NOT TO BE CITED WITHOUT PRIOR REFERENCE TO THE AUTHORS

International Council For
The Exploration Of The Sea

CM 1991/E:27
Marine Environmental Quality Committee

AN INTER-REGIONAL COMPARISON OF GRAVEL ASSEMBLAGES OFF THE ENGLISH EAST AND SOUTH COASTS: PRELIMINARY RESULTS

A J Kenny, H L Rees & R G Lees

Ministry of Agriculture, Fisheries and Food
Directorate of Fisheries Research
Fisheries Laboratory
Burnham-on-Crouch
Essex CM0 8HA
United Kingdom

ABSTRACT

A three-year study was initiated in 1990 to examine the impacts on the benthos arising from the commercial exploitation of marine aggregate deposits off the English Coast, including processes of recolonisation following disturbance. The first part of this study has involved an assessment of regional differences in the nature of sand and gravel assemblages. Stations were located close to areas licensed for aggregate extraction, but were not subject to the direct influence of dredging. The areas surveyed included the Isle of Wight and Hastings off the South coast, and Lowestoft and North Norfolk off the East coast.

Preliminary results indicated that although there was significant regional variability in the structure of faunal assemblages, it was nevertheless possible to identify similarities between those associated with the gravel deposits off Hastings, the Isle of Wight and North Norfolk. In particular, the bryozoans *Flustra foliacea* and *Alcyonidium* sp, the slipper limpet *Crepidula fornicata* and the ascidian *Dendrodoa grossularia*, were present at all these locations, as were a number of species of hydroids. These are typical of a relatively stable gravel/shell sediment. Indeed in these deeper waters, of about 20 m, erect bryozoans and hydroids may be considered to occupy a niche which in shallower water is often dominated by algae, and these taxa may therefore have a significant role to play in providing cover and food for many other benthic organisms. However, off Lowestoft, there was a much reduced species complement and it was noticeable that colonies of hydroids such as *Tubularia* sp were smaller than elsewhere, indicating a higher degree of natural disturbance at the seabed.

Possible explanations for regional variability are discussed, along with an outline of future project work.

INTRODUCTION

The benthos inhabiting gravel sediments off the UK coastline have been investigated on a number of occasions. In particular, wide scale surveys of the English Channel by (among others) Holme & Wilson (1985), Holme (1966), Davoult *et al.* (1988) and Davoult (1990) resulted in the identification of a number of distinct assemblage types which were closely related to the physical environment. On a more local scale, studies off the Isle of Wight (Lees *et al.*, 1990, Collins & Mallinson, 1983, 1989), Hastings (Rees, 1987), Southwold (Millner *et al.*, 1977) and the North Norfolk coast (Hamond, 1963), have provided descriptions of the biology of gravel deposits, either in their natural state, or in relation to the impacts of commercial aggregate extraction (see also Lees, 1989).

As part of a joint project between the Ministry of Agriculture, Fisheries and Food and the Crown Estate Commission (who own most of the seabed within the British sector and who are responsible for its management) an assessment has begun of regional variation in the benthic fauna of gravel deposits at or near to sites of commercial extraction off the English coastline so as to initiate a study of recolonisation of dredged areas. Drawing from existing and new information, this paper provides a preliminary assessment of the benthos at four areas, namely the Isle of Wight and Hastings off the South coast, and Lowestoft and North Norfolk off the East coast (see Fig 1).

METHODS

1. Field Sampling

All samples were collected with a modified Forster anchor dredge (Forster, 1953). Samples off Lowestoft, North Norfolk, Hastings and the Isle of Wight were collected from MAFF research vessels in December 1990, January 1991, October 1987 and December 1989, respectively.

Following estimation of the volume of retained material, a 1 l sub-sample was removed for particle size analysis. In addition, a 5 l sub-sample was removed and sieved over 5 mm and 1 mm mesh sieves. The 1-5 mm fraction was preserved for later laboratory analysis of the smaller macrofauna.

Animals retained on a 5 mm mesh sieve, along with those from the remaining sediment sample, were then extracted on deck and also preserved for later laboratory analysis. For certain encrusting and colonial taxa such as hydroids, serpulids, barnacles, ascidians and sponges, their relative abundance was assessed during preliminary sorting, and only representative specimens were retained. A similar sampling procedure was followed by Rees (1987) and Lees *et al.* (1990) for areas off Hastings and the Isle of Wight.

Although uncertainties over the performance of this type of sampler at the seabed dictate that the data obtained are at best "semi-quantitative", the device is considered adequate for the purpose of describing regional differences in the nature of gravel assemblages. In future surveys of the local impacts of dredging activity, improved quantification may be achieved through the use of alternative sampling devices such as the Hamon grab (see Holme & McIntyre 1984). This aspect is the subject of current attention.

2. Laboratory Procedures

Benthos were identified to species level as far as possible using the standard fauna keys. Sediment sub-samples for particle size analysis were initially wet sieved through a 63 micron mesh to provide an estimation of the "fines" fraction. The remaining sample was then oven-dried and sieved through a nest of sieves, conforming with the Wentworth scale, from -6 phi (64 mm) to +4 phi (0.063 mm). The percentage distribution, by weight, of particles for each size fraction was then calculated.

3. DATA ANALYSIS

To permit a preliminary regional comparison, 5 stations considered to be representative of faunal assemblages at about 20 m depth were selected from surveys off Lowestoft, North Norfolk, the Isle of Wight (Lees *et al.*, 1990) and off Hastings (Rees, 1987).

Clearly, seasonal and annual differences in survey times, as well as sampling efficiency, limit the scope for quantitative comparisons between areas. However, it is considered that such limitations do not preclude judgements on the major structural differences between assemblage types, especially in relation to the larger, generally longer-lived and sedentary organisms, which are likely to be more robust to temporal variability.

Cluster analysis of the data, expressed as presence/absence, was conducted using the Jaccard coefficient, and average-linkage sorting.

RESULTS

1. PHYSICAL MEASUREMENTS

Particle size data for each of the regions are shown in Figure 2a. The most notable feature is the bimodal nature of the distributions at Lowestoft, the Isle of Wight and Hastings. The modes correspond with the gravel and sand components, respectively. However, the coarse mode at North Norfolk is poorly defined.

Although there is appreciable sample-to-sample variability, as indicated by the ranges (see Fig 2b-e), there is a greater proportion of gravel at Lowestoft and the Isle of Wight, and this is better sorted than at North Norfolk. Regarding Hastings, there is an indication that the contribution of particles at the coarsest gravel fractions is somewhat greater than elsewhere. In contrast, the sand fraction appears to be better sorted at Hastings and North Norfolk, with peaks occurring at 0.25 mm and 0.18 mm, respectively. Maximum spring tidal currents for locations in the vicinity of samples, derived from Admiralty data, were as follows: Hastings 2.6 knots, Isle of Wight 2.0 knots, North Norfolk 1.7 knots and Lowestoft 2.7 knots. These do not provide an obvious explanation for differences in the distribution of particle sizes.

2. BIOLOGICAL MEASUREMENTS

Tables 1 and 2 show the benthos identified and enumerated for the >5 mm and 1-5 mm fractions (data for the Isle of Wight, 1-5 mm fraction, were not available). Both tables show that samples taken from Hastings and North Norfolk account for most of the species identified, whereas the Isle of Wight and Lowestoft samples have a greatly reduced species complement.

Many of the smaller polychaetes observed at the 5 mm fraction were attached to parts of sessile organisms such as *Flustra foliacea* or to stones. Whilst their presence is of ecological interest, the bulk of specimens could not strictly be considered as representative of this larger size fraction.

SPECIES NUMBERS AND COMPOSITION

Species acquisition curves (>5 mm fraction) for the 5 stations sampled within each region are shown in Figure 3a. It is interesting to note that the slopes of the curves for the North Norfolk and Hastings regions are somewhat steeper than those for either the Isle of Wight or Lowestoft regions. This might be explained by a greater heterogeneity in particle size distributions at North Norfolk and Hastings, so providing a wider range of micro-habitats for colonisation. The total numbers of species present were also markedly different between regions, with 94 present at Hastings, 58 at North Norfolk, 36 at the Isle of Wight and 28 at Lowestoft. Species acquisition curves for the 1-5 mm fraction (see Fig 3b) show a similar pattern to those for the 5 mm fraction.

CLUSTER ANALYSIS

Output from cluster analysis of presence/absence data for the >5 mm fraction excluding polychaetes is shown as a dendrogram in Figure 4, which expresses the "distance" (or dissimilarity) between stations or groups of stations. (The result of performing cluster analysis including polychaetes was similar, but with a slightly increased distance between clusters). It is evident that stations have initially been clustered according to their respective regions. Below this, the greatest distance occurs between the stations off Lowestoft and those from the other three regions. Overall the pattern is consistent with the species numbers and composition described above.

The combined output of cluster analysis by station and by species (see Fig 5) again highlights the contrast between Lowestoft and the other three regions. Many of the erect bryozoans such as *Alcyonidium* sp and *Flustra foliacea*, are common to Hastings, North Norfolk and the Isle of Wight, but are absent from the Lowestoft region. This is also true for a number of hydroid species such as *Abietinaria abietina*. Mature colonies of bryozoans and hydroids are likely to provide shelter and food for many other benthic organisms and in turn these may be available as prey items for larger animals such as fish and crabs.

Figure 5 also identifies an association of organisms specific to North Norfolk. This group is characterised by the filter-feeding horse-mussel *Modiolus modiolus*, and several species of ascidian, including *Polycarpa* sp. Mature populations of horse-mussels are known to promote the local build-up of organic-rich sediments through the accumulation of faeces (Roberts, 1979), to the benefit of other colonising taxa, eg polychaete infauna. This is suggested by the increase in the number of species observed within the 1-5 mm fraction from North Norfolk (see Fig 3b). Parallels with the North Norfolk *Modiolus modiolus* assemblage have been reported in Davoult (1990) and Holme & Wilson (1985) for the English Channel.

DISCUSSION

It is not possible to identify all the factors determining regional differences from the outcome of this preliminary assessment. However, in some areas, the abrasive effects of sand shifting under strong tidal currents and the effects of disturbance caused during storms are likely to be particularly important. Survey work carried out in a tide-swept gravel area of the English channel (Holme & Wilson 1985) showed that the patchiness of benthos on a local scale (100 m) was determined by the extent of scouring caused by shifting sand. They described a number of community types whose structure was determined by the frequency and extent of disruption caused by the movement of sand and pebbles. They also inferred that the various community types represented successional states towards a "climax" type.

A side-scan sonar survey of a licensed extraction site in the Lowestoft area conducted in 1990 (unpublished data) showed very few dredge tracks. Yet, it is known that this site has been, and continues to be, extensively dredged. It therefore appears that the tracks are quickly obscured by shifting sand, and this is supported by the notable presence of sand waves and ripples on the sonograph. Indeed, the lower rate of species acquisition compared with elsewhere (see Fig 3a), and the types of dominant species present (see Fig 5), suggests a superficial homogeneous habitat of mobile sand.

Due to the limited number of stations, conclusions on patchiness in the distribution of animal abundances within regions cannot be made. However, it is likely that such variation will be as great as that observed inter-regionally.

It may be concluded from the presented data that gravel deposits off the UK continental shelf have the ability to support different faunal assemblages, dependent on the local conditions. The most important of these conditions are probably tides and wave action.

It is difficult to predict how the physical structure of gravel deposits influences the benthos and an understanding of how the sediment behaves is perhaps more important (in terms of the effects upon the benthos) than a knowledge of particle size distributions alone. Further studies are required in order to relate the dynamics of sediment movement to the structure of biological communities.

SUMMARY

Notable variations in the types and numbers of benthic organisms occur on gravel deposits from the areas studied, with greater numbers of species off Hastings and North Norfolk than off Lowestoft and the Isle of Wight.

The rate of species acquisition was found to be higher off Hastings and North Norfolk, than off Lowestoft and the Isle of Wight. This may be a consequence both of a greater heterogeneity in the habitat available for colonisation, and the somewhat more benign environmental conditions promoting the survival of a greater range of species.

Future work will include a detailed appraisal of the processes of recolonisation following dredging. Effort will also be directed to further spatial surveys of regional variability.

REFERENCES

COLLINS, K. J. & MALLISON, J. J., 1983. Sublittoral Survey From Selsey Bill to the East Solent. A report to the Nature Conservancy Council. Contract HF3-11-04, Southampton University, 24pp.

COLLINS, K. J. & MALLISON, J. J., 1989. Marine Flora and Fauna off Bembridge, Isle of Wight. A report to the Nature Conservancy Council. Contract HF3-11-57(3), Southampton University, 17pp.

DAVOULT, D., 1990. Biofacies et Structure Trophique du Peuplement des Cailloutis du Pas-de-Calais. Oceanol., ACTA. 13, 335-348.

DAVOULT, D., DEWARUMEZ, J-M., PRYGIEL, J., RICHARD, A., 1988. Carte des Peuplements Benthiques de la Partie Francaise de la Mer du Nord. Station Marine de Wimereux URA-CNRS 1363, 30pp.

FORSTER, G. R., 1953. A new dredge for collecting burrowing animals. J. Mar. Biol. Ass. U.K., 32, 193-198.

HAMOND, R., 1963. A Preliminary Report on the Marine Fauna of the North Norfolk Coast. Trans. Norf. Norw. Nat. Soc., 20, 1, 2-31.

HOLME, N. A. & WILSON, J. B., 1985. Faunas Associated with Longitudinal Furrows and Sand Ribbons in a Tide-Swept Area in the English Channel. J. Mar. Biol. Ass. U.K, 65, 1051-1072.

HOLME, N. A., 1966. The Bottom Fauna of the English Channel. Part II. J. Mar. Biol. Ass. U.K. 46, 401-493.

HOLME, N. A., & MCINTYRE, A. D., eds., 1984. Methods for the study of marine benthos. Oxford: Blackwell Scientific Publications, 2nd edition, 165-166.

LEES, R. G., REES, H. L., LAMBERT, M. A., ROWLATT, S. M. & LIMPENNY, D. S., 1990. Benthic Studies in Relation to Dredging Activity off the Isle of Wight, Southern England. ICES. C.M. 1990/E:15, 18pp (mimeo).

LEES, R. G., 1989. Benthic Studies at UK extraction Sites: A Summary of Work by the Ministry of Agriculture, Fisheries and Food. In 8th Report of the benthos ecology working group. ICES C.M. 1989/L:19, 67-70 (mimeo).

MILLNER, R. S., DICKSON, R. R. & ROLFE, M. S., 1977. Physical and Biological Studies of a Dredging Ground off the East Coast of England. ICES C.M. 1977/E:48, 11pp (mimeo).

REES, H. L., 1987. A Survey of the Benthic Fauna Inhabiting Gravel Deposits off Hastings, Southern England. ICES C.M. 1987/L:19, 19pp (mimeo).

ROBERTS, C. D., 1979. The colonial behaviour of *Modiolus modiolus* (L.) and its ecological significance. In: Biology and Systematics of Colonial Organisms., Larwood G., & Rosen, B. B., eds. London: Academic Press, 255-256.

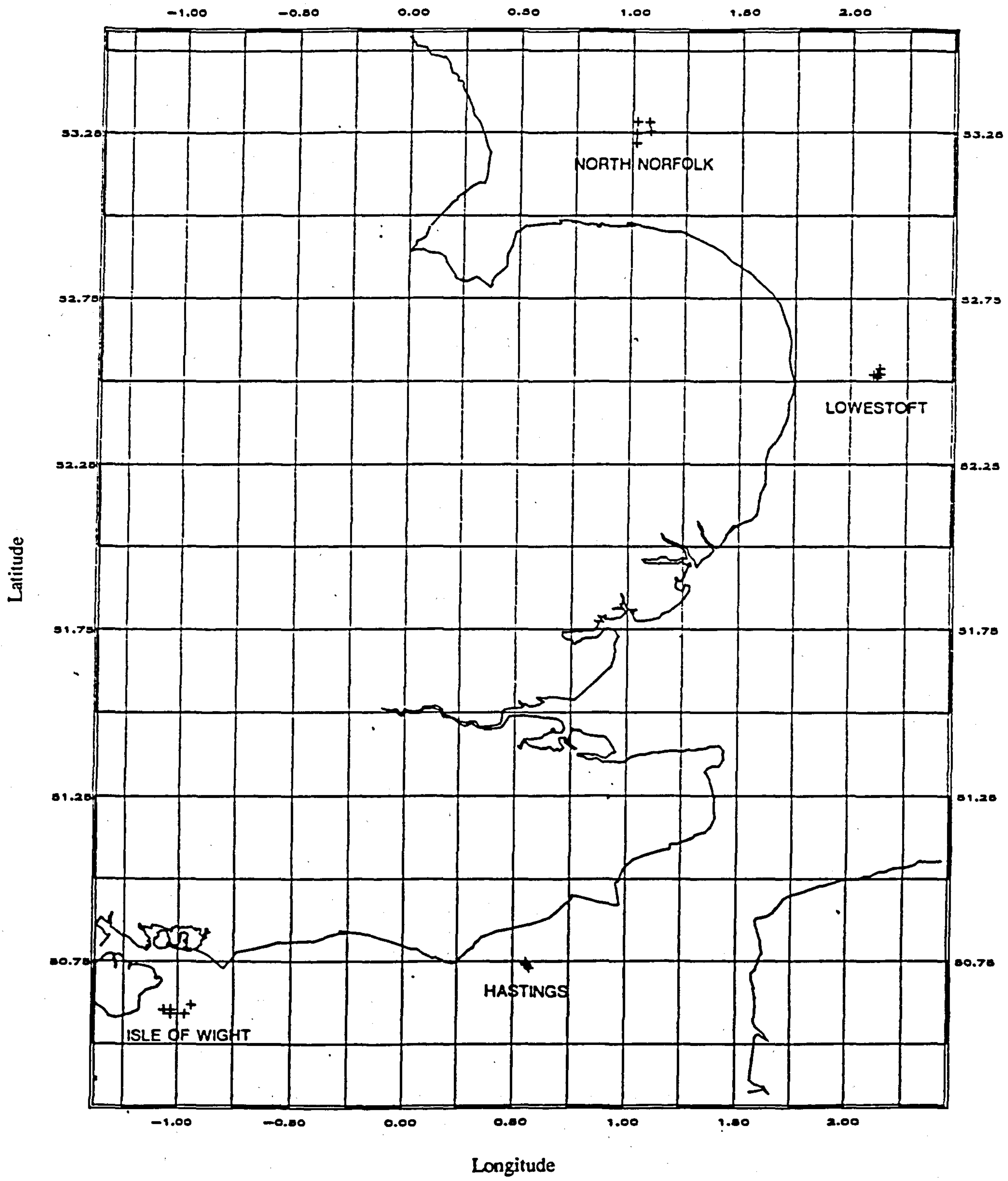


Figure 1. Map showing the location of sampling stations.

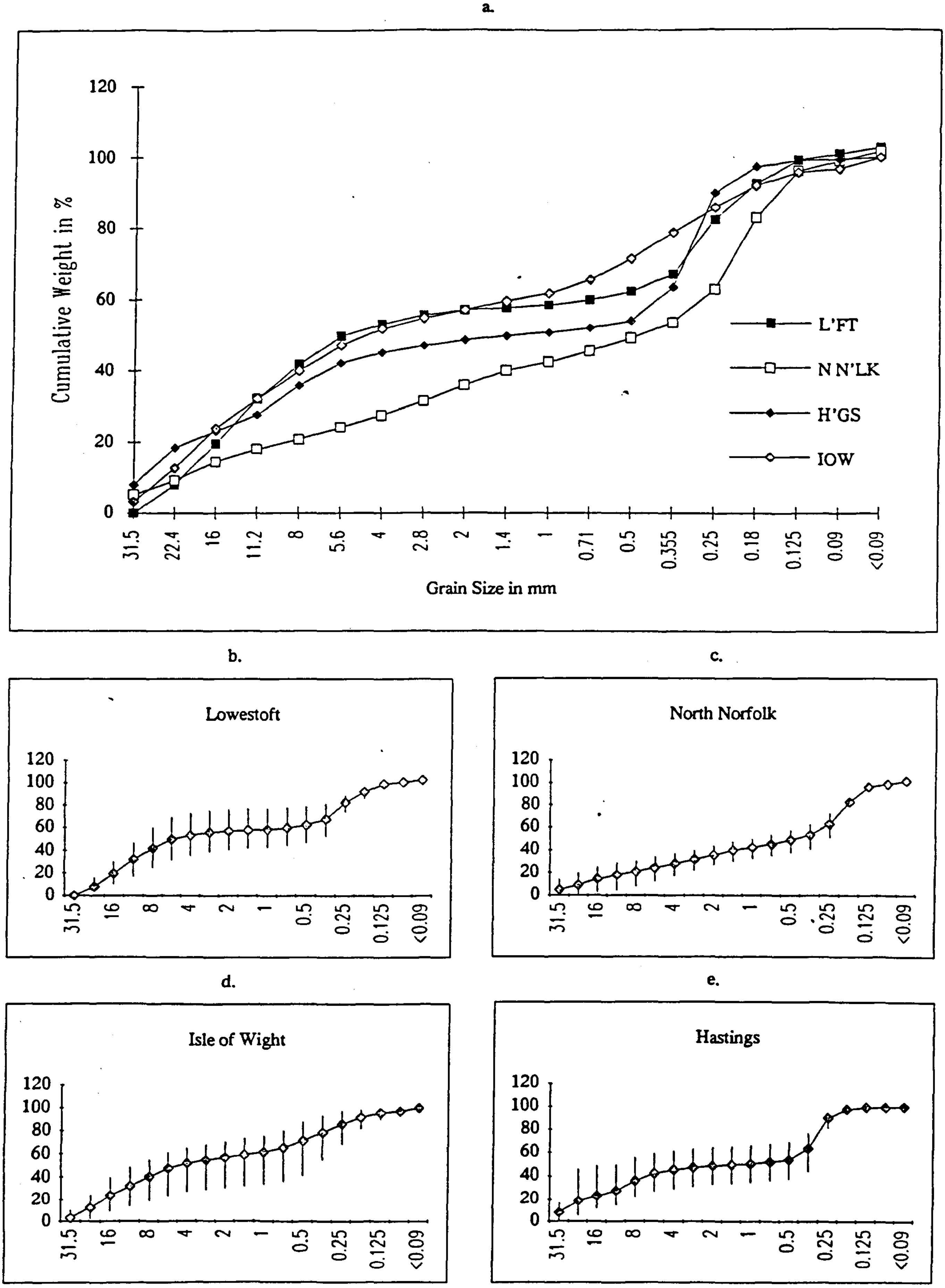
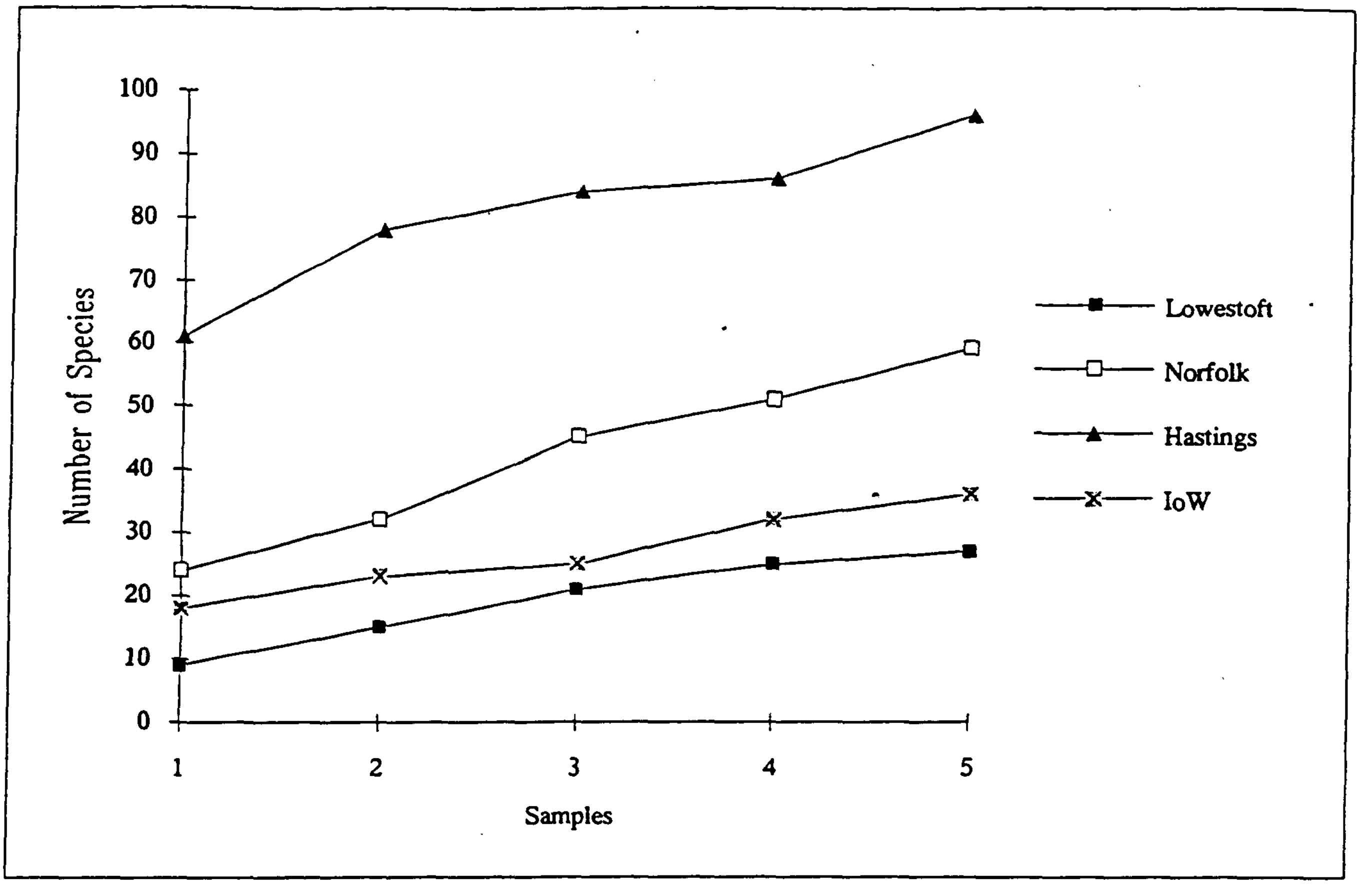


Figure 2. Particle size distributions. a: Cumulative curves derived from the average of five samples at each region. b-e: Cumulative curves showing sample variation from each region.

a.



b.

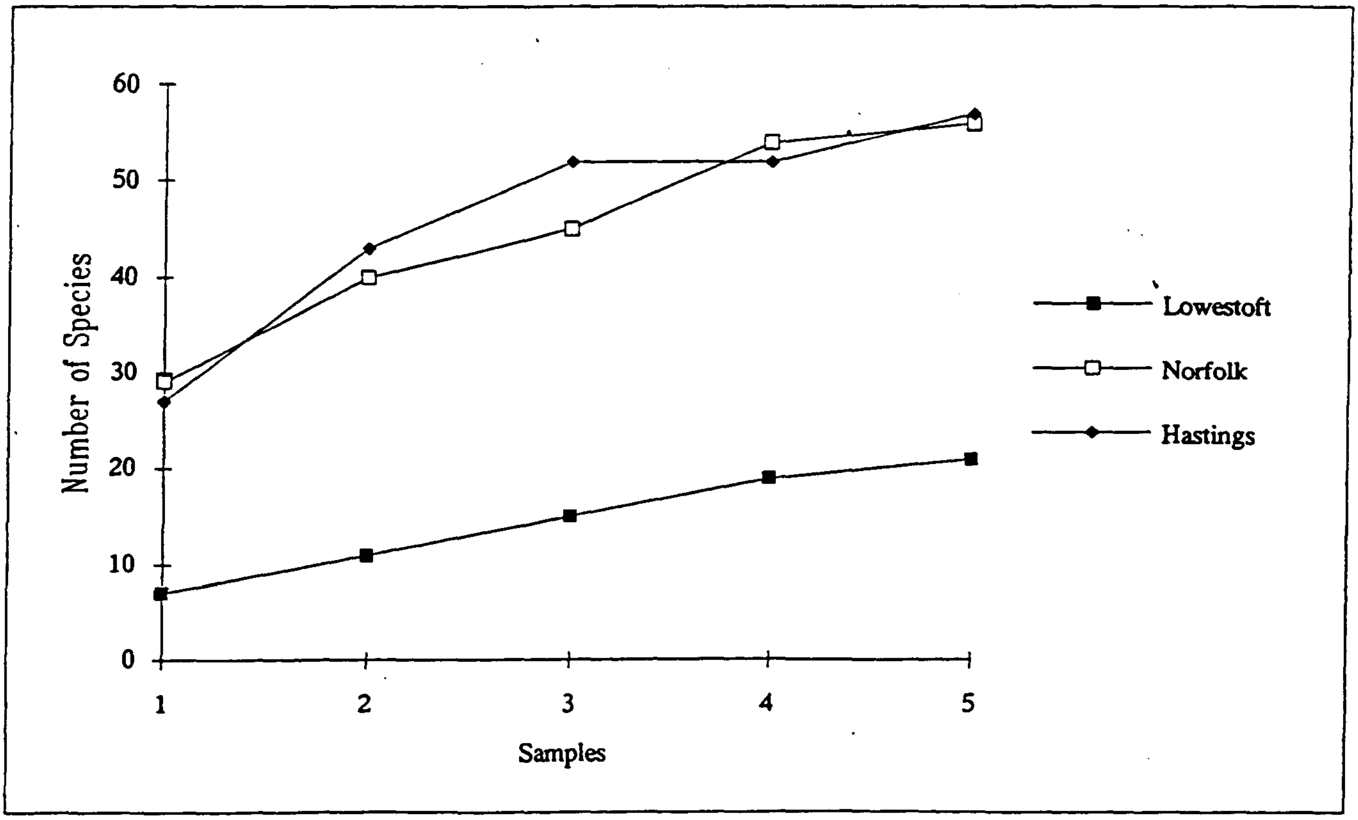


Figure 3. Species acquisition curves. a: Benthos greater than 5mm. b: Benthos 1-5mm.

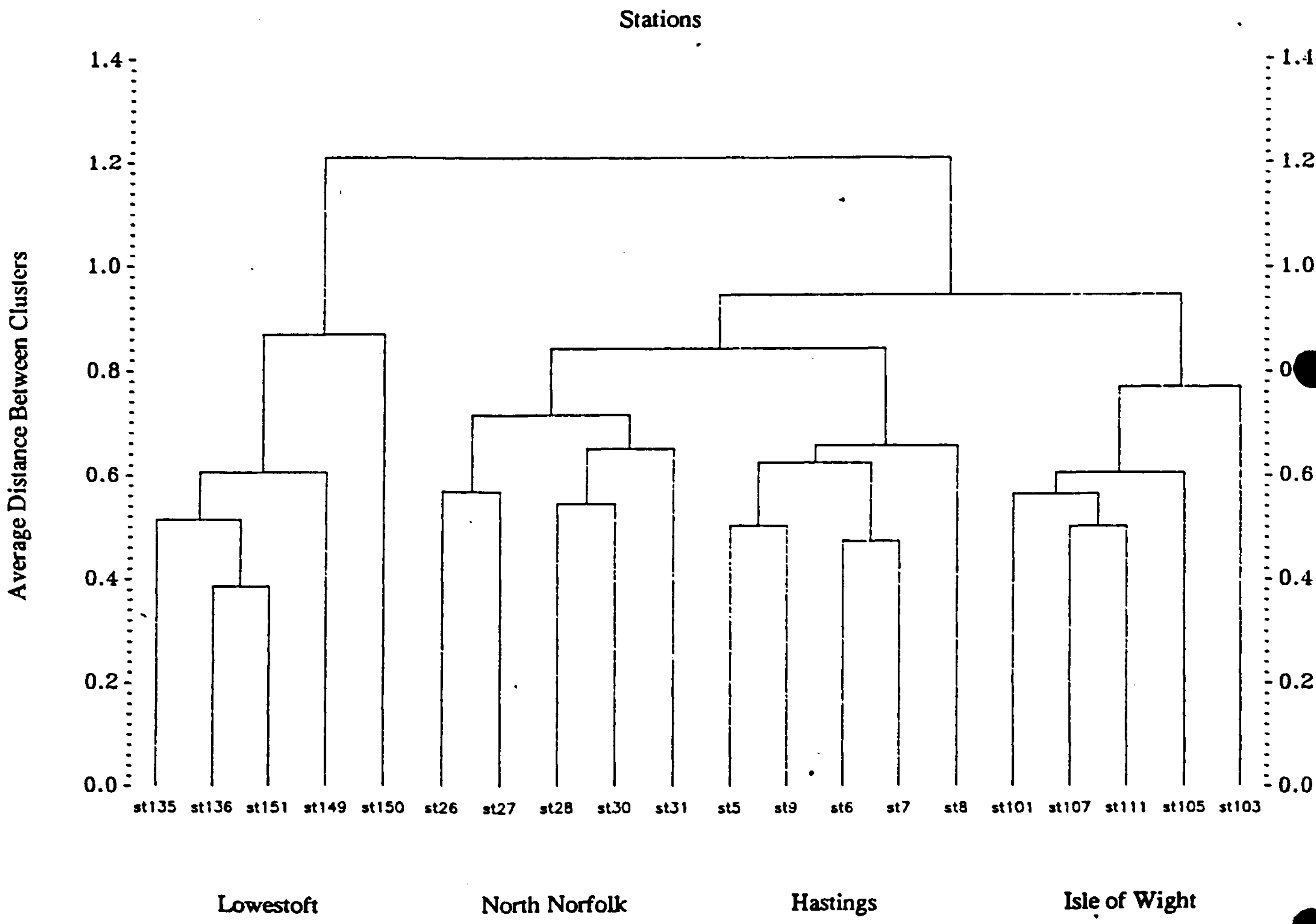


Figure 4. Average linkage cluster analysis between stations.

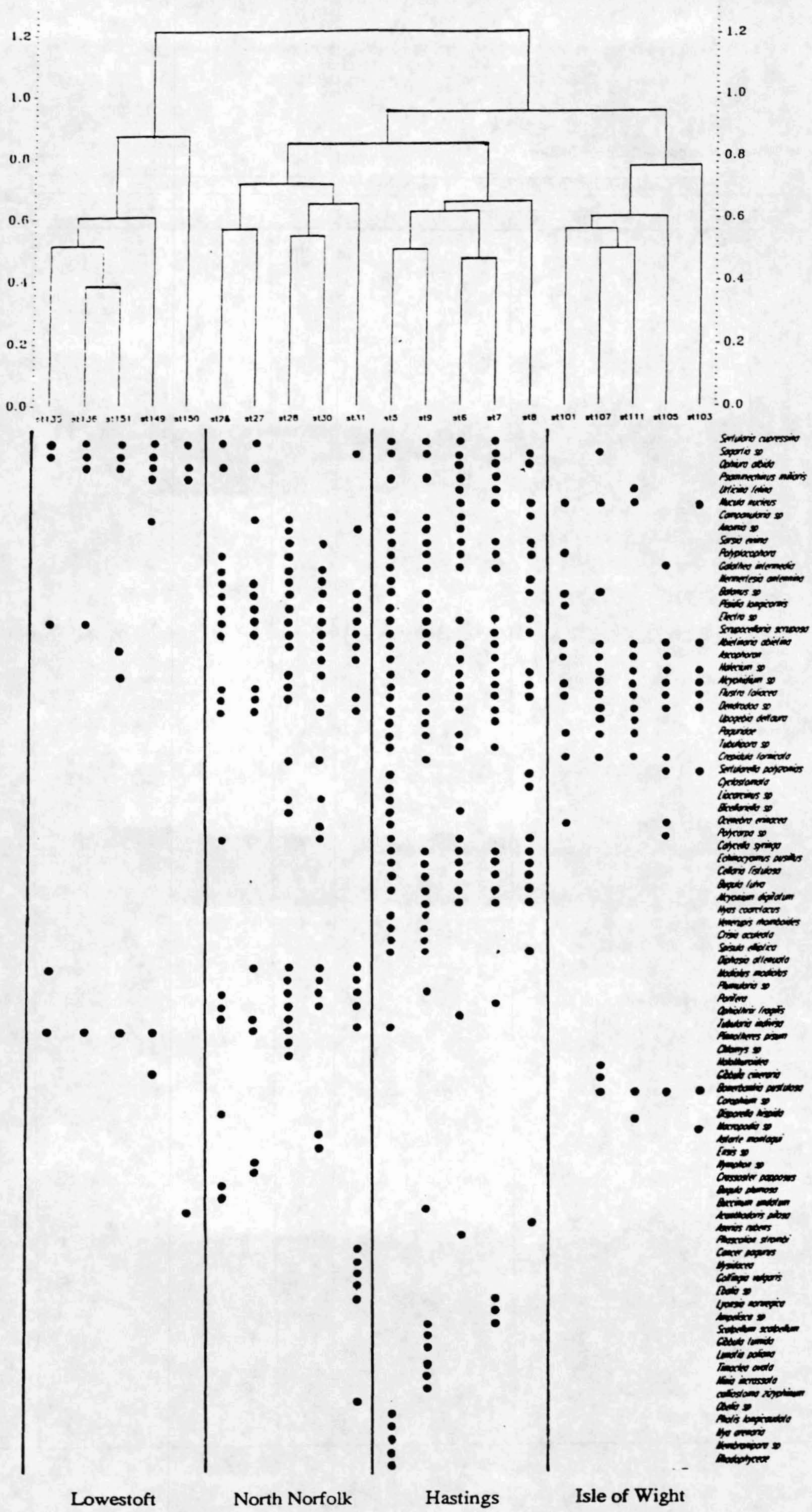


Figure 5. The combined output of cluster analysis by station and by species for each region.

Table 1. Benthos identified and enumerated for the >5mm fraction

Region	Lowestoft					North Norfolk					Hastings					Isle of Wight				
Station	**135**	**136**	**149**	**150**	**151**	**26**	**27**	**28**	**30**	**31**	**5**	**6**	**7**	**8**	**9**	**101**	**103**	**105**	**107**	**111**
Porifera						p		p	p	p			p							
Cnidaria																				
Tubularia indivisa	p	p	p		p		p	p		p	p									
Sarsia exima								p	p		p	p	p	p	p					
Calycella syringa											p	p	p	p	p					
Halecium sp							p	p			p	p	p	p	p	p		p	p	p
Nemertesia antennina						p	p	p	p		p			p						
Plumularia sp						p		p	p	p					p					
Abietinaria abietina					p			p	p	p	p	p	p		p	p		p	p	p
Diphasia attenuata	p						p	p	p	p										
Sertularia cupressina	p	p	p	p	p	p	p				p	p	p		p				p	
Sertularella polyzonias											p			p		p	p			
Campanularia sp			p				p	p			p	p		p	p					
Obelia sp											p									
Alcyonium digitatum												p	p	p	p					
Urticina felina												1	1							3
Sagartia sp	2	1	1	2	3					1	3	3	4	2	1					
Sipuncula																				
Golfingia vulgaris										1										
Phascolion strombi												1								
Annelida																				
Harmothoe sp									2	1							1			
Lepidonotus squamatus								2	1		1	3								
Polynoe scolopendrina											1									
Sthenelais boa			1																1	2
Anaitides maculata				4								1	1		3					
Eumida sp								1			1									
Phyllodoce laminosa					1	1	1													
Glycera capitata											1				1					
Glycinde normanni												2			1					
Goniada maculata			1		1						1		1							
Langerhansia cornuta										1										
Typosyllis armillaris											6				1					
Autolytus edwardsi											2									
Nereis longissima		1	1									1								
Nereis pelagica											1				1					
Nephtys caeca			1	1	1		1	1	3	1	2									
Marphysa sanguinea																			1	
Nematonereis sp											1									
Lumbrinereis sp											1	2		1		1		1		
Scoloplos armiger		1	2					1	1											
Aonides oxycephala													1							
Cirratulus sp								1												
Cirriformia sp										1										
Pherusa plumosa																				
Heteromastus filiformis				1											1					
Notomastus latericeus												1		2						1
Maldanidae sp		3	5	1	1		1				1			1						
Ophelia limacina	1				1						2	2		1						
Ophelia rathkei													1							
Ophelina acuminata																				
Ophelina modesta									1						1					
Scalibregma inflatum	4	2																		
Owenia fusiformis		1	9		1				4	2		1	2							
Lagis koreni		9	10	1	6	1									1					
Sabellaria spinulosa	7					54	36	7	19	2	1					c	r	c	p	r
Terebellides stroemi												1				1				
Eupolymnia nebulosa																	2	1		
Lanice conchilega						2			2			1								
Nicolea zostericola															1					
Polycirrus sp												1			1					
Thelepus cincinnatus											8	1								
Jasmineira caudata											2									
Laonome kroyeri																			1	
Serpulidae						p	p	p	p	p	p	p	p	p		p	p			
Chelicerata															p					
Nymphon sp							4													
Crustacea																				
Scalpellum scalpellum																				
Balanus crenatus						p	p	p	p	p	p			p	1	p			p	
Mysidacea										1					p					
Ampelisca sp													1							
Photis longicaudata											2				1					
Corophium sp				12																
Upogebia deltaura											2		1						1	1
Paguridae											1	1			1	3			5	1
Galathea intermedia						1		3	1		5	2	1		2			1		
Pisidia longicornis						4	1	15	17	16	4				8	2				

Table 1. Continued..

Region	Lowestoft					North Norfolk					Hastings					Isle of Wight				
Station	**135**	**136**	**149**	**150**	**151**	**26**	**27**	**28**	**30**	**31**	**5**	**6**	**7**	**8**	**9**	**101**	**103**	**105**	**107**	**111**
Ebalia sp										3			1		4					
Hyas coarctatus											1									
Macropodia sp									1						1		1			
Cancer pagurus										1										
Liocarcinus sp									2		1									
Pinnotheres pisum								1												
Mollusca																				
Polyplacophora						2		2			1	2	3	2		1				
Gibbula tumida															2					
Gibbula cineraria															2				1	
Calliostoma zizyphinum										1								1		
Crepidula fornicata								10	2						1	9		3	174	84
Lunatia poliana															1					
Ocenebra erinacea									2		1				2	3		2		
Buccinum undatum				1										1						
Hinia incrassata															1					1
Acanthodoris pilosa														1	1					
Nucula nucleus												1	2	2		6	6		270	64
Modiolus modiolus								12	1	26		1								
Chlamys sp								1												
Anomia ephippium								1		2	2	2								
Astarte montagui									1						1					
Spisula elliptica											2			6						
Ensis sp															1					
Venerupis rhomboides											1									
Timoclea ovata															1					
Mya arenaria											1				1					
Lyonsia norwegica													1							
Bryozoa																				
Cyclostomata											p			p						
Crisia aculeata											p									
Tubulipora sp											p	p	p		p	p	p	p	p	
Disporella hispida															p					p
Alcyonidium sp						p	p	p			p	p	p	p		p	p	p	p	p
Bowerbankia pustulosa																	p	p	p	
Ascophora									p	p	p	p	p			p		p	p	P
Membranipora sp											p									
Electra sp	p	p				p	p	p	p	p	p	p	p	p						
Flustra foliacea						p	p	p	p	p	p	p	p	p	p	p	p	p	p	p
Cellaria fistulosa											p	p		p	p					
Scrupocellaria scruposa						p	p	p	p	p	p		p	p	p					
Bicellariella sp								p			p	p			p					
Bugula fulva											p	p		p						
Bugula plumosa						p									p					
Echinodermata																				
Crossaster papposus						2														
Asterias rubens												2								
Ophiothrix fragilis						4	1	1				1								
Psammechinus miliaris				1							1	2	4							
Echinocyamus pusillus											1	2	4	3	4					
Ophiura albida		5	19	10	6	7	2					1	2	2	2					
Holothuroidea			1																1	
Tunicata																				
Polycarpa sp						8			1		2	3		2				8		
Dendrodoa grossularia						p	p		p	p	p	p	p				p	p	p	p
Algae															p					
Rhodophyceae											p									

Table 2. Benthos identified and enumerated for the 1-5mm fraction

Region	Lowestoft					North Norfolk					Hastings				
Station	**135**	**136**	**149**	**150**	**151**	**26**	**27**	**28**	**30**	**31**	**5**	**6**	**7**	**8**	**9**
Cnidaria															
Plumularia sp						p						p			
Abietinaria abietina											p	p			
Diphasia attenuata													p		
Hydrallmania falcata											p				
Sertularia cupressina						p									p
Obelia sp												p			
Sagartia sp															1
Annelida															
Harmothoe sp						4	1	2				1			
Lepidonotus squamatus									2	1					
Ophelia limacina	1			1	3		1		2			2			
Pholoe minuta					1	1	1	4	2	2	2	2			
Eteone sp									1	2	1				
Anaitides maculata				2			1					2			
Eumida sp						1		1			2				
Glycera lapidum											1	2	1	1	1
Goniada maculata		1	1												
Langerhansia cornuta						3	2	3	5	4					
Typosyllis sp												1			
Typosyllis armillaris											2		1		1
Eusyllis sp									1						
Exogone sp						1									
Sphaerosyllis sp						1									
Nereis longissima	1						1		1						
Nephtys sp				1		3	3	2	7	1		2		1	1
Marphysa bellii											1				
Lumbrinereis sp									1	1	4	1	1	1	10
Protodorvillea sp							1								
Scoloplos armiger						10	1	1	5	2	2				
Paraonidae											1				
Aricidea sp	1														
Aonides sp													1		
Laonice cirrata						3	1	3	2						
Polydora caeca						1									
Spiophanes bombyx		1					2	1	1						
Cirratulus sp							2					2			2
Cirriformia sp							1			1					
Tharyx marioni								1	1						
Mediomastus fragilis													1		
Notomastus latericeus											1		1		
Maldanidae		1	3	1		4	1		4	1		4			1
Scalibregma inflatum		4										1			
Owenia fusiformis			6						2	1					1
Lagis koreni				2	1	2									
Sabellaria spinulosa							2	1	1	8		1			
Ampharete sp										1					
Lanice conchilega						2									
Polycirrus sp											1				
Sabellidae						1									
Serpulidae						1			1		1				
Crustacea															
Balanus sp						p	p	p	p	p					
Mysidacea									1						
Stenothoidae	1														
Talitridae						1		2							
Urothoe sp				2	1	8	1	3	4	6	1	4		1	
Lysianassidae					1										
Acidostoma sarsi			1												
Anonyx lilljeborgi							1	1	1	1			1		
Anonyx sarsi									1	1					
Dexamine spinosa						1									
Ampelisca sp							7					1			1
Bathyporeia sp			1												
Isaeidae								1							
Photis longicaudata															1
Corophium sp	3			1											
Paguridae							1	1	1	1					
Galathea intermedia									1		2				
Pisidia longicornis						8	4	1	1	9	8				5
Liocarcinus sp								1							
Ostracoda											1	1			
Mollusca															
Polyplacophora								1		1					
Lunatia poliana						2	2								
Tritonia sp													1		

Table 2. Continued..

Region	Lowestoft					North Norfolk					Hastings				
Station	135	136	149	150	151	26	27	28	30	31	5	6	7	8	9
Nucula tenuis													2		
Modiolus modiolus										2					
Chlamys sp													1		
Mysella bidentata												8	6		1
Spisula elliptica			1									2	1	4	
Abra abra									1						
Bryozoa															
Crisia aculeata											p			p	p
Alcyonidium sp						p	p				p				
Electra sp											p				
Flustra foliacea						p					p	p		p	p
Cellaria fistulosa											p	p	p		p
Scrupocellaria scruposa						p				p	p	p		p	p
Bicellariella sp							p								
Echinodermata															
Ophiothrix fragilis						4	2	2	2	9	1				1
Ophiura albida	1			3	1										
Psammechinus miliaris												2			1
Echinocyamus pusillus	3	1	2	3	1						1	2	1	1	3
Tunicata															
Polycarpa sp													1	2	2