Linking backscatter, particle-size distributions and infaunal data- results from the Dogger Bank, North Sea.

Suzanne Ware and Markus Diesing

Cefas

- Linking sediment properties with faunal communities is crucial in habitat mapping.

- Traditionally habitat mapping has relied on the integration of a number of remote sensing and groundtruthing techniques.

- Linking the results of interdisciplinary surveys often relies on expert judgement but there is a need to improve methods for interpreting and integrating the outputs from a variety of techniques.

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Multibeam backscatter

• In addition to providing information on seabed morphology and bathymetry, multibeam backscatter can assist in the characterisation and delineation of seafloor habitat types.

• Differences in the acoustic response has been linked to a number of seafloor and sediment properties:

- Seabed Roughness

- Physical Sediment Properties

- Sediment Particle Size

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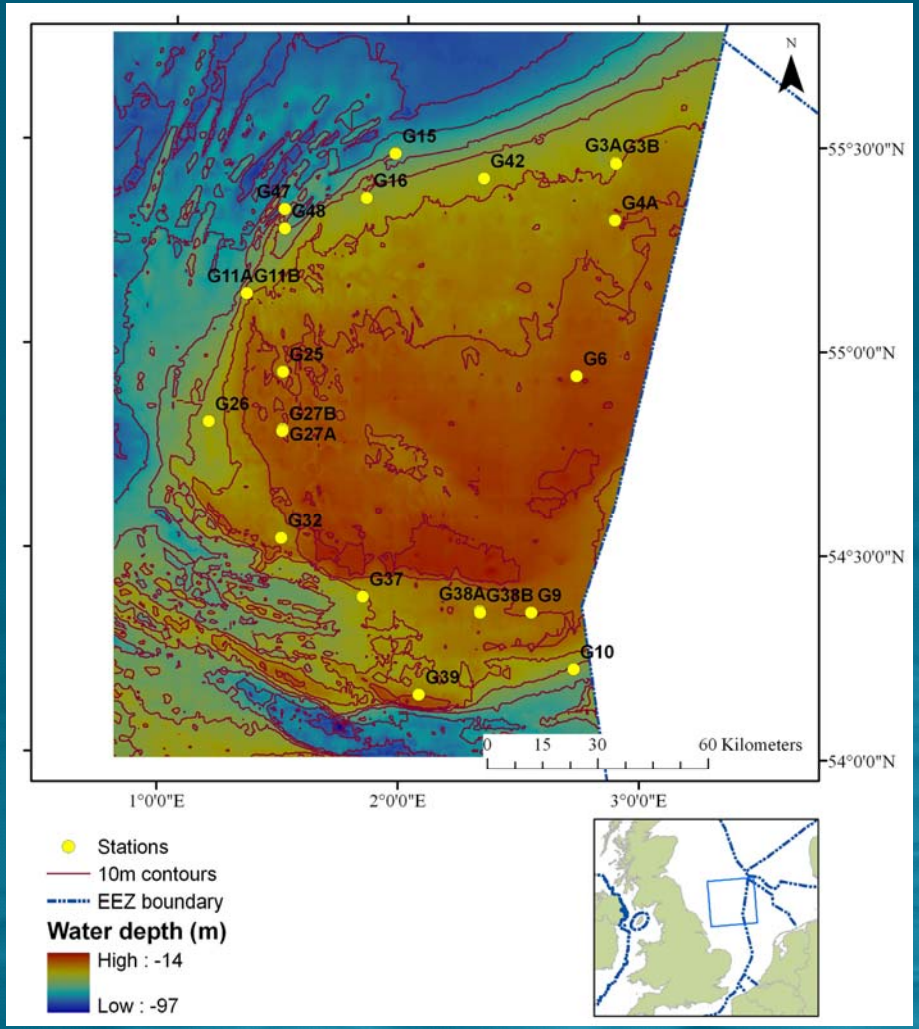
The data presented here were collected from 22 stations during the Joint Nature Conservation Committee (JNCC) commissioned survey of the Dogger Bank in April 2008.

The survey contributed to the wider offshore seabed survey programme and gathered data to support its work identifying potential offshore Special Areas of Conservation (SAC).



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Multibeam Data

The acoustic data consisted of backscatter intensity extracted from a circle of multibeam data (40m diameter) around each sampling site.

These values were used to construct histograms according to backscatter intensity, detailing the percentage occurrence of each 1dB class.

Particle Size Assessment (PSA) data

A sample of sediment for PSA was collected from Hamon grab samples taken at each station.

Samples were processed back at the laboratory to produce a particle size distribution in Phi units.

Infaunal Species Abundance Data

Hamon grab samples were collected at each station and processed on return to the laboratory to produce an infaunal species abundance matrix.

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Cluster Analysis

- A similarity or distance matrix was constructed for each data set:

The Manhattan distance measure was used for the multibeam backscatter and particle size data

The Bray-Curtis similarity co-efficient was applied to 4^{th} root transformed infaunal species abundance data

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Data analysis

‘Similarity profile’ SIMPROF permutation test

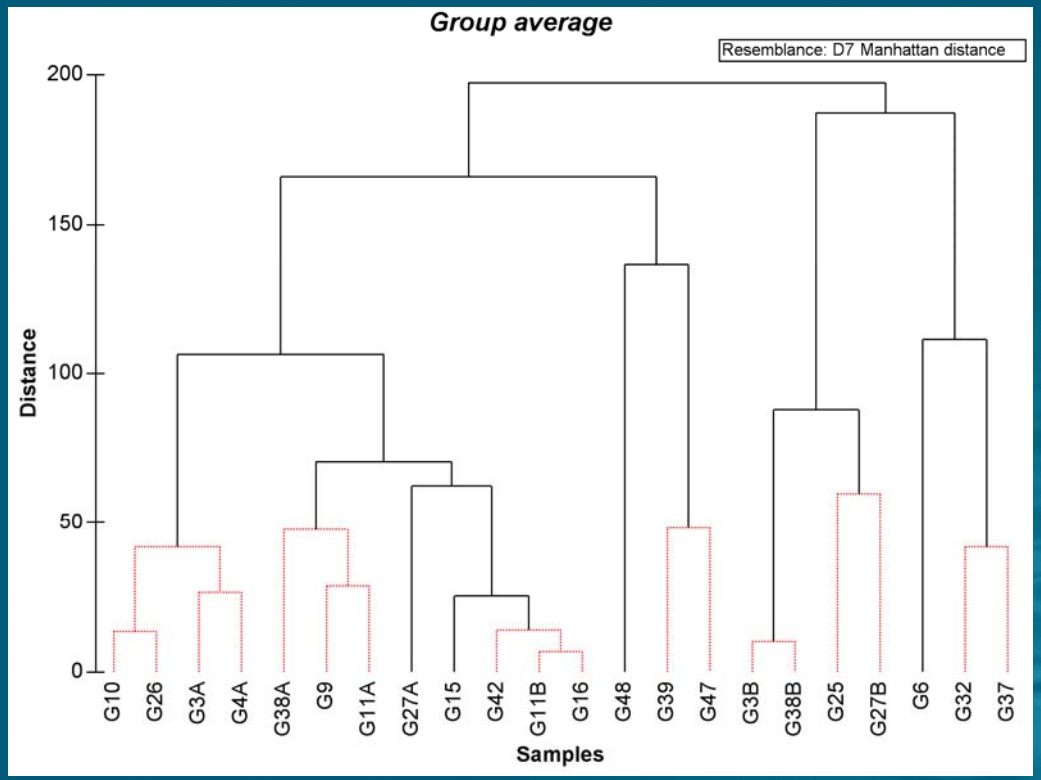
The three data sets (acoustic, PSA and infaunal abundance) were examined using the ‘similarity profile’ SIMPROF permutation test (PRIMER v6).

The SIMPROF test looks for statistically significant evidence of genuine clusters within samples that are *a priori* unstructured.

RELATE

Similarities in multivariate patterns between the three data sets were further examined using the PRIMER routine relate which measures how closely the related two sets of multivariate data are by calculating a rank correlation coefficient between each component of their respective similarity matrices.

Multibeam Backscatter



The SIMPROF routine applied to the multibeam backscatter data identified seven genuine clusters.

These seven clusters fell into one of two broad groups:

- a group of high backscatter characterised by peaks in the histogram between -13dB and -19dB.
- a group of low backscatter characterised by peaks in the histogram between -24dB and -31dB.

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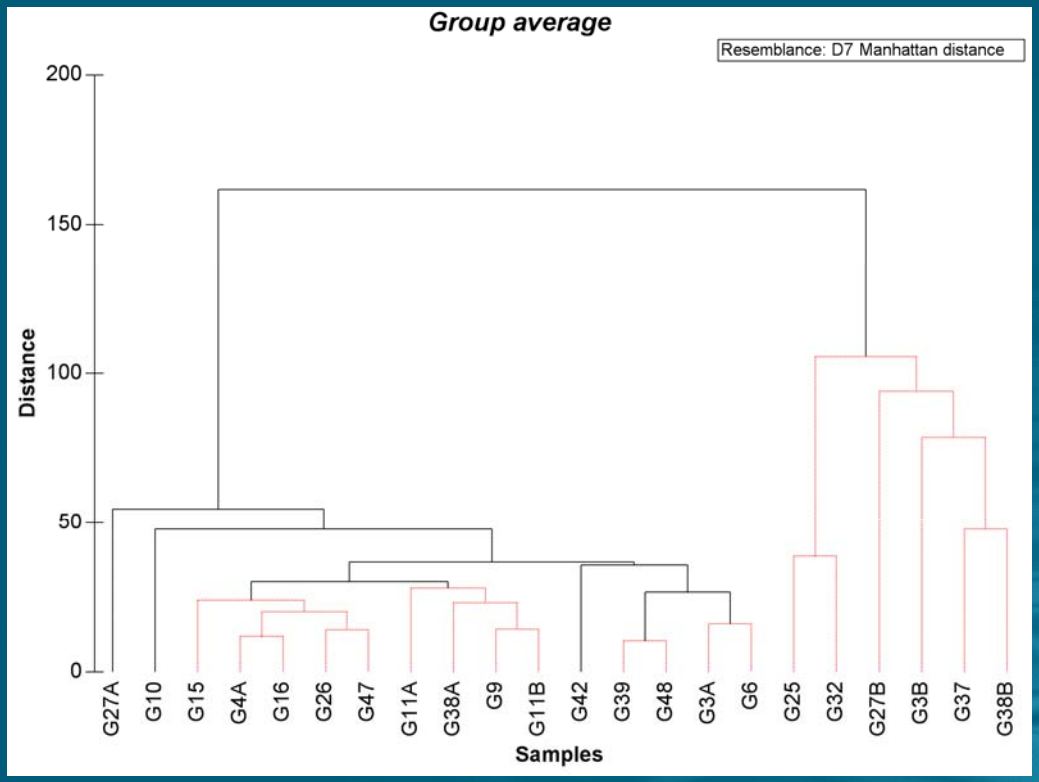
Particle Size Data



The SIMPROF routine applied to the particle size data identified five genuine clusters.

- One of the five clusters was largely characterised by coarse sediment fractions
- The remaining clusters were characterised by fine to medium sand with varying proportions of mud.

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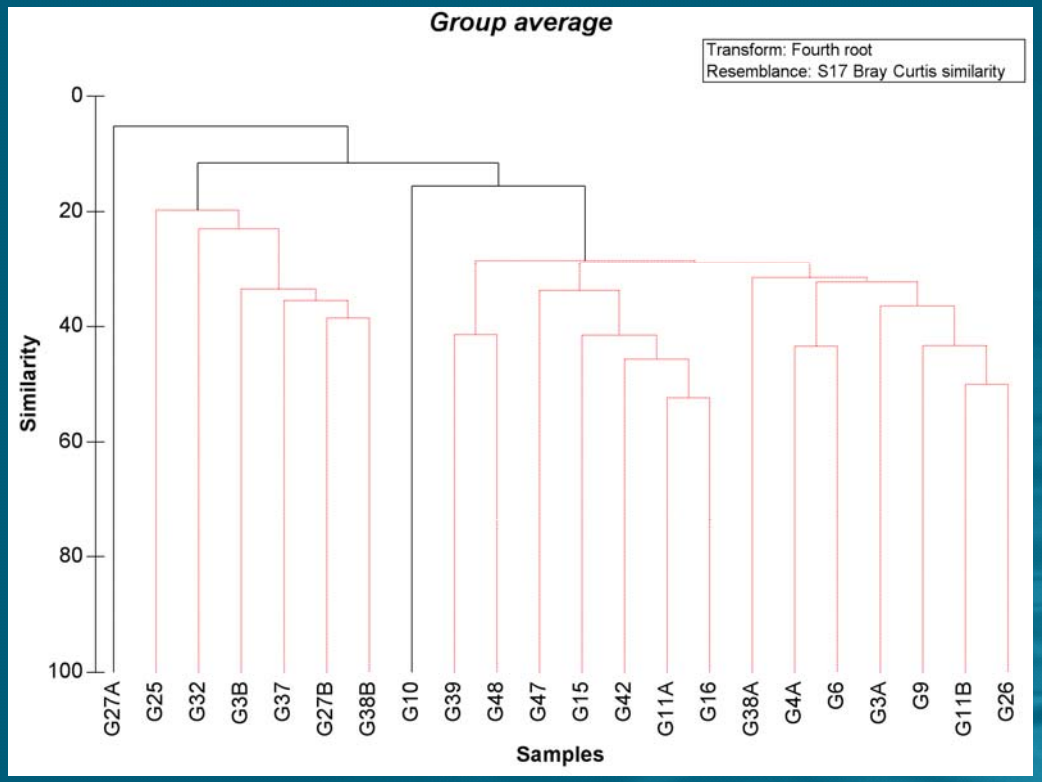
Infaunal Data



The SIMPROF routine applied to the particle size data identified two genuine clusters.

On cluster was characterised by species typical of sandy sediments whilst the other was characterised by species typical of coarser sediments.

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RELATE

- Multibeam Backscatter / Particle Size
  ρ = 0.673, significance = 0.1%

- Particle Size / Infauna
  ρ = 0.640, significance = 0.1%

- Multibeam Backscatter / Infauna
  ρ = 0.466, significance = 0.2%

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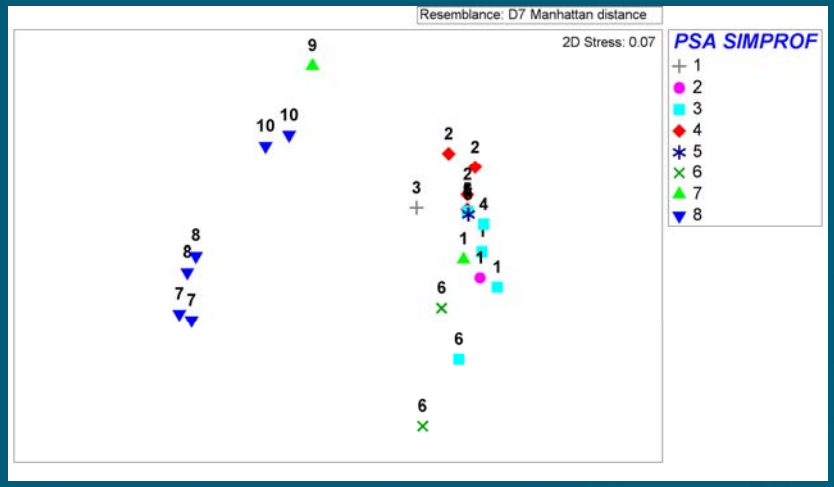
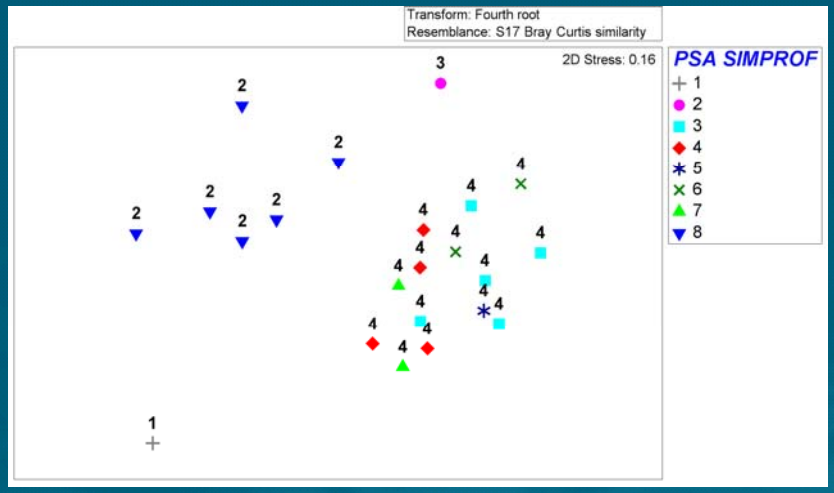
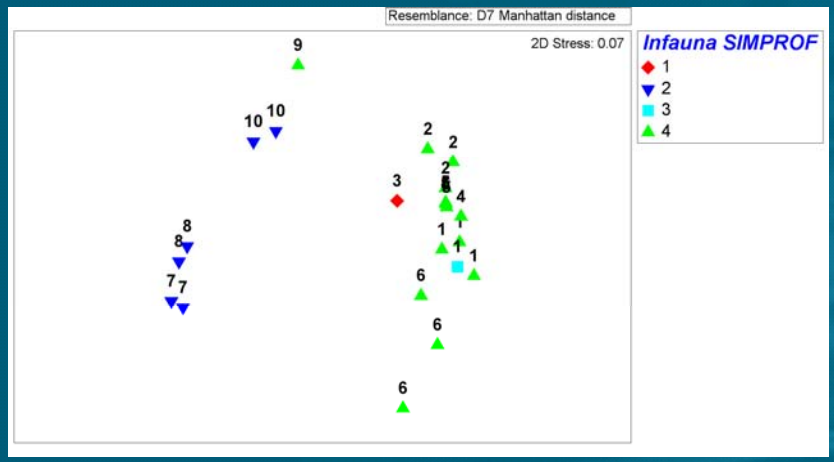
Multidimensional scaling ordinations



Multibeam backscatter data with PSA groups shown as symbols.

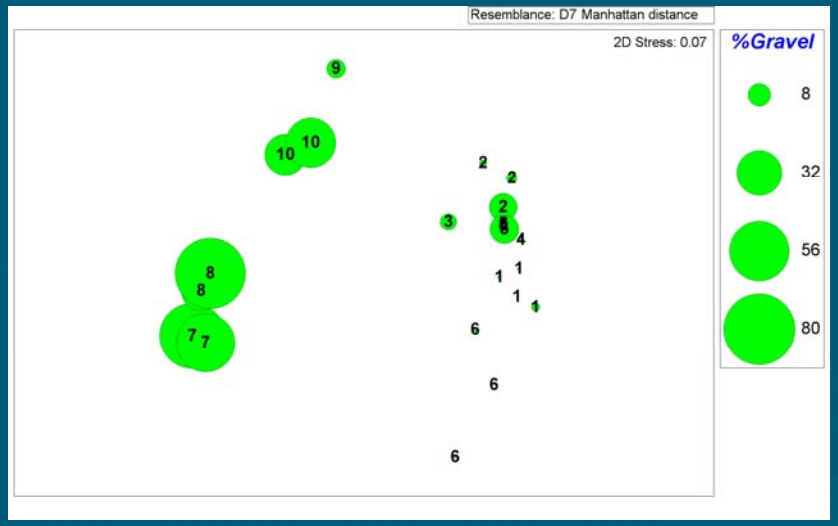


Infaunal species abundance data with PSA groups shown as symbols

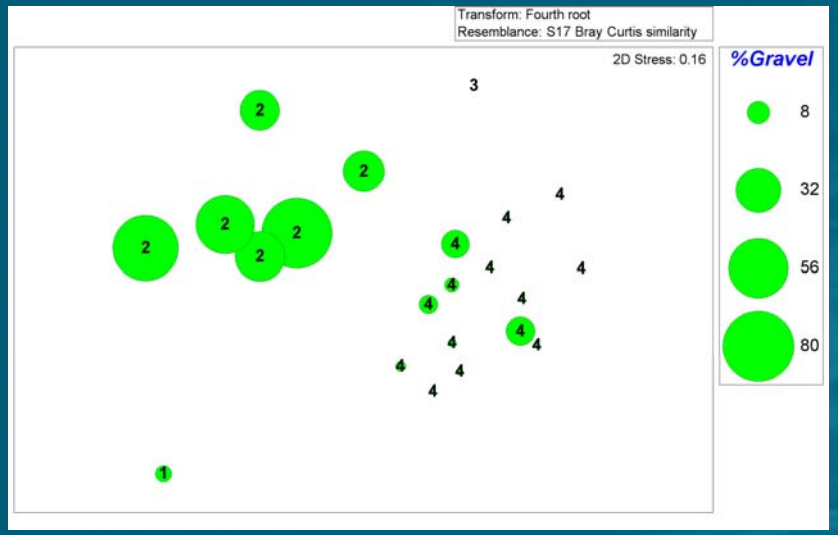


Multibeam backscatter data with infaunal groups shown as symbols

Cefas



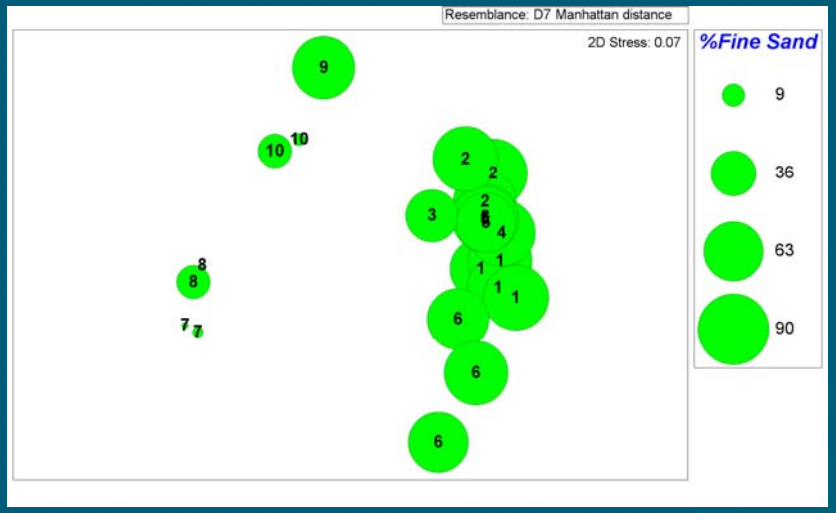
MDS of Multibeam Backscatter data with % gravel superimposed as bubble



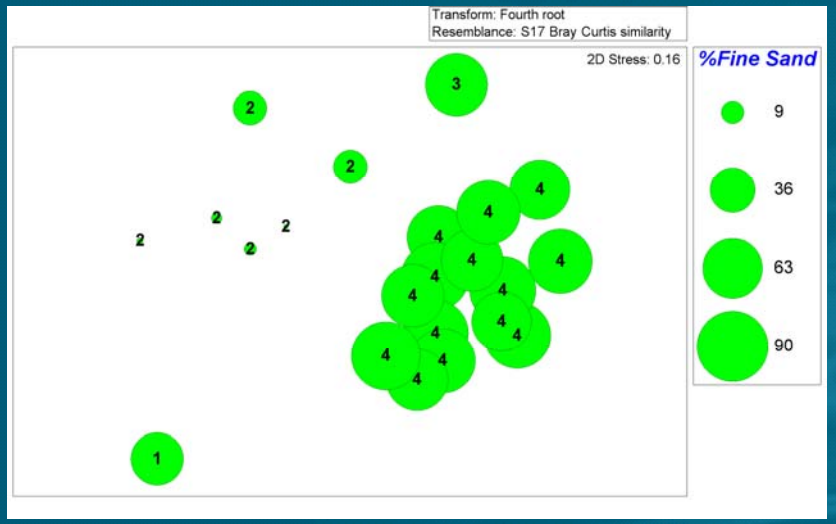
MDS of infaunal species data with % gravel superimposed as bubble

- Multibeam backscatter groups 7, 8 and 10 and infaunal group 2 are comprised of stations characterised by coarser sediments.

Cefas



MDS of Multibeam Backscatter data with % fine sand superimposed as bubble



MDS of infaunal species data with % fine sand superimposed as bubble

- The remaining multibeam backscatter groups and infaunal groups are comprised of stations characterised by fine sand.

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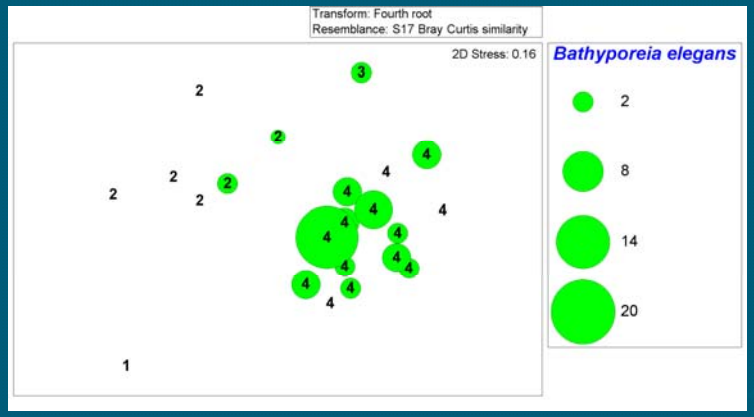
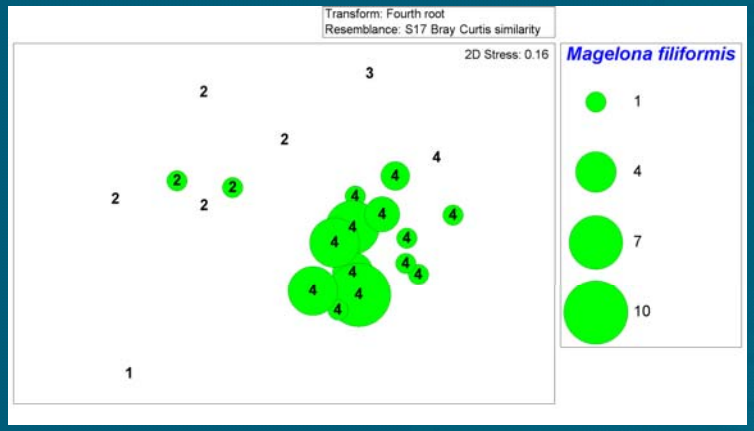
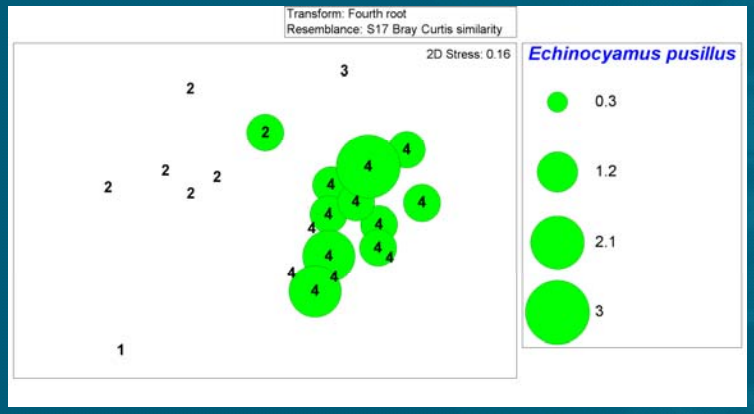
Image taken at station G25: representative of coarse sediment groupings and high multibeam backscatter.

Image taken at station G39: representative of fine sediment groupings and low multibeam backscatter.

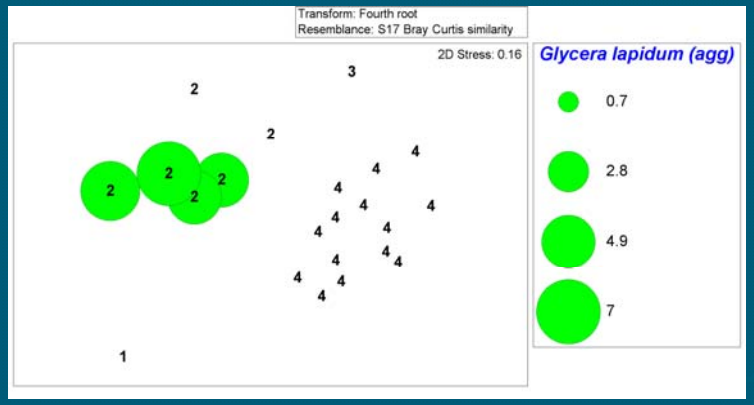
Cefas

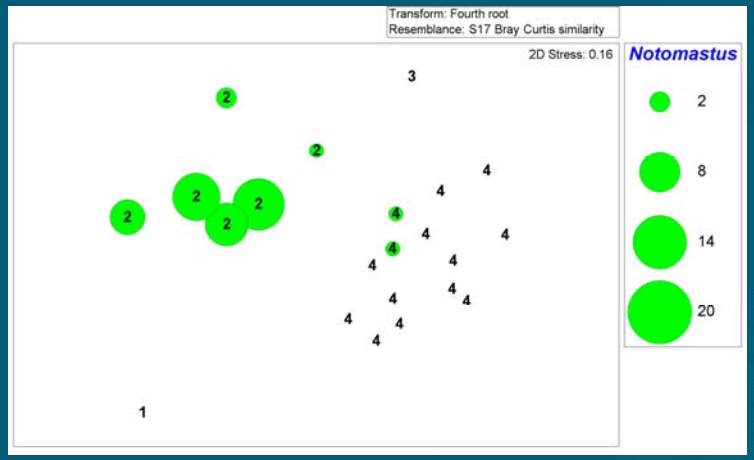

Transform: Fourth root
Resemblance: S17 Bray Curtis similarity
2D Stress: 0.16
Bathyporeia elegans
2
8
14
20

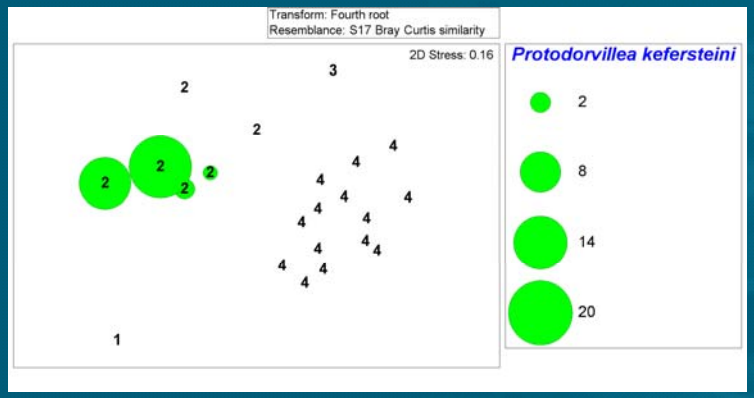

Transform: Fourth root
Resemblance: S17 Bray Curtis similarity
2D Stress: 0.16
Magelona filiformis
1
4
7
10


Transform: Fourth root
Resemblance: S17 Bray Curtis similarity
2D Stress: 0.16
Echinocyamus pusillus
0.3
1.2
2.1
3

Cefas


Transform: Fourth root
Resemblance: S17 Bray Curtis similarity
2D Stress: 0.16
Glycera lapidum (agg)
0.7
2.8
4.9
7


Transform: Fourth root
Resemblance: S17 Bray Curtis similarity
2D Stress: 0.16
Notomastus
2
8
14
20


Transform: Fourth root
Resemblance: S17 Bray Curtis similarity
2D Stress: 0.16
Protodorvillea kefersteini
2
8
14
20

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- Significant relationships in multivariate patterns were present between the three data sets.

- Interpretation of the faunal data was least complex:

Samples largely fell into either a group characterised by typically sand associated fauna or a group characterised by fauna typically associated with coarser sediments.

- Interpretation of the sediment particle size data was slightly more complex:

A single cluster was characterised by coarse sediment fractions.

Whilst the remaining 4 clusters were broadly characterised by fine to medium sands they could be delineated by varying proportions of mud and gravel.

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Interpretation of the multibeam backscatter data was perhaps most complex:

Three of the clusters (characterised by high backscatter) correlated well with the PSA cluster characterised by coarse sediments.

The remaining four clusters incorporated the stations that were characterised by fine to medium sand. However the clusters could be delineated by subtle differences in backscatter response and this may be explained by a number of potential factors (i.e. seafloor roughness, physical properties of the surface sediments etc.).

However, the significant correlation in multivariate pattern between the multibeam backscatter and particle size data suggests that subtle variability in sediment grain size may be the major contributor to the differences in backscatter intensity observed between the clusters.

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Acknowledgements

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