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NATIONAL ENVIRONMENT PROGRAMME: MONITORING OF THE DENVER LICENCE. THE 2005-2006 SURVEYS OF INTER-TIDAL SEDIMENTS, INVERTEBRATES AND BIRDS OF THE S E WASH.

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EXECUTIVE SUMMARY

1. The work reported here forms part of a study whose purpose is to monitor and evaluate the impact on the inter-tidal sediments, invertebrates and the shorebirds that eat them, of variations in the flow of freshwater into the south-east corner of the Wash via the river Great Ouse. This report deals with the results of sediment, invertebrate and shorebird surveys of the inter-tidal areas of the Wash adjacent to the outfall of the river Great Ouse made during autumn and winter of 2005-2006 (September -January). Comparisons are made with the results of 2004-2005 surveys, with particular consideration being given to how any changes were related to the distance from the river's outfall.

2. Sediment and invertebrate samples were taken from 42 sites during October 2005 .Bird surveys were undertaken during the period mid-November 2005 to late January 2006. These surveys followed a 12 month period (September 2004 to August 2005) during which freshwater flow into the Wash from the Gt Ouse of 654.4 Mm^3 was considerably lower than the long-term average of 1005 Mm^3 for the period 1974 to 2005.

Changes in sediment particle size and organic content between the 2004-2005 and 2005-2006 surveys.

3. Of the 42 sites sampled in 2005, 31 were muddy and 11 were sandy. All except one site located on the shore to the west of the Gt Ouse was muddy. Most sites (16 out of 22 sites) on the shore to the east of the river were also muddy. The exceptions were mid-to low- level sites of transects 19 and 20 which were sandy. On the outer banks two sites were muddy and the remaining four were sandy.

4. Overall there was little change in the sediment type of sample sites between the 2004 and 2005 surveys. Of the 42 sites, there were 28 muddy sites in 2004 compared to 31 in 2005. Although more sites were classed as mud in 2005, the sediment of most sites on the inner bank areas became sandier while, with the exception of one site, those on the outer banks became muddier. Those sites in transects 16 and 20 which were most distant from the river outfall all became sandier, but there was no statistically significant relationship between sediment change at a site and distance from the Gt Ouse outfall.

5. After the effect of changes in the proportion of fines in the sediment was taken into account, organic content of the sediment was significantly higher over the whole study area in 2005 than it was in 2004. However, there was no statistically significant evidence of the sediment organic content being related to the distance from the outfall of the river.

6. During the course of the study, sediments of both the inner banks alone and the entire area were muddiest in 2000 with sediments of the 2005 survey being around the average for the period of the study. Having statistically taking into account the variation in fine sediment, the sediment organic content in 2005 was the highest recorded during the course of the study.

Changes in invertebrate densities between the 2004 and 2005 surveys.

7. Of the 66 invertebrate families or species and species size categories that were sufficiently abundant to allow statistical comparisons to be made, the densities of 14 of them changed significantly over the whole study area between the 2004 and 2005 surveys.

8. Of the worms, one, small *Scoloplos armiger* (<15mm in size) increased in density while that of five other species decreased in 2005 compared with 2004.

9. Of the crustaceans, small *Corophium volutator* (<3mm) increased in density while larger ones (3+mm) decreased in 2005 compared with 2004.

10. The density of five molluscs decreased significantly in 2005 compared with 2004 densities but none increased in density.

11. There was some evidence of the spatial changes in invertebrate densities being associated with the distance from the Gt Ouse outfall. Changes in the densities of the worms *Eteone longa*, *Anaitides mucosa*, large *Hediste diversicolor* and small *Scoloplos armiger*, the crustacean *Corophium* (<3mm) and the bivalve mollusc *Scrobicularia* (11-20mm) were significantly related to the distance for the outfall after the changes in sediment particle size and organic content and shore-level had been accounted for statistically. Decreases in the densities of *Eteone*, *Hediste* and *Scrobicularia,* were greatest near the outfall but gradually lessened with increasing distance from the river, while the decrease in *Anaitides* density became greater as distance from the river increased. Both *Scoloplos* and *Corophium* densities increased overall with the increases in the former species becoming greater with increasing distance from the river and those of the latter becoming less.

12. Annual variations in the densities of the main classes of invertebrates were summarized as follows. Over the 11 successive years of this study, worm densities were at their lowest in 1996 and with the exception of 1998, increased annually until 2003 but have declined since then. Crustacean density was lowest in 1996 and again in 2000 since when it has increased annually to the highest density recorded in 2003. It dropped markedly in 2004 but increased in the current survey to densities a little above the average for the study period. There had been a general upward trend in snail densities between 1996 and 2001 but they dropped in 2002 since when they have risen annually to the highest density ever recorded in the study in the current survey. Bivalve mollusc density was at its highest in 2000 when there was a large spatfall of many species, notably cockle and *Macoma*. Since then their densities have remained relatively low with the 2005 densities as low as those recorded in 1997 and 1998.

Changes in bird numbers between the 2004-2005 and 2005-2006 surveys.

12. As in previous winters, the number and distribution of seven species of wading birds and the shelduck feeding at low tide in the study area was surveyed on two occasions during November 2005 to late January 2006.

13. The larger shorebird species, bar-tailed godwit, oystercatcher, curlew and shelduck were all more abundant in winter 2005-06 than they were in the previous winters' survey, while the smaller species, dunlin, redshank, knot and grey plover were less abundant.

14. Dunlin, redshank, grey plover and curlew were the most widespread species. Shelduck were similarly widespread although they were absent from the sandiest areas of the inner banks and from the outer bank areas. In contrast to the former five species, the distributions of knot, bar-tailed godwit and oystercatcher were aggregated in a few parts of the study area. Peaks in the numbers of knot occurred on Ferrier Sand, those of oystercatcher occurred on Stubborn Sand and on the outer banks while bar-tailed godwit were most numerous on Ferrier and Stubborn Sand.

15. Within the study area, there was no evidence of any relationship between spatial change in numbers from 2004 to 2005 and distance from the Gt Ouse outfall for any of the shorebird species.

16. Change in shorebird numbers within the study area between the current and the previous winters' survey was compared with that recorded in the whole Wash to determine whether changes were local or Wash-wide. Relative to the winter of 2004-05, curlew and shelduck number increased in proportion with those in the whole Wash implying that changes were Wash-wide. Increases in bar-tailed godwit and oystercatcher numbers were more pronounced in the study area than in the Wash suggesting a local effect, perhaps due to the area being more preferred by those species. Declines in dunlin and redshank numbers were more pronounced in the whole Wash while those of knot and grey were more pronounced in the study area. This implied that the study area remained a preferred area for dunlin and to a lesser extent for redshank, but that for knot and grey plover it was a less preferred as a feeding area.

17. The numbers of shorebirds feeding on the inner banks of the Gt Ouse study area at low tide have been surveyed for a total of 14 winters to date and were summarised in the report to put into perspective the changes that have occurred during the course of this study.

1. INTRODUCTION

The work reported here forms part of a study whose purpose is to monitor and evaluate the impact on the inter-tidal sediments, invertebrates and the shorebirds that eat them, of variations in the flow of freshwater into the south-east corner of the Wash via the river Great Ouse.

1.1 Objectives

Our study has the following objectives.

i) To monitor the particle size and organic content of sediments, the densities of invertebrates and the numbers of shorebirds feeding on the inter-tidal area adjacent to the Great Ouse outfall by annual surveys.

ii) To relate changes detected by the monitoring surveys to the distance from the outfall and to variations in river flow.

1.2 Reporting strategy

This report, like those produced annually since 1996-97, deals with objective i) and addresses year on year changes in distribution of sediments, invertebrates and birds and how these changes relate to the distance of the areas concerned from the Gt Ouse outfall. The underlying assumption being that any impact of variations in freshwater flow is most likely to be evident in those areas closest to the river outfall.

After the completion of the 2004-2005 surveys, eight sets of between-year data had been accumulated and we are able to address objective ii) of this study by beginning statistical analyses to detect any trends in distribution and abundance between years that may relate to freshwater flow into the Wash from the river Gt Ouse. This was the subject of a separate report (Yates *et al* 2006) that summarised all the accumulated data and explored changes in sediments, invertebrates and birds in relation to river flow and other environmental variables which either influenced flows, for example rainfall, or were influenced by flows, for example salinity and nutrient input.

1.3 River flow conditions prior to the 2005-2006 surveys

River flows in the Gt Ouse during the 12 months (September 2004 to August 2005) preceding the 2005-2006 surveys resulted in a discharge volume into the Wash of 654.4 million cubic metres (Mm^3) which was approximately 218.8 Mm^3 less than was discharged prior to the previous years' survey. The average for the same 12-month period from 1974 to 2005 was 1005 Mm^3, therefore, the current survey followed a period of much lower than average river flow. Indeed it was the 3rd lowest recorded over the period of this study (behind flows in 1996 and 1997).

2. SURVEY AND SAMPLING METHODS

A full description of the survey and sampling methods used in this study were given in Volume 2 of our report of the 1996-97 surveys (Yates *et al* 1998) so only a summary is given here. Readers requiring details are referred to that report, copies of which are held by Black and Veatch, or to the author. Details of specific statistical analyses used are presented in the relevant parts of the Results and Discussion section.

2.1 Survey areas and sample sites

Sediment and invertebrate samples are taken from sites, 1 ha in area, arranged in 10 transect lines orientated from upper to lower levels of the shore within the Gt Ouse study area (Figure 2.1)

Forty-two of the 45 sites that had been sampled since 1997 were again sampled in 2005. The exceptions were site 2 of transect 19 which was abandoned in 2002 because of encroaching salt-marsh vegetation and site 2 in transects 17 and B which were abandoned in 2003 for the same reason.

At each site, samples of sediment were taken to a depth of 2.5cm from five, randomly selected locations and placed in sealed plastic bags. These samples were frozen as soon as possible after collection. In addition five samples of substrate were taken using two, 10cm diameter by 30cm deep cores and the invertebrates were sieved from them on site using a 0.5mm mesh sieve. These invertebrate samples were placed in plastic pots and fixed in 4% buffered formaldehyde solution made up with sea-water.

Shorebird surveys were made over the inter-tidal areas shown in Figure 3.3.1. The distribution and number of feeding shorebirds was determined by walking an area, following a route that minimised disturbance, and observing the birds through a telescope.

Sediment and invertebrate sampling was undertaken during spring tides during October 2005. Two shorebird surveys were undertaken during the period mid-November 2005 to late January 2006. Each survey was conducted at the same time of year as previous surveys to allow them to be directly compared.

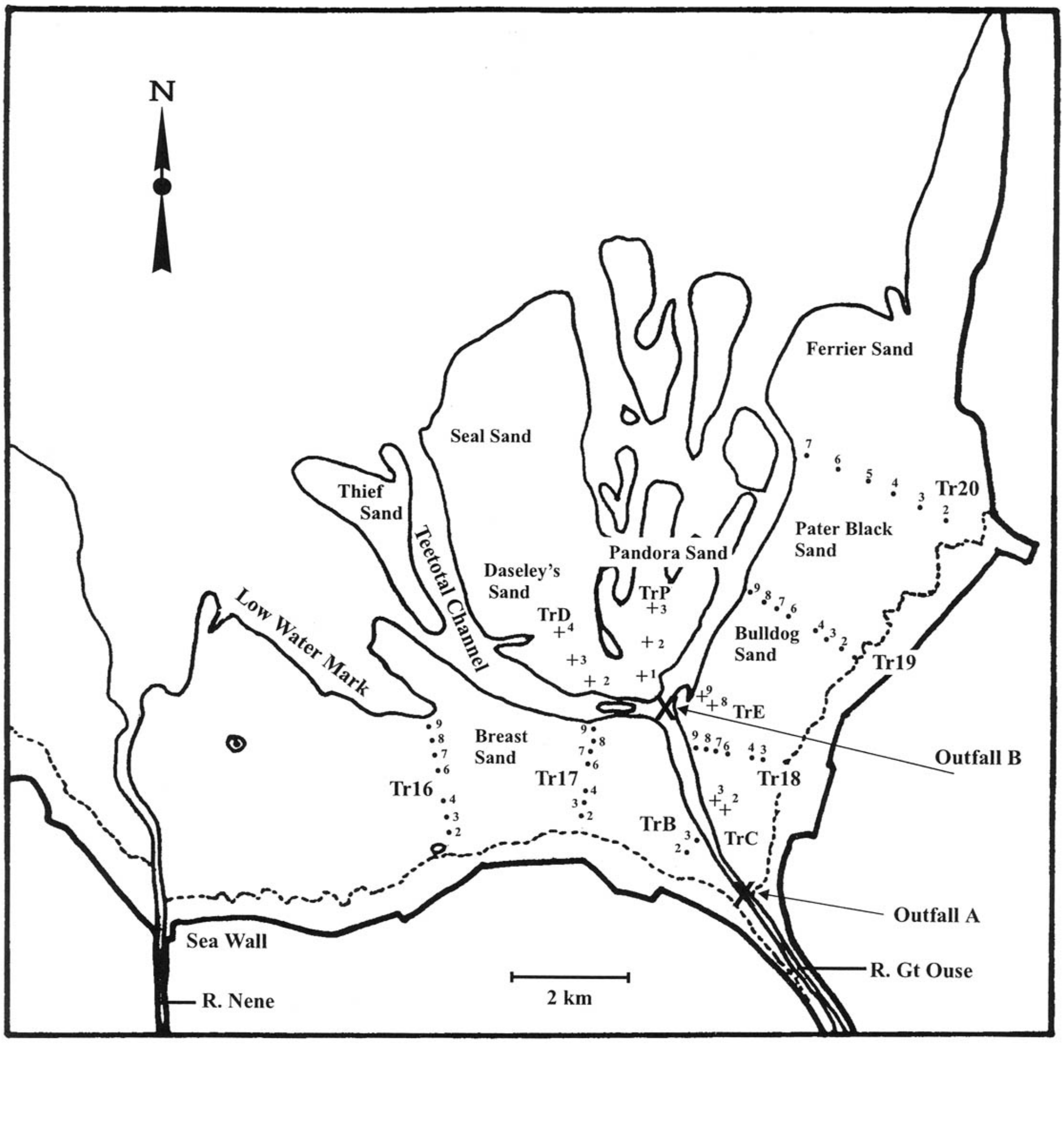
Section 2

Figure Legends

Figure 2.1 The ITE (now CEH) sediment and invertebrate sample sites. Sites that have been sampled each year since 1996 are shown as solid circles. Additional sites on Bulldog, Daseley's and Pandora Sands that were first established and sampled in 1997 and sampled thereafter are shown as crosses. *Note that site 2 in transects 19 and in transects 17and B were abandoned in 2002 and 2003 respectively, because of encroaching salt-marsh vegetation.

Figure 2.1 The sediment and invertebrate sample sites. Sites that have been sampled each year since 1996 are shown as solid circles. Additional sites on Bulldog, Daseley's and Pandora Sands that were first established and sampled in 1997 and sampled thereafter are shown as crosses. *Note that site 2 in transect 19 and in transects 17and B were abandoned in 2002 and 2003 respectively, because of encroaching salt-marsh vegetation.

Fig 2.1 CEH Sediment and Invertebrate Sampling Sites



3. RESULTS AND DISCUSSION OF THE 2005-2006 SURVEYS

3.1 Sediments

The sediments' particle size distribution has been summarised using the proportion of the particles less than 63 microns (<63μm) in diameter as in the reports of our previous surveys. This fraction contains silts and clays, and is collectively termed 'fines'. The fraction greater than 63 microns (>63μm) is called 'sands'. We have found this summary statistic, rather than mean or median particle size, to be the most useful for understanding the influence of particle size on the sediments' organic content and on the invertebrate fauna. Using this convention we defined muddy sediments as those in which the proportion of fines exceeds 25% as opposed to sandy sediments in which the fine fraction was 25% or less.

3.1.1 Sediment distribution in 2005

Figure 3.1.1 shows the spatial distribution of muddy and sandy sites within the study area in 2004. Of the 42 sites sampled in 2005, 31 were muddy and 11 were sandy. All except one site located on the shore to the west of the Gt Ouse was muddy. Most sites (16 out of 22 sites) on the shore to the east of the river were also muddy. The exceptions were mid-to low- level sites of transects 19 and 20 which were sandy. On the outer banks two sites were muddy while the remaining four were sandy.

3.1.2 Changes in sediment particle size between 2004 and 2005

Overall there was little change in the sediment type of sites within the study area between the 2004 and 2005 surveys. Of the 42 sites sampled in both years there were 31 muddy sites in 2005 compared to 28 in 2004 (Figures 3.1.1 and 3.1.2). The difference was due to three sites changing from sand to mud in 2005, these were sites 19.7 and E.8 on the east shore and site D4 on Daseley's Sand. Although more sites were classed as mud in 2005 than in the previous year most sites on the inner bank areas became sandier while, with the exception of one site, those on the outer banks became muddier.

The amount by which the proportion of fines in the sediment changed between the two surveys is shown for each site within a sampling transect in Figures 3.1.3a-j. Because the same 1 hectare blocks are sampled in each survey, we were able to determine the statistical significance of annual changes by performing one-way ANOVA on the mean of the five random samples taken at each site. All sites in transect 16 were muddy in both years, though sites 2, 3, 7, 8 and 9 were significantly less muddy in 2005 than in 2004 (Figure 3.1.3a). In transect 17, all sites were muddy except site 7 which was sand but none differed significantly from 2004 (Figure 3.1.3b).The single remaining site in transect B was significantly less muddy in 2005 than it was in 2004 (Figures 3.1.3c). All sites, except site 3 and 8 in transect 18 were sandier in 2005 with sites 4, 6,7 and 9 becoming significantly so (Figure 3.1.3e).Both sites in transect C site 2 became less muddy in 2005, site 2 being significantly so (Figure 3.1.3d). There was less change in transect 19; the only significant change being in site 7 which became muddy in 2005 having been sandy in 2004 (Figure 3.1.3g). Both sites in transect E were mud (Figure 3.1.3f), site 8 having changed from sand to mud between 2004 and 2005. The mid-lower shore sites of Transect 20 tended to be sandier in 2005 than they were in 2004 (Figure 3.1.3h), site 6 being significantly so, although sites 2 and 3 were still classed as muddy. Those sites lower on the shore remained sandy. Sediment on Daseley's Sand (Figure 3.1.3i) became significantly muddier at site D4 in 2005 but remained sandy at the other two sites. On Pandora Sand site 1 remained muddy and although there was a significant increase in muddy sediment at site 3 both sites 2 and 3 remained classed as sandy (Figure 3.1.3j).

Figure 3.1.4 shows the changes in the proportion of fines in the sediment between 2004 and 2005 at each sample site in relation to its distance from two points labelled A and B in Figure 2.1. We defined these points respectively as the high tide and low tide outfalls of the river Gt Ouse. There was no statistically significant relationship between sediment change at a site and distance from either outfall point although those sites in transects 16 and 20 which were most distant from the low tide outfall (point B) all became sandier.

An increase in sandiness of the sediment at a site can be the result the removal of fine sediment (winnowing), the deposition of sand particles or a combination of both. A possible explanation for the deposition of sand particles might be the influence of the beach recharge activity on Stubborn Sand to the north of the study area which was taking place prior to, and during the survey period. This could have given rise to the observed increase in sandiness in transect 20, the nearest to this recharge area. But such an explanation is less satisfactory in the case of transect 16 because of its distance from the recharge areas and the barrier to sediment transport posed by the outer banks which lie between it and the recharge site.

3.1.3 Organic content in 2005

Sediment organic content, as determined by loss on ignition (LOI), is positively related to the proportion of fines in the sediment; that is, muddy sediments have a higher organic content than sandy ones. This relationship was curvilinear and was apparent in the sediments from the 2005 survey (Figure 3.1.5) as it had been in all previous surveys. There was also an indication that the organic content of transect 20 was higher than its average particle size would suggest.

Having taken this relationship into account, the issue most relevant to this study was whether there was any pattern in the sediment's organic content in relation to its distance from the outfall of the Gt Ouse. For example, it might be anticipated that if river inputs were the major source of organics then, at times of low flows, those transects nearer the river would have a higher organic content. Conversely, after periods of high flow the influence of organic inputs might be more widely spread. This was explored statistically using regression analysis. First, the %LOI was transformed into logarithms to the base *e* ($\log_e$) to linearise the curvilinear relationship with the proportion of fine sediment and normalise the variation around it. Plots were then made between the residual variation in sediment organic content remaining after the influence of sediment particle size was removed and the distance of the transect from the Gt Ouse outfall (Figure 3.1.6a and b). Any indication of a trend was explored by regression analysis. However, there was no statistically significant evidence of the sediment organic content of a transect being related to its distance from either the high water or low water outfall of the river.

3.1.4 Changes in sediment organic content between 2004 and 2005

Comparisons in the sediment organic content between years were made after first using $\log_e$ transformation of the %LOI data to both linearise and normalise the relationship with the proportion of fine particles. Whether a transects' organic content differed between years was tested for by taking into account both the influence of fine sediment and the location of the sample site on the shore. Site location was included as it was possible that for a given proportion of fine sediment, upper shore sites might have a different organic content than those sites at lower shore levels because of the presence of more algae, diatoms and detritus in the sediment. The statistical procedure was, therefore, to test whether the response or dependent variable, $\log_e$%LOI, varied between years by including the proportion of fines in the sediment as a covariate with site location and the year as factors, in an analysis of variance. The general linear model (GLM) procedure in the MINITAB statistical software package was used.

The sediment's organic content over the whole of the study area in 2005 differed significantly from that in 2004 (Figure 3.1.7). This difference was due to muddier sites being more organically rich in 2005 than they were in the previous year while the organic content of the sandiest sites was unchanged.

Differences in sediment organic content within individual transects between the current and previous survey are shown Figure 3.1.8a-j. The sediment organic content of transects 16, 17, B, 20, D and P did not differ significantly between 2004 and 2005 (Figures 3.1.8a, b, c, h, I and j). However, that of transects C, 18, E and 19 was significantly different in 2005 (intercept p value <0.05) compared with the previous year (Figures 3.1.8d, e, f and g). For a given particle size the sediment organic content in these transects, all of which were located on the southern part of the shore to the east of the river outfall, was higher in 2005. It was these transects that contributed most to the higher organic content when the study area was considered as a whole (Figure 3.1.7).

3.1.5 Annual changes in sediments and organic content.

Figures 3.1.9 and 3.1.10 illustrate the changes that have occurred in sediments and their organic content during the course of the whole study. The relationship between these changes and river flows was the subject of a review (Yates *et al* 2006) that was undertaken after the completion of the 2004 survey. However these figures have been included here to help put the current survey data into a study-long perspective.

Two datasets were available. The first spanned the years 1986 and 1996 to the present and related to the inner banks of the Gt Ouse study. The second spanned the period 1997 to the present and related to the entire Gt Ouse study area, that is both inner bank and outer bank areas.

Sediment was muddiest in 2000 over both the inner banks alone (Figure 3.1.9a) and the entire area (Figure 3.1.9b), while sediments in the current survey were around the average in both areas. Having statistically taking into account the influence of fine sediment, the sediment organic content in the current survey was the highest out of both the 11 surveys of the inner banks and nine surveys of the entire study area (Figure 3.1.10a and b).

3.1.6 Summary and conclusions

Of the 42 sites sampled in 2005, 31 were muddy and 11 were sandy. All except one site located on the shore to the west of the Gt Ouse was muddy. Most sites (16 out of 22 sites) on the shore to the east of the river were also muddy. The exceptions were mid-to low- level sites of transects 19 and 20 which were sandy. On the outer banks two sites were muddy and the remaining four were sandy.

Overall there was little change in the sediment type of sites within the study area between the 2004 and 2005 surveys. Of the 42 sites sampled in both years there were 28 muddy sites in 2004 compared to 31 in 2005. Although more sites were classed as mud in 2005 than in the previous year the sediment of most sites on the inner bank areas became sandier while, with the exception of one site, those on the outer banks became muddier. However there was no statistically significant relationship between sediment change at a site and distance from the Gt Ouse outfall although those sites in transects 16 and 20 which were most distant from the river outfall all became sandier.

After the effect of changes in the proportion of fines in the sediment was taken into account, organic content of the sediment was significantly higher over the whole study area in 2005 than in 2004. However, there was no statistically significant evidence of the sediment organic content of a transect being related to its distance from the high outfall of the river. Within the 10 individual sampling transects, four had a significantly higher organic content in 2005 and they were all located on the southern part of the shore to the east of the river outfall. There was no significant change in the remaining six transects.

During the course of the study, sediments of both the inner banks alone and the entire area were muddiest in 2000 with sediments of the 2005 survey being around the average for the period of the study. Having statistically taking into account the variation in fine sediment, the sediment organic content was the highest recorded during the course of the study.

Section 3.1
Figure legends

Figures 3.1.1 and 2.

Map of sediment type at our sample sites in 2005 (Fig 3.1.1) and 2004 (Figure 3.1.2) as determined by ground survey. Shaded symbols indicate the site was sandy (<25% fine sediment), closed symbols indicate the site was mud (>25% fine sediment).

Figure 3.1.3 a-j

The percentage of fine sediment (particles <63 microns) that occurred in 2004 and 2005 within each transect. **a,** transect 16, **b,** transect 17, **c,** transect B, **d,** transect C, **e,** transect 18, **f**, transect E, **g**, transect 19, **h**, transect 20, **i,** transect D and **j**, transect P. Statistically significant differences in the percentage of fine sediment between years are shown as asterisks above the relevant sample block as follows:- *$p<0.05$, ** $p<0.01$, *** $p<0.001$ and **** $p<0.0001$.

Figure 3.1.4a and b

Changes in the percentage of fine sediment (particles<63 microns) that occurred between 2004 and 2005 in relation to the distance of the sample site from a, the Gt Ouse high tide outfall and b, low tide outfall (points A and B in Figure 2.1). The horizontal dotted line indicates zero change. Each data point relates to a sample site and its symbol indicates in which transect it occurred as shown in the legend box. Most sites became sandier in 2005 hence the number of data points that fall below the line of zero change.

Figure 3.1.5 The average sediment organic content, expressed as the average %Loss On Ignition, in relation to fine sediment (particles <63 microns) in each transect in 2005.

Figure 3.1.6 The residual variation in sediment organic content (Log_e %LOI), after the influence of particle size has been statistically accounted for, in relation to the sample transect's distance from the Gt Ouse outfall in 2005. The numbers identify the transects to which the data points relate.

Figure 3.1.7 The relationship between sediment organic content (log_e % Loss On Ignition) and the percentage of fine sediment (% of particles <63 microns) in 2004 and 2005 for the whole Gt Ouse study area. The fitted regression lines relating sediment organic content (log_e % Loss On Ignition) to the percentage of fine sediment (% of particles <63 microns) in 2004 (solid line) and 2005 (dashed line) had similar intercepts but significantly different slopes.

Figure 3.1.8a-j

The relationship between sediment organic content (log_e % Loss On Ignition) and the percentage of fine sediment (% of particles <63 microns) in each transect in 2004 and 2005. The fitted regression lines (solid line for 2004 and dashed line for 2005) are shown where there was a significant difference between years.

a, transect 16, **b,** transect 17, **c,** transect B, **d,** transect C, **e,** transect 18, **f**, transect E, **g**, transect 19, **h**, transect 20 **i**, transect D and **j,** transect P.

Figure 3.1.9a and b

Annual changes in the mean percentage of fine sediment on **a**, the inner banks alone from 1986 and 1996-2005 and **b**, on the entire Gt Ouse study area from 1997-2005.

Figure 3.1.10a and b.

Annual changes in the mean organic content of sediment (%LOI) on **a**, the inner banks alone from 1986 and 1996-2005 and **b**, on the entire Gt Ouse study area from 1997-2005. The organic content has been adjusted to take into account variation in the % of fine sediment in each year.

Figures 3.1.1 and 2. Map of sediment type at our sample sites in 2005 (Fig 3.1.1) and 2004 (Figure 3.1.2) as determined by ground survey. Shaded symbols indicate the site was sandy (<25% fine sediment), black symbols indicate the site was mud (25+% fine sediment).

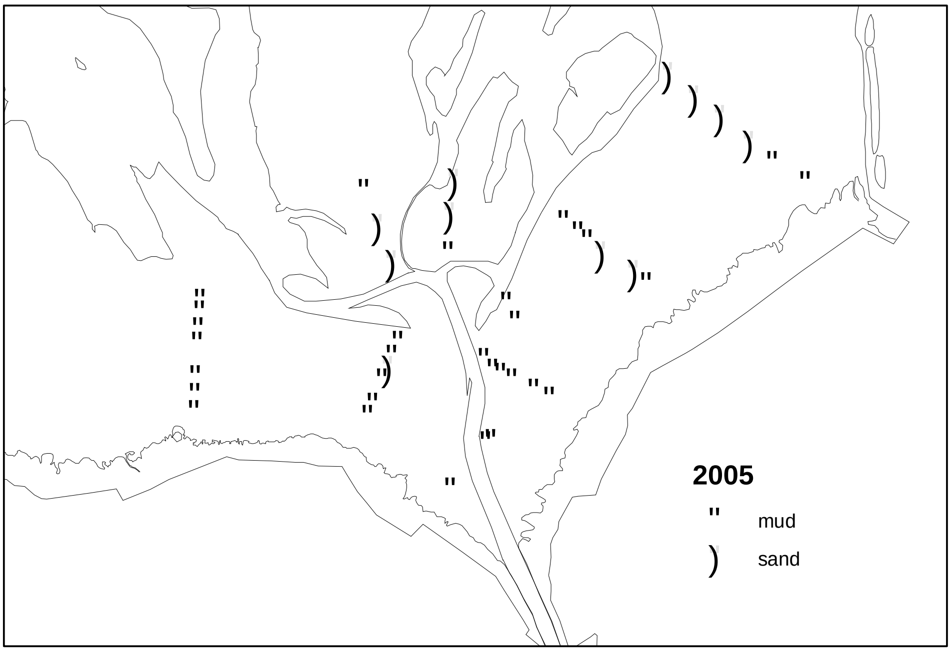


Figure 3.1.1Sediment type in 2005 (above) and Figure 3.1.2 in 2004 (below)

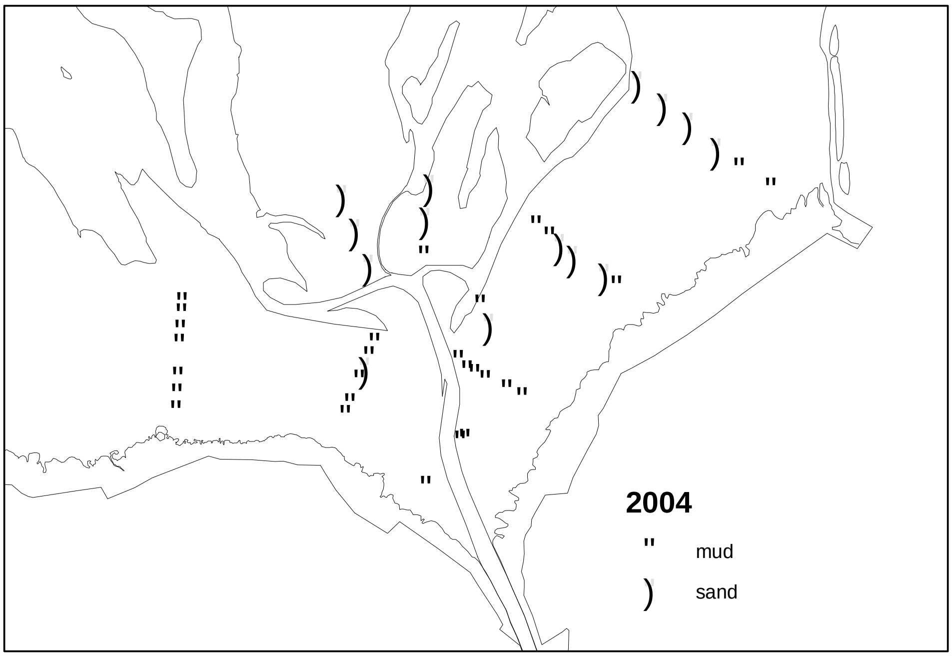
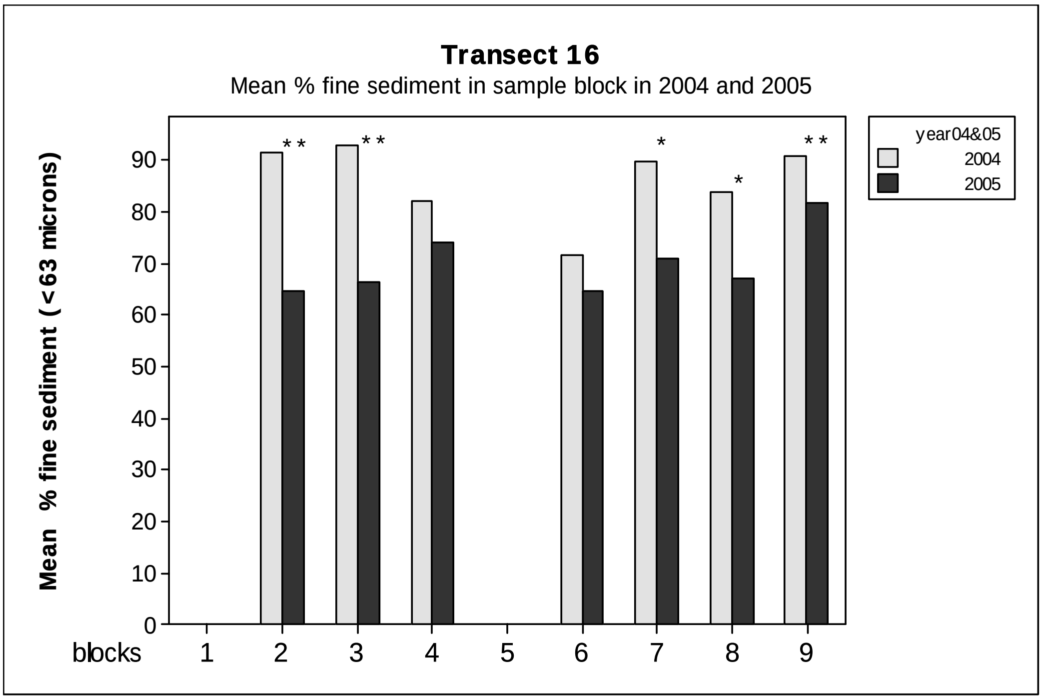


Figure 3.1.3 a-j. The percentage of fine sediment (particles <63 microns) that occurred in 2004 and 2005 within each transect. **a,** transect 16, **b,** transect 17, **c,** transect B, **d,** transect C, **e,** transect 18, **f**, transect E, **g**, transect 19, **h**, transect 20, **i,** transect D and **j**, transect P. Statistically significant differences in the percentage of fine sediment between years are shown as asterisks above the relevant sample block as follows:- *p<0.05, ** p<0.01, *** p<0.001 and **** p<0.0001.

a,



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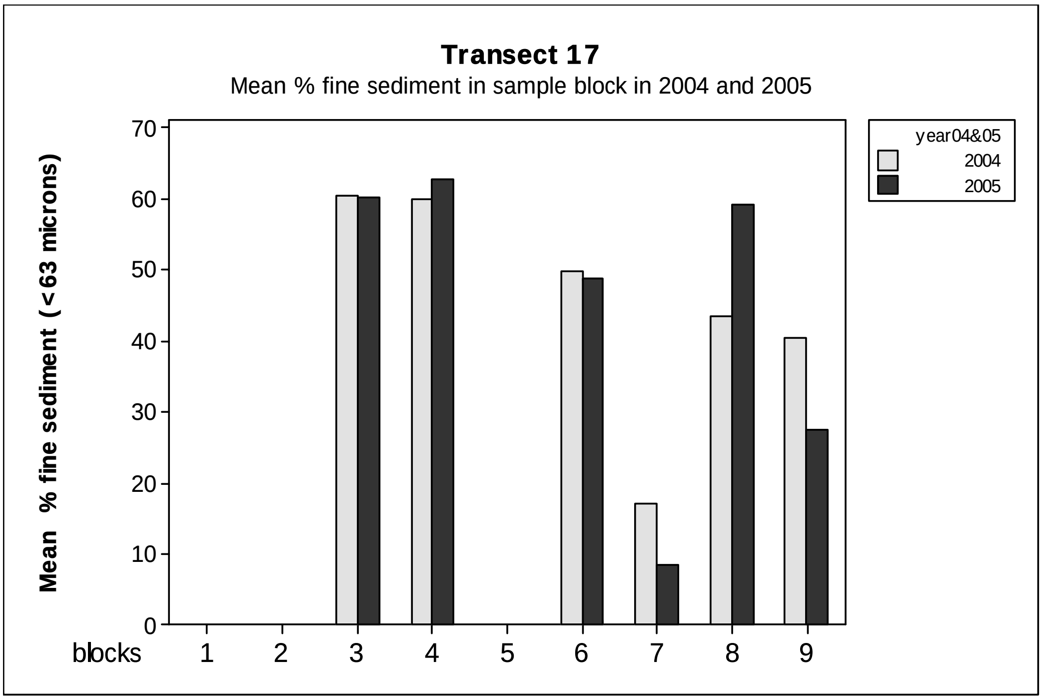

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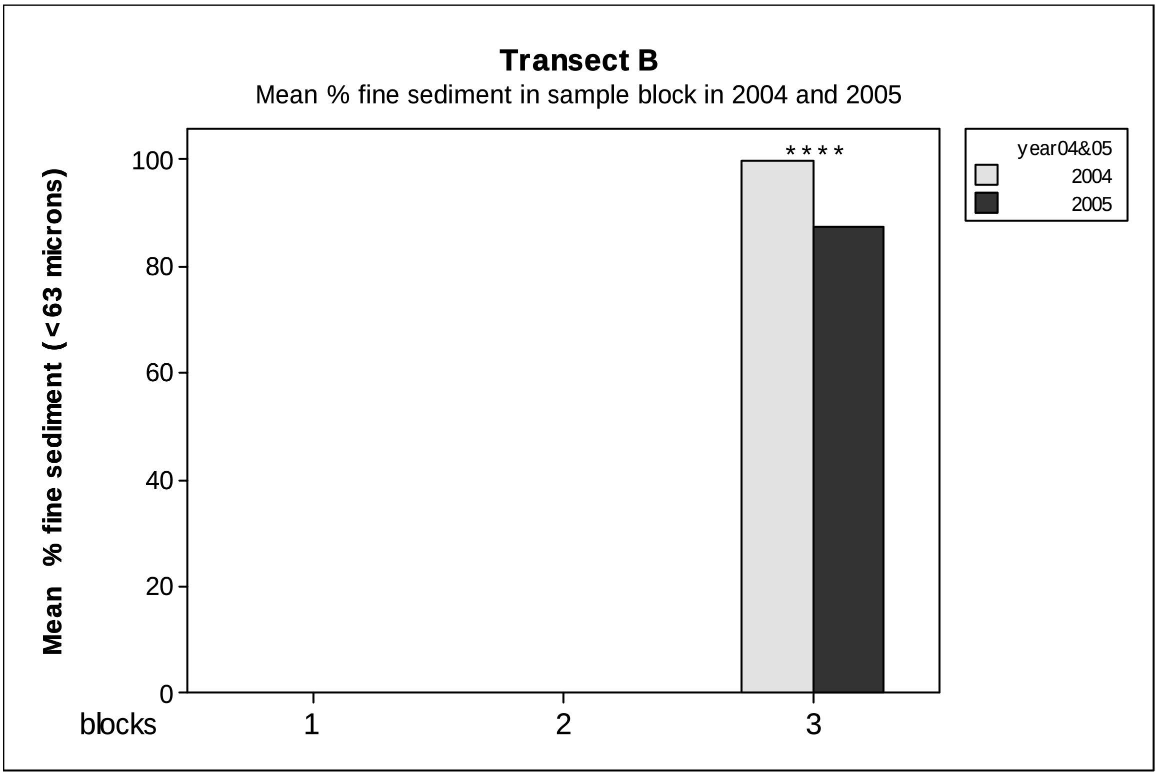

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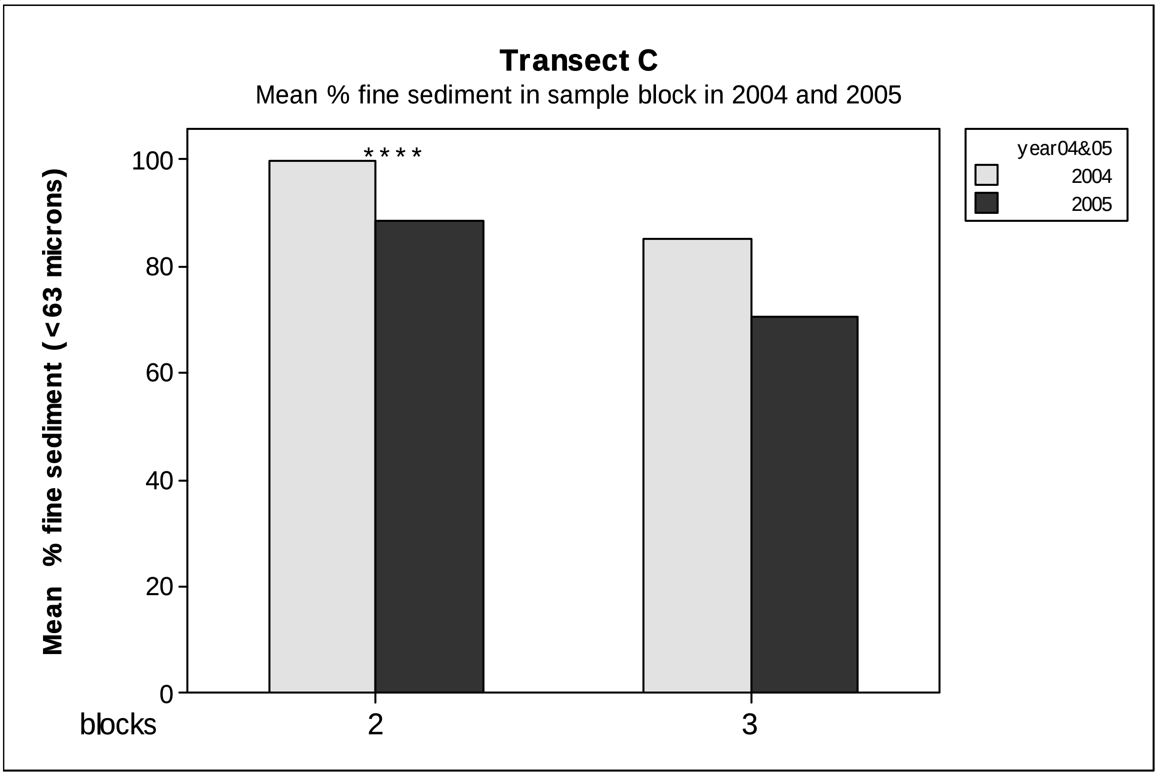

Figure 3.1.3 a-j. continued

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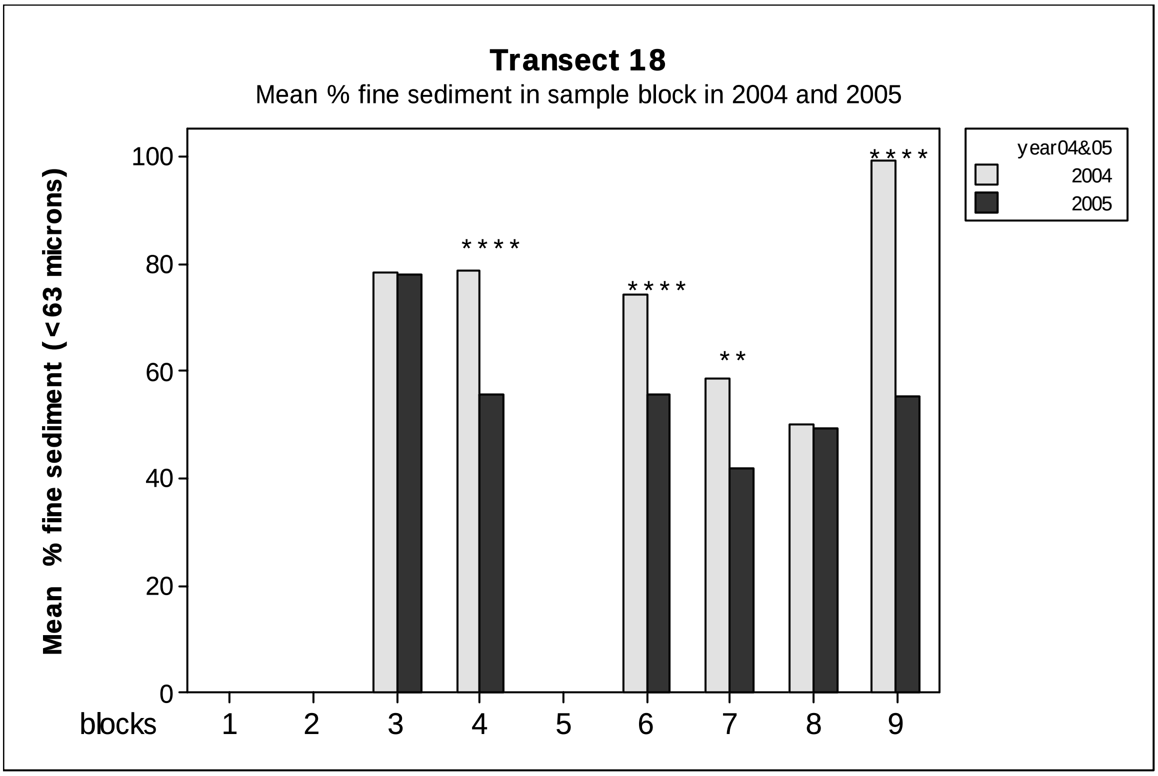

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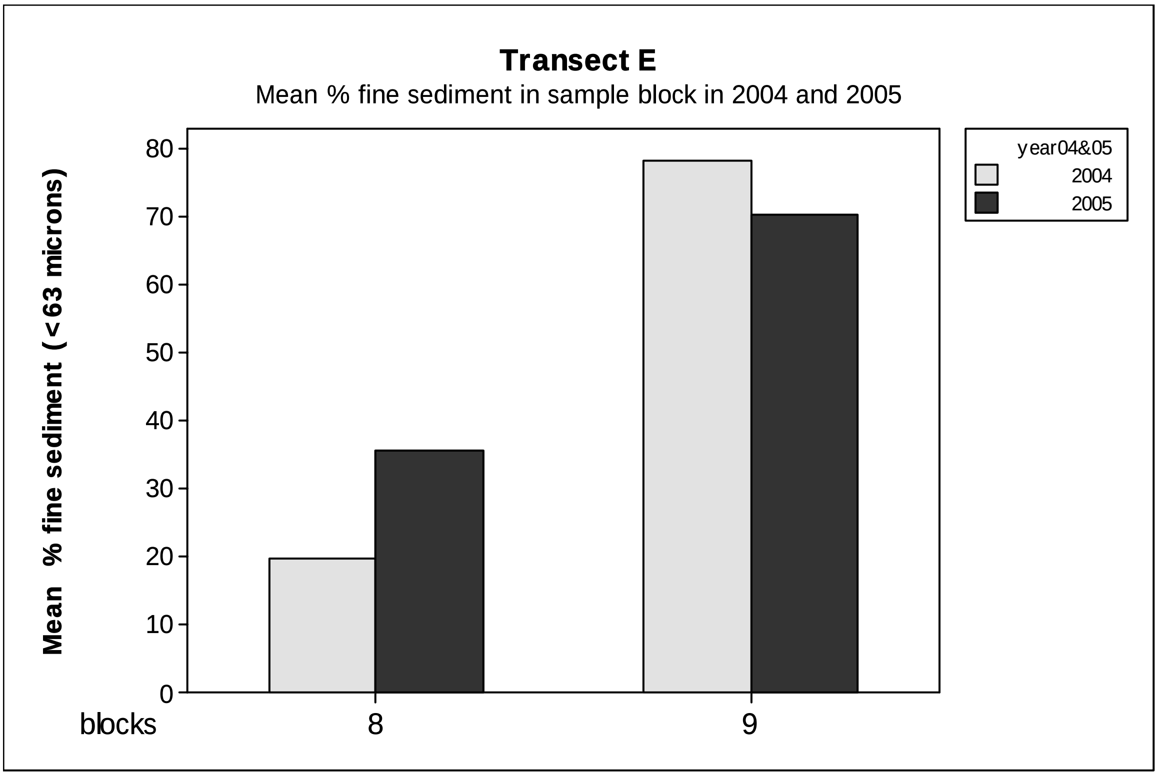
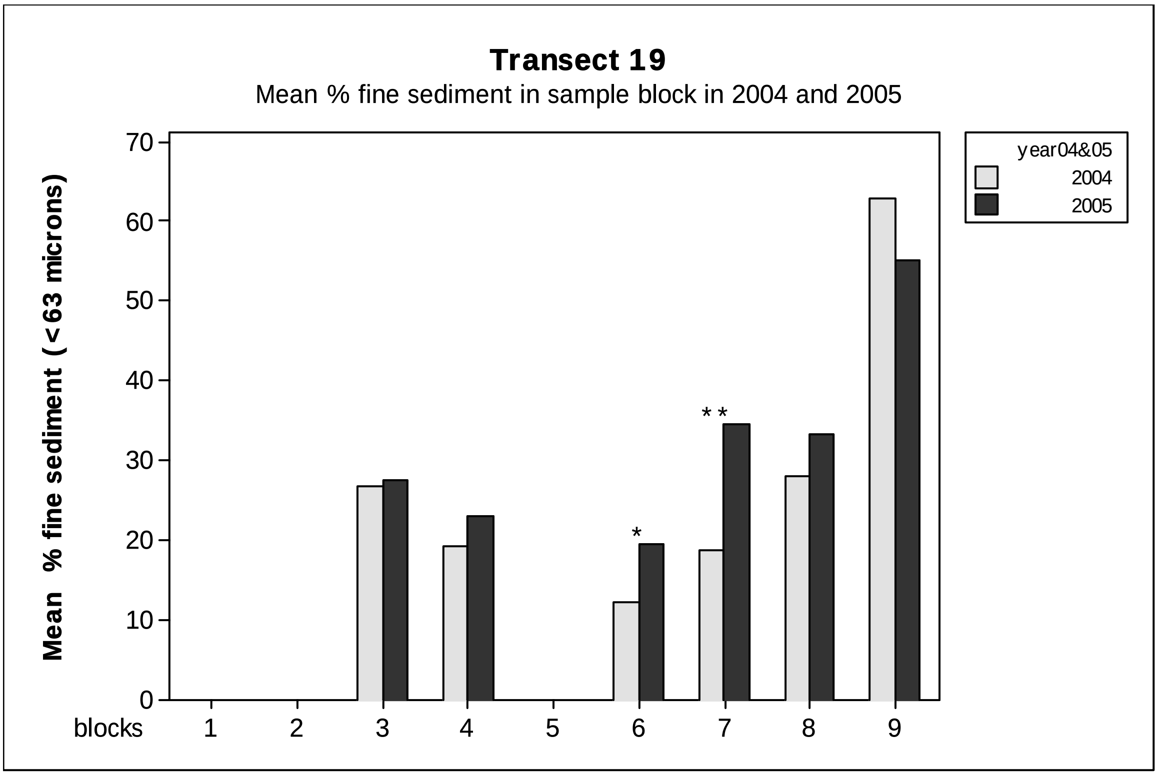


Figure 3.1.3 a-j. continued

g,



h,

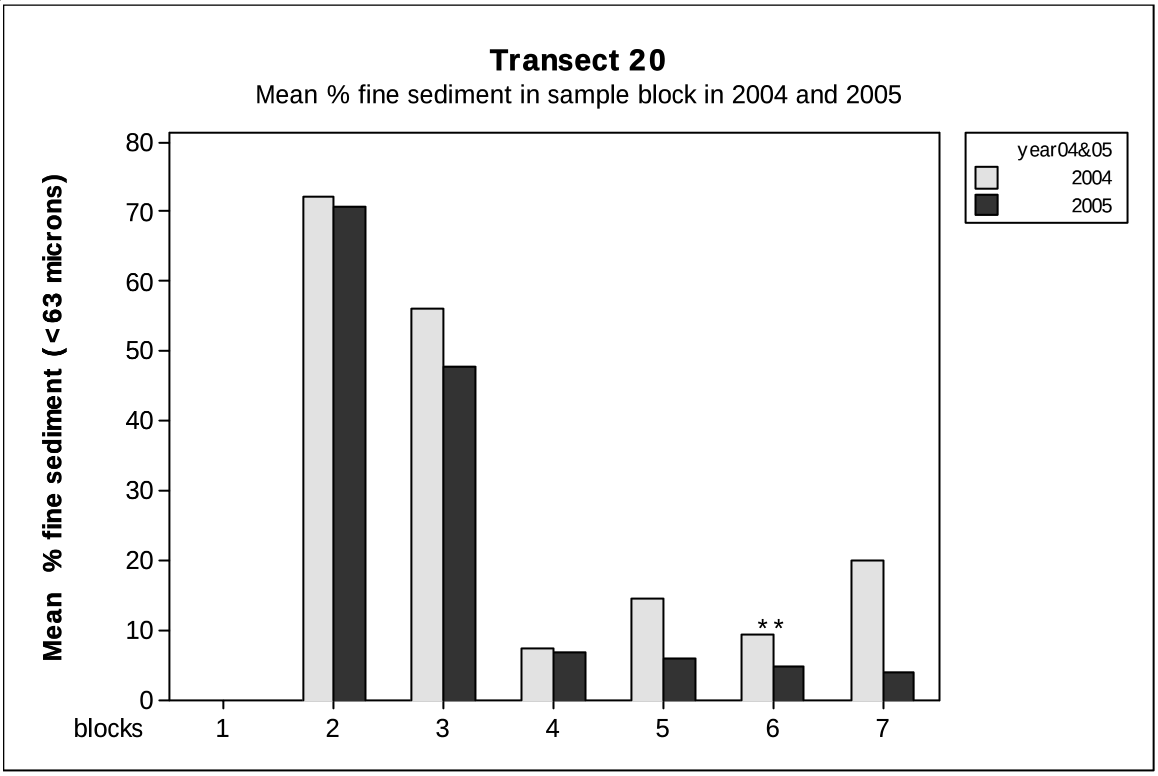
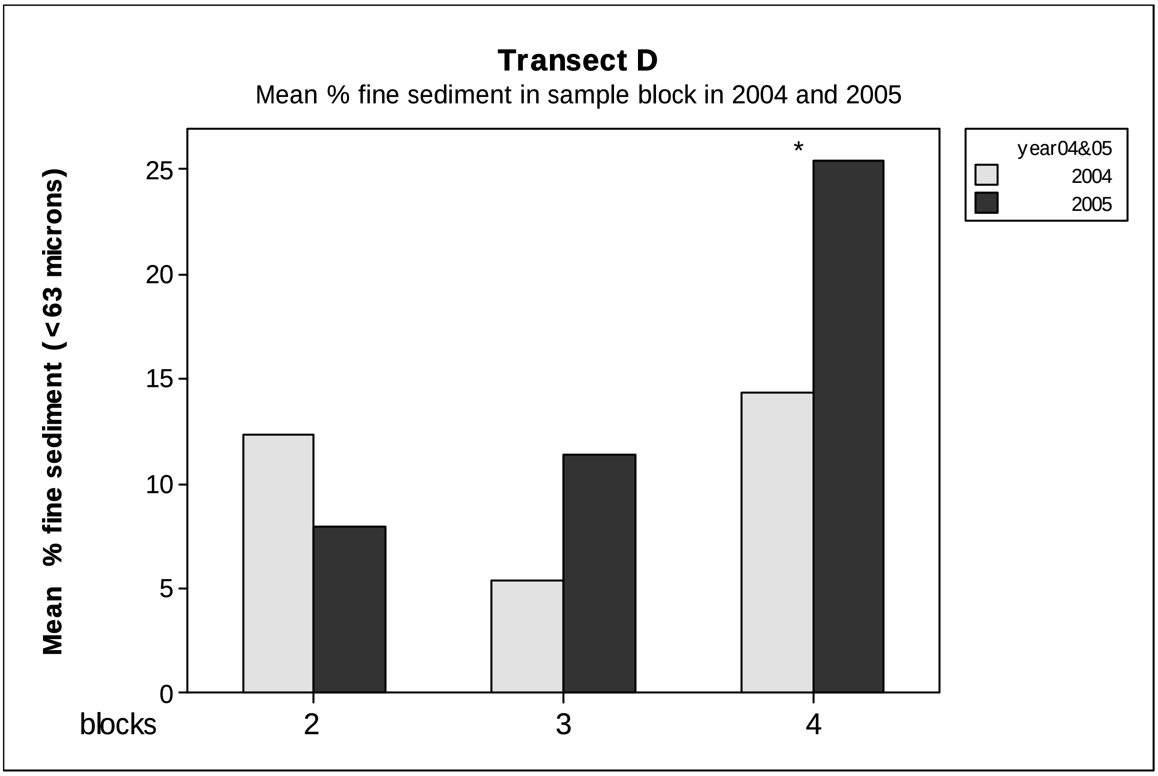


Figure 3.1.3 a-j. continued

i,



j,

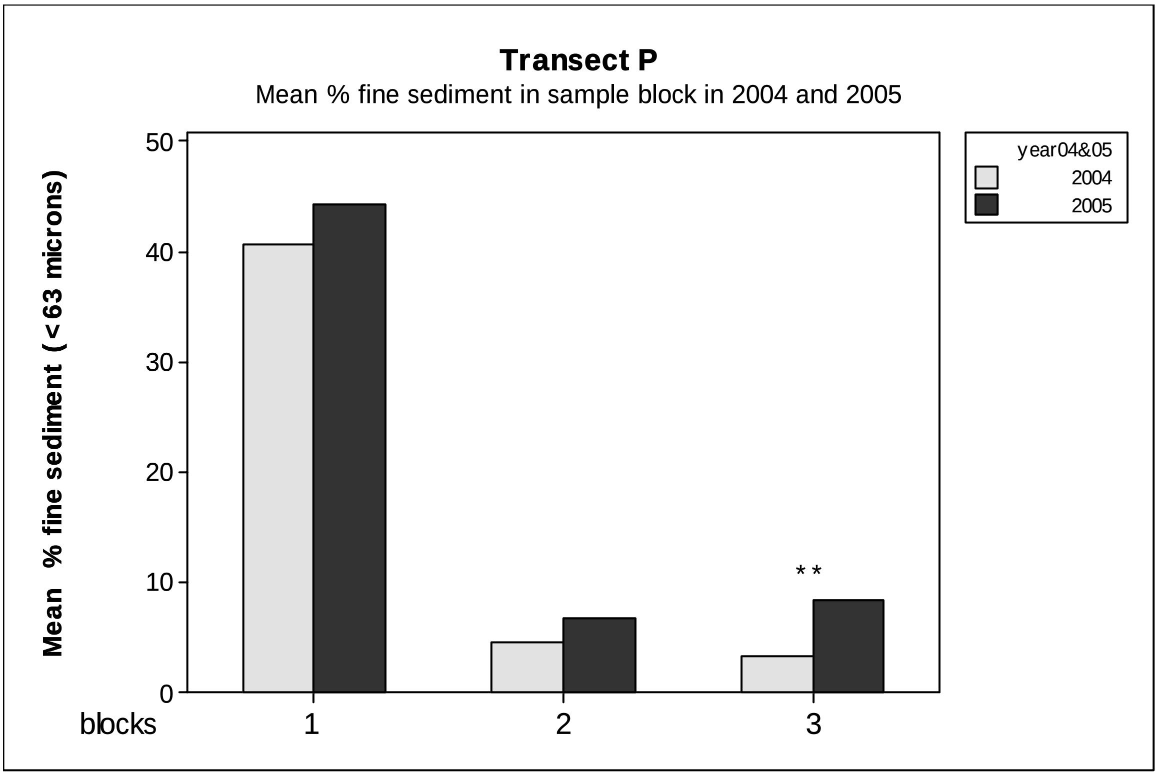
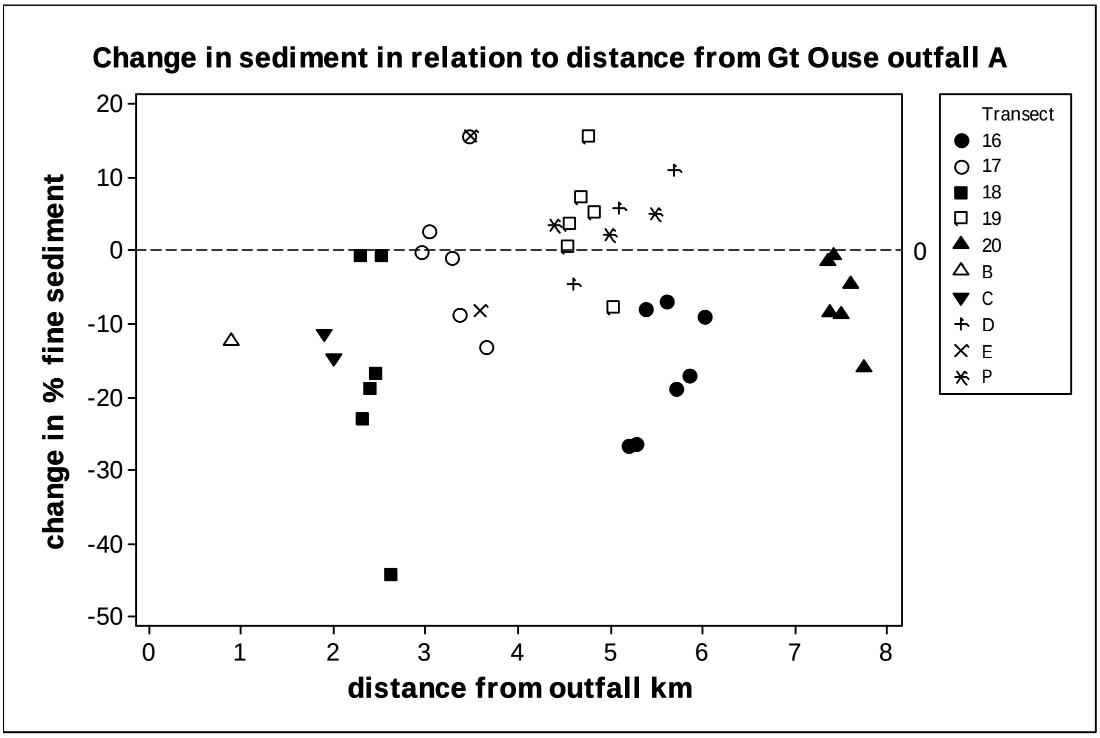


Figure 3.1.4a and b Changes in the percentage of fine sediment (particles<63 microns) that occurred between 2004 and 2005 in relation to the distance of the sample site from a, the Gt Ouse high tide outfall and b, low tide outfall (points A and B in Figure 2.1). The horizontal dotted line indicates zero change. Each data point relates to a sample site and its symbol indicates in which transect it occurred as shown in the legend box. Most sites became sandier in 2005 hence the number of data points that fall below the line of zero change.

a,



b,

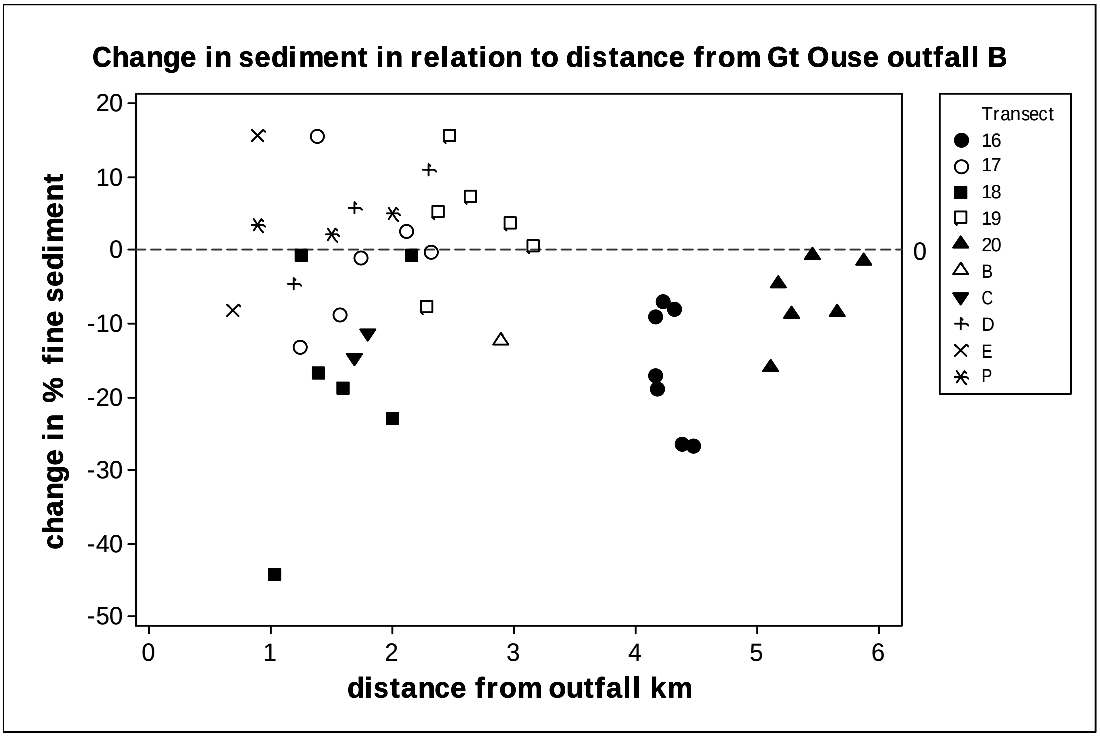


Figure 3.1.5 The average sediment organic content, expressed as %Loss On Ignition, in relation to fine sediment (particles <63 microns) in each transect in 2005.

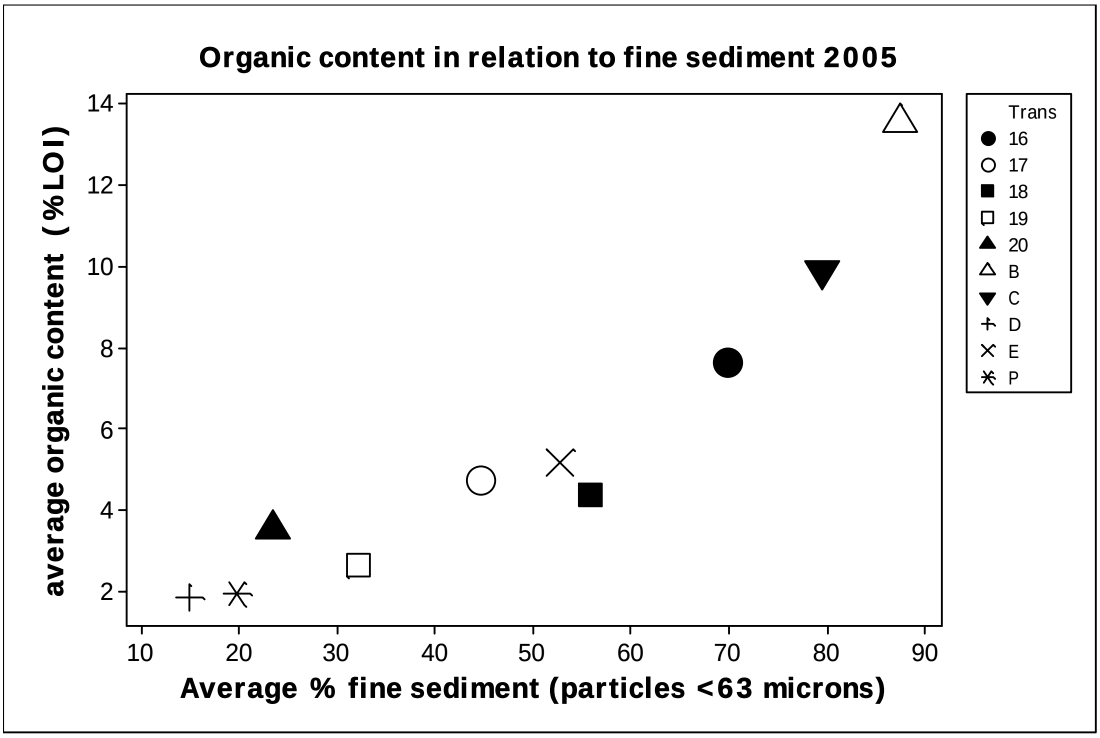
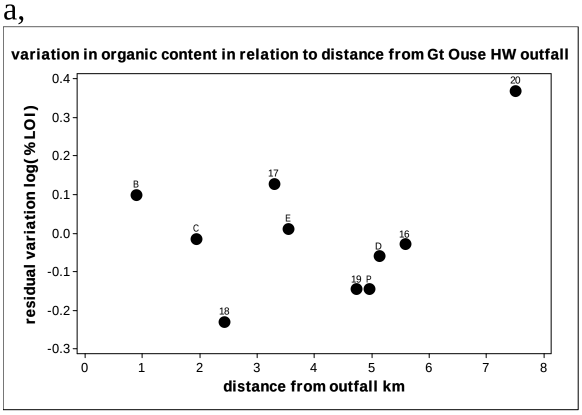


Figure 3.1.6a and b. The residual variation in sediment organic content (Log_e %LOI), after the influence of particle size has been statistically accounted for, in relation to the sample transect's distance from a, the Gt Ouse high tide outfall and b, low tide outfall (points A and B in Fig 2.1) in 2005. The numbers identify the transects to which the data points relate.

a,



b,

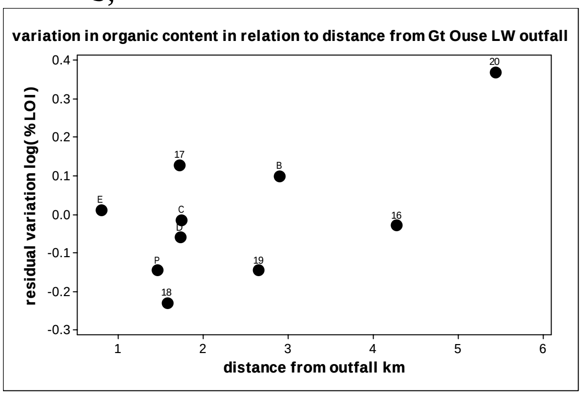


Figure 3.1.7 The relationship between sediment organic content ($\log_e$ % Loss On Ignition) and the percentage of fine sediment (% of particles <63 microns) in 2004 and 2005 for the whole Gt Ouse study area. The fitted regression lines relating sediment organic content ($\log_e$ % Loss On Ignition) to the percentage of fine sediment (% of particles <63 microns) in 2004 (solid line) and 2005 (dashed line) had similar intercepts but significantly different slopes.

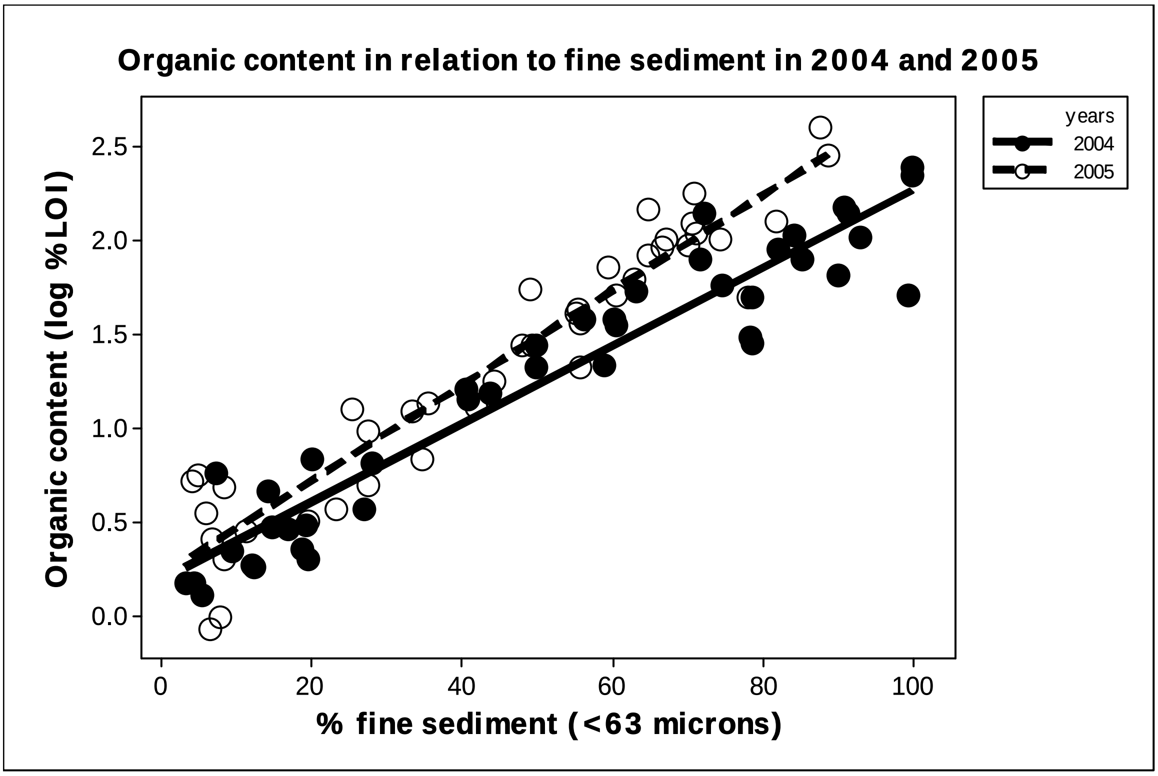
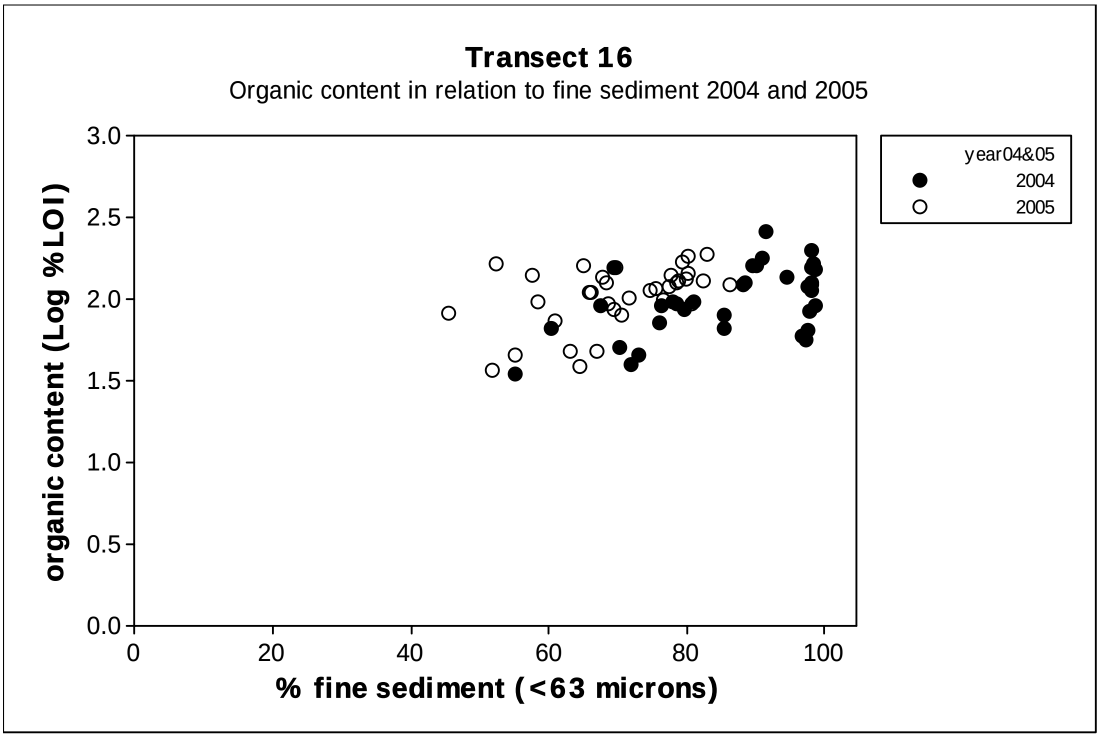


Figure 3.1.8a-j. The relationship between sediment organic content (log$_e$ % Loss On Ignition) and the percentage of fine sediment (% of particles <63 microns) in each transect in 2003 and 2004. The fitted regression lines (solid line for 2003 and dashed line for 2004) are shown where there was a significant difference between years.**a,** transect 16, **b,** transect 17, **c,** transect B, **d,** transect C, **e,** transect 18, **f**, transect E, **g**, transect 19, **h**, transect 20 **i**, transect D and **j,** transect P.

a,



b,

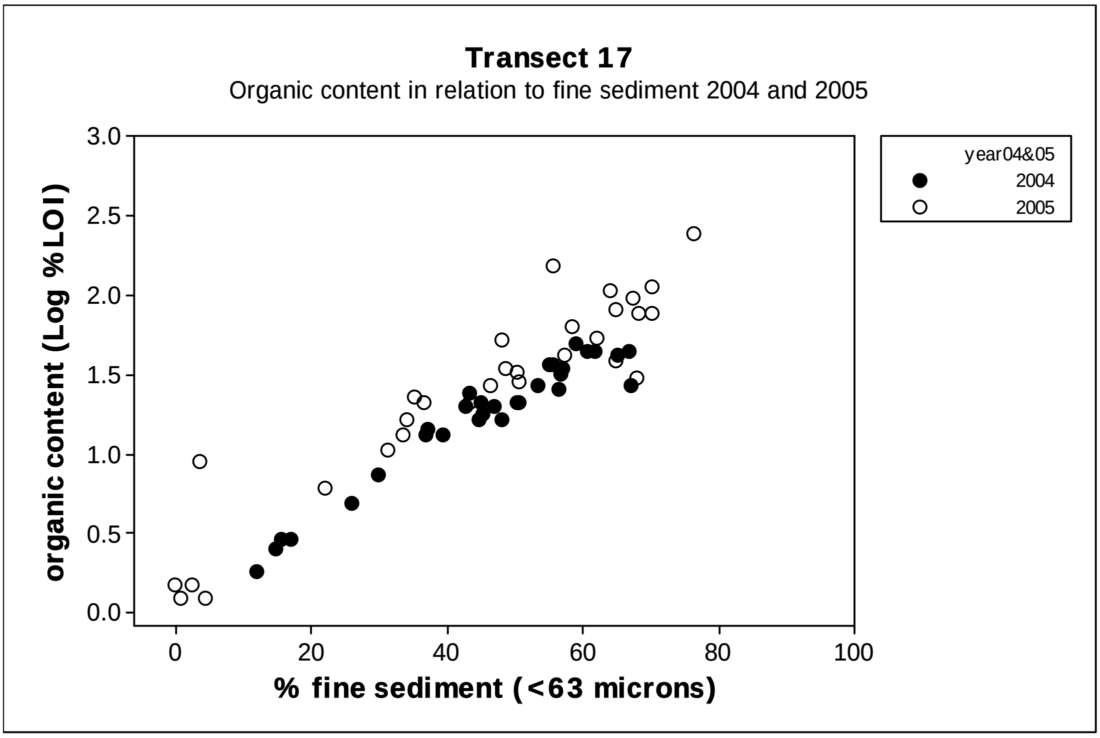
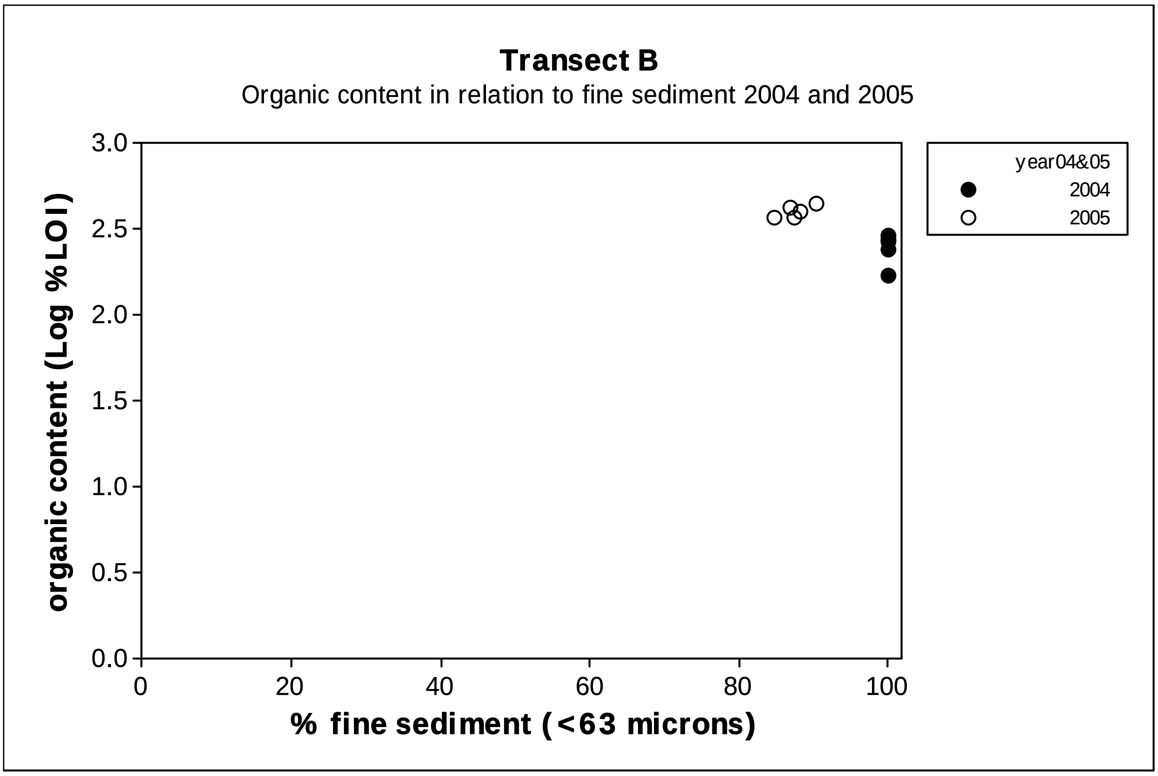


Figure 3.1.8a-j continued

c,



d,

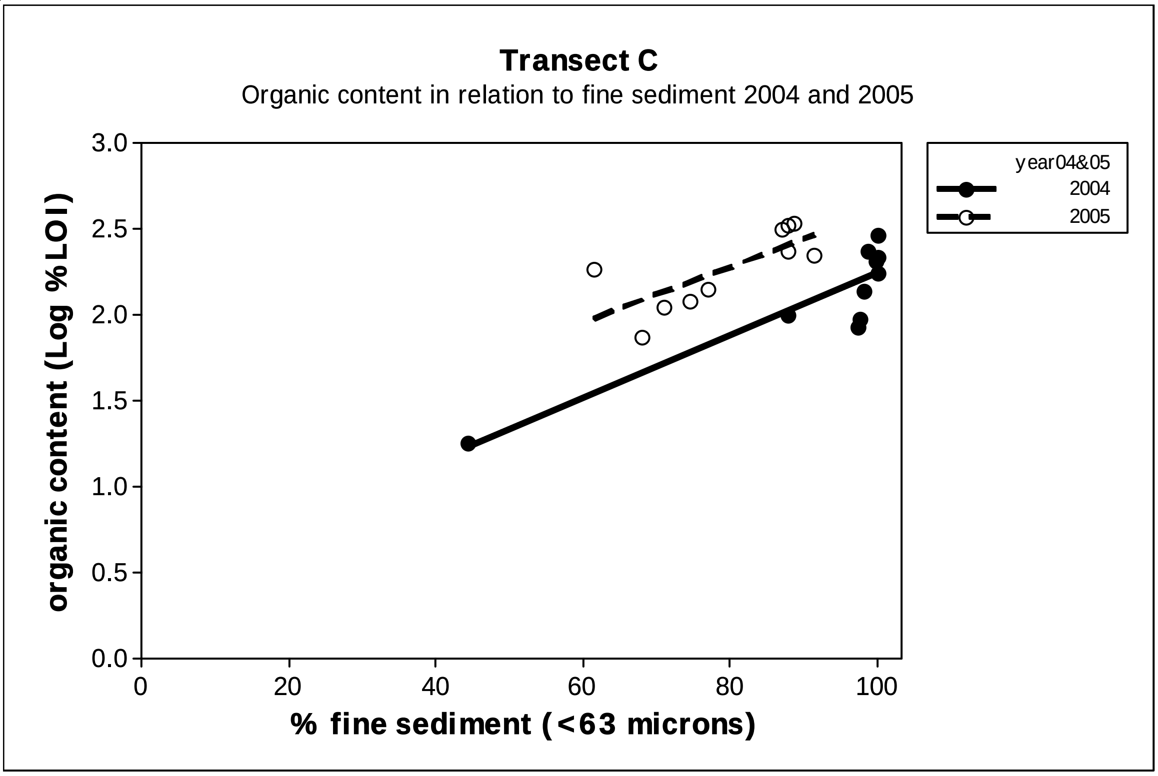
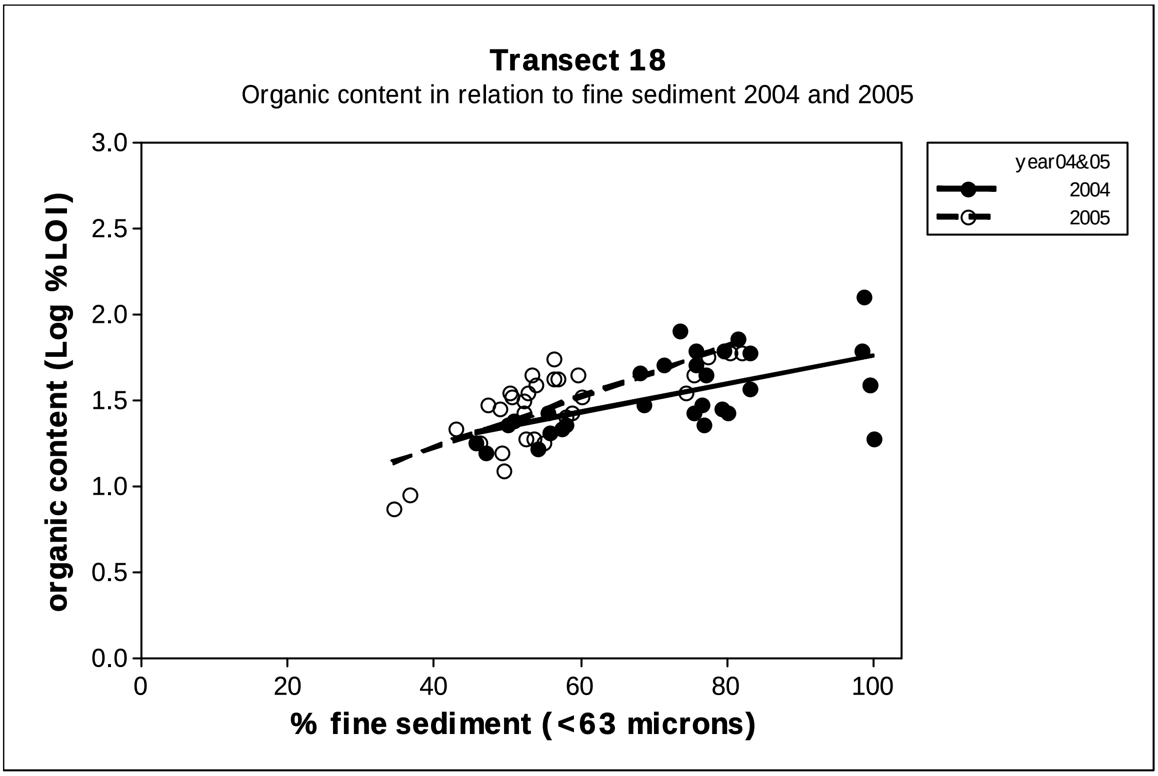


Figure 3.1.8a-j continued

e,



f,

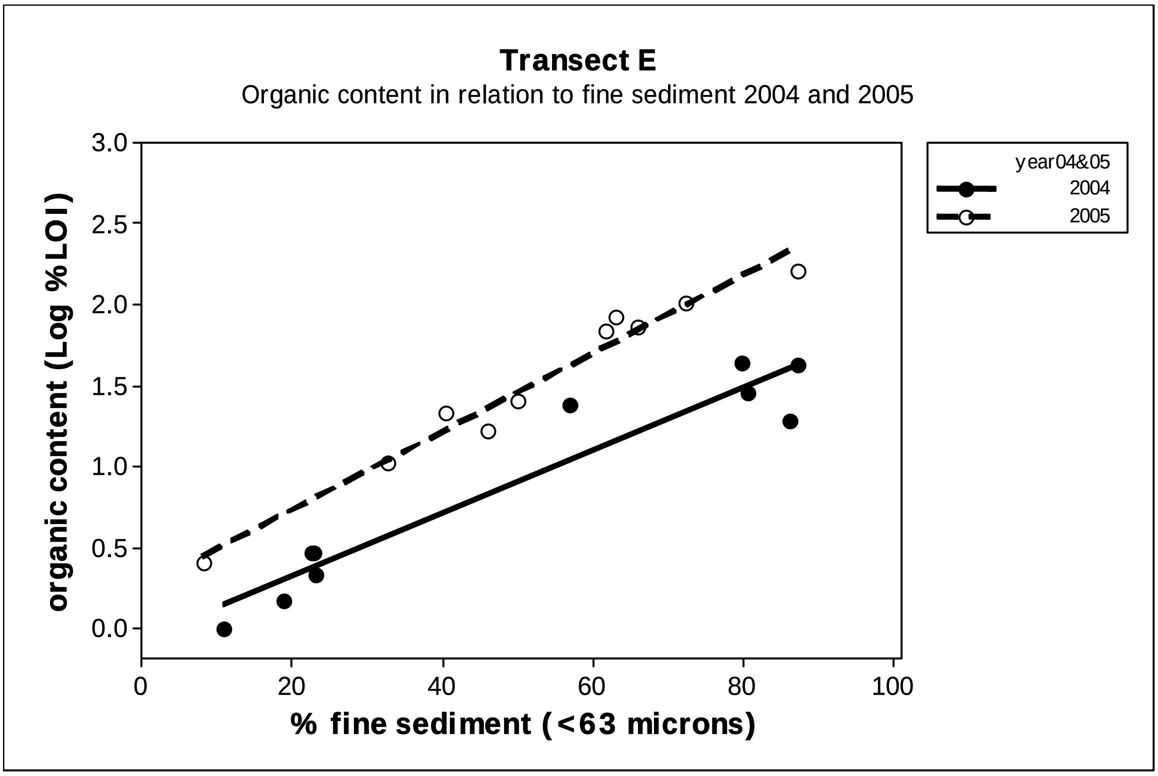
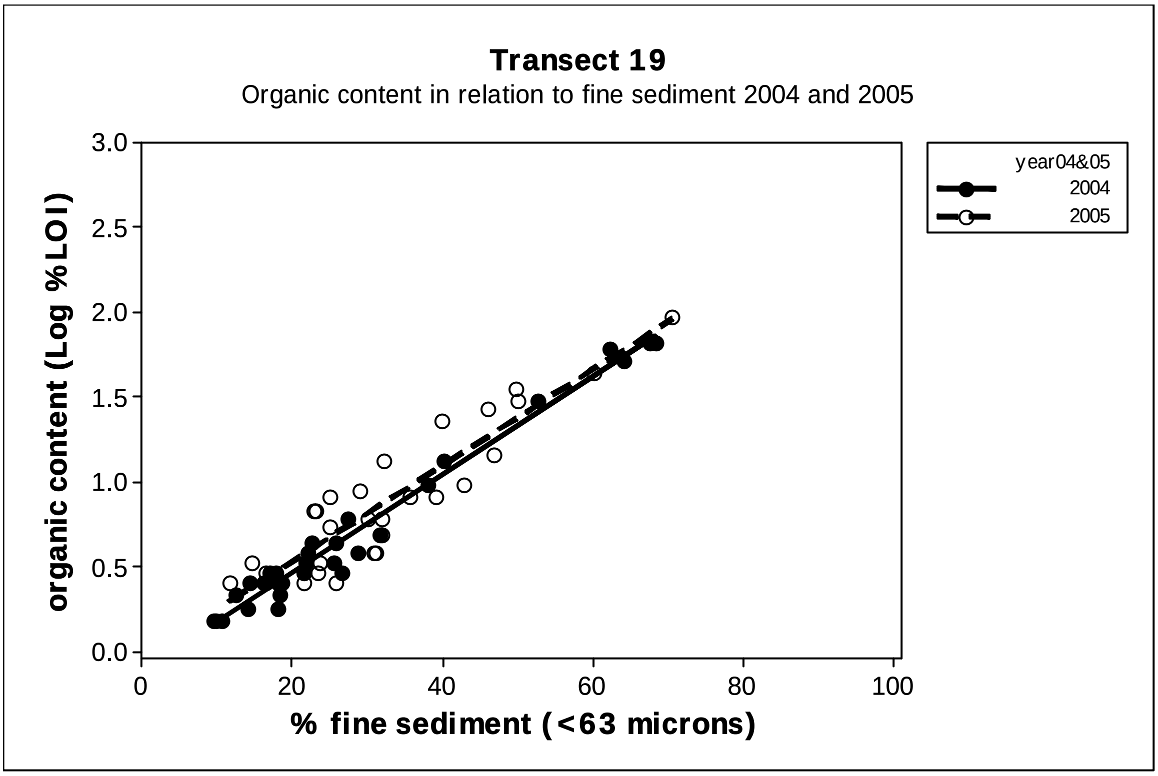


Figure 3.1.8a-j continued

g,



h,

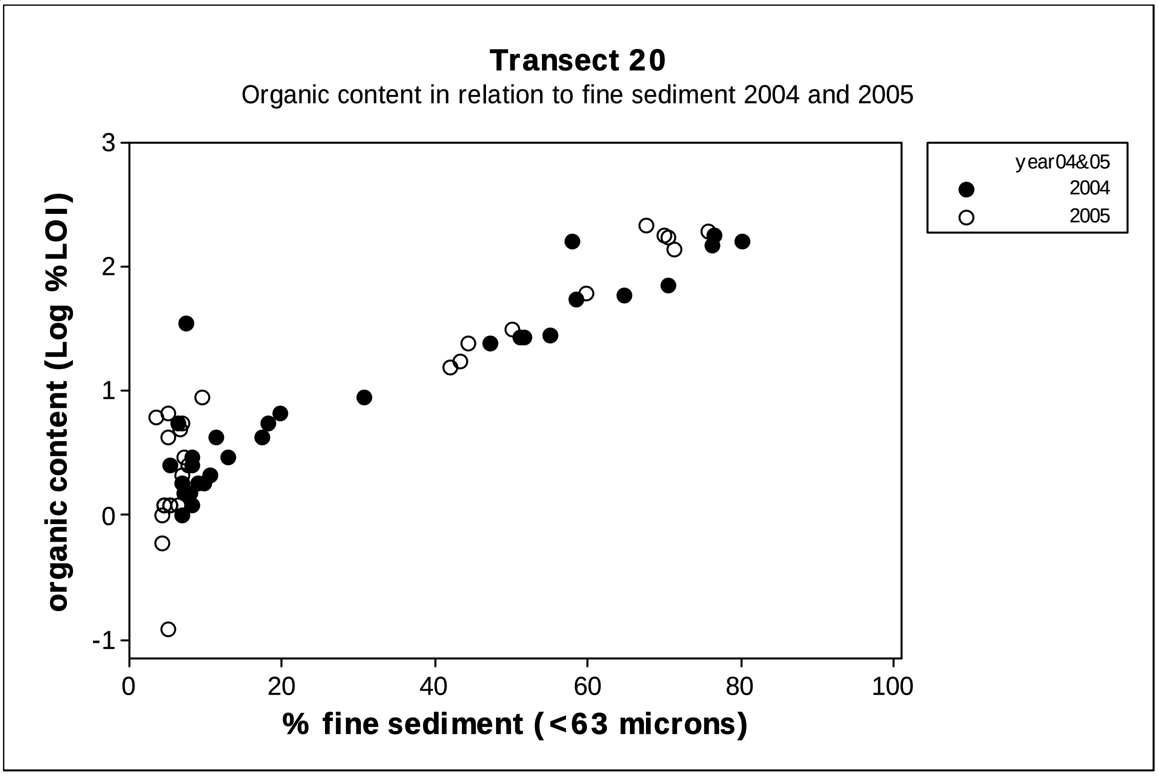
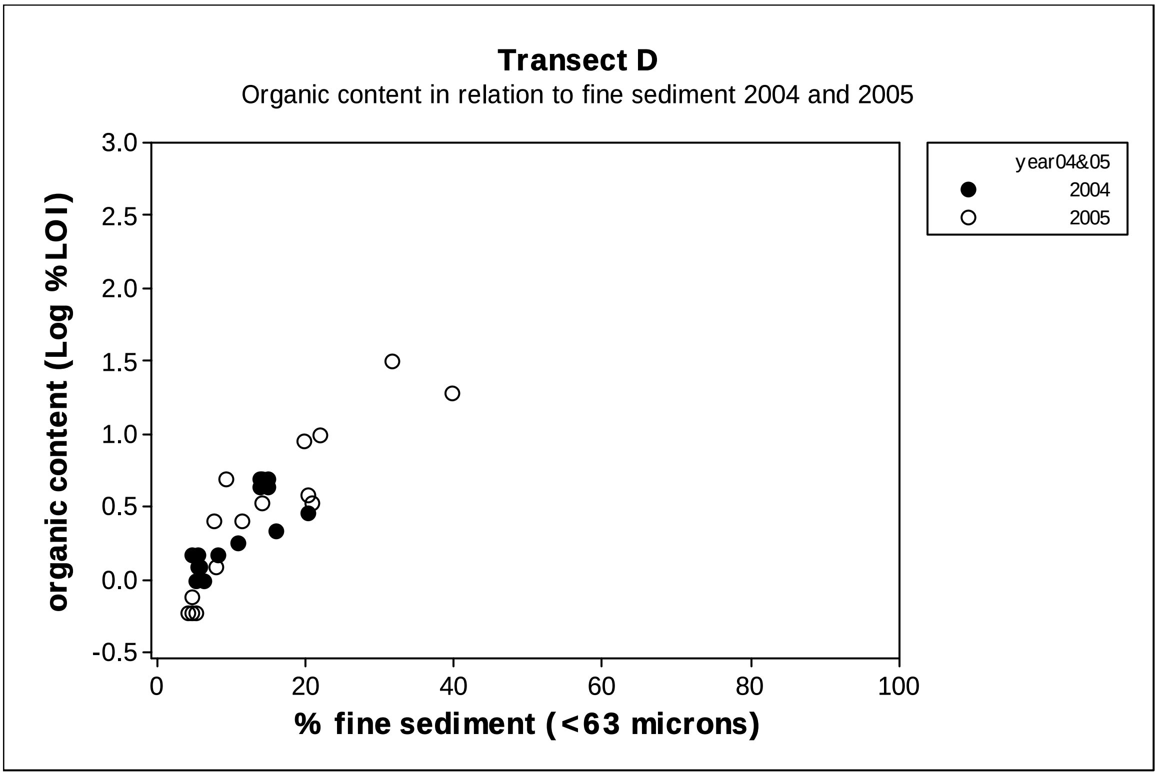


Figure 3.1.8a-j continued

i,



j,

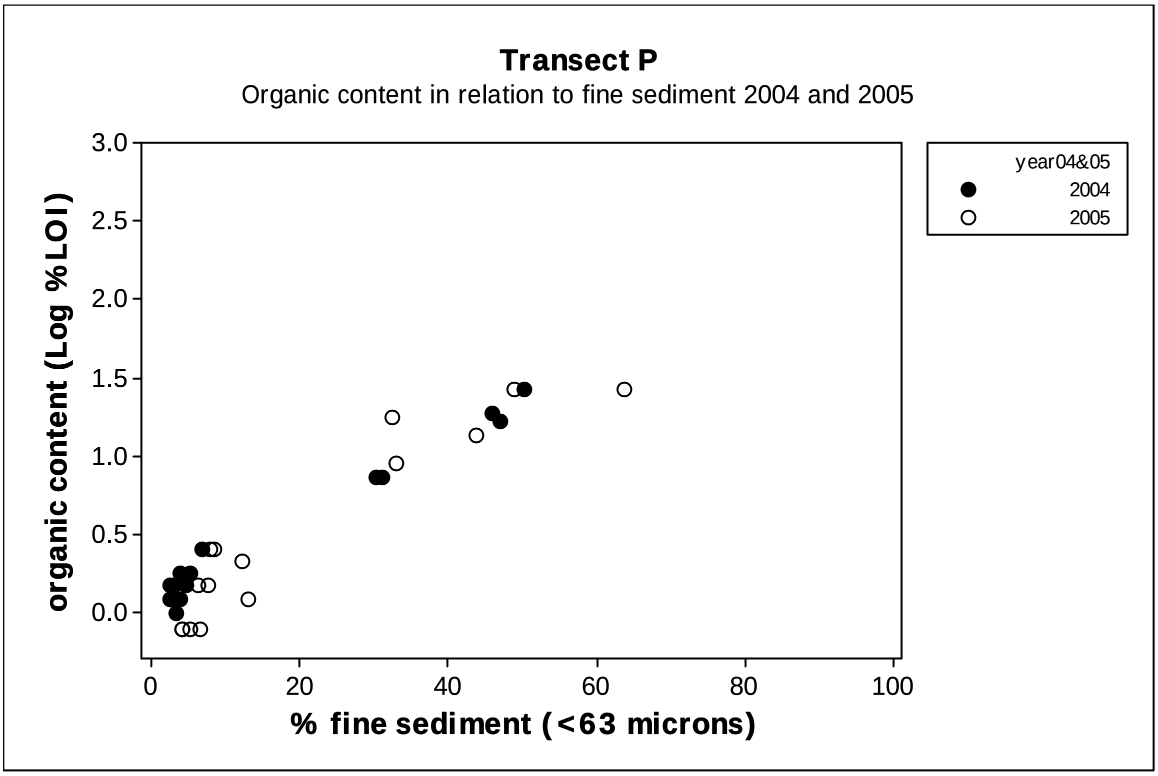
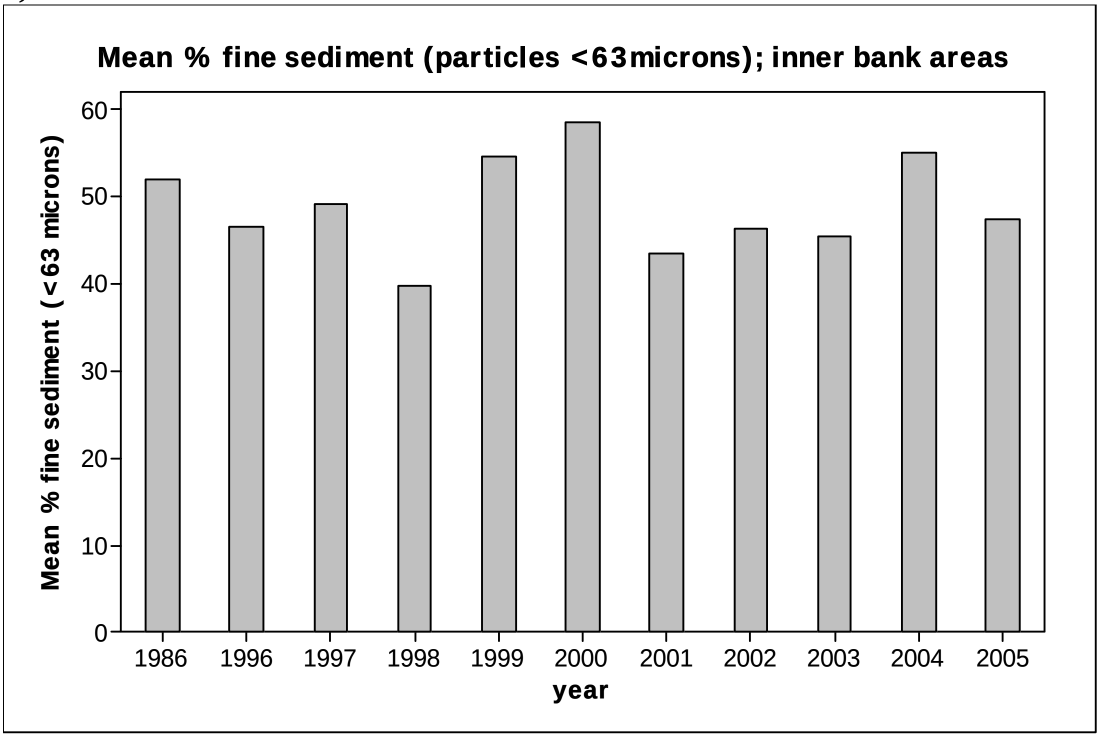


Figure 3.1.9a and b Annual changes in the mean percentage of fine sediment on **a**, the inner banks alone from 1986 and 1996-2005 and **b**, on the entire Gt Ouse study area from 1997-2005.

a,



b,

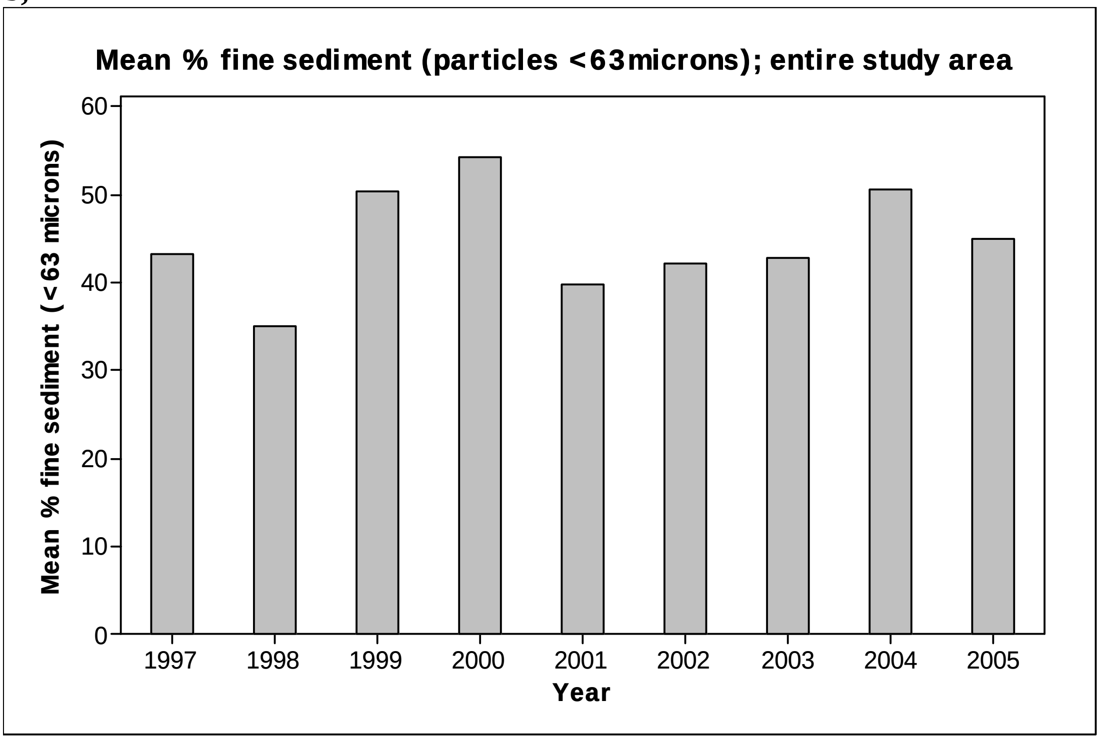
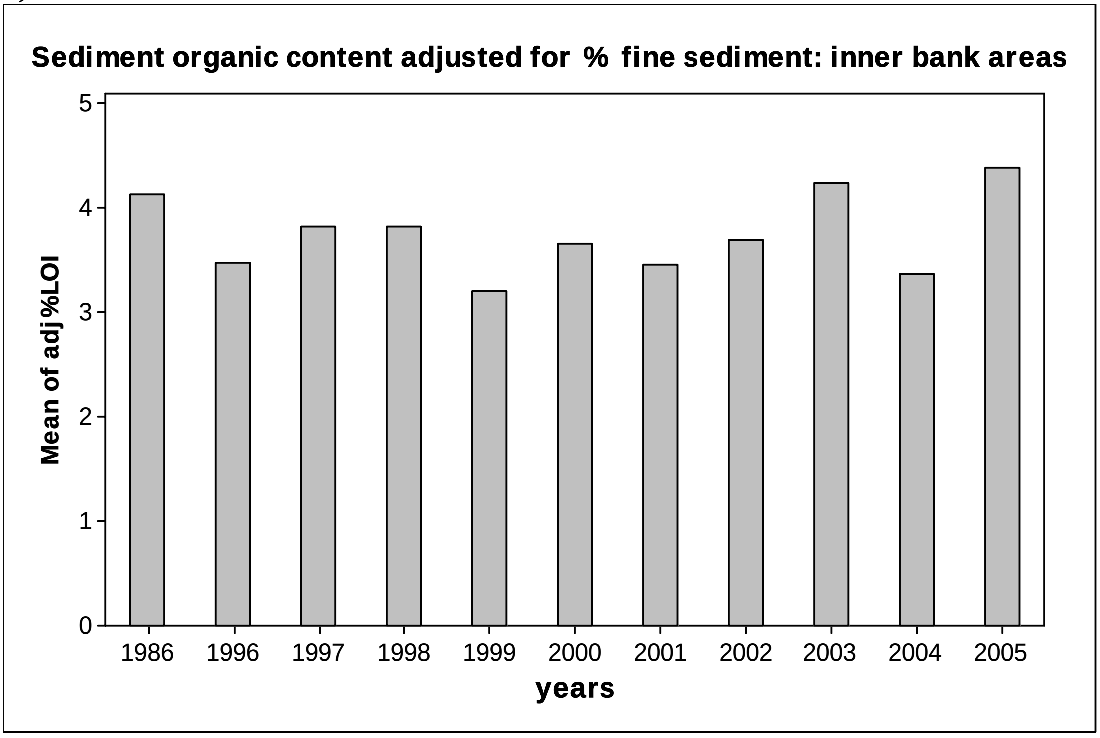
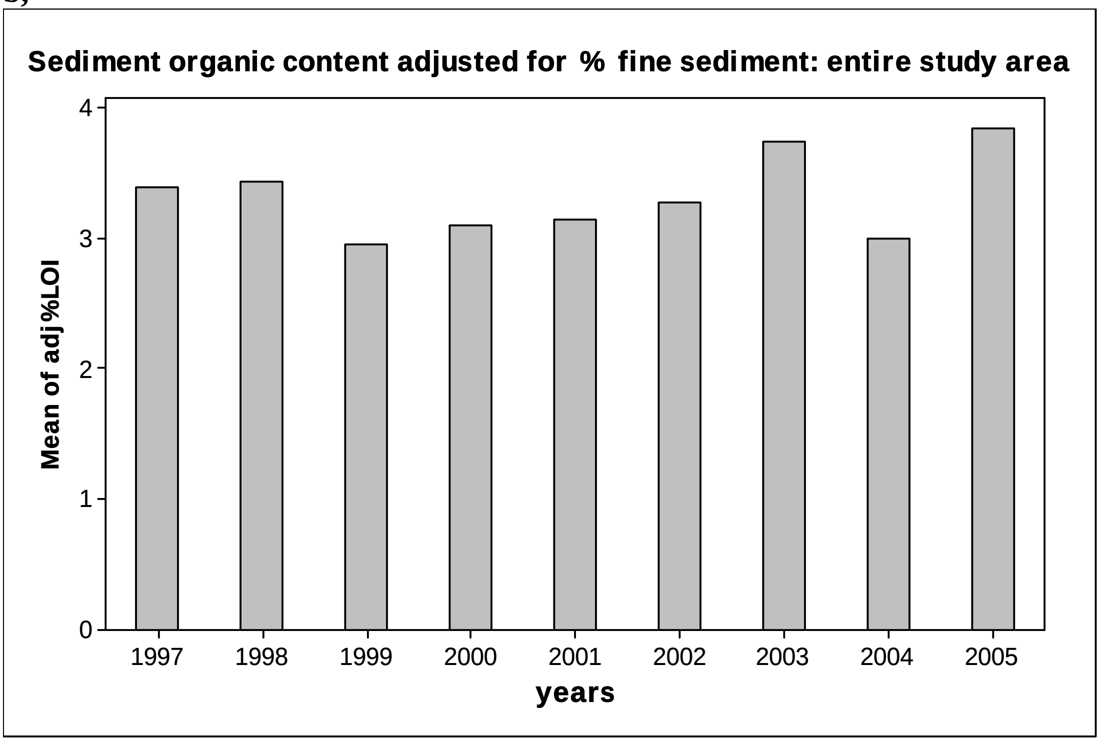


Figure 3.1.10a and b. Annual changes in the mean organic content of sediment (%LOI) on **a**, the inner banks alone from 1986 and 1996-2005 and **b**, on the entire Gt Ouse study area from 1997-2005. The organic content has been adjusted to take into account variation in the % of fine sediment in each year.

a,



b,



3.2. Invertebrates

3.2.1 Introduction

This section describes the distribution of the inter-tidal invertebrates within the study area in 2005. It is supplemented by the data tables presented in Appendix 1 which give the mean densities of invertebrates recorded in each 1hectare sample site and in Appendix 2 which give comparisons of densities of all but the least abundant species between 2004 and 2005 for the whole study area.

Distribution maps showing the density of an invertebrate species/species size category in each sample site in 2005 and the change in density compared to that in 2004 are presented (Figures 3.2.1a-n). Not all species were mapped. Only those whose density changed significantly over the whole study area (Appendix 2) between the two surveys are included.

A brief description of the invertebrates' biology and of the shorebirds that prey on them was given in Volume 2 of our 1996 study Report (Yates *et al* 1998).

3.2.2 Invertebrate distribution in 2005 and changes compared with the 2004 survey.

The uppermost maps in Figures 3.2.1a-n show the spatial distribution and density (expressed as numbers m^{-2}) of the invertebrates in the 2005 survey, while the lower maps show the changes in densities at a site between 2004 and 2005. Tables 3.2a-c summarise the results of analyses comparing densities of all invertebrates that occurred in sufficient numbers between the two surveys, within each transect. These comparisons were made by doing paired t-tests on the mean density of an invertebrate in each 1 hectare sampling site.

Statistical analyses were also made for those invertebrates in which the change in density between the two surveys was significant to determine whether the changes were related to sediment particle size, sediment organic content and shore level and to the proximity to the Gt Ouse outfall. Multiple regression analysis was used for this purpose. The procedure was to regress the change in invertebrate density at each of the 42 sample sites against the site variables, change in sediment particle size, change in sediment organic content and shore level, to account for any influence they had and then to include distance of the site from the Gt Ouse to determine if it had any significant additional influence.

Table 3.2 a-c. Summary of changes in invertebrate densities within transects between 2004 and 2005 surveys. Plus signs (+) indicate an increase in 2005, a minus (-) indicates a decrease and an equal sign (=) indicates no change. Empty cells indicate that the invertebrate did not occur in that transect in either survey. The statistical significance of the change is indicated as follows:- * p<0.05 and ** p<0.01. The overall change in the whole study area (see also Appendix 2) is given in the final column headed 'All' and where significant, the invertebrate concerned is shown in bold type.

a, worms

Invertebrate	Transect										
	16	17	B	C	18	E	19	20	D	P	**All**
Nemerteans	+				-		-	+		+	-
Nematodes	-	-	-	+	+	-	-	+	-	+	+
Anaitides maculata	+	-			-		-	-	-	-	-**
Eteone longa	-	-	-	-	-*	-	-*	-	-	-	-**
Syllid	-	-									-
Hediste diversicolor <15mm	+	+		-	-		=	-			-
H. diversicolor 15-30mm	-	+		-	-		-		-		-
***H. diversicolor* >30mm**	-	-		-	-*		-	-			-**
Nephtys cirrosa 15-30mm								-			-
N. cirrosa >30mm								-			-
***N. hombergii* 15-30mm**	+	-			-	-	-	-	-	-	-**
N. hombergii >30mm	-	-			+	-	+	-			-
Nephtys juveniles <15mm	-	-	+	-	+*	+	+	+	+	-	+
***Scoloplos armiger* <15mm**		+					+	+	+	+	+*
S. armiger 15-30mm		-						+		+	+
S. armiger >30mm		+					+	-	-	-	-
Polydora spp							-				-
Pygospio elegans	+	-	+	+	-	+	-	-	-	-	-
Scolelepis foliosa										-	-
Spio martinensis		+			-		+	+	+	-	+
Spiophanes bombyx	+	+						-		+	+
Magelona mirabilis										-	-
Tharyx sp complex A	-	-			-	-	+	+	-	+	-
Capitellids	+	-	-	-	+	-	+	-	-	-	-
Heteromastus filiformis	+				-		-	-			-
Arenicola marina casts		+			-		-	+	-	=	+
Tubificoides benedii	-*	-	-	-	-	-	-	-	-	-	-*
Enchytraeidea	+				-	+		+		+	+

Table 3.2 a-c. continued.

b, molluscs

Invertebrate	Transect										
	16	17	B	C	18	E	19	20	D	P	**All**
Hydrobia ulvae <3mm	-	+	+	-	-	+	-	+	+	+	+
H. ulvae 3+mm	+	+	+	-	-*	+	-	-	+	+	+
Retusa obtusa <3mm	+	+									+
R. obtusa 3+mm	+	-									+
***Mytilus edulis* <5mm**	-	-		-	-	-	-	-		-	-*
Mysella bidentata <5mm	+	+					+				+
M. bidentata 5-10mm	+										+
***Cerastoderma edule* <5mm**	-	-			-	-	-	-	-	-	-*
C. edule 5-10mm	-	-			-	-	+	-	-		-
C. edule 11-20mm	+						+		+		+
C. edule 20-30mm									+		+
Macoma balthica <5mm	+	-	+	-	+	-	-	-	-	+	-
M. balthica 5-10mm	-	+			-	+	-	-	-	-	-
***M. balthica* 16-20mm**	-				-				-		-*
M. arenaria <5mm	+	-			-	-		-			-
M. arenaria 6-10mm						-	-				-
M. arenaria 11-15mm							-				-
***Scrobicularia plana* <5mm**	-	-*		-	-	-	-	-	-	-	-**
***S. plana* 5-10mm**	-*	-			-	-	-	-	-	+	-*
***S. plana* 11-20mm**	-	-	+	-	-	-	-	+			-*
S. plana 21- 30mm	=	+	+		-	-	+	-			-
S. plana >30mm	+	+	+	-	+						+

Table 3.2 a-c continued.

c, crustaceans

Invertebrate	Transect										
	16	17	B	C	18	E	19	20	D	P	**All**
Urothoe poseidonis <3mm								+		+	+
U. poseidonis >3mm								=			=
Bathyporeia. pilosa <3mm								-			-
B. pilosa 3+mm								-			-
B. sarsi <3mm								+		+	+
B. sarsi 3+mm								+		+	+
***C. volutator* <3mm**	=	-		+	+*	+	+	+			+*
***C. volutator* 3+mm**		-		+	-*	-	-				-**
Cyathura carinata					+		-	-			-
Idotea linearis						-					-
Tanaids								+		+	+
Cumaceans								+	-		+
Crangon crangon	+	+	+		+	+	-	=	+	-	+
Liocarcinus arcuatus	+	+									+

Out of the 66 invertebrate families or species/species size categories that were considered, the densities of 14 of them differed significantly between 2004 and 2005. The mean density over the whole study area of one worm and one crustacean increased significantly in 2005, while density of five worms, one crustacean and six molluscs decreased significantly (Table 3.2 a, b and c, Appendix 2). This was a similar proportion (21%) to that which might be expected by chance given the 5 percent level of probability that was used as the statistical significance criteria. But because many of the invertebrates whose density differed at this level of significance were those whose densities had done so in past surveys, we considered the differences to be ecologically significant.

Densities of the Phyllodocid worms *Eteone longa* and *Anaitides mucosa* were significantly lower (p=0.0001 and p=0.007 respectively) in 2005 than in 2004 (Table 3.2a and Appendix 2). *Eteone* was widespread in 2005 occurring predominantly in mid and lower shore areas but it was in these same regions that its densities had decreased the most (Figure 3.2.1a). Changes in its density were significantly related to the change in sediment organic content and to the distance from the river LW outfall (point B in Fig 2.1). Its density decreased the most in sites near the river and increased most in sites farthest away (Figure 3.2.2a).

Anaitides occurred in just three lower shore sites in 2005 having been much more widespread on the lower shore in the previous year (Figure 3.2.1a). Changes in its density were not significantly related to either sediment characteristics or shore level but they were negatively related to the distance from the Gt. Ouse HW outfall (point A in Fig 2.1). The decline in its density in 2005 became greater as the distance from the HW outfall increased (Figure 3.2.2b).

Densities of large ragworms *Hediste diversicolor* (>30mm in size), decreased significantly ($p<0.001$) in 2005 (Table 3.2a and Appendix 2) compared with 2004 (as they had in that year compared to the 2003 survey). They decreased in density in all but one of the sites in which they had occurred in 2004 and were confined to a few upper shore sites in the current survey (Figure 3.2.1c). Changes in their density were significantly related to changes in sediment organic content, to shore level and to the distance from the Gt Ouse HW outfall ((Figure 3.2.2c). Decreases in density were greatest near to the outfall but at sites farther from the outfall their densities increased.

Densities of large cat worms, *Nephtys hombergii* (16-30mm in size) decreased significantly ($p=0.016$) in 2005 compared to its density in the previous year (Table 3.2a and Appendix 2 Figure 3.2.1d) reversing a significant increase that occurred between 2003 and 2004. In 2005 it was widespread across lower shore sites and its densities decreased relative to 2004 in many of those sites except but increased in others particularly in transect 16. Changes in their densities were significantly related to changes in fine sediment and shore level but not to the distance from the river.

Small sized (<16mm) *Scoloplos armiger* increased ($p=0.01$) in density in 2005 (Table 3.2a and Appendix 2) reversing a decrease that occurred between 2003 and 2004. In 2005 it occurred in sandy sites on both the east and west shore having previously occupied just two sandy sites on the east shore in 2004 (Figure 3.2.1e). There was no relationship between the change in its density from 2004 to 2005 and changes in sediment characteristics or to shore level but there was to the distance from the rivers' HW outfall (Figure 3.2.2d). They increased in density with increasing distance from the river primarily because the sandier sites occur farther from the river.

The densities of the Oligochaete worm *Tubificoides benedii* decreased ($p=0.012$) in 2005 compared to 2004 (Table 3.2a and Appendix 2). It was widely distributed throughout the muddier sites of the study and it was in same those sites that its density decreased the most (Figure 3.2.1f). Changes in its density were not related to sediment or site variables or to distance from the river.

There was a significant increase ($p=0.02$) in the density of small (<3mm) *Corophium volutator*, in 2005 but a significant decrease ($p=0.009$) in the density of the larger individuals (3+mm) (Table 3.2c and Appendix 2). Both size categories occurred primarily on upper shore sites east of the River Gt Ouse outfall at higher densities in case of the smaller size category but at lower densities in the case of the larger category (Figures 3.2.1g and h). Changes in the density of the <3mm size category were related to changes in sediment organic content and to the distance from the Gt Ouse (Figure 3.2.2e) with the increases being most pronounced in sites near the river and the decrease in those farther away. Changes in the density of larger *Corophium* were related to shore level but not to distance from the river.

The density of mussel spat *Mytilus edulis* (<5mm) decreased significantly in 2005 ($p=0.023$) compared to the previous year (Table 3.2b and Appendix 2). It occurred in a few lower shore sites in 2005 having been more widespread in the previous year (Figure 3.2.1i). Changes in its density were not related to changes in sediment characteristics, shore level or to distance from the river outfall.

The density of both cockle spat *Cerastoderma edule* (<5mm) decreased significantly in 2005 ($p=0.023$) compared to 2004 (Table 3.2b and Appendix 2). It was widely spread on lower shore sites in 2005 but it was in those same sites that it decreased the most (Figure 3.2.1j). The changes in their density were not significantly related to sediment changes or site level variables nor were they related to the distance from the Gt Ouse.

The density of larger *Macoma balthica* (16-20mm in size) decreased significantly ($p<0.032$) between the current and past survey (Table 3.2b and Appendix 2). They were not present in any site in 2005 having previously been present at low densities in upper and mid-shore areas of transect 16 and 18 (Figure 3.2.1k). Changes in their density were related to changes in the amount of fine sediment but not to shore level or to distance from the Gt Ouse.

The bivalve, *Scrobicularia plana* in the <5, 5-10 and 11-20mm size categories all occurred in significantly lower densities in 2005 ($p=0.002$, $p=0.015$ and $p=0.035$ respectively) than they had in 2004 (Table 3.2b and Appendix 2). They occurred primarily in the muddier mid- and lower-shore sites of the study area and it was in those same sites that they decreased the most (Figure 3.2.1l, 3.2.1m and 3.2.1n). Changes in the density of the <5mm and the 5-10mm size categories were not related to changes in sediment, nor were they related to shore level or to the distance from the Gt Ouse. However, the changes in the density of the 11-20mm category were significantly related to change in sediment organic content and to the distance from the Gt Ouse HW outfall (Figure 3.2.2f). Densities decreased most at sites near the outfall but did not change or increased with increasing distance away from it.

3.2.2.1 Annual changes in invertebrate density: 1986 and 1996-2005

The inner banks of the study area have now been surveyed on a total of eleven occasions and the changes in the densities of the main invertebrate classes, worms, crustacean, gastropod molluscs (snails) and bivalve molluscs are summarised in Figures 3.2.3a-d. Worm densities were at their lowest in 1996 and with the exception of 1998, increased annually until 2003 but have declined since then. Crustacean density was lowest in 1996 and again in 2000 since when it has increased annually to the highest density recorded in 2003. It dropped markedly in 2004 but increased in the current survey to densities a little above the average for the study period (Figure 3.2.3b). There had been a general upward trend in snail densities between 1996 and 2001 but they dropped in 2002 since when they have risen annually to the highest density ever recorded in the study in the current survey (Figure 3.2.3c). Bivalve mollusc density was at its highest in 2000 (Figure 3.2.3d) when there was a large spatfall of many species, notably cockle and *Macoma*. Since then their densities have remained relatively low with the 2005 density as low as those recorded in 1997 and 1998.

3.2.3 Summary and conclusions

There were a few changes in the densities or spatial distribution of the invertebrates recorded in the Gt Ouse study area between the 2004 and 2005 surveys. Of the 66 species/species size categories that were sufficiently numerous to be considered, two showed a statistically significant increase in density while twelve showed a significant decrease. Only the worm *Scoloplos armiger* (<15mm) and the crustacean *Corophium volutator* (<3mm) increased in density whereas the worms *Eteone longa, Anaitides mucosa,* large *Hediste diversicolor*, large

Nepthys hombergii and *Tubificoides benedii*, larger (3+mm) individuals of the crustacean *C. volutator* and the bivalve molluscs *Mytilus edulis* (<5mm), *Cerastoderma edule* <5mm *Macoma balthica* (16-20mm in size) and three size categories of *Scrobicularia plana* (<5, 5-10 and 11-20mm) all decreased in density.

There was some evidence of the spatial changes in invertebrate densities being associated with the distance from the Gt Ouse outfall. Changes in the densities of the worms *Eteone longa, Anaitides mucosa,* large *Hediste diversicolor* and small *Scoloplos armiger,* the crustacean *Corophium* (<3mm) and the bivalve mollusc *Scrobicularia* (11-20mm) were significantly related to the distance for the outfall after the changes in sediment particle size and organic content and shore-level had been accounted for statistically. Decreases in the densities of *Eteone, Hediste* and *Scrobicularia,* were greatest near the outfall but gradually lessened with increasing distance from the river, while the decrease in *Anaitides* density became greater as distance from the river increased. Both *Scoloplos* and *Corophium* densities increased overall with the increases in the former species becoming greater with increasing distance from the river and those of the latter becoming less.

Over the 11 successive years of this study, worm densities were at their lowest in 1996 and with the exception of 1998, increased annually until 2003 but have declined since then. Crustacean density was lowest in 1996 and again in 2000 since when it has increased annually to the highest density recorded in 2003. It dropped markedly in 2004 but increased in the current survey to densities a little above the average for the study period. There had been a general upward trend in snail densities between 1996 and 2001 but they dropped in 2002 since when they have risen annually to the highest density ever recorded in the study in the current survey. Bivalve mollusc density was at its highest in 2000 when there was a large spatfall of many species, notably cockle and *Macoma*. Since then their densities have remained relatively low with the 2005 densities as low as those recorded in 1997 and 1998.

Section 3.2

Figure legends

Figure 3.2.1a-k.

Maps showing the density of an invertebrate family, species or species size category within the sample sites in 2005 (upper map) and the change in density that occurred at each site between 2005 and 2004 (lower map). **Appendix 2** gives the mean density of each invertebrate within the whole study area in both surveys. Only those invertebrates whose density changed significantly between the two surveys and those that were present in both surveys were mapped.

Figure 3.2.2a-f.

The relationship between the residual variation in invertebrate density change between 2004 and 2005 and the distance of the sample sites from the Gt Ouse high water (HW) and low water (LW) outfall (points A and B in Figure 2.1). The fitted relationships are statistically significant ($p<0.05$). The residual variation was that remaining after the effect of sediment particle size and organic content and shore level had been taken into account statistically. Data points represent each of the 42 sample sites in the study area. **a**, *Eteone* longa, **b**, Anaitides *mucosa* **c**, *Hediste diversicolor* >30mm, **d**, *Scoloplos armiger* <15mm, **e**, *Corophium volutator* <3mm and **f**, *Scrobicularia plana* 11-20mm.

Figure 3.2.3 a-d.

The mean annual density of **a**, worms, **b**, crustacean, **c**, gastropod molluscs (snails) and **d**, bivalve molluscs on the inner banks of the Gt Ouse study area in 1986 and 1996-2005. Densities are expressed as numbers/m^2.

Figure 3.2.1a-n. Maps showing the density of an invertebrate family, species or species size category within the sample sites in 2004 (upper map) and the change in density that occurred at each site between 2005 and 2004 (lower map). **Appendix 2** gives the mean density of each invertebrate within the whole study area in both surveys. Only those invertebrates whose density changed significantly between the two surveys and those that were present in both surveys were mapped.

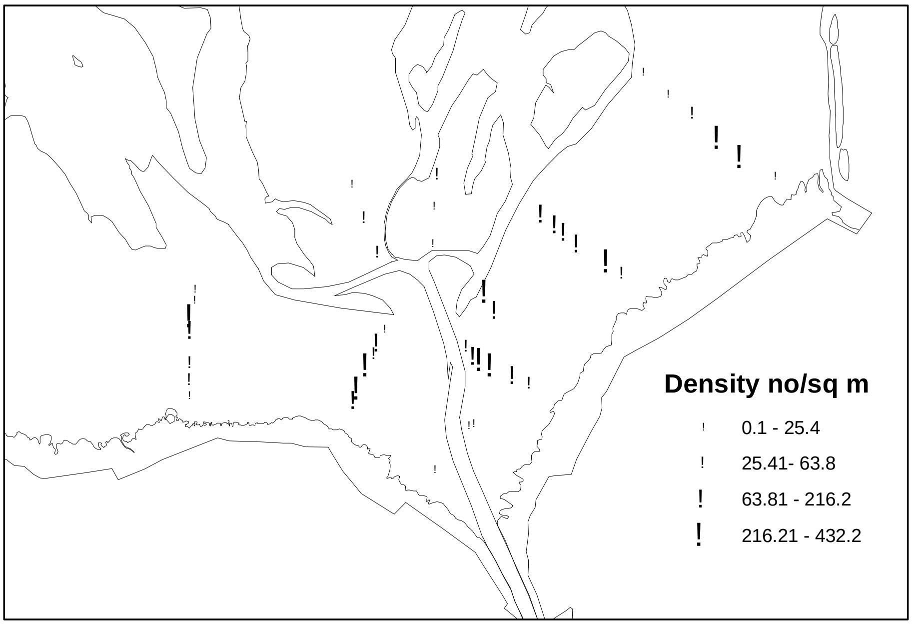
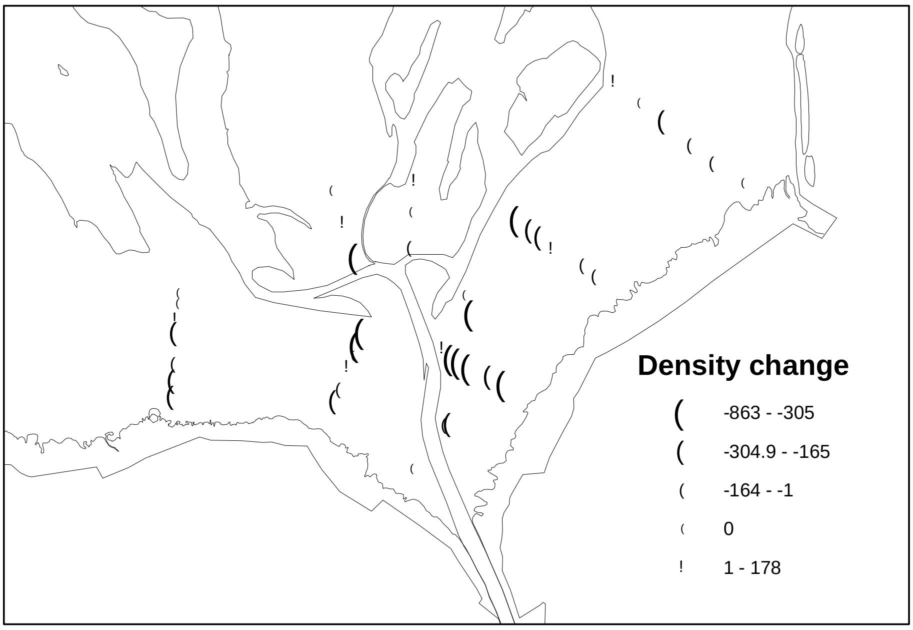


Figure 3.2.1a. Eteone longa



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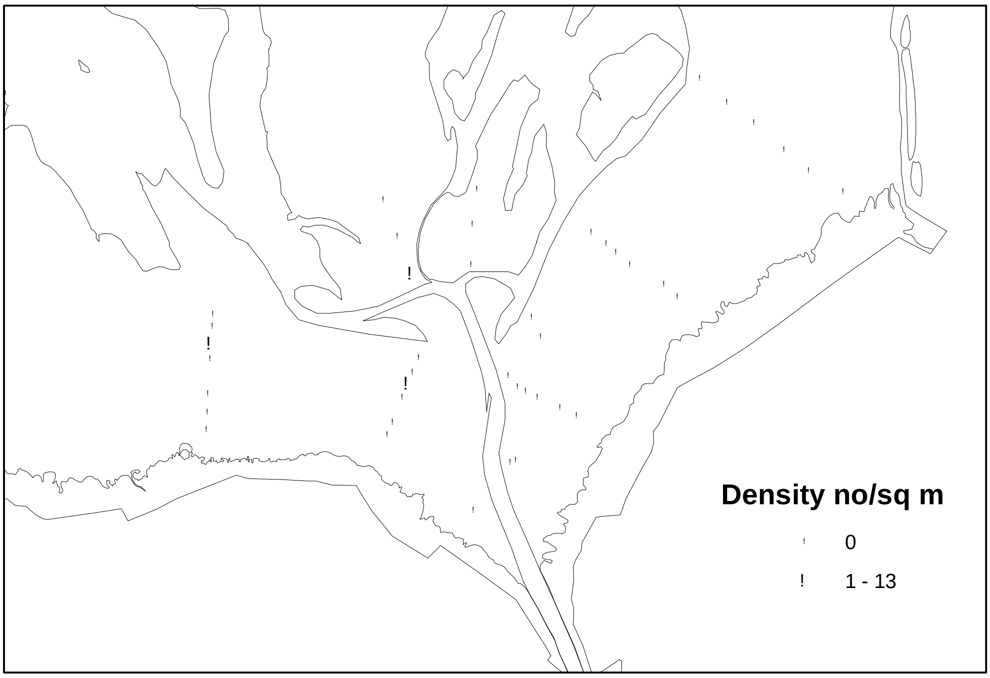
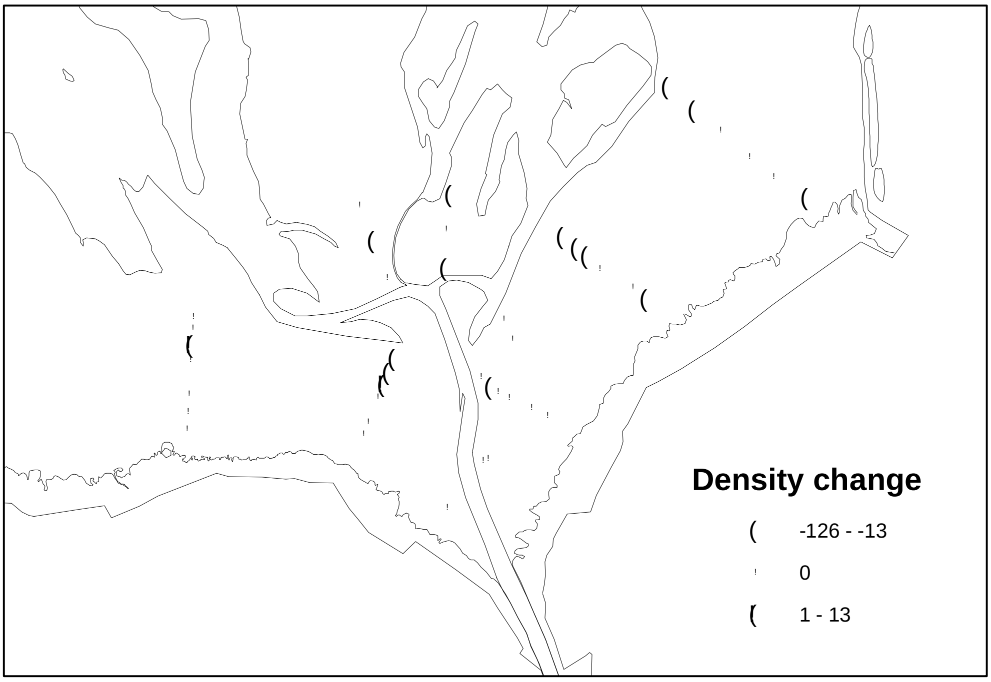


Figure 3.2.1b. Anaitides mucosa



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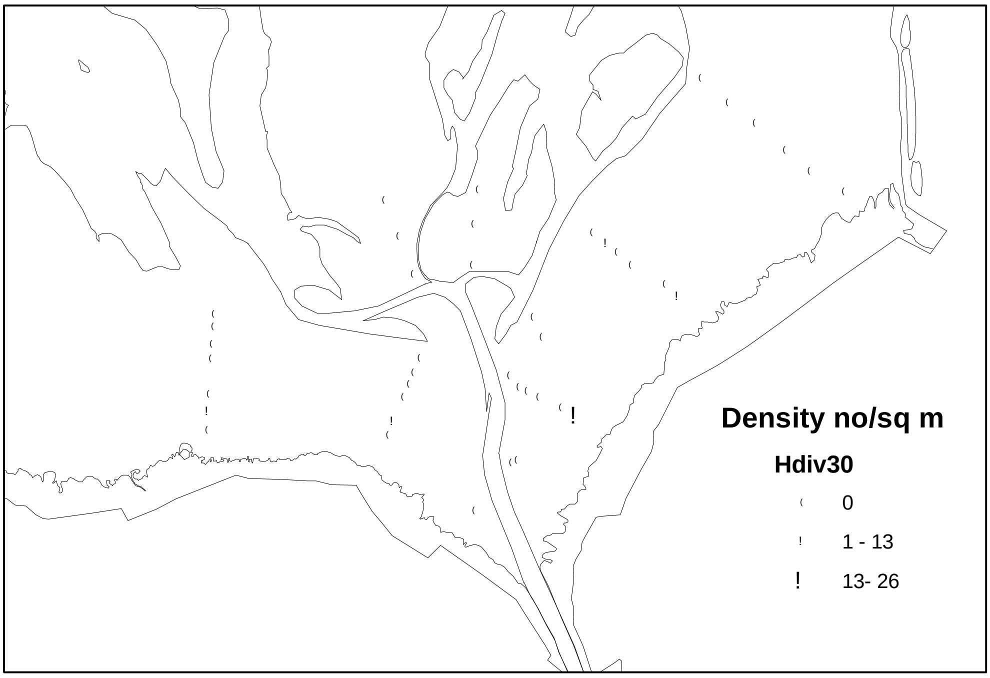
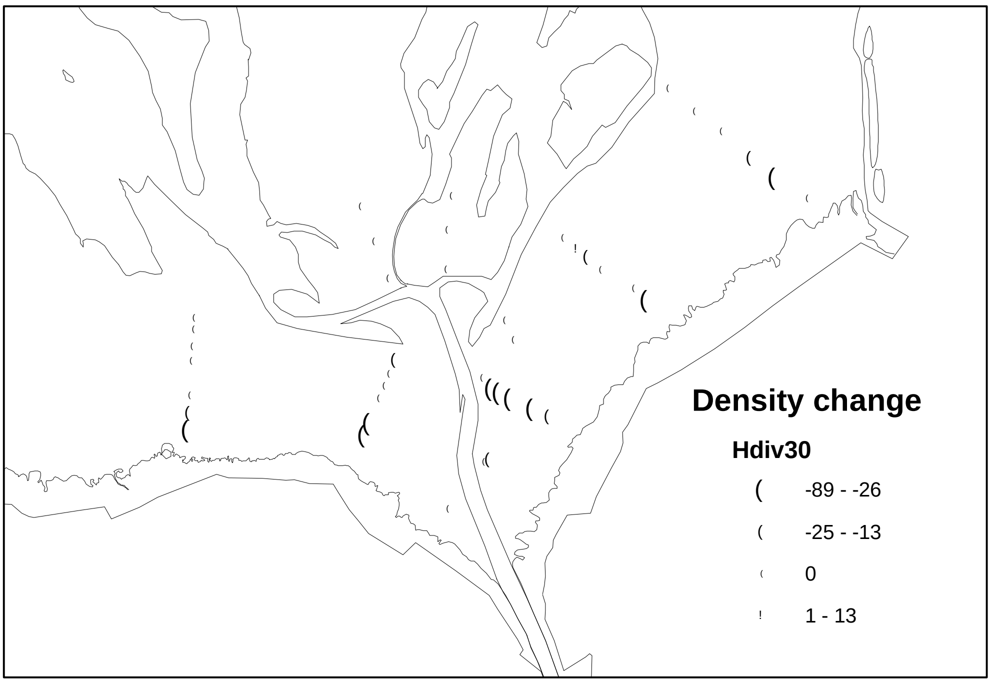


Figure 3.2.1c. Hediste diversicolor >30mm



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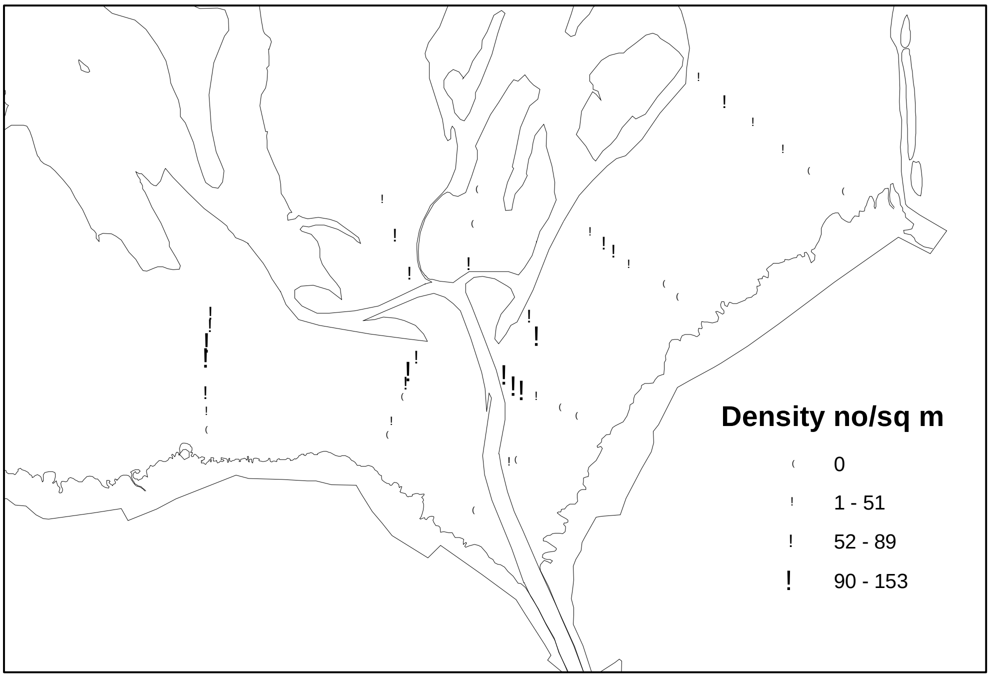
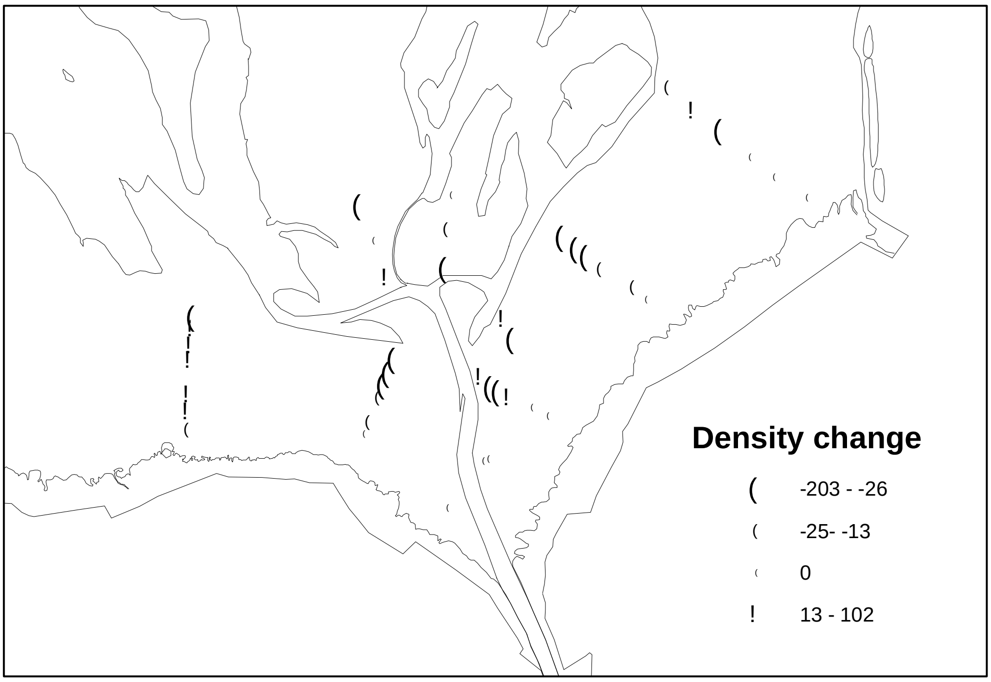


Figure 3.2.1d. Nephtys hombergii 16-30mm



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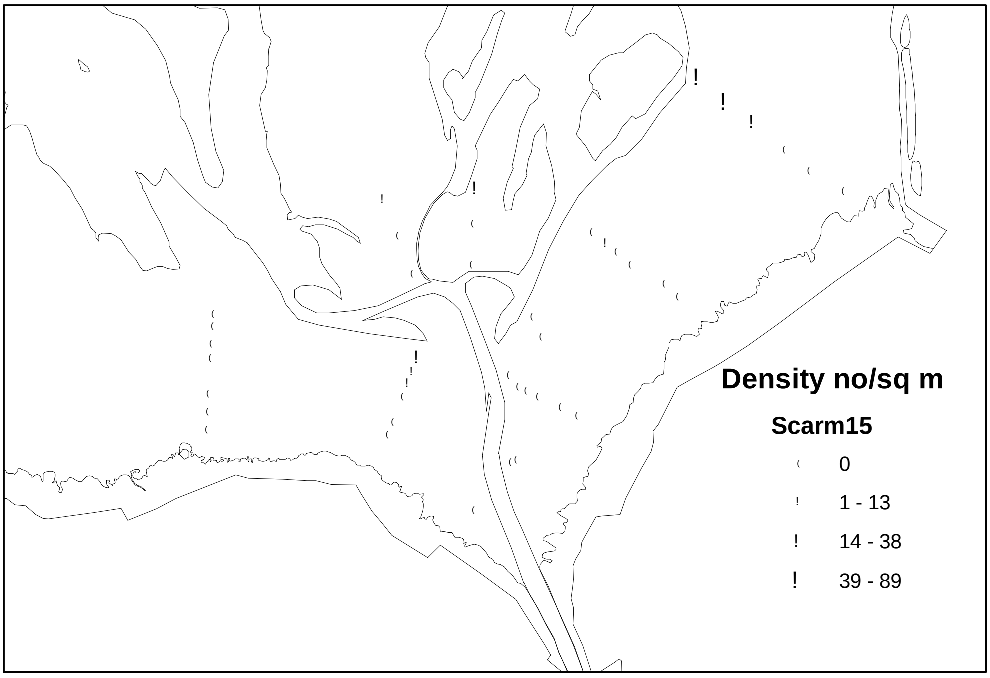
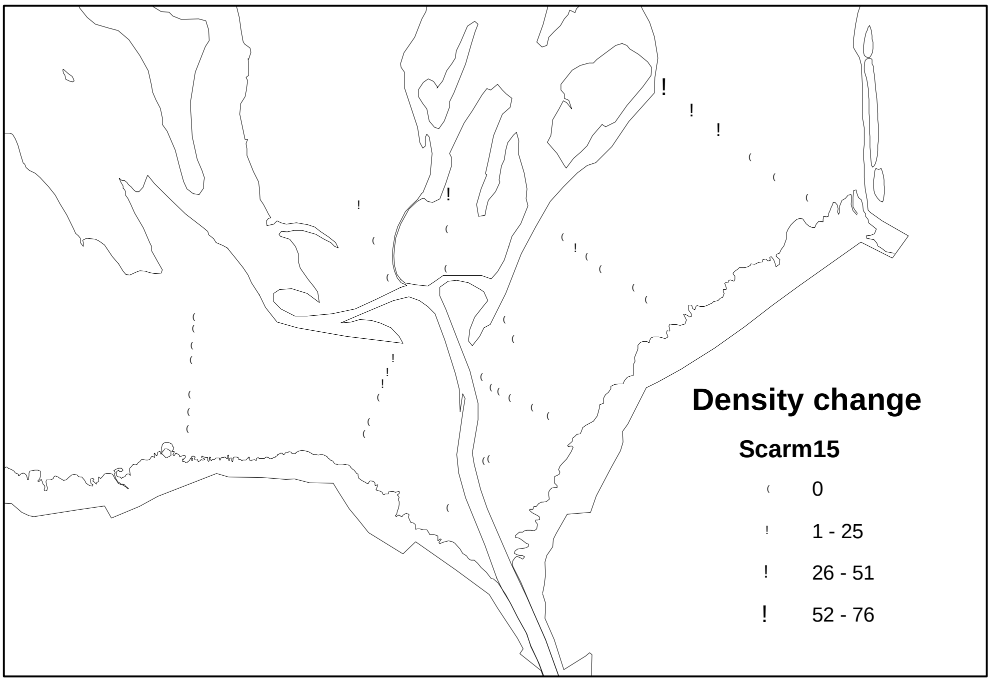


Figure 3.2.1e. Scoloplos armiger <15mm



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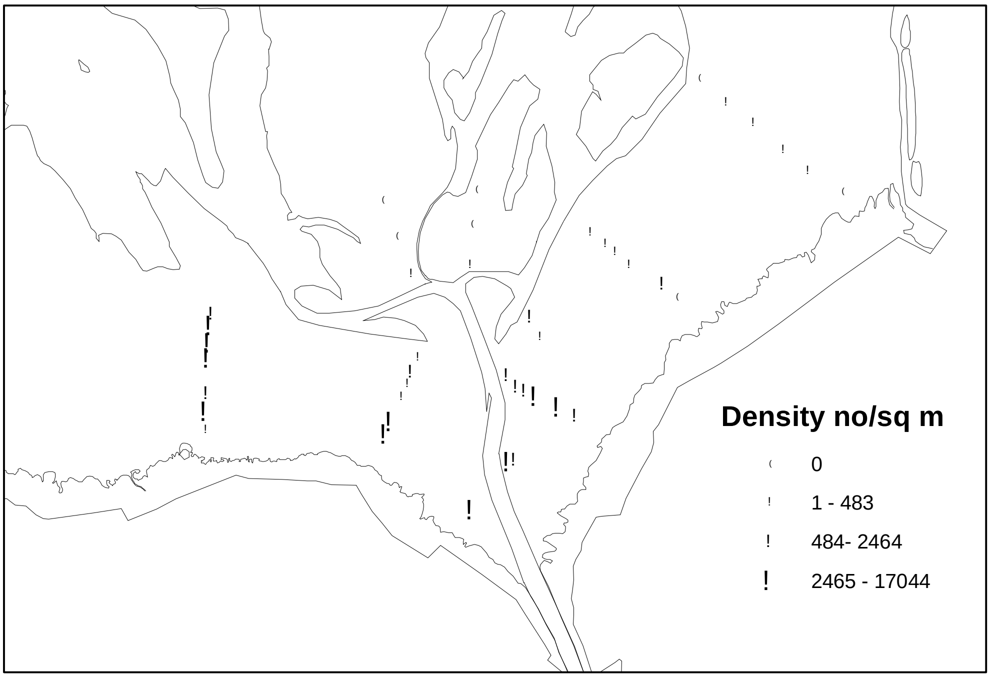
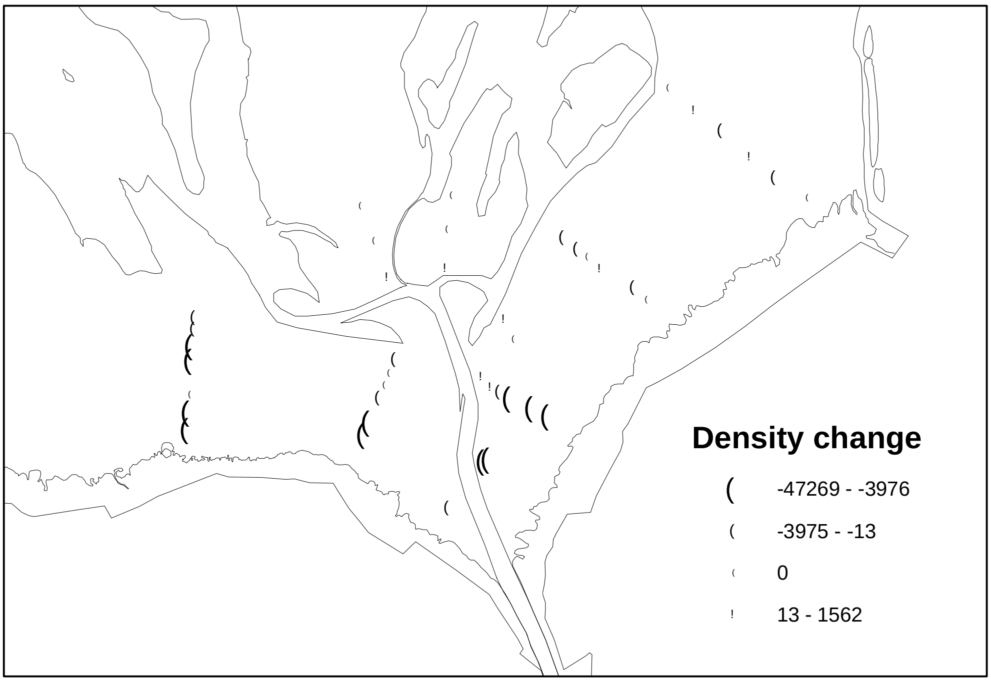


Figure 3.2.1f. Tubificoides benedii



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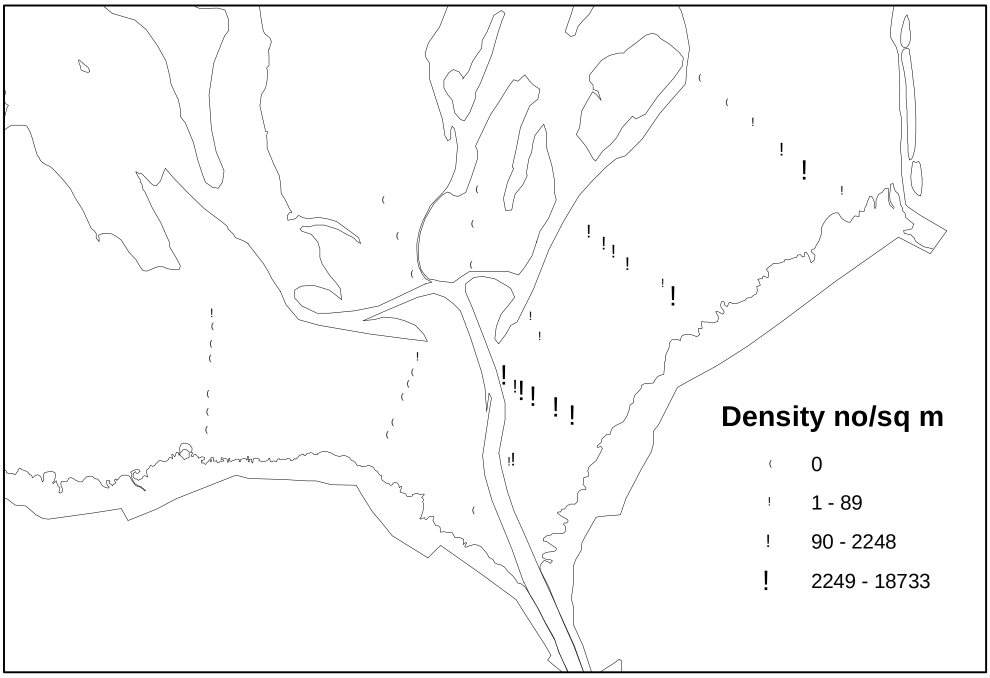
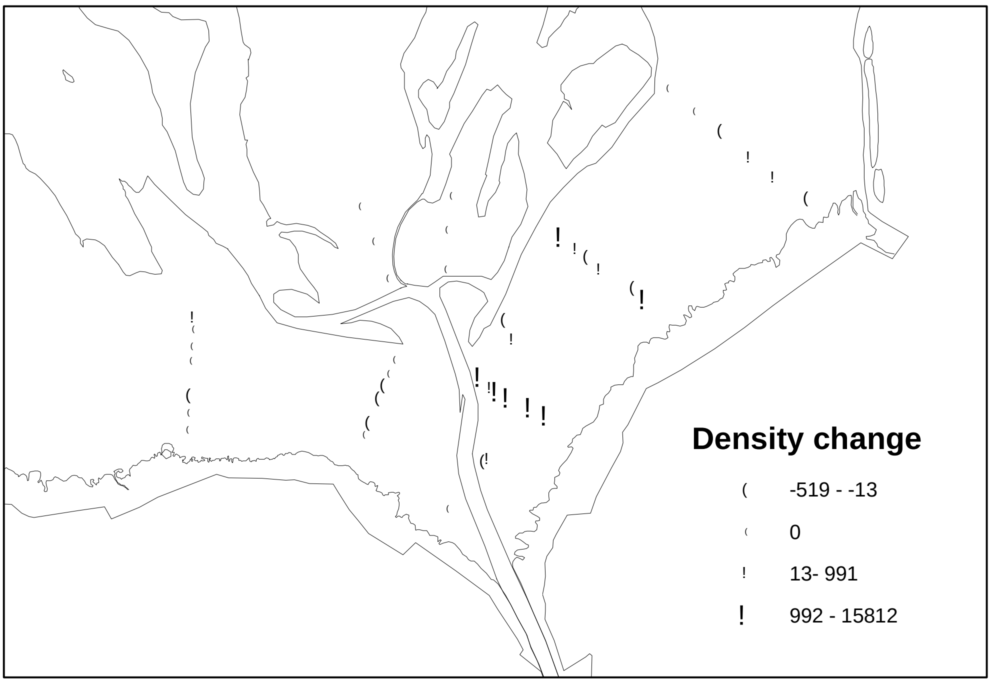


Figure 3.2.1g. Corophium volutator <3mm



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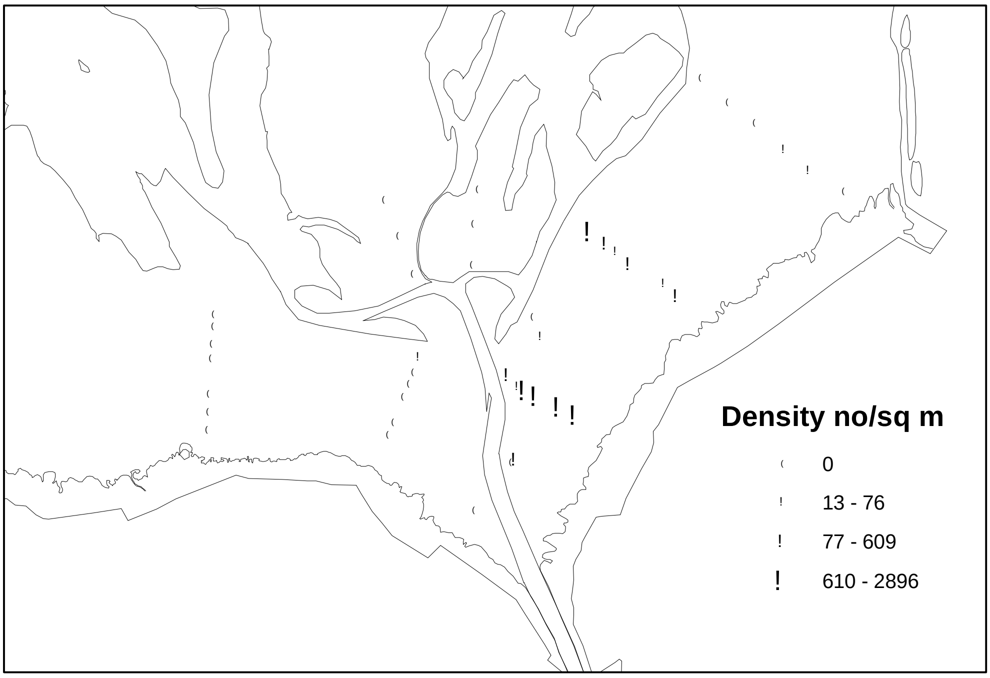
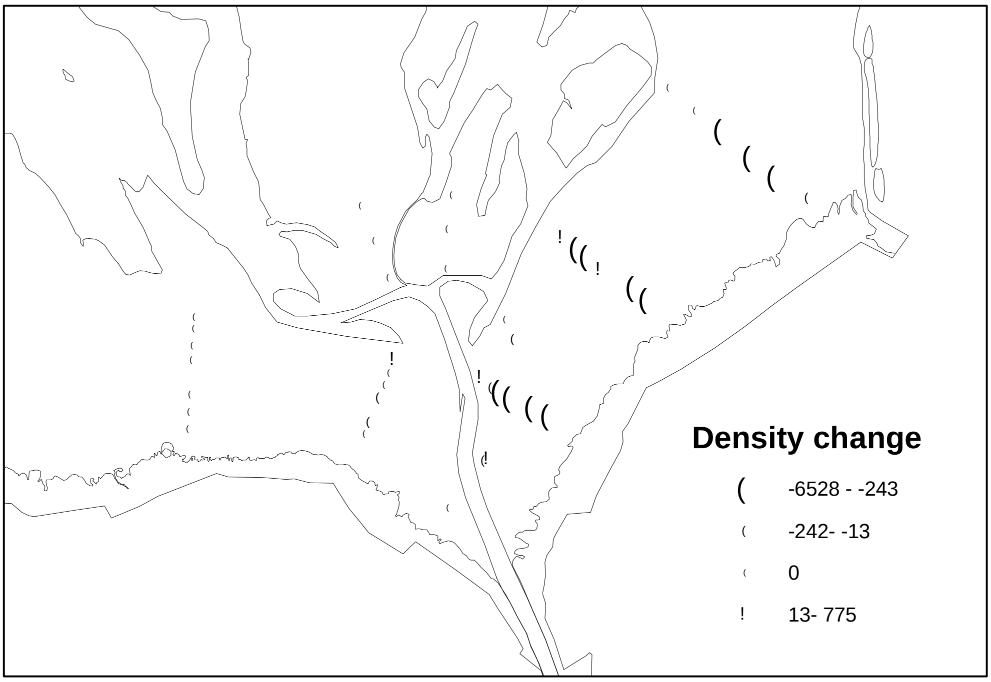


Figure 3.2.1h. Corophium volutator 3+mm



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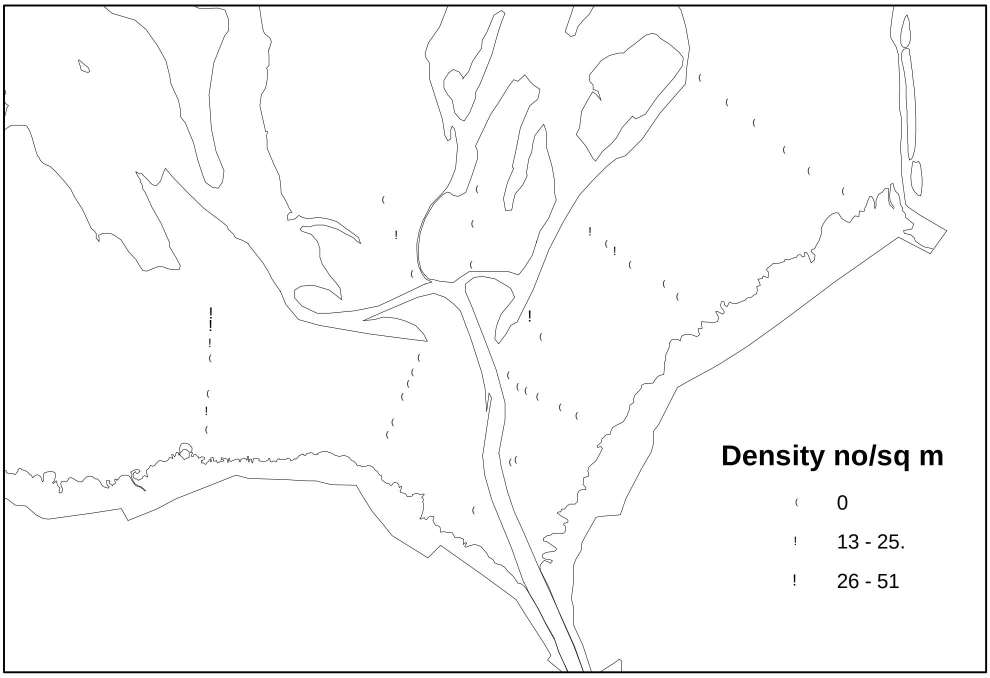
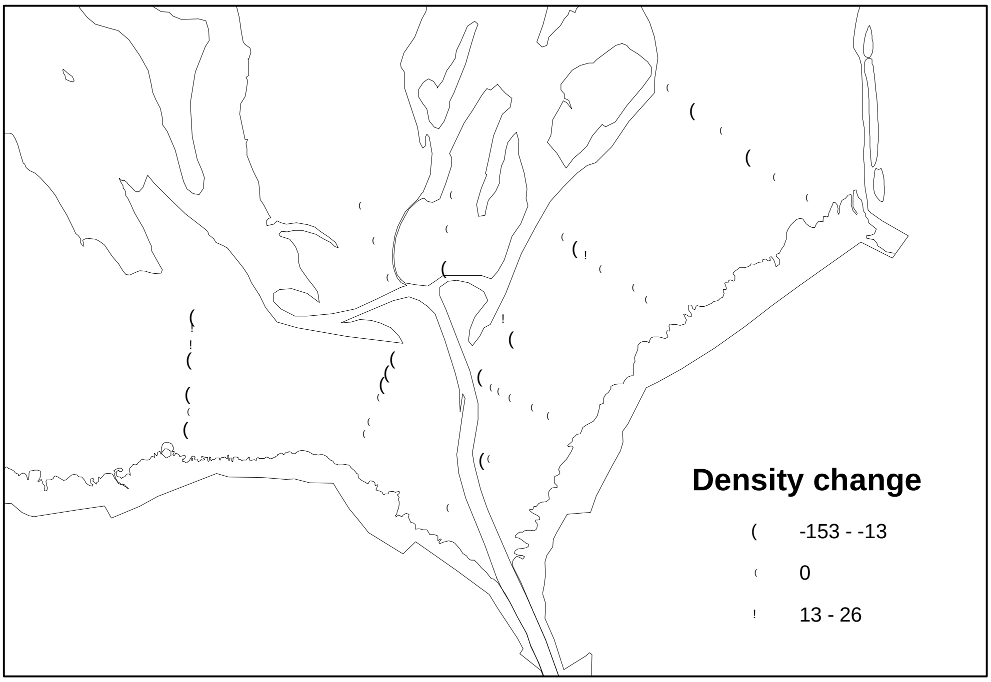


Figure 3.2.1i. Mytilus edulis <5mm



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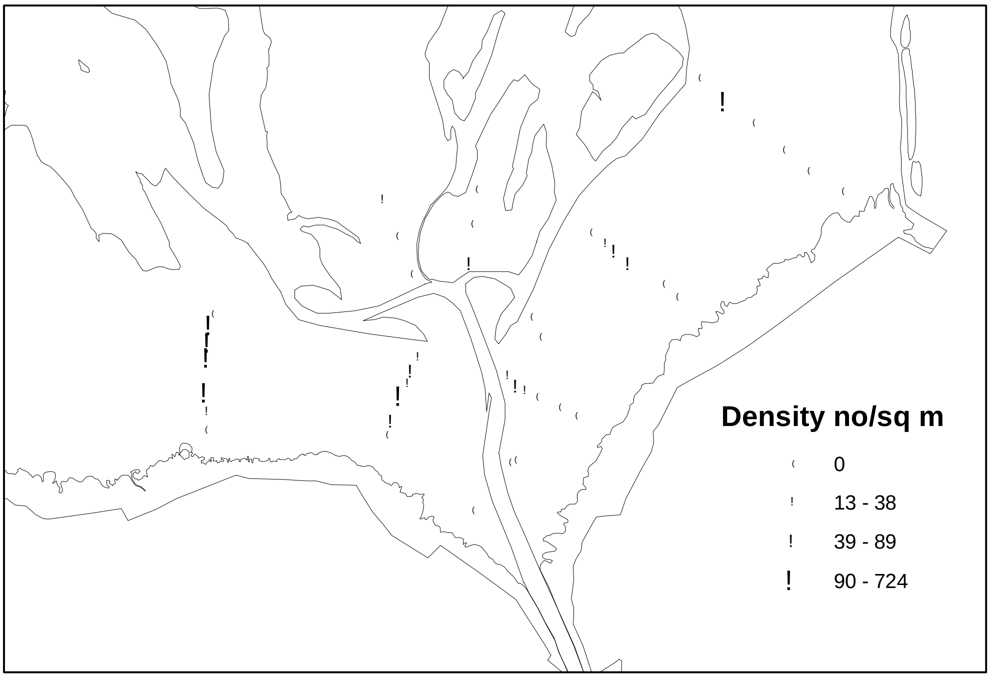
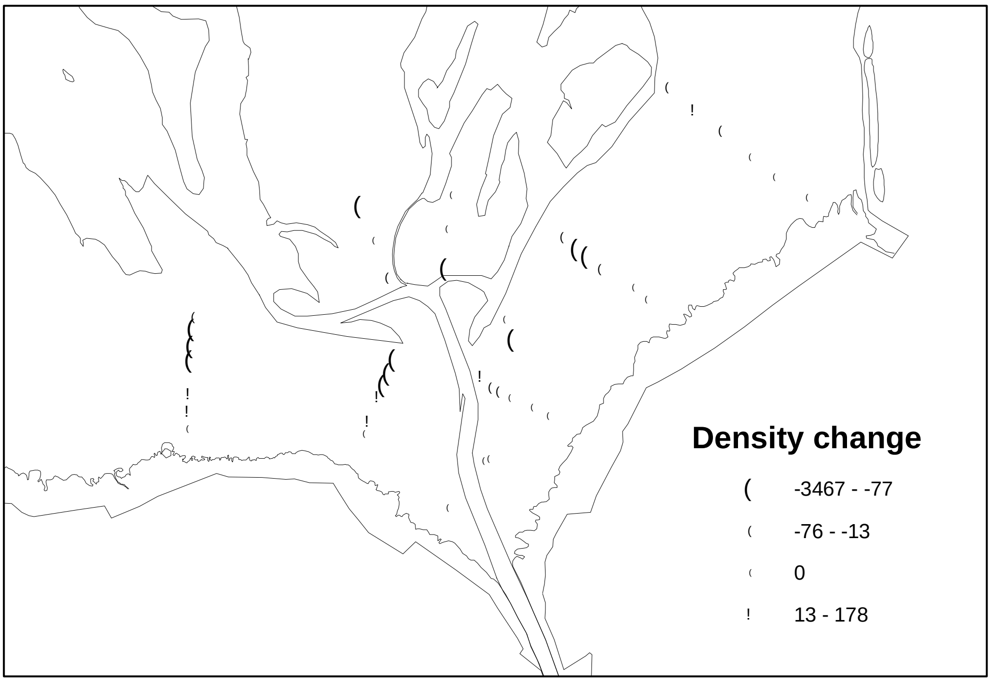


Figure 3.2.1j. Cerastoderma edulis <5mm



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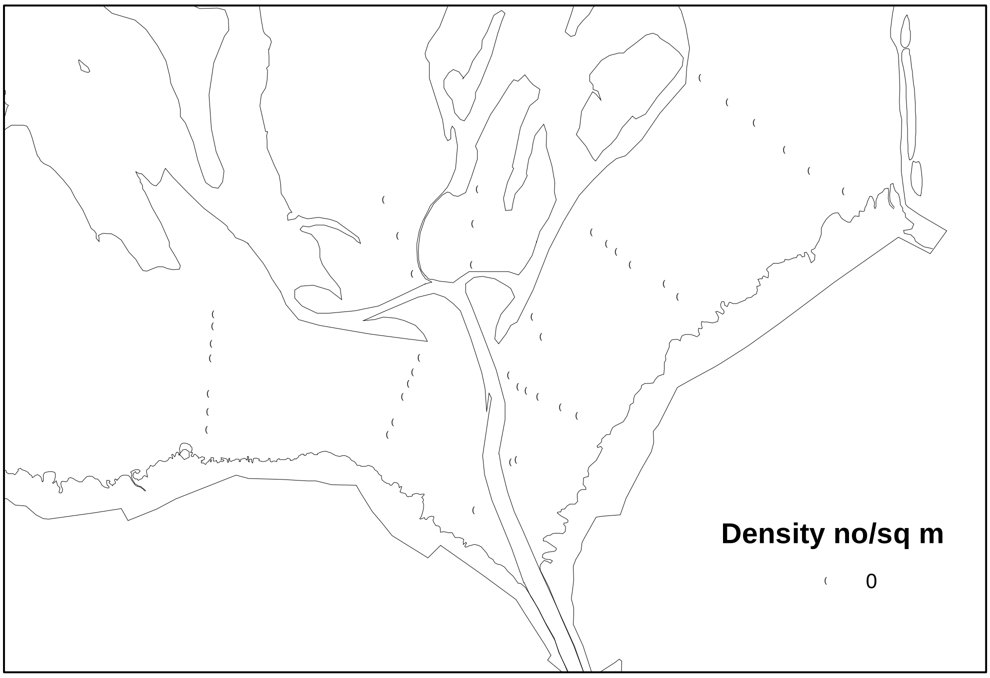
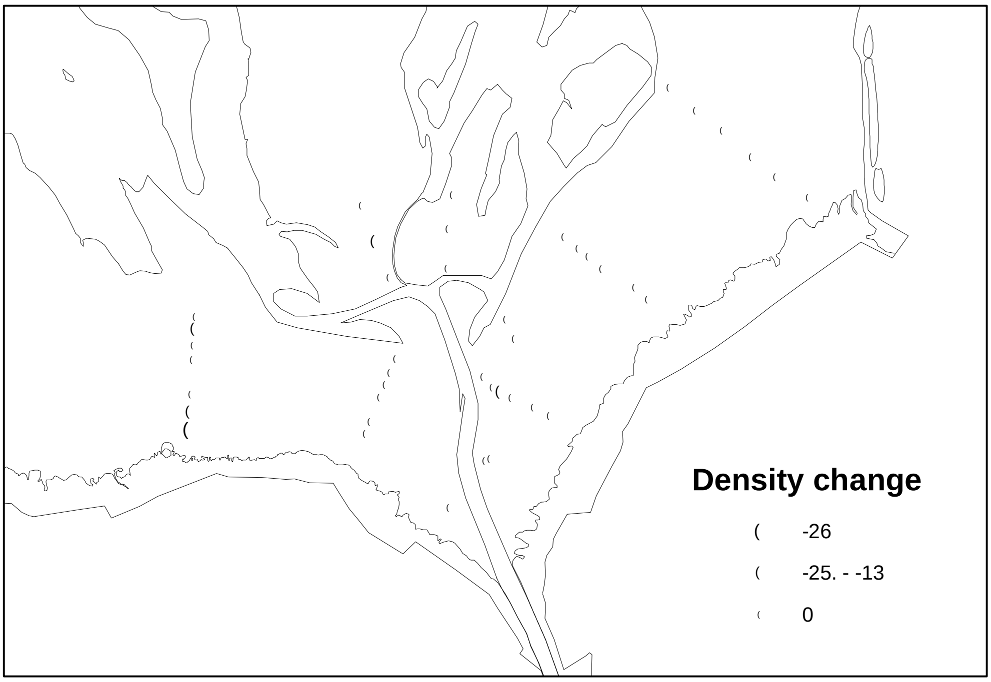


Figure 3.2.1k. Macoma balthica16-20mm



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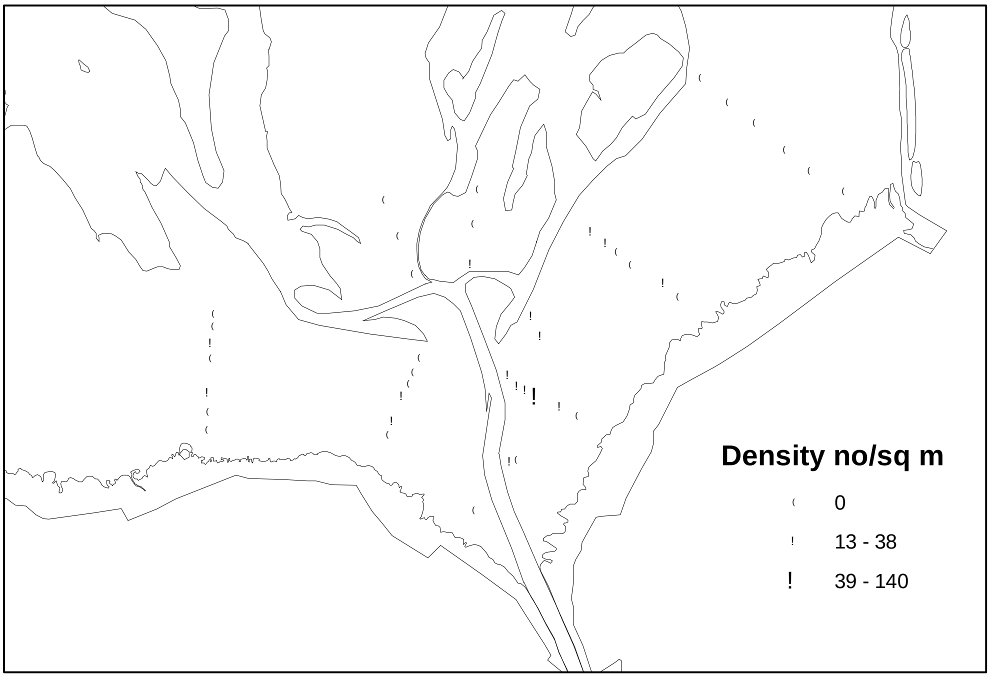
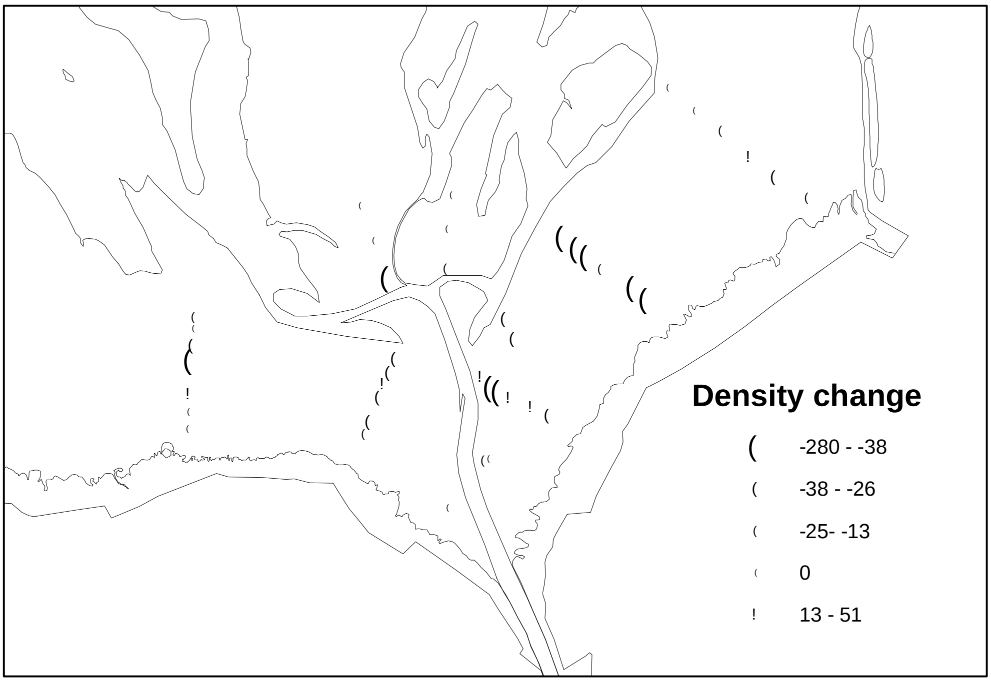


Figure 3.2.1l. Scrobicularia plana <5mm



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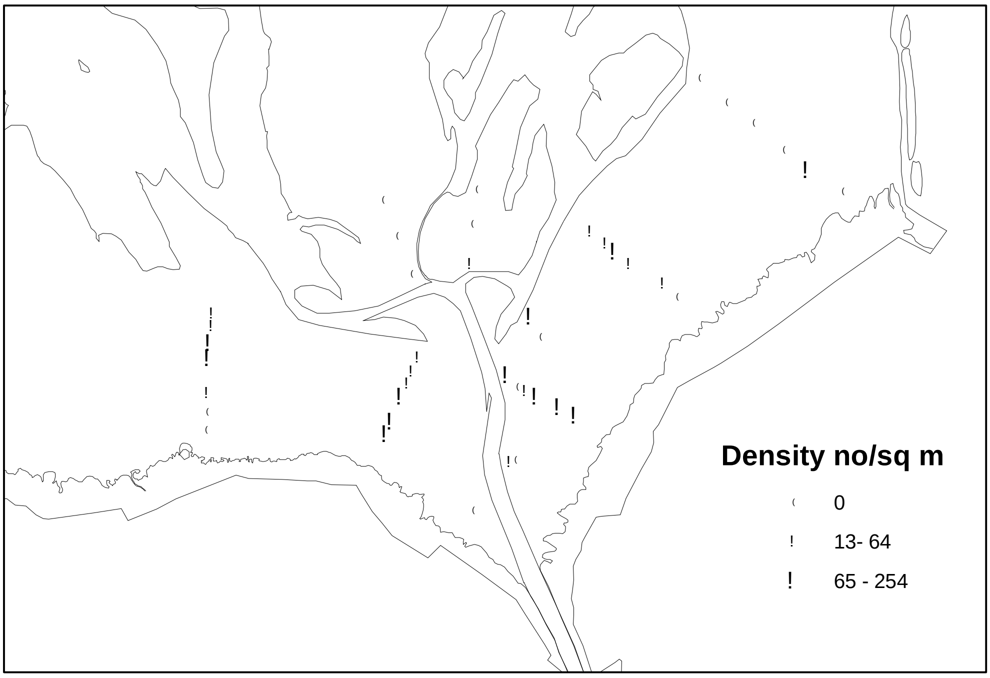
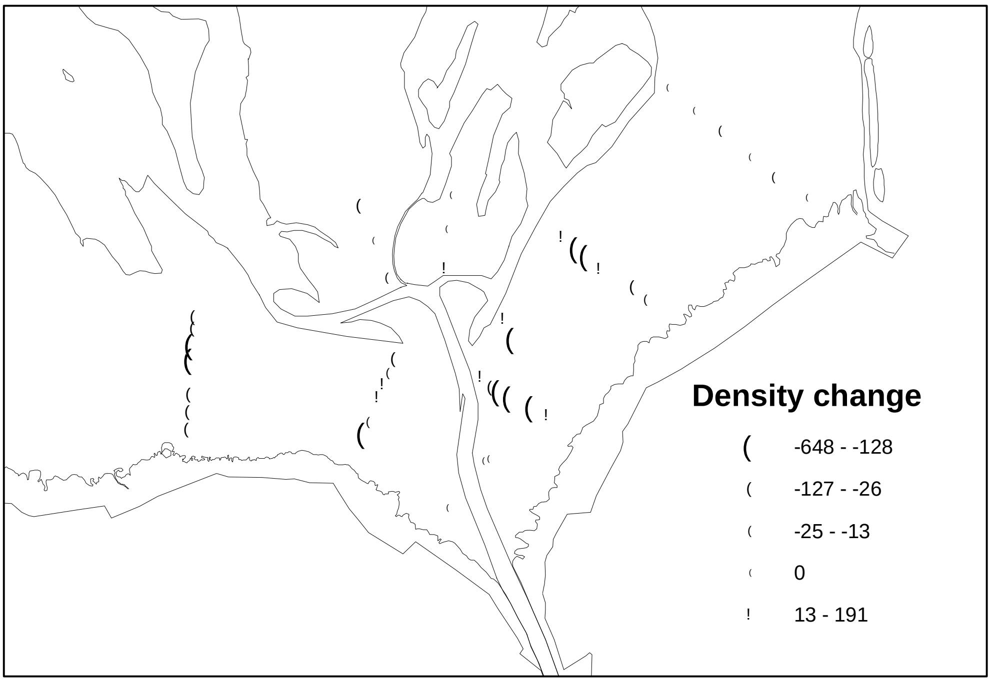


Figure 3.2.1m. Scrobicularia plana 6-10mm



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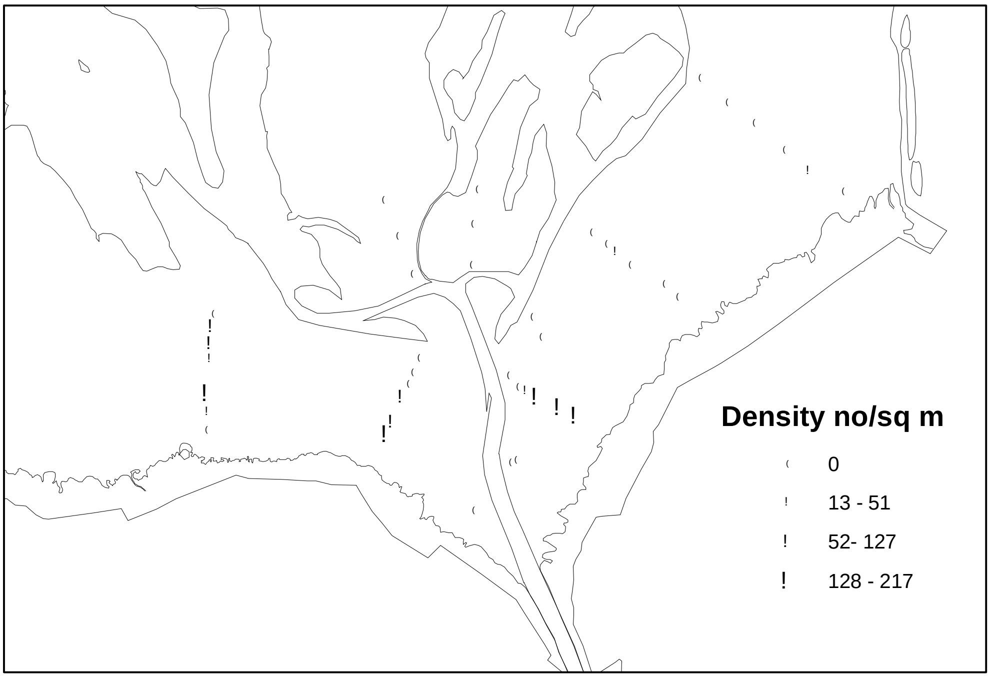


Figure 3.2.1n. Scrobicularia plana 11-20mm

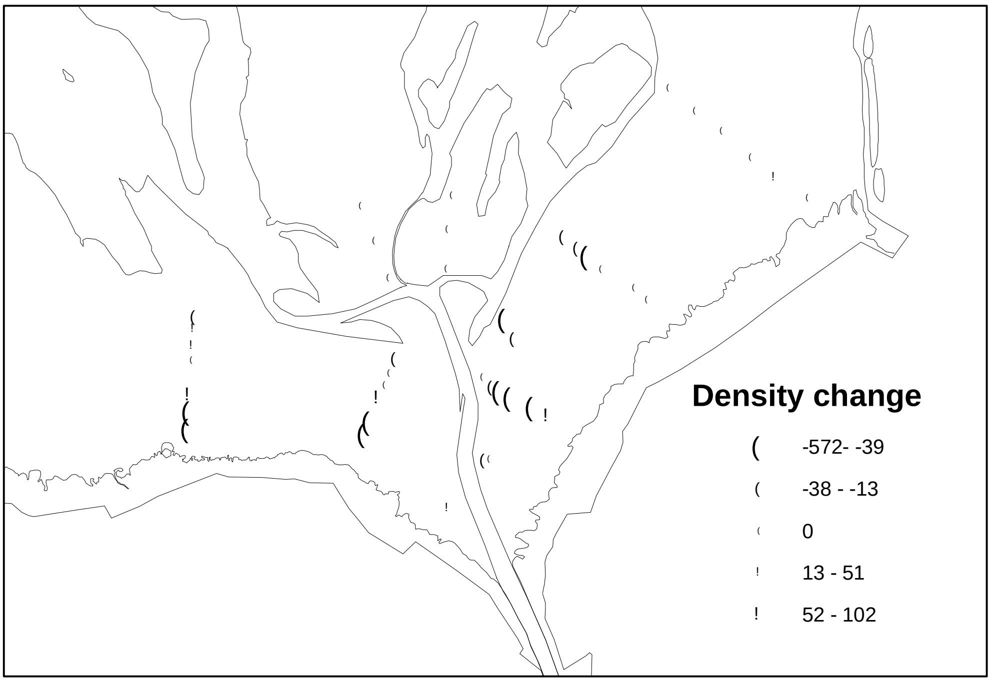
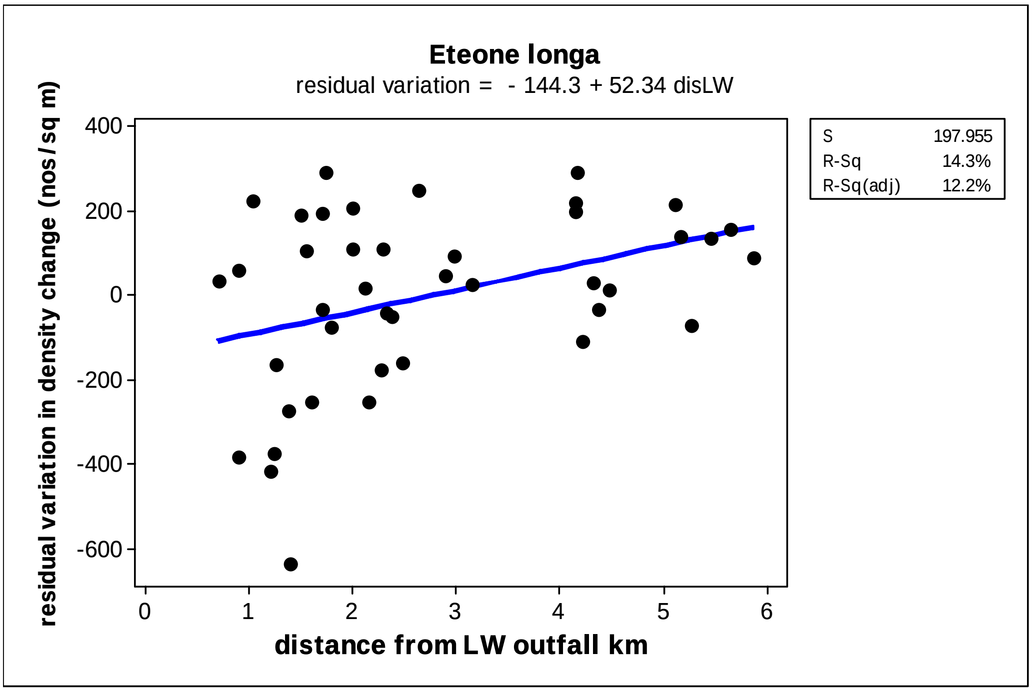


Figure 3.2.2a-f. The relationship between the residual variation in invertebrate density change between 2004 and 2005 and the distance of the sample sites from the Gt Ouse highwater (HW) and low water (LW) outfall (points A and B in Figure 2.1). The fitted relationships are statistically significant ($p<0.05$). The residual variation was that remaining after the effect of sediment particle size and organic content and shore level had been taken into account. Data points represent each of the 42 sample sites in the study area. **a**, *Eteone longa*, **b**, *Anaitides mucosa* **c**, *Hediste diversicolor* >30mm, **d**, *Scoloplos armiger* <15mm, **e**, *Corophium volutator* <3mm and **f**, *Scrobicularia plana* 11-20mm.

a,



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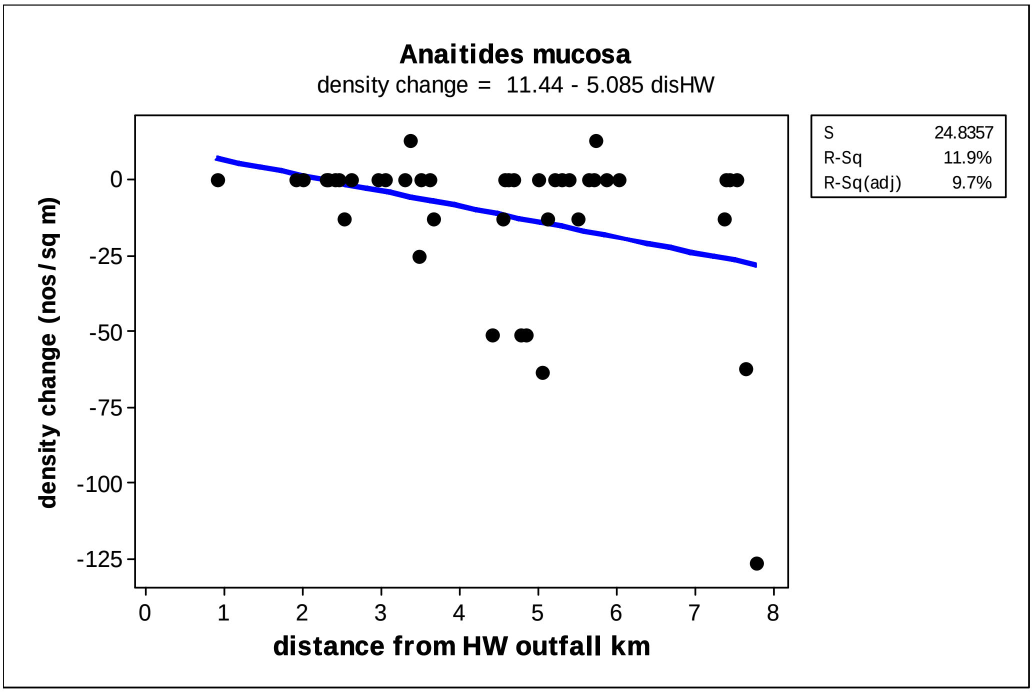

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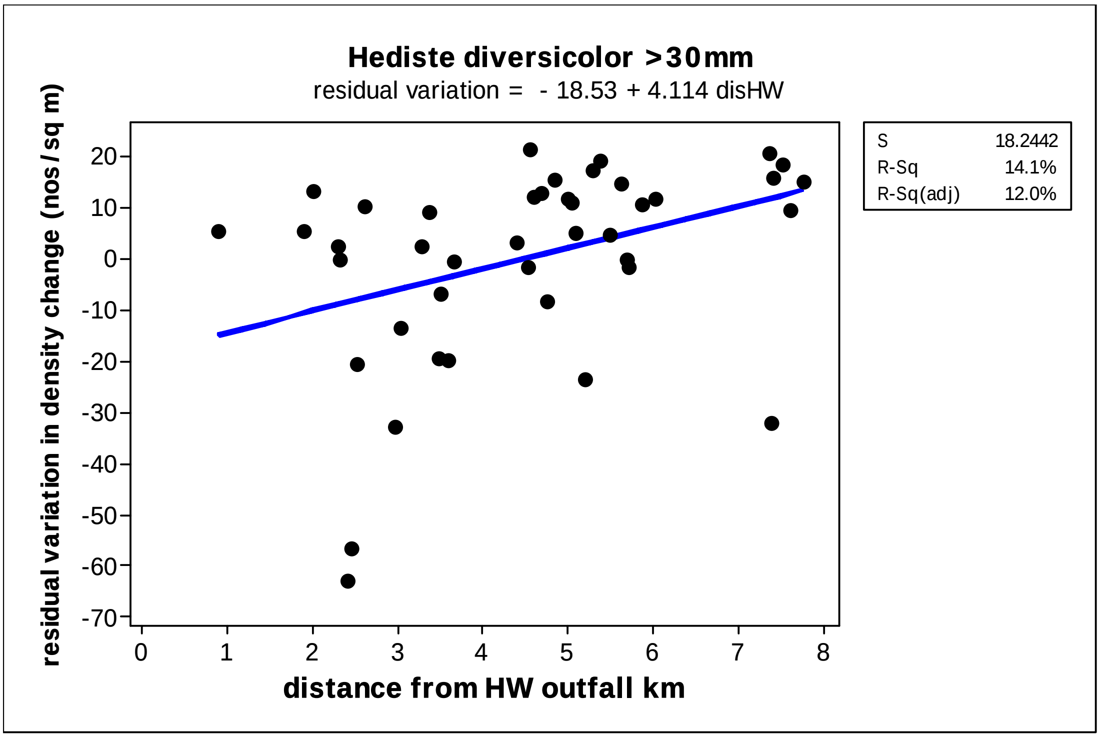

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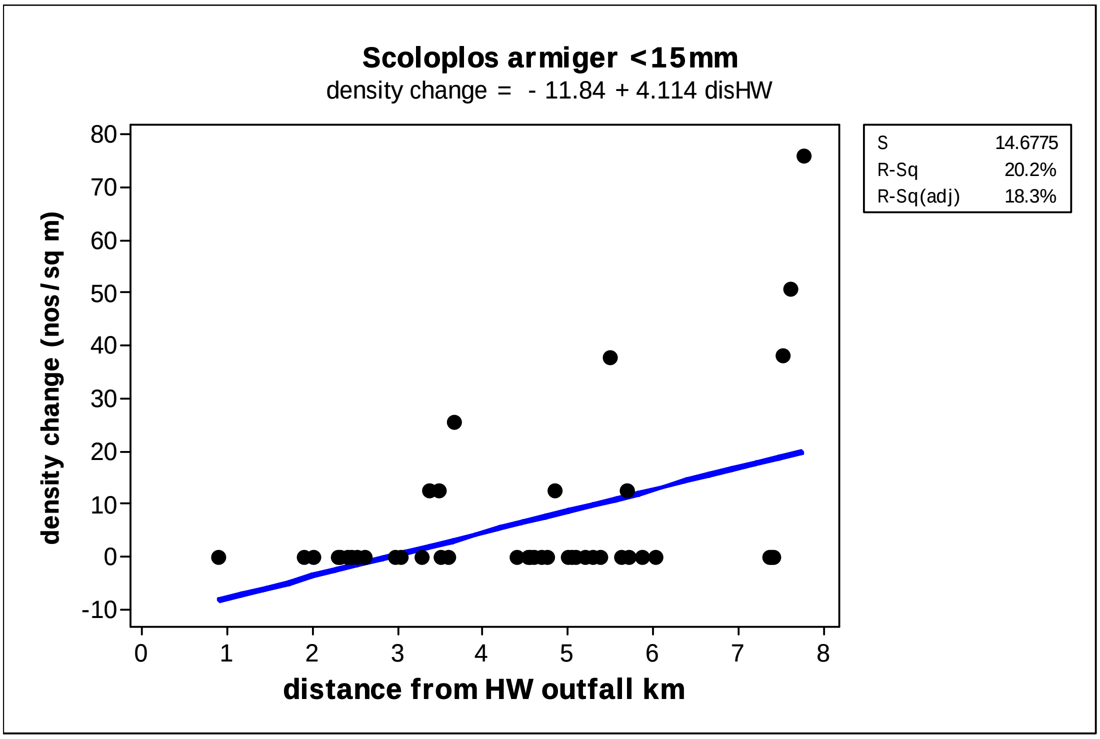
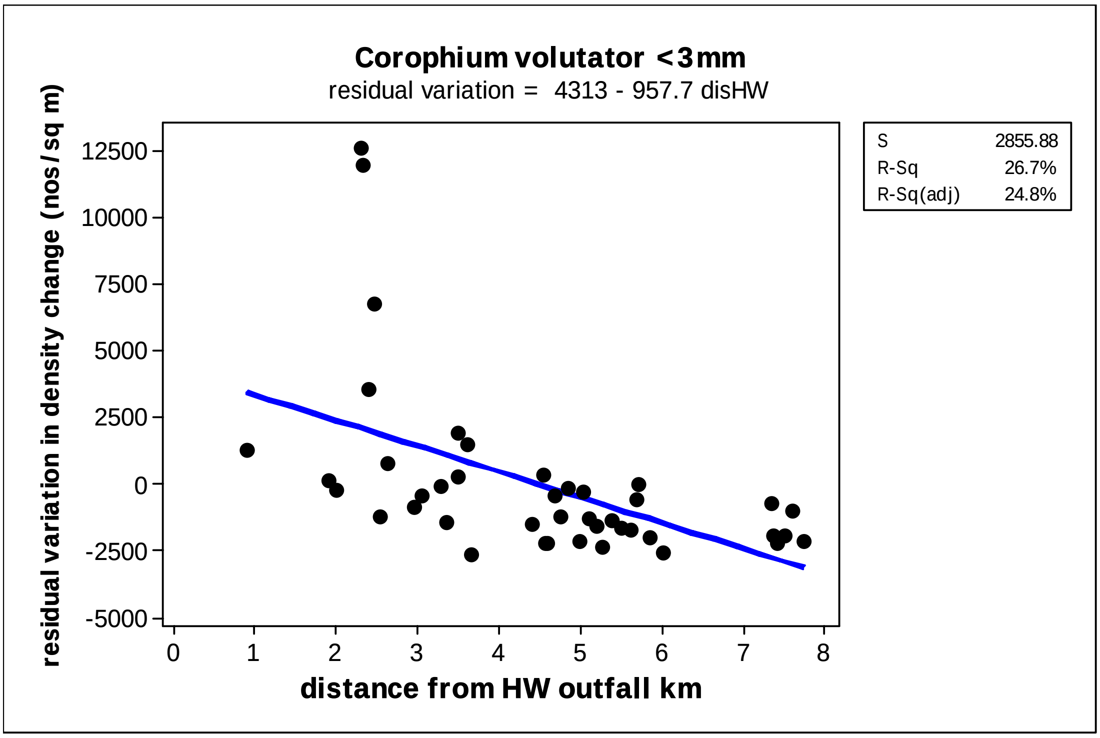


Figure 3.2.2a-f continued

e,



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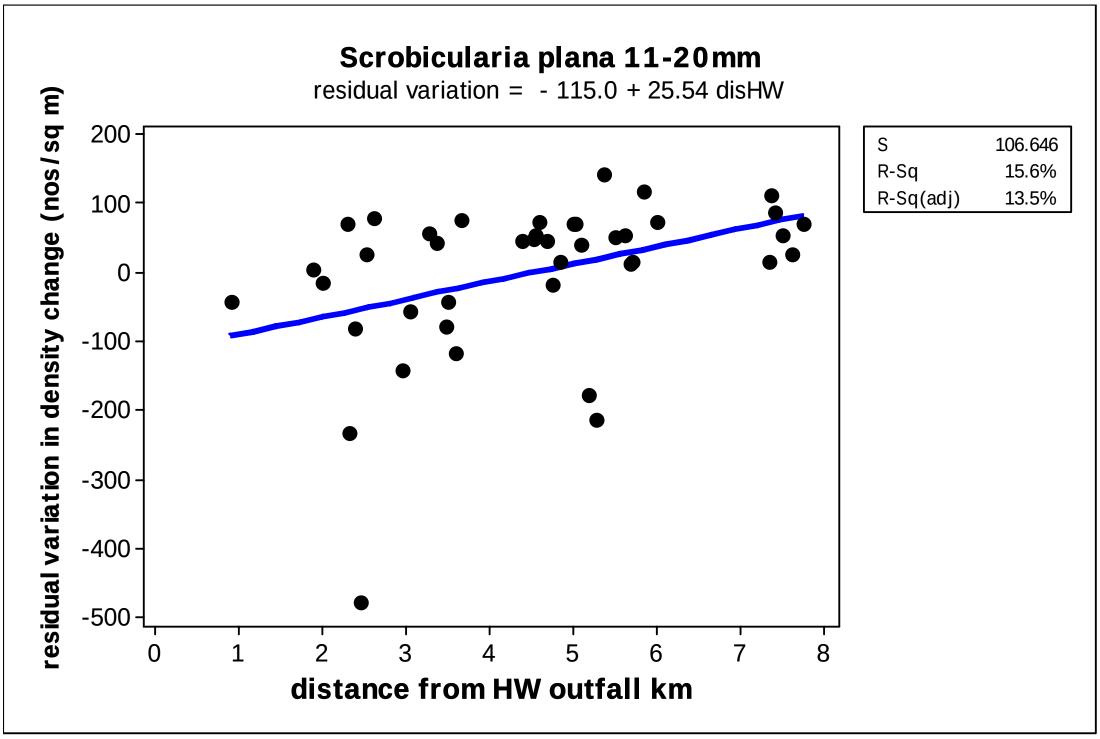
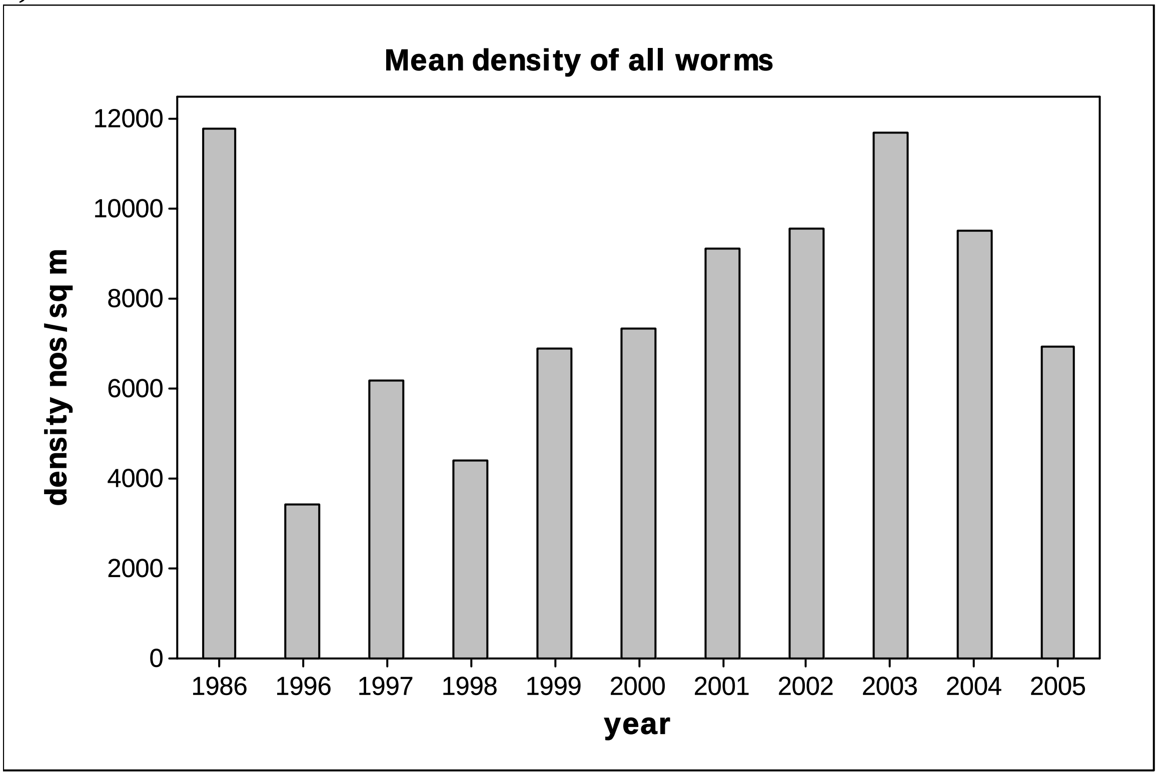


Figure 3.2.3 a-d. The mean annual density of **a**, worms, **b**, crustacean, **c**, gastropod molluscs (snails) and **d**, bivalve molluscs on the inner banks of the Gt Ouse study area in 1986 and 1996-2005. Densities are expressed as numbers/m^2.

a,



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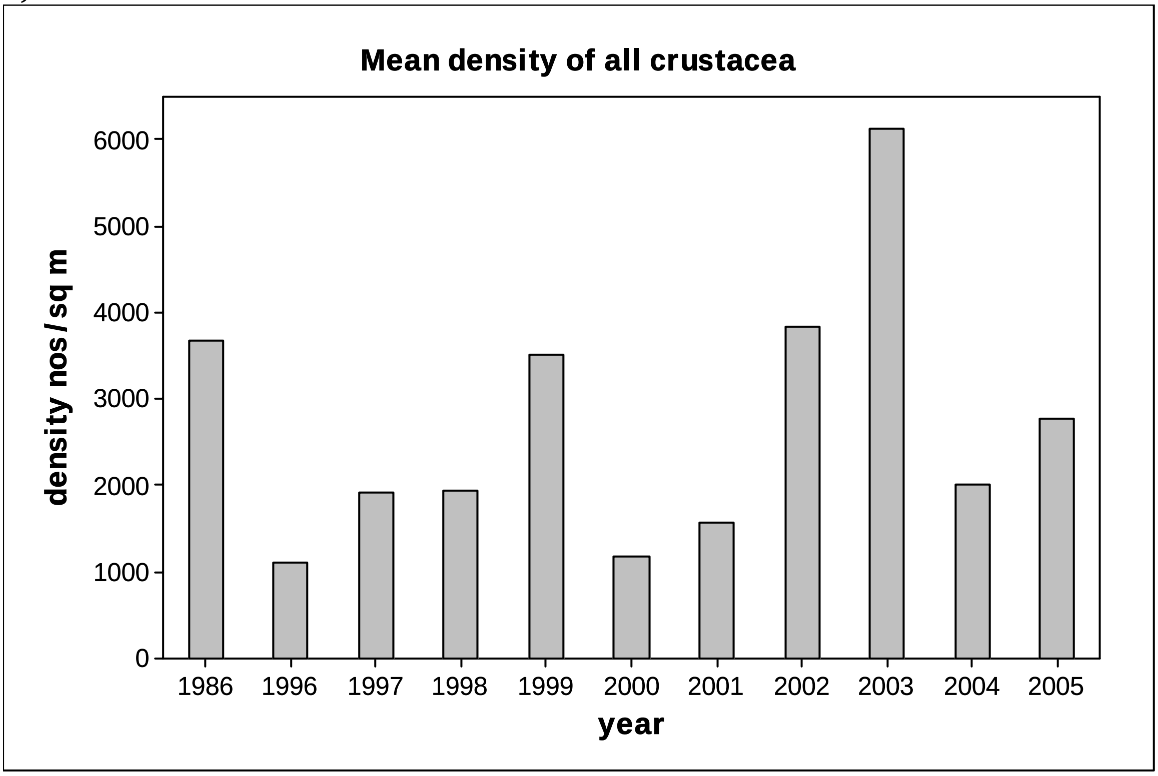

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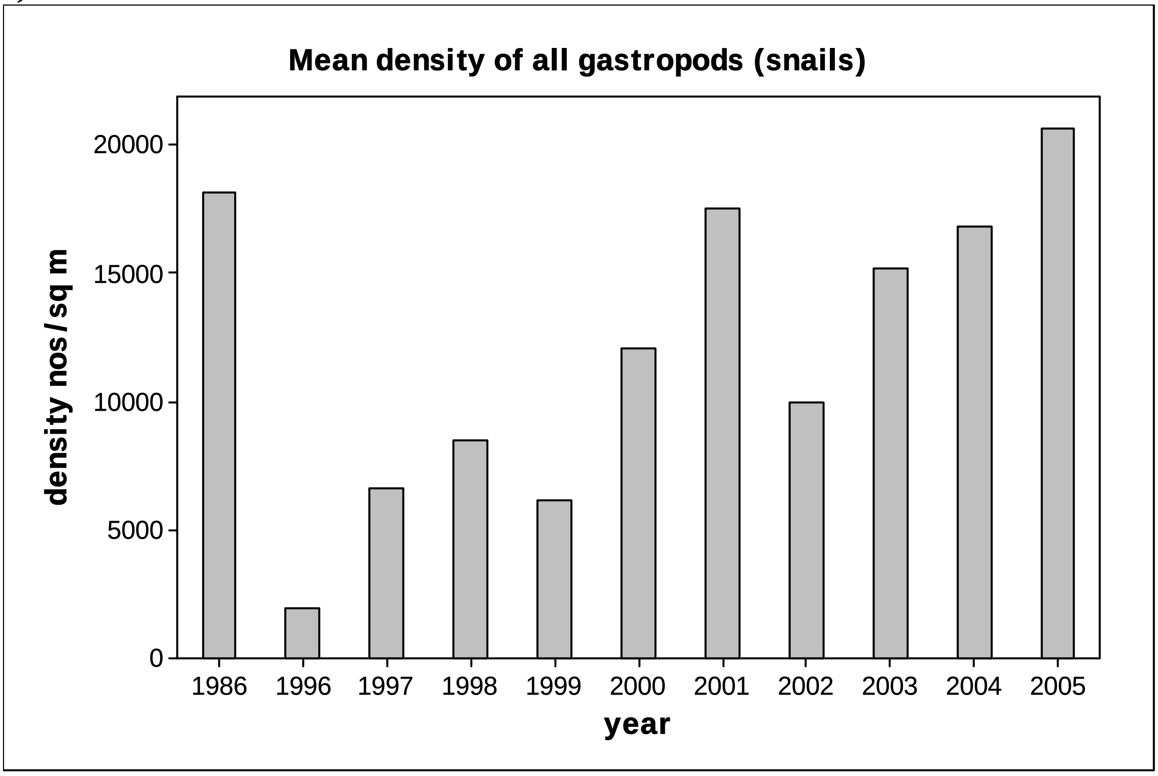
c,



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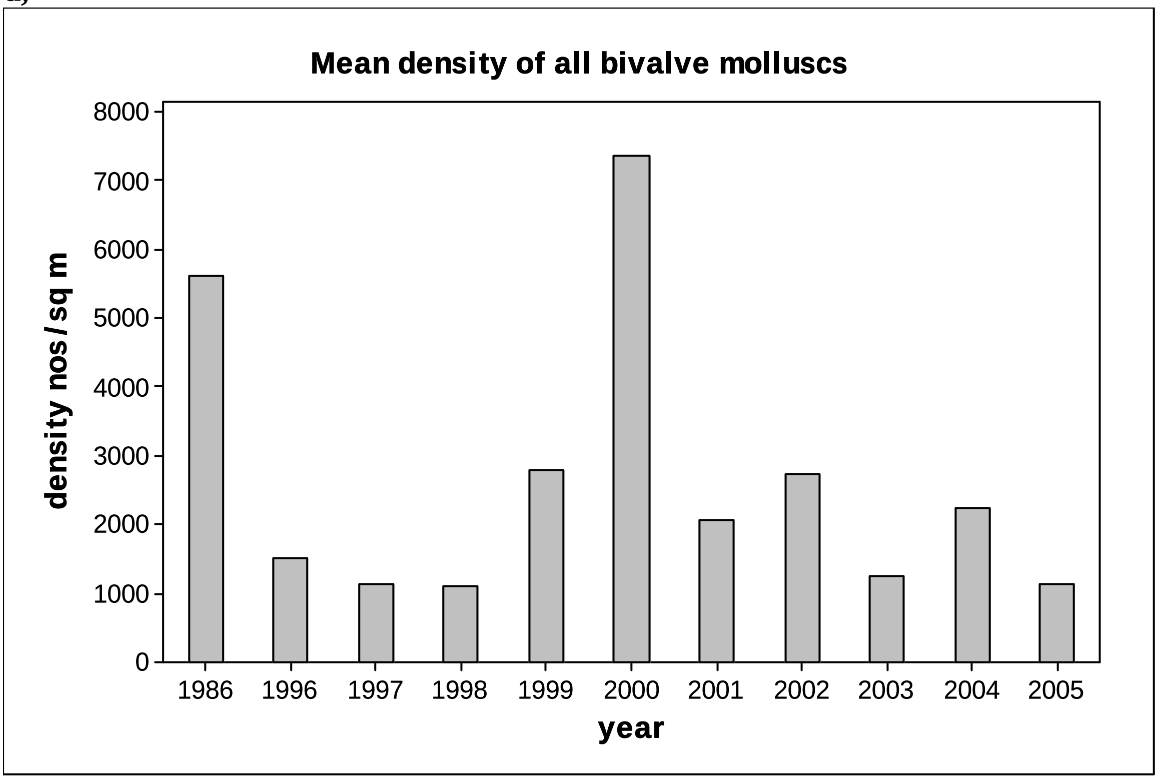


3.3 Shorebirds

3.3.1 Introduction

This section deals with the distribution of shorebirds feeding at low-water on the inter-tidal mud and sand flats adjacent to the Gt Ouse outfall. It also compares bird distribution in surveys made in winter 2005-2006 with those made in the previous winter's survey. Data are presented as summary tables and figures within the section and tabulated in Appendix 3. Each winter's survey data has been entered into a GIS-compatible database, an electronic version of which will be submitted at the end of the study.

The transects, labelled 51 to 66, DS and PS in Figure 3.3.1, indicate those parts of the inter-tidal areas adjacent to the Gt Ouse that were surveyed on two occasions in winter 2005-2006.

3.3.2 Shorebird distribution in the 2005-2006 survey and changes compared with 2004-2005 survey.

Both the distribution and abundance of birds in the 2005-2006 survey and in the previous survey are summarised in Figures 3.3.2a-h which chart the mean numbers recorded within each survey transect while Table 3.3.1 summarises the numbers of birds on shores either side the Gt Ouse outfall in the two surveys.

Distribution in winter 2005-2006

Dunlin (*Calidris alpina,* Figure 3.3.2a), redshank (*Tringa totanus,* Figure 3.3.2b), grey plover (*Pluvialis squatarola* Figure 3.3.2d), and curlew (*Numenius arquata* Figure 3.3.2g) were the most widespread species occurring in most of the survey transects including those adjacent to the Gt Ouse. Shelduck (*Tadorna tadorna,* Figure 3.3.2g) were similarly widespread though they were absent from the sandy areas of Stubborn Sand (transect 66) and the outer banks. Dunlin were most numerous on areas of Bulldog and Peter Black Sand (transects 57 to 61). Peaks in redshank numbers occurred in areas of Bulldog and Peter Black Sands spanned by transects 57 to 60 where their distribution coincided with that of one of their main prey *Corophium* (see Figures 3.2.1g and h). Grey plover were most numerous on Stubborn Sand. Curlew numbers peaked on Breast and Stubborn Sand while peaks in shelduck numbers occurred in transects 63 and 64 spanning upper shore areas of Ferrier Sand. In contrast to the former five species, the distributions of knot (*Calidris canutus,* Figure 3.3.2c), bar-tailed godwit (*Limosa lapponica,* Figure 3.3.2e) and oystercatcher (*Haematopus ostralegus,* Figure 3.3.2f) were aggregated in a few parts of the study area. Peaks in the numbers of knot occurred on Ferrier Sand (transect 64), those of oystercatcher occurred on Stubborn Sand and on the outer banks while bar-tailed godwit were most numerous on Ferrier and Stubborn Sand.

Table 3.3.1. The numbers of seven wader species and Shelduck recorded feeding within the study area adjacent to the Gt Ouse outfall in surveys made during the winters of 2004-2005 and 2005-2006. Numbers are the mean of two surveys made during mid November to early February each winter. The whole area incorporates the inter-tidal mud and sand flats spanned by transects 51-66 and D and P in Figure 3.3.1. The area defined as the west shore, ie to the west of the River Gt Ouse, is covered by transects 51-55, the outer banks by DS and PS and the east shore by transects 56-66.

Bird species	West shore		Outer banks		East shore		Whole study area	
survey	2004	2005	2004	2005	2004	2005	2004	2005
Dunlin	532	944	299	549	6331	5189	7161	6681
Redshank	45	20	15	5	496	396	555	420
Knot	1497	2519	12153	710	13037	3540	26686	6768
Grey Plover	63	21	77	6	291	172	431	199
Bar-tailed Godwit	94	82	18	3	1034	1213	1146	1297
Oystercatcher	286	212	214	308	503	1248	1002	1768
Curlew	77	77	22	28	173	221	272	325
Shelduck	720	1060	5	0	1393	1476	2118	2536

Changes in abundance and distribution within the study area.

The larger shorebird species, bar-tailed godwit, oystercatcher, curlew and shelduck were all more abundant in winter 2005-06 than they were in the previous winters' survey while the smaller species, dunlin, redshank, knot and grey plover, were less abundant (Table 3.3.1).

Though broadly similar between surveys, the pattern of dunlin distribution (Figure 3.3.2a) was more evenly spread over the study area in 2005-06. Redshank distribution (Figure 3.3.2b) varied little between winters with peak numbers occurring on areas of Bulldog Sand traversed by transects 57 and 60. Knot (Figure 3.3.2c) were more abundant on the shore to the west of the Gt Ouse in 2005-06 than they were in the previous winter and their main concentration on the east shore showed a southward shift to the area spanned by transect 64. There were far fewer knot on the outer bank areas in 2005-06 than in the previous year when unusually high numbers were recorded. Grey plover (Figure 3.3.2d) distribution was similar between winters, though more occurred on the northern part of the east shore in 2005-06. Bar-tailed godwit (Figure 3.3.2e), oystercatchers (Figure 3.3.2f), curlew (Figure 3.3.2g) and shelduck (Figure 3.3.2h) were all similarly distributed between the two winters and were more numerous in most areas in 2005-06 than they were in the previous winter.

In order to detect whether the within-transect change in bird numbers between years was related to proximity to the Gt Ouse outfall, the logarithm (log_{10}) of ratios between 2005-2006 and 2004-2005 numbers were plotted against the transect's distance from the outfall. Any visual indication of a pattern in the plots was tested by regression analysis. However, there was no evidence of any relationship for any of the species.

Year on year changes in abundance within the study area and the whole Wash.

The year on year change in bird numbers in the study area (Table 3.3.1) could represent localised changes around the Gt Ouse outfall or changes that occurred at a Wash-wide scale. We checked these possibilities by comparing the change in numbers between the current and previous winter's survey of the study area with that in the whole Wash (Table 3.3.2) by expressing the numbers recorded in winter 2005-06 as a percentage of those in the previous winter. The whole Wash data were calculated from the Wetlands and Estuary Birds Scheme (WeBS) counts that were made independently of our own.

Table 3.3.2. Bird numbers in winter 2005-2006 expressed as a percentage of those in winter 2004-2005 for the study area and the whole Wash (WeBS counts).

Bird species	Study area	Whole Wash
	2005 numbers as % of 2004 numbers	2005 numbers as % of 2004 numbers
Dunlin	93.3	68.2
Redshank	75.7	57.3
Knot	25.4	58.9
Grey Plover	46.2	69.1
Bar-tailed Godwit	113.2	79.6
Oystercatcher	176.5	106.4
Curlew	119.5	106.7
Shelduck	119.7	111.7

Relative to the winter of 2004-05, bar-tailed godwit oystercatcher, curlew and shelduck numbers in the study area all increased in winter 2005-06. In the case of curlew and shelduck this increase was in the same proportion as that in the whole Wash implying that changes were Wash-wide. In the case of bar-tailed godwit and oystercatcher increases were more pronounced in the study area suggesting a local effect, perhaps due to the area being more preferred by those species. The decline in dunlin, redshank, knot and grey plover numbers in the study area was matched by a decline in the whole Wash. However, the decline in dunlin and redshank was more pronounced in the whole Wash while that of knot and grey was more pronounced in the study area. This implies that the study area remained a preferred area for dunlin and to a lesser extent for redshank, but that for knot and grey plover it was a less preferred as a feeding area.

3.3.2.1 Changes in bird numbers: 1986, 1989-1991 and 1996-2005

The numbers of shorebirds feeding on the inner banks of the Gt Ouse study area at low tide have been surveyed for a total of 14 winters to date and they have been summarised (Figure 3.3.3) to put into perspective the changes that have occurred during the course of this study.

Though having declined in 2003, dunlin numbers have remained relatively stable over the last five years of the study compared to period 1986 to 1991 when both the highest and lowest numbers were recorded. Redshank numbers were at their high in 1990 but had dropped to their lowest in 1996 at the start of the study. Since then numbers have increased steadily to their highest in 2003, although since then numbers have declined. Knot were most abundant in 1990 and least abundant in 1999 since when their numbers have remained relatively stable until an increase in 2004 but not to numbers as high as those recorded in the late 1980's and early 1990's. Grey plover numbers were lowest in 1999 but have increased since then to a level in 2003 where they were nearing the highest numbers previously recorded in 1989 and 1990. However, since 2003 their numbers have declined almost to levels as low as in 1999. Bar-tailed godwit numbers were highest in 1996 when those of most other species were at or near their lowest. Then numbers decreased annually until 1999-2000 since when they have risen steadily with the exception of a drop in 2003. Oystercatcher numbers were at their lowest in early to mid 1990's following the decline in cockle and mussel stocks in the Wash. However, numbers had steadily increased until the 2004 survey when they dropped to their lowest since 1991 but have since increased. Curlew numbers have varied in a similar manner to those of redshank with low numbers being recorded in 1996 increasing steadily thereafter to a peak in 2001 since when they decreased in number to their lowest in 2004. But they increased in the current winter. Shelduck numbers were consistently higher in the late 1980's to early 1990's than they have been since 1996. Lowest numbers were recorded in 1999 since when they increased for two years, dropped in a further two winters and increased again in the last two winters.

3.3.3 Summary and conclusions

The larger shorebird species, bar-tailed godwit, oystercatcher, curlew and shelduck were all more abundant in winter 2005-06 than they were in the previous winters' survey while the smaller species, dunlin, redshank, knot and grey plover, were less abundant.

Dunlin, redshank, grey plover and curlew were the most widespread species occurring in most of the survey transects including those closest to the Gt Ouse. Shelduck were similarly widespread although they were absent from the sandiest areas of the inner banks and from the outer bank areas. In contrast to the former five species, the distributions of knot, bar-tailed godwit and oystercatcher were aggregated in a few parts of the study area. Peaks in the numbers of knot occurred on Ferrier Sand, those of oystercatcher occurred on Stubborn Sand and on the outer banks while bar-tailed godwit were most numerous on Ferrier and Stubborn Sand.

Within the study area, there was no evidence of any relationship between spatial change in numbers from 2004 to 2005 and distance from the Gt Ouse outfall for any shorebird species.

Change in shorebird numbers within the study area between the current winters' survey and the previous winter was compared with that recorded the whole Wash to determine whether changes were local or Wash-wide. Relative to the winter of 2004-05, bar-tailed godwit oystercatcher, curlew and shelduck numbers in the study area all increased in the current winter. In the case of curlew and shelduck this increase was in the same proportion as that in the whole Wash implying that changes were Wash-wide. In the case of bar-tailed godwit and oystercatcher increases were more pronounced in the study area suggesting a local effect, perhaps due to the area being more preferred by those species. The decline in dunlin, redshank, knot and grey plover numbers in the study area was matched by a decline in the whole Wash. However, the decline in dunlin and redshank was more pronounced in the whole Wash while that of knot and grey plover was more pronounced in the study area. This implies that the study area remained a preferred area for dunlin and to a lesser extent for redshank, but for knot and grey plover it was a less preferred as a feeding area.

The numbers of shorebirds feeding on the inner banks of the Gt Ouse study area at low tide have been surveyed for a total of 14 winters to date and were summarised to put into perspective the changes that have occurred during the course of this study.

Section 3.3

Figure legends

Figure 3.3.1

The ITE shorebird transects, numbered 51-66, within which the distribution of shorebirds feeding at low water was surveyed. Transects were aligned along the direction of flow of the ebbing tide. Areas of the outer banks, Daseley's Sand (DS) and Pandora Sand (PS), that were surveyed are indicated by cross-hatch shading.

Figure 3.3.2a-h

The numbers of shorebirds in each survey transect in the winters of 2003-2004 and 2004-2005. Numbers are the mean of two counts made during November to January in each winter. Transects are those shown in Figure 3.3.1(note; 'OBs' refer to the outer banks, Daseley's and Pandora Sands). **a**, Dunlin **b,** Redshank **c,** Knot **d,** Grey plover **e,** Bar-tailed godwit **f,** Oystercatcher **g,** Curlew and **h,** Shelduck.

Figure 3.3.3.

The total numbers of shorebirds feeding on the inner banks of the Gt Ouse study area in 1986, 1989-1991 and 1996-2004

Figure 3.3.1

The ITE shorebird transects, numbered 51-66, within which the distribution of shorebirds feeding at low water was surveyed. Transects were aligned along the direction of flow of the ebbing tide. Areas of the outer banks, Daseley's Sand (DS) and Pandora Sand (PS) that were surveyed are indicated by cross-hatch shading.

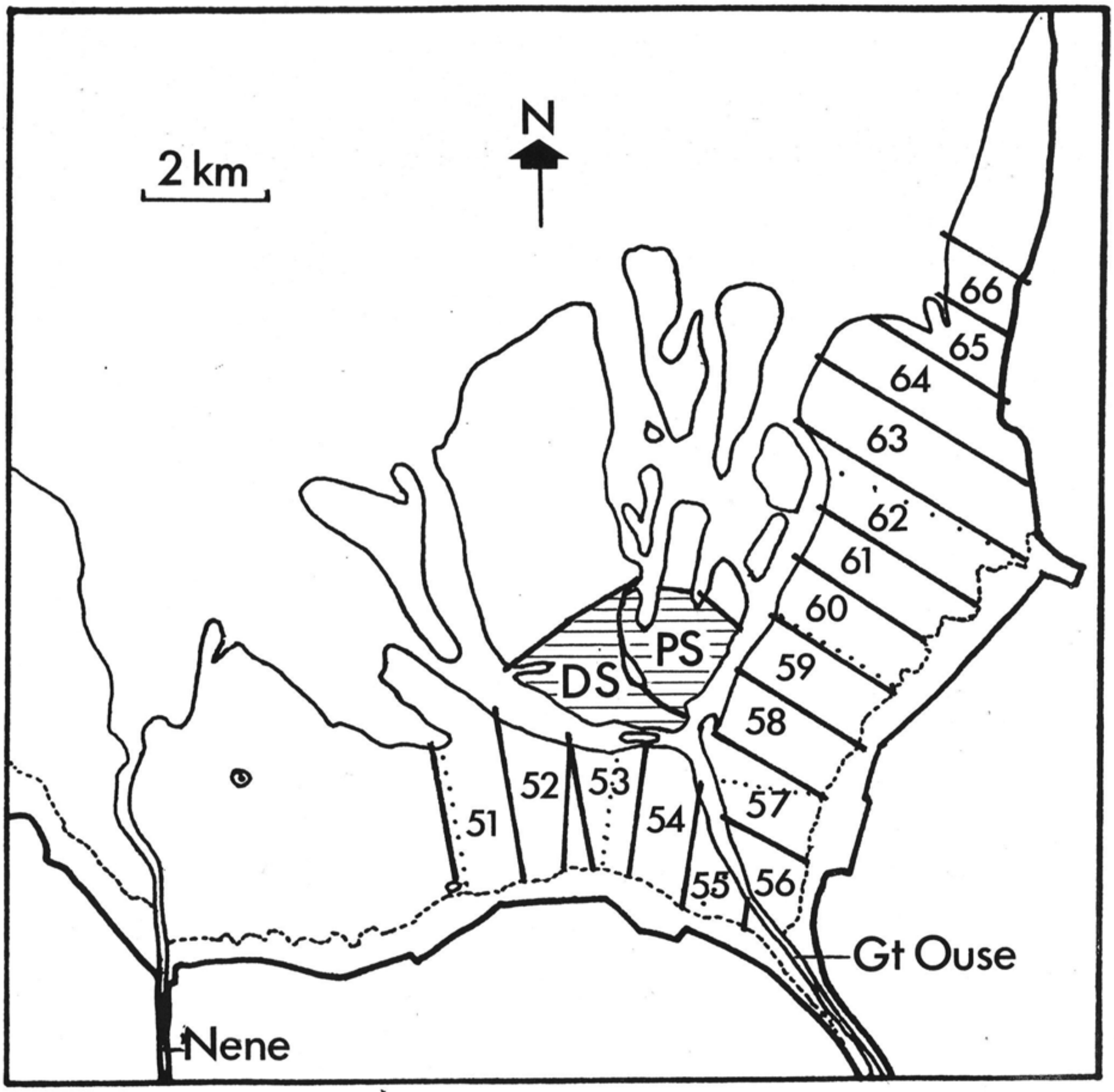
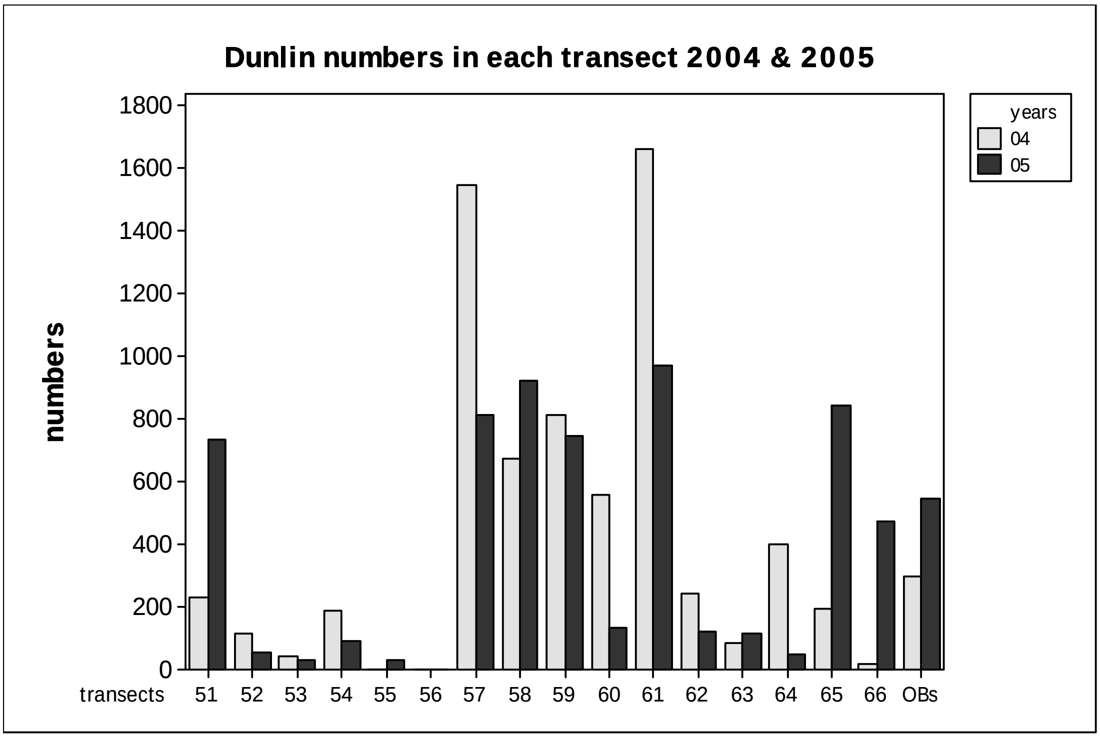


Figure 3.3.2a-h The numbers of shorebirds in each survey transect in the winters of 2004-2005 and 2005-2006. Numbers are the mean of two counts made during November to January in each winter. Transects are those shown in Figure 3.3.1(note; 'OBs' refer to the outer banks, Daseley's and Pandora Sands). **a**, Dunlin **b,** Redshank **c,** Knot **d,** Grey plover **e,** Bar-tailed godwit **f,** Oystercatcher **g,** Curlew and **h,** Shelduck.

a,



b,

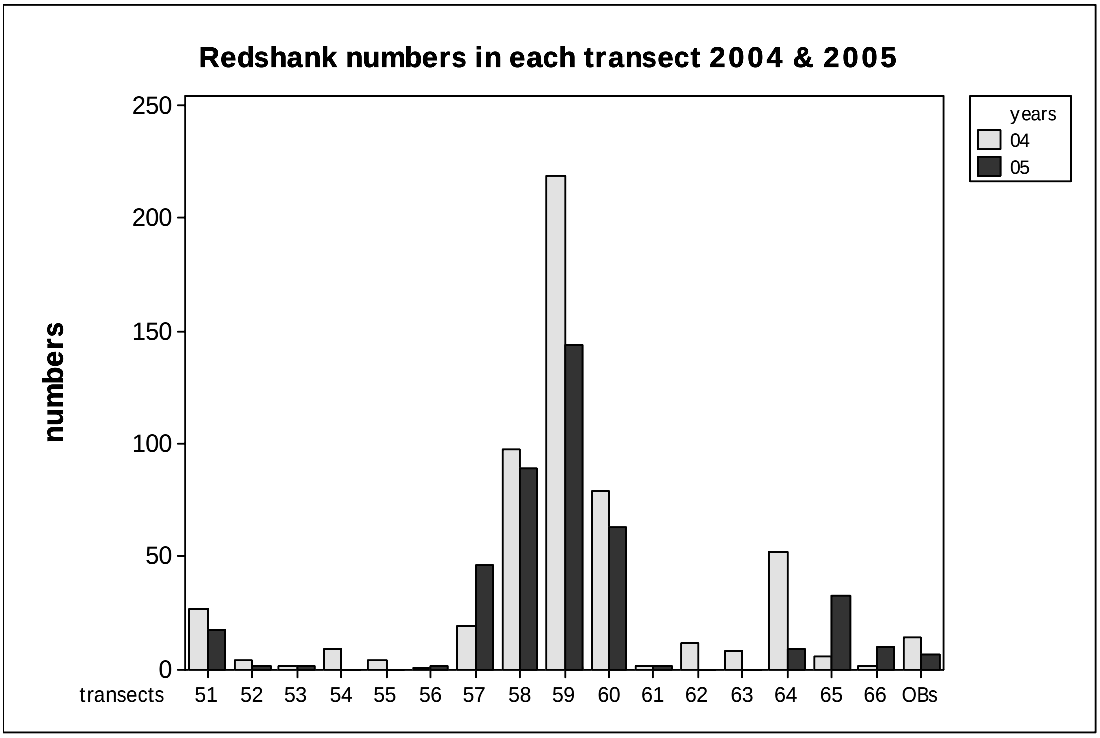
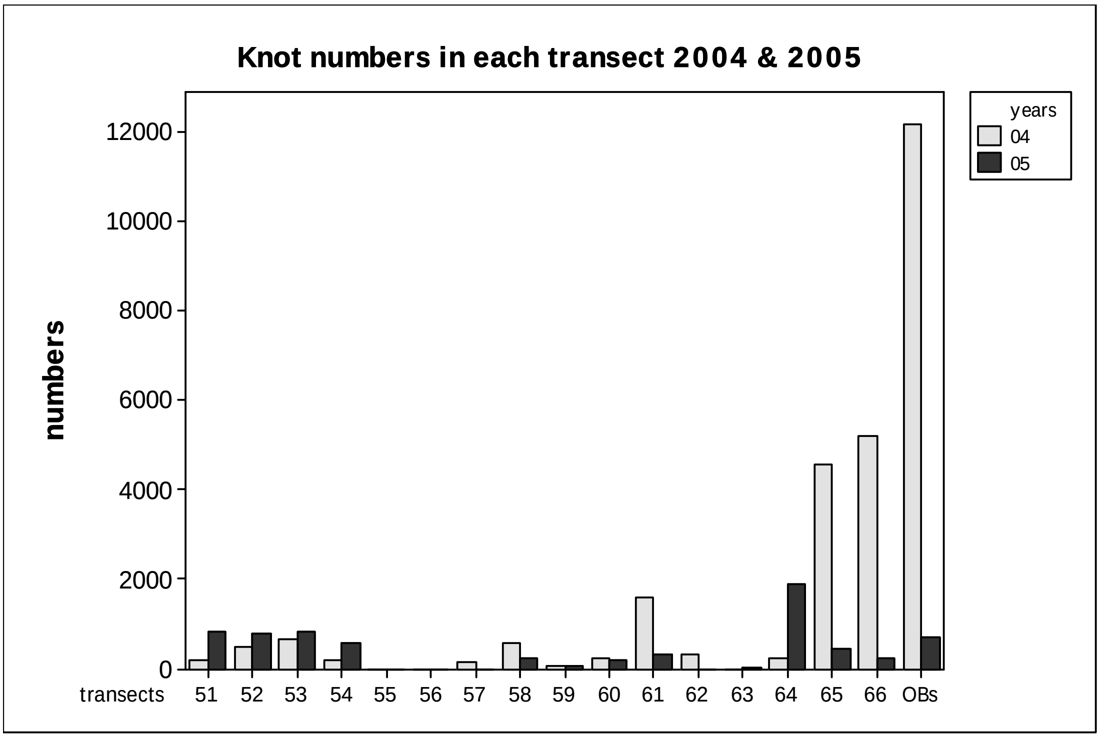


Figure 3.3.2a-h continued

c,



d,

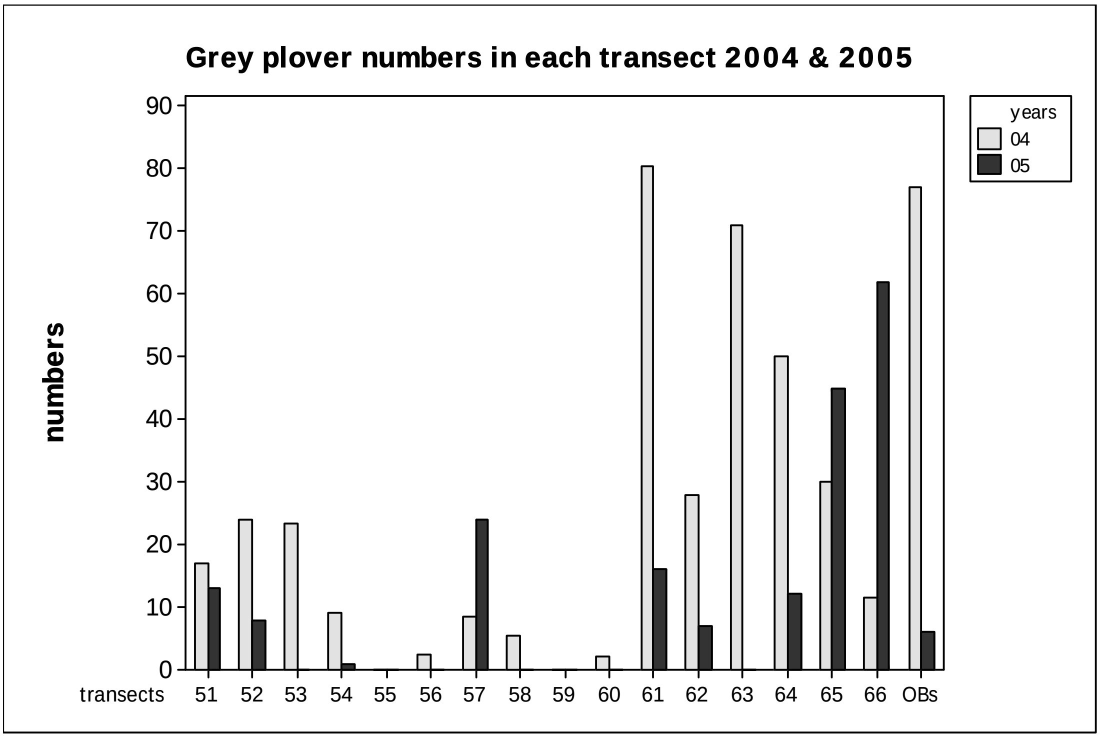
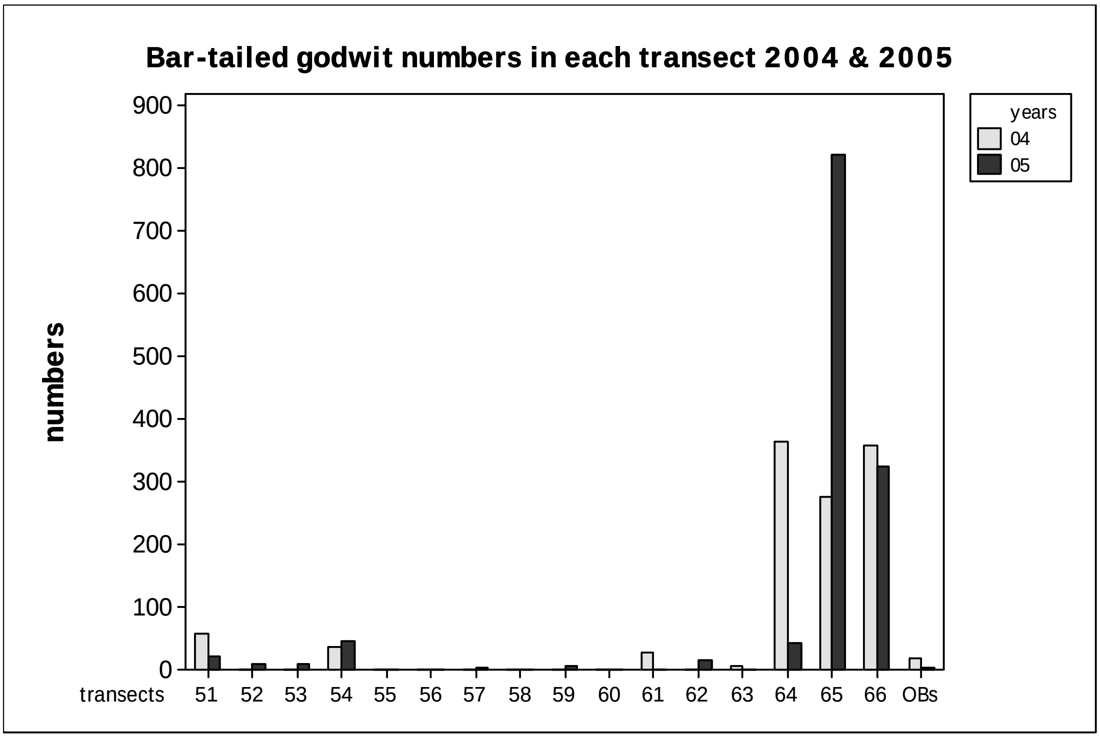


Figure 3.3.2a-h continued

e,



f,

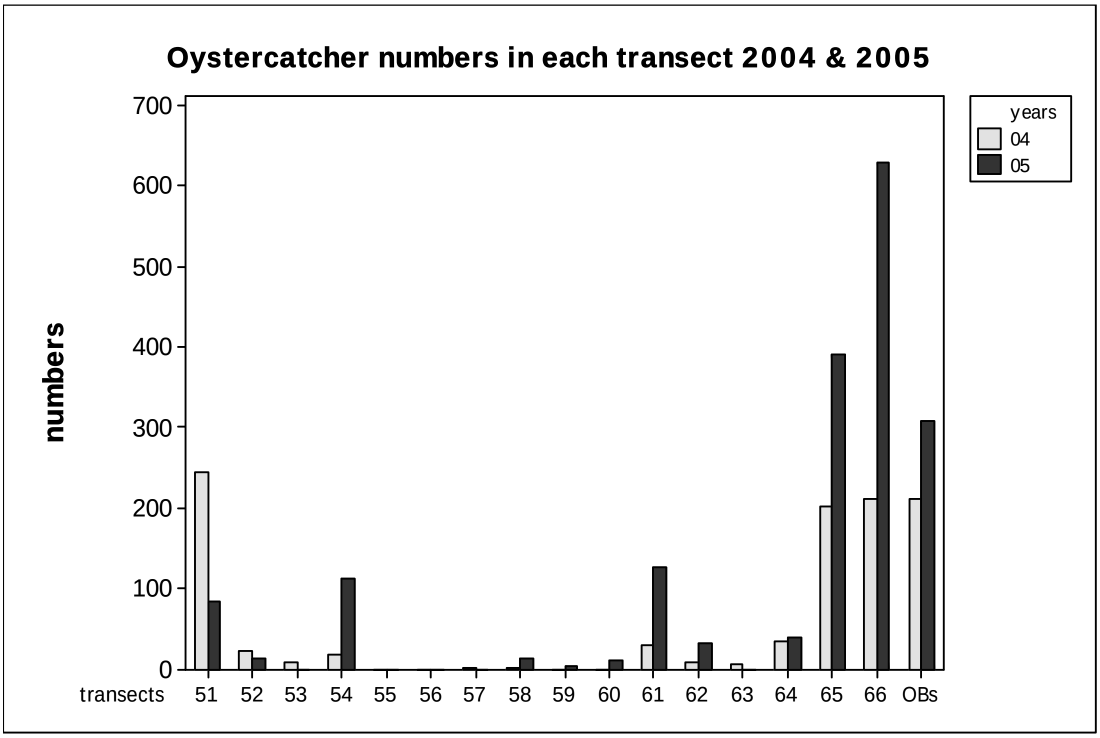
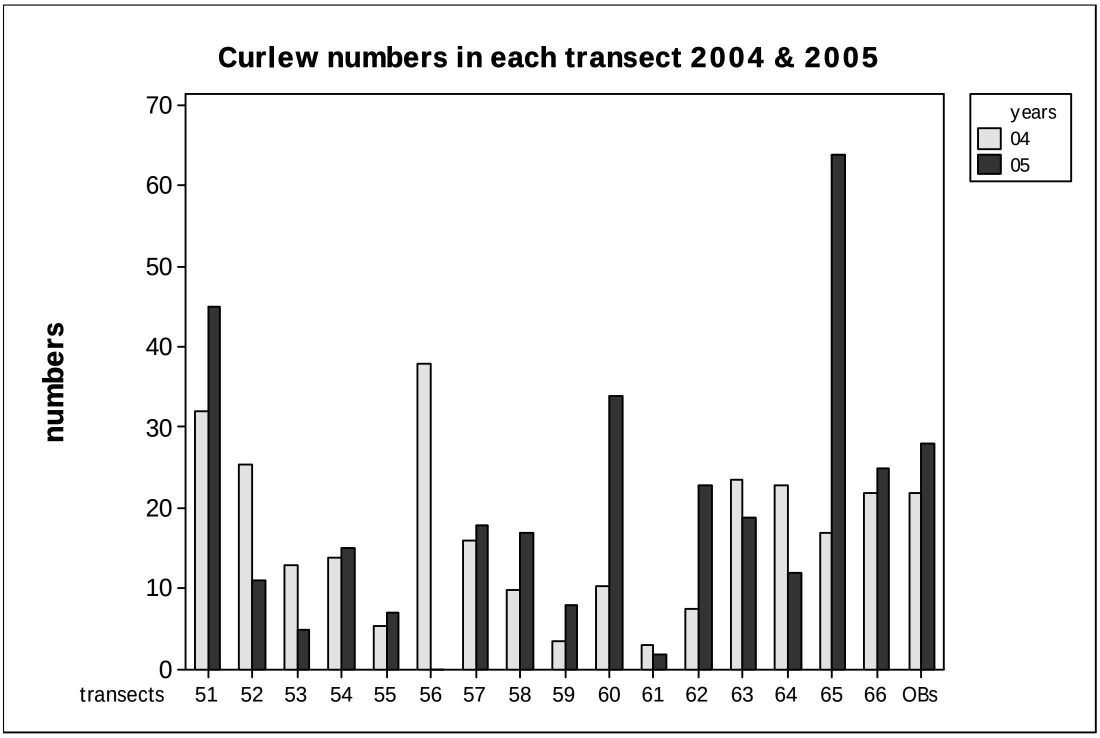


Figure 3.3.2a-h continued

g,



h,

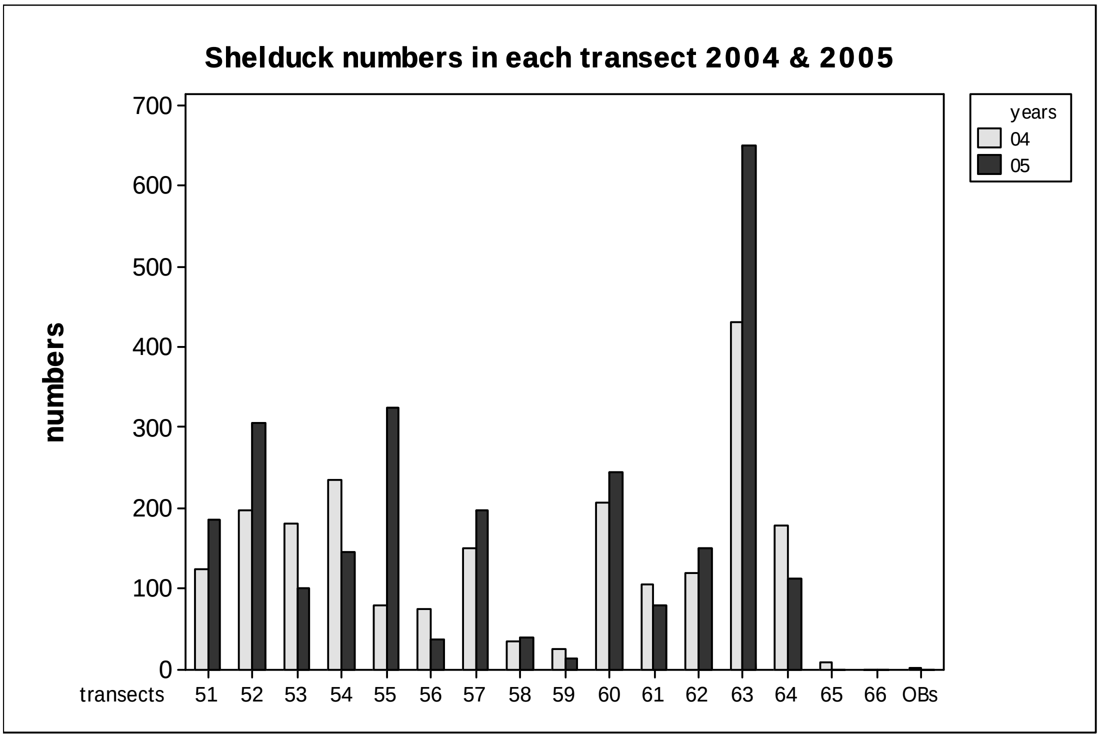
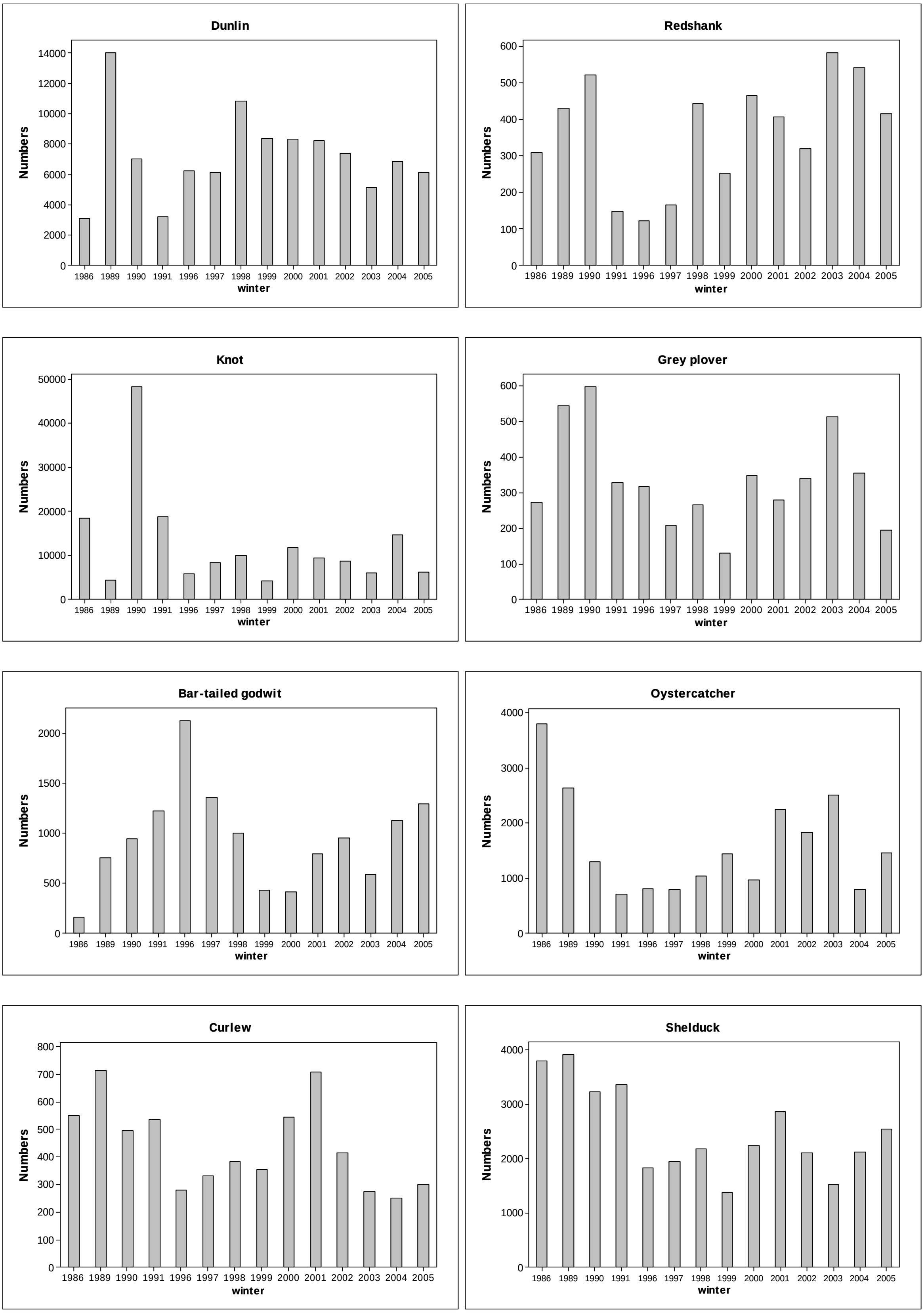


Figure 3.3.3. The total numbers of shorebirds feeding on the inner banks of the Gt Ouse study area in winters 1986-87, 1989-90 to 1991-92 and 1996-97 to 2005-06.



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APPENDICES

Appendix 1

Site location (as Ordnance Survey coordinates), invertebrate densities (numbers/square metre) and the sediment characteristics for each 1ha sample block in the 2005 survey.

Appendix 2
Comparisons between the mean density of invertebrates in the 2004 and 2005 surveys of the Gt Ouse study area.

Appendix 3
Shorebird numbers in each transect during the winter 2004-05 surveys. Column 1 of each table indicates the transect number or area name. Remaining columns give the numbers of dunlin, redshank, knot, grey plover, bar-tailed godwit, oystercatcher, curlew and shelduck recorded in the first and second counts and mean count for the whole survey. 'OB' refers to outer bank areas.

Appendix 1

Site location (as Ordnance Survey coordinates), invertebrate densities (numbers/square metre) and the sediment characteristics for each 1ha sample block in the 2005 survey.

sites	easting	northing	Nemertean indet	Nematode indet	Eteone longa	Anaitides mucosa
16.2	554630	327254	0.0	15.8	0.0	0.0
16.3	554647	327518	0.0	2451.4	63.8	0.0
16.4	554655	327782	0.0	775.0	25.6	0.0
16.6	554682	328299	0.0	12.8	139.8	0.0
16.7	554698	328517	25.4	38.2	228.8	12.8
16.8	554715	328768	12.8	63.6	12.8	0.0
16.9	554722	328949	0.0	114.6	12.8	0.0
17.3	557279	327181	0.0	51.0	216.2	0.0
17.4	557354	327364	0.0	76.4	228.8	0.0
17.6	557501	327737	0.0	89.0	343.2	0.0
17.7	557582	327924	0.0	0.0	63.6	12.8
17.8	557649	328099	0.0	0.0	89.0	0.0
17.9	557741	328309	0.0	0.0	25.4	0.0
18.3	560050	327461	0.0	1359.2	38.4	0.0
18.4	559811	327581	63.8	1409.8	178.0	0.0
18.6	559476	327732	114.4	1460.8	419.4	0.0
18.7	559305	327823	25.4	3569.0	432.2	0.0
18.8	559187	327882	0.0	38.2	127.4	0.0
18.9	559050	328046	0.0	140.0	63.8	0.0
19.3	561530	329206	12.8	1524.4	63.6	0.0
19.4	561330	329390	0.0	114.4	241.6	0.0
19.6	560833	329670	0.0	12.8	165.6	0.0
19.7	560629	329854	0.0	25.4	178.0	0.0
19.8	560482	329974	0.0	330.6	152.6	0.0
19.9	560266	330150	0.0	165.4	114.6	0.0
20.2	563950	330740	0.0	51.0	0.0	0.0
20.3	563450	331050	470.0	10947.6	279.6	0.0
20.4	563090	331350	25.4	25095.2	432.2	0.0
20.5	562650	331750	0.0	76.4	63.8	0.0
20.6	562250	332050	0.0	50.8	25.4	0.0
20.7	561850	332400	12.8	38.2	12.8	0.0
B3	558543	326079	0.0	0.0	0.0	0.0
C2	559156	326812	0.0	584.4	25.4	0.0
C3	559082	326779	0.0	965.6	25.4	0.0
D2	557639	329536	0.0	0.0	38.2	12.8
D3	557427	330087	0.0	0.0	25.6	0.0
D4	557221	330620	0.0	0.0	12.8	0.0
E8	559525	328614	0.0	0.0	101.8	0.0
E9	559392	328907	0.0	152.8	228.8	0.0
P1	558509	329675	25.4	101.8	12.8	0.0
P2	558529	330268	0.0	0.0	0.0	0.0
P3	558591	330779	0.0	0.0	25.6	0.0

Appendix 1 continued. Invertebrate densities (numbers/square metre).

sites	Syllids	Hediste diversicolor <15mm	H diversicolor 16-30mm	H diversicolor >30mm
16.2	0.0	0.0	0.0	0.0
16.3	0.0	25.6	12.8	12.8
16.4	0.0	0.0	0.0	0.0
16.6	0.0	0.0	0.0	0.0
16.7	0.0	12.8	0.0	0.0
16.8	0.0	0.0	0.0	0.0
16.9	0.0	0.0	0.0	0.0
17.3	0.0	25.6	38.4	0.0
17.4	0.0	51.0	25.4	12.8
17.6	0.0	25.6	0.0	0.0
17.7	0.0	0.0	0.0	0.0
17.8	0.0	0.0	0.0	0.0
17.9	0.0	0.0	0.0	0.0
18.3	0.0	76.2	114.6	25.6
18.4	0.0	76.4	127.2	0.0
18.6	0.0	89.2	89.0	0.0
18.7	0.0	0.0	0.0	0.0
18.8	0.0	0.0	0.0	0.0
18.9	0.0	0.0	0.0	0.0
19.3	0.0	0.0	0.0	12.8
19.4	0.0	0.0	12.8	0.0
19.6	0.0	25.6	0.0	0.0
19.7	0.0	0.0	0.0	0.0
19.8	0.0	0.0	0.0	12.8
19.9	0.0	0.0	0.0	0.0
20.2	0.0	0.0	0.0	0.0
20.3	0.0	0.0	25.6	0.0
20.4	0.0	12.8	0.0	0.0
20.5	0.0	0.0	0.0	0.0
20.6	0.0	0.0	0.0	0.0
20.7	0.0	0.0	0.0	0.0
B3	0.0	0.0	0.0	0.0
C2	0.0	0.0	0.0	0.0
C3	0.0	0.0	0.0	0.0
D2	0.0	0.0	0.0	0.0
D3	0.0	0.0	0.0	0.0
D4	0.0	0.0	0.0	0.0
E8	0.0	0.0	0.0	0.0
E9	0.0	0.0	0.0	0.0
P1	0.0	0.0	0.0	0.0
P2	0.0	0.0	0.0	0.0
P3	25.6	0.0	0.0	0.0

Appendix 1 continued. Invertebrate densities (numbers/square metre).

sites	Nephtys cirrosa <15mm	N cirrosa 16-30mm	N cirrosa >30mm	N hombergii <15mm
16.2	0.0	0.0	0	0.0
16.3	0.0	0.0	0	76.4
16.4	0.0	0.0	0	305.0
16.6	0.0	0.0	0	355.8
16.7	0.0	0.0	0	317.8
16.8	0.0	0.0	0	254.2
16.9	0.0	0.0	0	406.8
17.3	0.0	0.0	0	38.2
17.4	0.0	0.0	0	50.8
17.6	0.0	0.0	0	25.6
17.7	0.0	0.0	0	114.4
17.8	0.0	0.0	0	190.8
17.9	0.0	0.0	0	114.6
18.3	0.0	0.0	0	0.0
18.4	0.0	0.0	0	89.2
18.6	0.0	0.0	0	317.6
18.7	0.0	0.0	0	343.0
18.8	0.0	0.0	0	508.2
18.9	0.0	0.0	0	38.2
19.3	0.0	0.0	0	0.0
19.4	0.0	0.0	0	25.6
19.6	0.0	0.0	0	216.2
19.7	0.0	0.0	0	317.8
19.8	0.0	0.0	0	343.0
19.9	0.0	0.0	0	12.8
20.2	0.0	0.0	0	0.0
20.3	0.0	0.0	0	0.0
20.4	0.0	0.0	0	63.8
20.5	0.0	0.0	0	51.0
20.6	0.0	0.0	0	76.4
20.7	25.6	38.4	0	38.2
B3	0.0	0.0	0	12.8
C2	0.0	0.0	0	0.0
C3	0.0	0.0	0	0.0
D2	0.0	0.0	0	127.4
D3	0.0	0.0	0	330.4
D4	0.0	0.0	0	406.8
E8	0.0	0.0	0	431.8
E9	0.0	0.0	0	419.4
P1	0.0	0.0	0	787.6
P2	0.0	63.8	0	12.8
P3	12.8	12.8	0	0.0

Appendix 1 continued. Invertebrate densities (numbers/square metre).

sites	N hombergii 16-30mm	N hombergii >30mm	Nephtys juveniles <15mm
16.2	0.0	0.0	0.0
16.3	38.2	0.0	76.4
16.4	63.6	12.8	305.0
16.6	152.6	101.8	355.8
16.7	114.6	25.4	317.8
16.8	89.2	51.0	254.2
16.9	89.2	12.8	406.8
17.3	0.0	0.0	38.2
17.4	12.8	12.8	50.8
17.6	0.0	0.0	25.6
17.7	63.6	0.0	114.4
17.8	101.8	0.0	190.8
17.9	89.2	25.4	114.6
18.3	0.0	0.0	0.0
18.4	0.0	0.0	89.2
18.6	38.2	12.8	317.6
18.7	101.8	12.8	343.0
18.8	102.0	25.6	508.2
18.9	101.8	12.8	38.2
19.3	0.0	0.0	0.0
19.4	0.0	0.0	25.6
19.6	25.4	0.0	216.2
19.7	63.6	51.0	317.8
19.8	89.0	114.6	343.0
19.9	38.2	12.8	12.8
20.2	0.0	0.0	0.0
20.3	0.0	0.0	0.0
20.4	12.8	0.0	63.8
20.5	50.8	12.8	51.0
20.6	63.6	12.8	76.4
20.7	38.4	12.8	63.8
B3	0.0	0.0	12.8
C2	0.0	0.0	0.0
C3	12.8	0.0	0.0
D2	89.0	0.0	127.4
D3	89.2	12.8	330.4
D4	38.2	12.8	406.8
E8	152.6	12.8	431.8
E9	89.2	0.0	419.4
P1	51.0	0.0	787.6
P2	0.0	0.0	12.8
P3	0.0	25.6	12.8

Appendix 1 continued. Invertebrate densities (numbers/square metre).

sites	Scoloplos armiger <15mm	S armiger 16-30mm	S armiger >30mm	Polydora sp.?ciliata
16.2	0.0	0.0	0.0	0
16.3	0.0	0.0	0.0	0
16.4	0.0	0.0	0.0	0
16.6	0.0	0.0	0.0	0
16.7	0.0	0.0	0.0	0
16.8	0.0	0.0	0.0	0
16.9	0.0	0.0	0.0	0
17.3	0.0	0.0	0.0	0
17.4	0.0	0.0	0.0	0
17.6	0.0	0.0	0.0	0
17.7	12.8	0.0	0.0	0
17.8	12.8	0.0	0.0	0
17.9	25.6	0.0	12.8	0
18.3	0.0	0.0	0.0	0
18.4	0.0	0.0	0.0	0
18.6	0.0	0.0	0.0	0
18.7	0.0	0.0	0.0	0
18.8	0.0	0.0	0.0	0
18.9	0.0	0.0	0.0	0
19.3	0.0	0.0	0.0	0
19.4	0.0	0.0	0.0	0
19.6	0.0	0.0	0.0	0
19.7	0.0	0.0	0.0	0
19.8	12.8	0.0	12.8	0
19.9	0.0	0.0	0.0	0
20.2	0.0	0.0	0.0	0
20.3	0.0	0.0	0.0	0
20.4	0.0	0.0	0.0	0
20.5	38.4	12.8	0.0	0
20.6	76.4	38.2	0.0	0
20.7	89.2	0.0	0.0	0
B3	0.0	0.0	0.0	0
C2	0.0	0.0	0.0	0
C3	0.0	0.0	0.0	0
D2	0.0	0.0	0.0	0
D3	0.0	0.0	0.0	0
D4	12.8	0.0	0.0	0
E8	0.0	0.0	0.0	0
E9	0.0	0.0	0.0	0
P1	0.0	0.0	0.0	0
P2	0.0	0.0	0.0	0
P3	38.2	12.8	0.0	0

Appendix 1 continued. Invertebrate densities (numbers/square metre).

sites	Polydora cornuta	Polydora spp	Pygospio elegans	Scolelepis foliosa
16.2	0	0	0.0	0
16.3	0	0	3708.6	0
16.4	0	0	635.2	0
16.6	0	0	9436.4	0
16.7	0	0	6236.0	0
16.8	0	0	165.2	0
16.9	0	0	2375.2	0
17.3	0	0	381.4	0
17.4	0	0	3226.0	0
17.6	0	0	2108.4	0
17.7	0	0	101.8	0
17.8	0	0	990.8	0
17.9	0	0	4089.6	0
18.3	0	0	0.0	0
18.4	0	0	165.2	0
18.6	0	0	178.0	0
18.7	0	0	1016.2	0
18.8	0	0	3238.8	0
18.9	0	0	305.2	0
19.3	0	0	279.6	0
19.4	0	0	355.8	0
19.6	0	0	394.0	0
19.7	0	0	1917.8	0
19.8	0	0	1143.4	0
19.9	0	0	381.4	0
20.2	0	0	12.8	0
20.3	0	0	305.0	0
20.4	0	0	394.0	0
20.5	0	0	178.0	0
20.6	0	0	152.6	0
20.7	0	0	89.2	0
B3	0	0	89.0	0
C2	0	0	76.4	0
C3	0	0	2095.8	0
D2	0	0	762.4	0
D3	0	0	470.0	0
D4	0	0	152.4	0
E8	0	0	876.8	0
E9	0	0	4546.8	0
P1	0	0	2273.6	0
P2	0	0	12.8	0
P3	0	0	12.8	0

Appendix 1 continued. Invertebrate densities (numbers/square metre).

sites	Spio martinensis	Spiophanes bombyx	Magelona mirabilis	Tharyx A
16.2	0.0	0.0	0.0	0.0
16.3	0.0	0.0	0.0	127.0
16.4	0.0	12.8	0.0	152.8
16.6	0.0	0.0	0.0	1155.8
16.7	0.0	0.0	0.0	7188.4
16.8	0.0	0.0	0.0	4915.2
16.9	0.0	12.8	0.0	2514.8
17.3	0.0	12.8	0.0	12.8
17.4	0.0	0.0	0.0	12.8
17.6	0.0	0.0	0.0	0.0
17.7	546.4	0.0	0.0	101.8
17.8	25.6	0.0	0.0	965.2
17.9	25.4	0.0	0.0	2159.2
18.3	0.0	0.0	0.0	0.0
18.4	0.0	0.0	0.0	0.0
18.6	0.0	0.0	0.0	25.6
18.7	0.0	0.0	0.0	89.0
18.8	0.0	0.0	0.0	1499.0
18.9	0.0	0.0	0.0	178.2
19.3	0.0	0.0	0.0	0.0
19.4	0.0	0.0	0.0	0.0
19.6	38.2	0.0	0.0	12.8
19.7	0.0	0.0	0.0	254.4
19.8	0.0	0.0	0.0	305.0
19.9	0.0	0.0	0.0	826.0
20.2	0.0	0.0	0.0	0.0
20.3	0.0	0.0	0.0	0.0
20.4	0.0	0.0	0.0	0.0
20.5	241.6	0.0	0.0	0.0
20.6	711.4	0.0	0.0	190.8
20.7	470.2	0.0	0.0	267.0
B3	0.0	0.0	0.0	0.0
C2	0.0	0.0	0.0	0.0
C3	0.0	0.0	0.0	0.0
D2	432.2	0.0	0.0	76.4
D3	114.8	0.0	0.0	12.8
D4	89.0	0.0	0.0	76.2
E8	0.0	0.0	0.0	546.4
E9	0.0	0.0	0.0	1168.6
P1	0.0	0.0	0.0	559.0
P2	51.0	0.0	0.0	0.0
P3	63.6	12.8	12.8	12.8

Appendix 1 continued. Invertebrate densities (numbers/square metre).

sites	Capitella capitata / sp.indet.	Heteromastus filiformis	Arenicola marina casts	Ampharete grubei
16.2	0.0	0.0	0.0	0
16.3	0.0	0.0	0.0	0
16.4	0.0	0.0	0.0	0
16.6	241.4	0.0	0.0	0
16.7	635.2	12.8	0.0	0
16.8	63.8	0.0	0.0	0
16.9	0.0	0.0	0.0	0
17.3	12.8	0.0	0.0	0
17.4	25.4	0.0	0.0	0
17.6	101.8	0.0	0.0	0
17.7	76.2	0.0	0.0	0
17.8	190.6	0.0	0.0	0
17.9	114.4	0.0	0.2	0
18.3	0.0	0.0	0.0	0
18.4	38.2	0.0	0.0	0
18.6	25.6	0.0	0.0	0
18.7	76.4	0.0	0.0	0
18.8	165.2	0.0	0.0	0
18.9	12.8	0.0	0.0	0
19.3	12.8	0.0	0.0	0
19.4	12.8	0.0	0.2	0
19.6	0.0	0.0	0.4	0
19.7	25.4	0.0	0.4	0
19.8	12.8	0.0	0.2	0
19.9	25.4	0.0	0.0	0
20.2	0.0	0.0	0.0	0
20.3	0.0	0.0	0.0	0
20.4	0.0	0.0	9.0	0
20.5	0.0	0.0	2.2	0
20.6	0.0	0.0	3.6	0
20.7	50.8	0.0	3.2	0
B3	0.0	0.0	0.0	0
C2	0.0	0.0	0.0	0
C3	0.0	0.0	0.0	0
D2	12.8	0.0	0.4	0
D3	38.2	0.0	1.6	0
D4	0.0	0.0	1.8	0
E8	89.0	0.0	0.0	0
E9	0.0	0.0	0.0	0
P1	0.0	0.0	0.0	0
P2	0.0	0.0	1.0	0
P3	0.0	0.0	1.2	0

Appendix 1 continued. Invertebrate densities (numbers/square metre).

sites	Manayunkia aestuarina	Heterochaeta costata	?Tubificoides benedii	Enchytraeidae
16.2	0	0	13.2	40.6
16.3	0	0	2756.2	254.0
16.4	0	0	1028.8	139.8
16.6	0	0	11798.4	25.6
16.7	0	0	7074.2	0.0
16.8	0	0	3378.4	0.0
16.9	0	0	1905.2	0.0
17.3	0	0	17043.6	0.0
17.4	0	0	11150.6	0.0
17.6	0	0	241.4	0.0
17.7	0	0	127.0	0.0
17.8	0	0	876.6	0.0
17.9	0	0	203.4	0.0
18.3	0	0	1359.2	0.0
18.4	0	0	5156.4	0.0
18.6	0	0	6274.0	0.0
18.7	0	0	1308.4	0.0
18.8	0	0	2464.2	0.0
18.9	0	0	1943.4	0.0
19.3	0	0	0.0	0.0
19.4	0	0	1511.6	0.0
19.6	0	0	190.6	0.0
19.7	0	0	368.6	0.0
19.8	0	0	139.8	0.0
19.9	0	0	482.8	0.0
20.2	0	0	0.0	12.8
20.3	0	0	470.0	3416.4
20.4	0	0	152.6	0.0
20.5	0	0	38.4	0.0
20.6	0	0	12.8	25.6
20.7	0	0	0.0	0.0
B3	0	0	4318.0	0.0
C2	0	0	2159.0	0.0
C3	0	0	12065.2	0.0
D2	0	0	25.4	0.0
D3	0	0	0.0	0.0
D4	0	0	0.0	0.0
E8	0	0	165.4	25.4
E9	0	0	787.8	0.0
P1	0	0	38.4	0.0
P2	0	0	0.0	25.6
P3	0	0	0.0	12.8

Appendix 1 continued. Invertebrate densities (numbers/square metre).

sites	Oligochaet/Tubificoides	Anoplodactylus petiolatus	Elminius modestus	Copepod indet
16.2	53.8	0	0.0	0.0
16.3	3010.2	0	0.0	0.0
16.4	1168.6	0	0.0	0.0
16.6	11824.0	0	0.0	0.0
16.7	7074.2	0	38.2	0.0
16.8	3378.4	0	0.0	0.0
16.9	1905.2	0	0.0	0.0
17.3	17043.6	0	0.0	0.0
17.4	11150.6	0	0.0	0.0
17.6	241.4	0	0.0	0.0
17.7	127.0	0	0.0	0.0
17.8	876.6	0	0.0	0.0
17.9	203.4	0	0.0	0.0
18.3	1359.2	0	0.0	0.0
18.4	5156.4	0	0.0	0.0
18.6	6274.0	0	0.0	0.0
18.7	1308.4	0	0.0	0.0
18.8	2464.2	0	0.0	0.0
18.9	1943.4	0	0.0	0.0
19.3	0.0	0	0.0	0.0
19.4	1511.6	0	0.0	0.0
19.6	190.6	0	0.0	0.0
19.7	368.6	0	0.0	0.0
19.8	139.8	0	0.0	0.0
19.9	482.8	0	0.0	0.0
20.2	12.8	0	0.0	0.0
20.3	3886.4	0	0.0	0.0
20.4	152.6	0	0.0	0.0
20.5	38.4	0	0.0	0.0
20.6	38.4	0	0.0	0.0
20.7	0.0	0	0.0	25.6
B3	4318.0	0	0.0	0.0
C2	2159.0	0	0.0	0.0
C3	12065.2	0	0.0	0.0
D2	25.4	0	0.0	0.0
D3	0.0	0	0.0	0.0
D4	0.0	0	12.8	0.0
E8	190.8	0	0.0	0.0
E9	787.8	0	0.0	0.0
P1	38.4	0	0.0	0.0
P2	25.6	0	0.0	0.0
P3	12.8	0	0.0	0.0

Appendix 1 continued. Invertebrate densities (numbers/square metre).

sites	Urothoe poseidonis 0-3mm	U poseidonis >3mm	Bathyporeia pilosa 0-3mm
16.2	0.0	0.0	0
16.3	0.0	0.0	0
16.4	0.0	0.0	0
16.6	0.0	0.0	0
16.7	0.0	0.0	0
16.8	0.0	0.0	0
16.9	0.0	0.0	0
17.3	0.0	0.0	0
17.4	0.0	0.0	0
17.6	0.0	0.0	0
17.7	0.0	0.0	0
17.8	0.0	0.0	0
17.9	0.0	0.0	0
18.3	0.0	0.0	0
18.4	0.0	0.0	0
18.6	0.0	0.0	0
18.7	0.0	0.0	0
18.8	0.0	0.0	0
18.9	0.0	0.0	0
19.3	0.0	0.0	0
19.4	0.0	0.0	0
19.6	0.0	0.0	0
19.7	0.0	0.0	0
19.8	0.0	0.0	0
19.9	0.0	0.0	0
20.2	0.0	0.0	0
20.3	0.0	0.0	0
20.4	0.0	0.0	0
20.5	12.8	12.8	0
20.6	0.0	0.0	0
20.7	38.4	0.0	0
B3	0.0	0.0	0
C2	0.0	0.0	0
C3	0.0	0.0	0
D2	0.0	0.0	0
D3	0.0	0.0	0
D4	0.0	0.0	0
E8	0.0	0.0	0
E9	0.0	0.0	0
P1	0.0	0.0	0
P2	63.6	0.0	0
P3	0.0	0.0	0

Appendix 1 continued. Invertebrate densities (numbers/square metre).

sites	B pilosa >3mm	B sarsi 0-3mm	B sarsi >3mm	Corophium volutator 0-3mm
16.2	0	0.0	0.0	0.0
16.3	0	0.0	0.0	0.0
16.4	0	0.0	0.0	0.0
16.6	0	0.0	0.0	0.0
16.7	0	0.0	0.0	0.0
16.8	0	0.0	0.0	0.0
16.9	0	0.0	0.0	12.8
17.3	0	0.0	0.0	0.0
17.4	0	0.0	0.0	0.0
17.6	0	0.0	0.0	0.0
17.7	0	63.6	0.0	0.0
17.8	0	0.0	0.0	0.0
17.9	0	0.0	0.0	12.8
18.3	0	0.0	0.0	15253.0
18.4	0	0.0	0.0	18732.6
18.6	0	0.0	0.0	9347.4
18.7	0	0.0	0.0	12967.0
18.8	0	0.0	0.0	152.8
18.9	0	0.0	0.0	3302.4
19.3	0	0.0	0.0	5512.2
19.4	0	0.0	0.0	89.2
19.6	0	0.0	0.0	1029.0
19.7	0	0.0	0.0	114.6
19.8	0	0.0	0.0	1257.4
19.9	0	0.0	0.0	2248.0
20.2	0	0.0	0.0	51.0
20.3	0	0.0	0.0	4305.4
20.4	0	0.0	0.0	1727.4
20.5	0	139.8	127.2	63.6
20.6	0	38.4	25.4	0.0
20.7	0	38.2	51.0	0.0
B3	0	0.0	0.0	0.0
C2	0	0.0	0.0	521.0
C3	0	0.0	0.0	76.2
D2	0	0.0	0.0	0.0
D3	0	0.0	0.0	0.0
D4	0	0.0	0.0	0.0
E8	0	0.0	0.0	63.8
E9	0	0.0	0.0	25.6
P1	0	0.0	0.0	0.0
P2	0	38.2	12.8	0.0
P3	0	0.0	0.0	0.0

Appendix 1 continued. Invertebrate densities (numbers/square metre).

sites	C volutator >3mm	Cyathura carinata	Idotea linearis	Tanaissus lilljeborgi
16.2	0.0	0.0	0	0.0
16.3	0.0	0.0	0	0.0
16.4	0.0	0.0	0	0.0
16.6	0.0	0.0	0	0.0
16.7	0.0	0.0	0	0.0
16.8	0.0	0.0	0	0.0
16.9	0.0	0.0	0	0.0
17.3	0.0	0.0	0	0.0
17.4	0.0	0.0	0	0.0
17.6	0.0	0.0	0	0.0
17.7	0.0	0.0	0	0.0
17.8	0.0	0.0	0	0.0
17.9	12.8	0.0	0	0.0
18.3	914.8	0.0	0	0.0
18.4	2896.0	0.0	0	0.0
18.6	1549.6	0.0	0	0.0
18.7	2197.2	25.6	0	0.0
18.8	12.8	0.0	0	0.0
18.9	609.8	0.0	0	0.0
19.3	292.2	0.0	0	0.0
19.4	25.6	76.2	0	0.0
19.6	241.4	152.6	0	0.0
19.7	51.0	292.2	0	0.0
19.8	533.6	165.4	0	0.0
19.9	787.6	12.8	0	0.0
20.2	0.0	0.0	0	0.0
20.3	76.4	0.0	0	0.0
20.4	76.4	12.8	0	0.0
20.5	0.0	0.0	0	25.4
20.6	0.0	0.0	0	0.0
20.7	0.0	0.0	0	38.4
B3	0.0	0.0	0	0.0
C2	216.0	0.0	0	0.0
C3	0.0	0.0	0	0.0
D2	0.0	0.0	0	0.0
D3	0.0	0.0	0	0.0
D4	0.0	0.0	0	0.0
E8	25.6	0.0	0	0.0
E9	0.0	0.0	0	0.0
P1	0.0	0.0	0	0.0
P2	0.0	0.0	0	508.2
P3	0.0	0.0	0	152.8

Appendix 1 continued. Invertebrate densities (numbers/square metre).

sites	Cumacean indet.	Bodotria arenosa	Cumopsis goodsiri	All Cumaceans
16.2	0.0	0.0	0.0	0.0
16.3	0.0	0.0	0.0	0.0
16.4	0.0	0.0	0.0	0.0
16.6	0.0	0.0	0.0	0.0
16.7	0.0	0.0	0.0	0.0
16.8	0.0	0.0	0.0	0.0
16.9	0.0	0.0	0.0	0.0
17.3	0.0	0.0	0.0	0.0
17.4	0.0	0.0	0.0	0.0
17.6	0.0	0.0	0.0	0.0
17.7	0.0	0.0	0.0	0.0
17.8	0.0	0.0	0.0	0.0
17.9	0.0	0.0	0.0	0.0
18.3	0.0	0.0	0.0	0.0
18.4	0.0	0.0	0.0	0.0
18.6	0.0	0.0	0.0	0.0
18.7	0.0	0.0	0.0	0.0
18.8	0.0	0.0	0.0	0.0
18.9	0.0	0.0	0.0	0.0
19.3	0.0	0.0	0.0	0.0
19.4	0.0	0.0	0.0	0.0
19.6	0.0	0.0	0.0	0.0
19.7	0.0	0.0	0.0	0.0
19.8	0.0	0.0	0.0	0.0
19.9	0.0	0.0	0.0	0.0
20.2	0.0	0.0	0.0	0.0
20.3	0.0	0.0	0.0	0.0
20.4	12.8	0.0	0.0	12.8
20.5	12.8	0.0	0.0	12.8
20.6	63.6	0.0	0.0	63.6
20.7	229.0	0.0	0.0	229.0
B3	0.0	0.0	0.0	0.0
C2	0.0	0.0	0.0	0.0
C3	0.0	0.0	0.0	0.0
D2	0.0	12.8	12.8	25.6
D3	12.8	0.0	0.0	12.8
D4	0.0	12.8	0.0	12.8
E8	0.0	0.0	0.0	0.0
E9	0.0	0.0	0.0	0.0
P1	0.0	0.0	0.0	0.0
P2	12.8	38.2	0.0	51.0
P3	0.0	25.6	0.0	25.6

Appendix 1 continued. Invertebrate densities (numbers/square metre).

sites	Crangon crangon	Liocarcinus arcuatus	Isotoma maritima	Anurida maritima
16.2	0.0	0.0	0	0.0
16.3	25.6	0.0	0	0.0
16.4	0.0	0.0	0	0.0
16.6	0.0	0.0	0	0.0
16.7	0.0	0.0	0	0.0
16.8	25.4	12.8	0	0.0
16.9	0.0	0.0	0	0.0
17.3	0.0	0.0	0	0.0
17.4	25.4	12.8	0	0.0
17.6	0.0	0.0	0	0.0
17.7	12.8	0.0	0	0.0
17.8	0.0	0.0	0	0.0
17.9	0.0	0.0	0	0.0
18.3	0.0	0.0	0	0.0
18.4	12.8	0.0	0	0.0
18.6	0.0	0.0	0	0.0
18.7	0.0	0.0	0	0.0
18.8	0.0	0.0	0	0.0
18.9	0.0	0.0	0	0.0
19.3	12.8	0.0	0	0.0
19.4	0.0	0.0	0	0.0
19.6	0.0	0.0	0	0.0
19.7	12.8	0.0	0	0.0
19.8	0.0	0.0	0	0.0
19.9	0.0	0.0	0	0.0
20.2	0.0	0.0	0	0.0
20.3	0.0	0.0	0	25.4
20.4	12.8	0.0	0	0.0
20.5	0.0	0.0	0	0.0
20.6	0.0	0.0	0	0.0
20.7	12.8	0.0	0	0.0
B3	12.8	0.0	0	0.0
C2	0.0	0.0	0	0.0
C3	0.0	0.0	0	0.0
D2	0.0	0.0	0	0.0
D3	0.0	0.0	0	0.0
D4	51.0	0.0	0	0.0
E8	25.6	0.0	0	0.0
E9	0.0	0.0	0	0.0
P1	0.0	0.0	0	0.0
P2	0.0	0.0	0	0.0
P3	0.0	0.0	0	0.0

Appendix 1 continued. Invertebrate densities (numbers/square metre).

sites	?Hydrophorus oceanus larvae	FW larva	Diptera adult indet.
16.2	26.8	0	0.0
16.3	76.4	0	0.0
16.4	12.8	0	0.0
16.6	12.8	0	0.0
16.7	0.0	0	0.0
16.8	0.0	0	0.0
16.9	0.0	0	0.0
17.3	76.6	0	0.0
17.4	114.4	0	0.0
17.6	12.8	0	0.0
17.7	0.0	0	0.0
17.8	0.0	0	12.8
17.9	0.0	0	0.0
18.3	50.8	0	0.0
18.4	0.0	0	0.0
18.6	0.0	0	0.0
18.7	0.0	0	0.0
18.8	0.0	0	0.0
18.9	0.0	0	0.0
19.3	0.0	0	0.0
19.4	0.0	0	0.0
19.6	0.0	0	12.8
19.7	0.0	0	0.0
19.8	0.0	0	0.0
19.9	0.0	0	0.0
20.2	76.4	0	0.0
20.3	63.6	0	0.0
20.4	0.0	0	0.0
20.5	0.0	0	0.0
20.6	0.0	0	0.0
20.7	0.0	0	0.0
B3	51.0	0	0.0
C2	178.2	0	0.0
C3	50.8	0	0.0
D2	0.0	0	0.0
D3	0.0	0	0.0
D4	0.0	0	0.0
E8	25.4	0	0.0
E9	0.0	0	0.0
P1	0.0	0	0.0
P2	0.0	0	0.0
P3	0.0	0	0.0

Appendix 1 continued. Invertebrate densities (numbers/square metre).

sites	Hydrobia ulvae <3mm	H ulvae >3mm	Retusa obtusa <3mm	R obtusa >3mm
16.2	13	25.4	0.0	0.0
16.3	2997	4470.6	330.4	50.8
16.4	4229	3696.0	698.8	736.6
16.6	3848	3175.2	343.0	190.6
16.7	2159	2629.4	686.0	38.2
16.8	13246	838.6	152.6	139.8
16.9	9144	25.6	0.0	0.0
17.3	8750	1257.6	51.0	89.0
17.4	29108	1702.0	12.8	12.8
17.6	72923	444.8	0.0	0.0
17.7	13373	165.2	0.0	12.8
17.8	17514	0.0	0.0	0.0
17.9	1727	0.0	0.0	0.0
18.3	2121	0.0	0.0	0.0
18.4	4763	12.8	0.0	0.0
18.6	17018	0.0	0.0	0.0
18.7	12611	0.0	0.0	0.0
18.8	9919	0.0	0.0	0.0
18.9	1435	0.0	0.0	0.0
19.3	32626	0.0	0.0	0.0
19.4	51435	0.0	0.0	0.0
19.6	34036	0.0	0.0	0.0
19.7	25730	0.0	0.0	0.0
19.8	2401	0.0	0.0	0.0
19.9	927	0.0	0.0	0.0
20.2	89	0.0	0.0	0.0
20.3	22454	63.6	0.0	0.0
20.4	57734	63.6	0.0	0.0
20.5	53721	38.2	0.0	0.0
20.6	115926	12.8	0.0	0.0
20.7	11900	12.8	0.0	0.0
B3	2502	203.2	0.0	0.0
C2	102	0.0	0.0	0.0
C3	178	0.0	0.0	0.0
D2	5664	0.0	0.0	0.0
D3	34696	0.0	0.0	0.0
D4	88697	38.2	0.0	0.0
E8	35763	12.8	0.0	0.0
E9	12459	12.8	0.0	0.0
P1	26822	0.0	0.0	0.0
P2	242	12.8	0.0	0.0
P3	64	0.0	0.0	0.0

Appendix 1 continued. Invertebrate densities (numbers/square metre).

sites	Mytilus edulis <5mm	Mysella bidentata <5mm	M bidentata 6-10mm
16.2	0.0	0.0	0.0
16.3	12.8	12.8	0.0
16.4	0.0	76.4	63.6
16.6	0.0	0.0	0.0
16.7	25.6	12.8	0.0
16.8	38.2	12.8	0.0
16.9	38.4	12.8	0.0
17.3	0.0	0.0	0.0
17.4	0.0	0.0	0.0
17.6	0.0	0.0	0.0
17.7	0.0	25.4	0.0
17.8	0.0	0.0	0.0
17.9	0.0	0.0	0.0
18.3	0.0	0.0	0.0
18.4	0.0	0.0	0.0
18.6	0.0	0.0	0.0
18.7	0.0	0.0	0.0
18.8	0.0	0.0	0.0
18.9	0.0	0.0	0.0
19.3	0.0	0.0	0.0
19.4	0.0	0.0	0.0
19.6	0.0	0.0	0.0
19.7	25.4	0.0	0.0
19.8	0.0	25.4	0.0
19.9	12.8	0.0	0.0
20.2	0.0	0.0	0.0
20.3	0.0	0.0	0.0
20.4	0.0	0.0	0.0
20.5	0.0	0.0	0.0
20.6	0.0	0.0	0.0
20.7	0.0	0.0	0.0
B3	0.0	0.0	0.0
C2	0.0	0.0	0.0
C3	0.0	0.0	0.0
D2	0.0	0.0	0.0
D3	12.8	0.0	0.0
D4	0.0	0.0	0.0
E8	0.0	0.0	0.0
E9	51.0	0.0	0.0
P1	0.0	0.0	0.0
P2	0.0	0.0	0.0
P3	0.0	0.0	0.0

Appendix 1 continued. Invertebrate densities (numbers/square metre).

sites	Cerastoderma edule <5mm	C edule 6-10mm	C edule 11-15mm	C edule 16-20mm
16.2	0.0	0.0	0.0	0.0
16.3	38.2	50.8	25.4	0.0
16.4	114.4	12.8	76.4	0.0
16.6	495.4	838.4	216.0	0.0
16.7	724.2	4610.4	267.2	0.0
16.8	673.2	3632.6	1016.0	51.0
16.9	0.0	76.4	0.0	0.0
17.3	0.0	12.8	0.0	0.0
17.4	89.2	0.0	0.0	0.0
17.6	419.4	178.0	0.0	0.0
17.7	25.6	25.4	0.0	0.0
17.8	51.0	0.0	0.0	0.0
17.9	12.8	0.0	0.0	0.0
18.3	0.0	0.0	0.0	0.0
18.4	0.0	0.0	0.0	0.0
18.6	0.0	0.0	0.0	0.0
18.7	12.8	0.0	0.0	0.0
18.8	50.8	0.0	0.0	0.0
18.9	12.8	0.0	0.0	0.0
19.3	0.0	0.0	0.0	0.0
19.4	0.0	0.0	0.0	0.0
19.6	63.8	305.0	25.4	0.0
19.7	51.0	25.6	0.0	0.0
19.8	38.2	12.8	0.0	12.8
19.9	0.0	0.0	0.0	0.0
20.2	0.0	0.0	0.0	0.0
20.3	0.0	0.0	0.0	0.0
20.4	0.0	12.8	0.0	0.0
20.5	0.0	0.0	0.0	0.0
20.6	114.6	25.4	0.0	0.0
20.7	0.0	0.0	0.0	0.0
B3	0.0	0.0	0.0	0.0
C2	0.0	0.0	0.0	0.0
C3	0.0	0.0	0.0	0.0
D2	0.0	12.8	0.0	12.8
D3	0.0	12.8	0.0	0.0
D4	25.6	51.0	152.6	254.2
E8	0.0	12.8	0.0	0.0
E9	0.0	0.0	0.0	0.0
P1	76.4	0.0	0.0	0.0
P2	0.0	0.0	0.0	0.0
P3	0.0	0.0	0.0	0.0

Appendix 1 continued. Invertebrate densities (numbers/square metre).

sites	C edule 11-20mm	C edule 21-25mm	C edule 26-30mm	C edule 20-30mm
16.2	0.0	0.0	0	0
16.3	25.4	0.0	0	0
16.4	76.4	0.0	0	0
16.6	216.0	0.0	0	0
16.7	267.2	0.0	0	0
16.8	1067.0	0.0	0	0
16.9	0.0	0.0	0	0
17.3	0.0	0.0	0	0
17.4	0.0	0.0	0	0
17.6	0.0	0.0	0	0
17.7	0.0	0.0	0	0
17.8	0.0	0.0	0	0
17.9	0.0	0.0	0	0
18.3	0.0	0.0	0	0
18.4	0.0	0.0	0	0
18.6	0.0	0.0	0	0
18.7	0.0	0.0	0	0
18.8	0.0	0.0	0	0
18.9	0.0	0.0	0	0
19.3	0.0	0.0	0	0
19.4	0.0	0.0	0	0
19.6	25.4	0.0	0	0
19.7	0.0	0.0	0	0
19.8	12.8	0.0	0	0
19.9	0.0	0.0	0	0
20.2	0.0	0.0	0	0
20.3	0.0	0.0	0	0
20.4	0.0	0.0	0	0
20.5	0.0	0.0	0	0
20.6	0.0	0.0	0	0
20.7	0.0	0.0	0	0
B3	0.0	0.0	0	0
C2	0.0	0.0	0	0
C3	0.0	0.0	0	0
D2	12.8	12.8	0	0
D3	0.0	0.0	0	0
D4	406.6	12.8	0	0
E8	0.0	0.0	0	0
E9	0.0	0.0	0	0
P1	0.0	0.0	0	0
P2	0.0	0.0	0	0
P3	0.0	0.0	0	0

Appendix 1 continued. Invertebrate densities (numbers/square metre).

sites	Macoma balthica <5mm	M balthica 6-10mm	M balthica 11-15mm	M balthica 16-20mm
16.2	0.0	0.0	0.0	0
16.3	305.0	127.0	25.4	0
16.4	63.8	432.0	127.2	0
16.6	927.2	216.2	0.0	0
16.7	1359.2	267.2	0.0	0
16.8	368.4	216.2	0.0	0
16.9	203.4	12.8	0.0	0
17.3	762.2	381.4	51.0	0
17.4	330.4	177.8	25.6	0
17.6	165.4	127.0	12.8	0
17.7	38.2	152.8	0.0	0
17.8	76.4	165.4	0.0	0
17.9	51.0	89.0	25.6	0
18.3	25.6	101.8	12.8	0
18.4	38.2	381.0	76.2	0
18.6	787.8	267.0	50.8	0
18.7	1105.2	152.4	0.0	0
18.8	2591.2	89.0	0.0	0
18.9	584.6	0.0	0.0	0
19.3	63.8	127.4	12.8	0
19.4	127.2	216.2	12.8	0
19.6	114.4	127.2	0.0	0
19.7	203.4	762.4	25.6	0
19.8	355.8	229.0	12.8	0
19.9	216.2	38.4	0.0	0
20.2	0.0	0.0	0.0	0
20.3	25.6	0.0	0.0	0
20.4	317.6	190.8	25.6	0
20.5	0.0	114.4	0.0	0
20.6	0.0	89.0	0.0	0
20.7	0.0	102.0	25.6	0
B3	25.4	0.0	25.4	0
C2	0.0	0.0	0.0	0
C3	127.2	0.0	0.0	0
D2	0.0	25.6	0.0	0
D3	140.0	12.8	0.0	0
D4	114.6	165.2	25.6	0
E8	229.0	292.6	12.8	0
E9	406.6	152.8	12.8	0
P1	1397.2	38.2	12.8	0
P2	12.8	0.0	0.0	0
P3	0.0	0.0	0.0	0

Appendix 1 continued. Invertebrate densities (numbers/square metre).

sites	Macoma balthica 11-20mm	Mya arenaria <5mm	Mya arenaria 6-10mm	Mya arenaria 11-15mm
16.2	0.0	0.0	0	0
16.3	25.4	0.0	0	0
16.4	127.2	0.0	0	0
16.6	0.0	0.0	0	0
16.7	0.0	12.8	0	0
16.8	0.0	0.0	0	0
16.9	0.0	12.8	0	0
17.3	51.0	0.0	0	0
17.4	25.6	0.0	0	0
17.6	12.8	0.0	0	0
17.7	0.0	0.0	0	0
17.8	0.0	0.0	0	0
17.9	25.6	0.0	0	0
18.3	12.8	0.0	0	0
18.4	76.2	0.0	0	0
18.6	50.8	0.0	0	0
18.7	0.0	0.0	0	0
18.8	0.0	0.0	0	0
18.9	0.0	0.0	0	0
19.3	12.8	0.0	0	0
19.4	12.8	0.0	0	0
19.6	0.0	0.0	0	0
19.7	25.6	0.0	0	0
19.8	12.8	0.0	0	0
19.9	0.0	0.0	0	0
20.2	0.0	0.0	0	0
20.3	0.0	0.0	0	0
20.4	25.6	0.0	0	0
20.5	0.0	0.0	0	0
20.6	0.0	0.0	0	0
20.7	25.6	0.0	0	0
B3	25.4	0.0	0	0
C2	0.0	0.0	0	0
C3	0.0	0.0	0	0
D2	0.0	0.0	0	0
D3	0.0	0.0	0	0
D4	25.6	0.0	0	0
E8	12.8	0.0	0	0
E9	12.8	0.0	0	0
P1	12.8	0.0	0	0
P2	0.0	0.0	0	0
P3	0.0	0.0	0	0

Appendix 1 continued. Invertebrate densities (numbers/square metre).

sites	Scrobicularia plana <5mm	Scrobicularia plana 6-10mm	Scrobicularia plana 11-15m
16.2	0.0	0.0	0.0
16.3	0.0	0.0	25.6
16.4	25.6	50.8	127.2
16.6	0.0	152.6	51.0
16.7	25.6	63.8	76.4
16.8	0.0	38.2	63.8
16.9	0.0	51.0	0.0
17.3	12.8	89.0	203.4
17.4	38.2	203.4	89.0
17.6	25.6	190.6	76.2
17.7	12.8	12.8	0.0
17.8	12.8	12.8	0.0
17.9	12.8	12.8	0.0
18.3	0.0	76.6	152.6
18.4	38.4	241.6	101.8
18.6	139.8	254.2	127.2
18.7	38.4	51.0	38.2
18.8	38.4	0.0	0.0
18.9	38.2	139.8	0.0
19.3	0.0	0.0	0.0
19.4	25.6	12.8	0.0
19.6	0.0	12.8	0.0
19.7	0.0	63.8	25.4
19.8	25.6	38.2	0.0
19.9	38.2	63.6	0.0
20.2	0.0	0.0	0.0
20.3	0.0	76.2	38.2
20.4	12.8	0.0	0.0
20.5	0.0	0.0	0.0
20.6	0.0	0.0	0.0
20.7	0.0	0.0	0.0
B3	0.0	0.0	0.0
C2	0.0	0.0	0.0
C3	25.6	12.8	0.0
D2	0.0	0.0	0.0
D3	0.0	0.0	0.0
D4	0.0	0.0	0.0
E8	38.2	0.0	0.0
E9	25.6	229.0	0.0
P1	25.4	25.4	0.0
P2	0.0	0.0	0.0
P3	0.0	0.0	0.0

Appendix 1 continued. Invertebrate densities (numbers/square metre).

sites	Scrobicularia plana 16-20m	Scrobicularia plana 11-20m	Scrobicularia plana 21-25m	Scrobicularia plana 26-30m
16.2	0.0	0.0	0.0	0.0
16.3	0.0	25.6	0.0	12.8
16.4	38.2	165.2	0.0	0.0
16.6	12.8	51.0	0.0	0.0
16.7	12.8	89.0	0.0	0.0
16.8	12.8	76.6	0.0	0.0
16.9	0.0	0.0	0.0	0.0
17.3	12.8	216.2	12.8	12.8
17.4	38.2	127.2	12.8	12.8
17.6	0.0	76.2	0.0	0.0
17.7	0.0	0.0	0.0	0.0
17.8	0.0	0.0	0.0	0.0
17.9	0.0	0.0	0.0	0.0
18.3	12.8	165.2	0.0	12.8
18.4	51.0	152.6	12.8	25.4
18.6	38.2	165.4	12.8	0.0
18.7	12.8	51.0	0.0	0.0
18.8	0.0	0.0	0.0	0.0
18.9	0.0	0.0	0.0	0.0
19.3	0.0	0.0	0.0	0.0
19.4	0.0	0.0	0.0	0.0
19.6	0.0	0.0	0.0	0.0
19.7	12.8	38.2	0.0	12.8
19.8	0.0	0.0	0.0	0.0
19.9	0.0	0.0	0.0	0.0
20.2	0.0	0.0	0.0	0.0
20.3	0.0	38.2	0.0	0.0
20.4	0.0	0.0	0.0	0.0
20.5	0.0	0.0	0.0	0.0
20.6	0.0	0.0	0.0	0.0
20.7	0.0	0.0	0.0	0.0
B3	12.8	12.8	12.8	0.0
C2	0.0	0.0	0.0	0.0
C3	0.0	0.0	0.0	0.0
D2	0.0	0.0	0.0	0.0
D3	0.0	0.0	0.0	0.0
D4	0.0	0.0	0.0	0.0
E8	0.0	0.0	0.0	0.0
E9	0.0	0.0	0.0	0.0
P1	0.0	0.0	0.0	0.0
P2	0.0	0.0	0.0	0.0
P3	0.0	0.0	0.0	0.0

Appendix 1 continued. Invertebrate densities (numbers/square metre).

sites	Scrobicularia plana >30mm	All worms	All crustaceans	All gastropods	All bivalves
16.2	0.0	69.6	0.0	38	0.0
16.3	0.0	9526.8	25.6	7849	635.8
16.4	0.0	3151.4	0.0	9361	1208.4
16.6	0.0	23420.4	0.0	7557	2909.6
16.7	0.0	21922.4	38.2	5513	7458.0
16.8	0.0	9006.2	38.2	14377	6123.2
16.9	0.0	7444.2	12.8	9170	407.6
17.3	25.6	17845.6	0.0	10148	1576.6
17.4	0.0	14885.6	38.2	30836	1017.4
17.6	0.0	2935.0	0.0	73368	1195.0
17.7	0.0	1220.4	76.4	13551	293.0
17.8	0.0	3443.2	0.0	17514	318.4
17.9	0.0	6885.2	25.6	1727	204.0
18.3	12.8	2973.2	16167.8	2121	407.8
18.4	0.0	7304.2	21641.4	4776	966.4
18.6	12.8	9044.6	10897.0	17018	1690.6
18.7	0.0	6974.2	15189.8	12611	1410.8
18.8	0.0	8168.6	165.6	9919	2769.4
18.9	0.0	2796.2	3912.2	1435	775.4
19.3	0.0	1906.0	5817.2	32626	204.0
19.4	0.0	2274.8	191.0	51435	394.6
19.6	0.0	1081.6	1423.0	34036	648.6
19.7	0.0	3202.4	470.6	25730	1208.2
19.8	0.0	2669.4	1956.4	2401	750.6
19.9	0.0	2059.4	3048.4	927	369.2
20.2	0.0	76.6	51.0	89	0.0
20.3	0.0	15914.2	4381.8	22517	140.0
20.4	0.0	26197.8	1842.2	57798	559.6
20.5	0.0	766.2	394.4	53759	114.4
20.6	0.0	1440.4	127.4	115939	229.0
20.7	0.0	1186.8	433.4	11913	127.6
B3	12.8	4419.8	12.8	2705	89.2
C2	0.0	2845.2	737.0	102	0.0
C3	0.0	15164.8	76.2	178	165.6
D2	0.0	1577.0	25.6	5664	64.0
D3	0.0	1095.4	12.8	34696	178.4
D4	0.0	802.8	76.6	88735	801.6
E8	0.0	2402.0	115.0	35776	585.4
E9	0.0	7393.4	25.6	12472	877.8
P1	0.0	3849.6	0.0	26822	1575.4
P2	0.0	167.0	673.8	254	12.8
P3	0.0	282.2	191.2	64	0.0

Appendix 1 continued. Sediment details and distance of sites from the Gt Ouse outfalls shown as points A and B in Figure 2.1

sites	%<63um 2005	%LOI 2005	sediment type 2005	OusedisA km	OusedisB km
16.2	64.6	8.8	mud	5.2	4.48
16.3	66.4	7.2	mud	5.28	4.38
16.4	74.1	7.5	mud	5.38	4.32
16.6	64.7	6.8	mud	5.62	4.22
16.7	71.0	7.7	mud	5.72	4.18
16.8	66.9	7.5	mud	5.86	4.16
16.9	81.6	8.3	mud	6.02	4.16
17.3	60.3	5.6	mud	2.96	2.32
17.4	62.8	6.0	mud	3.04	2.12
17.6	48.9	5.7	mud	3.28	1.74
17.7	8.3	2.0	sand	3.36	1.56
17.8	59.4	6.4	mud	3.48	1.38
17.9	27.5	2.7	mud	3.66	1.24
18.3	77.9	5.5	mud	2.3	2.16
18.4	55.5	3.8	mud	2.32	2
18.6	55.6	4.8	mud	2.4	1.6
18.7	41.9	3.1	mud	2.46	1.4
18.8	49.3	4.3	mud	2.52	1.26
18.9	55.1	5.1	mud	2.62	1.04
19.3	27.6	2.0	mud	4.54	3.16
19.4	23.1	1.8	sand	4.56	2.98
19.6	19.6	1.7	sand	4.68	2.64
19.7	34.7	2.3	mud	4.76	2.48
19.8	33.4	3.0	mud	4.84	2.38
19.9	55.2	5.1	mud	5.04	2.28
20.2	70.9	9.6	mud	7.36	5.88
20.3	47.8	4.3	mud	7.38	5.66
20.4	6.9	1.5	sand	7.42	5.46
20.5	6.1	1.7	sand	7.52	5.28
20.6	4.8	2.1	sand	7.62	5.18
20.7	4.1	2.1	sand	7.76	5.12
B3	87.4	13.5	mud	0.9	2.9
C2	88.5	11.7	mud	1.94	1.8
C3	70.4	8.1	mud	1.96	1.7
D2	7.9	1.0	sand	4.56	1.18
D3	11.4	1.6	sand	5.1	1.68
D4	25.4	3.0	mud	5.74	2.3
E8	35.4	3.1	mud	3.46	0.9
E9	70.0	7.3	mud	3.62	0.68
P1	44.3	3.5	mud	4.44	0.86
P2	6.7	0.9	sand	5	1.46
P3	8.4	1.4	sand	5.52	1.96

Appendix 2
Comparisons between the mean density of invertebrates in the 2004 and 2005 surveys of the Gt Ouse study area. Invertebrates whose density differed significantly between surveys are shown in bold text.

Worm species, whole study area

Invertebrate group, family or species/species size category	Whole study area (N=42)			
	mean density±SE 2004	2005	t value	p value
Nemerteans	27.3±13.0	18.8±11.5	-0.74	0.46
Nematodes	1016 ±359	1235 ±644	0.47	0.64
Anaitides mucosa	**12.4 ±4.0**	**0.9 ±0.5**	**-2.84**	**0.007****
Eteone longa	**286±42**	**118±19**	**-5.03**	**0.0001******
Syllids	1.5±0.9	0.6±0.6	-0.83	0.41
Hediste diversicolor <15mm	16.1±7.3	10.1±3.5	-1.16	0.26
H. diversicolor 15-30mm	13.4±5.2	10.6±4.5	-1.24	0.22
***H. diversicolor* >30mm**	**14.0 ±3.6**	**1.8 ±0.8**	**-3.44**	**0.001*****
***N. hombergii* 15-30mm**	**72.1 ±12.0**	**49.1 ±7.04**	**2.51**	**0.016***
N. hombergii >30mm	18.7 ±4.1	13.9 ±3.8	-1.21	0.24
N. cirrosa 15-30mm	5.2 ±3.3	2.7 ±1.8	-0.97	0.34
N. cirrosa >30mm	0.6 ±0.6	0	-1.0	0.32
All *Nephtys* <15mm	155 ±30.1	173 ±28.6	0.73	0.47
***Scoloplos armiger* <15mm**	**0.9±0.7**	**7.6±3.0**	**2.67**	**0.011***
S. armiger 15-30mm	0.3±0.3	1.5±1.0	1.16	0.25
S. armiger >30mm	2.4±1.4	0.6±0.4	-1.23	0.23
Polydora spp	0.9 ±0.7	0	-1.36	0.18
Pygospio elegans	1357 ±253	1317 ±302	-0.15	0.88
Scolelepis foliosa	0.6 ±0.6	0	-1.0	0.32
Spio martinensis	17.0 ±9.7	66.9 ±25.4	1.97	0.055

Spiophanes bombyx	0.9±0.9	1.2±0.6	0.28	0.78

Appendix 2

Worm species, whole study area continued

Invertebrate group, family or species/species size category	Whole study area (N=42)			
	mean density±SE 2004	2005	t value	p value
Magelona mirabilis	0.6 ±0.4	0.3 ±0.3	-1.0	0.32
Tharyx *sp complex A*	803±271	605±214	-1.03	0.31
Capitellids	56.3 ±16.9	49 ±16.8	-0.59	0.56
Heteromastus filiformis	4.0±2.3	0.3±0.3	-1.55	0.13
Arenicola marina casts	0.56 ±0.2	0.91 ±0.4	1.01	0.32
Manayunkia aestuarina	1.82 ±0.93	0	-1.96	0.06
Heterochaeta costata	0.91±0.91	0	-1.0	0.32
Tubificoides benedii	**5488 ±1660**	**2358 ±613**	**-2.64**	**0.012***
Enchytraeidae	49.6 ±29.1	94.7 ±81.3	0.72	0.48

Appendix 2 contd

Mollusc species, whole study area.

Invertebrate group, family or species/species size category	Whole study area (N=42)			
	mean density±SE 2004	2005	t value	p value
Hydrobia ulvae <3mm	15946 ±2109	20073 ±4108	1.46	0.15
H. ulvae 3+mm	399 ±140	450 ±166	0.45	0.65
Retusa obtusa <3mm	12.1±7.1	54.2±25.1	1.87	0.069
R. obtusa 3+mm	9.7±3.8	30.3±18.2	1.16	0.25
***Mytilus edulis* <5mm**	**15.5 ±4.3**	**5.2 ±1.9**	**-2.35**	**0.02***
Mysella bidentata <5mm	1.5 ±0.9	4.2 ±2.1	1.24	0.22
Mysella bidentata 6-10mm	0.3 ±0.3	1.5 ±1.5	0.78	0.44
***Cerastoderma edule* <5mm**	**357±148**	**74±27**	**-2.37**	**0.023***
C. edule 5-10mm	694±361	236±138	-1.98	0.055
C. edule 11-20mm	9.4 ±3.9	50.2 ±22.7	1.6	0.12
C. edule 21-25mm	0	0.6 ±0.4	1.43	0.16
Macoma balthica <5mm	399 ±90	325 ±78	-0.86	0.4
M. balthica 5-10mm	180 ±26	144 ±23	-1.55	0.13
***M. balthica* 16-20mm**	**1.82 ±0.82**	**0**	**-2.22**	**0.03***
M. balthica 11-20mm	25.5 ±5.8	14.6 ±3.8	-1.69	0.099
M. arenaria <5mm	6.4±3.6	0.6±0.4	-1.57	0.12
M. arenaria 5-10 mm	0.6±0.4	0	-1.43	0.16
***Scrobicularia plana* <5mm**	**49.7 ±10.7**	**16.1 ±3.8**	**-3.25**	**0.002****
***S. plana* 5-10mm**	**107 ±25.5**	**51.8 ±11.5**	**-2.54**	**0.015***
***S. plana* 11-20mm**	**75.6 ±23.0**	**34.5 ±9.2**	**-2.16**	**0.037***
S. plana 20-30mm	4.6±1.6	3.6±1.6	-0.9	0.7
S. plana >30mm	0.9±0.5	1.5±0.8	0.63	0.53

Appendix 2 contd

Crustacean species, whole study area.

Invertebrate group, family or species/species size category	Whole study area (N=42)			
	mean density±SE 2004	2005	t value	p value
Elminius modestus	2.4 ±1.7	1.2 ±1.0	-0.78	0.44
Urothoe poseidonis <3mm	0	2.7 ±1.8	1.55	0.13
Urothoe poseidonis 3+mm	0.31 ±0.31	0.31 ±0.31	0	1.0
B. pilosa <3mm	2.4 ±1.9	0	-1.27	0.21
B. pilosa 3+mm	2.1 ±2.1	0	-1.0	0.32
B. sarsi <3mm	1.2 ±0.7	7.6 ±3.9	1.75	0.09
B. sarsi 3+mm	0.3 ±0.3	5.2 ±3.3	1.62	0.11
***C. volutator* <3mm**	**531±169**	**1830±668**	**2.4**	**0.02***
***C. volutator* 3+mm**	**971 ±325**	**250 ±94**	**-2.73**	**0.009****
Cyathura carinata	28.2 ±18.0	17.6 ±8.7	-0.91	0.37
Idotea linearis	0.3±0.3	0	-1.0	0.32
Tanaids	11.2±8.4	17.3±12.6	1.38	0.17
Cumaceans	3.6±2.3	10.6±5.7	1.19	0.24
Crangon crangon	3.7 ±1.1	5.8 ±1.7	1.08	0.29
Liocarcinus arcuatus	0	0.6 ±0.4	1.43	0.16

Appendix 3

Shorebird numbers in each transect during the winter 2004-05 surveys. Column 1 of each table indicates the transect number or area name. Remaining columns give the numbers of dunlin, redshank, knot, grey plover, bar-tailed godwit, oystercatcher, curlew and shelduck recorded in the first and second counts and mean count for the whole survey. 'OB' refers to outer bank areas.

1st count November - December 2005

Transect	dun1	red1	knot1	grp1	btg1	oyc1	cur1	shel1
51	1161	12	1330	19	16	107	49	130
52	66	0	730	6	13	23	11	71
53	65	1	510	0	7	0	0	150
54	0	0	1135	0	0	96	12	85
55	58	0	0	0	0	0	8	119
56	0	0	0	0	0	0	0	23
57	1482	49	0	0	1	0	19	234
58	1840	145	468	0	0	25	11	65
59	1460	158	131	0	4	9	2	26
60	210	0	55	0	0	23	8	93
61	1575	3	340	12	0	35	0	105
62	240	0	0	0	4	14	27	215
63	235	0	0	0	0	0	25	637
64	98	0	0	18	55	0	12	93
65	188	62	845	51	1110	252	60	0
66	570	19	330	51	283	694	13	0
OB Daseley's	94	6	60	10	5	130	20	0
OB Pandora	203	5	99	2	0	186	2	0

Appendix 3 continued

2nd count December 2005 - January 2006

Transect	dun2	red2	knot2	grp2	btg2	oyc2	cur2	shel2
51	313	23	339	6	28	63	40	244
52	45	3	875	10	3	5	10	540
53	0	3	1225	0	11	0	10	52
54	180	0	48	1	92	129	18	208
55	0	0	0	0	0	0	5	531
56	0	4	0	0	0	0	0	52
57	141	42	0	48	3	0	17	160
58	0	33	0	0	0	0	23	13
59	30	129	0	0	10	0	14	0
60	60	126	400	0	0	0	59	395
61	370	0	340	20	0	221	3	52
62	0	0	0	13	26	50	19	85
63	0	0	93	0	0	0	13	661
64	0	18	3850	6	29	79	12	135
65	1498	4	66	39	536	529	68	0
66	380	0	162	72	364	564	36	0
OB Daseley's	800	1	60	0	0	122	34	0
OB Pandora	0	0	1200	0	0	178	0	0

Appendix 3 continued

Mean count winter 2005-06

Transect	dun05	red05	knot05	grp05	btg05	oyc05	cur05	shel05
51	737	18	835	13	22	85	45	187
52	56	2	803	8	8	14	11	306
53	33	2	868	0	9	0	5	101
54	90	0	592	1	46	113	15	147
55	29	0	0	0	0	0	7	325
56	0	2	0	0	0	0	0	38
57	812	46	0	24	2	0	18	197
58	920	89	234	0	0	13	17	39
59	745	144	66	0	7	5	8	13
60	135	63	228	0	0	12	34	244
61	973	2	340	16	0	128	2	79
62	120	0	0	7	15	32	23	150
63	118	0	47	0	0	0	19	649
64	49	9	1925	12	42	40	12	114
65	843	33	456	45	823	391	64	0
66	475	10	246	62	324	629	25	0
OB Daseley's	447	4	60	5	3	126	27	0
OB Pandora	102	3	650	1	0	182	1	0