EA - WATER QUALITY Box 12

ENVIRONMENT AGENCY

A Report on a Baseline Survey of the Subtidal Benthic Communities within Portland Harbour (January 1997)

A Report On A Baseline Survey Of The Subtidal Benthic Communities Within Portland Harbour (January 1997).

Nicole Price
South West Marine Ecological Appraisal Team
September 2003

		PAGE
1.	**CONTENTS**	2
2.	**ABSTRACT**	3
3.	**INTRODUCTION**	5
	3.1 Aims	5
	3.2 The Physical and Ecological Characteristics of Portland Harbour	5
	3.3 Development of the former Military of Defence Naval Base	5
	3.4 Discharges into Portland Harbour	6
	3.5 Survey Design	6
4.	**METHODS**	7
	4.1 Survey Design	7
	4.2 Subtidal Survey	7
	4.3 Analytical Methods	7
	4.3.1 Invertebrate Samples	7
	4.3.2 Chemical Analyses	7
5.	**RESULTS**	8
	5.1 Invertebrate Analysis	8
	5.1.1 Univariate Statistics	8
	5.1.2 Multivariate Statistics	9
	5.1.2.1 MDS Ordinations	9
	5.1.2.2 ANOSIM	9
	5.1.2.3 SIMPER	10
	5.2 Environmental Analysis	11
	5.2.1 Natural Environmental Variables	11
	5.2.2 Chemical Variables	11
6.	**DISCUSSION**	13
7.	**CONCLUSIONS AND RECOMMENDATIONS**	14
8.	**REFERENCES**	15
9.	**APPENDICES**	16

1. Position Of Sample Sites
2. Laboratory Analysis
3. Portland Harbour Averaged Data
4. Univariate Statistics Using the Averaged Data
5. Contribution Of Species To The Within Group Similarity A,B,C And D
6. Contribution (%) Of Species Accounting For The Dissimilarities Between Groups
7. Portland Harbour Field Notes
8. Sediment Chemistry Data
9. Canadian Sediment Quality Guidelines

ABSTRACT

The aim of this study was to carry out a baseline survey of the subtidal benthic invertebrates to determine the community structure within Portland Harbour prior, to a change in use of the former Royal Military of Defence Naval Base.

In 1996, PPL (Portland Port Limited) submitted a planning application to change the existing use of the naval base into a commercial port and commercial and leisure estate. In 2000, however, the South West of England Regional Development Agency acquired the site and leased part of it to the WPSA (Weymouth and Portland Sailing Academy). In 2002, WPSA submitted a planning application to continue redeveloping the former naval base into a "world class" sailing facility. The application included slipway improvements, erection of floating pontoons and frontage reclamation.

Anthropogenic inputs into the harbour have included a number of minor consented drainage and discharges from the former naval base i.e. emergency sewage discharges, trade effluent, treated domestic sewage effluent and drainage from the Mere tank farm.

During January 1997 a total of 25 subtidal sites within Portland Harbour were sampled for either benthic macroinvertebrates and / or sediment chemistry.

Univariate and multivariate techniques were used to reveal patterns in the faunal distribution, and help to explain if any of the environmental parameters were influencing the faunal assemblages.

This study showed that the harbour contained a large number of taxa (i.e. 255) and individuals (i.e. 2816), especially around the western edge of the harbour in the shallower water. Diversity followed a similar trend. Data analysis revealed that the Terebellid, *Melinna palmata* was the most abundant species and present at all sites. The second most abundant species was *Chaetozone gibber*, a cirratulid, which is common subtidally in silty and sandy sediments. Similar to other marine studies carried out in Portland harbour, the rare (i.e. in the UK) Mediterranean polychaete, *Sternaspis scutata* was also recorded.

BIO-ENV, showed depth to be the primary variable responsible for the faunal patterns observed, followed by particle size (i.e. silt and sand).

Analysis of the heavy metals, organic and hydrocarbon data showed elevated levels at some sites located close the former naval base. Further investigation, using the Canadian Sediment Quality Guidelines revealed that for some heavy metals (i.e. arsenic, copper, lead, mercury and zinc) elevated concentrations could result in occasional adverse biological effects (Appendix 9). ANOSIM, however, showed no significant difference between the community structure at suspected 'polluted' sites near to the naval station and potentially 'cleaner' sites further away. Some of the sites adjacent to the naval base, however, were sampled for chemistry only. It is therefore not possible to determine conclusively whether there had been any detrimental impact on the fauna.

To conclude, this study demonstrated that:

1. The natural environmental variables of depth and particle size were mainly responsible for the observed community patterns.

2. It was not possible to demonstrate whether the elevated concentrations of contaminants were having a detrimental effect on the macrofauna at some of the sampled sites.

3. The data forms a baseline for future comparison following any redevelopment of the naval base or to determine the extent of any pollution issues, which may occur with the change of use

4. It is suggested that a full or partial repeat of this survey is carried out following redevelopment of the former naval base.

3. INTRODUCTION

3.1 Aims

The aim of this study was to carry out a baseline survey of the subtidal benthic invertebrates, to determine the community structure and sediment chemistry composition within Portland Harbour prior to a change in use of the former Portland Military of Defence Naval Base.

3.2 The Physical and Ecological Characteristics of Portland Harbour

Portland Harbour is located in the county of Dorset, in the Southwest of England (Figure 1.1). It is a man-made harbour created by a large breakwater, forming an extensive artificial tidal basin. It is sheltered, fully marine and shallow, resulting in elevated water temperatures (Howard *et al* 1988). The sedimentology varies from coarse sand with pebbles; through to platforms of pitted limestone and broken sandstone pavement, to expanses of hard and soft muddy sand. Consequently, there are a variety of available habitats for some very interesting and rare species to thrive, these include:

- Fragile Sea Pen, *Vigularia mirabilis*
- Mediterranean polychaete *Sternaspis scutata*
- Warm water fish species e.g. black faced blenny *Tripterygion atlanticus* and the red band fish *Cepola rubescens*
- Eel grass beds i.e. *Zostera marina* along the Northwest shore
- Lugworm, *Arenicola marina* in the intertidal sediments
- Burrowing anemone, *Cereus pedunculatus*
- A large unusual molluscan assemblage e.g. a colony of the rare white ruffed sea slug *Aeolidiella alderii* on the sandflats at Smallmouth, Sandsfoot and in front of Osprey Quay
- Rare lagoon sandworm, *Armandia cirrhosa*
- Lagoon sand shrimp *Gammarus insensibilis* in front of Osprey Quay

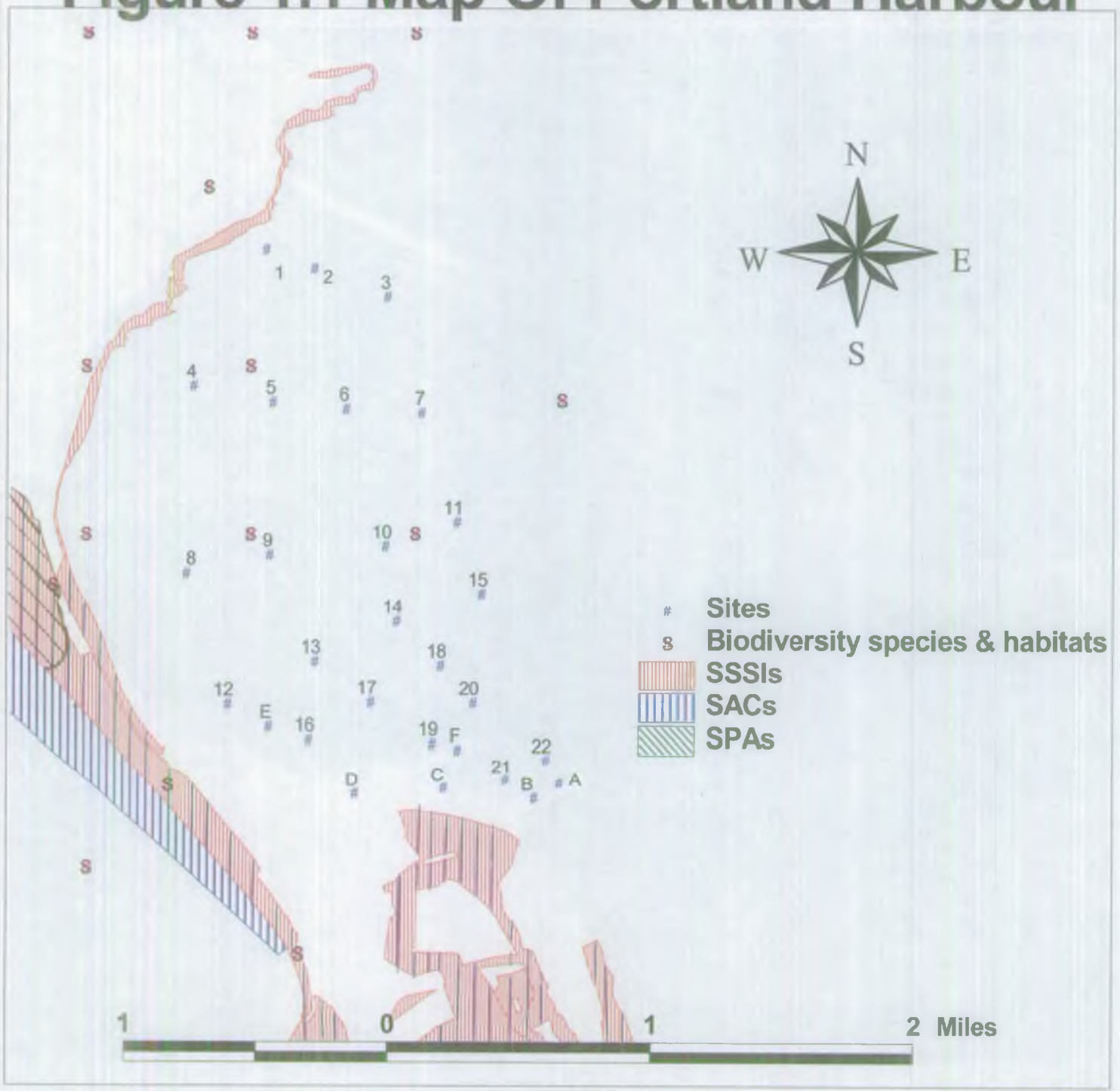
A number of statutory and non-statutory designations exist for the harbour, some of these include:

- Part of the Chesil and Fleet Lagoon candidate Special Area of Conservation (cSAC)
- Site of Special Scientific Interest (SSSI)
- Sensitive Marine Area (SMA)
- Voluntary Marine Conservation Area (vMCA)- which includes the waters of Portland Harbour and the Fleet Lagoon.

3.3 Development of the former Military of Defence Naval Base

In 1996, a planning application was submitted by Portland Port Limited (PPL) to change the existing use of the naval base into a commercial port and commercial and leisure estate. This development extended to 16.5 hectares.

Figure 1.1 Map Of Portland Harbour



The application included:

- General industrial use
- Erection of a molasses handling terminal within the commercial port
- To import liquid cargoes (i.e. petroleum products) and dry bulk (fertilisers, animal feeds and grain) with a lift-on lift-off (LoLo) and roll-on roll-off (RoRo) freight
- Terminal for RoRo freight and passenger ferries
- Centre for marine service vessels and cruise ships
- Business park offering office, light industrial and warehouse accommodation
- Marina with associated leisure facilities

In 2000, however, the South West of England Regional Development Agency acquired the site and leased part of it to the WPSA. In 2002, WPSA submitted a planning application to continue redeveloping the former naval base (N.B. now referred to as Osprey Quay) into a world class sailing facility.

The application included both offshore (marine) and onshore works, for example:

- New marine facilities including slipway improvements, floating pontoons, a pier with a crane lift, and land reclamation
- New sailing academy building and associated refurbishment
- Demolition of the existing sailing academy building, construction of a new road and adjustment of ground levels on the site

3.4 Discharges into Portland Harbour

Water quality is important not only to maintain a high ecological diversity within Portland Harbour, but also for the adjoining waters of the Fleet lagoon, which is a cSAC and one of the largest lagoons in the UK.

Over the years, however, there have been a number of minor consents (i.e. drainage and discharges) from the former naval base and currently from the WPSA Osprey Quay development, these include:

- Emergency sewage discharges
- Trade effluent
- Treated domestic sewage effluent
- Drainage from the Mere tank farm

3.5. Survey Design

In January 1997 a total of 25 subtidal sites were sampled for either benthic invertebrates and / or sediment chemistry (Figure 1.1). The infaunal samples were sieved through a 0.5mm and 1.0mm mesh sieve. The 1.0mm fraction was identified to species level wherever possible. The 0.5mm fraction was not analysed. Separate sediment samples were taken for particle size, heavy metals, hydrocarbons and organochlorine pesticides.

4.METHODS

4.1 Survey Design

A total of 25 subtidal sites were selected to establish the benthic community structure and sediment chemistry composition prior to a change in use of the former naval base. The sites were selected in order to give a good spatial coverage of the harbour. Additional "chemistry only" sites were selected adjacent to the MOD Naval Base to increase the detection of potential contaminants (Figure 1.1). Sampling was carried out at depths ranging from 3m to 14m.

4.2. The Subtidal Survey (3 days)

Sampling was carried out aboard the Environment Agency's coastal survey vessel 'Vigilance'. During the survey a GPS was used to record the specific sampling site coordinates (Appendix 1).

Biological samples were taken at 18 sites. At each site, 4 replicates were taken using a $0.1m^2$ Day Grab. These samples were then elutriated and sieved through 0.5mm and 1.0mm mesh sieves. Material retained on the mesh sieves was then placed into labelled pots and preserved in a 4% formaldehyde and water solution.

Sediment chemistry was taken at 25 sites (Appendix 8) and the analysis included:

- Particle size
- Heavy metals (i.e. aluminium, arsenic, iron, lead, mercury, nickel, cadmium, copper, chromium and zinc)
- Hydrocarbons (i.e. total oil and as forties crude oil)
- Organochlorine pesticides (i.e. HCH Gamma, Tri Fluralin, 1,3,5 Trichlorobenzene, DDT and PcP).

A metal scoop was used to obtain sediment from a depth of 5cm and 1cm, for particle size and organics, respectively. For metals a plastic scoop was used to take sediment from a depth of approx. 1cm or above if the anoxic layer is present.

4.3 Analytical Methods

4.3.1 Invertebrate Samples

All samples were re-sieved through 1.0mm and 0.5mm mesh sieves and rinsed with water to try and remove traces of formaldehyde. Only organisms retained on the 1.0mm mesh sieve were identified wherever possible down to species level, using binocular and compound microscopes. Due to a lack of funds the 0.5mm fraction was not analysed.

4.3.2 Chemical Analyses

Particle size, organochlorine pesticides, hydrocarbons and metals analysis was carried out at the Environment Agency's Llanelli laboratory, which is N.A.M.A.S accredited. For all methods refer to Appendix 2.

5. RESULTS

5.1 Invertebrate Analysis

All 18 invertebrate sites were successfully sampled. Overall, a total of 255 taxa were selected for analysis. The species list based on the averaged data is presented in Appendix 3. The AQC results for taxonomic analysis revealed a Bray Curtis Similarity Index (4 root) ranging from 80%-92%.

5.1.1 Univariate Statistics

A high number of species (i.e. 255) and individuals (i.e. 2816) were recorded. The most abundant species was *Melinna palmata,* which contributed 24% of the total fauna and was present at all sites. The second most abundant species was *Chaetozone gibber,* which made up a further 10%. In terms of the % class contributions the polychaetes comprised 80 %, molluscs 10% and the crustaceans 5% of the total fauna (Table 5.1).

TABLE 5.1 SHOWS THE % CLASS CONTRIBUTION TO THE TOTAL FAUNA

CLASS	% CLASS CONTRBUTION
Cnidaria	1.78
Nemertea	1.05
Sipuncula	0.09
Polychaetes	80.44
Chelicerata	0.01
Crustacea (lower)	0.17
Crustacea (higher)	4.39
Mollusca	9.51
Phoronida	1.66
Echinodermata	0.9

Referring to the averaged univariate data (Appendix 4), a greater number of taxa and individuals were found at sites located around the western edge of the harbour at shallower depths (i.e. sites 1,4,8,12 and 16). Diversity followed a similar pattern, but with site 21 (located further offshore) also recording a fairly high value. Closer investigation revealed that species richness varied from 14 taxa at site 9 to a maximum of 146 taxa at site 1. The number of individuals ranged from 79 at site 9 to 1133 at site 4. The lowest diversity (using log 2) was recorded at site 19 (H'= 2.06) and the highest at site 4 (H'= 4.84).

5. 1.2 Multivariate Analysis

The aim of analysing ecological data is to find "patterns" which explain the distribution of different organisms within a survey area. For small data sets searching for patterns can be effectively done by eye, but multivariate packages enable the information to be more readily organised and summarised into a form which can be more easily interpreted.

PRIMER

Several different analyses were performed on the data sets using this package:

a) Multidimensional Scaling Ordinations (M.D.S)
b) Analysis of Similarity (ANOSIM)
c) Similarity Percentage Analysis (SIMPER)

5.1.2.1 Multidimensional Scaling Ordinations

A total of three MDS plots were produced (Figures 5.1-5.3).

MDS analysis carried out using the full individual replicate data resulted in a stress value of 0.09 (i.e. it is a good ordination with no prospect of being misleading). Analysis produced an ordination with three groups (Figure 5.1). Group A contained most of the sites from within the harbour with no obvious pattern. Groups B and C, contained fewer sites (i.e. 1,4,8,12,and 16) all of which were located on the western edge of the harbour at shallower depths.

No further grouping was evident within group A, following the removal of groups B and C, plus site 8 (Figure 5.2).

MDS analysis carried out on the averaged data, resulted in an ordination with a lower stress value of 0.05 (i.e. an excellent representation with no prospect of misinterpretation). Four groups were present (Figure 5.3). Sites within groups A, B and C were similar to those described previously, the only difference was for sites 6,9 and 13 (formerly in group A) were now present in the new group D.

Further MDS analysis of group A alone, did not yield any additional information.

5.1.2.2 ANOSIM

ANOSIM was used to test for a significant difference between i) individual sites ii) sites within groups and iii) suspected 'polluted ' and 'cleaner' sites.

As might be expected from the MDS ordinations, ANOSIM testing using the averaged data, showed a significant difference between sites (i.e. Global R= 0.919 and p=0.1%). The pairwise tests, however, only showed a significant difference between Group A and the other groups, but not between groups B,C and D (Table 5.2).

TABLE 5.2 SHOWS THE RESULTS OF ANOSIM TESTING FOR DIFFERENCES BETWEEN GROUPS.

Global R=0.919		
Significance Level, p=0.1%		
Pairwise Tests	**R Significance**	
Groups	**Statistic**	**Significance Level**
*B,A	1	1.5
B,D	2	10
B,C	0.75	10
*A,D	0.778	0.3
*A,C	0.985	0.3
D,C	1	10

(N.B. * Significant difference)

ANOSIM was further used to test for a significant difference between communities present at suspected 'polluted' sites on the southern shore (i.e.19, 20, 21 and 22) and possibly other 'cleaner' sites (i.e. 5, 10, 11, 14, 17 and 18) within group A (Refer to Section 3.4). The results showed that there was no significant difference between sites present in the two conditions (i.e. Global R=0.139 and p=17.6%).

5.1.3 SIMPER

SIMPER was used to ascertain which species were responsible for the groupings observed on the MDS ordination (Figures 5.3) and any differences shown using ANOSIM (Table 5.2).

SIMPER analysis (Appendix 5) demonstrated that groups D, A and C had fairly close average similarities ranging from 56-69%. Group B recorded the lowest average similarity of 37.66% and contained the greatest number of species to reach the 50% cut off point. Interestingly groups A and D contained the same two top species, namely *Melinna palmata* and *Sternapsis scutata*. The average similarities were almost the same for both groups, although group A had a higher average abundance of *M.palmata* and group B for *S. scutata.* Referring to Figures 5.22 and 5.23 it is apparent, however, as mentioned previously that *M.palmata* is present in all groups and *S.scutata* is also present in group C.

Further exploratory analysis of the dissimilarity between groups (Appendix 6) revealed groups A and D to have the lowest average dissimilarity (i.e. 50.22), followed closely by groups B and C (i.e. 63.33). Closer examination of group B revealed that the separation of this group could mainly be attributed to a high average abundance of *Euclymene oerstedii* (Figure 5.24) and *Monticellina dorsobranchialis* (Figure 5.25). Group C's species composition revealed a greater average number of *Tubificoides benedii* (Figure 5.26) and *Aphelochaeta marioni* (Figure 5.27). Both B and C also contained a higher average abundance of *Chaetozone gibber*.

5.2 Environmental Analysis

The raw environmental data is presented in Appendix 8. In order to investigate some of the biotic patterns, the data was examined using the following techniques:

- Observing the raw environmental data
- Comparing the chemical data with any available sediment quality guidelines
- Using various multivariate tools to link the averaged biotic data with the environmental data to find the variable (s) which best explains the biotic patterns i.e. MDS Overlays and BIO-ENV.

(NB It was not possible to carry out the multivariate analysis on all of the environmental variables (i.e. those with many missing values) as both the environmental and benthic data had to be available for each site. Consequently, the MDS overlays for the hydrocarbon data could only be carried out on 9 sites. For the BIO-ENV procedure, neither the 1,3,5 Trichlorobenzene or hydrocarbon data was included due to the low number of matching benthic and chemical data available).

5.2.1 Natural Environmental Variables

The BIO-ENV procedure demonstrated that the most important environmental variable to influence the biological grouping was firstly depth (i.e. with a correlation value of 0.690), followed by silt (i.e. 0.545) and then sand (i.e. 0.507). Combining depth and silt gave the highest correlation value of 0.789.

Further supporting evidence was obtained from the MDS overlay for depth (Figure 5.6). This clearly showed that depth was an important variable in separating groups B and C located on the western edge of the harbour in the shallower water, from A and D.

The sand and silt ordinations (Figures 5.4 and 5.5, respectively), also suggest that the separation of group B could be attributed to substrate type. Examination of the raw environmental data showed that sites within group B contained lower levels of silt (i.e. 21-37%) and higher levels of sand (i.e. 63-78%). Conversely, the remaining groups A,C and D recorded higher levels of silt (i.e. ranging from 60-87%) and lower levels of sand (i.e. ranging from 13-40%).

5.2.2 Chemical Variables

Although, the BIO-ENV procedure suggested that the chemical data was not strongly influencing the biological groupings, there were still some very interesting findings:

Overlays of the heavy metals (Figures 5.7-5.16), showed mercury to be the only metal to record slightly elevated concentrations at sites within group A (Figure 5.7). Further examination of the raw data revealed higher concentrations of mercury at sites, 21, B and C, plus site D for lead and zinc. Elevated levels of chromium and aluminium were also recorded at sites D and E, respectively. Interestingly, all of these sites were located immediately adjacent to the naval base.

Comparing the metal data with the Canadian Sediment Quality Standards (Appendix 9) showed all samples to be below the PEL (Probable Effect Levels) whereby adverse effects frequently occur. Some samples (i.e. arsenic, copper, lead, mercury, zinc and nickel) contained metal concentrations which were higher than the ISQC (Interim Marine Sediment Quality Guidelines) whereby adverse effects occasionally occur.

No obvious trends were evident for the organic data (Figures 5.17-5.20). Examination, however, of the raw environmental data showed elevated levels of 1,3,5 Trichlorobenzene at sites 12, E and D close to the naval air station. Higher levels of PcP were recorded at site C.

Using the hydrocarbon overlay, it was tentatively suggested that group A and D contained higher concentrations than groups B and C (Figure 5.21). It was, however, very difficult to demonstrate this conclusively due to the limited data set. Further examination of the raw data showed elevated levels at sites 17, B, C and D, again located near to the naval base.

6. DISCUSSION

Overall, a large number of species and individuals were found to be present in Portland Harbour. The greatest number of taxa and individuals were found in sediments taken from the western edge of the harbour at shallower depths. Diversity also followed a similar pattern.

The most abundant species was the Terebellid, *Melinna palmata,* which was present at all sites. Other studies have found this species to be present under 'unpolluted' conditions in a range of substrates i.e. mud, muddy sand among *zostera* and on clay (Holthe, 1986). It actively uses its specialised appendages to feed on food particles. The appendage capture actively entrains and moves waterborne particles to the site of ingestion (SNIFFER, 1992). The second most abundant species was the cirratulid, *Chaetozone gibber*. This species is regularly recorded from the south coast of England, at subtidal depths of 3.5- 45m, and in silty and sandy sediments (Woodham & Chambers, 1994). This species feeds on organic/mineral aggregates, floc aggregates or detritus after they have settled at the water sediment interface (SNIFFER, 1992). Similarly to other studies carried out in Portland Harbour, the rare Mediterranean polychaete *Sternapsis scutata* was also recorded. The genus Sternaspidae are active burrowers and sub-surface deposit feeders which are present at different depths in a range of substrates i.e. sand, mud and clays (Rouse and Pleijel, 2001 Fauchald, 1977).

The MDS ordination (Figure 5.3) showed four groups to be present (i.e. A,B,C and D). Group A contained the majority of sites ranging from those sites located near to the naval base to those in the middle of the harbour. Group D contained three sites from the middle of the harbour. Groups B and C contained sites on the western edge of the harbour in the shallower waters.

The BIO-ENV procedure showed depth, followed by particle size to be the most important variables to influence the biological groupings (Section 5.2.1).

Examination of the raw chemical data revealed higher concentrations of mercury, lead, zinc, chromium and aluminium at sites near to the naval base. A similar trend was seen for some of the hydrocarbon and organochlorine pesticide (i.e. 1,3,5 Trichlorobenzene and PcP) data.

In this study, however, ANOSIM could not show that these elevated concentrations were having a detrimental effect on the benthic community i.e. no significant difference was found between sites located close to the naval base (i.e. potentially contaminated) and those further away (i.e. potentially 'cleaner') (Section 5.1.2.2). Although it must be remembered that for some of the chemical sites, no biological data was taken and therefore it is difficult to state this with true certainty.

Indeed, comparing heavy metal concentrations recorded in this study with Canadian Sediment Quality Guidelines suggests that for some metal concentrations (i.e. arsenic, copper, lead, mercury, zinc and nickel), above the ISQC, occasional adverse biological effects can occur (Appendix 9).

7. CONCLUSIONS AND RECOMMENDATIONS

- Portland Harbour contains a very diverse benthic community
- A higher diversity (i.e. greater number of taxa and individuals) was recorded at sites located on the western edge of the harbour in the shallower water.
- The natural environmental variables of depth, followed by particle size (i.e. silt and sand) were mainly responsible for the community patterns observed.
- Elevated contaminant levels were recorded at some sites, especially those located near to the naval base. Furthermore, Canadian quality guidelines suggest that for some heavy metals (i.e. arsenic, copper, lead, mercury, zinc and nickel) elevated levels are likely to result in occasional adverse biological effects.
- ANOSIM, however, showed no significant difference in the community structure between sites located close to the naval base and those further away.
- It is recommended that any redevelopment of the naval base is carried out in conjunction with chemical monitoring of nearby sediments.
- It is suggested that a full or partial repeat of this survey is carried out following redevelopment of the site.

8.REFERENCES

Canadian Council of Ministers of the Environment (2001). Canadian sediment quality guidelines for the protection of aquatic life: Summary table 1999. CCME. Winnipeg.

Clarke, K.R. & Warwick, R.M.(2001). Change in Marine Communities: An Approach to Statistical Analysis and Interpretation. 2nd Edition. PRIMER-E Ltd. Plymouth Marine Laboratory, UK.

Downie, A.J. (1995). Littoral survey of Portland Harbour (Small Mouth Spit Area) 1994. English Nature Research Report Number 146. Peterborough: English Nature.

Environment Agency (1996). Risk Assessment Of Contaminated Sediment. WRc R&D.

Holthe, T(1986). Polychaeta Terebellomorpha. Marine Invertebrate Of Scandinavia Number 7. Norwegian University Press

Howard, S., Howson, C and Moore, J. (1988). Surveys of Harbours, Rias and Estuaries in Southern Britain: Portland and Weymouth Harbours. Unpublished report by the Field Studies Council, Oil Pollution Research Unit to the Nature Conservancy Council.

Fauchald, K. (1977).The Polychaete Worms. Definitions and Keys to the Orders, Families and Genera. Natural History Museum Of Los Angeles County. Science Series 28.

Marine Conservation Society (1997). The Species Directory of the Marine Fauna and Flora of the British Isles and Surrounding Seas.

Rouse, G. W. & Pleijel, F (2001). Polychaetes. Oxford University Press, pp 354.

Royal Haskoning (2002).Development of Weymouth and Portland Sailing Academy. Environmental Statement. Final Report.

Seaward, D.R. (1987). The Marine Molluscs of Portland Harbour. Proceedings Dorset Natural History and Archaelogical Society. 108; 159-167.

SNIFFER (1992).Development Of A Biotic Index For The Assessment Of The Pollution Status Of Marine Benthic Communities. WRc plc. Final Report NR 3102/1.

Woodham, A & Chambers, S. (1994). A New Species Of Chaetozone (Polychaeta, Cirratulidae) From Europe, with re-description of Caulleriella zetlandica (McIntosh). Royal Museums of Scotland.307-316.

Figure 5.1. MDS ordination of the full replicate data

Figure 5.2. Full replicate data (groups B, C and site 8 removed)

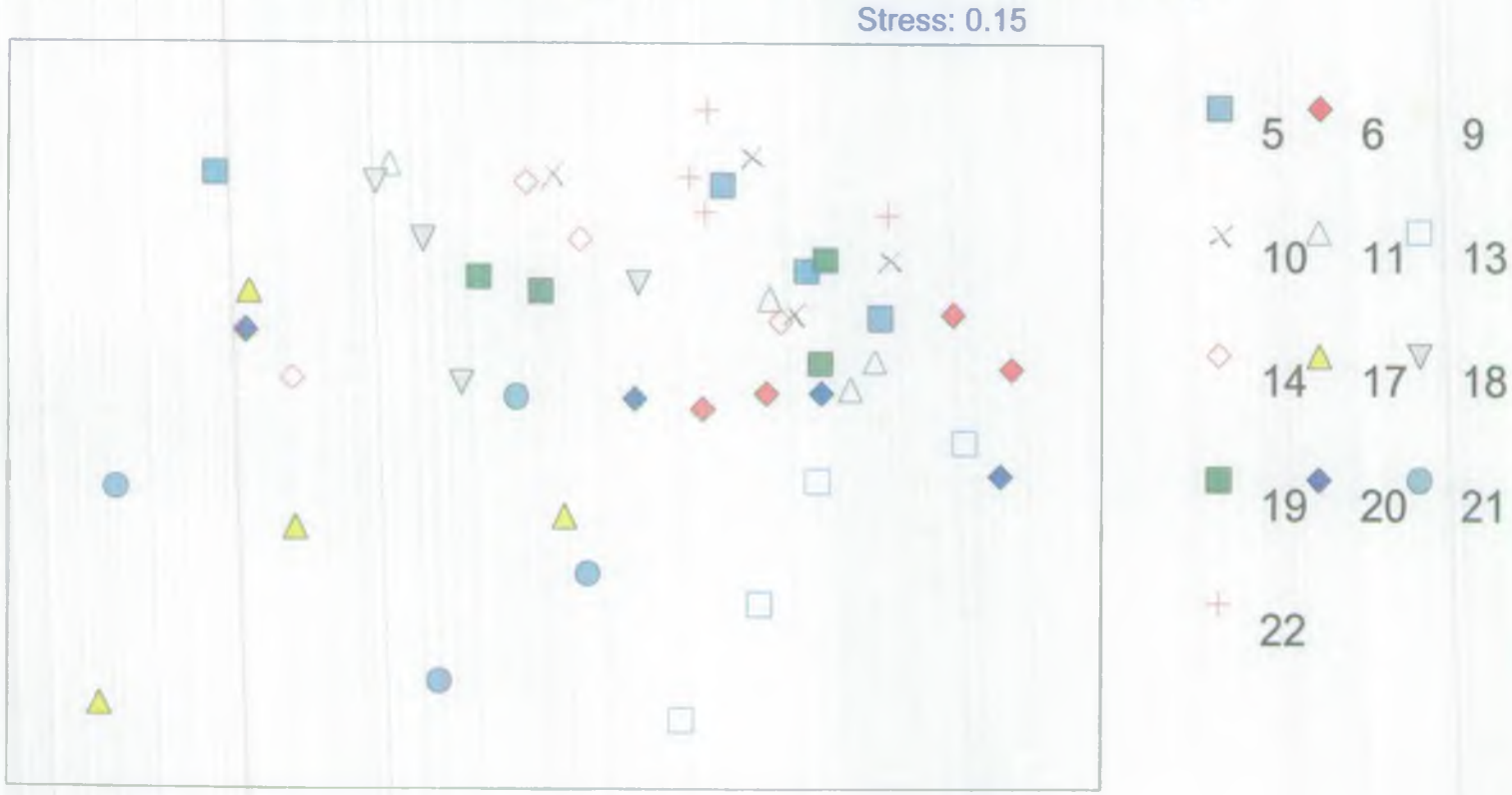


Figure 5.3 MDS ordination of averaged benthic data

Figure 5.4 MDS ordination of sand

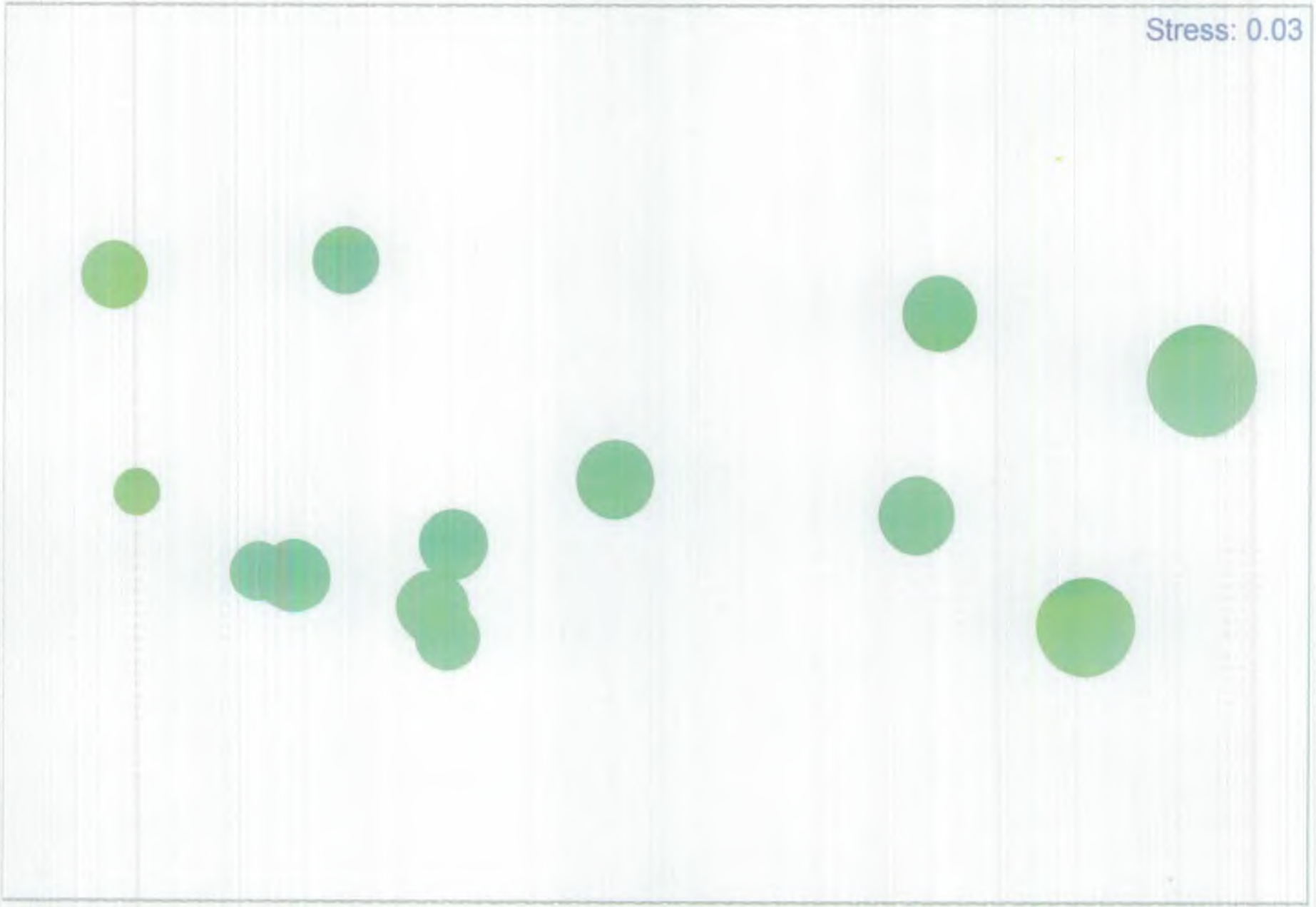


Figure 5.5 MDS ordination of silt

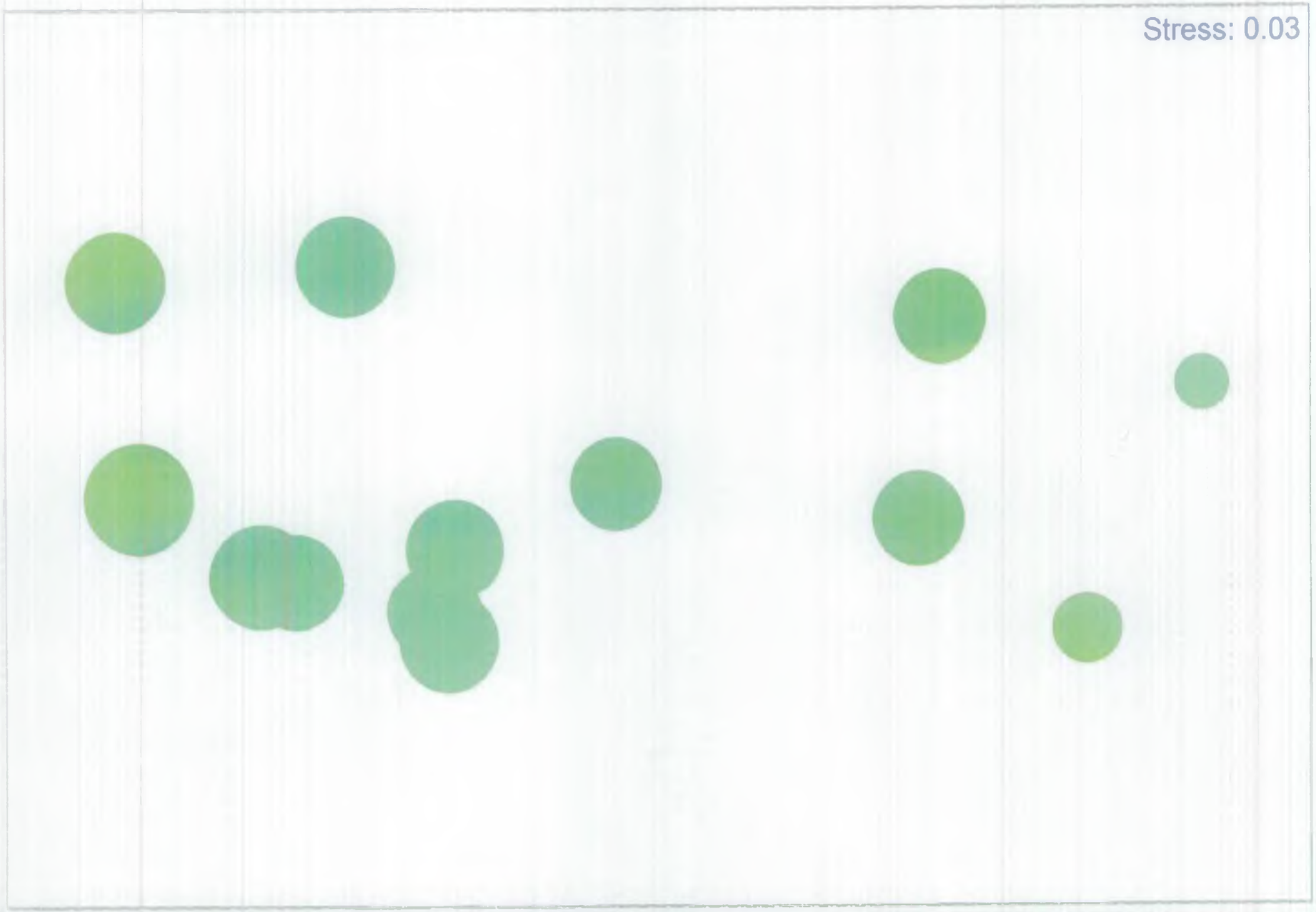


Figure 5.6 MDS ordination of depth

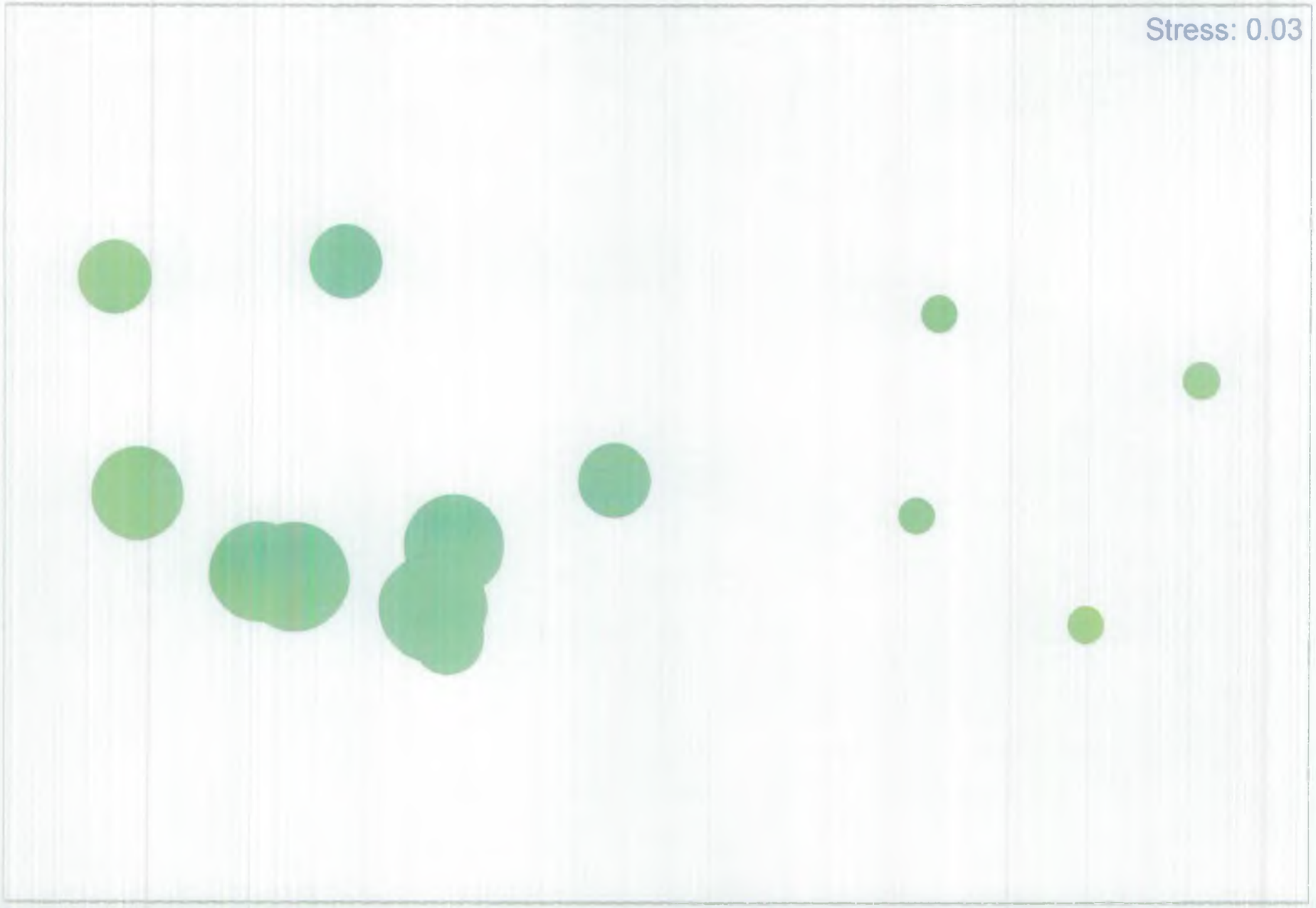


Figure 5.7 MDS ordination of mercury

Figure 5.8 MDS ordination of lead

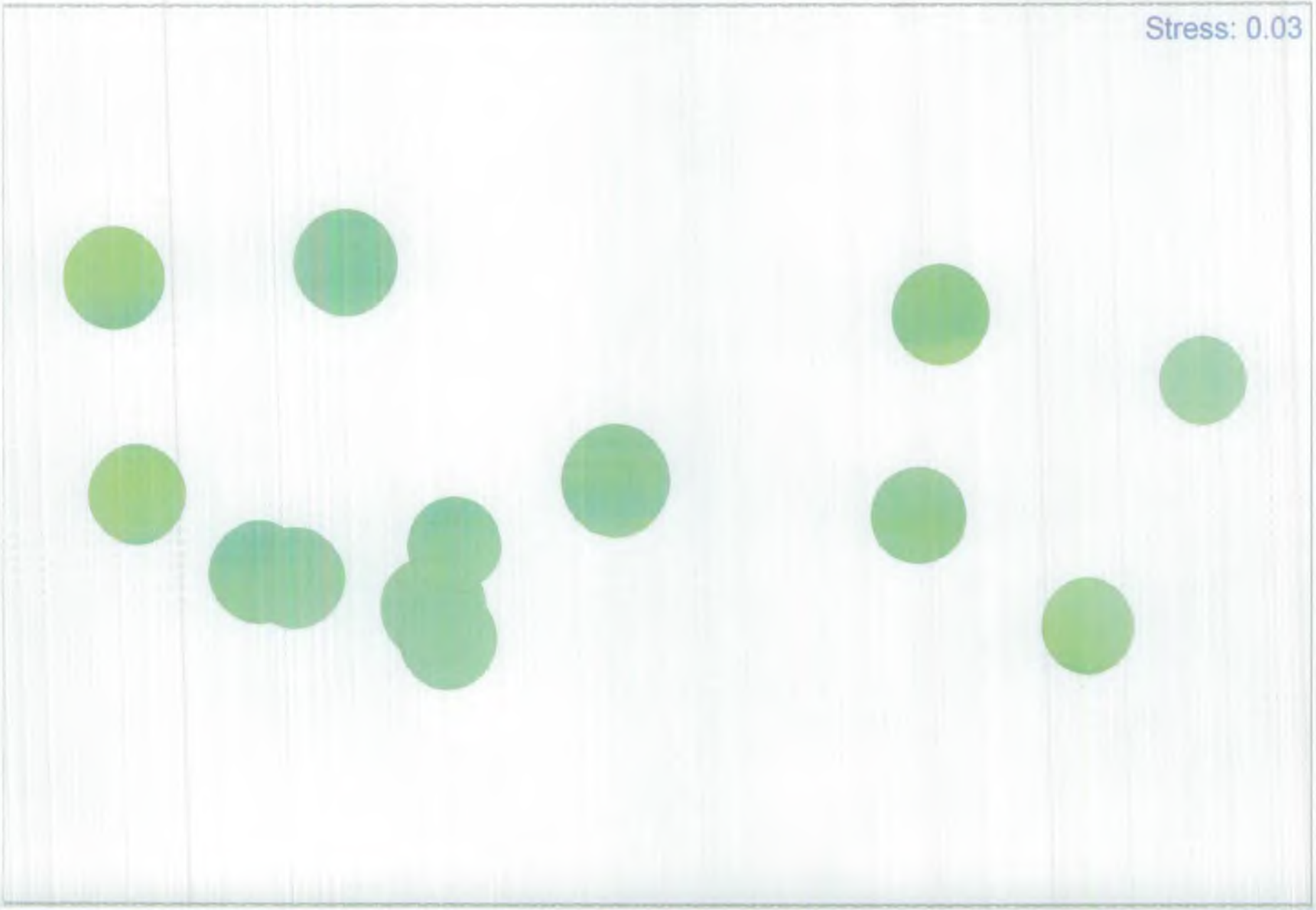


Figure 5.9 MDS ordination of zinc

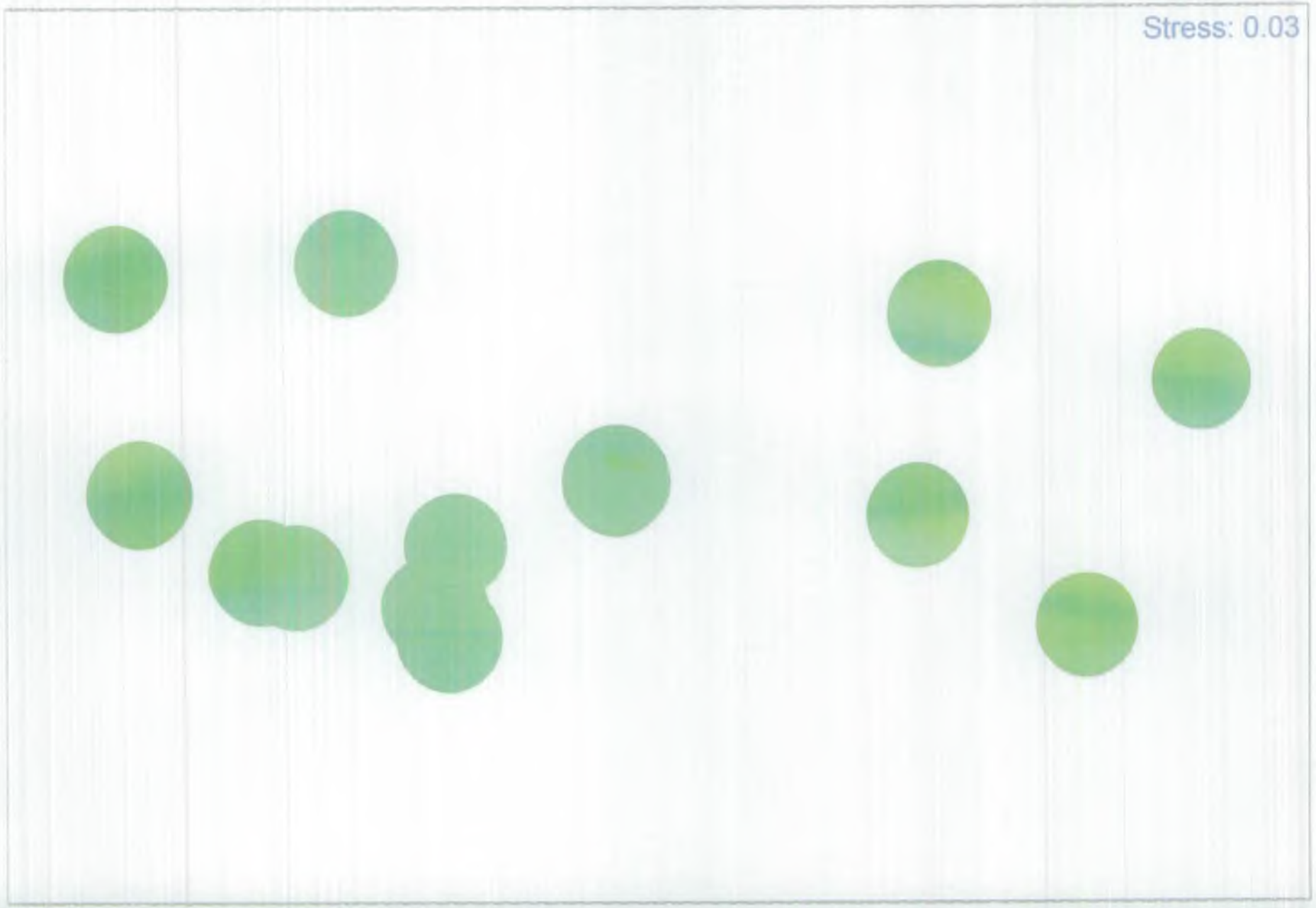


Figure 5.10 MDS ordination of arsenic

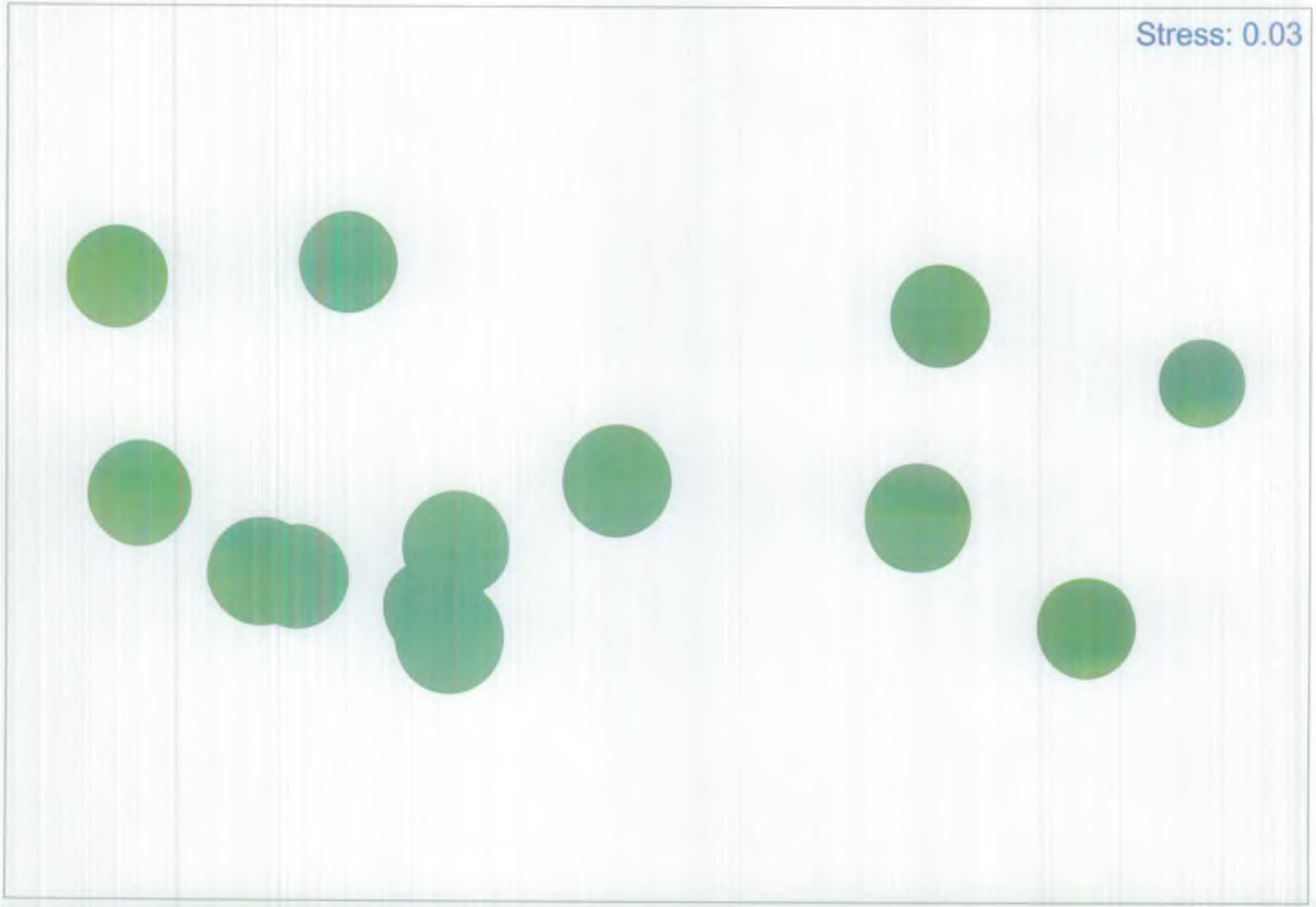


Figure 5.11 MDS ordination of nickel

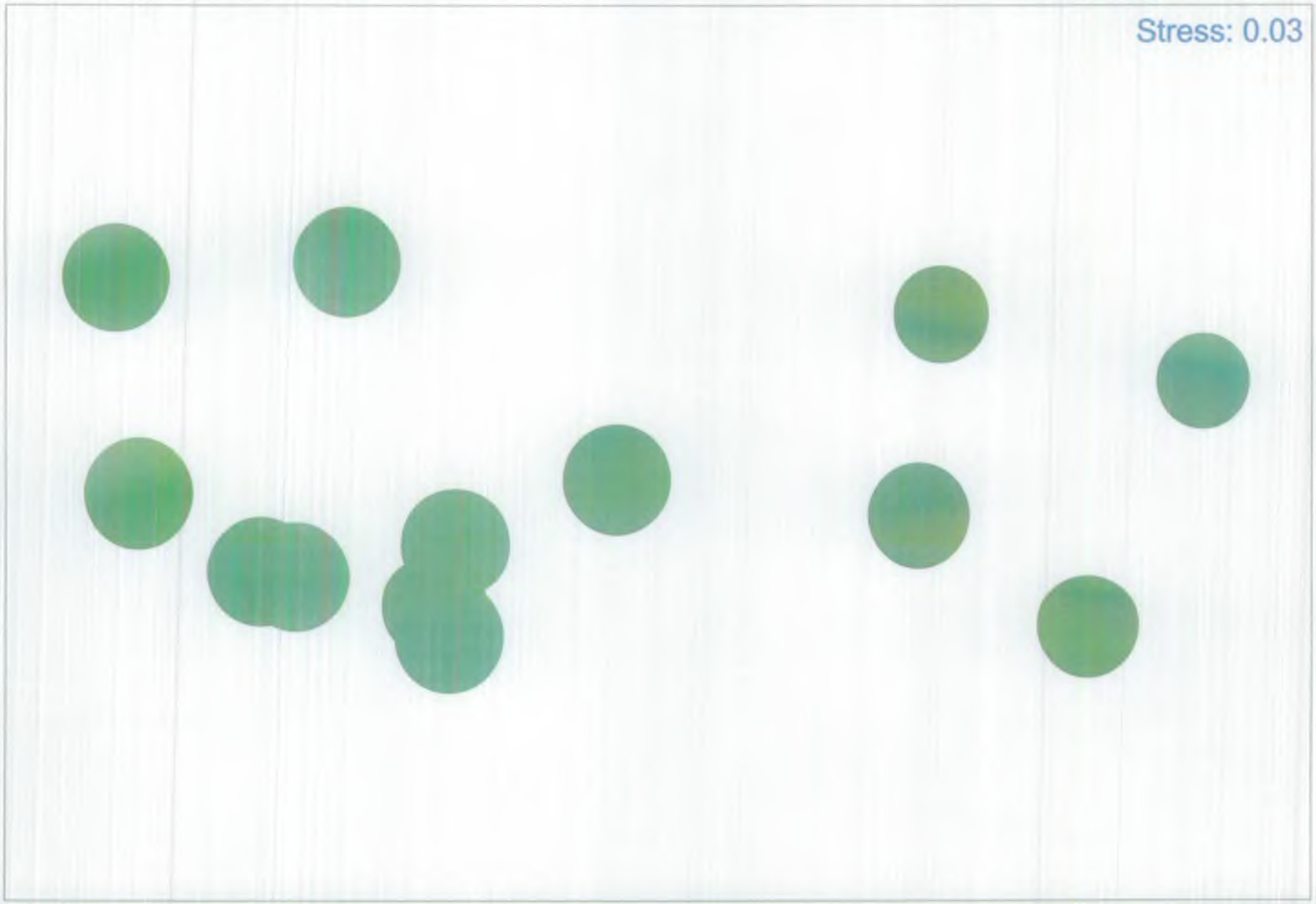


Figure 5.12 MDS ordination of chromium

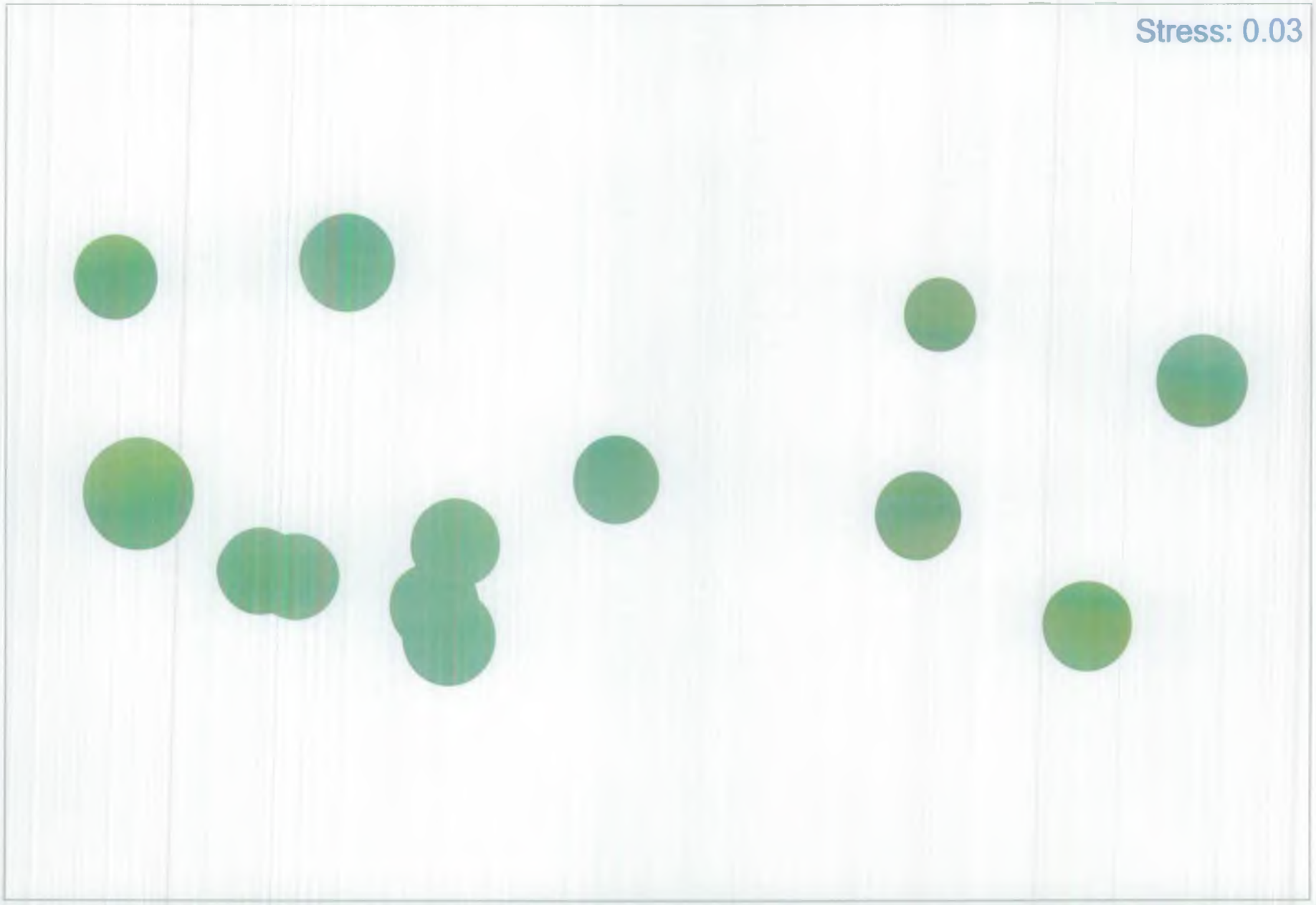


Figure 5.13 MDS ordination of cadmium

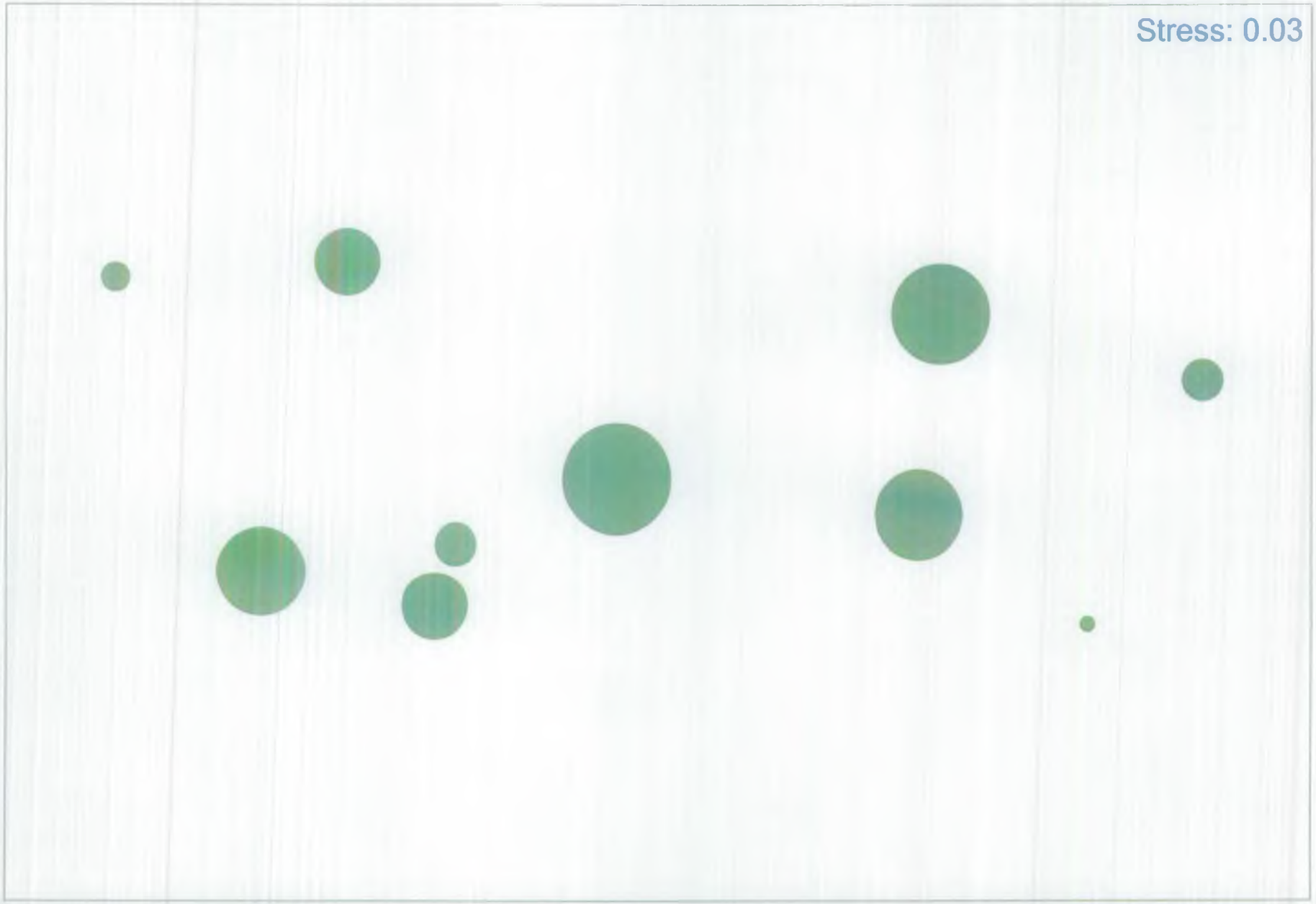


Figure 5.14 MDS ordination of copper

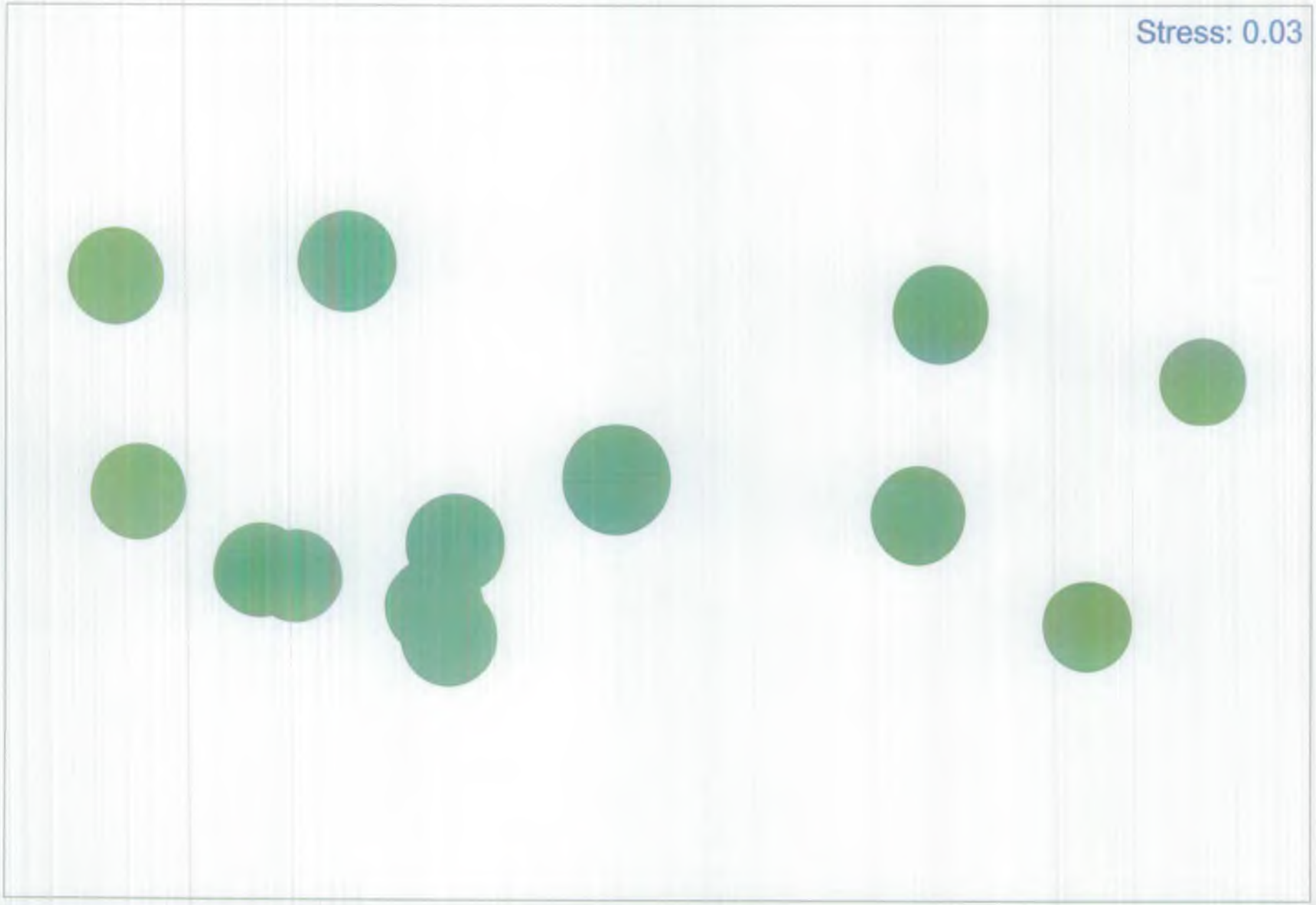


Figure 5.15 MDS ordination of iron

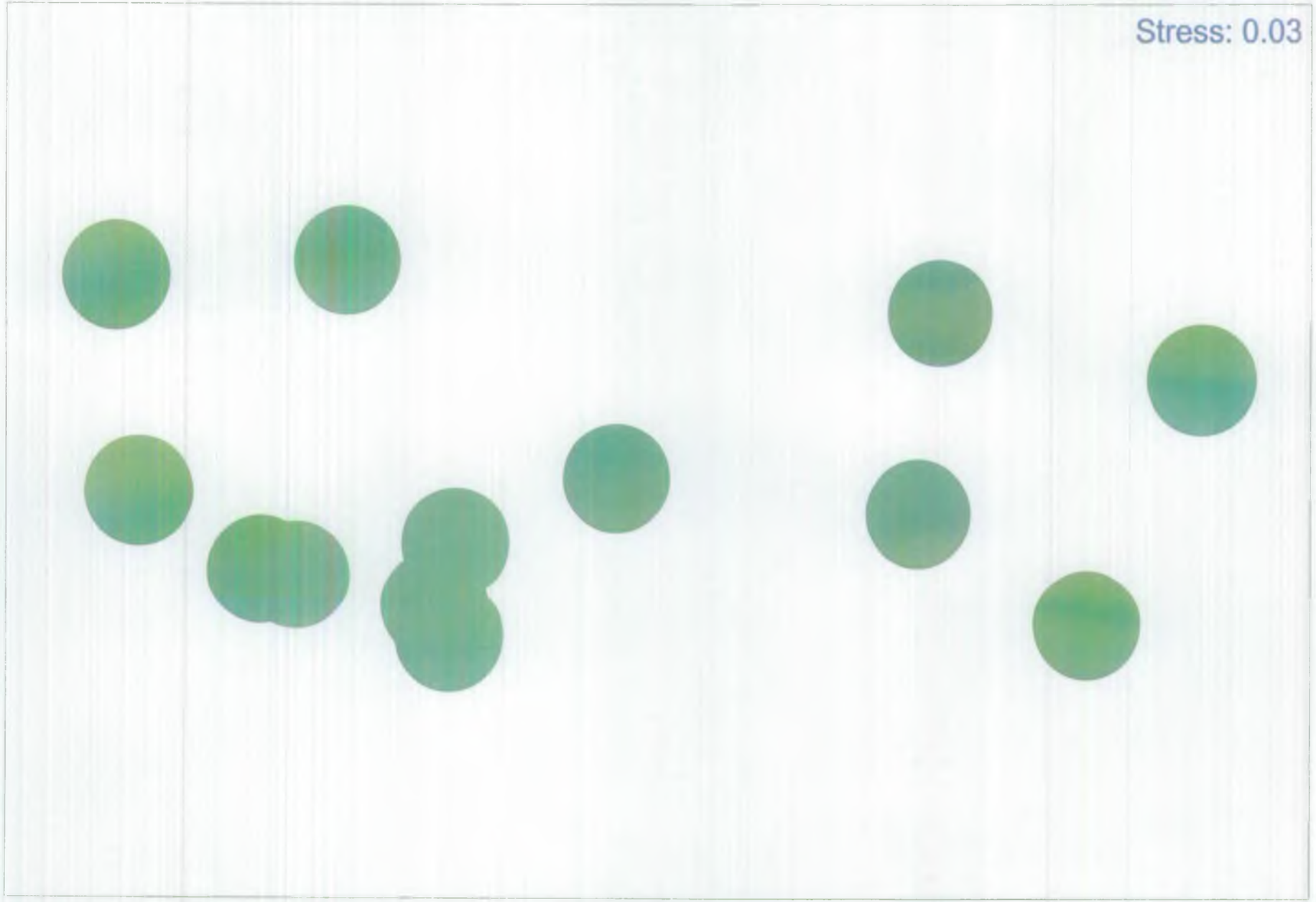


Figure 5.16 MDS ordination of aluminium

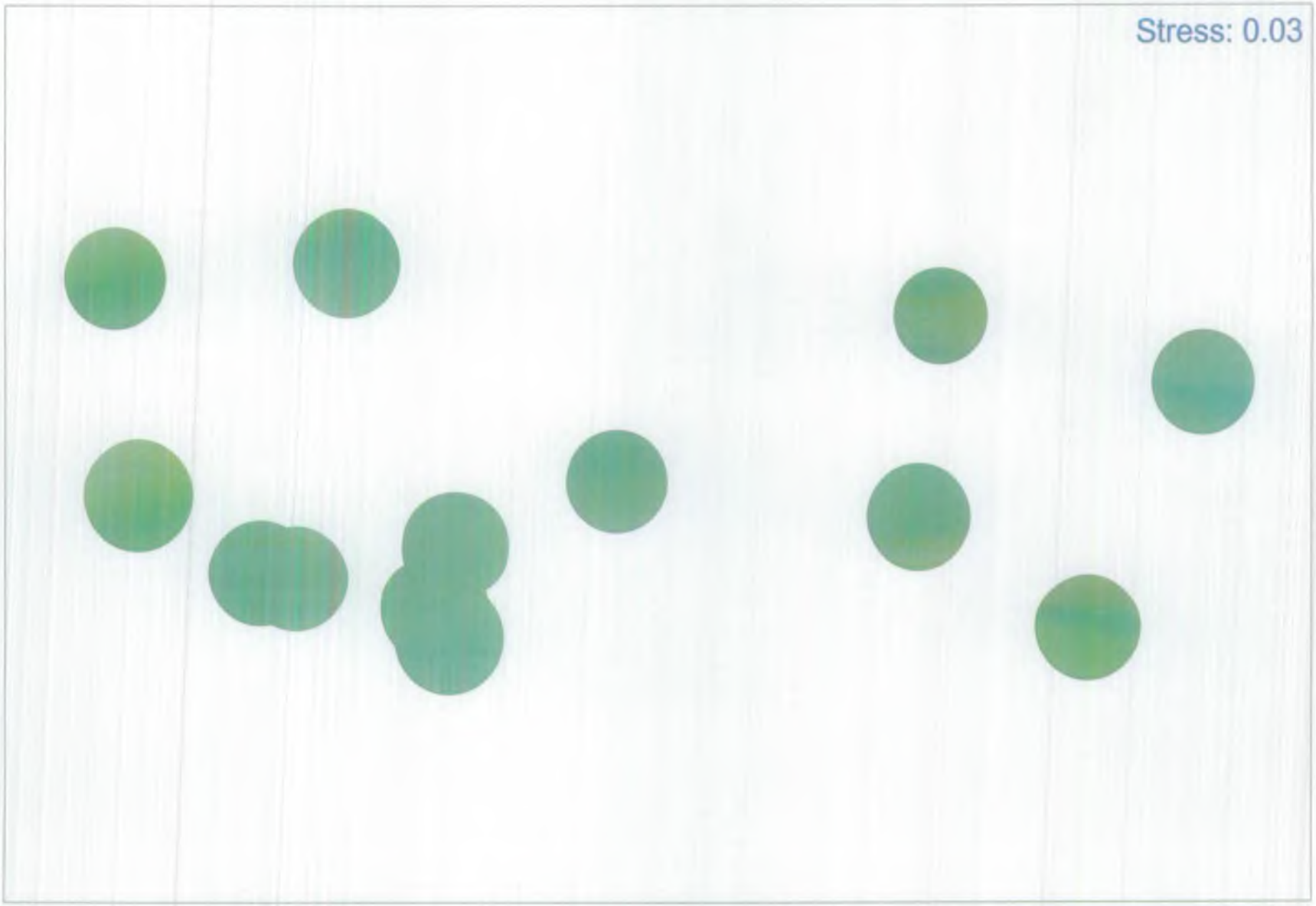


Figure 5.17 MDS ordination of HCH Gamma

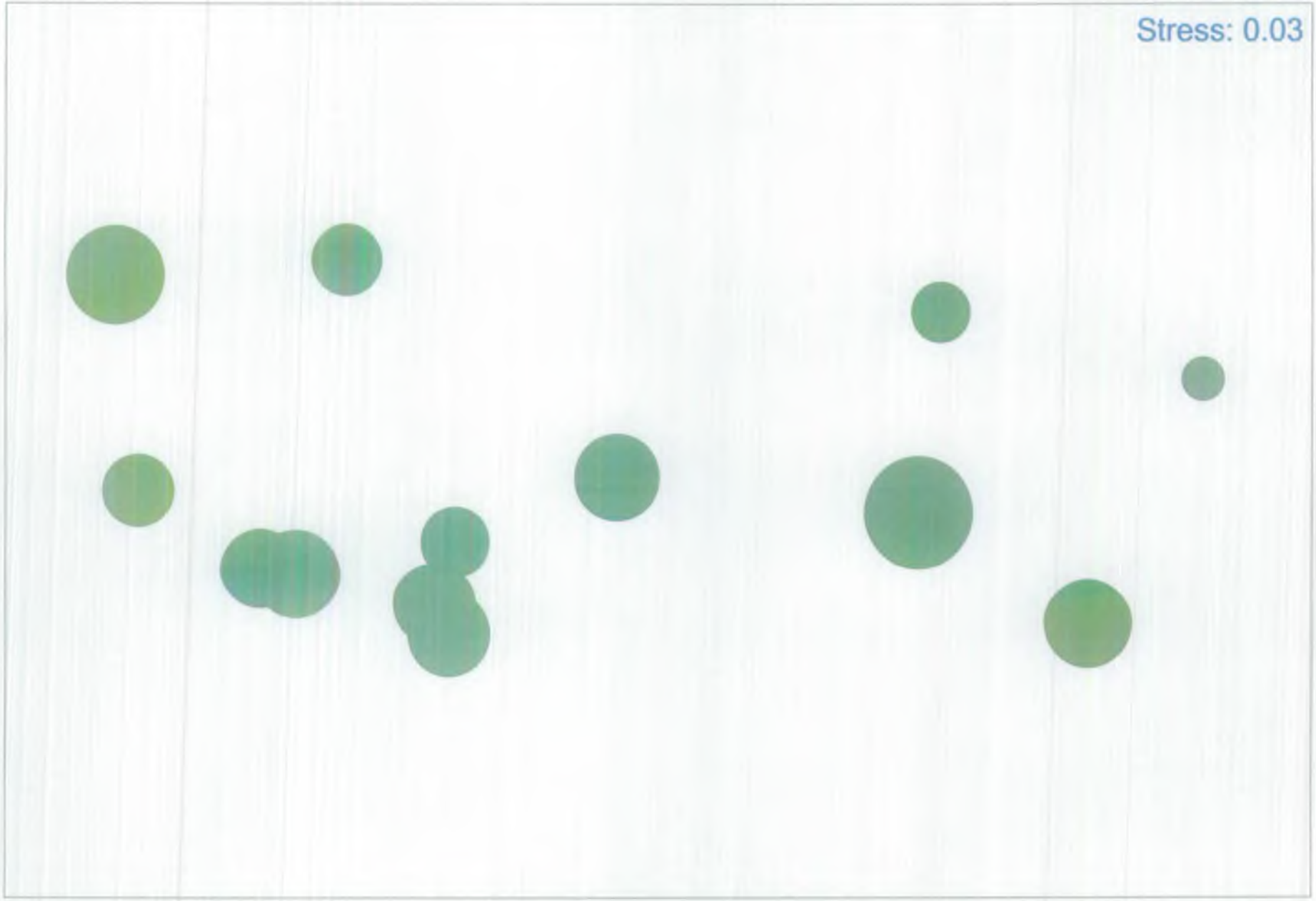


Figure 5.18 MDS ordination of DDT

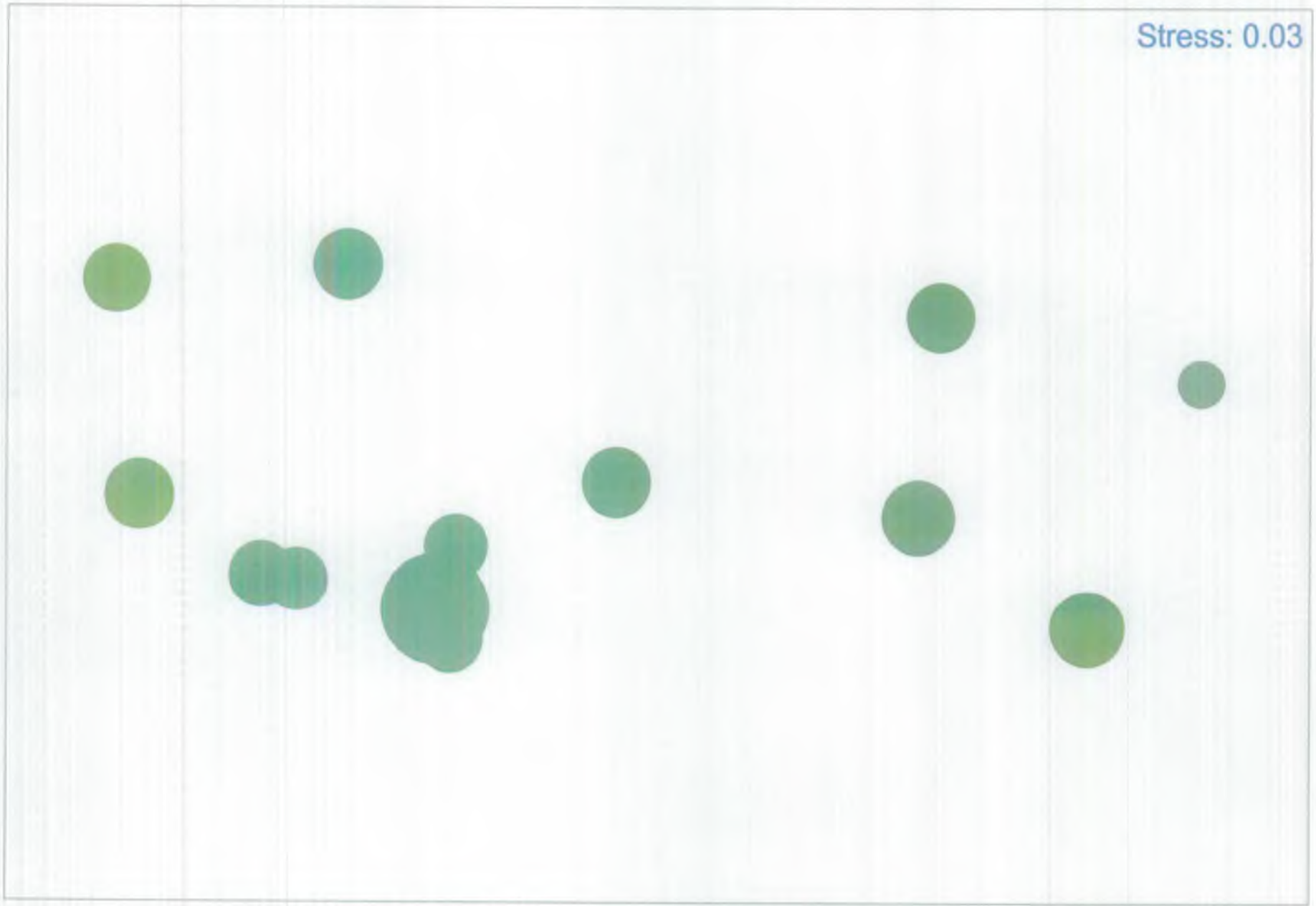


Figure 5.19 MDS ordination of PcP

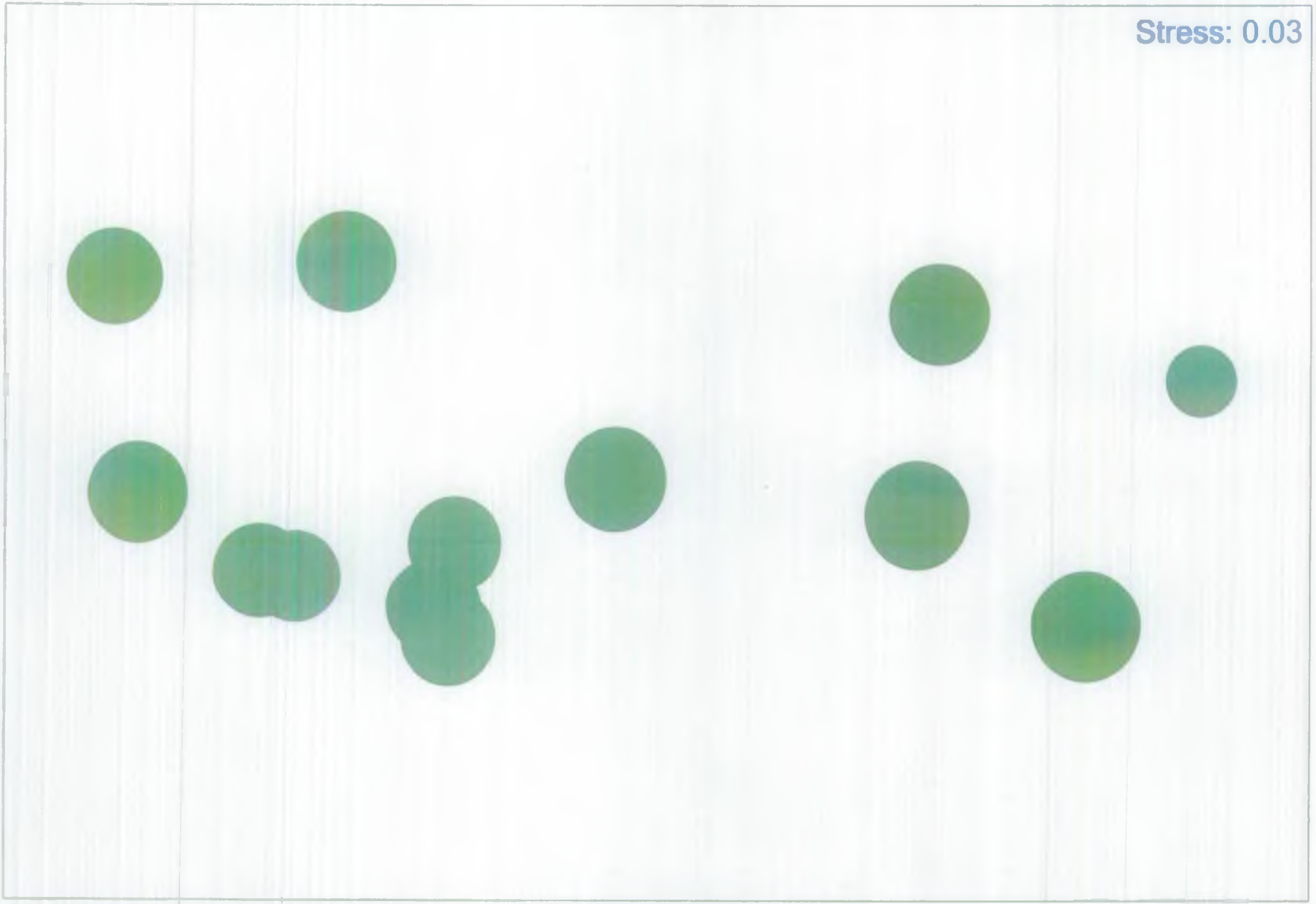


Figure 5.20 MDS ordination of Tri Fluralin

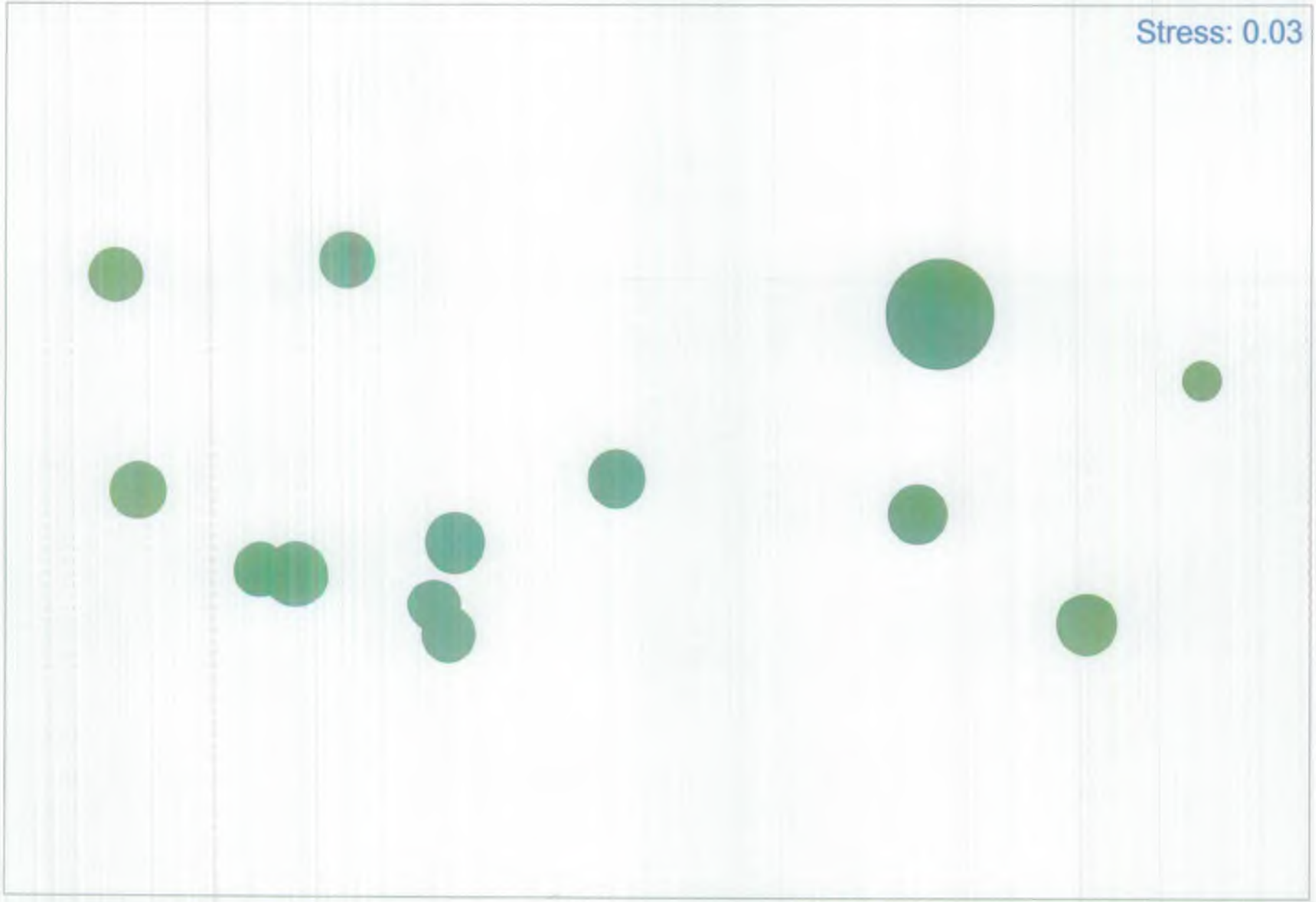


Figure 5.21 MDS ordination of total oil

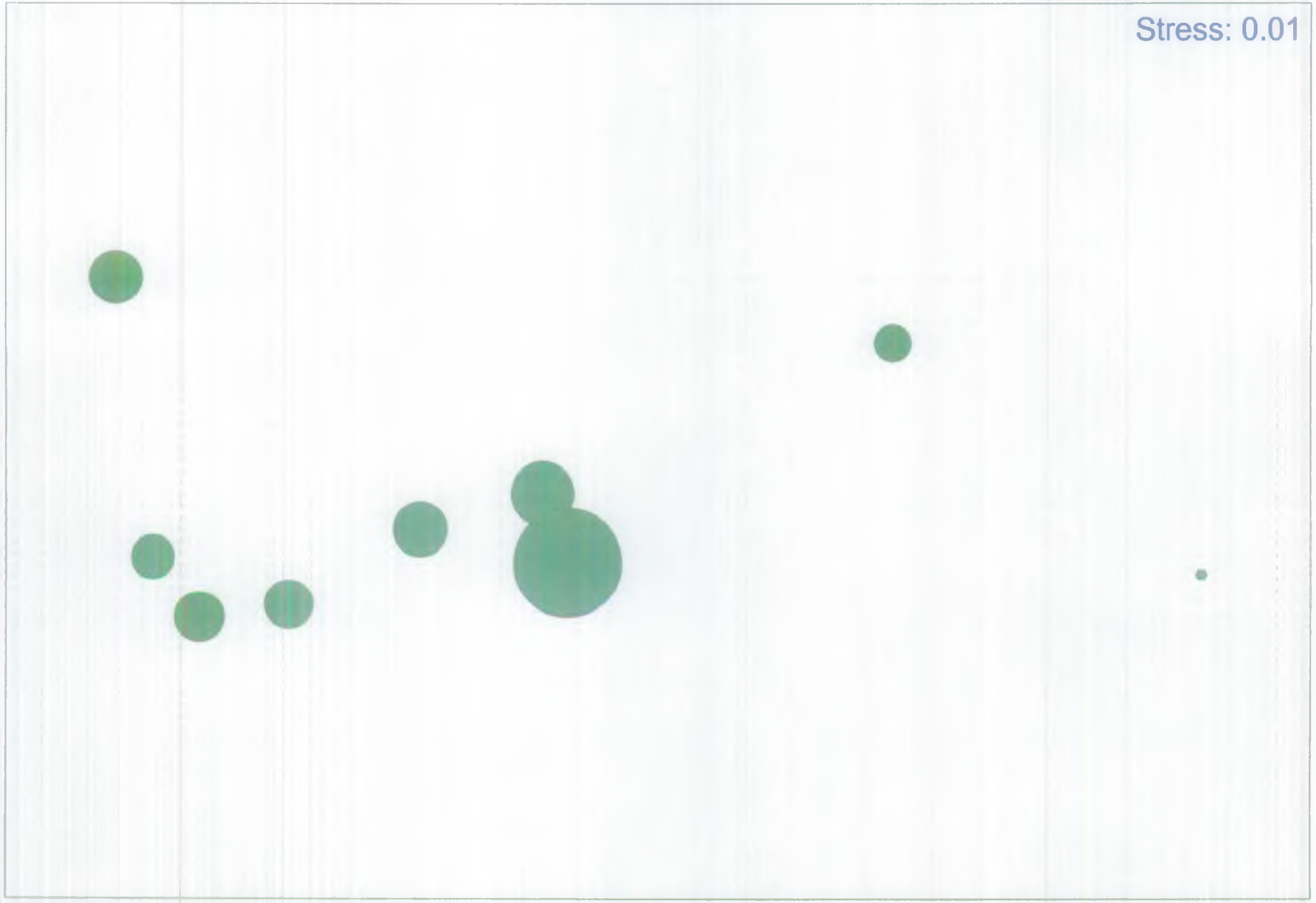


Figure 5.22 MDS ordination of S.scutata

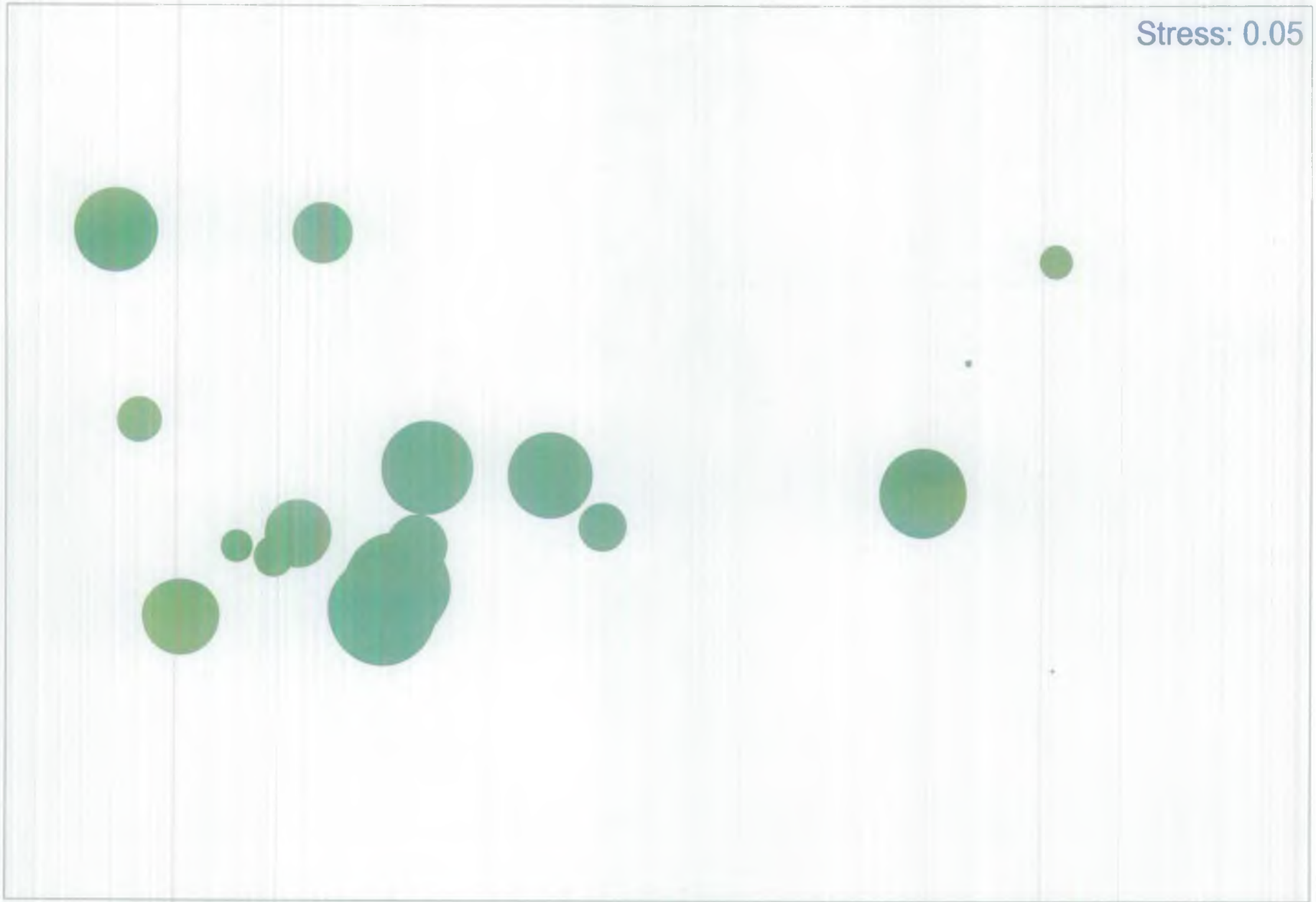


Figure 5.23 MDS ordination of M.palmata

Figure 5.24 MDS ordination of Euclymene oerstedii

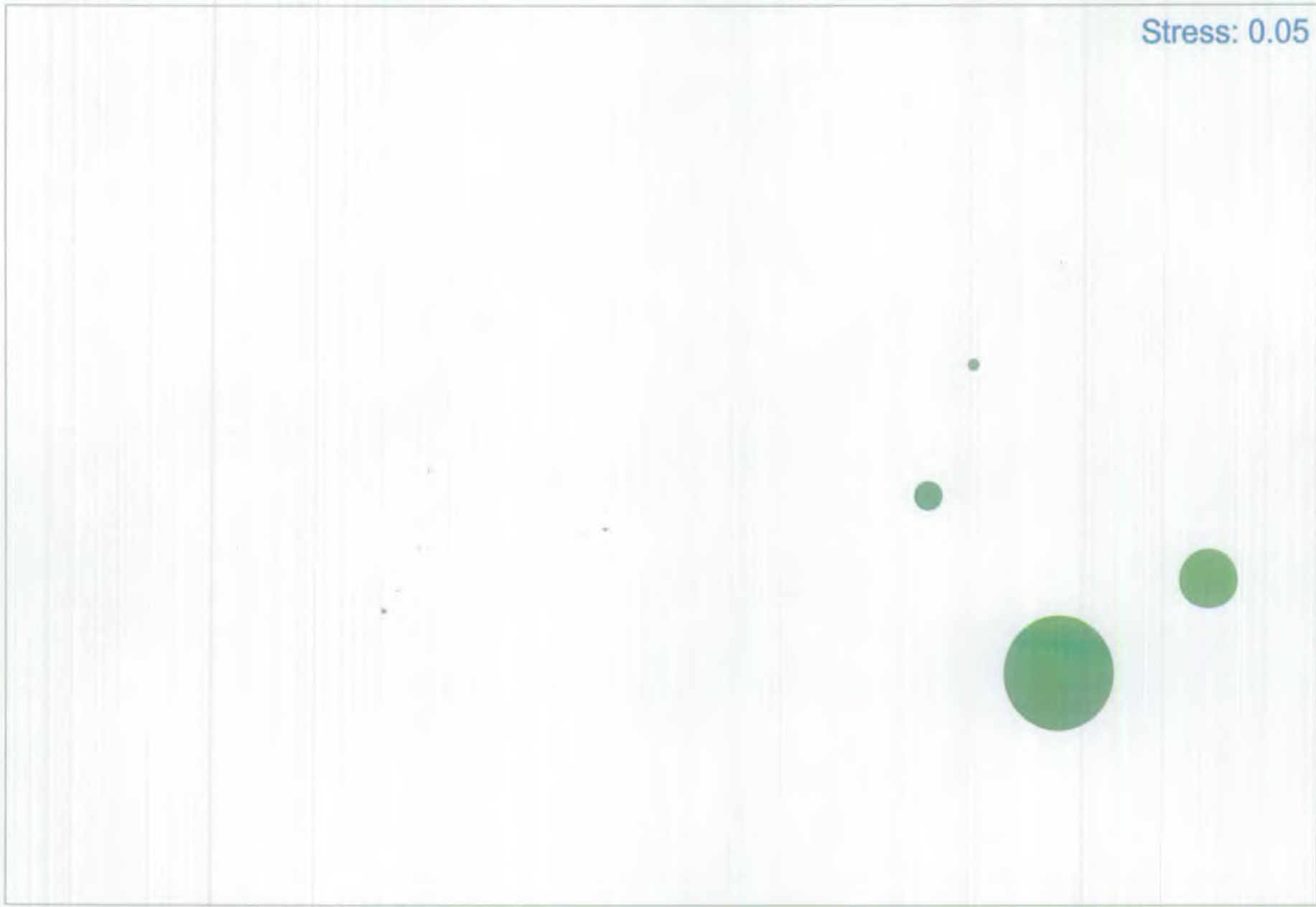


Figure 5.25 MDS ordination of M.dorsobranchialis

Figure 5.26 MDS ordination of T.benedii

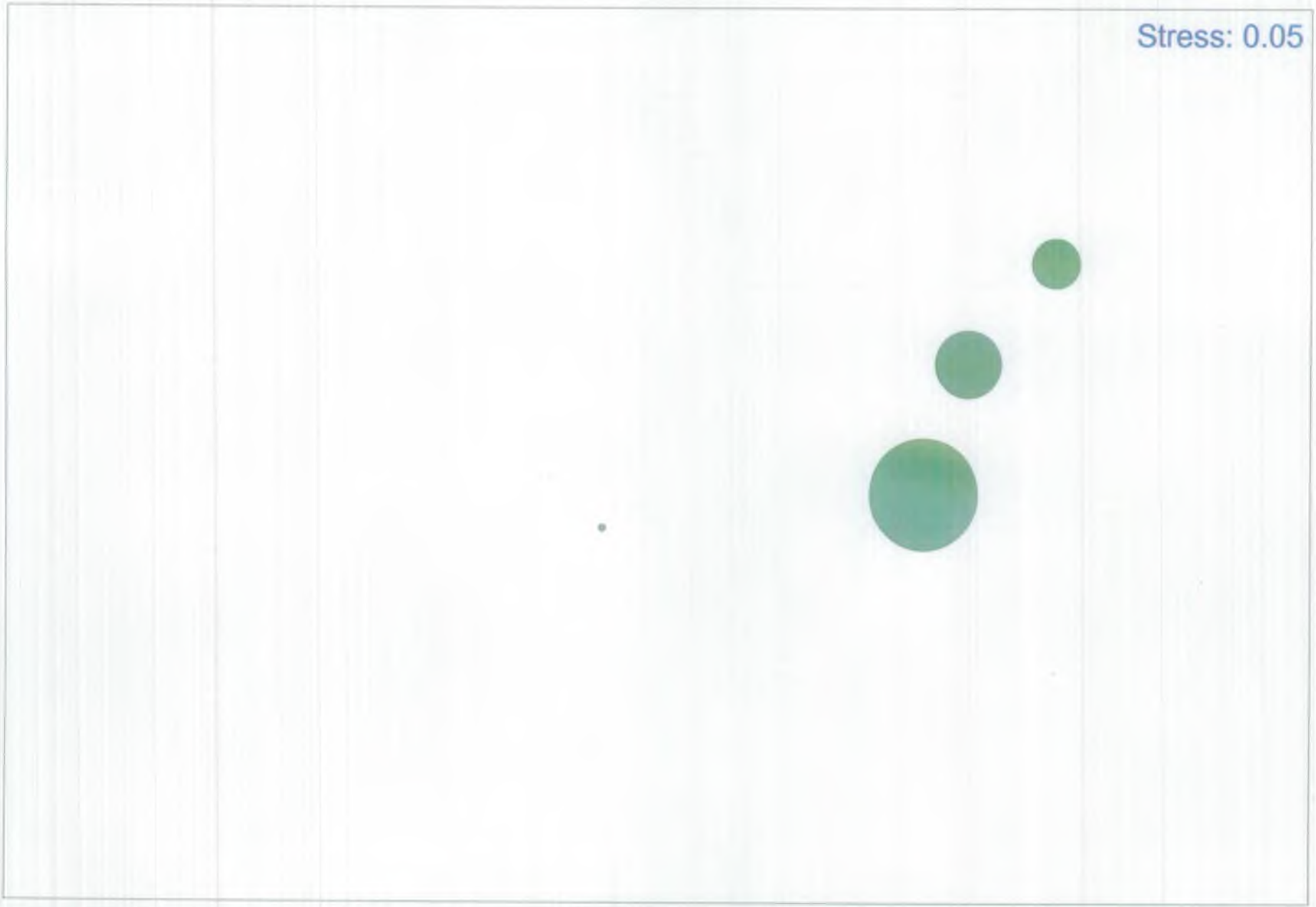
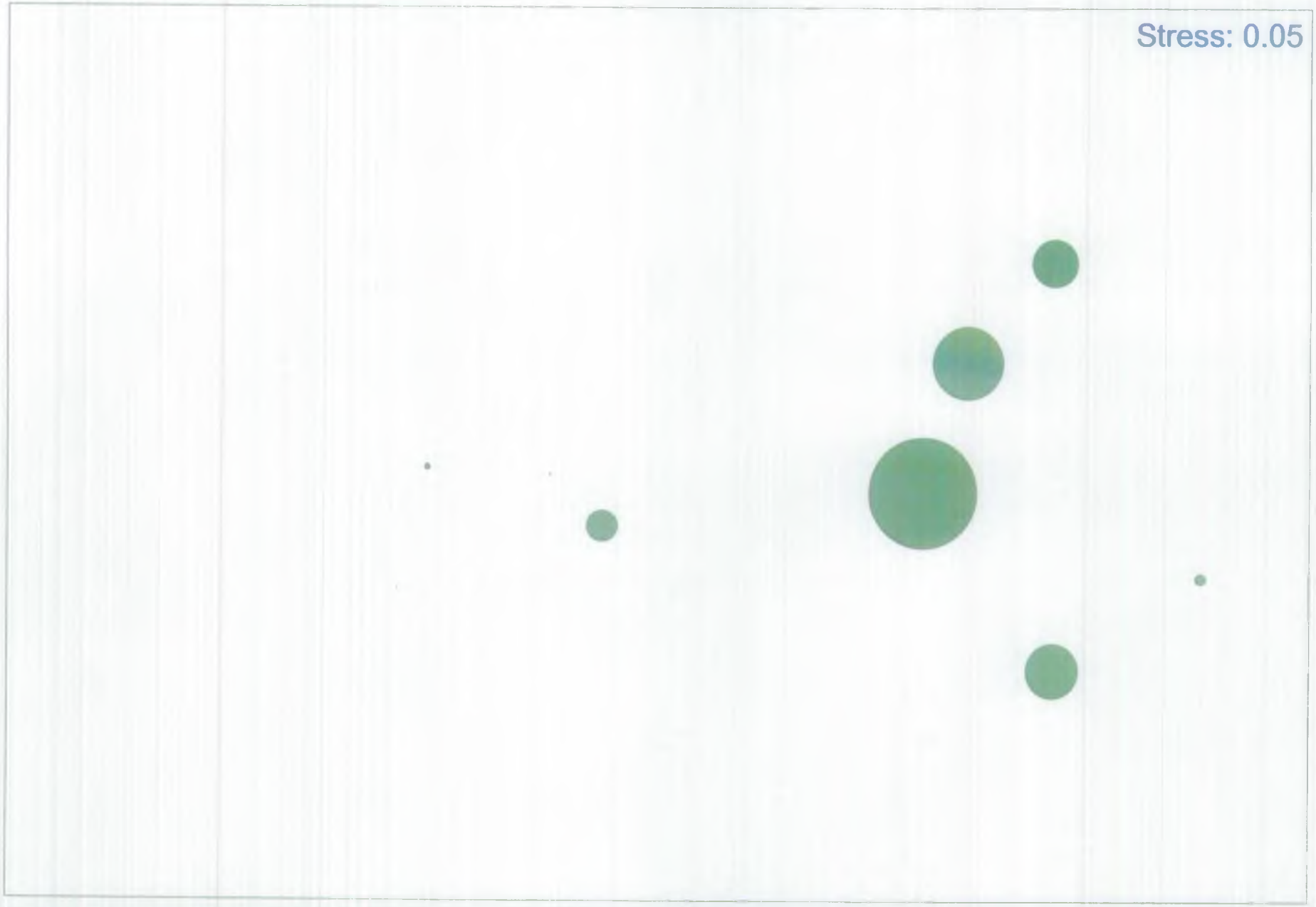


Figure 5.27 MDS ordination of A.marioni



APPENDIX 1

POSITION OF SAMPLE SITES

SITE NUMBER	GPS COORDINATES
1	N 50 35.850 W 2 27.050
2 (Chemistry only)	N 50 35.790 W 2 26.800
3 (Chemistry only)	N 50 35.700 W 2 26.420
4	N 50 35.410 W 2 27.420
5	N 50 35.360 W 2 27.010
6	N 50 35.340 W 2 26.630
7 (Not Sampled)	N 50 35.330 W 2 26.240
8	N 50 34.810 W 2 27.450
9	N 50 34.870 W 2 27.020
10	N 50 34.900 *W 2 27.420/ W 2 26.420
11	N 50 34.980 W 2 26.050
12	N 50 34.390 W 2 27.230
13	N 50 34.530 W 2 26.780
14	N 50 34.660 W 2 26.360
15 (Not Sampled)	N 50 34.750 W 2 25.920
16	N 50 34.280 W 2 26.810
17	N 50 34.400 W 2 26.490
18	N 50 34.520 W 2 26.130
19	N 50 34.270 W 2 26.170
20	N 50 34.400 W 2 25.960
21	N 50 34.150 W 2 25.790
22	N 50 34.220 W 2 25.580
A (Chemistry only)	N 50 34.140 W 2 25.510
B (Chemistry only)	N 50 34.090 W 2 25.640
C (Chemistry only)	N 50 34.120 W 2 26.110
D (Chemistry only)	N 50 34.100 W 2 26.570
E (Chemistry only)	N 50 34.320 W 2 27.020
F (Chemistry only)	N 50 34.250 W 2 26.040

* Error in coordinate / Corrected coordinate

APPENDIX 2

LABORATORY ANALYSIS

ENVIRONMENT AGENCY - LLANELLI LABORATORY		
COMPENDIUM MANUAL ORGANICS SECTION	SECTION:	ORGANICS
	AUTHORS:	DC/AG
	DATE:	7 July 1998
Determination of: RED LIST ORGANICS	ISSUE NO:	01
	PAGE 1 OF	1

Determinand:RED LIST ORGANICS - See Attached

Matrix: Sediments, Soils and Biota

TDIB Code: See Attached

Method of Analysis: Gas Chromatography/Mass Spectrometry (GCMS) with selective Ion Monitoring (SIM)

Basis of Analysis: In House Method

Principle: Surrogate standards are added to a freeze dried sample which is extracted with a suitable solvent under Soxhlet conditions. The solvent extract is reduced in volume and interfering organic compounds of high molecular weight are removed using Gel Permeation Chromatography (GPC). The cleaned up extract is concentrated again to low volume prior to injection onto a gas chromatograph equipped with a mass spectrometric detector operating in selective ion monitoring mode.

Range of Application: See Attached

Sample Container: 500 ml wide neck glass jar with ground glass stopper

Storage/Preservation: Frozen on arrival

MRV: See Attached

Inst. Sens. Check:

QC within Laboratory:

Error Target:	-	
Precision:	-	15%
Bias:	-	20%
AQC level (LOI):	-	
Current Precision:	-	
Performance testing:	-	
Duplicate Analysis:	-	
Spike Analysis:	-	

QC Interlaboratory:

Proficiency schemes:	-	
Other:	-	N

RED LIST ORGANICS

Determinand	TDIB Code	Range µ/l	LOD µ/l	Precision	Bias
		Sediments	Sediments	Target Actual	Target Actual
1,3,5-TCB	8372	1-100	1	15	20
1,2,4-TCB	8373	1-100	1	15	20
1,2,3-TCB	8371	1-100	1	15	20
HCBD	9969	1-50	1	15	20
Dichlorovos	508	1-200	1	15	20
Trifluralin	8368	1-100	1	15	20
A-HCH	488	1-50	1	15	20
b-HCH	492	1-50	1	15	20
G-HCH	500	1-50	1	15	20
D-HCH	496	1-50	1	15	20
HCB	9838	1-50	1	15	20
Heptachlor	528	1-150	1	15	20
Hept.Epox.(Endo-)	532	1-50	1	15	20
Aldrin	484	1-50	1	15	20
Isodrin	4405	1-50	1	15	20
op-DDE	1080	1-50	1	15	20
pp-DDE	552	1-50	1	15	20
op-TDE	574	1-50	1	15	20
pp-TDE	560	1-50	1	15	20
op-DDT	540	1-50	1	15	20
pp-DDT	1556	1-50	1	15	20

RED LIST ORGANICS

Determinand	TDIB Code	Range µ/l	LOD µ/l	Precision	Bias
		Sediments	Sediments	Target Actual	Target Actual
a-Endosulphan	8366	1-50	1	15	20
b-Endosulphan	8367	1-50	1	15	20
Dieldrin	512	1-50	1	15	20
Endrin	568	1-50	1	15	20
Prochloraz	4067	20-200	20	15	20
PCB 28	9842	1-50	1	15	20
PCB 52	9843	1-50	1	15	20
PCB 101	9844	1-50	1	15	20
PCB 118	9845	1-50	1	15	20
PCB 138	9846	1-50	1	15	20
PCB 153	9847	1-50	1	15	20
PCB 180	9848	1-50	1	15	20
Diazinon	724	1-200	1	15	20
Simazine	9523	2-200	2	15	20
Atrazine	9522	2-200	2	15	20
Propazine	9263	2-200	2	15	20
Propetamphos	8491	1-200	1	15	20
Terbutryn	8174	20-200	20	15	20
Propiconazole	4068	20-200	20	15	20
Methyl Parathion	4318	1-100	1	15	20
Ethyl Parathion	544	1-100	1	15	20
Malathion	536	1-150	1	15	20
Fenitrothion	8370	1-200	1	15	20
Chlorfenvinphos	504	1-100	1	15	20
Azinphos Methyl	8369	4-20	4	15	20

ENVIRONMENT AGENCY - LLANELLI LABORATORY	
COMPENDIUM MANUAL INORGANICS SECTION	SECTION: 3.3a
	AUTHORS:RHW/GH
	DATE: 24.03.00
Determination of: PARTICLE SIZE DISTRIBUTION (up to 2000µm) N.M.M.P.2	ISSUE NO: 01
	PAGE 1 OF 2

Determinand Codes: **STARLIMS/PREMIS** **Method Code 21**

Determinand:

GS2000	G<2000	G2000	GS564	GS261
5547	5546	5545	5544	5543
GS160	GS112	GS84.3	GS64.6	GS50.2
5542	5541	5540	5539	5549
GS39.3	GS30.3	GS23.7	GS18.5	GS14.5
5538	5537	5536	5535	5534
GS11.4	GS9.1	GS7.2	GS<5.8	Solids<63
5533	5532	5531	5530	9596
Sort Coeff	Median dia.	Mean dia.	Graph Skewn	
7331	7378	7379	7629	

Matrix: Soils, Sediments and Associated Samples

Method of Analysis: Laser diffraction particle size analysis

Instrumentation: Malvern Laser Diffraction Particle sizer, Mastersize X. % of sample in user determined size band measured in µm mean, standard deviation, skew, kurtosis.

Basis of Analysis:

Principle: A low power visible laser transmitter produces a parallel, monochromatic beam of light which illuminates the particles by use of an appropriate sample cell. The incident light is diffracted by the particles illuminated to give a stationary diffraction pattern regardless of particle movement. By integration over a suitable period using a continuous flux of particles through the illuminated area, a representative bulk sample of the particles contributes to the final measured diffraction pattern.

A Fourier transform lens focuses the diffraction pattern onto a multi-element photo-electric detector. This detector is directly interfaced to a computer which reads the diffraction pattern and performs the necessary integrations.

The computer uses a non-linear least squares analysis to find the size distribution which gives the most closely fitting diffraction pattern.

Range of Application: 5.8 µm → 2000 µm

Sample Container: 250 ml white screw topped polypropylene pot

	Sediments
Min. Weight Required:	10 g
Storage/Preservation:	Frozen
MRV:	< 5.8 um
Certified Reference Material:	BCR 130 Quartz 50 – 220 um
QC Interlaboratory:	Proficiency schemes: - NMBAQC
	Other: - Coulter Interlab

ENVIRONMENT AGENCY - LLANELLI LABORATORY	
COMPENDIUM MANUAL METALS SECTION	METHOD NO. 11.2 (i)
	AUTHORS: RR
Determination of: TRACE METALS IN ENVIRONMENTAL SAMPLES INCLUDING BIOTA, SEDIMENT, PAPER TISSUE AND RELATED MATERIAL	DATE: 19.09.01
	ISSUE NO: 04
	PAGE 1 OF 7

Determinand: MERCURY IN SOILS AND RELATED MATERIAL

Matrix: Soils, Sediments, Biota, Paper

TDIB Code: 0270

Method of Analysis: PSA Merlin System with Fluorescence Detector

Principle: The dried sample is digested with nitric acid and water for easily digested tissues (including fish tissue) and with nitric acid and hydrochloric acid for other sediments, in a microwave digester. The digest is then filtered and made up to volume with de-ionised water and the metals determined by PSA Merlin with and fluorescence detector.

Range of Application: 0 - 20 µg/l (without dilution) Range extend with dilution.

Sample Container: 500 mls Plastic Wide Neck Pot.

Storage Preparation: Samples are freeze dried to constant weight/dryness, and ground using a pestle and mortar.

MRV: 0.8 µg/Kg

Inst. Sens. Check: 250 ng/l^{-1} Standard

QC within Laboratory:

Error Target:	-	30% Total Error
Precision:	-	Better than 10% RSD
Bias:	-	Better than 10% Bias
AQC level (LOI):	-	Sediments : 1.03 mg/Kg Biota : 0.188 mg/Kg
Current Precision:	-	Yes
Performance testing:	-	Yes
Duplicate Analysis:	-	No
Spike Analysis:	-	No

QC Inter-laboratory: Proficiency schemes: - Aquacheck, QUASIMEME, CONTEST.

Determinand: ARSENIC AND SELENIUM IN SOILS

Matrix: Soils, Sediments, Biota, Paper

TDIB Code: 0357 0380

Method of Analysis: ICP-MS

Principle: The dried sample is digested with nitric acid and water for easily digested tissues (including fish tissue), and with nitric acid and hydrochloric acid for other sediments, in a microwave digester. The digest is then filtered and made up to volume with distilled water and the metals determined by ICP-MS.

Range of Application: 0 - 200 µg/l (without dilution)
Range Extended with dilution of sample.

Sample Container: 500 mls Wide Neck Plastic Pot.

Soil Sample Preparation: Freeze dried and ground using a pestle and mortar

MRV: 0.1 mg/Kg.

Inst. Sens. Check: Rh Internal Standard

QC within Laboratory:

Error Target:	-	30% Total Error
Precision:	-	Better than 10% RSD
Bias:	-	Better than 10% Bias
AQC level (LOI):	-	As sediment : 23.4 mg/Kg
		Se sediment : 1,12 mg/Kg
		As Biota : 0.188 mg/Kg
		Se Biota : Not available
Current Precision:	-	Better than 10%
Performance testing:	-	No
Duplicate Analysis:	-	No
Spike Analysis:	-	No

QC Inter-laboratory: Proficiency schemes: - Aquacheck, QUASIMEME, CONTEST.

PARTIAL METALS IN SOILS AND SEDIMENTS

Determinand: Cadmium, Chromium, Copper, Lead, Nickel, Zinc, Manganese, Iron, Tin, Vanadium, Beryllium, Boron, Sodium, Potassium, Calcium, Magnesium,Sulphate

Matrix: Sediments, Soils, Biota, and Paper

Method of Analysis: ICP-MS, ICP-OES

Instrumentation ELAN 5000,6000 and OPTIMA 3300RL and/or AAS

Principle: The dried sample is digested with nitric acid and water for easily digested tissues (including fish tissue) and with nitric acid / hydrochloric acid for other sediments in a microwave digester. The digest is then filtered and made up to volume with distilled water and the metals determined by ICP-MS, ICP-OES.

Storage & Preservation: Biota – freeze. Soils, sediments - refrigerate

Range of Application: Linear over a wide dynamic range.

Sample Container: Plastic Jars (wide mouth). Bottle capacity - 300 mls. Minimum volume required - 0.5 gm dried weight.

Sample pre-treatment The sample is freeze dried.

MRV (Currently reporting):

Cd < 0.01	Pb < 0.2	Mn < 0.2	Zn < 0.25
Cr < 0.05	Ni < 0.3	Fe < 0.3	Be < 0.3
Cu < 0.2	Zn < 0.2	B < 0.7	V < 0.2
Na < 0.7	K < 0.2	Mg < 0.2	Ca < 0.2

SO_4 All mg/kg

Inst. Sens. Check: Rh Internal Standard

QC within Laboratory:

Error Target:	-	30% Total Error
Precision:	-	Better than 10% RSD
Bias:	-	Better than 10% Bias
AQC level (LOI):	-	See Table
Current Precision:	-	Better than 10% RSD
Performance testing:	-	No
Duplicate Analysis:	-	No
Spike Analysis:	-	No

QC Inter-laboratory: Proficiency schemes: - Aquacheck, Quasimeme Contest.

Determinand	Currently Reporting	Sediment AQC	Biota AQC
Cd	<0.01 mg/kg	3.45	0.31
Cr	< 0.05 mg/kg	113.2	0.8
Cu	< 0.2 mg/kg	98.6	9.0
Pb	< 0.2 mg/kg	161	1.91
Ni	< 0.3 mg/kg	44.1	1.04
Zn	< 0.2 mg/kg	438	76
Mn	< 0.2 mg/kg	555	7.3
Fe	< 0.3 mg/kg	41,000	133
Sn	< 0.25 mg/kg	9.5	N/A
Be	< 0.3 mg/kg	N/A	N/A
B	<0.7 mg/kg	N/A	N/A
V	< 0.2 mg/kg	104	N/A
Sb	< 0.3 mg/kg	N/A	N/A

Determinand: TOTAL METALS IN SOILS AND SEDIMENTS
Aluminium, Chromium

Matrix: Sediments

Method of Analysis: ICP-MS, ICP-OES AND/OR AAS

Instrumentation ELAN 5000,6000 and Optima 3300RL

Principle: The dried sample is digested with nitric acid, perchloric acid and hydrofluoric acid. The sample is then evaporated to dryness, re-dissolved in hydrochloric acid, then made up to volume with de-ionised water and the metals determined by ICP-MS and/or ICPOES.

Storage & Preservation: No

Range of Application: Linear over a wide dynamic range.

Sample Container: Plastic Jars (wide mouth). Bottle capacity - 300 mls. Minimum volume required - 0.5 gm dried weight.

Sample pre-treatment The sample is freeze dried.

MRV: Cr < 0.05 mg/Kg
Al - N/A

Inst. Sens. Check: Rh Internal Standard.

QC within Laboratory:

Error Target:	-	30% Total Error
Precision:	-	Better than 10% RSD
Bias:	-	Better than 10% RSD
AQC level (LOI):	-	Sediment Cr 135, Al 61000mg/Kg
Current Precision:	-	Better than 10% RSD
Performance testing:	-	No
Duplicate Analysis:	-	No
Spike Analysis:	-	No

QC Inter-laboratory: Proficiency schemes: - QUASIMEME

ENVIRONMENT AGENCY - LLANELLI LABORATORY		
COMPENDIUM MANUAL INORGANICS SECTION	SECTION:	10.1
	AUTHORS:	RHW/GH
	DATE:	06/07/99
DETERMINANTION OF: Total Hydrocarbons (UV Fluorescence)	ISSUE NO:	02
	PAGE 1 OF	2

Determinand: Total Hydrocarbons

Matrix: Raw, Potable, Saline Waters (Estuarine + coastal) Saline Sediments.

TDIB Code: 8732 mg/l
8731 mg/kg dry wt.

Method of Analysis: The water or sediment is extracted with pentane and the solvent extract dried and analysed by fluorescence spectroscopy.

Instrumentation: Hitachi F-2000 Fluorescence Spectrophotometer with AS 3000 auto-sampler.

Basis of Analysis:

Principle: The hydrocarbons are extracted into pentane, the extract being dried with anhydrous sodium sulphate. The hydrocarbon concentration is determined by measurement of fluorescence emitted at 360nm whilst the sample is excited at 310nm, by comparison with the fluorescence of a standard solution of Ekofisk crude oil under the same conditions.

Range of Application:

Sample Container:	Bottle Capacity	Minimum vol.req
Aqueous: Amber Glass acid washed, Rinsed with pentane	2.50L	2.50L
Sediments: Glass stoppered, acid Washed, pentane rinsed.	500ml	50g

Storage/Preservation: Aqueous samples refrigerated at 2 - 8°C.
Sediments frozen at -18°C.

MRV: 0.2µg/l
0.05 mg/kg dry wt.

Inst. Sens. Check: Y

QC within Laboratory:	Error Target:	-	Better than 20%
	Precision:	-	Better than 5% RSD
	Bias:	-	Better than 10%
	AQC level (LOI):	-	0.4 mg/l
	Current Precision:	-	0.904%
	Performance testing:	-	Y
	Duplicate Analysis:	-	Y
	Spike Analysis:	-	Y
QC Inter laboratory:	Proficiency schemes:	-	N
	Other:	-	N

ENVIRONMENT AGENCY - LLANELLI LABORATORY	
COMPENDIUM MANUAL INORGANICS SECTION	SECTION: 10.2.1
	AUTHORS: GH
	DATE: 03/01/02
Determination of: TOTAL OIL AND GREASE IN SEDIMENTS	ISSUE NO: 2
	PAGE: 1 OF 1

Sample Matrix: Soils Sediments and Sludges

Determinand Code: 1079

Reporting Units: mg/kg

Instrumentation: ATI Mattson Genesis FTIR

Method of Analysis: The hydrocarbon oils are extracted by solid-liquid extraction into tetrachloroethylene and determined by infra red absorption spectroscopy.

Principle: Hydrocarbons are extracted with tetrachloroethylene and the concentration is calculated by measuring the infra red absorbencies absorbencies over the range 3100-2700cm $^{-1}$ at the C-H stretching frequencies 2930, 2960 and 2860 cm^{-1} compared with the absorbencies obtained from calibration standards of 37.5% Isooctane, 37.5% hexadecane, 25% benzene.

Range of Application: Up to 10mg/kg using 5cm cell 1cm cell
>200mg/kg using 1cm cell & >1.25 using 10cm cell

Sample Container: Plastic Sludge pot - minimum weight 50g. SED HC

Storage/Preservation: Refrigerated at 2 - 8°C.

LOD: 0.01 g/Kg

Standard Turnround: 10 days

Within Laboratory Quality Control & Performance Criteria:

QC* standard at LOI**	- 5mg/l
Total error Target	Better than 40%
Bias Targets	Better than 15%
Precision targets (RSD***)	Better than 5% RSD
Performance testing to WRc NS30	

External Quality Control: NONE

* QC - Quality Control *** RSD - Relative Standard Deviation
** LOI - Level of Interest (derived from environmental monitoring & regulatory requirements)

Any deviation from the above must be by agreement with the customer & the laboratory Oilgr10.2.1

ENVIRONMENT AGENCY - LLANELLI LABORATORY	
COMPENDIUM MANUAL ORGANICS SECTION	SECTION: ORGANICS AUTHORS: A. GRAVELL DATE: 22/10/ 2003
Determination of: PENTACHLOROPHENOL	ISSUE NO: 01 PAGE 1 OF 1

Determinand: Pentachlorophenol

Matrix: Sediment and Soil

Method of Analysis: Gas Chromatography/Mass Spectrometry

Basis of Analysis: In House Method

Principle: The sample is freeze dried and ground in a pestle and mortar. 1g of the freeze dried sample is placed in a 40ml screw cap glass vial. The sample is spiked with PCP surrogate standard (standard used is C13 PCP) and allowed to soak into the sample. Add 40ml of 1:1 Hexane Acetone to the vial and mix well. Sonicate for one hour and leave overnight. Filter solvent from sample and place in a turbovap tube. Rinse the sample with a further 10ml of hexane, filter, and add this to the turbovap tube. Evaporate to 0.5ml and derivatise with diazomethane (methylation). Analyse extract with Gas Chromatography with Mass Spectrometric detection.

Sample Container: 250ml wide necked glass jar (SEDO)

Storage/Preservation: Stored in Cold Room at 2-8°C.

MRV: 15ug/kg

Inst. Sens. Check: Yes

QC within Laboratory:

Error Target:	-	50%
Precision:	-	15%
Bias:	-	20%
AQC level (LOI):	-	400ug/kg
Current Precision:	-	See AQC Charts
Performance testing:	-	Yes
Duplicate Analysis:	-	Yes
Spike Analysis:	-	Yes (AQC)

QC Inter-laboratory: Proficiency schemes: - N/A

ENVIRONMENT AGENCY - LLANELLI LABORATORY		
COMPENDIUM MANUAL INORGANICS SECTION	SECTION:	10.1
	AUTHORS:	RHW/GH
	DATE:	06/07/99
DETERMINANTION OF: Total Hydrocarbons (UV Fluorescence)	ISSUE NO:	02
	PAGE 1 OF	2

Determinand: Total Hydrocarbons

Matrix: Raw, Potable, Saline Waters (Estuarine + coastal) Saline Sediments.

TDIB Code: 8732 mg/l
8731 mg/kg dry wt.

Method of Analysis: The water or sediment is extracted with pentane and the solvent extract dried and analysed by fluorescence spectroscopy.

Instrumentation: Hitachi F-2000 Fluorescence Spectrophotometer with AS 3000 auto-sampler.

Basis of Analysis:

Principle: The hydrocarbons are extracted into pentane, the extract being dried with anhydrous sodium sulphate. The hydrocarbon concentration is determined by measurement of fluorescence emitted at 360nm whilst the sample is excited at 310nm, by comparison with the fluorescence of a standard solution of Ekofisk crude oil under the same conditions.

Range of Application:

Sample Container:	Bottle Capacity	Minimum vol.req
Aqueous: Amber Glass acid washed, Rinsed with pentane	2.50L	2.50L
Sediments: Glass stoppered, acid Washed, pentane rinsed.	500ml	50g

Storage/Preservation: Aqueous samples refrigerated at 2 - 8°C.
Sediments frozen at -18°C.

MRV: 0.2µg/l
0.05 mg/kg dry wt.

Inst. Sens. Check: Y

QC within Laboratory:	Error Target:	-	Better than 20%
	Precision:	-	Better than 5% RSD
	Bias:	-	Better than 10%
	AQC level (LOI):	-	0.4 mg/l
	Current Precision:	-	0.904%
	Performance testing:	-	Y
	Duplicate Analysis:	-	Y
	Spike Analysis:	-	Y
QC Inter laboratory:	Proficiency schemes:	-	N
	Other:	-	N

APPENDIX 3 PORTLAND HARBOUR AVERAGED DATA																		
Species Name	**1**	**4**	**5**	**6**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
Virgularia mirabilis	0	0	4.25	3	1.5	0.25	3	3.25	0	0.25	2	0	1	3.25	1.5	2	1.75	3.75
Edwardsiidae sp.	7.25	6.5	2.75	1.75	7.75	4.5	3	4.75	2.5	6.25	7.5	0.5	16.25	5.25	1	8.75	5	3.5
Nemertean indet (combined)	4	5.25	0.25	0	3.25	0	0.5	0	0.5	0.25	0	0.75	0	0	0	0	0.25	0
Tubulanus superbus	9.25	12	1	0	16	0	0	0.5	4.75	0	0.75	2.5	1.75	0.25	0	1.25	1.5	0.25
Cerebratulus sp.	1	0	0.5	0	0.25	0	0.25	0	0.5	0.25	0	0.5	0.5	0.25	0.25	0	0	0.5
Tetrastemma sp.	0.25	0	0	0	0.25	0.25	0	0	0.25	0	0	0	0.25	0	0	0	0	0
Tetrastemma coronatum	0	0	0	0	0.25	0	0	0	0.25	0	0	0.5	0	0	0	0	0	0
Tetrastemma longissimum	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0
Golfingia spp. indet.	2.25	0.25	0.25	0	0	0	0	0	0.75	0.25	0.25	0.5	0.25	0	0	0	0.25	0
Golfingia vulgaris	0.25	0	0	0	0	0	0	0	0	0	0.25	0	0	0.25	0	0	0.25	0
Phascolion strombus	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Harmothoe spp. indet.	0.75	0.25	0	0	1.25	0	0	0	3.5	0	0.25	3.5	1.25	0.25	0.5	0.25	0.25	0
Harmothoe imbricata	0	0	0	0	0.25	0	0	0.75	0	0	0	0	0	0	0	0	0	0
Harmothoe impar	2	1	0	0	1.75	0	0	0	0	0	0	0	0	0	0	0	0	0
Harmothoe spinifera	2.25	1	0	0	0	0	0	0	2.25	0	0	3.25	1	0	0	0	0	0
Harmothoe andreapolis / Malmgrenia andreapolis*	0	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0
Lepidonotus squamatus	0	0	0	0	0	0	0	0	0	0	0.25	0	0.25	0	0	0	0	0
Pholoe minuta	6.75	0.25	0	0	0.25	0	0	0	0	0	0	0	0.25	0	0	0.25	0	0
Pholoe synophthalmica	4.5	3.5	0	0	0.5	0	0	0	0	0	1	0.25	0	0	0	0	0	0
Sthenelais boa	0.25	0.75	0.25	0	0.25	0	0	0	0	0	0.75	0	1.5	0.25	0	0	1	0
Eteone flava / longa	0.25	1.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mysta picta	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0
Pseudomystides limbata Saint	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anaitides spp. indet. [juv.]	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0
Anaitides mucosa	1.5	0.25	0	0	0	0	0	0	1	0	0.25	0.25	0.5	0	0	0	0	0
Eumida spp. indet. [juv.]	0.25	0.25	0.25	0	0	0	0	0	0	0	0	0.75	0	0	0	0	0	0
Eumida bahusiensis	0.25	1	0	0	0.75	0	0	0.25	1	0	0.25	0.75	0	0	0	0	0	0
Paranaitis kosteriensis	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glycera spp. indet. [juv.]	0.25	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glycera alba	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0
Glycera rouxi	0	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sphaerodorum gracilis	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0	0
Hesionidae sp.	0.25	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0	0	0	0
Kefersteinia cirrata	0	0	0	0	0	0	0	0	6.5	0	0	12.5	0.25	0	0	0	0	0
Ophiodromus flexuosus	6.25	0.5	0	0	0.75	0	0	0	0.5	0.25	0	1	0	0.25	0.25	0	0.25	0
Syllidia armata	1	3.25	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0.25	0
Syllidae sp.	0	0	0	0	0.25	0	0	0	0	0	0	0.25	0	0	0	0	0	0
Haplosyllis spongicola	0.25	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0
Syllis sp.	1.25	0.25	0	0	0.5	0	0	0	0.25	0	0	0	0	0	0	0	0	0
Typosyllis armillaris	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0.25	0	0	0	0
Odontosyllis ctenostoma	0	0	0	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0
Odontosyllis gibba	0.25	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Exogone hebes	4.25	8	0	0	1	0	0	0	0	0	0	0.25	0	0	0	0	0	0
Exogone naidina	0	0.75	0	0	0.25	0	0	0	0.25	0	0	0.25	0	0	0	0	0	0
Sphaerosyllis spp. indet.	1	5	0	0	3.5	0	0	0	1.5	0	0	3.25	0	0.25	0	0	0.25	0
Neanthes irrorata	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Perinereis cultrifera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Platynereis dumerilii	12	1.25	0	0	8.75	0	0	0	7	0	0.25	16.25	0.25	0.25	0	0	0.25	0
Nephtys spp. indet. [juv.]	0	3.25	0.5	1.75	0.75	0	2.25	0	0.75	0.25	0.5	0.25	0.25	0	0.5	0	0.25	2.5
Nephtys caeca	0	0	0	0	0.75	0	0	0	0	0	0	0.25	0	0	0	0	0	0
Nephtys hombergii	0	0.75	0	0	0.25	0	0	0	0.25	0	0	0	0	0	0	0	0	0
Nephtys kersivalensis	0.5	0.25	0	0	0.5	0	0.25	0	0.25	0	0	0	0	0	0	0	0	0
Nephtys incisa	0.25	0	3.5	0.75	1.75	0	1.5	6.75	0.25	0	10.75	0	12.5	23	6.5	11	5	0
Nematonereis unicornis	3.25	1.5	0	0	0.25	0	0	0	0.75	0	0	1.75	0	0	0	0.25	0	0

APPENDIX 3 PORTLAND HARBOUR AVERAGED DATA																		
Species Name	**1**	**4**	**5**	**6**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
Lumbrineris spp. indet. [juv.]	1	22.75	0.5	0	0	0	0	0	0	0	0	0.25	0.75	0.5	0	0	0	0
Lumbrineris sp.	0	0	0	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0
Lumbrineris gracilis	7.5	16.75	0.25	0	2.75	0	0	0	6.25	0	0	4.75	0	0	0	0.5	0.25	0
Drilonereis filum	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ophryotrocha hartmanni	0	1.5	0	0	2.25	0	0	0	0	0.25	0	0	0	0	0	0	0	0
Protodorvillea kefersteini	8	0.25	0	0	0.25	0	0	0	0.5	0	0	0	0	0	0	0	0	0
Schistomeringos rudolphi	0.5	0.25	0	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0
Orbinia sertulata	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scoloplos armiger	0.25	1	0	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0
Aricidea catherinae	0.25	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cirrophorus furcatus	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paradoneis lyra	2.75	1.5	0	0.25	1.25	0	0	0	0	0	0	0	0	0	0	0	0	0
Poecilochaetus serpens	0.5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
*Aonides oxycephala /*Aonides paucibranchiata*	0	1.75	0	0	0.5	0	0	0	0.25	0	0	0.25	0	0	0	0	0	0
Malacoceros fuliginosus	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Minuspio cirrifera	0	0	0	0	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0
Polydora spp. indet.	0	0	0	0	0.75	0	0	0	0	0	0.75	0.5	1.25	0.5	0	0	0	0
Polydora caeca	0	0	0	0	0.75	0	0	0	0.25	0	0	0	0.75	0	0.5	0	0.75	0
Polydora ciliata	0	0	0	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0
Polydora quadrilobata	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0
Prionospio fallax	3.5	10.25	0.25	0	3.25	0	0	0	3.25	0	0	1.25	0.25	0	0	0.25	0.75	0
Pseudopolydora pulchra	0	1.25	0	0	0.5	0	0	0.5	0	0	0	0	1	2.5	0.25	0.5	0	0
Spio spp. indet. [juv.]	0	1	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spio filicornis	0.25	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Magelona spp. indet.	1.25	0.5	0	0	1.25	0	0	0	0	0	0	0	0	0	0	0	0.25	0
Magelona equilamellae	0.5	1.5	0	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0
Magelona minuta	0	0	0.25	0	0	0	0.25	0	0	0	0	0	0	0.25	0	0	0	0
Cirratulidae indet. [juv.]	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0.5	0
*Cirratulidae sp / *Protocirrineus chrysoderma*	0	0	0	0	17.75	0	0	0	0	0	0	0	0	0	0	0	0	0
Caulleriella alata	0.5	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0
Caulleriella bioculata	15.25	1	0	0	1.75	0	0	0	0.25	0	0	0	0	0	0	0	0	0
Tharyx killariensis	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caulleriella zetlandica	2.25	55.25	0	0.25	1	0	0	0	0.5	0	0	0	0	0	0	0	0	0
Chaetozone gibber	28.75	228	19.25	2	146	0.75	1	5.25	163.75	9.25	11.5	22.75	20.75	5.5	7.75	9.25	39.5	0.75
Cirratulus chrysoderma	66	20.25	0	0	1.5	0	0	0	0.75	0	0	0	0	0	0	0	0.75	0
*Cirriformia tentaculata / *Cirratulus sp juv*	32.5	2.75	0	0	7	0	0	0	24.25	0	0	42.75	1	0	0	0	1	0
Dodecaceria concharum	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0
*Tharynx sp / *Tharynx A*	0	0	0	0	2.25	0	0	0	0	0	0	0	0	0	0	0	0	0
Aphelochaeta marioni	20.75	106	0.5	0	219	0	0	0	143.75	0.5	1.25	92.25	62.75	2.75	1	11	3.25	0
Monticellina dorsobranchialis	256	47.5	4.25	0	3.5	0	0	1.75	11.75	0	0	0.75	1.5	0	0.5	0	2.5	0
Cossura longocirrata	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0
Brada villosa	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0
Diplocirrus glaucus	0.25	0.5	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pherusa plumosa	3	0	0	0	0	0	0	0	0.25	0.75	0.25	0.25	0	0	0	0	0	0
Sternaspis scutata	0	1	35.5	14.25	28.25	26.75	10	12.5	2	19.25	19.5	10.5	15.5	35	21.5	29.75	27.5	24.75
Capitella spp. agg.	0.5	5.25	0	0	0.25	0	0	0	2.5	0	0.25	2.25	0	0	0	0	0	0
Heteromastus filiformis	0.5	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mediomastus fragilis	9.25	30	0.25	0	6.25	0	0	0	19.75	0	0	26.25	3	0.25	0	0	0.5	0
Notomastus latericeus	3.75	2.5	0.5	0	0.5	0	0	0	0.25	0	0	1.5	0	0	0	0	0	0
Maldanidae sp.	2	1.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
*Lumbriclymene minor/ *Clymenura*	1.25	2.75	0	0	14.25	0	0	0	6	0	0	1.5	0.75	0	0	0.5	1.25	0

APPENDIX 3 PORTLAND HARBOUR AVERAGED DATA																		
Species Name	**1**	**4**	**5**	**6**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
*Euclymene oerstedii / *Praxillella affinis*	54	102.75	4.5	0.5	26.25	0	0.25	0.5	10.25	0	1	1.25	3.25	1.5	0.5	1.5	1	0
Ophelia limacina	0	0	0	0	0.25	0	0	0	1.25	0	0	4.75	0	0	0	0	0	0
Ophelina modesta	0.5	3.5	0	0	3.25	0	0	0	0	0	0	0	0	0	0	0	0	0
Scalibregma celticum	0.25	0.25	0	0	0.25	0	0	0	0	0	0	0.25	0	0	0	0	0	0
Scalibregma inflatum	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Galathowenia oculata	5	14	0	0	1.25	0	1.25	0.25	1.5	0	0.5	0	1	2	0.5	3.75	6	0.25
Amphictene auricoma	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0	0
Lagis koreni	0	0	0	0	0.25	0.25	0	0	0	0	0	0	0	0	0	0	0.25	0
Melinna palmata	36.75	139	172.25	57.25	153	30.5	116.75	101.75	46.25	47.25	127.75	7.5	92.5	157.25	147.75	86.25	70	91.25
Ampharete sp.	1.25	4.5	0	0	0.25	0	0	0.75	0	0	0	0	0	0	0	0	0	0
Ampharete lindstroemi	5.25	4.25	0.75	1.25	3.5	0	0.25	0	2.25	0	1.25	1.5	3.25	0	0	2.5	8	0
Amphicteis midas	2	0.25	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0
Terebellides stroemi	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trichobranchus roseus	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0.25	0
Eupolymnia nesidensis	0.5	0	0	0	0.25	0	0	0	0	0	0	0.5	0	0	0	0	0.5	0
Lanice conchilega	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neoamphitrite affinis	0	0.75	0	0	0	0	0	0.25	0	0	0	0	0.5	0	0	0	0	0
Pista cristata	3.25	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amaeana trilobata	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0
Polycirrus spp. indet. [juv.]	5	1	0	0	0.25	0	0	0	2.25	0	0	2.5	0	0	0	0.25	0	0
Polycirrus caliendrum	0.25	0	0	0	0	0	0	0	0	0	0	0.25	0.75	0	0	0	0	0
*Chrone duneri / *Jasmineira elegans*	0.5	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0	0
Myxicola aesthetica	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pseudopotamilla reniformis	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tubificidae sp.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tubificoides benedii	2.25	2.75	0.25	0.75	225	0	0	0	138.25	0.5	1	100.75	15	0.25	0	0	1.5	0
Tubificoides insularis	15.25	88.5	0.75	0.25	29.75	0	0.5	0.5	5.25	2.5	0.5	61	0.75	0	0	0	8.25	0
Limnodriloides spp. indet.	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hirudinea indet.	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Achelia echinata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0
Anoplodactylus petiolatus	0.25	0	0	0	0	0	0	0	0	0	0.25	0	0	0.25	0	0	0	0
Harpacticoida sp.	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0	0	0	0
Ascidicola rosea	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0
Asterope norvegica	2.5	6.25	0	0	0	0	0	0	0.5	0	0	0.75	0	0	0	0.5	0	0
Philomedes brenda	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gastrosaccus sp.	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0
Nebalia herbstii	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0	0	0	0
Apherusa ovalipes	0	0.5	0	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0
Monoculodes subnudus	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leucothoe lilljeborgi	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0
Leucothoe spinicarpa	0.25	0	0	0	0.25	0	0	0	0.25	0	0	0.5	0	0	0	0	0	0
Harpinia crenulata	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Harpinia pectinata	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Parametaphoxus fultoni	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25
Metaphoxus pectinatus	8.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acidostoma nodiferum	0	0	0	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0
Orchomene humilis	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0
Dexamine spinosa	0	0	0	0	0.25	0	0	0	0.25	0	0	0.25	0	0	0	0	0	0
Ampelisca spp. indet.	0.25	0.25	0	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0
Ampelisca brevicornis	0	0.5	0	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0
Ampelisca spinipes	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ampelisca tenuicornis	0	4	0.75	0	0	0	0.25	0	0	0	2	0	0.75	1.25	0.25	2.25	1.5	0.25
Cheirocratus sundevallii	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

APPENDIX 3 PORTLAND HARBOUR AVERAGED DATA																		
Species Name	**1**	**4**	**5**	**6**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
Gammarella fucicola	5.75	0.75	0	0	0	0	0	0	0.25	0	0	0	0	0	0	0	0	0
Maera grossimana	2.25	0.25	0	0	0.5	0	0	0	0.75	0	0	1.75	0	0	0	0	0	0
Ampithoe rubricata	0.25	2.5	0	0	5	0	0	0	0	0	0	1	0	0	0	0	0	0
Gammaropsis maculata	0	0	0	0	0.25	0	0	0	0	0	0	0.25	0	0	0	0	0	0
Ericthonius brasiliensis	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aora gracilis	0	0.5	0	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0
Microdeutopus anomalus	29.75	7.25	0	0	6.75	0	0	0	19.75	0.25	0.5	36.25	0.25	0	0.25	0	0.5	0
Microdeutopus versiculatus	12.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corophium sextonae	0	0.25	0	0	0.25	0	0	0	0.25	0	0	0.75	0	0	0	0	0	0
Caprellidae indet.	0	0	0	0	0.25	0	0	0	0.5	0	0	0	0	0	0	0	0	0
Pariambus typicus	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5
Phtisica marina	7.75	4.75	0	0	0	0	0	0	0.75	0	0	1	0.5	0	0	0	0	0
Gnathia oxyuraea	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Munna kroyeri	0	2	0	0	0	0	0	0	0.25	0	0	0	0	0	0	0	0	0
Munna minuta	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0
Astacilla longicornis	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leptochelia dubia	0	1	0	0	0	0	0	0	1	0	0	1.75	0	0	0	0	0.25	0
Tanaopsis graciloides	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apseudes latreillii	25	58.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eudorella truncatula	0	0.25	0.25	0	0	0	0	0	0	0	0	0	0.75	0	0	0	1.5	0
Diastylis rugosa	0	1.25	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0,5	0
Palaemon adspersus	0	0	0	0	0	0	0	0	0.25	0	0	0.5	0	0	0	0	0	0
Athanus nitescens	0.5	0	0	0	0.25	0	0	0	0.75	0	0	1	0	0	0	0	0	0
Hippolyte varians	0	0.25	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0
Thoralus cranchii	0.25	1	0	0	1	0	0	0	0.5	0	0	0.75	0	0	0	0	0	0
Processa canaliculata	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crangon bispinosus neglecta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25
Crangon fasciatus	0	0	0	0	0.25	0	0	0	0	0	0	0.25	0	0	0	0	0	0
Upogebia deltaura	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0	0
Paguridae indet.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0
Pagurus cuanensis	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Galathea intermedia	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0
Pisidia longicornis	0.75	0	0	0	0	0	0	0	0.75	0	0.25	2	0.25	0	0	0	0	0
Macropodia deflexa	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Macropodia linaresi	0	0	0	0	0.25	0	0	0	0	0	0	0.5	0	0	0	0	0	0
Pisinae indet.	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0
Liocarcinus arcuatus	0.25	0	0	0	0.75	0	0	0	1.25	0	0	1	0.25	0	0	0	0	0
Carcinus maenas	0.5	0	0.25	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0
Pinnotheres pisum	0	0	0	0	0.25	0	0	0	0	0	0	0	0	0	0.25	0	0	0
Polyplacophora sp.	4	0	0	0	1.25	0	0	0	1.5	0.5	0	0	0	0	0	0	0	0
Leptochiton asellus	2	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0
Lepidochitona cinereus	1	0	0	0	0	0	0	0	0	0	0	4.25	0	0	0	0	0	0
Callochiton septemvalvis	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0
Acanthochitona crinitus	0	0	0	0	0.5	0	0	0	0.5	0	0	0.75	0	0	0	0	0	0
Tectura testudinalis	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tectura virginea	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0
Gibbula spp. indet. [juv.]	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gibbula cineraria	0.75	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0
Tricolia pullus	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rissoa interrupta	0	0.25	0	0	0.25	0	0	0	3	0	0	0.5	0	0	0	0	0	0
*Rissoa parva / *Rissoa lilacina*	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0.25	0.25
Onoba semicostata	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0
Turritella communis	0	0	0.25	0	0	0	0.25	0	0	0	0	0	0	0.75	0	0	0	0.25
Bittium reticulatum	25.5	5.25	0	0	2.25	0	0	0	6.5	2	0	9	0.25	0	0	0	1.25	0
Chrysallida indistincta	0	0	1	0	0	0	0.75	0	0.25	0.5	1.5	0.25	0.25	0.25	0	0	0.5	11.25

APPENDIX 3 PORTLAND HARBOUR AVERAGED DATA																		
Species Name	**1**	**4**	**5**	**6**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
Odostomia spp. indet.	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0	0	1.25
Turbonilla lactea	0	0.5	0	0	0	0	0.5	0	0.25	0	0	1.5	0	0	0	0	0	0
Turbonilla acuta	0	0.25	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0.5
Epitonium turtonis	0	0	0	0	0	0	0.25	0	0	0	0	0	0	0	0	0	0	0
Calyptraea chinensis	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crepidula fornicata	11.5	1.5	0	0	8	1.5	0	0	7.75	1.75	4.25	14.25	24.25	5.75	0	4.5	22	0
Polinices fuscus	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hinia incrassata	1.5	0	0	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	1
Hinia pygmaea	1.75	0.25	1.25	0.5	0	0	1	1.75	0.5	0.25	2.5	0	0	1.25	0.75	0.25	0.75	1.5
Hinia reticulata	0.75	0	0	0	0.25	0	0	0	0	0.25	0	2	0	0.25	0	0.25	2	0
Haedropleura septangularis	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cylichna cylindracea	0	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Philine aperta	0	2.5	0.5	0	1.75	0.25	1.25	2.75	0.25	0	3.5	0.25	2	1.75	2.5	1.25	2	2.5
Philine scabra	0	0	0	0.75	0	0	0	0	0	0	0	0.75	0	0	0.25	0	0	0
Akera bullata	0	0	0	0	0	0	0	0.25	0	0	0	0.5	0	0	0	0	0	0.25
Aplysia spp. indet.	0	0	0	0	0	0.5	0	0	0	0.5	0	0	0	0	0	0	0	0
Pelecypoda indet. [damaged]	1.25	1.5	0.5	0	0.5	0	0.25	0	0	0	0	0	0	0	0	0	0	3
Nucula nitidosa	0.5	1.75	9	6.5	8.5	13	12.25	13.25	5.75	13.25	24.25	1	5.5	20.5	33.25	7.5	17	24.5
Nucula nucleus	4	0.25	0	0	0	0	0	0	0	0.25	0.25	1.5	0	0	0	0	0	0
Musculus discors	0	0	0	0	0.25	0	0	0	0.25	0	0	0	0	0	0	0	0	0
Lucinoma borealis	0.75	0	0	0	0	0	0	0	1.75	0	0	0	0	0	0	0	0	0
Thyasira flexuosa	4.5	14.5	6.5	0	3.5	0	0.5	2.5	5	0.25	6.75	0.75	8	11.5	2.25	5.5	2.5	1
Mysella bidentata	3	1	0	0	0	0.25	1.5	0	1	0.5	0.5	1.75	0.25	0	0	0.25	0.75	0
Tellimya ferruginosa	0	0	0	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0.25
Parvicardium exiguum	2.25	0.75	0	0	0	0.25	0	0	3	0.25	0	1.25	0.25	0	0	0	0	0
Phaxus pellucidus	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0.25	0	0
Abra alba	2.5	2.5	3.25	0	1	0	0.25	1	2.75	0	8.25	3.25	3	5.25	3.25	1.5	2.25	3
Abra nitida	0	0.25	0	0	0	0	0	0	0	0	0	0	0.25	1.75	0	0.25	0.25	0.25
Venus verrucosa	0.25	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0
Dosinia lupinus	2.75	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dosinia exoleta	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tapes rhomboides	2	0	0	0	0	0	0	0	0.5	0	0	0.5	0.25	0	0	0	0	0
Venerupis senegalensis	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mya truncata	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corbula gibba	0.25	0.25	1.5	1	0	0.25	2.25	1.75	0	0	2	0.25	0.75	3.25	1.75	2.75	2.5	4.5
Pandora pinna	0	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thracia phaseolina	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phoronis spp. indet.	2.75	0	12.75	4.25	0	0	14.5	27.5	0	0	16.5	0	9.25	28	0	0.5	0.5	0.25
Amphiura filiformis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	0	0.25
Amphipholis squamata	26	9	0	0	2	0	0	0	11.75	2.25	0.25	4.25	1	0.75	0	0	1	0
Leptopentacta elongata	0	0	0	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0
Paracucumaria hyndmani	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0
Leptosynapta inhaerens	0	0	0.75	0	0	0	0	0.75	0	0	0.25	0	0	0.5	0.75	0	0.5	0
* Possible misidentification of species following AQC																		

APPENDIX 4

UNIVARIATE STATISTICS USING THE AVERAGED DATA

	S	N	d	J	H (loge)	h(log2)	H(log10)	Llambda
1	146	906	21.2952	0.67362	3.35708	4.84324	1.45796	0.90193
4	119	1133.25	16.7784	0.63812	3.04967	4.39975	1.32446	0.91277
5	46	294	7.91755	0.45747	1.7515	2.52688	0.76067	0.63559
6	18	97	3.71608	0.53971	1.55997	2.25056	0.67749	0.62758
8	111	1014	15.8921	0.53774	2.53249	3.65362	1.09985	0.85784
9	14	79.25	2.97305	0.5577	1.47181	2.12338	0.6392	0.7163
10	29	176.75	5.4109	0.43594	1.46795	2.1178	0.63752	0.55079
11	25	191.75	4.56604	0.55599	1.78965	2.58193	0.77724	0.6888
12	86	710.5	12.9455	0.58529	2.6071	3.76125	1.13225	0.86064
13	31	111.75	6.36097	0.57995	1.99153	2.87316	0.86491	0.77268
14	48	265.5	8.4205	0.55712	2.15673	3.1115	0.93666	0.7469
16	103	543.25	16.1967	0.6455	2.99173	4.31615	1.29929	0.90748
17	58	323	9.8656	0.63451	2.57638	3.71693	1.11891	0.8623
18	44	326	7.43058	0.53929	2.04076	2.9442	0.88629	0.7389
19	27	236.25	4.75764	0.43394	1.43021	2.06335	0.62113	0.58084
20	37	199	6.80104	0.60657	2.19028	3.15991	0.95123	0.77962
21	61	252.25	10.8491	0.65166	2.67891	3.86485	1.16344	0.87341
22	31	184.5	5.74972	0.54141	1.85918	2.68224	0.80743	0.71744

APPENDIX 5

SHOWS THE CONTRIBUTION OF SPECIES TO THE WITHIN GROUP SIMILARITY A,B,C and D.

GROUP B Average similarity: 37.66	**Average Abundance**	**Average Similarity**	**%Contribution**	**Cumulative %**
**Euclymene oerstedii/Praxillella affinis*	78.38	5.3	14.06	14.06
Monticellina dorsobranchialis	151.75	4.66	12.37	26.43
Melinna palmata	87.88	3.6	9.57	36
Chaetozone gibber	128.38	2.82	7.49	43.49
Apseudes latreillii	41.75	2.45	6.51	50
GROUP A Average similarity: 65.9				
Melinna palmata	116.35	39.81	60.4	60.4
Sternaspis scutata	23.15	7.26	11.02	71.42
GROUP C Average similarity: 56.89				
Tubificoides benedii	154.67	15.01	26.4	26.4
Aphelochaeta marioni	151.67	14.41	25.34	51.75
GROUP D Avergage similarity:68.61				
Melinna palmata	45	37.27	54.33	54.33
Sternaspis scutata	20.08	16.66	24.28	78.61

(N.B. A 50% cumulative cut off point was used or the two top species in a particular group)

APPENDIX 6

TABLES SHOWING THE CONTRIBUTION (%) OF SPECIES ACCOUNTING FOR THE DISSIMILARITIES BETWEEN GROUPS USING A 60 % CUT OFF.

GROUPS B & A Average dissimilarity: 81.27	**GROUP B Average Abundance**	**GROUP A Average Abundance**	**Average Dissimilarity**	**Contribution %**	**Cumulative %**
Monticellina dorsobranchialis	151.75	1.05	12.79	15.74	15.74
Chaetozone gibber	128.38	12.05	8.68	10.69	26.42
**Euclymene Oerstedii/Praxillella affinis*	78.38	1.4	5.98	7.35	33.77
Melinna palmata	87.88	116.35	4.7	5.79	39.56
Aphelochaeta marioni	63.38	8.25	4.47	5.5	45.05
Tubificoides insularis	51.88	1.13	3.79	4.66	49.72
Cirratulis chrysoderma	43.13	0.08	3.6	4.43	54.15

GROUPS B & D Average dissimilarity: 89.81	**GROUP B Average Abundance**	**GROUP D Average Abundance**	**Average Dissimilarity**	**Contribution %**	**Cumulative %**
Monticellina dorsobranchialis	151.75	0	14.71	16.37	16.37
Chaetozone gibber	128.38	4.0	10.35	11.53	27.9
**Euclymene oerstedii/Praxillella affinis*	78.38	0.17	6.86	7.64	35.54
Aphelochaeta marioni	63.38	0.17	5.33	5.94	41.48
Melinna palmata	87.88	45	4.45	4.95	46.43
Tubificoides insularis	51.88	0.92	4.28	4.76	51.19
Cirratulis chrysoderma	43.13	0	4.12	4.58	55.77

GROUPS A & D Average dissimilarity: 50.22	**GROUP A Average Abundance**	**GROUP D Average Abundance**	**Average Dissimilarity**	**Contribution %**	**Cumulative %**
Melinna palmata	116.35	45	20.93	41.68	41.68
Phoronis spp. Indet.	10.98	1.42	3.11	6.2	47.88
Chaetozone gibber	12.05	4.0	2.82	5.61	53.48

GROUPS B & C Average dissimilarity: 63.33	**GROUP B Average Abundance**	**GROUP C Average Abundance**	**Average Dissimilarity**	**Contribution %**	**Cumulative %**
Monticellina dorsobranchialis	151.75	5.33	8.77	13.85	13.85
Tubificoides benedii	2.5	154.67	8.39	13.25	27.11
Chaetozone gibber	128.38	110.83	5.74	9.06	36.16
Aphelochaeta marioni	63.38	151.67	5.17	8.16	44.32
**Euclmene oerstedii/Praxillella affinis*	73.38	12.58	3.74	5.9	50.22

GROUPS A & C Average dissimilarity: 78.47	**GROUP A Average Abundance**	**GROUP C Average Abundance**	**Average Dissimilarity**	**Contribution %**	**Cumulative %**
Tubificoides benedii	1.4	154.67	14.91	19.01	19.01
Aphelochaeta marioni	8.25	151.67	13.95	17.78	36.78
Chaetozone gibber	12.05	110.83	9.49	12.09	48.88
Melinna palmata	116.35	68.92	8.12	10.35	59.22

GROUPS D & C Average dissimilarity: 86.52	**GROUP D Average Abundance**	**GROUP C Average Abundance**	**Average Dissimilarity**	**Contribution %**	**Cumulative %**
Tubificoides benedii	0.42	154.67	17.68	20.43	20.43
Aphelochaeta marioni	0.17	151.67	17.31	20.01	40.44
Chaetozone gibber	4.0	110.83	11.85	13.70	54.14

APPENDIX 7

PORTLAND HARBOUR FIELD NOTES

SITE LOCATION	FIELD DESCRIPTION
1	Sand and gravel. Sample C contained sea squirts.
2	Mud and sand
3	Chemistry only
4	Mud and sand over clay. Sample A contained cobbles and Snakelocks anemone. Sample B contained cobbles.
5	Mud and sand
6	Mud and sand
7	Not sampled
8	Crepidula on mud
9	Muddy sand
10	Mud and sand
11	Muddy sand
12	Crepidula and shells
13	Mud and gravel
14	Sand and mud
15	Not sampled
16	Shells, mud and sea squirts
17	Mud over clay with sea squirts and crepidula
18	Full soft mud. Sample C contained sea squirts
19	Soft mud. Sample D soft mud over clay.
20	Soft Mud over clay. Sample D contained sea squirts.
21	Soft mud. Samples C and D consisted of soft mud over clay
22	Soft mud
A	Chemistry only
B	Chemistry only
C	Chemistry only
D	Chemistry only
E	Shells and mud. Anoxic layer only a few mm below the surface.
F	Soft mud over clay.

APPENDIX 8

TABLES SHOWING THE SEDIMENT CHEMISTRY DATA

	Sites														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	17
Mercury (mg/kg)	0.07	0.14	0.09	0.11	0.22	0.11	no data	0.089	0.159	0.187	0.228	0.129	0.167	0.191	0.221
Cadmium (mg/kg	0.13	0.1	<0.1	0.11	<0.1	<0.1	no data	0.17	0.12	0.17	0.1	0.18	0.15	0.13	0.19
Copper (mg/kg)	11.8	14.2	14.2	13	16	14.9	no data	15.3	15.1	14.7	14	15.9	16.8	17.1	23.3
Lead (mg/kg)	22	27.1	30.1	26.6	33.2	30.7	no data	29.2	34.7	36.4	35.1	32.1	39.1	28.2	47.9
Nickel (mg/kg)	17.9	22.8	29	23.3	29.6	28.4	no data	23.4	26.8	28.1	27.4	19.1	27.9	28.9	28.4
Zinc (mg/kg)	56.8	57.5	71.8	65.5	75.7	74.7	no data	65.8	70.8	72.9	70.2	71.3	69.1	67.3	86.3
Chromium (mg/kg)	51.8	48.8	50.8	48.4	55.9	114	no data	41.2	35.6	42.5	41	22.6	61.4	47.2	42.2
Arsenic (mg/kg)	9.6	13.4	16.3	13.4	17.5	14.7	no data	16.4	13.8	17	15.1	13.8	13.1	16.6	17.6
Iron (mg/kg)	28575	22811	25205	24312	26594	25405	no data	20722	22256	23127	21852	18464	22124	23912	23006
Aluminium (mg/kg)	15762	1996	25810	21561	29250	26567	no data	17016	12246	17392	17068	6970	22590	23745	13394
Total Oil (ug/kg)	34.5	91.3	122	nr	nr	nr	no data	123	174	166	163	anp	anp	anp	362
as forties crude (ug/kg)	39.7	105	140	nr	nr	nr	no data	141	200	191	187	anp	anp	anp	416
HCH Gamma (ug/kg)	0.8	2.2	2	3.3	2.9	2.2	no data	5.1	4	2.7	3.3	<1.5	2.1	2	3.1
Tri Fluralin (dry weight - ug/kg)	<3.5	<7.9	<7.5	<8.5	<6.6	<7.1	no data	<8.1	<6.5	<6.3	9.4	27.2	<7	8.2	<7.4
1,3,5 -Trichlorobenzene (dry weight -ug/kg)	nr	nr	nr	nr	nr		no data	nr	nr	<23	<21.3	45.6	<25.7	<22.7	<27.1
DDT (pp[1]) (dry weight -ug/kg)	<0.7	<1.6	<1.6	<1.8	<1.4	<1.5	no data	<1.7	<1.4	<1.3	<1.2	<1.5	<1.5	<1.3	<1.5
PcP (ug/kg)	<59	<129	<125	<143	<108	<118	no data	<133	<108	<105	<98	<121	<118	<103	<125

(nr- no result) (anp-analysis not possible) (no data- sample not taken)

Particle Size (in Microns)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	17
<5.8	0	0	0	0	0	0	no data	0	0	0	0	0	0	0	0
7.2 - 5.8	0.48	1.27	0.89	0.67	0.94	0.92	no data	0.47	0.77	0.86	0.75	0.58	0.8	0.76	0.68
9.1 - 7.2	2.01	4.96	6.5	3.37	6.05	6.87	no data	4.02	5.69	6.4	5.5	4.61	5.85	5.62	4.99
11.4 - 9.1	3.94	9.32	18.1	7.25	15.72	19.53	no data	12.31	16.03	18.05	15.41	13.56	16.33	15.77	14.01
18.5 - 14.5	5.44	12.13	24.1	9.63	21.03	26.59	no data	17.95	21.64	24.4	20.7	19.04	21.81	21.15	18.8
23.7 - 18.5	1.69	2.4	1.14	1.3	1.68	1.49	no data	1.45	1.17	1.32	1.06	0.126	1.04	1.05	0.9
30.3 - 23.7	0.8	0.97	0.57	0.79	0.86	0.74	no data	0.83	0.61	0.6	0.46	0.68	0.48	0.52	0.4
39 - 30.3	0.56	2.25	3.77	2.11	3.84	4.33	no data	3.54	3.6	3.67	2.97	3.39	3.4	3.41	2.79
50.2 - 39	0.67	3.51	6.03	2.65	5.62	6.66	no data	5.4	5.62	5.68	4.69	5.26	5.66	5.51	4.6
64.6 - 50.2	2.37	4.45	5.92	2.97	5.47	6.25	no data	6.06	5.6	5.33	4.4	5.67	5.71	5.49	4.57
84.3 - 64.6	7.85	6.88	4.94	5.26	4.75	4.74	no data	6.44	4.8	3.94	3.25	5.62	4.66	4.49	3.77
112.8 - 84.3	18.12	11.7	4.42	11.89	4.54	3.77	no data	7.37	4.5	3	2.53	6.07	3.82	3.87	3.27
160.4 - 112.8	28.56	16.13	4.87	23.04	5.09	3.48	no data	8.76	5.06	3.2	3.32	7.1	3.91	4.34	3.84
261.6 - 160.4	17.1	10.72	4.43	21.35	4.99	1.75	no data	7.64	4.23	3.43	5.96	6.54	3.59	5.01	4.3
564 - 261.6	1.52	1.06	2.52	2.25	5.41	0.08	no data	3.69	3.04	5.52	10.71	5.52	5.63	4.77	4.62
564 - 2000	4.87	4.33	0.64	0	3.05	0	no data	4.57	7.34	2.94	8.52	5.55	7.15	8.33	19.71
<2000	100	100	100	100	100	100	no data	100	100	100	100	100	100	100	100
>2000	0	0	0	0	0	0	no data	0	0	0	0	0	0	0	0
% Dry Matter	68	31	32	28	37	34	no data	30	37	38	41	33	34	39	32

APPENDIX 8

TABLES SHOWING THE SEDIMENT CHEMISTRY DATA

	Sites										
	18	**19**	**20**	**21**	**22**	**A (31)**	**B (32)**	**C (33)**	**D (34)**	**E (35)**	**F (36)**
Mercury (mg/kg)	0.252	0.205	0.196	0.456	0.202	0.203	0.58	0.437	0.122	0.119	0.163
Cadmium (mg/kg	0.15	<0.1	0.11	0.11	0.13	0.12	0.24	0.14	0.32	0.39	0.16
Copper (mg/kg)	17.2	24.2	17.1	23.9	17	19.7	41.1	53.8	29.6	19.7	23.3
Lead (mg/kg)	43.3	47.6	39.6	58.2	43.5	47.7	89.7	86.4	54.2	37.2	45.8
Nickel (mg/kg)	26	23.3	23.9	24.3	24.9	25	27.2	23.3	26.4	23.4	28.5
Zinc (mg/kg)	80.5	83.9	73.3	99.5	79.7	87.8	162	157	96.1	84.7	87
Chromium (mg/kg)	47.7	47.1	44.6	48.1	42.3	46.8	56.7	52	72.9	36.4	44.8
Arsenic (mg/kg)	14.7	18.2	14.5	15.7	16.9	16.7	17.8	18.8	21.7	11.9	16.7
Iron (mg/kg)	24867	24761	22914	24664	24442	24539	28015	26584	25549	20877	24633
Aluminium (mg/kg)	25374	24995	22337	25642	19179	24601	31167	26007	42308	61309	22251
Total Oil (ug/kg)	anp	anp	180	213	142	194	420	531	378	226	207
as forties crude (ug/kg)	anp	anp	207	245	163	223	483	611	435	260	238
HCH Gamma (ug/kg)	2.9	4.5	2.4	1.1	<1.3	0.9	<1.4	1.8	<1.6	<1.7	<1.5
Tri Fluralin (dry weight - ug/kg)	<6.5	<6.8	<6.3	<3.3	6.6	<3.7	8.5	9.6	13.2	9	<7.3
1,3,5 -Trichlorobenzene (dry weight -ug/kg)	<23.7	<25	<23.1	<11.9	<22.2	<13.7	<24.6	<28.7	51.3	56.8	<26.6
DDT (pp^1) (dry weight -ug/kg)	3.8	<1.4	<1.3	<0.7	<1.3	<0.8	<1.4	2.4	<1.6	<1.7	<1.5
PcP (ug/kg)	<108	<114	<105	<111	<100	<108	<111	420	<129	<138	<121

(nr- no result)

Particle Size (in Microns)	**18**	**19**	**20**	**21**	**22**	**A (31)**	**B (32)**	**C (33)**	**D (34)**	**E (35)**	**F (36)**
<5.8	0										
7.2 - 5.8	0.56										
9.1 - 7.2	4.56										
11.4 - 9.1	14.35										
18.5 - 14.5	20.61										
23.7 - 18.5	0.93										
30.3 - 23.7	0.53										
39 - 30.3	3.3										
50.2 - 39	5.24										
64.6 - 50.2	5.19										
84.3 - 64.6	4.21										
112.8 - 84.3	3.55										
160.4 - 112.8	3.82										
261.6 - 160.4	4.41										
564 - 261.6	5.4										
564 - 2000	13.89										
<2000	100										
>2000	0										
% Dry Matter	37	35	38	36	40	36	31	31	31	29	33

ANALYSIS NOT POSSIBLE

APPENDIX 9

CANADIAN SEDIMENT QUALITY GUIDELINES

(PEL=PROBABLE EFFECT LEVELS; TEL / ISQG=THRESHOLDS EFFECTS LEVEL / INTERIM MARINE SEDIMENT QUALITY GUIDELINES)

These guidelines comprise of two assessment levels.

Substance	Units (dry sediment)	TEL /ISQG	PEL
Arsenic	mg.kg -1	7.24	41.6
Cadmiuim	mg.kg -1	0.67	4.2
Chromium	mg.kg -1	52.3	160
Copper	mg.kg -1	18.7	108
Lead	mg.kg -1	30.2	112
Mercury	mg.kg -1	0.13	0.7
Zinc	mg.kg -1	124	271
***Nickel**	mg.kg -1	15.9	-

*NB As the Canadian guidelines do not include effects levels for nickel, a TEL value was obtained from the Florida sediment quality assessment guidelines (expressed in dry weight sediment).

Explanation:

- Below the TEL: the minimal effect range within which adverse effects rarely occur (i.e. less than 25% of effects);
- Between the TEL and PEL: the possible effect range within which adverse effects occasionally occur; and,
- Above the PEL: the probable effect range within which adverse effects frequently occur (i.e. more than 50% of effects).

The TEL is consistent with the definition of a Canadian Interim Sediment Quality Guideline (ISQG).