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DIATOM FLORA OF MINK CREEK, IDAHO, USA

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ABSTRACT.—Diatoms were collected from an open-canopy and closed-canopy site on Mink Creek, Bannock County, Idaho, a third-order Rocky Mountain stream. Ninety diatom taxa were identified. *Achnanthes minutissima* Kuetz. and *Navicula lanceolata* (Ag.) Kuetz. dominated the open-canopy site, whereas *Cocconeis placentula* var. *euglypta* (Ehr.) Cl. comprised greater than 40% of the diatom assemblage at the closed-canopy site. Seven of the 10 most important diatoms were present at both sites. A high degree of similarity was evident between natural and artificial substrates at both sites. Although most taxa were present at both sites, it is apparent from this study that differences in the abundance of taxa occur according to variations in light.

The purpose of this paper is threefold: (1) to provide a description of the diatom assemblage present in an open- and a closed-canopy section of a third-order Rocky Mountain stream, (2) to compare our findings with those of other studies on lotic diatom communities from mountain streams in Idaho, and (3) to compare the colonizing diatom assemblage on natural substrates with that on clay brick artificial substrates.

METHODS

Study Area Description

Mink Creek is a third-order stream located in the Caribou National Forest, Bannock County, Idaho, USA (112°23′ W longitude, 42°48′ N latitude). Diatom samples were collected from the East Fork and the main stem. The East Fork site had a closed canopy with solar radiation reaching the stream bed ranging from 80 to 260 uE m^{-2} s^{-1}. The main stem site had an open canopy with solar radiation reaching the stream bed ranging from 310 to 1880 uE m^{-2} s^{-1}. Solar radiation was measured with a Lambda light meter (Model LI–185). Stream temperatures at both sites ranged from 8 to 20 C. Water chemistry was analyzed in the field using a HACH kit. At the time of sampling, pH = 8.9, hardness = 220 mg l^{-1} ($CaCO_3$), ortho-phosphate = 1.0–1.7 mg l^{-1} (PO_4), nitrate = 13–17 mg l^{-1}, and turbidity = 10 FTUs. Additional descriptions of the sites are given by Robinson and Rushforth (1987).

Experimental Methods

Twenty-five half-bricks (4 × 10 × 15 cm) were placed in the stream at each site on 1 July 1983. On 14 November 1983 periphyton was collected in the field by scrubbing a 3.5-cm^2 area from the top of the half-bricks and natural substrates using a technique derived from Stockner and Armstrong (1971). A 35-ml syringe tube was reduced to 5 cm in length by removing the "needle" end, and a neoprene gasket (made from 0.5-cm wet suit material) was glued to the flared "plunger" end. During sampling, the apparatus was pressed onto the substrate surface with the neoprene gasket, thus creating a seal. Periphyton was then scrubbed into a slurry with a coarse brush. This slurry was pipetted into a storage vial, placed on ice, and returned to the laboratory. Two samples were collected from each substrate, one being analyzed for chlorophyll *a* and one for diatoms.

Chlorophyll *a* samples were vacuum filtered (103 kPa) through 2.4-cm Whatman GF/C filters (pore size 0.45 um) and immediately frozen at −20 C for analysis later. Chlorophyll *a* was extracted by grinding the previously frozen filter in 3 ml reagent-grade acetone (100%). The extractant was transferred to a centrifuge tube, filled to 10 ml with acetone, and then refrigerated at 4 C for 24 hours. Chlorophyll *a* and pheaopigment concentrations were determined using a Turner model 111 fluorometer by multiplying the fluorescence reading for each sample by a calibration factor derived with a Beckman Instruments

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TABLE 1. Ten most important diatom taxa, species importance values (FDI), species richness values, and Simpson's diversity values categorized by site and substrate type. N = number of samples. **Species notation descriptions.

Species rating	East bricks N = 25	Main bricks N = 23	All bricks N = 48	East natural N = 5	Main natural N = 2	All combined N = 55
1	COPE	NALA	COPE	COPE	ACMI	COPE
2	NALA	NIDI	NALA	ACMI	NALA	ACMI
3	ACMI	COPE	ACMI	NALA	COPE	NALA
4	ACLA	ACMI	NIDI	NIPA	NACV	NACV
5	AMPE	AMPE	AMPE	GOOL	NIDI	NIDI
6	NIDI	NACV	ACLA	NIDI	NART	NIPA
7	NACV	NATR	NACV	NACV	NATR	GOOL
8	NASA	NASA	NASA	NASA	AMPE	NASA
9	GOOL	ACLA	NIPA	ACLA	NASA	AMPE
10	NIPA	SUOV	GOOL	AMPE	GOOL	ACLA
Importance values						
Top species	48.4	23.2	35.1	42.3	26.9	32.9
Top 5 species	82.9	84.9	81.3	76.6	77.2	75.8
Top 10 species	92.8	91.7	91.3	92.2	90.2	89.7
Others	3.3	5.4	4.9	2.8	7.1	3.2
Species richness	55	79	90	34	40	49
Simpson's diversity	.29	.17	.20	.24	.18	.19

**ACLA *Achnanthes lanceolata* (Brev.) Grun. in Cl. & Grun., ACMI *A. minutissima* Kuetz., AMPE *Amphora perpusilla* (Grun.) Grun., COPE Cocconeis placentula var. *euglypta* (Ehr.) Cl., GOOL *Gomphonema olivaceum* (Lyngb.) Kuetz., NACV *Navicula cryptocephela* var. *veneta* (Kuetz.) Rabh., NALA *N. lanceolata* (Ag.) Kuetz., NART *N. radiosa* var. *tenella* (Breb. ex Kuetz.) Grun., NASA *N. secreta* var. *apiculata* Patr., NATR *N. tripunctata* (O. F. Muell.) Bory, NIDI *Nitzschia dissipata* (Kuetz.) Grun., NIPA *N. palacea* Grun., SUOV *Surirella ovalis* Breb.

model-DB spectrophotometer (American Public Health Association 1980).

Diatom samples were boiled in concentrated nitric acid, rinsed, and strewn mounts prepared using Naphrax mountant following methods described by St. Clair and Rushforth (1976). The samples were examined under 1,000X oil immersion using a Zeis RA microscope with Nomarski and bright field optics. Each species was photographed for identification. Counts of 300–400 diatom frustules were made from each slide to determine percent relative density, species richness, and Simpson's diversity index (Simpson 1949). The most important diatom taxa present in the study were determined using a species importance index (FDI). This was calculated by multiplying percent presence (frequency) by average percent relative density in all samples (Warner and Harper 1972, Ross and Rushforth 1980, Robinson and Rushforth 1987). Species present on the bricks were added to those from the natural substrates to provide a complete taxonomic listing of the diatoms of Mink Creek.

RESULTS AND DISCUSSION

Chlorophyll *a* values ranged from 30 to 113 g/m^2. The lower chlorophyll values were found at the East Fork site and can be attributed to low light intensity (Towns 1981). Chlorophyll *a* values were found to be highly correlated (r = .85) to ash-free dry weights of individual samples. This suggests that chlorophyll values were indicative of algal standing crops in study sections, and that algal material collected was composed primarily of living cells.

The chlorophyll *a* values found in this study were consistent with values found for the Middle Fork of the Salmon River of Idaho (Cushing et al. 1983). Overall, fewer taxa were found in Mink Creek (third order) than in the Middle Fork of the Salmon River (seventh order). In addition, Cushing and Rushforth (1984) found *A. minutissima* Kuetz. and *C. placentula* var. *euglypta* (Ehr.) Cl. to be prevalent in the Middle Fork of the Salmon River. Both of these taxa were predominant in Mink Creek. This predominance of small, adnate growth forms found in Mink Creek can be attributed to grazing by invertebrates (Sumner and McIntire 1982, Gregory 1983, Peterson 1987, Hill and Knight 1988) or frequent physical disturbance (Luttenton and Rada 1986, Robinson and Rushforth 1987).

A total of 90 diatom taxa were identified from Mink Creek. Species richness varied

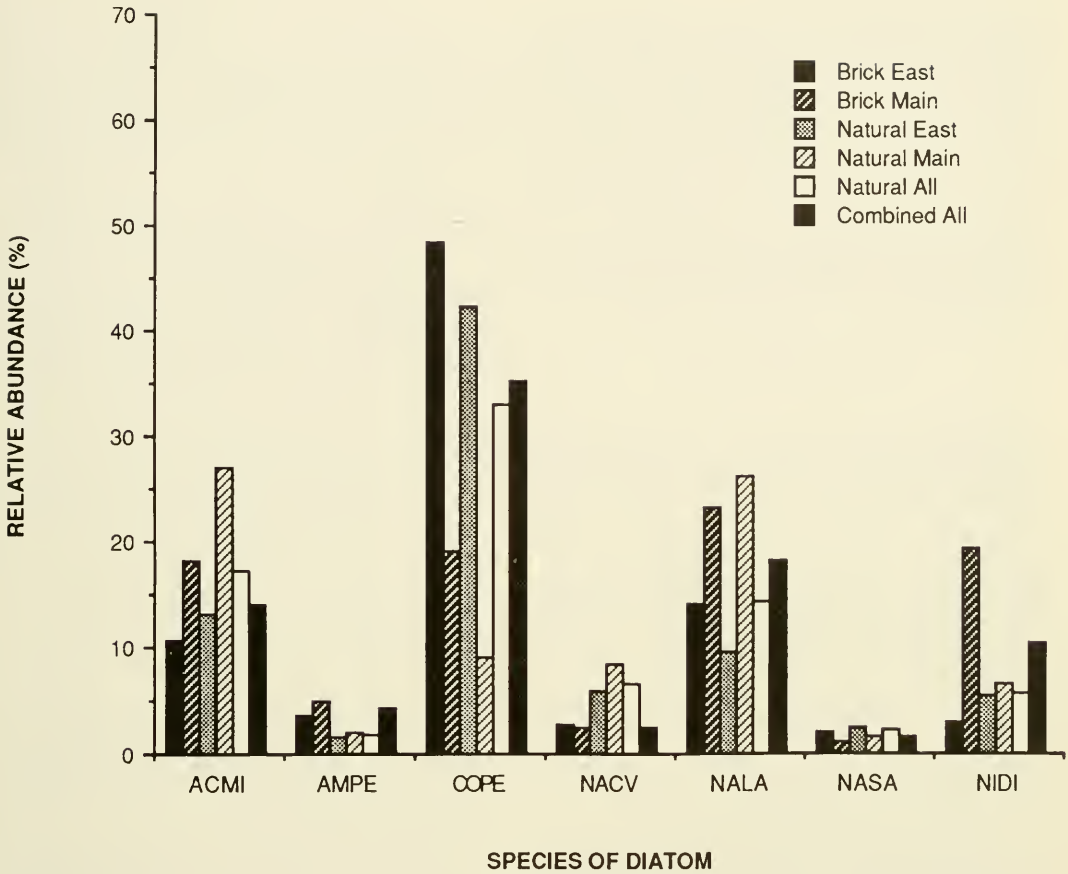

Fig. 1. Relative abundances of 7 diatom taxa from the 10 most important taxa common to each site and substrate type. ACMI = *Achnanthes minutissima* Kuetz., AMPE = *Amphora perpusilla* (Grun.) Grun., COPE = *Cocconeis placentula* var. *euglypta* (Ehr.) Cl., NACV = *Navicula cryptocephela* var. *veneta* (Kuetz.) Rabh., NALA = *Navicula lanceolata* (Ag.) Kuetz., NASA = *Navicula secreta* var. *apiculata* Patr., NIDI = *Nitzschia dissipata* (Kuetz.) Grun.

widely between sites, ranging from 55 taxa at the East Fork to 79 taxa at the main stem (Table 1). Fewer species were found on natural substrates than on the clay half-bricks. The greater number of taxa found on the bricks may simply be an artifact of a difference in sample size (Table 1). The top 10 taxa predominated the system, and 7 of the 10 most important taxa (by FDI) were found in all samples, with the remaining taxa being low in abundance. A complete taxonomic list can be found in Robinson and Rushforth (1987).

Differences also exist within the diatom community between sites. *Cocconeis placentula* var. *euglypta* (Ehr.) Cl. comprised over 40% of the community in the East Fork, whereas *Navicula lanceolata* (Ag.) Kuetz. and *Achnanthes minutissima* Kuetz. dominated the main stem, with combined relative abundances of greater than 53% (Fig. 1). Simpson's index (an index of dominance) was greater in the East Fork than in the main stem (Table 1), further emphasizing the predominance of *C. placentula* var. *euglypta* (Ehr.) Cl. at the East Fork site. Of interest is the evidence of a high degree of similarity among samples within a site, and the relatively low similarity between sites. Considering all samples, the East Fork had an average of 70.1% within-group similarity. The within-group similarity of the main stem equaled 68.2%, whereas between-group similarity equaled only 35%.

Numerous studies have demonstrated good comparability of manufactured substrates with

natural substrates after a set colonization period (e.g., Tuchman and Blinn 1979, Tuchman and Stevenson 1980, Lamberti and Resh 1985). Our study also displays good comparability of artificial substrates with natural substrates. However, specific site differences were evident, suggesting that diatom studies should be made at the site-specific scale of study to take into account possible differences in physical or chemical properties between sites (see also Clark and Rushforth 1977).

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