East Anglia
Offshore Wind

VATTENFALL

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East Anglia THREE

Appendix 10.6

Multivariate Analysis of Combined Data

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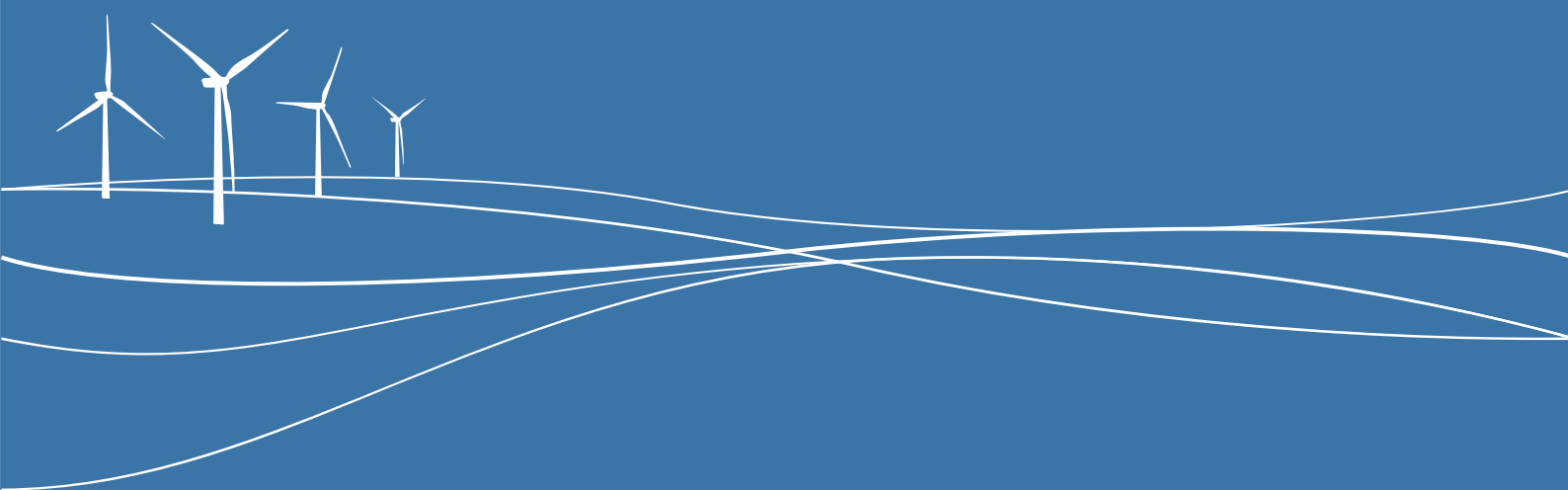

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10.6 MULTIVARIATE STATISTICAL ANALYSIS OF COMBINED DATA

10.6.1 Introduction

1. This appendix contains information regarding the multivariate statistical analysis that was conducted in order to characterise the faunal groups which exist across the East Anglia Zone.

10.6.2 Data Acquisition

2. As outlined in Chapter 10 Benthic Ecology data from three separate survey campaigns commissioned by East Anglia Offshore Wind (EAOW) have been used to inform the Benthic Ecology baseline. These include: ZEA surveys, East Anglia ONE cable route surveys and East Anglia THREE and East Anglia FOUR surveys. Data has been collected using three different methodologies:

- Grab samples to characterise the infauna (animals living within the sediment);
- Beam trawls to characterise the epifauna (animals living attached to the sea bed); and
- Video footage to identify the presence and extent of biogenic reefs (Reef structures created by organisms).

3. *Table 10.6.1* shows the number of samples that have been acquired from the three different campaigns across the East Anglia THREE site and the offshore cable corridor. Further detail regarding the different surveys is provided in Chapter 10 Benthic Ecology and the survey methodologies in *Appendix 10.2* and *Appendix 10.3* within Volume 3 of this Environmental Statement and in *Appendix 9.2* of the East Anglia ONE Environmental statement.

Table 10.6.1. Sample stations included within the multivariate analyses

Study Area	Grab samples (Infauna)	Trawl samples (Epifauna)
ZEA Surveys	566	78
East Anglia ONE Cable Route Survey	41	None acquired
East Anglia THREE FOUR surveys	49	12
Total	**656**	**90**

10.6.3 Analysis

4. Multivariate statistical analysis was conducted on the infaunal data (from the grab surveys) and the Epifaunal data (from the trawl surveys) separately. The analyses were conducted using the Plymouth Marine Laboratories PRIMER v6 (Plymouth Routines in Multivariate Ecological Research) suite of programs (Clarke and Warwick, 2001; Clarke and Gorley, 2006).

5. Faunal data for multivariate analysis were imported into PRIMER and initially subjected to fourth root transformation to reduce the influence of any highly abundant taxa allowing less abundant species a greater role in driving the emergent multivariate patterns. The transformed data were then subjected to hierarchical clustering to identify sample groupings based on the Bray Curtis index of similarity. This process combines samples into groups starting with the highest mutual similarities and then gradually lowers the similarity level at which groups are formed. The process ends with a single cluster containing all stations and is best expressed as a dendrogram showing the sequential clustering of stations against relative similarity. To best describe the ecological differences between sites, the groups were identified on the basis of a slice at 20% similarity for the Infaunal communities and a slice at 48% similarity for the Epifaunal communities.

6. The MDS (Multi-dimensional Scaling) procedure uses the same similarity matrix as that used by the cluster analysis to produce an ordination of stations which is multidimensional. This is carried out to satisfy the between samples relationships indicated by the similarity matrix. This multi-dimensional ordination is then reduced to a 2 or 3 dimensional representation that is a more accessible and useable representation. The representativeness of these low dimensional versions, in comparison to the multi-dimensional array, is indicated by a stress level. The closer this stress level is to zero, the better the representation.

10.6.4 Results

10.6.4.1 Infaunal communities

7. Some data rationalisation was undertaken before performing multivariate analysis on the full grab sample dataset. Only the enumerated components of the species recorded in the grabs was included. Were a presence or number of species per volume had been recorded a value of 1 was used in the data.

8. 16 distinct infaunal communities were identified at a 20% similarity slice. At this level communities at six stations did not fit within any of the groups nor did any of these six group fit with one another. Therefore, these stations were termed outliers.

9. The resultant dendrogram was very large and therefore it is not possible to display within this report, the MDS plots are displayed below. The stress revealed by 2–dimensional representation (Diagram 10.6.1) is given as 0.24 (top right corner of the MDS plot). This indicates that although still potentially a useful representation of the multi-dimensional space the image is stretched and could be misinterpreted. For this reason, Diagram 10.6.2 presents a 3-dimesional representation of the same MDS plot, which shows at lower stress level (0.19). 0.19 is still considered to be a relatively high stress level and is a consequence of the high number of samples within the data. Therefore the Diagrams 10.6.1 and 10.6.2 should be interpreted with caution as many of the relationship between infaunal communities will not be apparent.

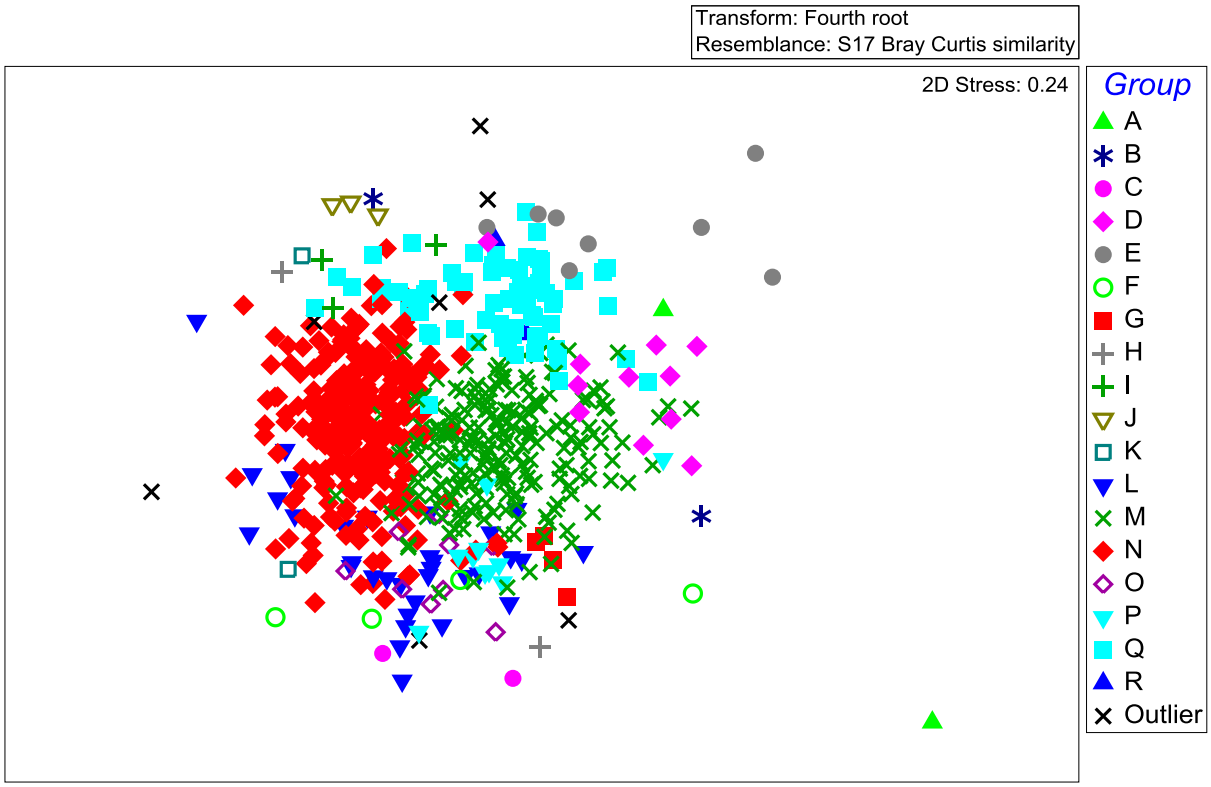

Diagram 10.6.1. MDS 2D Dimensional Plot Showing Groupings Based on 20% Similarity Slice of Faunal Data.

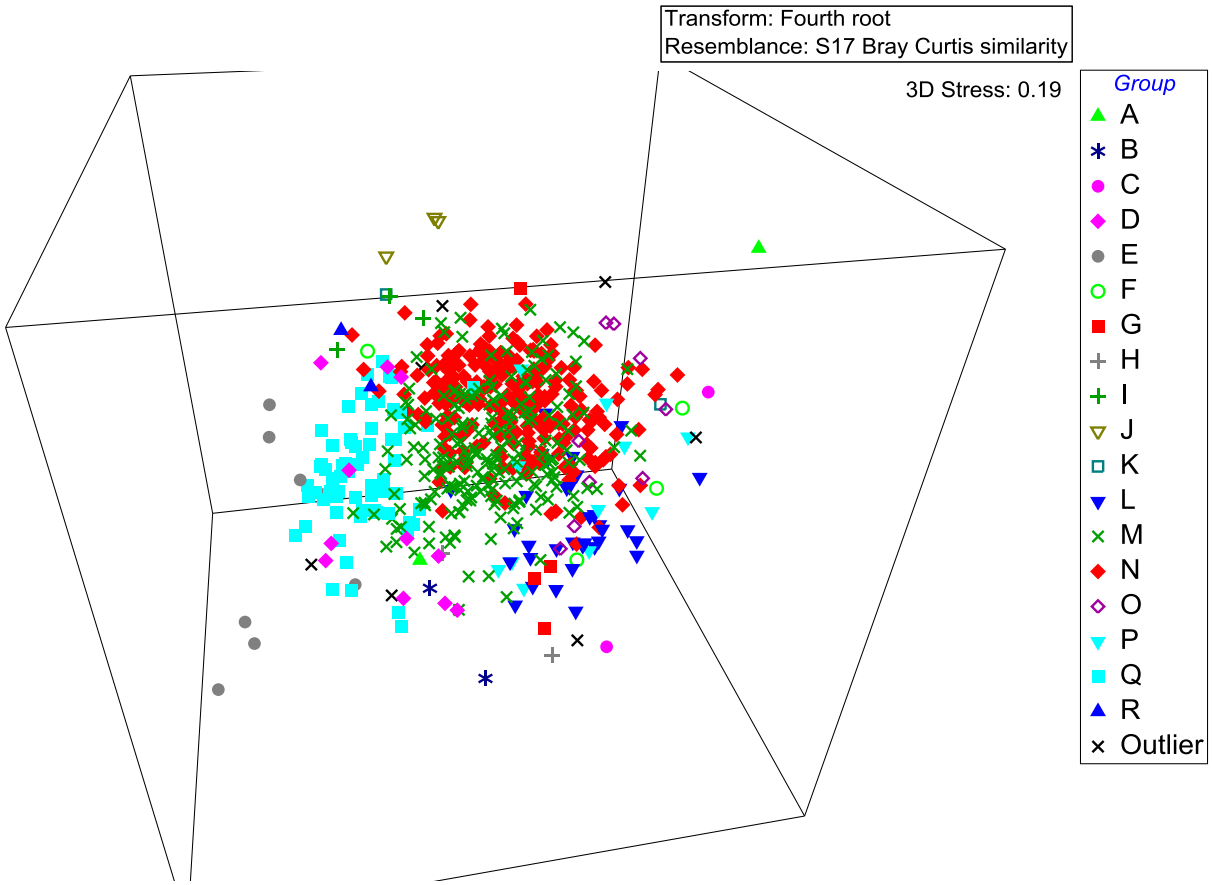

Diagram 10.6.2. MDS 3D Dimensional Plot Showing Groupings Based on 20% Similarity Slice of Faunal Data.

10.6.4.2 Epifaunal communities

10. Trawl data analysis was carried using the numerated taxa with their full abundance and the presence of the non-numerable colonial species accounted for by giving them an abundance of one. The Cluster analysis and the correspondent 2D multi-dimensional plot are presented in *Figure 10.5.3* and *Figure 10.5.4*. Six distinct epifaunal communities were identified at a 48% similarity slice.

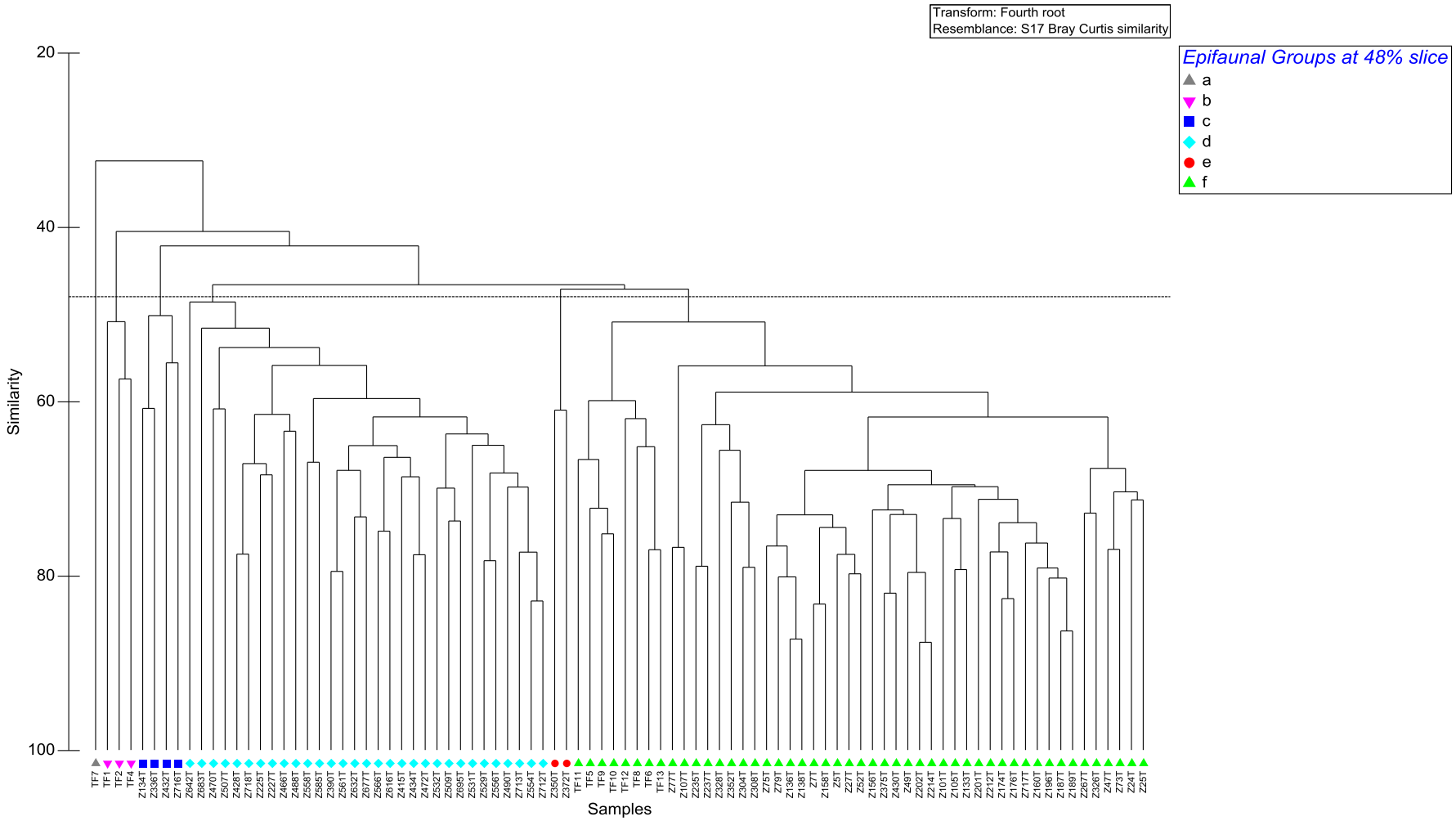

Figure 10.6.3 Dendrogram Showing Groupings Based on 48% Similarity Slice of Faunal Data. Labels distinguish the different survey campaingns (TF = THREE / FOUR survey, Z= Zone survey)

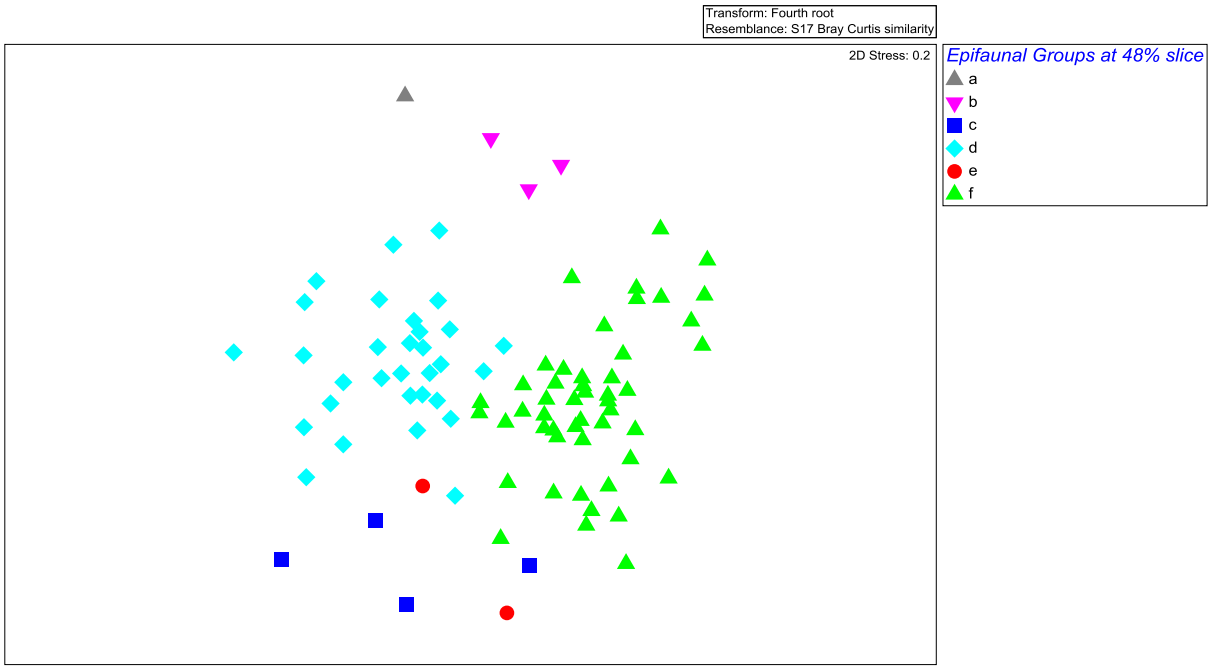

Figure 10.6.4 Dendrogram and MDS 2D Dimensional Plot Showing Groupings Based on 21% Similarity Slice of Faunal Data. Labels Show the Correspondent Folk (1954) Sediment Classification.

11. Group a, formed by sample 7 of the East Anglia THREE / FOUR survey was less diverse than the other sites, accounting for only 19 taxa. This site was dissimilar enough to any other sample to mean that it forms a group on its own.

10.6.5 References

Clarke, K. R. and Warwick R. M. (2001) Change in marine communities: an approach to statistical analysis and interpretation 2nd edition, Plymouth: PRIMER-E.

Clarke, K. R. and Gorley, R. N. (2006) Primer v6: user manual/tutorial Plymouth: PRIMER-E.

Appendix 10.6 Ends Here