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# Notes on Autumn Collections of Diatoms from Brewer's Creek, Hamilton County, Iowa[1]

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SYNOPSIS: Biweekly diatom collections and chemical analyses were made in the autumn of 1970 from sites on Brewer's Creek, a small central Iowa stream, and the Boone River. Eight diatom collection sites and five chemical analysis sites were used. Diatom population data and chemical data both indicate that this is a high alkaline, eutrophic stream. The creek water has a high conductivity which may, in part, explain why diatoms considered to be mesohalobous are present in the collections.

## INTRODUCTION

Diatom studies and water analyses have been conducted on small Iowa streams in the past. A study of Dugout Creek was made by Shobe et al. (1962) in the northwestern part of the state. E. J. Fee (1967) completed a more intensive study in Dutch Creek in east-central Iowa. This study was made on a small stream in central Iowa about midway between the other creeks studied. Chemical analyses of water and diatom populations were reported in these papers, but not correlated. We made similar observations and have attempted to show a relationship between the two.

## STUDY AREA

The stream selected for study was Brewer's Creek in Hamilton County, Iowa. It meanders for about one and one-half miles through Freedom, Fremont and Independence Townships (T-88-N; R-36 W). It originates in farmland made up of Clarion-Webster glacial till. The last mile of the stream flows through Webster City where it enters the Boone River. The creek bottom is mud in its upper reaches, changing to sand and gravel in the central area, finally becoming extremely rocky in the last 100 yards before the river.

TABLE 1a. CHEMICAL DATA BREWER'S CREEK

| Date | Alk ppm $CaCO_3$ | Total Hardness Mg | Ca | Total ppm $CaCO_3$ | Ortho $PO_4$ | Turb. JTU | $NH_4$ ppmN | $NO_3$ ppmN | $NO_2$ ppmN |
|---|---|---|---|---|---|---|---|---|---|
| Sept. 28, 1970 | | | | | | | | | |
| Station #1 | 250 | 70 | 260 | 330 | 1.00 | 50 | 0.40 | 17.6 | 0.175 |
| #2 | 200 | 60 | 170 | 330 | 0.30 | 32 | 0.45 | 22.0 | 0.182 |
| #5 | 290 | 100 | 260 | 360 | 0.02 | 5 | 0.54 | 22.0 | 0.281 |
| Boone ) #7 | 230 | 115 | 200 | 315 | 0.60 | 45 | 0.62 | 10.6 | 0.017 |
| River) #8 | 235 | 120 | 180 | 300 | 0.50 | 42 | 0.70 | 13.2 | 0.017 |
| Oct. 7, 1970 | | | | | | | | | |
| Station #1 | 300 | 200 | 180 | 380 | 0.23 | 90 | 2.65 | 59.4 | 0.026 |
| #2 | 280 | 230 | 110 | 340 | 0.21 | 38 | 4.60 | 38.7 | 0.109 |
| #5 | 310 | 140 | 250 | 390 | 0.50 | 15 | 0.61 | 8.8 | 0.003 |
| Boone ) #7 | 230 | 130 | 170 | 300 | 0.85 | 30 | 0.53 | 13.2 | 0.017 |
| River) #8 | 245 | 210 | 100 | 310 | 0.70 | 28 | 0.10 | 8.8 | 0.017 |
| Oct. 21, 1970 | | | | | | | | | |
| Station #1 | 305 | 160 | 285 | 445 | 0.55 | 20 | 0.62 | 37.4 | 0.396 |
| #2 | 305 | 185 | 195 | 380 | 0.75 | 7 | 0.40 | 35.2 | 0.241 |
| #5 | 330 | 170 | 270 | 440 | 0.48 | 0 | 0.14 | 48.4 | 0.198 |
| Boone ) #7 | 285 | 170 | 210 | 380 | 0.40 | 8 | 0.44 | 17.6 | 0.059 |
| River) #8 | 300 | 130 | 245 | 375 | 0.75 | 12 | 0.38 | 26.2 | 0.073 |
| Nov. 4, 1970 | | | | | | | | | |
| Station #1 | 345 | 170 | 310 | 480 | 2.00 | 20 | 0.12 | 66.0 | 0.185 |
| #2 | 315 | 140 | 300 | 440 | 0.90 | 15 | 0.20 | 66.0 | 0.149 |
| #5 | 325 | 170 | 275 | 445 | 0.50 | 10 | 0.20 | 66.0 | 0.145 |
| Boone ) #7 | 295 | 160 | 230 | 390 | 0.60 | 0 | 0.15 | 44.0 | 0.026 |
| River) #8 | 310 | 150 | 260 | 410 | 0.60 | 5 | 0.08 | 52.8 | 0.043 |
| Nov. 18, 1970 | | | | | | | | | |
| Station #1 | 321 | 190 | 300 | 490 | 0.50 | 22 | 0.25 | 83.6 | 0.066 |
| #2 | 283 | 155 | 325 | 480 | 0.50 | 12 | 0.20 | 61.6 | 0.049 |
| #5 | 284 | 155 | 310 | 465 | 0.76 | 5 | 0.10 | 83.6 | 0.059 |
| Boone ) #7 | 283 | 125 | 305 | 430 | 0.50 | 9 | 0.12 | 52.8 | 0.059 |
| River) #8 | 293 | 155 | 290 | 445 | 0.30 | 15 | 0.15 | 55.0 | 0.036 |

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TABLE 1b. CHEMICAL DATA BREWER'S CREEK

| Date | $SO_4$ | Mn | Cl | $SiO_4$ | Cu | Fe | Disso $O_2$ | pH | Temp. |
|---|---|---|---|---|---|---|---|---|---|
| Sept. 28, 1970 | | | | | | | | | |
| Station #1 | 145 | 8.0 | 55 | 6.6 | 0.01 | 0.14 | 10 | 8.50 | 17.5°C |
| #2 | 150 | 4.7 | 50 | 3.8 | 0.08 | 0.12 | 12 | 8.75 | 23.5 |
| #5 | 200 | 13.6 | 40 | 6.4 | 0.10 | 0.02 | 8 | 8.48 | 14.5 |
| Boone ) #7 | 220 | 9.0 | 40 | 4.2 | 0.22 | 0.10 | 7 | 8.50 | 18.5 |
| River) #8 | 225 | 5.7 | 40 | 4.2 | 0.15 | 0.21 | 13 | 8.70 | 19.5 |
| Oct. 7, 1970 | | | | | | | | | |
| Station #1 | 265 | 10.0 | 35 | 3.0 | 0.15 | 0.62 | 10 | 7.50 | 17.5 |
| #2 | 115 | 12.0 | 60 | 9.8 | 0.15 | 0.20 | 9 | 8.25 | 17.5 |
| #5 | 130 | 18.5 | 45 | 4.9 | 0.15 | 0.05 | 5.5 | 8.10 | 17.5 |
| Boone ) #7 | 155 | 5.0 | 45 | 5.8 | 0.15 | 0.13 | 9 | 8.90 | 20.5 |
| River) #8 | 145 | 8.0 | 50 | 3.4 | 0.11 | 0.20 | 6 | 8.10 | 19.5 |
| Oct. 21, 1970 | | | | | | | | | |
| Station #1 | 130 | 17.0 | 32 | 5.0 | 0.17 | 0.09 | 9 | 8.45 | 14.0 |
| #2 | 150 | 10.5 | 32 | 4.0 | 0.15 | 0.06 | 14 | 8.63 | 17.0 |
| #5 | 125 | 16.0 | 40 | 5.0 | 0.15 | 0.08 | 12 | 8.40 | 12.0 |
| Boone ) #7 | 125 | 17.0 | 28 | 3.8 | 0.13 | 0.04 | 12 | 8.45 | 15.0 |
| River) #8 | 125 | 11.5 | 32 | 3.3 | 0.13 | 0.08 | 12 | 8.40 | 15.0 |
| Nov. 4, 1970 | | | | | | | | | |
| Station #1 | 135 | 16.0 | 57 | 3.8 | 0.10 | 0.80 | 10 | 8.48 | 7.0 |
| #2 | 120 | 17.5 | 45 | 4.6 | 0.09 | 0.08 | 12 | 8.48 | 9.0 |
| #5 | 125 | 15.5 | 55 | 5.0 | 0.05 | 0.04 | 10 | 8.52 | 7.0 |
| Boone ) #7 | 110 | 15.5 | 40 | 3.9 | 0.15 | 0.02 | 9 | 8.40 | 7.0 |
| River) #8 | 125 | 17.0 | 40 | 2.9 | 0.14 | 0.05 | 11 | 8.43 | 6.0 |
| Nov. 18, 1970 | | | | | | | | | |
| Station #1 | 125 | 14.5 | 55 | 4.2 | 0.22 | 0.11 | 7 | 8.60 | 5.0 |
| #2 | 160 | 12.0 | 42 | 3.4 | 0.18 | 0.05 | 8 | 8.55 | 5.0 |
| #5 | 135 | 20.0 | 50 | 4.8 | 0.13 | 0.04 | 8 | 8.55 | 5.0 |
| Boone ) #7 | 120 | 13.1 | 42 | 4.8 | 0.13 | 0.05 | 9 | 8.60 | 4.0 |
| River) #8 | 128 | 14.5 | 40 | 3.3 | 0.14 | 0.02 | 11 | 8.55 | 4.0 |

## METHODS AND MATERIALS

Chemical and physical parameters were determined on a biweekly basis from September 28 to November 18, 1970. This information was collected near the stream's origin (station 1), about midway downstream (station 2) and near the mouth (station 5). The same conditions were measured on the Boone River: one just above the mouth of the stream (station 7) and one just below (station 8). A Hach Engineers Portable Water Testing Laboratory (model Dr-El) was used. All collections and tests were made in the afternoon hours.

Diatom collection stations were selected at random at six points (1-6) along the stream and two places (7-8) on the river (Table 3). Rock and plant scrapings and bottom samples were made at each station on a biweekly basis. Higher plant forms were scarce in the collecting areas but filamentous algal mats were common. The diatom collections were cleaned by using the hydrogen peroxide-potassium dichromate method (Van der Werff, 1953). Burned mounts were also made from each collection, and it was these slides that were used for identification and counting. Uncleaned material from each collection was preserved in formalin-acetic acid-alcohol (FAA) and retained by the senior author.

The cleaned material was placed on #1 cover slips, air dried, then burned for one and one-half hours (Christensen, 1971) and mounted in Hyrax on microscope slides. These slides have been catalogued and numbered Ia-2e2a to Ia-8e5a. Most of the diatom identification specimens have been circled with a diamond marker (Table 2). A duplicate set of slides has been deposited at the Iowa Lakeside Laboratory Diatom Herbarium, Milford, Iowa.

Relative abundance was first determined by completing genera counts of 500 frustules on each slide under oil immersion (Table 3). The slides were then scanned to identify all taxa present.

## RESULTS

The chemical data are contained in table 1a-1b. The water is hard and of relatively high pH (7.5-8.9). This is considered normal for natural waters in this area of the state and in agreement with other Iowa stream studies. It is evident from the table that both calcium and total hardness tend to be greater in the stream than in the river.

Total alkalinity shows an increase as the stream passes over the limestone outcroppings between stations 2 and 5. The results of the tests indicate that total alkalinity is higher in the stream than in the Boone river. It is from these results that the stream's high conductivity can be implied.

The stream water gradually cleared as autumn progressed. Turbidity was always highest over the muddy bottom and lowest in the rocky area near the mouth of the stream. Nitrate readings during this same period tended to increase. The studies also show consistently higher nitrate and nitrite readings in the creek. The low chloride readings in October are perhaps a reflection of the dilution factor resulting from heavy rains during the month.

The stream, in general, reflected environmental changes

more rapidly and to a greater degree than the larger Boone river. Even though temperature readings became lower during the study, the readings tended to remain higher in the stream than in the river.

TABLE 2. DIATOM TAXA IDENTIFIED, BREWER'S CREEK

*Achanthes hauckiana* Grun.
*A. lanceolata* (Bréb.) Grun.
*Amphora ovalis* var. *affinis* (Kütz.) V.H.
*A. ovalis* var. *pediculus* Kütz.
*Anomoeoneis sphaerophora* (Ehr.) Pfitzer
*Caloneis amphisbaena* (Bory) Cleve
*C. bacillum* (Grun.) Cleve
*C. lewisii* Patr.
*C. lewisii* var. *inflata* (Schultze) Patr.
*Cocconeis pediculus* Ehr.
*C. placentula* var. *euglypta* (Ehr.) Cleve
*Cyclotella atomos* Hust.
*C. meneghiniana* Kütz.
*Cylindrotheca gracilis* (Bréb.) Grun.
*Cymatapleura cochlea* J. Brun
*C. solea* (Bréb.) W. Sm.
*Cymbella ventricosa* Kütz.
*Diatoma vulgare* Bory
*Diploneis puella* (Schumann) Cleve
*Epithemia turgida* (Ehr.) Kütz.
*Eunotia curvata* (Kütz.) Lagerst
*Fragilaria vaucheriae* (Kütz.) Peters
*Frustulia vulgaris* Thwaites
*Gomphonema accuminatum* var. *coronata* (Ehr.) W. Sm.
*G. acuminatum* var. *turris* (Ehr.) Cleve
*G. lanceolatum* var. *insignis* (Greg.) Cleve
*G. olivaceum* (Lyngbye) Kütz.
*G. parvulum* (Kütz.) Grun.
*Gyrosigma acuminatum* (Kütz.) Rabh.
*Melosira varians* Agardh
*Meridion circulaire* Agardh
*Navicula capitata* Ehr.
*N. cuspidata* (Kütz.) Kütz.
*N. decussis* Østr.
*N. gastrum* (Ehr.) Kütz.
*N. lanceolata* (Agardh) Kütz.
*N. luzonensis* Hust.
*N. pupula* Kütz.
*N. pupula* var. *rectangularis* (Greg.)
*N. pygmaea* Kütz.
*N. tripunctata* (O. F. Mull.) Bory
*N. viridula* var. rostellata (Kütz.) Cleve
*Neidium affine* (Ehr.) Cleve
*Nitzschia acicularis* (Kütz.) W. Sm.
*N. amphibia* Grun.
*N. angustata* (W. Sm.) Grun.
*N. apiculata* (Greg.) Grun.
*N. vitrea* var. *salinarum* Grun.
*N. fonticola* Grun. in V. H.
*N. frustulum* var. *perminuta* Grun.
*N. hungarica* Grun.
*N. linearis* (Agardh.) W. Sm.
*N. longissima* var. *reversa* Grun.
*N. palea* (Kütz.) W. Sm.
*N. sigmoidea* (Nitzsch.) W. Sm.
*Pinnularia brebissonii* (Kütz.) Rebh.
*P. iridis* (Nitzsch.) Ehr.
*Rhoicosphenia curvata* (Kütz.) Grun.
*Rhopalodia gibba* (Ehr.) O. Mull.
*R. gibberula* (Ehr.) O. Mull.
*Stauroneis acuta* W. Sm.
*S. phoenicenteron* (Nitzsch.) Ehr.
*S. smithii* Grun.
*Surirella angusta* Kütz.
*S. brightwelii* W. Sm.
*S. ovata* Kütz.
*S. tenera* Greg.
*Synedra rumpens* Kütz.
*S. ulna* (Nitzsch.) Ehr.

We identified 69 diatom taxa from 28 genera (Table 2), including 20 genera with a raphe in both valves and eight with a raphe in only one valve or lacking a raphe. *Navicula* and *Nitzschia* constituted the largest part of the populations in most collections. Results show that the *Navicula*, in general, represented a larger percent of the stream populations than those of the river. *Surirella* and *Synedra* became more numerous in late autumn; *Amphora* and *Cyclotella* species, on the other hand, almost disappear.

## DISCUSSION

Our data reveal that the water in this stream is hard. The high phosphate and nitrogen readings indicate a eutrophic condition. The stream also shows high pH and alkalinity readings which reflect the high conductivity present in the water.

The diatom flora of Brewer's creek reflects the high pH. The forms encountered have been classified from pH-indifferent through alkaliphilous to alkalibiontic. *Anomoeoneis sphaerophora* and *Gyrosigma acuminatum* are examples of alkalibiontic taxa as reported by Foged (1954) and Hustedt (1930).

Plankton forms of diatoms were collected only from small, calm, backwater pools. They represent only a minority of the total population. Species of floating forms of diatoms observed included: *Cyclotella atomos, C. meneghiniana, Epithemia turgida, Fragilaria vaucheriae, Gomphonema accuminatum* var. *coronata, Melosira varians, Navicula gastrum, N. lanceolata, Nitzschia acicularis* and *Synedra rumpens.*

*Anomoeoneis sphaerophora, Caloneis amphisbaena* and *Cylotella meneghiniana* are listed (Foged, 1951) as halophilous diatoms (0-5% salt). *Cylindrotheca gracilis, Achnanthes hauckiana, Navicula pygmaea* and *Nitzschia apiculata* are considered (Foged, 1951) to be mesohalobous diatoms (5-20% salt). Various authors have indicated that these diatoms are brackish water forms. We suggest that the presence of these diatoms in this and other small Iowa streams are an indication of their environmental requirement for high conductivity in the water rather than their need for chloride ions (Christensen-Reimer, 1968).

The majority of species in the diatom population indicate, by their presence in this stream, an alkaline, eutrophic condition in the water. This correlates well with the chemical data. Indicator species observed for high alkalinity and eutrophic conditions are *Gyrosigma acuminatum, Nitzschia palea, Gomphonema accuminatum* and *Anomoeoneis sphaerophora* (Foged, 1951).

TABLE 3a DIATOM POPULATIONS IN %, BREWER'S CREEK

| | | Achnanthes | Amphora | Anomoeoneis | Caloneis | Cocconeis | Cyclotella | Cylindrotheca | Cymatapleura | Cymbella | Diatoma | Diploneis | Epithemia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sept. 28, '70 | | | | | | | | | | | | | |
| Station | #1 | 6.0 | 2.6 | | | | + | 1.0 | x | x | | + | |
| | 2 | 1.6 | x | | | | 1.0 | | | + | | x | |
| | 3 | 1.6 | + | | x | x | 2.2 | x | x | + | | x | |
| | 4 | 1.2 | + | | | x | 1.0 | x | | + | | x | |
| | 5 | 1.4 | 1.6 | | x | | 4.8 | x | | + | | + | |
| | 6 | 1.0 | 1.2 | | | | 9.2 | | | x | | + | |
| Boone) | 7 | + | + | | x | x | 72.4 | | x | x | | | |
| River ) | 8 | + | x | | x | x | 55.8 | | x | + | | | |
| Oct. 7, '70 | | | | | | | | | | | | | |
| Station | #1 | + | 1.7 | x | | | + | x | x | + | | x | |
| | 2 | 1.5 | + | | + | x | 1.9 | x | x | x | x | x | |
| | 3 | + | 2.8 | x | x | x | + | x | x | + | x | + | |
| | 4 | 3.6 | + | | | x | 2.6 | | | + | | 1.6 | |
| | 5 | 2.5 | 11.2 | | + | + | 6.5 | | + | + | | 2.5 | |
| | 6 | 2.8 | 4.0 | | + | + | 8.0 | | x | + | x | + | |
| Boone) | 7 | 1.8 | x | | x | | 52.2 | | x | x | | | |
| River ) | 8 | + | + | | x | x | 44.9 | | + | | | + | |
| Oct. 18, '70 | | | | | | | | | | | | | |
| Station | #1 | + | 3.5 | | + | + | 1.1 | x | + | x | | x | |
| | 2 | 1.0 | + | | + | | + | x | | + | | x | |
| | 3 | + | + | | | | + | x | | x | x | | |
| | 4 | 1.2 | + | | x | x | x | | x | + | | x | |
| | 5 | + | 1.0 | | + | x | 2.2 | | x | x | | + | x |
| | 6 | + | + | x | x | + | 1.2 | | x | + | x | x | x |
| Boone) | 7 | + | + | | x | x | 16.4 | | + | x | x | x | |
| River ) | 8 | + | x | x | x | x | 3.4 | x | x | x | | | x |
| Nov. 4, '70 | | | | | | | | | | | | | |
| Station | #1 | x | + | | | x | x | x | + | x | | x | |
| | 2 | + | x | | + | | x | x | | + | | | |
| | 3 | 1.4 | + | | | | + | + | | + | | | |
| | 4 | + | + | | + | | + | | x | x | | | |
| | 5 | + | x | | x | | + | | | + | | x | |
| | 6 | + | + | | x | x | + | | x | + | | x | |
| Boone) | 7 | + | x | | x | x | 3.2 | | x | | | + | |
| River ) | 8 | 3.0 | x | | | x | 2.2 | | x | x | | | |
| Nov. 18, '70 | | | | | | | | | | | | | |
| Station | #1 | 1.2 | + | | | x | 1.0 | x | | + | | | |
| | 2 | 1.8 | x | | + | | + | | | x | x | | |
| | 3 | + | x | | x | | + | x | | + | x | | |
| | 4 | 2.4 | x | | + | | | | | + | | | |
| | 5 | 1.2 | x | | + | x | x | | | + | | x | |
| | 6 | + | x | | x | | + | | + | + | | | x |
| Boone) | 7 | | x | x | x | | + | | x | | | | |
| River ) | 8 | 5.6 | x | | x | | x | | x | | | | |

+ = less than 1%
x = present

TABLE 3b DIATOM POPULATIONS IN %, BREWER'S CREEK

| | Fragilaria | Gomphonema | Gyrosigma | Melosira | Navicula | Nitzschia | Pinnularia | Rhoicosphenia | Rhopalodia | Stauroneis | Surirella | Synedra |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sept. 28, '70 | | | | | | | | | | | | |
| Station #1 | | x | + | 1.6 | 62.6 | 23.8 | + | | | | + | |
| 2 | | 1.4 | x | | 49.2 | 45.6 | 1.0 | | | | + | |
| 3 | | + | x | | 38.6 | 56.2 | + | | | | + | |
| 4 | | + | x | x | 65.8 | 29.8 | | + | | | + | + |
| 5 | | + | x | + | 20.6 | 50.0 | | + | | | + | x |
| 6 | | + | x | + | 40.0 | 45.4 | | 1.0 | | | + | + |
| Boone) 7 | | + | + | 1.0 | 5.4 | 19.6 | | + | + | | x | |
| River ) 8 | | + | + | + | 15.6 | 25.8 | | + | + | | + | + |
| Oct. 7, '70 | | | | | | | | | | | | |
| Station #1 | | + | + | x | 50.3 | 44.2 | x | | | x | + | + |
| 2 | | 4.7 | x | | 26.3 | 59.9 | | + | x | | 1.1 | x |
| 3 | 1.6 | 1.6 | x | + | 38.2 | 53.0 | + | | | | + | |
| 4 | + | 1.2 | x | | 41.8 | 44.8 | x | 2.0 | | | 1.0 | |
| 5 | | + | + | x | 40.4 | 33.1 | | 1.1 | x | | + | + |
| 6 | | 3.0 | x | x | 40.2 | 31.4 | x | 8.2 | x | | + | + |
| Boone) 7 | | 2.8 | x | | 13.4 | 29.0 | | | + | | + | x |
| River ) 8 | | 2.1 | x | x | 22.8 | 26.2 | | x | | | x | + |
| Oct. 18, '70 | | | | | | | | | | | | |
| Station #1 | + | 12.8 | 1.2 | + | 31.7 | 40.9 | x | + | | | 2.5 | 3.5 |
| 2 | | 4.4 | + | x | 27.6 | 63.6 | x | x | | | 1.2 | + |
| 3 | | 4.8 | x | + | 39.0 | 53.4 | x | | | | + | + |
| 4 | | + | + | x | 38.6 | 57.6 | x | + | x | | + | + |
| 5 | | x | + | x | 27.2 | 67.2 | x | + | x | | + | + |
| 6 | | 3.9 | x | x | 28.8 | 61.6 | | x | | x | 1.6 | + |
| Boone) 7 | | + | + | | 9.2 | 74.4 | x | + | x | | + | x |
| River ) 8 | | x | + | x | 17.6 | 79.8 | x | | | | + | + |
| Nov. 4, '70 | | | | | | | | | | | | |
| Station #1 | + | + | + | x | 16.6 | 51.0 | | | | | 15.4 | 14.8 |
| 2 | + | 9.8 | | | 25.4 | 57.8 | x | | | | 2.8 | 2.4 |
| 3 | | 1.0 | x | x | 24.4 | 68.6 | + | | x | | 2.2 | + |
| 4 | | + | + | | 27.2 | 61.3 | x | | | | 5.8 | 2.7 |
| 5 | | 1.8 | x | x | 3.9 | 90.0 | | | | | + | 2.5 |
| 6 | | + | x | x | 15.0 | 80.6 | | | x | | 2.2 | + |
| Boone) 7 | | x | x | x | 8.0 | 88.0 | | | x | | + | |
| River ) 8 | | 1.6 | x | x | 19.8 | 73.6 | | | | | 1.6 | 4.2 |
| Nov. 18, '70 | | | | | | | | | | | | |
| Station #1 | 1.4 | x | + | x | 5.8 | 24.2 | | + | | | 46.0 | 19.0 |
| 2 | + | 7.8 | + | + | 23.4 | 49.2 | + | | | | 10.6 | 4.4 |
| 3 | x | 2.0 | + | x | 26.0 | 49.2 | + | | | | 14.8 | 6.4 |
| 4 | | + | x | x | 22.4 | 46.8 | | + | x | | 22.6 | 3.8 |
| 5 | | + | x | x | 9.0 | 79.6 | | | | | 4.8 | 4.2 |
| 6 | + | + | x | x | 14.0 | 67.6 | | | x | | 15.4 | 1.2 |
| Boone) 7 | | x | x | | 2.6 | 97.2 | x | | | | x | |
| River ) 8 | | 3.8 | x | | 24.2 | 61.2 | | | | | 4.2 | 1.0 |

+ = less than 1%
x = present

Several species and varieties encountered during this investigation do not yet appear in the published record for Iowa. The majority of these are probably of common occurrence in the state as they are listed in various unpublished theses in the library of Iowa State University. We include the following taxa as previously unpublished for the state: *Achnanthes hauchiana, A. lanceolata, Amphora ovalis* var. *affinis, Diploneis puella, Fragilaria vaucheriae, Gomphonema accuminatum* var. *coronata, G. lanceolatum* var. *insignis, Navicula capitata, N. luzonensis, N. viridula* var. *rostellata, Nitzschia angustata, N. vitrea* var. *salinarum, N. longissima* var. *reversa* and *Surirella brightwelii*. These three entities appear to be new records for the state: *Diploneis puella* (Schum.) Cl., *Nitzschia vitrea* var. *salinarum* Grun. and *Nitzschia longissima* var. *reversa* Grun.

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