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Gateway National Recreation Area

A PHOTOGRAPHIC INVENTORY OF DIATOMS JAMAICA BAY 1992

PREPARED BY

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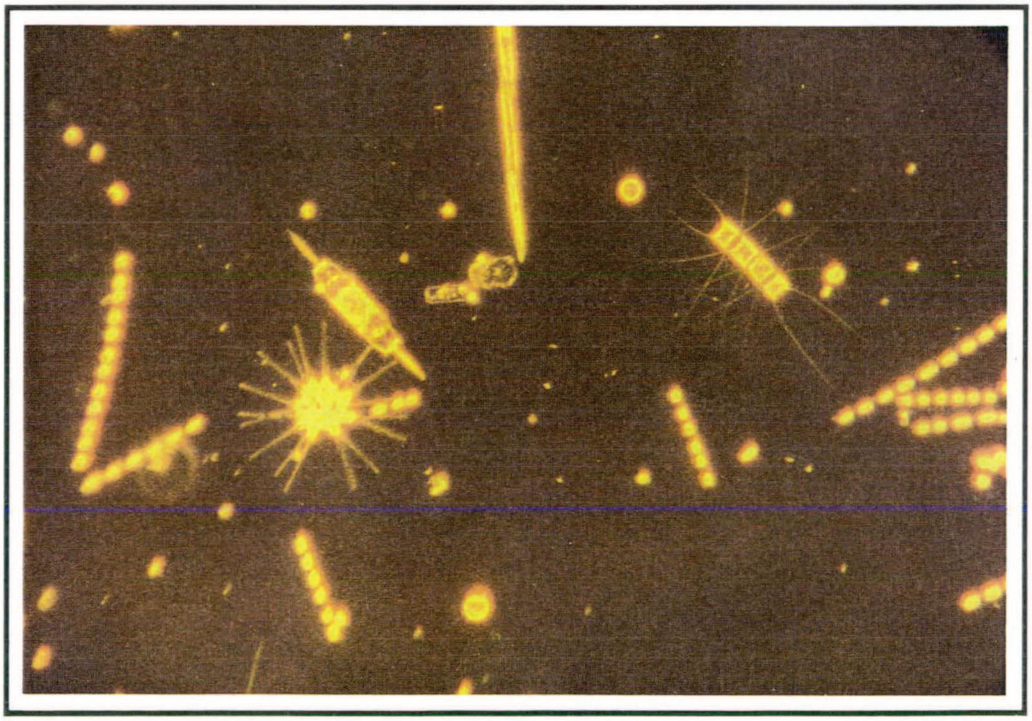

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DIATOMS OF JAMAICA BAY

INTRODUCTION

Diatoms, with over 10,000 living species, are an important group of phytoplankton that perform vital ecological functions. They form the foundation of the marine and freshwater food chain by converting CO_2 and sunlight into carbohydrates, food for higher organisms. A byproduct of this process is oxygen. It is estimated that approximately 20-25% of the world's oxygen is produced by diatoms, which is a dominant phytoplankton group in many aquatic regions over the earth.

The structure of the diatom tests, or shell, is distinguished by its cell wall or external skeleton, referred to as the frustule. It consists of two halves or valves, with one (epitheca) overlapping the other (hypotheca). The area the valves overlap is known as the girdle area, which may be made up of additional wall material. The frustule is composed largely of silica, which the diatom removes from natural waters, and may often be ornamented by a variety of markings such as pores, lines or rib-like thickenings. Diatoms may also have other features such as appendages. Cells united in chains may be connected by spines extending from the valve margins.

There are two major classes of diatoms: the centric diatoms and the pennate diatoms. The centric forms are distinguished by their valve patterns radiating from a central or lateral point.

The cells may be disk, drum, or cylindrically shaped. Pennate cells are known by their linear, cigar-like shape. The sculpturing in pennate forms are more or less straight lines, giving the cells a somewhat feather-like appearance. In addition, many pennates have a narrow, longitudinal slit running along one or both valves called a raphe which can provide independent movement by exuding a cytoplasmically produced slime, along which the diatom slowly glides. Representative samples are noted in this report.

The diatoms presented here were collected from two areas in Jamaica Bay New York City and consisted of 5 collections at each site, one at the inlet and one at an inner bay site within Jamaica Bay during the late summer/early fall season in 1984 (Peterson and Dam, 1987). It should not be concluded that all the diatoms in Jamaica Bay are represented here. To adequately describe the various types of planktonic species that occur in this estuarine ecosystem would require a long term effort. However, this initial inventory reveals that urban estuarine systems can reflect the conspicuous diversity of organisms usually taken for granted or at a minimum, not well understood.

Skeletonema costatum

Skeletonema costatum is a widely distributed species particularly in nearshore waters and is commonly found when waters are enriched. It may dominate during winter as well as spring and may initiate the late-winter or spring bloom in many temperate inshore areas. It can tolerate a wide range of salinities and appears to have a vitamin B_{12} requirement. Vitamin B_{12} is present in estuarine environments. Its doubling rate may be rapid. It is a dominant species in many eastern estuaries.

The cells are cylindrical or disc shaped when young and oblong when fully grown. They may form long chains by the connection of straight, threadlike processes up to 20 um from the margins of the valves. The processes vary greatly in length but they are always of equal length between opposite cells. The connection of processes between each cell is seen by a dividing line. Frustules are not ornamented by markings, known as hyaline, though the markings on fully developed frustules appear to be minute dotlike holes called puncta, arranged in longitudinal rows. The valves are slightly convex. The diameter of cells ranges from 7-15 um. There are only one or two chloroplasts per cell. Since frustules are low in siliceous material, cells may constrict after mounting.

Figure 1.

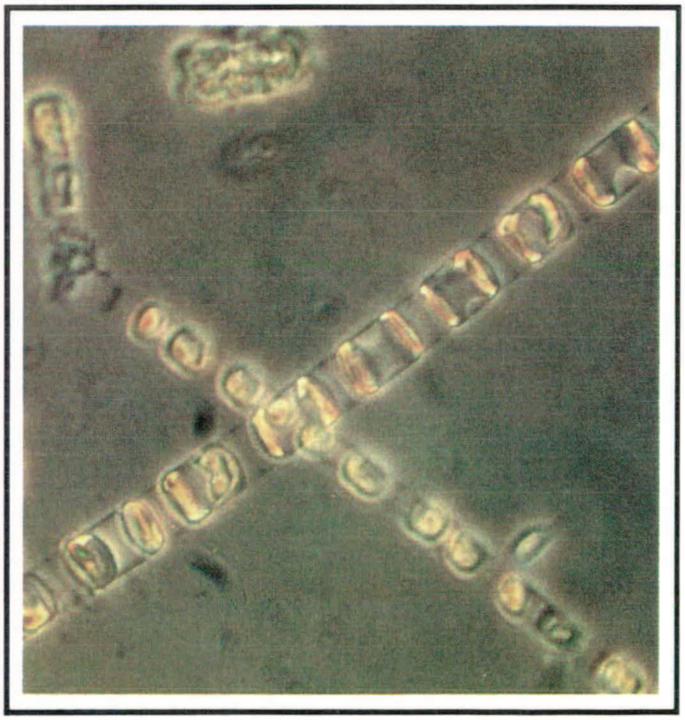


Figure 2.

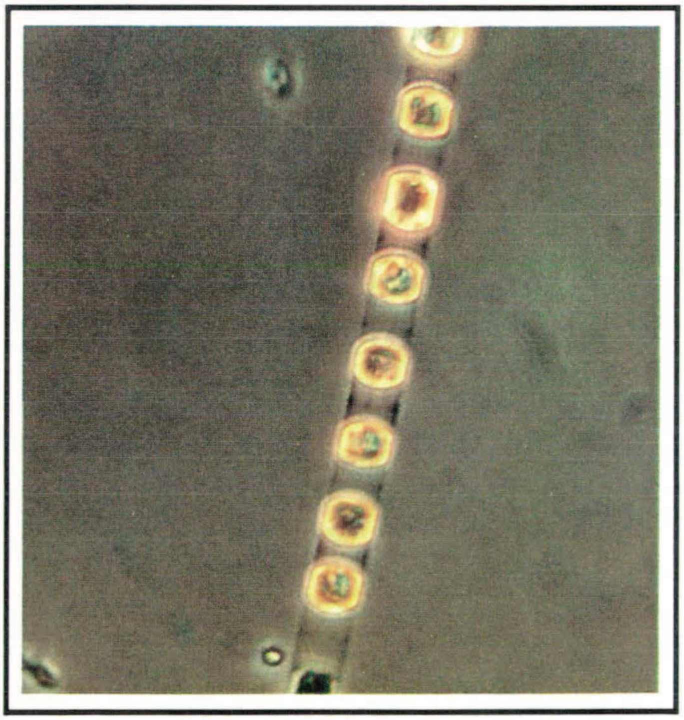
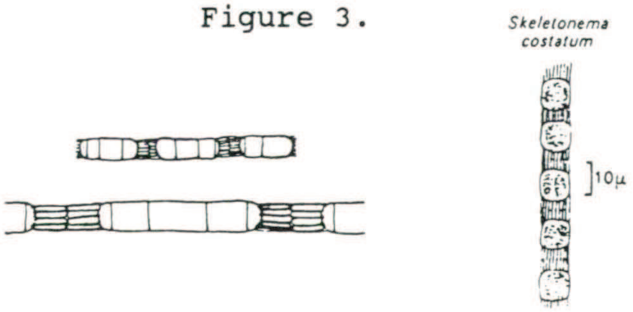


Figure 3.



Thalassiosira decipiens

Thalassiosira decipiens is mainly a northern species that prefers nearshore waters. It is found in Narragansett Bay and Long Island Sound, generally in minimal quantities. It was found to have initiated a winter bloom in Long Island Sound under unusual conditions. These conditions included a stable surface layer, one which is indicative of reduced turbulence, which received a large input of freshwater through autumnal rains. The bloom either reduced itself or was absent by late summer (Riley and Conover, 1967).

The cells are disc shaped with many curved spines extending outward from the valves. A single gelatinous thread protruding from the center of the cells holds the cells together in a chain with large spaces between them. The diameter of cells range from 12-40 um.

Figure 4.

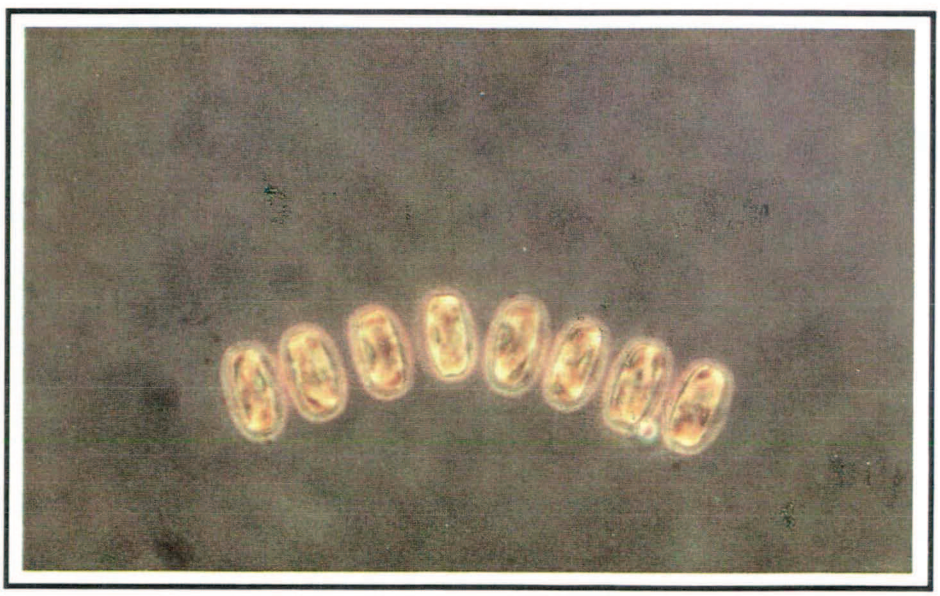
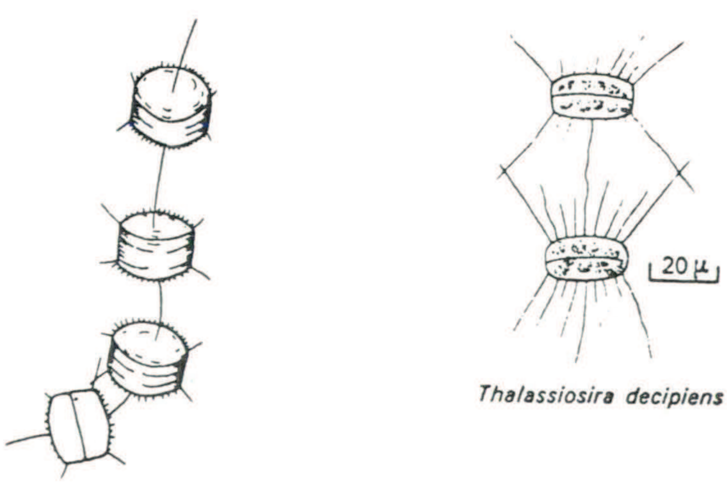


Figure 5.



Thalassiosira gravida

In very cold waters of the northern hemisphere (1-5° C), *Thalassiosira gravida* is one of the species that initiates the first stage of succession. However, it was also shown to be consistently successful in waters above 20° C (Riley and Conover, 1967). It is a dominant species in Long Island Sound and Narragansett Bay.

The cells are rectangular with slightly rounded angles and form long chains by a thick thread from the center of the cells. The valves are circular, with an almost invisible puncta and have minute spines on the border. The diameter is about 35 um and is similar to *T. decipiens* but has shorter spines and a larger cell size when mature.

Figure 6.

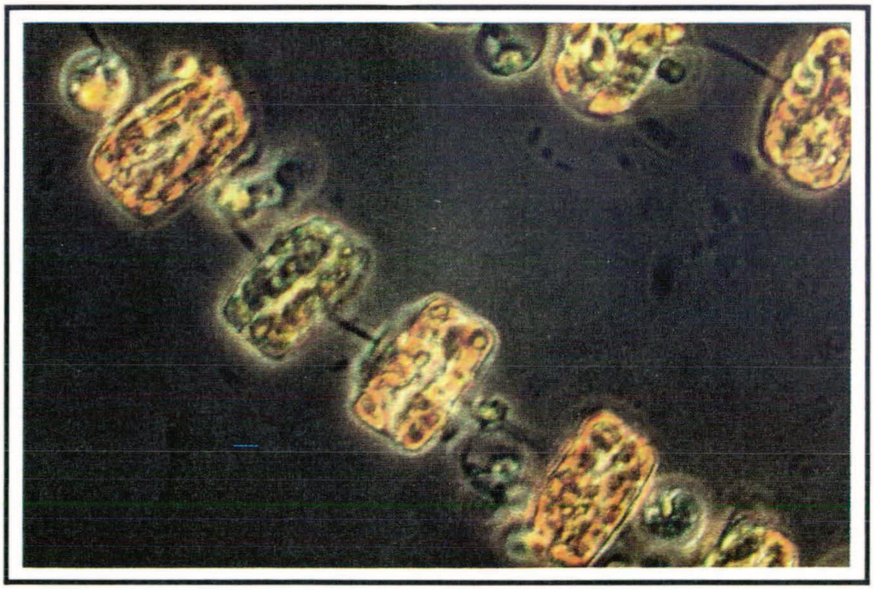


Figure 7.

Thalassiosira nordenskioldii

Thalassiosira nordenskioldii is a northern species that is usually dominant in early spring when water temperatures reach 2-3° C. Like *T. gravida*, it is one of the species that initiates the first stage of succession in very cold waters (1-5° C). As the waters warm, it is usually replaced by other species, mainly *S. costatum* and *T. nordenskioldii,* which appear to have a higher growth rate at lower temperatures and lower light levels. Its dominance in the Lower Hudson Bay, Long Island Sound and Narragansett Bay was important during spring blooms, constituting up to as much as 80% of the population (Smayda, 1957). It was also found to dominate the cold waters of the Gulf of Maine during the winter season (Guillard and Kilham, 1977).

The cells are rectangular with obliquely truncated angles. Markings on the valves are barely visible except when they are dry and their color is a pale yellowish-brown. They have short club-shaped spines that are somewhat distant from each other. The diameter of the cells range from 12-43 um.

Figure 8.

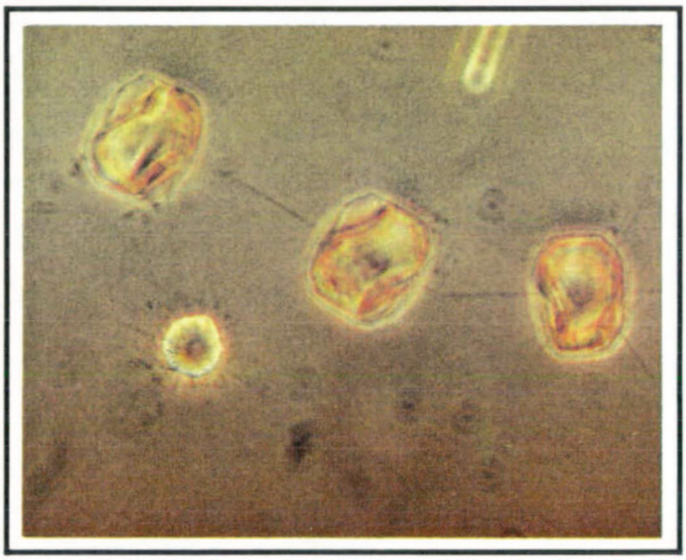
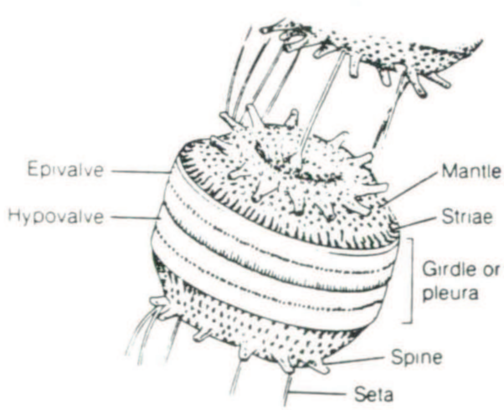


Figure 9. (Hicks, 1953)



Thalassiosira nordenskjøldii [Drawing by E. Hoffman]

Coscinodiscus spp.

There are many species in this genus, ranging from benthic to tychopelagic (temporarily planktonic) to true planktonic forms. Many are large in size, up to a few hundred microns in diameter. This species was reported to occur in Long Island Sound and Narragansett Bay, but none were shown to be dominant.

The cells are solitary, disc or box shaped, and laterally compressed. The valves are mostly circular, however, some may be elliptical with a surface that may be flat, wavy, convex or concave. They are marked by either fine openings arranged radially without radial hyaline areas or by hexagonally shaped pores called areolae. The areolae may be arranged in various ways across the valve either in curved rows or radially. The center area of the valve may be either smooth or sculptured. The valve margins may or may not have tiny spines and may contain up to two apiculae. The cells have a single girdle band for each valve or one with one or more collarlike bands of silica occurring between the valve mantle and the girdle. They have numerous chloroplasts in either round, angular, or irregular disc forms.

Figure 10.

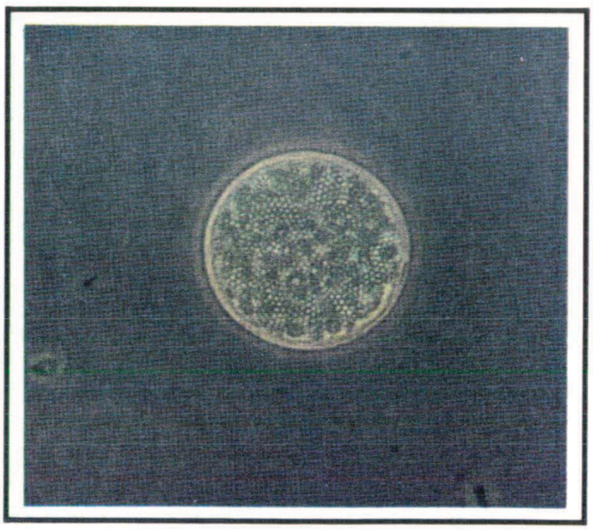


Figure 11.

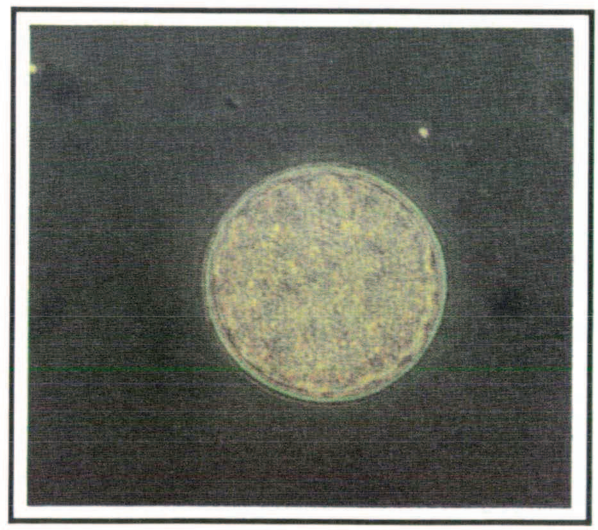
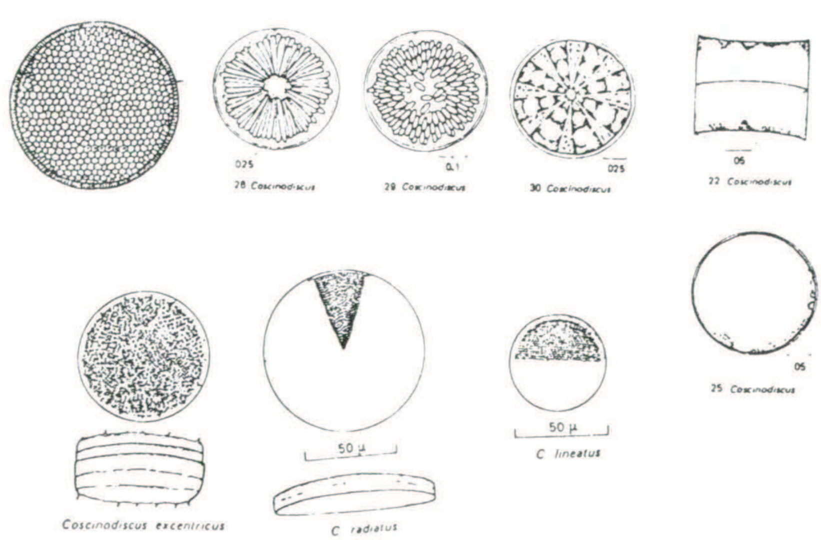


Figure 12.



Rhizosolenia alata

Rhizosolenia alata is found in nearshore and ocean waters. It may be seen as a dominant species in nutrient poor waters under extreme oligotrophic conditions. However, it has been found to bloom and remain abundant with a sudden increase of nutrients in these environments (Guillard and Kilham, 1977). It is considered a ubiquitous species because it occurs throughout the year under both types of nutrient conditions. Its maximum growth rate is considered low with an estimate of one cell division per day. It occurs in a variety of saline environments ranging from 15 to 35 ppt. It has been found in Long Island Sound and Narragansett Bay and is dominant in Raritan Bay during the winter.

R. alata is a relatively large diatom with a low surface to volume ratio. The cells are elongated, slender and cylindrical. Ringlike markings decorate the cell in the form of overlapping rhomboidal scales. The rows of pores are subtle. The calyptra or cap is elongated and twisted with a minute fissure. A short spine extends from the base of one calyptra and enters the fissure at the end of the opposite calyptra. The cell diameter is approximately 5 to 8 um.

Figure 13.

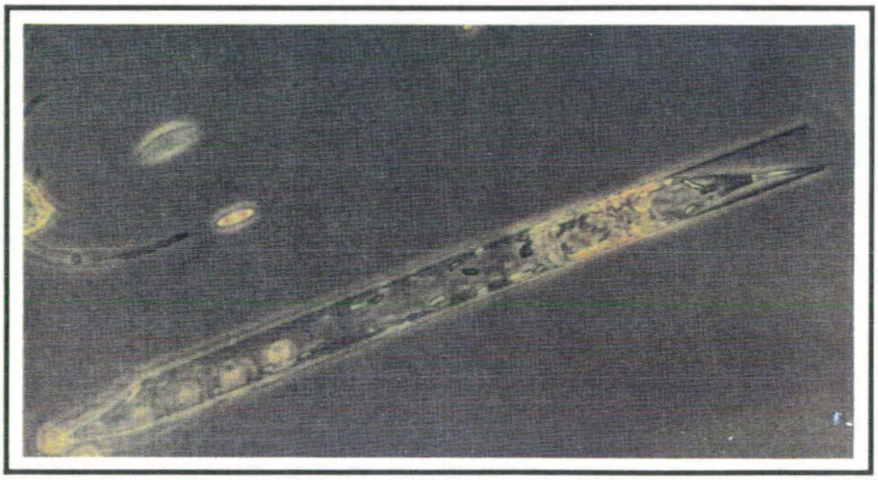
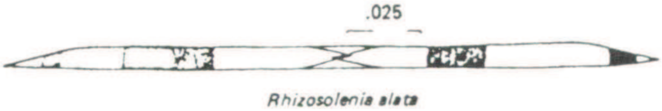
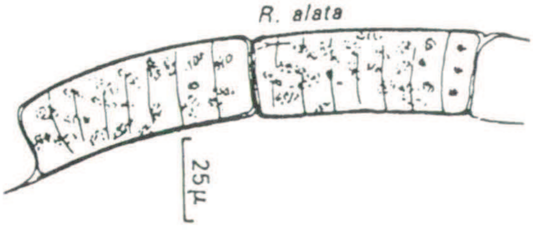


Figure 14.





Rhizosolenia delicatula

Rhizosolenia delicatula is a nearshore specie that was found dominant in Long Island Sound only during springtime. It appears to have a fairly narrow range of light tolerance. Variations in temperature and salinity do not appear to have any effect on its abundance during its springtime appearance.

The cells are cylindrical and united in closely set, straight chains. The valves are almost completely flat, with only a slight rounding on the margins. The intercalary bands are ring shaped, but are usually difficult to see. A short spine from the valve fits into a corresponding depression on the adjacent cell. A cell may contain two lobed shaped chloroplasts near the cell wall of the girdle region. The diameter of the cells ranges from 9 to 16 um with the entire length usually about three times as long.

Figure 15.

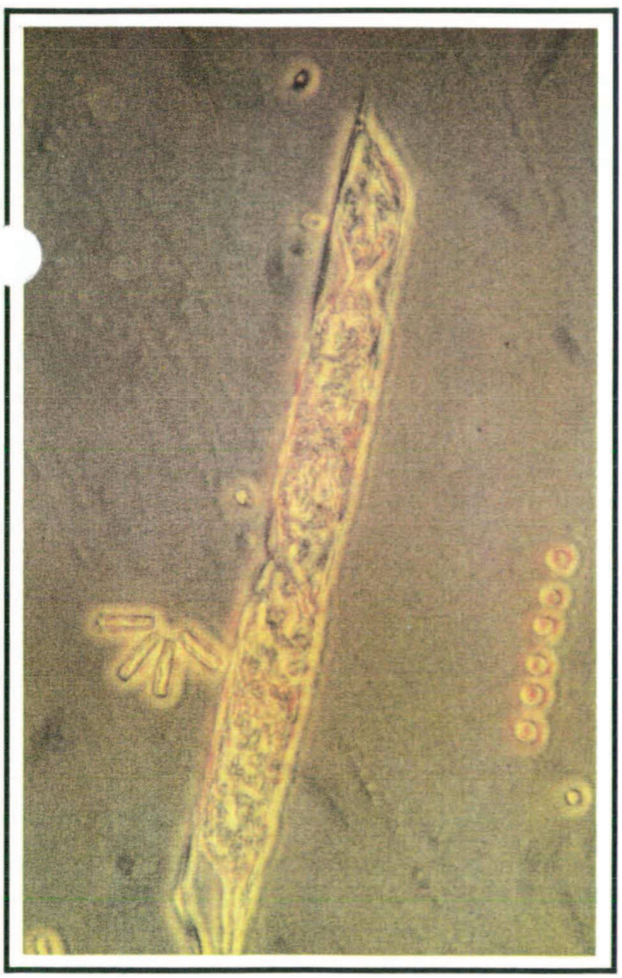


Figure 16.

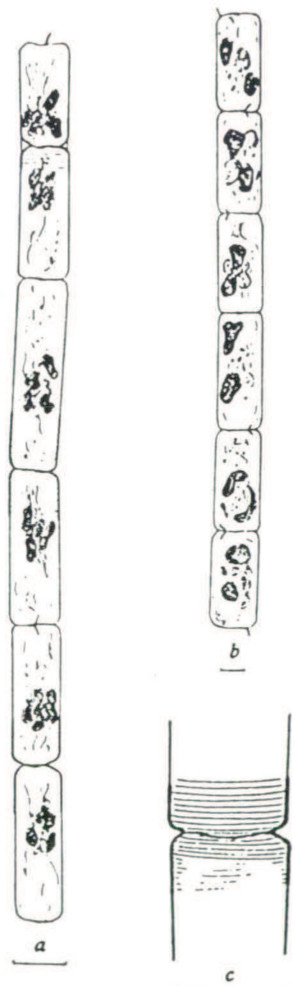


Figure 17.

Rhizosolenia fragilissima

Rhizosolenia fragilissima is a nearshore species that was found to be dominant in Long Island Sound and Narragansett Bay. It peaks in August at a temperature of 19° C and is found to occur in water temperatures between 9 and 23° C.

The cells of this specie are cylindrical with rounded ends and unite in short, straight chains. The intercalary bands, the bands between valve mantle or edge and girdle, are ring or collar shaped, but are difficult to see. The small spine near the center of the valve fits into the depression of the next cell. There are many small chloroplasts distributed over the entire cell wall, which is thin and weakly siliceous. The nucleus is also located near cell wall. The diameter is between 12 and 20 um and its length ranges from 42 to 67 um.

Figure 18.

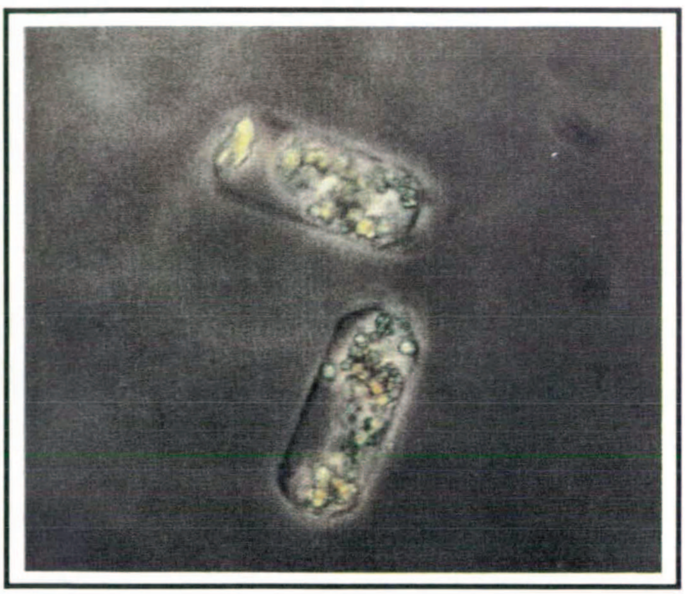
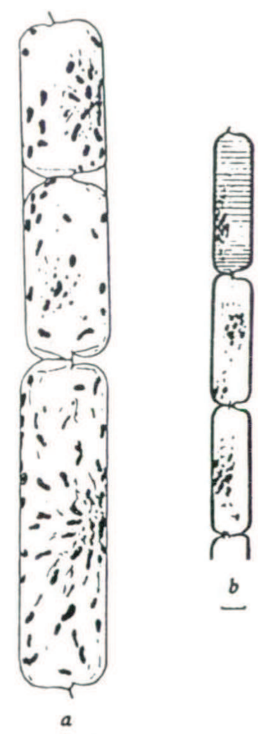


Figure 19.

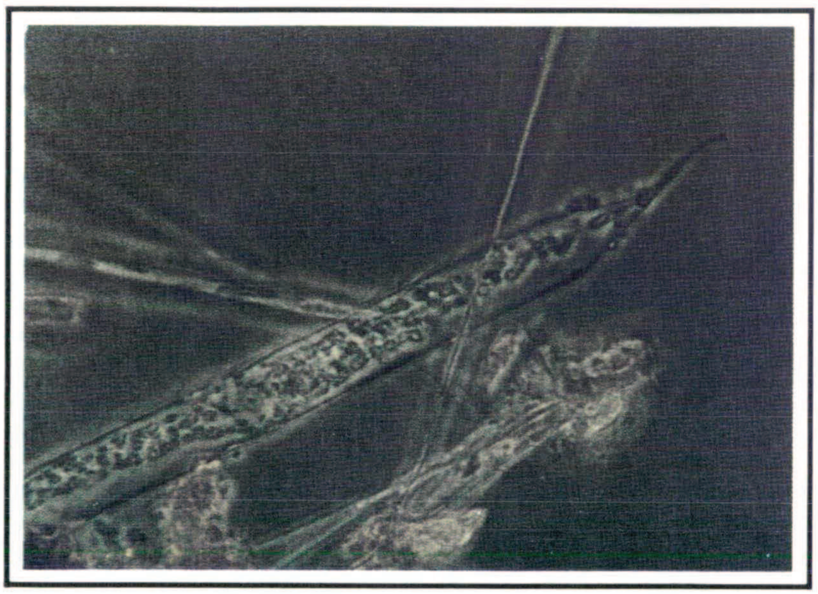


Rhizosolenia hebetata

Rhizosolenia hebetata may be found dominate in nutrient poor conditions or the third stage of succession.

The cells of this specie are elongate and cylindrical. They have ringlike markings in the form of overlapping rhomboidal scales, which are often irregular. Rows of pores are arranged in crisscross fashion, about 25 cells per 10 um. The cap or calyptra is elongated and without depression, but has coarse markings that run lengthwise or as irregular, interrupted lines. The end is blunt with a hollow center. The diameter of the cells ranges from 20 to 30 um. The cells enlarge by about fivefold after auxospore or zygote formation.

Figure 20.



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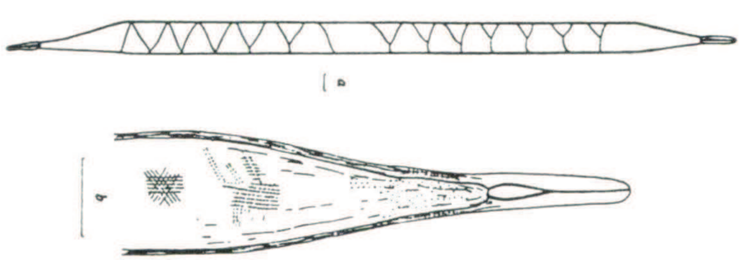


Rhizosolenia stolterfothii

Rhizosolenia stolterfothii is believed to be a nearshore species, but some consider it to be oceanic. It appears to tolerate a wide range of salinities.

The cells are elongated and somewhat curved and are marked by narrow, finely dotted rings in straight lines. The valves are circular and convex with a short, curved off-centered spine at the end. The diameter varies, but is usually about 60 um.

Figure 22.

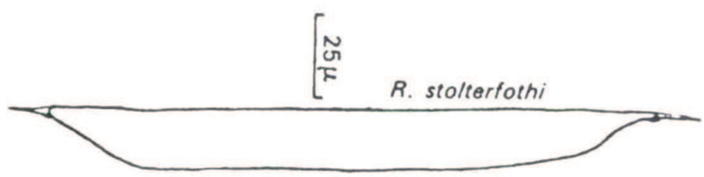


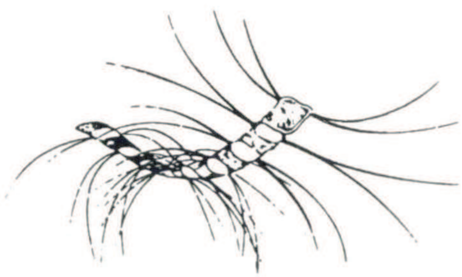
Figure 23.

Chaetoceros curvisetus

Chaetoceros curvisetus is dominant in Narragansett Bay during the summer and autumn and in Long Island Sound during the autumn. It also occurs in the Lower Hudson Bay complex. Temperatures between 18 and 20° C are required for optimum development. The chain length may be shortened by increased turbulence.

The cells are rectangular with acute angles and occur in curved filaments. The valves are concave and elliptical. The setae or spines of adjacent cells cross near their insertion and extend perpendicularly from the filament, but they also curve back. The terminal setae are thicker than the other setae and have dotted markings. There is one chloroplast present which is flat and located against the cell wall. The diameter ranges from 10 to 16 um.

Figure 24.



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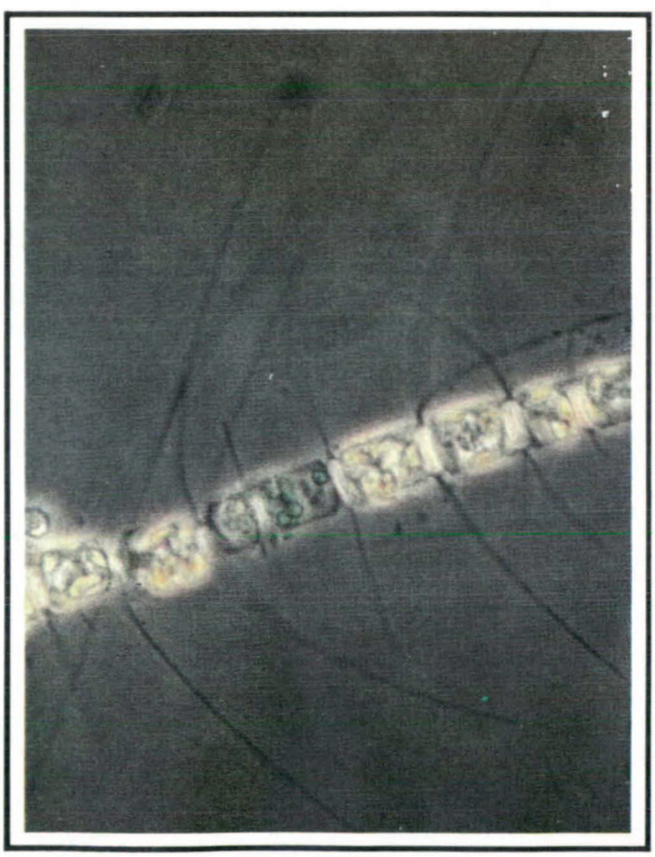

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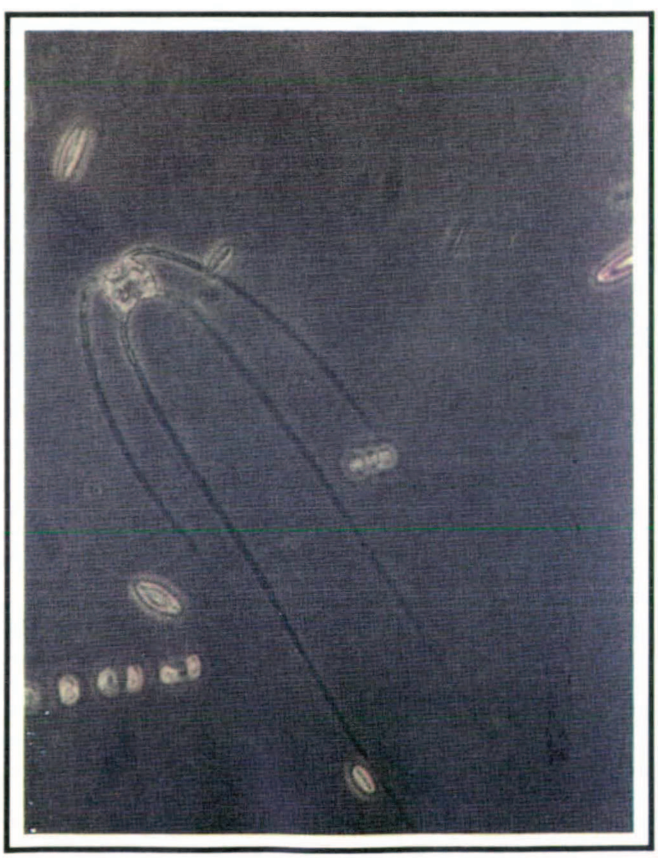
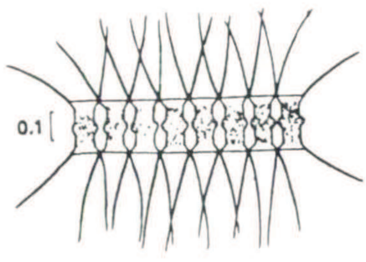


Chaetoceros didymus

Chaetoceros didymus is a nearshore species. Its growth can occur in a range of temperatures from 2-28° C. It is dominant in Long Island Sound but is also found in the Lower Hudson and Narragansett Bays.

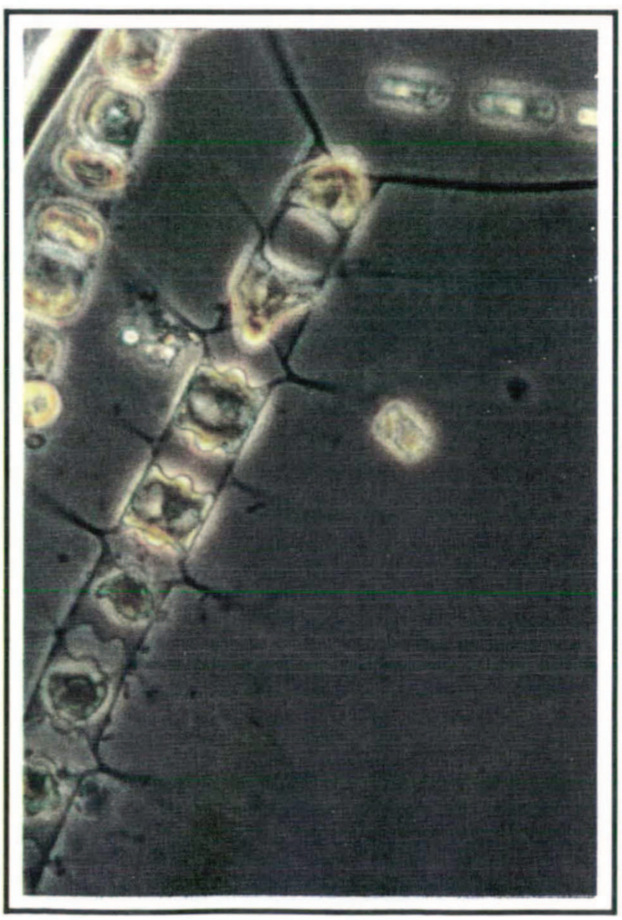
The cells are quadrangular in shape with sharp angles and often filamentous. The spines are long, slender and smooth. The spines of adjacent cells crisscross at oblique angles close to the filament, and extend outward from the chains perpendicularly. Frequently, the spines recurve back toward the filament. The terminal setae or spines are long, slightly broader than the others and also curve back toward the filament. The valves are concave with a spherical elevation in the middle.

Figure 27.



Chaetoceros didymus

Figure 28.



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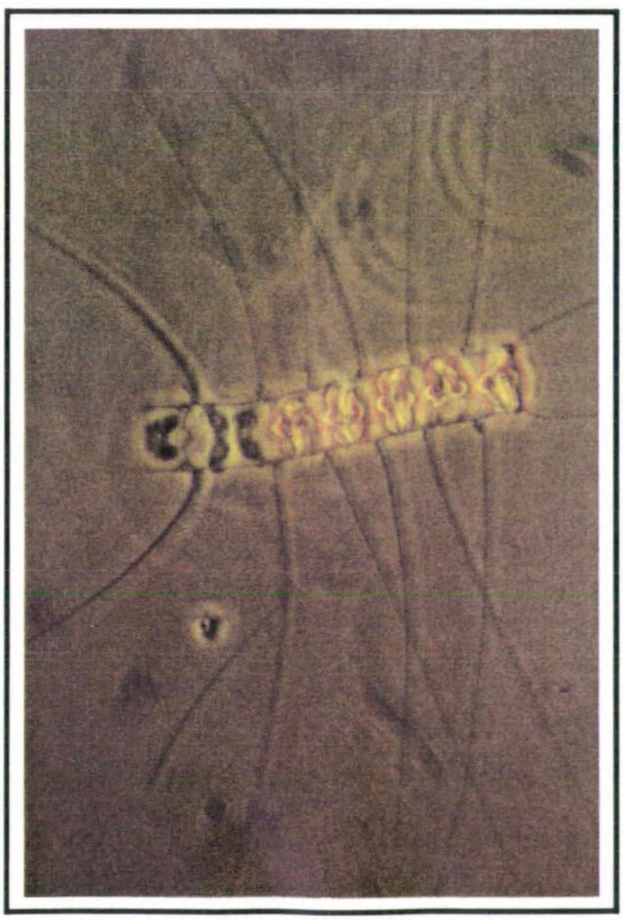
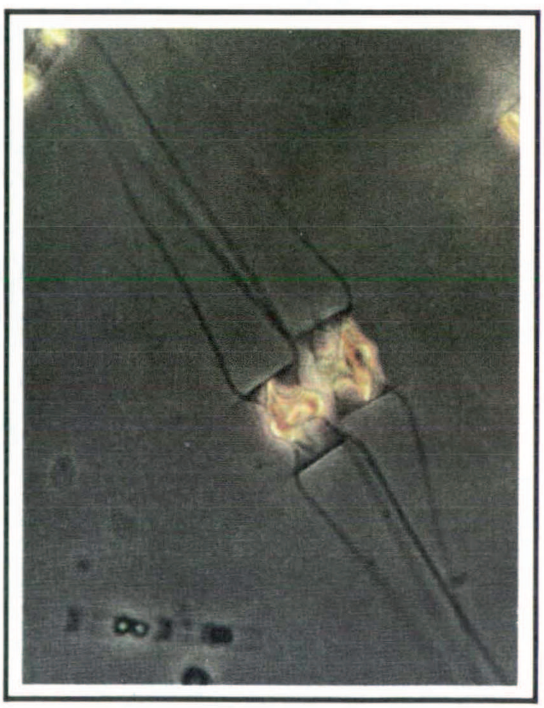


Chaetoceros simplex

Chaetoceros simplex is a nearshore species that is characteristic of brackish waters with temperatures that range from 15 to 25° C. It is uncommon in open marine waters of high salinity.

The cells are small and rectangular when seen viewing the girdle. They occur either alone or in very short chains of 2 or 3 cells. The valves are elliptical and have a slight wavy appearance due to a central swelling of their concave surfaces. The setae or spines extend outward from the apices of the valves and run parallel to each other, sometimes converging at the ends. They are long, straight and lie in the apical axis of the cell. The setae are thin and weakly siliceous. Each cell usually contains one chloroplast in the girdle area. The girdle is barely distinguishable from the valves' mantle and it covers about one third of the cell. The diameter of valve ranges from 6 to 20 um.

Figure 30.



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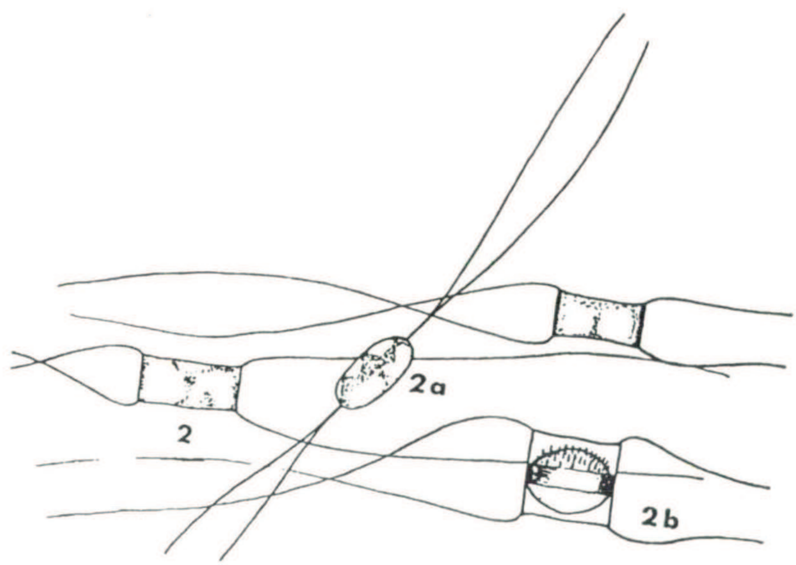


Cerataulina bergonii

The cells of *Cerataulina bergonii* are cylindrical and usually appear in chains. The valves are slightly convex with two blunt processes near the margins. From these processes, adjacent cells are connected by means of a fine, slightly curved hairlike projection that fits into the valve of the next cell. The cell wall is weakly siliceous and collapses when dry. A very delicate sculpturing is found on the cell wall and many ringlike intercalary bands are present. The diameter is approximately 40 um.

Figure 32.

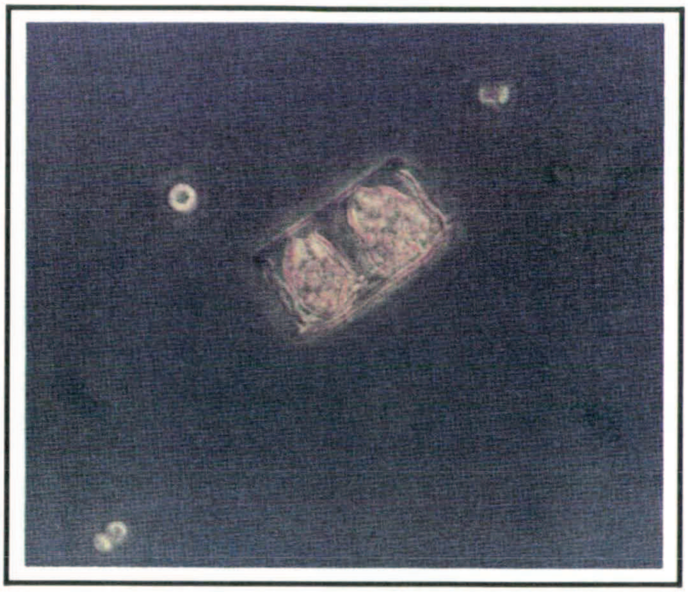
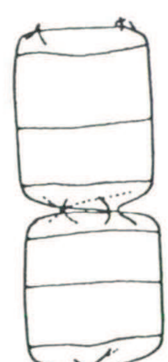


Figure 33.



Eucampia zoodiacus

The *Eucampia zoodiacus* cells are concave at each end and are united in spiral chains. The large spaces between cells are a result of their concave shape. The valves are elliptical with a wavy surface and rounded ends. There are about 7 dotlike markings 10 um long in the center region extending outward to about 10 um. The ends of the valves are without markings. The girdle view reveals indistinct markings and ringlike structures. The length of the valve ranges from 40 to 95 um and the diameter ranges from 25 to 75 um.

Figure 34.

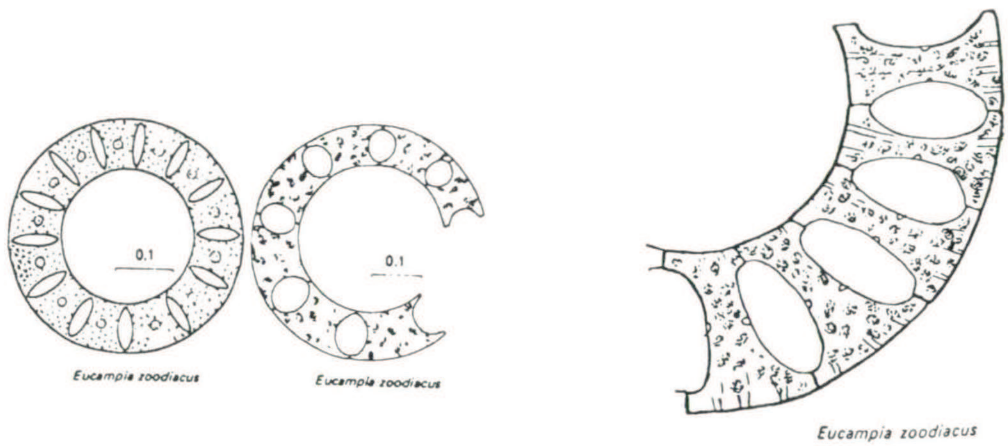
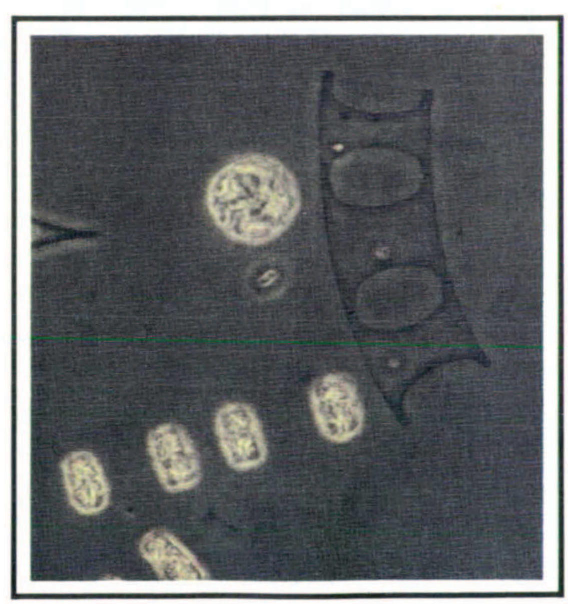


Figure 35.

Figure 36.



Hemiaulus membranaceus

Hemiaulus membranaceus is a tropical species that is also considered to be oceanic.

The configuration of the cell varies. It can be square or the width can be 5 to 6 times greater than the length. The cells are united in chains by short processes with sharp points. The openings or apertures between adjacent cells range from narrow and linear to elliptical. The valves are concave or flat between the processes. They have very fine pore openings which are difficult to see. The diameter ranges from 30 to 97 um.

Figure 37.

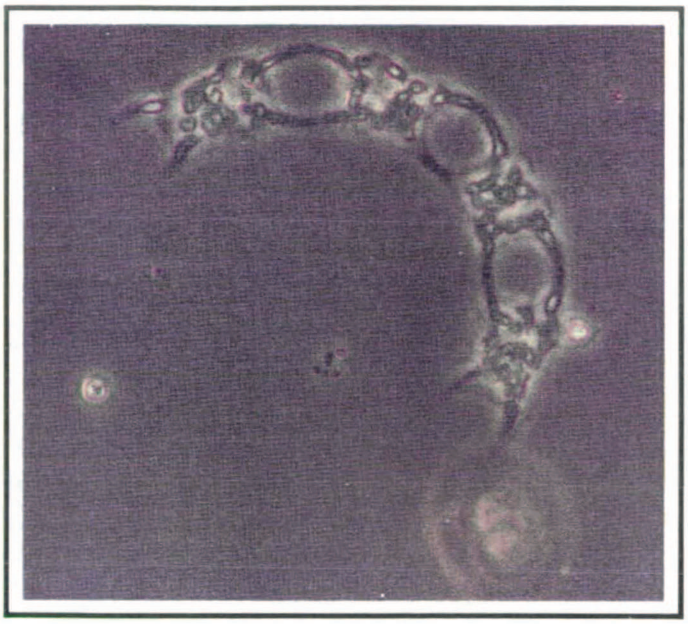


Figure 38.

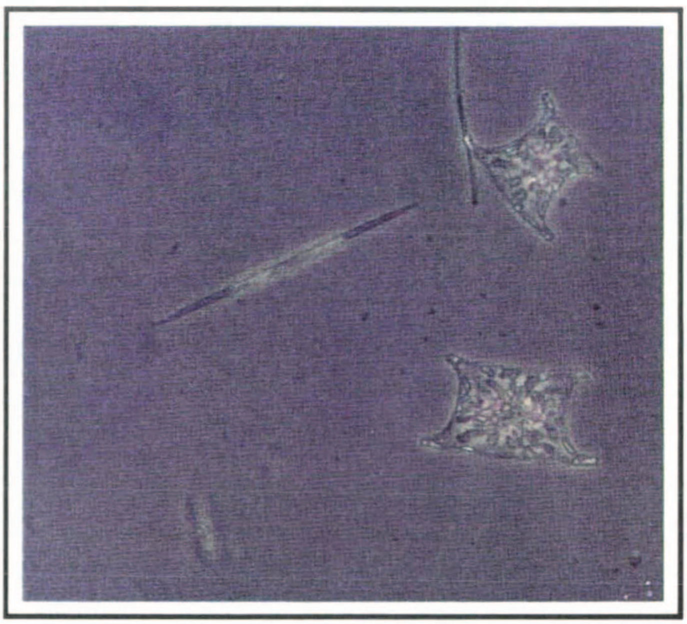
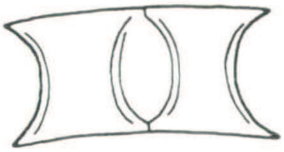


Figure 39.



Ditylum brightwelli

Ditylum brightwelli is a nearshore species that is common in northeastern bays and estuaries.

The cells vary from prisms to cylinders in shape. The valves are triangular to circular with a centrally located hollow spine, which is structureless, in the center region. The valves have about 10 pores located in the center, becoming more delicate towards the outer regions. On the valve mantle, there are 16 to 19 pores. The girdle is very long and not easily distinguisable from the valves. Staining is required to view the scalelike intercalary bands which are also marked with pores. The cell wall is weakly siliceous. The nucleus is centrally located and there are many small chloroplasts within each cell. The diameter ranges from 14 to 85 um with the length 3 to 5 times greater than the width.

Figure 40.

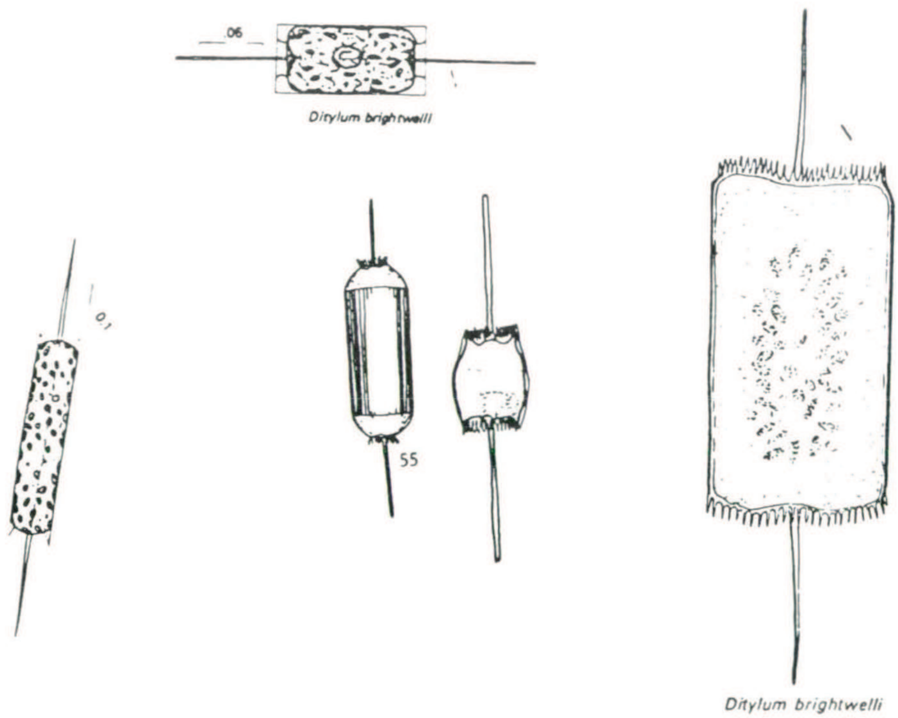


Figure 41.

Leptocylindricus minimus

Leptocylindricus minimus appears to be a nearshore species and is considered by some experts to be "opportunistic". There is a narrow limit on its light tolerance and it is dominant in northeastern waters during the spring months. Its responses to temperature and salinity are similar to that of *R. delicatula* (Riley and Conover, 1967).

The cells are tubular. In all respects this species is similar to *L. danicus* except the valves are smaller in diameter and there are only two chloroplasts per cell, which are located in the girdle area. There are many narrow intercalary bands, which have pointed ends. These composed the girdle. The cell walls terminate close above each other, giving the appearance of a parallel line to the girdle's edge. The diameter of the valve is 5 to 6 um and its length ranges from 40 to 50 um.

Figure 42.

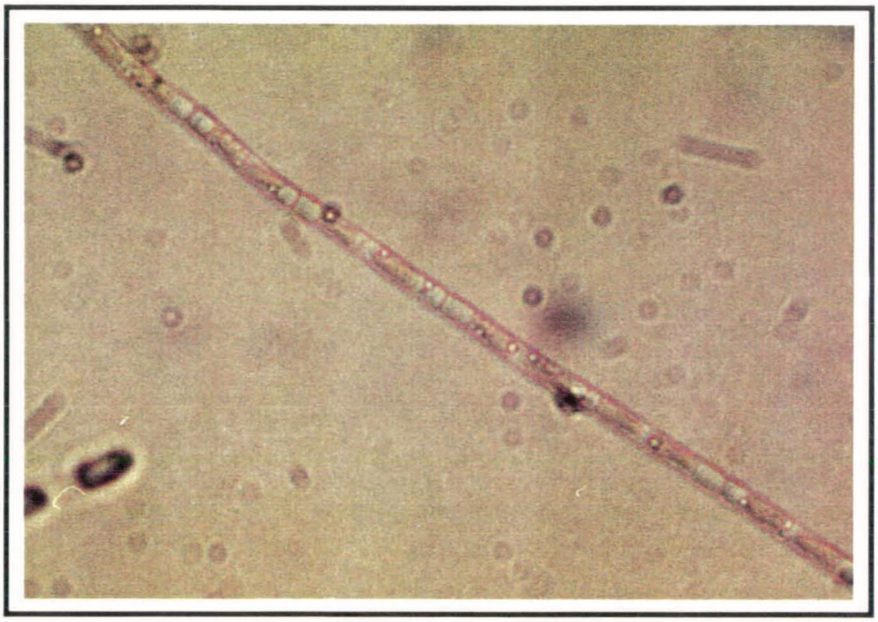
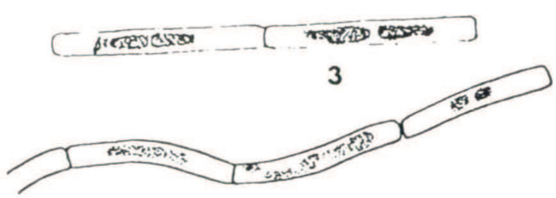


Figure 43.



Asterionella glacialis

Asterionella glacialis is a common nearshore species with a worldwide distribution which includes many northeastern coastal regions. It is generally considered to be an autumnal species, but may also be dominant during the winter months when radiation and temperature exceed the norm for this time of year. This is due to the higher growth rate of *A. glacialis* over other competing species. Its abundance during the summer is low due to temperatures beyond its tolerance range (Riley and Conover, 1967).

Its cells are very narrow with parallel sides and a greatly enlarged tricornered region at its base. The cells attach at this end to form starlike spiral colonies. The valves are also very narrow with a knoblike widening at the base. There are 28 to 34 parallel markings running across valves which are very fine. One or two small chloroplasts are found in the enlarged basal region. The length of the valve ranges from 30 to 150 um. The length and width of the enlarged region are 10 to 23 um and 8 to 12 um respectively.

Figure 44.

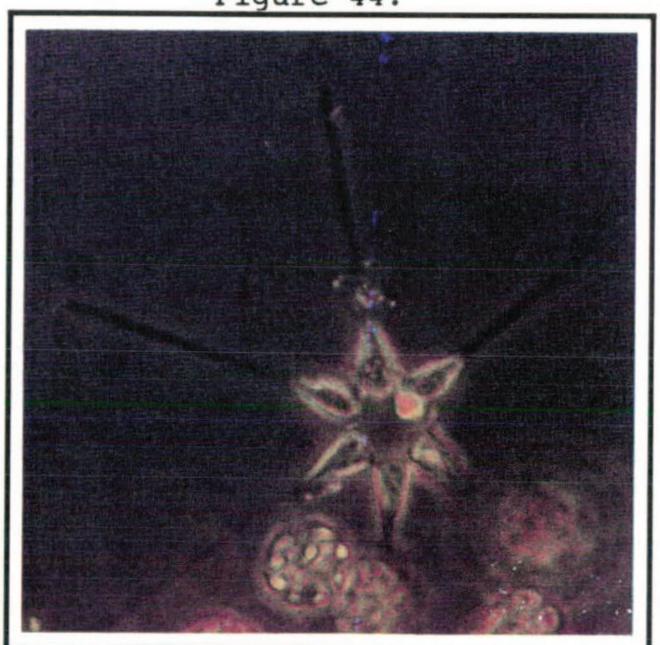
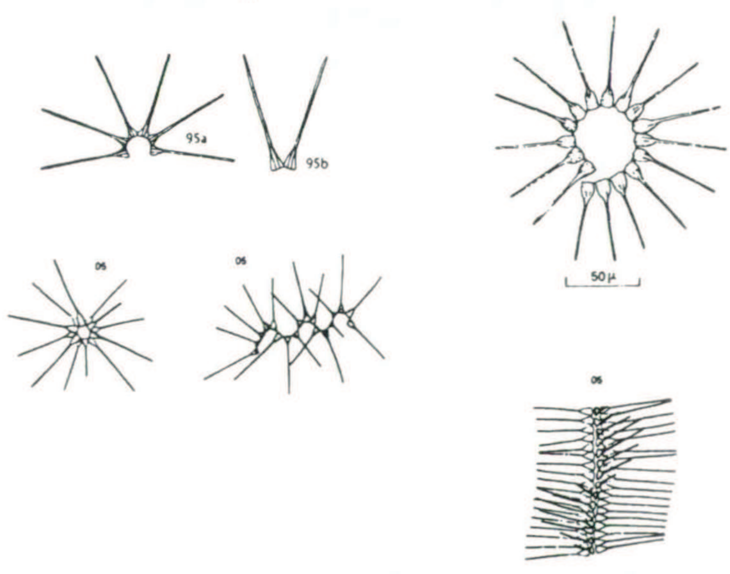


Figure 45.



Thalassionema nitzschioides

Thalassionema nitzschioides are confined primarily to nearshore regions and are ubiquitous in these areas. It has a broad tolerance to both euryhaline and eurythermal conditions and is present throughout the year. It is a dominant specie in the temperate coastal regions of the northeast.

The cells are linear and rod shaped with rounded ends. They are united in zigzag colonies with an attachment by gelatinous cushions at the angles. There are 10 to 12 small markings along the margins. The length of the valve varies from 20 to 75 um.

Figure 46.

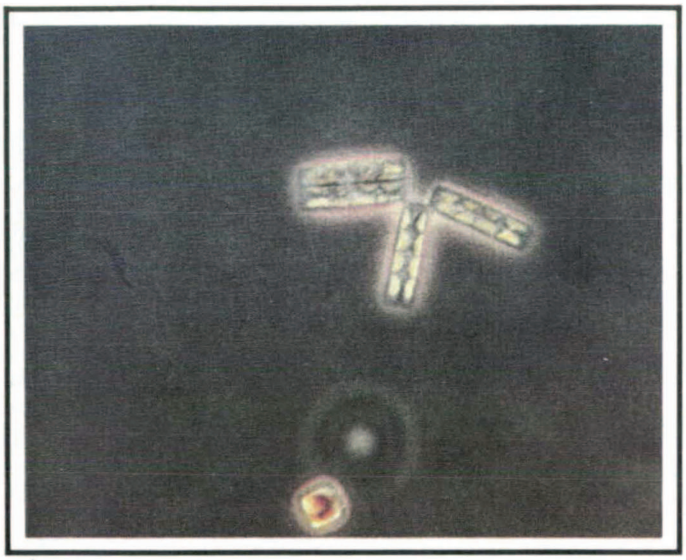


Figure 47.

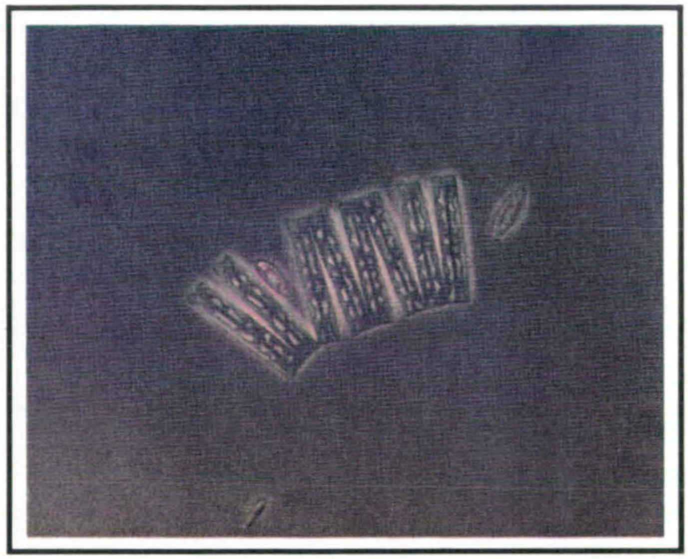
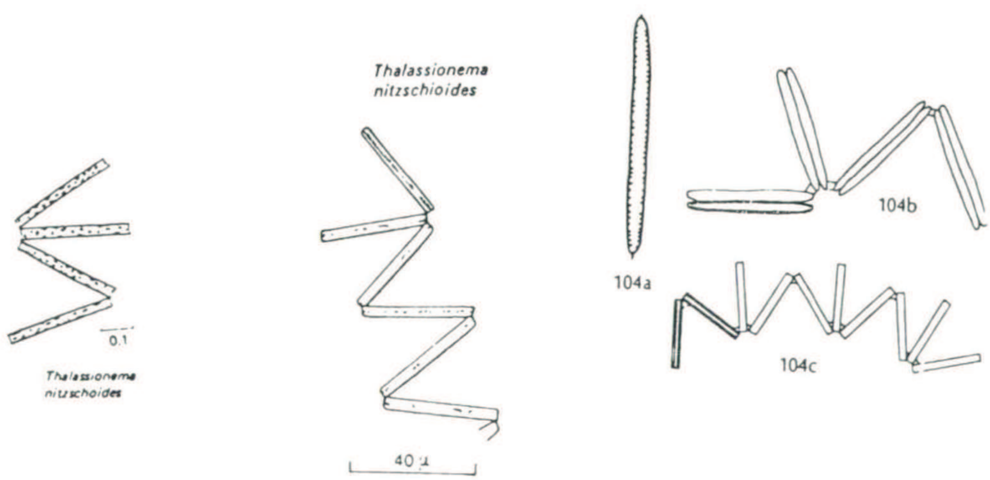


Figure 48.



Nitzschia closterium

The cells of *Nitzschia closterium* are capable of independent movement. In addition to being found in Jamaica Bay they are also common in Narragansett Bay and Long Island Sound.

The cells are spindle shaped with a long spine at each end. The opposing spines may be curved in the same or opposite directions. There are about 7 tiny markings along the keel, the flange on the valve's surface. The length of the valve is usually around 100 um, but it can vary.

Figure 49.

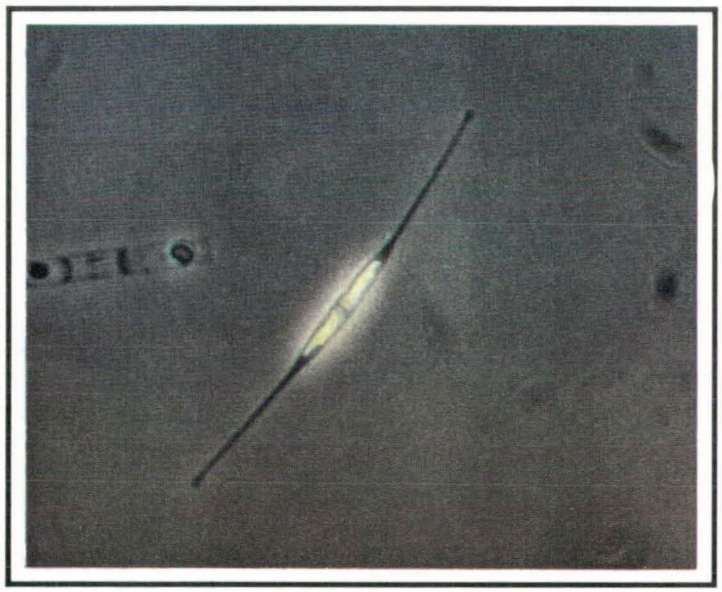
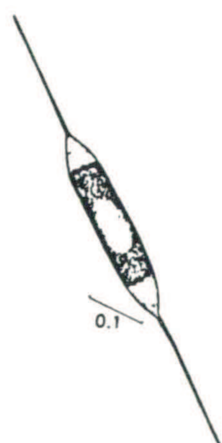


Figure 50.

Nitzschia closterium



Nitzschia closterium

Nitzschia serriata

Nitzschia serriata usually occurs in the winter season, because it is believed to have an upper temperature limit which is exceeded in late summer. In the northeast it is the dominant specie found in plankton samples throughout the winter and early spring.

Its cells are spindle shaped and form long chains by an attachment at the ends. The cells have 16 to 18 parallel markings every 10 um, but there are no distinct markings on the keel. The length of the valve varies from 80 to 110 um.

Figure 51.

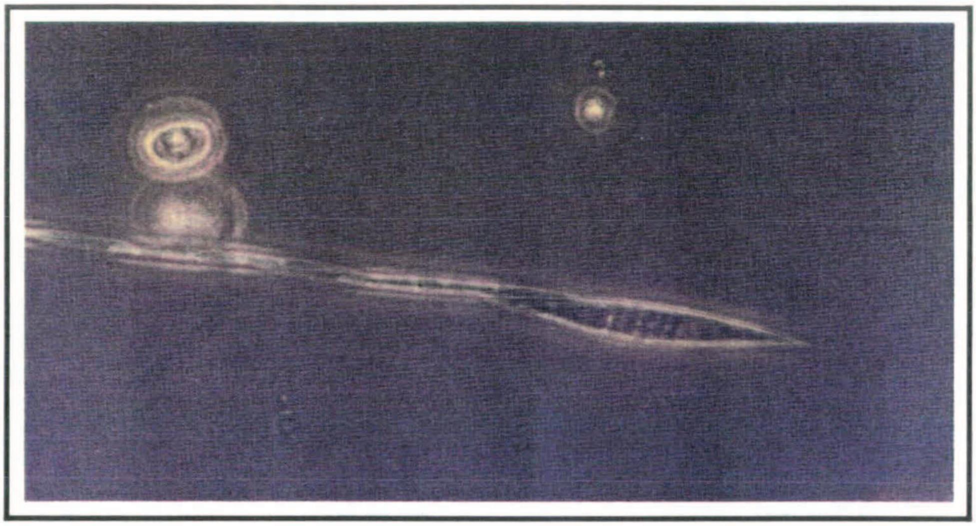
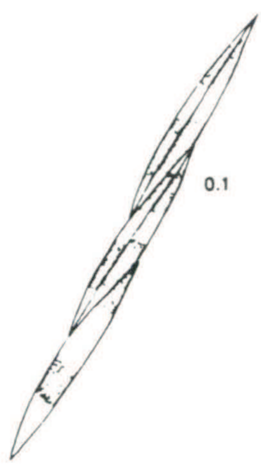


Figure 52.



6 *Nitzschia seriata*

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* Photomicrographs were originally prepared by Peterson and Dam (1986).