Marsh Foraminifera from Nanaimo, British Columbia: Infaunal Habitat and Taphonomic Implications

by

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The undersigned hereby recommend to
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Chair, Department of Earth Sciences

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ABSTRACT

Marsh foraminiferal fauna from nine cores and two transects in and around the Nanaimo inlet were examined for impact of infaunal habit and taphonomic processes on biofacies formation. High marsh fauna live slightly deeper infaunally compared to those in the low marsh environment, reflecting harsher conditions in the high marsh. Most live *Jadammina macrescens* are found from 0-20 cm in the high marsh setting and from 0-11 cm in the low marsh setting; the main depth preference is from 2-8 cm. *Trochammina salsa* and *Jadammina macrescens* live in nearly identical infaunal living habits and standing crop distribution, indicating that a systematic re-examination of species is in order. Most living *Trochammina inflata* were found from 0-25 cm in the high marsh and from 0-20 cm in the low marsh environment. *Haplophragmoides wilberti* is overall most abundant from 3-7 cm being almost absent from the near-surface samples in all cores. *H. wilberti* is primarily found from 0-15 cm In a high marsh setting, and from 0-12 cm in a low marsh environment. Most live *Miliammina fusca* are found from 0-10 cm but are most abundant in the top 3 cm.

Five cluster analyses of the foraminiferal data using 0-1, 0-3, 0-5, 0-7 and 0-10 cm surface samples, respectively, were carried out and five biofacies were discriminated within each case to determine which near-surface aliquot is most analogous to deeper subsurface biofacies. Results of cluster analysis of the data show near-surface sediment sampling should be done on the 0-10 cm interval. This aliquot allows the main infaunal species characteristics to be observed, yet is thin enough that epifaunal species are also accurately represented.

ACKNOWLEDGMENTS

This thesis was funded by NSERC research grant OGP 8349-05 to R.T. Patterson. Thanks to R.T. Patterson, Elizabeth Patterson and George Harvey for critical review of the manuscript. R.T. Patterson also assisted with methodology, and identification of species. Sample collection was done by Harry Williams and R.T. Patterson.

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Marsh Foraminifera from Nanaimo, British Columbia: Infaunal Habitat and Taphonomic Implications

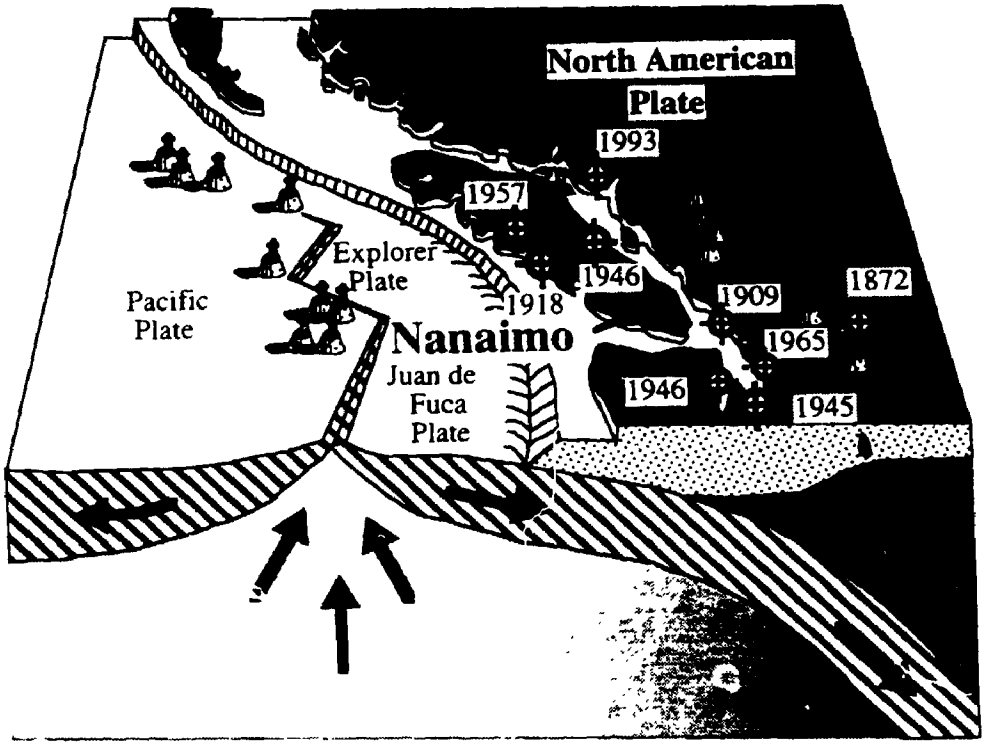
1.0 BACKGROUND

Southwestern British Columbia is located in the most tectonically active area of Canada and there is concern that an earthquake much larger than any of the historical period may cause extensive damage to cities and the economic infrastructure of the region. Details of the periodicity and magnitude of prehistoric earthquakes in the area are not well known (written records date back less than 200 years), but the proximity of the Cascadia Subduction Zone (CSZ) dramatically increases potential for megathrust and other earthquakes (Clague and Bobrowski, 1990; Clague and Bobrowski, 1994). This high potential for damaging earthquakes has led to increased emphasis on seismic risk assessment studies.

New stratigraphic evidence and radiocarbon ages show that the zone of subsidence associated with earthquakes in the CSZ may extend north to central Vancouver Island, British Columbia. The amount of subsidence would be expected to decrease eastward, approaching zero several tens of kilometers east of the outer coast (Clague and Bobrowski, 1990; Mathewes and Clague, 1994). This evidence is in accord with geodetic and geophysical modelling which indicate that the convergence between the oceanic Juan de Fuca and Explorer plates, and the continental North American plate within the Cascadia Subduction Zone is locked and accumulating strain, which could be released in a potentially catastrophic (M8+) megathrust earthquake (Clague and Bobrowski, 1994; Blais and Patterson, in press; Figure 1).

Figure 1: Tectonic setting of Nanaimo, British Columbia. Epicenters and dates of crustal earthquakes are indicated.

Figure 1


North American
Plate
1993
1957
Explorer
Plate
1946
1909
1872
Pacific
Plate
1918
Nanaimo
1965
Juan de
Fuca
Plate
1946
1945

Two types of earthquakes, crustal and subcrustal, also occur in southwestern British Columbia. Crustal earthquakes are the most common and originate within the North American plate, generally at depths of 10-30 km. These earthquakes occur along deep brittle fractures because the crust under southwestern British Columbia is thicker and cooler than normal. Subcrustal earthquakes occur within the Juan de Fuca Plate at depths down to 80 km. These earthquakes are concentrated in two regions beneath Vancouver Island and beneath the Strait of Georgia. This seismicity is concentrated in a narrow band between 47°N and 49.5°N and is probably due to arching of the subducting plate to accommodate the bend of the coastline in this region (Blais and Patterson, in press; Figure 1).

Marsh foraminifera have proven to be one of the most effective tools in recognizing paleo-seismic events. Distribution of foraminifera in tidal marshes is highly zoned and controlled by various physical parameters (e.g. salinity, pH, temperature and oxygen concentration; de Rijk, 1995). Very small changes in relative sea level (<10 cm) modify these parameters and can produce significant changes in the foraminiferal assemblages (Patterson et al., 1994; Patterson et al., 1995). Through a detailed knowledge of marsh foraminiferal biozones, valuable insights can be gleaned about previous depositional environments and identification of former sea levels which may, in turn, be associated with seismic events (see Patterson, 1990; Jacobsson and Patterson, 1992; Guilbault et al., 1995). The characteristic result of seismic events in the west coast is always associated with sudden subsidence. In the marsh, this results in a low marsh fauna being juxtaposed upon a high marsh fauna. Tsunami deposits occasionally are associated with this boundary.

Many reconstructions of past sea level change utilize the modern distribution of marsh foraminifera as analogues of their fossil distribution

(Goldstein and Harben, 1993). However, important parameters not widely studied to date, yet vital to such reconstructions, are the nature of the infaunal habitat of many foraminiferal taxa and their taphonomy.

The purpose of this baseline study in marshes adjacent to Nanaimo on Vancouver Island is to enhance the utility of marsh foraminifera as paleo-seismic indicators. In particular, the main objectives are:

1. to determine preservational potential (taphonomic biasing) of marsh foraminiferal faunas in the subsurface;

2. to determine the implication of marsh foraminifera infaunal habitat on biofacies distribution.

Once the impact of taphonomic biasing and infaunal foraminiferal faunal habitat on biofacies formation is understood, application of transfer functions (Guilbault et al., 1995) and Error Weighted Maximum Likelihood clustering methodologies (Fishbein and Patterson, 1993) will allow both subtle eustatic and dramatic seismically generated subsidence events to be fully documented.

2.0 PREVIOUS WORK

Only a few studies have been carried out that address the impact of infaunal habitat and taphonomic effects on fossil foraminiferal distribution. For example, Corliss (1985) documented the infaunal nature of some species of calcareous foraminifera living to depths of 15 cm in the western North Atlantic. Elsewhere, Goldstein (1988) found foraminifera living to depths of 30 cm below the marsh surface, along the eastern coast of St. Catherine's Island, Georgia. In both deep water and intertidal settings these researchers found that infaunal habitat may significantly alter the composition of subsurface assemblages.

Smith (1987) studied the fossilization potential of various modern shallow water benthic foraminiferal assemblages, to predict taphonomic effects. He found that many agglutinated forms may have little or no fossilization potential in oceanic conditions because most loosely cemented tests disaggregate upon death and return to the sediment. Loubere and Gary (1990) expanded on previous studies of taphonomic processes affecting deep water benthic foraminifera. By analyzing both living and dead assemblages, they were able to distinguish the extent of taphonomic biasing, through development of a theoretical treatment of fossil abundances in sediments for species living in both epifaunal and infaunal microhabitats. More recently Jonasson and Patterson (1992) also found an overall decrease downcore in agglutinated and calcareous foraminiferal numbers, implying poor preservation potential in marsh environments of the Fraser River delta.

3.0 METHODS AND MATERIALS

A total of 180 samples were taken from nine/31-cm cores along two transects in the marsh adjacent to Nanaimo inlet (Figures 2 & 3; Appendix 1). Sample coring was done using a vibracore. Foraminiferal samples were taken at 1 cm intervals for the first 10 cm and then at 1.5 - 2 cm intervals through the remainder of the core. The cores generally consisted of an organic rich silt or peat, overlying sand. Most samples were stored in sterilized plastic vials and treated in the field with formaldehyde in order to prevent microbial decay of living foraminiferal protoplasm. However, samples from cores N95-1 and N95-2 were stored in sterilized ziploc bags and treated in the field with isopropyl alcohol. The elevation of each core site was obtained using a surveying level.

Figure 2: Location map of cores (1-1 to 1-5; 2-1, 2-2, N95-1, N95-2) examined for this study.

Figure 2

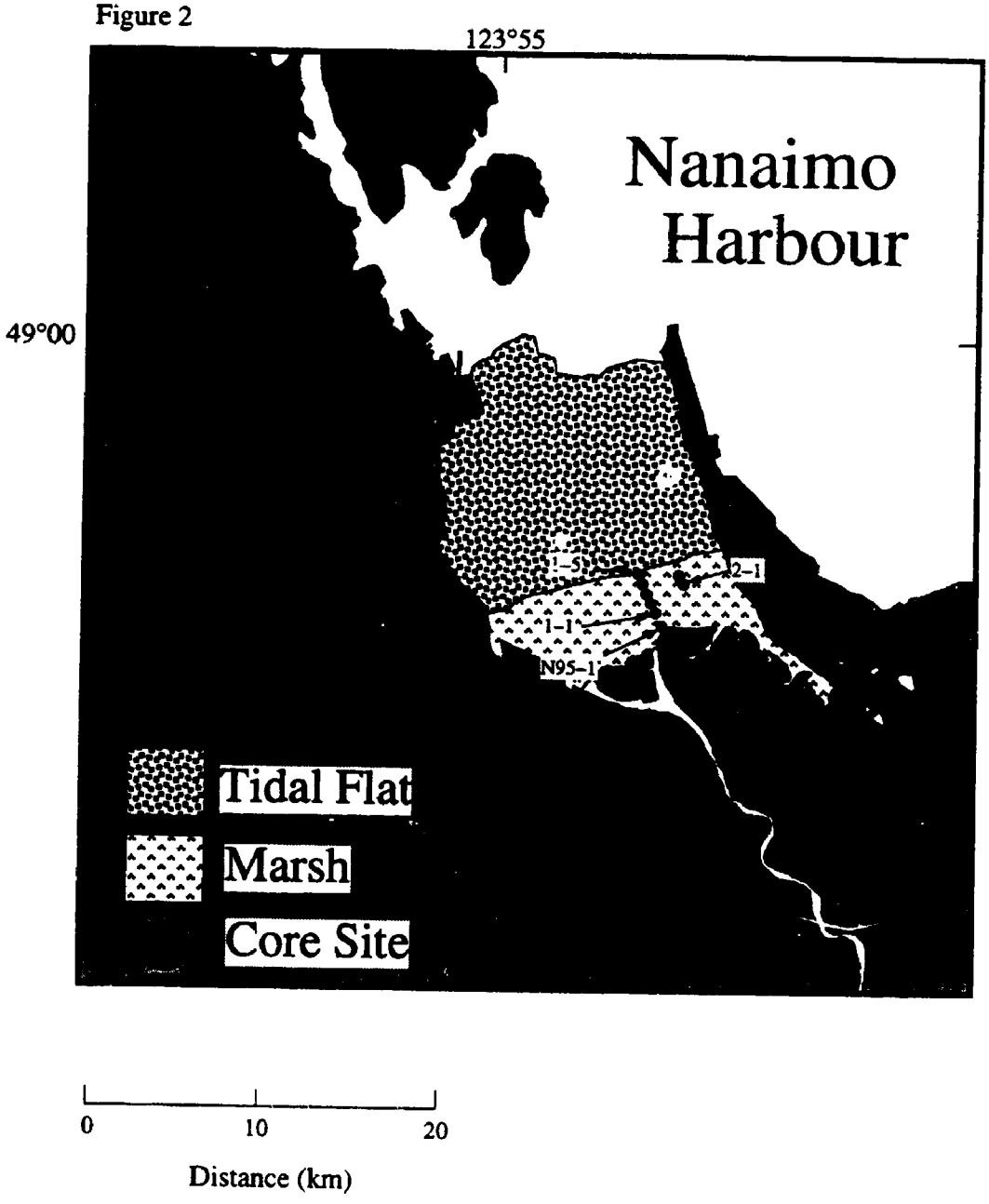
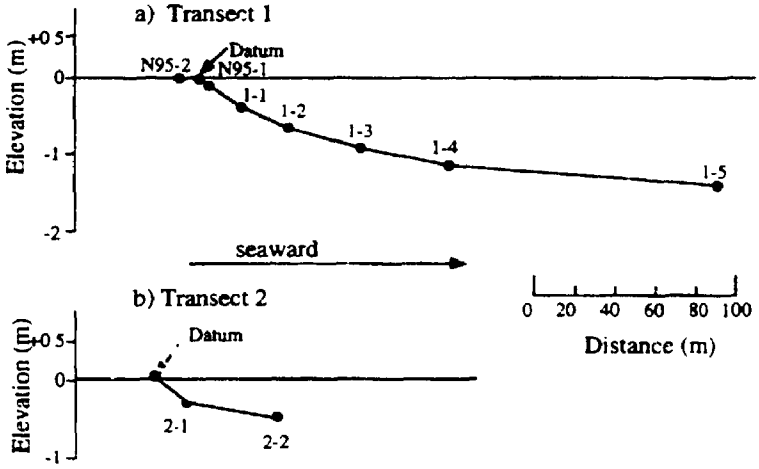

123°55
49°00
Nanaimo
Harbour
1–5
2–1
1–1
N95–1
Tidal Flat
Marsh
Core Site
0
10
20
Distance (km)

Figure 3: Cross-section of sampling sites indicating elevation of sample sites above or below mean sea level.

Figure 3


a) Transect 1
Elevation (m)
+0.5
0
-1
-2
Datum
N95-2
N95-1
1-1
1-2
1-3
1-4
1-5
seaward
b) Transect 2
Elevation (m)
+0.5
0
-1
Datum
2-1
2-2
0 20 40 60 80 100
Distance (m)

Absolute elevations were obtained by comparing these results to topographic maps of the tidal flats and marshes (Figure 3; Canada, 1:50 000, 1994).

In the laboratory, approximately 10 cc of each sample were washed and sieved using a 0.063 mm sieve. Once washed, samples were stained with Rose Bengal in order to distinguish foraminifera living at the time of collection (Scott and Medioli, 1980). After staining, the samples were washed in tap water and preserved in a 5% isopropyl alcohol solution. Samples were sieved using a 0.5 mm screen to remove large plant debris to facilitate counting. The sample residue was then split using a wet splitter until a fraction of countable size (usually 1/6) was obtained (Scott and Hermelin, 1993). Wet samples were then examined under a binocular microscope (generally at around 40 X). Water immersion aids in sample identification of march species because organic matter found in marsh samples tends to stick to foraminifera tests if samples are dried. Of the 180 samples, 157 contained statistically significant numbers of foraminifera (Appendix 1; see Patterson and Fishbein, 1989, for background on estimating statistical significance).

4.0 QUANTITATIVE ANALYTICAL PROCEDURES

The counts for each sample were converted into fractional abundances and standard errors calculated as proposed by Patterson and Fishbein, (1989) according to the following formula:

$$S_{Xi} = [X_i(1-X_i)N]^{1/2}$$

where S_{Xi} is the standard error: X_i is the estimated fractional abundance for each i = 1,2,3,...I species, where I = the total number of species in the sample; i

is each species; and N is the total number of specimens counted in a sample. When making N counts, the actual fractional abundance f_i lies between,

$$X_i-1.96S_{X_i}>f_i<X_i+1.96S_{X_i}$$

95% of the time. Therefore, the 95% confidence interval on the estimated fractional abundances is $X_i+1.96S_{X_i}$.

Q-Mode cluster analysis was carried out in order to group samples that had similar foraminiferal species distributions. Samples that had similar species distributions were considered to be representative of a particular environment or biofacies.

Only foraminiferal species that were deemed to be present in statistically significant numbers were used in the Q-Mode cluster analysis. The statistically significant species were those that had abundances equal to the standard error $\pm$ 1% at the 95% confidence level in at least one sample. Those species not included in the analyses are: *Ammotium salsum* (Cushman and Brönnimann, 1948), *Ammobaculites foliaceous* (Brady, 1884), *Trochammina irregularis* (Cushman and Brönnimann, 1948), *Reophax nana* (Rhumbler, 1911), *Centropyxis aculeata* (Ehrenberg, 1832) , *Difflugia oblonga* (Ehrenberg, 1832), *Pontigulasia compressa* (Carter, 1864), and *Arcella vulgaris* Ehrenberg, 1830. Q-Mode clustering of the reduced dataset was done on an Apple Macintosh cx computer using the SYSTAT v.5.2 statistical software package and Ward's minimum variance method (Wilkinson, 1989). The results of the cluster analysis were then reported as Euclidean distances and arranged in a hierarchical dendrogram (Fig. 4 and 5). The dendrogram was then used to define sample associations or biofacies (Figs. 4-6; Table 2). This methodology simulates a

Figure 4a: Q-mode dendrogram showing the 0-1 cm sampling interval cluster analysis, from Nanaimo, British Columbia, divided into distinct assemblages as indicated by the dashed line. Distinct clusters of samples with correlation coefficient greater than a selected level were considered biofacies. Each biofacies and selected samples associated with these biofacies are shown in Figures 4b - 4f.

Figure 4a

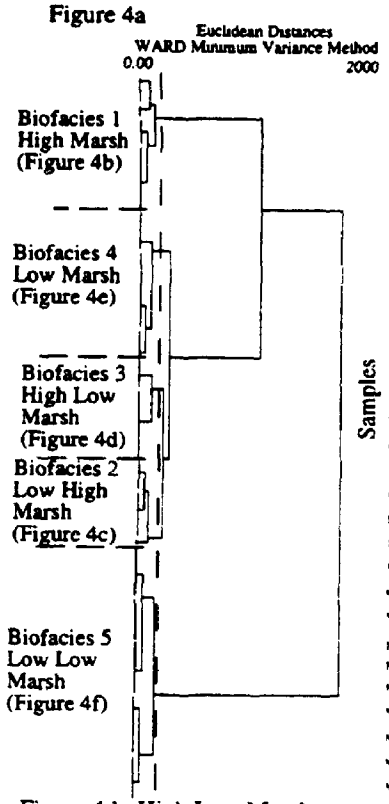


Figure 4b: High Marsh (Biofacies 1)

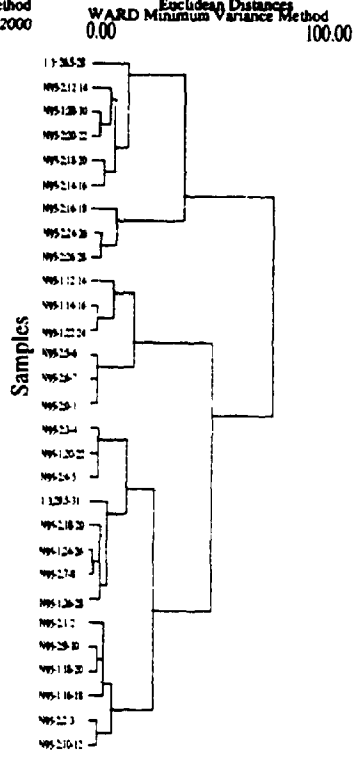


Figure 4c: Low High Marsh (Biofacies 2)

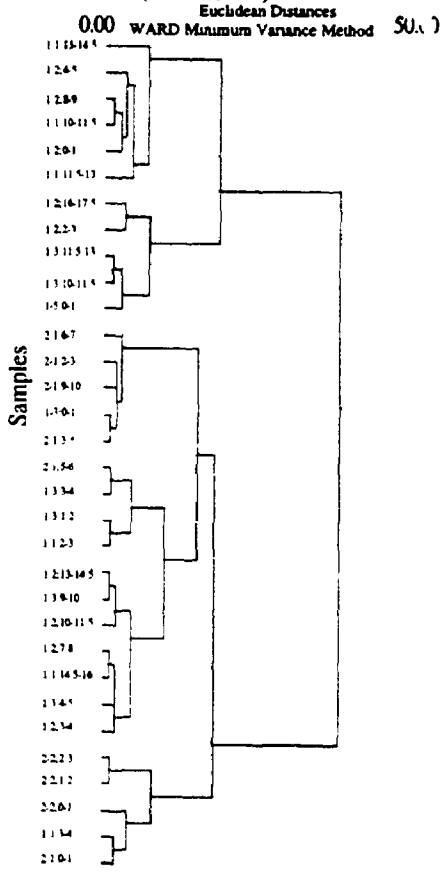


Figure 4d: High Low Marsh (Biofacies 3)

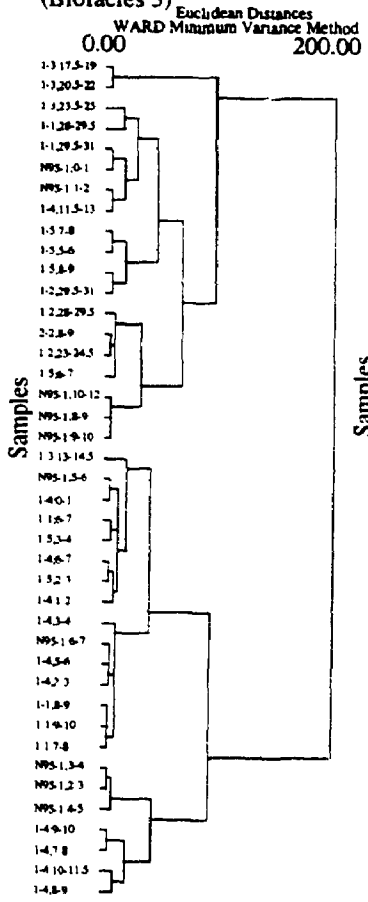


Figure 4e: Low Marsh (Biofacies 4)

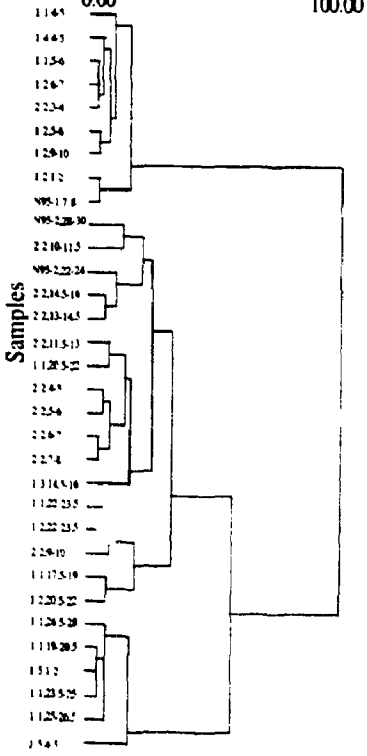


Figure 4f: Low Low Marsh (Biofacies 5)

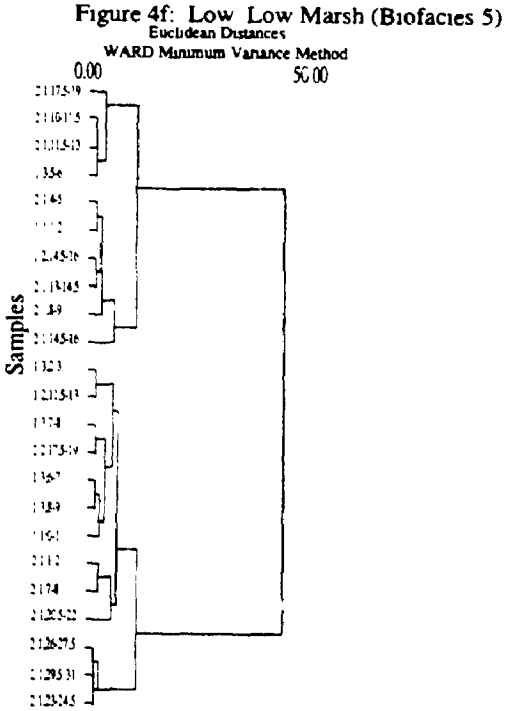


Figure 5: Q-mode dendrogram showing the 0-10 cm sampling interval cluster analysis, from Nanaimo, British Columbia, divided into distinct assemblages as indicated by the dashed line.

Figure 5

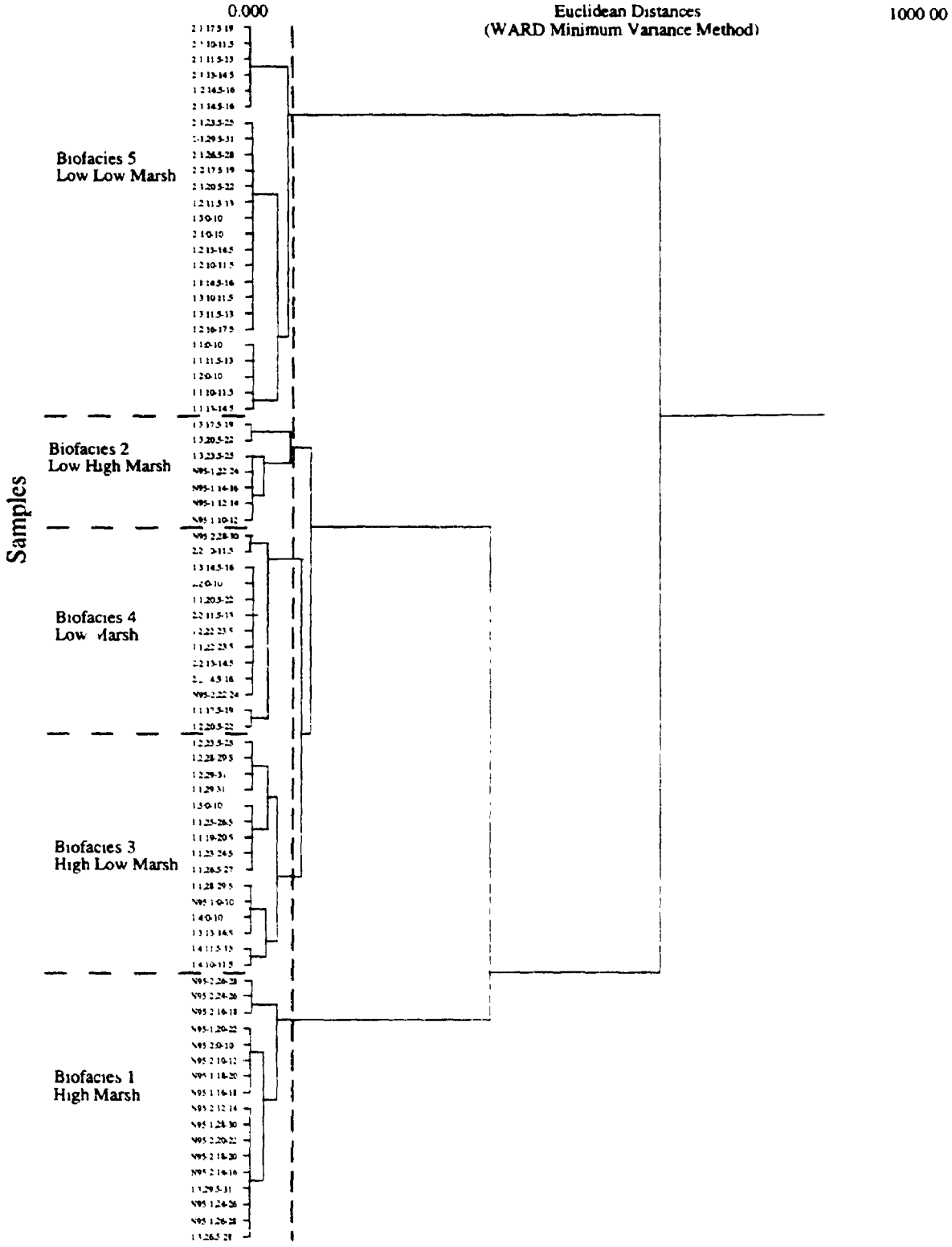

0.000
Euclidean Distances
(WARD Minimum Variance Method)
1000 00
Samples
Biofacies 5
Low Low Marsh
Biofacies 2
Low High Marsh
Biofacies 4
Low Marsh
Biofacies 3
High Low Marsh
Biofacies 1
High Marsh

Figure 6: Percent abundance of four most abundant marsh species in five biofacies based on a 0-10 cm sample aliquot.

Figure 6

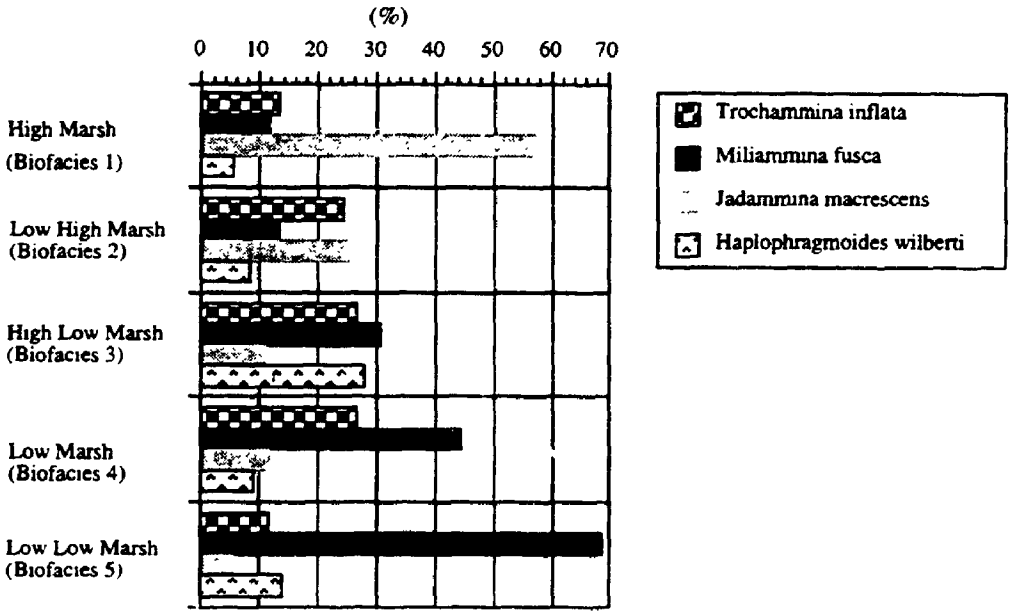

(%)
0
10
20
30
40
50
60
70
High Marsh
(Biofacies 1)
Low High Marsh
(Biofacies 2)
High Low Marsh
(Biofacies 3)
Low Marsh
(Biofacies 4)
Low Low Marsh
(Biofacies 5)
Trochammina inflata
Miliammina fusca
Jadammina macrescens
Haplophragmoides wilberti

Table 1: Mean fractional abundances and associated standard error of four most abundant marsh species best characterizing each assemblage.

Biofacies	1	2	3	4	5
Assignment	High marsh	Low High Marsh	High Low Marsh	Low Marsh	Low Low Marsh
Species	(%)	(%)	(%)	(%)	(%)
Trochammina inflata	13.2 +/- 5.41	24.1 +/- 4.45	26.5 +/- 14.62	26.5 +/- 10.49	11.6 +/- 8.20
Miliammina fusca	11.7 +/- 9.31	13.3 +/- 8.58	30.8 +/- 15.90	44.2 +/- 6.71	68.6 +/- 14.90
Jadammina macrescens	57.4 +/- 7.94	25 +/- 13.64	11.0 +/- 7.41	11.8 +/- 6.16	5.4 +/- 3.62
Haplophragmoides wilberti	5.5 +/- 2.25	8.4 +/- 4.58	27.7 +/- 12.62	8.8 +/- 5.61	13.7 +/- 7.60

statistically based Error-Weighted Maximum Likelihood (EWML) clustering method fully described in Fishbein and Patterson (1993).

Five separate cluster analyses were carried out on the data, using 0-1 cm, 0-3 cm, 0-5 cm, 0-7 cm and 0-10 cm foraminiferal distribution data, to detect possible effects of foraminiferal infaunal habitat and taphonomically induced biasing on resultant biofacies solutions.

5.0 RESULTS AND DISCUSSION

5.1 PART 1: Downcore Foraminiferal Distribution Patterns

In order to accurately assess infaunal habitat of the various foraminiferal species, and variations in their total population, distributional trends displayed by the four most abundant marsh species (*Jadammina macrescens* (Brady, 1870), *Miliammina fusca* (Brady, 1870), *Trochammina inflata* (Montagu, 1808) and *Haplophragmoides wilberti* (Andersen, 1953)) will be discussed (Fig. 7 and Appendix 1).

5.1.1 Jadammina macrescens

Jadammina macrescens has a primarily infaunal habitat. The highest abundances and percentages of living *J. macrescens* are found in cores N95-1 and to a lesser extent N95-2 (up to 10.5%) collected in the high marsh. As *J. macrescens* is most abundant in the high marsh, distributional trends are most clearly identified here. To evaluate the depth where the majority of each species resided, the depth above which 95% of specimens lived, as well as the depth above which 50% of the population of each species lived was calculated.

Figure 7: Downcore species abundances in total forams/cc and percent live for individual species of each core, as well as 50% and 95% of total percent live, represented by solid and dashed lines respectively across cores. Overall stratigraphy of the core is given beside each core (legend on page 35).

Figure 7

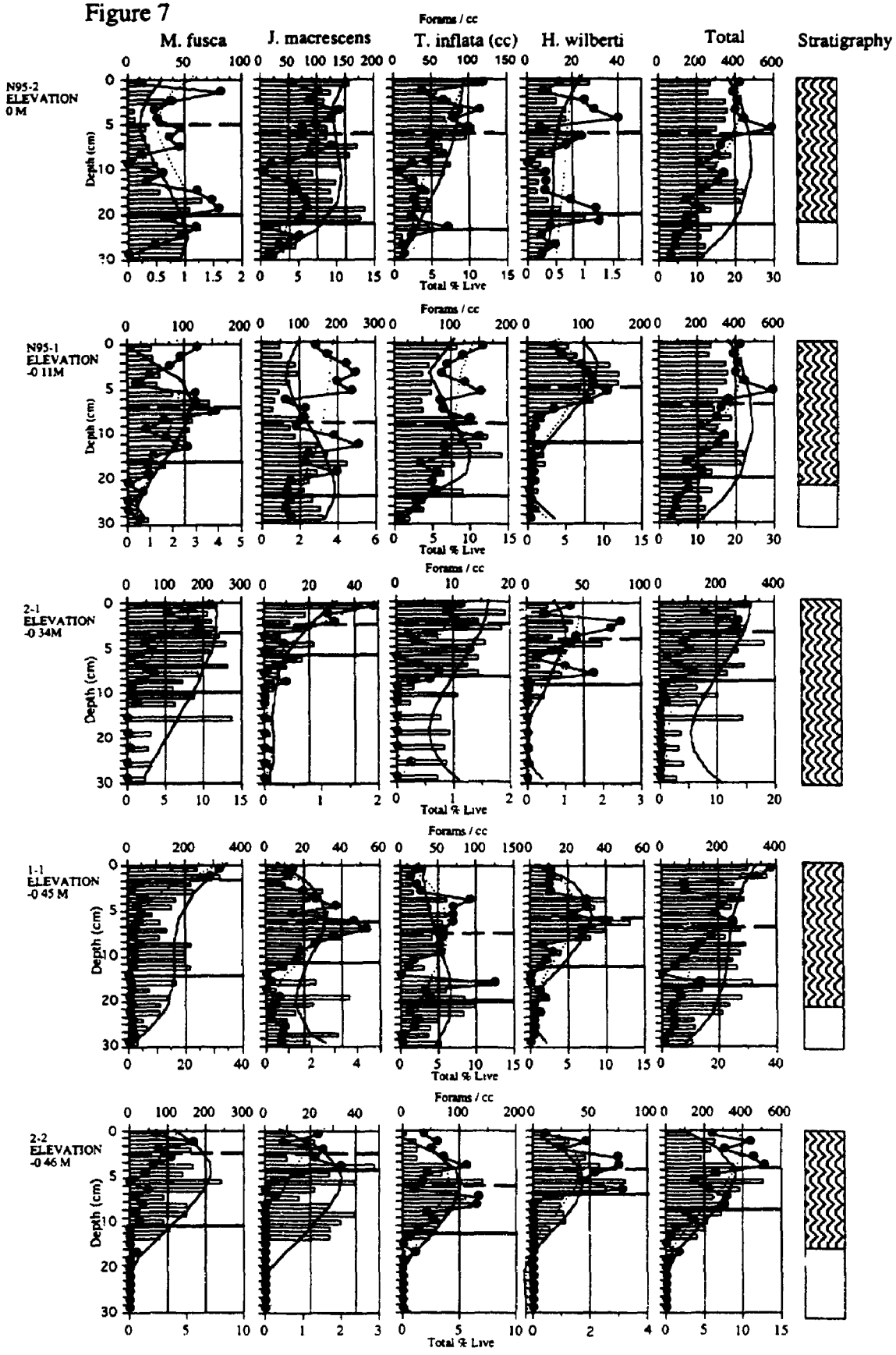
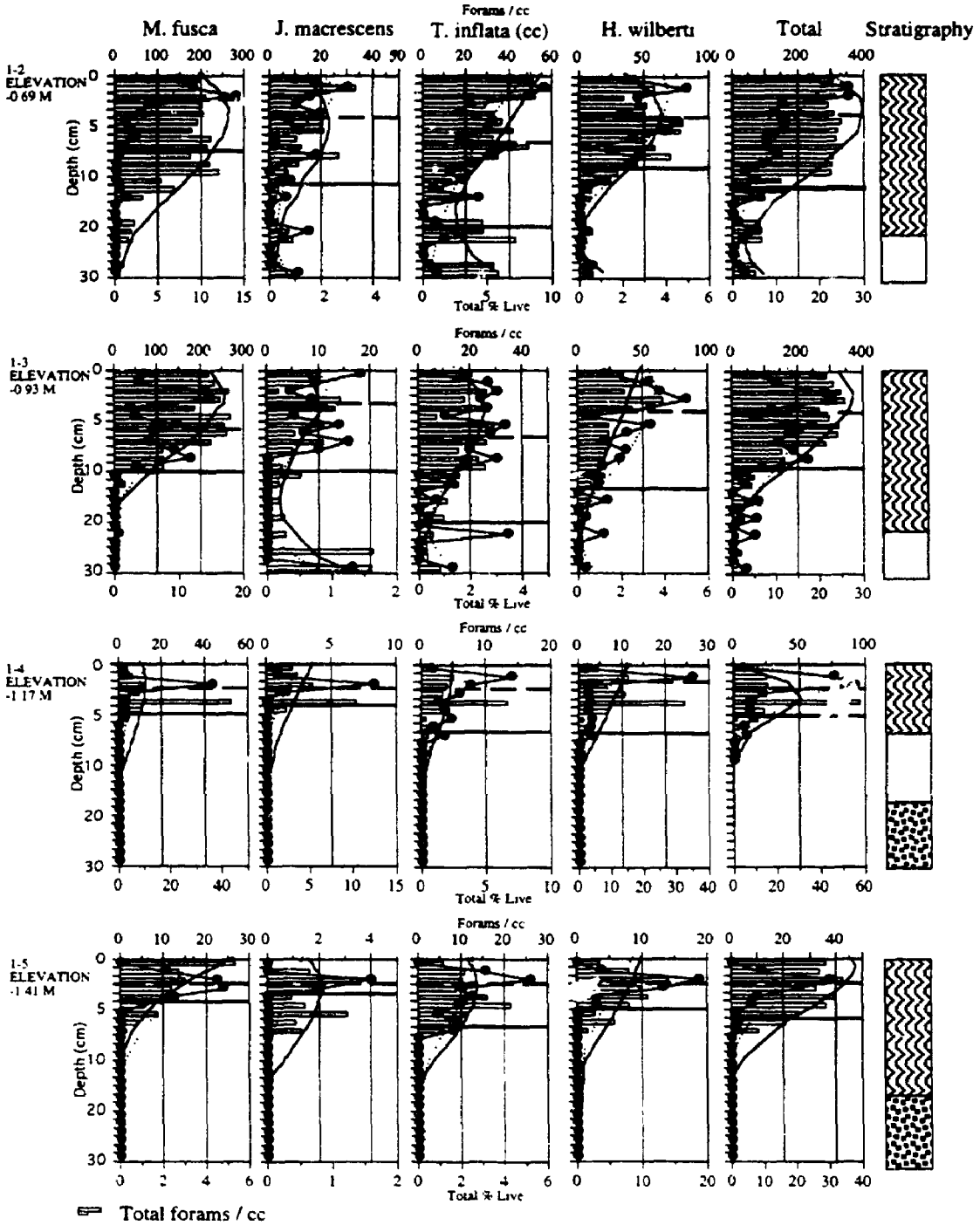

M. fusca
J. macrescens
T. inflata (cc)
H. wilberti
Total
Stratigraphy
Forams / cc
N95-2
ELEVATION
0 M
N95-1
ELEVATION
-0 11M
2-1
ELEVATION
-0 34M
1-1
ELEVATION
-0 45 M
2-2
ELEVATION
-0 46 M
Depth (cm)
Total % Live

Figure 7 (con't)



This is indicated by the solid and straight lines respectively, across each graph of downcore species abundances (Fig. 7). Although most live *J. macrescens* are found from 0-20 cm deep in the high marsh setting and from 0-11 cm in the low marsh setting , the main depth preference is from 2-8 cm as indicated by a slight "bulge" in the smoothed curve (Core 1-1 in Fig. 7) and by the average depth of infaunal habitat (see Cores 1-1, N95-1 and N95-2 in Fig. 7).

Under steady state conditions, unless taphonomic processes interfere, infaunal species will have abundances that increase down to preferred habitat depth, and then remain constant below that depth. Should taphonomic processes be at work, then a certain proportion of each species production will be destroyed and species abundance patterns will resemble the dashed lines in Fig. 8 (Loubere, 1989). By comparing the trend of *J. macrescens* with the trend in Fig. 8b, it can be concluded that there are taphonomic processes at work. Because both living populations and the total population (live plus dead) of *J. macrescens* decrease downcore, there is evidence of some taphonomic biasing.

Trochammina salsa (Brady, 1870) was grouped with *J. macrescens* in the first transect analyzed because it was unclear that these were two distinct species (Cores 1-1 through 1-5; Fig. 7). However, separate counts were made in samples from cores N95-1 and N95-2 analyzed subsequent to a personal communication from J. P. Guilbault. Interestingly, *T. salsa* and *J. macrescens* show nearly identical infaunal living habitats and total population distribution (Fig. 9), perhaps suggesting that a systematic reexamination of these species is in order. For consistency and since they behave similarly, these species have been lumped for the overall analysis.

Figure 8: Theoretical downcore foraminiferal test preservation profiles, after Loubere, 1989. Solid line represents theoretical downcore foraminiferal test preservation profile with no taphonomic biasing; dashed line represents theoretical downcore foraminiferal test preservation profile with taphonomic biasing.

Figure 8

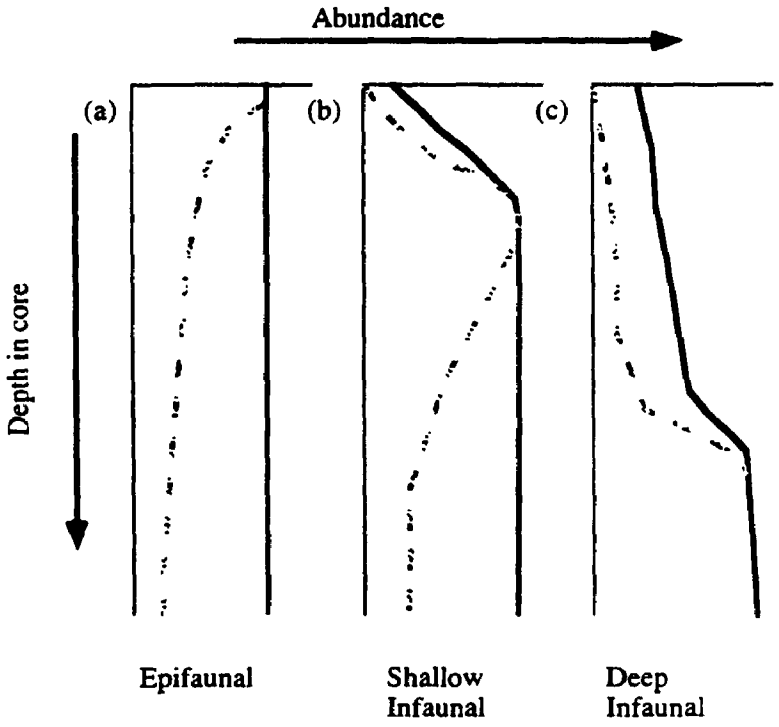
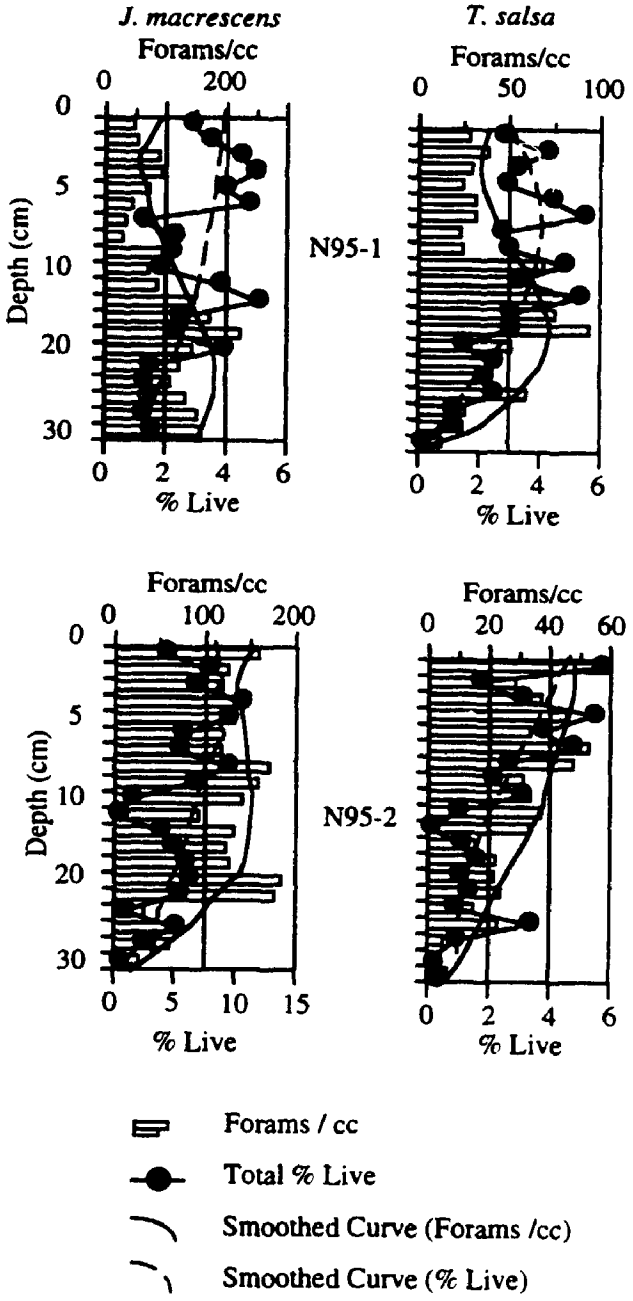

Abundance
(a)
(b)
(c)
Depth in core
Epifaunal
Shallow Infaunal
Deep Infaunal

Figure 9: Downcore species abundance of *Jadammina macrescens* and *Trochammina salsa* showing total forams/cc and percent live for two cores from the high marsh.

Figure 9


J. macrescens
T. salsa
Forams/cc
Depth (cm)
N95-1
N95-2
% Live
Forams / cc
Total % Live
Smoothed Curve (Forams /cc)
Smoothed Curve (% Live)

5.1.2 Trochammina inflata

Trochammina inflata was fairly abundant in all low marsh cores. On average, *T. inflata* has a slightly deeper infaunal habitat than *J. macrescens*, being most abundant between 4 and 9 cm, and showing little variation from high to low marsh. However, based on the depth where 95% of the species lived, most living *T. inflata* occur between 0 and 25 cm in the high marsh and between 0 and 20 cm in the low marsh environment (see Cores 1-1 and 2-2; Fig. 7). The average depth of infaunal habitat of *T. inflata* was 10 cm. This observation is in agreement with Goldstein (1988) who found *T. inflata* living to depths of 30 cm. In all cores, the total population trends for *T. inflata* closely mirror declines in the total percent live trends downcore, illustrating strong taphonomic biasing of *T. inflata* fossil faunas.

5.1.3 Haplophragmoides wilberti

Most common in the low marsh (see Cores 1-3; 1-4 and 1-5; Fig. 7), *Haplophragmoides wilberti* also has an infaunal habitat. Although *H. wilberti* lives at slightly shallower depths in a low marsh environment compared to the high marsh, it is overall most abundant between 3 and 7 cm, being almost absent near the surface in all cores. The infaunal habitat for this species consistently averaged around 5 cm depth. *H. wilberti* is primarily found between 0 and 15 cm in a high marsh setting, and between 0 and 12 cm in a low marsh environment, as can be seen from the 95% line in Figure 7. In all cores, the total population mirrors declines in the percent live trend downcore, indicating the strong taphonomic effects on *H. wilberti* fossil populations.

5.1.4 Miliammina fusca

Miliammina fusca is epifaunal. Populations of *M.* fusca in cores N95-1 and N95-2 are very low (with associated high standard errors) and thus they do not give an accurate representation of this species' distribution (Appendix 1). Most live *M. fusca* are found between 0 and 10 cm (95%) but are most abundant in the top 3 cm (50%). In contrast to live populations, total population remains high in the subsurface. This indicates better resistance to taphonomic effects and slightly better preservation potential than for *J. macrescens, T. inflata* and *H. wilberti.* However, the total population declines dramatically at the base of the cores indicating that taphonomic biasing can impact this species. In some cores (e.g. cores N95-1, 1-1, 1-2,1-3) this is the result of higher marsh overlain by a lower marsh facies, however, in cores 2-1, 2-2, 1-4 and 1-5, there was no change in the marsh but the trend is still observed.

5.1.5 General Distributional trends

Through analysis of total percent live vs. total population it is possible to determine overall marsh foraminiferal taphonomic effects. In the high marsh environment, 95% of living specimens tend to live slightly deeper infaunally (0-24 cm) as compared to the low marsh environment (0-12 cm; Fig. 7) and this holds true for individual species as well. The average depth of living specimens is 2-6 cm. This may be due to more unfavorable surface conditions in the higher marsh. There also appears to be a slight "bulge" in the percent live occurring within the 2-7 cm interval due to these infaunal living habitats. This is in accord with Denne and Gupta (1989) who observed a similar 'bulge" in the 2-4 cm interval from samples taken in deep water from the Gulf of Mexico.

The preservation potential decreases from high to low marsh settings. Overall, higher marsh cores (N956-2, N95-1, 2-1, 1-1) show very little change in total population downcore, whereas low marsh cores (1-2 - 1-5; 2-2) show a rapid decrease in species abundance downcore. This pattern is again the result of species in the higher marsh tending to live deeper infaunally than in the low marsh, and there are also greater numbers of infaunal vs. epifaunal species.

5.2 PART 2: Comparison of Sampling intervals

In studies of deep sea foraminifera, there has been some uncertainty regarding the thickness of the below-surface interval that provides the best analogue for fossil faunas. For example, Denne and Gupta, (1989) observed that the differences in population densities in cores from the same area could be attributed to surface sampling intervals, rather than variation in fossil faunas. They observed that some researchers sampled 0-1, 0-2 or 0-5 cm below the sediment-water interface, with each interval providing different results (Denne and Gupta, 1989). They concluded that although the 0-1 cm interval may yield more accurate information about distribution of epifaunal specimens currently living in the area, information about infaunal species will be low. Thus biofacies distributions, determined for relatively thick (2, 5 or 10 cm deep) sediment layers are more useful analogues of fossil biofacies distribution for paleoecological applications (Denne and Gupta, 1989)

From the infaunal distributional results reported in the previous section, it is obvious that a fossil foraminiferal biofacies assignment based on only the uppermost 0-1 cm will not provide a highly resolved identification of marsh characteristics. As the majority of species live several cm down in the

subsurface, foraminiferal analysis of a thicker near-surface sediment layer provides a better analogue for neotectonic and paleoecological applications.

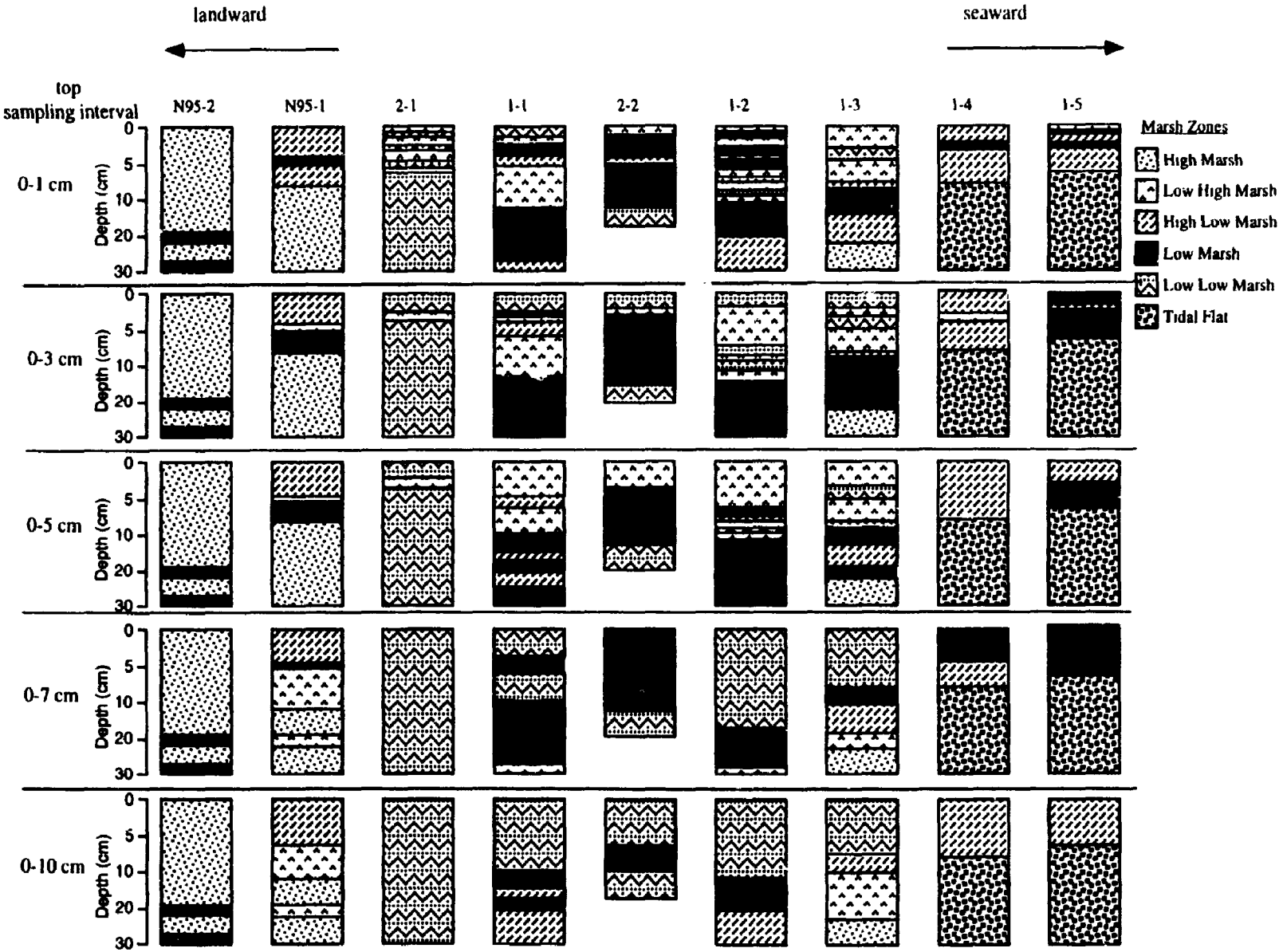
Five cluster analyses of the foraminiferal data using 0-1, 0-3, 0-5, 0-7, and 0-10 cm surface samples were carried out and five biofacies discriminated within each case. These analyses were carried out 1) to demonstrate if the 0-1 cm below-surface sample is sufficient to characterize fossil faunas, and if not, 2) to determine which near-surface interval is most analogous of these subsurface biofacies. These analyses resulted in highly varied subsurface biofacies assignments (Fig. 10). As expected, a dendrogram based on a 0-1 cm surface interval resulted in many small and discontinuous marsh zones. Little correlation between surface samples and core samples could be delineated, and it was unclear whether observed changes were actually characteristic of the core or artifacts of the analysis, the result of some infaunal marsh species not being considered.

The second dendrogram was generated by lumping samples from the 0-3 cm interval in each core together thus partially taking the infaunal habitat of some foraminiferal species into consideration (Fig. 10). Biofacies resolution is clearer based on this interval, as many of the discontinuous zones have disappeared. Some biofacies could also be clearly traced between cores using this grouping.

The third dendrogram was based on grouping the top 5 cm in each core and included even more infaunal components (Fig. 10). Correlation between cores was further improved resulting in more realistic sea level change records. The fourth and fifth dendrograms produced were based on grouping the top 7 and 10 cm of each core, respectively (Fig. 5,10). Both of these groupings eliminated much of the noise in the data, and still provided a good indication of biofacies distribution in the marsh. Although results of both clusters are similar,

Figure 10: Zonation of each core based on biofacies analysis of sample intervals 0-1 cm, 0-3 cm, 0-5 cm, 0-7 cm, and 0-10 cm, below sediment-water interface.

Figure 10


landward
seaward
top sampling interval
N95-2
N95-1
2-1
1-1
2-2
1-2
1-3
1-4
1-5
0-1 cm
0-3 cm
0-5 cm
0-7 cm
0-10 cm
Depth (cm)
0
5
10
20
30
Marsh Zones
High Marsh
Low High Marsh
High Low Marsh
Low Marsh
Low Low Marsh
Tidal Flat

it is suggested that the 0-10 cm sampling interval more accurately reflects the infaunal characteristics of many species of marsh foraminifera, as 95% of live foraminifera are found in the upper 10-15 cm of the surface sediments. This interval is also thin enough that epifaunal species (e.g. *M. fusca*) are not under-represented in the analysis (Fig. 10).

6.0 CONCLUSIONS

1. Strong taphonomic biasing greatly decreases the preservation potential of many marsh foraminifera species. These taphonomic effects are higher in a low marsh environment than in a high marsh environment.

2. Individual infaunal marsh foraminifera species (*T. inflata, J. macrescens, T. salsa, H. wilberti*) have a slightly deeper infaunal habitat in a high marsh than in a low marsh. *M. fusca* remains epifaunal regardless of the environment.

3. Ninety-five percent of foraminifera species in a marsh of the Nanaimo area live within the 0-10 or 15 cm sub-surface interval. Based on results of cluster analysis, and the infaunal habitat of many marsh foraminifera, it is necessary to take near-surface samples in marsh environments to a depth of 10 cm to obtain a representative samples. Sampling only the uppermost 0-1 cm will not give an accurate representation of marsh species. This will allow researchers to delineate both subtle and dramatic sea level changes more precisely, which is critical to differentiating a magnitude of seismic events and also to represent subtle eustatic events as well.

7.0 REFERENCES

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Appendix 1:Microfaunal occurrences from cores taken from Nanaimo, British Columbia (con't)

Sample #	N95-1,2-3	N95-1,3-4,	N95-1,4-5,	N95-1,5-6,	N95-1,6-7,	N95-1,7-8,	N95-1,8-9,	N95-1;9-10;	N95-1,10-12	N95-1;12-14;	N95-1;14-16;	N95-1;16-18,
Actual count	586	607	582	507	573	485	635	508	605	689	731	703
Fraction examined	1	1	1	1	1	1	1	1	1	1	1	1
Total foraminifera /cc	352	364	349	304	344	291	381	305	363	413	439	422
Biofacies Assignment	3	3	3	3	3	3	3	3	2	2	2	1
Trochammina inflata (%)	8 9	7 3	9 6	10 8	7 3	8 9	18.6	18 3	22 8	18 8	21.9	12 6
Uncertainty +/-	2 97	2 66	3 09	3 49	2 76	3 27	3 91	4 34	4 32	3 76	3 87	3 16
Trochammina inflata (% live)	3 8	3 4	4 9	6 0	3 2	3 5	5 3	3 8	5 8	3 5	3 5	2 0
Uncertainty +/-	1 99	1 86	2 26	2 66	1 87	2 10	2 25	2 15	2 40	1 78	1 73	1 33
Miliammina fusca (%)	16 4	15 8	14 8	26 2	42 1	55 7	29 9	35 0	28 1	21 2	10 9	15.4
Uncertainty +/-	3 87	3 75	3 72	4 94	5 22	5 71	4 60	5 36	4 62	3 94	2 92	3 44
Miliammina fusca (% live)	1 9	1 0	0 3	3 0	3 0	3 9	1 6	0 8	1 7	2 6	1 1	0 9
Uncertainty +/-	1 42	1 02	0 61	1 90	1 79	2 23	1 25	0 99	1 31	1 54	0 97	0 88
Jadaminna macrescens (%)	25 4	26 0	20 6	14 4	9 6	9 7	25 2	24 0	23 5	35 6	39 1	52 9
Uncertainty +/-	4 55	4 51	4 24	3 95	3 11	3 40	4 36	4 80	4 36	4 61	4 57	4.76
Jadaminna macrescens (% live)	4 4	4 9	4 0	4 7	1 2	2 3	2 2	1 8	3 8	5 1	2 5	2 3
Uncertainty +/-	2 15	2 23	2 04	2 39	1 16	1 71	1 47	1 48	1 97	2 12	1 45	1 42
Haplophragmoides wilberti (%)	41 0	44 2	45 5	38 3	33 7	16 9	7 6	4 5	3 0	6 2	6 4	7 1
Uncertainty +/-	5 14	5 10	5 22	5 46	5 00	4 31	2 65	2 33	1 75	2 33	2 30	2 45
Haplophragmoides wilberti (% live)	7 2	7 9	8 6	10 5	7 9	3 5	1 3	1 0	0 5	1 2	0 4	0 6
Uncertainty +/-	2 70	2 77	2 94	3 44	2 84	2 11	1 12	1 11	0 72	1 03	0 60	0 72
Reophax nana (%)	0 0	0 0	0 2	0 0	0 4	0 4	0 3	0 0	0 3	0 0	0 1	0 0
Uncertainty +/-	0 00	0 00	0 43	0 00	0 62	0 73	0 56	0 00	0 59	0 00	0 35	0 00
Reophax nana (% live)	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
Ammobaculites foluaceous (%)	0 0	0 2	0 2	0 0	0 2	0 0	0 3	0 4	0 0	0 0	0 1	0 0
Uncertainty +/-	0 00	0 42	0 43	0 00	0 44	0 00	0 56	0 70	0 00	0 00	0 35	0 00
Trochammina regularis												
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
Trochammina salsa (%)	8 4	6 7	9 1	10 3	6 8	8 4	18 1	17 8	22 3	18 2	21 4	12 0
Uncertainty +/-	2 89	2 57	3 02	3 41	2 66	3 19	3 86	4 29	4 28	3 72	3 84	3 11
Trochammina salsa (% live)	3 2	2 9	4 4	5 5	2 7	2 9	4 8	3 3	5 3	3 0	3 0	1 4
Uncertainty +/-	1 85	1 71	2 15	2 55	1 72	1 94	2 14	2 00	2 30	1 65	1 60	1 14
Ammotium salsum (%)												
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
*Centropyxis aculeata (%)**												
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
*Difflugia oblonga (%)**												
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
*Arcella vulgaris (%) *												
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
*Pontigulasia compressa (%) *												
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
Total live	20 5	20 1	22 2	29 6	18 0	16.1	15 1	10 6	17.0	15.4	10 5	7 1

* N.B. not foraminifera

Appendix 1:Microfaunal occurrences from cores taken from Nanaimo, British Columbia

Sample #	1-1,0-1	1-1;1-2	1-1;2-3;	1-1,3-4;	1-1,4-5;	1-1;5-6;	1-1,6-7;	1-1;7-8	1-1,8-9;	1-1;9-10	1-1;10-11 5	1-1;11 5-13	1-1;13-14.5	1-1,14.5-16	1-1;17.5-19	1-1;19-20.5
Actual count	523	626	515	493	558	459	509	514	574	470	551	548	512	495	557	487
Fraction examined	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Total foraminifera /cc	314	376	289	298	328	276	260	312	340	282	335	325	309	305	321	167
Biofacies Assignment	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	3
Trochammina inflata (%)	10 3	4 0	5 0	5 8	18 5	14 6	24 2	17 7	15 3	14.9	14.1	14 9	7.2	10.0	37.9	32.9
Uncertainty +/-	3 36	1 98	2 50	2 66	4 20	4 16	5 20	4 23	3 83	4.15	3 73	3.87	2 88	3.37	5 31	7 13
Trochammina inflata (% live)	2 3	1 3	2 1	2 6	9 1	7 0	6 9	6 9	5 6	5 5	5 2	5.4	1 7	1 0	12 3	3.2
Uncertainty +/-	1 66	1 13	1 64	1 81	3 12	3 00	3 08	2 82	2 45	2 67	2 37	2 45	1.46	1.11	3 60	2 68
Miliammina fusca (%)	76 9	85 8	75 0	75 7	50 6	54 8	32 3	35 2	39 1	38 3	64 8	60 0	65 2	70 5	52 5	40 6
Uncertainty +/-	4 67	3 53	4 99	4 87	5 41	5 87	5 68	5 30	5 18	5 67	5.11	5 33	5.31	5 12	5 46	7.45
Miliammina fusca (% live)	31 9	28 7	2 9	1 2	5 7	3 0	4 6	3 8	2 5	1 7	4 1	1 5	2 1	1 4	0.9	1 0
Uncertainty +/-	5 16	4 57	1 93	1 24	2 50	2 03	2 55	2 13	1 65	1 51	2 13	1 31	1 61	1 31	1 05	1 50
Jadammina macrescens (%)	5 0	3 5	3 5	10 1	7 1	7 0	12 7	14 2	15 0	14 3	5 6	5 0	4 9	3.5	8 2	3.7
Uncertainty +/-	2 40	1 86	2 12	3 41	2 78	3 00	4 04	3 88	3 79	4 08	2 45	2 36	2.40	2 07	3 00	2.87
Jadammina macrescens (% live)	1 1	1 0	0 2	1 6	2 2	3 0	1 2	3 8	4 4	3 0	2 1	1 5	1 4	0 6	0 2	0 0
Uncertainty +/-	1 18	0 98	0 52	1 43	1 58	2 03	1 30	2 13	2 18	1 98	1 55	1 31	1 29	0 86	0 47	0 00
Haplophragmoides wilberti (%)	7 8	6 5	16 4	7 9	23 8	23 7	30 9	32 9	29 8	32 6	15 6	20.1	22 7	15 9	1 3	22 3
Uncertainty +/-	2 97	2 50	4 26	3 05	4 61	5 02	5 61	5 21	4 86	5 47	3 88	4 36	4 67	4 11	1 24	6.32
Haplophragmoides wilberti (% live)	2 5	2 7	2 5	2 6	7 3	7 4	5 8	10 2	6 9	6 8	1 6	3 0	2.1	1 4	0.0	1 2
Uncertainty +/-	1 72	1 64	1 79	1 81	2 82	3 09	2 83	3 36	2 69	2 94	1 35	1.84	1.61	1 31	0 00	1 68
Reophax nana (%)	0 0	0 2	0 0	0 6	0 0	0 0	0 0	0 0	0 7	0 0	0 0	0 0	0 0	0 0	0 0	0 5
Uncertainty +/-	0 00	0 40	0 00	0 88	0 00	0 00	0 00	0 00	0 89	0 00	0 00	0 00	0 00	0 00	0 00	1 07
Reophax nana (% live)																
Uncertainty +/-	0.00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0.00	0 00
Ammobaculites foliaeceous (%)	0 0	0 0	0 2	0 0	0 0	0 0	0 0	0 0	0 2	0 0	0 0	0.0	0 0	0.0	0 0	0.0
Uncertainty +/-	0 00	0 00	0 52	0 00	0 00	0 00	0 00	0 00	0 45	0 00	0 00	0 00	0 00	0 00	0.00	0.00
Trochammina regularis Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
Trochammina salsa (%) Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
Trochammina salsa (% live) Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0.00
Ammotium salsum (%) Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
*Centropyxis aculeata (%)** Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
*Difflugia oblonga (%)** Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0.00
*Arcella vulgaris (%) ** Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
*Pontigulasia compressa (%) ** Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
Total live	37 9	33 7	7 7	8 0	24 3	20 4	18 4	24 8	19.4	17.0	13 1	11 3	7.4	4 3	13 5	5 4

* N.B. not foraminifera

Appendix 1:Microfaunal occurrences from cores taken from Nanaimo, British Columbia (con't)

Sample #	1-1;20.5-22	1-1;22-23.5	1-1;23.5-25	1-1;25-26.5	1-1;26 5-28	1-1;28-29.5	1-1;29.5-31	1-2;0-1	1-2;1-2	1-2;2-3	1-2;3-4	1-2;4-5;	1-2,5-6;	1-2;6-7;
Actual count	552	467	461	466	424	452	526	504	547	564	485	511	551	532
Fraction examined	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Total foraminifera /cc	334	272	277	143	147	131	134	309	339	316	295	311	334	320
Biofacies Assignment	4	4	3	3	3	3	3	5	5	5	5	5	5	5
Trochammina inflata (%)	25 5	36 6	30.1	34.4	26.7	27.2	39 2	16.5	17.4	16.5	10.0	10.8	11.0	13.1
Uncertainty +/-	4 67	5 72	5.40	7 78	7.14	7 62	8.25	4.14	4.03	4.10	3 42	3.45	3 35	3.70
Trochammina inflata (% live)	3 9	1 8	1 1	2 3	1 6	0 0	0 2	6 8	9 4	8.2	3.7	2.9	5.4	5.1
Uncertainty +/-	2 09	1 56	1 22	2 46	2 04	0 00	0 79	2 81	3.10	3.02	2 15	1.86	2.42	2.40
Miliammina fusca (%)	41 5	40 8	38 7	34.6	43 4	25.9	22 4	63 1	55.4	66 7	69 0	66.0	57 6	55 6
Uncertainty +/-	5 28	5 84	5 73	7.79	8 00	7 50	7 04	5.38	5.29	5.20	5.28	5 27	5.30	5 44
Miliammina fusca (% live)	0 5	1 3	0 4	1 0	1 2	1 4	0 0	7.4	9.0	14 1	3 9	3 1	1 1	1 5
Uncertainty +/-	0 78	1 36	0 77	1 67	1.77	1.99	0.00	2 91	3.05	3 84	2 20	1 92	1.11	1.33
Jadammina macrescens (%)	13 1	9 3	5 4	7 6	5 3	28 8	17.7	6 2	9.9	5 3	3.5	6.6	6.1	6.6
Uncertainty +/-	3 62	3.44	2 66	4 33	3.62	7.75	6.45	2 69	3.18	2.48	2.09	2.75	2.57	2.71
Jadammina macrescens (% live)	0 5	0 4	0 2	0 2	0 8	0 7	0 7	1 0	3 0	1 5	1 0	1.9	0.7	1.1
Uncertainty +/-	0 78	0 79	0 55	0 75	1 45	1 41	1.37	1.09	1 82	1 35	1.15	1 53	0.91	1.15
Haplophragmoides wilberti (%)	19 9	13 4	25.8	23.5	24.6	18 1	20 8	14 0	17 2	10 8	17 5	16.4	23 9	24.3
Uncertainty +/-	4 28	4 05	5 15	6 95	6 96	6 59	6 86	3.87	4 01	3 43	4 34	4.12	4 57	4.70
Haplophragmoides wilberti (% live)	1 8	0 4	1 3	0 4	0 6	0 5	0.0	2 5	5 0	2.7	2.9	1 9	4 5	3.9
Uncertainty +/-	1.42	0.79	1 33	1 06	1 26	1 16	0.00	1 75	2 31	1 78	1.90	1 53	2 22	2 13
Reophax nana (%)	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 2	0 0	0.0	0.9	0.0
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0.00	0.48	0 00	0.00	1.01	0.00
Reophax nana (% live)														
Uncertainty +/-	0.00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0.00
Ammobaculites foliaeceous (%)	0 0	0.0	0 0	0 0	0 0	0 0	0.0	0 2	0 2	0.4	0.0	0.2	0 5	0.4
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0.00	0.49	0 45	0.68	0 00	0.49	0.78	0 67
Trochammina regularis														
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0	0 00	0.00	0 00	0 00	0 00
Trochammina salsa (%)														
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
Trochammina salsa (% live)														
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0.00	0.00	0 00	0.00	0 00	0 00
Ammotium salsum (%)														
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0.00	0 00	0 00	0 00
*Centropyxis aculeata (%)**														
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0.00	0 00
*Difflugia oblonga (%)**														
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
Arcella vulgaris (%) *														
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0.00	0.00	0 00	0.00
Pontigulasia compressa (%) *														
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0.00	0 00	0 00	0 00
Total live	6 8	4 0	3 0	4 0	4 3	2 5	0 9	17.7	26 4	26.4	11.4	9.8	11 7	11.6

* N.B. not foraminifera

Appendix 1:Microfaunal occurrences from cores taken from Nanaimo, British Columbia (con't)

Sample #	1-2,7-8	1-2;8-9;	1-2,9-10	1-2;10-11 5	1-2,11 5-13	1-2;13-14 5	1-2;14 5-16	1-2;16-17 5	1-2;20 5-22	1-2;22-23 5	1-2;23.5-25	1-2;28-29.5	1-2;29.5-31	1-3;0-1
Actual count	513	602	508	498	503	485	532	500	538	567	586	548	604	467
Fraction examined	1	1	1	1	1	2	1	2	3	2	2	3	3	1
Total foraminifera /cc	316	334	308	306	302	147	159	98	81	81	89	66	66	289
Biofacies Assignment	5	5	5	5	5	5	5	5	4	4	3	3	3	5
Trochammina inflata (%)	10 4	14 7	11 3	8 6	7 2	9 2	5 9	21 9	34 3	34 9	48 1	48.9	52.6	7.3
Uncertainty +/-	3 37	3 80	3 53	3 15	2 91	4 66	3.65	8 21	10 34	10.40	10.40	12.03	12.06	3.00
Trochammina inflata (% live)	2 8	6 6	5 4	3 7	2 2	3 1	0 8	4.3	0.9	3 7	1 7	0 4	1 1	0 6
Uncertainty +/-	1 83	2 67	2 53	2 12	1 65	2 78	1 35	4 03	2 09	4 13	2 68	1 44	2 48	0.91
Miliammina fusca (%)	70 8	63 7	57 0	71 8	80 5	73 5	86 0	66 8	56 3	43.5	35 2	31 5	18.1	76.1
Uncertainty +/-	5 01	5 15	5 53	5 04	4 47	7 13	5 39	9 34	10 80	10 82	9 94	11 17	9.30	4.92
Miliammina fusca (% live)	2 3	0 7	0 4	0 2	0 2	0 2	0 4	1 2	0 2	0 0	0 0	0.0	0.0	4.6
Uncertainty +/-	1 64	0 91	0 69	0 50	0 50	0 73	0 95	2 19	0 94	0 00	0.00	0.00	0 00	2.41
Jadammina macrescens (%)	3 2	3 6	8 8	3 7	2 4	3 9	2 1	2 7	3 9	9 3	10 0	5 6	14.0	3 5
Uncertainty +/-	1 95	1 99	3 15	2 12	1 72	3 11	2 22	3 19	4 21	6.33	6.24	5.52	8.39	2.13
Jadammina macrescens (% live)	0 2	0 2	1 8	0 6	0 0	0 8	0 0	0.6	0 0	1.5	0 5	0.0	1 1	1.5
Uncertainty +/-	0 48	0 45	1 46	0 86	0 00	1 45	0 00	1 55	0 00	2 64	1 48	0 00	2 48	1.38
Haplophragmoides wilberti (%)	15 4	17 4	23 0	14 7	9 9	13 4	6 0	8 6	5 6	12 3	6.8	14.0	15.3	12.3
Uncertainty +/-	3 98	4 07	4 69	3 97	3 38	5 51	3 70	5 57	4 99	7 16	5 23	8 36	8.69	3.79
Haplophragmoides wilberti (% live)	2 5	0 4	2 7	2 4	0 4	1 2	0 2	0 0	0 0	0 4	0 0	0 5	0 4	1 2
Uncertainty +/-	1 71	0 64	1 82	1 70	0 71	1 77	0.67	0 00	0 00	1 33	0.00	1 76	1.44	1.28
Reophax nana (%)	0 2	0 0	0 0	0 2	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0.0	0.8
Uncertainty +/-	0 48	0 00	0 00	0 50	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	1.05
Reophax nana (% live)														0 0
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
Ammobaculites foliaceous (%)	0 0	0 5	0 0	1 0	0 0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	0 0	0.0
Uncertainty +/-	0 00	0 78	0 00	1 10	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0.00	0.00	0.00
Trochammina regularis														0.0
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0.00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
Trochammina salsa (%)														
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0.00	0.00	
Trochammina salsa (% live)														
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
Ammotium salsum (%)														
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0.00
*Centropyxis aculeata (%)**														0.0
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0.00	0.00	0 00	0 00	0.00
*Difflugia oblonga (%)**														0.0
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
*Arcella vulgaris (%) **														
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0.00	0 00
*Pontigulasia compressa (%) **														
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
Total live	7 8	7 9	10.3	6 9	2 8	5 3	1 3	6 1	1 1	5 6	2 2	0 9	2 5	7.9

* N.B. not foraminifera

Appendix 1:Microfaunal occurrences from cores taken from Nanaimo, British Columbia (con't)

Sample #	1-3;1-2	1-3;2-3;	1-3;3-4;	1-3;4-5;	1-3;5-6;	1-3;6-7;	1-3;7-8	1-3;8-9;	1-3;9-10	1-3;10-11.5	1-3;11 5-13	1-3;13-14.5	1-3;14.5-16	1-3;17.5-19	1-3,20.5-22
Actual count	521	563	509	444	502	528	463	475	540	531	512	343	314	301	305
Fraction examined	1	1	1	1	1	1	1	1	2	2	2	3	3	4	5
Total foraminifera /cc	313	333	349	269	296	325	324	287	152	160	161	67	62	44	37
Biofacies Assignment	5	5	5	5	5	5	5	5	5	5	3	3	3	2	2
Trochammina inflata (%)	6 5	7 9	5 2	9 7	2 4	9 1	8 7	9 2	10 0	14.7	16 0	22 7	24 2	24 3	26.2
Uncertainty +/-	2.73	2 90	2 32	3.54	1 75	3 12	3 07	3 34	4.77	5.49	5 65	10.02	10.70	12.71	14 23
Trochammina inflata (% live)	2 7	3 1	2 4	2.7	1 0	3 3	2 8	2 1	2 0	3 0	1 9	0.0	1 3	0 7	0 3
Uncertainty +/-	1.79	1 85	1.61	1.92	1 14	1 95	1 79	1.65	2 21	2 65	2 08	0.00	2 80	2 41	1.85
Miliammina fusca (%)	74.3	80.4	70.9	69 3	91.1	79.1	80.7	78.7	72.8	71.8	70.3	21 6	40.1	4 0	5 3
Uncertainty +/-	4.84	4 27	4 77	5 52	3 25	4.42	4 29	4.73	7 06	6 98	7.05	9 83	12 24	5 81	7 21
Miliammina fusca (% live)	3 6	14.1	14 8	2 4	3 2	9 6	6 1	5 4	9.1	11 7	3 3	0.0	0 6	0.0	0.0
Uncertainty +/-	2 07	3.73	3.73	1 84	2 02	3 21	2 61	2 62	4 56	4.98	2 77	0 00	1.99	0 00	0.00
Jadammina macrescens (%)	2 9	0.7	4 1	4 9	1 4	3 3	1 7	3 8	3 2	0 8	1 7	9 3	3 8	5 7	9 2
Uncertainty +/-	1 85	0 91	2 09	2 57	1 35	1 95	1.40	2 20	2 77	1 34	1 98	6 95	4.79	6 85	9 34
Jadammina macrescens (% live)	0 8	0.4	0 7	0 4	0 4	1 1	0 6	1.3	0 8	0 0	0 0	0 0	0 0	0 0	0 0
Uncertainty +/-	0 97	0 64	0 87	0 79	0 72	1.14	0 81	1 29	1.40	0.00	0 00	0 00	0.00	0.00	0.00
Haplophragmoides wilberti (%)	16 1	11 0	18.9	15 3	5 1	7 6	7 6	7.7	14 0	12 0	11 5	30 0	16 6	16 0	9 2
Uncertainty +/-	4 07	3 36	4.11	4.30	2 50	2 88	2.88	3.09	5.51	5.05	4 93	10.96	9 28	10.86	9 34
Haplophragmoides wilberti (% live)	3 3	3.8	5 0	3 3	0 4	3 3	2 2	1.3	2 2	1 9	1 1	0 6	1 0	1 3	0 3
Uncertainty +/-	1 97	2.05	2 29	2 14	0 72	1 95	1 61	1 29	2 31	2 11	1.62	1 82	2 43	3 40	1.85
Reophax nana (%)	0 0	0 0	0 2	0 0	0 0	0 9	1 3	0 6	0 0	0 8	0.4	13.1	11 8	44 9	46.2
Uncertainty +/-	0 00	0 00	0.43	0 00	0 00	1 04	1 23	0 91	0 00	1 34	0 94	8 07	8 05	14 75	16 13
Reophax nana (% live)	0 0	0 0	0 0	0.0	0 0	0 9	1 3	0 6	0.0	0 8	0.4	0 3	0.0	4 0	4.6
Uncertainty +/-	0 00	0 00	0.00	0 00	0 00	1 04	1 23	0 91	0.00	1 34	0 94	1.29	0.00	5 80	6.77
Ammobaculites foliaeceous (%)	0 2	0 0	0.7	0 9	0 0	0 0	0 0	0 0	0 0	0 0	0 0	1 2	1 6	2 0	2 6
Uncertainty +/-	0.48	0 00	0 87	1 12	0 00	0 00	0 00	0 00	0 00	0 00	0 00	2 57	3 13	4 15	5 17
Trochammina regularis	0 0	0 0	0.0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 3	0 3	1.7	0 3
Uncertainty +/-	0 00	0.00	0 00	0.00	0 00	0 00	0 00	0 00	0 00	0.00	0 00	1 29	1 41	3 79	1.85
Trochammina salsa (%)															
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0.00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
Trochammina salsa (% live)															
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
Ammotium salsum (%)															
Uncertainty +/-	0.00	0 00	0 00	0 00	0 00	0 00	0.00	0 60	0 00	0 00	0 00	0 00	0 00	0 00	0 00
*Centropyxis aculeata (%)**	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 3	0 0	0 0	0 3
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0.00	0 00	1 29	0.00	0.00	1 85
*Difflugia oblonga (%)**	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
Uncertainty +/-	0 00	0.00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0.00	0 00	0.00	0 00
*Arcella vulgaris (%) **															
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 0	0 00	0 00
*Pontigulasia compressa (%) **															
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0.00	0 00	0 00
Total live	10 3	21.3	22 9	8 8	5 1	18 3	13 0	10 6	14 0	17 3	6.7	0.9	2 9	6.0	5.2

* N.B. not foraminifera

Appendix 1:Microfaunal occurrences from cores taken from Nanaimo, British Columbia (con't)

Sample #	1-3,23 5-25	1-3;26 5-28	1-3,29.5-31	1-4,0-1	1-4,1-2	1-4;2-3,	1-4,3-4;	1-4;4-5,	1-4;5-6,	1 4,6-7,	1-4;7-8	1-4;8-9;	1-4,9-10	1-4;10-11 5	1-4;11.5-13
Actual count	174	302	304	348	328	315	338	311	369	214	106	52	145	46	51
Fraction examined	6	2	6	3	2	2	2	1	2	6	6	6	6	6	6
Total foraminifera /cc	168	271	302	65	84	89	86	164	79	30	35	24	26	31	21
Biofacies Assignment	2	1	1	3	3	3	3	3	3	3	3	3	3	3	3
Trochammina inflata (%)	32 8	11 4	27 3	17 3	19 8	15 6	13 1	13 5	19 0	25 2	27 3	48 0	30.3	39 1	35 3
Uncertainty +/-	7 10	3 78	5 02	9 20	8 51	7 54	7 15	5 23	8 66	15 48	14 72	19.82	17 66	17 18	20 44
Trochammina inflata (% live)	3 4	0 0	1 3	0 9	7 0	3 8	3 0	1 3	1 9	2 3	0 9	1 8	0 0	0 0	0 0
Uncertainty +/-	2 76	0 00	1 29	2 25	5 45	3 97	3 61	1 73	3 01	5 35	3 12	5 28	0 00	0 00	0.00
Miliammina fusca (%)	12 6	1 1	1 3	30 2	25 3	43 2	37 5	52 8	44 5	27 1	10 4	8 6	16 6	4 4	17 7
Uncertainty +/-	5 02	1 24	1 29	11 17	9 29	10 30	10 26	7 63	10 97	15 85	10 08	11 12	14 30	7 22	16 32
Miliammina fusca (% live)	0 6	0 0	0 0	0 9	2 4	36 2	5 3	2 3	2 2	2 3	0 0	0 0	0.0	0 0	0.0
Uncertainty +/-	1 14	0 00	0 00	2 25	3 27	9 99	4 75	2 29	3 24	5 35	0 00	0 00	0 00	0 00	0 00
Judammina macrescens (%)	20 7	74 6	66 1	15 3	9 1	13 3	6 8	7 1	6 3	5 1	10 4	1 9	4 1	10.9	9 8
Uncertainty +/-	6 13	5 18	5 34	8 76	6 14	7 06	5 33	3 93	5 36	7 85	10 08	5 42	7 62	10 97	12 72
Judammina macrescens (% live)	0 0	0 0	1 3	0 6	1 2	12 4	1 5	0 0	0 3	0 0	0 0	0 0	0 0	0 0	0 0
Uncertainty +/-	0 00	0 00	1 29	1 85	2 33	6 85	2 58	0 00	1 21	0 00	0 00	0 00	0 00	0 00	0 00
Haplophragmoides wilberti (%)	12 6	11 4	4 6	35 1	45 2	24 5	41 2	24 7	29 6	41 1	51 9	40 4	49 0	43 5	37 3
Uncertainty +/-	5 02	3 78	2 37	11 62	10 63	8 94	10 43	6 59	10 08	17 55	16 51	19 47	19 22	17 45	20 68
Haplophragmoides wilberti (% live)	1 1	0 0	0 3	2 3	3 8	2 9	3 0	3 5	3 0	4 2	3 8	3 9	0 0	0 0	0 0
Uncertainty +/-	1 61	0 00	0 65	3 65	10 17	3 49	3 61	2 81	3 77	7 15	6 32	7 68	0 00	0 00	0 00
Reophax nana (%)	17 2	1 1	0 0	0 0	0 3	3 2	1 2	1 6	0 8	0 9	0 0	0 0	0 0	2 2	0 0
Uncertainty +/-	5 71	1 24	0 00	0 00	1 17	3 66	2 31	1 92	1 97	3 37	0 00	0 00	0 00	5 16	0 00
Reophax nana (% live)	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 5	0 0	0 0	0 0	0 0	0 0	0 0
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	1 56	0 00	0 00	0 00	0 00	0 00	0 00
Ammobaculites foliaeceous (%)	0 6	0 0	0 0	2 0	0 0	0 3	0 3	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
Uncertainty +/-	1 14	0 00	0 00	3 41	0 00	1 14	1 16	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
Trochammina regularis	1 1	0 4	0 7												
Uncertainty +/-	1 61	0 72	0 91	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
Trochammina salsa (%)															
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
Trochammina salsa (% live)															
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
Ammotium salsum (%)				0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
*Centropyxis aculeata (%)**	0 6	0 0	0 0												
Uncertainty +/-	1 14	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
*Difflugia oblonga (%)**	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 3	0 0	0 0	0 0	0 0	0 0	0 0	0 0
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 84	0 00	0 00	0 00	0 00	0 00	0.00	0 00
*Arcella vulgaris (%) **				0 3	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
Uncertainty +/-	0 00	0 00	0 00	1 33	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
*Pontigulasia compressa (%) **				0 0	0 3	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
Uncertainty +/-	0 00	0 00	0 00	0 00	1 17	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
Total live	5 2	0 0	3 0	4 6	45 4	55 3	12 8	7 1	7 9	8 8	4 7	5 7	0 0	0 0	0 0

* N.B. not foraminifera

Appendix 1:Microfaunal occurrences from cores taken from Nanaimo, British Columbia (con't)

Sample #	1-5,0-1	1-5,1-2	1-5,2-3,	1-5,3-4,	1-5,4-5,	1-5,5-6,	1-5,6-7,	1-5,7-8	1-5,8-9,	2-1,0-1	2-1;1-2	2-1,2-3,	2-1,3-4,	2-1,4-5,	2-1,5-6,	2-1,6-7,	2-1,7-8
Actual count	31	191	309	250	315	105	108	119	100	526	450	485	499	468	612	460	404
Fraction examined	6	6	4	5	4	6	6	6	6	1	1	1	1	1	1	1	1
Total foraminifera /cc	36	38	63	41	43	38	26	21	10	316	270	291	299	281	367	276	242
Biofacies Assignment	3	3	3	3	3	3	3	3	3	5	5	5	5	5	5	5	5
Trochammina inflata (%)	16 1	31 4	21 7	23 6	40 3	58 1	43 5	49 7	58.1	3 8	7.1	5 0	6 2	2 6	4.3	4 6	5.9
Uncertainty +/-	12 01	14.72	10.18	12 97	14.66	15 65	19.06	21 33	30.28	2.11	3.07	2.49	2 73	1 85	2 06	2.46	2.98
Trochammina inflata (% live)	0.0	3 1	5 2	2 0	2.5	1 9	0.9	1.8	1 6	0 6	0.9	1 0	1 2	0 2	0 3	1.3	0.0
Uncertainty +/-	0 00	5 50	5 48	4 27	4 67	4.33	3 63	5 67	7 70	0 87	1 12	1 16	1 23	0 54	0 58	1 34	0.00
Miliammina fusca (%)	74 2	37 7	28 5	31 6	28 5	14.3	33.3	18 5	12.9	74.9	78.4	76 9	75.8	86 1	70 8	79 1	81.9
Uncertainty +/-	14 29	15 37	11 15	14 42	13 49	11 10	18 12	16 57	20 57	4 78	4 91	4 84	4 85	4 05	4.65	4.79	4.84
Miliammina fusca (% live)	0 0	2 1	4 5	4 8	2 5	1 0	0 0	0 0	0 0	10 6	5 3	9 1	9.4	4 5	2 3	3 3	0.5
Uncertainty +/-	0 00	4 55	5.12	6 53	4.67	3 16	0 00	0 00	0 00	3.40	2.68	3.30	3 31	2 42	1.53	2.10	0.88
Jadammina macrescens (%)	0 0	4 2	6 8	5 2	2 2	3 8	12 0	5 0	12 9	13 3	6 7	3.9	4 4	2 6	5 9	3 7	6.9
Uncertainty +/-	0 00	6.36	6 22	6 78	4 38	6 06	12.49	9.30	20 57	3 75	2 98	2 23	2.33	1 85	2 41	2.23	3.20
Jadammina macrescens (% live)	0 0	0 0	1 5	0.8	0 0	0 0	0 0	0.0	0.0	1.9	1.1	1.2	0.6	0.0	0 3	0 0	0.5
Uncertainty +/-	0 00	0 00	3 10	2 72	0.00	0 00	0 00	0 00	0 00	1 51	1 25	1 27	0 88	0 00	0 58	0 00	0.88
Haplophragmoides wilberti (%)	9.7	24 6	41.1	36 8	28 3	23 9	11.1	27.7	16 1	5 9	7 1	3 4 0	12 2	8 1	17.8	12.4	5.0
Uncertainty +/-	9 67	13 66	12 15	14 73	13 46	13 52	12 07	19 10	22 56	2 60	3.07	3 99	3 71	3.19	3 91	3.89	2.73
Haplophragmoides wilberti (% live)	0 0	3 7	18 8	13 2	2 0	2 9	0 0	0 0	0 0	1 1	0 4	2 5	2 2	1 3	1 1	0 7	0 2
Uncertainty +/-	0 00	5 99	9 65	10 34	5 02	5 32	0 00	0 00	0 00	1 17	0 79	1.78	1.66	1 32	1 09	0 95	0.63
Reophax nana (%)	0 0	1 1	0 6	0 4	0 0	0 0	0 0	0 0	0 0	1 9	0 7	1.9	0.8	0 2	0 7	0 0	0 3
Uncertainty +/-	0 00	3 31	1 91	1 93	0 00	0 00	0 00	0 00	0 00	1 51	0 97	1 55	1 01	0 54	0 82	0 00	0 63
Reophax nana (% live)										0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0.00	0.00
Ammobaculites foliaceous (%)					0 0		0 0			0 0	0 0	0.2	0 6	0 4	0.7	0 2	0 0
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 52	0 88	0 76	0 82	0 55	0 00
Trochammina regularis																	
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
Trochammina salsa (%)																	
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
Trochammina salsa (% live)																	
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
Ammotium salsum (%)	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0								
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
*Centropyxis aculeata (%)**	0 0	0 5	0 3	0 4	0 0	0 0	0 0	0 0	0 0								
Uncertainty +/-	0 00	2 24	1 35	1 93	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
*Difflugia oblonga (%)**	0 0	0 5	0 6	0 0	0 0	0 0	0 0	0 0	0 0								
Uncertainty +/-	0 00	2 24	1 91	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
*Arcella vulgaris (%) **																	
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
*Pontigulasia compressa (%) **	0 0	0 0	0 3	0 0	0 0	0 0	0 0	0 0	0 0								
Uncertainty +/-	0 00	0 00	1 35	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
Total live	0 0	5 2	11 3	7 6	5 0	2 9	0 9	1 8	1 6	14 3	7 8	13 8	13 4	6 0	4 1	5 2	1 2

* N.B. not foraminifera

Appendix 1:Microfaunal occurrences from cores taken from Nanaimo, British Columbia (con't)

Sample #	2-1,8-9,	2-1,9-10	2-1,10-11 5	2-1,11 5-13	2-1;13-14 5	2-1,14 5-16	2-1;17 5-19	2-1,20 5-22	2-1;23 5-25	2-1;26 5-28	2-1;29.5-31	2-2;0-1	2-2;1-2	2-2;2-3;
Actual count	501	401	527	440	340	498	487	370	361	420	407	434	430	394
Fraction examined	1	1	2	2	1	2	1	3	3	3	4	2	1	1
Total foraminifera /cc	301	241	158	132	204	149	292	74	72	84	61	130	258	236
Biofacies Assignment	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Trochammina inflata (%)	4 2	6 0	2 5	2 3	5 3	1 6	2 7	12 4	11 6	10 5	11 8	6 0	9 1	10 9
Uncertainty +/-	2 27	3 00	2 42	2 54	3 07	2 02	1 85	7 52	7 39	6 55	8 09	4 08	3 50	3 97
Trochammina inflata (% live)	0 4	0 7	0 6	0 0	0 0	0 0	0 0	0 0	0 0	0 2	0 0	1 8	3 0	2 5
Uncertainty +/-	0 71	1 09	1 17	0 00	0 00	0 00	0 00	0 00	0 00	1 04	0 00	2 31	2.09	2.00
Miliammina fusca (%)	87 8	77 1	91 1	90 9	86 2	84 3	94 1	81 9	73 4	77 1	75 9	73 0	68 8	68.5
Uncertainty +/-	3 70	5 31	4 44	4 90	4 74	5 83	2 67	8 77	10 19	8 98	10 73	7 62	5 65	5 92
Miliammina fusca (% live)	1 8	3 5	1 5	0 5	0 6	1 2	0 0	0 0	0 3	0 0	0 0	2 3	5 6	2 5
Uncertainty +/-	1 50	2 32	1 91	1 15	1 05	1 75	0 00	0 00	1 21	0 00	0 00	2 58	2 80	2 00
Judammina macrescens (%)	3 2	2 7	2 7	2 7	0 9	0 4	1 0	3 2	4 2	2 9	4 4	8 8	8 4	8 9
Uncertainty +/-	1 99	2 06	2 51	2 78	1 28	1 01	1 16	4 03	4 61	3 56	5 16	4 86	3 38	3 63
Judammina macrescens (% live)	0 2	0 0	0 4	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	1 4	0 5	1 5
Uncertainty +/-	0 50	0 00	0 96	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	2 01	0 83	1 56
Haplophragmoides wilberti (%)	3 8	12 7	3 4	3 6	7 4	1 6	0 8	2 2	5 0	5 2	4 4	11 5	12 3	10 7
Uncertainty +/-	2 16	4 21	2 83	3 19	3 58	2 02	1 03	3 31	5 02	4 77	5 16	5 48	4 01	3 93
Haplophragmoide. wilberti (% live)	1 0	1 7	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 5	1 9	1 0
Uncertainty +/	1 12	1 65	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	1 16	1 65	1 28
Reophax nana (%)	0 8	1 3	0 2	0 2	0 0	0 2	1 2	0 3	5 8	4 5	3 2	0 0	0 9	0 8
Uncertainty +/-	1 01	1 40	0 68	0 82	0 00	0 72	1 26	1 18	5 40	4 44	4 41	0 00	1 17	1 11
Reophax nana (% live)	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 3	0 2	0 2	0 0	0 0	0 0
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	1 21	1 04	1 24	0 00	0 00	0 00
Ammobaculites foliaceous (%)	0 2	0 2	0 2	0 2	0 3	0 0	0 0	[illegible]	0 3	0 2	0 2	0 5	0 5	0 3
Uncertainty +/-	0 50	0 63	0 68	0 81	0 74	0 00	0 00	[illegible]	1 21	1 04	1 24	1 16	0 83	0 64
Trochammina regularis Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
Trochammina salsa (%) Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
Trochammina salsa (% live) Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
Ammotium salsum (%) Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
*Centropyxis aculeata (%)** Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
*Difflugia oblonga (%)** Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
*Arcella vulgaris (%) ** Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
*Pontigulasia compressa (%) ** Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
Total live	3 4	6 0	2 5	0 5	0 6	1 2	0 0	0 0	0 6	0 5	0 2	6 0	10 9	7 6

* N.B. not foraminifera

Appendix 1:Microfaunal occurrences from cores taken from Nanaimo, British Columbia (con't)

Sample #	2-2;3-4;	2-2;4-5;	2-2;5-6;	2-2;6-7;	2-2;7-8	2-2;8-9,	2-2;9-10	2-2;10-11.5	2-2;11.5-13	2-2;13-14.5	2-2;14.5-16	2-2;17.5-19	N95-1;0-1	N95-1;1-2;
Actual count	610	596	466	843	641	404	537	687	362	346	549	362	456	433
Fraction examined	2	1	1	1	1	1	1	1	1	1	2	6	1	1
Total foraminifera /cc	183	358	280	506	385	242	322	412	217	208	165	36	274	260
Biofacies Assignment	5	5	5	5	5	5	5	4	4	4	5	5	3	3
Trochammina inflata (%)	13.9	22 8	24.5	27.9	25.9	46 0	37.2	18.3	29 6	27.8	27 9	9 7	20.8	15.3
Uncertainty +/-	5 02	4 35	5 04	3 91	4 38	6 27	5 28	3.74	6 07	6.09	6.85	9 63	4 81	4.37
Trochammina inflata (% live)	3 6	5 7	2 1	1 8	0 9	6 7	6 5	2 2	2 8	1 4	0 5	1.1	6 1	4.8
Uncertainty +/-	2 70	2 40	1 70	1 15	0 96	3.14	2.70	1.41	2 18	1 62	1.13	3.41	2.83	2 59
Miliammina fusca (%)	55 3	47 0	50 2	47.9	51 5	37 1	46 6	36 2	41.7	50.6	46 6	80.4	15.4	17 1
Uncertainty +/-	7.20	5.17	5 86	4 35	4.99	6 08	5.45	4.64	6 56	6.80	7 62	12 93	4.27	4.58
Miliammina fusca (% live)	3 6	2 0	1 3	0.0	1.6	0.5	1.1	0.4	0.8	0.0	0.0	0 6	3.1	2.3
Uncertainty +/-	2 70	1 46	1 32	0 00	1.24	0 88	1 15	0.64	1.21	0 00	0.00	2 41	2.04	1 83
Jadammina macrescens (%)	5 3	13 4	10 1	7 8	5 6	6 2	8 8	9.6	15 5	13.9	17 1	2 8	17.3	20 8
Uncertainty +/-	3 23	3 53	3 53	2.34	2 30	3.03	3 09	2.85	4.81	4.70	5.75	5 34	4.48	4.93
Jadammina macrescens (% live)	1.3	2 0	0 9	0 2	0 0	0 2	0 0	0 0	0 0	0 0	0 0	0 0	2.9	3.5
Uncertainty +/-	1 65	1 46	1.08	0.42	0 00	0 63	0 00	0 00	0 00	0 00	0 00	0 00	1 9	2 22
Haplophragmoides wilberti (%)	25 6	16 4	14 2	16 0	16.5	10.6	7.5	6.6	13.3	7.2	7.3	5.8	26.3	33.3
Uncertainty +/-	6 32	3 84	4 09	3 20	3 71	3 88	2 87	2 39	4.51	3.52	3 97	7.61	5.22	5.73
Haplophragmoides wilberti (% live)	3 0	3 0	2 1	1 7	3 1	0 5	0.0	0 0	0 0	0 0	0 0	0 0	3 5	4 6
Uncertainty +/-	2 45	1 77	1 70	1 11	1.74	0 88	0.00	0.00	0.00	0.00	0.00	0.00	2.18	2.55
Reophax nana (%)	0 2	1.0	0 9	0 2	0 5	0 0	0 0	0 2	0 0	0.6	1.1	0.8	0 0	0 2
Uncertainty +/-	0 58	1 04	1 08	0 43	0 68	0 00	0.00	0 37	0 00	1 03	1 59	2 96	0 00	0 58
Reophax nana (% live)	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0.0	0.0	0.0	0 0	0.0	0.0	0.0
Uncertainty +/-	0 00	0 00	0 00	0 00	0.00	0 00	0 00	0.00	0 00	0 00	0 00	0 00	0.00	0.00
Ammobaculites foliaceous (%)	0 0	0 3	0 2	0 1	0 0	0 0	0 2	0 0	0.0	0 0	0 0	0 0	0 0	0.2
Uncertainty +/-	0 00	0 60	0 54	0 30	0 00	0 00	0 47	0 00	0 00	0 00	0 00	0 00	0 00	0 58
Trochammina regularis														
Uncertainty +/-	0 00	0 00	0 00	0.00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
Trochammina salsa (%)													10.1	14.8
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0.00	0.00	0 00	0 00	0 00	3 57	4.31
Trochammina salsa (% live)													2 8	4 2
Uncertainty +/-	0 00	0 00	0 00	0 00	0.00	0.00	0 00	0 00	0 00	0 00	0 00	0 00	1 95	2 45
Ammotium salsum (%)														
Uncertainty +/-	0.00	0 00	0 00	0.00	0 00	0 00	0 00	0 00	0.00	0 00	0 00	0 00	0 00	0.00
*Centropyxis aculeata (%)**														
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0.00	0 00	0 00	0 00	0 00	0 00	0 00
*Difflugia oblonga (%)**														
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0.00	0 00	0 00	0 00	0 00	0 00
*Arcella vulgaris (%) **														
Uncertainty +/-	0 00	0.00	0 00	0 00	0 00	0.00	0 00	0 00	0 00	0.00	0 00	0 00	0 00	0.00
*Pontigulasia compressa (%) **														
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0.00	0 00	0 00	0.00
Total live	11 5	12 8	6 4	3.7	5 6	7 9	7.6	2.6	3.6	1.4	0.5	1.7	18.3	19.4

* N.B. not foraminifera

Appendix 1:Microfaunal occurrences from cores taken from Nanaimo, British Columbia (con't)

Sample #	N95-1,2-3	N95-1;3-4;	N95-1,4-5,	N95-1,5-6,	N95-1;6-7;	N95-1,7-8,	N95-1,8-9;	N95-1;9-10;	N95-1,10-12	N95-1;12-14;	N95-1;14-16;	N95-1;16-18;
Actual count	586	607	582	507	573	485	635	508	605	689	731	703
Fraction examined	1	1	1	1	1	1	1	1	1	1	1	1
Total foraminifera /cc	352	364	349	304	344	291	381	305	363	413	439	422
Biofacies Assignment	3	3	3	3	3	3	3	3	2	2	2	1
Trochammina inflata (%)	8 9	7 3	9 6	10 8	7 3	8 9	18 6	18 3	22 8	18.8	21.9	12.6
Uncertainty +/-	2 97	2 66	3 09	3 49	2 76	3 27	3 91	4 34	4.32	3 76	3 87	3.16
Trochammina inflata (% live)	3 8	3 4	4 9	6 0	3 2	3 5	5 3	3 8	5 8	3 5	3 5	2 0
Uncertainty +/-	1 99	1 86	2 26	2 66	1 87	2 10	2 25	2 15	2 40	1 78	1 73	1 33
Miliammina fusca (%)	16 4	15 8	14 8	26 2	42 1	55 7	29 9	35 0	28 1	21 2	10 9	15 4
Uncertainty +/-	3 87	3 75	3 72	4 94	5 22	5 71	4 60	5 36	4 62	3 94	2 92	3 44
Miliammina fusca (% live)	1 9	1 0	0 3	3 0	3 0	3 9	1 6	0 8	1 7	2 6	1 1	0 9
Uncertainty +/-	1 42	1 02	0 61	1 90	1 79	2 23	1 25	0 99	1 31	1.54	0 97	0 88
Jadammina macrescens (%)	25 4	26 0	20 6	14 4	9 6	9 7	25 2	24 0	23 5	35 6	39 1	52 9
Uncertainty +/-	4 55	4 51	4 24	3 95	3 11	3 40	4 36	4 80	4.36	4 61	4 57	4.76
Jadammina macrescens (% live)	4 4	4 9	4 0	4 7	1 2	2 3	2 2	1 8	3 8	5 1	2 5	2 3
Uncertainty +/-	2 15	2 23	2 04	2 39	1 16	1 71	1 47	1 48	1 97	2 12	1.45	1 42
Haplophragmoides wilberti (%)	41 0	44 2	45 5	38 3	33 7	16 9	7 6	4 5	3 0	6 2	6 4	7 1
Uncertainty +/-	5 14	5 10	5 22	5 46	5 00	4 31	2 65	2 33	1 75	2 33	2 30	2 45
Haplophragmoides wilberti (% live)	7 2	7 9	8 6	10 5	7 9	3 5	1 3	1 0	0 5	1 2	0 4	0 6
Uncertainty +/-	2 70	2 77	2 94	3 44	2 84	2 11	1 12	1 11	0 72	1 03	0 60	0 72
Reophax nana (%)	0 0	0 0	0 2	0 0	0 4	0 4	0 3	0 0	0 3	0 0	0 1	0 0
Uncertainty +/-	0 00	0 00	0 43	0 00	0 62	0 73	0 56	0 00	0 59	0 00	0 35	0 00
Reophax nana (% live)	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
Ammobaculites foliaceous (%)	0 0	0 2	0 2	0 0	0 2	0 0	0 3	0 4	0 0	0 0	0 1	0 0
Uncertainty +/-	0 00	0 42	0 43	0 00	0 44	0 00	0 56	0 70	0 00	0 00	0 35	0 00
Trochammina regularis												
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
Trochammina salsa (%)	8 4	6 7	9 1	10 3	6 8	8 4	18 1	17 8	22 3	18 2	21 4	12 0
Uncertainty +/-	2 89	2 57	3 02	3 41	2 66	3 19	3 86	4 29	4 28	3 72	3 84	3 11
Trochammina salsa (% live)	3 2	2 9	4 4	5 5	2 7	2 9	4 8	3 3	5 3	3 0	3 0	1 4
Uncertainty +/-	1 85	1 71	2 15	2 55	1 72	1 94	2 14	2 00	2 30	1 65	1 60	1 14
Ammotium salsum (%)												
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
*Centropyxis aculeata (%)**												
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
*Difflugia oblonga (%)**												
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
*Arcella vulgaris (%) **												
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0.00
*Pontigulasia compressa (%) **												
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
Total live	20 5	20 1	22 2	29 6	18 0	16 1	15 1	10.6	17.0	15.4	10 5	7.1

* N.B. not foraminifera

Appendix 1:Microfaunal occurrences from cores taken from Nanaimo, British Columbia (con't)

Sample #	N95-1;18-20;	N95-1;20-22;	N95-1;22-24;	N95-1;24-26	N95-1;26-28	N95-1;28-30	N95-2;0-1	N95-2;1-2;	N95-2;2-3	N95-2;3-4;	N95-2;4-5;	N95-2;5-6;	N95-2;6-7;	N95-2;7-8;
Actual count	459	345	461	360	399	400	544	366	398	430	378	434	419	449
Fraction examined	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Total foraminifera /cc	275	207	278	216	239	240	326	220	239	258	227	260	251	269
Biofacies Assignment	1	1	2	1	1	1	1	1	1	1	1	1	1	1
Trochammina inflata (%)	15.7	16 5	22 0	12.5	10 7	5 9	18.6	13 4	16 1	18.1	15.2	20 8	19.5	12.1
Uncertainty +/-	4 30	5.06	4.87	4.41	3.91	2 98	4.22	4.50	4.66	4.69	4.67	4 93	4 89	3.89
Trochammina inflata (% live)	3 0	2 7	3 0	1 6	1 6	0 6	6 1	2 2	3 5	6 0	4 2	5 2	3.1	2 [illegible]
Uncertainty +/-	2 01	2 22	1 99	1.70	1.61	1.00	2 60	1 93	2 34	2 89	2 62	2.70	2 15	1.90
Miliammina fusca (%)	13 1	4 6	10 6	8 1	6 8	14 5	4.8	9 3	13 6	2 3	2 9	6 2	6 0	6 9
Uncertainty +/-	3 98	2 87	3 62	3 63	3 18	4 45	2 31	3 84	4 34	1 84	2 19	2 [illegible]	2 93	3.03
Miliammina fusca (% live)	0 9	0.0	0 6	0 0	0 0	0.5	0 2	1 6	0 8	0 5	0 5	0.9	0.7	0 9
Uncertainty +/-	1 10	0 00	0 94	0 00	0 00	0 89	0 46	1 68	1 10	0 83	0 94	1.16	1 04	1.12
Jadammina macrescens (%)	52 3	58.6	38 7	61 7	63 9	67 0	48 4	56 3	47 2	55 1	58.5	45 6	46 8	63.3
Uncertainty +/-	5.90	6 71	5 73	6 48	6.08	5 95	5 42	6.56	6.33	6 07	6 41	6 05	6.17	5.76
Jadammina macrescens (% live)	3 9	1 4	1 3	1 4	1 3	1 5	4 [illegible]	7 7	6 5	10.5	9 3	5.5	5.3	9.4
Uncertainty +/-	2 29	1.63	1 33	1 56	1.41	1 54	2 18	3 52	3 13	3 74	3.77	2 78	2 76	3.48
Haplophragmoides wilberti (%)	3 1	4 4	6 3	5 8	7 8	4.8	8.5	4 9	5 5	6 7	7 7	5 5	8.1	5 4
Uncertainty +/-	2 03	2 78	2 85	3 12	3 39	2 69	3 02	2 86	2 90	3 06	3 46	2 78	3 37	2.69
Haplophragmoides wilberti (% live)	0 7	0 9	0 2	0 3	0 3	0 3	0 6	0 3	1 0	1 2	1 6	0 2	1 0	0 7
Uncertainty +/-	0 95	1 26	0 55	0 70	0 63	0 63	0 80	0.69	1 27	1 31	1 63	0.58	1.20	0.97
Reophax nana (%)	0 4	0 0	0 9	0 0	0.3	2 5	1 8	3 0	2 0	0 2	0 8	0.9	0 2	0.7
Uncertainty +/-	0 78	0 00	1 09	0.00	0 63	1 98	1 46	2 26	1 78	0 58	1 15	1 16	0 60	0 97
Reophax nana (% live)	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	0 0	0.0	0.0
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0.00	0.00
Ammobaculites foliaeceous (%)	0 2	0 0	0 2	0 0	0 5	0 0	0 0	0 3	0 0	0 0	0 3	0 7	0.5	0 0
Uncertainty +/-	0 55	0 00	0 55	0 00	0 89	0 00	0 00	0 69	0 00	0 00	0 67	1 01	0 85	0.00
Trochammina regularis														
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0.00	0 00	0 00	0 00	0 00
Trochammina salsa (%)	15 2	16.0	21 4	12 0	10 1	5 4	18 0	12 9	15 6	17 5	14.7	20.2	19.0	11.5
Uncertainty +/-	4 24	4 99	4 83	4 33	3 82	2 85	4 17	4.43	4.60	4 64	4 61	4 88	4 84	3.82
Trochammina salsa (% live)	2 5	2 2	2 4	1 1	1.1	0 1	5 6	1 7	3 0	5 4	3 7	4.7	2 6	2 1
Uncertainty +/-	1 83	2 00	1 81	1 41	1 33	0 43	2 50	1 69	2 17	2 77	2 46	2 57	1 97	1.70
Ammotium salsum (%)														
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
*Centropyxis aculeata (%)**														
Uncertainty +/	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0.00	0.00
*Difflugia oblonga (%)**														
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
*Arcella vulgaris (%) **														
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0.00
*Pontigulasia compressa (%) **														
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0.00	0 00	0.00	0 00	0 00	0 00	0.00
Total live	10 9	7 2	7 6	4 4	4 3	3 0	16.7	13.4	14 8	23 5	19 3	16 6	12 6	15.6

* N.B. not foraminifera

Appendix 1:Microfaunal occurrences from cores taken from Nanaimo, British Columbia (con't)

Sample #	N95-2;8-9,	N95-2;9-10;	N95-2,10-12	N95-2;12-14;	N95-2;14-16;	N95-2;16-18;	N95-2,18-20,	N95-2;20-22;	N95-2,22-24;	N95-2,24-26;	N95-2,26-28;	N95-2;28-30
Actual count	428	417	324	313	333	407	502	458	253	439	427	416
Fraction examined	1	1	1	1	1	1	1	1	1	2	2	2
Total foraminifera /cc	257	250	194	188	200	244	301	275	152	132	128	125
Biofacies Assignment	1	1	1	1	1	1	1	1	4	1	1	4
Trochammina inflata (%)	13 3	15 4	17 5	8 6	11 7	9 4	8 3	5.9	15 3	4 1	3.7	5 9
Uncertainty +/-	4 16	4 47	5 35	4 00	4.45	3 65	3 12	2.79	5 72	3.40	3.25	4.14
Trochammina inflata (% live)	3 5	1 5	0 6	1 5	2 1	1 5	1 8	1 4	3 8	1 4	0.7	0.9
Uncertainty +/-	2 26	1 49	1 06	1 76	1 97	1 52	1 48	1 37	3 05	2 01	1 47	1.62
Miliammina fusca (%)	6 3	10 6	14 2	10 5	13 8	26 5	17 7	15 1	41 5	32 8	38 9	37 5
Uncertainty +/-	2 97	3 81	4 91	4 39	4 78	5 54	4 31	4 23	7 84	8 02	8 44	8 49
Miliammina fusca (% live)	0 2	0 0	0 6	0 3	1 2	1 5	1 6	0 7	1 2	0 9	0 5	0 0
Uncertainty +/-	0 59	0 00	1 10	0 81	1 51	1 51	1 41	0 95	1 72	1 62	1 18	0 00
Jadammina macrescens (%)	61 7	56 1	47 8	70 0	61 3	51 6	61.2	64 4	21 7	54 2	48 2	21.9
Uncertainty +/-	5 95	6 15	7 02	6 56	6 76	6 27	5 50	5 66	6 56	8 51	8 65	7 25
Jadammina macrescens (% live)	6 5	1 4	0 3	3.8	4 8	5 9	6 2	5 2	0.8	5 0	2 3	1.0
Uncertainty +/-	3 02	1.48	0 78	2 75	2 97	2 95	2 72	2 63	1 41	3 73	2 62	1.71
Haplophragmoides wilberti (%)	4 4	2 4	3 4	2 6	2 1	3 7	4 8	9 2	6 3	3 9	6 1	5 3
Uncertainty +/-	2 52	1 90	2 55	2 26	1 99	2 36	2 41	3 41	3 87	3 29	4 14	3 93
Haplophragmoides wilberti (% live)	0 2	0 0	0 3	0 3	0 3	0 7	1 2	1 3	0 4	0 2	0 5	0 2
Uncertainty +/-	0 59	0 00	0 78	0 81	0 76	1 07	1 23	1 34	1 00	0 81	1 18	0 86
Reophax nana (%)	1 2	0 7	0 0	0 3	0 0	0 0	0 2	0 0	0 0	0 0	0 0	0.0
Uncertainty +/-	1 32	1 05	0 00	0 81	0 00	0 00	0 50	0 00	0 00	0 00	0 00	0 00
Reophax nana (% live)	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0.0
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
Ammobaculites foliaeceous (%)	0 2	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
Uncertainty +/-	0 59	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
Trochammina regularis												
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
Trochammina salsa (%)	12 8	14 9	17 0	8 0	11 2	8 8	7 8	5 4	14 8	3 6	3 1	5.4
Uncertainty +/-	4 09	4 41	5 28	3 89	4 36	3 56	3 03	2 68	5 64	3 19	3 02	3.96
Trochammina salsa (% live)	3 0	0 9	0 0	1 0	1 5	1 0	1 2	0 8	3 3	0 9	0 2	0 3
Uncertainty +/-	2 09	1 20	0 31	1 44	1 71	1 23	1 25	1 07	2 84	1 59	0 79	1 02
Ammotium salsum (%)												
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
*Centropyxis aculeata (%)**												
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
*Difflugia oblonga (%)**												
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0.00	0 00	0 00
*Arcella vulgaris (%) **												
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
*Pontigulasia compressa (%) **												
Uncertainty +/-	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00
Total live	13 6	3 8	1 9	7 0	9 9	10 6	12 0	9.4	9 5	8 4	4 2	2 4

* N.B. not foraminifera

APPENDIX 2: Glossary of terms

Biofacies: An ecological association of fossils; the biological aspect or fossil character of a stratigraphic facies.

Epifaunal: Organisms that live on the surface sediment.

Infaunal: Organisms whose habitat is below the sediment surface; and lives in the sediment.

Marsh: A low coastal grassland frequently inundated by the tide. Foraminiferal populations in salt marshes are highly zoned according to parameters such as salinity, pH, temperature and oxygen concentration. Foraminiferal researchers and botanists have subjectively subdivided marshes according to the species found at varying elevations (e.g. high marsh, low high marsh, high low marsh, low marsh and low low marsh).

Taphonomy: The study of the transition of all or part of an organism, from the biosphere into the lithosphere.

END

11-06-96

FIN