Iowa Science Teachers Journal

Volume 20 | Number 1 Article 7

1983

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Introduction

Diatoms are found in a wide variety of habitats. Fossil evidence suggests that diatoms are of relatively recent geologic origin in comparison to other algal groups. The oldest known fossil specimens come from the Jurassic Period (Vinyard 1979). Centric diatoms are predominant in the more ancient strata and also are the predominant forms in present day oceans (Vinyard 1979). Fossil diatoms are used to locate oil strata and water strata, to record the movement of glaciers and to reconstruct paleoecological environments.

Diatom Distribution

Living diatoms are found in a number of ecological settings. Diatoms may be restricted in their occurrence to a specific community (coenobiontic) or they may be found in a variety of communities (coenophilic). Some occur in a habitat by accident (coenoxenic).

Rhenobiontic diatoms are restricted to aquatic communities. Acidophilic diatoms are adapted to a wide range of pH levels although the range for most diatoms is from pH 6 to 9. Some diatoms are acidobiontic, preferring acid environments, while others prefer alkaline settings.

Diatoms have a wide range of temperature preferences. Eustenothermic diatoms prefer temperatures from 5°C to 15°C, mesostenothermic diatoms prefer temperatures from 10°C to 20°C, mesoeurythermic diatoms prefer temperature ranges from 15°C to 25°C, and eueurythermic diatoms prefer temperatures in the 20°C to 30°C range (Hudstedt 1957). Few diatoms can exist in temperatures above 50°C.

Light also influences the distribution of diatoms. Euphotic diatoms require bright light; dysphotic diatoms occur in dim light; and aphotic diatoms occur in dark environments.

Planktonic diatoms spend their lives afloat in the upper layers of water in aquatic communities. Small planktonic diatoms (nannoplankton) are represented by genera such as *Stephanodiscus* and *Cyclotella*. Large plankton (net plankton) are represented by generic forms such as *Synedra*, *Fragilaria* and *Melosira*.

Benthic diatoms are found on the bottoms of rivers and lakes and are represented by genera such as *Navicula*, *Surirella*, *Nitzschia* and

Campylodiscus. Most benthic diatoms possess a raphe and move about on their substrate.

Epiphytic diatoms attach themselves (by secretions) to the stems and leaves of plants. Stalk-like attachments are produced by *Cymbella* and *Gomphonema*. Whole valve attachments are produced by *Achnanthes* and *Cocconeis*. One may find *Gomphonema olivaceum* growing on fungi, and *Nitzschia* and *Eunotia* growing on the leaves and tops of sphagnum moss.

Bogs and swamps are high in humates and low in dissolved nutrients and oxygen. Diatom genera associated with such habitats are *Eunotia* and *Pinnularia*.

In rapidly flowing streams, only diatoms that secrete attachments can survive. In such situations, *Achnanthes*, *Cocconeis*, *Cymbella* and *Gomphonema* are prevalent. The speed of the current in a stream also affects the shape of diatoms. In standing water, *Desmogonium* has capitate ends which are much reduced when found in flowing water. Current affects the amount of dissolved nutrients, temperature, oxygen and turbidity which in turn affects diatom distribution.

Diatoms also occur in rivers. *Melosira*, *Cyclotella*, *Stephanodiscus*, *Fragilaria*, *Tabellaria* and *Syndedra* are commonly associated with riverine plankton. Dominant spring blooms in rivers will include *Asterionella*, *Synedra* and *Fragilaria* which are pennate genera. Autumn blooms include *Melosira*, *Cyclotella*, and *Stephanodiscus* which are centric genera. *Bacillaria* is the predominant genus during flood season.

Factors involved in lacustrine blooms include turbidity, wind, precipitation, solar radiation, and dissolved mineral content with special reference to Ca_2CO_3 and SiO_2 concentrations. Eutrophic lakes will contain planktonic genera such as *Stephanodiscus*, *Cyclotella* and *Asterionella*. Littoral forms will include *Cymbella*, *Epithemia*, *Gomphonema*, *Navicula* and *Nitzschia*. The more eutrophic the condition, the greater the ratio of centric to pennate genera. Oligotrophic environments have poorly developed populations of *Cyclotella* and *Tabellaria*. *Nitzschia* will often form films on still water.

Spray zones on lake shores include attachment secreting diatoms such as *Achnanthes*, *Cymbella*, *Gomphonema* and *Epithemia*. Moist aerial habitats will contain genera such as *Pinnularia*, *Navicula*, *Cymbella* and *Synedra*. *Fragilaria* is often associated with caves.

Interpretations

The interpretation of the ecological significance of diatom populations must be done with care. Four basic guidelines have been proposed by Hudstedt (1957).

1. Species of diatoms which occur only in very restricted environments may reflect unfavorable chemical and physical conditions when found outside their normal habitats.
2. The presence of large numbers of diatom species in a habitat does not prove that the ecological conditions observed are optimal for that species. It only indicates that the species is tolerant to the conditions present. Its status may be assessed better by the disappearance, reappearance or repression of species more sensitive to the environment being observed.
3. The concept of rare or frequent occurrence loses biological significance when the counting of individuals is done on an absolute numerical basis rather than on a number per volume (total biomass) basis.
4. Microenvironments must be carefully explored or false results will be obtained with respect to dominant species.

Summary

Many chemical and physical factors influence the distribution of diatoms within biological communities. However, care must be taken when interpreting the ecological significance of diatom populations. Diatoms can be used as biological indicators of ecological conditions if such cautions are observed.

Literature Cited

Hudstedt, F. 1957. Die Diatomeenflora des Flusssystems der Weser im Gebiet der Hansestadt Bremen. *Abh Naturwiss. Ver. Bremen* 34:181-440.
Vinyard, W.C. 1979. *Diatoms of North America.* Mad River Press, Inc. 120 pp.

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Energy Crunch

Chop up some spinach, throw in some fat, add water, sunlight and a few other chemicals, and you may end up with a recipe for easing the energy crunch.

At the Michigan State University laboratory of biophysicist Dr. H. Ti Tien, these ingredients are used to make a device for generating electricity directly from sunlight.

Supported by a five-year, $450,000 research grant from the National Institutes of Health, Dr. Tien is experimenting with artificial membranes mimicking the properties of membranes contained in plant and animal cells.

Made from fatty materials, the basic structure is less than one-millionth of an inch thick. Built into this ultra thin film is chlorophyll or other pigments which have been extracted from spinach, or, in a pinch, from grass cuttings taken from Dr. Tien's front lawn.