

# DIATOM STRATIGRAPHY OF BASIN HEAD HARBOUR PRINCE EDWARD ISLAND

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Diatoms have not been exploited to date in studies of changes in the coastal environments of Atlantic Canada. A core of estuarine sediments, 836 cm long, from Basin Head Harbour, Prince Edward Island, was found to contain diatoms representing various salinity preference ranges. The microfossil populations in the cored sediments contain 102 distinguishable taxa which were analysed statistically and interpreted. The lowest sediments which contain freshwater diatoms have radiocarbon dates of  $4,185 \pm 85$  B.P. at the base and  $3,370 \pm 135$  B.P. at 733 to 738 cm core depth. Abundant marine and brackish water diatoms appear at about 600 cm core depth and they decline markedly in frequency above the 287 cm level. A drowned tree stump retrieved from a nearby salt marsh was dated at  $1,050 \pm 90$  B.P. A rapid postglacial marine transgression is inferred and a contemporary submergence rate of about 3.6 to 10.2 cm/century is calculated.

## Introduction

In Atlantic Canada, several studies have elucidated the general trends of postglacial changes in sea level (Grant 1970, 1972, 1975; Kranck 1972; Wightman & Cooke 1978). The information used in interpretation has been based variously on: conventionally dredged marine sediments, drowned forests, uplifted marine terraces, and mooring rings inappropriately disposed relative to contemporary mean sea level. Many of these data available have been derived (with known error limits) from the fortuitous retrieval of materials usually datable by radiocarbon analysis. The most useful information is that which incorporates both a geologically significant stratigraphic marker and an associated date. Many attempts at obtaining material in the coastal zone which meet both of these criteria have been unsuccessful.

Diatoms have unexploited potential as geologically significant stratigraphic markers with respect to changing sea level. The frustules of these small siliceous (and thus relatively resistant) microflora have been found well-preserved in estuarine sediments and record with fidelity the changing salinity of the aquatic environment (and by implication changing sea level) at a given site. Some of the reasons for their value are:

1. Ubiquity in natural aquatic environments (fresh and salt water).
2. Salt specificity of many diatom species.
3. Relative resistance to chemical alteration (after burial).
4. Preservation along with other organic material, some of which is carbonaceous and therefore is datable.

Salinity preferences of different diatom species have been recognized since the last century and can be applied to the studies of sea level change.

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### Basin Head Harbour

At Basin Head Harbour, Prince Edward Island, an uncommon ridged sand deposit now protects a lagoon and salt marsh environment (Fig 1). The area is partly covered by spruce and fir growing on the ridge crests slightly above higher-high water datum while salt marsh plants occupy the valleys. Geomorphological evidence suggests that deposition of these reworked sands is related to postglacial marine transgression (Crowl 1969; Prest 1973). Contemporary processes are eroding the deposit as evidenced by: a) the altered beach outline and associated disappearance of fishing huts; and b) the truncated arcuate ridges shown in the photomosaic (cf. Fig 1 and Fig 2).

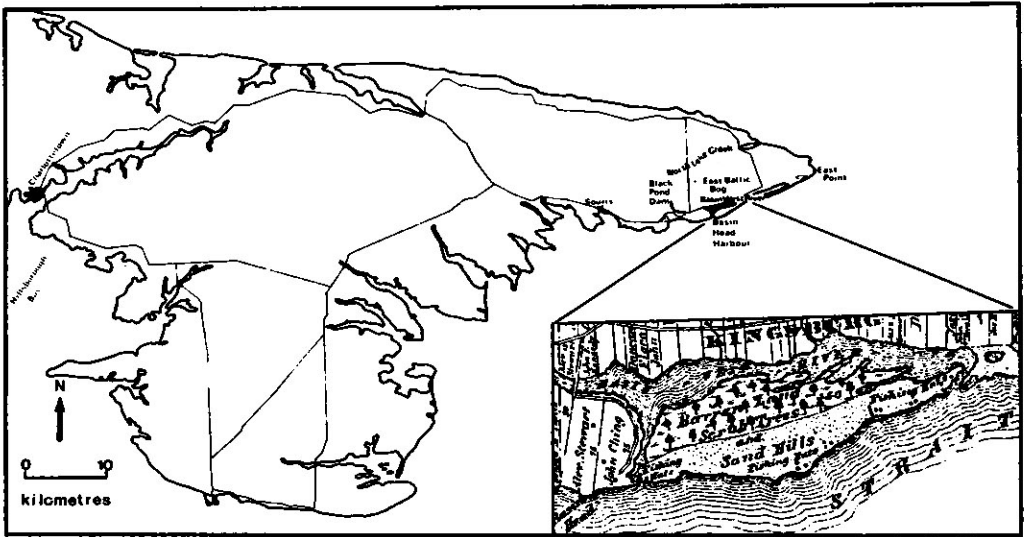


Fig 1. General location map of eastern Prince Edward Island showing Basin Head Harbour near the eastern extremity. The inset map is extracted from a land ownership map compiled in the last century. Note the "Fishing Huts" on the beach, and the outlet of Basin West River.

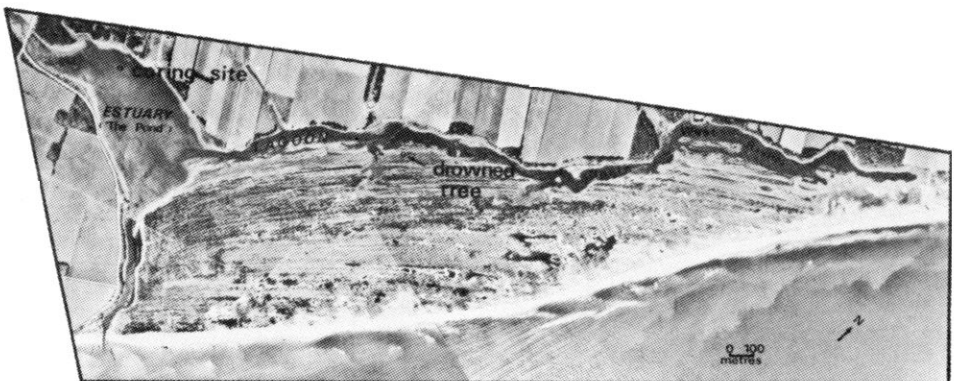


Fig 2. Photomosaic of Basin Head Harbour showing sand ridges, the coring site, and the site of a drowned tree stump all noted in the text.

The underlying bedrock configuration was established from the results of hammer seismic and resistivity observations (Fig 3); however, there is not a strong relationship between the surface expression of the deposit and the buried bedrock surface.

Examination of test pits in the sand ridges and samples in the laboratory failed to reveal any good evidence with which to determine the time or mode of deposition. The search for such information was extended to include undisturbed areas of the salt marsh and lagoon. Both areas furnished indirect evidence related to the depositional history of the Basin Head study area.

The ridges adjacent to the lagoon are low-lying and have the least amplitude of those in the whole deposit; salt marsh peat has filled in the swales to maximum depth of 1 m. One of several stumps occurring in growth position was retrieved from a small drainage channel in this salt marsh. It had a known 'root crown' elevation of 41 to 98 cm below the local higher-high water mark. The exhumed stump was radiocarbon dated at  $1050 \pm 90$  B.P. (DAL 27b, Ogden & Hart 1976). The age of this tree stump gives the youngest possible date for ridge formation prior to the growth and death of the spruce tree which was presumably killed by tidal flooding of the area.

It is known from local history that dredging was conducted in 1937-1938 for the benefit of local fishermen. The distal outlet of Basin West River (Fig 1) was closed and the proximal inlet was created artificially (Fig 2). There is no field evidence for an earlier inlet at this location.

A site for sampling estuarine sediments remote from areas of human disturbance was selected (Fig 2). At this site, a Livingstone Corer was used to retrieve 836 cm of estuarine sediments 3 m below a stable ice surface in mid-winter. It was necessary to use silicone grease as a lubricant to isolate the brass and aluminum components of the corer in the brackish lagoon and to preclude hydrocarbon (grease) contamination of potentially datable radiocarbon material.

### Laboratory Observations and Methods

In the laboratory, the core was found to have 3 gross color and textural features: a) RED MUD (10YR 2/2) - about 650 to 836 cm; b) GREEN MUD (5YR 3/2) - about 300 to 650 cm; and c) organic BROWN CLAY (10YR 3/2) - 000 to 300 cm. These and other macroscopic characteristics are illustrated in Figure 4.

Reconnaissance samples were extracted at 50 cm intervals and examined for sedimentological characteristics and microfossil content. Diatom frustules were discovered in abundance and dissimilar microfossil spectra implied that detailed population analysis would be worthwhile (Fig 5).

An examination of the literature showed that diatoms had been used previously in pertinent paleoecological studies (Foged 1970), but that a sound statistical and universal approach to sampling and population analysis apparently did not exist (Setty 1966; VanLandingham 1967, 1970; Hecky & Kilham 1973).

The sampling and mounting technique eventually employed was based on that described by Smith (1873). The Fleet counting method was used, well known to geologists for the counting of microscopic mineral grains (Galehouse 1971) and an 'ideal' optimum of 300 individual frustules was counted in each sample. Some 68 samples were prepared from various levels in the core. The specimens that were not identifiable during counting were later allocated either to identifiable taxonomic groups or to a category of 'unknowns'. All the statistics used incorporated the 'unknowns' including unrecognizable diatom specimens represented by at least half a frustule.

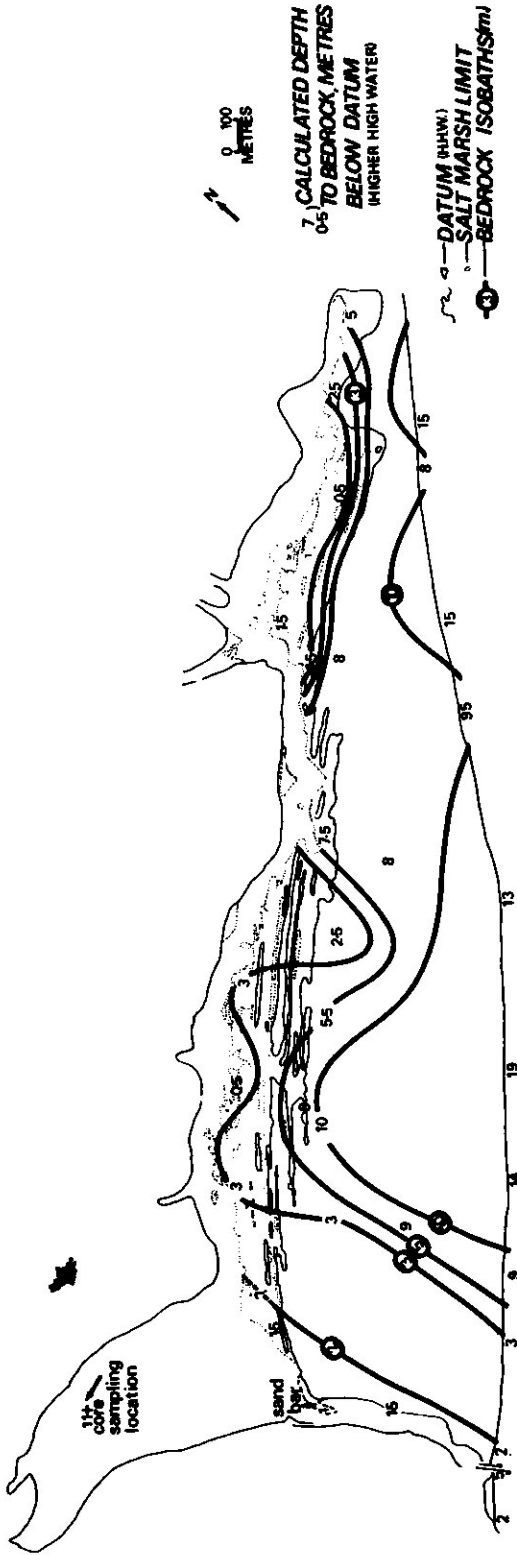


Fig 3. Map of calculated depths to bedrock below higher high water as determined by hammer seismic refraction and Schlumberger resistivity soundings. Bedrock isobaths are included to show the inferred configuration of bedrock topography.

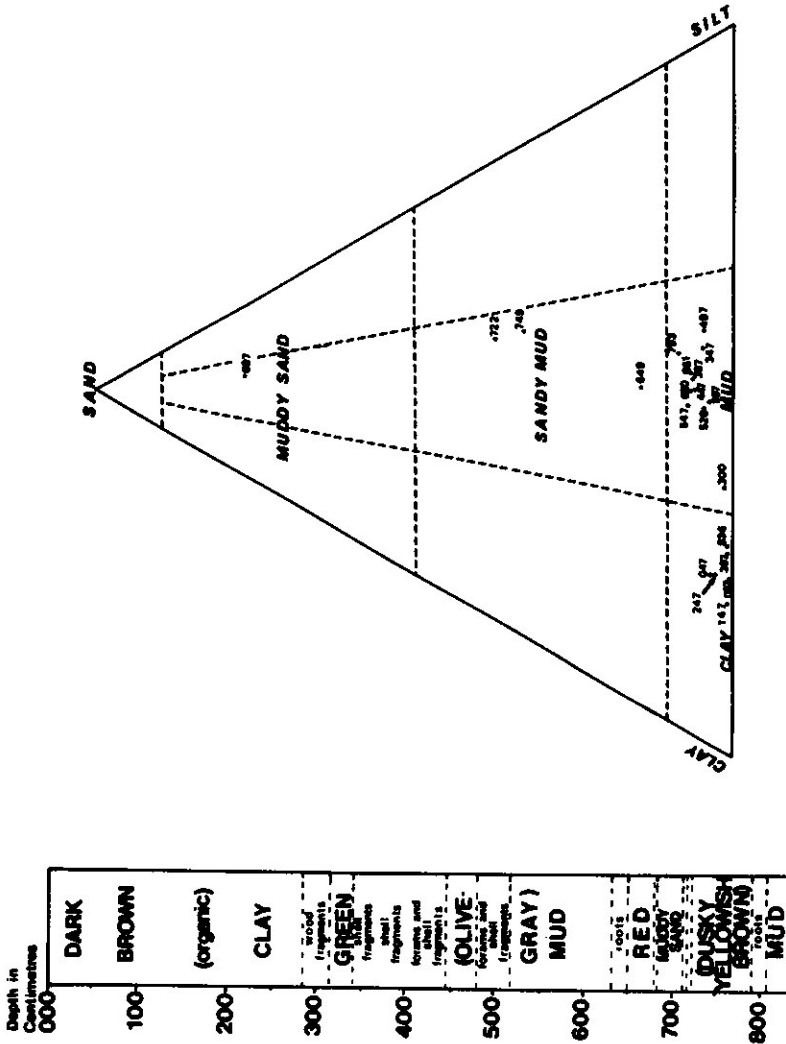
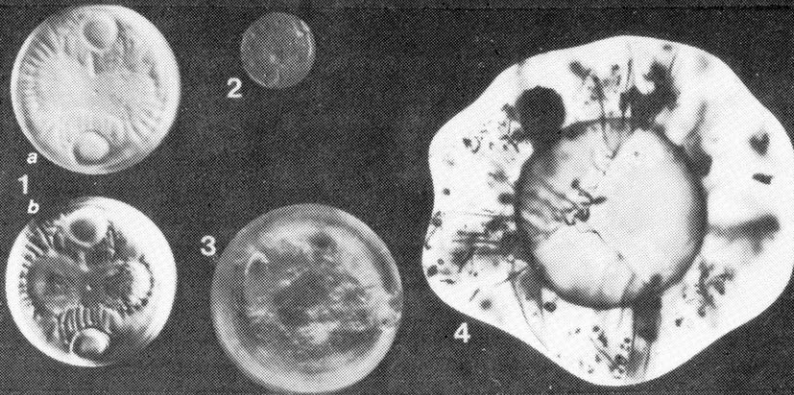
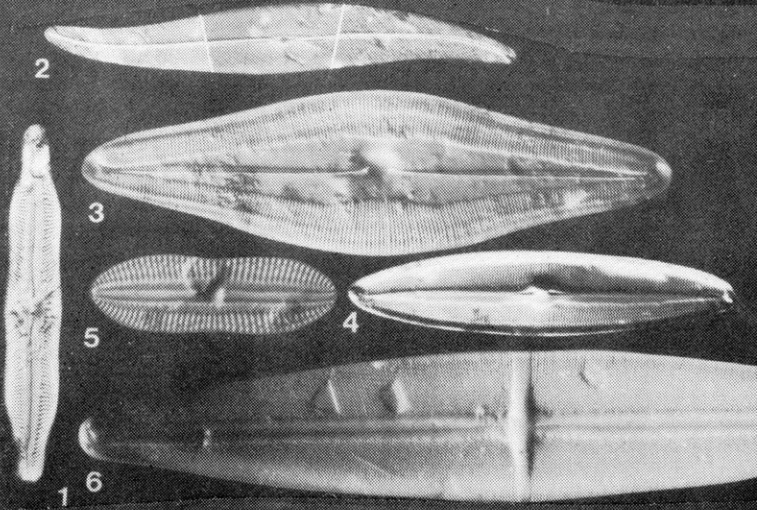


Fig. 4 Stratigraphic column and triangular diagram showing proportions of sand, silt, and clay determined in sediment samples extracted from the core. Numbers indicate the depth in cm expressed in cm from top. Note the root and wood fragment layers between: the Dark Brown Clay and Green Mud at about 300 cm, and the Green Mud and Red Mud at about 600 cm.



1. a,b) *Auliscus sculptus*  
 2. *Coscinodiscus curvatulus*  
 3. *Biddulphia laevis* 4. *Planktoniella sol*

A



1. *Pinnularia legumen*  
 2. *Gyrosigma attenuatum*  
 3. *Caloneis permanga* 4. *C. westii*  
 4. *Diploneis crabro*  
 5. *Stauroneis phoenicentron*

B

Fig 5. Diatoms in sediments from Basin Head Harbour.

### Diatom Analysis and Stratigraphy

One hundred and two taxonomic groups were identified (Table I) and the habitat preferences for the various taxa were compiled from 2 sources: a) the ecological reports in the literature (e.g. Cleve-Euler 1951-1955; Frenguelli 1938-1943; Hustedt 1930-1966; Hendey 1964; Patrick & Reimer 1966); and b) a reference sample collected from a contemporary freshwater environment at Black Pond Dam (Fig 1).

The various taxa from each stratigraphic level were assigned to one of several 'Halobian' (salt sensitivity) habitat categories listed as follows: a) 'Oligohalobian' (freshwater); b) 'Euryhaline' (Oligohalobian) (taxa tolerant of increased salinity but nominally freshwater); c) 'Mesohalobian' (brackish water); d) 'Euhalobian' (marine); and e) 'Unknowns' (both unidentifiable specimens and those of uncertain salinity preferences). A distribution chart was prepared to illustrate how the proportions of halobian categories varied throughout the core. This chart (Fig 6) is based upon the relative frequencies (i.e. percentages of the various halobian categories at any given stratigraphic level and show the probable error range of the observed relative frequencies at the 95% level of confidence computed according to the formula (Galehouse 1971):

$$E_{95} = 1.96 \sqrt{\frac{P(100-P)}{N}}$$

Where:  $E_{95}$  is the probable error of the observed frequency in percent (%) at the 95% confidence limit, and 1.96 is the number of standard deviations from the mean in the 'normal' sampling distribution associated with  $E_{95}$ .

P is the percentage in a category, and N is the total sample population counted at a given level.

The distribution chart (Fig 6) was then used for a paleoecological reconstruction based upon the premise that the variations in Halobian categories represent population changes responding to alterations in habitat.

The core can be broadly subdivided into 3 stratigraphic levels, identified here for simplicity as Lowest Zone (600-836 cm), Middle Zone (287-600 cm), and Highest Zone (000-287 cm). The 2 zonal boundaries at about 600 and 287 cm core depth are based on the significant fluctuations in the 'Mesohalobian' and 'Euhalobian' categories. There is a general agreement between the biozone boundaries at 600 and 287 cm core depth and the gradational contacts between the Red and Green Mud and the Green Mud and Brown Clay of the cored sediments.

In the Lowest Zone, the 'Euryhaline' (Oligohalobian) and 'Oligohalobian' diatoms dominate. The relative frequencies of 'Mesohalobian' and 'Euhalobian' taxa are collectively very low in this zone, rarely exceeding a few percentage points. A sand layer (690-730 cm) with gradational contacts is notably coarser than the red mud typical of this zone and contained relatively far fewer diatom frustules. The lower absolute numbers counted in preparations are reflected in very high Probable Errors on the counts of 'Oligohalobian' diatoms. Neither 'Mesohalobian' nor 'Euhalobian' forms were observed within the counted samples.

The Middle Zone is markedly different from the Lowest Zone in that 'Mesohalobian' and 'Euhalobian' forms show a persistent and gradual increase in relative frequencies until maxima are reached at the uppermost level of the zone (287 cm). Both the 'Euryhaline' (Oligohalobian) and 'Oligohalobian' taxa manifest a concomitant decline in relative frequencies in this zone. The 'Unknowns' are most frequent in this zone. The sediments of this zone are mainly green muds containing some foraminifera and shell fragments in addition to 'Mesohalobian' and 'Euhalobian' diatoms.



Table 1

|     |   |  |
|-----|---|--|
| 1.  | <i>Meloria juergensii</i> Agardh (E)  |  |
| 2.  | <i>Paralia eilicata</i> (Ehrenberg) Cleve (E)   |  |
| 3.  | <i>Cyclotella meneghiniana</i> Kützling (O)   |  |
| 4.  | <i>Cyclotella kaitangiana</i> (Thwaites) Chauvin (O)  |  |
| 5.  | <i>Cyclotella stylorum</i> Brightwell (E)   |  |
| 6.  | <i>Cyclotella caespita</i> Grunow (M)   |  |
| 7.  | <i>Stephanodiscus kantschii</i> Grunow (O)  |  |
| 8.  | <i>Stephanodiscus astraea</i> (Ehrenberg) Grunow var. <i>minutula</i> (Kützling) Grunow (O)                             |  |
| 9.  | <i>Coecynodiscus marginatus</i> Ehrenberg (E)   |  |
| 10. | <i>Coecynodiscus eocenarius</i> Ehrenberg (E)   |  |
| 11. | <i>Actinopterygus senarius</i> (Ehrenberg) Ehrenberg (E)  |  |
| 12. | <i>Biddulphia obtusa</i> (Kützling) Ralfs (E), <i>Biddulphia laevis</i> Ehrenberg (M-E)                                 |  |
| 13. | <i>Diatoma tenue</i> var. <i>elongatum</i> (Lyngbye) (O-M)  |  |
| 14. | <i>Meridion circulare</i> (Greville) Agardh var. <i>circulare</i> (O)   |  |
| 15. | <i>Opheora martyi</i> Héribaud var. <i>martyi</i> (O)   |  |
| 16. | <i>Fragilaria vaucheriae</i> var. <i>meoziatica</i> Rabenhorst (O)  |  |
| 17. | <i>Fragilaria vaucheriae</i> (Kützling) Petersen var. <i>vaucheriae</i> (O)   |  |
| 18. | <i>Fragilaria leptostauron</i> (Ehrenberg) Hustedt var. <i>vaucheriae</i> (Grunow) Hustedt, var. <i>abubia</i> (Grunow) |  |
| 19. | <i>Fragilaria leptostauron</i> var. <i>leptostauron</i> f. <i>minuta</i> A. Cleve-Euler (O)                             |  |
| 20. | <i>Fragilaria constrictus</i> var. <i>constrictus</i> (Ehrenberg) Grunow (O)  |  |
| 21. | <i>Fragilaria constrictus</i> var. <i>binodis</i> (Ehrenberg) Grunow (O)  |  |
| 22. | <i>Fragilaria constrictus</i> var. <i>venster</i> f. <i>pusilla</i> Grunow, f. <i>elliptica</i> Schumann (O)            |  |
| 23. | <i>Fragilaria producta</i> (Lagerstedt) Grunow (O)  |  |
| 24. | <i>Fragilaria pinnata</i> var. <i>pinnata</i> Ehrenberg (O)   |  |
| 25. | <i>Fragilaria pinnata</i> var. <i>minutissima</i> (Grunow) A. Cleve-Euler (O)   |  |
| 26. | <i>Fragilaria pinnata</i> var. <i>intercedens</i> (Grunow) Hustedt (O)  |  |
| 27. | <i>Fragilaria brevistriata</i> Grunow (O)   |  |
| 28. | <i>Fragilaria lapponica</i> Grunow (O)  |  |
| 29. | <i>Fragilaria atomus</i> Hustedt (O-M)  |  |
| 30. | <i>Synedra exota</i> Wallace (O)  |  |
| 31. | <i>Synedra faetoniata</i> (Agardh) Kützling (O-M)   |  |
| 32. | <i>Synedra pulchella</i> Ralfs ex Kützling (O-M)  |  |
| 33. | <i>Litomphora</i> sp. n. <i>abbreviata</i> Agardh? (E)  |  |
| 34. | <i>Raphoneis amphiceros</i> (Ehrenberg) Ehrenberg (E)   |  |
| 35. | <i>Raphoneis australis</i> var. <i>australis</i> Petit (E)  |  |
| 36. | <i>Grammatophora coeniza</i> (Ehrenberg) Grunow (E)   |  |
| 37. | <i>Amanthea affinis</i> Grunow (O)  |  |
| 38. | <i>Amanthea bisaculeolata</i> Kützling, var. ? (O-M7)   |  |
| 39. | <i>Amanthea brevipes</i> Agardh (M-E)   |  |
| 40. | <i>Amanthea erigua</i> Grunow var. <i>heterovalva</i> Kraske (O)  |  |
| 41. | <i>Amanthea haukiana</i> Grunow var. <i>haukiana</i> (M)  |  |
| 42. | <i>Amanthea lanceolata</i> (de Brébisson) Grunow and varieties (O)  |  |
| 43. | <i>Amanthea linearis</i> (Wm. Smith) Grunow (O (halophobe))   |  |
| 44. | <i>Amanthea peragalli</i> Brun et Héribaud (O)  |  |
| 45. | <i>Amanthea leandrii</i> Hustedt (O)  |  |
| 46. | <i>Cocconeis placenta</i> Ehrenberg, and varieties (O)  |  |
| 47. | <i>Cocconeis sautezum</i> Cleve, var. <i>parva</i> Grunow, <i>Cocconeis stauroneiformis</i> (Van Heurck) Okuno (M)      |  |
| 48. | <i>Cocconeis pediculus</i> var. <i>bailloni</i> (Juhl in-Dannfelt) Cleve (O-M)  |  |
| 49. | <i>Cocconeis</i> sp.  |  |



50. *Rhizosolenia curvata* (Kützting) Grunow ex Rabenhorst (O)  
 51. *Raviana calinam* Grunow (M)  
 52. *Raviana halophila* (Grunow) Cleve (M)  
 53. *Raviana peregrina* (Ehrenberg) Kützting (M)  
 54. *Raviana vauipina* Kützting (O)  
 55. *Raviana integra* (Wm. Smith) Raifs (O)  
 56. *Raviana cuspidata* (Kützting) Kützting (O)  
 57. *Raviana tyra* var. *subelliptica* Cleve (E)  
 58. *Raviana crypsocephala* Kützting (O-M), and var. *veneta* (Kützting) Rabenhorst (M-O)  
 59. *Raviana rhizosolenia* Kützting (O-M), and var. *germanica* (Maffae) Patrick (O)  
 60. *Raviana romanesina* (Agardh) Cleve (E)  
 61. *Raviana digitato-radiata* (Gregory) Raifs ex Pritchard (E)  
 62. *Raviana seminulum* Grun. (O-M)  
 63. *Raviana discana* (Wm. Smith) Schmidt (E)  
 64. *Raviana inoenta* Grunow ex Van Heurck (E)  
 65. *Raviana barbarica* Hustedt (O)  
 66. *Catonella fusoides* Grunow (E)  
 67. *Mastogloia smithii* Thwaites ex Wm. Smith (M)  
 68. *Mastogloia pumila* (Grunow) Cleve (M)  
 69. *Pinnularia major* (Kützting) Rabenhorst (O)  
 70. *Pleurosigma angulatum* (Quekett) Wm. Smith (M)  
 71. *Gyrodigma bairdium* (Ehrenberg) Cleve (M-E)  
 72. *Gyrodigma attenuatum* (Kützting) Rabenhorst (O)  
 73. *Gyrodigma obscurum* (Wm. Smith) Griffith and Henfrey (M), *G. fasciola* (Ehrenberg) Griffith and Henfrey (M)  
 74. *Amphipora densusata* Grunow var. *gigantea* (E)  
 75. *Amphipora alata* (Ehrenberg) Kützting (M)  
 76. *Frachetia aspera* (Ehrenberg) Cleve (E)  
 77. *Amphileuca mutilata* (Trentepoh) Cleve (M)  
 78. *Amphileuca micans* (Lyngbye) Cleve (E)  
 79. *Diploneta intermedia* (Kützting) Cleve var. *clausula* (Schmidt) Cleve? (E)  
 80. *Diploneta smithii* (de Brébisson) Cleve (M-E)  
 81. *Gomphonema parvulum* (Kützting) Grunow (O)  
 82. *Gomphonema lanceolatum* Ehrenberg (O)  
 83. *Cymbella elzevbergii* Kützting (O)  
 84. *Cymbella otavala* (Hemprich) Grunow, and var. *maculata* (Kützting) Van Heurck (O)  
 85. *Amphora angusta* var. *ventricosa* (Gregory) Cleve (E)  
 86. *Amphora ovata* Kützting, var. *affinis* Grunow (O-M)  
 87. *Amphora coffeaeformis* Agardh (M)  
 88. *Amphora* sp.  
 89. *Eythemia argus* Kützting (O)  
 90. *Eythemia eowae* Kützting (O-M)  
 91. *Eythemia turgida* (Ehrenberg) Kützting (O-M)  
 92. *Rhopalodia gibberula* (Ehrenberg) O. Müller (M-E)  
 93. *Nitzschia tryblionella* Nantzsch (M)  
 94. *Nitzschia panduriformis* Gregory var. *minor* Grunow (E)  
 95. *Nitzschia aptanula* (Gregory) Grunow (E)  
 96. *Nitzschia socialis* Gregory (E)  
 97. *Nitzschia frustulum* (Kützting) Grunow (M), and varieties (O-M)  
 98. *Nitzschia fonticola* Grunow (O-M)  
 99. *Nitzschia* sp.  
 100. *Surirella ovata* Kützting (M)  
 101. *Surirella str-lata* Turpin (M)  
 102.

O = Oligohablian  
 M = Mesohablian  
 E = Eubablian

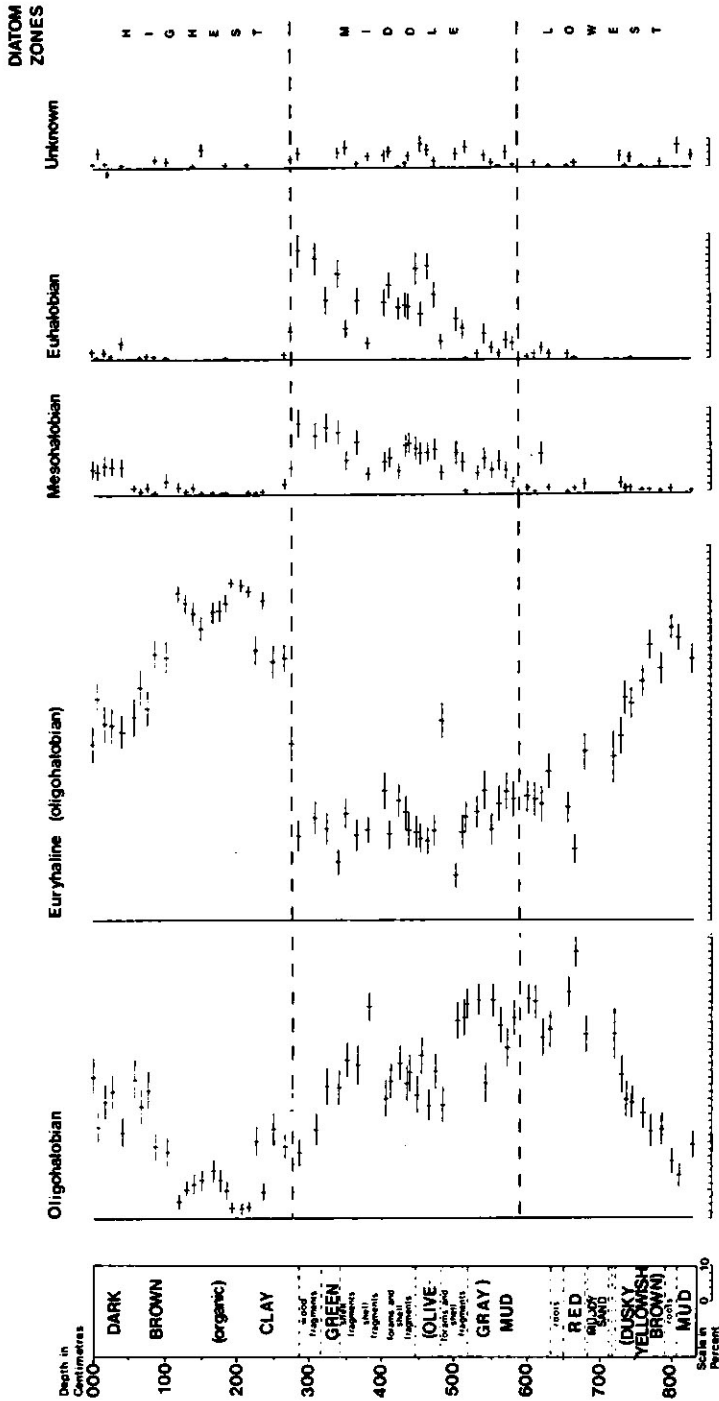


Fig 6. Distribution of components of various fossil diatom populations found at various levels within core of estuarine sediments at Basin Head; 'crosses' show the Probable Error range on relative frequencies at 95% level of confidence.

The boundary between the Middle and Highest Zone is quite remarkable because within about 10 cm the 'Mesohalobian' and 'Euhalobian' taxa decline to barely perceptible relative frequencies. Aside from a minor persistent occurrence of 'Mesohalobian' diatoms near the top of the core, the brackish and marine forms have effectively disappeared. The abundant 'Euryhaline' (Oligohalobian) and 'Oligohalobian' forms are preserved in a dark-brown (organic) clay.

### Discussion

The sediments deposited in the Basin Head Harbour study area constitute a record of the Holocene rise in sea level and of coastline development.

The ridge system, which is a relatively large sand deposit, records a uniform constructional process. The absolute time required for construction of the individual ridges (which must be earlier than the growth of the dated tree) cannot be determined directly because datable material is not available. The contemporary littoral processes active at the shore are essentially responsible for erosion and modification, and therefore are not informative concerning constructional processes active there in the past. Paleoenvironmental information is, however, available from the adjacent estuary.

As indicated in Figure 4, roots and fibrous material were found in the Lowest Zone of the core of estuarine sediments. Two samples were removed for radiocarbon analysis and yielded dates of  $4,185 \pm 85$  B.P. (DAL 182) and  $3,370 \pm 135$  B.P. (DAL 95) at the 835 to 827 cm and 738 to 733 cm levels respectively (Ogden & Hart 1976).

The lowest Zone (600-836 cm), now dated, generally contains an abundance of fossil freshwater microflora. Some saline forms occur in sample populations which clearly represent the habitat at the site of deposition; an exception may be with the sand lens where only low relative frequencies of robust freshwater forms were observed. These taxa probably represent allochthonous populations transported and deposited during a single fluvial event and preserved within the anomalous coarse (muddy sand) detritus at 690 to 730 cm core depth. The paucity of mesohalobes and euhalobes strongly suggests that the fine-grained sediments and associated 'Oligohalobian' diatoms accumulated in quiet freshwater, above the influence of seawater. Thus, sea level (represented by higher-high water) was below the base of the core at the time of deposition; about 4,200 radiocarbon yr ago, higher-high water was at least 11.4 m lower than at present (3.0 m water column + 8.4 m sediment). If constant sedimentation is assumed except for the 'instantaneous' deposition of the sand lens, the top of the zone is dated by extrapolation at 1,415 B.P.

At the zone boundary - 600 cm core depth - the onset of marine influences is detected by the statistically significant occurrence of both 'Mesohalobian' and 'Euhalobian' diatoms. Their respective relative frequencies increase steadily to maxima at the top of the zone. This, coupled with the occurrence of shell fragments and foraminifera, records the increasing salinity of the habitat caused by a relative rise of sea level. The fine-grained sediments indicate that quiescent conditions prevailed during their deposition.

Immediately after the time when the salinity of the habitat reached its maximum, it was abruptly lowered, never again to achieve such levels. This decline constitutes the zone boundary at 287 cm core depth. It can reasonably be inferred that the ridges of the adjacent sand deposit were constructed rapidly at this time resulting in some isolation of the lagoon and causing the decline in habitat salinity (represented by the decline in mesohalobian and euhalobian diatoms). A related distinctive feature of the Highest Zone is the minor but persistent occurrence of mesohalobes in the top 40 cm. This records a slight salinity increase which probably was brought about by the opening of the proximal inlet during the dredging of 1937-38.

In the Basin Head Harbour core, allocation of the diatoms to groups on the basis

of recognized salinity preferences permits inferences concerning changing salinity of the aquatic environment to be made. The inferred history is as follows:

The basal sediments record a ponded freshwater environment which was probably shallow. A quantity of sand was transported into the pond and consequently interrupted the normal sedimentation of fine materials. Following this deposition of sand, normal (quiet) conditions returned for a very short time, during which freshwater (Oligohalobian) diatoms, considered to be true environmental indicators, achieved a maximum frequency for all the counted sample populations. This freshwater maximum was immediately followed by the onset of marine conditions which progressively increased to a maximum at 287 cm. This maximum reflects open circulation of seawater in a coastal regime which was later terminated abruptly by the construction of a barrier. The ponding of freshwater behind the barrier is associated with limited circulation. The supposed contemporary marine transgression is recorded in a slight rise in salinity of the environment. Dredging in cultural time, and the creation of a proximal inlet is recorded with fidelity in the small but sharp increase in diatoms that prefer saline water.

It is possible to relate the local evidence of the rise of sea level to the regional trends and to the absolute rise in sea level. Grant (1970) showed that the Maritimes are characterized by an anomalous submergence rate, relative to coastal reference areas where the record of the postglacial absolute rise of sea level is believed to be accurate.

Local data from Basin Head can be compared with the general Maritimes submergence data and information on the world-wide sea level rise (Fig 7). There is a strong similarity between the general Maritimes submergence rate and that of Basin Head. Both are clearly much more rapid than the world-wide rise of sea level for reasons discussed by Bloom (1967), Grant (1970), and Walcott (1970).

### Conclusions

1. The salt marsh contains evidence of a recent rise in relative sea level. The crown of a submerged tree stump in the salt marsh lies between 41 cm and 98 cm below datum. The tree lived in this location but not while submerged by salt water. Two possible inferences can be drawn from this observation: a) the tree was drowned by the rise of sea water, or b) the tree was not killed by salt water, but died of other causes and was submerged later.

Considering the range in errors of the known elevation and age of the tree, (1050  $\pm$  90 radiocarbon yr, Dal 27b) it is reasonable to assume that datum one millenium ago was about equivalent to the crown elevation (or slightly lower), and thus that the death of the tree and the local datum elevation were time-equivalent. Using this information, it is possible to calculate that the post-drowning rise of relative sea level in this area is between about 3.6 and 10.2 cm/century.

2. The data from Basin Head indicate rapid postglacial submergence and corroborate Grant's (1970) observations of high submergence rates in the Maritimes.
3. Finally, this study has demonstrated the value of diatoms as a tool and it is believed that this is the first time that diatom stratigraphy has been used in the Maritimes to develop paleoenvironmental interpretations in an attempt to solve a coastal geology problem. This comes fully 3 decades after a precedent was set by similar work in Scandinavia.

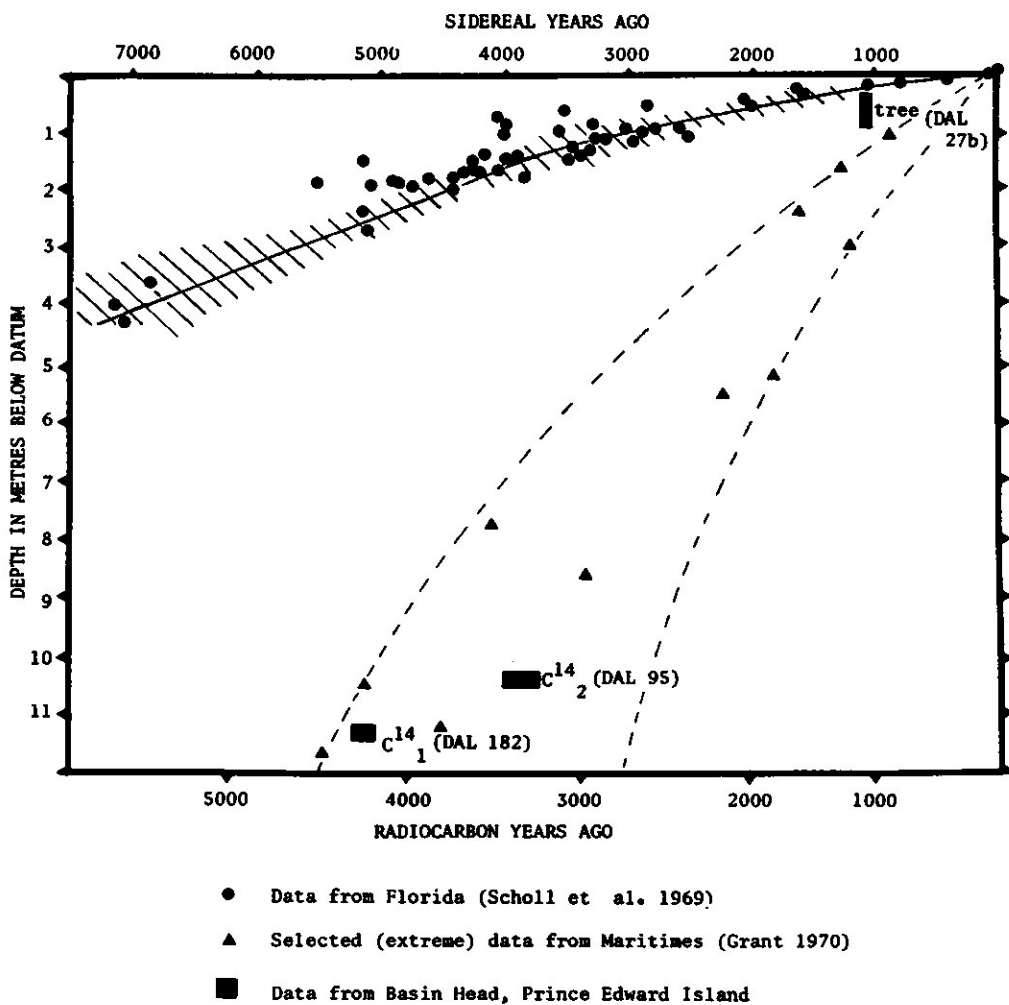


Fig 7. Depth-time graph illustrating submergence of features originally formed at or above sea level; full line shows curve for Florida derived by Scholl et al. (1969) and the dashed lines indicate limiting values for the Maritimes according to Grant (1970).

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