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DISTRIBUTION AND TAXONOMY OF DIATOMS (BACILLARIOPHYTA) IN SURFACE
SAMPLES AND A TWO-METER CORE FROM WINSLOW MARSH, BAINBRIDGE
ISLAND, WASHINGTON

by

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ABSTRACT

Diatoms (Bacillariophyta) were examined in 14 surface samples and a 2-m-long core from Winslow Marsh, a small fresh-brackish wetland which lies immediately north of the Seattle fault on Bainbridge Island, central Puget Sound, Washington. This report documents the distribution and taxonomy of 152 diatom species observed in the surface and core samples.

INTRODUCTION

Several previous studies presented evidence for a magnitude 7 or larger earthquake approximately 1000 yr B.P. on the Seattle fault, a shallow reverse fault striking east-west across central Puget Sound and underlying the city of Seattle (fig. 1; Atwater and Moore, 1992; Bucknam and others, 1992; Jacoby and others, 1992; Karlin and Abella, 1992). Deformation resulting from this earthquake included approximately 7 m of uplift on the south side of the fault at Restoration Point on Bainbridge Island (fig. 1; Bucknam and others, 1992), and, conversely, about 1 m of submergence on the north side of the fault at West Point (fig. 1; Atwater and Moore, 1992). Atwater and Moore (1992) further proposed that a tsunami triggered by the earthquake propagated northward and deposited sand sheets both at West Point and at Cultus Bay, located further to the north on Whidbey Island in Puget Sound. The purpose of this study was to examine diatom assemblages at an additional site located north of the Seattle fault, Winslow Marsh on Bainbridge Island (fig. 1), to determine if there was paleoecological evidence to support coseismic subsidence and tsunami deposition at this site correlative with the 1000 yr B.P. earthquake on the Seattle fault.

Diatoms are unicellular algae (Bacillariophyta) found in most benthic and planktonic aquatic environments. Benthic taxa proliferate, for example, on surface sediment in freshwater marshes and swamps, salt marshes, tidal flats, and shallow nearshore areas. Because of different tolerances for salinity by different species, diatoms have long been used in sea-level studies (Palmer and Abbot, 1986), and the correlation of various benthic taxa with specific intertidal environments has made them highly beneficial for studies of small-scale relative sea-level changes in the Pacific Northwest (Darienzo and Peterson, 1990; Hemphill-Haley, 1995).

Diatoms were collected in surface sediment at Winslow Marsh, a 150 x 70 m fresh-brackish wetland with measured salinities of less than 4‰ (figs. 1-3; tables 1-2). A two-meter core collected at Winslow Marsh (Core A; fig. 4) contains a record of about 2,000 yr of sediment accumulation at this site (R. Bucknam and D. Ekblaw, written commun.), allowing us to examine diatom assemblages which were deposited prior to and following the 1000 yr B.P. earthquake on the Seattle fault. We surmised that coseismic subsidence at this site

would result in a rapid rise in average salinity, and be recorded by a change in diatom populations from primarily freshwater taxa to those which prefer higher levels of salt. Further, we expected that a tsunami generated during the earthquake 1000 yr B.P. would transport brackish-marine taxa from Puget Sound and deposit them onshore at Winslow Marsh. Our findings on the diatom biostratigraphic record of coseismic subsidence and possible tsunami deposition are discussed below, in addition to the census data and taxonomic references for diatoms observed in Core A and in the surface samples from Winslow Marsh (tables 2-4).

METHODS

Diatoms were collected in surface samples at Winslow Marsh on 13 June 1993, along a transect line that extended perpendicular to Puget Sound, from the landward edge of the marsh to the leeward side of a gravel berm separating the marsh from the sound (fig. 2; stations WM-1 to WM-12). In addition, diatoms were collected on the sandy nearshore about 10 cm below the water surface during low tide on the afternoon of 13 June 1993 (station WM-B), and in a 0.55 m deep pond located about 35 m west of the transect line (station WM-P). About 1-2 cm² of the uppermost 1-3 mm of sediment was collected by scraping with a spatula, and then transferred with distilled water to a glass vial and sealed. Samples were cleaned by oxidizing in 30% H₂O₂ and rinsing with distilled water. An aliquot of the cleaned sample was transferred to a cover slip, and mounted with Hyrax. At each station, surface salinities were measured with a YSI Model 33 S-C-T meter with reported accuracies of $\pm 0.5^{\circ}\text{C}$ and $\pm 0.5\text{‰}$, respectively, and approximate proportions of dominant macrophytes were recorded (table 1; fig. 2).

Core A was collected near station WM-8 at Winslow Marsh. Details for core recovery and lithologic descriptions were provided by Dan Ekblaw (written commun.). About 1-2 cm² of sediment was sampled for diatoms at 5-10 cm intervals, and processed using the method described above. About 400-500 diatom valves were counted in most of Core A and WM samples at a magnification of 1250 \times (tables 3, 4). Salinity terms used in this paper are modified from Vos and de Wolf (1993): freshwater, $< 0.2\text{‰}$; fresh-brackish, 0.2-4 ‰ ; brackish-marine, 5-25 ‰ ; marine, $> 25\text{‰}$; euryhaline, 0-30 ‰ .

Digital images of diatom taxa for plates 1-6 were captured with a Kodak Professional DSC 420 digital camera, shot through a Leitz light microscope at magnifications of 500 \times and 1000 \times . The plates were compiled using Adobe Photoshop 2.5.

Diatom slides for this study are stored in the U.S. Geological Survey Western Regional Diatoms Collection (WRDC).

RESULTS

A total of 152 diatom taxa were recorded for this report, with 131 taxa observed in Core A, and 81 observed in surface samples from Winslow Marsh. There were 59 taxa in common between the core and marsh samples.

A 0.5-m-high gravel berm separating Winslow Marsh from Puget Sound prevents regular tidal incursions, but probably permits overwash from Puget Sound during highest spring tides and during storm surges (D. Ekblaw, pers. commun.). Salinities of standing water 1-15 cm deep on the marsh surface (stations 1-9; fig. 2) measured 0-2.8‰ (table 1) on 13 June 1993, and is consistent with the populations of fresh-brackish diatoms and plants observed at the marsh. Core A was collected near WM-8 in a zone of dark stagnant water about 15 cm deep. The small creek and pool (WM-P) at Winslow Marsh are fresh (0‰). Salinities near the low-tide level on Puget Sound (WM-B) measured approximately 25‰.

Variations in diatom populations in the marsh samples are primarily a response to differences in amount of standing water at the surface (fig. 3). For example, diatoms at WM-9, where the water was > 10 cm deep, are dominated by species of *Fragilaria*. In contrast, diatoms at stations WM-11 and WM-12, where the marsh is well drained, are dominated by species that prefer drier, more aerophile conditions (*Hantzschia amphioxys*, *Pinnularia lagerstedtii*, *Diadsmis contenta*). Both assemblages, however, are found within 15 m of one another, and thus are indicative of the fresh-brackish Winslow Marsh environment as a whole. Diatoms from the small, freshwater pond (WM-P) are dominated by *Cymbella descripta* and *Surirella brébissonii* (fig. 3), with less frequent occurrences of species that are also found in marsh samples (table 3). Therefore, microenvironments observed on the modern marsh may be identifiable as micro-paleoenvironments in the fossil record, but these differences need to be recognized as small ecological variations of the same general environment. In contrast, brackish-marine diatoms collected on the Puget Sound side of the berm, from sandy substrate at station WM-B, consist of abundant small benthic taxa that are distinct from those collected from the marsh and pond.

Diatoms are abundant at all levels in Core A except for black charcoal-bearing sandy clay at the base of the core (fig. 4), which may record deposition on an upland preceding the development of a marsh at this site. Diatom analyses in Core A suggest that coseismic subsidence probably occurred at Winslow Marsh as a result of the earthquake on the Seattle fault about 1000 years ago, but it is unlikely that the tsunami generated by this event washed across Winslow Marsh. The diatom evidence consists of an anomalous increase in salt marsh diatoms -- not presently found at Winslow Marsh -- in a narrow zone of coarse reddish-brown peat between 115-100 cm (fig. 4). An AMS radiocarbon age on a bark-bearing twig (R. Bucknam and D. Ekblaw, written commun.), collected above a discontinuous

sand layer 10 cm below the sudden appearance of salt-marsh diatoms (fig. 4) gave an age of 1115 ± 50 ^{14}C yr B.P., suggesting a correlation between the anomalous rise in salinity at Winslow Marsh and the earthquake approximately 1000 years ago on the Seattle fault. The discontinuous sand layer about 10 cm below the salt-marsh assemblage (fig. 4) was considered a possible candidate for a tsunami deposit related to the 1000 yr B.P. event (Bucknam et al., 1994), but the sand contains no benthic marine diatoms which are ubiquitous in shallow nearshore areas of Pacific Northwest estuaries and Puget Sound (for example, sample WM-B), and which were observed in the 1000 yr BP tsunami sand at both West Point and Whidbey Island (E. Hemphill-Haley, unpub. data). This suggests that Puget Sound was not the source for the sand layer in Core A, and that tsunami deposition did not coincide with coseismic subsidence approximately 1000 yr B.P. at Winslow Marsh.

SYSTEMATICS

The following list provides references with good illustrations for diatom taxa observed in samples from transect (WM) and Core A (WCA) samples at Winslow Marsh. Terminology follows Ross and others (1979). Taxa are listed alphabetically for convenience. Abbreviations are as follows: L = length. W = width. Diam = diameter. Str = striae. Ar = areolae. Cost = costae. P = puncta. RV = raphe valve. RLV = rapheless valve. IB = intercalary bands. LM = light microscopy. Syn = synonym. Bas = basionym.

Abbreviations for diatom concentrations in WM and WCA samples are as follows: very rare (VR), < 2%; rare (R), 2-4.99%; frequent (F), 5-9.99 %; common (C), 10-33%; abundant (A), > 33%.

ACHNANTHES Bory 1832

***Achnanthes brevipes* var. *intermedia* (Kützing) Cleve 1895**

(pl. 1, fig. 1)

Syn: *Achnanthes intermedia* Kützing 1833.

Description: Hustedt, 1927-66, II, p. 425, fig. 877d, e.

Schmidt's Atlas, plate 417, fig. 11-14; Foged, 1978, p. 23, pl. 15, fig. 13-14, 18-20; Foged, 1979, p. 18, pl. 15, fig. 14; McIntire & Reimer, 1974, p. 171, pl. 2, fig. 8a,b; pl. 3, fig. 2a,b; John 1983, p. 68, pl. 29, fig. 10-11; Jensen, 1985, p. 368, fig. 877d, e; Lange-Bertalot and Krammer, 1989, pl. 12, pl. 100; Pankow, 1990, p. 153, pl. 32, fig. 8; Krammer and Lange-Bertalot, 1991, p. 3, pl. 1, fig. 4-8;

Dimensions: Length: 78-90 μm . Width: 8-9 μm . Str: 12/10 μm .

WM: Not observed.

WCA: VR at 125-126 cm (salt marsh peat).

Remarks: Both Hustedt (1927-66) and John (1983) suggested that *A. brevipes* var. *intermedia* may be indicative of somewhat lower salinities than the nominate variety. A.

brevipes var. *intermedia* is commonly found attached to eelgrass (*Zostera* spp.) in the lower half of the intertidal zone in estuaries of the Pacific Northwest.

Foged (1978, p. 23): "Polyhalobous (mesohalobous?), alkaliphilous. Cosmopolitan."

***Achnanthes exigua* Grunow in Cleve and Grunow 1880**

Description: Patrick and Reimer, 1966, p. 257, pl. 16, fig. 21-22.

Grunow in Cleve and Grunow, 1880, p. 21; Hustedt, 1927-66, II, p. 386, fig. 832a, b; Van der Werff and Huls, 1957-74; John, 1983, p. 70, pl. 30, figs. 5,6; Jensen, 1985, p. 336, fig. 832a, b; Lange-Bertalot and Krammer, 1989, p. 51, pl. 45, figs. 4-36; pl. 46, figs. 1-3; Pankow, 1990, p. 154, pl. 32, figs. 6-7.

Dimensions: L: 7-17 μm . W: 4.5-6 μm . Str: 24-25/10 μm (RV), 20-22/10 μm (RLV).

WM: Not observed.

WCA: VR in various samples.

Remarks: Very rare in WCA. Distinguished by the capitate apices and parallel to weakly radiate striae. The raphe valve has a transverse fascia, while the central area on the rapheless valve extends to the margin on one side only.

Patrick and Reimer (1966, p. 257): "Distinguished from similar-shaped species of *Achnanthes* by the sharply defined quadrangular valve body and the stauros-like central area on the raphe valve."

***Achnanthes hauckiana* Grunow 1880**

(pl. 1, figs. 2, 3)

Syn: *Achnanthes delicatula* spp. *hauckiana* Lange-Bertalot and Ruppel 1980.

Description: Patrick and Reimer, 1966, p. 267, pl. 17, fig. 23-24.

Hustedt, 1927-66, II, p. 388, fig. 834; Foged, 1982, p. 27, pl. 9, fig. 16; Van der Werff and Huls, 1957-74; Jensen, 1985, p. 338, fig. 834; Laws, 1988, p. 153, pl. 17, fig. 14.

(As *A. delicatula* spp. *hauckiana*): Lange-Bertalot and Krammer, 1989, p. 45, pl. 87, figs. 14-23; Pankow, 1990, p. 158, pl. 33, fig. 17.

Dimensions: L: 9-31 μm . W: 5-9 μm . Str: 10-12/10 μm (mid-valve), 12-15/10 μm (apices).

WM: C at WM-B (sandy nearshore)

WCA: VR in various samples.

Remarks: Patrick and Reimer (1966, p. 267): "A taxon quite variable in shape. Best distinguished by the coarse striae, at least some of which are usually wedge-shaped or conical; the broad portion of the striae is at the valve margin."

***Achnanthes lanceolata* (Brébisson) Grunow in Cleve & Grunow 1880**

(pl. 1, figs. 11, 12)

Description: Patrick and Reimer, 1966, p. 269, pl. 18 figs. 1-10.

Hustedt, 1927-66, II, p. 408, figs. 863a-d; Van der Werff and Huls, 1957-74; Foged, 1978, p. 26, pl. 15, figs. 4,5; Foged, 1981, p. 49, pl. 12, figs. 11,12, 23, 24; Germain, 1981, p. 115, pl. 44, figs. 1-18; Foged, 1982, p. 27, pl. 9, figs. 3,4,6; John, 1983, p. 73, pl. 31, figs. 13-16; Jensen, 1985, p. 354, figs. 863a-d; Laws, 1988, p. 153, pl. 17, fig. 20; pl. 25, figs. 8,9; Lange-Bertalot and Krammer, 1989, p. 83, pl. 84, figs. 1-16; Pankow, 1990, p. 156, pl. 32, fig. 11.

Dimensions: L: 12-31 μm . W: 4.5-8 μm . Str: 11-14/10 μm .

WM: VR in various samples.

WCA: R to C, particularly concentrated in the lower part of the core.

Remarks: Patrick & Reimer (1966, p. 269): "A quite common species occurring under a wide range of ecological conditions. Observed especially in rather well-aerated flowing waters

(?rheophil) of neutral to alkaline pH (pH, ?indifferent or alkaliphil); does not seem to appear in large numbers under conditions of heavy organic enrichment.”

***Achnanthes lemmermanii* Hustedt 1933 in Hustedt 1927-66**

(pl. 2, figs. 6, 7)

Description: Patrick and Reimer, 1966, p. 265, pl. 17, figs. 15-16.

Hustedt, 1927-66, II, p. 390, fig. 837; Jensen, 1985, p. 340, fig. 837; Simonsen, 1987, p. 133, pl. 220, figs. 10-12; Pankow, 1990, p. 160, pl. 33, fig. 13.

Dimensions: L: 10-15 μm . W: 4.5-5 μm . Str: 16-18/10 μm .

WM: VR to R in samples where standing is present; associated with *Fragilaria virescens* var. *oblongella* at WM-9.

WCA: VR at 20 cm.

Remarks: May be confused with *A. hauckiana*, but distinguished by the produced apices, and the uninterrupted striae and narrow-oval sternum on the rapheless valve.

***Achnanthes rupestoides* Hohn 1961**

(pl. 1, figs. 4, 5, 8-10)

Bas: *Cocconeis hustedtii* Krasske 1923.

Syn: *Achnanthes hustedtii* (Krasske) Reimer in Patrick and Reimer 1966; *Achnanthes krasskei* Kobayasi and Sawatari 1986.

Description: Krammer and Lange-Bertalot, 1991b, p. 31, pl. 17, figa. 35-42.

(As *A. krasskei*): Kobayasi and Sawatari, 1986, p. 261; Lange-Bertalot and Krammer, 1989, p. 75, pl. 29, figa. 1-9.

(As *A. hustedtii*): Patrick and Reimer, 1966, p. 264, pl. 17, figa. 9,10;

(As *C. hustedtii*): Krasske, 1923, figs. 10a-b; Germain, 1981, p. 106, pl. 40, figa. 3,4; Jensen, 1985, p. 318, fig. 816.

Dimensions: L: 12-17 μm . W: 5-7 μm . Str: 19-22/10 μm (RV), 18-20/10 μm (RLV).

WM: C in samples from wet areas of the marsh.

WCA: C at 10 and 40 cm, absent in probable salt marsh peat at 100-140 cm, and VR in remaining samples.

Remarks: The raphe valve has a subquadrate central area almost reaching the margins; the rapheless valve has a lanceolate sternum formed by the striae being of equal length along the margins of the valve.

AMPHORA Ehrenberg ex Kützing 1844

***Amphora coffeaeformis* (Agardh) Kützing 1844**

Syn: *Frustulia coffeaeformis* Agardh 1827; *Amphora salina* W. Smith 1853.

Description: Hustedt, 1930, p. 345, fig. 634.

Van der Werff and Huls, 1957-74; Hendey, 1964, p. 264; Patrick and Reimer, 1975, p. 78, pl. 14, figs. 11-12; John, 1983, p. 149, pl. 61, figs. 8-11; Jensen, 1985, p. 797, fig. 634; Krammer and Lange-Bertalot, 1986, p. 347, pl. 151, figs. 1-6; Pankow, 1990, p. 257, pl. 60, fig. 8.

Dimensions: L: 20-50 μm . W: 10-18 μm . Str: 16-18/10 μm (mid-valve), 25/10 μm (apices).

WM: VR in a few samples.

WCA: VR in a few samples.

Remarks: Distinguished by the protracted subcapitate to capitate apices, arched dorsal margin and nearly straight ventral margin, and the gently-radiating striae. Ventral side has only one marginal row of delicate striae.

***Amphora granulata* Gregory 1857**

Description: Pankow, 1990, p. 257.

Rizynk, 1973, p. 116, pl. 2, fig. 3.

Dimensions: L: 38-47 μm . W: 13-23 μm . Str: 10-14/10 μm . IB: 7-11/10 μm .

WM: Not observed.

WCA: VR at 20 cm.

Remarks: Distinguished by the straight raphe and ventral margin; the cells are linear-lanceolate, with truncated apices.

***Amphora libyca* Ehrenberg 1840**

(pl. 1, fig. 13)

Syn: *Amphora ovalis* var. *affinis* (Kützing) Van Heurck 1880; *Amphora ovalis* var. *libyca* (Ehrenberg) Cleve 1895; *Amphora ovalis* var. *pediculus* (Kützing) Cleve 1895.

Description: John, 1983, p. 152, pl. 62, figs. 11, 12 (as *Amphora ovalis* var. *libyca*).

Krammer and Lange-Bertalot, 1986, p. 345, pl. 149, figs. 3-11.

(As *Amphora ovalis* var. *affinis*): Hustedt, 1930, p. 342, fig. 628; Patrick and Reimer, 1975, p. 69, pl. 13, fig. 3-4; Foged, 1978, p. 33, pl. 36, fig. 11; John, 1983, p. 152, pl. 62, figs. 11, 12.

(As *Amphora ovalis* var. *libyca*): Van der Werff and Huls, 1957-74; Krammer, 1980, p. 209, figs. 4, 12-20; Foged, 1981, p. 54, pl. 45, fig. 3; Foged, 1982, p. 30, pl. 27, figs. 3, 15; .

(As *Amphora copulata*): Pankow, 1990, p. 251, pl. 60, fig. 1.

Dimensions: L: 20-48 μm . W: 5-9 μm . Str: 12-14/10 μm (mid-valve); 14/10 μm (apices).

WM: VR in various samples.

WCA: VR in various samples.

Remarks: Distinguished by the shape of the frustule, the filiform raphe with central and apical fissures turned in a dorsal direction, and the interruption of the dorsal striae in the middle of the valve by a hyaline area.

***Amphora ventricosa* (Gregory) Hendey 1951**

Syn: *Amphora angustata* (Gregory) Cleve 1895.

Description: John, 1983, p. 156, pl. 64, fig. 7, 8.

Hendey, 1951, p. 70, pl. 9, fig. 6; Hendey, 1964, p. 269, pl. 38, fig. 12; Laws, 1988, p. 154, pl. 27, fig. 9; Foged, 1978, p. 34, pl. 38, fig. 9, 10; pl. 65, fig. 1-10; pl. 66, fig. 1, 2.

(As *Amphora angustata*): Brockmann, 1950, p. 23, pl. 4, fig. 18.

Dimensions: L: 25-80 μm . W: 6-14 μm . Str: 12-18/10 μm .

WM: Not observed.

WCA: VR at 30 cm.

Remarks: Distinguished by the valve shape, straight ventral margin, axial area narrowing towards the apices, and the straight raphe branches. John (1983) reported variability in the shape of the valve and striae density in populations from different salinities. Forms that I have observed in coastal Washington and Puget Sound tend to be narrowly lanceolate in shape, with broad raphe sternums and strongly parallel and dense striae.

ANOMOEONEIS Pfitzer 1871

Anomoeoneis brachysira (Brébisson in Rabenhorst) Grunow in Cleve 1895

Syn: *Navicula brachysira* Brébisson in Rabenhorst 1853; *Anomoeoneis serians* var. *brachysira* (Brébisson) Cleve in Cleve & Möller 1882; *Anomoeoneis serians* var. *thermalis* Grunow in Van Heurck 1880; *Anomoeoneis brachysira* var. *thermalis* (Grunow) Cleve-Euler 1953 in Cleve-Euler 1951-1955.

Description: Krammer and Lange-Bertalot, 1986, p. 254, pl. 94, figs. 1-14, 29.

Hein, 1990, p. 22, pl. 4, figs. 3, 4.

(As *A. serians* var. *brachysira*): Hustedt, 1927-66, II, p. 748, fig. 1112h; Patrick and Reimer, 1966, p. 379, pl. 33, figs. 7-11; Foged, 1981, p. 55, pl. 12, fig. 18; Foged, 1982, p. 30, pl. 15, figs. 2-5.

Dimensions: L: 14-47 μm . W: 4-10 μm . Str: 26-30/10 μm .

WM: Not observed.

WCA: VR at 140 cm.

Remarks: Distinguished by the small valve with blunt apices, very narrow raphe sternum with distinct rhombic or diagonally oval central area, and the wavy longitudinal lines.

AULACOSEIRA Thwaites 1848

Aulacoseira islandica (O. Müller) Simonsen 1979

Syn: *Melosira islandica* O. Müller 1906.

Description: Pankow, 1990, p. 95, pl. 14, fig. 2 (as *Melosira islandica*).

Laws, 1988, p. 154, pl. 2, fig. 2-4.

(As *Melosira islandica*): Hustedt, 1927-66, I, p. 252, fig. 106, 107;

Dimensions: Diam: 7-30 μm .

WM: Not observed.

WCA: C at 50-80 cm -- possible evidence for standing fresh water. See also *Eunotia formica*.

Remarks: Pankow (1990, p. 95): "valves with scattered small pores, those on the mantle surface form rows which run parallel to the perivalvar axis..."

BIREMIS Mann and Cox in Round and others 1990

Biremis ambigua (Cleve) Mann in Round and others 1990

Syn: *Pinnularia ambigua* Cleve 1895.

Description: Hendey, 1964, p. 233, pl. 34, fig. 5-8 (as *Pinnularia ambigua*).

(As *Pinnularia ambigua*): Brockmann, 1950, p. 20, pl. 1, fig. 7; pl. 3, fig. 21, pl. 4, fig. 19;

John, 1983, p. 123, pl. 53, fig. 1.

Dimensions: L: 35-80 μm . W: (7)8-10(12) μm .

WM: A single, presumably *in situ*, frustule was observed at WM-B (sandy nearshore), and two presumably reworked valves were observed at WM-11.

WCA: Not observed.

Remarks: Hendey (1964, p. 233): "Valves, linear, narrowly oblong, straight, with rounded apices, or asymmetric, sublunate, with sub-acute apices. Axial area wide; valve surface furnished with somewhat coarse striae that do not completely break up into puncta. Striae short and marginal in the symmetrical form. In the asymmetrical form the striae are more developed upon the dorsal side and reduced to a narrow line of puncta on the ventral margin."

Raphe slightly curved. Girdle of the larger asymmetrical form wide and bearing a few longitudinal lines or folds; girdle view slightly constricted in the middle... Littoral and euryhaline... on sandy foreshores."

CALONEIS Cleve 1894

***Caloneis amphisbaena* (Bory) Cleve 1894**

Bas: *Navicula amphisbaena* Bory de Saint Vincent 1824.

Syn: *Navicula fuscata* Schumann 1867.

Description: Patrick and Reimer, 1966, p. 579, pl. 53, fig. 2.

Hustedt, 1930, p. 230, fig. 346; Foged, 1982, p. 31, pl. 11, fig. 1; Jensen, 1985, p. 768, fig. 346; Krammer and Lange-Bertalot, 1986, p. 385, pl. 168, fig. 4; Pankow, 1990, p. 195, pl. 44, fig. 2.

Dimensions: L: 36-80 μm . W: 20-30 μm . L: 36-80 μm .

WM: VR at WM-1 and WM-2 (innermost marsh).

WCA: VR at 1 cm.

Remarks: The broad lanceolate valves, produced, bluntly rostrate ends, and the broad oval raphe sternum are all distinguishing features of this taxon.

Patrick and Reimer (1966, p. 579): This taxon is characterized by the shape of the central area, the shape of the ends, and the position of the longitudinal lines... Fresh to slightly brackish water."

***Caloneis bacillum* (Grunow) Cleve 1894**

(pl. 5, fig. 1)

Syn: *Stauroneis bacillum* Grunow 1860; *Navicula fasciata* Lagerstedt 1873; *Pinnularia fasciata* (Lagerstedt) Hustedt 1930; *Stauroneis amphioxys* var. *obtusa* Hendey 1964.

Description: Patrick and Reimer, 1966, p. 586, pl. 54, fig. 7.

Germain, 1981, p. 238, pl. 87, fig. 1-28; John, 1983, p. 107, pl. 45, fig. 1-2; Krammer and Lange-Bertalot, 1986, p. 390, pl. 173, fig. 9-20; Laws, 1988, p. 155, pl. 22, fig. 6,11; Pankow, 1990, p. 196, pl. 44, fig. 8.

(As *Pinnularia fasciata*): Hustedt, 1930, p. 316, fig. 569; Jensen, 1985, p. 722, fig. 569.

(As *Stauroneis amphioxys* var. *obtusa*): Hendey, 1964, p. 220, pl. 43, fig. 7-9.

Dimensions: L: 15-45 μm . W: 4-9 μm . Str: (22)24-30/10 μm .

WM: C at WM-1; VR in other marsh samples.

WCA: VR in various samples.

Remarks: Hendey 's (1964, p. 220) description for *Stauroneis amphioxys* var. *obtusa* is equivalent, in terms of valve form and dimensions, to descriptions for *C. bacillum*. Although Hendey did not mention longitudinal lines crossing the valves, these are clearly shown in the figures (pl. 43, fig. 7-9). The linear-lanceolate valve shape, parallel to slightly radiate striae, and the straight-edged transverse fascia are distinguishing features.

***Caloneis permagna* (Bailey) Cleve 1894**

Syn: *Pinnularia permagna* Bailey 1851; *Navicula fenzi* Grunow 1863; *Caloneis amphisbaena* var. *fenzi* (Grunow) Cleve 1894.

Description: Krammer and Lange-Bertalot, 1986, p. 384, pl. 168, fig. 1-3; pl. 164, fig. 4.

Patrick and Reimer, 1966, p. 580, pl. 53, fig. 5; Jensen, 1985, p. 769, fig. 349; Pankow, 1990, p. 196, pl. 44, fig. 3.

Dimensions: L: 85-220 μm . W: 35-55 μm . Str: 10-12/10 μm .

WM: Not observed.

WCA: VR at 115 cm.

Remarks: Distinguished by the large rhombic valves and lanceolate sternum.

Hendey (1964, p. 230): "A brackish-water species, frequently found on sandy beaches, often abundant. Common along all shores of the North Sea, English Channel and estuaries leading thereto."

***Caloneis westii* (Wm. Smith) Hendey 1964**

Syn: *Navicula westii* W. Smith 1853; *Navicula formosa* Gregory 1856; *Caloneis formosa* (Gregory) Cleve 1894; *Caloneis liburnica* Grunow in Van Heurck 1880; *Caloneis oregonica* (Ehrenberg) Patrick in Patrick and Reimer 1966.

Description: Hendey, 1964, p. 230, pl. 44, fig. 5-10; pl. 45, figs. 1-13.

Rizynk, 1973, p. 118, pl. 4; Krammer and Lange-Bertalot, 1986, p. 386, pl. 170, figs. 1-2;

Laws, 1988, p. 155, pl. 22, figs. 4,5,9; Pankow, 1990, p. 198, pl. 44, fig. 12.

(As *Caloneis formosa*): Hustedt, 1930, fig. 350; Hendey, 1951, p. 57, pl. 17, fig. 13; Jensen, 1985, p. 770, fig. 350.

Dimensions: L: 60-130 μm . W: 20-28 μm . Str: 12-14/10 μm .

WM: Not observed.

WCA: VR at 110 cm.

Remarks: Widely distributed in low salt marshes in coastal Washington.

CATENULA Mereschkowsky 1903

***Catenula adhaerens* Mereschkowsky 1903**

(pl. 1, fig. 16)

Description: Hendey, 1964, p. 157.

Brockmann, 1950, p. 22, pl. 1, fig. 9; Tynni, 1986, p. 17, pl. 27, fig. 163.

Dimensions: L: 13-16 μm . W: 2.8-3.3 μm .

WM: VR at WM-B.

WCA: Not observed.

Remarks: Distinguished by the small asymmetrical valve, slightly indented on the dorsal margin, and the thickened central and polar raphe endings which stand out in LM relative to the rest of the finely-silicified valve.

Brockmann (1950, p. 22): "Attached to sand grains on tidal flats and on the bottom of the North Sea."

CAVINULA Mann and Stickle in Round and others 1990

***Cavinula cocconeiformis* (Gregory ex Greville) Mann and Stickle in Round and others 1990**

Syn: *Navicula cocconeiformis* Gregory ex Greville 1855.

Description: Patrick and Reimer, 1966, p. 451, pl. 41, fig. 5 (as *Navicula cocconeiformis*).

Hustedt, 1927-66, III, p. 132, fig. 1266; Schmidt's Atlas, pl. 400, figs. 96-98; Foged, 1971, p. 954, pl. 15, figs. 16, 18, 19; Foged, 1981, p. 109, pl. 30, fig. 8; pl. 37, fig. 6; Germain, 1981, p. 214, pl. 81, figs. 1-3; Krammer and Lange-Bertalot, 1986, p. 158, pl. 59, figs. 2-5.

Dimensions: L: 12-40 μm . W: 7-15 μm . Str: 12-40/10 μm .

WM: VR in various samples.

WCA: Not observed.

Remarks: Patrick and Reimer (1966, p. 451): "Indifferent to halophobe, prefers some iron."
Foged (1981, p. 110): "Halophobe. pH: indifferent. Cosmopolite (?)".

***Cavinula variostriata* (Krasske) Mann in Round and others 1990**

Syn: *Navicula variostriata* Krasske 1923.

Description: Krammer and Lange-Bertalot, 1986, p. 203, pl. 73, figs. 8-11 (as *Navicula variostriata*).

Hustedt, 1927-66, III, p. 201, fig. 1320; Schmidt's Atlas, pl. 404, figs. 28-30; Patrick and Reimer, 1966, p. 447, pl. 40, fig. 6; Foged, 1974, p. 84, pl. 13, figs. 8,9; Germain, 1981, p. 231, pl. 8, figs. 32,33; Hein, 1990, p. 76, pl. 31, figs. 7-9.

Dimensions: L: 15-44 μm . W: 5-10 μm . Str: 27-30/ 10 μm .

WM: Not observed.

WCA: VR-R in various samples.

Remarks: Patrick and Reimer (1966, p. 447): "In swamps, especially with *Sphagnum*; often found in dystrophic water."

Foged (1981, p. 128): "Oligohalobe (indifferent). Acidophil to pH-circumneutral. Cosmopolite."

COCCONEIS Ehrenberg 1837

***Cocconeis peltoides* Hustedt 1939**

Description: Hustedt, 1939, p. 606, figs. 23-27.

Brockmann, 1950, p. 13, pl. 6, figs. 5,7; Hendey, 1964, p. 181; Pankow, 1990, p. 164.

Dimensions: L: 7-18 μm . W: 6-10 μm . Str: 16/10 μm .

WM: VR at WM-B.

WCA: Not observed.

Remarks: Hendey (1964, p. 181): "A widely distributed littoral species commonly found attached to sand grains. German and Danish coasts, east coast of England." Brockmann (1950, p. 13): "Not rare on sandy tidal flats."

***Cocconeis placentula* Ehrenberg 1838**

Description: Krammer and Lange-Bertalot, 1991b, p. 86, pl. 49, figs. 2,4; pl. 50, fig. 5; pl. 51, figs. 1-5.

Hustedt, 1927-66, II, p. 347, fig. 802a, b; Patrick and Reimer, 1966, p. 240, pl. 15, figs. 5,6; John, 1983, p. 79, pl. 34, figs. 11,12; pl. 35, fig. 1; Jensen, 1985, p. 306, figs. 802a, b; Laws, 1988, p. 157, pl. 18, figs. 5,6;

Dimensions: L: 7.5-98 μm . W: 8-40 μm . Str: 20-23/10 μm (RV); 24-26/10 μm (RLV). P: 18-22/10 μm .

WM: Not observed.

WCA: VR in lower part of core at 125, 135, 140 and 185 cm.

Remarks: Patrick and Reimer (1966, p. 241): "Best distinguished from *Cocconeis pediculus* by the relatively flat valves and the presence of two hyaline areas - one marginal, one submarginal - encircling the raphe valve near the margin instead of one (marginal) area in *C. pediculus*... A widespread eurytopous species epiphytic on aquatic plants and other objects... apparently salt "indifferent" but not observed in great numbers in slightly brackish waters."

***Cocconeis scutellum* Ehrenberg 1838**

(pl. 5, fig. 2)

Description: John, 1983, p. 82, pl. 36, figs. 2-4.

Jensen, 1985, p. 298, fig. 790; Hustedt, 1927-66, II, p. 337, fig. 790; Hendey, 1964, p. 180, pl. 27, fig. 8; Laws, 1988, p. 157, pl. 18, fig. 4; pl. 19, fig. 5.

Dimensions: L: 10-40 μm . W: 7-29 μm . Str: 12-14/10 μm (RV); 11-12/10 μm (RLV). P: 16-18/10 μm (RV); 12-14/10 μm (RLV).

WM: Not observed.

WCA: VR at 10 and 30 cm.

Remarks: A common epiphyte on estuarine plants, particularly *Zostera* (eel grass). Jensen (1985, p. 301): "Distributed and common as growth form in all oceans." Hendey (1964, p. 180): "Ubiquitous, common on coasts all over the world." Main and McIntire (1974, p. 94): "...*Cocconeis scutellum* was primarily associated with *Zostera*, a host that is exposed to little or no desiccation."

***Cocconeis scutellum* var. *parva* Grunow in Van Heurck 1880**

Description: Krammer and Lange-Bertalot, 1991b, p. 93, pl. 57, figs. 5-7.

Hustedt, 1927-66, II, p. 338, fig. 791; John, 1983, p. 82, pl. 36, figs. 5,6; Jensen, 1985, p. 300, fig. 791.

Dimensions: L: 20-25 μm . Str: 11-14/10 μm (RL).

WM: VR at WM-10.

WCA: Not observed.

Remarks: Commonly found in coastal Washington attached to *Zostera* (eel grass).

Hendey (1964, p. 180): "Common on all coasts of the British Isles; often found with the type. Main and McIntire (1974, p. 94): Observed attached to macrophytes throughout the intertidal zone.

COSMIONEIS Mann and Stickle in Round and others 1990

***Cosmioneis pusilla* (W. Smith) Mann and Stickle in Round and others 1990**

(pl. 1, fig. 14; pl. 5, fig. 3)

Syn: *Navicula pusilla* W. Smith 1853.

Description: Patrick and Reimer, 1966, p. 452, pl. 41, fig. 7 (as *Navicula pusilla*).

Smith, 1853, p. 52, pl. 17, fig. 145; Hustedt, 1927-1966, III, p. 722, fig. 1704; Foged, 1978, p. 97, pl. 32, fig. 9; Foged, 1979, p. 79, pl. 30, fig. 1; Foged, 1981, p. 122, pl. 34, figs. 7,8; Germain, 1981, p. 216, pl. 81, fig. 9; Krammer and Lange-Bertalot, 1986, p. 167, pl. 57, figs. 7-9.

Dimensions: L: 25-50 μm . W: 12-25 μm . Str: 10-14/10 μm (center); 18-20/10 μm (ends).

WM: Present in all marsh samples: A at WM-12 (grassy site behind berm); C at WM-8 and WM-11.

WCA: VR-R in numerous samples; F at 100 cm.

Remarks: Patrick and Reimer (1966, p. 452): "In W. Smith's original drawing the striae at the center of the valve are more widely spaced, but not definitely irregular in length. The slide from which our specimen was drawn is one of W. Smith's from South Wales. The specimens on this slide have striae of irregular length about the central area. The same observation has been made by Cleve (1895, p. 41) and Hustedt (1930, p. 311)... Boyer [1916] separates the variety from the species on the basis of the shape of the ends of the valve and the shape of the central area. He evidently did not closely observe W. Smith's illustration which shows the ends to be distinctly rostrate-capitate. As to the central area, its shape may

be variable... Seems to prefer fresh water of high mineral content or slightly brackish water; aerophil; often found in cool temperate areas."

Foged (1981, p. 122): "Oligohalobe (indifferent). pH: circumneutral. Cosmopolite."

Pankow (1990, p. 233): "Oligohalobous (indifferent), mesoeuryhaline [\approx 0-10 ‰]."

CRATICULA A. Grunow 1868

Craticula accomoda Mann in Round and others 1990

Syn: *Navicula accomoda* Hustedt 1950.

Description: Patrick and Reimer, 1966, p. 468, pl. 44, fig. 7 (as *Navicula accomoda*).

Germain, 1981, p. 170, pl. 63, fig. 5; Foged, 1981, p. 106, pl. 38, fig. 27; Krammer and Lange-Bertalot, 1986, p. 128, pl. 45, figs. 13-20.

Dimensions: L: 19-35 μm . W: 7-10 μm . Str: 20-25/10 μm .

WM: Not observed.

WCA: VR at 150, 180 cm.

Remarks: Patrick and Reimer (1966, p. 468): "This species is similar to *Navicula halophila* (Grun.) Cl. but differs from it in that the striae are more distant in the middle portion of the valve... This species is distinguished by the median ends of the raphe being distant from each other and by the shape of the valve... Grows well in the presence of organic pollution."

Foged (1981, p. 106): "Oligohalobe (indifferent). Alkaliphil. Cosmopolite."

Craticula halophila (Kützing) Mann in Round and others 1990

Syn: *Navicula cuspidata* var. *halophila* Grunow in Van Heurck 1885; *Navicula halophila* (Grunow) Cleve 1894.

Description: Krammer and Lange-Bertalot, 1986, p. 126, pl. 44, figs. 1-11, 14-18.

Brockmann, 1950, p. 15, pl. 2, fig. 23; Patrick and Reimer, 1966, p. 467, pl. 44, fig. 4; Foged, 1978, p. 90, pl. 27, fig. 7; Germain, 1981, p. 170, pl. 65, figs. 1-11.

Dimensions: L: 7-140 μm . W: 4.5-18 μm . Str: 15-24/10 μm .

WM: Not observed.

WCA: VR in a few samples.

Remarks: Very variable in size and valve outline. There is no obvious central area; striae are parallel along most of the valve, slightly convergent near the apices. Rare at Winslow.

Hendey, 1964, (p. 190): "A brackish-water species, frequent on English Channel coasts."

CYCLOTELLA Kützing 1833

Very rare specimens of the planktonic genus *Cyclotella* were observed at Winslow Marsh and in Core A, but individual species were not counted.

CYMBELLA Agardh 1830

Cymbella aspera (Ehrenberg) Peragallo in Pelletan 1889

Description: Patrick and Reimer, 1975, p. 53, pl. 10, fig. 8.

Hustedt, 1930, p. 365, fig. 680; Foged, 1978, p. 46, pl. 38, fig. 8; Foged, 1979, p. 37, pl. 35, fig. 14; Foged, 1981, p. 65, pl. 47, fig. 4; John, 1983, p. 145, pl. 60, fig. 7; Jensen, 1985, p. 818, fig. 680; Krammer and Lange-Bertalot, 1986, p. 319, pl. 131, fig. 1; Pankow, 1990, p. 248, pl. 57, fig. 9.

Dimensions: L: 70-200 μm . W: 20-30 μm . Str: 7-10/10 μm (mid-valve); 11-12/10 μm (apices). P: 11-15/10 μm .

WM: Not observed.

WCA: VR in a few samples.

Remarks: A large diatom, often reworked in coastal samples.

Cymbella descripta (Hustedt 1943) Krammer and Lange-Bertalot 1985

(pl. 1, fig. 15)

Bas: *Navicula descripta* Hustedt 1943.

Syn: *Cymbella cesatii* var. *capitata* Krieger 1933; *Cymbella brownlundensis* Foged 1955.

Description: Krammer and Lange-Bertalot, 1986, p. 327, pl. 135, fig. 1-5.

Krammer and Lange-Bertalot, 1985, p. 24, pl. 8, figs. 1-5; Hein, 1990, p. 33, pl. 9, fig. 6.

Dimensions: L: 15-33 μm . W: 4-6.5 μm . Str: 18-21/10 μm .

WM: A at WM-P (freshwater pond); VR-R in various marsh samples.

WCA: Not observed.

Remarks: The valve appears linear-lanceolate, but is actually slightly asymmetrical (i.e., dorsal-ventral), with narrowed rostrate ends. Striae are very gently radiate to parallel at the middle, parallel to gently convergent at the apices. The asymmetrical form can be seen by the striae at the middle of the valve, which on the dorsal margin are crowded together and alternate short and long, whereas on the ventral margin they are parallel and not crowded together. The center-most striae are a bit shorter than the others, producing a subquadrate central area that is larger on the dorsal side with the uneven striae. The raphe sternum is very narrow, there is an elongate thickening for the central nodule, and terminal nodules are small but distinct.

Translation: Krammer and Lange-Bertalot (1986, p. 327): "Valve slightly dorsiventral, narrowly linear-elliptical or linear-lanceolate with distinct, mostly capitate, rarely produced ends, Length 15-33 μm , Width 4-6.5 μm . Raphe in the middle of the valve or shifted slightly to the dorsal or ventral side, lateral, Type 1-2, apical fissures semicircular, bent ventrally, central pores distinct. Axial area very narrow, widened in the middle of the valve, either round or fascia-like, stigmata and apical pore fields absent. Striae radial without exception, areolae foramen in LM barely visible, in REM elongated with a large transapical outer lengthening. Striae in the middle 18-21/10 μm , at the ends somewhat closer, foramina in REM about 36-42/10 μm .

A nordic-alpine species, but also distributed and not rare in the foothills. Its previous type localities are in oligotrophic, oxygen-rich and cool water.

C. similis and *C. hybrida* are coarser structurally, the latter is larger. *C. falaisensis* distinguishes itself in outline, in the form of the valve ends and through essentially a much rounder central area. *C. cesatii* possesses a different valve outline with narrowly produced ends, differently constructed and arranged terminal raphe fissures and a round central area."

***Cymbella incerta* (Grunow) Cleve 1894**

Description: Hustedt, 1930, p. 360, fig. 665.

Schmidt's Atlas, pl. 379, figs. 15-20; Foged, 1981, p. 70, pl. 45, figs. 18,19; Jensen, 1985, p. 812, fig. 665; Krammer and Lange-Bertalot, 1986, p. 329, pl. 136, figs. 1-12.

Dimensions: L: 40-70 μm . W: 7-9 μm . Str: 14-20/10 μm .

Hustedt (in Jensen, 1985): "Valves naviculoid, very slightly asymmetrical, linear with weakly convex margins and bluntly rounded ends, 40-70 μm long, 7-9 μm wide. Raphe slightly eccentric, with slightly wavy outer furrows. Axial area slender, somewhat lanceolate toward the middle, more or less roundishly widened around the central nodule. Transapical striae slightly radial throughout, somewhat more strongly inclined near the ends on the dorsal side, 14-20 in 10 μm . Punctuation very delicate, discernible only in strongly refractive medium."

WM: Not observed.

WCA: VR at 125 and 180 cm.

Remarks: Distinguished by the slightly asymmetrical valve with weakly convex margins; striae area more strongly convergent near the ends on the dorsal side than on the ventral side.

Foged (1981, p. 71): "Halophobe. Acidophil. Eurasia. Greenland. N. America."

***Cymbella minuta* Hilse ex Rabenhorst 1862 in Rabenhorst 1861-1879**

Syn: *Cymbella ventricosa* Kützing 1844; *Encyonema minutum* (Hilse in Rabenhorst) Mann in Round and others 1990.

Description: Patrick and Reimer, 1975, p. 47, pl. 8, fig. 1a-4b.

John, 1983, p. 145, pl. 60, figs. 8-9; Krammer and Lange-Bertalot, 1986, p. 305, pl. 119, figs. 1-13; Laws, 1988, p. 159, pl. 27, fig. 14.

(As *Cymbella ventricosa*): Hustedt, 1930, p. 359, fig. 661; Riznyk, 1973, p. 121, pl. 7, fig. 3; Foged, 1978, p. 50, pl. 37, fig. 6-8; Foged, 1979, p. 42, pl. 34, fig. 11,12; Germain, 1981, p. 292, pl. 107, fig. 11-22; Jensen, 1985, p. 811, fig. 661.

Dimensions: L: 9-28 μm . W: 4.5-6 μm . Str: 14-16/10 μm (middle); 18-19/10 μm (ends).

WM: Not observed.

WCA: VR in a few samples.

Remarks: Best distinguished by the small, strongly dorsi-ventral valve, with the raphe and narrow axial area lying near and parallel to the straight ventral margin.

Patrick and Reimer (1975, p. 48): "Ecological: The species complex is very widespread and eurytopic. In the U.S. it appears to be pH 'indifferent,' oligohalobous."

***Cymbella silesiaca* Bleisch in Rabenhorst 1864**

Syn: *Cymbella minuta* var. *silesiaca* (Bleisch) Reimer in Patrick and Reimer 1975; *Cymbella ventricosa* Kützing 1844 pro parte.

Description: Krammer and Lange-Bertalot, 1986, p. 304, pl. 117, figs. 1-24.

Pankow, 1990, p. 248, pl. 57, fig. 6; Hein, 1990, p. 38, pl. 12, fig. 2.

(As *Cymbella minuta* var. *silesiaca*): Patrick and Reimer, 1975, p. 49, pl. 8, figs. 9-10;

Dimensions: L: 15-46 μm . W: 6.5-14.2 μm . Str: 10-15/10 μm (dorsal middle); 14-20/10 μm (ventral and dorsal ends).

WM: Not observed.

WCA: VR in a few samples.

Remarks: Rare at Winslow Marsh.

Pankow (1990, p. 248): "Oligohalobous (indifferent), mesoeuryhaline [~1-10 ‰]."

DENTICULA Kützing 1844

Denticula subtilis Grunow 1862

(pl. 1, fig. 22, 23)

Syn: *Denticula rainierensis* Sovereign 1963.

Description: Krammer and Lange-Bertalot, 1988, p. 140, pl. 96, fig. 1-9.

Patrick and Reimer, 1975, p. 172, pl. 22, fig. 10-11; John, 1983, p. 159, pl. 67, fig. 1; Lange-Bertalot and Krammer, 1987, p. 66, pl. 42, fig. 12; Laws, 1988, p. 159, pl. 30, fig. 12, 13.

(As *Denticula rainierensis*): Sovereign 1963, p. 364, fig. 22-24.

Dimensions: L: 7-20 μm . W: 2-3 μm . Cost: 6-10/10 μm . Str: 28-30/10 μm .

WM: C at WM-11 (grassy surface); VR-R in various remaining marsh samples.

WCA: F at 1 cm.

Remarks: Widely distributed in marshes above mean higher high water in coastal Washington. Patrick and Reimer (1975, p. 172): "This taxon is distinguished by its small valves with acute apices... Brackish water of estuaries."

DIADESMIS Kützing 1844

Diadasmus contenta (Grunow ex Van Heurck) D.G. Mann in Round and others 1990

Syn: *Diadasmus biceps* Arnott ex Grunow in Van Heurck 1880; *Navicula contenta* Grunow in Van Heurck 1880-1885.

Description: Krammer and Lange-Bertalot, 1986, p. 219, pl. 75, figs. 1-5 (as *Navicula contenta*).

Hustedt, 1927-66, III, p. 209, figs. 1328a-d; Schmidt's Atlas, pl. 402, figs. 12,13; Foged, 1979, p. 70, pl. 30, fig. 22; Germain, 1981, p. 228, pl. 85, figs. 15-18.

Dimensions: L: 4-30 μm . W: 2-6 μm . Str: 25-30/10 μm .

WM: VR at WM-3, WM-4 and WM-11; R at WM-12 where it occurs with *Hantzschia amphioxys*.

WCA: VR-R in numerous samples.

Remarks: Most commonly found in moist (but not wet) fresh-brackish soil samples.

DIMEREGRAMMA Ralfs in Pritchard 1861

Dimeregramma minor (Gregory) Ralfs in Pritchard 1861

Description: Hustedt, 1927-66, II, p. 118, fig. 640.

Hendey, 1964, p. 156, pl. 27, fig. 12; Riznyk, 1973, p. 17, pl. 7, figs. 6,7; Rao and Lewin, 1976, p. 183, figs. 66-70; John, 1983, p. 46, pl. 17, figs. 4,5; Jensen, 1985, p. 113, fig. 640; Laws, 1988, p. 160, pl. 15, figs. 15,16.

Dimensions: L: 10-40 μm . W: 6-10 μm . Str: 9-14/10 μm .

WM: R at WM-B (sandy nearshore)

WCA: Not observed.

Remarks: Common on sandy tidal flats in coastal Washington, especially where *Zostera* is present.

Hendey (1964, p. 156): "A widely distributed littoral species, common on sandy beaches."

DIPLONEIS Ehrenberg ex Cleve 1894

Diploneis boldtiana Cleve 1891

(pl. 5, fig. 6-8)

Description: Krammer and Lange-Bertalot, 1986, p. 288, pl. 109, figs. 10,11.

Hustedt, 1927-66, II, p. 674, fig. 1067; Foged, 1981, p. 79, pl. 14, figs. 10, 13; pl. 15, figs. 4,6; Jensen, 1985, p. 565, fig. 1067.

Dimensions: L: 23-38 μm . W: 10-12 μm . Cost: 14-15/10 μm .

WM: Not observed.

WCA: F at 120, 125, and 135 cm.

Remarks: Hustedt (1927-66, II, p. 674) compared this taxon with *D. ovalis*, but noted that the transapical costae (ribs) are more radial, and that in *D. ovalis* there are "more or less" distinct single rows of areolae between the costae, which are not seen in *D. boldtiana*. *D. boldtiana* has a valve with nearly parallel sides, sometimes slightly inflated; the central area is oval, but not large, and the costae are only slightly radiate.

Diploneis elliptica (Kützing 1844) Cleve 1894

Description Krammer and Lange-Bertalot, 1986, p. 285, pl. 108, figs. 1-6.

Hustedt, 1927-66, II, p. 690, fig. 1077; Patrick and Reimer, 1966, p. 414, pl. 38, fig. 10; Jensen, 1985, p. 577, fig. 1077; Pankow, 1990, p. 188, pl. 41, fig. 1.

Dimensions: L: 20-130 μm . W: 10-60 μm . Str: 8-14/10 μm . Alveolae: 12-14/10 μm .

WM: Not observed.

WCA: R at 80 cm.

Remarks: Distinguished by the robust transapical ribs, crossed by wavy longitudinal ribs that are the same distance apart as the transapical ribs.

Pankow (1990, p. 188): "Oligohalobous, pleioeuryhaline [\sim 0-20 ‰]." Hustedt (1927-66, II, p. 691): "Distributed generally in fresh water, especially as a bottom form in standing water."

Diploneis finnica (Ehrenberg) Cleve 1891

Description: Hustedt, 1927-66, II, p. 669, fig. 1064.

Patrick and Reimer, 1966, p. 410, pl. 38, fig. 1; Foged, 1981, p. 80, pl. 15, fig. 1,2 Jensen, 1985, p. 561, fig. 1064; Krammer and Lange-Bertalot, 1986, p. 290, pl. 110, fig. 1,2; pl. 112, fig. 1.

Dimensions: L: 35-85 μm . W: 25-45 μm . Str: 7-8/10 μm .

WM: Not observed.

WCA: F at 80 cm.

Remarks: Distinguished by the valve shape and robust striae, and particularly by the rows of tiny puncta on the transapical ribs where they cross the longitudinal canals (i.e., in the interior part of the valve near the raphe).

Hustedt (in Jensen, 1985, p. 561): "In fresh water, especially in standing waters, distributed throughout all of Europe and very common." Patrick and Reimer (1966, p. 410): "This species is related to *Diploneis smithii* (Bréb.) Cl. from which it differs mainly in the structure of the axial area... Fresh water, particularly standing water; indifferent to small amounts of salt."

***Diploneis interrupta* (Kützing) Cleve 1894**

(pl. 5, figs. 4, 5)

Syn: *Navicula interrupta* Kützing 1844.

Description: Hustedt, 1927-66, II, p. 602, fig. 1019.

Patrick and Reimer, 1966, p. 416, pl. 38, fig. 12; Riznyk, 1973, p. 122, pl. 7, fig. 13; Foged, 1979, p. 44, pl. 21, fig. 3; Jensen, 1985, p. 508, fig. 1019; Krammer and Lange-Bertalot, 1986, p. 292, pl. 112, figs. 5,6; Laws, 1988, p. 160, pl. 23, figs. 1,2; Pankow, 1990, p. 184, pl. 40, fig. 1.

Dimension: L: 30-80 μm . W: 12-17 μm ; 7-15 μm at the constriction. Ribs: 8-12/10 μm .

WM: Not observed.

WCA: C to A in salt marsh peat from 100 to 115 cm.

Remarks: Widely distributed in salt marshes on the Washington coast. Distinguished by the constricted middle, and strongly radiating costae which are absent at mid-valve.

Superficially similar to *D. stroemi* but with more lanceolate longitudinal canals, more strongly radiate costae, and better developed hyaline area along the central part of the margin.

Hustedt (1927-66, II, p. 602): "Salt water form. Distributed and common in saline waters of the interior, as well as on ocean coasts with more or less saline waters."

***Diploneis ovalis* (Hilse) Cleve 1891**

(pl. 2, fig. 1)

Description: Hustedt, 1927-66, II, p. 671, figs. 1065a-e.

Foged, 1978, p. 52, pl. 25, fig. 4; Foged, 1981, p. 80, pl. 14, fig. 5; Germain, 1981, p. 142, pl. 55, figs. 1-8; John, 1983, p. 110, pl. 45, figs. 10, 11; pl. 46, fig. 1; Jensen, 1985, p. 562, figs. 1065a-e; Krammer and Lange-Bertalot, 1986, p. 286, pl. 108, figs. 14-16; Pankow, 1990, p. 188, pl. 41, fig. 7.

Dimensions: L: 20-100 μm . W: 10-35 μm . Ribs: 10-19/10 μm . P: 13-20/10 μm .

WM: VR at WM-2 and WM-3.

WCA: VR-R in various samples.

Remarks: Distinguished by the strongly arched valve surface with a large oval central nodule, and narrow longitudinal canals. There is a single row of puncta between the transapical ribs.

Hustedt (*in* Jensen, 1985, p. 563): "Widely distributed in fresh water and in slightly brackish waters of the interior. With predilection for places with springs as well as mossy marshes, it appears frequently, therefore, as an aerophil form."

***Diploneis pseudovalis* Hustedt 1930**

(pl. 2, fig. 2)

Description: Krammer and Lange-Bertalot, 1986, p. 287, pl. 108, figs. 11-13.

Hustedt, 1927-66, II, p. 668, fig. 1063c; Patrick and Reimer, 1966, p. 412, pl. 38, fig. 5; Foged, 1981, p. 81, pl. 14, fig. 11; Jensen, 1985, p. 560, fig. 1063c.

Dimensions: L: 16-31 μm . W: 9-14 μm . Str: 8-12/10 μm . P: 18-22/10 μm .

WM: Not observed.

WCA: VR-R from 100-130 cm.

Remarks: Differs from *D. ovalis* by the smaller size, and the double row of areolae between costae (*D. ovalis* has a single row of areolae between costae).

Patrick and Reimer (1966, p. 412): "This species is closely related to the fresh-water species *Diploneis subovalis* which is usually larger. It is also closely related to *D. smithii* var. *pumila* (Grun.) Hustedt... In slightly to definitely brackish water."

***Diploneis smithii* (Brébisson) Cleve 1894**

(pl. 5, fig. 9)

Description: Hustedt, 1927-66, II, p. 647, fig. 1051.

Hendey, 1964, p. 225, pl. 32, fig. 10; Patrick and Reimer, 1966, p. 410, pl. 38, fig. 2; Germain, 1981, p. 146, pl. 56, figs. 1-3; Jensen, 1985, p. 543, fig. 1051; Pankow, 1990, p. 186, pl. 41, fig. 8.

Dimensions: L: 12-200 μm . W: 6.5-75 μm . Str: 5-15/10 μm .

WM: Not observed.

WCA: VR in lower part of the core.

Remarks: Patrick and Reimer (1966, p. 410): "This species is distinguished by the shape of the longitudinal canals, the double rows of alveoli, and the absence of distinct longitudinal lines... In slightly brackish to brackish water."

Krammer and Lange-Bertalot (1986, p. 291): "The nominate variety is a marine form and in brackish water of the coast mostly only allochthon. The smaller varieties also in weakly brackish coastal waters or in weakly saline interior waters."

***Diploneis smithii* var. *dilatata* (Peragallo) Terry 1908**

(pl. 2, fig. 3)

Syn: *Diploneis smithii* var. *dilatata* (M. Peragallo) Boyer 1927.

Description: Krammer and Lange-Bertalot, 1986, p. 291, pl. 112, fig. 4.

Patrick and Reimer, 1966, p. 411, pl. 38, fig. 3.

Dimensions: L: 12-200 μm . W: 6.5-75 μm . Str: 5-15/10 μm .

WM: Not observed.

WCA: C at 120 cm; VR-R in various other samples.

Remarks: A euryhaline species. Patrick and Reimer (1966, p. 411): "This variety differs from the nominate variety in that the central area with its horns forms a broad lanceolate space and the longitudinal canals are narrow. Also it has been found in fresh water. It might be well to consider this taxon as a separate species."

***Diploneis stroemii* Hustedt 1933 in Hustedt 1927-66**

Description: Hustedt, 1927-66, II, p. 608, fig. 1022.

Jensen, 1985, p. 512, fig. 1022; Pankow, 1990, p. 186, pl. 40, fig. 5.

Description: L: 30-80 μm . W: 13-23 μm (widest); 8-14 μm (constriction). Ribs: 10-12/10 μm . Pankow (1990, p. 186): "Polyhalob, mesoeuryh. [=8-32 ppm]. Baltic Sea area."

WM: Not observed.

WCA: F at 100 cm.

Remarks: Hustedt (in Jensen, 1985, p. 512): "The absent or extremely delicate areolation on the middle chambers brings about an apparent interruption of the chamber formation, which produces a certain similarity with *Diploneis interrupta*.... *Diploneis Stroemi* is differentiated readily by the poroid outer layer and by the characteristic arrangement of the transapical ribs, and additionally by the linear longitudinal canals."

***Diploneis subovalis* Cleve 1894**

Description: Hustedt, 1927-66, II, p. 667, fig. 1063.

Rao and Lewing, 1976, p. 193, figs. 206-207; John, 1983, p. 111, pl. 46, figs. 5,6; Jensen, 1985, p. 560, fig. 1063; Krammer and Lange-Bertalot, 1986, p. 288, pl. 109, figs. 8-9.

Dimensions: L: 10-50 μm . W: 8-20 μm . Cost: 10-12/10 μm .

WM: VR at WM-7.

WCA: VR in samples in the lower part of the core.

Remarks: This taxon is difficult to distinguish from *D. pseudovalis* which also has two rows of areolae between the costae. One distinguishing feature that is present in *D. subovalis* but not in *D. pseudovalis* is an isolated row of areolae along the longitudinal canals, separated from the rows of areolae between the costae by a longitudinal line. This was described by Hustedt (in Jensen, 1985, p. 560), who reported that the longitudinal canals have "...weak continuations of the transapical ribs and with more or less isolated poroids (continuations of the rows of areolae) in the outer wall..." Hustedt also reported this as a "tropical" freshwater species.

EPITHEMIA Brébisson 1838

***Epithemia turgida* (Ehrenberg) Kützing 1844**

Description: Patrick and Reimer, 1975, p. 182, pl. 25, figs. 1a-1b. Hustedt, 1930, p. 387, fig. 733; Germain, 1981, p. 318, pl. 118, figs. 1-4; Foged, 1981, p. 82, pl. 55, fig. 10; Jensen, 1985, p. 839, fig. 733; John, 1983, p. 161, pl. 30, fig. 1; Krammer and Lange-Bertalot, 1988, p. 155, pl. 109, figs. 4-7.

Dimensions: L: 60-150 μm . W: 15-20 μm . Cost: 3-5/10 μm .

WM: Not observed.

WCA: VR at 50, 70 and 180 cm.

Remarks: Widely distributed in marshes and tidal flats in coastal Washington.

Patrick and Reimer (1975, p. 182): "This species is distinguished by the 2-3 rows of alveoli between the costae, the shape of the raphe, and the rounded, indistinct ends of the costae in girdle view... A littoral species which prefers alkaline water." Hustedt (in Jensen, 1985, p. 840): "Distributed and common throughout the entire area, in fresh water as well as in slightly brackish water."

EUNOTIA Ehrenberg 1837

***Eunotia formica* Ehrenberg 1843**

Description: Patrick and Reimer, 1966, p. 190, pl. 10, fig. 7. Hustedt, 1927-66, II, p. 303, fig. 775; Schmidt's Atlas, pl. 271, figs. 3-5; pl. 291, figs. 4-6; Foged, 1977, p. 55, pl. 11, figs. 3,4,5; Foged, 1981, p. 86, pl. 6, fig. 5; pl. 7, figs. 3,4; John, 1983, p. 66, pl. 28, fig. 14; Jensen, 1985, p. 278, fig. 775; Krammer and Lange-Bertalot, 1991a, p. 209, pl. 152, figs. 8-12A.

Dimensions: L: 40-160 μm . W: 7-13 μm . Str: 8-12/10 μm .

WM: Not observed.

WCA: A at 60 cm (with *Aulacoseira islandica*).

Remarks: Distinguished by the large valve which is broader at the apices than at the middle. The swelling on the dorsal margin is variable.

Patrick and Reimer (1966, p. 190): "It is typically found in acid to circumneutral soft water, standing or usually slow-moving water."

***Eunotia minor* (Kützing) Grunow in Van Heurck 1881**

Syn: *Eunotia pectinalis* var. *minor* (Kützing) Rabenhorst 1864; *Eunotia pectinalis* var. *minor* (Kützing) Grunow in Van Heurck 1881

Description: Krammer and Lange-Bertalot, 1991a, p. 196, pl. 142, figs. 7-15.

(As *Eunotia pectinalis* var. *minor*): Hustedt, 1927-66, II, p. 296, figs. 763d-f; Patrick and Reimer, 1966, p. 207, pl. 12, figs. 13-14; Foged, 1978, p. 59, pl. 11, figs. 13,15; Foged, 1979, p. 49, pl. 9, fig. 12; John, 1983, p. 68, pl. 28, fig. 13; Jensen, 1985, p. 268, figs. 763d-f.

Dimensions: L: 20-60 μm . W: 4.5-8 μm . Str: 9-15/10 μm at mid-valve, usually fewer at the ends.

WM: Not observed.

WCA: R-C in numerous samples; absent 100-115 cm.

Remarks: Widely distributed in fresh-brackish marshes in coastal Washington.

***Eunotia pectinalis* (Kützing) Rabenhorst 1864**

Syn: *Eunotia pectinalis* f. *curta* Van Heurck 1885.

Description: Krammer and Lange-Bertalot, 1991a, p. 193, pl. 141, figs. 6, 7; pl. 143, fig. 1. Hustedt, 1927-66, II, p. 296, figs. 763a, k; Patrick and Reimer, 1966, p. 204, pl. 12, fig. 8; Foged, 1978, p. 59, pl. 12, fig. 10; Foged, 1979, p. 49, pl. 9, fig. 15; pl. 11, fig. 5; Germain, 1981, p. 96, pl. 33, 34, 35, 36, 37; John, 1983, p. 67, pl. 28, figs. 10-12; Jensen, 1985, p. 267, figs. 763a, k.

Dimensions: L: 10-140 μm . W: 5-10 μm . Str: 7-15/10 μm .

WM: VR at WM-7.

WCA: VR in various samples.

Remarks: Distinguished by the usually elongate valve, straight ventral margin, and the straight or slightly convex dorsal margin that is usually almost parallel to the ventral margin.

Patrick and Reimer (1966, p. 204): "It is most commonly found in the cooler regions or in the northern or central parts of the United States. It prefers water of a low mineral content, and oligotrophic to eutrophic."

***Eunotia praerupta* var. *bidens* (Ehrenberg) Grunow in Cleve and Grunow 1880**

Syn: *Eunotia bidens* Ehrenberg 1843; *Eunotia praerupta-bidens* Berg 1939; *Eunotia sarekensis* Cleve-Euler 1953 pro parte (fig. 454e, i, j).

Description: Patrick and Reimer, 1966, p. 194, pl. 10, fig. 13. Hustedt, 1927-66, II, p. 281, figs. 747i-m; Jensen, 1985, p. 253, figs. 747i-m; Krammer and Lange-Bertalot, 1991a, p.187, pl. 148, figs. 11, 12.

Dimensions: L: 20-100 μm . W: 4-15 μm . Str: 6-113/10 μm .

WM: Not observed.

WCA: VR in a few samples.

Remarks: Distinguished by the broad valve with widely spaced striae, and blunt apices. Krammer and Lange-Bertalot (1991a) categorize this taxon as "bidens-Sippen" (i.e., bidens group) rather than a separate variety.

Foged (1981, p. 88): "Halophobe. Acidophil. Cosmopolite."

FALLACIA Stickle and Mann in Round and others 1990

***Fallacia cryptolyra* (Brockmann) Stickle and Mann in Round and others 1990**

Syn: *Navicula cryptolyra* Brockmann 1950.

Description: Krammer and Lange-Bertalot, 1986, p. 172, pl. 65, fig. 7-9.

Brockmann, 1950, p. 19, pl. 3, fig. 22, 23.

Dimensions: L: 8-15 μm . W: 5-6 μm . Str: 24-25/10 μm .

WM: VR at WM-B.

WCA: Not observed.

Remarks: Widely distributed on sandy tidal flats in coastal Washington.

FRAGILARIA Lyngbye 1819

Note: Many of the taxa listed under the genus "*Fragilaria*" have been transferred into various new genera, as summarized in Round and others (1990). As the assignment of taxa to these revised genera are difficult using light microscopy and not yet in wide use, the revisions are included below as synonyms.

Fragilaria famelica var. *littoralis* (Germain) Lange-Bertalot in Krammer and Lange-Bertalot 1991a

(pl. 1, fig. 21)

Syn: *Fragilaria intermedia* var. *littoralis* Germain 1981.

Description: Krammer and Lange-Bertalot, 1991a, p. 128, pl. 111, figs. 13-15.

(As *F. intermedia* var. *littoralis*): Germain, 1981, p. 68, pl. 20, figs. 11-21.

Dimensions: L: 10-100 μm . W: 2.5-4 μm . Str: 11-16/10 μm .

WM: Present in all marsh samples, R-C in WM-9 to WM-12.

WCA: C in uppermost 10 cm of the core.

Remarks: According to Krammer and Lange-Bertalot (1991a, p.128), the distribution of the taxon is probably cosmopolitan. Confusion regarding its proper identification has resulted in its distribution not being reliably well known. Its ecological preference, which differs from *F. capucina*, is in electrolyte-rich waters of the interior and brackish waters of the marine coast. It is sometimes found to be locally very abundant in electrolyte-rich mineral springs and calcium-rich mountain waters, in estuarine rivers, and in mudflats of the North Sea coast.

Fragilaria construens formaventer (Ehrenberg) Hustedt 1957

Syn: *Fragilaria venter* Ehrenberg 1854; *Fragilaria construens* var. *venter* (Ehrenberg) Grunow 1881 in Van Heurck 1880-1885; *Staurosira construens* var. *venter* (Grunow) Williams and Round 1987.

Description: Krammer and Lange-Bertalot, 1991a, p. 153, pl. 132, figs. 9-16, 28; pl. 129, figs. 21-27, 34.

(As *Fragilaria construens* var. *venter*): Hustedt, 1927-66, II, p. 157, figs. 670h-m; Patrick and Reimer, 1966, p. 126, pl. 4, figs. 8-9; Germain, 1981, p. 70, pl. 21, figs. 6-14; John, 1983, p. 42, pl. 16, figs. 4-6; Jensen, 1985, p. 146, figs. 670h-m.

Dimensions: L: 4-35 μm . W: 2-12 μm . Str: (12?)14-18(20)/10 μm .

WM: VR at WM-B.

WCA: VR at 140-160 cm; F at 100 cm.

Remarks: Usually reported as a freshwater species, but observed on sandy tidal flats from Puget Sound and Hood Canal. Rao and Lewin (1976, p. 185) reported it from a tidal flat at San Juan Island: "Occurred as epipsammon. Abundant at all stations on the surface (10-20 mm) and progressively decreased with depth... A highly variable form."

Krammer and Lange-Bertalot (1991a, p. 153): Valves elliptical, elliptical-lanceolate to rhombic."

***Fragilaria parasitica* (W. Smith) Grunow in Van Heurck 1881**

Syn: *Synedra parasitica* (Wm. Smith) Hustedt 1930.

Description: Patrick and Reimer, 1966, p. 140, pl. 5, fig. 12.

Krammer and Lange-Bertalot, 1991a, p. 133, pl. 130, figs. 1-8; Pankow, 1990, p. 142, pl. 30, fig. 1.

(As *Synedra parasitica*): Hustedt, 1930, p. 161, fig. 195; Hustedt, 1927-66, II, p. 204, fig. 695; Foged, 1981, p. 170, pl. 5, figs. 6,7; Germain, 1981, p. 82, pl. 28, figs. 33-35; Jennings, 1985, p. 191, fig. 695; Hein, 1990, p. 102, pl. 50, fig. 3.

Dimensions: L: 10-25 µm. W: 3-5 µm. Str: 16-19/10 µm.

WM: Not observed.

WCA: VR at 50 and 80 cm.

Remarks: Patrick and Reimer (1966, p. 140): "Fresh water, usually epiphytic on other diatoms, in circumneutral, slightly alkaline water; mesotrophic to eutrophic."

Pankow (1990, p. 142): "Oligohalobous (indifferent). Epiphytic..."

***Fragilaria pinnata* Ehrenberg 1843**

Syn: *Staurosirella pinnata* Williams and Round 1987.

Description: Krammer and Lange-Bertalot, 1991a, p. 157, pl. 133, figs. 1-11, 32, 32A; pl. 131, figs. 3,4.

Hustedt, 1927-66, II, p. 110, figs. 671a-i; Patrick and Reimer, 1966, p. 127, pl. 4, fig. 10; Foged, 1978, p. 64, pl. 8, fig. 7; Foged, 1979, p. 54, pl. 7, figs. 8-10; Foged, 1981, p. 93, pl. 4, fig. 21; pl. 5, fig. 3; Germain, 1981, p. 72, pl. 21, figs. 44-52; Jensen, 1985, p. 149, figs. 671a-i; Hein, 1990, p. 54, pl. 22, figs. 4,5; Pankow, 1990, p. 149, pl. 30, fig. 30.

Dimensions: L: 3-35 µm. W: 2-8 µm. Str: 8-12/10 µm.

WM: Not observed.

WCA: VR at 10 cm.

Remarks: Rare at Winslow Marsh. Distinguished by the coarse striae that are offset from one another across the sternum.

Pankow (1990, p. 149): "Oligohalobous, (indifferent), mesoeuryhaline [=0-10 ppm]."

Hendey (1964, p. 153): "Common littoral species on all British coasts."

***Fragilaria virescens* Ralfs 1843**

Syn: *Fragilaria aequalis* Heiberg 1863 sensu Grunow in Van Heurck 1881 non sensu Mayer 1937; *Fragilariforma virescens* (Ralfs) Williams and Round 1988.

Description: Krammer and Lange-Bertalot, 1991a, p. 135, pl. 126, figs. 1-10.

Hustedt, 1927-66, II, p. 162, figs. 672a, b; Schmidt's Atlas, pl. 297, figs. 3-6, 8-12, 20-33; Patrick and Reimer, 1966, p. 119, pl. 3, figs. 7-9; Foged, 1978, p. 64, pl. 8, fig. 4; Germain, 1981, p. 72, pl. 22, figs. 1-11; Jensen, 1985, p. 151, figs. 672a, b.

Dimensions: L: 10-120 µm. W: 6-10 µm. Str: 13-19/10 µm.

WM: Not observed.

WCA: VR-C in numerous samples; A at 100 and 190 cm.

Remarks: Patrick and Reimer (1966, p. 119): "...This taxon distinguished by the shape of the valve and the lack of the central area... Widely distributed in fresh water." Foged (1979, p. 54): "Halophobous (?). pH: circumneutral. Cosmopolitan."

***Fragilaria virescens* var. *oblongella* Grunow in Van Heurck 1881**

(pl. 1, figs. 17-20)

Description: Hustedt, 1927-66, II, p. 164, figs. 672A-f.

Jensen, 1985, p. 153, figs. 672A-f.

Dimensions: L: 12-120 μm . W: 5-10 μm . Str: 15/10 μm .

WM: A at WM-9 (zone of standing stagnant water).

WCA: R-C throughout most of the core above 150 cm; the dominant taxon at 20 and 70 cm.

Remarks: According to Krammer and Lange-Bertalot (1991a, p. 136), it remains to be determined if var. *oblongella* is a true variety of *F. virescens*. The dominant diatom in shallow, slightly brackish water at Winslow Marsh Station 9. The taxon is distinguished by the elongate valve shape, the sternum which is narrow but distinct (rather than indistinct or absent as in *F. exigua*), and the striae which are offset across the sternum (rather than parallel as in *F. nitzschioides*).

Hustedt (in Jensen, 1985, p. 153): "...var. *oblongella* often found in pure culture."

FRUSTULIA Rabenhorst 1853

***Frustulia cruezbergensis* (Krasske) Hustedt 1957**

Syn: *Navicula cruezbergensis* Krasske 1927.

Description: Krammer and Lange-Bertalot, 1986, p. 261, pl. 97, figs. 10, 11.

Hustedt, 1957, p. 256; Germain, 1981, p. 140, pl. 53, figs. 7,8.

(As *Navicula cruezbergensis*): Hustedt, 1927-66, III, p. 281, fig. 1412; Brockmann, 1950, p. 16, pl. 2, figs. 38, 39; Patrick and Reimer, 1966, p. 461, pl. 43, fig. 6; John, 1983, p. 87, pl. 38, fig. 2.

Dimensions: L: 30-34 μm . W: 6-8 μm . Str: 24-30/10 μm .

WM: VR at the inner marsh sites WM-2 to WM-4.

WCA: Not observed.

Remarks: Distinguished by the "wavy" striae, and the absence of strong siliceous ribs on either side of the raphe. Also, the central area is asymmetrical and broader on one side.

Krammer and Lange-Bertalot (1986, p. 261): "Valve is linear-elliptical, slightly broader in the middle; raphe distinct, and bends slightly toward one side at the middle... Epipellic and epiphytic."

***Frustulia vulgaris* (Thwaites) De Toni 1891**

(pl. 5, fig. 12)

Syn: *Schizonema vulgare* Thwaites 1848.

Description: Patrick and Reimer, 1966, p. 309, pl. 22, fig. 3.

Hustedt, 1927-66, II, p. 730, fig. 1100a; Schmidt's Atlas, pl. 369, fig. 8; Foged, 1978, p. 113, p. 66, pl. 20, fig. 1; Foged, 1981, p. 95, pl. 16, fig. 9; Germain, 1981, p. 140, pl. 53, figs. 3-6; John, 1983, p. 113, pl. 16, figs. 11, 12; Jensen, 1985, p. 610, fig. 1100a; Krammer and Lange-Bertalot, 1986, p. 260, pl. 97, figs. 1-6; Hein, 1990, p. 58, pl. 23, fig. 4.

Dimensions: L: 50-70 μm . W: 10-13 μm . Str: 24/10 μm .

WM: VR at WM-7 and WM-P.

WCA: VR in numerous samples.

Remarks: Patrick and Reimer (1966, p. 309): "This species is distinguished by its size, shape, and the striae which are slightly radiate at the center of the valve and may be slightly convergent at the ends... Usually found in water of mineral content which is circumneutral."

John (1983, p. 113): "Terminal ends shaped like a 'pencil point.'" Foged (1981, p. 95): "Oligohalobe (indifferent). Alkaliphil. Cosmopolite." Pankow (1990, p. 191): "Oligohalobous (indifferent), mesoeuryhaline [\approx 0-10 ppm]".

GOMPHONEMA Ehrenberg 1832

***Gomphonema angustatum* (Kützing) Rabenhorst 1864**

(pl. 5, fig. 10)

Description: Krammer and Lange-Bertalot, 1986, p. 360, pl. 155, figs. 1-21.

Patrick and Reimer, 1975, p. 125, pl. 17, figs. 17-19; Foged, 1978, p. 67, pl. 40, fig. 18;

Germain, 1981, p. 306, pl. 114, figs. 1-21; Jensen, 1985, p. 826, fig. 690; Pankow, 1990, p. 243, pl. 56, fig. 9; Krammer and Lange-Bertalot, 1991b, pl. 84, figs. 9-14.

Dimensions: L: 12-14 μ m. W: 5-9 μ m. Str: 9-14 μ m.

WM: VR at WM-7.

WCA: VR-R in numerous samples.

Remarks: Similar to *G. parvulum*, but differs in having fewer striae in 10 μ m (9-12 compared to 13-16) which are radiate throughout.

Patrick and Reimer (1975, p. 125): "Striae at the center of the valve more distantly placed than in *G. parvulum*, and therefore the central area is distinguished by the more widely spaced striae. Stria on one side of the central area ending in a punctum. Stria opposite punctum short. Striae radiate throughout the valve, at the apices the terminal pair of striae may be almost parallel."

***Gomphonema parvulum* Kützing 1849**

Syn: *Gomphonema lagenula* Kützing 1844.

Description: Krammer and Lange-Bertalot, 1986, p. 358, pl. 154, figs. 1-25.

Patrick and Reimer, 1975, p. 122, pl. 17, figs. 7-12; Foged, 1978, p. 71, pl. 40, figs. 12, 15;

Foged, 1979, p. 59, pl. 37, fig. 7; Germain, 1981, p. 308, pl. 114, figs. 23-28; John, 1983, p. 142, pl. 59, figs. 7-9; Pankow, 1990, p. 243, pl. 56, figs. 4-5; Krammer and Lange-Bertalot, 1991b, pl. 76.

Dimensions: L: 10-36 μ m. W: 4-8 μ m. Str: 7-20/10 μ m.

WM: VR at WM-P.

WCA: VR-C throughout the core except at 1, 110 and 115 cm.

Remarks: A widely distributed and variable taxonomic group (e.g., Krammer and Lange-Bertalot, 1991b).

***Gomphonema truncatum* Ehrenberg 1832**

(pl. 2, fig. 4)

Syn: *Gomphonema constrictum* Ehrenberg 1832; *Gomphonema capitatum* Ehrenberg 1838;

Gomphonema turgidum Ehrenberg 1854.

Description: Patrick and Reimer, 1975, p. 118, pl. 16, fig. 3.

Krammer and Lange-Bertalot, 1986, p. 369, pl. 159, figs. 11-18; Pankow, 1990, p. 244, pl. 56, fig. 3; Hein, 1990, p. 61, pl. 25, fig. 7.

(As *Gomphonema constrictum*): Schmidt's Atlas, pl. 247, figs. 3-11; Hustedt, 1930, p. 377, fig. 714; Germain, 1981, p. 301, pl. 112, figs. 1-12; pl. 161, fig. 4; Foged, 1981, p. 98, pl. 14, figs. 3-5; Jensen, 1985, p. 830, fig. 714.

Dimensions: L: 26-65 μ m. W: 6-14 μ m. Str: 10-12 in 10 μ m.

WM: VR at WM-P.

WCA: VR in a few samples.

Remarks: Distinguished by the valve shape and strongly radiate striae.

GOPHONEMOPSIS Medlin in Medlin and Round 1986

***Gomphonemopsis pseudexigua* (Simonsen) Medlin in Medlin and Round 1986**

Bas: *Gomphonema pseudexiguum* Simonsen 1959, p. 83, pl. 12, fig. 8,9.

Syn: *Gomphonema exiguum* sensu Cholnoky 1959; *Gomphonema valentinicum* Nikolajev 1969; *Gomphonema exiguum* var. *minutissima* Grunow in Van Heurck 1880 sensu Krammer and Lange-Bertalot, 1985.

Description: Krammer and Lange-Bertalot, 1986, p. 376, pl. 165, fig. 20 (as *Gomphonema exiguum* var. *minutissima*).

Medlin and Round, 1986, p. 207, figs. 8-11.

(As *Gomphonema valentinica*): John, 1983, p. 144, pl. 60, figs. 3-6.

Dimensions: L: 10 μm . W: 2-3.5 μm . Str: 15-25/10 μm .

WM: VR at WM-12.

WCA: VR at 10 cm.

GYROSIGMA Hassall 1845

***Gyrosigma acuminatum* (Kützing) Rabenhorst 1853**

Description: Patrick and Reimer, 1966, p. 314, pl. 23, figs. 1-3.

Hustedt, 1930, p. 222, fig. 329; Foged, 1971, p. 950, pl. 8, fig. 15; Foged, 1981, p. 101, pl. 17, figs. 2,4; Jensen, 1985, p. 782, fig. 329; Krammer and Lange-Bertalot, 1986, p. 296, pl. 114, figs. 4,8; Hein, 1990, p. 59, pl. 25, figs. 1,2; Pankow, 1990, p. 177, pl. 38, fig. 8.

Dimensions: L: 60-125 μm . W: 12-16 μm . Str: 16-18/10 μm (transverse); 17-20/10 μm (longitudinal).

WM: Not observed.

WCA: VR at 120, 170 cm.

Remarks: Pankow (1990, p. 177): "Oligohalobous (indifferent), mesoeuryhaline [= 0-10 μm]. Baltic Sea area."

HANTZSCHIA Grunow in Cleve and Grunow 1880

***Hantzschia amphioxys* (Ehrenberg) Grunow in Cleve and Grunow 1880**

(pl. 5, fig. 13, 14)

Description: Hustedt, 1930, p. 394, fig. 747.

Foged, 1979, p. 62, pl. 41, figs. 3,4; Germain, 1981, p. 326, pl. 122, figs. 5-10; John, 1983, p. 163, pl. 68, figs. 8,9; Jensen, 1985, p. 847, fig. 747; Laws, 1988, p. 164, pl. 31, fig. 4; Krammer and Lange-Bertalot, 1988, p. 128, pl. 88, figs. 1-7.

Dimensions: L: 20-100 μm . W: 5-10 μm . Str: 13-20/10 μm .

WM: F at WM-12 (well-drained grassy surface).

WCA: R at 150 cm; VR in numerous samples.

Remarks: Widely distributed in fresh-brackish marshes in coastal Washington. Hustedt (*in* Jensen, 1985, p. 847): "One of the most widely distributed fresh water diatoms of extreme variability and adaptability, the described variations of which have their origins conditioned by ecological factors, probably more so than has hitherto been realized."

HYALODISCUS Ehrenberg 1845

Hyalodiscus scoticus (Kützing) Grunow 1879

Description: Hustedt, 1927-66, I, p. 293, fig. 133a.

Foged, 1979, p. 63, pl. 4, fig. 5; John, 1983, p. 18, pl. 3, figs. 6-8; Tynni, 1986, pl. 2, fig. 3; Laws, 1988, p. 164, pl. 12, figs. 10,11.

Dimensions: Diam: 10-40 μm .

WM: Not observed.

WCA: VR at 20 cm.

Remarks: Hendey (1964, p. 90): "A euryhaline species common on all North Sea coasts, in marine and brackish waters."

LUTICOLA D.G. Mann in Round and others 1990

Luticola mutica (Kützing) D.G. Mann in Round and others 1990

Syn: *Navicula mutica* Kützing 1844.

Description: Patrick and Reimer, 1966, p. 454, pl. 42, fig. 2.

Hustedt, 1927-66, III, p. 583, figs. 1592a-f; Foged, 1978, p. 76, pl. 25, fig. 13; Foged, 1979, p. 93, pl. 28, fig. 11; Germain, 1981, p. 209, pl. 79, figs. 1-4; John, 1983, p. 94, pl. 40, figs. 5-8; Krammer and Lange-Bertalot, 1986, p. 149, pl. 61, figs. 1-7; Pankow, 1990, p. 229, pl. 52, fig. 13.

Dimensions: L: 10-40 μm . W: 7-12 μm . Str: 14-20/10 μm .

WM: VR at WM-4, WM-12, and WM-P.

WCA: VR in numerous samples.

Remarks: Patrick and Reimer (1966, p. 454): "Found in fresh, brackish, and alkaline water; often an aerophil."

MELOSIRA Agardh 1824

Melosira varians Agardh 1827

(pl. 2, fig. 5; pl. 5, fig. 15)

Syn: *Gallionella varians* Ehrenberg 1838.

Description: Krammer and Lange-Bertalot, 1991a, p. 7, pl. 3, fig. 8; pl. 4, figs 1-8.

Hustedt, 1927-66, I, p. 240, fig. 100; Schmidt's Atlas, pl. 178, figs. 1-2; Crawford, 1975, pl. 2 fig. 13, pl. 3, figs. 14,15; Foged, 1978, p. 83, pl. 1, fig. 12; Foged, 1981, p. 106, pl. 1, fig. 6; Germain, 1981, p. 22, pl. 2, figs. 9,10; John, 1983, p. 17, pl. 2, fig. 10; Foged, 1982, p. 57, pl. 1, fig. 12; Pankow, 1990, p. 94, pl. 14, figs. 2-4.

Dimensions: Diam: 8-35 μm . Mantle height (perivalvar axis) 4-14 μm , rarely up to 17 μm .

WM: VR at WM-7 and WM-10; F at WM-P (pond).

WCA: F at 30 cm.

Remarks: Also a dominant taxon in wet, fresh-brackish marshes in southeastern Alaska. According to Pankow (1990, p. 94), found in salinities of 0-10 ppm.

MERIDION Agardh 1834

Meridion circulare (Greville) Agardh 1831

(pl. 5, fig. 11)

Description: Krammer and Lange-Bertalot, 1991a, p. 101, pl. 100, figs. 1-3; pl. 101, figs. 1-5, 13, 14; pl. 102, figs. 2, 3.

Hustedt, 1927-66, II, p. 93, figs. 6271-f; Patrick and Reimer, 1966, p. 113, pl. 2, fig. 15; Foged, 1978, p. 83, pl. 7, figs. 8-9; Foged, 1979, p. 68, pl. 6, figs. 12-13; Foged, 1981, p. 106, pl. 5, fig. 22; Foged, 1982, p. 57, pl. 2, figs. 12,13; Germain, 1981, p. 54, pl. 15, fig. 7; pl. 16, figs. 1-13; John, 1983, p. 49, pl. 20, figs. 1-2; Jensen, 1985, p. 89, figs. 627a-f; Pankow, 1990, p. 135, pl. 28, figs. 1-2.

Dimensions: L: 10-82 μm . W: 4-8 μm . Str: 12-16/10 μm .

WM: VR at WM-3, WM-6 and WM-P.

WCA: VR in numerous samples, F at 30 cm; absent in salt marsh peat between 105-115 cm.

Remarks: The var. *constrictum* (Ralfs) Van Heurck 1881 is included in the total counts for this taxon (see pl. 5, fig. 11).

Patrick and Reimer (1966, p. 113): "Seems to prefer flowing, fresh water."

NAVICULA Bory de Saint Vincent 1824

Navicula angusta Grunow 1860

Syn: *Navicula cari* var. *angusta* Grunow in Van Heurck 1880; *Navicula cincta* var. *angusta* (Grunow) Cleve 1895; *Navicula cincta* var. *linaris* Østrup 1910; *Navicula pseudocari* Krasske 1939.

Description: Patrick and Reimer, 1966, p. 514, pl. 49, fig. 5.

Krammer and Lange-Bertalot, 1986, p. 97, pl. 28, figs. 1-5.

Dimensions: L: 43-65 μm . W: 5-7 μm . Str: 12-14/10 μm .

WM: Not observed.

WCA: VR-R in numerous samples.

Remarks: Patrick and Reimer (1966, p. 514): "Axial area narrow. Central area transverse, rounded, almost reaching the margins of the valve. Terminal nodules distinct, not large. Striae radiate at the center of the valve to convergent at the ends."

Navicula cari Ehrenberg 1836a

(pl. 2, figs. 7, 8)

Syn: *Navicula cincta* var. *cari* (Ehrenberg) Cleve 1895; (?) *Navicula graciloides* Mayer 1919.

Description: Krammer and Lange-Bertalot, 1986, p. 96, pl. 27, fig. 12-17.

Hustedt, 1930, p. 299, fig. 512; Lange-Bertalot, 1980, p. 36, pl. 6, fig. 1-7; Germain, 1981, p. 194, pl. 73, fig. 1; Foged, 1981, p. 109, pl. 31, fig. 15; Pankow, 1990, p. 222.

Dimensions: L: (13) 25-80 μm . W: 6-11 μm . Str: 9-12 (16)/10 μm .

WM: R at the inner marsh (WM-1 and WM-2).

WCA: VR in various samples.

Remarks: Pankow (1990, p. 223): Oligohalobous (indifferent)." Foged (1979, p. 69): "Oligohalobous (indifferent). pH: circumneutral. Cosmopolitan."

***Navicula cf. cryptotenella* Lange-Bertalot in Krammer and Lange-Bertalot 1985**
(pl. 2, figs. 9, 10)

Description: L: 14-16 μm . W: 2.5-2.8 μm . Str: 24/10 μm . Differs from *N. cryptotenella* by having more parallel sides and tapered apices. Striae shorter at the middle and strongly radiate, parallel to gently radiate along rest of valve.

WM: VR at the inner marsh (WM-1 to WM-4).

WCA: VR in various samples.

Remarks: Compare with *Navicula* aff. *tenella* in Gasse (1986, p. 116).

***Navicula cincta* (Ehrenberg) Ralfs in Pritchard 1861**

Syn: *Pinnularia cincta* Ehrenberg 1854; *Navicula cari* var. *cincta* (Ehrenberg) Lange-Bertalot 1980.

Description: Krammer and Lange-Bertalot, 1986, p. 98, pl. 28, figs. 8-15.

Brockmann, 1950, p. 17, pl. 2, figs. 17-20; Hendey, 1964, p. 196, pl. 30, fig. 8; Patrick and Reimer, 1966, p. 516, pl. 49, fig. 11; Foged, 1978, p. 85, pl. 30, fig. 6; Foged, 1979, p. 70, pl. 29, fig. 14; Germain, 1981, p. 186, pl. 71, figs. 8-13; John, 1983, p. 84, pl. 37, fig. 6; Krammer and Lange-Bertalot, 1985, p. 61, pl. 17, figs. 6-8, pl. 30, fig. 2); Pankow, 1990, p. 221, pl. 49, figs. 11-12.

Dimensions: L: 13-34(55) μm . W: 5-8 μm . Str: 8-12(17?)/10 μm .

WM: Not observed.

WCA: VR at 135 and 170 cm.

Remarks: Widely distributed in brackish high and low marshes between extremem high water (EHW) and mean lower higher water (MLHW) in coastal Washington.

***Navicula costulata* Grunow in Cleve and Grunow 1880**

Description: Patrick and Reimer, 1966, p. 535, pl. 51, fig. 9.

Hustedt, 1930, p. 298, fig. 503; Schmidt's Atlas, pl. 398, figs. 52-53; Foged, 1981, p. 110, pl. 38, fig. 17; Krammer and Lange-Bertalot, 1986, p. 124, pl. 42, figs. 13-15; Pankow, 1990, p. 218, pl. 48, fig. 9.

Dimensions: L: 12-20 μm . W: 4-5 μm . Str: 7-10/10 μm .

WM: Not observed.

WCA: VR-C in numerous samples; absent between 100-115 cm.

Remarks: The valve is distinctive with thick, strongly radiate and clearly separate striae, and a transverse central area.

Foged (1981, p. 110): "Oligohalobe (indifferent to halophil). Alkaliphil. Eurasia. N. America."

Counts for this taxon also include a variety with a narrower lanceolate valve with narrow apices. The striae are also denser, 12-14/10 μm . This was observed most frequently in WCA samples.

***Navicula crucicula* (W. Smith) Donkin 1870-1873**

Syn: *Stauroneis crucicula* W. Smith 1853.

Description: Patrick and Reimer, 1966, p. 471, pl. 45, fig. 2.

Hustedt, 1930, p. 264, fig. 471; Brockmann, 1950, p. 15, pl. 4, figs. 1,2; Germain, 1981, p. 219, pl. 83, fig. 5; Krammer and Lange-Bertalot, 1986, p. 161, pl. 54, figs. 1-13; Pankow, 1990, p. 238, pl. 54, fig. 6.

Dimensions: L: 45-70 µm. W: 14-19 µm. Str: 9-10/10 µm (mid-valve), 16-19/10 µm (apices).

WM: VR at WM-P.

WCA: VR at 70 cm.

Remarks: Winslow specimens have broadly lanceolate valves, with gently tapered to rounded ends. Valve faces are gently convex. Raphe branches are straight, central endings only slightly inflated; the raphe sternum is narrow but distinct, widening to an oval central area and small rounded apical areas. Striae are gently radiate throughout, much more widely spaced at the middle of the valve. These specimens may be comparable to *N. brasiliensis* Cleve because of the shape of the central area and the apices which may be broader than is typical for *N. crucicula*.

Patrick and Reimer (1966, p. 471): "The angle and number of striae in 10 µm, and the shape of the valve distinguishes this species from other species in this group... Brackish to fresh water, euryhaline."

***Navicula cryptocephala* Kützing 1844**

Syn: *Navicula exilis* Kützing 1844.

Description: Krammer and Lange-Bertalot, 1986, p. 102, pl. 31, figs. 8-14 (see below). Hustedt, 1930, p. 295, fig. 496; Schmidt's Atlas, pl. 252, figs. 35-37; Foged, 1978, p. 86, pl. 31, fig. 12; Foged, 1979, p. 71, pl. 29, fig. 10; Foged, 1982, p. 59, pl. 18, figs: 10, 11, 15.

Dimensions: L: 20-40 µm. W: 5-7 µm. Str: 14-17/10 µm.

WM: VR at WM-11.

WCA: Not observed.

Remarks: Pankow (1990, p. 219): "Oligohalobous (indifferent), haloeuryhaline [= 0 > 30 ppm]." Foged (1981, p. 110): "Oligohalobe (indifferent). Alkaliphil. Cosmopolite."

Translation of description by Krammer and Lange-Bertalot (1986, p. 102): "Valve lanceolate with ± produced subcapitate ends, length 20-40 µm, breadth 5-7 µm. Raphe filiform, axial area narrow, linear, central area medium-sized, only slightly asymmetrical, ± round. Striae (as compared to *N. veneta*) strongly radial, convergent at the ends, 14-17/10 µm, lineolae barely resolvable, about 40/10 µm. In REM slightly significant characteristic differentiating it from closely related species. Central pores in several groups studied are apically elongated and slightly curved, the regularity of the characteristic marks remains to be checked. Distribution cosmopolitan, in the area moderately abundant. More precise ecological characterization is hardly possible at this time because of the differing descriptions of the species and additional misinterpretations, e.g., with *N. gregaria* or *N. pyllepta*, particularly as details beyond occurrence in brackish water are in many ways doubtful. The "center of existence" of the species sensu stricto certainly seems to lie in electrolyte-poor and humic-acid waters. To be sure there are also occurrences under eutrophic conditions, in oxygen-rich upper courses of streams even in strong organic pollution beyond critical limits."

***Navicula cryptotenella* Lange-Bertalot in Krammer and Lange-Bertalot 1985**

Syn: *Navicula tenella* Brébisson ex Kützing 1849 sensu Grunow 1880; *Navicula radiosa* var. *tenella* (Brébisson ex Kützing) Van Heurck 1885.

Description: Krammer and Lange-Bertalot, 1985, p. 62, pl. 18, figs. 22-23; pl. 19, figs. 1-10 (see below).

Krammer and Lange-Bertalot, 1986, p. 106, pl. 33, figs. 9-11.

(As *Navicula radiosa* var. *tenella*): Patrick and Reimer, 1966, p. 510, pl. 48, fig. 17; Germain, 1981, p. 184, pl. 70, figs. 9-12.

Dimensions: L: 14-40 µm. W: 5-7 µm. Str: 12(14)-16(18?)/10 µm.

WM: Not observed.

WCA: VR at 10 cm.

Translation of description by Krammer and Lange-Bertalot (1985, p. 62): "Valves narrow-lanceolate to rhombic-lanceolate with pointedly rounded ends, which can be lightly pulled forward, 14-40 μm long, 5-7 μm wide. Raphe filiform to weakly lateral with distinctly marked central pores. Axial area narrow, linear, central area always small and irregularly restricted. Striae radial, parallel to convergent at the ends, irregularly shortened in the central area, 12(14)-16 (18?)/10 μm , lineolae for the most part barely resolvable, 35-45/10 μm . In REM except for the typical characteristics of the "Lineolatae" few significant differential characteristics to distinguish it from similar taxa are recognizable; although by means of a few special criteria - especially the absence of bent hook-shaped central pores - a close link with *N. radiosa* and *N. capitoradiata* can be excluded. In contrast to *N. menisculus* the central pores are rounder and smaller, drop shaped. Median costae and raphe costae appear narrow, without particular differentiation in the area of the central nodule...

"Distribution cosmopolitan, in the area very abundant in all fresh water biotopes with the exception of extremely low and extremely high electrolyte content. Ecology especially interesting as an indicator of clean water 'β-mesoaprob and better.' Sensitivity to pollution is already recognized by disappearance at the critical stress levels (β-a-mesoaprob).

"The nomenclature problems and the systematics of this taxon are exceptionally complicated and sometimes confused. *N. tenella* Brébisson in the Herbar Kützing (no. 1476 with the inscription of Brébisson) can no longer be definitely determined. The only thing that is certain is that no forms appear in it which Grunow later used as basis for the combination *N. radiosa* var. *tenella*. The only forms that Brébisson could have meant as *N. tenella* are *N. phyllepta* Kützing and a *Navicula* of the *complanata* group. Kützing's Protolog (1849, p. 74) can only partly apply, as far as size is concerned, to both groups. His statements about the girdle view, namely broad-linear, as well as the valve view, namely 'angustissima' and sharply lanceolate, however, much more likely apply to *N. complanata*; because on the same page he characterizes the width of valve view of *N. phyllepta* only as "angusta." The slide preparation of Cleve and Möller no. 224 contains as *N. radiosa* var. *tenella* a *N. radiosa* with only slightly below average size. Type de Synopsis 107 as well as Grunow's no. 1275 (the latter corresponding to V.H. Synopsis fig. 7.21 u.22) contain one of the most frequent freshwater diatoms. Again and again various older authors brought it into a different systematic connection, and the concept changed constantly (compare for example Cleve 1895, p. 22). Grunow assigned it, before his work on the Synopsis, partly to *N. cryptocephala* and partly as a variety of *N. cari*. A revised definition for the nomenclature therefore appears unavoidable.

"However, a delimitation between it and a number of different taxa remains problematic and needs further clarification. As closely related species, on account of the clearly defined hook-shaped course of the raphe to the central pores (in REM), *N. radiosa* and *N. capitoradiata* can be excluded. *N. menisculus*, *N. lancettula*, *N. stankovicii*, *N. notha* Wallace 1960 and *N. heimänsii* in general or their entire range of variation are so little known that convergence or overlapping of the dimensions can be suspected. *N. menisculus* is normally distinguished by means of a larger width/breadth relation and larger lineolae as well as larger central pores (in REM), however there are constant delimitation problems when the two species occur together (compare the discussion under this taxon). *N. lancettula* Schumann would only be certain if it is actually a synonym of *N. veneta* (as Van Landingham 1975 represents it). Especially difficult as well is the differentiation between *N. cryptotenella* and *N. cryptocephala*, in which smaller specimens with slightly produced ends from time to time are counted. The (not on the whole satisfactory) differential characteristic remains the central area: the former through individually reduced or irregularly alternating longer and shorter striae, and the latter with relatively large, ± round with gradual shortening of the striae. The definition of *N. cryptotenella* furthermore is made more difficult in that -- quite different comparatively as for *N. veneta* or *N. lanceolata* -- the valve shapes already within

supposedly uniform populations vary more strongly, and obviously as well the ecological conditions contribute to the variability of the forms."

***Navicula elegans* W. Smith 1853**

(pl. 6, fig. 11)

Syn: *Navicula elegans* var. *cuspidata* Cleve 1895; *Pinnuavis elegans* (W. Smith) Okuno 1975.

Description: Patrick and Reimer, 1966, p. 540, pl. 52, figs. 8-9.

Hendey, 1964, p. 215, pl. 34, figs. 1-4; Krammer and Lange-Bertalot, 1986, p. 236, pl. 82, figs. 7,8; Pankow, 1990, p. 210, pl. 51, fig. 1.

Dimensions: L: 60-115 μm . W: 20-30 μm . Str: 8-12/10 μm .

WM: VR at WM-9 only.

WCA: F at 70 cm.

Remarks: Frequent in wet surface samples at Winslow Marsh. Easily distinguished by the strongly radiate striae, valve shape, and broad central area.

***Navicula elginensis* (Gregory) Ralfs in Pritchard 1861**

Syn: *Navicula dicephala* (Ehrenberg) W. Smith 1853.

Description: Patrick and Reimer, 1966, p. 524, pl. 50, fig. 6.

Krammer and Lange-Bertalot, 1986, p. 136, pl. 46, figs. 1-12.

(As *N. dicephala*): Hustedt, 1930, p. 302, fig. 526; Schmidt's Atlas, pl. 72, figs. 29-33; Foged, 1979, p. 72, pl. 29, figs. 15, 22; Foged, 1981, p. 111, pl. 31, fig. 14; pl. 32, fig. 14; Foged, 1982, p. 60, pl. 19, fig. 5; Germain, 1981, p. 195, pl. 74, fig. 13; Pankow, 1990, p. 225, pl. 50, fig. 5.

Dimensions: L: 20-40 μm . W: 8-14 μm . Str: 9-11 μm .

WM: Not observed.

WCA: VR-R in numerous samples.

Remarks: Distinguished by the strongly radiate striae near the apices, and the shape of the central area. Varieties of *N. elginensis* are based on differing shapes of the valve; the nominate variety has strongly produced rostrate-capitate apices.

Patrick and Reimer (1966, p. 524): "Tolerant of a wide range of conditions in fresh to slightly brackish water." Pankow (1990, p. 225): "Oligohalobous (indifferent), mesoeuryhaline [\approx 0-10 ‰]."

***Navicula elginensis* var. *cuneata* (M. Møller ex Foged) Lange-Bertalot in Krammer and Lange-Bertalot 1985**

(pl. 2, fig. 6)

Syn: *Navicula dicephala* forma *cuneata* M. Møller ex Foged 1977; *Navicula ignorata* Schimanski 1978.

Description: Krammer and Lange-Bertalot, 1986, p. 136, pl. 46, figs. 10-12.

Krammer and Lange-Bertalot, 1985, p. 68, pl. 23, figs. 3-6.

Dimensions: L: 20-40 μm . W: 8-15 μm . Str: 8-12/10 μm .

WM: Not observed.

WCA: VR-R in numerous samples.

Remarks: Differs from *N. elginensis* by the blunt (as compared to rostrate-capitate) apices.

***Navicula forcipata* Greville 1859**

Description: Krammer and Lange-Bertalot, 1986, p. 172, fig. 65, pl. 12, 13. Hustedt, 1927-66, III, p. 531, fig. 1568; Schmidt's Atlas, pl. 1, fig. 2; pl. 2, fig. 16,18; Patrick and Reimer, 1966, p. 571; Foged, 1981, p. 113, pl. 37, fig. 8; Pankow, 1990, p. 209, pl. 46, fig. 5.

Dimensions: L: 20-80 μm . W: 10-24 μm . Str: 13-16/10 μm .

WM: VR at WM-B.

WCA: Not observed.

Remarks: A brackish intertidal species. Foged (1981, p. 114): "Oligohalobe (indifferent to halophobe?). pH: circumneutral. Cosmopolite." Pankow (1990, p. 210): "Polyhalobous, mesoeuryhaline [=8-32 ppm]."

***Navicula lanceolata* (Agardh) Ehrenberg 1838**

Syn: *Frustulia lanceolata* Argardh 1827; *Navicula avenacea* de Brébisson ex Grunow 1878.

Description: Krammer and Lange-Bertalot, 1986, p. 100, pl. 29, figs. 5-7.

Germain, 1981, p. 180, pl. 68, figs. 1-6; Lange-Bertalot, 1980, p. 6.

(As *N. avenacea*): Brockmann, 1950, p. 17, pl. 1, fig. 6; Foged 1977, p. 76, pl. 28, fig. 19.

(As *N. viridula* var. *avenacea*): Patrick and Reimer, 1966, p. 507, pl. 48, fig. 10.

Dimensions: L: 28-70 μm . W: (8)9-12 μm . Str: 10-13/10 μm .

WM: VR at WM-P.

WCA: Not observed.

Remarks: This taxon is widely distributed, and cited in the literature usually as either *N. avenacea* de Brébisson ex Grunow 1878, or as *N. viridula* var. *avenacea* (Brébisson ex Grunow) Van Heurck 1885. Discrepancies among these investigators regards whether or not the taxon warrants a position as a separate species (Hendey, 1964; Brockmann, 1950; Foged, 1977, 1981) or should be maintained as a variety of *N. viridula* (Patrick and Reimer, 1966). However, Lange-Bertalot (1980, p. 30) reported that *N. avenacea* Brébisson ex Grunow 1878 is a junior synonym of *Navicula lanceolata* (Agardh) Ehrenberg 1838. Further, this taxon should not be confused with *N. lanceolata* sensu Kützing 1844 (Patrick and Reimer, 1966, p. 511, pl. 48, figs. 19-20), which Lange-Bertalot (1980) transferred to *Navicula trivialis*, or *Navicula lanceolata* sensu Hustedt 1930 (Foged, 1981, p. 117, pl. 31, fig. 17), which Lange-Bertalot (1980, p. 32) transferred to *N. pseudolanceolata*. In addition, Krammer and Lange-Bertalot (1986) reported that the central area for this taxon is "± round" while the central area for *N. viridula* (and its varieties) is "± round to cross-rectangular, mostly with strong asymmetry." Therefore, separated from *N. viridula* by the valve shape and absence of a truly asymmetrical central area.

***Navicula libonensis* Schoemann 1970**

Description: Krammer and Lange-Bertalot, 1986, p. 99, pl. 28, figs. 17-19.

Hein, 1990, p. 69, pl. 29, fig. 2.

Dimensions: L: 25-40 μm . W: 5.5-8 μm . Str: 12-13.5/10 μm .

WM: Not observed.

WCA: VR in numerous samples.

***Navicula miniscula* Grunow in Van Heurck 1880**

Syn: *Navicula importuna* Hustedt 1942; *Navicula miniscula* Grunow 1880 (pro parte) non sensu Cleve 1895.

Description: Krammer and Lange-Bertalot, 1986, p. 207, pl. 69, figs. 18-23.

Patrick and Reimer, 1966, p. 487, pl. 46, fig. 14; Germain, 1981, p. 231, pl. 85, fig. 37.

Dimensions: L: 8-16 μm . W: 3.2-5.5 μm . Str: 30-45/10 μm .

WM: VR-C at inner marsh stations WM-1 to WM-5.

WCA: VR at 40, 50, and 90 cm.

Remarks: Patrick and Reimer (1966, p. 487): "Axial area narrow, distinct. Central area not differentiated from the axial area. Striae radiate except near the center of the valve where they may be parallel... Widely distributed in fresh water."

***Navicula peregrina* (Ehrenberg) Kützing 1844**

Syn: *Pinnularia peregrina* Ehrenberg 1843.

Description: Krammer and Lange-Bertalot, 1986, p. 100, pl. 30, fig. 1.

Hustedt, 1930, p. 300, fig. 511; Patrick and Reimer, 1966, p. 533, pl. 51, fig. 5; Hendey, 1964, p. 201, pl. 30, figs. 12,13; Laws, 1988, p. 166, pl. 24, figs. 19,20.

Dimensions: L: 40-180 μm . W: 10-30 μm . Str: 5-7/10 μm .

WM: VR at WM-5 and WM-P.

WCA: R in salt marsh peat between 105-125 cm; VR in several other samples.

Remarks: Patrick and Reimer (1966, p. 533): "Valve lanceolate, usually narrowed toward broadly rounded ends. Ends sometimes acute. Axial area narrow, distinct. Central area transversely widened; usually rounded, sometimes almost rectangular. Striae radiate throughout most of the valve, becoming parallel to slightly convergent towards the ends; lineate... Seems to prefer water of high mineral content or brackish water."

***Navicula phyllepta* Kützing 1844**

Syn: *Navicula lanceolata* var. *phyllepta* (Kützing) Van Heurck 1885; *N. cryptocephala* sensu Brockmann 1950.

Description: Krammer and Lange-Bertalot, 1986, p. 104, pl. 32, figs. 5-11.

Germain, 1981, p. 190, pl. 72, figs. 14-17; Krammer and Lange-Bertalot, 1985, p. 85, pl. 21, fig. 5; Pankow, 1990, p. 217, pl. 47, fig. 12; Gasse, 1986, p. 108, pl. 18, fig. 1.

(As *N. cryptocephala*): Brockmann, p. 16, pl. 2, figs. 24-30.

Dimensions: L: 12-45 μm . W: 4-8 μm . Str: 14-20/10 μm .

WM: VR at WM-1 and WM-6.

WCA: VR at 20 and 30 cm.

Remarks: *N. phyllepta* is superficially similar to *Navicula veneta* (compare with Krammer and Lange-Bertalot, 1986, pl. 32, fig. 1-4 for *N. veneta* and figs. 5-11 for *N. phyllepta*), but with more strongly lanceolate valve without produced apices, more strongly radiate central striae, and no open central area.

Pankow (1990, p. 217): "Mesohalobous [0.2-30 ‰]."

***Navicula radiosa* Kützing 1844**

(pl. 5, figs. 16, 17)

Description: Patrick and Reimer, 1966, p. 509, pl. 48, fig. 15.

Foged, 1981, p. 123, pl. 32, fig. 1, pl. 35, fig. 5; Germain, 1981, p. 182, pl. 70, figs. 1-5; Gasse, 1986, p. 111, pl. 21, fig. 6; Krammer and Lange-Bertalot, 1986, p. 99, pl. 29, figs. 1-4.

Dimensions: L: 40-120 μm . W: 10-19 μm . Str: 10-12/10 μm .

WM: Not observed.

WCA: VR from 40 to 80 cm.

Remarks: Patrick and Reimer (1966, p. 509): "Common in all types of circumneutral fresh water; oligohalobous to indifferent to salt concentration."

Foged (1981, p. 123): "Oligohalobous (indifferent). pH: circumneutral. Cosmopolite."

***Navicula rhyncocephala* Kützing 1844**

(pl. 6, fig. 1, 2)

Description: Krammer and Lange-Bertalot, 1986, p. 101, pl. 30, figs. 5-8, pl. 31, figs. 1-2.

Hustedt, 1930, p. 296, fig. 501; Patrick and Reimer, 1966, p. 505, pl. 48, fig. 6; Foged, 1974, p. 80, pl. 12, fig. 2; Foged, 1981, p. 124, pl. 35, fig. 9; Germain, 1981, p. 180, pl. 69; Pankow, 1990, p. 219, pl. 48, fig. 10.

Dimensions: L: 35-80 μm . W: 9-14 μm . Str: 7-12/10 μm .

WM: Present in most marsh samples, A at WM-2, C at WM-P (pond).

WCA: R-F in most core samples, but absent in salt marsh peat from 105-120 cm.

Remarks: Most specimens observed in Winslow samples have apices that are tapered but not strongly produced (compare with Krammer and Lange-Bertalot, 1986, pl. 31, fig. 2), and therefore resemble shorter, narrower versions of *N. peregrina* (L: 40-190 μm ; W: 10-30 μm ; Str: 5-7/10 μm).

Patrick and Reimer (1966, p. 505): "Widely distributed in fresh water; seems to prefer water of high mineral content, halophilous to indifferent to small amounts of chloride."

Pankow (1990, p. 219): "Oligohalobous (indifferent), meio- bis mesoeuryhaline [\approx 0-10 ‰]."

Foged (1981, p. 124): "Oligohalobe (indifferent). Alkaliphil. Cosmopolite."

***Navicula salinarum* Grunow in Cleve and Grunow 1880**

(pl. 2, fig. 11)

Description: Patrick and Reimer, 1966, p. 502, pl. 48, figs. 1,2.

Hustedt, 1930, p. 295, fig. 498; Rao and Lewin, 1976, p. 203, figs. 249-251; Foged, 1978, p. 98, pl. 30, fig. 9; John, 1983, p. 99, pl. 42, figs. 1,2; Gasse, 1986, p. 115, pl. 20, fig. 8; Krammer and Lange-Bertalot, 1986, p. 110, pl. 35, figs. 5-8; Laws, 1988, p. 167, pl. 24, figs. 6-8; Pankow, 1990, p. 215, pl. 47, fig. 2.

Dimensions: L: 23-41 μm . W: 8-12 μm . Str: 14-18/10 μm .

WM: R-F at most marsh stations, 5% at WM-P.

WCA: VR at 30 cm.

Remarks: Patrick and Reimer (1966, p. 502): "Seems to prefer brackish water or fresh water of high mineral content."

Foged (1978, p. 98): "Mesohalobous, euryhaline, pH circumneutral. Cosmopolitan."

Brockmann (1950, p. 16, translated by Silke Clausen): "Common, especially in mixed water but also in mud flats of the west coast, very abundant on the soft mud flats off Nordstrand."

***Navicula slesvicensis* Grunow in Van Heurck 1880**

(pl. 2, fig. 12; pl. 5, figs. 19-21)

Syn: *Navicula viridula* var. *slesvicensis* (Grunow) Cleve 1895.

Description: Krammer and Lange-Bertalot, 1986, p. 102, pl. 31, figs. 3-5.

Germain, 1981, p. 178, pl. 67, figs. 6-10; Pankow, 1990, p. 218.

Dimensions: L: 25-60 µm. W: 8-11 µm. Str: 8-9/10 µm.

WM: R at WM-1.

WCA: VR-F at numerous samples between 80-160 cm.

Remarks: Related to *Navicula viridula*. Distinguished by the broad valve with only 7-9 striae/10 µm. The central area is often subquadrate.

Pankow (1990, p. 218): "Oligohalobous, meioeuryhaline [= 0-5 ‰]."

***Navicula tripunctata* (Müller) Bory de Saint Vincent 1822**

Syn: *Navicula gracilis* Ehrenberg 1838.

Description: Krammer and Lange-Bertalot, 1986, p. 95, pl. 27, figs. 1-3.

John, 1983, p. 103, pl. 43, figs. 2-5; Patrick and Reimer, 1966, p. 513, pl. 49, fig. 3; Cox, 1979, p. 150, pl. 1-3, figs. 1-6; Laws, 1988, p. 167, pl. 25, figs. 15-18; Pankow, 1990, p. 213, pl. 47, fig. 3.

(As *N. gracilis*): Germain, 1981, p. 184, pl. 71, figs. 1-3.

Dimensions: L: 30-70 µm. W: 6-10 µm. Str: 9-12/10 µm.

WM: Not observed.

WCA: VR-R between 150-170 cm).

Remarks: Distinguished by the parallel or slightly constricted margins, broad valve, nearly parallel striae, and rectangular central area.

Patrick and Reimer (1966, p. 513): Fresh to slightly brackish water. Pankow (1990, p. 213): "Oligohalobous, mesoeuryhaline [= 0-10 ppm]." Foged (1981, p. 127): "Oligohalobe (indifferent). pH: circumneutral. Europe. N. America."

***Navicula veneta* Kützing 1844**

Syn: *Navicula cryptocephala* var. *veneta* (Kützing) Rabenhorst 1864; *Navicula lancettula* Schumann 1867.

Description: Krammer and Lange-Bertalot, 1986, p. 104, pl. 32, figs. 1-4.

Pankow, 1990, p. 219, pl. 49, fig. 5.

(As *Navicula cryptocephala* var. *veneta*): Patrick and Reimer, 1966, p. 504, pl. 48, fig. 5;

Germain, 1981, p. 188, pl. 72, fig. 5.

Dimensions: L: 13-30 µm; B: 5-6 µm. Str: 13.5-15 ITM.

WM: VR-R at WM-1 to WM-11.

WCA: Not observed.

Remarks: Patrick and Reimer (1966, p. 504): "This taxon is best separated from *N. cryptocephala* var. *exilis* Grun. by its coarser striation and its linear to rhombic-lanceolate shape. The ends in variety *Exilis* are subrostrate or obtuse... Seems to prefer brackish water; also found in fresh water with high mineral content."

Pankow (1990, p. 219): "Oligohalobous, holoeuryhaline [0-30‰]."

NEIDIUM Pfitzer 1871

Neidium dubium (Ehrenberg) Cleve 1894

Syn: *Navicula dubia* Ehrenberg 1843; *Neidium dubium* forma *constricta* Hustedt 1930.

Description: Patrick and Reimer, 1966, p. 404, pl. 37, fig. 5.

Hustedt, 1930, p. 246, fig. 384a.; Schmidt's Atlas, pl. 49, figs. 7,8,11; Foged, 1971, p. 969, pl. 2, fig. 5; pl. 10, fig. 5; Foged, 1981, p. 132, pl. 25, fig. 6; Krammer and Lange-Bertalot, 1986, p. 267, pl. 99, figs. 1-7.

Dimensions: L: 30-50 μm . W: 10-16 μm . Str: 18-20/10 μm . Puncta: 20/10 μm .

WM: Not observed.

WCA: VR at 50, 80, 90, 160 cm.

Remarks: Patrick and Reimer (1966, p. 404): "This diatom is best distinguished by the straight - not hooked - proximal raphe ends, shallow puncta, and slightly radiate to parallel striae... Found in lakes and streams; pH 'indifferent.' Has not been found in large numbers."

Foged (1981, p. 132): "Oligohalobe (indifferent). pH: indifferent. Cosmopolite."

Neidium hercynicum Mayer 1917

Syn: *Neidium affine* forma *hercynica* (A. Mayer) Hustedt 1930.

Description: Patrick and Reimer, 1966, p. 398, pl. 36, figs. 9,10.

Foged, 1981, p. 132, pl. 34, fig. 6; pl. 25, figs. 4,8.

(As *N. affine* forma *hercynica*: Hustedt, 1930, p. 243; Jensen, 1985, p. 755.

Dimensions: L: 25-50 μm . W: 5-8 μm . Str: 26-28/10 μm . Puncta: 26-30/10 μm .

WM: Not observed.

WCA: VR at 80 cm.

Remarks: Foged, 1981, p. 133: "Oligohalobe (indifferent). pH: circumneutral. Europe. N. America."

Patrick and Reimer (1966, p. 398): "Small dystrophic streams and swamps."

NITZSCHIA Hassall 1845

Nitzschia capitellata Hustedt 1922 in Schmidt's Atlas

Syn: *Nitzschia subcapitellata* Hustedt 1939.

Description: Krammer and Lange-Bertalot, 1988, p. 88, pl. 62, fig. 1-12A; pl. 63, figs. 1-3, 14. Hustedt, 1922, in Schmidt's Atlas, pl. 348, fig. 57-59; Jensen, 1985, p. 867, fig. 792.

(As *Nitzschia subcapitellata*): Germain, 1981, p. 360, pl. 137, figs. 1-4.

Dimensions: L: 20-70 μm . W: 3.5-6.5 μm . Keel fibulae: 10-18/10 μm .

WM: Not observed.

WCA: VR at 160 and 180 cm.

Remarks: The two median fibulae are wider apart than the others, the sides are gently convex at the middle, and the apices are subcapitate. Compared with *N. tubicola*, which has fibulae that are generally of irregular distances along the valve, but with the median ones most widely spaced, and non-convex margins.

***Nitzschia commutata* Grunow in Cleve and Grunow 1880**

Syn.: *Nitzschia dubia* W. Smith 1853 pro parte (excluding Typus); *Nitzschia hybrida* Grunow in Van Heurck 1881 pro parte (excluding Typus).

Description: Krammer and Lange-Bertalot, 1988, p. 56, pl. 42, figs. 1-6. Hustedt, 1930, p. 405, fig. 774; Germain, 1981, p. 338, pl. 126, figs. 11-13; Foged, 1981, p. 137, pl. 57, figs. 7,9; Jensen, 1985, p. 857, fig. 774; Lange-Bertalot and Krammer, 1987, p. 10, pl. 22, figs. 1-9.

Dimensions: L: 45 to >100 µm. W: 5-8 µm. Str: (18) 19-23(24)/10 µm. Puncta: 25/10 µm.

WM: VR at WM-3 and WM-P.

WCA: VR at 180 cm.

Remarks: Distinguished in girdle view by the blunt ends and slightly constricted middle. In valve view the keel fibulae (about 10/10 µm), the striae (about 20/10 µm) and the produced capitate apices are all distinctive features.

Foged (1981, p. 86): "Halophilous (mesohalobous ?). pH: circumneutral. Cosmopolitan."

The following is a comparison of *N. commutata* with morphologically similar species:

	length (µm)	width middle (µm)	striae /10 µm	fibulae /10 µm	description
<i>N. bilobata</i>	50-150	5-14	15-27	5-8	valve strongly constricted in the middle; apices asymmetrical to slightly capitate; fibulae narrow lines
<i>N. commutata</i>	45-100	5-8	19-23	9-12	strongly concave in middle; apices tend to be asymmetrical and capitate; fibulae thick lines
<i>N. dubia</i>	80-160	12-16	21-24	9-10	gently concave at the middle, but not strongly constricted; apices asymmetrical but not capitate; fibulae are narrow lines
<i>N. dubiformis</i>	40-50	5-7	40	16-18	middle only gently concave; apices asymmetrical, narrowed, capitate; keel strongly eccentric; fibulae small, not elongate
<i>N. hybrida</i>	48-103	8-14	21-24	8-10	strongly constricted in the middle, apices strongly asymmetrical but not capitate; fibulae suborbicula, appear thickened in LM
<i>N. hybridaeformis</i>	60-93	6-8	35	5-10	Keel puncta irregularly elongate and irregularly spaced; striae very delicate
<i>N. pellucida</i>	var.	var.	30-40	12-18	Both sides concave in the middle, striae very delicate, central fibulae distantly spaced

***Nitzschia dissipata* (Kützing) Grunow 1862**

Description: Hustedt, 1930, p. 412, fig. 789.

Germain, 1981, p. 344, pl. 130, figs. 1-10; John, 1983, p. 167, pl. 69, figs. 6,7; Jensen, 1985, p. 864, fig. 789; Krammer and Lange-Bertalot, 1988, p. 19, pl. 11, figs. 11-14.

Dimensions: L: 15-17 μm . W: 4-7 μm . Keel puncta: 6-8/10 μm .

WM: VR in all marsh samples except WM-7 and WM-8.

WCA: VR at 40 cm.

Remarks: Distinguished by the large squarish keel puncta.

***Nitzschia dubia* W. Smith 1853**

(pl. 6, fig. 6)

Description: Krammer and Lange-Bertalot, 1988, p. 55, pl. 41, figs. 1-2.

Hendey, 1964, p. 279 (not figured); Germain, 1981, p. 338, pl. 128, figs. 1-2; Jensen, 1985, p. 856, fig. 770.

Dimensions: L: 80-160 μm . W: (6?)12-16 μm . Keel fibulae: 9-10/10 μm .

WM: R at WM-P (pond).

WCA: Not observed.

Remarks: Reported by Hendey (1964) and Hustedt (1930) as a saline species, but Krammer and Lange-Bertalot (1988) report that it also occurs rarely in freshwater.

***Nitzschia fasciculata* (Grunow) Grunow in Van Heurck 1881**

Syn: *Nitzschia sigma* var. *fasciculata* Grunow 1878.

Description: Krammer and Lange-Bertalot, 1988, p. 33, pl. 22, figs. 12, 13.

Hustedtd, 1930, p. 421, fig. 815; Germain, 1981, p. 368, pl. 139, figs. 12, 13; John, 1983, p. 168, pl. 49, fig. 8; Jensen, 1985, p. 874, fig. 815; Laws, 1988, p. 168, pl. 33, figs. 14,15; Pankow, 1990, p. 281, pl. 69, fig. 7.

Dimensions: L: 45-95 μm . W: 3-7 μm . Str: 27-30/10 μm . Keel fibulae: 4-7/10 μm .

WM: Not observed.

WCA: VR at 115 cm.

Remarks: Distinguished by the sigmoid shape and prominent keel fibulae.

Pankow (1990, p. 281) reports its salinity preference "Oligohalobous, meioeuryhaline [i.e., ~ 0-5 ‰]," , but this does not agree with the distribution in estuarine marshes and tidal flats in coastal Washington which I have observed for this species. My observations agree more closely with Foged (1978, p. 104), who reports it as "Mesohalobous."

***Nitzschia hybrida* Grunow in Cleve and Grunow 1880**

(pl. 3, fig. 1)

Syn: *Nitzschia bilobata* var. *hybrida* Grunow in Van Heurck 1881.

Description: Krammer and Lange-Bertalot, 1988, p. 61, pl. 46, figs. 3-6; pl. 47, figs. 1-3.

Lange-Bertalot and Krammer, 1987, p. 25, pl. 23, figs. 2,3.

Jensen, 1985, p. 858, fig. 778; Pankow, 1990, p. 278, pl. 68, fig. 4.

Dimensions: L: 48-103 μm . W: 8-14 μm . Keel fibulae: 8-10/10 μm . Str: 21-24(27)/10 μm .

WM: R to C in most marsh samples; absent at WM-9 (stagnant standing water).

WCA: VR to R in various samples.

Remarks: Distinguished by the distinct elongate keel fibulae and strongly bilobate valve. The striae are usually distinct in LM as well.

***Nitzschia inconspicua* Grunow 1862**

Syn: *Nitzschia (perpusilla* Rabenhorst var.) *inconspicua* Grunow in Cleve and Möller 1878; *Nitzschia frustulum* var. *inconspicua* Grunow in Van Heurck 1881; (?) *Nitzschia abbreviata* Hustedt in Schmidt's Atlas, 1924.

Description: Krammer and Lange-Bertalot, 1988, p. 95, pl. 69, figs. 1-13.

Germain, 1981, p. 356, pl. 134, figs. 23-26.

Dimensions: L: 3-22 μm . W: 2.5-3.5 μm . Str: 23-32/10 μm .

WM: VR at WM-B.

WCA: Not observed.

Remarks: Translated from Krammer and Lange-Bertalot (1988, p. 95): "Valve elliptical to linear-lanceolate with \pm bluntly rounded ends which are not produced, 3-22 μm long, 2.5-3.5 μm wide. Raphe keel with 8-13 'plumpish' fibulae/10 μm , the median ones both further apart from one another than from adjacent fibulae. Str. 23-32/10 μm . In [electron microscopy]: at least in the type material all the fine structures of *N. frustulum* are not distinguishable... Distribution cosmopolitan, frequent in the region in freshwater of average and moderately raised electrolyte content, to a critical stress level (a-b-mesosaprob); often in the breaker zone (supralittoral), under conditions of varying osmotic pressure as might be assumed."

***Nitzschia nana* Grunow in Van Heurck 1881**

(pl. 3, fig. 12)

Syn: *Nitzschia obtusa* var. *nana* (Grunow) Van Heurck 1885; *Nitzschia ignorata* Krasske 1929.

Description: Krammer and Lange-Bertalot, 1988, p. 26, pl. 17, figs. 4-8.

(As *Nitzschia ignorata* Krasske 1929): Hustedt, 1930, p. 422, fig. 819; Germain, 1981, p. 370, pl. 140, fig. 5; Foged, 1981, p. 139, pl. 58, fig. 4; pl. 59, fig. 2; Jensen, 1985, p. 876, fig. 819.

Dimensions: L: 35-120. W: 3-4.5 μm . Fibulae: 7-11/10 μm . Str: 30-36/10 μm

WM: R-F at stations WM-1 to WM-9.

WCA: VR at 40 cm.

Remarks: According to Hustedt (1930), *N. nana* is closely related to *N. filiformis*, but is more sigmoid. Krammer and Lange-Bertalot (1988) also note that it is systematically close to *N. filiformis*.

***Nitzschia palea* (Kützing) W. Smith 1856**

(pl. 3, fig. 2)

Description: Krammer and Lange-Bertalot, 1988, p. 85, pl. 59, fig. 1-24, pl. 60, fig. 1-7.

Hustedt, 1930, p. 416, fig. 801; Germain, 1981, p. 350, pl. 132; Foged, 1981, p. 140, pl. 18, fig. 2, pl. 19, fig. 6,7; John, 1983, p. 171, pl. 70, fig. 12; fig. 1-11; Jensen, 1985, p. 870, fig. 801; Pankow, 1990, p. 285, pl. 71, fig. 1.

Dimensions: L: 15-70 μm . W: 2.5-5 μm . Keel fibulae: 9-17/10.

WM: R at WM-P; VR at WM-4,5,7.

WCA: VR at 90 cm.

Remarks: This taxon is morphologically variable, as demonstrated by Krammer and Lange-Bertalot (1988, pl. 59). Pankow (1990, p. 285): "Oligohalobous, meioeuryhaline [salinities < 5‰]."

***Nitzschia pellucida* Grunow in Cleve and Grunow 1880**

Syn: *Hantzschia hyalina* Grunow in Van Heurck 1880; *Nitzschia littoralis* var. *parva* Grunow in Van Heurck 1881.

Description: Krammer and Lange-Bertalot, 1988, p. 63, pl. 47, fig. 4-6; pl. 48, figs 1-9.

Dimensions: L: 55-70 µm. Keel fibulae: 12-19/10 µm. Str: 30-40/10 µm.

WM: Not observed.

WCA: R at the top of the core.

Remarks: *N. pellucida* is structurally similar to *N. bilobata*, but more delicate and with short fibulae (rather than the characteristically long fibulae of *N. bilobata*). It is also similar to *N. hybrida*, but more delicate, with narrower valves, and smaller fibulae. The spacing between fibulae may be somewhat irregular, and the central fibulae are more widely spaced than any others.

***Nitzschia perminuta* (Grunow) M. Peragallo 1903**

Syn: *Nitzschia palea* var. *perminuta* Grunow in Cleve and Grunow 1880; *Nitzschia frustulum* var. *tenella* Grunow in Van Heurck 1881; *Nitzschia hiemalis* Hustedt 1943.

Description: Krammer and Lange-Bertalot, 1988, p. 99, pl. 72, figs. 1-23A.

Foged, 1974, p. 91, pl. 31, fig. 13; Lange-Bertalot, 1977, p. 263, pl. 2, figs. 9-10.

(As *Nitzschia frustulum* var. *tenella*): Hustedt, 1930, p. 415; Jensen, 1985, p. 868.

Dimensions: L: 8-45 µm. W: 2.5-3 µm. Keel fibulae: 10-16/10 µm. Str: 26-32/10 µm.

WM: Not observed.

WCA: VR to R in most core samples.

Remarks: The valve has mostly parallel sides that taper sharply to subcapitate apices. Striae are delicate, punctate, and keel fibulae are rounded. Overall dimensions are similar to *N. frustulum*, but valve is narrower, apices are more produced, and fibulae are rounded.

Foged (1981, p. 141): "Oligohalobe (indifferent). Alkaliphil. Cosmopolite."

***Nitzschia recta* Hantsch in Rabenhorst 1861-1879**

(pl. 6, fig. 7)

Description: Hustedt, 1930, p. 411, fig. 785.

Germain, 1981, p. 344, pl. 131, figs. 1-3; Jensen, 1985, p. 862, fig. 785; Gasse, 1986, p. 140, pl. 33, fig. 10; Krammer and Lange-Bertalot, 1988, p. 20, pl. 12, figs. 1-11.

Dimensions: L: 60-130 µm. W: 5-7 µm. Keel fibulae: 5-9/10 µm. Str: 40/10 µm.

WM: VR at various stations.

WCA: Not observed.

Remarks: The keel fibulae are quite elongate and sometimes unevenly distributed along the length of the valve, and the two center fibulae are not more widely spaced than the others. The striae are also sometimes impossible to discernible in LM.

Hustedt (in Jensen, 1985, p. 862): "Cells with parallel sides in girdle view, somewhat narrowed, wedge-shaped toward the ends, flatly trimmed on the apices, middle not constricted. Valves typically linear, without constrictions, with narrowed, wedge-shaped, quite sharply rounded ends... Keel narrow, not retracted. Keel puncta robust... the two middle puncta not standing far apart. Transapical striae very delicate, hardly discernible... Widely distributed and common in fresh water, easily distinguishable by the form and structure."

***Nitzschia sigma* (Kützing) Wm. Smith 1853**

Description: Krammer and Lange-Bertalot, 1988, p. 32, pl. 23, fig. 1-9; pl. 24, fig. 1. Hustedt, 1930, p. 420, fig. 813; Hendey, 1964, p. 281, pl. 42, fig. 1; John, 1983, p. 173, pl. 72, figs. 10-11; Jensen, 1985, p. 873, fig. 813; Pankow, 1990, p. 281, pl. 69, fig. 5.

Dimensions: L: 35-1000 μm . W: 4-15(26) μm . Keel fibulae: (3)7-12/10 μm . Str: (15)19-38/10 μm .

WM: VR to R at various stations.

WCA: VR at 105 and 110 cm.

Remarks: Distinguished by the large sigmoid valve and the "wavy" striae. If reports of its distribution are correct, it is a euryhaline species. I have observed it most frequently in estuarine low marshes and tidal flats.

Hendey (1964, p. 281): "One of the commonest and most widely spread diatoms around British coasts. Marine and brackish."

Pankow (1990, p. 281): "Mesohalobous, [possibly] holoeuryhaline [\sim 0-35 ‰]."

***Nitzschia terrestris* (Petersen) Hustedt 1934**

(pl. 6, figs. 3-5)

Basionym: *Nitzschia vermicularis* var. *terrestris* Petersen 1928.

Description: Krammer and Lange-Bertalot, 1988, p. 30, pl. 22, figs. 7-11.

Lange-Bertalot and Krammer, 1987, p. 56, pl. 10, figs. 10-13.

Dimensions: L: 25-115 μm . W: 3-5 μm . Keel fibulae: 5-8/10 μm . Str: 32-35/10 μm .

WM: Common at WM-12 (well-drained grassy surface).

WCA: VR to R in numerous core samples; absent between 105-115 cm.

Remarks: Observed in the highest part of brackish marshes in coastal Washington; a dominant species in the grassy area behind the berm (WM-12) at Winslow Marsh.

***Nitzschia tubicola* Grunow in Cleve & Grunow 1880**

Description: Krammer and Lange-Bertalot, 1988, p. 90, pl. 63, fig. 8-12; pl. 64, figs. 1-16.

Dimensions: L: 14-70 μm . W: 3.5-6 μm . Str: 29-35/10 μm . Keel fibulae: 7-13/10 μm .

WM: VR to F at numerous marsh stations; R at WM-P.

WCA: C at the top of the core; VR in various other samples.

Remarks: Valves are lanceolate to linear-lanceolate, keel fibulae are distinct and unevenly distributed in some cases, and the median fibulae are more widely spaced than the others. The apices are capitate apices and sometimes very distinctly set off from the rest of the valve.

***Nitzschia vitrea* Norman 1861**

Description: Krammer and Lange-Bertalot, 1988, p. 72, pl. 56, figs. 1-7.

Hustedt, 1930, p. 411, fig. 787; Foged, 1980, p. 74, pl. 43, figs. 5,6; Foged, 1981, p. 142, pl. 57, figs. 10,11; Germain, 1981, p. 342, pl. 131, figs. 4,5; Jensen, 1985, p. 864, fig. 787; Pankow, 1990, p. 286, pl. 71, fig. 7.

Dimensions: L: 30-220 μm . W: (4)5-14 μm . Str: 17-35/10 μm .

WM: Not observed.

WCA: VR to R in samples below 120 cm.

Remarks: Description for specimen from WCA 120-121 cm: valve linear with apices bent to one side, 105 x 6.5 μm . Striae delicate, punctate, offset by wavy longitudinal lines, ca. 18-20/10 μm . Keel fibulae very large, squarish, a distinguishing feature of the valve, 4/10 μm .

Pankow (1990, p. 286): "Mesohalobous, euryhaline [= 2-30 ‰]."

Foged (1981, p. 143): "Mesohalobe. Alkaliphil. Cosmopolite."

ODONTELLA Agardh 1832

Odontella aurita (Lyngbye) Agardh 1832

Syn: *Biddulphia aurita* (Lyngbye) Brébisson 1838.

Description: John, 1983, p. 32, pl. 11, figs. 8, 9.

Sancetta, 1982, p. 234, pl. 3, figs. 11-12.

(As *Biddulphia aurita*): Hustedt, 1927-1966, I, p. 847, fig. 501; Cupp, 1943, p. 161, fig. 112; Hendey, 1964, p. 103, pl. 24, fig. 6; Riznyk, 1973, p. 118, pl. 3, fig. 9; Laws, 1988, p. 155, pl. 14, fig. 2.

Dimensions: Pervalvar axis: 36-49 μm . W: 33-44 μm . Ar: 9-12/10 μm .

WM: VR at WM-B.

WCA: VR at 100 cm.

Remarks: Commonly observed attached to sandy substrate in Pacific Northwest estuaries. Hendey (1964, p. 103): "A neritic and littoral species, sometimes found free, but usually in long chains attached to a substratum."

OPEPHORA Petit 1888

Opephora marina (Gregory) Petit 1888

(pl. 3, fig. 3)

Description: Rao and Lewin, 1976, p. 185, fig. 95-100.

Hustedt, 1927-66, II, p. 136, fig. 656; Jensen, 1985, p. 128, fig. 656; Pankow, 1990, p. 139, pl. 29, fig. 18.

Dimensions: L: 5-20 μm . W: 3-5 μm . Str: 8-16/10 μm .

WM: VR at WM-B.

WCA: Not observed.

Remarks: Hustedt (1927-66, II, p. 136) described a much larger form of *O. marina* than is observed along the Washington coast. My observations agree with Rao and Lewin (1976, p. 185) who reported valves 5-10 μm long, and XX μm broad. Average specimens observed at WM-B were 10.5-20 μm long and x 1.5-2.8 μm wide, with a clavate valve and very short marginal striae forming a lanceolate sternum, about 16 striae in 10 μm . Specimens of *O. marina* were generally larger and less abundant than *O. parva*, and were distinguished by the short marginal striae and oval sternum.

Rao and Lewin (1976, p. 185): "Occurred as epipsammon. Abundant at all stations on the surface (10-20 mm) and decreased with depth. Healthy pigmented cells found at 210-220 mm."

Hendey (1964, p. 160): "Frequent on sandy beaches on all North Sea coasts."

Pankow (1990, p. 139): "Polyhalobous, pleioeuryhaline [~ 5-35‰]."

Opephora pacifica (Grunow) Petit 1888

Description: Hustedt, 1927-66, II, p. 135, fig. 655.

Brockmann, 1950, p. 13, pl. 4, figs. 13, 15; Hendey, 1964, p. 159, not figured; Foged, 1982, p. 73, pl. 2, figs. 17, 18; Jensen, 1985, p. 128, fig. 655; Laws, 1988, p. 170, pl. 16, fig. 3; Pankow, 1990, p. 141, pl. 29, fig. 16.

Dimensions: L: 20-60 μm . W: 5-7 μm . Str: 6/10 μm .

WM: Not observed.

WCA: VR at 105 cm.

Remarks: Common in tidal flat samples in coastal Washington and Oregon (Whiting, 1983). Hustedt (1927-66, II, p. 135): "Littoral ocean form, known primarily on the Pacific coasts;

rare in the area of Europe." Distinguished by short linear marginal striae that are closely spaced, and the narrow linear sternum.

***Opephora parva* (Van Heurck) Krasske 1939**

(pl. 3, figs. 4, 5)

Syn: *Opephora parva* (Grunow) Krasske in Hendey 1974.

Description: Rao and Lewin, 1976, p. 185, figs. 9-94 (as *O. pacifica*).

Tynni, 1986, p. 20, pl. 14, fig. 66.

Dimensions: L: 6-10 μm . W: 3-5 μm . Costae: 8-10/10 μm .

WM: A at WM-B (74%); VR at WM-12 across berm.

WCA: Not observed.

Remarks: Specimens at WM-B have clavate valves, 9-12 μm long, 2-3 μm wide. Striae are distinct, ca. 10/10 μm , offset from one another across a narrow sternum.

Tynni (1986, p. 21): "Hustedt (1955) extended the previous size range of *Opephora pacifica*, 20-60 μm (Hustedt, 1962 [in 1927-66, II]), to include smaller forms to 8 μm . These small forms are very similar to the form presented by Krasske. Both are marine epiphytes."

Rao and Lewin (1976, p. 185) reported this taxon as a small form of *O. pacifica*:
"Frustules small, valves clavate with large, rounded apex. Length of valve in our material 6-10 μm , breadth 3-5 μm . Sides slightly convex. Valve surface with strong transverse costae, about 8-10 in 10 μm . Axial area narrow. *Probably a small form of O. pacifica*... Occurred as epipsammon. Abundant at all stations on the surface (10-20 mm) and decreased with depth. Healthy pigmented cells were found at 210-220 mm."

PARALIA Heiberg 1863

***Paralia sulcata* (Ehrenberg) Cleve 1873**

(pl. 3, figs. 15, 16)

Syn: *Melosira sulcata* (Ehrenberg) Kützing 1844.

Description: Crawford, 1979, p. 200-210, figs. 1-33.

Gran and Angst, 1931, p. 430, fig. 4; Hendey, 1964, p. 73, pl. 23, fig. 5; Sancetta, 1982, p. 235, pl. 3, figs. 13-15; Laws, 1988, p. 170, pl. 2, figs 5-17.

(As *Melosira sulcata*): Hustedt, 1927-66, I, p. 276, figs 118-120;

Cupp, 1943, p. 40, fig. 2; Riznyk, 1973, p 124, pl. 10, fig. 8.

Dimensions: Crawford (1979, p. 200) reports diameters of 40-130 μm , but this was for the type material (the "Plymouth Material) collected from open-marine salinities. Hendey (1964) reported diameters of 36-60 μm , and Hemphill-Haley (1993) reported diameters of 15-70 μm for estuarine samples from coastal Washington.

WM: VR at WM-11, WM-12, WM-B.

WCA: Small specimens VR between 105-135 cm.

Remarks: Hendey (1964, p. 73): "A true bottom form, found in neritic plankton, particularly after winter gales. Very common along the southeastern shores of the North Sea." Cupp (1943, p. 40): "Very common in littoral zone. Occurs in plankton accidentally (tychopelagic). Cold-water species."

PINNULARIA Ehrenberg 1843

Pinnularia acrosphaeria W. Smith 1853

Description: Patrick and Reimer, 1966, p. 623, pl. 60, figs. 2-3.

Hustedt, 1930, p. 330, fig. 610; Schmidt's Atlas, pl. 43, figs. 14-16, 23; Foged, 1981, p. 143, pl. 43, fig. 13; Gasse, 1986, p. 154, pl. 34, fig. 4.

Dimensions: L: 30-180 μm . W: 8-20 μm . Str: 6-14/10 μm .

WM: Not observed.

WCA: VR in a few samples.

Remarks: Patrick and Reimer (1966, p. 623): "This species is distinguished by the broad, granular axial area... Seems to prefer littoral areas of circumneutral lakes and ponds."

Gasse (1986, p. 154): "This species occurred in the bottom mud of shallow lakes, rivers, and peat-bogs."

Pinnularia appendiculata (Agardh) Cleve 1895

(pl. 3, fig. 6)

Syn: *Frustulia appendiculata* Agardh 1827; *Pinnularia silvatica* Petersen 1935; *Pinnularia irrorata* (Grunow) Hustedt 1939.

Description: Krammer and Lange-Bertalot, 1986, p. 427, pl. 193, figs. 19-29.

Hustedt, 1930, p. 317, fig. 570a; Patrick and Reimer, 1966, p. 593, pl. 55, fig. 2; Germain, 1981, p. 245, pl. 88, figs. 29-32; Jensen, 1985, p. 723, fig. 570a; Gasse, 1986, p. 154, pl. 23, figs. 4, 5.

(As *Pinnularia silvatica*): Petersen, 1935, p. 147, fig. 7; Cleve-Euler, 1955, IV, p. 17, fig. 1001; Foged, 1982, p. 79, pl. 26, fig. 13.

Dimensions: L: 14-36 μm . W: 3.2-6 μm . Str: 16-23/10 μm .

WM: F-C in most marsh samples.

WCA: VR to R in various samples; absent between 100-135 cm.

Remarks: This was one of the more ubiquitous diatoms in surface samples from Winslow marsh, but was not as dominant in Core A. It is superficially similar to *P. subcapitata*, but differs by having finer striae and the raphe sternum that broadens gradually towards the central area.

Krammer and Lange-Bertalot (1986, p. 427): "Cosmopolitan in aerophile locations, but also in marshes, springs, and in banks of large streams, the smaller forms especially in moss. In the region distributed everywhere, in the mountains not rare and scattered, especially frequent in aerophile locations." Gasse (1986, p. 155): "This species was found in... peat bogs... it lived as an aerophilous or a benthic form..."

Foged (1981, p. 144) reported *P. appendiculata* as a halophobe, but occurrences at Winslow Marsh indicate that it can tolerate small amounts of salt.

Pinnularia borealis Ehrenberg 1843

(pl. 5, fig. 22)

Description: Patrick and Reimer, 1966, p. 618, pl. 58, fig. 13.

Foged, 1978, p. 113, pl. 33, fig. 15, pl. 34, fig. 9; Foged, 1981, p. 145, pl. 40, figs. 6,7; Germain, 1981, p. 270, pl. 98, figs. 1-8; John, 1983, p. 125, pl. 53, fig. 4; Krammer and Lange-Bertalot, 1986, p. 405, pl. 177, figs. 1-12; pl. 178, fig. 7; Gasse, 1986, p. 155, pl. 24, fig. 6; Laws, 1988, p. 170; pl. 25, fig. 14.

Dimensions: L: 28-110 μm . W: 7-18 μm . Str: 4-6/10 μm .

WM: R at WM-12.

WCA: VR in a few samples.

Remarks: Differs from *P. lagerstedtii* by the larger valve and coarser striae.

Patrick and Reimer (1966, p. 618): "Valve broadly linear with rounded ends. Axial area narrow. Median ends of the raphe turned slightly to one side; terminal fissures distinct. Central area rounded, transverse. Striae usually parallel; sometimes slightly radiate toward the center of the valve and slightly convergent near the ends... This species is distinguished by its slightly curved raphe and the shape of the axial and central areas."

Gasse (1986, p. 156): "The species occurred in lakes, rivers and peat-bogs... where it lived as an aerophilous."

***Pinnularia gibba* Ehrenberg var. *linearis* Hustedt 1930**

Syn: *Pinnularia abaujensis* var. *linearis* (Hustedt) Patrick in Patrick and Reimer 1966.

Description: Krammer and Lange-Bertalot, 1986, p. 424, pl. 189, figs. 4-7. Hustedt, 1930, p. 327, fig. 604; Foged, 1981, p. 148, pl. 43, figs. 5,9; Jensen, 1985, p. 732, fig. 604.

(As *Pinnularia abaujensis* var. *linearis*): Patrick and Reimer, 1966, p. 613, pl. 58, fig. 3.

Dimensions: L: 50-140 μm . W: 7-13 μm . Str: 9-12/10 μm .

WM: Not observed.

WCA: F at 80 cm; VR in several other samples.

Remarks: Distinguished by the parallel margins of the valve, and the large central area.

***Pinnularia ignobilis* (Krasske) Cleve-Euler 1955**

Syn: *Navicula ignobilis* Krasske 1938.

Description: Krammer and Lange-Bertalot, 1986, p. 417, pl. 187, figs. 6-8; pl. 206, figs. 12-19.

Dimensions: L: 14-32 μm . W: 4-6 μm . Str: 18-24/10 μm .

WM: 4-10% at most marsh stations; VR at WM-12 (dry surface) and WM-9 (stagnant standing water).

WCA: VR to R in the upper half of the core.

Remarks: An aerophile species which, according to Krammer and Lange-Bertalot (1986), is often found with *Pinnularia krockii*. Occurs with *P. krockii* in WM samples (Table 4).

***Pinnularia krockii* (Grunow) Cleve 1891**

(pl. 2, fig. 13; pl. 3, figs. 9-11)

Description: Krammer and Lange-Bertalot, 1986, p. 416, pl. 187, fig. 9, pl. 206, figs. 8,9,11.

Hustedt, 1930, p. 319, fig. 580; Pankow, 1990, p. 192, pl. 43, fig. 10.

Dimensions: L: 14-40 μm . W: 5-11 μm . Str: 17-21/10 μm .

WM: Observed at all marsh stations; C at WM-4,6,7,10.

WCA: C at the top of the core; F at 100 cm.

Remarks: Distinguished by the broad capitate apices. Also common in fresh-brackish marshes beside Turnagain Arm (south-central Alaska).

***Pinnularia lagerstedtii* (Cleve) Cleve-Euler 1934**

(pl. 3, fig. 8)

Syn: *Pinnularia parva* var. *lagerstedtii* Cleve 1895; *Pinnularia parva* var. *minuta* Østrup 1918.

Description: Krammer and Lange-Bertalot, 1986, p. 404, pl. 176, figs. 8-10.

(As *Pinnularia parva* var. *minuta*): Foged, 1981, p. 153, pl. 39, figs. 18,22.

Dimensions: L: 16-40 μm . W: 5-8 μm . Str: 8.5-10/10 μm .

WM: R to F at most marsh stations; absent at WM-9; >28% at WM-8.

WCA: F at the top of the core (9%); VR to R at most intervals except 40-70 cm and 115 cm.

Remarks: An aerophile species, indicative of high marshes above mean higher high water in coastal Washington.

This taxon is probably confused with *P. borealis* in some studies, but differs by the smaller valve size and denser striae. The central area forms a broad fascia, and striae are slightly radiate or parallel at the middle, convergent at the ends. See also Hemphill-Haley (1993).

***Pinnularia microstauron* (Ehrenberg) Cleve 1891**

Description: Hustedt, 1930, p. 320, fig. 582.

John, 1983, p. 129, pl. 54, fig. 8; Germain, 1981, p. 249, pl. 90, figs. 8-11; Jensen, 1985, p. 726, fig. 582; Patrick and Reimer, 1966, p. 597, pl. 55, fig. 12; Foged, 1981, p. 152, pl. 41, fig. 9, pl. 43, figs. 2, 3; pl. 44, fig. 7; Krammer and Lange-Bertalot, 1986, p. 425, pl. 191, figs. 1-9; pl. 192, figs. 1-16; Gasse, 1986, p. 159, pl. 23, figs. 16, 17.

Dimensions: L: 25-80 μm . W: 7-11 μm . Str: 10-13/10 μm .

WM: Not observed.

WCA: VR to R in the lower part of the core.

Remarks: Distinguished by the linear valve with broad apices, and the narrow sternum which widens to a transverse central area (extending to the margins).

***Pinnularia obscura* Krasske 1932**

(pl. 3, fig. 7)

Description: Patrick and Reimer, 1966, p. 617, pl. 58, fig. 9.

Krasske, 1932, p. 117, pl. 3, fig. 33; Schmidt's Atlas, pl. 388, fig. 18-21; Tynni, 1976, pl. 9, figs. 38a-c; Foged, 1981, p. 153, pl. 39, figs. 8,9; Krammer and Lange-Bertalot, 1986, p. 420, pl. 185, figs. 20-23; Gasse, 1986, p. 159, pl. 23, figs. 2,3.

WM: Not observed.

WCA: VR to R in numerous samples.

Dimensions: L: 12-22 μm . W: 3-5 μm . Str: 13-15/10 μm .

Remarks: Distinguished by the radiate costae and broad central area. "*P. intermedia*" is probably synonymous with this taxon.

Gasse (1986, p. 159): "This species reached its maximal percentage in [a] peat bog where it lived as an aerophile on mosses. It also occurred in shallow lakes and rivers. The species is usually regarded as being oligohalobous, pH-indifferent (Hustedt, 1957, p. 308)."

***Pinnularia pulchra* var. *angusta* (Cleve) Krammer 1984**

Syn: *Pinnularia mesolepta* var. *angusta* Cleve 1895.

Description: Krammer and Lange-Bertalot, 1986, p. 414, pl. 184, fig. 6.

(As *Pinnularia mesolepta* var. *angusta*): Hustedt, 1930, p. 319, fig. 575a; Patrick and Reimer, 1966, p. 601, pl. 55, fig. 19; Jensen, 1985, p. 724, fig. 575a.

Dimensions: L: 42-80 μm . W: 7-10 μm . Str: 10-13/10 μm .

WM: Not observed.

WCA: VR at 90, 130, 180 cm.

Remarks: Distinguished by the tri-undulate valve with subcapitate apices and slightly undulate raphe branches.

Hustedt (in Jensen, 1985, p. 724): "Common and distributed in standing and flowing waters of the entire area. Closely related to [*P. interrupta*] and perhaps should be perceived only as a three-waved variation."

***Pinnularia streptoraphe* Cleve 1891**

Description: Patrick and Reimer, 1966, p. 639, pl. 64, fig. 4.

Hustedt, 1930, p. 327, fig. 605; Germain, 1981, p. 266, pl. 97, fig. 6; Jensen, 1985, p. 740, fig. 605.

Dimensions: L: 135-260 μm . W: 20-35 μm . Str: 5/10 μm .

WM: Not observed.

WCA: R at 130 cm; VR at 60, 80, 90 cm.

Remarks: Patrick and Reimer (1966, p. 639): "This species is related to *Pinnularia viridis* but differs in its more broadly linear shape, the number of the striae - which in this taxon are coarser - wider axial area, and the more strongly twisted raphe... Lakes, ponds, or bogs in water of low mineral content; seems to prefer acid water."

***Pinnularia viridis* (Nitzsch) Ehrenberg 1843**

(pl. 4, fig. 1; pl. 6, fig. 9)

Description: Krammer and Lange-Bertalot, 1986, p. 428, pl. 194, fig. 1-4; pl. 195, figs. 1-6.

Schmidt's Atlas, pl. 42, figs. 11-14; pl. 19, figs. 21-23; Hustedt, 1930, p. 335, fig. 617a; Patrick and Reimer, 1966, p. 639, pl. 64, fig. 5; Foged, 1978, p. 118, pl. 33, fig. 5; Foged, 1981, p. 156, pl. 42, fig. 2; pl. 43, fig. 1; Germain, 1981, p. 260, pl. 95, figs. 1-6; pl. 96, figs. 1-9; John, 1983, p. 130, pl. 54, figs. 10-12; Pankow, 1990, p. 192, pl. 43, fig. 11.

Dimensions: L: 50-170 μm . W: 10-30 μm . Str: 6-12/10 μm .

WM: VR at WM-7.

WCA: VR to R in most core samples.

Remarks: Pankow (1990, p. 192) reported salinity tolerances of 0-10 ppm.

PLAGIOGRAMMA Greville 1859

***Plagiogramma staurophorum* (Greg.) Heiberg 1863**

(pl. 3, figs. 13, 14; pl. 5, fig. 18)

Description: Hustedt, 1927-66, II, p. 110, fig. 635.

Hendey, 1964, p. 166, pl. 36, fig. 1; Riznyk, 1973, p. 131, pl. 14, fig. 4; Rao and Lewin, 1976, p. 181, figs. 53-55; John, 1983, p. 52, pl. 20, figs. 14-15; Jensen, 1985, p. 106, fig. 635; Pankow, 1990, p. 135, pl. 27, fig. 4.

Dimensions: L: 12-65 μm . W: 5-11 μm . Str: 8-11/10 μm .

WM: VR at WM-B.

WCA: VR at 110 and 120 cm.

Remarks: A common species on sandy tidal flats in the Pacific Northwest.

Hustedt (in Jensen, 1985, p. 106): "Widely distributed and not uncommon on all European coasts from the Mediterranean to the arctic area; in our flora the commonest species of the genus." Hendey (1964, p. 166): "Common marine littoral species on all North Sea coasts, favoring sandy shores."

RHAPHONEIS Ehrenberg 1844

Rhaphoneis ampiceros (Ehrenberg) Ehrenberg 1844

Description: Hustedt, 1927-66, II, p. 174, fig. 680.

Hendey, 1964, p. 154, pl. 26, figs. 1-4; Riznyk, 1973, p. 131, pl. 15, figs. 1, 2; Rao and Lewin, 1976, p. 183, figs. 56-59; Germain, 1981, p. 60, pl. 17, fig. 9; John, 1983, p. 53, pl. 21, fig. 7; Jensen, 1985, p. 162, fig. 680.

Dimensions: L: 20-100 μm . W: 18-25 μm . Str: 6-7/10 μm .

WM: VR at WM-B.

WCA: Not observed.

Remarks: A common epipsammic species in coastal Washington.

RHOICOSPHENIA Grunow 1860

Rhoicosphenia abbreviata (C. Agardh) Lange-Bertalot 1980

(pl. 4, figs. 2, 3)

Syn: *Rhoicosphenia curvata* (Kützing) Grunow ex Rabenhorst 1864.

Description: Krammer and Lange-Bertalot, 1986, p. 381, pl. 91, figs. 20-28.

Pankow, 1990, p. 241, pl. 55, figs. 3,4.

(As *Rhoicosphenia curvata*): Hustedt, 1927-66, II, p. 430, fig. 879; Patrick and Reimer, 1966, p. 282, pl. 20, figs. 1-5; Riznyk, 1973, p. 132, pl. 15, figs. 5, 6; Rao and Lewin, 1976, p. 193, figs. 200-203; Foged, 1978, p. 122, pl. 17, figs. 1-3; Foged, 1979, p. 102, pl. 16, figs. 1-4; Foged, 1981, p. 157, pl. 14, fig. 1; Germain, 1981, p. 118, pl. 44, figs. 21-25; Jensen, 1985, p. 373, fig. 879; Laws, 1988, p. 172, pl. 19, fig. 6.

Dimensions: L: 12-75 μm . W: 4-8 μm . Str: 11-15/10 μm .

WM: VR at WM-P.

WCA: C at 30 cm.

Remarks: Hendey (1964, p. 183): "A very common species in brackish water, frequent in estuarine conditions on all European coasts." Pankow (1990, p. 242): "Oligohalobous, holo-to-pleioeuryhaline [i.e., 0-35 to 0-20 ‰]." Germain (1981, p. 118): Attaches to floating objects, macrophytes, filamentous algae (i.e., *Cladophora*), and rocks. Hustedt (in Jensen, 1985, p. 373): "Halophile fresh water form, euryhaline, widely distributed and very abundant especially on brackish coasts, but also distributed and very abundant in waters of low salinity as well as in fresh water of the interior, rare in mountain water."

RHOPALODIA Müller 1895

Rhopalodia gibba (Ehrenberg 1832) O. Müller 1897

Description: Patrick and Reimer, 1975, p. 189, pl. 28, fig. 1.

Hustedt, 1930, p. 390, fig. 740; Schmidt's Atlas, pl. 253, figs. 1-13; Jensen, 1985, p. 842, fig. 740; Krammer and Lange-Bertalot, 1986, p. 159, pl. 111, figs. 1,2,4,6,7-13; Gasse, 1986, p. 162, pl. 39, figs. 8, 9; Pankow, 1990, p. 265, pl. 64, fig. 6.

Dimensions: L: 80-300 μm . W: 8-11 μm . Costae: 6-8/10 μm . Str: 12-16/10 μm .

WM: Not observed.

WCA: VR at 50 and 190 cm.

Remarks: Patrick and Reimer (1975, p. 189): "Raphe without distinct nodules, appearing notched in the middle due to the valve shape. Costae well developed, with usually two to three rows of alveoli between the costae, sometimes a single row. Costae, 6-8 in 10 μm . Rows of alveoli, 12-16 in 10 μm ; usually 2-3 between the costae. Length, 80-300 μm . Breadth of

frustule, 18-30 µm. Valve breadth, 8-11 µm... The nominate variety is distinguished by its size and the appearance of the frustule in girdle view which is only swollen in the central portion. It is also distinguished by the striae being composed of a single row of alveoli... Usually epiphytic and in water with moderate to fairly high conductivity."

Pankow (1990, p. 265): "Oligohalobous (indifferent), mesoeuryhaline [0-10 ‰]."
Foged (1981, p. 157): "Oligohalobe (indifferent). Alkalibiontic."

***Rhopalodia gibberula* (Ehrenberg) O. Müller 1900**

Description: Patrick and Reimer, 1976, p. 191, pl. 28, fig. 6.

Hustedt, 1930, p. 391, fig. 742; Jensen, 1985, p. 843, fig. 742; Foged, 1978, p. 123, pl. 43, fig. 1; John, 1983, p. 161, pl. 67, figs. 11,12; Gasse, 1986, p. 163, pl. 30, figs. 15, 16; Krammer and Lange-Bertalot, 1988, p. 160, pl. 110, fig. 2; pl. 112, figs. 1-6; pl. 113, figs. 4-6; Laws, 1988, p. 172, pl. 30, figs. 7-10; Pankow, 1990, p. 265, pl. 64, figs. 1-3.

Dimensions: L: (25)40-70(80). W: 7-14. Costae: 3-4/10 µm. Str: 12-17/10 µm.

WM: Not observed.

WCA: VR at 30 cm.

Remarks: Patrick and Reimer (1976, p. 191): "Seems to prefer water with some chloride (halophil), but may be found in low conductivity water. It is a widely tolerant species."

Pankow (1990, p. 266): "Oligohalobous (indifferent to halophilous), pleioeuryhaline [= 0-20 ‰]."

***Rhopalodia operculata* (Agardh) Håkansson 1979**

(pl. 5, fig. 23)

Syn: *Frustulia operculata* Agardh 1827; *Cymbella operculata* Agardh 1830; *Epithemia minuta* Hantzsch 1863.

Description: Håkansson, 1979, p. 1, pl. 66, figs. 1-5.

Krammer and Lange-Bertalot, 1988, p. 165, pl. 115, figs. 9-12; Laws, 1988, p. 172, pl. 30, fig. 11.

Dimensions: L: 18-52 µm. W: 13-26 µm (frustule); 5-10 µm (valve). Costae: 3-6/10 µm. Str: 16-18/10 µm.

WM: Not observed.

WCA: VR-R in numerous core samples.

Remarks: Distinguished by the 2-7 striae between the costae, the straight ventral margin, and the apices bent in a ventral direction.

SELLAPHORA C. Mereschkowsky 1902

***Sellaphora pupula* (Kützing) Mereschkowsky 1902**

Syn: *Navicula pupula* Kützing 1844.

Description: Krammer and Lange-Bertalot, 1986, p. 189, pl. 68, figs. 1-12 (as *Navicula pupula*).

Hustedt, 1927-66, III, p. 120, figs. 1254a-g; Schmidt's Atlas, pl. 396, figs. 15-21; Patrick and Reimer, 1966, p. 495, pl. 47, fig. 7; Foged, 1981, p. 122, pl. 38, fig. 20; Gasse, 1986, p. 110, pl. 17, fig. 1.

Dimensions: L: 10-90 µm. W: 4.2-21 µm. Str: 16-26 ITM

WM: Not observed.

WCA: VR-R in various samples, but absent in salt marsh peat between 100-125 cm.

Remarks: Patrick and Reimer (1966, p. 495): "Seems to prefer fresh, circumneutral water of fairly high mineral content; halophilous."

Foged (1981, p. 122): "Oligohalobe (indifferent). pH: circumneutral. Cosmopolite."

Description for specimen in Core A at 130-131 cm: Valve broadly lanceolate, slightly inflated at the middle and ends, apices broad. Raphe branches straight, raphe sternum narrow, central area subquadrate but irregular, formed by shorter middle striae of varying length. Striae delicate-looking, gently radiate, with central striae thicker than the others, 24 in 10 μm . Distinguished by the valve shape, delicate dense striae, and irregular central area formed by the shorter central striae of irregular lengths.

***Sellaphora seminulum* (Grunow) Mann 1989**

(pl. 4, figs. 4, 5)

Syn: *Navicula atomoides* Grunow in Van Heurck 1880 pro parte; *Navicula seminulum* Grunow 1860.

Description: Patrick and Reimer, 1966, p. 489, pl. 46, figs. 19-20.

Hustedt, 1927-66, III, p. 241, fig. 1367; Germain, 1981, p. 230, pl. 85, figs. 22-30; Krammer and Lange-Bertalot, 1986, p. 230, pl. 76, figs. 30-36.

Dimensions: L: 7-18 μm . W: 4-5 μm . Str: 18-20/10 μm .

WM: Not observed.

WCA: VR-F in numerous samples; 17% at 150 cm.

Remarks: Patrick and Reimer (1966, p.489): "Margins of the valve parallel at the ends, becoming convex at the center. This produces a swollen effect about the central area. Ends of the valve rounded. Axial area narrow. Central area rectangular, transversely widened. Striae radiate throughout the valve except around the central area where they are almost parallel. Striae shortened about the central area, often somewhat irregular in length; slightly more distant from each other than in the rest of the valve... Fresh to slightly brackish water."

Gasse (1986, p. 115): "*N. seminulum* has been found in various biotopes: river and lake plankton, periphyton and bottom mud. It also tolerates subaerial habitats... since it occurred in the Mt. Badda peat-bogs."

Foged (1981, p. 125): "Oligohalobe (indifferent). pH: circumneutral to alkaliphil. Cosmopolite."

STAURONEIS Ehrenberg 1843

***Stauroneis kriegeri* Patrick 1945**

Syn: *Stauroneis anceps* var. *capitata* Peragallo in Tempère and Peragallo 1908; *Stauroneis pygmaea* Krieger 1929.

Description: Patrick and Reimer, 1966, p. 362, pl. 30, fig. 5.

Hustedt, 1927-66, II, p. 780, figs. 1126a, b. Jensen, 1985, p. 656, figs. 1126a, b. Krammer and Lange-Bertalot, 1986, p. 248, pl. 90, figs. 23-27.

(As *S. pygmaea*): Germain, 1981, p. 60, fig. 25.

Dimensions: L: 20-23 μm . W: 4-6 μm . Str: 26/10 μm .

WM: Not observed.

WCA: VR-F in most samples, but absent in salt marsh peat from 100-115 cm, and in the upper 30 cm of the core.

Remarks: Patrick and Reimer (1966, p. 362): "Best distinguished by the small size, the fine but distinctly punctate striae and the linear or only slightly expanded fascia... Appears to be pH 'indifferent,' oligohalob; more characteristic of headwater areas."

Foged (1981, p. 160): "Oligohalobe (indifferent). pH: circumneutral. Cosmopolite (?)."

Hustedt (in Jensen, 1985, p. 657): "Cosmopolitan fresh water form. Common, especially in shallow bogs, meadow ditches, swamps, rarely also in littoral of lakes."

***Stauroneis phoenicenteron* (Nitzsch) Ehrenberg 1843**

Syn: *Bacillaria phoenicenteron* Nitzsch 1817; *Stauroneis lanceolata* Kützing 1844.

Description: Krammer and Lange-Bertalot, 1986, p. 239, pl. 6, figs. 7-8; pl. 8, fig. 3; pl. 15, fig. 2; pl. 84, figs. 1-3; pl. 85, figs. 1-6.

Hustedt, 1927-66, II, p. 766, fig. 1118a; Patrick and Reimer, 1966, p. 359, pl. 29, figs. 1-2; Foged, 1978, p. 125, pl. 26, fig. 1; Germain, 1981, p. 156, pl. 59, figs. 1-6; Foged, 1981, p. 161, pl. 21, fig. 2; John, 1983, p. 138, pl. 57, fig. 11; Jensen, 1985, p. 643, fig. 1118a.

WM: VR at WM-P.

WCA: VR in various samples.

Remarks: Patrick and Reimer (1966, p. 359): "Oligohalob, pH 'indifferent'; apparently has a wide range of ecological tolerance (euryhök).

Foged (1981, p. 161): "Oligohalobe (indifferent). pH: circumneutral. Cosmopolite."

Foged (1981, pl. 21, fig. 2) further reports specimens attached to "Withered *Carex* leaves in running water."

***Stauroneis producta* Grunow 1880**

(pl. 6, fig. 8)

Syn: *Pleurostauron parvulum* Grunow 1878 in Cleve and Möller 1877-1882; *Stauroneis parvula* var. *producta* (Grunow) Cleve 1894; *Stauroneis parvula* var. *prominula* sensu Hustedt 1930.

Description: Hustedt, 1927-1966, II, p. 807, fig. 1154.

Patrick and Reimer, 1966, p. 371; Jensen, 1985, p. 679, fig. 1154; Krammer and Lange-Bertalot, 1986, p. 243, pl. 89, figs. 1-7.

Dimensions: L: 30-50 μm . W: 8-11 μm . Str: 22-28/10 μm .

WM: R at WM-1.

WCA: VR at 40, 70, 160 cm.

Remarks: Foged (1981, p. 162): "Halophil. Alkaliphil. Cosmopolite (?)"

SURIRELLA Turpin 1828

***Surirella amphioxys* W. Smith 1856**

(pl. 6, fig. 10)

Syn: *Surirella moelleriana* Grunow ex Möller 1868.

Description: Krammer and Lange-Bertalot, 1988, p. 189, pl. 138, figs. 1-5; pl. 39, figs. 1-8. Schmidt's Atlas, pl. 56, figs. 21-23; Foged, 1977, p. 109, pl. 47, fig. 9, pl. 48, fig. 8; Foged, 1981, p. 164, pl. 60, fig. 5; pl. 64, fig. 5; Hein, 1990, p. 98, pl. 47, figs. 3-4.

(As *S. moelleriana*): Hustedt, 1930, p. 435, fig. 842; Jensen, 1985, p. 889, fig. 842.

Dimensions: L: 15-120 μm . W: 12-20 μm . Str: 14-16 (18) /10 μm .

WM: Not observed.

WCA: VR in various samples.

Remarks: Foged (1981, p. 164): "Oligohalobe (indifferent to halophil). pH: Circumneutral. Cosmopolite."

***Surirella angusta* Kützing 1844**

Description: Krammer and Lange-Bertalot, 1988, p. 187, pl. 133, figs. 6-13; pl. 134, figs. 1, 6-10.

Hustedt, 1930, p. 435, fig. 844; Foged, 1978, p. 127, pl. 47, figs. 5,6; Foged, 1981, p. 164, pl. 54, figs. 14, 19; John, 1983, p. 178, pl. 75, figs. 1-4; Jensen, 1985, p. 889, fig. 844; Pankow, 1990, p. 289, pl. 73, fig. 3.

Dimensions: L: 18-70 μm . W: 6-15 μm . Str: (20)22-28/10 μm . Fibulae: 5.5-8/10 μm .

WM: Not observed.

WCA: VR in uppermost 30 cm.

Remarks: Foged (1981, p. 164): "Oligohalobe (indifferent). Alkaliphil. Cosmopolite."
Pankow (1990, p. 289): "Oligohalobous, meioeuryhaline [0-5‰]."

***Surirella brébissonii* Krammer and Lange-Bertalot in Lange-Bertalot and Krammer 1987**

(pl. 4, figs. 6, 7)

Syn: *Surirella ovata* sensu Hustedt 1930, figs. 863, 864.

Description: Krammer and Lange-Bertalot, 1987, figs. 1, 4, 5, 9, 21-33.

Krammer and Lange-Bertalot, 1987, p. 94, pl. 53, fig. 5; Krammer and Lange-Bertalot, 1988, p. 179, pl. 126, figs. 2-11; pl. 127, figs. 1-13.

(As *Surirella ovata*): Hustedt, 1930, p. 442, figs. 863, 864; Germain, 1981, p. 390, pl. 152, fig. 1-21; Hendey, 1951, p. 77, pl. 14, figs. 4-7; Hendey, 1964, p. 287, pl. XL, figs. 7-9; Riznyk, 1973, p. 133, pl. 16, fig. 7; Rao and Lewin, 1976, p. 209, fig. 352; Foged, 1981, p. 168, pl. 63, fig. 11; Jensen, 1985, p. 895, figs. 863, 864; Gasse, 1986, p. 173, pl. 40, fig. 7; Laws, 1988, p. 174, pl. 34, fig. 2.

Dimensions: L: 8-70 μm . W: 8-30 μm . Str: (16)17-19(20)/10 μm . Fibulae: 3.6-6/10 μm .

WM: VR at several marsh stations; F at WM-P (pond).

WCA: VR at 30 cm.

Description: Foged (1981, p. 168): "Oligohalobe (indifferent). Alkaliphil. Cosmopolite."
Brockmann (1950, p. 25): "Distributed in mixed waters, beach pools, silting up areas."

Surirella brébissonii is reported by Krammer and Lange-Bertalot (1987) as synonymous with "*S. ovata*" as figured by Hustedt (1830), and *S. brébissonii* var. *kuetzingii* as synonymous with "*S. ovata*" Kützing 1844 pro parte. The differences between these taxa are mainly based on size, with *S. brébissonii* var. *brébissonii* much larger (L: 60-70 μm ; W: 25-30 μm) than *S. brébissonii* var. *kuetzingii* (L: 8-36 μm ; W: 8-18 μm). Differences in striae number and style are difficult to discern in LM. For this study, *S. brébissonii* and *S. brébissonii* var. *kuetzingii* were not separated, but most specimens probably belong to the latter smaller variety. According to Krammer and Lange-Bertalot (1987, p. 86), var. *kuetzingii* can tolerate water with lower electrolyte content than the nominate variety, and both are also found in brackish water along sea coasts. Compared with *S. ovalis*, the striae of *S. brébissonii* appear to be more irregular, and the concentric undulations in the valve are not as distinct.

***Surirella spiralis* Kützing 1844**

Description: Krammer and Lange-Bertalot, 1988, p. 206, pl. 168, figs. 1-7.

Hustedt, 1930, p. 445, fig. 870; Germain, 1981, p. 392, pl. 153, figs. 1-2; Foged, 1981, p. 169; Jensen, 1985, p. 897, fig. 870.

Dimensions: L: 40-220 μm . W: 50-80 μm . Str: 25/10 μm . Keel fibulae: 1.5-3/10 μm .

WM: Not observed.

WCA: VR at 125 and 135 cm.

Remarks: Foged (1981, p. 169): "Oligohalobe (indifferent). Alkaliphil (?). Europe. N. America." Observed with large forms of *Stauroneis phoenicenteron* common.

Hustedt (in Jensen, 1985, p. 897): "Found especially in mountain waters, in springs, on wet rocks in drainage ditches, distributed and common in lakes, occurring isolated in the plains."

SYNEDRA Ehrenberg 1832

Synedra fasciculata (Agardh) Ehrenberg 1832.

Syn: *Diatoma fasciculatum* Agardh 1812; *Diatoma tabulatum* Agardh 1832; *Synedra tabulata* (Agardh) Kützing 1844; *Fragilaria fasciculata* (C. Agardh) Lange-Bertalot 1980.

Description: (As *Fragilaria fasciculata*): Krammer and Lange-Bertalot, 1991a, p. 150, pl. 135, figs. 1-18; pl. 124, fig. 3.

Patrick and Reimer, 1966, p. 141, pl. 5, figs. 17-18; John, 1983, p. 56, pl. 22, figs. 6-14.

(As *Synedra tabulata*): Hustedt, 1927-66, II, 218, figs. 710a-d; Foged, 1978, p. 132, pl. 9, fig. 5; Germain, 1981, p. 78, pl. 26, figs. 5-10; Jensen, 1985, p. 201, figs. 710a-d.

(As *Fragilaria tabulata*): Lange-Bertalot, 1980, p. 723; Laws, 1988, p. 162, pl. 16, fig. 13.

Dimensions: L: (12)20 to >400 μm . W: 2-8 μm . Str: 7.5-26/10 μm .

WM: VR at WM-B.

WCA: Not observed.

Remarks: A common diatom on tidal flats of the Pacific Northwest, and a dominant epiphyte on eelgrass (*Zostera*).

***Synedra ulna* (Nitzsch) Ehrenberg 1832**

Syn: *Bacillaria ulna* Nitzsch 1817; *Fragilaria ulna* (Nitzsch 1817) Lange-Bertalot 1980.

Description: Patrick and Reimer, 1966, p. 148, pl. 7, figs. 1-2.

Hustedt, 1927-66, II, p. 195, figs. 691A a-c; Schmidt's Atlas, pl. 301, figs. 1-26; Germain, 1981, p. 78, pl. 24, pl. 25; Foged, 1981, p. 171, pl. 5, figs. 12,13; John, 1983, p. 61, pl. 26, figs. 1-5; Jensen, 1985, p. 181, figs. 691A a-c; Hein, 1990, p. 102, pl. 52, figs. 1, 2.

(As *Fragilaria ulna*): Pankow, 1990, p. 147, pl. 29, figs. 11-14; Krammer and Lange-Bertalot, 1991a, p. 143, pls. 119-122.

Dimensions: L: (50)75-100(350) μm . W: 5-9 μm . Str: 9-11/10 μm .

WM: Not observed.

WCA: VR at 20 and 30 cm.

Remarks: The valve of this taxon is highly variable (John, 1983, p. 62).

TABELLARIA Ehrenberg 1840

Tabellaria fenestrata (Lyngbye) Kützing 1844

Syn: *Diatoma fenestratum* Lyngbye 1819.

Description: Krammer and Lange-Bertalot, 1991a, p. 106, pl. 105, figs. 1-4; pl. 107, fig. 8.

Hustedt, 1927-66, II, p. 26, fig. 554; Patrick and Reimer, 1966, p. 103, pl. 1, figs. 1-2; Foged, 1981, p. 172, pl. 4, fig. 4; Germain, 1981, p. 50, pl. 12, figs. 1-7; Foged, 1982, p. 87, pl. 2, figs. 2, 3, 4, 5; Jensen, 1985, p.24, fig. 554 Pankow, 1990, p. 132, pl. 26, figs. 1-2.

Dimensions: L: (25)33-116 (mostly 40-75) μm . W: 4-10 μm . Str: (14)17-22/10 μm .

WM: Not observed.

WCA: VR at 120 and 160 cm.

Remarks: Hustedt (in Jensen, 1985, p. 24): "Freshwater form; also sporadically living in brackish water. Commonly distributed throughout Europe in standing and slowly flowing waters." Patrick and Reimer (1966, p. 104): "Usually in shallow water, often attached to substrate."

TRACHYNEIS Cleve 1894

***Trachyneis aspera* (Ehrenberg) Cleve 1894**

Description: John, 1983, p. 138, pl. 53, figs. 1-3.

Hendey, 1964, p. 236, pl. 29, fig. 13; Foged, 1975, p. 56, pl. 24, figs 9-11; Foged, 1979, p. 112, pl. 38, fig. 1; Foged, 1978, p. 134, pl. 36, fig. 5; Riznyk, 1973, p. 135, pl. 17, figs. 1, 2; Tynni, 1986, pl. 25, fig. 152.

Dimensions: L: 67-130 μm . W: 15-23 μm . Str: 12-13/10 μm .

WM: Not observed.

WCA: VR in salt marsh peat at 110 cm.

Remarks: Hendey (1964, p. 236): "A littoral species, widely distributed around North Sea and North Atlantic coasts." Found on muddy tidal flats of coastal Washington (Hemphill-Haley, 1993).

TRYBLIONELLA W. Smith 1853

***Tryblionella debilis* (Hustedt) Mann in Round and others 1990**

Syn: *Nitzschia tryblionella* var. *debilis* (Arnott) Hustedt 1913; *Nitzschia debilis* (Arnott) Grunow in Cleve and Grunow 1880.

Description: Krammer and Lange-Bertalot, 1988, p. 39, pl. 27, figs. 9-11.

Pankow, 1990, p. 275, pl. 67, fig. 6.

(As *Nitzschia tryblionella* var. *debilis*): Hustedt, 1930, p. 400, fig. 759; Jensen, 1985, p. 852, fig. 759.

Dimensions: L: 13-26 μm . W: 7-10 μm . Keel fibulae: 8-10/10 μm .

WM: R to C in all marsh samples.

WCA: VR in numerous samples; C at the top of the core.

Remarks: Widely distributed in low and high brackish marshes in coastal Washington. According to Pankow (1990), can tolerate salinities of 5-35 ppm, but its occurrences at Winslow indicates that it can also tolerate salinities as low as 1-2 ppm.

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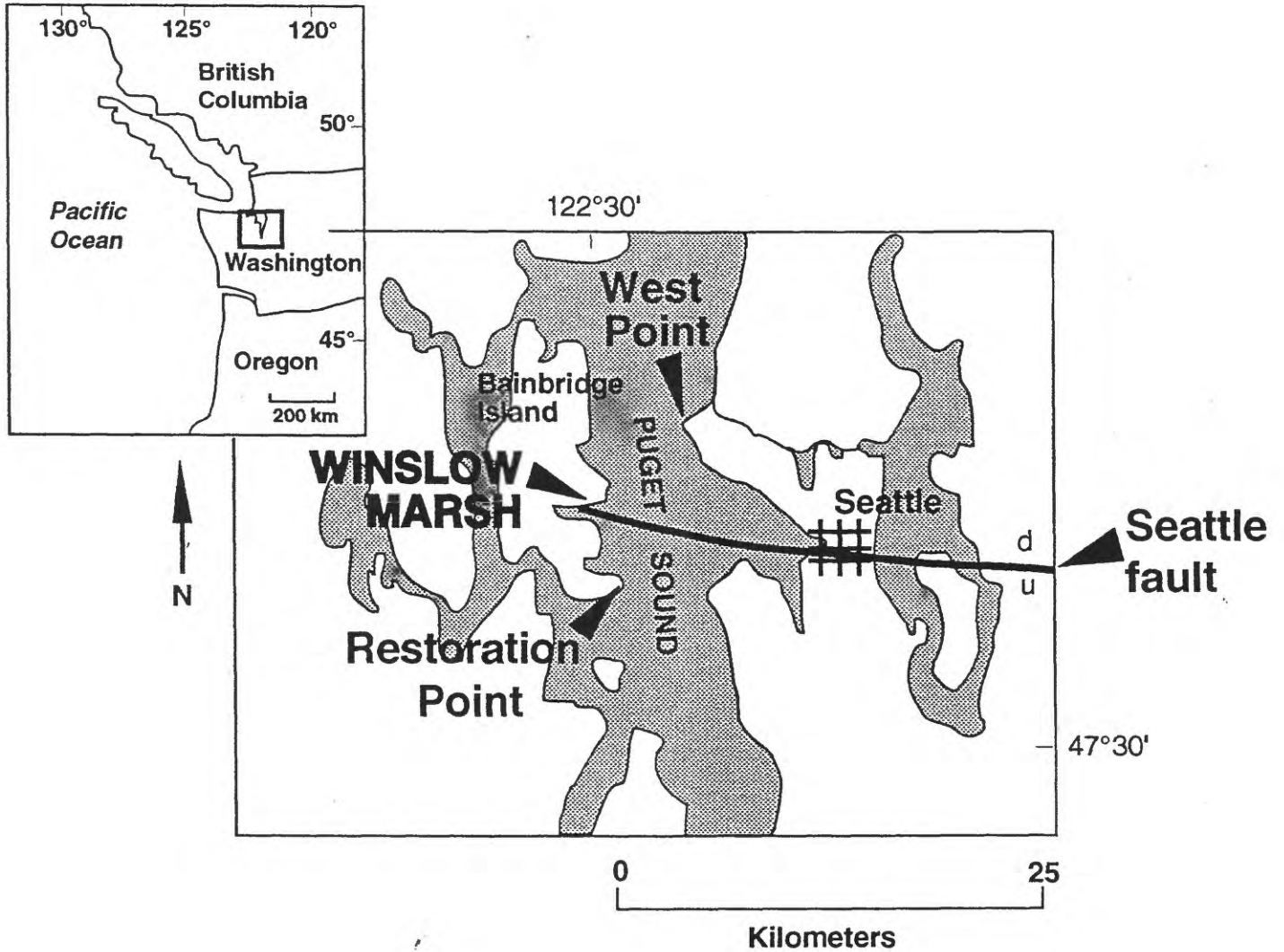


FIGURE 1. Location of Winslow Marsh, on Bainbridge Island in central Puget Sound, Washington. The Seattle fault is a shallow reverse fault trending E-W across Puget Sound; relative motion approximately 1000 yr B.P. was up to the south.

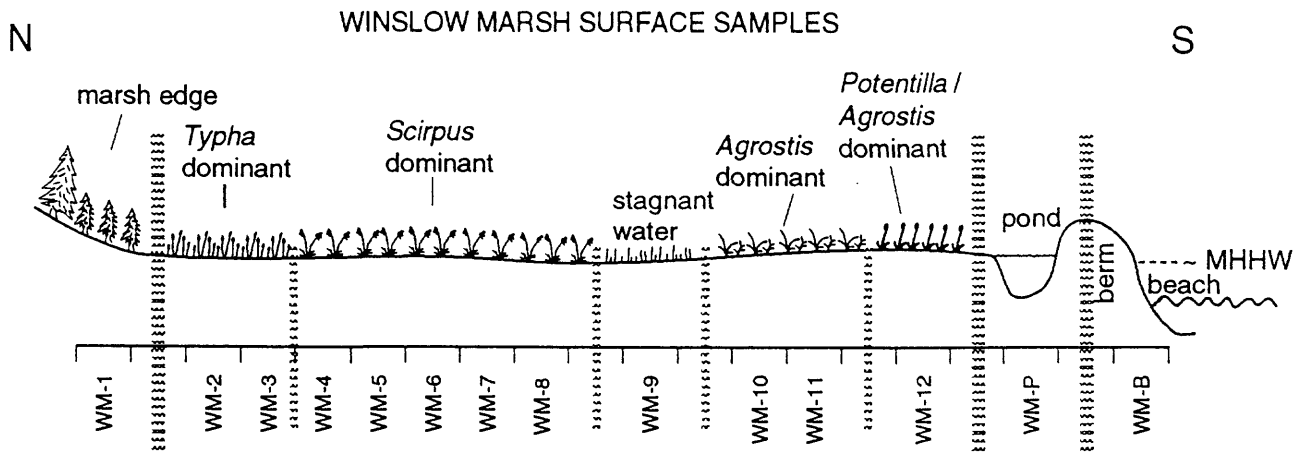


FIGURE 2. Schematic profile for a transect across Winslow Marsh, from the transition from the landward edge of the marsh at the north, to the sandy nearshore of Puget Sound at the south. A 0.55-m deep pond (station WM-P) is located on the leeward side of the berm about 30 m east of the transect line. MHHW = estimated mean higher high water.

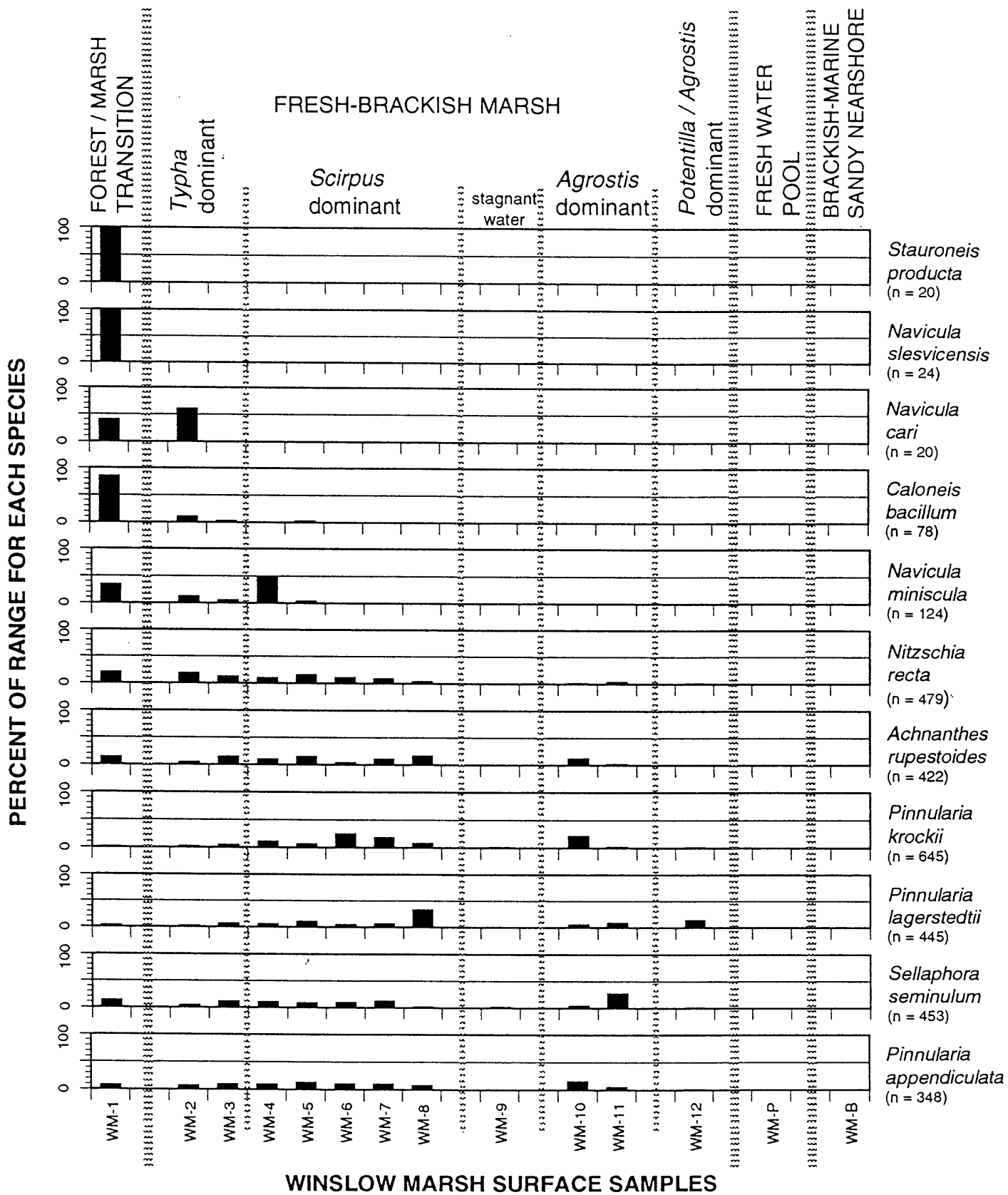
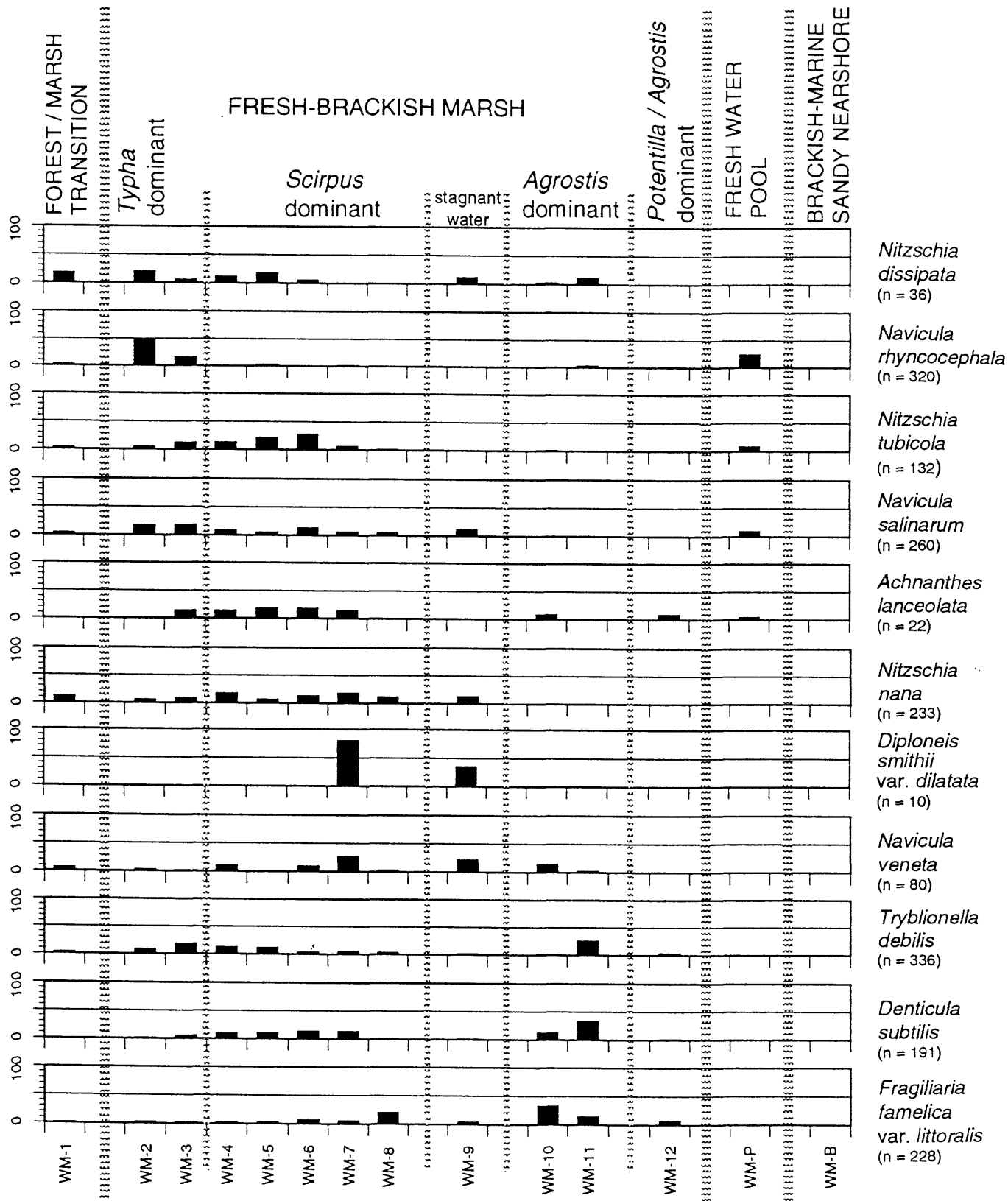


FIGURE 3a. Distribution of select taxa from surface samples at Winslow Marsh.

PERCENT OF RANGE FOR EACH SPECIES



WINSLOW MARSH SURFACE SAMPLES

FIGURE 3b. Distribution of select taxa from surface samples at Winslow Marsh.

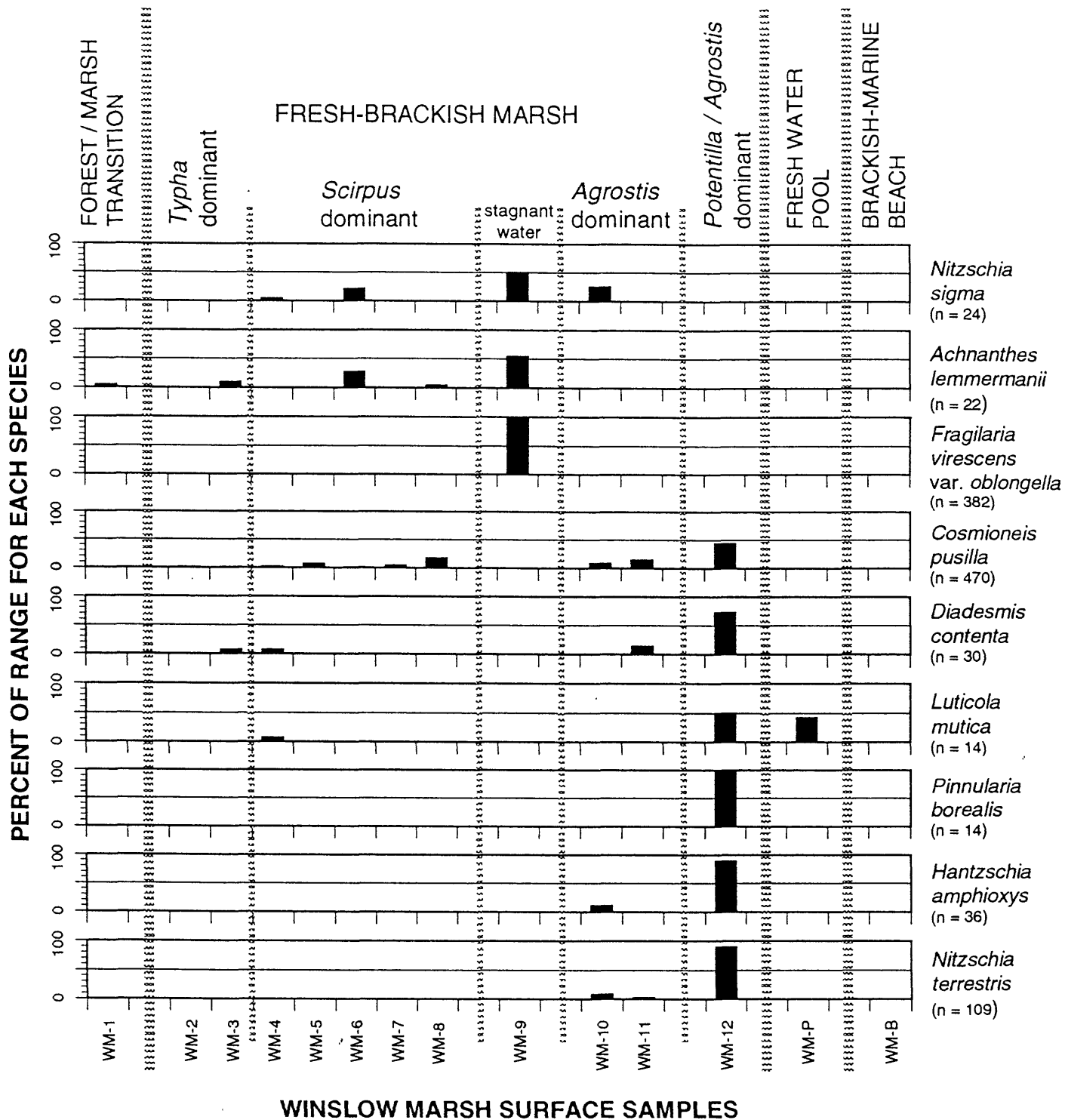


FIGURE 3c. Distribution of select taxa from surface samples at Winslow Marsh.

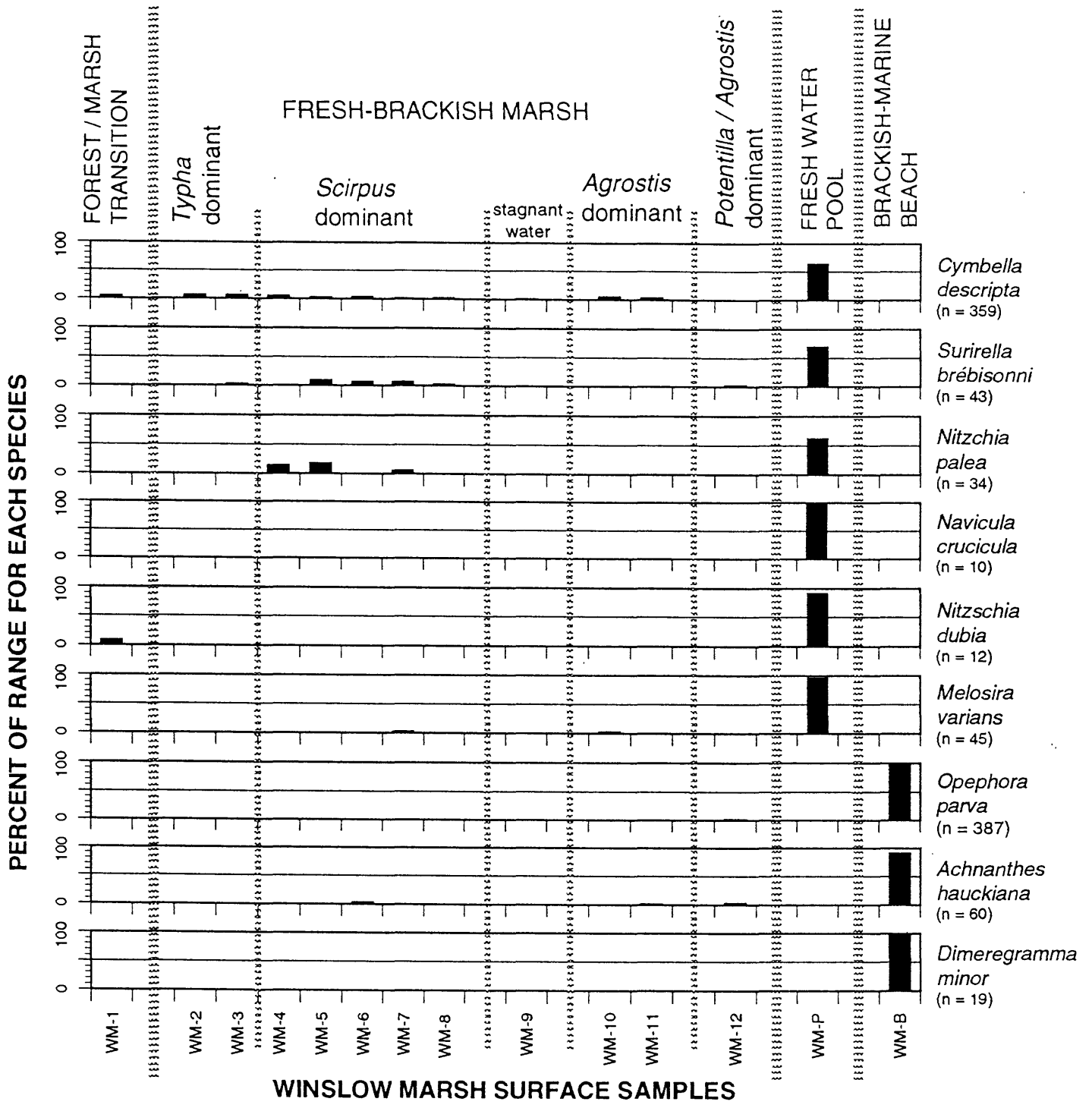


FIGURE 3d. Distribution of select taxa from surface samples at Winslow Marsh.

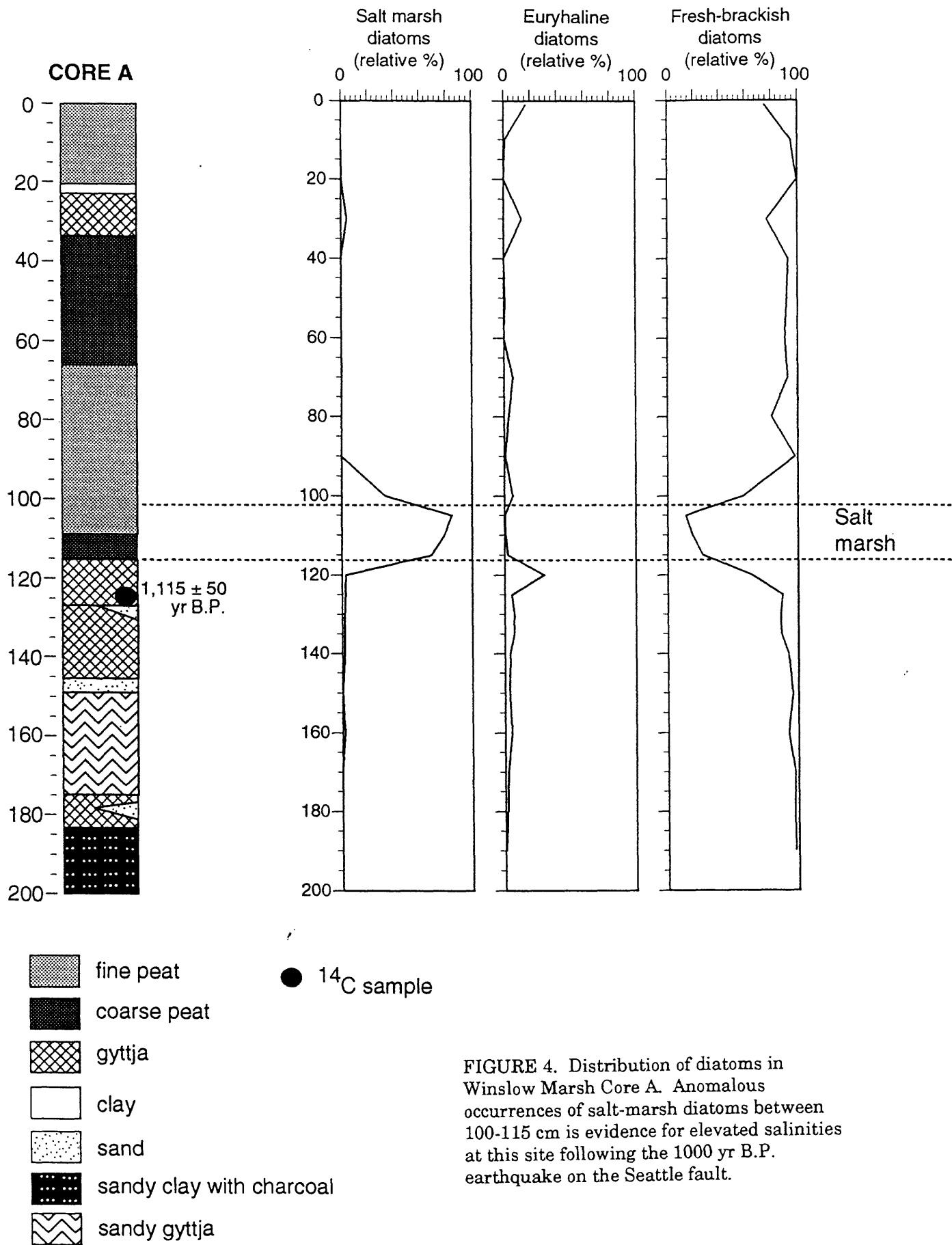


FIGURE 4. Distribution of diatoms in Winslow Marsh Core A. Anomalous occurrences of salt-marsh diatoms between 100-115 cm is evidence for elevated salinities at this site following the 1000 yr B.P. earthquake on the Seattle fault.

TABLE 1

Station	Site Description	Depth of Standing Water at Surface (cm)	Salinity of Surface Water (‰)
WM-1	Wet surface at base of blackberry bushes; landward edge of marsh	2	1.5
WM-2	Thick stands of <i>Typha latifolia</i> (cattail) and <i>Potentilla pacifica</i> (silverweed); dense root zone	2	2
WM-3	Thick stands of <i>T. latifolia</i> and <i>P. pacifica</i> ; dense root zone	2	1.5
WM-4	Transition from dominant <i>T. latifolia</i> with low stands of <i>P. pacifica</i> to dominant <i>Scirpus acutus</i> (bulrush) with low stands of <i>P. pacifica</i>	5	1.5
WM-5	Zone of dense <i>S. acutus</i> / <i>P. pacifica</i>	8	2.8
WM-6	Zone of dense <i>S. acutus</i> / <i>P. pacifica</i> .	10	1.5
WM-7	Transition to <i>S. acutus</i> / <i>P. pacifica</i> / <i>Agrostis</i> sp. zone	10	2.2
WM-8	Location for Core A; zone of low <i>Agrostis</i> with patches of <i>S. acutus</i> and <i>P. pacifica</i>	15	2.2
WM-9	Zone of dark stagnant water with strong H ₂ S odor; <i>Scirpus americanus</i> , <i>Triglochin maritima</i> (arrowgrass) <i>Agrostis</i> sp. in patches	15	2.2
WM-10	Zone of thick <i>Agrostis</i> sp., with 20% <i>P. pacifica</i> , 15% <i>S. acutus</i> , 15% tall <i>T. maritima</i>	5	2
WM-11	Moist surface, no standing water; dominant <i>Agrostis</i> sp. with 5% <i>T. maritima</i> and 20% <i>P. pacifica</i>	0	-
WM-12	Marsh surface on leeward side of gravel berm; soil moist but not wet; dominant <i>P. pacifica</i> and <i>Agrostis</i> sp.; thick plant debris	0	-
WM-B	Sandy nearshore sample collected just below water line during low tide at 12:55 p.m. on 7/13/93	5	25
WM-P	Periphytes scraped from log submerged in 0.55-m deep freshwater pond	55	0

TABLE 1. Description of surface-sampling stations along the Winslow Marsh transect.

Diatoms	Winslow Core A	surface samples
<i>Achnanthes brevipes v. angustata</i>	x	
<i>Achnanthes exigua</i>	x	
<i>Achnanthes haukiana</i>	x	x
<i>Achnanthes lanceolata</i>	x	x
<i>Achnanthes lemmermanii</i>	x	x
<i>Achnanthes rupestoides</i>	x	x
<i>Achnanthes spp.</i>	x	
<i>Amphora coffeaeformis</i>	x	x
<i>Amphora granulata</i>	x	
<i>Amphora libyca</i>	x	
<i>Amphora ventricosa</i>	x	
<i>Anomoneis brachysira</i>	x	
<i>Aulacoseira islandica</i>	x	
<i>Biremis ambigua</i>		x
<i>Caloneis amphisbaena</i>	x	x
<i>Caloneis bacillum</i>	x	x
<i>Caloneis permagna</i>	x	
<i>Caloneis westii</i>	x	
<i>Catenula adhaerens</i>		x
<i>Cavinula cocconeiformis</i>		x
<i>Cavinula variostrata</i>	x	
<i>Cocconeis placentula</i>	x	
<i>Cocconeis peltoides</i>		x
<i>Cocconeis scutellum</i>	x	
<i>Cocconeis scutellum v. parva</i>		x
<i>Cosmioneis pusilla</i>	x	x
<i>Craticula accomoda</i>	x	
<i>Craticula halophila</i>	x	
<i>Cyclotella spp.</i>	x	x
<i>Cymbella aspera</i>	x	
<i>Cymbella descripta</i>		x
<i>Cymbella incerta</i>	x	
<i>Cymbella minuta</i>	x	
<i>Cymbella silesiaca</i>	x	
<i>Denticula subtilis</i>	x	x
<i>Diadismis contenta</i>	x	x
<i>Dimeregramma minor</i>		x
<i>Diploneis boldtiana</i>	x	
<i>Diploneis elliptica</i>	x	
<i>Diploneis finnica</i>	x	
<i>Diploneis interrupta</i>	x	
<i>Diploneis ovalis</i>	x	x
<i>Diploneis pseudovalis</i>	x	

TABLE 2. Occurrences of diatom taxa in Core A and surface samples from Winslow Marsh.

Diatoms	Winslow Core A	surface samples
<i>Diploneis smithii</i>	x	
<i>Diploneis smithii v. dilatata</i>	x	x
<i>Diploneis stroemii</i>	x	
<i>Diploneis subovalis</i>	x	x
<i>Epithemia turgida</i>	x	
<i>Eunotia formica</i>	x	
<i>Eunotia minor</i>	x	
<i>Eunotia pectinalis</i>	x	x
<i>Eunotia praerupta v. bidens</i>	x	
<i>Eunotia spp.</i>	x	
<i>Fallacia cryptolyra</i>		x
<i>Fragilaria construens v. venter</i>	x	x
<i>Fragilaria famelica v. littoralis</i>	x	x
<i>Fragilaria parasitica</i>	x	
<i>Fragilaria pinnata</i>	x	
<i>Fragilaria virescens</i>	x	
<i>Fragilaria virescens v. oblongella</i>	x	x
<i>Frustulia cruezbergensis</i>		x
<i>Frustulia vulgaris</i>	x	x
<i>Gomphonema angustum</i>	x	x
<i>Gomphonema parvulum</i>	x	x
<i>Gomphonema truncatum</i>	x	x
<i>Gomphonemopsis pseudexigua</i>	x	x
<i>Gyrosigma acuminatum</i>	x	
<i>Hantzschia amphioxys</i>	x	x
<i>Hyalodiscus scoticus</i>	x	
<i>Luticola mutica</i>	x	x
<i>Melosira varians</i>	x	x
<i>Meridion circulare</i>	x	x
<i>Navicula angusta</i>	x	
<i>Navicula cari</i>	x	x
<i>Navicula cf. cryptotenella</i>	x	x
<i>Navicula cf. seminulum</i>	x	
<i>Navicula cincta</i>	x	
<i>Navicula costulata</i>	x	
<i>Navicula crucicula</i>	x	x
<i>Navicula cryptocephala</i>		x
<i>Navicula cryptotenella</i>	x	
<i>Navicula elegans</i>	x	x
<i>Navicula elginensis</i>	x	
<i>Navicula elginensis v. cuneata</i>	x	
<i>Navicula forcipata</i>		x
<i>Navicula lanceolata</i>		x

TABLE 2 (cont.). Diatom taxa in Core A and surface samples from Winslow Marsh.

Diatoms	Winslow Core A	surface samples
<i>Navicula libonensis</i>	x	
<i>Navicula miniscula</i>	x	x
<i>Navicula peregrina</i>	x	x
<i>Navicula phyllepta</i>	x	x
<i>Navicula radiosa</i>	x	
<i>Navicula rhyncocephala</i>	x	x
<i>Navicula salinarum</i>	x	x
<i>Navicula slesviscensis</i>	x	x
<i>Navicula tripunctata</i>	x	
<i>Navicula veneta</i>		x
<i>Neidium dubium</i>	x	
<i>Neidium hercynicum</i>	x	
<i>Nitzschia capitata</i>	x	
<i>Nitzschia commutata</i>	x	x
<i>Nitzschia dissipata</i>	x	x
<i>Nitzschia dubia</i>		x
<i>Nitzschia fasciculata</i>	x	
<i>Nitzschia hybrida</i>	x	x
<i>Nitzschia inconspicua</i>		x
<i>Nitzschia nana</i>	x	x
<i>Nitzschia palea</i>	x	x
<i>Nitzschia pellucida</i>	x	
<i>Nitzschia perminuta</i>	x	x
<i>Nitzschia recta</i>		x
<i>Nitzschia sigma</i>	x	x
<i>Nitzschia spp.</i>		x
<i>Nitzschia terrestris</i>	x	x
<i>Nitzschia tubicola</i>	x	x
<i>Nitzschia vitrea</i>	x	
<i>Odontella aurita</i>	x	x
<i>Opephora cf. marina</i>		x
<i>Opephora pacifica</i>	x	
<i>Opephora parva</i>		x
<i>Paralia sulcata (small form)</i>	x	x
<i>Pinnularia acrosphaeria</i>	x	
<i>Pinnularia appendiculata</i>	x	x
<i>Pinnularia borealis</i>	x	x
<i>Pinnularia gibba v. linearis</i>	x	
<i>Pinnularia ignobilis</i>	x	x
<i>Pinnularia krockii</i>	x	x
<i>Pinnularia lagerstedtii</i>	x	x
<i>Pinnularia microstauron</i>	x	
<i>Pinnularia obscura</i>	x	

TABLE 2 (cont.). Diatom taxa in Core A and surface samples from Winslow Marsh.

Diatoms	Winslow Core A	surface samples
<i>Pinnularia pulchra v. angusta</i>	x	
<i>Pinnularia streptoraphe</i>	x	
<i>Pinnularia viridis</i>	x	x
<i>Plagiogramma staurophorum</i>	x	x
<i>Rhaphoneis amphicerus</i>		x
<i>Rhoicosphenia abbreviata</i>	x	x
<i>Rhopalodia gibba</i>	x	
<i>Rhopalodia gibberula</i>	x	
<i>Rhopalodia operculata</i>	x	
<i>Sellaphora pupula</i>	x	
<i>Sellaphora seminulum</i>	x	
<i>Stauroneis kreigeri</i>	x	
<i>Stauroneis phoenicenteron</i>	x	x
<i>Stauroneis producta</i>	x	x
<i>Surirella amphioxys</i>	x	
<i>Surirella angusta</i>	x	
<i>Surirella brebissonii</i>	x	x
<i>Surirella spiralis</i>	x	
<i>Synedra fasciculata</i>		x
<i>Synedra ulna</i>	x	
<i>Tabellaria fenestrata</i>	x	
<i>Trachyneis aspera</i>	x	
<i>Tryblionella debilis</i>	x	x

TABLE 2 (cont.). Diatom taxa in Core A and surface samples from Winslow Marsh.

	<i>Achnanthes haukiana</i>	<i>Achnanthes lanceolata</i>	<i>Achnanthes lemmermannii</i>	<i>Achnanthes rupestris</i>	<i>Amphora coffaeiformis</i>	<i>Biremis ambigua</i>	<i>Caloneis amphibia</i>	<i>Caloneis bacillum</i>	<i>Catenula adhaerens</i>	<i>Cavinula cocconeiformis</i>	<i>Cocconeis peltoides</i>	<i>Cocconeis scutellum var. parva</i>	<i>Cosmineis pusilla</i>	<i>Cyclotella spp.</i>	<i>Cymbella descripta</i>	<i>Denticula subtilis</i>	<i>Diadesmis contenta</i>	<i>Dimeregramma minor</i>	<i>Diploneis ovalis</i>	<i>Diploneis subovalis</i>	<i>Eunotia pectinalis</i>
surface sample	DIATOM COUNTS -- RAW DATA																				
WM-1			1	58				66		4			2		16						
WM-2				20			2	8					5		21	1				2	
WM-3		2	2	60			2	2		2			3	1	21	9	2			1	
WM-4		2		38									8		18	17	2				
WM-5		2		60				2		2			31	2	8	21					
WM-6	2	2	6	14									5		10	26					
WM-7		2		44									18	1	3	25				4	4
WM-8			1	67									79		4	2					
WM-9			12	2									2		1	2					
WM-10		1		51						2		1	41	2	19	24					
WM-11	1			8		2				2			68		10	63	4				
WM-12	2	1											208			1	22				
WM-P		10													228						
WM-B	55				2	2			1		2							19			
total	60	22	22	422	2	4	4	78	1	12	2	1	470	6	359	191	30	19	3		4
surface sample	DIATOM COUNTS - RELATIVE PERCENTAGES																				
WM-1			0.2	11.2				12.7		0.8			0.4		3.1						
WM-2				3.9			0.4	1.6					1.0		4.1	0.2				0.4	
WM-3		0.4	0.4	11.5			0.4	0.4		0.4			0.6	0.2	4.0	1.7	0.4			0.2	
WM-4		0.4		7.4									1.6		3.5	3.3	0.4				
WM-5		0.4		12.0				0.4		0.4			6.2	0.4	1.6	4.2					
WM-6	0.4	0.4	1.1	2.7									1.0		1.9	5.0					
WM-7		0.4		8.4									3.5	0.2	0.6	4.8				0.8	0.8
WM-8			0.2	13.1									15.4		0.8	0.4					
WM-9			2.2	0.4									0.4		0.2	0.4					
WM-10		0.2		10.0						0.4		0.2	8.0	0.4	3.7	4.7					
WM-11	0.2			1.6		0.4				0.4			13.2		1.9	12.2	0.8				
WM-12	0.4	0.2											40.5			0.2	4.3				
WM-P		1.9													43.4						
WM-B	10.7				0.4	0.4			0.2		0.4							3.7			

TABLE 3. Diatom taxa in Winslow Marsh surface samples.

	<i>Fallacia cryptolyra</i>	<i>Fragilaria construens</i> v. <i>venter</i>	<i>Fragilaria famelica</i> var. <i>littoralis</i>	<i>Fragilaria virescens</i> v. <i>oblongella</i>	<i>Frustulia cruebergensis</i>	<i>Frustulia vulgaris</i>	<i>Gomphonema angustum</i>	<i>Gomphonema parvulum</i>	<i>Gomphonema truncatum</i>	<i>Gomphonemopsis pseudexigua</i>	<i>Hantzschia amphioxys</i>	<i>Luticola mutica</i>	<i>Melosira varians</i>	<i>Meridion circulare</i> var. <i>constricta</i>	<i>Navicula cari</i>	<i>Navicula</i> cf. <i>cryptocephala</i>	<i>Navicula craticula</i>	<i>Navicula cryptocephala</i>	<i>Navicula elegans</i>	<i>Navicula forcipata</i>	<i>Navicula lanceolata</i>
surface sample	DIATOM COUNTS -- RAW DATA																				
WM-1			2												8	2					
WM-2			5		2										12	2					
WM-3			4		2									2		3					
WM-4			4									1				4					
WM-5			6																		
WM-6			15		2									2							
WM-7			12			2	1						1								
WM-8			47																		
WM-9			10	382															4		
WM-10			76								4		1								
WM-11			32															2			
WM-12			15							1	32	7									
WM-P					4		2	2				6	43	2			5				2
WM-B	1	7																		1	
total	1	7	228	382	6	6	1	2	2	1	36	14	45	6	20	11	5	2	4	1	2
surface sample	DIATOM COUNTS - RELATIVE PERCENTAGES																				
WM-1			0.4												1.5	0.4					
WM-2			1.0		0.4										2.4	0.4					
WM-3			0.8		0.4									0.4		0.6					
WM-4			0.8									0.2				0.8					
WM-5			1.2																		
WM-6			2.9		0.4									0.4							
WM-7			2.3			0.4	0.2						0.2								
WM-8			9.2																		
WM-9			1.9	71.1															0.7		
WM-10			14.8								0.8		0.2								
WM-11			6.2														0.4				
WM-12			2.9							0.2	6.2	1.4									
WM-P					0.8		0.4	0.4				1.1	8.2	0.4			1.0				0.4
WM-B	0.2	1.4																		0.2	

TABLE 3 (cont.). Diatom taxa in Winslow Marsh surface samples.

	<i>Navicula miniscula</i>	<i>Navicula peregrina</i>	<i>Navicula phyllepta</i>	<i>Navicula rhyncocephala</i>	<i>Navicula salinarum</i>	<i>Navicula slesvicensis</i>	<i>Navicula veneta</i>	<i>Nitzschia cf. commutata</i>	<i>Nitzschia dissipata</i>	<i>Nitzschia dubia</i>	<i>Nitzschia hybrida</i>	<i>Nitzschia inconspicua</i>	<i>Nitzschia nana</i>	<i>Nitzschia palea</i>	<i>Nitzschia recta</i>	<i>Nitzschia sigma</i>	<i>Nitzschia spp.</i>	<i>Nitzschia terrestris</i>	<i>Nitzschia tubicola</i>	<i>Odontella aurita</i>	<i>Tryblionella debilis</i>
surface sample	DIATOM COUNTS -- RAW DATA																				
WM-1	42		6	7	10	24	5		6	1	93		25						5		10
WM-2	14			158	44		2		7		83		12		2		6		6		28
WM-3	6			49	47		1	2	2		56		18						16		60
WM-4	58			2	22		9		4		44		39	5	1	1			17		40
WM-5	4	2		10	14				6		74		13	6					28		38
WM-6			2		33		8		2		49		29		4	5			36		12
WM-7				4	17		21				42		41	2	5				8		18
WM-8					15		2				18		26		2				2		12
WM-9				2	30		18		4				30			12					8
WM-10							12		1		2					6	8	9	2		8
WM-11				8	2		2		4		14						3	2.5			88
WM-12				3							4							97			14
WM-P		9		77	26			2		11				21			13		12		
WM-B												1					8			2	
total	124	11	8	320	260	24	80	4	36	12	479	1	233	34	14	24	38	109	132	2	336
surface sample	DIATOM COUNTS - RELATIVE PERCENTAGES																				
WM-1	8.1		1.2	1.4	1.9	4.6	1.0		1.2	0.2	18.0		4.8						1.0		1.9
WM-2	2.7			31.0	8.6		0.4		1.4		16.3		2.4		0.4		1.2		1.2		5.5
WM-3	1.2			9.4	9.0		0.2	0.4	0.4		10.8		3.5						3.1		11.5
WM-4	11.4			0.4	4.3		1.8		0.8		8.6		7.6	1.0	0.2	0.2			3.3		7.8
WM-5	0.8	0.4		2.0	2.8				1.2		14.8		2.6	1.2					5.6		7.6
WM-6			0.4		6.3		1.5		0.4		9.4		5.5		0.8	1.0			6.9		2.3
WM-7				0.8	3.3		4.0				8.1		7.9	0.4	1.0				1.5		3.5
WM-8					2.9		0.4				3.5		5.1		0.4				0.4		2.3
WM-9				0.4	5.6		3.4		0.7				5.6			2.2					1.5
WM-10							2.3		0.2		0.4					1.2	1.6	1.8	0.4		1.6
WM-11				1.6	0.4		0.4		0.8		2.7						0.6	0.5			17.1
WM-12				0.6							0.8							18.9			2.7
WM-P		1.7		14.7	5.0			0.4		2.1				4.0			2.5		2.3		
WM-B												0.2					1.6			0.4	

TABLE 3 (cont.). Diatom taxa in Winslow Marsh surface samples.

	<i>Opephora marina</i>	<i>Opephora parva</i>	<i>Paralia sulcata</i>	<i>Pinnularia appendiculata</i>	<i>Pinnularia borealis</i>	<i>Pinnularia ignobilis</i>	<i>Pinnularia kroekii</i>	<i>Pinnularia lagerstedtii</i>	<i>Pinnularia viridis</i>	<i>Plagiogramma staurorhorum</i>	<i>Rhaphoneis amphicerus</i>	<i>Rhicosphenia abbreviata</i>	<i>Stauroneis phoenicenteron</i>	<i>Stauroneis producta</i>	<i>Surirella brebissonii</i>	<i>Synedra fasciculata</i>	unidentified	total
surface sample	DIATOM COUNTS - RAW DATA																	
WM-1				58		28	6	12						20			1	518
WM-2				16		25	15	9									1	510
WM-3				47		34	29	29							1		5	520
WM-4				45		34	65	25									6	511
WM-5				38		46	41	46							4		1	501
WM-6				39		37	158	20							3		2	523
WM-7				54		35	115	28	4						3		8	521
WM-8				6		28	51	148							1		2	513
WM-9				8		2	8											537
WM-10				19		55	138	26									4	512
WM-11			1	122		19	10	40									8	516
WM-12		5	1	1	14	5	9	62							1		10	514
WM-P												8	2		30		10	525
WM-B	10	382	3							6	2					4	8	514
total	10	387	5	453	14	348	645	445	4	6	2	8	2	20	43	4	66	7235
surface sample	DIATOM COUNTS - RELATIVE PERCENTAGES																	
WM-1				11.2		5.4	1.2	2.3						3.9			0.2	100.0
WM-2				3.1		4.9	2.9	1.8									0.2	100.0
WM-3				9.0		6.5	5.6	5.6							0.2		1.0	100.0
WM-4				8.8		6.7	12.7	4.9									1.2	100.0
WM-5				7.6		9.2	8.2	9.2							0.8		0.2	100.0
WM-6				7.5		7.1	30.2	3.8							0.6		0.4	100.0
WM-7				10.4		6.7	22.1	5.4	0.8						0.6		1.5	100.0
WM-8				1.2		5.5	9.9	28.8							0.2		0.4	100.0
WM-9				1.5		0.4	1.5											100.0
WM-10				3.7		10.7	27.0	5.1									0.8	100.0
WM-11			0.2	23.6		3.7	1.9	7.8									1.6	100.0
WM-12		1.0	0.2	0.2	2.7	1.0	1.8	12.1									1.9	100.0
WM-P												1.5	0.4		5.7		1.9	100.0
WM-B	1.9	74.3	0.6							1.2	0.4					0.8	1.6	100.0

TABLE 3 (cont.). Diatom taxa in Winslow Marsh surface samples.

depth in core (cm)	DIATOM COUNTS - RAW DATA													total																
	<i>Achnanthes brevipus</i> v. <i>intermedia</i>	<i>Achnanthes exigua</i>	<i>Achnanthes haukiana</i>	<i>Achnanthes lanceolata</i>	<i>Achnanthes lemmermannii</i>	<i>Achnanthes rupestrides</i>	<i>Achnanthes</i> spp.	<i>Amphora coffeaeformis</i>	<i>Amphora granulata</i>	<i>Amphora libyca</i>	<i>Amphora ventricosa</i>	<i>Anomoneis brachysira</i>	<i>Aulacoseira islandica</i>		<i>Caloneis amphibiae</i>	<i>Caloneis bacillum</i>	<i>Caloneis permagna</i>	<i>Caloneis westii</i>	<i>Cocconeis placentula</i>	<i>Cocconeis scutellum</i>	<i>Cosmoneis pusilla</i>	<i>Craticula aecomoda</i>	<i>Craticula halophila</i>	<i>Cyclotella</i> sp.	<i>Cymbella aspera</i>	<i>Cymbella incerta</i>	<i>Cymbella minuta</i>	<i>Cymbella silesiaca</i>	<i>Denticula subtilis</i>	
1						30	16							1						6		18							24	
10						71	2												1	8		4								
20															1															
30															1				3	1										
40						67				1			12		2										7					
50						12						106			1										7					
60												107																		
70						1						72																		
80						7						64			2															
90						14									1															
100															1															
105															3															
110															5															
115															3															
120															2															
125															7															
130															8															
135															1															
140															3															
150															6															
160															8															
170															4															
180															5															
190															3															
total	1	15	5	939	6	220	21	23	1	53	1	390	1	32	2	2	13	4	55	5	28	8	13	3	13	12	12	24		

TABLE 4 (cont.). Diatom taxa in Core A from Winslow Marsh.

depth in core (cm)	DIATOM COUNTS - RELATIVE PERCENTAGES																													
	<i>Achnanthes brevipus v. intermedia</i>	<i>Achnanthes exigua</i>	<i>Achnanthes haukiana</i>	<i>Achnanthes lanceolata</i>	<i>Achnanthes lemmermannii</i>	<i>Achnanthes rupestrides</i>	<i>Achnanthes</i> spp.	<i>Amphora coffeaeformis</i>	<i>Amphora granulata</i>	<i>Amphora libyca</i>	<i>Amphora ventricosa</i>	<i>Anomoneis brachysira</i>	<i>Aulacoseira islandica</i>	<i>Caloneis amphibaena</i>	<i>Caloneis bacillum</i>	<i>Caloneis permagna</i>	<i>Caloneis westii</i>	<i>Cocconeis placentula</i>	<i>Cocconeis scutellum</i>	<i>Cosmoneis pusilla</i>	<i>Craticula accomoda</i>	<i>Craticula halophila</i>	<i>Cyclotella</i> sp.	<i>Cymbella aspera</i>	<i>Cymbella incerta</i>	<i>Cymbella minuta</i>	<i>Cymbella silesiaca</i>	<i>Denticula subtilis</i>		
1				2.3		7.0	3.7							0.2						1.4			4.2						5.6	
10				21.8		16.4	0.5												0.2	1.9			0.9							
20				0.1	0.7										0.1										0.4					
30				11.2				2.4	0.2		0.2				0.2				0.7	0.2			0.5	1.7						
40				22.9		16.3						2.9			0.5									1.7						
50				14.4		3.0				0.7		26.4			0.2															
60												26.6																		
70				1.2		0.2						16.7																		
80				4.2		1.7				1.0		15.7			0.5													0.5	0.7	
90				14.4		4.6									0.3													1.3	1.3	
100															0.3															
105								1.6							0.9															
110								1.6									0.6													
115								0.9		0.6																				
120				2.9					2.3																					
125	0.3			22.3					1.0						2.6															
130				17.0			0.3		1.3			2.6			0.3															
135				19.0			0.3		1.6			1.3			1.9															
140		0.7	0.7	20.0					2.3						1.0															
150				12.7		1.9																								
160		0.3		25.5		1.6	0.3					1.0			0.6															
170				31.6		0.6						1.3																0.3		
180		0.6		27.3		1.0												1.6										0.6		
190				5.5					1.0																					

TABLE 4 (cont.). Diatom taxa in Core A from Winslow Marsh.

depth in core (cm)	DIATOM COUNTS - RAW DATA																											
	<i>Diaesmis contenta</i>	<i>Diploneis boldiana</i>	<i>Diploneis elliptica</i>	<i>Diploneis finica</i>	<i>Diploneis interrupta</i>	<i>Diploneis ovalis</i>	<i>Diploneis pseudovalis</i>	<i>Diploneis smithii</i>	<i>Diploneis smithii v. dilatata</i>	<i>Diploneis stroemii</i>	<i>Diploneis subovalis</i>	<i>Epithemia turghida</i>	<i>Bunotia formica</i>	<i>Bunotia pectinalis</i>	<i>Bunotia pectinalis v. minor</i>	<i>Bunotia praerupta v. bidens</i>	<i>Bunotia spp.</i>	<i>Fragilaria constriens v. venter</i>	<i>Fragilaria famelica v. littoralis</i>	<i>Fragilaria parasitica</i>	<i>Fragilaria pinnata</i>	<i>Fragilaria virescens</i>	<i>Fragilaria virescens v. oblongella</i>	<i>Frustulia vulgaris</i>	<i>Gomphonema angustum</i>	<i>Gomphonema parvulum</i>	<i>Gomphonema truncatum</i>	
1																			48									
10		1						1										86			2					3	67	
20								1																850			8	1
30						4																	1	115			19	1
40		5	1									1			20	2	2							2	4	7	33	
50		1	5			3								3	31	2					3			14	1	22	26	
60													235	3	31								2					
70		2										1			1									282		1	2	
80	11	2	10	28		23		2						34						6			2	4	1	2	20	
90	1	4									8			3	5								1	15	2	8	30	
100		1			12																		48	7			5	
105					233																		1	38			1	
110		1			211					17													5	49				
115		1			202			9																89				
120		24				3		63							2								6	60			3	
125		23				10		4							5								26	6	1		19	
130	3	10			1		1	8							14								42	10	2		13	
135	1	16			1	7		6							6								32	2	1		27	
140	3	4			3	4		2			4				5								15	4			18	
150					1	7		2			2				37								26				4	
160	3	2			2	6		2			3				11								29			4	14	
170	1					5		1			2				8	1							39			1	15	
180	4	4				4		1			4				12								10	3		10	26	1
190	3					2					1				6	67	6	1					125			7	27	
total	36	101	10	32	665	78	11	7	102	18	24	3	235	22	289	11	3	16	134	9	2	2	410	1550	14	74	392	3

TABLE 4 (cont.). Diatom taxa in Core A from Winslow Marsh.

depth in core (cm)	DIATOM COUNTS - RELATIVE PERCENTAGES																											
	<i>Diadsmis contenta</i>	<i>Diploneis boldiana</i>	<i>Diploneis elliptica</i>	<i>Diploneis finnica</i>	<i>Diploneis interrupta</i>	<i>Diploneis ovalis</i>	<i>Diploneis pseudovalis</i>	<i>Diploneis smithii</i>	<i>Diploneis smithii v. dilatata</i>	<i>Diploneis stroemii</i>	<i>Diploneis subovalis</i>	<i>Epithemia turgida</i>	<i>Bunotia formica</i>	<i>Bunotia pectinalis</i>	<i>Bunotia pectinalis v. minor</i>	<i>Bunotia praerupta v. bidens</i>	<i>Bunotia spp.</i>	<i>Ragilaria constuens v. venter</i>	<i>Ragilaria famelica v. littoralis</i>	<i>Ragilaria parasitica</i>	<i>Ragilaria pinnata</i>	<i>Ragilaria virescens</i>	<i>Ragilaria virescens v. oblongella</i>	<i>Frustulia vulgaris</i>	<i>Gomphonema angustum</i>	<i>Gomphonema parvulum</i>	<i>Gomphonema truncatum</i>	
1																												
10		0.2						0.2											11.2			0.5				0.7	15.5	
20								0.1											19.9					95.4			0.9	0.1
30						1.0																		27.5			4.5	0.2
40		1.2	0.2			0.7						0.2			4.9	0.5	0.5			0.7			0.5	0.5	1.0	1.7	8.0	
50		0.2	1.2									0.2			7.7	0.5						0.5	3.5	0.2	5.5	6.5		
60													58.3		7.7												2.5	
70			0.5											0.2									65.3			0.2	0.5	
80		2.7	0.5	2.5	6.9	5.6									8.3				1.5				0.5	1.0	0.2	0.5	4.9	
90		0.3	1.3								2.6				1.0	1.6							0.3	4.9	0.7	2.6	9.9	
100			0.8		9.4		1.6											9.4					37.5	5.5			3.9	
105					75.6		2.3			0.3													0.3	12.3			0.3	
110			0.3		66.4					5.3													1.6	15.4				
115			0.3		60.8		0.3	0.3	2.7															26.8				
120			7.8			1.0																						
125			7.4			3.2			20.5						0.7								2.0	19.5			1.0	
130		1.0	3.3						1.3						1.6								8.4	1.9	0.3		6.1	
135		0.3	5.2				0.3		2.6						4.6								13.7	3.3	0.7		4.2	
140		1.0	1.3			2.3			1.9						1.9								10.3	0.6	0.3		8.7	
150						2.2			0.6						2.0	1.7							5.0	1.3		3.0	6.0	
160		1.0	0.6		0.6	1.9			0.6						11.5			0.6					8.1			1.2	4.3	
170		0.3				1.6			1.0						3.5			0.6					9.4			2.9		
180		1.3	1.3			1.3			0.3						2.6	0.3							12.6		0.6	0.3	4.8	
190		1.0				0.6			0.3					1.3	3.9								3.2	1.0		3.2	8.4	0.3
											0.3			1.9	21.7	1.9	0.3						40.5			2.3	8.7	

TABLE 4 (cont.). Diatom taxa in Core A from Winslow Marsh.

depth in core (cm)	DIATOM COUNTS - RAW DATA																																					
	<i>Comphonemopsis pseudexigua</i>	<i>Cyrosigma acuminatum</i>	<i>Hantzschia amphioxys</i>	<i>Hyalodiscus scoticus</i>	<i>Luticola mutica</i>	<i>Melosira varians</i>	<i>Meridion circulare</i>	<i>Navicula angusta</i>	<i>Navicula capitata</i>	<i>Navicula cari</i>	<i>Navicula cf. cryptotenella</i>	<i>Navicula cf. seminumum</i>	<i>Navicula cincta</i>	<i>Navicula costulata</i>	<i>Navicula cruciata</i>	<i>Navicula cryptotenella</i>	<i>Navicula elegans</i>	<i>Navicula elgimensis</i>	<i>Navicula elgimensis v. cuneata</i>	<i>Navicula libonensis</i>	<i>Navicula miniscula</i>	<i>Navicula peregrina</i>	<i>Navicula phyllepta</i>	<i>Navicula radiosa</i>	<i>Navicula rhyncocephala</i>	<i>Navicula salinarum</i>	<i>Navicula slesviscensis</i>	<i>Navicula spp</i>										
1																																						
10	1										1														2													
20				1																		1	2		47													
30						30	26										1					1	3		7													
40									4	8			23				1		3		5				14	3												
50			2							3		15								7	1			1	15													
60																								2	2													
70															1	22						2			1	17												
80			2				1		2	1		20						7	12	1				1	12								1					
90							2	1	8			30							4	3	1				18									2				
100					2		3																	1											2			
105																																						
110						1		1																														
115																																						
120		4						7				4						6								43												1
125			3		4		1	8				4						4				3			4												24	
130					3		2	1	8			4						5				2			16												13	
135			4		5		2	11				3						2				1			11												12	
140							3	2					13												22													6
150			21		2		1		4			7							5	2					25												7	
160			2		4			2	1			21						4	2	5				41													3	
170		1						1				1	19					1	1	1				61													1	
180										1		42							2	2				20														2
190												2							7																			2
total	1	5	35	1	22	50	49	41	4	16	13	18	4	207	1	1	23	29	36	26	7	41	5	6	396	3	73	5								5		

TABLE 4 (cont.). Diatom taxa in Core A from Winslow Marsh.

depth in core (cm)	DIATOM COUNTS - RELATIVE PERCENTAGES																														
	<i>Comphonemopsis pseudexigua</i>	<i>Gyrosigma acuminatum</i>	<i>Hantzschia amphioxys</i>	<i>Hyalodiscus scoticus</i>	<i>Luticola mutica</i>	<i>Melosira varians</i>	<i>Meridion circulare</i>	<i>Navicula angusta</i>	<i>Navicula capitata</i>	<i>Navicula cari</i>	<i>Navicula cf. cryptotenella</i>	<i>Navicula cf. seminum</i>	<i>Navicula cincta</i>	<i>Navicula costulata</i>	<i>Navicula cruciata</i>	<i>Navicula cryptotenella</i>	<i>Navicula elegans</i>	<i>Navicula elginensis</i>	<i>Navicula elginensis v. cuneata</i>	<i>Navicula libonensis</i>	<i>Navicula miniscula</i>	<i>Navicula peregrina</i>	<i>Navicula phyllepta</i>	<i>Navicula radiosa</i>	<i>Navicula rhyncocephala</i>	<i>Navicula salinarum</i>	<i>Navicula slesviscensis</i>	<i>Navicula spp</i>			
1																															
10	0.2															0.2									0.5						
20				0.1																			0.1	0.2	10.9						
30						7.2	6.2										0.2						0.2	0.7	3.3	0.7					
40			0.5							1.0	2.0			5.6					0.7		1.7	0.2			0.2	3.7					
50											0.7		3.7											0.2	4.5						
60																								0.5	0.5						
70			0.5											4.9	0.2		5.1				0.2	0.5			0.2	3.9					
80							0.2																								
90							0.7	0.3		0.7	0.3	2.6		9.9					1.3	1.0	0.3				5.9	2.9					
100																										0.8					
105																							2.9								
110																							0.3								0.6
115																							4.5								
120														1.3									2.0			14.0					0.6
125			1.0			4.6								1.3									1.0			1.3					0.3
130						0.3	2.6							1.3									0.7			5.2					7.8
135			1.3			0.7	0.3	2.6						1.3									0.3			5.2					4.2
140						0.6	3.5							1.0	1.0								0.3			3.5					3.9
150						1.0	0.7							4.3												7.3					2.0
160			6.5			0.3								2.2												7.8					2.2
170			0.6			0.6	0.3							6.8												13.2					1.0
180						1.0	1.9							6.1												19.7					0.3
190			0.3			1.3								13.5												6.4					0.6
														0.6																	0.6

TABLE 4 (cont.). Diatom taxa in Core A from Winslow Marsh.

depth in core (cm)	DIATOM COUNTS - RAW DATA														total														
	<i>Navicula tripunctata</i>	<i>Navicula variostrata</i>	<i>Neidium dubium</i>	<i>Neidium hercynicum</i>	<i>Neidium commutata</i>	<i>Nitzschia dissipata</i>	<i>Nitzschia fasciculata</i>	<i>Nitzschia hybrida</i>	<i>Nitzschia nana</i>	<i>Nitzschia palea</i>	<i>Nitzschia pellucida</i>	<i>Nitzschia permunita</i>	<i>Nitzschia sigma</i>	<i>Nitzschia spp.</i>		<i>Nitzschia terrestris</i>	<i>Nitzschia tubicola</i>	<i>Nitzschia vitrea</i>	<i>Odontella aurita</i>	<i>Opephora pacifica</i>	<i>Paralia sulcata (small form)</i>	<i>Pinnularia acrosphaeria</i>	<i>Pinnularia appendiculata</i>	<i>Pinnularia borealis</i>	<i>Pinnularia gibba linearis</i>	<i>Pinnularia ignobilis</i>	<i>Pinnularia kroekii</i>	<i>Pinnularia lagerstedtii</i>	<i>Pinnularia microstauron</i>
1							5			18	2					53							2			21	51	39	
10																2										11		6	
20																												2	
30											38					3												1	
40								3		2				2	4	6						12				1	2		
50													2	2	5	1						3							
60																1													
70																1													
80											1			4	10	2					1							2	
90											3			0.5	3													7	
100											2			2	1												9	6	
105											1			2	1													2	
110														2														2	
115																					1								
120														5														1	
125											2			1	7						1							7	8
130											4			5	4													5	2
135											4			6	4						2							9	10
140											6			2	3							1						7	
150											13				5													1	
160															1							3						5	1
170											3											1						1	
180														1														4	2
190																3												1	1
total	14	22	7	2	1	1	4	10	3	2	20	85	4	30.5	45	79	17	1	1	13	5	28	8	39	36	62	108	24	

TABLE 4 (cont.). Diatom taxa in Core A from Winslow Marsh.

depth in core (cm)	DIATOM COUNTS - RELATIVE PERCENTAGES																														
	<i>Navicula tripunctata</i>	<i>Navicula varicostriata</i>	<i>Neidium dubium</i>	<i>Neidium hercynicum</i>	<i>Nitzschia commutata</i>	<i>Nitzschia dissipata</i>	<i>Nitzschia fasciculata</i>	<i>Nitzschia hybrida</i>	<i>Nitzschia nana</i>	<i>Nitzschia polea</i>	<i>Nitzschia pelliculata</i>	<i>Nitzschia perminuta</i>	<i>Nitzschia sigma</i>	<i>Nitzschia spp.</i>	<i>Nitzschia terrestris</i>	<i>Nitzschia tubicola</i>	<i>Nitzschia vitrea</i>	<i>Odontella aurita</i>	<i>Opephora pacifica</i>	<i>Paralia sulcata (small form)</i>	<i>Pinnularia acrosphaeria</i>	<i>Pinnularia appendiculata</i>	<i>Pinnularia borealis</i>	<i>Pinnularia gibba linearis</i>	<i>Pinnularia ignobilis</i>	<i>Pinnularia kroekii</i>	<i>Pinnularia lagerskeldtii</i>	<i>Pinnularia microstauron</i>			
1							1.2				4.2	0.5				12.4							0.5			4.9	11.9	9.1			
10												0.5				0.5									2.5				1.4		
20																													0.2		
30												9.1				0.7													0.2		
40											0.5			0.5	1.0	1.5						2.9				0.2	0.5				
50													0.5	1.2	0.2							0.7									
60																0.2															
70																															
80													0.2	1.0	2.5	0.5					0.2								0.5		
90														0.2		1.0						2.6				1.0			2.3		
100															0.8												7.0	4.7			
105															0.3						0.3								0.6		
110														0.6	0.6						1.9								0.6		
115																				0.3											
120														1.7															0.3		
125													0.7	0.3	2.3						0.3							2.3	2.6		
130													2.0	1.6	1.3													1.6	0.7		
135													1.3	1.9	1.3						0.6							2.9	3.2		
140													2.0	0.7	1.0													2.3			
150													4.0		1.6													0.3	0.3		
160															0.3	1.6												1.0	1.6	0.3	
170																												0.3	0.3		
180																													1.3	0.6	
190														0.3		1.0													0.3	0.3	

TABLE 4 (cont.). Diatom taxa in Core A from Winslow Marsh.

depth in core (cm)	DIATOM COUNTS - RAW DATA																total							
	<i>Pinnularia obscura</i>	<i>Pinnularia pulchra angusta</i>	<i>Pinnularia streptoraphe</i>	<i>Pinnularia viridis</i>	<i>Plagiogramma staurorhorum</i>	<i>Rhicosphenia abbreviata</i>	<i>Rhopalodia gibba</i>	<i>Rhopalodia gibberula</i>	<i>Rhopalodia operculata</i>	<i>Sellaphora pupula</i>	<i>Sellaphora seminulum</i>	<i>Stauroneis kreiigeri</i>	<i>Stauroneis phoenicenteron</i>	<i>Stauroneis producta</i>	<i>Stauroneis amphioxys</i>	<i>Stauroneis angusta</i>		<i>Stauroneis brebissonii</i>	<i>Surrella spiralis</i>	<i>Synedra ulna</i>	<i>Tabellaria fenestrata</i>	<i>Trachyneis aspera</i>	<i>Tryblionella debilis</i>	total
1								2								1							60	427
10				4											1								4	432
20																			6					891
30						44	2	6							1	1	2		4				4	418
40				14				7	2							1							2	410
50	4			6				1	4														2	402
60				5				2																403
70				3				7																432
80	3			3					6	4	8												1	408
90	4	1	2	12		1			8	1	14	2												304.5
100												1												128
105								2																308
110				1	1			2														1		318
115																								332
120				4	1																			307
125	1			3				9															4	309
130		1	8					8	2	9	5	3			2		1						2	309
135				3				8		4	8				1								2	306
140	8			4				7		9	9	3			4								2	310
150	5							4		9	15												4	300
150	5							1		54	11												3	322
160	6			2				2	1	10	3	1	1										3	310
170				2				3	4		5	1											4	310
180	5	1		2					5	1	7	6											2	311
190	2			3							8	1												309
total	38	3	16	71	2	45	3	65	32	101	115	22	4	11	3	2	2	10	4	1		97	8708	
																								232

TABLE 4 (cont.). Diatom taxa in Core A from Winslow Marsh.

depth in core (cm)	DIATOM COUNTS - RELATIVE PERCENTAGES																total %	total	chrysophytes						
	<i>Pinnularia obscura</i>	<i>Pinnularia pulchra angusta</i>	<i>Pinnularia streptoraphe</i>	<i>Pinnularia viridis</i>	<i>Plagiogramma staurorhorum</i>	<i>Rhoicosphenia abbreviata</i>	<i>Rhopalodia gibba</i>	<i>Rhopalodia gibberula</i>	<i>Rhopalodia operculata</i>	<i>Sellaphora pupula</i>	<i>Sellaphora seminulum</i>	<i>Stauroneis kriegeri</i>	<i>Stauroneis phoenicenteron</i>	<i>Stauroneis producta</i>	<i>Surtirella amphioxys</i>	<i>Surtirella angusta</i>				<i>Surtirella brebissonii</i>	<i>Surtirella spiralis</i>	<i>Synedra ulna</i>	<i>Tabellaria fenestrata</i>	<i>Trachyneis aspera</i>	<i>Tryblionella debilis</i>
1								0.5							0.2								14.1	100	
10				0.9											0.2								0.9	100	
20																			0.7					100	
30						10.5	0.5	1.4							0.2	0.2	0.5		1.0				1.0	100	
40				3.4				1.7	0.5		2.2	0.5	0.2											100	20
50	1.0			1.5				0.2	1.0		2.5	0.5											0.5	100	50
60				1.2				0.5																100	31
70				0.7				1.6			0.5		0.5											100	7
80	0.7			1.0	0.7				1.5	1.0	2.0												0.2	100	5
90	1.3	0.3	0.7	3.9		0.3			2.6	0.3	4.6	0.7			0.8									100	8
100																								100	5
105									0.6															100	1
110				0.3	0.3			0.6														0.3		100	4
115																								100	
120				1.3	0.3			2.9			0.3												1.3	100	
125	0.3			1.0				2.6		2.9	1.6	1.0		0.6								0.6	100	15	
130								2.6	0.7	1.3	2.6			0.3							0.7		0.7	100	13
135				1.0				2.3		2.9	2.9	1.0		1.3									0.6	100	16
140	2.7			1.3				1.3		3.0	5.0												1.3	100	5
150	1.6							0.3		16.8	3.4											0.9	100	13	
160	1.9			0.6				0.6	0.3	3.2	1.0	0.3	0.3							0.6		1.0	100	6	
170				0.6				1.0	1.3		1.6	0.3										1.3	100	2	
180	1.6	0.3		0.6					1.6	0.3	2.3	1.9										0.6	100	3	
190	0.6			1.0							2.6	0.3		0.3										100	28

TABLE 4 (cont.). Diatom taxa in Core A from Winslow Marsh.

PLATE 1

1. *Achnanthes brevipes* var. *intermedia* (Kützing) Cleve 1895
(WRDC 0054)
- 2, 3. *Achnanthes hauckiana* Grunow 1880
(1, rapheless valve; 2, rapheless valve; WRDC 0054)
- 4, 5, 8-10. *Achnanthes rupestoides* Hohn 1961
(4, raphe valve; 5, rapheless valve; WRDC 0044)
(9, raphe valve; 10, rapheless valve; WRDC 0044)
(8, rapheless valve; WRDC 0050)
- 6, 7. *Achnanthes lemmermanii* Hustedt 1933 in Hustedt 1927-66
(6, raphe valve; 7, rapheless valve; WRDC 0050)
- 11, 12. *Achnanthes lanceolata* (Brébisson) Grunow in Cleve & Grunow 1880
(11, raphe valve; 12, rapheless valve; WRDC 0050)
13. *Amphora libyca* Ehrenberg 1840
(WRDC 0057)
14. *Cosmioneis pusilla* (W. Smith) Mann and Stickle in Round and others 1990
(WRDC 0050)
15. *Cymbella descripta* (Hustedt 1943) Krammer and Lange-Bertalot 1985
(WRDC 0057)
16. *Catenula adhaerens* Mereschkowsky 1903
(WRDC 0054)
- 17-20. *Fragilaria virescens* var. *oblongella* Grunow in Van Heurck 1881
(17, 19, 20, valve view; 18, girdle view; WRDC 0050)
21. *Fragilaria famelica* var. *littoralis* (Germain) Lange-Bertalot in Krammer and Lange-Bertalot 1991a
(WRDC 0044)
- 22, 23. *Denticula subtilis* Grunow 1862
(22, girdle view; 23, valve view; WRDC 0044)

Plate 1

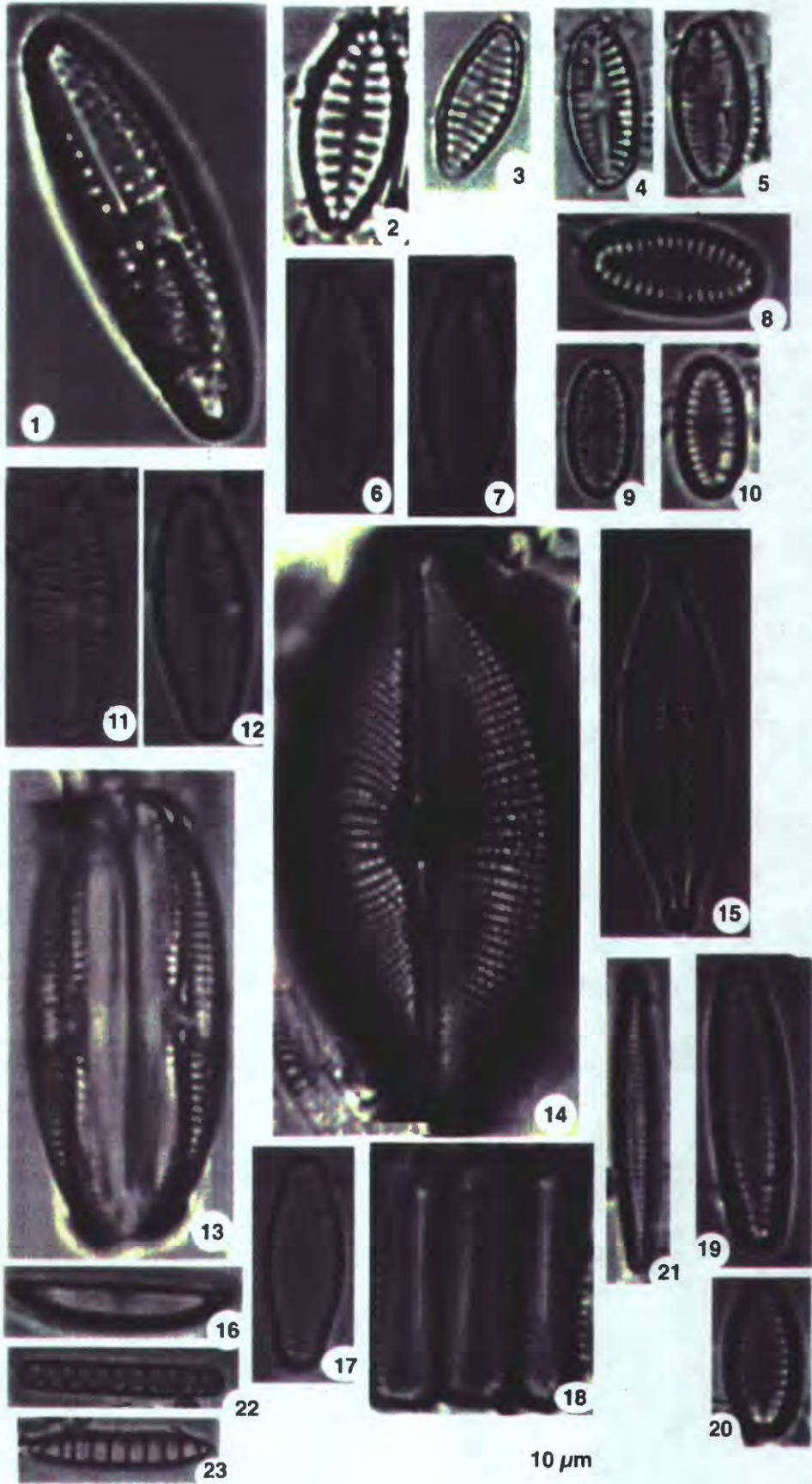


PLATE 2

1. *Diploneis ovalis* (Hilse) Cleve 1891
(WRDC 0050)
2. *Diploneis pseudovalis* Hustedt 1930
(WRDC 0044)
3. *Diploneis smithii* var. *dilatata* (Peragallo) Terry 1908
(WRDC 0050)
4. *Gomphonema truncatum* Ehrenberg 1832
(WRDC 0057)
5. *Melosira varians* Agardh 1827
(WRDC 0057)
6. *Navicula elginensis* var. *cuneata* (M. Møller ex Foged) Lange-Bertalot in Krammer and Lange-Bertalot 1985
(WRDC 0019)
- 7, 8. *Navicula cari* Ehrenberg 1836a
(WRDC 0057)
- 9, 10. *Navicula* cf. *cryptotenella* Lange-Bertalot in Krammer and Lange-Bertalot 1985
(9, WRDC 0050; 10, WRDC 0043)
11. *Navicula salinarum* Grunow in Cleve and Grunow 1880
(WRDC 0057)
12. *Navicula slesvicensis* Grunow in Van Heurck 1880
(WRDC 0050)
13. *Pinnularia krockii* (Grunow) Cleve 1891
(WRDC 0050)

Plate 2

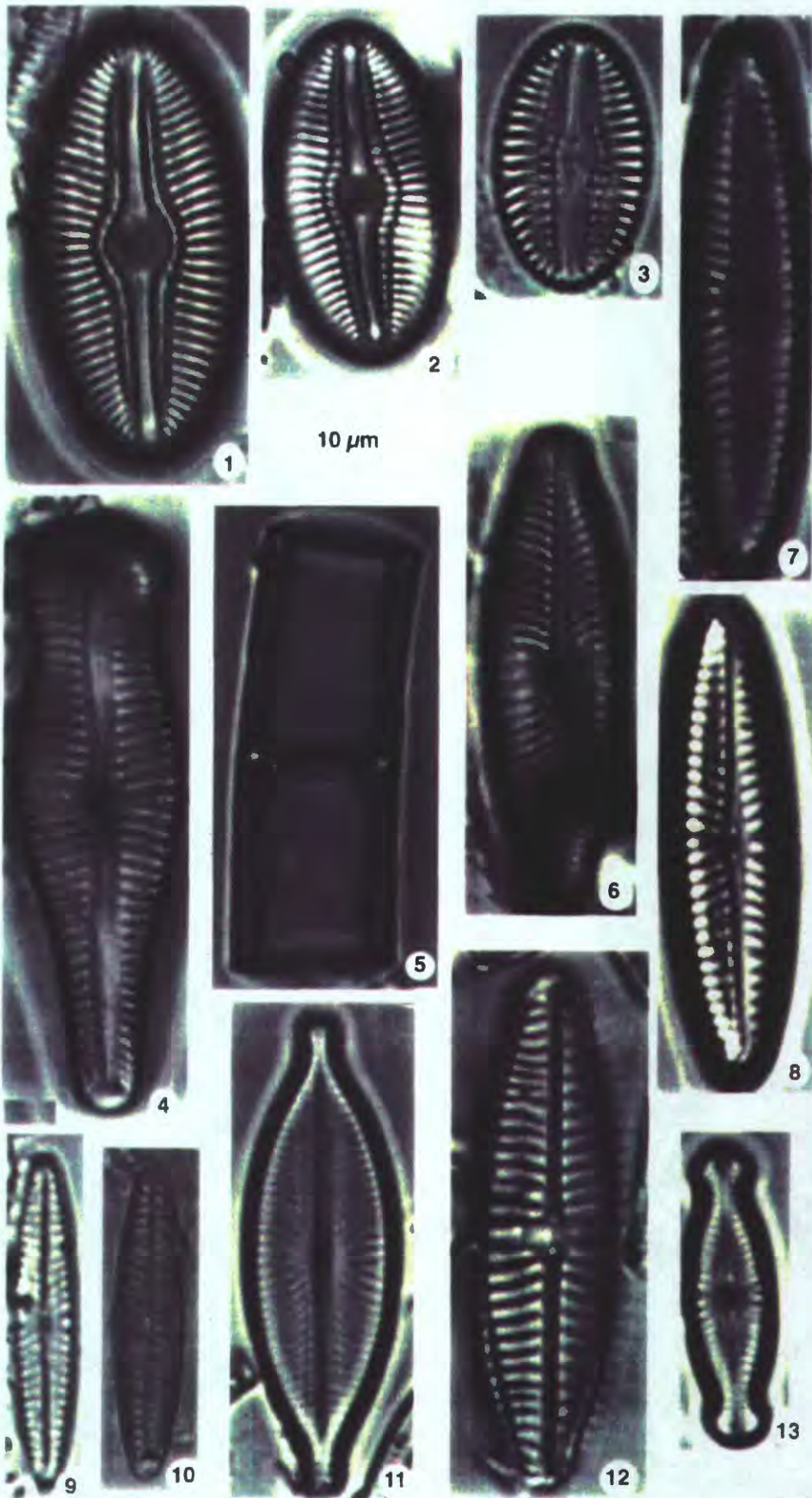


PLATE 3

1. *Nitzschia hybrida* Grunow in Cleve and Grunow 1880
(WRDC 0043)
2. *Nitzschia palea* (Kützing) W. Smith 1856
(WRDC 0057)
3. *Opephora marina* (Gregory) Petit 1888
(WRDC 0054)
- 4, 5. *Opephora parva* (Van Heurck) Krasske 1939
(4, valve view; 5, girdle view; WRDC 0054)
6. *Pinnularia appendiculata* (Agardh) Cleve 1895
(WRDC 0044)
7. *Pinnularia obscura* Krasske 1932
(WRDC 0019)
8. *Pinnularia lagerstedtii* (Cleve) Cleve-Euler 1934
(WRDC 0043)
- 9-11. *Pinnularia krockii* (Grunow) Cleve 1891
(9, WRDC 0050; 10, WRDC 0043; 11, WRDC 0044)
12. *Nitzschia nana* Grunow in Van Heurck 1881
(WRDC 0050)
- 13, 14. *Plagiogramma staurophorum* (Greg.) Heiberg 1863
(13, valve view; 14, girdle view; WRDC 0054)
- 15, 16. *Paralia sulcata* (Ehrenberg) Cleve 1873
(WRDC 0054)

Plate 3

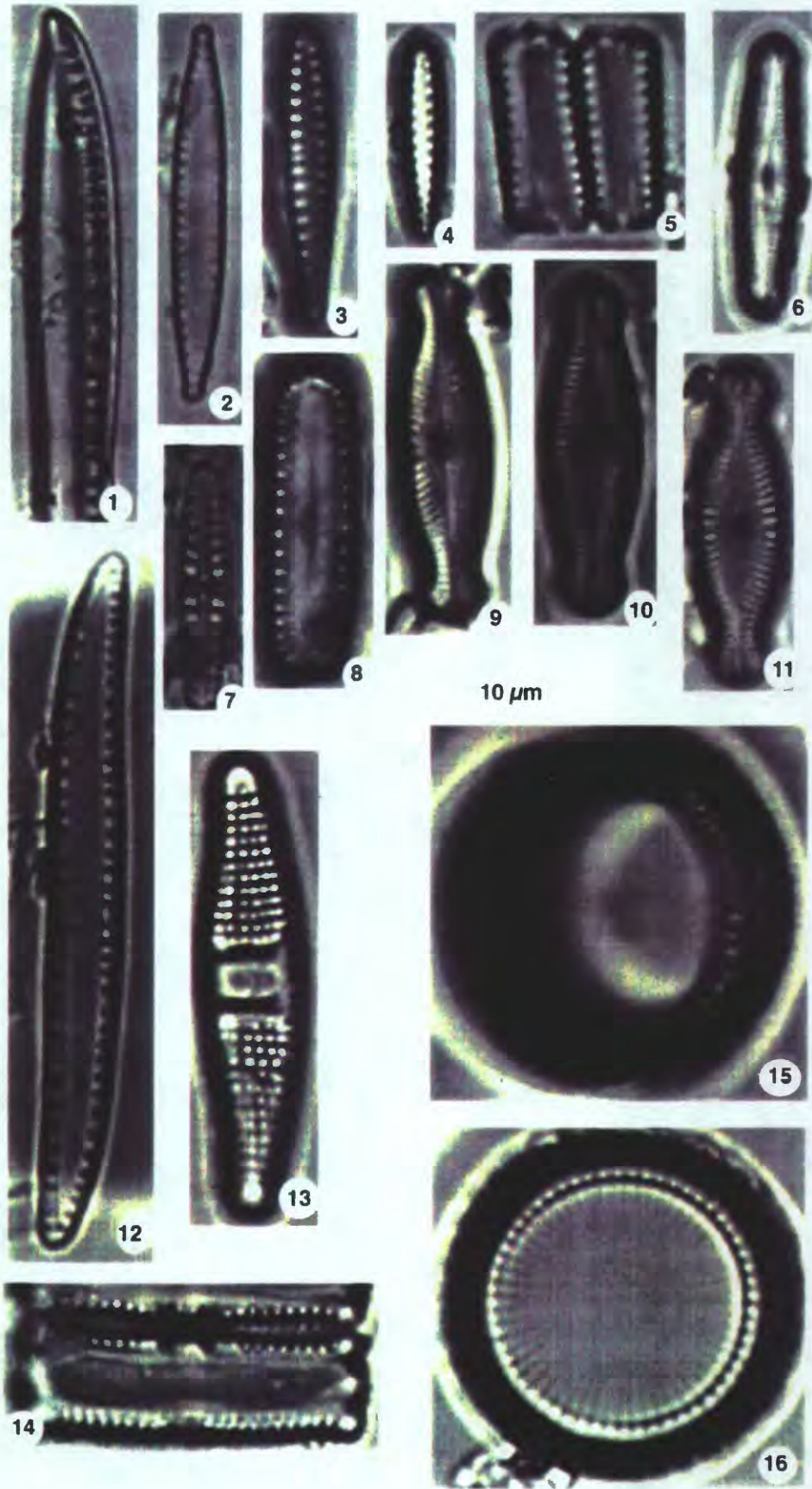


PLATE 4

1. *Pinnularia viridis* (Nitzsch) Ehrenberg 1843
(WRDC 0050)
- 2, 3. *Rhoicosphenia abbreviata* (C. Agardh) Lange-Bertalot 1980
(2, girdle view; 3, valve view; WRDC 0057)
- 4, 5. *Sellaphora seminulum* (Grunow) Mann 1989
(WRDC 0044)
- 6, 7. *Surirella brébissonii* Krammer and Lange-Bertalot in Lange-Bertalot and Krammer
1987
(WRDC 0057)

Plate 4

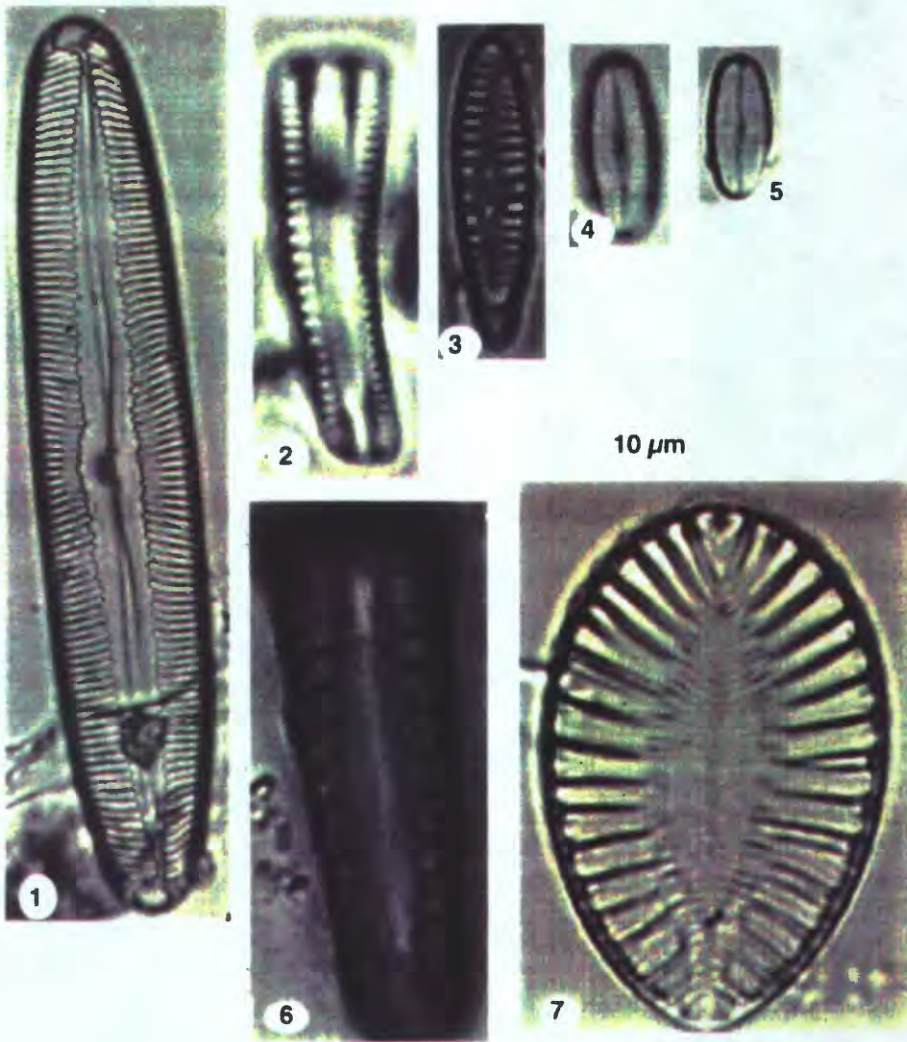


PLATE 5

1. *Caloneis bacillum* (Grunow) Cleve 1894
(WRDC 0021)
2. *Cocconeis scutellum* Ehrenberg 1838
(WRDC 0023)
3. *Cosmioneis pusilla* (W. Smith) Mann and Stickle in Round and others 1990
(WRDC 0050)
- 4, 5. *Diploneis interrupta* (Kützing) Cleve 1894
(WRDC 0021)
- 6-8. *Diploneis boldtiana* Cleve 1891
(6, 8, WRDC 0021; 7, WRDC 0023)
9. *Diploneis smithii* (Brébisson) Cleve 1894
(WRDC 0025)
10. *Gomphonema angustatum* (Kützing) Rabenhorst 1864
(WRDC 0021)
11. *Meridion circulare* var. *constrictum* (Ralfs) Van Heurck 1881
(WRDC 0021)
12. *Frustulia vulgaris* (Thwaites) De Toni 1891
(WRDC 0019)
- 13, 14. *Hantzschia amphioxys* (Ehrenberg) Grunow in Cleve and Grunow 1880
(WRDC 0053)
15. *Melosira varians* Agardh 1827
(WRDC 0057)
- 16, 17. *Navicula radiosa* Kützing 1844
(16, WRDC 0044; 17, WRDC 0042)
18. *Plagiogramma staurophorum* (Greg.) Heiberg 1863
(WRDC 0023)
- 19-21. *Navicula slesvicensis* Grunow in Van Heurck 1880
(19, 20, WRDC 0044; 21, WRDC 0043)
22. *Pinnularia borealis* Ehrenberg 1843
(WRDC 0021)
23. *Rhopalodia operculata* (Agardh) Håkansson 1979
(WRDC 0025)

Plate 5

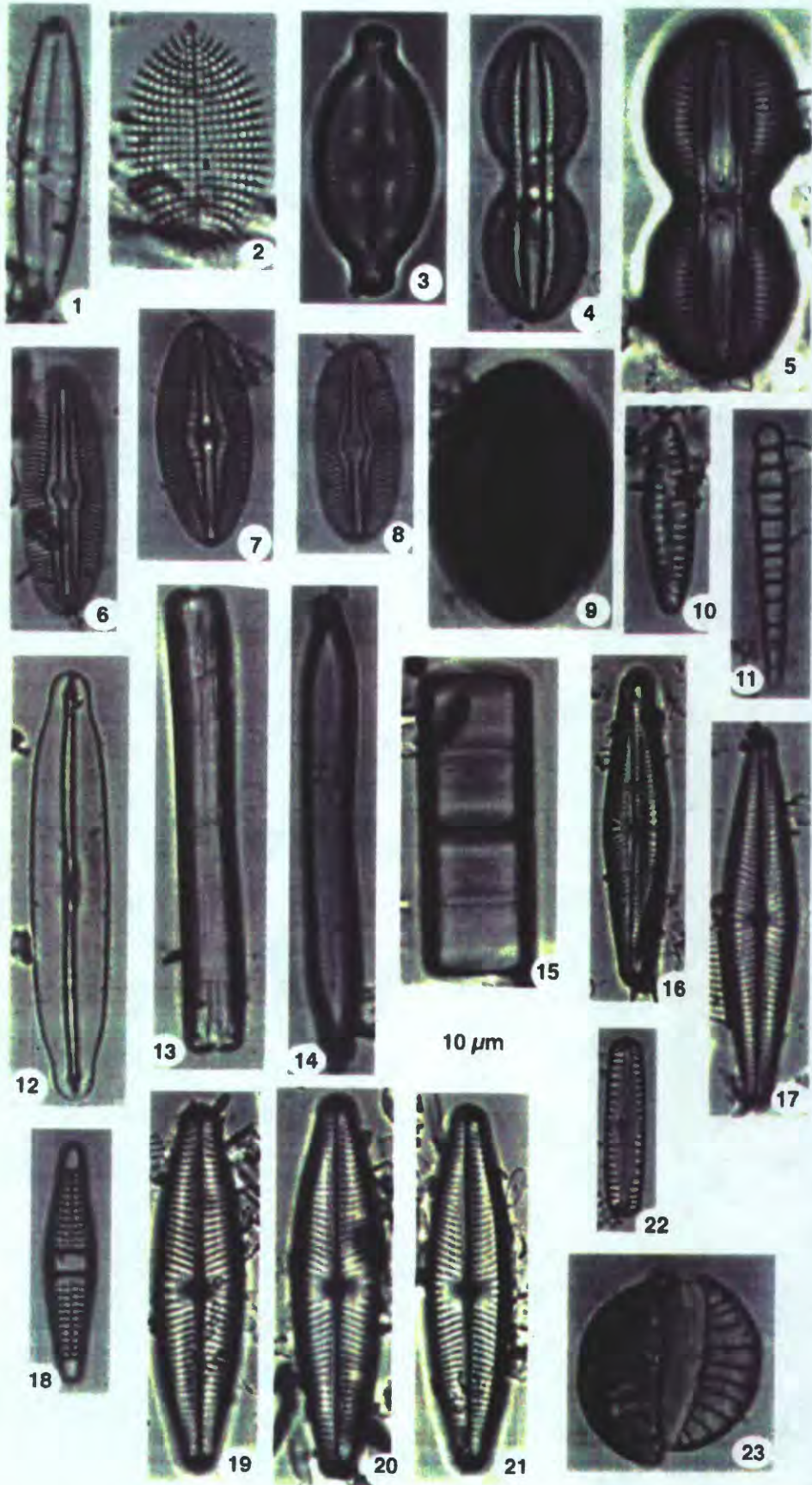


PLATE 6

- 1, 2. *Navicula rhyncocephala* Kützing 1844
(WRDC 0057)**
- 3-5. *Nitzschia terrestris* (Petersen) Hustedt 1934
(WRDC 0053)**
- 6. *Nitzschia dubia* W. Smith 1853
(WRDC 0057)**
- 7. *Nitzschia recta* Hantsch in Rabenhorst 1861-1879
(WRDC 0042)**
- 8. *Stauroneis producta* Grunow 1880
(WRDC 0044)**
- 9. *Pinnularia viridis* (Nitzsch) Ehrenberg 1843
(WRDC 0042)**
- 10. *Surirella amphioxys* W. Smith 1856
(WRDC 0025)**
- 11. *Navicula elegans* W. Smith 1853
(WRDC 0050)**

Plate 6

