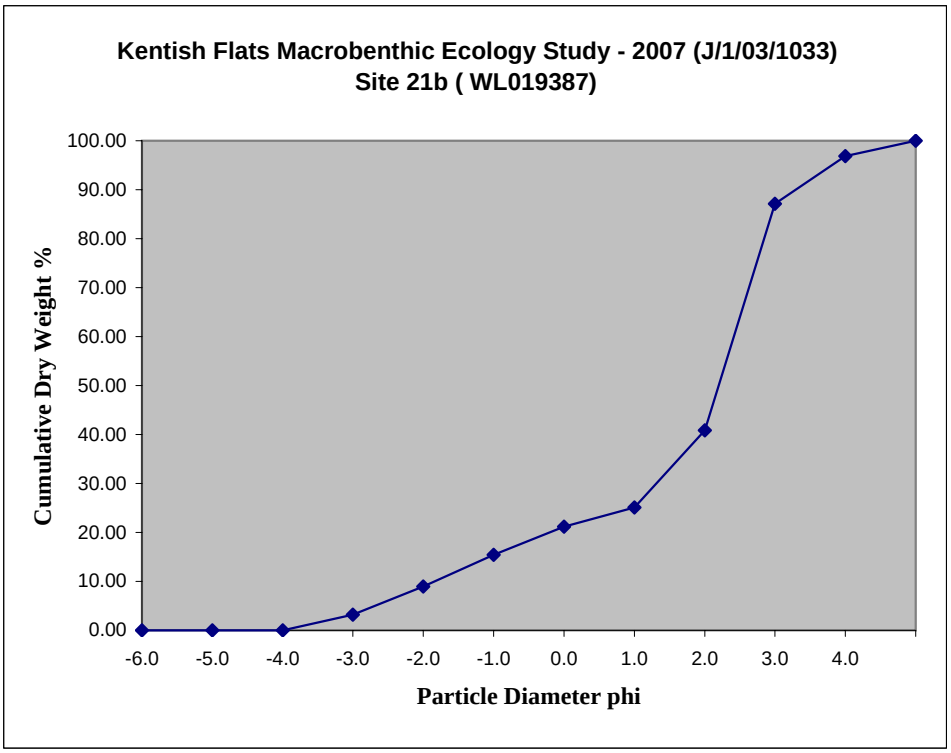
Mean mm	0.38
Md mm	0.22
Mean phi	1.41
Md phi	2.20
Sorting	1.81
Skq	-0.68
Kurtosis	1.30

%Gravel	8.98
% Sand	87.89
% Fines	3.12

Sand

* Based on Connor *et al*, 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 21b (WL019387)
Fractional Dry Weight %
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 21b (WL019387)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 21c (WL019388)

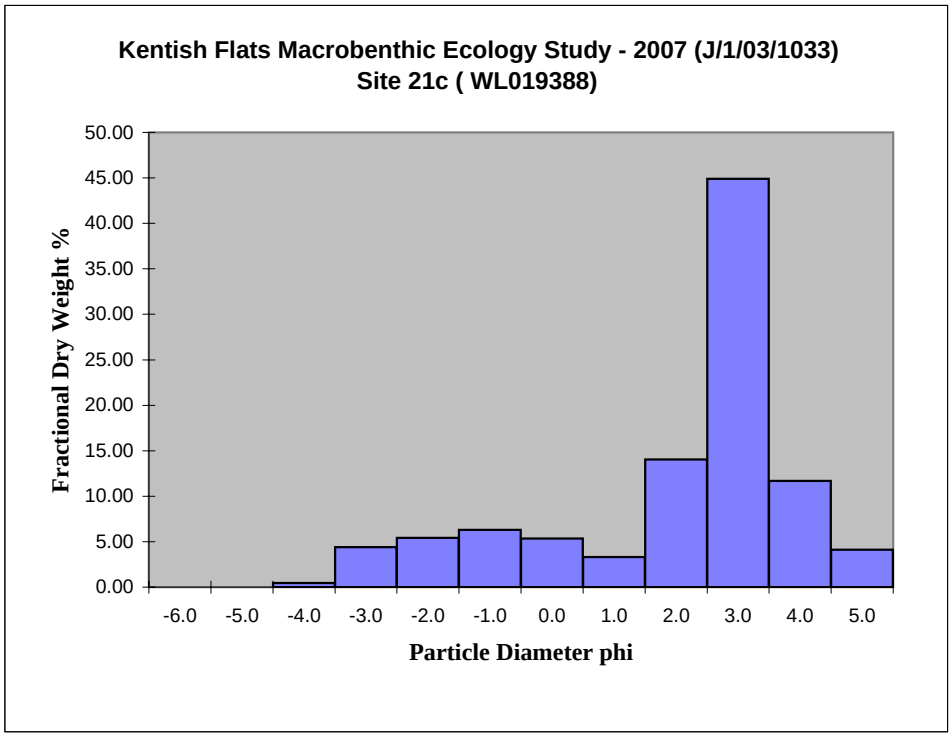
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage	
				Fractional	Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	1.150	0.45	0.45
Gravel	8	-3.0	11.269	4.41	4.86
	4	-2.0	13.861	5.43	10.29
Coarse Sand	2	-1.0	16.090	6.30	16.58
	1	0.0	13.684	5.36	21.94
Medium Sand	0.5	1.0	8.477	3.32	25.26
	0.25	2.0	35.846	14.03	39.29
Fine Sand	0.125	3.0	114.693	44.89	84.18
	0.063	4.0	29.884	11.70	95.88
Silt/Clay	<0.063	5.0	10.529	4.12	100.00
		Total Weight	255.483	100.00	

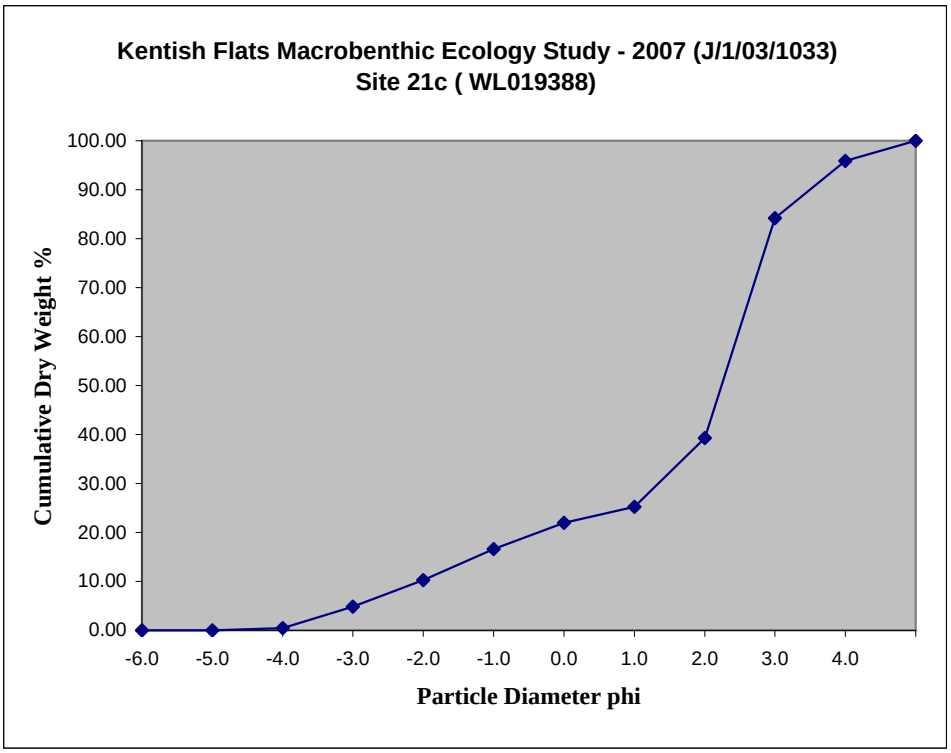
Mean mm	0.38
Md mm	0.21
Mean phi	1.38
Md phi	2.24
Sorting	1.91
Skq	-0.71
Kurtosis	1.28

%Gravel	10.29
% Sand	85.59
% Fines	4.12

Sand

* Based on Connor *et al*, 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 21c (WL019388)
Fractional Dry Weight %
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 21c (WL019388)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 29a (WL019389)

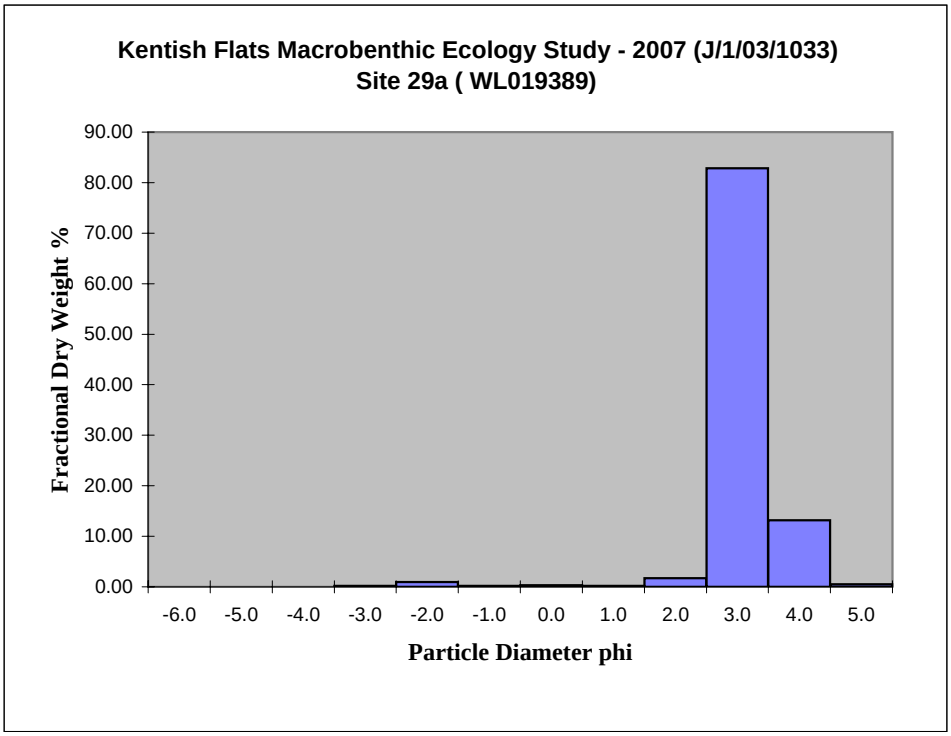
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage	
				Fractional	Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	0.000	0.00	0.00
Gravel	8	-3.0	0.400	0.18	0.18
	4	-2.0	2.139	0.97	1.15
Coarse Sand	2	-1.0	0.428	0.19	1.34
	1	0.0	0.641	0.29	1.63
Medium Sand	0.5	1.0	0.462	0.21	1.84
	0.25	2.0	3.750	1.70	3.54
Fine Sand	0.125	3.0	183.213	82.84	86.37
	0.063	4.0	29.078	13.15	99.52
Silt/Clay	<0.063	5.0	1.058	0.48	100.00
		Total Weight	221.169	100.00	

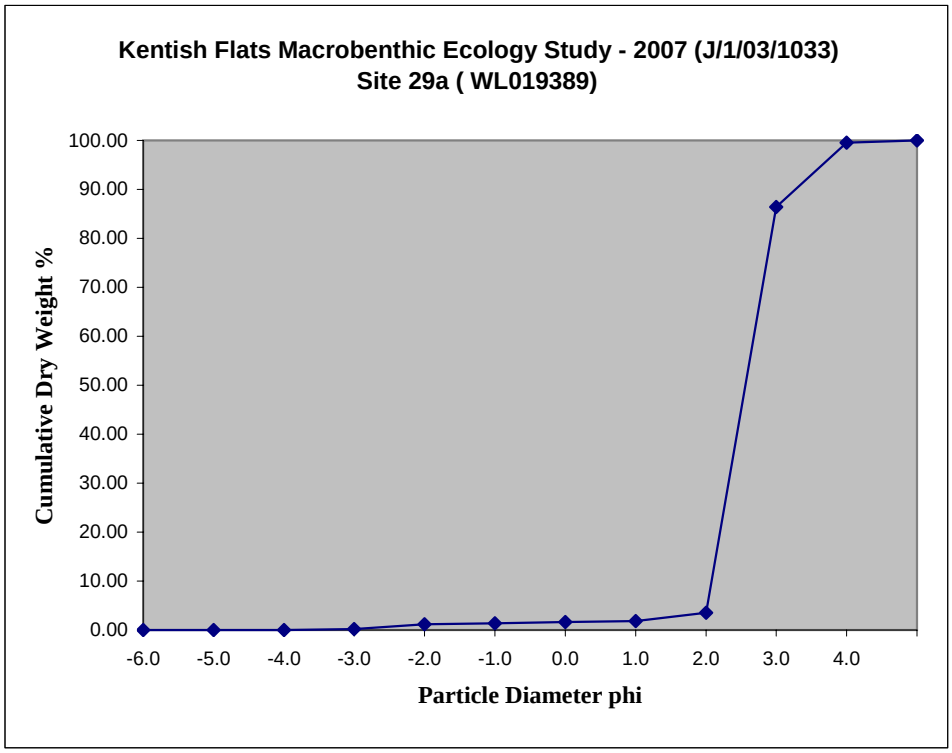
Mean mm	0.17
Md mm	0.17
Mean phi	2.56
Md phi	2.56
Sorting	0.34
Skq	-0.12
Kurtosis	0.60

%Gravel	1.15
% Sand	98.37
% Fines	0.48

Sand

* Based on Connor *et al*, 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 29a (WL019389)
Fractional Dry Weight %
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 29a (WL019389)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 29b (WL019390)

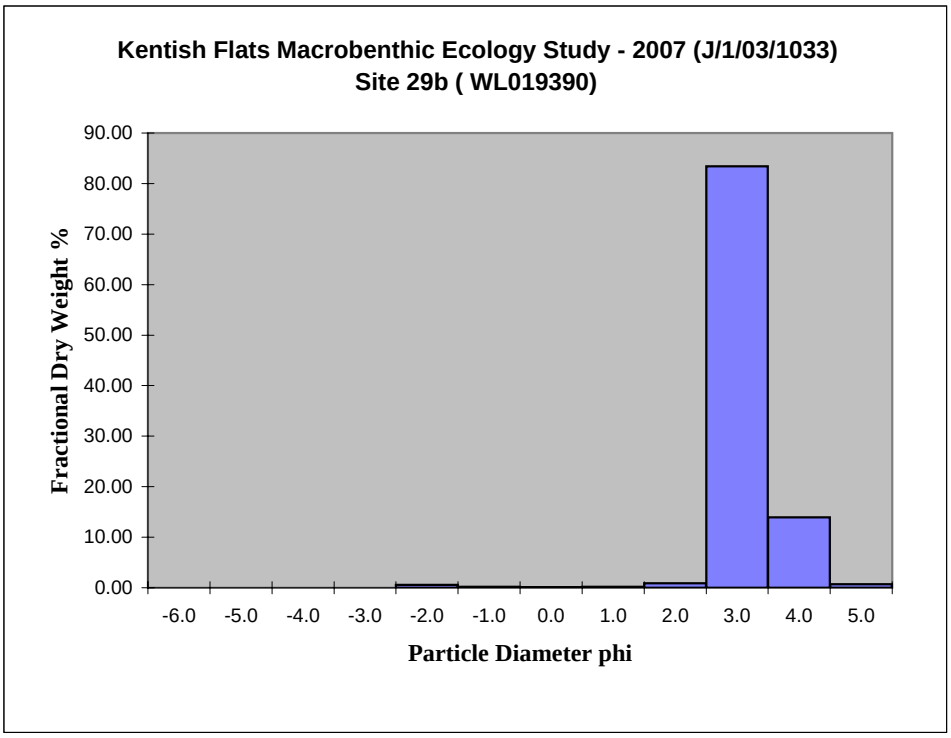
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	0.000	0.00	0.00
Gravel	8	-3.0	0.000	0.00	0.00
	4	-2.0	1.179	0.55	0.55
Coarse Sand	2	-1.0	0.456	0.21	0.76
	1	0.0	0.301	0.14	0.90
Medium Sand	0.5	1.0	0.356	0.17	1.07
	0.25	2.0	1.954	0.91	1.98
Fine Sand	0.125	3.0	179.181	83.42	85.40
	0.063	4.0	29.934	13.94	99.33
Silt/Clay	<0.063	5.0	1.430	0.67	100.00
		Total Weight	214.791	100.00	

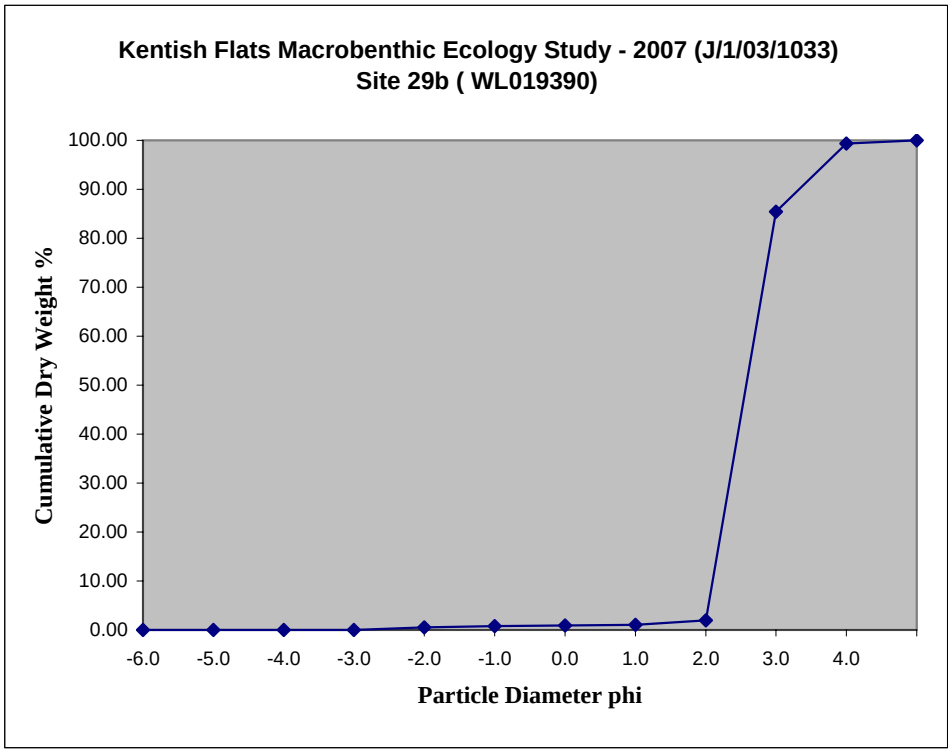
Mean mm	0.17
Md mm	0.17
Mean phi	2.58
Md phi	2.58
Sorting	0.33
Skq	-0.13
Kurtosis	0.58

%Gravel	0.55
% Sand	98.79
% Fines	0.67

Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 29b (WL019390)
Fractional Dry Weight %
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 29b (WL019390)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 29c (WL019391)

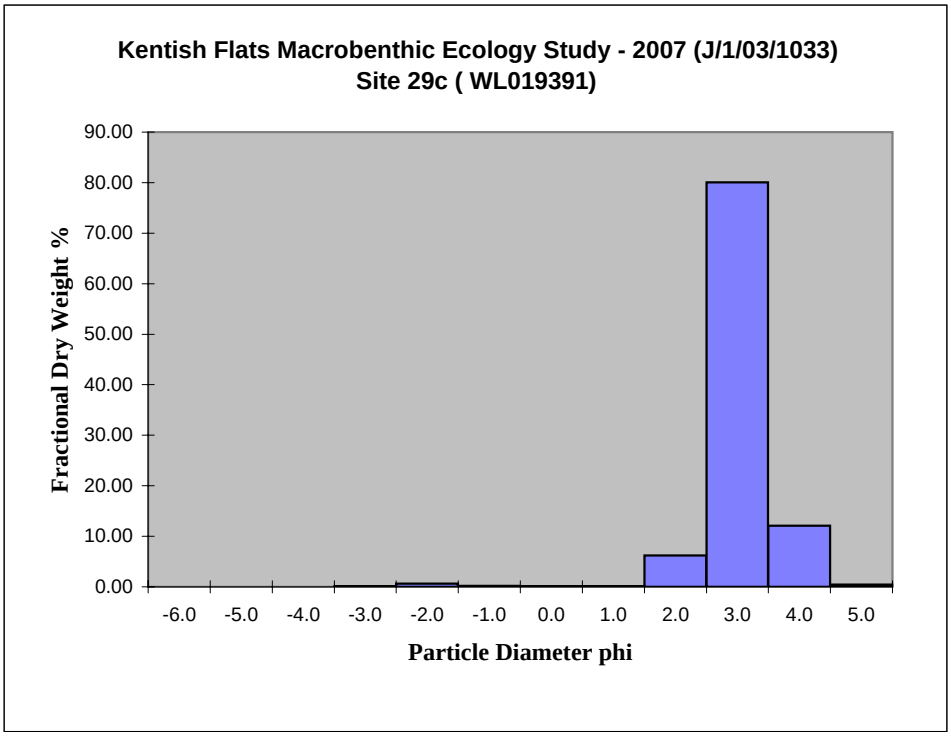
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage	
				Fractional	Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	0.000	0.00	0.00
Gravel	8	-3.0	0.274	0.12	0.12
	4	-2.0	1.448	0.66	0.78
Coarse Sand	2	-1.0	0.380	0.17	0.96
	1	0.0	0.275	0.13	1.08
Medium Sand	0.5	1.0	0.292	0.13	1.22
	0.25	2.0	13.676	6.23	7.44
Fine Sand	0.125	3.0	175.776	80.04	87.48
	0.063	4.0	26.560	12.09	99.58
Silt/Clay	<0.063	5.0	0.927	0.42	100.00
		Total Weight	219.608	100.00	

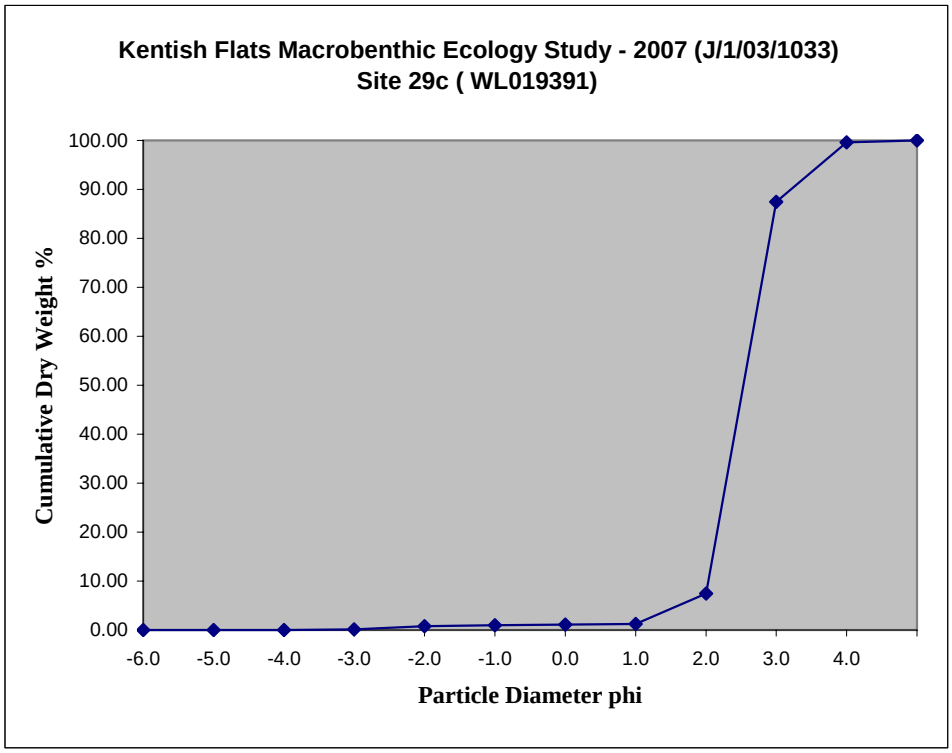
Mean mm	0.17
Md mm	0.17
Mean phi	2.53
Md phi	2.53
Sorting	0.41
Skq	-0.21
Kurtosis	0.86

%Gravel	0.78
% Sand	98.79
% Fines	0.42

Sand

* Based on Connor *et al*, 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 29c (WL019391)
Fractional Dry Weight %
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 29c (WL019391)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 31a (WL019392)

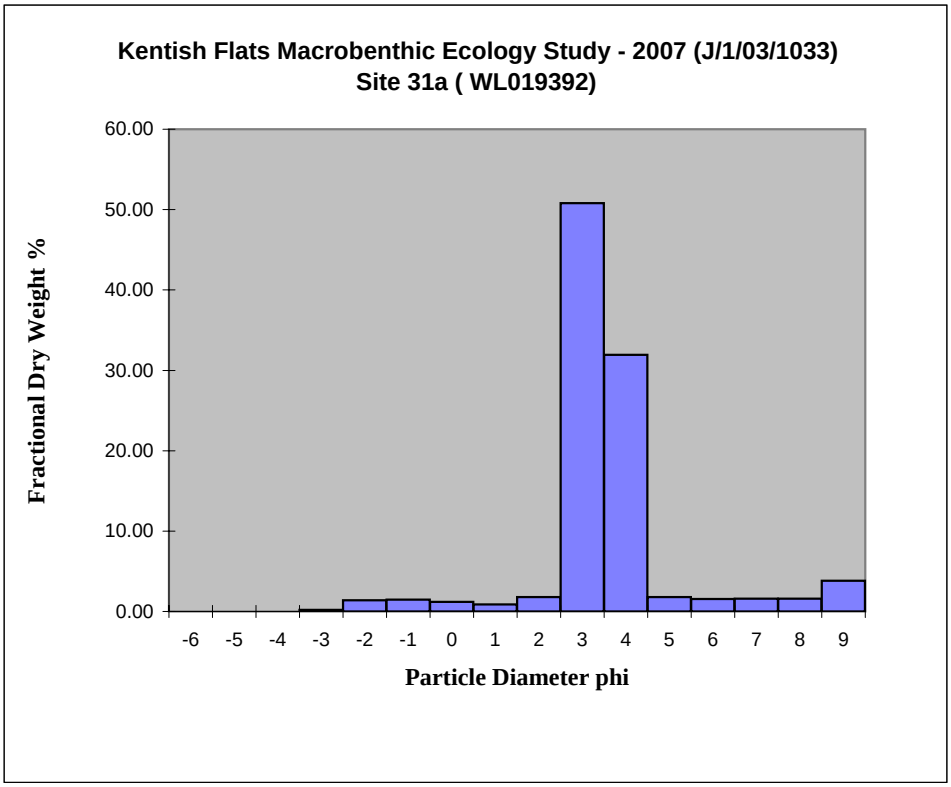
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage	
				Fractional	Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	0.000	0.00	0.00
Gravel	8	-3.0	0.382	0.18	0.18
	4	-2.0	2.961	1.40	1.58
Coarse Sand	2	-1.0	3.105	1.47	3.04
	1	0.0	2.568	1.21	4.26
Medium Sand	0.5	1.0	1.866	0.88	5.14
	0.25	2.0	3.820	1.80	6.94
Fine Sand	0.125	3.0	107.590	50.79	57.73
	0.063	4.0	67.619	31.92	89.65
Silt	0.032	5.0	3.817	1.80	91.45
	0.0156	6.0	3.313	1.56	93.02
	0.0078	7.0	3.350	1.58	94.60
	0.0039	8.0	3.347	1.58	96.18
Clay	<0.0039	9.0	8.097	3.82	100.00
		Total Weight	212	100	

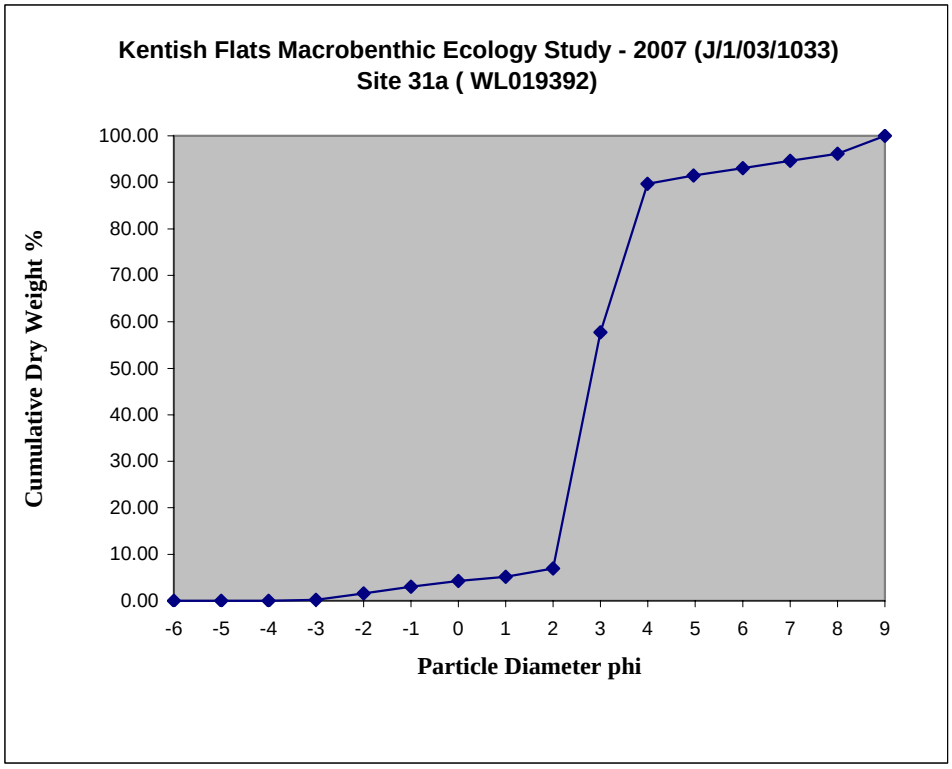
Mean mm	0.13
Md mm	0.14
Mean phi	2.95
Md phi	2.85
Sorting	1.38
Skq	0.28
Kurtosis	2.23

%Gravel	1.58
% Sand	88.07
% Fines	10.35

Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 31a (WL019392)
Fractional Dry Weight %
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 31a (WL019392)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

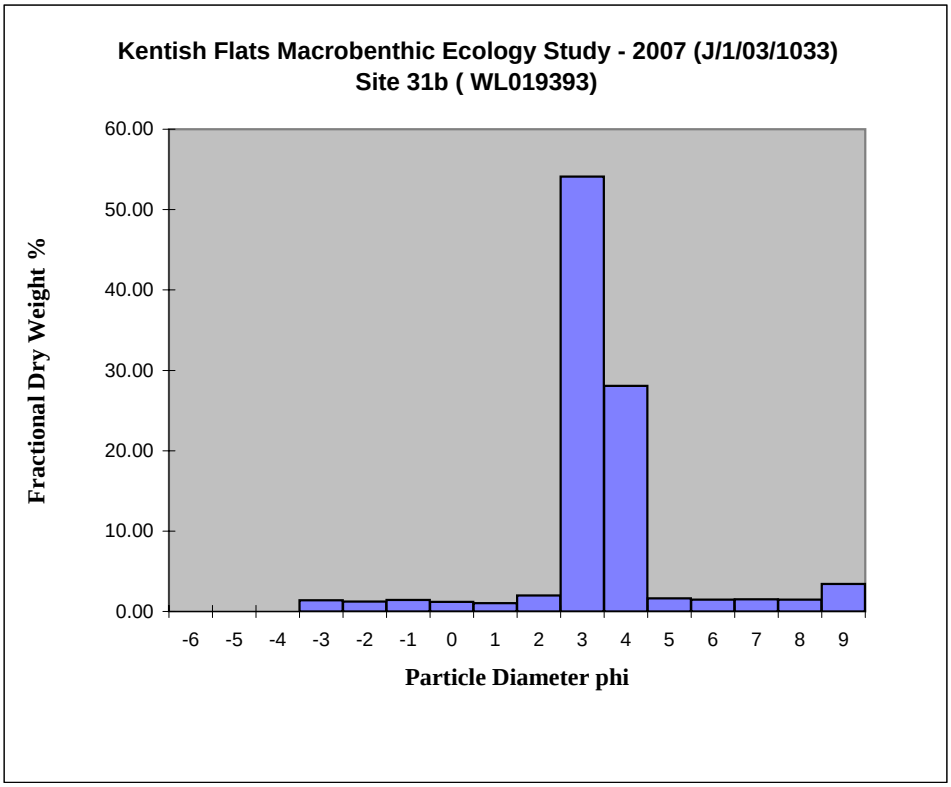
Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 31b (WL019393)

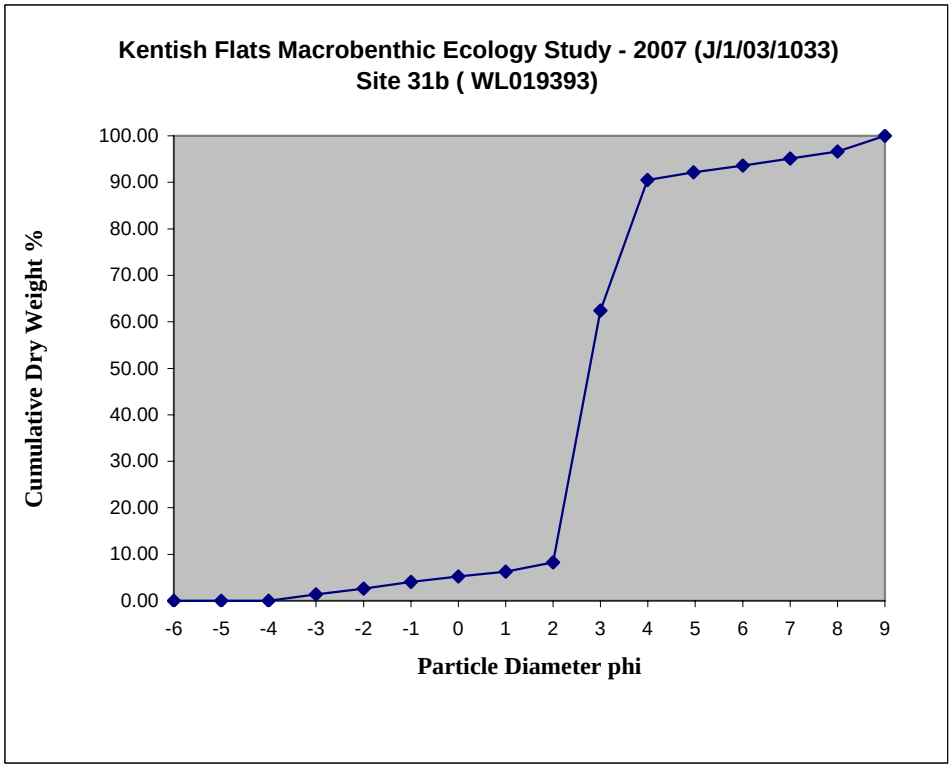
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	0.000	0.00	0.00
Gravel	8	-3.0	2.264	1.39	1.39
	4	-2.0	2.003	1.23	2.61
Coarse Sand	2	-1.0	2.341	1.43	4.05
	1	0.0	1.979	1.21	5.26
Medium Sand	0.5	1.0	1.658	1.02	6.27
	0.25	2.0	3.273	2.00	8.28
Fine Sand	0.125	3.0	88.368	54.12	62.40
	0.063	4.0	45.844	28.08	90.47
Silt	0.032	5.0	2.698	1.65	92.13
	0.0156	6.0	2.415	1.48	93.60
	0.0078	7.0	2.484	1.52	95.13
	0.0039	8.0	2.396	1.47	96.59
Clay	<0.0039	9.0	5.562	3.41	100.00
		Total Weight	163	100	

Mean mm	0.13
Md mm	0.15
Mean phi	2.89
Md phi	2.77
Sorting	1.49
Skq	0.19
Kurtosis	2.58

%Gravel	2.61
% Sand	87.86
% Fines	9.53
	Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 31b (WL019393)
Fractional Dry Weight %
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 31b (WL019393)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 31c (WL019394)

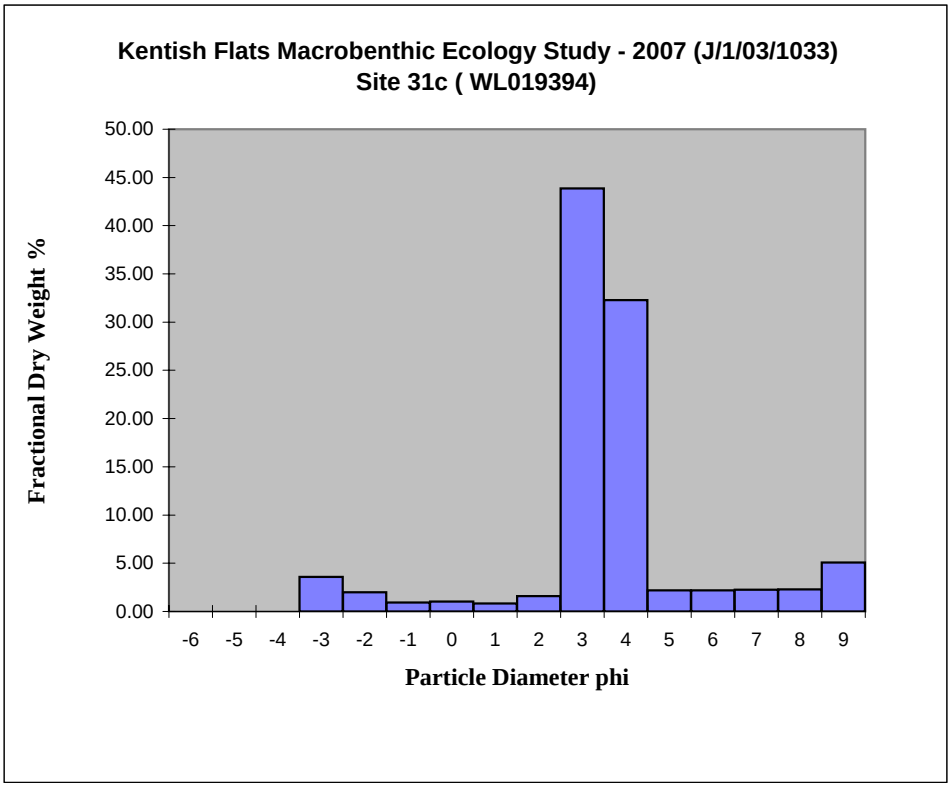
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	0.000	0.00	0.00
Gravel	8	-3.0	3.619	3.57	3.57
	4	-2.0	2.023	2.00	5.57
Coarse Sand	2	-1.0	0.954	0.94	6.51
	1	0.0	1.028	1.01	7.52
Medium Sand	0.5	1.0	0.844	0.83	8.35
	0.25	2.0	1.600	1.58	9.93
Fine Sand	0.125	3.0	44.444	43.85	53.78
	0.063	4.0	32.705	32.27	86.05
Silt	0.032	5.0	2.204	2.17	88.22
	0.0156	6.0	2.207	2.18	90.40
	0.0078	7.0	2.282	2.25	92.65
	0.0039	8.0	2.307	2.28	94.93
Clay	<0.0039	9.0	5.140	5.07	100.00
		Total Weight	101	100	

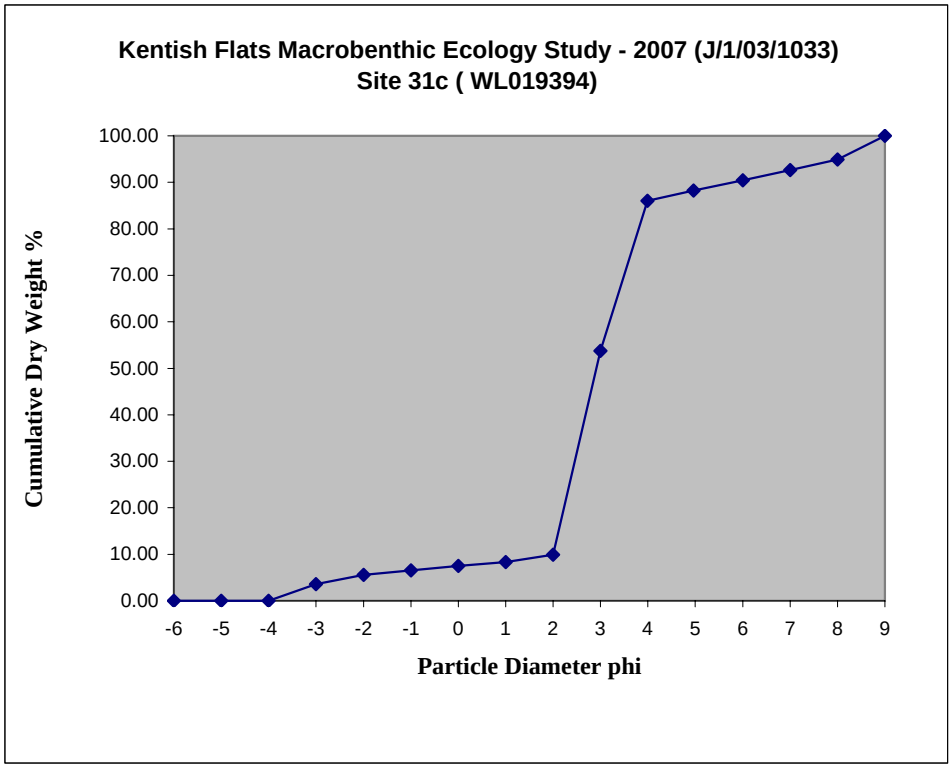
Mean mm	0.13
Md mm	0.13
Mean phi	2.99
Md phi	2.91
Sorting	2.01
Skq	0.06
Kurtosis	3.23

%Gravel	5.57
% Sand	80.48
% Fines	13.95

Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 31c (WL019394)
Fractional Dry Weight %
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 31c (WL019394)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 33a (WL019395)

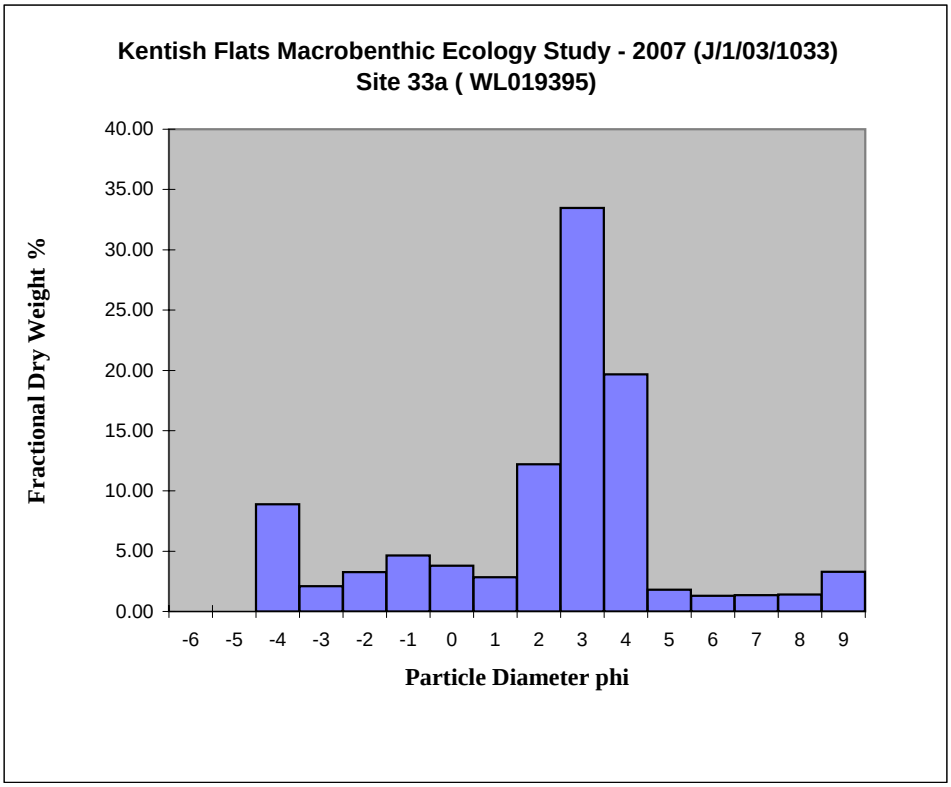
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	28.178	8.88	8.88
Gravel	8	-3.0	6.617	2.09	10.96
	4	-2.0	10.384	3.27	14.24
Coarse Sand	2	-1.0	14.708	4.63	18.87
	1	0.0	12.058	3.80	22.67
Medium Sand	0.5	1.0	8.981	2.83	25.50
	0.25	2.0	38.782	12.22	37.72
Fine Sand	0.125	3.0	106.213	33.47	71.19
	0.063	4.0	62.450	19.68	90.87
Silt	0.032	5.0	5.741	1.81	92.68
	0.0156	6.0	4.087	1.29	93.97
	0.0078	7.0	4.257	1.34	95.31
	0.0039	8.0	4.427	1.40	96.70
Clay	<0.0039	9.0	10.462	3.30	100.00
		Total Weight	317	100	

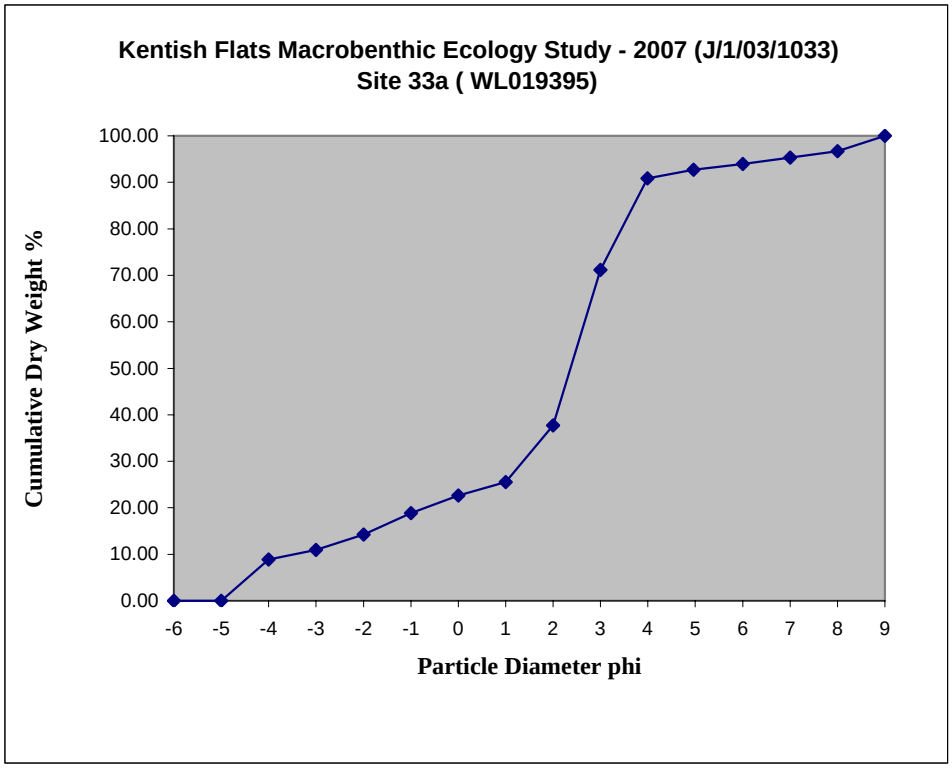
Mean mm	0.36
Md mm	0.19
Mean phi	1.46
Md phi	2.37
Sorting	3.01
Skq	-0.36
Kurtosis	1.94

%Gravel	14.24
% Sand	76.63
% Fines	9.13

Gravelly Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 33a (WL019395)
Fractional Dry Weight %
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 33a (WL019395)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 33b (WL019396)

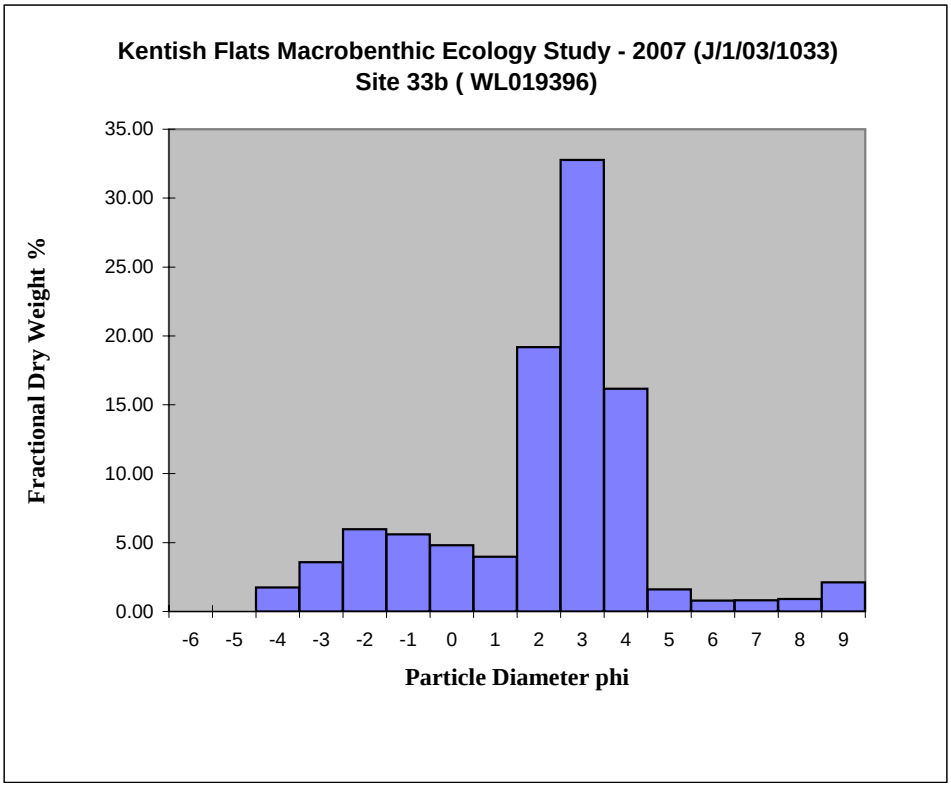
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	6.082	1.75	1.75
Gravel	8	-3.0	12.421	3.58	5.33
	4	-2.0	20.673	5.96	11.29
Coarse Sand	2	-1.0	19.400	5.59	16.88
	1	0.0	16.678	4.81	21.69
Medium Sand	0.5	1.0	13.747	3.96	25.65
	0.25	2.0	66.602	19.20	44.85
Fine Sand	0.125	3.0	113.716	32.77	77.62
	0.063	4.0	56.080	16.16	93.78
Silt	0.032	5.0	5.542	1.60	95.38
	0.0156	6.0	2.778	0.80	96.18
	0.0078	7.0	2.791	0.80	96.98
	0.0039	8.0	3.158	0.91	97.89
Clay	<0.0039	9.0	7.307	2.11	100.00
		Total Weight	347	100	

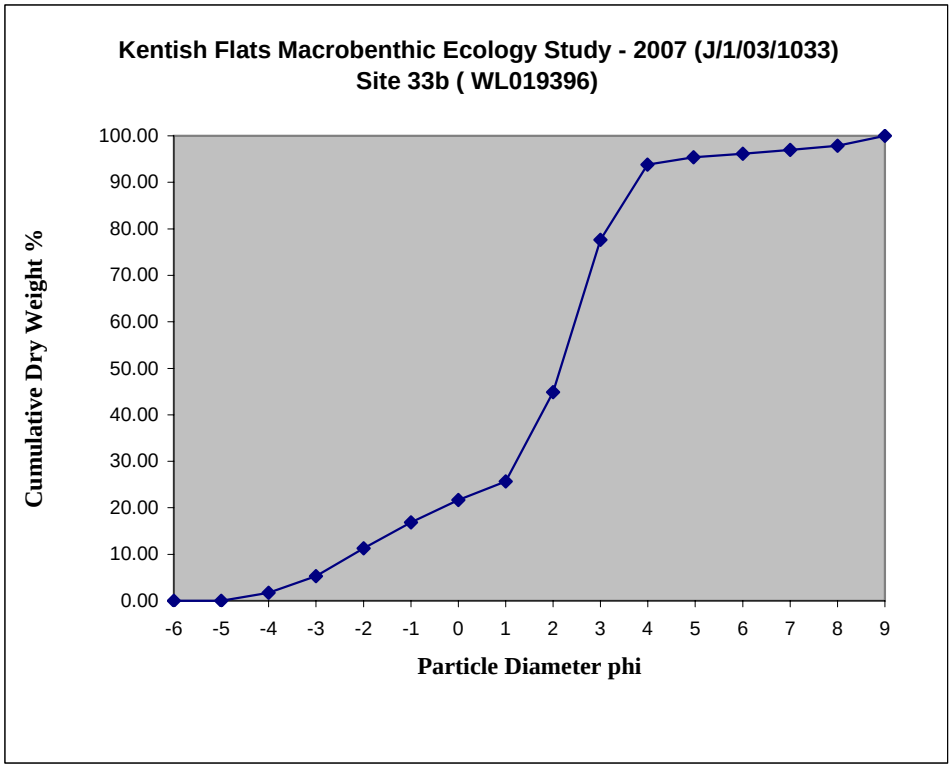
Mean mm	0.36
Md mm	0.22
Mean phi	1.46
Md phi	2.16
Sorting	2.32
Skq	-0.40
Kurtosis	1.54

%Gravel	
% Sand	82.49
% Fines	6.22

Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 33b (WL019396)
Fractional Dry Weight %
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 33b (WL019396)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 33c (WL019397)

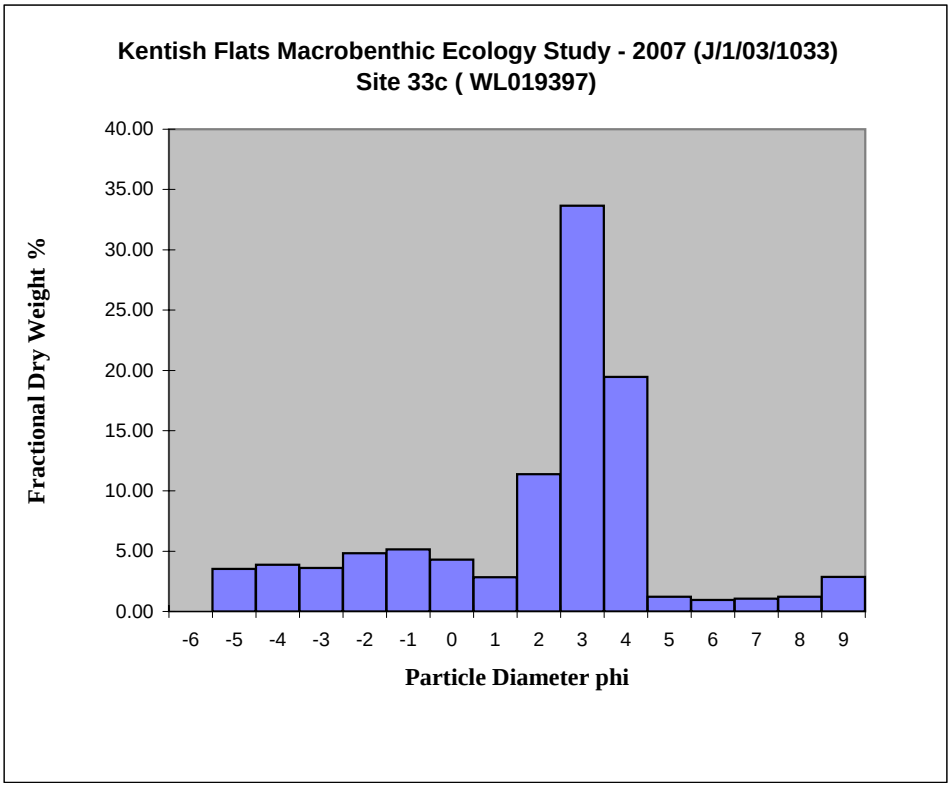
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage	
				Fractional	Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	11.753	3.54	3.54
	16	-4.0	12.894	3.88	7.41
Gravel	8	-3.0	12.026	3.62	11.03
	4	-2.0	16.047	4.83	15.86
Coarse Sand	2	-1.0	17.089	5.14	21.00
	1	0.0	14.278	4.30	25.30
Medium Sand	0.5	1.0	9.459	2.85	28.14
	0.25	2.0	37.868	11.39	39.54
Fine Sand	0.125	3.0	111.865	33.65	73.19
	0.063	4.0	64.704	19.47	92.66
Silt	0.032	5.0	4.057	1.22	93.88
	0.0156	6.0	3.201	0.96	94.84
	0.0078	7.0	3.565	1.07	95.91
	0.0039	8.0	4.087	1.23	97.14
Clay	<0.0039	9.0	9.501	2.86	100.00
		Total Weight	332	100	

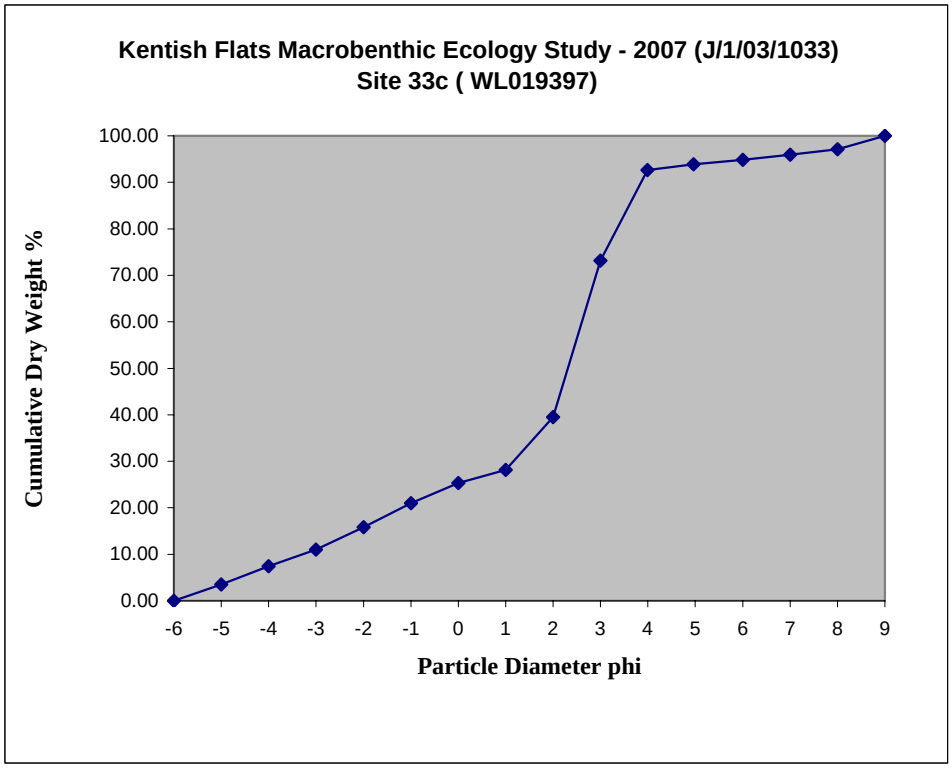
Mean mm	0.41
Md mm	0.20
Mean phi	1.30
Md phi	2.31
Sorting	3.01
Skq	-0.42
Kurtosis	1.40

%Gravel	15.86
% Sand	76.80
% Fines	7.34

Gravelly Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 33c (WL019397)
Fractional Dry Weight %
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 33c (WL019397)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 35a (WL019398)

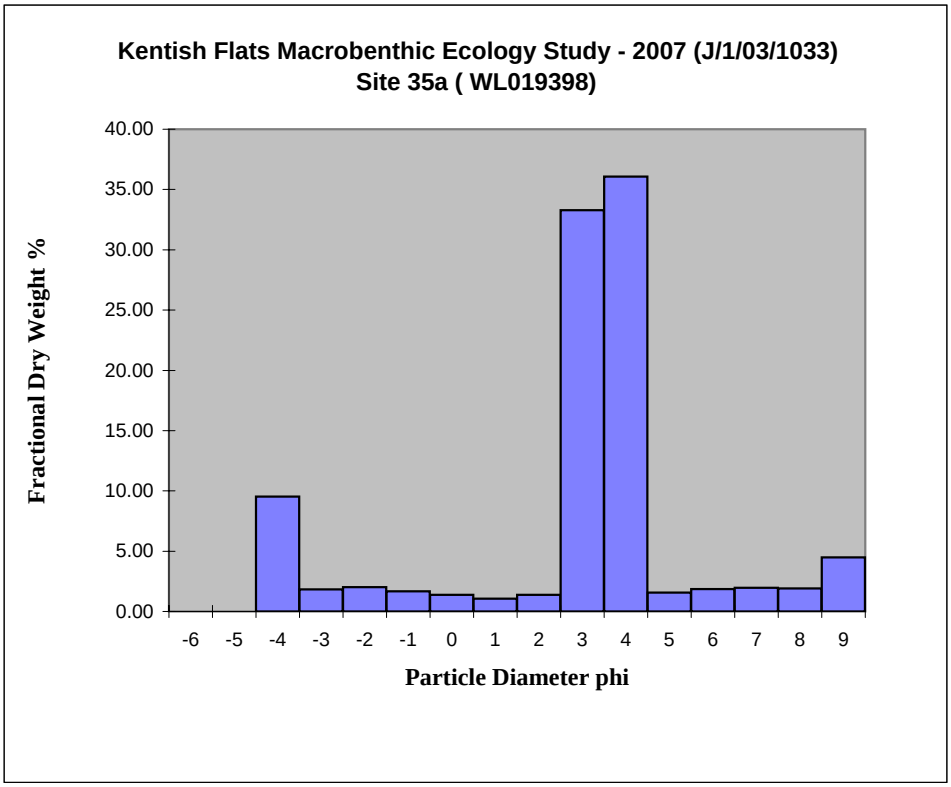
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	14.822	9.53	9.53
Gravel	8	-3.0	2.838	1.83	11.36
	4	-2.0	3.138	2.02	13.38
Coarse Sand	2	-1.0	2.588	1.66	15.04
	1	0.0	2.161	1.39	16.43
Medium Sand	0.5	1.0	1.631	1.05	17.48
	0.25	2.0	2.163	1.39	18.87
Fine Sand	0.125	3.0	51.760	33.29	52.16
	0.063	4.0	56.076	36.07	88.23
Silt	0.032	5.0	2.419	1.56	89.79
	0.0156	6.0	2.869	1.85	91.63
	0.0078	7.0	3.057	1.97	93.60
	0.0039	8.0	2.971	1.91	95.51
Clay	<0.0039	9.0	6.979	4.49	100.00
		Total Weight	155	100	

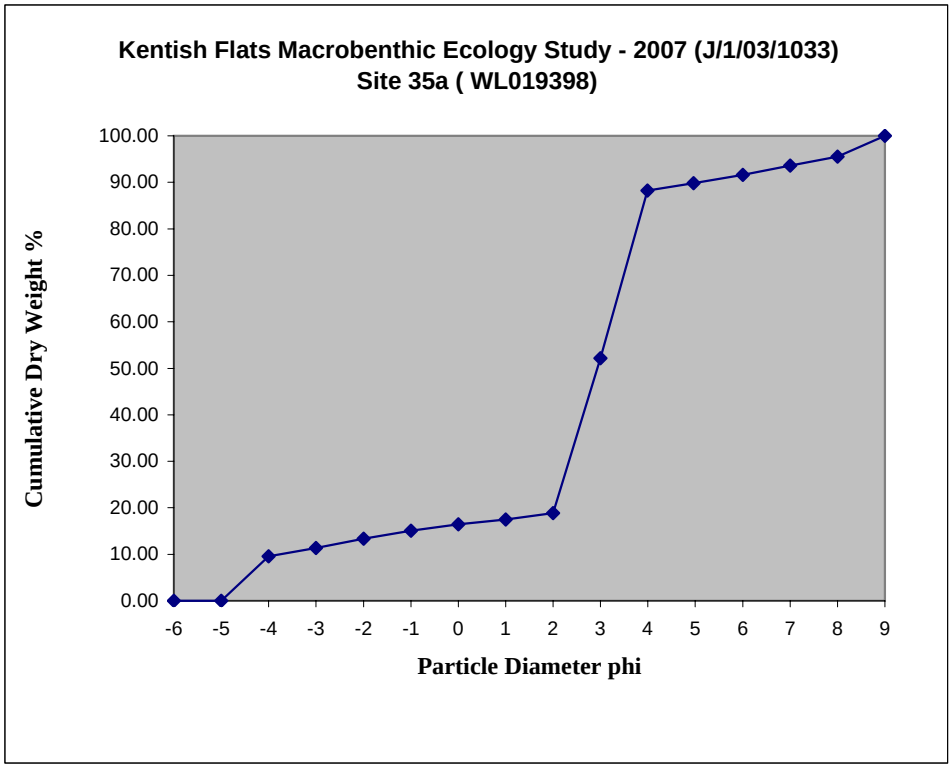
Mean mm	0.22
Md mm	0.13
Mean phi	2.17
Md phi	2.93
Sorting	2.90
Skq	-0.38
Kurtosis	3.47

%Gravel	13.38
% Sand	74.86
% Fines	11.77

Silty gravelly sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 35a (WL019398)
Fractional Dry Weight %
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 35a (WL019398)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 35b (WL019399)

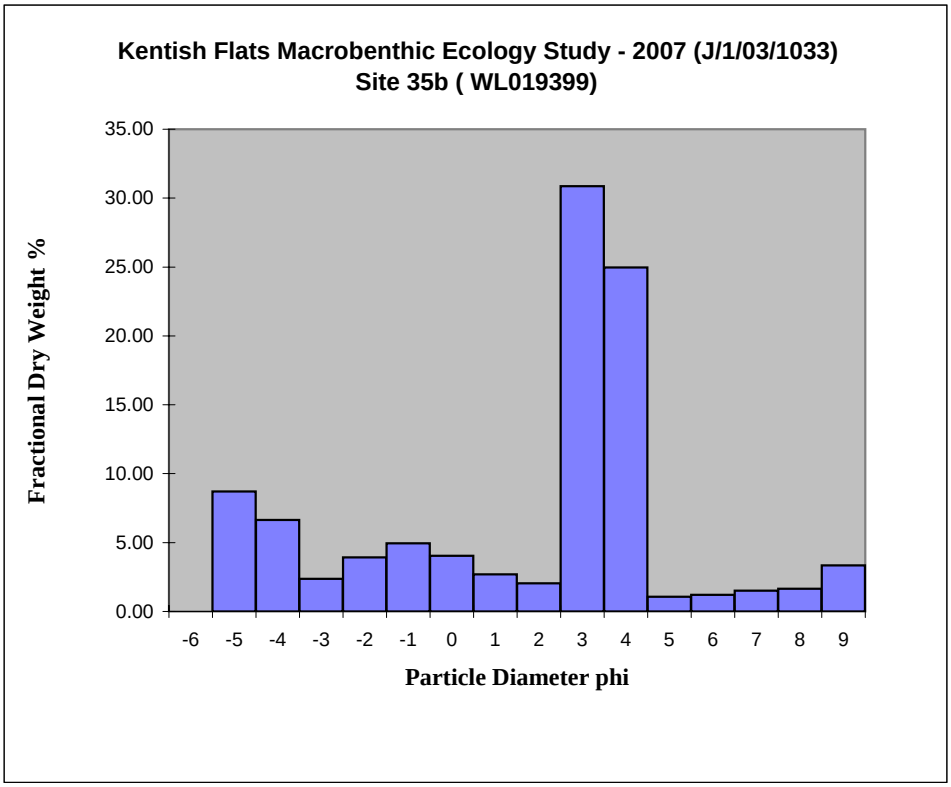
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	15.720	8.71	8.71
	16	-4.0	12.004	6.65	15.37
Gravel	8	-3.0	4.286	2.38	17.74
	4	-2.0	7.070	3.92	21.66
Coarse Sand	2	-1.0	8.904	4.94	26.60
	1	0.0	7.278	4.03	30.63
Medium Sand	0.5	1.0	4.867	2.70	33.33
	0.25	2.0	3.672	2.04	35.36
Fine Sand	0.125	3.0	55.706	30.88	66.24
	0.063	4.0	45.039	24.96	91.21
Silt	0.032	5.0	1.925	1.07	92.27
	0.0156	6.0	2.199	1.22	93.49
	0.0078	7.0	2.736	1.52	95.01
	0.0039	8.0	2.956	1.64	96.65
Clay	<0.0039	9.0	6.050	3.35	100.00
		Total Weight	180	100	

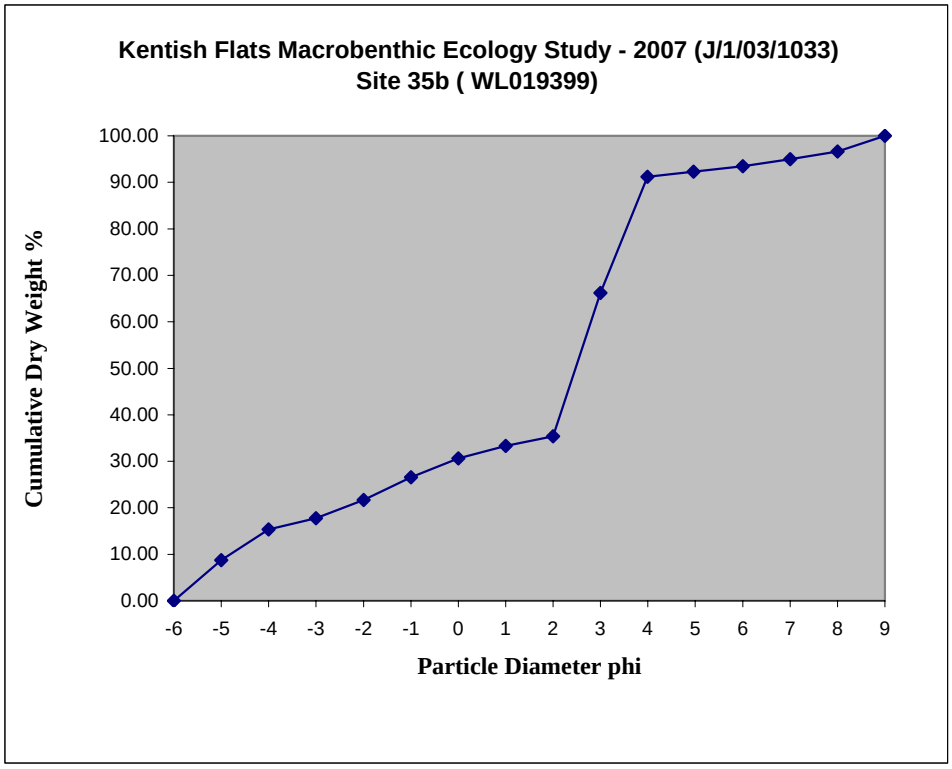
Mean mm	0.57
Md mm	0.18
Mean phi	0.81
Md phi	2.47
Sorting	3.87
Skq	-0.49
Kurtosis	1.16

%Gravel	21.66
% Sand	69.54
% Fines	8.79

Gravelly Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 35b (WL019399)
Fractional Dry Weight %
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 35b (WL019399)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 35c (WL019400)

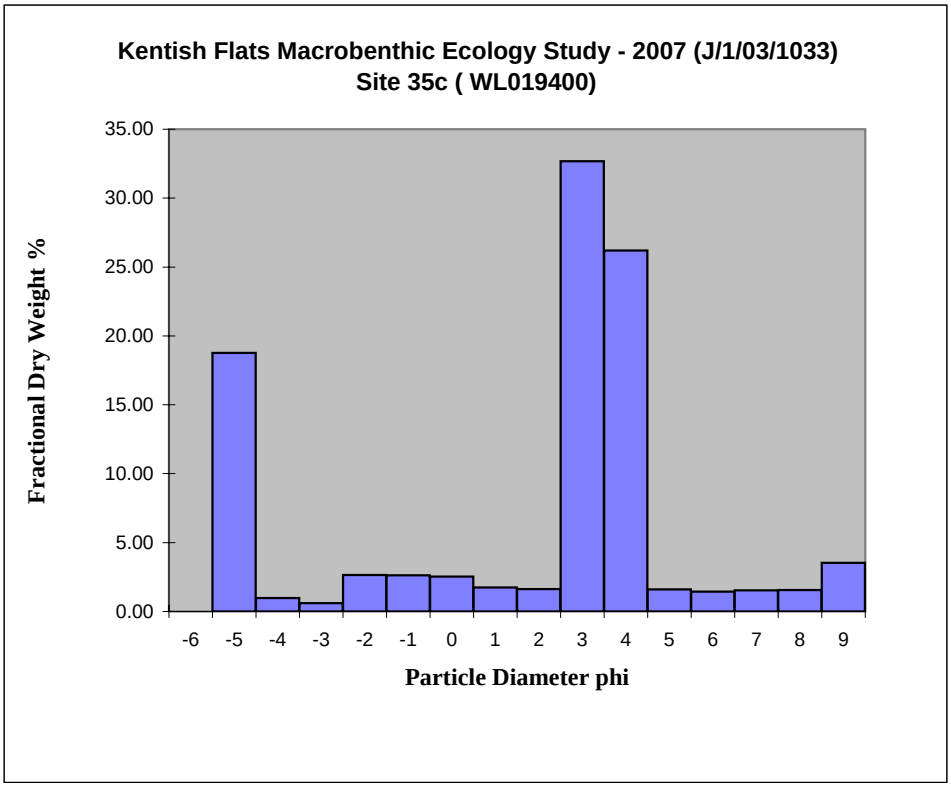
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	52.914	18.75	18.75
	16	-4.0	2.743	0.97	19.73
Gravel	8	-3.0	1.706	0.60	20.33
	4	-2.0	7.456	2.64	22.97
Coarse Sand	2	-1.0	7.375	2.61	25.59
	1	0.0	7.144	2.53	28.12
Medium Sand	0.5	1.0	4.908	1.74	29.86
	0.25	2.0	4.562	1.62	31.48
Fine Sand	0.125	3.0	92.175	32.67	64.15
	0.063	4.0	73.925	26.20	90.35
Silt	0.032	5.0	4.530	1.61	91.95
	0.0156	6.0	4.033	1.43	93.38
	0.0078	7.0	4.307	1.53	94.91
	0.0039	8.0	4.383	1.55	96.46
Clay	<0.0039	9.0	9.981	3.54	100.00
		Total Weight	282	100	

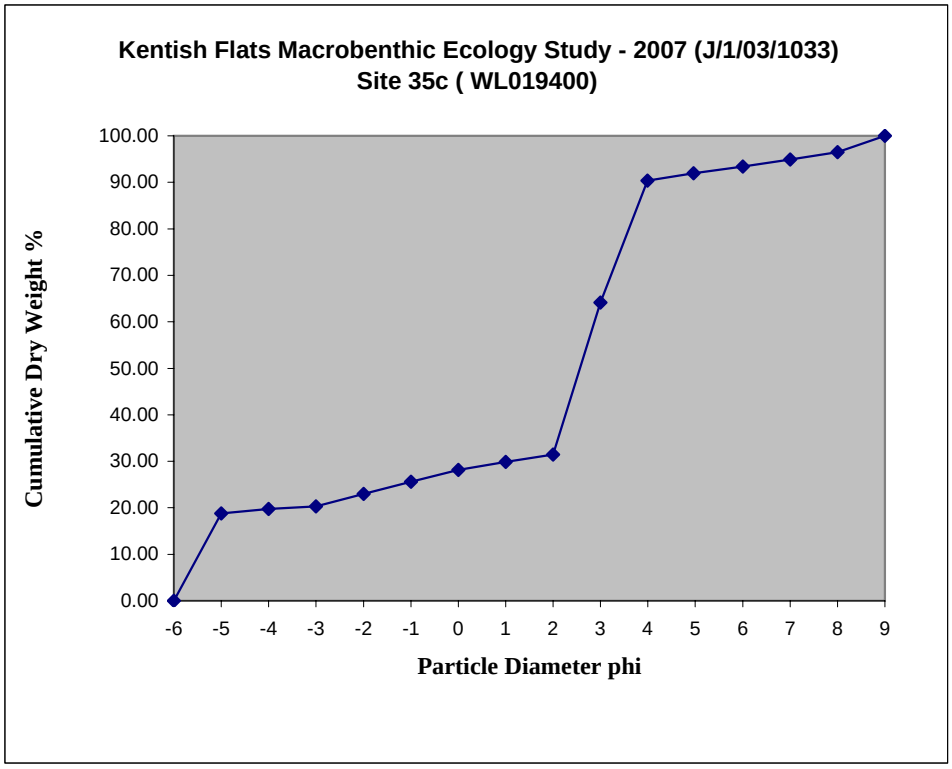
Mean mm	0.82
Md mm	0.17
Mean phi	0.29
Md phi	2.57
Sorting	4.46
Skq	-0.56
Kurtosis	1.26

%Gravel	22.97
% Sand	67.37
% Fines	9.65

Gravelly Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 35c (WL019400)
Fractional Dry Weight %
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 35c (WL019400)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 36a (WL019401)

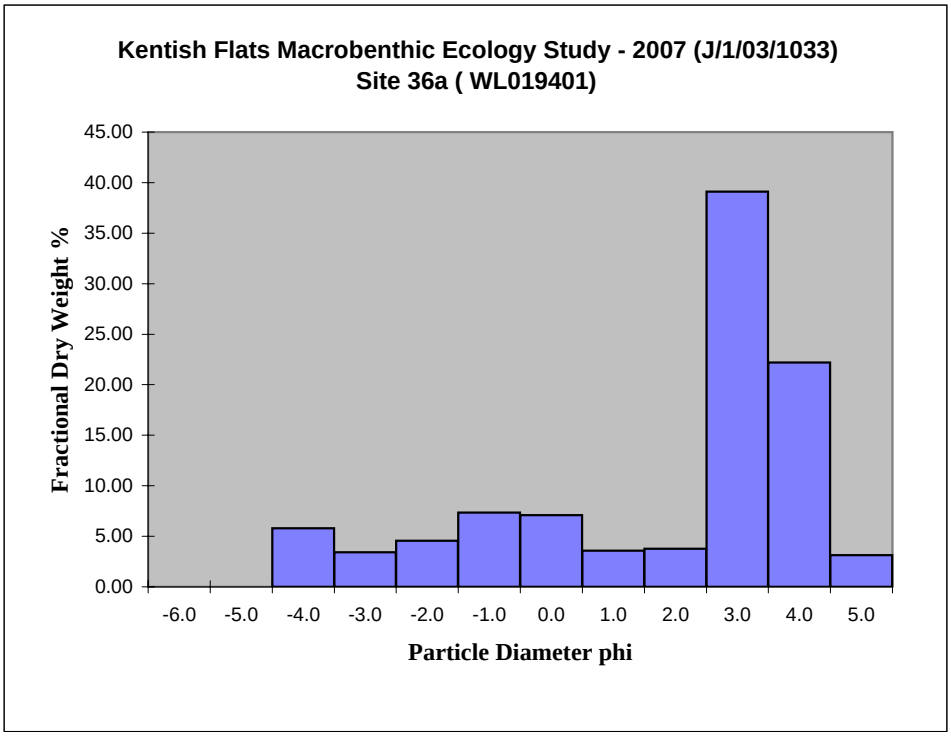
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	17.596	5.80	5.80
Gravel	8	-3.0	10.411	3.43	9.22
	4	-2.0	13.811	4.55	13.77
Coarse Sand	2	-1.0	22.317	7.35	21.12
	1	0.0	21.528	7.09	28.21
Medium Sand	0.5	1.0	10.879	3.58	31.80
	0.25	2.0	11.426	3.76	35.56
Fine Sand	0.125	3.0	118.701	39.10	74.66
	0.063	4.0	67.395	22.20	96.86
Silt/Clay	<0.063	5.0	9.545	3.14	100.00
		Total Weight	303.609	100.00	

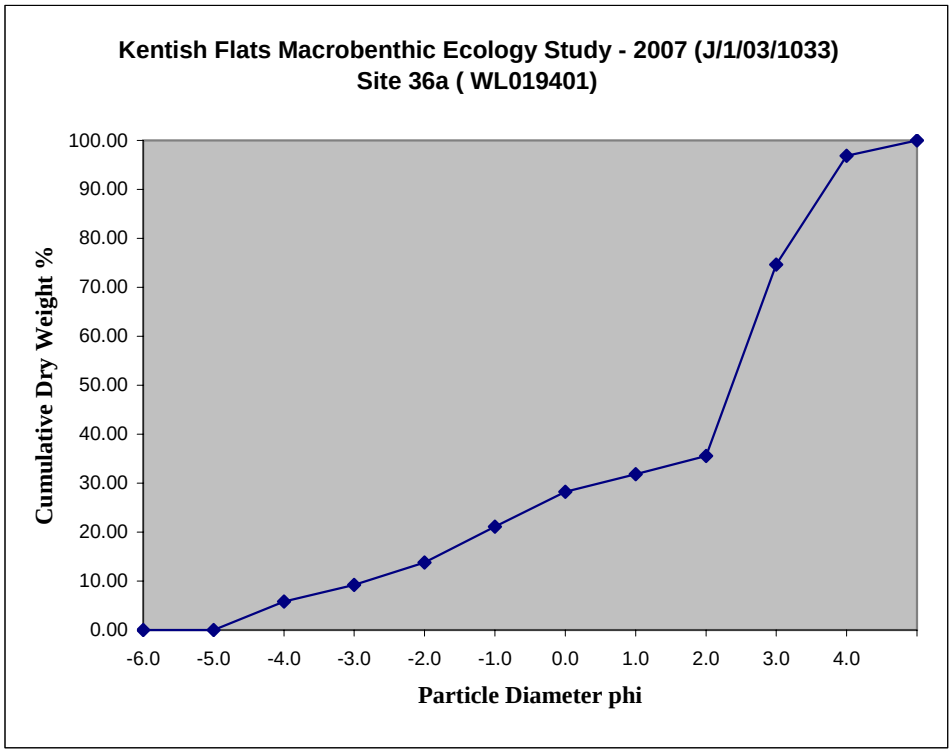
Mean mm	0.44
Md mm	0.19
Mean phi	1.18
Md phi	2.37
Sorting	2.18
Skq	-0.84
Kurtosis	0.82

%Gravel	13.77
% Sand	83.08
% Fines	3.14

Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 36a (WL019401)
Fractional Dry Weight %
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 36a (WL019401)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 36b (WL019402)

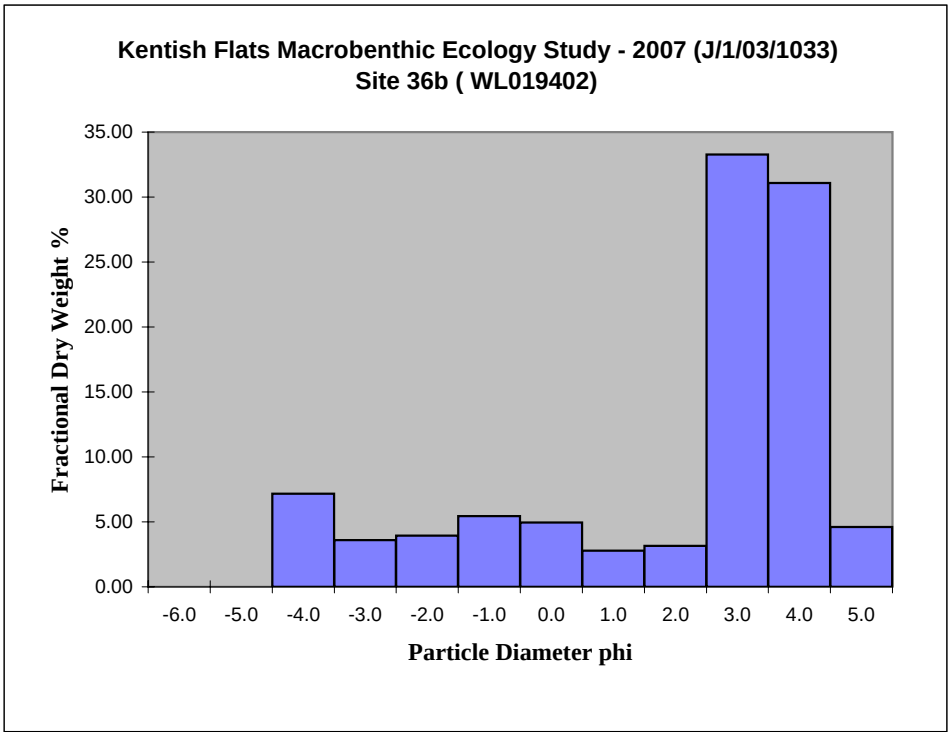
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	19.304	7.16	7.16
Gravel	8	-3.0	9.692	3.59	10.75
	4	-2.0	10.653	3.95	14.70
Coarse Sand	2	-1.0	14.710	5.45	20.15
	1	0.0	13.342	4.95	25.10
Medium Sand	0.5	1.0	7.539	2.79	27.89
	0.25	2.0	8.488	3.15	31.04
Fine Sand	0.125	3.0	89.738	33.27	64.31
	0.063	4.0	83.833	31.08	95.39
Silt/Clay	<0.063	5.0	12.444	4.61	100.00
		Total Weight	269.743	100.00	

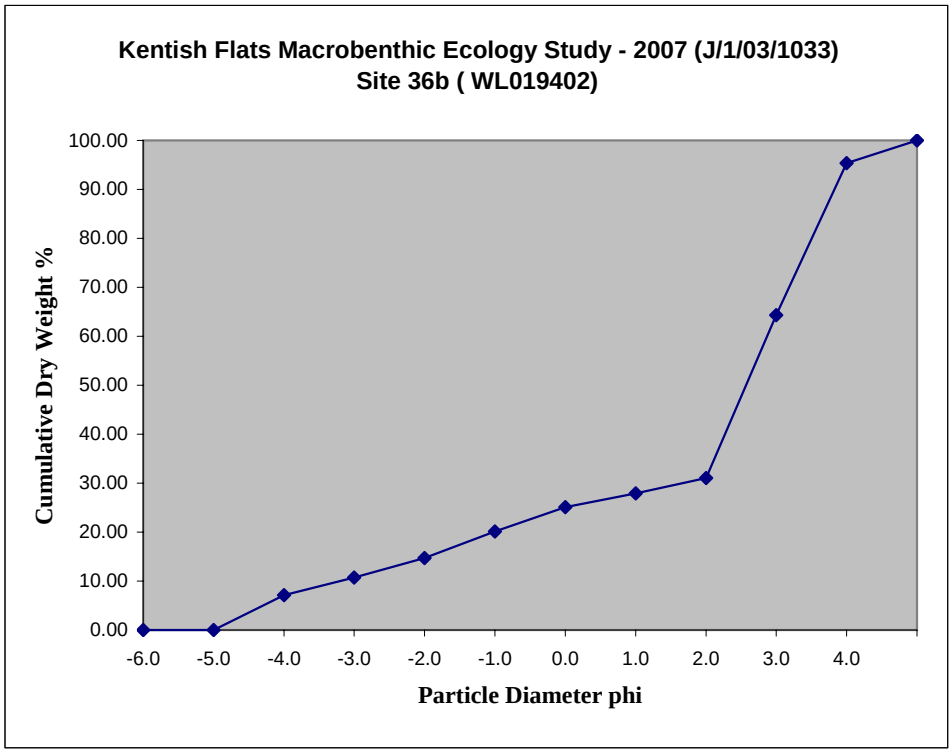
Mean mm	0.45
Md mm	0.17
Mean phi	1.17
Md phi	2.57
Sorting	2.15
Skq	-0.98
Kurtosis	0.98

%Gravel	14.70
% Sand	80.69
% Fines	4.61

Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 36b (WL019402)
Fractional Dry Weight %
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 36b (WL019402)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 36c (WL019403)

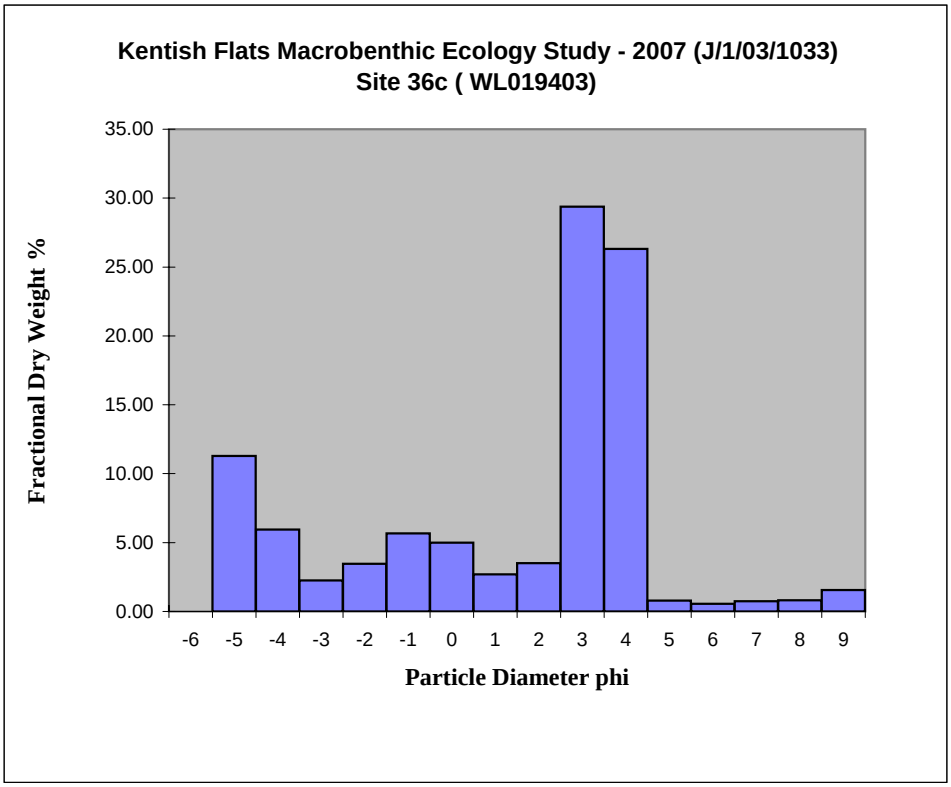
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	38.652	11.28	11.28
	16	-4.0	20.388	5.95	17.23
Gravel	8	-3.0	7.725	2.25	19.48
	4	-2.0	11.883	3.47	22.95
Coarse Sand	2	-1.0	19.393	5.66	28.61
	1	0.0	17.138	5.00	33.61
Medium Sand	0.5	1.0	9.209	2.69	36.30
	0.25	2.0	11.994	3.50	39.80
Fine Sand	0.125	3.0	100.696	29.38	69.18
	0.063	4.0	90.215	26.32	95.50
Silt	0.032	5.0	2.746	0.80	96.30
	0.0156	6.0	1.943	0.57	96.87
	0.0078	7.0	2.584	0.75	97.63
	0.0039	8.0	2.815	0.82	98.45
Clay	<0.0039	9.0	5.321	1.55	100.00
		Total Weight	343	100	

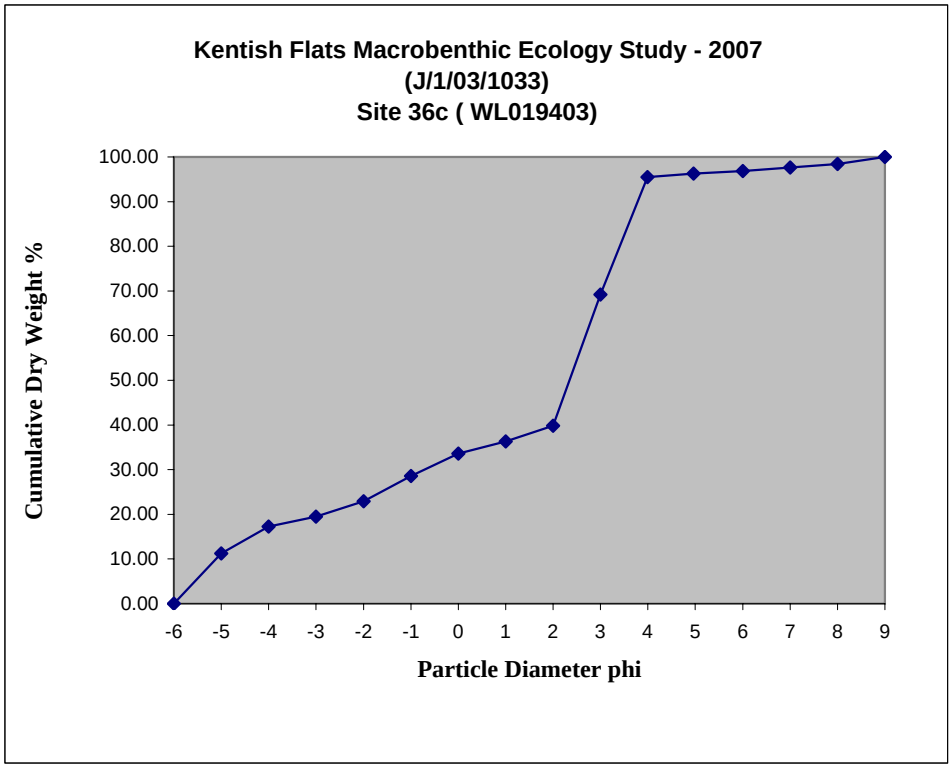
Mean mm	0.68
Md mm	0.20
Mean phi	0.57
Md phi	2.35
Sorting	3.55
Skq	-0.69
Kurtosis	0.90

%Gravel	22.95
% Sand	72.55
% Fines	4.50

Gravelly Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 36c (WL019403)
Fractional Dry Weight %
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007
(J/1/03/1033)
Site 36c (WL019403)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 38a (WL019404)

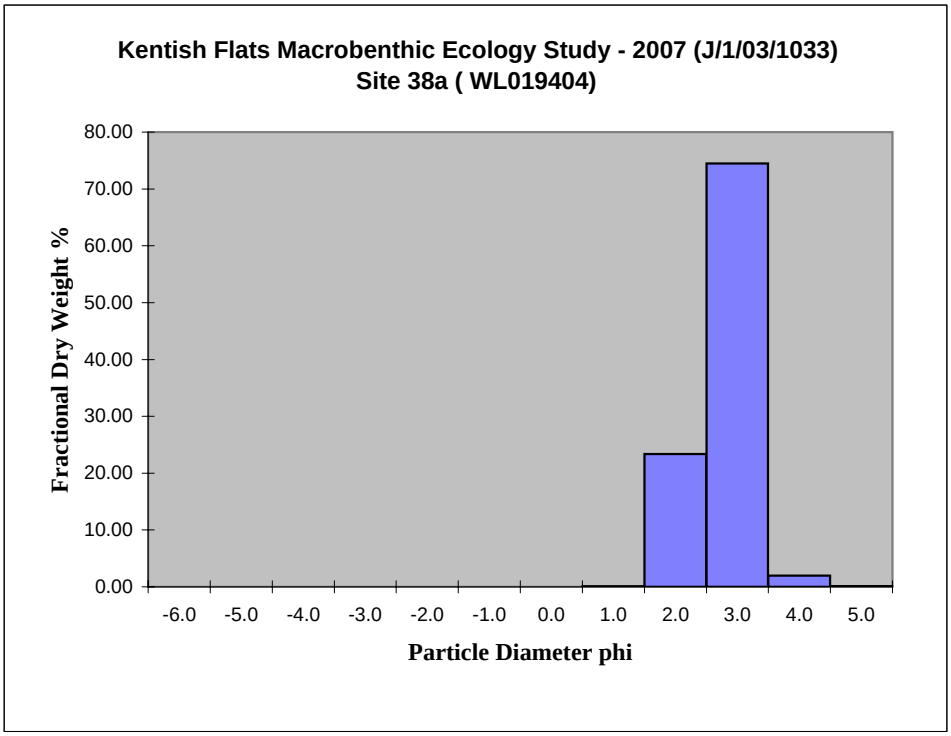
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	0.000	0.00	0.00
Gravel	8	-3.0	0.000	0.00	0.00
	4	-2.0	0.000	0.00	0.00
Coarse Sand	2	-1.0	0.000	0.00	0.00
	1	0.0	0.009	0.00	0.00
Medium Sand	0.5	1.0	0.122	0.05	0.06
	0.25	2.0	54.425	23.38	23.44
Fine Sand	0.125	3.0	173.387	74.49	97.93
	0.063	4.0	4.593	1.97	99.90
Silt/Clay	<0.063	5.0	0.229	0.10	100.00
		Total Weight	232.765	100.00	

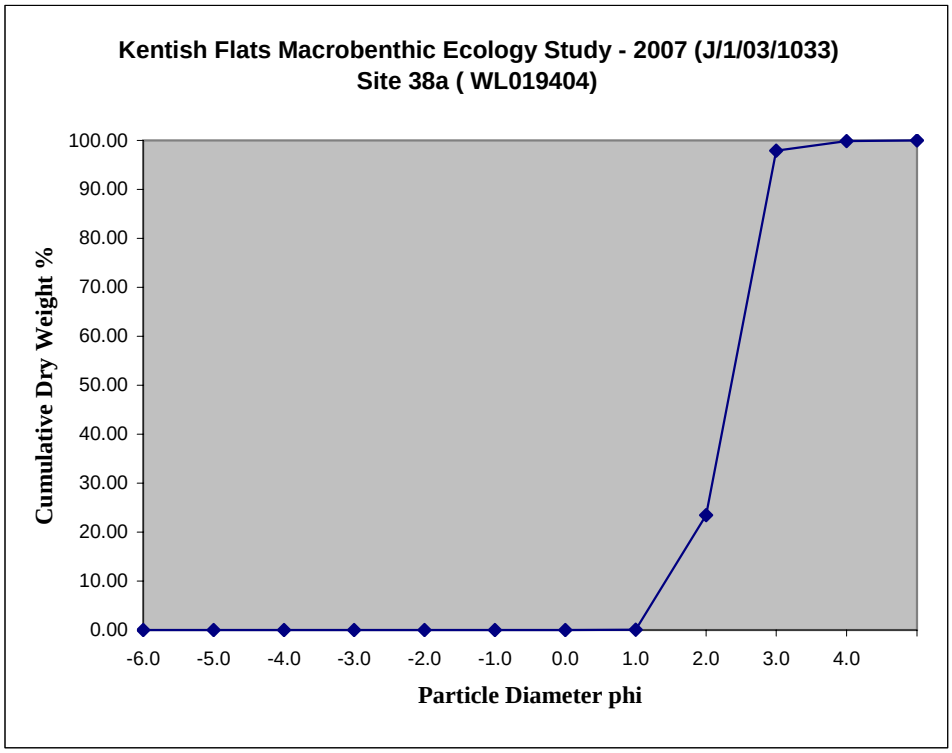
Mean mm	0.21
Md mm	0.20
Mean phi	2.28
Md phi	2.36
Sorting	0.55
Skq	-0.25
Kurtosis	1.07

%Gravel	0.00
% Sand	99.90
% Fines	0.10

Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 38a (WL019404)
Fractional Dry Weight %
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 38a (WL019404)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 38b (WL019405)

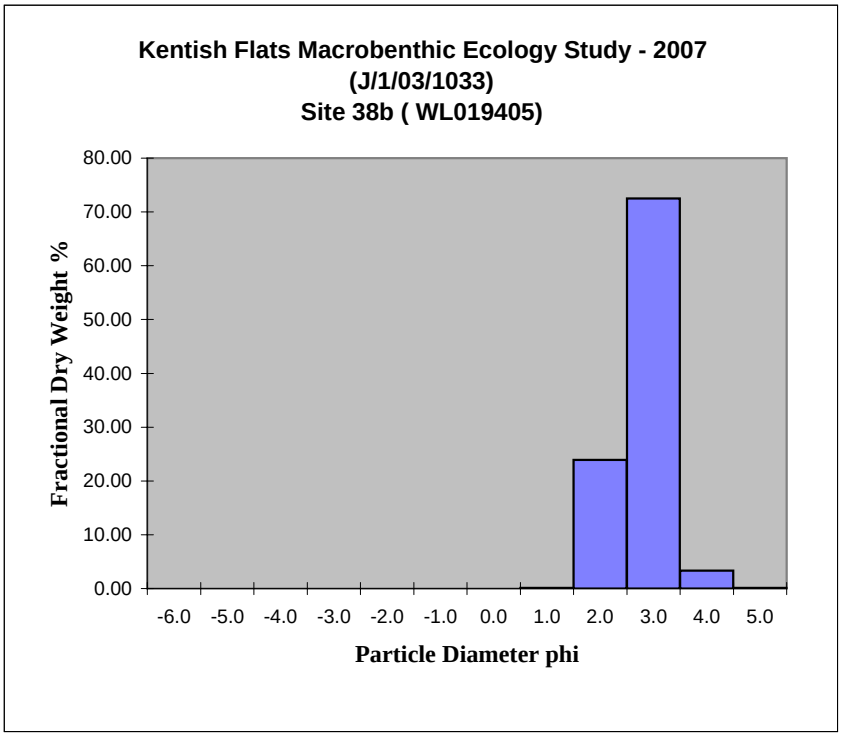
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	0.000	0.00	0.00
Gravel	8	-3.0	0.000	0.00	0.00
	4	-2.0	0.000	0.00	0.00
Coarse Sand	2	-1.0	0.000	0.00	0.00
	1	0.0	0.022	0.01	0.01
Medium Sand	0.5	1.0	0.222	0.11	0.12
	0.25	2.0	49.768	23.91	24.02
Fine Sand	0.125	3.0	150.940	72.51	96.53
	0.063	4.0	6.990	3.36	99.89
Silt/Clay	<0.063	5.0	0.228	0.11	100.00
		Total Weight	208.17	100.00	

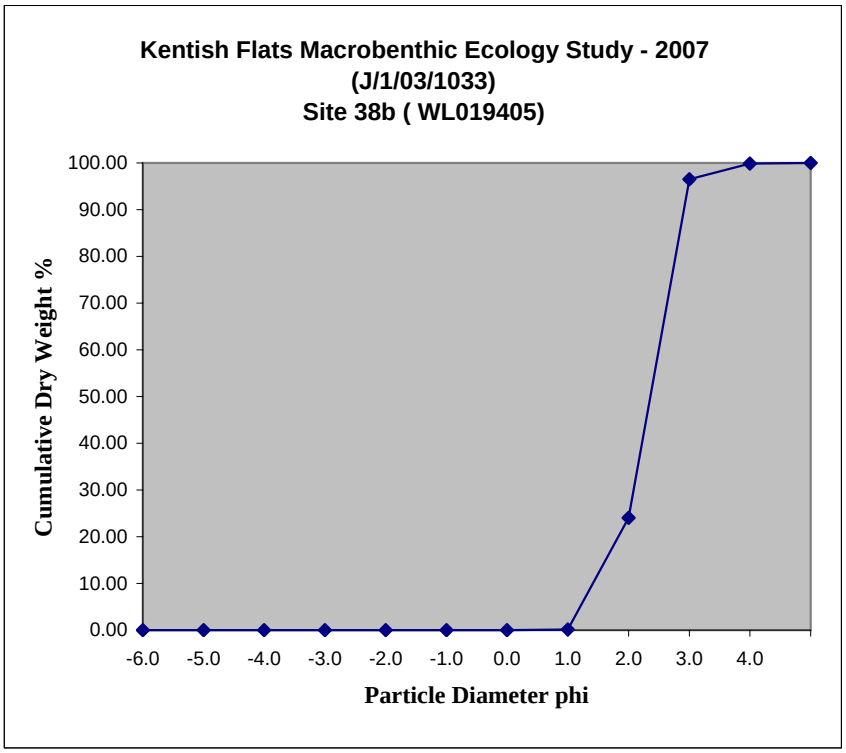
Mean mm	0.21
Md mm	0.20
Mean phi	2.28
Md phi	2.36
Sorting	0.56
Skq	-0.25
Kurtosis	1.05

%Gravel	0.00
% Sand	99.89
% Fines	0.11

Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007
(J/1/03/1033)
Site 38b (WL019405)
Fractional Dry Weight %
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0 -5.0 -4.0 -3.0 -2.0 -1.0 0.0 1.0 2.0 3.0 4.0 5.0
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007
(J/1/03/1033)
Site 38b (WL019405)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0 -5.0 -4.0 -3.0 -2.0 -1.0 0.0 1.0 2.0 3.0 4.0
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 38c (WL019406)

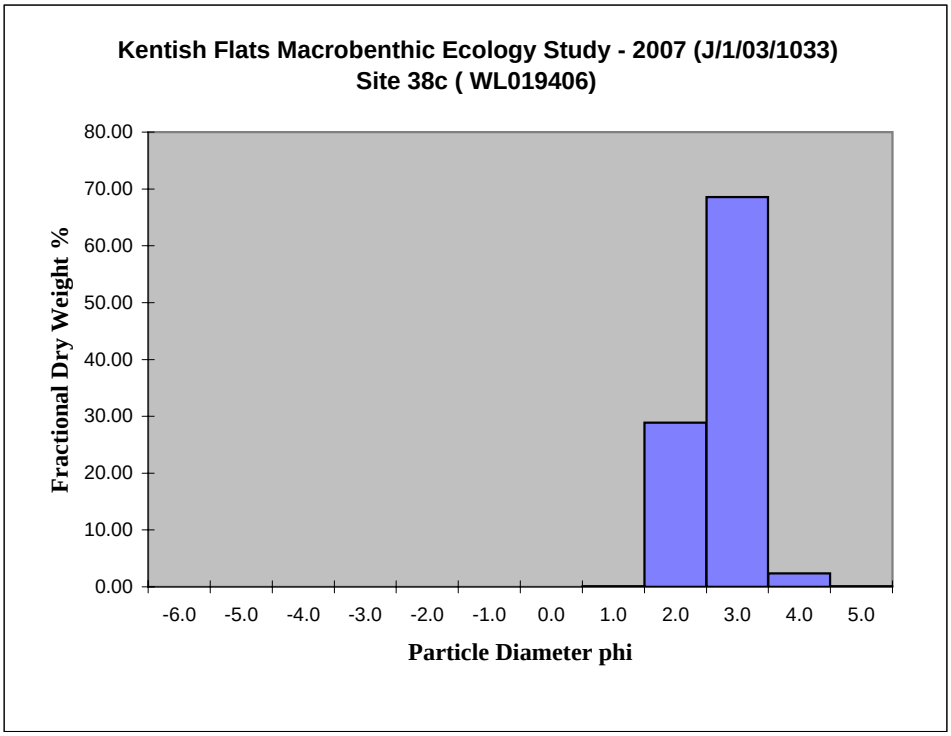
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	0.000	0.00	0.00
Gravel	8	-3.0	0.000	0.00	0.00
	4	-2.0	0.000	0.00	0.00
Coarse Sand	2	-1.0	0.044	0.02	0.02
	1	0.0	0.011	0.01	0.03
Medium Sand	0.5	1.0	0.155	0.08	0.11
	0.25	2.0	53.661	28.87	28.98
Fine Sand	0.125	3.0	127.497	68.60	97.58
	0.063	4.0	4.381	2.36	99.94
Silt/Clay	<0.063	5.0	0.110	0.06	100.00
		Total Weight	185.859	100.00	

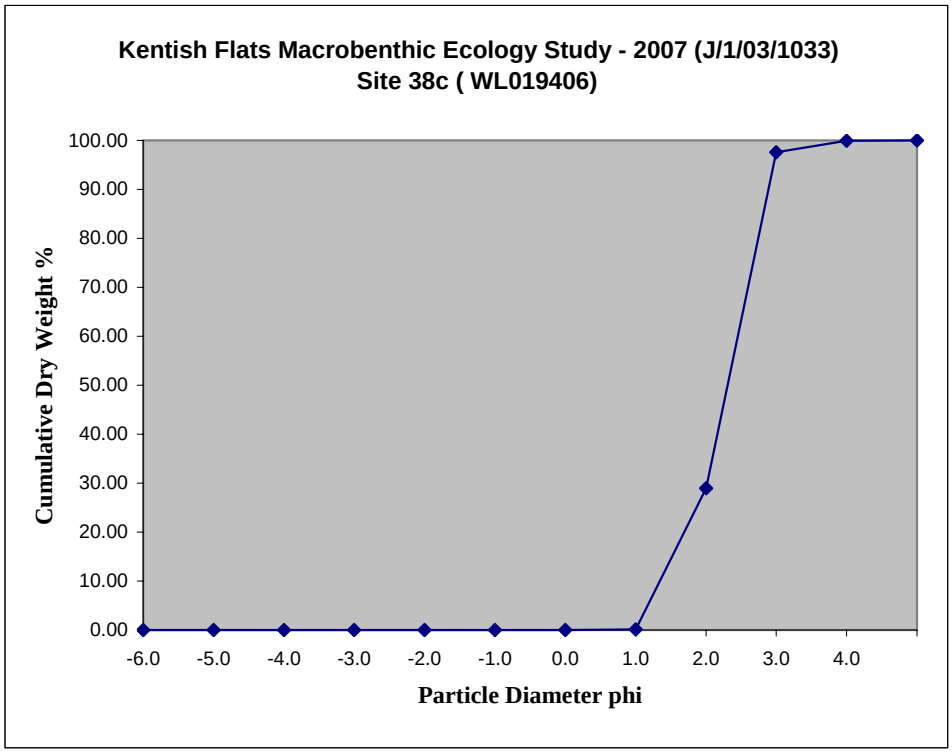
Mean mm	0.21
Md mm	0.20
Mean phi	2.22
Md phi	2.31
Sorting	0.58
Skq	-0.24
Kurtosis	0.91

%Gravel	0.00
% Sand	99.94
% Fines	0.06

Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 38c (WL019406)
Fractional Dry Weight %
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 38c (WL019406)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 40a (WL019407)

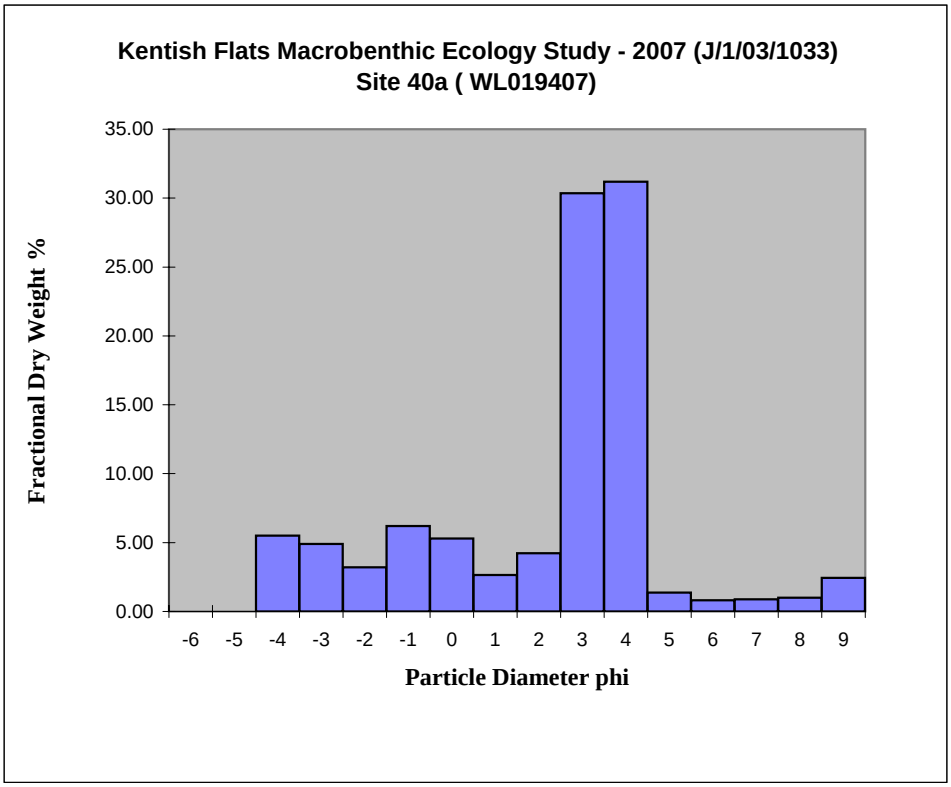
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	11.122	5.50	5.50
Gravel	8	-3.0	9.906	4.90	10.39
	4	-2.0	6.472	3.20	13.59
Coarse Sand	2	-1.0	12.557	6.21	19.80
	1	0.0	10.695	5.29	25.08
Medium Sand	0.5	1.0	5.345	2.64	27.72
	0.25	2.0	8.559	4.23	31.95
Fine Sand	0.125	3.0	61.428	30.36	62.31
	0.063	4.0	63.131	31.20	93.51
Silt	0.032	5.0	2.755	1.36	94.88
	0.0156	6.0	1.638	0.81	95.69
	0.0078	7.0	1.780	0.88	96.57
	0.0039	8.0	2.030	1.00	97.57
Clay	<0.0039	9.0	4.918	2.43	100.00
		Total Weight	202	100	

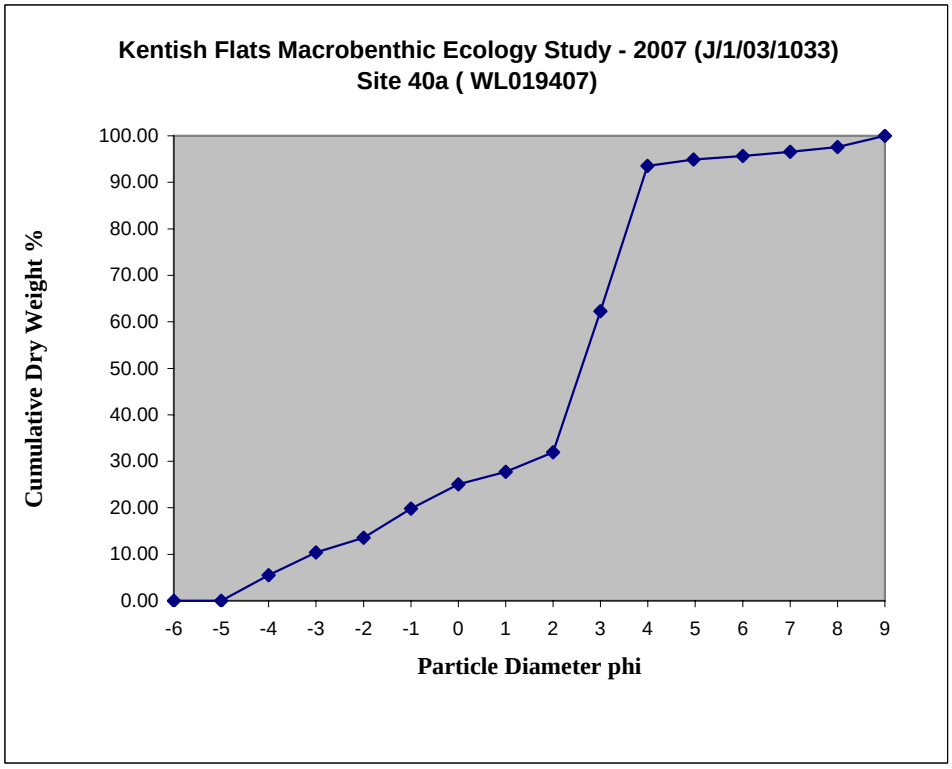
Mean mm	0.34
Md mm	0.17
Mean phi	1.56
Md phi	2.59
Sorting	2.72
Skq	-0.52
Kurtosis	1.10

%Gravel	13.59
% Sand	79.92
% Fines	6.49

Gravelly Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 40a (WL019407)
Fractional Dry Weight %
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 40a (WL019407)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 40b (WL019408)

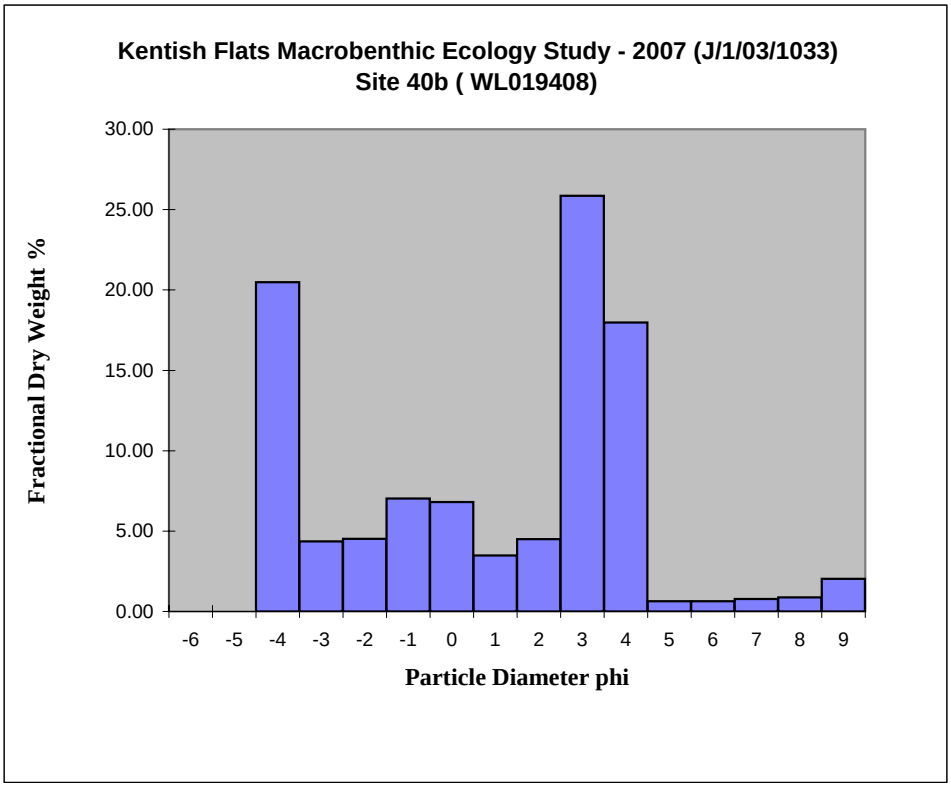
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	51.699	20.48	20.48
Gravel	8	-3.0	11.002	4.36	24.84
	4	-2.0	11.425	4.53	29.37
Coarse Sand	2	-1.0	17.755	7.03	36.40
	1	0.0	17.183	6.81	43.21
Medium Sand	0.5	1.0	8.781	3.48	46.68
	0.25	2.0	11.365	4.50	51.19
Fine Sand	0.125	3.0	65.297	25.87	77.05
	0.063	4.0	45.365	17.97	95.03
Silt	0.032	5.0	1.619	0.64	95.67
	0.0156	6.0	1.629	0.65	96.31
	0.0078	7.0	1.949	0.77	97.08
	0.0039	8.0	2.221	0.88	97.96
Clay	<0.0039	9.0	5.138	2.04	100.00
		Total Weight	252	100	

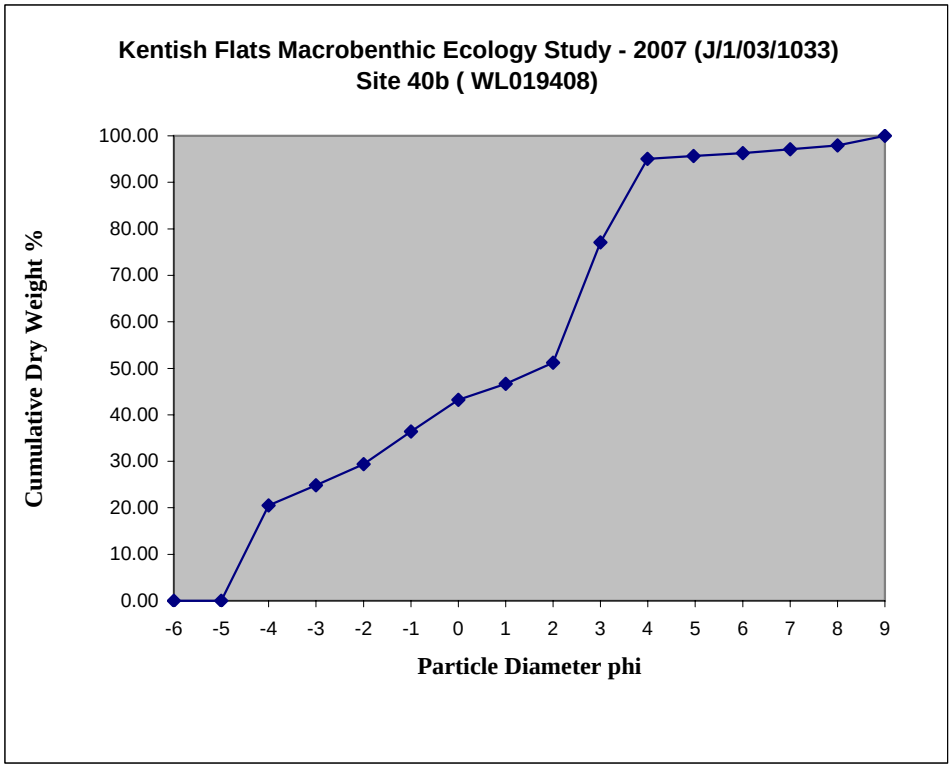
Mean mm	0.81
Md mm	0.30
Mean phi	0.30
Md phi	1.74
Sorting	3.22
Skq	-0.53
Kurtosis	0.61

%Gravel	29.37
% Sand	65.66
% Fines	4.97

Gravelly Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 40b (WL019408)
Fractional Dry Weight %
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 40b (WL019408)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 40c (WL019409)

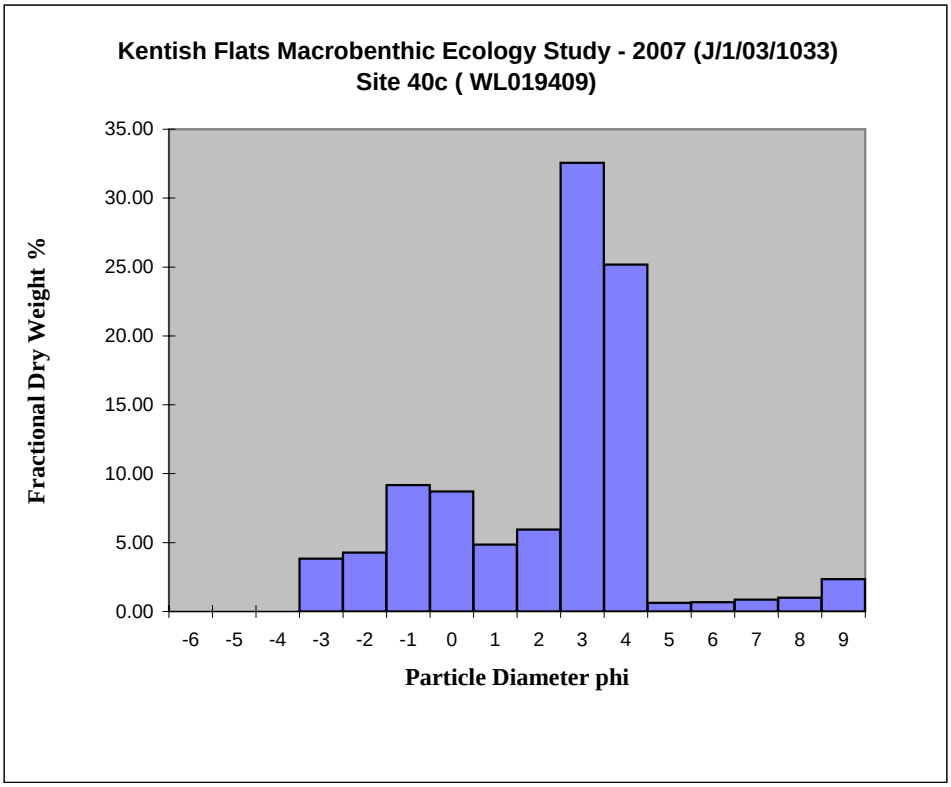
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	0.000	0.00	0.00
Gravel	8	-3.0	9.785	3.83	3.83
	4	-2.0	10.911	4.27	8.09
Coarse Sand	2	-1.0	23.429	9.16	17.26
	1	0.0	22.253	8.70	25.96
Medium Sand	0.5	1.0	12.403	4.85	30.81
	0.25	2.0	15.190	5.94	36.75
Fine Sand	0.125	3.0	83.278	32.57	69.32
	0.063	4.0	64.365	25.17	94.49
Silt	0.032	5.0	1.597	0.62	95.12
	0.0156	6.0	1.714	0.67	95.79
	0.0078	7.0	2.224	0.87	96.66
	0.0039	8.0	2.573	1.01	97.66
Clay	<0.0039	9.0	5.975	2.34	100.00
		Total Weight	256	100	

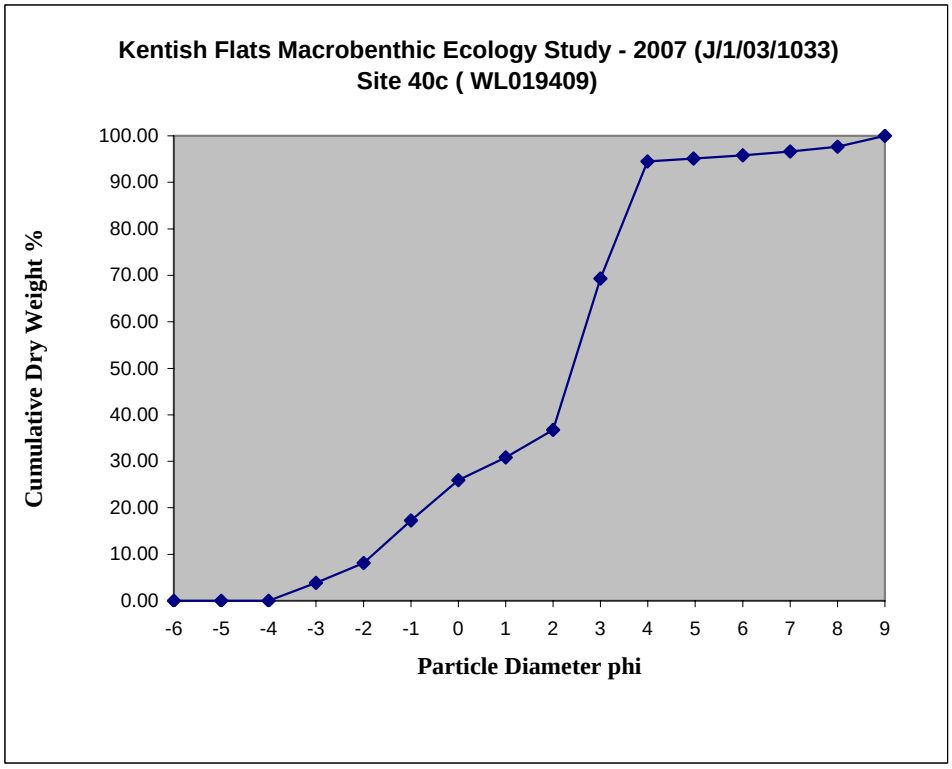
Mean mm	0.33
Md mm	0.19
Mean phi	1.62
Md phi	2.41
Sorting	2.32
Skq	-0.44
Kurtosis	0.92

%Gravel	8.09
% Sand	86.40
% Fines	5.51

Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 40c (WL019409)
Fractional Dry Weight %
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 40c (WL019409)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 42a (WL019413)

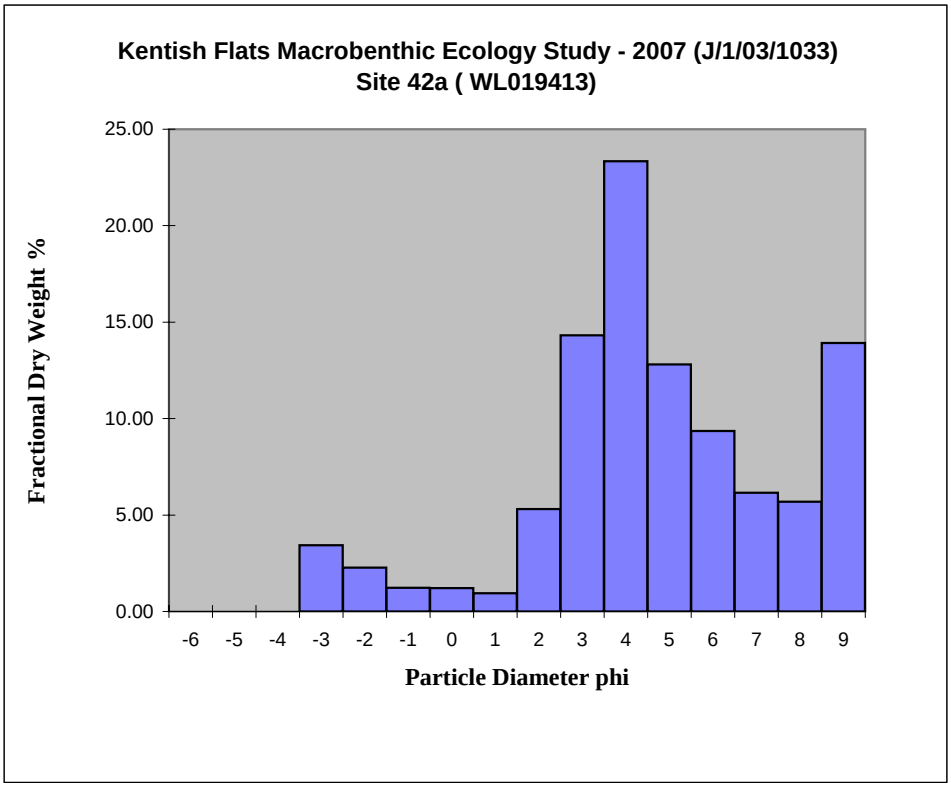
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage	
				Fractional	Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	0.000	0.00	0.00
Gravel	8	-3.0	3.391	3.43	3.43
	4	-2.0	2.243	2.27	5.71
Coarse Sand	2	-1.0	1.208	1.22	6.93
	1	0.0	1.196	1.21	8.14
Medium Sand	0.5	1.0	0.935	0.95	9.09
	0.25	2.0	5.246	5.31	14.40
Fine Sand	0.125	3.0	14.136	14.32	28.71
	0.063	4.0	23.055	23.35	52.06
Silt	0.032	5.0	12.654	12.81	64.88
	0.0156	6.0	9.245	9.36	74.24
	0.0078	7.0	6.073	6.15	80.39
	0.0039	8.0	5.618	5.69	86.08
Clay	<0.0039	9.0	13.750	13.92	100.00
		Total Weight	99	100	

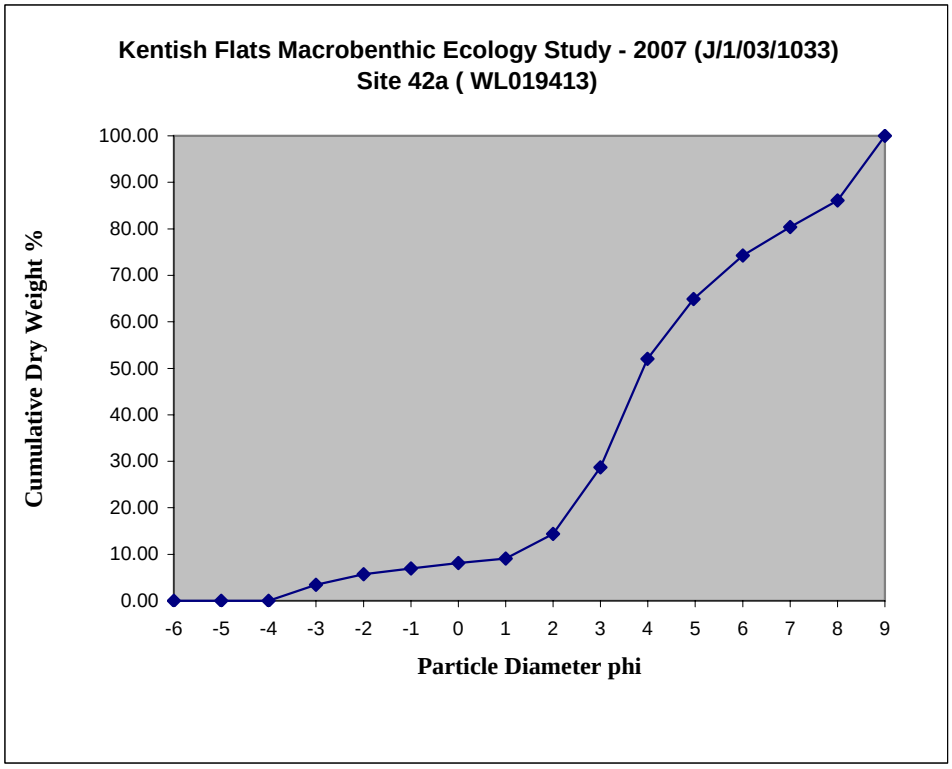
Mean mm	0.04
Md mm	0.07
Mean phi	4.55
Md phi	3.90
Sorting	2.93
Skq	0.07
Kurtosis	1.24

%Gravel	5.71
% Sand	46.36
% Fines	47.94

Sandy silt

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 42a (WL019413)
Fractional Dry Weight %
25.00
20.00
15.00
10.00
5.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 42a (WL019413)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 42b (WL019414)

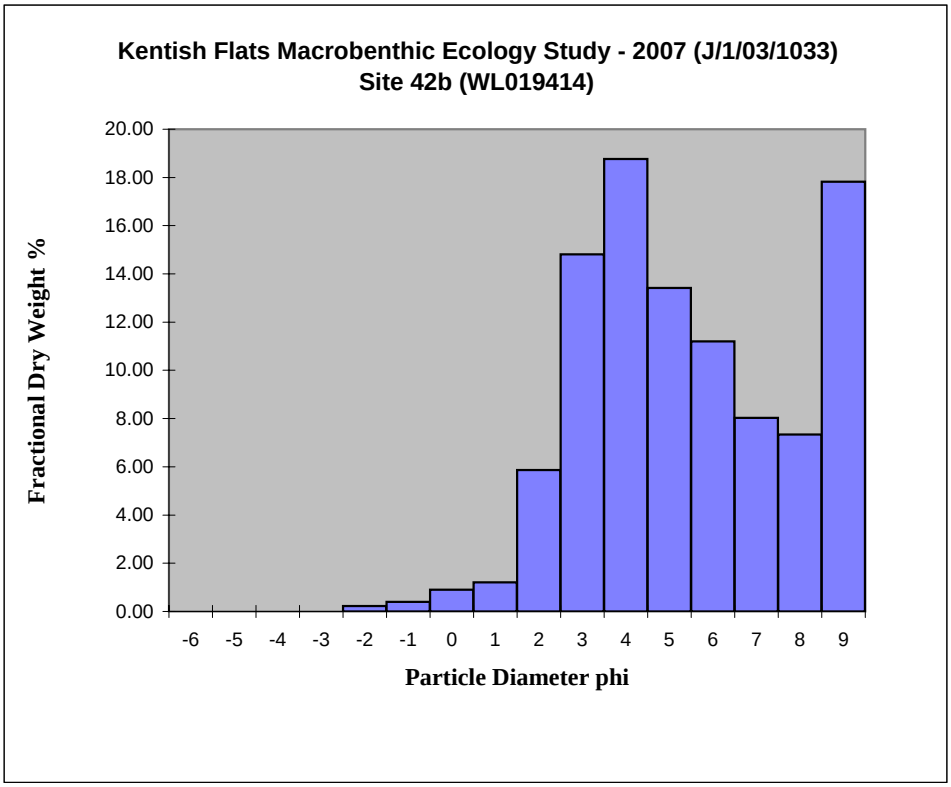
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	0.000	0.00	0.00
Gravel	8	-3.0	0.000	0.00	0.00
	4	-2.0	0.292	0.22	0.22
Coarse Sand	2	-1.0	0.524	0.40	0.62
	1	0.0	1.192	0.91	1.53
Medium Sand	0.5	1.0	1.584	1.21	2.74
	0.25	2.0	7.705	5.87	8.61
Fine Sand	0.125	3.0	19.431	14.80	23.41
	0.063	4.0	24.634	18.77	42.18
Silt	0.032	5.0	17.614	13.42	55.60
	0.0156	6.0	14.706	11.20	66.81
	0.0078	7.0	10.540	8.03	74.84
	0.0039	8.0	9.640	7.34	82.18
Clay	<0.0039	9.0	23.388	17.82	100.00
		Total Weight	131	100	

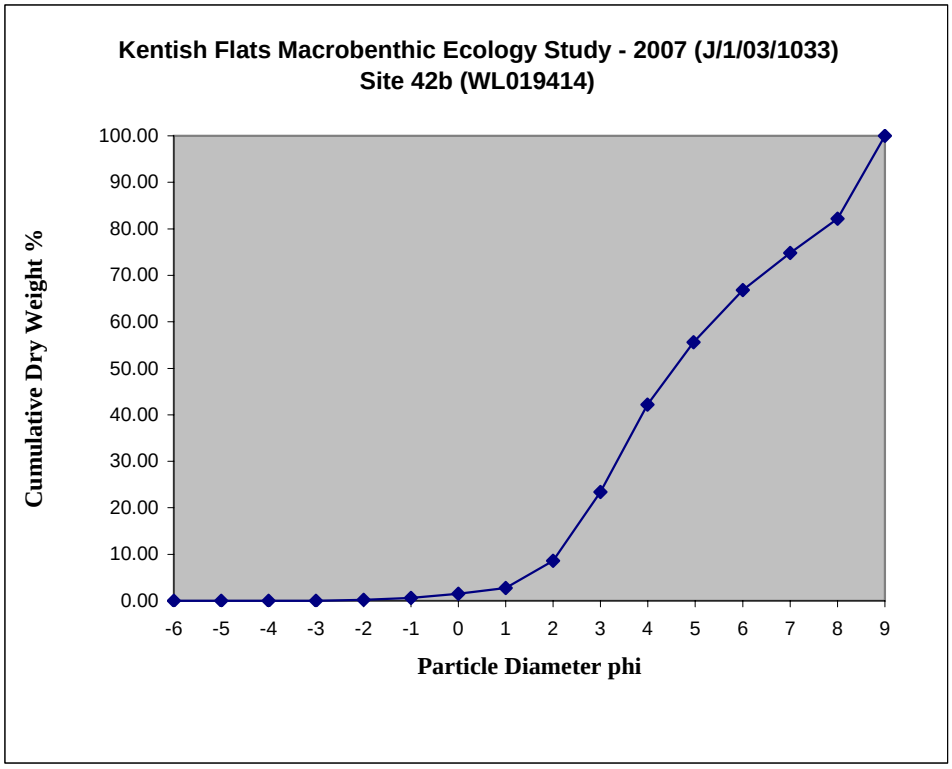
Mean mm	0.03
Md mm	0.04
Mean phi	5.01
Md phi	4.56
Sorting	2.35
Skq	0.13
Kurtosis	0.67

%Gravel	0.22
% Sand	41.96
% Fines	57.82

Sandy silt

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 42b (WL019414)
Fractional Dry Weight %
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 42b (WL019414)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 42c (WL019415)

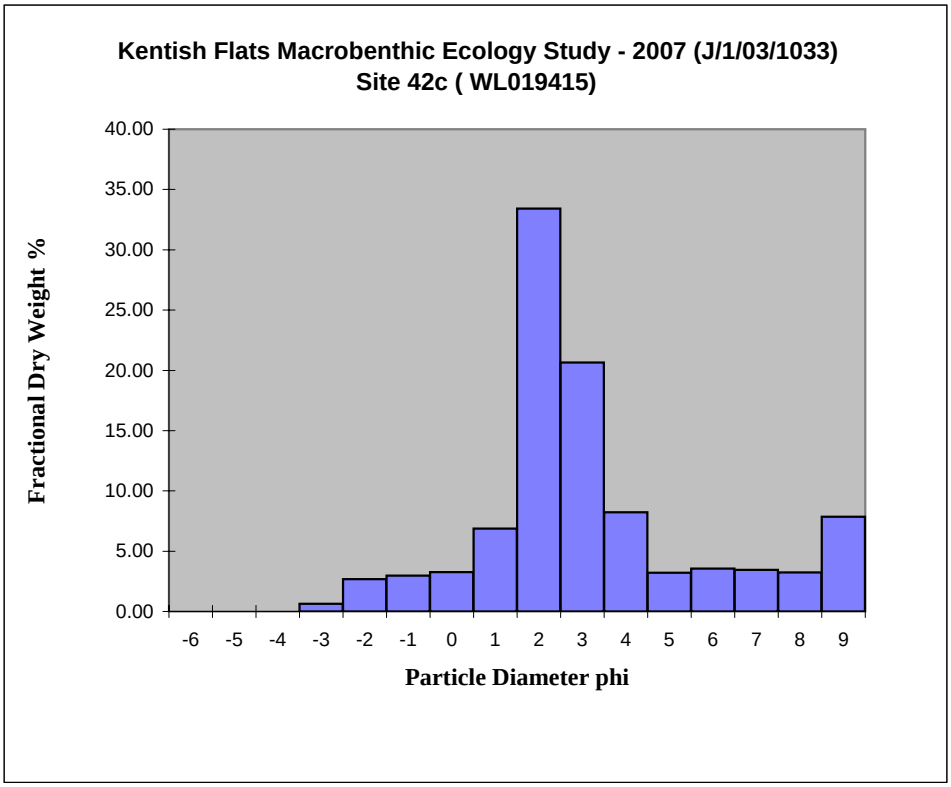
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	0.000	0.00	0.00
Gravel	8	-3.0	1.192	0.65	0.65
	4	-2.0	4.937	2.67	3.32
Coarse Sand	2	-1.0	5.510	2.98	6.30
	1	0.0	6.028	3.26	9.56
Medium Sand	0.5	1.0	12.698	6.87	16.44
	0.25	2.0	61.710	33.41	49.85
Fine Sand	0.125	3.0	38.134	20.64	70.49
	0.063	4.0	15.179	8.22	78.71
Silt	0.032	5.0	5.916	3.20	81.91
	0.0156	6.0	6.584	3.56	85.48
	0.0078	7.0	6.360	3.44	88.92
	0.0039	8.0	5.978	3.24	92.16
Clay	<0.0039	9.0	14.490	7.84	100.00
		Total Weight	185	100	

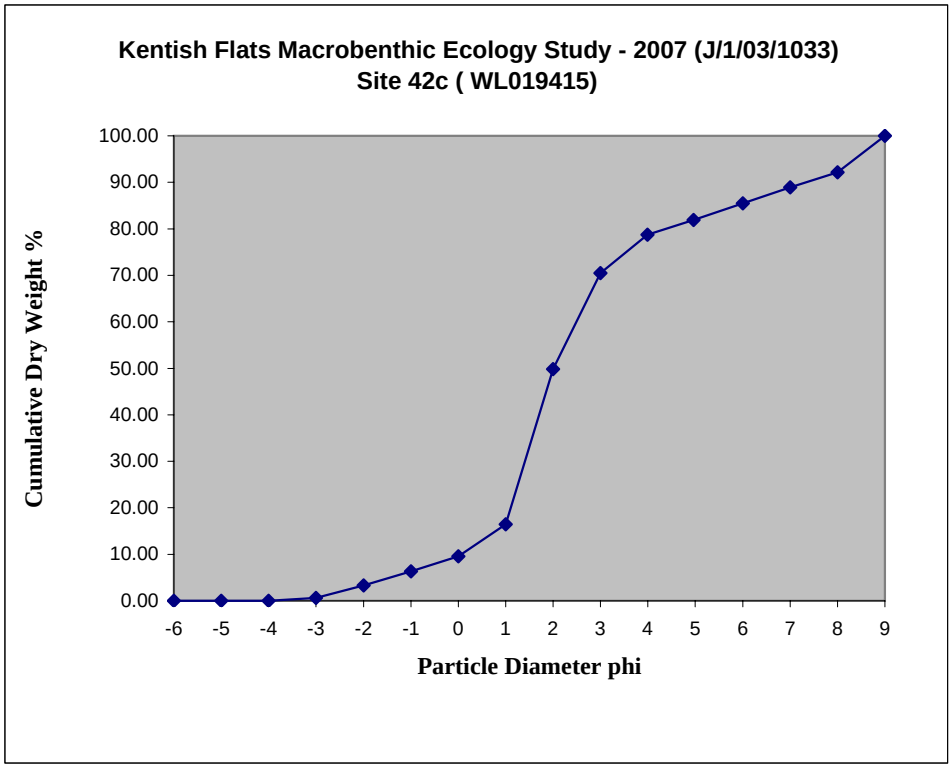
Mean mm	0.14
Md mm	0.25
Mean phi	2.84
Md phi	2.01
Sorting	2.58
Skq	0.40
Kurtosis	1.69

%Gravel	3.32
% Sand	75.39
% Fines	21.29

Silty sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 42c (WL019415)
Fractional Dry Weight %
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 42c (WL019415)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 43a (WL019416)

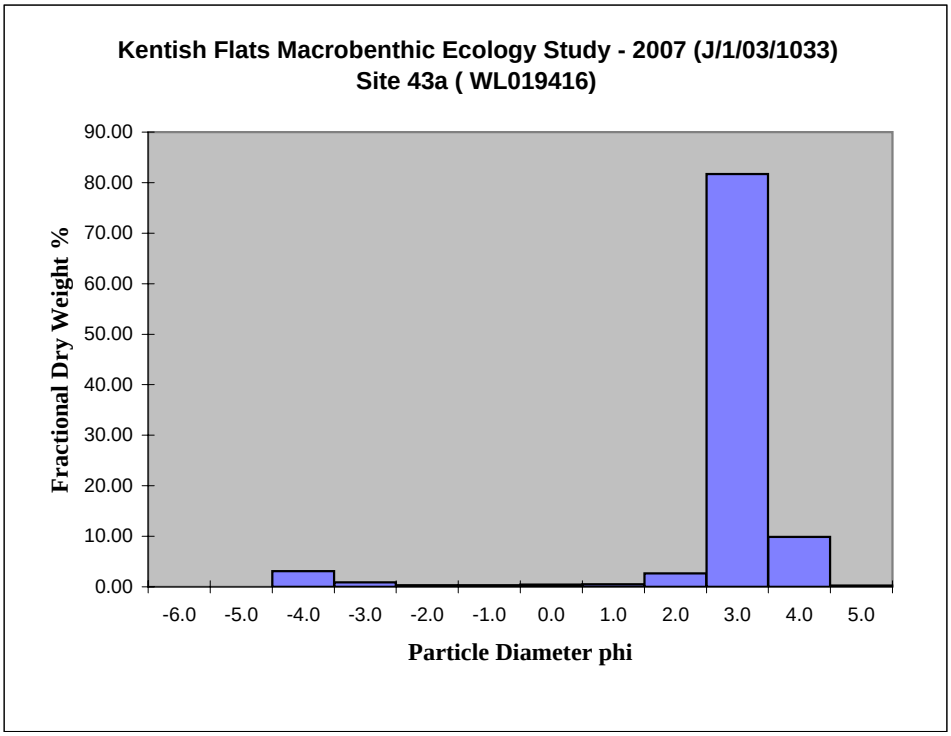
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	6.398	3.10	3.10
Gravel	8	-3.0	1.882	0.91	4.01
	4	-2.0	0.697	0.34	4.35
Coarse Sand	2	-1.0	0.600	0.29	4.64
	1	0.0	0.907	0.44	5.08
Medium Sand	0.5	1.0	0.982	0.48	5.56
	0.25	2.0	5.434	2.63	8.19
Fine Sand	0.125	3.0	168.504	81.70	89.89
	0.063	4.0	20.346	9.86	99.76
Silt/Clay	<0.063	5.0	0.502	0.24	100.00
		Total Weight	206.252	100.00	

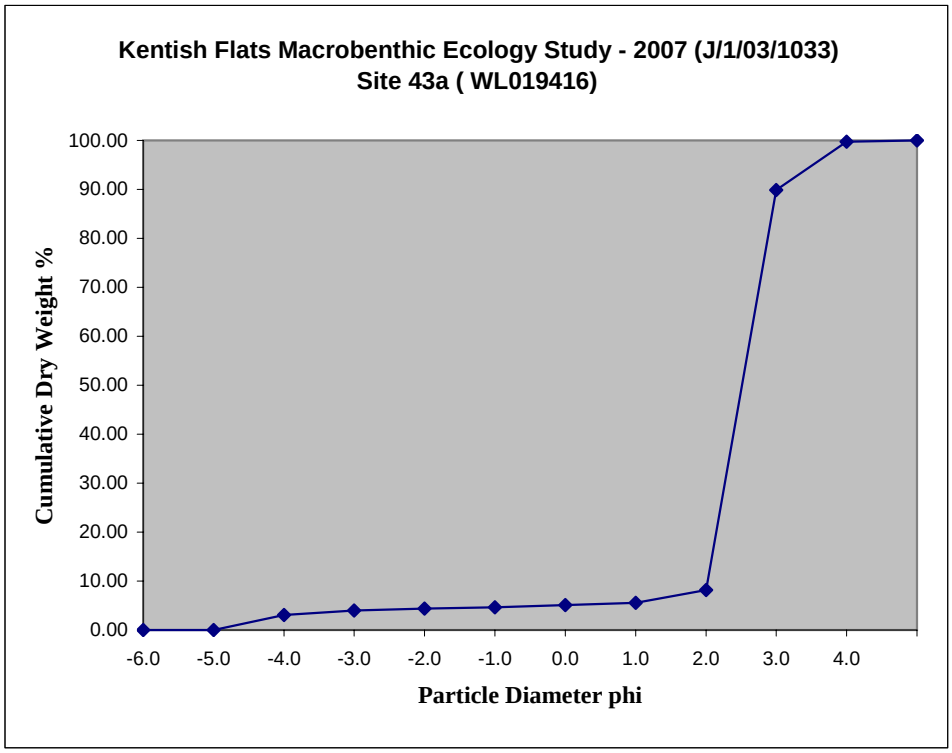
Mean mm	0.18
Md mm	0.18
Mean phi	2.51
Md phi	2.51
Sorting	0.68
Skq	-0.36
Kurtosis	2.10

%Gravel	4.35
% Sand	95.40
% Fines	0.24

Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 43a (WL019416)
Fractional Dry Weight %
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 43a (WL019416)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 43b (WL019417)

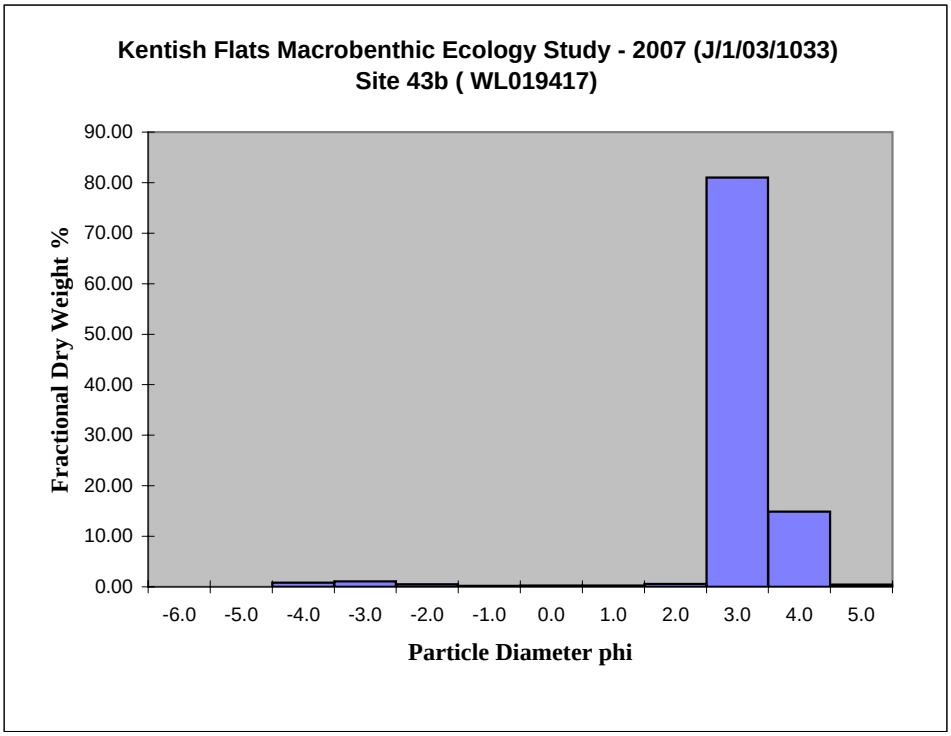
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	1.357	0.80	0.80
Gravel	8	-3.0	1.809	1.06	1.86
	4	-2.0	0.814	0.48	2.34
Coarse Sand	2	-1.0	0.326	0.19	2.53
	1	0.0	0.454	0.27	2.80
Medium Sand	0.5	1.0	0.414	0.24	3.04
	0.25	2.0	0.946	0.56	3.60
Fine Sand	0.125	3.0	137.794	81.04	84.64
	0.063	4.0	25.319	14.89	99.53
Silt/Clay	<0.063	5.0	0.805	0.47	100.00
		Total Weight	170.038	100.00	

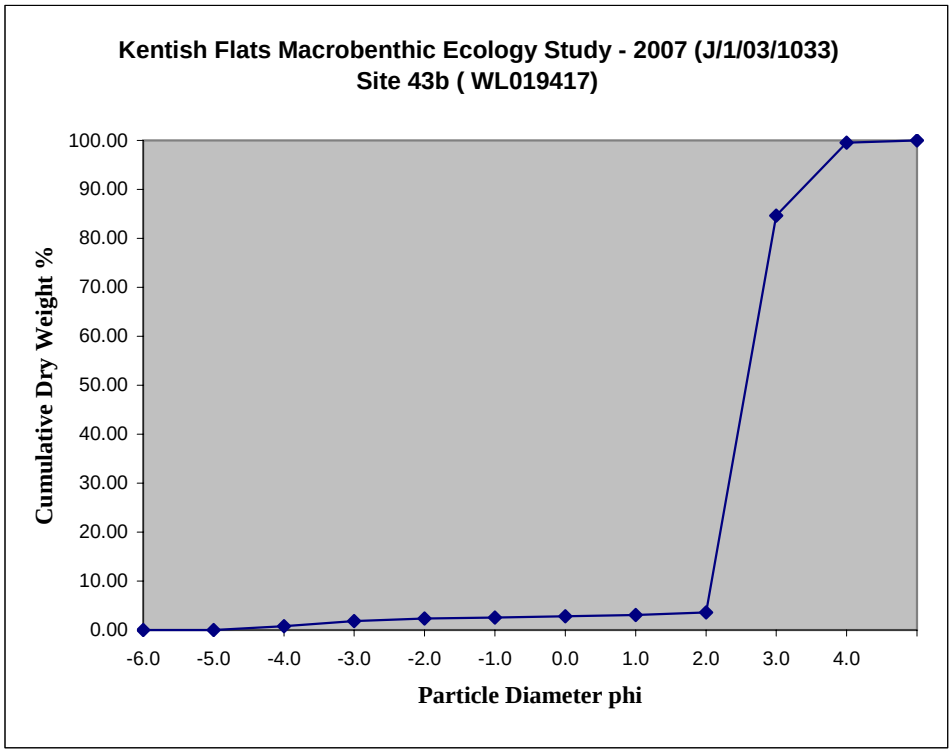
Mean mm	0.17
Md mm	0.17
Mean phi	2.57
Md phi	2.57
Sorting	0.34
Skq	-0.15
Kurtosis	0.57

%Gravel	2.34
% Sand	97.19
% Fines	0.47

Sand

* Based on Connor *et al*, 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 43b (WL019417)
Fractional Dry Weight %
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 43b (WL019417)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 43c (WL019418)

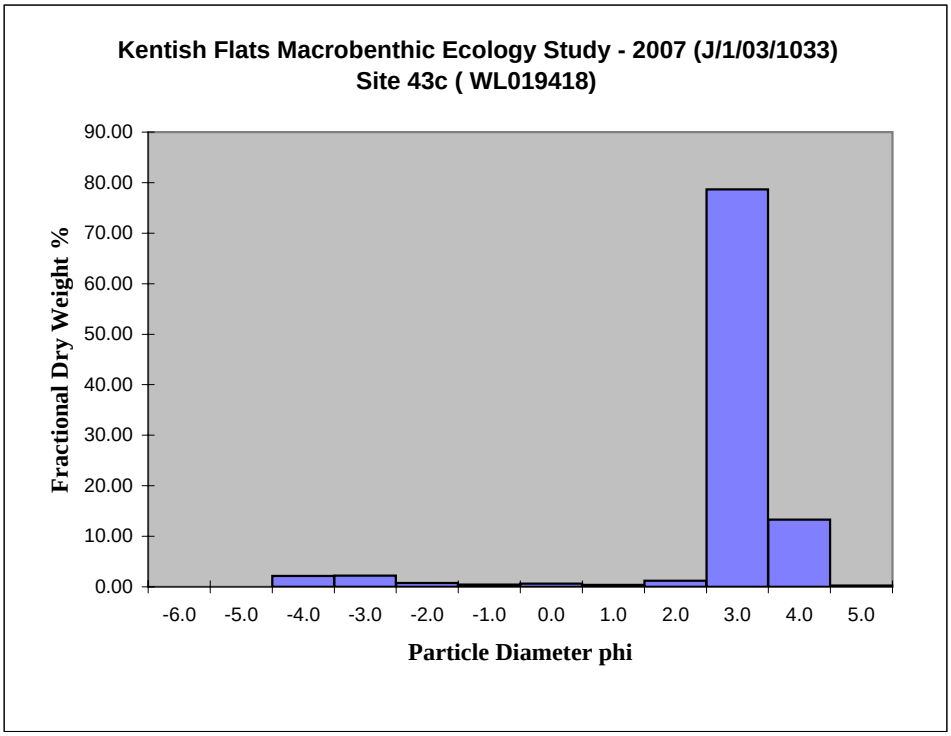
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	3.228	2.18	2.18
Gravel	8	-3.0	3.266	2.20	4.38
	4	-2.0	1.157	0.78	5.16
Coarse Sand	2	-1.0	0.615	0.42	5.58
	1	0.0	0.913	0.62	6.20
Medium Sand	0.5	1.0	0.588	0.40	6.59
	0.25	2.0	1.736	1.17	7.76
Fine Sand	0.125	3.0	116.533	78.66	86.43
	0.063	4.0	19.701	13.30	99.73
Silt/Clay	<0.063	5.0	0.406	0.27	100.00
		Total Weight	148.143	100.00	

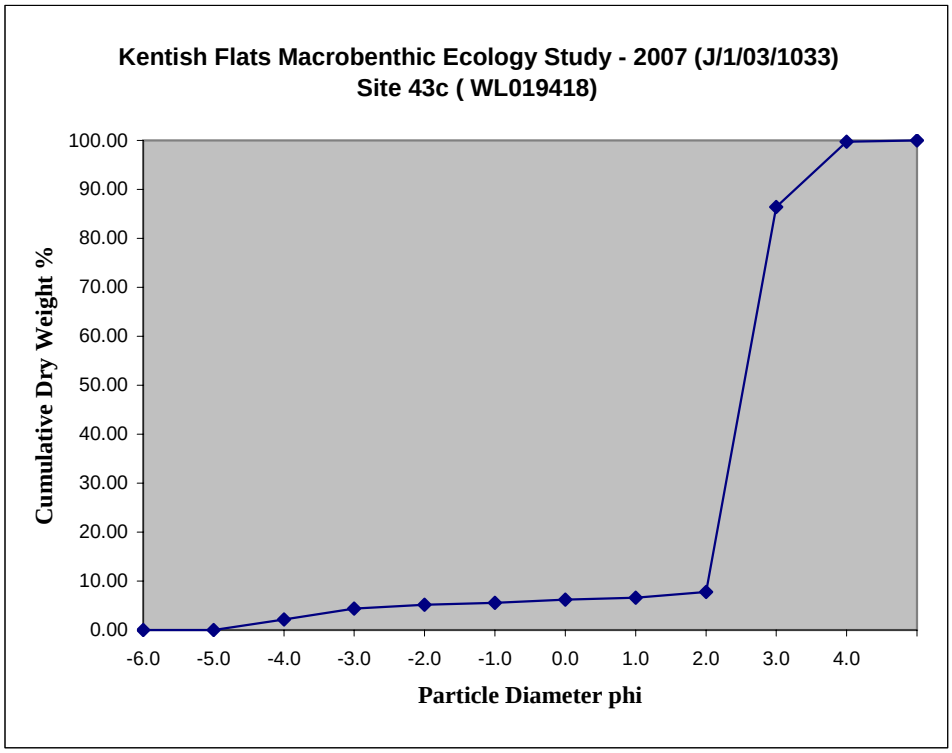
Mean mm	0.17
Md mm	0.17
Mean phi	2.54
Md phi	2.54
Sorting	0.99
Skq	-0.43
Kurtosis	3.30

%Gravel	5.16
% Sand	94.56
% Fines	0.27

Sand

* Based on Connor *et al*, 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 43c (WL019418)
Fractional Dry Weight %
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 43c (WL019418)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 44a (WL019419)

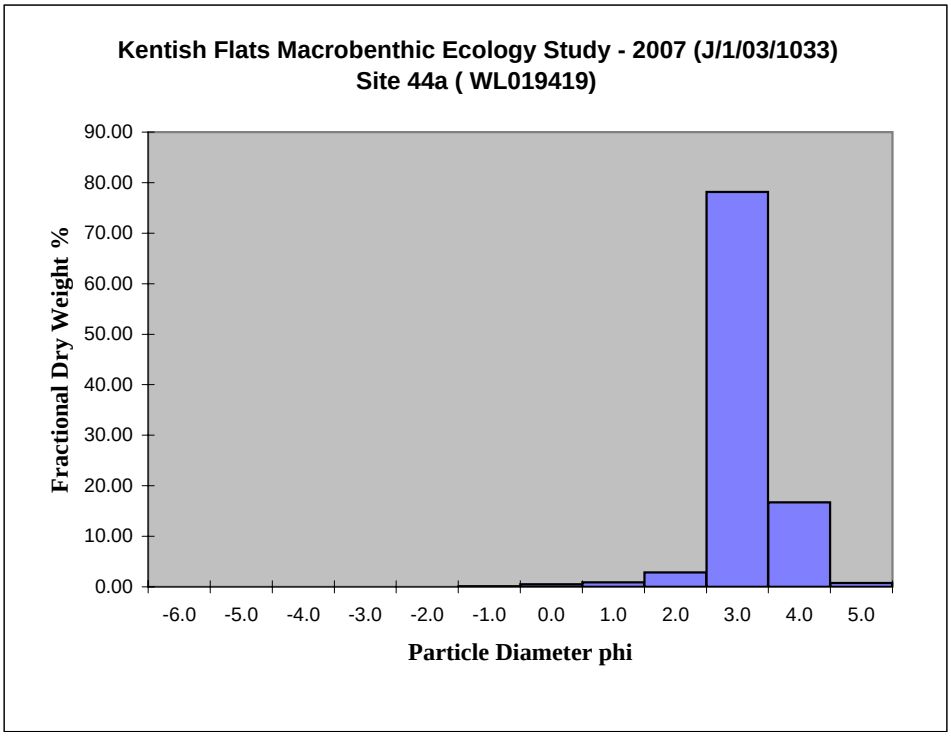
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	0.000	0.00	0.00
Gravel	8	-3.0	0.000	0.00	0.00
	4	-2.0	0.014	0.01	0.01
Coarse Sand	2	-1.0	0.162	0.08	0.09
	1	0.0	1.019	0.51	0.60
Medium Sand	0.5	1.0	1.833	0.92	1.52
	0.25	2.0	5.681	2.85	4.36
Fine Sand	0.125	3.0	155.997	78.13	82.49
	0.063	4.0	33.448	16.75	99.24
Silt/Clay	<0.063	5.0	1.517	0.76	100.00
		Total Weight	199.671	100.00	

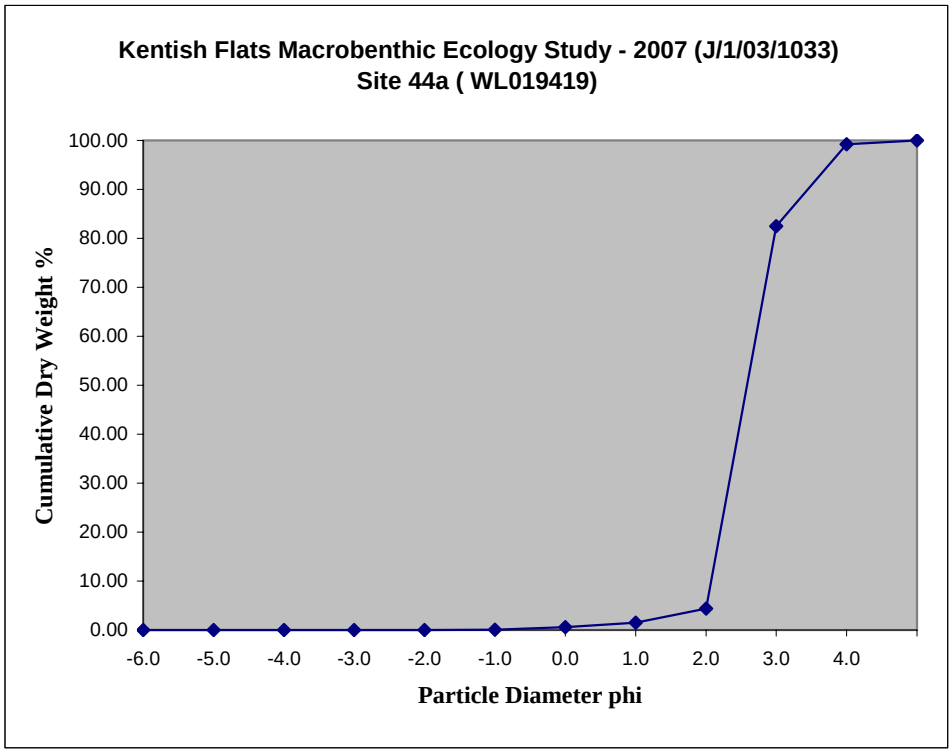
Mean mm	0.17
Md mm	0.17
Mean phi	2.57
Md phi	2.58
Sorting	0.34
Skq	-0.21
Kurtosis	0.54

%Gravel	0.01
% Sand	99.23
% Fines	0.76

Sand

* Based on Connor *et al*, 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 44a (WL019419)
Fractional Dry Weight %
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 44a (WL019419)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 44b (WL019420)

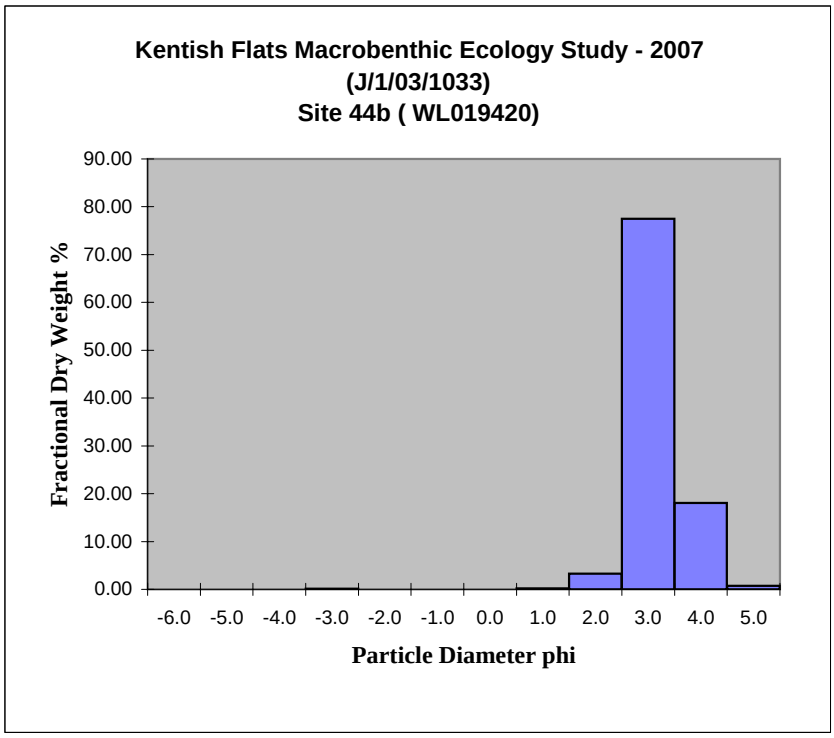
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	0.000	0.00	0.00
Gravel	8	-3.0	0.207	0.11	0.11
	4	-2.0	0.063	0.03	0.14
Coarse Sand	2	-1.0	0.000	0.00	0.14
	1	0.0	0.043	0.02	0.16
Medium Sand	0.5	1.0	0.453	0.23	0.39
	0.25	2.0	6.404	3.28	3.67
Fine Sand	0.125	3.0	151.449	77.48	81.15
	0.063	4.0	35.353	18.09	99.24
Silt/Clay	<0.063	5.0	1.487	0.76	100.00
		Total Weight	195.459	100.00	

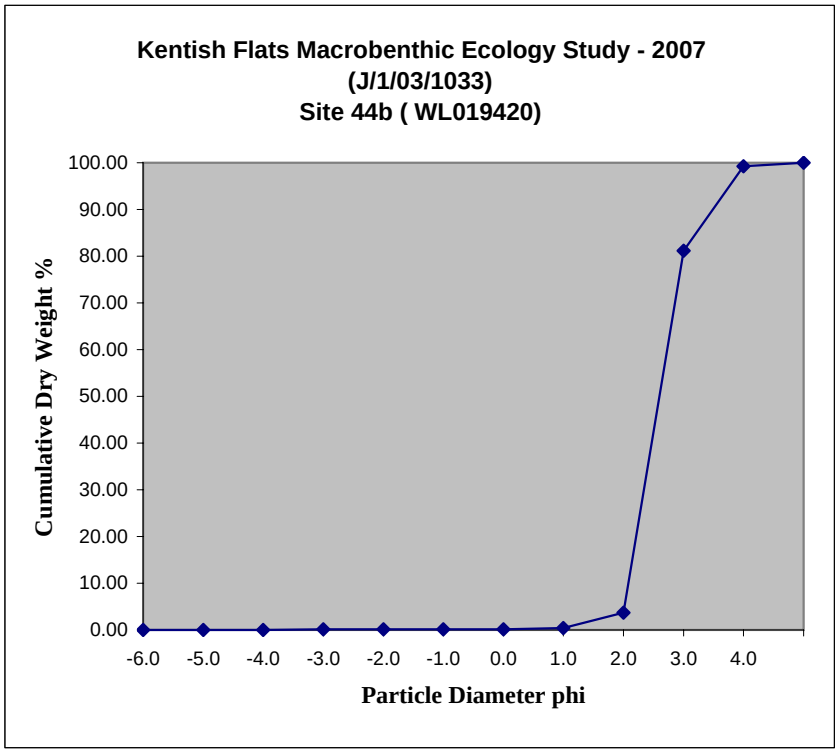
Mean mm	0.17
Md mm	0.17
Mean phi	2.57
Md phi	2.60
Sorting	0.32
Skq	-0.26
Kurtosis	0.52

%Gravel	0.14
% Sand	99.10
% Fines	0.76

Sand

* Based on Connor *et al*, 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007
(J/1/03/1033)
Site 44b (WL019420)
Fractional Dry Weight %
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0 -5.0 -4.0 -3.0 -2.0 -1.0 0.0 1.0 2.0 3.0 4.0 5.0
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007
(J/1/03/1033)
Site 44b (WL019420)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0 -5.0 -4.0 -3.0 -2.0 -1.0 0.0 1.0 2.0 3.0 4.0
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 44c (WL019421)

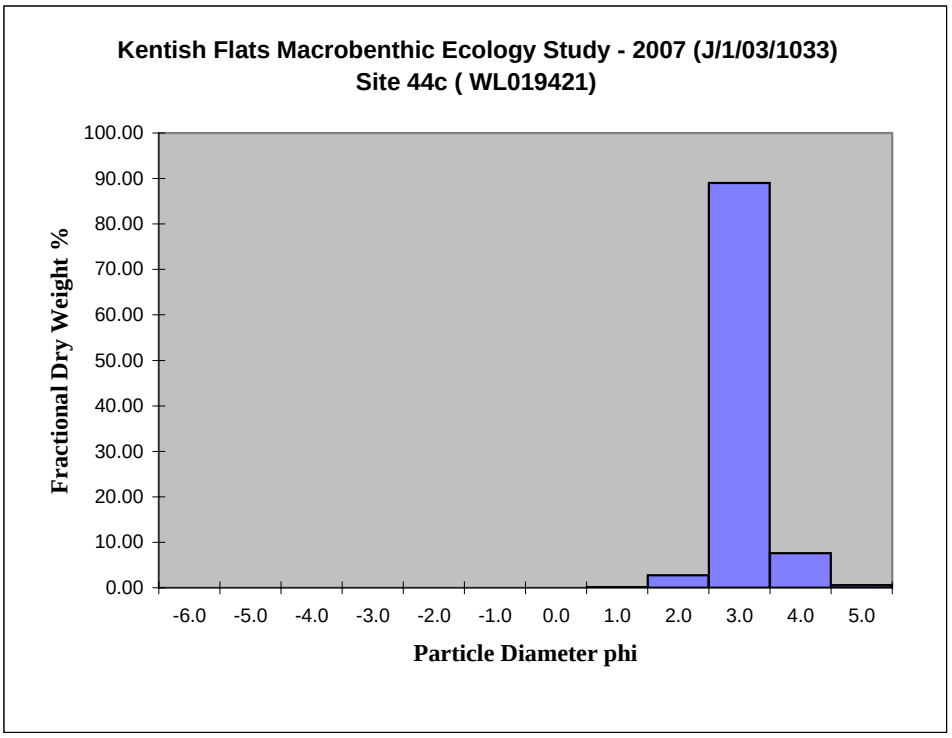
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	0.000	0.00	0.00
Gravel	8	-3.0	0.000	0.00	0.00
	4	-2.0	0.000	0.00	0.00
Coarse Sand	2	-1.0	0.033	0.02	0.02
	1	0.0	0.016	0.01	0.02
Medium Sand	0.5	1.0	0.084	0.04	0.06
	0.25	2.0	6.081	2.77	2.83
Fine Sand	0.125	3.0	195.287	89.02	91.86
	0.063	4.0	16.681	7.60	99.46
Silt/Clay	<0.063	5.0	1.185	0.54	100.00
		Total Weight	219.367	100.00	

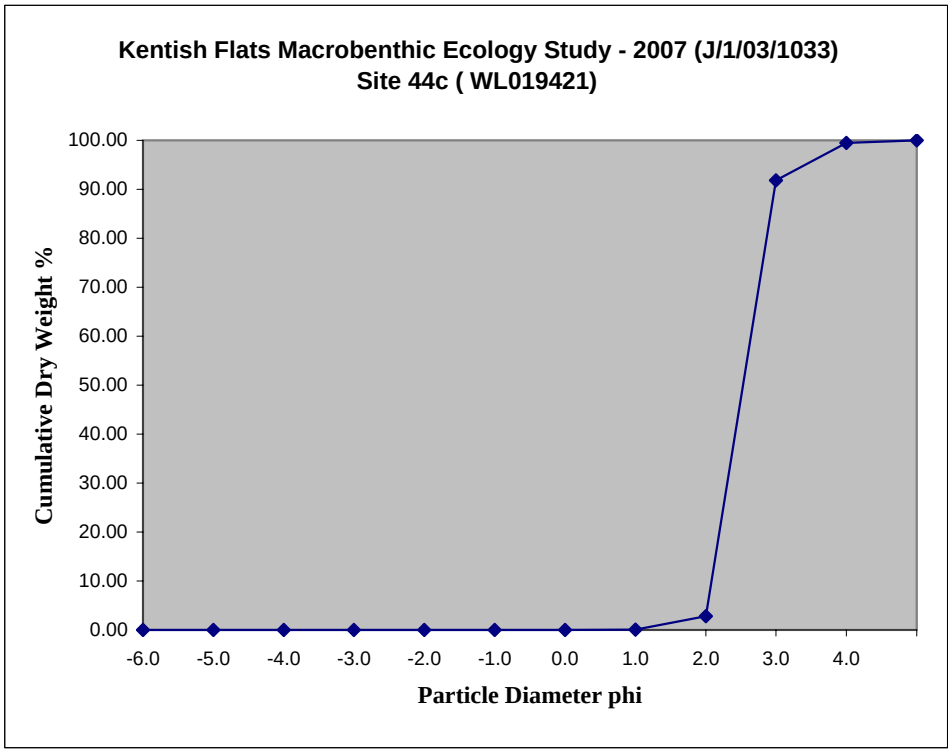
Mean mm	0.17
Md mm	0.17
Mean phi	2.53
Md phi	2.53
Sorting	0.33
Skq	-0.04
Kurtosis	0.69

%Gravel	0.00
% Sand	99.46
% Fines	0.54

Sand

* Based on Connor *et al*, 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 44c (WL019421)
Fractional Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 44c (WL019421)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 45a (WL019422)

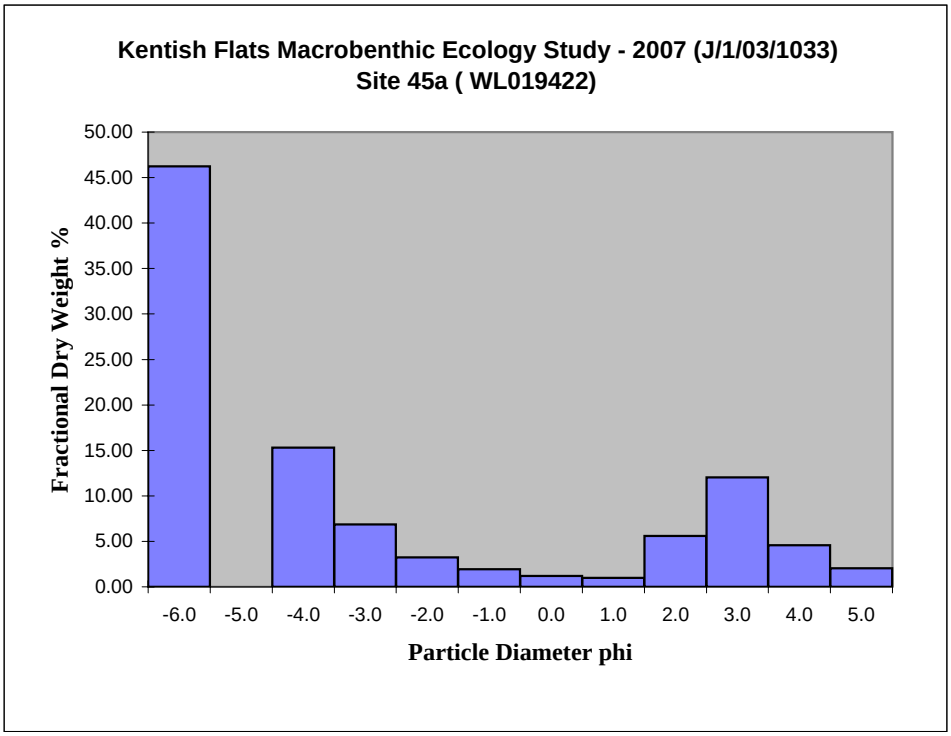
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	371.961	46.24	46.24
Pebble	32	-5.0	0.000	0.00	46.24
	16	-4.0	123.070	15.30	61.54
Gravel	8	-3.0	55.250	6.87	68.41
	4	-2.0	26.116	3.25	71.65
Coarse Sand	2	-1.0	15.654	1.95	73.60
	1	0.0	9.706	1.21	74.81
Medium Sand	0.5	1.0	7.964	0.99	75.80
	0.25	2.0	44.938	5.59	81.38
Fine Sand	0.125	3.0	96.677	12.02	93.40
	0.063	4.0	36.747	4.57	97.97
Silt/Clay	<0.063	5.0	16.337	2.03	100.00
		Total Weight	804.42	100.00	

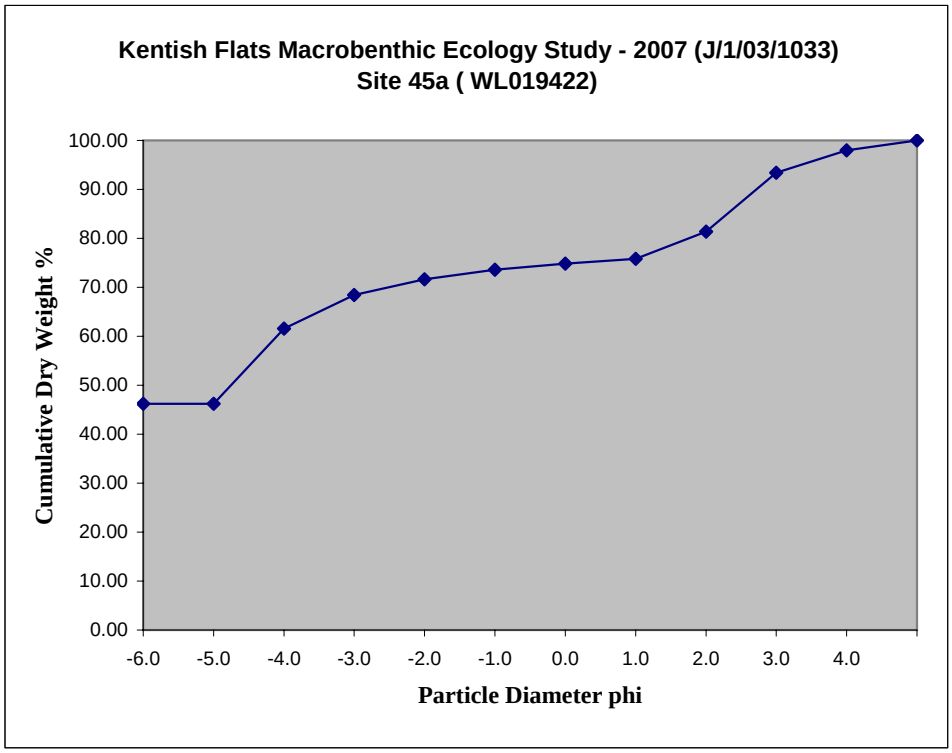
Mean mm	8.98
Md mm	26.99
Mean phi	-3.17
Md phi	-4.75
Sorting	3.91
Skq	0.49
Kurtosis	0.66

%Gravel	71.65
% Sand	26.32
% Fines	2.03

0

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 45a (WL019422)
Fractional Dry Weight %
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 45a (WL019422)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
Particle Diameter phi

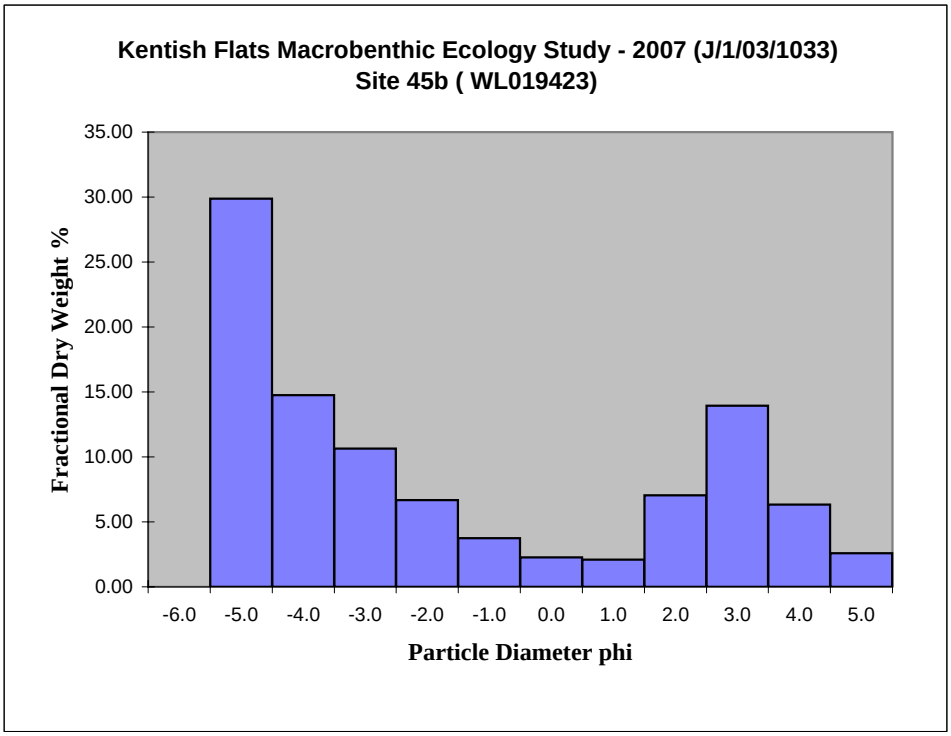
Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 45b (WL019423)

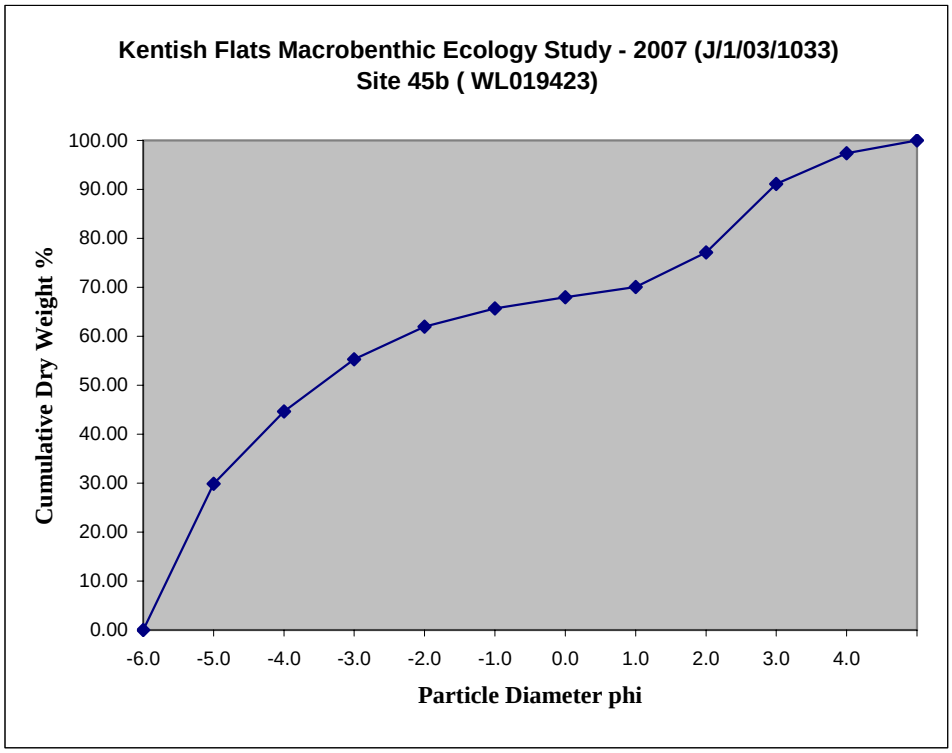
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	126.431	29.88	29.88
	16	-4.0	62.461	14.76	44.64
Gravel	8	-3.0	45.041	10.64	55.28
	4	-2.0	28.286	6.68	61.97
Coarse Sand	2	-1.0	15.843	3.74	65.71
	1	0.0	9.633	2.28	67.99
Medium Sand	0.5	1.0	8.876	2.10	70.08
	0.25	2.0	29.858	7.06	77.14
Fine Sand	0.125	3.0	59.012	13.95	91.09
	0.063	4.0	26.747	6.32	97.41
Silt/Clay	<0.063	5.0	10.977	2.59	100.00
		Total Weight	423.165	100.00	

Mean mm	5.52
Md mm	11.28
Mean phi	-2.47
Md phi	-3.50
Sorting	3.81
Skq	0.29
Kurtosis	0.60

%Gravel	61.97
% Sand	35.44
% Fines	2.59

* Based on Connor *et al*, 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 45b (WL019423)
Fractional Dry Weight %
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 45b (WL019423)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
Particle Diameter phi

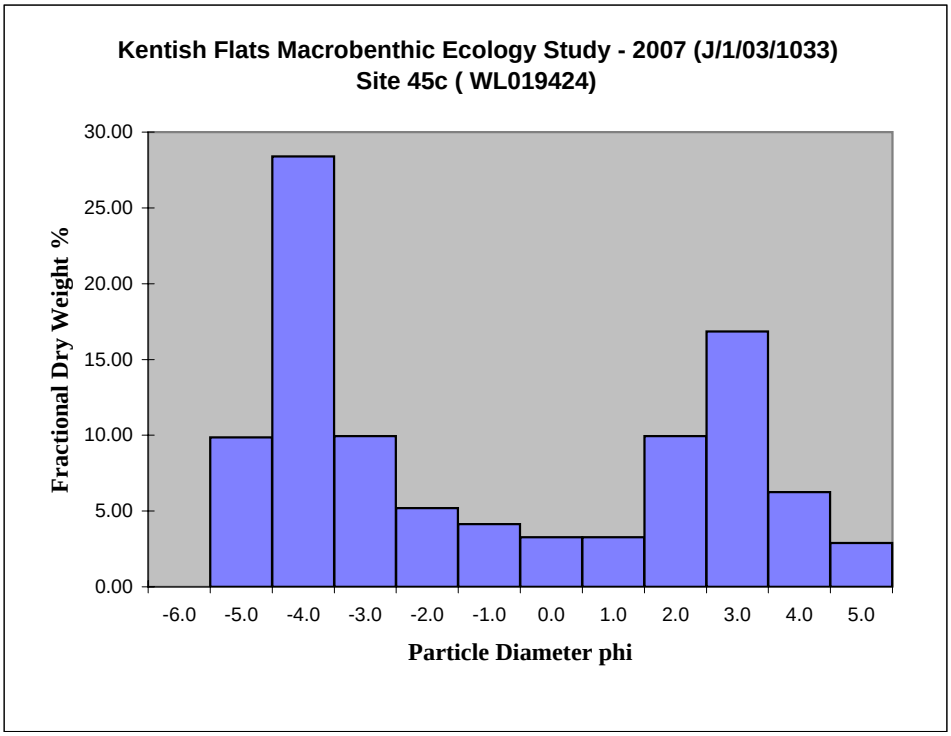
Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 45c (WL019424)

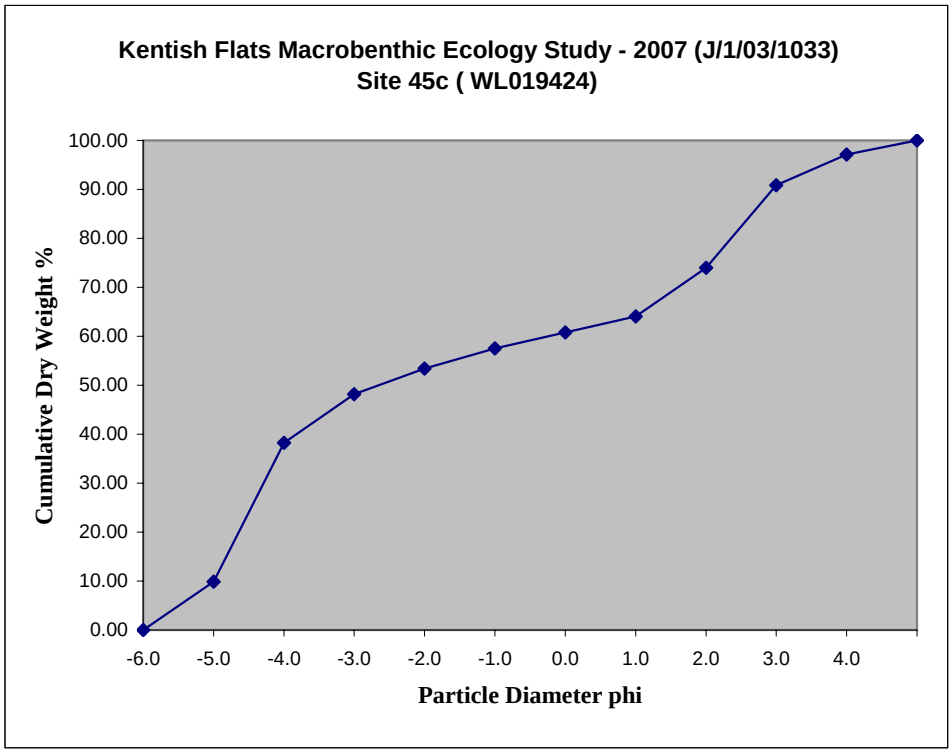
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	39.937	9.85	9.85
	16	-4.0	115.116	28.39	38.24
Gravel	8	-3.0	40.295	9.94	48.18
	4	-2.0	21.065	5.19	53.37
Coarse Sand	2	-1.0	16.818	4.15	57.52
	1	0.0	13.262	3.27	60.79
Medium Sand	0.5	1.0	13.229	3.26	64.05
	0.25	2.0	40.308	9.94	73.99
Fine Sand	0.125	3.0	68.341	16.85	90.85
	0.063	4.0	25.355	6.25	97.10
Silt/Clay	<0.063	5.0	11.764	2.90	100.00
		Total Weight	405.49	100.00	

Mean mm	3.06
Md mm	6.27
Mean phi	-1.61
Md phi	-2.65
Sorting	3.27
Skq	0.30
Kurtosis	0.59

%Gravel	53.37
% Sand	43.73
% Fines	2.90

* Based on Connor *et al*, 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 45c (WL019424)
Fractional Dry Weight %
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 45c (WL019424)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 47a (WL019425)

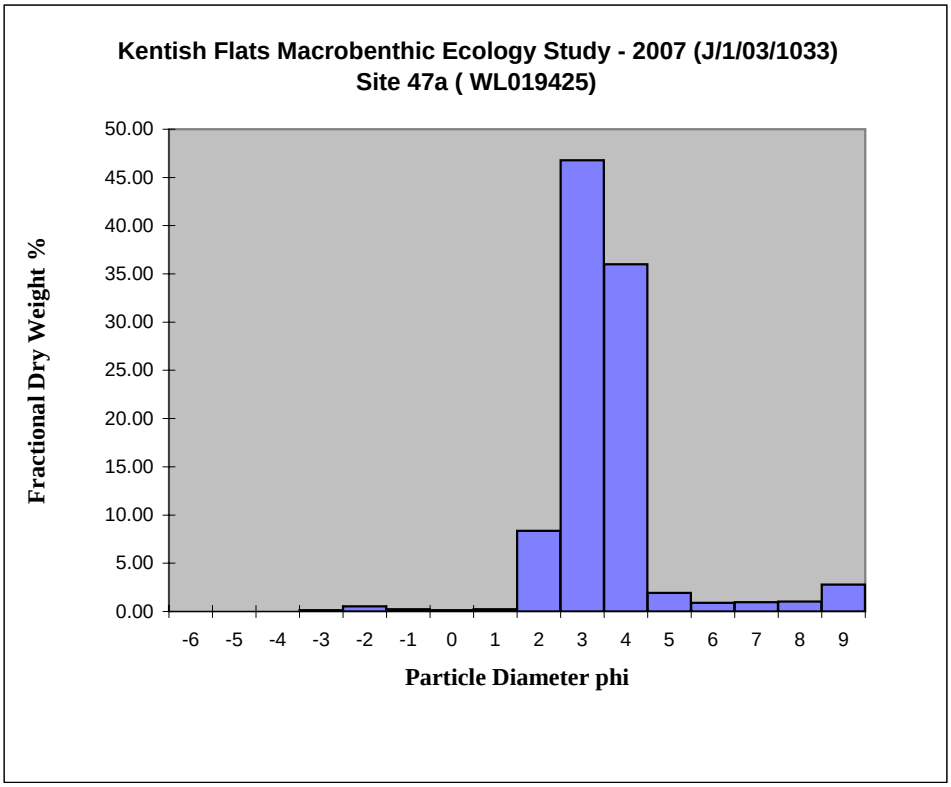
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	0.000	0.00	0.00
Gravel	8	-3.0	0.236	0.14	0.14
	4	-2.0	0.885	0.53	0.68
Coarse Sand	2	-1.0	0.361	0.22	0.90
	1	0.0	0.196	0.12	1.01
Medium Sand	0.5	1.0	0.386	0.23	1.25
	0.25	2.0	13.851	8.37	9.61
Fine Sand	0.125	3.0	77.446	46.79	56.40
	0.063	4.0	59.601	36.01	92.41
Silt	0.032	5.0	3.161	1.91	94.32
	0.0156	6.0	1.505	0.91	95.23
	0.0078	7.0	1.567	0.95	96.17
	0.0039	8.0	1.702	1.03	97.20
Clay	<0.0039	9.0	4.635	2.80	100.00
		Total Weight	166	100	

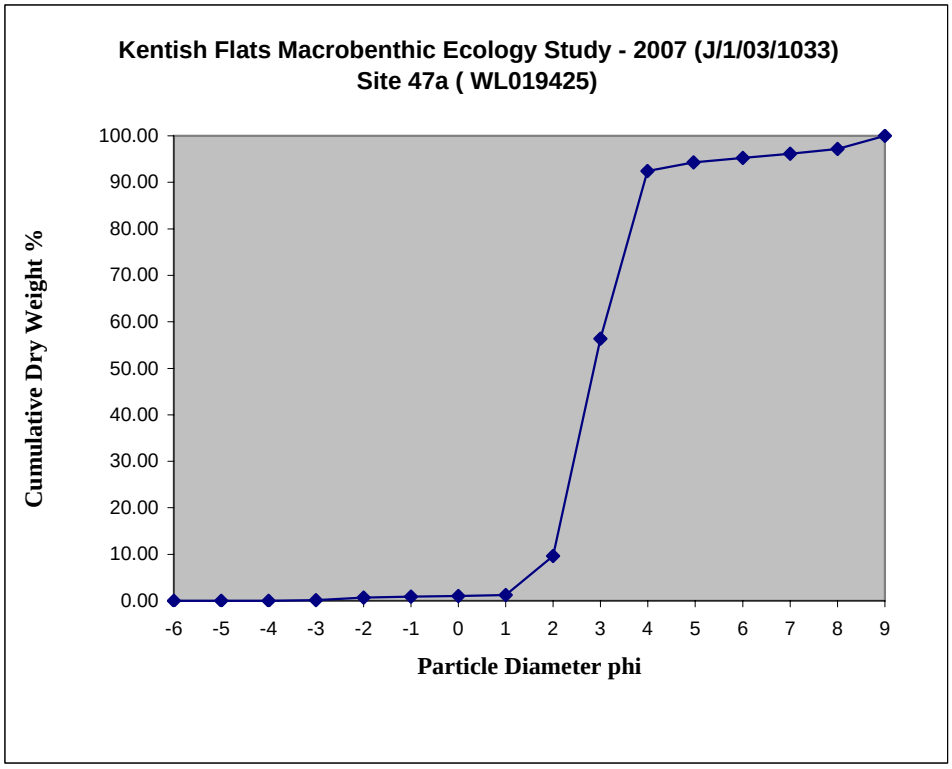
Mean mm	0.13
Md mm	0.14
Mean phi	2.92
Md phi	2.86
Sorting	1.06
Skq	0.22
Kurtosis	1.49

%Gravel	0.68
% Sand	91.73
% Fines	7.59

Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 47a (WL019425)
Fractional Dry Weight %
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 47a (WL019425)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 47b (WL019426)

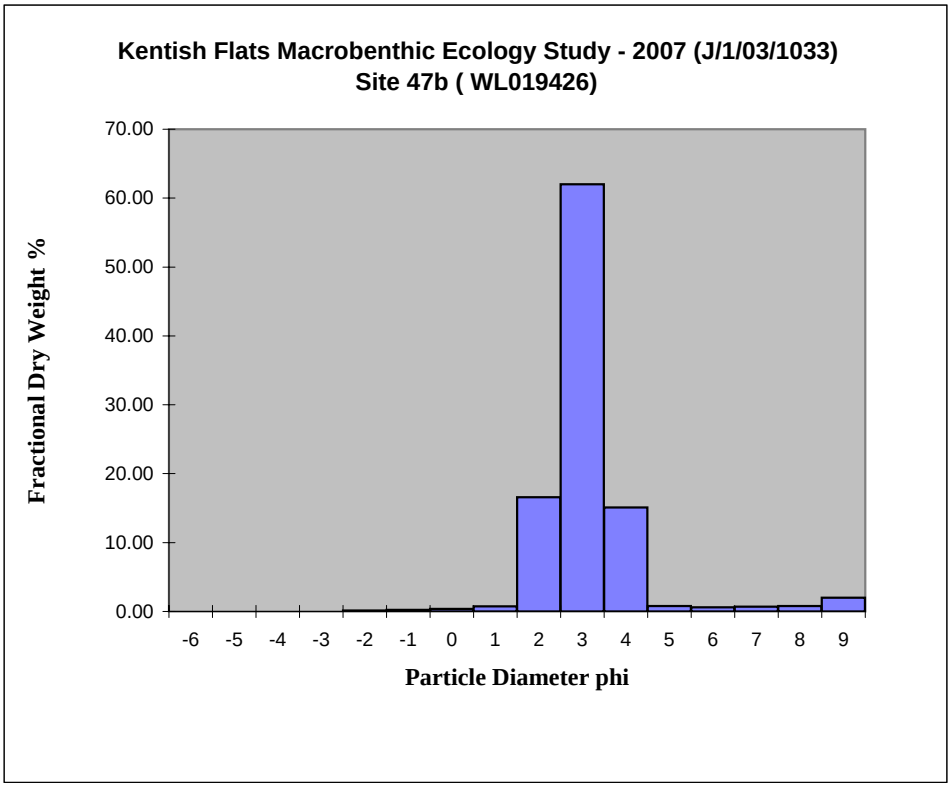
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage	
				Fractional	Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	0.000	0.00	0.00
Gravel	8	-3.0	0.000	0.00	0.00
	4	-2.0	0.277	0.12	0.12
Coarse Sand	2	-1.0	0.530	0.22	0.34
	1	0.0	0.823	0.35	0.69
Medium Sand	0.5	1.0	1.753	0.74	1.43
	0.25	2.0	39.082	16.58	18.01
Fine Sand	0.125	3.0	146.154	61.99	80.00
	0.063	4.0	35.540	15.07	95.07
Silt	0.032	5.0	1.907	0.81	95.88
	0.0156	6.0	1.469	0.62	96.51
	0.0078	7.0	1.669	0.71	97.21
	0.0039	8.0	1.911	0.81	98.02
Clay	<0.0039	9.0	4.658	1.98	100.00
		Total Weight	236	100	

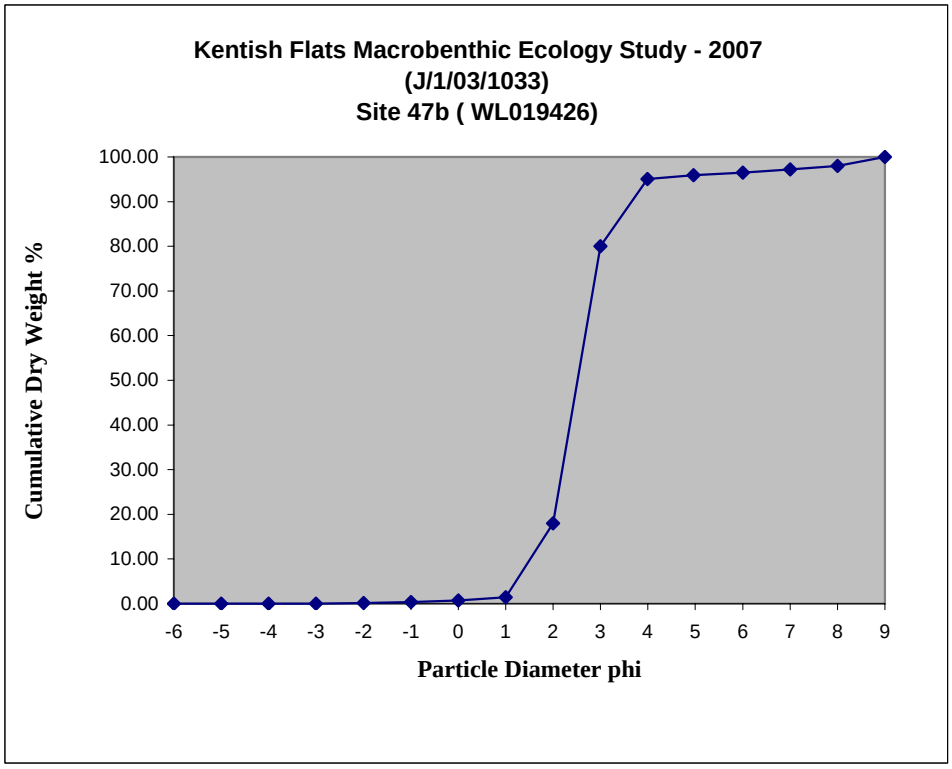
Mean mm	0.17
Md mm	0.17
Mean phi	2.55
Md phi	2.52
Sorting	0.77
Skq	0.07
Kurtosis	1.41

%Gravel	0.12
% Sand	94.96
% Fines	4.93

Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 47b (WL019426)
Fractional Dry Weight %
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007
(J/1/03/1033)
Site 47b (WL019426)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

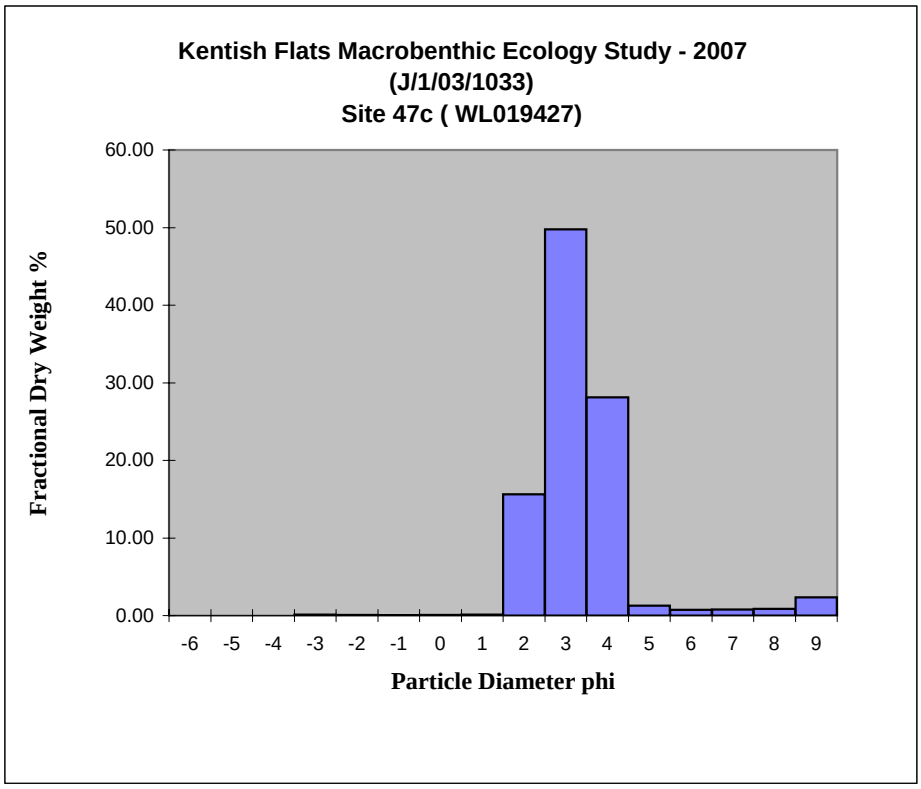
Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 47c (WL019427)

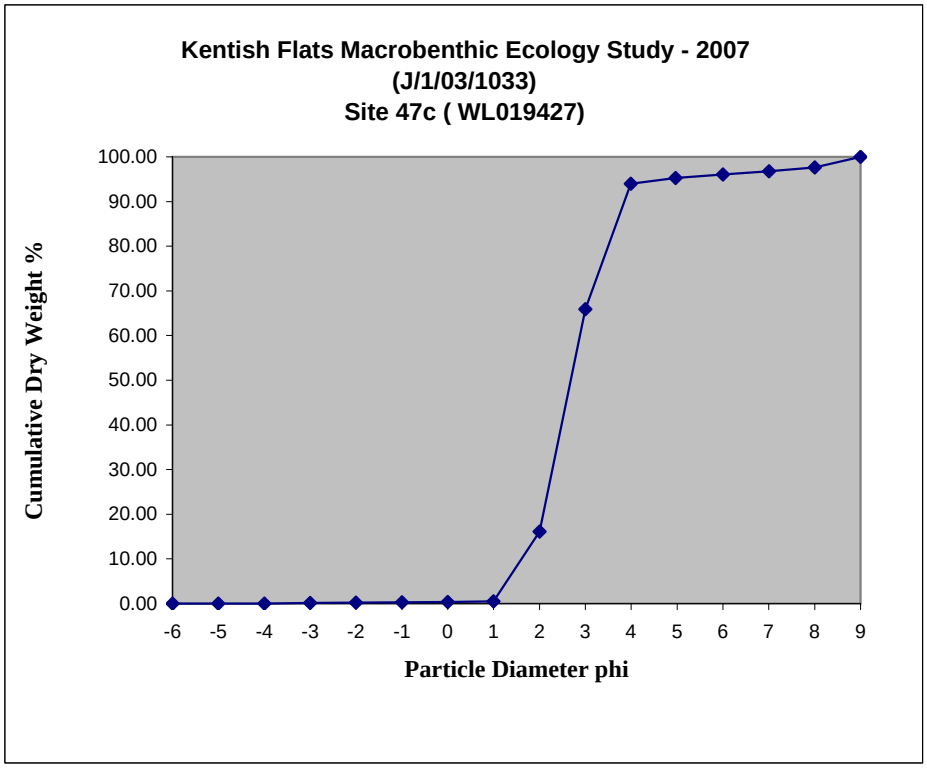
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	0.000	0.00	0.00
Gravel	8	-3.0	0.268	0.12	0.12
	4	-2.0	0.231	0.10	0.22
Coarse Sand	2	-1.0	0.138	0.06	0.28
	1	0.0	0.169	0.07	0.35
Medium Sand	0.5	1.0	0.298	0.13	0.48
	0.25	2.0	35.601	15.61	16.10
Fine Sand	0.125	3.0	113.517	49.79	65.89
	0.063	4.0	64.122	28.12	94.01
Silt	0.032	5.0	2.958	1.30	95.31
	0.0156	6.0	1.656	0.73	96.03
	0.0078	7.0	1.768	0.78	96.81
	0.0039	8.0	1.950	0.86	97.66
Clay	<0.0039	9.0	5.324	2.34	100.00
		Total Weig	228	100	

Mean mm	0.15
Md mm	0.16
Mean phi	2.77
Md phi	2.68
Sorting	0.93
Skq	0.18
Kurtosis	1.24

%Gravel	0.22
% Sand	93.79
% Fines	5.99
	Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007
(J/1/03/1033)
Site 47c (WL019427)
Fractional Dry Weight %
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007
(J/1/03/1033)
Site 47c (WL019427)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

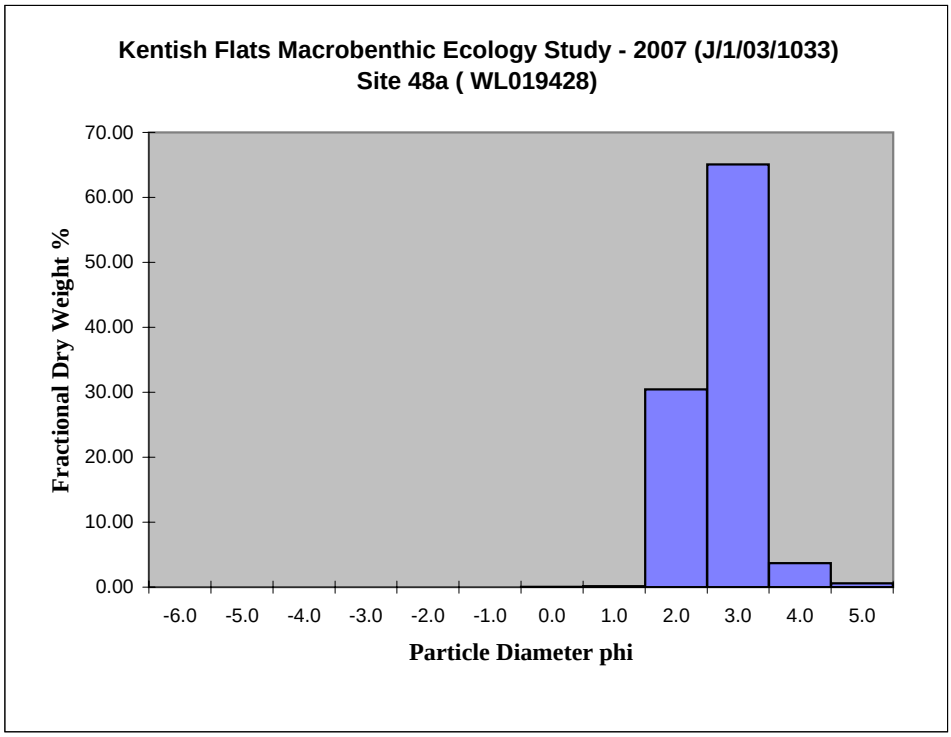
Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 48a (WL019428)

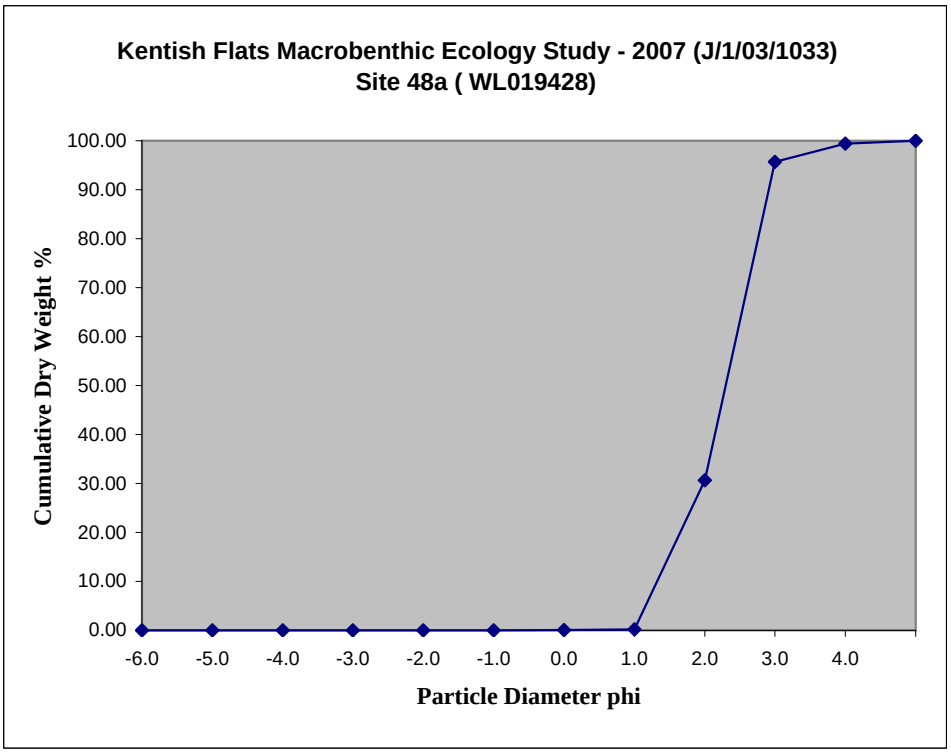
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage	
				Fractional	Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	0.000	0.00	0.00
Gravel	8	-3.0	0.000	0.00	0.00
	4	-2.0	0.034	0.02	0.02
Coarse Sand	2	-1.0	0.032	0.01	0.03
	1	0.0	0.060	0.03	0.06
Medium Sand	0.5	1.0	0.273	0.12	0.18
	0.25	2.0	67.159	30.45	30.63
Fine Sand	0.125	3.0	143.534	65.08	95.71
	0.063	4.0	8.145	3.69	99.40
Silt/Clay	<0.063	5.0	1.323	0.60	100.00
		Total Weight	220.56	100.00	

Mean mm	0.22
Md mm	0.20
Mean phi	2.21
Md phi	2.30
Sorting	0.60
Skq	-0.22
Kurtosis	0.87

%Gravel	0.02
% Sand	99.38
% Fines	0.60

* Based on Connor *et al*, 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 48a (WL019428)
Fractional Dry Weight %
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 48a (WL019428)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
Particle Diameter phi

Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 48b (WL019429)

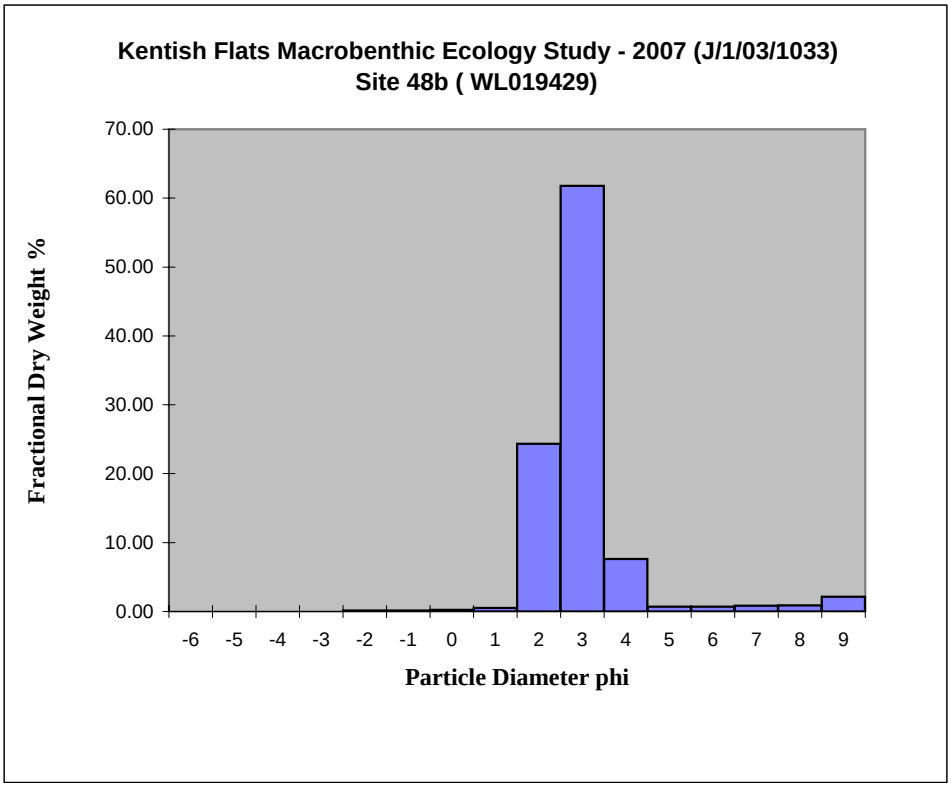
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	0.000	0.00	0.00
Gravel	8	-3.0	0.000	0.00	0.00
	4	-2.0	0.381	0.16	0.16
Coarse Sand	2	-1.0	0.307	0.13	0.29
	1	0.0	0.577	0.24	0.53
Medium Sand	0.5	1.0	1.269	0.53	1.07
	0.25	2.0	57.862	24.33	25.39
Fine Sand	0.125	3.0	146.944	61.78	87.17
	0.063	4.0	18.128	7.62	94.79
Silt	0.032	5.0	1.674	0.70	95.50
	0.0156	6.0	1.671	0.70	96.20
	0.0078	7.0	1.941	0.82	97.02
	0.0039	8.0	2.047	0.86	97.88
Clay	<0.0039	9.0	5.052	2.12	100.00
		Total Weight	238	100	

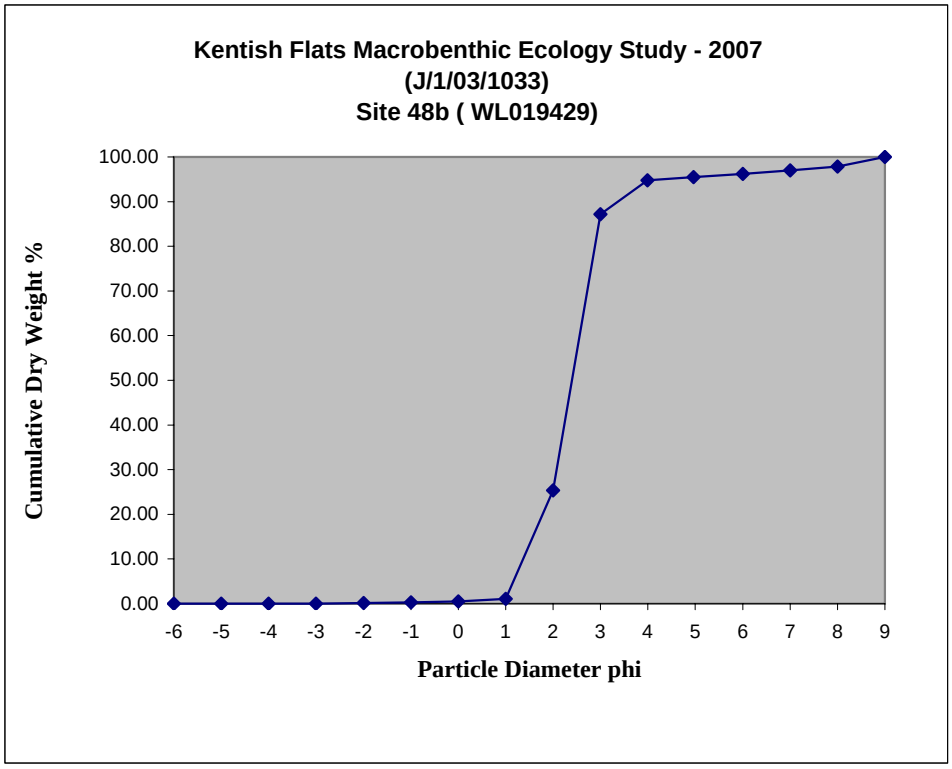
Mean mm	0.20
Md mm	0.19
Mean phi	2.32
Md phi	2.40
Sorting	0.81
Skq	0.02
Kurtosis	1.56

%Gravel	0.16
% Sand	94.63
% Fines	5.21

Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 48b (WL019429)
Fractional Dry Weight %
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007
(J/1/03/1033)
Site 48b (WL019429)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

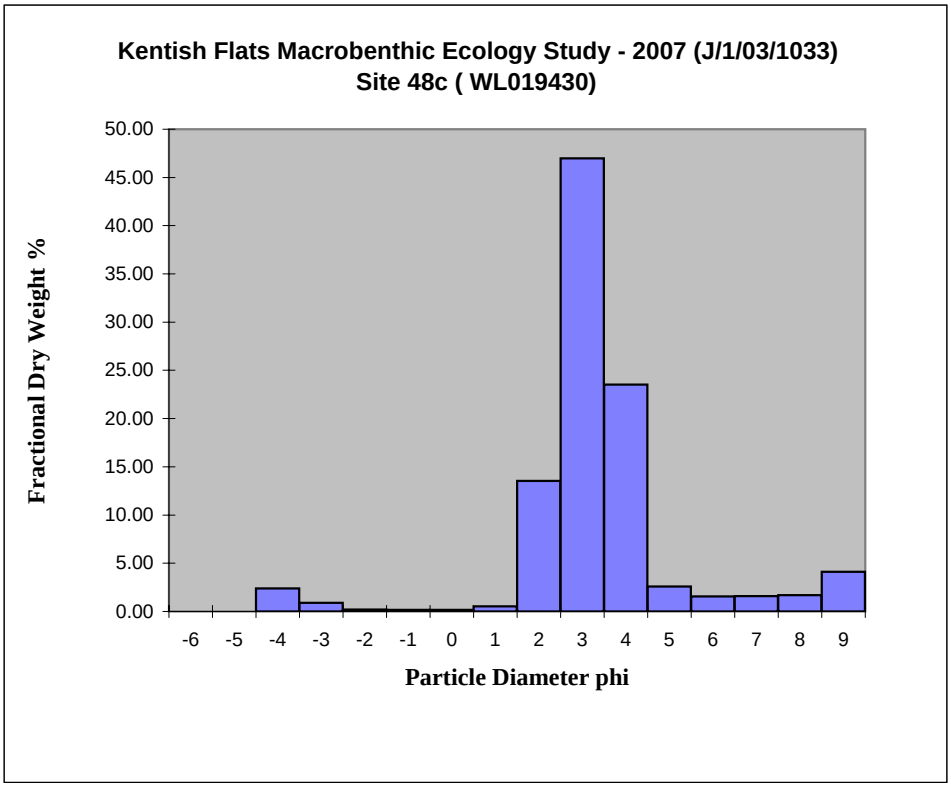
Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 48c (WL019430)

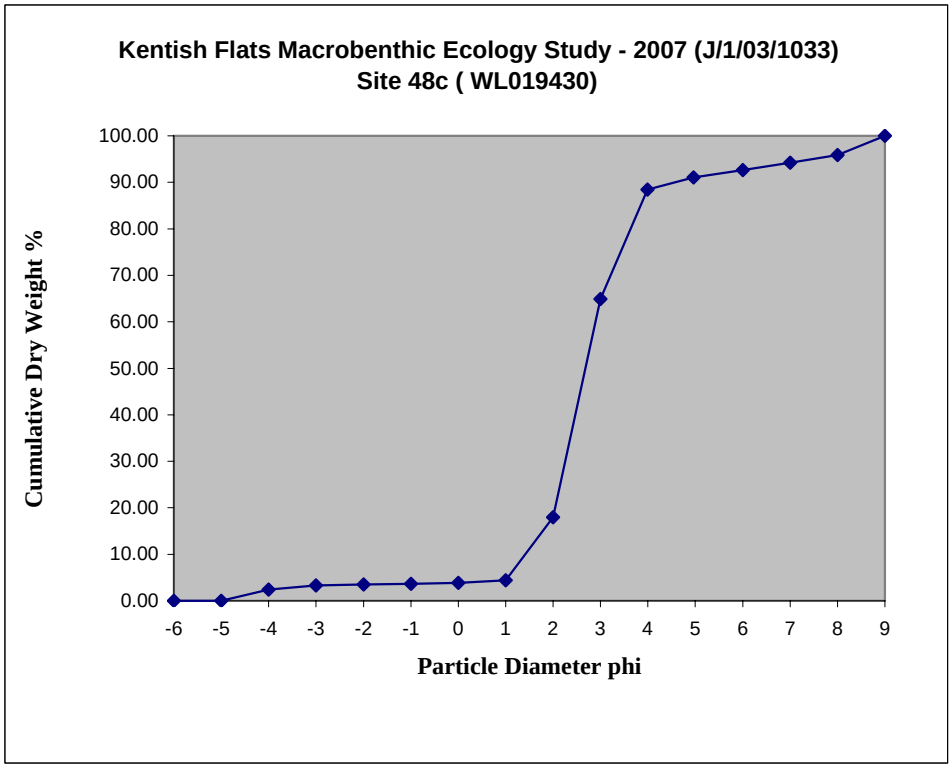
*Broad Description of Grain Size	Aperture mm	Aperture (phi units)	Weight Retained (g)	Percentage Fractional	Percentage Cumulative
Cobble	64	-6.0	0.000	0.00	0.00
Pebble	32	-5.0	0.000	0.00	0.00
	16	-4.0	5.976	2.40	2.40
Gravel	8	-3.0	2.208	0.89	3.29
	4	-2.0	0.496	0.20	3.49
Coarse Sand	2	-1.0	0.431	0.17	3.67
	1	0.0	0.447	0.18	3.84
Medium Sand	0.5	1.0	1.333	0.54	4.38
	0.25	2.0	33.683	13.55	17.93
Fine Sand	0.125	3.0	116.800	46.99	64.92
	0.063	4.0	58.486	23.53	88.44
Silt	0.032	5.0	6.458	2.60	91.04
	0.0156	6.0	3.901	1.57	92.61
	0.0078	7.0	3.935	1.58	94.19
	0.0039	8.0	4.193	1.69	95.88
Clay	<0.0039	9.0	10.240	4.12	100.00
		Total Weight	249	100	

Mean mm	0.15
Md mm	0.16
Mean phi	2.78
Md phi	2.68
Sorting	1.46
Skq	0.32
Kurtosis	2.07

%Gravel	3.49
% Sand	84.95
% Fines	11.56
	Sand

* Based on Connor *et al* , 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 which uses a modified Wentworth Scale.


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 48c (WL019430)
Fractional Dry Weight %
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi


Kentish Flats Macrobenthic Ecology Study - 2007 (J/1/03/1033)
Site 48c (WL019430)
Cumulative Dry Weight %
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9
Particle Diameter phi

Appendix VI

Grab Samples Species List

(J/1/03/1033)

APPENDIX VI SPECIES LIST FROM GRAB SAMPLES
Kentish Flats 2007 **Colonial Epifauna**
J/1/03/1033 **Solitary epifauna**
Infaunal abundance

		3A	3B	3C	9A	9B	9C	14A	14B	14C	16A	16B	16C	18A	18B	18C	21A	21B	21C	29A	29B	29C	31A	31B	31C	33A	33B
		9371	9372	9373	9374	9375	9376	9377	9378	9379	9380	9381	9382	9383	9384	9385	9386	9387	9388	9389	9390	9391	9392	9393	9394	9395	9396
Species	**MCS**																										
Leucosolenia sp.	C0053																										
Grantia compressa	C0078																										
Scypha ciliata	C0133																										
Cliona celata	C0480				1	1	1																				1
Haliclona sp.	C1420																										
Tubularidae	D0163							1																			
Sarsia sp.	D0180						1																				
Eudendrium sp.	D0218																										
Bougainvilliidae	D0246						1	1																			
Eucheilota maculata	D0333																										
Phialella quadrata	D0343																										
Calycella syringa	D0348																									1	
Campanulina pumila	D0351						2	1																			
Halecium spp.	D0390					1	1	1										1									
Halecium (=*beanii*?)	D0391						2																				
Hydrallmania falcata	D0424					1	3			1																1	
Sertularella spp.	D0427																										
Sertularia spp.	D0433				1	1		1										1								1	1
Sertularia argentea	D0434						3	2																			
Sertularia cupressina	D0435																										
Tridentata distans	D0445																										
Clytia gracilis	D0502																										
Clytia hemisphaerica	D0503					1	2	1																		1	
Obeliinae	D0506																										
Obelia bidentata	D0518																										
Obelia dichotoma	D0519	1				2	3	1		1														2		1	
Obelia (=*longissima*)	D0521																										
ACTINIARIA	D0662						1		2																	1	
NEMERTEA	G0001				3	4	22	2	2	1							9	5				1	1		2	32	16
NEMATODA	HD0001					2																					
ENTOPROCTA	K0001					1	1																				
CHAETOGNATHA	L0001														1												
SIPUNCULA (juv.)	N0001																										2
Aphrodita aculeata	P0019				1																						
Gattyana cirrosa	P0049																									2	
Harmothoe sp.	P0050																										
Harmothoe pagenstecheri	P0050																										
Harmothoe impar	P0065				1	1	1																				
Malmgreniella marphysae	P0068					1																					

APPENDIX VI SPECIES LIST FROM GRAB SAMPLES
Kentish Flats 2007 **Colonial Epifauna**
J/1/03/1033 **Solitary epifauna**
Infaunal abundance

		3A	3B	3C	9A	9B	9C	14A	14B	14C	16A	16B	16C	18A	18B	18C	21A	21B	21C	29A	29B	29C	31A	31B	31C	33A	33B
		9371	9372	9373	9374	9375	9376	9377	9378	9379	9380	9381	9382	9383	9384	9385	9386	9387	9388	9389	9390	9391	9392	9393	9394	9395	9396
Species	**MCS**																										
Lepidonotus squamatus	P0082																										
Pholoe baltica	P0091						1																			3	1
Pholoe inornata	P0092	1			2	1	6		1																		2
Sthenelais boa	P0107					2																					
Eteone flava/longa	P0117/8						1																				
Anaitides rosea	P0146																										
Eumida sp. (juv.)	P0163																										
Eumida bahusiensis	P0164																									3	1
Pterocirrus macroceros	P0188					1																					
Glycera sp. (juv.)	P0255																				1						
Glycera alba	P0256				1	2	6	1		1											1					2	1
Glycera lapidum	P0260																	3									
Glycera tridactyla	P0265						2																			1	
Glycinde nordmanni	P0268																										
Goniada maculata	P0271	2		1	2	1	1	1		2				1	1	1		1		2						1	3
Psamathe fusca	P0305				1																						
Ophiodromus sp.	P0312																										1
Podarkeopsis capensis	P0319																						1	1			
Microphthalmus similis	P0333							1									2	1	5								
Syllis gracilis	P0360																										
Eusyllis blomstrandi	P0380						1																				
Streptosyllis websteri	P0405																										
Exogone naidina	P0422				1	1	3																				
Sphaerosyllis taylori	P0430				1		3	1																			
Autolytus sp.	P0434						3																				1
Procerastea nematodes	P0457																										
Eunereis longissima	P0475							2																			1
Nephtys sp. (juv.)	P0494				2					1	4			1				1		2	3			1		1	
Nephtys assimilis	P0495	1											1			1											
Nephtys caeca	P0496	1					2			1																3	1
Nephtys cirrosa	P0497		1		1			2					1	1	2	2		3	4	2	7	4					
Nephtys hombergii	P0499	1						4			4	3	2											1	2		
Nephtys kersivalensis	P0502																							1			
Marphysa bellii	P0564																										1
Lumbrineris gracilis	P0579				2		8		1								1	1								2	7
Protodorvillea kefersteini	P0638				1	1	5																				
Scoloplos armiger	P0672				1												2	2									
Aricidea minuta	P0677					1																				1	
Poecilochaetus serpens	P0717					2	3			1																1	1

APPENDIX VI SPECIES LIST FROM GRAB SAMPLES
Kentish Flats 2007 **Colonial Epifauna**
J/1/03/1033 **Solitary epifauna**
Infaunal abundance

		3A	3B	3C	9A	9B	9C	14A	14B	14C	16A	16B	16C	18A	18B	18C	21A	21B	21C	29A	29B	29C	31A	31B	31C	33A	33B
		9371	9372	9373	9374	9375	9376	9377	9378	9379	9380	9381	9382	9383	9384	9385	9386	9387	9388	9389	9390	9391	9392	9393	9394	9395	9396
Species	**MCS**																										
Aonides oxycephala	P0722					1	1		1																	5	1
Aonides paucibranchiata	P0723																										
Polydora caeca (agg.)	P0750							1																			1
Polydora ciliata (agg.)	P0752						1																				
Pseudopolydora pulchra	P0774																									2	
Pygospio elegans	P0776																									1	
Scolelepis bonnieri	P0779													1													
Spio decorata	P0789														1												
Spio martinensis	P0791										3	6	1			3						2					
Spiophanes bombyx	P0794			1	4	2	7	4	3	3				1										3		15	8
Magelona johnstoni	P0803						2				1			2	2	4					7	2					
Magelona alleni	P0804																										
Magelona filiformis	P0805				1										1	1											
Aphelochaeta marioni	P0824																										
Caulleriella alata	P0829					1	1	1	3																	1	2
Chaetozone zetlandica	P0831				2	3	2																			1	2
Chaetozone setosa	P0834													1													
Cirriformia tentaculata	P0839																										
Capitella capitata agg.	P0907							1																			
Mediomastus fragilis	P0919				1		2																			5	3
Notomastus spp.	P0920						2	6	5	9										1	3		2	4	2		
Clymenella torquata	P0954																										
Euclymene oerstedii	P0964	1			9	4	27	1															7	13	18	6	5
Ophelia borealis	P0999																5	37	11								
Travisia forbesii	P1007																	7	1								
Scalibregma inflatum	P1027																										
Galathowenia oculata	P1093				4		1																		1	2	3
Owenia fusiformis	P1098				2	2	2																				
Lagis koreni	P1107																									1	1
Sabellaria spinulosa	P1117						2																			1	1
Ampharete baltica	P1134																										
Ampharete lindstroemi	P1139						2																			4	2
Terebellides stroemi	P1175					1																					
Amphitritinae sp. (juv.)	P1180				5			2	4																		
Lanice conchilega	P1195				3	1	15									1							2	5	2	7	4
Loimia sp.	P1200																										
Polycirrus sp.	P1235																		3							2	1
Polycirrus medusa	P1242							1									3	8									
Polycirrus norvegicus	P1243																										

APPENDIX VI SPECIES LIST FROM GRAB SAMPLES
Kentish Flats 2007 **Colonial Epifauna**
J/1/03/1033 **Solitary epifauna**
Infaunal abundance

		3A	3B	3C	9A	9B	9C	14A	14B	14C	16A	16B	16C	18A	18B	18C	21A	21B	21C	29A	29B	29C	31A	31B	31C	33A	33B
		9371	9372	9373	9374	9375	9376	9377	9378	9379	9380	9381	9382	9383	9384	9385	9386	9387	9388	9389	9390	9391	9392	9393	9394	9395	9396
Species	**MCS**																										
Sabella pavonina	P1320				3																						
Pomatoceros sp. (juv.)	P1339									1																	
Pomatoceros lamarcki	P1340						2	1																			
Tubificoides cf. *galiciensis*	P1487				1	6	9																			1	2
Tubificoides benedii	P1490				1																						
Tubificoides pseudogaster	P1498				1	1	8						1										2			1	
Nymphon brevirostre	Q0005				5	1	12	1		1																18	14
Achelia echinata	Q0015					4	5																				2
Anoplodactylus petiolatus	Q0044						24			4														3		1	
CRUSTACEA (larva)	R0001																										
Balanus crenatus	R0077				2	2	8		314	112	17																
COPEPODA	R0142										1																
OSTRACODA	R2412																										
Amphilochus neapolitanus	S0159					1																					
Stenothoe marina	S0213																										
Urothoe brevicornis	S0247																										
Urothoe elegans	S0248				1																						1
Urothoe poseidonis	S0250													7							3						
Acidostoma obesum	S0275						3																				
Atylus falcatus	S0410																				2						
Atylus guttatus	S0411						1																				
Ampelisca brevicornis	S0427					1																					
Ampelisca diadema	S0429																										
Ampelisca spinipes	S0438																									1	
Bathyporeia elegans	S0452													2	8	3				3	10	3				1	
Bathyporeia guilliamsoniana	S0454																				2						
Bathyporeia nana	S0455																										
Bathyporeia pelagica	S0456		1															1									
Abludomelita obtusata	S0498																										
Cheirocratus sp. (female)	S0503					2																					
Cheirocratus intermedius	S0505																										
Cheirocratus sundevallii	S0506				1																						
Maerella tenuimana	S0521																										
Gammaropsis cornuta	S0539								1																		
Microprotopus maculatus	S0550								1																		
Photis reinhardi	S0554						1																				
Ericthonius sp. (female)	S0561																										
Ericthonius punctatus	S0564																										
Aoridae (female)	S0577																										

APPENDIX VI SPECIES LIST FROM GRAB SAMPLES
Kentish Flats 2007 **Colonial Epifauna**
J/1/03/1033 **Solitary epifauna**
Infaunal abundance

		3A	3B	3C	9A	9B	9C	14A	14B	14C	16A	16B	16C	18A	18B	18C	21A	21B	21C	29A	29B	29C	31A	31B	31C	33A	33B
		9371	9372	9373	9374	9375	9376	9377	9378	9379	9380	9381	9382	9383	9384	9385	9386	9387	9388	9389	9390	9391	9392	9393	9394	9395	9396
Species	**MCS**																										
Aora gracilis	S0579																										
Corophium crassicorne	S0611				4		2																				
Corophium sextonae	S0615																										
Dyopedos monocanthus	S0628																										
Pariambus typicus	S0651																										9
Phtisica marina	S0657						1																				
Tanaopsis graciloides	S1142																									4	
Bodotria scorpioides	S1197					1																					
Diastylis rathkei	S1253						1																				
DECAPODA (juv.)	S1276					1	2																				
Crangon sp. (juv.)	S1383																										
Philoceras sp. (juv.)	S1386										1																
Diogenes pugilator	S1444													3													
Paguridae (juv.)	S1445				1			1																		1	
Pisidia longicornis	S1482					2																					
Macropodia parva	S1529						1																				
Macropodia rostrata	S1532																										
Corystes cassivelaunus	S1552	1					1					2	1		1	1		1		1	1						
Liocarcinus pusillus	S1584						1																				
Pinnotheres pisum	S1638																										
COLLEMBOLA	T0000																										
Leptochiton asellus	W0053																										1
Lepidochitona cinerea	W0079																										
Gibbula sp. (juv.)	W0157																										
Gibbula cineraria	W0163																										
Crepidula fornicata	W0439																										
Polinices pulchellus	W0491									1																	
Epitonium clathratulum	W0556																										
OPISTHOBRANCHIA	W1001.5																	1									
Doto spp.	W1270				4		12																			1	
Tergipedidae	W1426																										
Facelina sp.	W1467																										
BIVALVIA	W1560							1													1						
Nucula hanleyi	W1568							2																			
Nucula nitidosa	W1569						1																				
Nucula nucleus	W1570				1					1																	
Mytilidae (juv.)	W1691						8		2	10	1						2	1								1	7
Mytilus edulis	W1695				3					6																	
Diplodonta rotundata	W1864																										

APPENDIX VI SPECIES LIST FROM GRAB SAMPLES
Kentish Flats 2007 **Colonial Epifauna**
J/1/03/1033 **Solitary epifauna**
Infaunal abundance

		3A	3B	3C	9A	9B	9C	14A	14B	14C	16A	16B	16C	18A	18B	18C	21A	21B	21C	29A	29B	29C	31A	31B	31C	33A	33B
		9371	9372	9373	9374	9375	9376	9377	9378	9379	9380	9381	9382	9383	9384	9385	9386	9387	9388	9389	9390	9391	9392	9393	9394	9395	9396
Species	**MCS**																										
Tellimya ferruginosa	W1902													1													
Mysella bidentata	W1906			1	1	3				2														2		6	1
Mactra stultorum	W1972													2													
Spisula elliptica	W1975														1						1						
Ensis sp.	W1996																										
Ensis arcuatus	W1998																						1	1	5		
Fabulina fabula	W2019							3			5	11	7														
Abra sp. (juv.)	W2058		1						2																		
Abra alba	W2059				1		1	2				1	2											3	6		
Corbula gibba	W2157				1																						
Alcyonidium diaphanum	Y0076				1																					1	1
Alcyonidium mamillatum	Y0079																			1							
Alcyonidium mytili	Y0080					1	1	1																			1
Alcyonidium parasiticum	Y0081				1		1																				
Nollela dilatata	Y0092																										
Anguinella palmata	Y0096					1	1																				
Vesicularia spinosa	Y0131				1	1	3																	2		1	1
Amathia lendigera	Y0135																										
Bowerbankia gracilis	Y0139						1																				
Conopeum reticulum	Y0172	1	1	1	2	3	3	2	2	2	1				1		2	2	1	1		1	1	1	1	3	2
Electra monostachys	Y0177				1	2	1	2	2	2	1						1	1	1			1	1			3	2
Electra pilosa	Y0178				1	1	2	1	1	1			1					1						1		1	1
Aspidelectra melolontha	Y0182	1		1	1	2	1	1	1	1							2	2	1			1	1	1	1	3	1
Chartella papyracea	Y0192																										
Callopora discreta	Y0203																		1								
Callopora dumerilii	Y0204																										
Bicellariella ciliata	Y0256																										
Scrupocellaria scruposa	Y0279					1	1																	1			
Escharella immersa	Y0364				1													1								1	
Schizomavella auriculata	Y0468									1																	
Schizomavella linearis	Y0474																										
Fenestrulina malusii	Y0483					1																					
Phoronis sp.	ZA0003																										2
Asterias rubens	ZB0102																										1
Ophiothrix fragilis	ZB0124																										1
Amphipholis squamata	ZB0161				1																						
Ophiuridae (juv.)	ZB0165					1																					
Ophiura sp. (juv.)	ZB0166																										
Ophiura albida	ZB0168					2																					

APPENDIX VI SPECIES LIST FROM GRAB SAMPLES
Kentish Flats 2007 **Colonial Epifauna**
J/1/03/1033 **Solitary epifauna**
Infaunal abundance

		3A	3B	3C	9A	9B	9C	14A	14B	14C	16A	16B	16C	18A	18B	18C	21A	21B	21C	29A	29B	29C	31A	31B	31C	33A	33B
		9371	9372	9373	9374	9375	9376	9377	9378	9379	9380	9381	9382	9383	9384	9385	9386	9387	9388	9389	9390	9391	9392	9393	9394	9395	9396
Species	**MCS**																										
Ophiura ophiura	ZB0168																								2		
Echinocardium cordatum	ZB0223													1													
Didemnidae	ZD0041																										
Diademnum (=maculosum)	ZD0054																										
Styela clava	ZD0104							1																			
Polycarpa fibrosa	ZD0112						1																				
Polycarpa pomaria	ZD0115																										
Dendrodoa grossularia	ZD0120																										
Pyura squamulosa	ZD0140						1																				
Molgula manhattensis	ZD0151					1																					
Pisces (juv.)	ZE0000																										1

APPENDIX VI SPECIES LIST FROM GRAB SAMPL
Kentish Flats 2007 **Colonial Epifauna**
J/1/03/1033 **Solitary epifauna**
Infaunal abundance

		33C	35A	35B	35C	36A	36B	36C	38A	38B	38C	40A	40B	40C	42A	42B	42C	43A	43B	43C	44A	44B	44C	45A	45B	45C	47A
		9397	9398	9399	9400	9401	9402	9403	9404	9405	9406	9407	9408	9409	9413	9414	9415	9416	9417	9418	9419	9420	9421	9422	9423	9424	9425
Species	**MCS**																										
Leucosolenia sp.	C0053														1												
Grantia compressa	C0078																1										
Scypha ciliata	C0133														1	1	1										
Cliona celata	C0480												2			1											
Haliclona sp.	C1420																1										
Tubularidae	D0163																										
Sarsia sp.	D0180																										
Eudendrium sp.	D0218	1													1	1	2										
Bougainvilliidae	D0246						1	1					1														
Eucheilota maculata	D0333																										1
Phialella quadrata	D0343											1															
Calycella syringa	D0348	2															1										
Campanulina pumila	D0351				1	1							1											2	1	2	
Halecium spp.	D0390	1				1	1					1	1	1	1		1										
Halecium (=*beanii*?)	D0391																										
Hydrallmania falcata	D0424	1		1	1		1	1									2							2	2	2	
Sertularella spp.	D0427											1			1												
Sertularia spp.	D0433					1	1						1		1		1							2	1	1	
Sertularia argentea	D0434	2			2							1												2			
Sertularia cupressina	D0435					1																					
Tridentata distans	D0445																									1	
Clytia gracilis	D0502											1					1							1		1	
Clytia hemisphaerica	D0503	2		1			1	2					1											1			
Obeliinae	D0506						1																			1	
Obelia bidentata	D0518														1										1		
Obelia dichotoma	D0519	2	1	1	2	1	1	2				1	1				1							1	2	2	
Obelia (=*longissima*)	D0521						1																				
ACTINIARIA	D0662	1				1	4	1							24	65	17							1		1	
NEMERTEA	G0001	7	1	1	1	16	10	4				8	4	8										4	3	4	
NEMATODA	HD0001							1					4		3	1	1										
ENTOPROCTA	K0001											1	1		1		1										
CHAETOGNATHA	L0001																									1	
SIPUNCULA (juv.)	N0001																										
Aphrodita aculeata	P0019																										
Gattyana cirrosa	P0049															1											
Harmothoe sp.	P0050	2						1				1	3														
Harmothoe pagenstecheri	P0050														1												
Harmothoe impar	P0065																									1	
Malmgreniella marphysae	P0068												1														

APPENDIX VI SPECIES LIST FROM GRAB SAMPL
Kentish Flats 2007 **Colonial Epifauna**
J/1/03/1033 **Solitary epifauna**
Infaunal abundance

		33C	35A	35B	35C	36A	36B	36C	38A	38B	38C	40A	40B	40C	42A	42B	42C	43A	43B	43C	44A	44B	44C	45A	45B	45C	47A
		9397	9398	9399	9400	9401	9402	9403	9404	9405	9406	9407	9408	9409	9413	9414	9415	9416	9417	9418	9419	9420	9421	9422	9423	9424	9425
Species	**MCS**																										
Lepidonotus squamatus	P0082															1											
Pholoe baltica	P0091						2						1												1		
Pholoe inornata	P0092	1	1				2					2	3	2	1	3											
Sthenelais boa	P0107						1																		1		
Eteone flava/longa	P0117/8		2																								
Anaitides rosea	P0146		1																								
Eumida sp. (juv.)	P0163														1												
Eumida bahusiensis	P0164																										
Pterocirrus macroceros	P0188																										
Glycera sp. (juv.)	P0255																										
Glycera alba	P0256	3			1	2	3	1									1										
Glycera lapidum	P0260							1																			
Glycera tridactyla	P0265	1	1			1	1						1	1	1	1								1		1	
Glycinde nordmanni	P0268							3																			
Goniada maculata	P0271				3	1		5										1	1						1	1	2
Psamathe fusca	P0305																										
Ophiodromus sp.	P0312																										
Podarkeopsis capensis	P0319	1	2	1	1	2																					
Microphthalmus similis	P0333																										
Syllis gracilis	P0360												1														
Eusyllis blomstrandi	P0380				1																						
Streptosyllis websteri	P0405	1																									
Exogone naidina	P0422											1	3														
Sphaerosyllis taylori	P0430													1													
Autolytus sp.	P0434	2						19									1							5			
Procerastea nematodes	P0457															1											
Eunereis longissima	P0475						1																				
Nephtys sp. (juv.)	P0494			2		1						2							1				1		1		
Nephtys assimilis	P0495																	1									
Nephtys caeca	P0496	2					1	1																			
Nephtys cirrosa	P0497									1								1	2	7	5	3	1	1			3
Nephtys hombergii	P0499	1	3									1				2											
Nephtys kersivalensis	P0502																										
Marphysa bellii	P0564																										
Lumbrineris gracilis	P0579	6				1	1	1	1			1	1	1			1							1			
Protodorvillea kefersteini	P0638							1																			
Scoloplos armiger	P0672	3	2	1			2																	2	5	1	
Aricidea minuta	P0677	2						2																			
Poecilochaetus serpens	P0717											2												5	3		

APPENDIX VI SPECIES LIST FROM GRAB SAMPL
Kentish Flats 2007 **Colonial Epifauna**
J/1/03/1033 **Solitary epifauna**
Infaunal abundance

		33C	35A	35B	35C	36A	36B	36C	38A	38B	38C	40A	40B	40C	42A	42B	42C	43A	43B	43C	44A	44B	44C	45A	45B	45C	47A
		9397	9398	9399	9400	9401	9402	9403	9404	9405	9406	9407	9408	9409	9413	9414	9415	9416	9417	9418	9419	9420	9421	9422	9423	9424	9425
Species	**MCS**																										
Aonides oxycephala	P0722											1															
Aonides paucibranchiata	P0723						1																				
Polydora caeca (agg.)	P0750			3																							
Polydora ciliata (agg.)	P0752	1															1										
Pseudopolydora pulchra	P0774				1																						
Pygospio elegans	P0776																										
Scolelepis bonnieri	P0779																	1									
Spio decorata	P0789																										
Spio martinensis	P0791																										2
Spiophanes bombyx	P0794	3	4	3		4	6	6				1	2									1		1	11	3	
Magelona johnstoni	P0803																		1		2	2		1			
Magelona alleni	P0804												1	1													
Magelona filiformis	P0805																										
Aphelochaeta marioni	P0824													1													
Caulleriella alata	P0829	2				1	2	1				2	2											1			
Chaetozone zetlandica	P0831	1	1					1					1		1		1								1		
Chaetozone setosa	P0834																										
Cirriformia tentaculata	P0839														1	2											
Capitella capitata agg.	P0907	1																									
Mediomastus fragilis	P0919	1	1				1					1				16	4										
Notomastus spp.	P0920		5	2	2										2	1				1							
Clymenella torquata	P0954															6	1										
Euclymene oerstedii	P0964	8				3	1					7	16	6	1	7	4							2	2	8	
Ophelia borealis	P0999								2	1																	
Travisia forbesii	P1007																										
Scalibregma inflatum	P1027																										
Galathowenia oculata	P1093											17	9	3		2											
Owenia fusiformis	P1098											2	1												1		
Lagis koreni	P1107	1																							1		
Sabellaria spinulosa	P1117					1																					
Ampharete baltica	P1134														2	11	5										
Ampharete lindstroemi	P1139	1				1	1	1																	1		
Terebellides stroemi	P1175																										
Amphitritinae sp. (juv.)	P1180				2							1														3	
Lanice conchilega	P1195	5	1	3		1	6	7					2											1	2		1
Loimia sp.	P1200				1																						
Polycirrus sp.	P1235					1																			1		
Polycirrus medusa	P1242																1										
Polycirrus norvegicus	P1243														4	5											

APPENDIX VI SPECIES LIST FROM GRAB SAMPL
Kentish Flats 2007 **Colonial Epifauna**
J/1/03/1033 **Solitary epifauna**
Infaunal abundance

		33C	35A	35B	35C	36A	36B	36C	38A	38B	38C	40A	40B	40C	42A	42B	42C	43A	43B	43C	44A	44B	44C	45A	45B	45C	47A
		9397	9398	9399	9400	9401	9402	9403	9404	9405	9406	9407	9408	9409	9413	9414	9415	9416	9417	9418	9419	9420	9421	9422	9423	9424	9425
Species	**MCS**																										
Sabella pavonina	P1320																										
Pomatoceros sp. (juv.)	P1339																										
Pomatoceros lamarcki	P1340	1				1		1				1															
Tubificoides cf. *galiciensis*	P1487	1										1	4														
Tubificoides benedii	P1490															11											
Tubificoides pseudogaster	P1498					1	1	2				2															
Nymphon brevirostre	Q0005	46		2	7	2	3	7				8	2				1							19	6	7	
Achelia echinata	Q0015			1								2	9			1											
Anoplodactylus petiolatus	Q0044						1	3					1		1									2			
CRUSTACEA (larva)	R0001																										
Balanus crenatus	R0077	1				3	7																	661	510	94	7
COPEPODA	R0142																										
OSTRACODA	R2412													1													
Amphilochus neapolitanus	S0159																										
Stenothoe marina	S0213	4																							1		
Urothoe brevicornis	S0247								2	3	4																
Urothoe elegans	S0248																										
Urothoe poseidonis	S0250																										
Acidostoma obesum	S0275																										
Atylus falcatus	S0410																										
Atylus guttatus	S0411	2											2														
Ampelisca brevicornis	S0427																										
Ampelisca diadema	S0429					1	1					1					1										
Ampelisca spinipes	S0438	1																									
Bathyporeia elegans	S0452								4		1									1	8	6	1				
Bathyporeia guilliamsoniana	S0454																	1	2	1							
Bathyporeia nana	S0455																					1					
Bathyporeia pelagica	S0456										3										1						
Abludomelita obtusata	S0498						1																				
Cheirocratus sp. (female)	S0503	1													1											1	
Cheirocratus intermedius	S0505											1															
Cheirocratus sundevallii	S0506																										
Maerella tenuimana	S0521																										
Gammaropsis cornuta	S0539																										
Microprotopus maculatus	S0550					1		2																			
Photis reinhardi	S0554												1														
Ericthonius sp. (female)	S0561	1																									
Ericthonius punctatus	S0564	1															6										
Aoridae (female)	S0577	1																							1		

APPENDIX VI SPECIES LIST FROM GRAB SAMPL
Kentish Flats 2007 **Colonial Epifauna**
J/1/03/1033 **Solitary epifauna**
Infaunal abundance

		33C	35A	35B	35C	36A	36B	36C	38A	38B	38C	40A	40B	40C	42A	42B	42C	43A	43B	43C	44A	44B	44C	45A	45B	45C	47A
		9397	9398	9399	9400	9401	9402	9403	9404	9405	9406	9407	9408	9409	9413	9414	9415	9416	9417	9418	9419	9420	9421	9422	9423	9424	9425
Species	**MCS**																										
Aora gracilis	S0579	1																						1		1	
Corophium crassicorne	S0611												3	1													
Corophium sextonae	S0615																1										
Dyopedos monocanthus	S0628	2					2							1													
Pariambus typicus	S0651							1				1															
Phtisica marina	S0657	8																									
Tanaopsis graciloides	S1142																										
Bodotria scorpioides	S1197																										
Diastylis rathkei	S1253																										
DECAPODA (juv.)	S1276																										
Crangon sp. (juv.)	S1383								1																		
Philoceras sp. (juv.)	S1386																										
Diogenes pugilator	S1444																										
Paguridae (juv.)	S1445																										
Pisidia longicornis	S1482																										
Macropodia parva	S1529																							1			
Macropodia rostrata	S1532											1															
Corystes cassivelaunus	S1552						1	1										1	1	1		1					
Liocarcinus pusillus	S1584	1			1																			1			
Pinnotheres pisum	S1638										1																
COLLEMBOLA	T0000																										
Leptochiton asellus	W0053					1																					
Lepidochitona cinerea	W0079																1										
Gibbula sp. (juv.)	W0157														2	2											
Gibbula cineraria	W0163																1										
Crepidula fornicata	W0439														1												
Polinices pulchellus	W0491						1																				
Epitonium clathratulum	W0556														1												
OPISTHOBRANCHIA	W1001.5																										
Doto spp.	W1270	2						2																1	1	1	
Tergipedidae	W1426																								2		
Facelina sp.	W1467											1															
BIVALVIA	W1560																									1	
Nucula hanleyi	W1568													1													
Nucula nitidosa	W1569																										
Nucula nucleus	W1570																1										
Mytilidae (juv.)	W1691	2										2	1			1								9	3	1	
Mytilus edulis	W1695																2										
Diplodonta rotundata	W1864																									1	

APPENDIX VI SPECIES LIST FROM GRAB SAMPL
Kentish Flats 2007 **Colonial Epifauna**
J/1/03/1033 **Solitary epifauna**
Infaunal abundance

		33C	35A	35B	35C	36A	36B	36C	38A	38B	38C	40A	40B	40C	42A	42B	42C	43A	43B	43C	44A	44B	44C	45A	45B	45C	47A
		9397	9398	9399	9400	9401	9402	9403	9404	9405	9406	9407	9408	9409	9413	9414	9415	9416	9417	9418	9419	9420	9421	9422	9423	9424	9425
Species	**MCS**																										
Tellimya ferruginosa	W1902																										
Mysella bidentata	W1906	1					6						1		2									1			
Mactra stultorum	W1972																										
Spisula elliptica	W1975																										
Ensis sp.	W1996				1																						
Ensis arcuatus	W1998		1																								
Fabulina fabula	W2019																		1		2	1					
Abra sp. (juv.)	W2058			1																							
Abra alba	W2059	1	2	5	4		2					1	1		3	6	2										
Corbula gibba	W2157				1																						
Alcyonidium diaphanum	Y0076	1										1		1										1			
Alcyonidium mamillatum	Y0079																										
Alcyonidium mytili	Y0080	2				1						1	1		2	2	2							1	1		
Alcyonidium parasiticum	Y0081																										
Nollela dilatata	Y0092											1															
Anguinella palmata	Y0096														1												
Vesicularia spinosa	Y0131	1			1		1					2	3														
Amathia lendigera	Y0135														1		1										
Bowerbankia gracilis	Y0139												1			1											
Conopeum reticulum	Y0172	3	1	1	2	2	2	3				3	2	2	1	1				1				2	2	3	1
Electra monostachys	Y0177	3	1			1	1	3				1	2											1	2		
Electra pilosa	Y0178	2			1	1	1	1				2	2	1	1		1							1	1	1	
Aspidelectra melolontha	Y0182	2	1		1	1	2	2				1		1										1	1		1
Chartella papyracea	Y0192															1											
Callopora discreta	Y0203						1																				
Callopora dumerilii	Y0204																										
Bicellariella ciliata	Y0256	1													1												
Scrupocellaria scruposa	Y0279												1														
Escharella immersa	Y0364	1																									
Schizomavella auriculata	Y0468																										
Schizomavella linearis	Y0474							1																			
Fenestrulina malusii	Y0483																										
Phoronis sp.	ZA0003	2														2	1										
Asterias rubens	ZB0102																										
Ophiothrix fragilis	ZB0124	1														2	18										
Amphipholis squamata	ZB0161												1		1		1										
Ophiuridae (juv.)	ZB0165																										
Ophiura sp. (juv.)	ZB0166											2															
Ophiura albida	ZB0168						1					2	1	1													

APPENDIX VI SPECIES LIST FROM GRAB SAMPL
Kentish Flats 2007 **Colonial Epifauna**
J/1/03/1033 **Solitary epifauna**
Infaunal abundance

		33C	35A	35B	35C	36A	36B	36C	38A	38B	38C	40A	40B	40C	42A	42B	42C	43A	43B	43C	44A	44B	44C	45A	45B	45C	47A
		9397	9398	9399	9400	9401	9402	9403	9404	9405	9406	9407	9408	9409	9413	9414	9415	9416	9417	9418	9419	9420	9421	9422	9423	9424	9425
Species	**MCS**																										
Ophiura ophiura	ZB0168																										
Echinocardium cordatum	ZB0223																			1			2				
Didemnidae	ZD0041														1												
Diademnum (=maculosum)	ZD0054															1	2										
Styela clava	ZD0104												1														
Polycarpa fibrosa	ZD0112												1		20	21	62										
Polycarpa pomaria	ZD0115														11	23	8										
Dendrodoa grossularia	ZD0120														4												
Pyura squamulosa	ZD0140														8		3										
Molgula manhattensis	ZD0151														4	2	2										
Pisces (juv.)	ZE0000																										

APPENDIX VI SPECIES LIST FROM GRAB SAMPL
Kentish Flats 2007 **Colonial Epifauna**
J/1/03/1033 **Solitary epifauna**
Infaunal abundance

		47B	47C	48A	48B	48C	SA2A	SA2B	SA2C	SA6A	SA6B	SA6C	SA10A	SA10B	SA10C
		9426	9427	9428	9429	9430	9431	9432	9433	9434	9435	9436	9437	9438	9439
Species	**MCS**														
Leucosolenia sp.	C0053														
Grantia compressa	C0078														
Scypha ciliata	C0133														
Cliona celata	C0480														
Haliclona sp.	C1420														
Tubularidae	D0163														
Sarsia sp.	D0180														
Eudendrium sp.	D0218														
Bougainvilliidae	D0246														
Eucheilota maculata	D0333		1												
Phialella quadrata	D0343														
Calycella syringa	D0348														
Campanulina pumila	D0351						1	1							
Halecium spp.	D0390														1
Halecium (=*beanii* ?)	D0391														
Hydrallmania falcata	D0424						1								
Sertularella spp.	D0427														
Sertularia spp.	D0433			1			1						1	1	1
Sertularia argentea	D0434														
Sertularia cupressina	D0435														
Tridentata distans	D0445														
Clytia gracilis	D0502														
Clytia hemisphaerica	D0503														
Obeliinae	D0506														
Obelia bidentata	D0518						2		1						
Obelia dichotoma	D0519							1						1	
Obelia (=*longissima*)	D0521														
ACTINIARIA	D0662						1								
NEMERTEA	G0001						5						2	3	
NEMATODA	HD0001						1								
ENTOPROCTA	K0001														
CHAETOGNATHA	L0001														
SIPUNCULA (juv.)	N0001														
Aphrodita aculeata	P0019														
Gattyana cirrosa	P0049														
Harmothoe sp.	P0050							1							
Harmothoe pagenstecheri	P0050														
Harmothoe impar	P0065														
Malmgreniella marphysae	P0068								1						

APPENDIX VI SPECIES LIST FROM GRAB SAMPL
Kentish Flats 2007 **Colonial Epifauna**
J/1/03/1033 **Solitary epifauna**
Infaunal abundance

		47B	47C	48A	48B	48C	SA2A	SA2B	SA2C	SA6A	SA6B	SA6C	SA10A	SA10B	SA10C
		9426	9427	9428	9429	9430	9431	9432	9433	9434	9435	9436	9437	9438	9439
Species	**MCS**														
Lepidonotus squamatus	P0082														
Pholoe baltica	P0091						1								
Pholoe inornata	P0092							8							
Sthenelais boa	P0107						1								
Eteone flava/longa	P0117/8														
Anaitides rosea	P0146														
Eumida sp. (juv.)	P0163														
Eumida bahusiensis	P0164														
Pterocirrus macroceros	P0188														
Glycera sp. (juv.)	P0255														
Glycera alba	P0256						2					1			
Glycera lapidum	P0260														
Glycera tridactyla	P0265														
Glycinde nordmanni	P0268								1						
Goniada maculata	P0271	1						1					1	1	
Psamathe fusca	P0305														
Ophiodromus sp.	P0312														
Podarkeopsis capensis	P0319						1		1			1			
Microphthalmus similis	P0333														
Syllis gracilis	P0360														
Eusyllis blomstrandi	P0380														
Streptosyllis websteri	P0405														
Exogone naidina	P0422													1	
Sphaerosyllis taylori	P0430														
Autolytus sp.	P0434														
Procerastea nematodes	P0457														
Eunereis longissima	P0475														
Nephtys sp. (juv.)	P0494									1	6				
Nephtys assimilis	P0495														
Nephtys caeca	P0496				1										
Nephtys cirrosa	P0497	1	1	1	3	1									
Nephtys hombergii	P0499										2	2			
Nephtys kersivalensis	P0502														
Marphysa bellii	P0564														
Lumbrineris gracilis	P0579						1	1							
Protodorvillea kefersteini	P0638														
Scoloplos armiger	P0672						1						3		
Aricidea minuta	P0677														
Poecilochaetus serpens	P0717														

APPENDIX VI SPECIES LIST FROM GRAB SAMPL
Kentish Flats 2007 **Colonial Epifauna**
J/1/03/1033 **Solitary epifauna**
Infaunal abundance

		47B	47C	48A	48B	48C	SA2A	SA2B	SA2C	SA6A	SA6B	SA6C	SA10A	SA10B	SA10C
		9426	9427	9428	9429	9430	9431	9432	9433	9434	9435	9436	9437	9438	9439
Species	**MCS**														
Aonides oxycephala	P0722														
Aonides paucibranchiata	P0723														
Polydora caeca (agg.)	P0750						1								
Polydora ciliata (agg.)	P0752														
Pseudopolydora pulchra	P0774						1								
Pygospio elegans	P0776														
Scolelepis bonnieri	P0779														
Spio decorata	P0789														
Spio martinensis	P0791	1	2	3						1					
Spiophanes bombyx	P0794							1	2	3	1		4	5	3
Magelona johnstoni	P0803												1	1	
Magelona alleni	P0804														
Magelona filiformis	P0805										1		1		
Aphelochaeta marioni	P0824														
Caulleriella alata	P0829						1	1							
Chaetozone zetlandica	P0831						4	1	1						1
Chaetozone setosa	P0834														
Cirriformia tentaculata	P0839														
Capitella capitata agg.	P0907														
Mediomastus fragilis	P0919														
Notomastus spp.	P0920	1	1		1	2		1	7	5	2	4	1		
Clymenella torquata	P0954														
Euclymene oerstedii	P0964						1						1		
Ophelia borealis	P0999														
Travisia forbesii	P1007														
Scalibregma inflatum	P1027						1								
Galathowenia oculata	P1093														
Owenia fusiformis	P1098														
Lagis koreni	P1107														
Sabellaria spinulosa	P1117														
Ampharete baltica	P1134														
Ampharete lindstroemi	P1139														
Terebellides stroemi	P1175														
Amphitritinae sp. (juv.)	P1180									10					
Lanice conchilega	P1195						6	1						3	1
Loimia sp.	P1200														
Polycirrus sp.	P1235														
Polycirrus medusa	P1242														
Polycirrus norvegicus	P1243														

APPENDIX VI SPECIES LIST FROM GRAB SAMPL
Kentish Flats 2007 **Colonial Epifauna**
J/1/03/1033 **Solitary epifauna**
Infaunal abundance

		47B	47C	48A	48B	48C	SA2A	SA2B	SA2C	SA6A	SA6B	SA6C	SA10A	SA10B	SA10C
		9426	9427	9428	9429	9430	9431	9432	9433	9434	9435	9436	9437	9438	9439
Species	**MCS**														
Sabella pavonina	P1320														
Pomatoceros sp. (juv.)	P1339														
Pomatoceros lamarcki	P1340							1	1						
Tubificoides cf. *galiciensis*	P1487														
Tubificoides benedii	P1490														
Tubificoides pseudogaster	P1498								1						
Nymphon brevirostre	Q0005		1				1								
Achelia echinata	Q0015														
Anoplodactylus petiolatus	Q0044														
CRUSTACEA (larva)	R0001								1						
Balanus crenatus	R0077	3					225	498	82				22	158	9
COPEPODA	R0142														
OSTRACODA	R2412														
Amphilochus neapolitanus	S0159														
Stenothoe marina	S0213							1							
Urothoe brevicornis	S0247														
Urothoe elegans	S0248												1	1	
Urothoe poseidonis	S0250														
Acidostoma obesum	S0275														
Atylus falcatus	S0410									1					
Atylus guttatus	S0411														
Ampelisca brevicornis	S0427														
Ampelisca diadema	S0429														
Ampelisca spinipes	S0438														
Bathyporeia elegans	S0452	1	7	15	1					2	2				
Bathyporeia guilliamsoniana	S0454									2	1				
Bathyporeia nana	S0455														
Bathyporeia pelagica	S0456					1									
Abludomelita obtusata	S0498										1				
Cheirocratus sp. (female)	S0503														
Cheirocratus intermedius	S0505														
Cheirocratus sundevallii	S0506														
Maerella tenuimana	S0521						1								
Gammaropsis cornuta	S0539													1	
Microprotopus maculatus	S0550														
Photis reinhardi	S0554														
Ericthonius sp. (female)	S0561														
Ericthonius punctatus	S0564														
Aoridae (female)	S0577														

APPENDIX VI SPECIES LIST FROM GRAB SAMPL
Kentish Flats 2007 **Colonial Epifauna**
J/1/03/1033 **Solitary epifauna**
Infaunal abundance

		47B	47C	48A	48B	48C	SA2A	SA2B	SA2C	SA6A	SA6B	SA6C	SA10A	SA10B	SA10C
		9426	9427	9428	9429	9430	9431	9432	9433	9434	9435	9436	9437	9438	9439
Species	**MCS**														
Aora gracilis	S0579														
Corophium crassicorne	S0611												4	1	
Corophium sextonae	S0615														
Dyopedos monocanthus	S0628														
Pariambus typicus	S0651						3								
Phtisica marina	S0657														
Tanaopsis graciloides	S1142														
Bodotria scorpioides	S1197														
Diastylis rathkei	S1253											1			
DECAPODA (juv.)	S1276														
Crangon sp. (juv.)	S1383														
Philoceras sp. (juv.)	S1386														
Diogenes pugilator	S1444														
Paguridae (juv.)	S1445														
Pisidia longicornis	S1482														
Macropodia parva	S1529														
Macropodia rostrata	S1532														
Corystes cassivelaunus	S1552								1	1		1			
Liocarcinus pusillus	S1584								1						
Pinnotheres pisum	S1638														
COLLEMBOLA	T0000	1													
Leptochiton asellus	W0053														
Lepidochitona cinerea	W0079														
Gibbula sp. (juv.)	W0157														
Gibbula cineraria	W0163														
Crepidula fornicata	W0439													1	1
Polinices pulchellus	W0491														
Epitonium clathratulum	W0556														
OPISTHOBRANCHIA	W1001.5														
Doto spp.	W1270						1								
Tergipedidae	W1426														
Facelina sp.	W1467														
BIVALVIA	W1560														
Nucula hanleyi	W1568														
Nucula nitidosa	W1569														
Nucula nucleus	W1570														
Mytilidae (juv.)	W1691						1								
Mytilus edulis	W1695														
Diplodonta rotundata	W1864														

APPENDIX VI SPECIES LIST FROM GRAB SAMPL
Kentish Flats 2007 **Colonial Epifauna**
J/1/03/1033 **Solitary epifauna**
Infaunal abundance

		47B	47C	48A	48B	48C	SA2A	SA2B	SA2C	SA6A	SA6B	SA6C	SA10A	SA10B	SA10C
		9426	9427	9428	9429	9430	9431	9432	9433	9434	9435	9436	9437	9438	9439
Species	**MCS**														
Tellimya ferruginosa	W1902									3		4			
Mysella bidentata	W1906														
Mactra stultorum	W1972														
Spisula elliptica	W1975														
Ensis sp.	W1996														
Ensis arcuatus	W1998														
Fabulina fabula	W2019									4	5	1			
Abra sp. (juv.)	W2058				1										
Abra alba	W2059								1						
Corbula gibba	W2157														
Alcyonidium diaphanum	Y0076													1	
Alcyonidium mamillatum	Y0079														
Alcyonidium mytili	Y0080	1					1	1							
Alcyonidium parasiticum	Y0081														
Nollela dilatata	Y0092														
Anguinella palmata	Y0096														
Vesicularia spinosa	Y0131													1	
Amathia lendigera	Y0135														
Bowerbankia gracilis	Y0139														
Conopeum reticulum	Y0172	2	1			1	3	1	2	1		1	1	1	1
Electra monostachys	Y0177	1						1	2					1	1
Electra pilosa	Y0178	1		1			2	1						1	
Aspidelectra melolontha	Y0182	2				1	2	1	2	1		1	1	1	1
Chartella papyracea	Y0192														
Callopora discreta	Y0203														
Callopora dumerilii	Y0204						1								
Bicellariella ciliata	Y0256														
Scrupocellaria scruposa	Y0279														
Escharella immersa	Y0364														
Schizomavella auriculata	Y0468														
Schizomavella linearis	Y0474														
Fenestrulina malusii	Y0483														
Phoronis sp.	ZA0003														
Asterias rubens	ZB0102						1								
Ophiothrix fragilis	ZB0124														
Amphipholis squamata	ZB0161							1							
Ophiuridae (juv.)	ZB0165														
Ophiura sp. (juv.)	ZB0166														
Ophiura albida	ZB0168														

APPENDIX VI SPECIES LIST FROM GRAB SAMPL
Kentish Flats 2007 **Colonial Epifauna**
J/1/03/1033 **Solitary epifauna**
Infaunal abundance

		47B	47C	48A	48B	48C	SA2A	SA2B	SA2C	SA6A	SA6B	SA6C	SA10A	SA10B	SA10C
		9426	9427	9428	9429	9430	9431	9432	9433	9434	9435	9436	9437	9438	9439
Species	**MCS**														
Ophiura ophiura	ZB0168														
Echinocardium cordatum	ZB0223									1		2			
Didemnidae	ZD0041														
Diademnum (=maculosum)	ZD0054														
Styela clava	ZD0104														
Polycarpa fibrosa	ZD0112														
Polycarpa pomaria	ZD0115														
Dendrodoa grossularia	ZD0120														
Pyura squamulosa	ZD0140														
Molgula manhattensis	ZD0151														
Pisces (juv.)	ZE0000														

Appendix VII

Univariate Analyses

(J/1/03/1033)

APPENDIX VII
Univariate Analyses - Kentish Flats 2007 Survey

Area	Site	Species S	Individuals N	Richness d	Evenness J'	Diversity H'(loge)	Dominance (λ)
DS	**3A**	7	8.0	2.89	0.98	1.91	0.16
	3B	2	2.0	1.44	1.00	0.69	0.50
	3C	3	3.0	1.82	1.00	1.10	0.33
	9A	37	75.0	8.34	0.93	3.36	0.04
	9B	33	60.0	7.82	0.95	3.32	0.04
	9C	52	232.0	9.36	0.85	3.35	0.05
	14A	21	39.0	5.46	0.93	2.84	0.07
	14B	11	334.0	1.72	0.15	0.35	0.88
	14C	14	145.0	2.61	0.39	1.04	0.60
	35A	15	28.0	4.20	0.93	2.53	0.09
	35B	10	22.0	2.91	0.93	2.15	0.13
	35C	13	25.0	3.73	0.88	2.26	0.14
	36A	21	46.0	5.22	0.82	2.51	0.15
	36B	30	73.0	6.76	0.90	3.07	0.06
	36C	25	75.0	5.56	0.85	2.72	0.10
	mean	**19.6**	**77.8**	**4.66**	**0.83**	**2.21**	**0.22**
	stdev	*13.8*	*93.1*	*2.5*	*0.2*	*1.0*	*0.2*
SA	**SA2A**	21	260.0	3.60	0.25	0.76	0.75
	SA2B	13	517.0	1.92	0.09	0.23	0.93
	SA2C	12	100.0	2.39	0.34	0.84	0.68
	SA6A	10	23.0	2.87	0.93	2.14	0.13
	SA6B	8	15.0	2.58	0.91	1.89	0.18
	SA6C	9	17.0	2.82	0.92	2.02	0.16
	SA10A	11	41.0	2.69	0.70	1.67	0.32
	SA10B	11	176.0	1.93	0.23	0.54	0.81
	SA10C	5	15.0	1.48	0.73	1.17	0.41
	mean	**11.1**	**129.3**	**2.48**	**0.57**	**1.25**	**0.49**
	stdev	*4.4*	*168.9*	*0.6*	*0.3*	*0.7*	*0.3*
SI	**16A**	5	30.0	1.18	0.77	1.23	0.38
	16B	5	23.0	1.28	0.82	1.32	0.32
	16C	8	16.0	2.52	0.84	1.75	0.24
	18A	12	23.0	3.51	0.89	2.22	0.15
	18B	8	17.0	2.47	0.81	1.69	0.27
	18C	9	17.0	2.82	0.93	2.04	0.15
	21A	6	22.0	1.62	0.87	1.55	0.26
	21B	12	70.0	2.59	0.68	1.68	0.31
	21C	5	24.0	1.26	0.85	1.38	0.30
	29A	5	9.0	1.82	0.95	1.52	0.23
	29B	10	37.0	2.49	0.87	2.00	0.17
	29C	5	12.0	1.61	0.94	1.52	0.24
	31A	7	16.0	2.16	0.85	1.66	0.25
	31B	11	37.0	2.77	0.85	2.04	0.18
	31C	9	40.0	2.17	0.79	1.74	0.25
	38A	4	9.0	1.37	0.92	1.27	0.31
	38B	3	5.0	1.24	0.86	0.95	0.44
	38C	4	9.0	1.37	0.88	1.21	0.33

APPENDIX VIII cont.

Univariate Analyses - Kentish Flats 2007 Survey

Area	Site	Species S	Individuals N	Richness d	Evenness J'	Diversity H'(loge)	Dominance (λ)
SI	**43A**	6	6.0	2.79	1.00	1.79	0.17
	43B	6	8.0	2.40	0.97	1.73	0.19
	43C	6	12.0	2.01	0.75	1.35	0.38
	44A	5	18.0	1.38	0.85	1.37	0.30
	44B	7	15.0	2.22	0.86	1.68	0.24
	44C	3	4.0	1.44	0.95	1.04	0.38
	mean	**6.7**	**20.0**	**2.02**	**0.86**	**1.57**	**0.27**
	stdev	*2.6*	*14.8*	*0.6*	*0.1*	*0.3*	*0.1*
CC	**40A**	26	69.0	5.90	0.83	2.72	0.11
	40B	30	80.0	6.62	0.87	2.94	0.08
	40C	13	28.0	3.60	0.85	2.19	0.16
	42A	22	95.0	4.61	0.78	2.41	0.14
	42B	23	192.0	4.18	0.75	2.34	0.16
	42C	27	148.0	5.20	0.68	2.23	0.21
	mean	**23.5**	**102.0**	**5.02**	**0.79**	**2.47**	**0.14**
	stdev	*5.9*	*58.8*	*1.1*	*0.1*	*0.3*	*0.0*
REF	**33A**	35	139.0	6.89	0.81	2.89	0.10
	33B	36	105.0	7.52	0.86	3.09	0.07
	33C	43	136.0	8.55	0.78	2.92	0.13
	45A	21	713.0	3.04	0.14	0.43	0.86
	45B	20	555.0	3.01	0.16	0.49	0.85
	45C	14	125.0	2.69	0.42	1.10	0.57
	47A	5	15.0	1.48	0.87	1.40	0.30
	47B	6	8.0	2.40	0.93	1.67	0.22
	47C	5	12.0	1.61	0.77	1.23	0.39
	48A	3	19.0	0.68	0.58	0.63	0.65
	48B	4	6.0	1.67	0.90	1.24	0.33
	48C	3	4.0	1.44	0.95	1.04	0.38
	mean	**16.3**	**153.1**	**3.42**	**0.68**	**1.51**	**0.40**
	stdev	*14.6*	*233.6*	*2.7*	*0.3*	*0.9*	*0.3*

APPENDIX VIII cont.

Summary Tables

Area	DS	SA	SI	CC	REF
Phyla	Mean no Species/0.1m^2 ± Standard Deviation				
Solitary epifauna	1.3 ± 83.8	1 ± 0.9	0.04 ± 0.2	3 ± 2.4	0.1 ± 1
Infauna	18.3 ± 53.0	10.1 ± 3.9	6.7 ± 2.7	20.5 ± 5.6	15.3 ± 14
Annelida	12.1 ± 8.5	6.1 ± 3.3	3.9 ± 2.1	12.3 ± 3.8	10.3 ± 9.6
Crustacea	2.1 ± 2.5	2.1 ± 1.2	1.6 ± 1.3	2.2 ± 1.5	2.3 ± 2.6
Mollusca	1.9 ± 1.7	1.0 ± 0.7	0.8 ± 0.9	2.5 ± 1.6	1.1 ± 1.2
Echinodermata	0.2 ± 0.4	0.4 ± 0.5	0.2 ± 0.4	1.3 ± 0.5	0.3 ± 0.6
Others	2.1 ± 1.5	0.9 ± 0.9	0.4 ± 0.6	2.2 ± 1.2	1.8 ± 2.0

Summary Table (1) **Spatial variations of the mean number of species of the major phyla of infaunal organisms from grab samples, Kentish Flats, 2007 survey**

Area	DS	SA	SI	CC	REF
	77.8 ± 93.1	**129.3 ± 169**	**20 ± 14.8**	**102 ± 58.8**	**153 ± 234**
Phyla	Mean Abundance/0.1m^2 ± Standard Deviation				
Solitary epifauna	31.1 ± 83.8	111 ± 167	0.7 ± 3.5	46.2 ± 51.1	0.9 ± 1.0
Infauna	46.7 ± 53	18.6 ± 7.4	19.3 ± 14.7	55.8 ± 24.7	15.3 ± 14.1
Annelida	28.9 ± 31.9	11.4 ± 5.3	11.8 ± 13.3	35.7 ± 22.7	23.0 ± 24.6
Crustacea	2.7 ± 3.47	3.0 ± 1.9	4.1 ± 4.6	3.5 ± 3.1	5.9 ± 7.0
Mollusca	4.8 ± 4.52	2.3 ± 2.6	2.2 ± 3.7	4.2 ± 2.8	1.7 ± 2.2
Echinodermata	0.3 ± 0.59	0.6 ± 0.7	0.3 ± 0.6	4.5 ± 7.1	0.3 ± 0.6
Others	10.0 ± 15.7	1.2 ± 2.1	0.9 ± 2.1	8.0 ± 7.4	15.5 ± 20.7

Summary Table (2) **Spatial variations of the mean number of individuals of the major phyla of infaunal organisms from grab samples, Kentish Flats, 2007 survey**

Area	DS	SA	SI	CC	REF
Phyla	Mean Biomass(AFDW g/m^2)± Standard Deviation				
Annelida	0.065 ± 0.06	0.039 ±0.06	0.029 ± 0.03	0.058 ± 0.07	0.085 ± 0.09
Crustacea	0.004 ± 0.01	0.002 ± 0.00	0.004 ± 0.01	0.001 ± 0.00	0.005 ± 0.01
Mollusca	0.083 ± 0.19	0.007 ± 0.01	0.134 ± 0.32	0.013 ± 0.01	0.001 ± 0.00
Echinodermata	0.004 ± 0.01	0.307 ± 0.60	0.256 ± 0.71	0.012 ± 0.01	0.011 ± 0.04
Others	0.003 ± 0.00	0.004 ± 0.01	0.001 ± 0.00	0.030 ± 0.06	0.009 ± 0.01

Summary Table (3) **Spatial variations of the mean biomass of major infaunal phyla from grab samples, Kentish Flats, 2007 survey**

Appendix VIII

Biomass

(J/1/03/1033)

APPENDIX VIII

Infaunal Biomass – Kentish Flats 2007 Survey

Area	Site	WL01	Phylum					
			Annelida	Crustacea	Mollusca	Echinodermata	Others	Total
DEVELOPMENT SITE	3A	9371	0.0321	0.0018	0.0000	0.0000	0.0000	0.0340
	3B	9372	0.0006	0.0000	0.0001	0.0000	0.0000	0.0007
	3C	9373	0.0033	0.0000	0.0001	0.0000	0.0000	0.0034
	9A	9374	0.0837	0.0015	0.0153	0.0004	0.0009	0.1018
	9B	9375	0.0995	0.0391	0.0004	0.0274	0.0020	0.1683
	9C	9376	0.0946	0.0052	0.0052	0.0000	0.0111	0.1161
	14A	9377	0.1803	0.0005	0.0772	0.0000	0.0002	0.2581
	14B	9378	0.0334	0.0002	0.0004	0.0000	0.0007	0.0347
	14C	9379	0.2187	0.0000	0.0981	0.0000	0.0002	0.3170
	35A	9398	0.0999	0.0000	0.7046	0.0000	0.0009	0.8053
	35B	9399	0.0343	0.0000	0.0072	0.0000	0.0003	0.0417
	35C	9400	0.0150	0.0009	0.2924	0.0000	0.0006	0.3088
	36A	9401	0.0328	0.0002	0.0010	0.0000	0.0074	0.0414
	36B	9402	0.0257	0.0010	0.0365	0.0265	0.0069	0.0967
	36C	9403	0.0242	0.0013	0.0005	0.0000	0.0161	0.0422
	MEAN		**0.0652**	**0.0037**	**0.0826**	**0.0036**	**0.0032**	**0.1580**
	Stdev		*0.0645*	*0.0103*	*0.1884*	*0.0095*	0.0050	0.2080
SCOUR ASSESSMENT	*SA10A*	*9437*	0.0084	0.0009	0.0000	0.0000	0.0004	0.0097
	SA10B	*9438*	0.0069	0.0089	0.0002	0.0000	0.0008	0.0167
	SA10C	*9439*	0.0003	0.0000	0.0281	0.0000	0.0000	0.0284
	SA2A	*9431*	0.0077	0.0006	0.0000	0.7724	0.0317	0.8124
	SA2B	*9432*	0.0055	0.0001	0.0000	0.0001	0.0000	0.0057
	SA2C	*9433*	0.1682	0.0007	0.0003	0.0000	0.0000	0.1693
	SA6A	*9434*	0.0846	0.0016	0.0033	0.2439	0.0000	0.3334
	SA6B	*9435*	0.0423	0.0011	0.0112	0.0000	0.0000	0.0546
	SA6C	*9436*	0.0293	0.0018	0.0211	1.7445	0.0000	1.7967
	MEAN		**0.0392**	**0.0017**	**0.0071**	**0.3068**	**0.0037**	**0.3585**
	Stdev		*0.0553*	*0.0028*	*0.0107*	*0.5971*	*0.0105*	*0.5995*
SECONDARY IMPACT	16A	9380	0.0270	0.0000	0.0031	0.0000	0.0000	0.0301
	16B	9381	0.0077	0.0009	0.0720	0.0000	0.0000	0.0806
	16C	9382	0.0468	0.0012	0.0018	0.0000	0.0000	0.0498
	18A	9383	0.0064	0.0461	0.3132	0.8724	0.0000	1.2382
	18B	9384	0.0055	0.0035	0.2651	0.0000	0.0003	0.2744
	18C	9385	0.0719	0.0026	0.0000	0.0000	0.0000	0.0744
	21A	9386	0.0089	0.0000	0.0001	0.0000	0.0044	0.0133
	21B	9387	0.0832	0.0006	0.0002	0.0000	0.0012	0.0852
	21C	9388	0.0100	0.0000	0.0000	0.0000	0.0000	0.0100
	29A	9389	0.0076	0.0014	0.0000	0.0000	0.0000	0.0089
	29B	9390	0.0487	0.0057	0.0005	0.0000	0.0000	0.0548
	29C	9391	0.0056	0.0011	0.0000	0.0000	0.0002	0.0068
	31A	9392	0.0401	0.0000	0.4805	0.0000	0.0054	0.5260
	31B	9393	0.0980	0.0000	0.6528	0.0000	0.0005	0.7513
	31C	9394	0.0239	0.0000	1.4144	0.3007	0.0003	1.7393
	38A	9404	0.0031	0.0023	0.0000	0.0000	0.0000	0.0055
	38B	9405	0.0166	0.0028	0.0000	0.0000	0.0000	0.0195
	38C	9406	0.0016	0.0030	0.0000	0.0000	0.0000	0.0047

APPENDIX VIII cont.

Infaunal Biomass – Kentish Flats 2007 Survey

Area	Site	WL01	Phylum					
			Annelida	Crustacea	Mollusca	Echinodermata	Others	Total
SI	43A	9416	0.1311	0.0010	0.0000	0.0000	0.0000	0.1321
	43B	9417	0.0044	0.0020	0.0003	0.0000	0.0000	0.0066
	43C	9418	0.0219	0.0012	0.0000	2.6235	0.0000	2.6466
	44A	9419	0.0116	0.0035	0.0091	0.0000	0.0000	0.0242
	44B	9420	0.0107	0.0020	0.0005	0.0075	0.0000	0.0207
	44C	9421	0.0018	0.0006	0.0000	2.3312	0.0000	2.3336
	MEAN		**0.0289**	**0.0035**	**0.1339**	**0.2556**	**0.0005**	**0.4224**
	Stdev		*0.0347*	*0.0094*	*0.3231*	*0.7102*	*0.0014*	*0.7715*
CABLE CORRIDOR	40A	9407	0.0670	0.0016	0.0003	0.0159	0.0076	0.0924
	40B	9408	0.0263	0.0008	0.0044	0.0097	0.0024	0.0436
	40C	9409	0.0203	0.0010	0.0084	0.0232	0.0011	0.0539
	42A	9413	0.0261	0.0021	0.0192	0.0004	0.0000	0.0477
	42B	9414	0.1922	0.0000	0.0193	0.0041	0.1359	0.3514
	42C	9415	0.0188	0.0023	0.0265	0.0215	0.0017	0.0707
	MEAN		**0.0584**	**0.0013**	**0.0130**	**0.0125**	**0.0297**	**0.1100**
	Stdev		*0.0679*	*0.0009*	*0.0102*	*0.0093*	*0.0594*	*0.1196*
REFERENCE AREA	33A	9395	0.1604	0.0101	0.0013	0.0000	0.0302	0.2021
	33B	9396	0.1347	0.0041	0.0028	0.1300	0.0108	0.2824
	33C	9397	0.0483	0.0202	0.0060	0.0004	0.0368	0.1117
	45A	9422	0.0144	0.0111	0.0020	0.0000	0.0039	0.0314
	45B	9423	0.1139	0.0005	0.0004	0.0000	0.0018	0.1166
	45C	9424	0.0149	0.0005	0.0001	0.0000	0.0015	0.0170
	47A	9425	0.0130	0.0000	0.0000	0.0000	0.0000	0.0130
	47B	9426	0.0261	0.0000	0.0000	0.0000	0.0000	0.0261
	47C	9427	0.0041	0.0016	0.0000	0.0000	0.0000	0.0056
	48A	9428	0.0020	0.0047	0.0000	0.0000	0.0000	0.0067
	48B	9429	0.2921	0.0003	0.0001	0.0000	0.0000	0.2925
	48C	9430	0.2016	0.0003	0.0000	0.0000	0.0000	0.2019
	MEAN		**0.0855**	**0.0044**	**0.0011**	**0.0109**	**0.0071**	**0.1089**
	Stdev		*0.0948*	*0.0063*	*0.0018*	*0.0375*	*0.0128*	*0.1099*

APPENDIX VII cont

Infaunal Biomass – Kentish Flats 2007 survey

CABLE CORRIDOR	40A	9407	0.0670	0.0016	0.0003	0.0159	0.0076	0.0924
	40B	9408	0.0263	0.0008	0.0044	0.0097	0.0024	0.0436
	40C	9409	0.0203	0.0010	0.0084	0.0232	0.0011	0.0539
	42A	9413	0.0261	0.0021	0.0192	0.0004	0.0000	0.0477
	42B	9414	0.1922	0.0000	0.0193	0.0041	0.1359	0.3514
	42C	9415	0.0188	0.0023	0.0265	0.0215	0.0017	0.0707
		MEAN	**0.0584**	**0.0013**	**0.0130**	**0.0125**	**0.0297**	**0.1100**
		SD	*0.0679*	*0.0009*	*0.0102*	*0.0093*	*0.0594*	*0.1196*
REFERENCE AREA	33A	9395	0.1604	0.0101	0.0013	0.0000	0.0302	0.2021
	33B	9396	0.1347	0.0041	0.0028	0.1300	0.0108	0.2824
	33C	9397	0.0483	0.0202	0.0060	0.0004	0.0368	0.1117
	45A	9422	0.0144	0.0111	0.0020	0.0000	0.0039	0.0314
	45B	9423	0.1139	0.0005	0.0004	0.0000	0.0018	0.1166
	45C	9424	0.0149	0.0005	0.0001	0.0000	0.0015	0.0170
	47A	9425	0.0130	0.0000	0.0000	0.0000	0.0000	0.0130
	47B	9426	0.0261	0.0000	0.0000	0.0000	0.0000	0.0261
	47C	9427	0.0041	0.0016	0.0000	0.0000	0.0000	0.0056
	48A	9428	0.0020	0.0047	0.0000	0.0000	0.0000	0.0067
	48B	9429	0.2921	0.0003	0.0001	0.0000	0.0000	0.2925
	48C	9430	0.2016	0.0003	0.0000	0.0000	0.0000	0.2019
	MEAN		**0.0855**	**0.0044**	**0.0011**	**0.0109**	**0.0071**	**0.1089**
	SD		*0.0948*	*0.0063*	*0.0018*	*0.0375*	*0.0128*	*0.1099*

Appendix IX

Species List From Beam Trawl Samples
&
Fish Measurements

(J/1/03/1033)

APPENDIX IX

2m Beam Trawl Species List Colonial epifauna

KENTISH FLATS 2007 **J/1/03/1033** Solitary Epifauna

Taxon	MCS Code	Trawl T1	Trawl T2	Trawl T3	Trawl T4	Trawl T5	Trawl T7	Trawl T8	Trawl T9	Trawl T10	Trawl T11
Cliona celata	C0480								1		
Halichondria panicea	C0651							1	1		
Myxillidae	C1010								1		
Sertularia argentea	D0434	1	1		1			1			
Sertularia cupressina	D0435				1		1				1
Nemertesia antennina	D0463				1						1
Nemertesia ramosa	D0466	1									1
Alcyonium digitatum	D0597				1					1	
Actinaria sp. indet.	D0662		1								
Metridium senile	D0710		2	1	6		1				1
Tubularia indivisa	D166								1		
Sertularidae sp. indet.	D407	1									
Hydrallmania falcata	D424	1	1	1	1		1	1	1		1
Ctenophora indet.	E0001			1		1					1
Tubulanus annulatus	G28				1						
Aphrodita aculeata	P0019	12	10	15	2	3	2	19		55	1
Balanus crenatus	R0077		35				48			19	
Balanus perforatus	R79				1						
Idotea linearis	S0939	8									1
Caridea	S1337				2						
Pandalidae	S1370				2						
Pandalus montagui	S1377							4	9	5	1
Crangonidae	S1380	1							1	4	
Crangon crangon	S1385	1	36	2	2	31	1	45	22		40
Pagurus bernhardus	S1457	9	14	52	38	27	43	8	7	17	3
Pisidia longicornis	S1482							4	7		
Ebalia tuberosa	S1508								1		
Hyas coarctatus	S1519	1			2		1		1	1	
Inachus dorsettensis	S1526								2		1
Macropodia rostrata	S1532	1	2	5	15		6	35	38		38
Corystes cassivelaunus	S1552	7	5	30							
Atelecyclus rotundatus	S1555		2								1
Cancer pagurus (female)	S1566										
Cancer pagurus (male)	S1566		1						1		
Liocarcinus arcuatus	S1578	1	3		5		3	5	2		
Liocarcinus depurator	S1580	5	7	2	5		2	23	5	17	1

APPENDIX IX

2m Beam Trawl Species List Colonial epifauna

KENTISH FLATS 2007 J/1/03/1033 Solitary Epifauna

Taxon	MCS Code	Trawl T1	Trawl T2	Trawl T3	Trawl T4	Trawl T5	Trawl T7	Trawl T8	Trawl T9	Trawl T10	Trawl T11
Liocarcinus pusillus	S1584		3		3			2	4		3
Necora puber	S1589		1								
Carcinus maenas	S1594						1		6		
Nepinnotheres pinnotheres	S1636									1	
Gibbula cineraria	W0163								1		
Crepidula fornicata	W0439		13	9	7			9	21	7	13
Polinices pulchellus	W0491	6	2	10	4	1	9	4		1	1
Buccinum undatum	W0708	3	7	4	6			4	31	14	
Hinia reticulata	W0745	2	2	3			5	3	1	2	
Philine aperta	W1038							9	1	6	
Mytilus edulis	W1695	1	4		1					1	
Ostrea edulis	W1758				1					5	
Cerastoderma edule	W1961	6		2							
Mactra stultorum	W1972	1	1								
Ensis arcuatus	W1998			1							
Sepiola atlantica	W2329	5	1			1		3		1	
Oceanebra erinacea	W685							1			
Alcyonidium diaphanum	Y0076			1				1	1		1
Vesicularia spinosa	Y0131							1			1
Electra pilosa	Y0178										1
Flustra foliacea	Y0187	1	1				1	1	1	1	1
Asterias rubens	ZB0102	85	365	391	226	31	80	155		409	60
Ophiothrix fragilis	ZB0124							6	3		1
Ophiura albida	ZB0168	15	54	1260	31	1	1026	341		2	13
Ophiura ophiura	ZB0170	417	811	1526	114	1	171	5		23	1
Psammechinus miliaris	ZB0193	6	264	40	505	5	112	8		346	3
Styela clava	ZD0104			1	3		4	352	1	15	1
Dendrodoa grossularia	ZD0120								1		
Molgula manhattensis	ZD0151							1			
Scyliorhinus canicula (female)	ZF0028				1				1	1	
Raja clavata (female)	ZF0089	1		3			1				
Merlangius merlangus	ZG0123						2			1	
SYGNATHIFORMES	ZG0231	1									
Trigla lucerna	ZG0269	1							1		
Agonus cataphractus	ZG0291									3	
Echiichthys vipera	ZG0405	1									

APPENDIX IX

2m Beam Trawl Species List Colonial epifauna

KENTISH FLATS 2007 **J/1/03/1033** Solitary Epifauna

Taxon	MCS Code	Trawl T1	Trawl T2	Trawl T3	Trawl T4	Trawl T5	Trawl T7	Trawl T8	Trawl T9	Trawl T10	Trawl T11
Pholis gunnellus	ZG0440									1	
Callionymus lyra	ZG0452	1	10	3		1	1	13	32	8	
Gobiidae	ZG0455		1						7		
Limanda limanda	ZG0572	1			1			2	11		
Microstomus kitt	ZG0574								1		
Pleuronectes platessa	ZG0576	3	1	3	2	6		3			
Solea solea	ZG0591	5	10	1		3	1	2		2	
Belone belone	ZG185		1					1			
Entelurus aequoreus	ZG237						1	2		1	1
Hippocampus hippocampus	ZG239	2			1						
Syngnathus acus	ZG245										1
Pipefish sp.		2									

APPENDIX IX
KENTISH FLATS J/1/03/1033
2m Beam Trawls Fish Species Measurements

Fish Species Measurements	Total lengths (cm)																																
Trawl T1																																	
Hioppocampus hippocampus	4	7																															
Pleuronectes platessa	10	14	18																														
Echiichthys vipera	11																																
Limanda limanda	8																																
Trigla lucerna	11																																
Callionymus lyra	18																																
Pipefish	15	25																															
Solea solea	10	14	16	19	26																												
Trawl T2																																	
Belone belone	53																																
Solea solea	17	10	12	10	9	9	18	17	10	21																							
Callionymus lyra	11	8	9	12	10	9	9	8	7	6																							
Sepiola atlantica	1																																
Pleuronectes platessa	24																																
Trawl T3																																	
Raja clavata (male)	70l x 65l x 42w																																
Raja clavata (female)	46l x 32w																																
Callionymus lyra	8	9	11																														
Pleuronectes platessa	10	12	18																														
Solea solea	11																																
Trawl T4																																	
Scyliorhinus canicula (male)	55																																
Pleuronectes platessa	14	20																															
Limanda limanda	19																																
Hippocampus hippocampus	6																																
Trawl T5																																	
Pleuronectes platessa	12	11	13	13	22	12																											
Solea solea	8	17	21																														
Sepiola atlantica	1																																
Callionymus lyra	12																																
Trawl T7																																	
Raja clavata (female)	50l x 33w																																
Callionymus lyra	11																																
Merlangius merlangus	6	7																															
Solea solea	21																																

APPENDIX IX
KENTISH FLATS J/1/03/1033
2m Beam Trawls Fish Species Measurements

Fish Species Measurements	Total lengths (cm)																															
Entelurus aequoreus	25																															
Trawl T8																																
Belone belone	57																															
Soela solea	14	24																														
Pleuronbectes platessa	14	21	23																													
Entelurus aequoreus	27	39																														
Callionymus lyra	13	11	11	8	9	8	11	11	9	8	12	8	8																			
Sepiola atlantica	1	1	2																													
Limanda limanda	11	20																														
Trawl T9																																
Trigla lucerna	28																															
Callionymus lyra	11	14	10	11	10	14	20	13	8	10	10	9	13	9	13	11	10	8	13	11	12	10	10	14	8	8	12	10	13	9	11	21
Scyliorhinus canicula (female)	56																															
Limanda limand	11	14																														
Micrstomos kitt	11																															
Trawl T10																																
Agonus cataphractus	7	8	8																													
Entelurus aequoreus	38																															
Scyliorhinus canicula (female)	48																															
Callionymus lyra	10	10	10	10	10	10	10	7																								
Solea solea	19	21																														
Sepiola atlantica	1																															
Merlangius merlangus	21																															
Trawl T11																																
Entelurus aequoreus	30																															
Syngnathus acus	11																															

APPENDIX IX
KENTISH FLATS J/1/03/1033
2m Beam Trawls Fish Species Measurements

Fish Species Measurements				Abundance	mean length (cm)
Trawl T1					
Hioppocampus hippocampus				2	5.5
Pleuronectes platessa				3	14
Echiichthys vipera				1	11
Limanda limanda				1	8
Trigla lucerna				1	11
Callionymus lyra				1	18
Pipefish				2	20
Solea solea				5	17
Trawl T2					
Belone belone				1	53
Solea solea				10	13.3
Callionymus lyra				10	8.9
Sepiola atlantica					1
Pleuronectes platessa				1	24
Trawl T3					
Raja clavata (male)				0	
Raja clavata (female)				0	
Callionymus lyra				3	9.3
Pleuronectes platessa				3	13.3
Solea solea				1	11
Trawl T4					
Scyliorhinus canicula (male)				1	55
Pleuronectes platessa				2	17
Limanda limanda				1	19
Hippocampus hippocampus				1	6
Trawl T5					
Pleuronectes platessa				6	13.8
Solea solea				3	15.3
Sepiola atlantica					1
Callionymus lyra				1	12
Trawl T7					
Raja clavata (female)				0	
Callionymus lyra				1	11
Merlangius merlangus				2	6.5
Solea solea				1	21

APPENDIX IX
KENTISH FLATS J/1/03/1033
2m Beam Trawls Fish Species Measurements

Fish Species Measurements				Abundance	mean length (cm)
Entelurus aequoreus				1	25
Trawl T8					
Belone belone				1	57
Soela solea				2	19
Pleuronbectes platessa				3	19.3
Entelurus aequoreus				2	33.0
Callionymus lyra				13	9.8
Sepiola atlantica					1.3
Limanda limanda				2	15.5
Trawl T9					
Trigla lucerna				1	28.0
Callionymus lyra				32	11.4
Scyliorhinus canicula (female)				1	56.0
Limanda limand				2	12.5
Micrstomos kitt				1	11.0
Trawl T10					
Agonus cataphractus				3	7.7
Entelurus aequoreus				1	38.0
Scyliorhinus canicula (female)				1	48.0
Callionymus lyra				8	9.6
Solea solea				2	20.0
Sepiola atlantica					1.0
Merlangius merlangus				1	21.0
Trawl T11					
Entelurus aequoreus				1	30.0
Syngnathus acus				1	11.0

Appendix X

Multivariate Analyses

(J/1/03/1033)

APPENDIX X (1)

SIMPER OF FAUNAL GROUPS IDENTIFIED BY THE MULTIVARIATE ANALYSIS – KENTISH FLATS 2007 SURVEY

Similarity Percentages - species contributions

One-Way Analysis

Data worksheet; Name: Data5; Data type: Other; Sample selection: All; Variable selection: All; Data Transformation: 4th root

Parameters
Resemblance: S17 Bray Curtis similarity
Cut off for low contributions: 90.00% **TOP TEN SPECIES SHOWN**

		Samples
Groups	8	3A, 16A, 16B, 16C, SA6A, SA6B ,SA6C
	7	3B, 18A, 18B, 18C, 29A, 29B, 29C, 43A, 43B, 43C, 44A, 44B, 44C, 47A, 47B, 47C, 48A, 48B, 48C,
	1	3C
	4	9A, 9B, 9C, 14A, 14B, 14C, 31A, 31B, 31C, 33A, 33B, 33C, 35A, 35B, 35C, 36A, 36B, 36C, 40A, 40B, 45A ,45B, 45C, 2A, 2B, 2C, 10A, 10B, 10C
	5	21A, 21B, 21C
	6	38A, 38B, 38C
	3	40C
	2	42A, 42B, 42C

Group 8
Average similarity: 34.76

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Fabulina fabula	1.26	10.64	1.40	30.60	30.60
Nephtys hombergii	1.04	9.87	1.51	28.40	59.00
Corystes cassivelaunus	0.74	5.35	0.92	15.40	74.40
Spio martinensis	0.70	3.53	0.59	10.15	84.56
Notomastus spp.	0.59	1.74	0.40	5.00	89.55
Abra alba	0.31	0.60	0.22	1.72	91.28

Group 7
Average similarity: 38.92

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Nephtys cirrosa	1.20	17.66	3.31	45.38	45.38
Bathyporeia elegans	1.02	9.21	0.98	23.68	69.06
Goniada maculata	0.44	2.17	0.43	5.58	74.64
Magelona johnstoni	0.53	2.13	0.43	5.48	80.12
Corystes cassivelaunus	0.42	2.08	0.43	5.36	85.47
Notomastus spp.	0.40	2.08	0.36	5.35	90.82

Group 1
Less than 2 samples in group

Group 4
Average similarity: 29.90

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Spiophanes bombyx	1.19	3.89	1.30	13.00	13.00
NEMERTEA	1.24	3.59	1.45	12.02	25.02
Balanus crenatus	1.64	3.07	0.54	10.27	35.29
Lanice conchilega	0.95	2.45	0.87	8.20	43.49
Euclymene oerstedii	0.99	1.99	0.73	6.65	50.14
Nymphon brevirostre	1.00	1.79	0.79	5.98	56.12
Notomastus spp.	0.60	1.40	0.46	4.67	60.79
Goniada maculata	0.57	1.02	0.55	3.41	64.21
Abra alba	0.53	0.88	0.42	2.93	67.14
Caulleriella alata	0.56	0.84	0.56	2.80	69.94

APPENDIX X (1) cont

SIMPER OF FAUNAL GROUPS IDENTIFIED BY THE MULTIVARIATE ANALYSIS – KENTISH FLATS 2007 SURVEY

Group 5
Average similarity: 47.57

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Ophelia borealis	1.93	16.06	4.26	33.76	33.76
Microphthalmus similis	1.23	10.95	2.56	23.03	56.79
NEMERTEA	1.08	4.15	0.58	8.73	65.51
Nephtys cirrosa	0.91	3.79	0.58	7.97	73.49
Polycirrus medusa	1.00	3.65	0.58	7.68	81.17
Scoloplos armiger	0.79	3.30	0.58	6.94	88.11
Travisia forbesii	0.88	2.88	0.58	6.06	94.16

Group 6
Average similarity: 44.23

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Urothoe brevicornis	1.31	29.01	7.48	65.58	65.58
Ophelia borealis	0.73	8.22	0.58	18.59	84.17
Bathyporeia elegans	0.80	7.00	0.58	15.83	100.00

Group 3
Less than 2 samples in group

Group 2
Average similarity: 47.77

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Polycarpa fibrosa	2.35	6.66	21.70	13.94	13.94
ACTINIARIA	2.36	6.57	10.76	13.75	27.69
Polycarpa pomaria	1.90	5.43	11.19	11.36	39.05
Ampharete baltica	1.50	4.03	12.35	8.44	47.49
Abra alba	1.36	3.87	9.89	8.10	55.59
Molgula manhattensis	1.26	3.73	18.92	7.81	63.39
Euclymene oerstedii	1.35	3.54	6.55	7.42	70.81
Polycirrus norvegicus	0.97	1.53	0.58	3.21	74.02
Pyura squamulosa	1.00	1.41	0.58	2.95	76.97
Mediomastus fragilis	1.14	1.39	0.58	2.91	79.88
Notomastus spp.	0.73	1.08	0.58	2.27	91.41

Groups 8 & 7
Average dissimilarity = 80.83

	Group 8	Group 7				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Fabulina fabula	1.26	0.17	7.80	1.64	9.65	9.65
Nephtys hombergii	1.04	0.00	7.31	2.04	9.04	18.69
Nephtys cirrosa	0.14	1.20	7.12	2.39	8.80	27.50
Bathyporeia elegans	0.34	1.02	5.86	1.29	7.25	34.75
Spio martinensis	0.70	0.38	4.70	1.04	5.81	40.56
Notomastus spp.	0.59	0.40	4.17	1.05	5.15	45.71
Corystes cassivelaunus	0.74	0.42	3.94	1.04	4.87	50.58
Magelona johnstoni	0.14	0.53	3.30	0.91	4.09	54.67
Goniada maculata	0.17	0.44	3.16	0.86	3.90	58.57
Balanus crenatus	0.29	0.15	2.88	0.51	3.57	62.14

APPENDIX X (1) cont

SIMPER OF FAUNAL GROUPS IDENTIFIED BY THE MULTIVARIATE ANALYSIS – KENTISH FLATS 2007 SURVEY

Groups 8 & 1
Average dissimilarity = 92.91

Species	Group 8 Av.Abund	Group 1 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Fabulina fabula	1.26	0.00	10.86	1.83	11.68	11.68
Nephtys hombergii	1.04	0.00	9.38	2.07	10.10	21.78
Mysella bidentata	0.00	1.00	8.65	6.74	9.31	31.09
Goniada maculata	0.17	1.00	7.52	2.72	8.09	39.18
Spiophanes bombyx	0.33	1.00	6.81	1.67	7.33	46.52
Corystes cassivelaunus	0.74	0.00	6.35	1.36	6.83	53.35
Spio martinensis	0.70	0.00	6.24	0.95	6.72	60.07
Notomastus spp.	0.59	0.00	4.37	0.80	4.70	64.77
Abra alba	0.31	0.00	2.86	0.59	3.08	67.85
Balanus crenatus	0.29	0.00	2.83	0.38	3.04	70.89

Groups 7 & 1
Average dissimilarity = 90.34

Species	Group 7 Av.Abund	Group 1 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Nephtys cirrosa	1.20	0.00	13.30	3.82	14.72	14.72
Mysella bidentata	0.00	1.00	11.30	3.24	12.51	27.23
Bathyporeia elegans	1.02	0.00	10.52	1.38	11.65	38.88
Spiophanes bombyx	0.11	1.00	10.51	2.15	11.63	50.52
Goniada maculata	0.44	1.00	7.49	1.11	8.29	58.81
Notomastus spp.	0.40	0.00	4.48	0.70	4.95	63.76
Magelona johnstoni	0.53	0.00	4.46	0.81	4.94	68.70
Spio martinensis	0.38	0.00	4.11	0.64	4.55	73.25
Corystes cassivelaunus	0.42	0.00	3.94	0.81	4.36	77.61
Bathyporeia pelagica	0.16	0.00	2.45	0.41	2.72	80.32

Groups 8 & 4
Average dissimilarity = 89.66

Species	Group 8 Av.Abund	Group 4 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Balanus crenatus	0.29	1.64	5.60	0.94	6.25	6.25
Fabulina fabula	1.26	0.05	4.20	1.52	4.68	10.93
NEMERTEA	0.00	1.24	3.66	2.08	4.08	15.01
Spiophanes bombyx	0.33	1.19	3.14	1.33	3.51	18.52
Nephtys hombergii	1.04	0.24	3.08	1.33	3.43	21.95
Lanice conchilega	0.00	0.95	2.96	1.29	3.30	25.25
Euclymene oerstedii	0.14	0.99	2.85	1.05	3.18	28.43
Nymphon brevirostre	0.00	1.00	2.62	1.20	2.92	31.35
Notomastus spp.	0.59	0.60	2.47	0.96	2.76	34.11
Spio martinensis	0.70	0.00	2.41	0.93	2.69	36.79

Groups 7 & 4
Average dissimilarity = 93.17

Species	Group 7 Av.Abund	Group 4 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Balanus crenatus	0.15	1.64	6.13	0.90	6.58	6.58
Nephtys cirrosa	1.20	0.11	4.20	1.77	4.51	11.09
Spiophanes bombyx	0.11	1.19	3.93	1.48	4.22	15.31
NEMERTEA	0.05	1.24	3.86	1.86	4.14	19.45
Bathyporeia elegans	1.02	0.03	3.68	1.19	3.95	23.40
Euclymene oerstedii	0.00	0.99	3.18	0.98	3.41	26.81
Lanice conchilega	0.11	0.95	3.12	1.17	3.35	30.16
Nymphon brevirostre	0.05	1.00	2.81	1.18	3.01	33.17
Notomastus spp.	0.40	0.60	2.58	0.93	2.77	35.94
Goniada maculata	0.44	0.57	2.04	0.92	2.19	38.13

APPENDIX X (1) cont

Groups 1 & 4
Average dissimilarity = 86.97

Species	Group 1 Av.Abund	Group 4 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Balanus crenatus	0.00	1.64	7.22	0.86	8.30	8.30
NEMERTEA	0.00	1.24	4.56	1.90	5.24	13.54
Lanice conchilega	0.00	0.95	3.81	1.15	4.38	17.92
Euclymene oerstedii	0.00	0.99	3.67	0.92	4.22	22.14
Mysella bidentata	1.00	0.41	3.57	1.24	4.11	26.25
Notomastus spp.	0.00	0.60	3.20	0.82	3.68	29.92
Nymphon brevirostre	0.00	1.00	3.16	1.14	3.63	33.55
Goniada maculata	1.00	0.57	2.66	0.87	3.06	36.62
Abra alba	0.00	0.53	2.29	0.69	2.64	39.25
Spiophanes bombyx	1.00	1.19	2.11	1.05	2.43	41.68

Groups 8 & 5
Average dissimilarity = 96.71

Species	Group 8 Av.Abund	Group 5 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Ophelia borealis	0.00	1.93	10.21	6.98	10.55	10.55
Microphthalmus similis	0.00	1.23	6.92	2.85	7.16	17.71
Fabulina fabula	1.26	0.00	6.90	1.85	7.14	24.85
Nephtys hombergii	1.04	0.00	5.88	2.01	6.08	30.94
NEMERTEA	0.00	1.08	5.50	1.24	5.69	36.62
Polycirrus medusa	0.00	1.00	4.91	1.35	5.08	41.71
Nephtys cirrosa	0.14	0.91	4.58	1.24	4.73	46.44
Travisia forbesii	0.00	0.88	4.32	1.36	4.46	50.90
Scoloplos armiger	0.00	0.79	4.00	1.29	4.13	55.03
Spio martinensis	0.70	0.00	3.91	0.99	4.04	59.08
Corystes cassivelaunus	0.74	0.33	3.48	1.09	3.60	62.67

Groups 7 & 5
Average dissimilarity = 87.38

Species	Group 7 Av.Abund	Group 5 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Ophelia borealis	0.00	1.93	11.84	4.55	13.55	13.55
Microphthalmus similis	0.00	1.23	8.10	2.45	9.28	22.82
NEMERTEA	0.05	1.08	6.26	1.21	7.17	29.99
Bathyporeia elegans	1.02	0.00	6.20	1.38	7.10	37.09
Polycirrus medusa	0.00	1.00	5.63	1.32	6.44	43.53
Travisia forbesii	0.00	0.88	4.96	1.34	5.67	49.20
Scoloplos armiger	0.00	0.79	4.59	1.25	5.25	54.46
Lumbrineris gracilis	0.00	0.67	3.86	1.25	4.42	58.88
Nephtys cirrosa	1.20	0.91	3.82	1.07	4.37	63.25
Polycirrus sp.	0.00	0.44	3.34	0.68	3.82	67.07

Groups 1 & 5
Average dissimilarity = 96.51

Species	Group 1 Av.Abund	Group 5 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Ophelia borealis	0.00	1.93	14.91	5.31	15.45	15.45
Microphthalmus similis	0.00	1.23	10.34	2.13	10.71	26.16
Spiophanes bombyx	1.00	0.00	8.12	3.22	8.41	34.57
Mysella bidentata	1.00	0.00	8.12	3.22	8.41	42.98
NEMERTEA	0.00	1.08	7.90	1.00	8.18	51.16
Nephtys cirrosa	0.00	0.91	6.99	0.99	7.24	58.41
Polycirrus medusa	0.00	1.00	6.95	1.12	7.20	65.61
Goniada maculata	1.00	0.33	6.37	1.15	6.60	72.21
Travisia forbesii	0.00	0.88	6.16	1.14	6.38	78.59
Scoloplos armiger	0.00	0.79	5.71	1.04	5.91	84.50

APPENDIX X (1) cont

Groups 4 & 5
Average dissimilarity = 90.77

Species	Group 4 Av.Abund	Group 5 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Ophelia borealis	0.00	1.93	6.14	2.61	6.76	6.76
Balanus crenatus	1.64	0.00	5.41	0.87	5.96	12.72
Microphthalmus similis	0.03	1.23	3.98	1.90	4.39	17.11
Spiophanes bombyx	1.19	0.00	3.63	1.70	4.00	21.11
Polycirrus medusa	0.03	1.00	3.00	1.20	3.30	24.41
Lanice conchilega	0.95	0.00	2.84	1.27	3.13	27.55
Euclymene oerstedii	0.99	0.00	2.81	1.02	3.09	30.64
Nephtys cirrosa	0.11	0.91	2.80	1.10	3.08	33.72
Travisia forbesii	0.00	0.88	2.65	1.19	2.92	36.64
NEMERTEA	1.24	1.08	2.61	1.08	2.88	39.51

Groups 8 & 6
Average dissimilarity = 96.47

Species	Group 8 Av.Abund	Group 6 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Urothoe brevicornis	0.00	1.31	10.20	6.24	10.57	10.57
Fabulina fabula	1.26	0.00	9.79	1.94	10.15	20.72
Nephtys hombergii	1.04	0.00	8.43	2.17	8.74	29.46
Ophelia borealis	0.00	0.73	5.77	1.35	5.98	35.44
Corystes cassivelaunus	0.74	0.00	5.73	1.44	5.94	41.38
Spio martinensis	0.70	0.00	5.61	1.01	5.81	47.19
Bathyporeia elegans	0.34	0.80	5.60	1.20	5.80	52.99
Notomastus spp.	0.59	0.00	4.00	0.84	4.14	57.13
Bathyporeia pelagica	0.00	0.44	3.29	0.68	3.42	60.55
Nephtys cirrosa	0.14	0.33	3.11	0.75	3.23	63.77

Groups 7 & 6
Average dissimilarity = 81.85

Species	Group 7 Av.Abund	Group 6 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Urothoe brevicornis	0.00	1.31	12.86	3.46	15.71	15.71
Nephtys cirrosa	1.20	0.33	7.98	1.63	9.75	25.46
Ophelia borealis	0.00	0.73	7.31	1.27	8.93	34.39
Bathyporeia elegans	1.02	0.80	7.14	1.11	8.73	43.12
Bathyporeia pelagica	0.16	0.44	4.87	0.80	5.95	49.07
Magelona johnstoni	0.53	0.00	4.02	0.83	4.91	53.98
Notomastus spp.	0.40	0.00	3.90	0.72	4.77	58.75
Goniada maculata	0.44	0.00	3.79	0.81	4.63	63.38
Spio martinensis	0.38	0.00	3.61	0.66	4.41	67.79
Corystes cassivelaunus	0.42	0.00	3.52	0.82	4.30	72.09

Groups 1 & 6
Average dissimilarity = 100.00

Species	Group 1 Av.Abund	Group 6 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Urothoe brevicornis	0.00	1.31	18.13	6.49	18.13	18.13
Goniada maculata	1.00	0.00	13.87	8.14	13.87	32.00
Spiophanes bombyx	1.00	0.00	13.87	8.14	13.87	45.86
Mysella bidentata	1.00	0.00	13.87	8.14	13.87	59.73
Ophelia borealis	0.00	0.73	10.36	1.15	10.36	70.10
Bathyporeia elegans	0.00	0.80	10.36	1.11	10.36	80.46
Bathyporeia pelagica	0.00	0.44	5.67	0.58	5.67	86.13
Nephtys cirrosa	0.00	0.33	5.28	0.58	5.28	91.41

APPENDIX X (1) cont

Groups 4 & 6
Average dissimilarity = 98.79

Species	Group 4 Av.Abund	Group 6 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Balanus crenatus	1.64	0.00	6.78	0.88	6.87	6.87
Urothoe brevicornis	0.00	1.31	5.40	2.12	5.47	12.33
Spiophanes bombyx	1.19	0.00	4.53	1.58	4.59	16.92
NEMERTEA	1.24	0.00	4.32	1.96	4.37	21.29
Lanice conchilega	0.95	0.00	3.57	1.20	3.62	24.91
Euclymene oerstedii	0.99	0.00	3.46	0.96	3.50	28.41
Bathyporeia elegans	0.03	0.80	3.22	1.07	3.26	31.67
Ophelia borealis	0.00	0.73	3.04	1.09	3.08	34.75
Nymphon brevirostre	1.00	0.00	3.02	1.16	3.05	37.80
Notomastus spp.	0.60	0.00	2.98	0.83	3.02	40.82

Groups 5 & 6
Average dissimilarity = 81.99

Species	Group 5 Av.Abund	Group 6 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Urothoe brevicornis	0.00	1.31	9.58	3.70	11.69	11.69
Microphthalmus similis	1.23	0.00	9.32	2.53	11.36	23.05
Ophelia borealis	1.93	0.73	8.10	1.94	9.88	32.93
NEMERTEA	1.08	0.00	7.20	1.16	8.78	41.71
Polycirrus medusa	1.00	0.00	6.36	1.29	7.76	49.47
Nephtys cirrosa	0.91	0.33	5.68	1.22	6.93	56.39
Bathyporeia elegans	0.00	0.80	5.67	1.19	6.92	63.31
Travisia forbesii	0.88	0.00	5.62	1.32	6.85	70.16
Scoloplos armiger	0.79	0.00	5.21	1.22	6.35	76.51
Lumbrineris gracilis	0.67	0.33	3.91	0.99	4.77	81.28

Groups 8 & 3
Average dissimilarity = 97.40

Species	Group 8 Av.Abund	Group 3 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
NEMERTEA	0.00	1.68	7.18	13.18	7.37	7.37
Euclymene oerstedii	0.14	1.57	6.03	3.78	6.19	13.56
Galathowenia oculata	0.00	1.32	5.62	13.18	5.77	19.33
Fabulina fabula	1.26	0.00	5.38	1.96	5.52	24.85
Nephtys hombergii	1.04	0.00	4.55	2.14	4.67	29.52
Pholoe inornata	0.14	1.19	4.43	2.75	4.54	34.07
Glycera tridactyla	0.00	1.00	4.27	13.18	4.38	38.45
Sphaerosyllis taylori	0.00	1.00	4.27	13.18	4.38	42.83
Lumbrineris gracilis	0.00	1.00	4.27	13.18	4.38	47.22
Magelona alleni	0.00	1.00	4.27	13.18	4.38	51.60

Groups 7 & 3
Average dissimilarity = 99.50

Species	Group 7 Av.Abund	Group 3 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
NEMERTEA	0.05	1.68	7.74	5.10	7.78	7.78
Euclymene oerstedii	0.00	1.57	7.44	7.52	7.48	15.25
Galathowenia oculata	0.00	1.32	6.25	7.52	6.29	21.54
Nephtys cirrosa	1.20	0.00	5.67	5.82	5.70	27.24
Pholoe inornata	0.00	1.19	5.65	7.52	5.68	32.92
Glycera tridactyla	0.00	1.00	4.75	7.52	4.78	37.69
Sphaerosyllis taylori	0.00	1.00	4.75	7.52	4.78	42.47
Lumbrineris gracilis	0.00	1.00	4.75	7.52	4.78	47.25
Magelona alleni	0.00	1.00	4.75	7.52	4.78	52.02
Aphelochaeta marioni	0.00	1.00	4.75	7.52	4.78	56.80

APPENDIX X (1) cont

Groups 1 & 3
Average dissimilarity = 100.00

Species	Group 1 Av.Abund	Group 3 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
NEMERTEA	0.00	1.68	9.47	Undefined!	9.47	9.47
Euclymene oerstedii	0.00	1.57	8.82	Undefined!	8.82	18.29
Galathowenia oculata	0.00	1.32	7.41	Undefined!	7.41	25.70
Pholoe inornata	0.00	1.19	6.70	Undefined!	6.70	32.40
Glycera tridactyla	0.00	1.00	5.63	Undefined!	5.63	38.04
Goniada maculata	1.00	0.00	5.63	Undefined!	5.63	43.67
Sphaerosyllis taylori	0.00	1.00	5.63	Undefined!	5.63	49.30
Lumbrineris gracilis	0.00	1.00	5.63	Undefined!	5.63	54.94
Spiophanes bombyx	1.00	0.00	5.63	Undefined!	5.63	60.57
Magelona alleni	0.00	1.00	5.63	Undefined!	5.63	66.20

Groups 4 & 3
Average dissimilarity = 80.96

Species	Group 4 Av.Abund	Group 3 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Balanus crenatus	1.64	0.00	4.60	0.89	5.68	5.68
Galathowenia oculata	0.33	1.32	3.14	1.82	3.87	9.55
Spiophanes bombyx	1.19	0.00	3.11	1.89	3.84	13.39
Aphelochaeta marioni	0.00	1.00	2.76	3.14	3.41	16.80
Magelona alleni	0.03	1.00	2.69	2.66	3.33	20.13
Nucula hanleyi	0.04	1.00	2.69	2.75	3.32	23.46
Dyopedos monocanthus	0.08	1.00	2.66	2.53	3.29	26.75
Sphaerosyllis taylori	0.11	1.00	2.58	2.21	3.19	29.94
Ophiura albida	0.15	1.00	2.51	2.00	3.10	33.04
Corophium crassicorne	0.22	1.00	2.46	2.10	3.04	36.08

Groups 5 & 3
Average dissimilarity = 86.72

Species	Group 5 Av.Abund	Group 3 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Ophelia borealis	1.93	0.00	7.65	8.23	8.82	8.82
Euclymene oerstedii	0.00	1.57	6.39	5.58	7.36	16.18
Galathowenia oculata	0.00	1.32	5.37	5.58	6.19	22.37
Microphthalmus similis	1.23	0.00	5.12	2.82	5.90	28.27
Pholoe inornata	0.00	1.19	4.85	5.58	5.59	33.87
Glycera tridactyla	0.00	1.00	4.08	5.58	4.70	38.57
Sphaerosyllis taylori	0.00	1.00	4.08	5.58	4.70	43.28
Magelona alleni	0.00	1.00	4.08	5.58	4.70	47.98
Aphelochaeta marioni	0.00	1.00	4.08	5.58	4.70	52.69
Corophium crassicorne	0.00	1.00	4.08	5.58	4.70	57.39

Groups 6 & 3
Average dissimilarity = 96.59

Species	Group 6 Av.Abund	Group 3 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
NEMERTEA	0.00	1.68	8.85	22.22	9.16	9.16
Euclymene oerstedii	0.00	1.57	8.23	22.22	8.53	17.69
Galathowenia oculata	0.00	1.32	6.92	22.22	7.17	24.85
Urothoe brevicornis	1.31	0.00	6.88	10.03	7.12	31.97
Pholoe inornata	0.00	1.19	6.26	22.22	6.48	38.45
Glycera tridactyla	0.00	1.00	5.26	22.22	5.45	43.90
Sphaerosyllis taylori	0.00	1.00	5.26	22.22	5.45	49.35
Magelona alleni	0.00	1.00	5.26	22.22	5.45	54.79
Aphelochaeta marioni	0.00	1.00	5.26	22.22	5.45	60.24
Corophium crassicorne	0.00	1.00	5.26	22.22	5.45	65.69

APPENDIX X (1) cont

Groups 8 & 2
Average dissimilarity = 93.85

Species	Group 8 Av.Abund	Group 2 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
ACTINIARIA	0.00	2.36	5.82	6.54	6.21	6.21
Polycarpa fibrosa	0.00	2.35	5.78	8.85	6.16	12.37
Polycarpa pomaria	0.00	1.90	4.69	7.71	4.99	17.36
Ampharete baltica	0.00	1.50	3.68	7.41	3.92	21.28
Molgula manhattensis	0.00	1.26	3.14	5.88	3.35	24.63
Fabulina fabula	1.26	0.00	3.12	2.09	3.32	27.95
Euclymene oerstedii	0.14	1.35	2.92	2.89	3.11	31.06
Mediomastus fragilis	0.00	1.14	2.67	1.31	2.85	33.91
Abra alba	0.31	1.36	2.56	1.95	2.73	36.64
Pyura squamulosa	0.00	1.00	2.55	1.30	2.71	39.36

Groups 7 & 2
Average dissimilarity = 98.46

Species	Group 7 Av.Abund	Group 2 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
ACTINIARIA	0.00	2.36	6.17	6.11	6.27	6.27
Polycarpa fibrosa	0.00	2.35	6.13	7.90	6.22	12.49
Polycarpa pomaria	0.00	1.90	4.96	6.96	5.04	17.53
Ampharete baltica	0.00	1.50	3.89	6.94	3.95	21.49
Abra alba	0.00	1.36	3.55	6.70	3.61	25.09
Euclymene oerstedii	0.00	1.35	3.48	6.41	3.53	28.63
Molgula manhattensis	0.00	1.26	3.33	5.44	3.39	32.01
Nephtys cirrosa	1.20	0.00	3.14	5.53	3.19	35.20
Mediomastus fragilis	0.00	1.14	2.82	1.33	2.87	38.07
Pyura squamulosa	0.00	1.00	2.71	1.31	2.75	40.81

Groups 1 & 2
Average dissimilarity = 97.85

Species	Group 1 Av.Abund	Group 2 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
ACTINIARIA	0.00	2.36	6.79	5.60	6.94	6.94
Polycarpa fibrosa	0.00	2.35	6.74	8.12	6.88	13.82
Polycarpa pomaria	0.00	1.90	5.46	6.57	5.58	19.40
Ampharete baltica	0.00	1.50	4.28	6.90	4.37	23.77
Abra alba	0.00	1.36	3.91	6.24	3.99	27.77
Euclymene oerstedii	0.00	1.35	3.82	6.24	3.91	31.67
Molgula manhattensis	0.00	1.26	3.67	4.71	3.75	35.42
Mediomastus fragilis	0.00	1.14	3.09	1.10	3.16	38.58
Pyura squamulosa	0.00	1.00	2.99	1.08	3.05	41.63
Ophiothrix fragilis	0.00	1.08	2.92	1.05	2.99	44.62

Groups 4 & 2
Average dissimilarity = 84.99

Species	Group 4 Av.Abund	Group 2 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Polycarpa fibrosa	0.07	2.35	4.22	3.52	4.97	4.97
ACTINIARIA	0.37	2.36	3.75	2.37	4.41	9.38
Polycarpa pomaria	0.00	1.90	3.49	4.01	4.10	13.49
Balanus crenatus	1.64	0.00	3.07	0.91	3.61	17.09
Ampharete baltica	0.00	1.50	2.74	3.88	3.23	20.32
Molgula manhattensis	0.03	1.26	2.29	3.20	2.69	23.01
Spiophanes bombyx	1.19	0.00	2.10	2.10	2.48	25.49
NEMERTEA	1.24	0.00	2.10	2.25	2.47	27.96
Mediomastus fragilis	0.31	1.14	1.89	1.23	2.22	30.18
Ophiothrix fragilis	0.07	1.08	1.88	1.20	2.22	32.40

APPENDIX X (1) cont

Groups 5 & 2
Average dissimilarity = 98.07

Species	Group 5 Av.Abund	Group 2 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
ACTINIARIA	0.00	2.36	5.65	5.55	5.76	5.76
Polycarpa fibrosa	0.00	2.35	5.61	6.87	5.72	11.48
Polycarpa pomaria	0.00	1.90	4.54	6.27	4.63	16.11
Ophelia borealis	1.93	0.00	4.54	6.50	4.63	20.74
Ampharete baltica	0.00	1.50	3.56	6.07	3.63	24.37
Abra alba	0.00	1.36	3.25	6.07	3.31	27.69
Euclymene oerstedii	0.00	1.35	3.19	5.63	3.25	30.94
Molgula manhattensis	0.00	1.26	3.05	5.12	3.11	34.05
Microphthalmus similis	1.23	0.00	2.98	3.72	3.04	37.09
Mediomastus fragilis	0.00	1.14	2.59	1.26	2.65	39.73

Groups 6 & 2
Average dissimilarity = 99.43

Group 6 Species	Group 2 Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
ACTINIARIA	0.00	2.36	6.55	6.45	6.58	6.58
Polycarpa fibrosa	0.00	2.35	6.50	9.19	6.54	13.12
Polycarpa pomaria	0.00	1.90	5.27	7.57	5.30	18.42
Ampharete baltica	0.00	1.50	4.13	7.76	4.15	22.57
Abra alba	0.00	1.36	3.77	7.20	3.79	26.36
Euclymene oerstedii	0.00	1.35	3.69	7.01	3.71	30.07
Urothoe brevicornis	1.31	0.00	3.63	8.47	3.65	33.72
Molgula manhattensis	0.00	1.26	3.54	5.50	3.56	37.28
Mediomastus fragilis	0.00	1.14	2.99	1.27	3.00	40.28
Pyura squamulosa	0.00	1.00	2.88	1.25	2.89	43.18

Groups 3 & 2
Average dissimilarity = 85.21

Species	Group 3 Av.Abund	Group 2 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
ACTINIARIA	0.00	2.36	5.07	5.76	5.95	5.95
Polycarpa fibrosa	0.00	2.35	5.03	7.82	5.91	11.85
Polycarpa pomaria	0.00	1.90	4.08	7.03	4.78	16.64
NEMERTEA	1.68	0.00	3.62	12.89	4.24	20.88
Ampharete baltica	0.00	1.50	3.20	6.25	3.76	24.64
Abra alba	0.00	1.36	2.92	6.70	3.42	28.06
Molgula manhattensis	0.00	1.26	2.73	5.44	3.21	31.26
Mediomastus fragilis	0.00	1.14	2.34	1.10	2.75	34.01
Ophiothrix fragilis	0.00	1.08	2.22	1.05	2.60	36.62
Pyura squamulosa	0.00	1.00	2.21	1.10	2.59	39.20

APPENDIX X (2)

SIMPER OF BENTHIC COMMUNITIES WITHIN DIFFERENT AREAS - KENTISH FLATS 2007 SURVEY – ENUMERATED FAUNA

Similarity Percentages - species contributions

One-Way Analysis

Data worksheet
Name: Data5; Data type: Other; Sample selection: All; Variable selection: All; Data Transformation: 4th root

Parameters
Resemblance: S17 Bray Curtis similarity
Cut off for low contributions: 90.00% TOP TEN SPECIES SHOWN

Group DS
Average similarity: 23.27

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Spiophanes bombyx	1.10	3.45	1.08	14.84	14.84
NEMERTEA	1.10	2.80	1.17	12.01	26.86
Goniada maculata	0.76	2.16	0.66	9.27	36.12
Nymphon brevirostre	0.89	1.79	0.78	7.69	43.81
Notomastus spp.	0.66	1.28	0.46	5.51	49.32
Glycera alba	0.68	1.18	0.68	5.09	54.41
Lanice conchilega	0.72	1.00	0.56	4.32	58.73
Balanus crenatus	0.96	0.96	0.39	4.12	62.85
Abra alba	0.57	0.89	0.43	3.81	66.67
Pholoe inornata	0.53	0.77	0.44	3.30	69.97

Group SI
Average similarity: 21.20

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Nephtys cirrosa	0.83	6.48	0.82	30.59	30.59
Bathyporeia elegans	0.68	3.96	0.54	18.67	49.26
Corystes cassivelaunus	0.47	2.38	0.48	11.22	60.48
Magelona johnstoni	0.46	1.68	0.38	7.95	68.43
Goniada maculata	0.30	0.85	0.28	4.01	72.43
Fabulina fabula	0.34	0.85	0.24	4.00	76.43
Ophelia borealis	0.33	0.62	0.19	2.91	79.35
Notomastus spp.	0.30	0.61	0.24	2.89	82.23
Spio martinensis	0.27	0.54	0.19	2.53	84.77
Nephtys hombergii	0.25	0.43	0.19	2.05	86.81

Group REF
Average similarity: 24.28

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Nephtys cirrosa	0.64	5.25	0.60	21.64	21.64
Bathyporeia elegans	0.55	2.21	0.34	9.09	30.73
Balanus crenatus	1.41	2.11	0.45	8.69	39.42
Notomastus spp.	0.35	1.89	0.31	7.80	47.22
Spio martinensis	0.39	1.77	0.31	7.29	54.51
Nymphon brevirostre	1.07	1.65	0.65	6.81	61.32
Goniada maculata	0.54	1.21	0.44	4.99	66.30
NEMERTEA	0.85	0.97	0.53	3.98	70.28
Euclymene oerstedii	0.73	0.89	0.52	3.68	73.96
Spiophanes bombyx	0.76	0.86	0.52	3.56	77.52

Group CC
Average similarity: 29.92

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Euclymene oerstedii	1.54	4.70	3.83	15.70	15.70
Pholoe inornata	1.00	2.71	1.30	9.05	24.75
Abra alba	1.01	2.21	1.33	7.40	32.15
Polycarpa fibrosa	1.34	1.93	0.71	6.44	38.59
Galathowenia oculata	1.04	1.90	0.77	6.34	44.92
Glycera tridactyla	0.67	1.47	0.77	4.93	49.85
Lumbrineris gracilis	0.67	1.43	0.77	4.79	54.64
ACTINIARIA	1.18	1.31	0.48	4.39	59.03
NEMERTEA	0.80	1.16	0.47	3.87	62.90
Polycarpa pomaria	0.95	1.09	0.48	3.63	66.53

APPENDIX X (2) cont.

SIMPER OF BENTHIC COMMUNITIES WITHIN DIFFERENT AREAS - KENTISH FLATS 2007 SURVEY

Group SA
Average similarity: 25.03

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Balanus crenatus	2.12	6.77	0.81	27.05	27.05
Spiophanes bombyx	0.97	5.50	1.09	21.99	49.04
Notomastus spp.	0.86	3.76	0.79	15.03	64.07
Lanice conchilega	0.54	1.16	0.43	4.64	68.71
Chaetozone zetlandica	0.49	1.11	0.42	4.45	73.17
Fabulina fabula	0.43	0.91	0.29	3.65	76.82
Corystes cassivelaunus	0.33	0.68	0.30	2.72	79.54
NEMERTEA	0.44	0.58	0.29	2.33	81.87
Goniada maculata	0.33	0.55	0.30	2.20	84.06
Podarkeopsis capensis	0.33	0.51	0.29	2.05	86.11

Groups DS & SI
Average dissimilarity = 89.92

Species	Group DS Av.Abund	Group SI Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Spiophanes bombyx	1.10	0.14	3.64	1.28	4.04	4.04
Nephtys cirrosa	0.21	0.83	3.28	0.94	3.65	7.69
Balanus crenatus	0.96	0.08	3.23	0.61	3.59	11.28
NEMERTEA	1.10	0.27	3.21	1.29	3.57	14.86
Bathyporeia elegans	0.00	0.68	3.01	0.73	3.35	18.21
Goniada maculata	0.76	0.30	2.74	0.87	3.05	21.26
Notomastus spp.	0.66	0.30	2.69	0.89	2.99	24.25
Nymphon brevirostre	0.89	0.00	2.61	1.15	2.90	27.15
Euclymene oerstedii	0.65	0.23	2.20	0.80	2.45	29.60
Lanice conchilega	0.72	0.20	2.19	0.92	2.43	32.03

Groups DS & REF
Average dissimilarity = 80.23

Species	Group DS Av.Abund	Group REF Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Balanus crenatus	0.96	1.41	4.63	0.84	5.77	5.77
Spiophanes bombyx	1.10	0.76	2.79	0.93	3.48	9.25
Nymphon brevirostre	0.89	1.07	2.64	1.06	3.29	12.54
NEMERTEA	1.10	0.85	2.60	1.21	3.25	15.78
Bathyporeia elegans	0.00	0.55	2.55	0.53	3.17	18.96
Nephtys cirrosa	0.21	0.64	2.54	0.77	3.16	22.12
Notomastus spp.	0.66	0.35	2.48	0.71	3.09	25.21
Goniada maculata	0.76	0.54	2.16	0.71	2.69	27.90
Euclymene oerstedii	0.65	0.73	1.99	0.96	2.48	30.38
Lanice conchilega	0.72	0.64	1.96	0.91	2.44	32.82

Groups SI & REF
Average dissimilarity = 83.82

Species	Group SI Av.Abund	Group REF Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Balanus crenatus	0.08	1.41	5.39	0.87	6.44	6.44
Bathyporeia elegans	0.68	0.55	4.20	0.86	5.01	11.44
Spio martinensis	0.27	0.39	3.22	0.73	3.85	15.29
Nephtys cirrosa	0.83	0.64	3.04	0.97	3.63	18.92
Notomastus spp.	0.30	0.35	3.04	0.73	3.63	22.54
Nymphon brevirostre	0.00	1.07	3.03	1.08	3.61	26.15
NEMERTEA	0.27	0.85	2.67	0.89	3.19	29.34
Goniada maculata	0.30	0.54	2.58	0.78	3.08	32.41
Euclymene oerstedii	0.23	0.73	2.40	0.78	2.87	35.28
Corystes cassivelaunus	0.47	0.00	2.35	0.72	2.80	38.08

APPENDIX X (2) cont.

SIMPER OF BENTHIC COMMUNITIES WITHIN DIFFERENT AREAS - KENTISH FLATS 2007 SURVEY

Groups DS & CC
Average dissimilarity = 81.52

Species	Group DS Av.Abund	Group CC Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Polycarpa fibrosa	0.07	1.34	2.59	1.12	3.18	3.18
Euclymene oerstedii	0.65	1.54	2.41	1.26	2.95	6.13
ACTINIARIA	0.37	1.18	2.36	1.03	2.89	9.02
Galathowenia oculata	0.16	1.04	2.22	1.11	2.72	11.74
NEMERTEA	1.10	0.80	1.87	1.03	2.29	14.03
Polycarpa pomaria	0.00	0.95	1.87	0.92	2.29	16.32
Balanus crenatus	0.96	0.00	1.79	0.63	2.20	18.52
Spiophanes bombyx	1.10	0.36	1.78	1.31	2.19	20.71
Pholoe inornata	0.53	1.00	1.59	1.05	1.96	22.67
Abra alba	0.57	1.01	1.56	1.10	1.92	24.58
Gattyana cirrosa	0.00	0.17	0.32	0.43	0.39	89.66
Lepidonotus squamatus	0.00	0.17	0.32	0.43	0.39	90.05

Groups SI & CC
Average dissimilarity = 95.50

Species	Group SI Av.Abund	Group CC Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Euclymene oerstedii	0.23	1.54	3.94	2.21	4.13	4.13
Polycarpa fibrosa	0.00	1.34	3.34	1.22	3.49	7.62
ACTINIARIA	0.00	1.18	2.97	0.97	3.11	10.74
Galathowenia oculata	0.04	1.04	2.97	1.26	3.11	13.84
Pholoe inornata	0.00	1.00	2.90	1.83	3.04	16.88
NEMERTEA	0.27	0.80	2.47	0.93	2.59	19.47
Polycarpa pomaria	0.00	0.95	2.39	0.98	2.50	21.97
Abra alba	0.21	1.01	2.35	1.62	2.46	24.43
Nephtys cirrosa	0.83	0.00	2.34	1.23	2.46	26.89
Glycera tridactyla	0.00	0.67	1.99	1.24	2.09	28.98

Groups REF & CC
Average dissimilarity = 87.43

Species	Group REF Av.Abund	Group CC Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Balanus crenatus	1.41	0.00	2.86	0.80	3.27	3.27
Polycarpa fibrosa	0.00	1.34	2.82	1.11	3.23	6.49
Euclymene oerstedii	0.73	1.54	2.60	1.07	2.98	9.47
ACTINIARIA	0.33	1.18	2.54	0.99	2.91	12.38
Galathowenia oculata	0.21	1.04	2.41	1.07	2.75	15.13
Pholoe inornata	0.18	1.00	2.26	1.31	2.58	17.71
NEMERTEA	0.85	0.80	2.16	0.87	2.48	20.19
Abra alba	0.08	1.01	2.08	1.56	2.38	22.57
Polycarpa pomaria	0.00	0.95	2.02	0.91	2.31	24.88
Nymphon brevirostre	1.07	0.65	1.98	1.22	2.27	27.14

Groups DS & SA
Average dissimilarity = 79.82

Species	Group DS Av.Abund	Group SA Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Balanus crenatus	0.96	2.12	6.29	1.04	7.87	7.87
Notomastus spp.	0.66	0.86	2.63	0.93	3.30	11.17
NEMERTEA	1.10	0.44	2.58	1.28	3.23	14.40
Nymphon brevirostre	0.89	0.11	2.20	1.15	2.75	17.15
Lanice conchilega	0.72	0.54	2.17	0.93	2.72	19.87
Goniada maculata	0.76	0.33	2.13	0.93	2.67	22.54
Spiophanes bombyx	1.10	0.97	2.09	0.77	2.61	25.15
Chaetozone zetlandica	0.38	0.49	1.72	0.80	2.16	27.31
Fabulina fabula	0.09	0.43	1.72	0.61	2.16	29.47
Glycera alba	0.68	0.24	1.71	1.01	2.14	31.61

APPENDIX X (2) cont.

SIMPER OF BENTHIC COMMUNITIES WITHIN DIFFERENT AREAS - KENTISH FLATS 2007 SURVEY

Groups SI & SA
Average dissimilarity = 87.25

Species	Group SI Av.Abund	Group SA Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Balanus crenatus	0.08	2.12	9.08	1.30	10.41	10.41
Spiophanes bombyx	0.14	0.97	4.69	1.41	5.38	15.79
Nephtys cirrosa	0.83	0.00	4.12	1.23	4.72	20.51
Notomastus spp.	0.30	0.86	3.93	1.18	4.51	25.02
Bathyporeia elegans	0.68	0.26	3.43	0.99	3.93	28.95
Fabulina fabula	0.34	0.43	3.02	0.83	3.47	32.42
Lanice conchilega	0.20	0.54	2.65	0.90	3.03	35.46
Corystes cassivelaunus	0.47	0.33	2.43	0.91	2.78	38.24
Magelona johnstoni	0.46	0.22	2.43	0.86	2.78	41.02
NEMERTEA	0.27	0.44	2.36	0.82	2.71	43.73

Groups REF & SA
Average dissimilarity = 82.92

Species	Group REF Av.Abund	Group SA Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Balanus crenatus	1.41	2.12	7.40	1.17	8.92	8.92
Spiophanes bombyx	0.76	0.97	3.58	1.00	4.32	13.24
Nephtys cirrosa	0.64	0.00	3.39	1.00	4.09	17.33
Bathyporeia elegans	0.55	0.26	2.88	0.75	3.48	20.81
Notomastus spp.	0.35	0.86	2.81	1.02	3.39	24.20
Nymphon brevirostre	1.07	0.11	2.59	1.14	3.13	27.33
NEMERTEA	0.85	0.44	2.36	1.00	2.85	30.18
Lanice conchilega	0.64	0.54	2.33	0.90	2.82	32.99
Spio martinensis	0.39	0.11	2.21	0.69	2.67	35.66
Goniada maculata	0.54	0.33	1.96	0.84	2.37	38.03

Groups CC & SA
Average dissimilarity = 90.14

Species	Group CC Av.Abund	Group SA Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Balanus crenatus	0.00	2.12	4.81	1.22	5.34	5.34
Euclymene oerstedii	1.54	0.22	3.26	2.07	3.62	8.96
Polycarpa fibrosa	1.34	0.00	2.95	1.20	3.27	12.23
ACTINIARIA	1.18	0.11	2.64	1.00	2.93	15.15
Galathowenia oculata	1.04	0.00	2.59	1.27	2.88	18.03
Pholoe inornata	1.00	0.19	2.41	1.77	2.68	20.71
Polycarpa pomaria	0.95	0.00	2.11	0.97	2.34	23.05
Abra alba	1.01	0.11	2.10	1.71	2.33	25.38
NEMERTEA	0.80	0.44	2.08	0.95	2.30	27.69
Spiophanes bombyx	0.36	0.97	1.99	1.21	2.21	29.90

APPENDIX X (3)

SIMPER OF GROUPS OF SAMPLES IDENTIFIED BY THE MULTIVARAITE ANALYSIS. KENTISH FLATS, 2002 – 2007 SURVEYS – ENUMERATED FAUNA FROM GRAB SAMPLES

Similarity Percentages - species contributions, One-Way Analysis.

Data worksheet Name: Data2; Data type: Other; Sample selection: All; Variable selection: All; **Data Transformation: 4th root**

Parameters
Resemblance: S17 Bray Curtis similarity
Cut off for low contributions: 90.00% TOP TEN SPECIES PRESENTED

Factor Groups

Group	*Samples*
5	3 02, 14 02, 16 02, 18 02, 29 02, 43 02, 44 02, 3 05, 14 05, 16 05, 18 05, 29 05, 43 05, 44 05, 47 05, 48 05, 6 05, 3 06, 16 06, 18 06, 29 06, 43 06, 44 06, 47 06, 48 06, 6 06, 16 07, 18 07, 29 07, 43 07, 44 07, 47 07, 48 07, 6 07.
3	9 02, 31 02, 35 02, 36 02, 40 02, 45 02, 9 05, 31 05, 33 05, 35 05, 36 05, 40 05, 45 05, 2 05, 10 05, 9 06, 14 06, 31 06, 33 06, 35 06, 36 06, 40 06, 45 06, 10 06, 2 06, 9 07, 14 07, 31 07, 33 07, 35 07, 36 07, 40 07, 45 07, 2 07, 10 07
4	21 02, 38 02, 21 05, 38 05, 21 06, 38 06, 21 07, 38 07
1	33 02, 3 07
2	41 02, 42 02, 41 05, 42 05, 41 06, 42 06, 42 07

Group 5
Average similarity: 33.32

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Nephtys cirrosa	0.91	6.95	1.23	20.87	20.87
Bathyporeia elegans	0.83	5.84	1.05	17.54	38.41
Magelona johnstoni	0.77	4.92	0.91	14.78	53.19
Notomastus sp.	0.48	2.24	0.60	6.74	59.92
Fabulina fabula	0.53	2.21	0.60	6.64	66.57
Goniada maculata	0.44	2.12	0.54	6.36	72.92
Abra alba	0.53	2.03	0.50	6.08	79.00
Scoloplos armiger	0.30	1.07	0.31	3.22	82.23
Spiophanes bombyx	0.34	0.85	0.36	2.55	84.78
Spio martinensis	0.30	0.81	0.32	2.45	87.22

Group 3
Average similarity: 35.36

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Spiophanes bombyx	1.38	3.60	3.30	10.20	10.20
NEMERTEA	1.17	2.56	1.93	7.25	17.45
Lanice conchilega	1.15	2.17	1.31	6.14	23.59
Abra alba	1.06	1.95	1.15	5.53	29.12
Goniada maculata	0.77	1.69	1.27	4.78	33.89
Nymphon brevirostre	0.94	1.34	0.86	3.80	37.69
Mysella bidentata	0.80	1.34	0.99	3.78	41.48
Scoloplos armiger	0.74	1.34	0.86	3.78	45.26
Anoplodactylus petiolatus	0.70	1.08	0.78	3.05	48.31
Pholoe inornata	0.63	0.82	0.77	2.33	50.65

Group 4
Average similarity: 39.96

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Ophelia borealis	1.57	13.53	3.29	33.86	33.86
Scoloplos armiger	0.76	4.70	0.95	11.75	45.60
Nephtys cirrosa	0.84	4.49	0.99	11.23	56.84
Bathyporeia pelagica	0.62	4.15	0.68	10.38	67.21
Bathyporeia elegans	0.56	2.94	0.49	7.37	74.58
Urothoe brevicornis	0.48	2.61	0.51	6.52	81.10
Polycirrus medusa	0.93	2.41	0.49	6.02	87.13

Lumbrineris gracilis	0.42	1.21	0.50	3.04	90.16

APPENDIX X (3) cont.

Group 1
Average similarity: 26.56

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Goniada maculata	1.00	10.54	#######	39.69	39.69
Nephtys caeca	0.88	8.01	#######	30.16	69.84
Mysella bidentata	0.97	8.01	#######	30.16	100.00

Group 2
Average similarity: 46.85

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
ACTINIARIA	2.54	3.82	9.09	8.16	8.16
Abra alba	1.94	2.70	9.76	5.76	13.92
Mediomastus fragilis	1.51	2.13	4.06	4.55	18.47
Cirriformia tentaculata	1.40	2.05	5.51	4.37	22.84
Pholoe inornata	1.26	1.90	12.53	4.05	26.90
Notomastus sp.	1.26	1.66	3.78	3.54	30.43
Lepidonotus squamatus	1.15	1.62	5.64	3.47	33.90
Phoronis sp.	1.20	1.62	5.40	3.45	37.36
Tubificoides benedii	1.32	1.56	1.44	3.33	40.69
Ampelisca diadema	1.08	1.56	6.13	3.32	44.01

Groups 5 & 3
Average dissimilarity = 86.57

Species	Group 5 Av.Abund	Group 3 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Spiophanes bombyx	0.34	1.38	2.53	1.67	2.92	2.92
NEMERTEA	0.12	1.17	2.38	2.07	2.75	5.67
Lanice conchilega	0.12	1.15	2.36	1.65	2.72	8.40
Abra alba	0.53	1.06	2.01	1.19	2.32	10.72
Bathyporeia elegans	0.83	0.04	1.96	1.29	2.26	12.98
Nymphon brevirostre	0.02	0.94	1.94	1.28	2.25	15.22
Nephtys cirrosa	0.91	0.25	1.87	1.29	2.16	17.38
Mysella bidentata	0.04	0.80	1.72	1.29	1.99	19.37
Balanus crenatus	0.11	0.64	1.70	0.52	1.96	21.33
Scoloplos armiger	0.30	0.74	1.56	1.10	1.80	23.13

Groups 5 & 4
Average dissimilarity = 81.21

Species	Group 5 Av.Abund	Group 4 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Ophelia borealis	0.17	1.57	7.30	2.55	8.99	8.99
Magelona johnstoni	0.77	0.00	4.27	1.19	5.26	14.25
Polycirrus medusa	0.00	0.93	4.16	0.90	5.12	19.37
Bathyporeia pelagica	0.09	0.62	3.58	1.12	4.41	23.78
Bathyporeia elegans	0.83	0.56	3.53	1.17	4.34	28.13
Scoloplos armiger	0.30	0.76	3.25	1.23	4.00	32.12
Nephtys cirrosa	0.91	0.84	3.23	1.08	3.98	36.10
Urothoe brevicornis	0.00	0.48	3.07	0.91	3.78	39.88
Abra alba	0.53	0.09	2.83	0.85	3.48	43.37
Fabulina fabula	0.53	0.00	2.65	0.96	3.26	46.63

APPENDIX X (3) cont.

Groups 3 & 4
Average dissimilarity = 89.77

Species	Group 3 Av.Abund	Group 4 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Ophelia borealis	0.12	1.57	3.37	2.19	3.75	3.75
Lanice conchilega	1.15	0.00	2.49	1.73	2.78	6.53
Spiophanes bombyx	1.38	0.36	2.45	1.57	2.73	9.27
Abra alba	1.06	0.09	2.37	1.29	2.64	11.90
NEMERTEA	1.17	0.51	2.06	1.42	2.29	14.20
Polycirrus medusa	0.10	0.93	2.02	0.91	2.25	16.45
Nymphon brevirostre	0.94	0.09	1.90	1.25	2.12	18.57
Mysella bidentata	0.80	0.00	1.75	1.30	1.95	20.52
Nephtys cirrosa	0.25	0.84	1.69	1.26	1.88	22.40
Goniada maculata	0.77	0.19	1.57	1.31	1.75	24.15

Groups 5 & 1
Average dissimilarity = 85.33

Species	Group 5 Av.Abund	Group 1 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Mysella bidentata	0.04	0.97	5.00	3.05	5.86	5.86
Bathyporeia elegans	0.83	0.00	4.47	1.48	5.24	11.09
Nephtys caeca	0.07	0.88	4.35	2.93	5.10	16.19
Magelona johnstoni	0.77	0.00	4.15	1.29	4.86	21.05
Nephtys cirrosa	0.91	0.38	3.52	1.45	4.13	25.18
Goniada maculata	0.44	1.00	3.06	1.20	3.59	28.77
Euclymeninae	0.02	0.59	3.05	0.98	3.58	32.35
Abra alba	0.53	0.00	2.73	0.86	3.20	35.55
Fabulina fabula	0.53	0.00	2.60	1.00	3.04	38.59
NEMERTEA	0.12	0.50	2.59	1.00	3.03	41.62

Groups 3 & 1
Average dissimilarity = 80.68

Species	Group 3 Av.Abund	Group 1 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Lanice conchilega	1.15	0.00	2.50	1.78	3.10	3.10
Abra alba	1.06	0.00	2.48	1.40	3.07	6.17
Spiophanes bombyx	1.38	0.38	2.32	1.89	2.87	9.05
Nymphon brevirostre	0.94	0.00	1.95	1.28	2.42	11.47
Scoloplos armiger	0.74	0.00	1.81	1.17	2.24	13.71
NEMERTEA	1.17	0.50	1.73	1.31	2.14	15.85
Euclymeninae	0.63	0.59	1.68	1.10	2.08	17.93
Anoplodactylus petiolatus	0.70	0.00	1.56	1.16	1.93	19.86
Balanus crenatus	0.64	0.00	1.55	0.47	1.92	21.78
Nephtys caeca	0.46	0.88	1.44	1.16	1.79	23.57

Groups 4 & 1
Average dissimilarity = 89.06

Species	Group 4 Av.Abund	Group 1 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Ophelia borealis	1.57	0.00	7.98	6.23	8.96	8.96
Mysella bidentata	0.00	0.97	5.23	3.32	5.87	14.83
Nephtys caeca	0.00	0.88	4.74	3.87	5.32	20.16
Goniada maculata	0.19	1.00	4.72	1.93	5.30	25.46
Polycirrus medusa	0.93	0.00	4.09	0.90	4.59	30.05
Scoloplos armiger	0.76	0.00	3.77	1.53	4.23	34.28
Bathyporeia elegans	0.56	0.00	3.22	0.94	3.62	37.90
Nephtys cirrosa	0.84	0.38	3.15	1.38	3.54	41.44
NEMERTEA	0.51	0.50	3.12	1.11	3.51	44.95
Euclymeninae	0.00	0.59	3.06	0.92	3.44	48.39
Urothoe brevicornis	0.48	0.00	2.99	0.92	3.35	51.74

APPENDIX X (3) cont.

Groups 5 & 2
Average dissimilarity = 94.78

Species	Group 5 Av.Abund	Group 2 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
ACTINIARIA	0.00	2.54	3.65	8.02	3.85	3.85
Mediomastus fragilis	0.03	1.51	2.15	3.41	2.27	6.12
Abra alba	0.53	1.94	2.06	1.69	2.17	8.29
Cirriformia tentaculata	0.00	1.40	2.04	5.01	2.15	10.44
Molgula manhattensis	0.00	1.38	1.97	1.24	2.08	12.51
Tubificoides benedii	0.00	1.32	1.91	1.99	2.01	14.52
Pholoe inornata	0.00	1.26	1.82	8.99	1.92	16.44
Phoronis sp.	0.00	1.20	1.72	3.65	1.81	18.25
Dendrodoa grossularia	0.00	1.13	1.71	2.18	1.81	20.06
Lepidonotus squamatus	0.00	1.15	1.65	5.13	1.74	21.80

Groups 3 & 2
Average dissimilarity = 76.48

Species	Group 3 Av.Abund	Group 2 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
ACTINIARIA	0.41	2.54	2.29	2.87	2.99	2.99
Cirriformia tentaculata	0.02	1.40	1.47	3.82	1.93	4.91
Spiophanes bombyx	1.38	0.00	1.46	4.53	1.91	6.82
Molgula manhattensis	0.07	1.38	1.42	1.19	1.86	8.68
Tubificoides benedii	0.05	1.32	1.37	1.86	1.79	10.48
Dendrodoa grossularia	0.02	1.13	1.23	2.04	1.61	12.09
Lepidonotus squamatus	0.02	1.15	1.19	3.66	1.55	13.64
Phoronis sp.	0.10	1.20	1.18	2.39	1.54	15.18
Mediomastus fragilis	0.48	1.51	1.15	1.59	1.50	16.68
Ampharete baltica	0.00	1.05	1.13	1.82	1.48	18.16

Groups 4 & 2
Average dissimilarity = 94.50

Species	Group 4 Av.Abund	Group 2 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
ACTINIARIA	0.00	2.54	3.63	7.25	3.84	3.84
Abra alba	0.09	1.94	2.68	2.68	2.83	6.68
Ophelia borealis	1.57	0.00	2.23	3.87	2.36	9.04
Mediomastus fragilis	0.00	1.51	2.18	3.65	2.31	11.35
Cirriformia tentaculata	0.00	1.40	2.03	4.78	2.14	13.49
Molgula manhattensis	0.00	1.38	1.96	1.22	2.07	15.56
Tubificoides benedii	0.00	1.32	1.90	1.96	2.01	17.57
Notomastus sp.	0.00	1.26	1.82	2.77	1.93	19.50
Pholoe inornata	0.00	1.26	1.81	7.97	1.91	21.42
Phoronis sp.	0.00	1.20	1.71	3.54	1.81	23.23

Groups 1 & 2
Average dissimilarity = 90.59

Species	Group 1 Av.Abund	Group 2 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
ACTINIARIA	0.50	2.54	2.93	3.24	3.23	3.23
Abra alba	0.00	1.94	2.81	3.12	3.10	6.34
Mediomastus fragilis	0.00	1.51	2.20	3.70	2.42	8.76
Cirriformia tentaculata	0.00	1.40	2.04	4.98	2.25	11.01
Molgula manhattensis	0.00	1.38	1.97	1.20	2.17	13.18
Tubificoides benedii	0.00	1.32	1.91	1.93	2.11	15.29
Notomastus sp.	0.00	1.26	1.83	2.76	2.02	17.31
Phoronis sp.	0.00	1.20	1.72	3.58	1.90	19.21
Dendrodoa grossularia	0.00	1.13	1.71	2.12	1.89	21.10
Lepidonotus squamatus	0.00	1.15	1.65	5.11	1.82	22.92

APPENDIX X (4)

SIMPER OF SPECIES COMPOSITION WITHIN DIFFERENT AREAS OVER TIME KENTISH FLATS 2002 – 2007 SURVEYS

Similarity Percentages - species contributions

One-Way Analysis

Data worksheet Name: Data15; Data type: Other; Sample selection: All; Variable selection: All; Data transformation: 4th root

Parameters
Resemblance: S17 Bray Curtis similarity
Cut off for low contributions: 30.00%

Factor Groups
Sample areas & years

DS	**2002**	**2005**	**2006**	**2007**
	3 02	3A 05	3A 06	3A 07
	9 02	3B 05	3B 06	3B 07
	14 02	3C 05	3C 06	3C 07
	35A 02	9A 05	9A 06	9A 07
	35B 02	9B 05	9B 06	9B 07
	35c 02	9C 05	9C 06	9C 07
	36A 02	14A 05	14A 06	14A 07
	36B 02	14B 05	14B 06	14B 07
	36C 02	14C 05	14C 06	14C 07
		35A 05	35A 06	35A 07
		35B 05	35B 06	35B 07
		35C 05	35C 06	35C 07
		36A 05	36A 06	36A 07
		36B 05	36B 06	36B 07
		36C 05	36C 06	36C 07
SA	n/a	SA 05	SA 06	2A 07
		SA 05	SA 06	2B 07
		SA 05	SA 06	2C 07
		SA 05	SA 06	6A 07
		SA 05	SA 06	6B 07
		SA 05	SA 06	6C 07
		SA 05	SA 06	10A 07
		SA 05	SA 06	10B 07
		SA 05	SA 06	10C 07
SI	16 02	16A 05	16A 06	16A 07
	18 02	16B 05	16B 06	16B 07
	21 02	16C 05	16C 06	16C 07
	29 02	18A 05	18A 06	18A 07
	31 02	18B 05	18B 06	18B 07
	38a 02	18C 05	18C 06	18C 07
	38b 02	21A 05	21A 06	21A 07
	38c 02	21B 05	21B 06	21B 07
	43a 02	21C 05	21C 06	21C 07
	43b 02	29A 05	29A 06	29A 07
	43c 02	29B 05	29B 06	29B 07
	44a 02	29C 05	29C 06	29C 07
	44b 02	31A 05	31A 06	31A 07
	44c 02	31B 05	31B 06	31B 07
		31C 05	31C 06	31C 07
		38A 05	38A 06	38A 07
		38B 05	38B 06	38B 07
		38C 05	38C 06	38C 07
		43A 05	43A 06	43A 07
		43B 05	43B 06	43B 07
		43C 05	43C 06	43C 07
		44A 05	44A 06	44A 07
		44B 05	44B 06	44B 07
		44C 05	44C 06	44C 07

APPENDIX X (4) cont.

CC	40A 02	40A 05	40A 06	40A 07
	40B 02	40B 05	40B 06	40B 07
	40C 02	40C 05	40C 06	40C 07
	41A 02	41A 05	41A 06	42A 07
	41B 02	41B 05	42A 06	42B 07
	41C 02	41C 05	42B 06	42C 07
	42A 02	42A 05	42C 06	33A 07
	42B 02	42B 05	33A 06	33B 07
	42C 02	42C 05	33B 06	33C 07
	33 02	33A 05	33C 06	45A 07
REF	45A 02	33B 05	45A 06	45B 07
	45B 02	33C 05	45B 06	45C 07
	45C 02	45A 05	45C 06	47A 07
		45B 05	47A 06	47B 07
		45C 05	47B 06	47C 07
		47A 05	47C 06	48A 07
		47B 05	48A 06	48B 07
		47C 05	48B 06	48C 07
		48A 05	48C 06	
		48B 05		
		48C 05		

Groups DS 02 & DS 07
Average dissimilarity = 82.78

Species	Group DS 02 Av.Abund	Group DS 07 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Magelona johnstoni	0.90	0.08	3.45	1.15	4.17	4.17
Scoloplos armiger	0.98	0.29	2.94	1.05	3.56	7.72
Cirripedia	0.00	0.96	2.69	0.60	3.25	10.97
NEMERTEA	0.37	1.10	2.62	1.32	3.16	14.13
Spiophanes bombyx	1.46	1.10	2.45	0.73	2.96	17.10
Notomastus sp.	0.41	0.66	2.37	0.92	2.87	19.96
Nymphon brevirostre	0.00	0.89	2.32	1.17	2.80	22.77
Goniada maculata	0.58	0.76	2.11	0.85	2.54	25.31
Abra alba	0.11	0.57	1.85	0.76	2.23	27.54
Mysella bidentata	0.41	0.40	1.81	0.79	2.19	29.74

Groups DS 05 & DS 07
Average dissimilarity = 81.59

Species	Group DS 05 Av.Abund	Group DS 07 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Abra alba	0.91	0.57	3.28	0.75	4.02	4.02
Cirripedia	0.00	0.96	2.73	0.57	3.35	7.37
NEMERTEA	0.42	1.10	2.73	1.23	3.35	10.72
Nymphon brevirostre	0.79	0.89	2.68	1.01	3.29	14.00
Spiophanes bombyx	0.85	1.10	2.66	0.73	3.26	17.27
Goniada maculata	0.43	0.76	2.45	0.75	3.01	20.27
Notomastus sp.	0.32	0.66	2.42	0.84	2.97	23.24
Lanice conchilega	0.69	0.72	2.31	0.98	2.83	26.07
Mysella bidentata	0.27	0.40	1.88	0.59	2.30	28.37
Euclymeninae	0.30	0.65	1.85	0.87	2.26	30.63

Groups DS 06 & DS 07
Average dissimilarity = 75.93

Species	Group DS 06 Av.Abund	Group DS 07 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Cirripedia	1.40	0.96	3.87	0.88	5.10	5.10
Abra alba	1.49	0.57	3.34	0.78	4.40	9.50
Lanice conchilega	1.12	0.72	2.27	1.14	2.99	12.50
Notomastus sp.	0.70	0.66	2.14	0.90	2.82	15.32
Spiophanes bombyx	1.10	1.10	2.09	0.89	2.76	18.08
NEMERTEA	0.77	1.10	1.96	1.06	2.59	20.66
Nymphon brevirostre	0.49	0.89	1.84	1.03	2.42	23.09
Mysella bidentata	0.59	0.40	1.72	0.78	2.27	25.36
Goniada maculata	0.59	0.76	1.68	0.77	2.22	27.57
Sabellaria spinulosa	0.75	0.15	1.62	0.99	2.14	29.71

APPENDIX X (4)

Groups SI 02 & SI 07
Average dissimilarity = 80.75

Species	Group SI 02 Av.Abund	Group SI 07 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Scoloplos armiger	0.86	0.10	6.13	1.46	7.59	7.59
Bathyporeia elegans	0.39	0.68	5.51	1.00	6.82	14.41
Magelona johnstoni	0.57	0.46	4.95	0.93	6.14	20.54
Nephtys cirrosa	0.81	0.83	4.64	1.07	5.75	26.30
Ophelia borealis	0.43	0.33	4.62	0.84	5.73	32.02

Groups SI 05 & SI 07
Average dissimilarity = 79.24

Species	Group SI 05 Av.Abund	Group SI 07 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Bathyporeia elegans	0.77	0.68	5.35	1.01	6.76	6.76
Nephtys cirrosa	0.75	0.83	4.94	0.97	6.23	12.99
Magelona johnstoni	0.64	0.46	4.45	0.95	5.61	18.60
Ophelia borealis	0.45	0.33	4.11	0.76	5.19	23.79
Abra alba	0.54	0.21	3.17	0.83	4.00	27.79
Corystes cassivelaunus	0.00	0.47	3.08	0.81	3.89	31.68

Groups SI 06 & SI 07
Average dissimilarity = 79.68

Species	Group SI 06 Av.Abund	Group SI 07 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Abra alba	0.80	0.21	4.83	1.05	6.06	6.06
Bathyporeia elegans	0.39	0.68	4.56	0.99	5.72	11.78
Nephtys cirrosa	0.77	0.83	4.23	0.99	5.31	17.09
Ophelia borealis	0.51	0.33	4.16	0.84	5.22	22.31
Magelona johnstoni	0.51	0.46	3.97	0.95	4.98	27.29
Fabulina fabula	0.49	0.34	3.86	0.94	4.84	32.14

Groups REF 02 & REF 07
Average dissimilarity = 90.04

Species	Group REF 02 Av.Abund	Group REF 07 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Cirripedia	0.00	1.41	5.15	0.85	5.72	5.72
Nephtys cirrosa	0.00	0.64	4.39	1.06	4.87	10.59
Spiophanes bombyx	0.68	0.76	3.79	0.87	4.21	14.80
Bathyporeia elegans	0.00	0.55	3.64	0.69	4.05	18.85
NEMERTEA	0.55	0.85	3.34	1.04	3.70	22.55
Scoloplos armiger	0.63	0.42	3.31	0.82	3.68	26.23
Nymphon brevirostre	0.00	1.07	2.98	1.10	3.31	29.54
Anoplodactylus petiolatus	0.55	0.18	2.86	0.79	3.18	32.72

Groups REF 05 & REF 07
Average dissimilarity = 83.23

Species	Group REF 05 Av.Abund	Group REF 07 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Cirripedia	0.00	1.41	5.07	0.76	6.09	6.09
Bathyporeia elegans	0.18	0.55	4.00	0.59	4.80	10.90
Nephtys cirrosa	0.45	0.64	3.70	0.68	4.44	15.34
Nymphon brevirostre	0.65	1.07	3.24	0.98	3.89	19.23
Spio martinensis	0.08	0.39	3.11	0.57	3.74	22.96
Notomastus sp.	0.08	0.35	3.02	0.54	3.63	26.59
NEMERTEA	0.73	0.85	2.65	0.98	3.19	29.78
Goniada maculata	0.25	0.54	2.46	0.63	2.95	32.73

APPENDIX X (4)

Groups REF 06 & REF 07
Average dissimilarity = 77.65

Species	Group REF 06 Av.Abund	Group REF 07 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Cirripedia	0.89	1.41	4.97	0.89	6.40	6.40
Bathyporeia elegans	0.18	0.55	3.06	0.62	3.94	10.35
Lanice conchilega	1.01	0.64	2.78	0.99	3.58	13.92
Nymphon brevirostre	0.44	1.07	2.77	1.05	3.56	17.49
Spiophanes bombyx	0.85	0.76	2.67	0.97	3.44	20.93
Nephtys cirrosa	0.70	0.64	2.52	1.28	3.24	24.17
Spio martinensis	0.17	0.39	2.41	0.62	3.10	27.27
Notomastus sp.	0.33	0.35	2.24	0.63	2.89	30.16

Groups CC 02 & CC 07
Average dissimilarity = 78.11

Species	Group CC 02 Av.Abund	Group CC 07 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Tubificoides benedii	1.52	0.30	2.16	1.75	2.77	5.69
ACTINIARIA	1.32	1.18	2.11	1.19	2.70	8.39
Galathowenia oculata	0.11	1.04	1.77	1.17	2.27	10.66
Euclymeninae	0.63	1.54	1.71	1.52	2.19	12.85
Scoloplos armiger	1.03	0.00	1.60	1.50	2.05	14.91
NEMERTEA	0.42	0.80	1.42	0.97	1.82	16.73
Cirriformia tentaculata	1.02	0.36	1.41	1.26	1.81	18.53
Mediomastus fragilis	0.78	0.74	1.30	1.12	1.67	20.20
Achelia echinata	0.88	0.65	1.25	1.18	1.60	21.80
Ampharete baltica	0.11	0.75	1.24	0.93	1.58	23.39

Groups CC 05 & CC 07
Average dissimilarity = 72.50

Species	Group CC 05 Av.Abund	Group CC 07 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
ACTINIARIA	1.70	1.18	2.15	1.22	2.97	2.97
Polycarpa sp.	0.24	1.47	2.10	1.14	2.89	5.86
Eteone flava/longa	1.03	0.00	1.56	2.22	2.15	8.01
Mysella bidentata	1.23	0.36	1.53	1.38	2.11	10.12
Mediomastus fragilis	1.48	0.74	1.53	1.42	2.11	12.23
Galathowenia oculata	0.34	1.04	1.52	1.17	2.10	14.32
Molgula manhattensis	1.07	0.63	1.45	1.09	2.00	16.32
Scoloplos armiger	0.86	0.00	1.34	1.49	1.86	18.18
NEMERTEA	1.28	0.80	1.28	1.10	1.76	19.94
Pholoe baltica	0.97	0.17	1.24	1.45	1.71	21.65

Groups CC 06 & CC 07
Average dissimilarity = 69.04

Species	Group CC 06 Av.Abund	Group CC 07 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
ACTINIARIA	1.93	1.18	2.29	1.34	3.31	3.31
Molgula manhattensis	1.65	0.63	2.07	1.30	3.01	6.32
Polycarpa sp.	0.58	1.47	1.94	1.19	2.81	9.13
Lanice conchilega	1.25	0.20	1.63	1.59	2.36	11.49
Abra alba	1.93	1.01	1.35	1.21	1.95	13.43
Mediomastus fragilis	1.32	0.74	1.32	1.53	1.91	15.35
Phoronis sp.	1.00	0.36	1.27	1.18	1.84	17.18
Galathowenia oculata	0.76	1.04	1.22	1.19	1.77	18.95
NEMERTEA	1.01	0.80	1.21	1.08	1.76	20.71
Ampharete baltica	0.78	0.75	1.17	1.11	1.69	22.40

Groups SA 05 & SA 07
Average dissimilarity = 86.73

Species	Group SA 05 Av.Abund	Group SA 07 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Cirripedia	0.65	2.12	9.07	1.18	10.46	10.46
Abra alba	1.39	0.11	5.26	1.14	6.07	16.53
Spiophanes bombyx	0.42	0.97	3.94	1.01	4.54	21.07
Notomastus sp.	0.35	0.86	3.79	1.00	4.37	25.44
Lanice conchilega	0.68	0.54	3.09	1.00	3.56	29.00
Nephtys cirrosa	0.59	0.00	2.91	0.95	3.35	32.35

APPENDIX X (4)

Groups SA 06 & SA 07
Average dissimilarity = 77.50

Species	Group SA 06 Av.Abund	Group SA 07 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Cirripedia	0.86	2.12	7.07	1.20	9.12	9.12
Lanice conchilega	0.90	0.54	2.99	1.20	3.85	12.97
Notomastus sp.	0.49	0.86	2.83	1.09	3.66	16.63
Fabulina fabula	0.47	0.43	2.46	0.96	3.17	19.80
Abra alba	0.67	0.11	2.39	0.84	3.08	22.89
Goniada maculata	0.49	0.33	2.11	0.90	2.73	25.61
Tellimya ferruginosa	0.39	0.30	2.06	0.77	2.66	28.27
NEMERTEA	0.39	0.44	2.01	0.89	2.60	30.87

APPENDIX X (5)

SIMPER OF GROUP OF SAMPLES IDENTIFIED BY THE MULTIVARAIATE ANALYSIS, KENTISH FLATS 2002 – 20077 – COLONIAL EPIFAUNA FROM GRAB SAMPLES

Similarity Percentages - species contributions; One-Way Analysis;

Data worksheet Name: Data8; Data type: Other; Sample selection: All; Variable selection: All.

Parameters
Resemblance: S17 Bray Curtis similarity
Cut off for low contributions: 90.00% TOP TEN SPECIES SHOWN

Factor Groups

Group	*Samples*
1	3 02, 6 05, 16 05
5	9 02, 14 02, 21 02, 31 02, 33 02, 36 02, 40 02, 41 02, 45 02, 2 05, 9 05, 10 05, 14 05, 31 05, , 33 05, 35 05, 36 , 5, 40 05, 41 05, 42 05, 45 05, 9 06, 14 06, 21 06, 31 06, 33 06, 35 06, 36 06, 40 06, 45 06, 2 06, 10 06, 9 07, 14 07, 21 07, 31 07, 33 07, 35 07, 36 07, 40 07, 45 07, 47 07, 2 07, 10 07
2	35 02, 3 05, 21 05, 29 05, 48 05, 3 06, 47 06, 48 06, 3 07, 16 07, 18 07, 29 07, 43 07, 48 07, 6 07
3	42 02
4	41 06,42 06, 42 07

Group 1
Average similarity: 64.81

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Vesicularia spinosa	0.89	51.94	4.24	80.13	80.13
Conopeum reticulum	0.72	12.88	0.58	19.87	100.00

Group 5
Average similarity: 48.80

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Conopeum reticulum	1.23	11.13	3.30	22.80	22.80
Electra monostachys	1.07	8.80	2.31	18.02	40.82
Aspidelectra melolontha	0.92	6.56	1.49	13.44	54.26
Electra pilosa	0.78	4.80	1.23	9.83	64.09
Vesicularia spinosa	0.64	3.17	0.76	6.49	70.58
Alcyonidium mytili	0.56	2.55	0.72	5.22	75.81
Hydrallmania falcata	0.56	2.24	0.70	4.59	80.39
Clythia hemispaerica	0.47	1.68	0.58	3.44	83.83
Obelia dichotoma	0.47	1.62	0.58	3.33	87.16
Sertularia argentea	0.49	1.59	0.55	3.25	90.41

Group 2
Average similarity: 60.24

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Conopeum reticulum	0.86	44.43	2.58	73.75	73.75
Aspidelectra melolontha	0.58	14.69	0.82	24.39	98.14

Group 3
Less than 2 samples in group

APPENDIX X (5) cont

Group 4
Average similarity: 42.94

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Alcyonidium mytili	1.09	6.26	8.07	14.57	14.57
Conopeum reticulum	1.03	5.76	4.78	13.42	27.99
Electra pilosa	0.97	5.76	4.78	13.42	41.42
ENTOPROCTA	0.94	5.54	6.28	12.90	54.32
Bicellariella ciliata	0.92	5.22	3.24	12.15	66.47
Clytia gracilis	0.84	4.66	6.28	10.85	77.32
Electra monostachys	0.70	2.11	0.58	4.91	82.23
Alcyonidium diaphanum	0.59	1.77	0.58	4.13	86.35
Scypha ciliata	0.67	1.69	0.58	3.94	90.29

Groups 1 & 5
Average dissimilarity = 79.83

Species	Group 1 Av.Abund	Group 5 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Electra monostachys	0.00	1.07	9.14	2.46	11.44	11.44
Aspidelectra melolontha	0.00	0.92	7.50	1.85	9.40	20.84
Electra pilosa	0.00	0.78	6.04	1.74	7.56	28.41
Conopeum reticulum	0.72	1.23	5.84	1.08	7.31	35.72
Alcyonidium mytili	0.00	0.56	4.33	1.06	5.42	41.14
Vesicularia spinosa	0.89	0.64	4.23	0.95	5.30	46.44
Hydrallmania falcata	0.00	0.56	3.91	1.11	4.90	51.33
Clythia hemispaerica	0.00	0.47	3.36	0.93	4.20	55.54
Sertularia argentea	0.00	0.49	3.26	0.93	4.08	59.61
Obelia dichotoma	0.00	0.47	3.23	0.94	4.05	63.66

Groups 1 & 2
Average dissimilarity = 68.60

Species	Group 1 Av.Abund	Group 2 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Vesicularia spinosa	0.89	0.05	26.08	2.19	38.01	38.01
Conopeum reticulum	0.72	0.86	16.03	1.15	23.37	61.38
Aspidelectra melolontha	0.00	0.58	15.00	1.26	21.87	83.25
Electra monostachys	0.00	0.15	3.74	0.48	5.46	88.71
Electra pilosa	0.00	0.10	2.44	0.38	3.56	92.27

Groups 5 & 2
Average dissimilarity = 72.85

Species	Group 5 Av.Abund	Group 2 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Electra monostachys	1.07	0.15	7.78	1.86	10.68	10.68
Electra pilosa	0.78	0.10	5.51	1.56	7.57	18.25
Vesicularia spinosa	0.64	0.05	4.93	1.12	6.77	25.02
Aspidelectra melolontha	0.92	0.58	4.50	1.00	6.18	31.19
Alcyonidium mytili	0.56	0.00	4.20	1.07	5.77	36.96
Hydrallmania falcata	0.56	0.00	3.81	1.11	5.23	42.19
Conopeum reticulum	1.23	0.86	3.27	1.56	4.49	46.68
Clythia hemispaerica	0.47	0.00	3.27	0.94	4.48	51.17
Obelia dichotoma	0.47	0.05	3.22	0.95	4.42	55.59
Sertularia argentea	0.49	0.00	3.18	0.93	4.36	59.95

Groups 1 & 3
Average dissimilarity = 89.95

Species	Group 1 Av.Abund	Group 3 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Distomus variolosus	0.00	1.07	8.42	17.00	9.36	9.36
Halichondria bowerbanki	0.00	1.07	8.42	17.00	9.36	18.72
Laomedea flexuosa	0.00	1.00	7.83	17.00	8.71	27.43
Alcyonidium mytili	0.00	0.90	7.08	17.00	7.87	35.29
Amathia lendigera	0.00	0.90	7.08	17.00	7.87	43.16
Electra pilosa	0.00	0.90	7.08	17.00	7.87	51.03
Escharella immersa	0.00	0.90	7.08	17.00	7.87	58.90
Escharella ventricosa	0.00	0.90	7.08	17.00	7.87	66.77
Vesicularia spinosa	0.89	0.00	6.94	8.36	7.71	74.48
Eudendrium ramosum	0.00	0.76	5.95	17.00	6.62	81.10

APPENDIX X (5) cont

Groups 5 & 3

Average dissimilarity = 73.51

Species	Group 5 Av.Abund	Group 3 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Distomus variolosus	0.00	1.07	5.00	4.76	6.80	6.80
Halichondria bowerbanki	0.00	1.07	5.00	4.76	6.80	13.59
Electra monostachys	1.07	0.00	4.86	3.35	6.61	20.20
Laomedea flexuosa	0.09	1.00	4.31	2.77	5.86	26.06
Amathia lendigera	0.00	0.90	4.20	4.76	5.72	31.78
Escharella ventricosa	0.00	0.90	4.20	4.76	5.72	37.49
Aspidelectra melolontha	0.92	0.00	4.09	2.19	5.56	43.05
Escharella immersa	0.23	0.90	3.37	1.78	4.58	47.64
Laomedea neglecta	0.09	0.76	3.30	2.99	4.49	52.13
Eudendrium ramosum	0.07	0.76	3.24	2.56	4.40	56.53

Groups 2 & 3

Average dissimilarity = 84.89

Species	Group 2 Av.Abund	Group 3 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Distomus variolosus	0.00	1.07	8.20	13.84	9.66	9.66
Halichondria bowerbanki	0.00	1.07	8.20	13.84	9.66	19.31
Laomedea flexuosa	0.00	1.00	7.63	13.84	8.99	28.30
Alcyonidium mytili	0.00	0.90	6.89	13.84	8.12	36.42
Amathia lendigera	0.00	0.90	6.89	13.84	8.12	44.54
Escharella ventricosa	0.00	0.90	6.89	13.84	8.12	52.66
Escharella immersa	0.05	0.90	6.55	4.08	7.72	60.38
Electra pilosa	0.10	0.90	6.16	2.89	7.26	67.64
Eudendrium ramosum	0.00	0.76	5.80	13.84	6.83	74.47
Laomedea neglecta	0.00	0.76	5.80	13.84	6.83	81.30

Groups 1 & 4

Average dissimilarity = 92.99

Species	Group 1 Av.Abund	Group 4 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Alcyonidium mytili	0.00	1.09	6.33	4.08	6.81	6.81
Electra pilosa	0.00	0.97	5.79	2.89	6.23	13.04
ENTOPROCTA	0.00	0.94	5.63	2.70	6.05	19.09
Bicellariella ciliata	0.00	0.92	5.58	2.50	6.00	25.09
Vesicularia spinosa	0.89	0.00	5.25	3.04	5.65	30.74
Clytia gracilis	0.00	0.84	5.18	2.14	5.57	36.30
Electra monostachys	0.00	0.70	4.83	1.12	5.20	41.50
Alcyonidium diaphanum	0.00	0.59	4.07	1.12	4.37	45.87
Bowerbankia gracilis	0.00	0.59	3.90	1.07	4.19	50.07
Conopeum reticulum	0.72	1.03	3.47	1.15	3.73	53.80

Groups 5 & 4

Average dissimilarity = 68.60

Species	Group 5 Av.Abund	Group 4 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
ENTOPROCTA	0.06	0.94	3.40	2.43	4.96	4.96
Aspidelectra melolontha	0.92	0.00	3.38	2.04	4.93	9.89
Bicellariella ciliata	0.07	0.92	3.36	2.23	4.90	14.79
Clytia gracilis	0.08	0.84	3.08	2.01	4.48	19.27
Bowerbankia gracilis	0.03	0.59	2.37	1.14	3.46	22.73
Vesicularia spinosa	0.64	0.00	2.33	1.19	3.39	26.12
Scypha ciliata	0.02	0.67	2.19	1.35	3.20	29.32
Alcyonidium mytili	0.56	1.09	2.16	1.09	3.16	32.48
Alcyonidium diaphanum	0.42	0.59	2.05	1.06	2.98	35.46
Hydrallmania falcata	0.56	0.30	1.89	1.08	2.75	38.21

APPENDIX X (5) cont

Groups 2 & 4

Average dissimilarity = 86.96

Species	Group 2 Av.Abund	Group 4 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Alcyonidium mytili	0.00	1.09	6.20	4.30	7.13	7.13
ENTOPROCTA	0.00	0.94	5.50	2.85	6.33	13.45
Bicellariella ciliata	0.00	0.92	5.46	2.63	6.27	19.73
Electra pilosa	0.10	0.97	5.10	2.17	5.86	25.59
Clytia gracilis	0.00	0.84	5.06	2.26	5.82	31.41
Electra monostachys	0.15	0.70	4.29	1.13	4.94	36.35
Alcyonidium diaphanum	0.05	0.59	3.84	1.14	4.41	40.76
Bowerbankia gracilis	0.00	0.59	3.80	1.12	4.37	45.13
Aspidelectra melolontha	0.58	0.00	3.25	1.24	3.74	48.87
Scypha ciliata	0.00	0.67	3.09	1.38	3.55	52.42

Groups 3 & 4

Average dissimilarity = 72.42

Species	Group 3 Av.Abund	Group 4 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Distomus variolosus	1.07	0.00	3.98	4.52	5.50	5.50
Halichondria bowerbanki	1.07	0.00	3.98	4.52	5.50	11.01
Laomedea flexuosa	1.00	0.00	3.71	4.52	5.12	16.13
ENTOPROCTA	0.00	0.94	3.50	3.51	4.83	20.96
Bicellariella ciliata	0.00	0.92	3.46	3.02	4.78	25.74
Escharella ventricosa	0.90	0.00	3.35	4.52	4.63	30.37
Clytia gracilis	0.00	0.84	3.19	2.53	4.40	34.77
Electra monostachys	0.00	0.70	2.86	1.04	3.95	38.72
Laomedea neglecta	0.76	0.00	2.82	4.52	3.89	42.61
Penetrantia concharum	0.76	0.00	2.82	4.52	3.89	46.50

APPENDIX X(6)

SIMPER ANALYSIS OF TRAWL SAMPLES – FISH SPECIES ONLY – KENTISH FLATS 2002 – 2007 SURVEYS –

Similarity Percentages - species contributions

One-Way Analysis

Data worksheet
Name: Data6 DATA TRANSFORMATION: PRESENCE/ABSENCE

Parameters
Resemblance: S17 Bray Curtis similarity
Cut off for low contributions: 90.00%

Factor Groups
Sample years

Groups 2002 & 2005
Average dissimilarity = 45.54

Species	Group 2002 Av.Abund	Group 2005 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Scyliorhinus canicula	0.00	0.60	3.32	1.18	7.28	7.28
Trisopterus minutus	0.56	0.00	3.25	1.08	7.14	14.43
Platichthys flesus	0.56	0.00	2.99	1.08	6.57	20.99
Clupea harengus	0.56	0.30	2.89	1.02	6.34	27.33
Trisopterus luscus	0.56	0.60	2.75	0.95	6.04	33.37

Groups 2002 & 2006
Average dissimilarity = 59.39

Species	Group 2002 Av.Abund	Group 2006 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Merlangius merlangus	1.00	0.10	5.55	2.70	9.35	9.35
Aphia minuta	0.00	0.70	4.10	1.42	6.90	16.25
Trisopterus minutus	0.56	0.00	3.49	1.07	5.87	22.12
Agonus cataphractus	0.78	0.40	3.42	1.08	5.76	27.88
Clupea harengus	0.56	0.00	3.22	1.08	5.43	33.31

Groups 2005 & 2006
Average dissimilarity = 55.73

Species	Group 2005 Av.Abund	Group 2006 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Merlangius merlangus	0.90	0.10	6.40	1.82	11.49	11.49
Aphia minuta	0.00	0.70	5.14	1.33	9.22	20.71
Scyliorhinus canicula	0.60	0.20	4.23	1.04	7.59	28.30
Agonus cataphractus	0.70	0.40	4.09	1.01	7.34	35.63
Pleuronectes platessa	0.80	0.50	3.94	0.94	7.07	42.70

Groups 2002 & 2007
Average dissimilarity = 67.72

Species	Group 2002 Av.Abund	Group 2007 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Merlangius merlangus	1.00	0.20	5.30	1.86	7.82	7.82
Agonus cataphractus	0.78	0.10	4.69	1.53	6.93	14.75
Gobiidae	0.78	0.20	4.33	1.35	6.39	21.14
Limanda limanda	1.00	0.40	4.08	1.18	6.02	27.16
Trisopterus minutus	0.56	0.00	3.83	1.08	5.66	32.82

Groups 2005 & 2007
Average dissimilarity = 61.84

Species	Group 2005 Av.Abund	Group 2007 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Merlangius merlangus	0.90	0.20	6.36	1.46	10.29	10.29
Gobiidae	0.80	0.20	5.58	1.31	9.03	19.32
Agonus cataphractus	0.70	0.10	5.32	1.27	8.61	27.92
Scyliorhinus canicula	0.60	0.30	4.53	1.00	7.33	35.25
Trisopterus luscus	0.60	0.00	4.35	1.18	7.03	42.28

APPENDIX X(6) cont

Groups 2006 & 2007
Average dissimilarity = 66.08

Species	Group 2006 Av.Abund	Group 2007 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Gobiidae	1.00	0.20	7.58	1.64	11.47	11.47
Aphia minuta	0.70	0.00	6.41	1.30	9.70	21.16
Pleuronectes platessa	0.50	0.60	4.75	0.93	7.19	28.36
Limanda limanda	0.60	0.40	4.69	0.98	7.10	35.46
Solea solea	0.70	0.70	4.09	0.79	6.19	41.65

APPENDIX X(7)

SIMPER ANALYSIS OF EPIBENTHIC FAUNA FROM TRAWL SAMPLES – KENTISH FLATS 2002 – 2007 SURVEYS

Similarity Percentages - species contributions

One-Way Analysis

Data worksheet
Name: Data7 DATA TRANSFORMATION: PRESENCE/ABSENCE
Data type: Other

Parameters
Resemblance: S17 Bray Curtis similarity
Cut off for low contributions: 90.00%

Factor Groups
Sample years

Groups 2002 & 2005
Average dissimilarity = 52.07

Species	Group 2002 Av.Abund	Group 2005 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Hydrallmania falcata	0.11	0.90	2.53	1.80	4.85	4.85
Hyas coarctatus	0.33	0.70	1.80	1.05	3.45	8.30
Alcyonidium diaphanum	0.00	0.60	1.77	1.10	3.40	11.70
Macropodia sp.	0.44	0.90	1.68	0.99	3.23	14.93
Actiniaria	0.11	0.60	1.63	1.11	3.14	18.07

Groups 2002 & 2006
Average dissimilarity = 59.41

Species	Group 2002 Av.Abund	Group 2006 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Hydrallmania falcata	0.11	0.90	2.02	1.61	3.39	3.39
Electra pilosa	0.11	0.80	1.64	1.57	2.75	6.15
Sertularia argentea	0.00	0.70	1.47	1.44	2.48	8.63
Clytia haemisphaerica	0.00	0.70	1.47	1.44	2.47	11.10
Macropodia sp.	0.44	0.90	1.31	0.95	2.21	13.31

Groups 2005 & 2006
Average dissimilarity = 49.41

Species	Group 2005 Av.Abund	Group 2006 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Electra pilosa	0.00	0.80	1.59	1.87	3.22	3.22
Sertularia argentea	0.00	0.70	1.36	1.46	2.75	5.97
Clytia haemisphaerica	0.00	0.70	1.36	1.46	2.75	8.72
Pandalus montagui	0.40	0.90	1.25	1.11	2.53	11.24
Halecium sp.	0.00	0.60	1.18	1.19	2.39	13.63

Groups 2002 & 2007
Average dissimilarity = 53.85

Species	Group 2002 Av.Abund	Group 2007 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Polinices pulchellus	0.00	0.90	2.54	2.24	4.72	4.72
Hydrallmania falcata	0.11	0.80	1.98	1.59	3.69	8.41
Hinia reticulata	0.00	0.70	1.86	1.44	3.45	11.86
Styela clava	0.33	0.70	1.59	1.10	2.95	14.81
Ophiura albida	0.44	0.90	1.50	0.99	2.78	17.58

Groups 2005 & 2007
Average dissimilarity = 43.57

Species	Group 2005 Av.Abund	Group 2007 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Polinices pulchellus	0.30	0.90	1.68	1.28	3.85	3.85
Hinia reticulata	0.20	0.70	1.53	1.23	3.50	7.35
Actiniaria	0.60	0.10	1.37	1.13	3.14	10.49
Corystes cassivelaunus	0.60	0.30	1.32	1.04	3.03	13.52
Alcyonidium diaphanum	0.60	0.40	1.30	0.98	2.99	16.51

APPENDIX X(7)

Groups 2006 & 2007
Average dissimilarity = 48.31

Species	Group 2006 Av.Abund	Group 2007 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Electra pilosa	0.80	0.10	1.41	1.59	2.92	2.92
Polinices pulchellus	0.30	0.90	1.39	1.23	2.87	5.79
Clytia haemisphaerica	0.70	0.00	1.28	1.46	2.66	8.45
Halecium sp.	0.60	0.00	1.11	1.19	2.31	10.75
Styela clava	0.40	0.70	1.11	1.02	2.29	13.05