EPIPHYTIC DIATOMS IN FARM PONDS AND EXPERIMENTAL PONDS IN BRYAN COUNTY, OKLAHOMA

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Submersed macrophytes *Najas quadalupensis* and *Chara* sp. in four Bryan County, Oklahoma ponds supported diverse populations of epiphytic diatoms. A total of 25 genera and 130 taxa were present in 40 samples taken in May and in August 1976. The genus *Navicula* had the most species followed by *Nitzschia* and *Pinnularia. Achnanthes linearis* and *Cocconeis placentula* were the most abundant taxa. Fifty-seven new taxa were found for Oklahoma.

INTRODUCTION

Until recently, few articles have been published on diatoms in Oklahoma. Maloney (1) and Leake (2) reported diatoms in a stream and small lakes in central Oklahoma. Koch and Risser (3) studied algal communities on leaf detritus in a stream, and Koch (4) reported on diatoms in southwestern Oklahoma. Pfiester and Terry (5) provided recent observations of newly identified Oklahoma algae. Cooper and Wilhm (6) included diatoms in their study of effects of industrial effluents on a stream. Other Oklahoma diatoms were reported by Wilhm et al. (7) and Seyfer and Wilhm (8). This paper reports on the relative proportions of diatoms epiphytic on submersed macrophytes in four ponds in Bryan County, Oklahoma.

MATERIALS AND METHODS

Pond Description.

Two farm ponds and two model ponds were studied (Table 1). The two farm ponds (1A and 15), located in Bryan County near Durant, Oklahoma, were used primarily for livestock watering and fish raising. Both were over 10 years old and had a broad development of macrophytes including cattails, sedges, and rushes as well as mats of macrophytes growing on the pond bottoms. *Chara* sp. was the predominant bottom macrophyte in 1A while *Najas guadalupensis* (Spreng). Morong was abundant in 15. Watersheds for ponds 15 and 1A contained San Saba clay and Bowie loam soils, respectively.

Model ponds (8 and 9) were located at the Water Quality Management Laboratory (WQML) in Durant, Oklahoma, and were established in 1974 to study phosphorus enrichment. These ponds had much smaller surface areas and volumes than the farm ponds and were contained in glass-coated steel silo sections. Pond rims were 0.2 m above the ground, thereby preventing inflow. Pond 8 contained San Saba sediment from the farm pond 15 watershed and pond 9 had Bowie soil from farm pond 1A watershed. Each received mud and water inoculum from its respective watershed pond when they were first built in 1974. Both model ponds contained large benthic stands of *Najas guadalupensis,* which were harvested periodically.

Sample Gathering and Processing

Five macrophyte samples for diatom analysis were taken twice from each of the four ponds; this produced 40 samples. Farm ponds were sampled on 5/19/76 and

TABLE 1. *Description of four ponds used in this project.*

Pond[a]	Age (yr)	Depth (m)	Surface area (ha)	Volume (m^3)	Sediment soil type
1A	15	4.0	1.3	20,365	Bowie loam[b]
15	38	4.0	1.5	28,433	San Saba clay[b]
8	2	2.5	0.003	70	San Saba clay
9	2	2.5	0.003	70	Bowie loam

[a]Ponds 1A, 8, and 9 are located at Durant, OK, and pond 15 is at Caddo, OK.
[b]Both watersheds are in pasture.

8/3/76; model ponds were sampled on 5/20/76 and 8/4/76. Samples were taken near the pond bottom about 1.0 - 2.5 m below the water surface. In the farm ponds two locations were near the dam and the other three were away from the dam. In the model ponds four locations were distributed around the pond about 1 m from the walls and the fifth location was in the center. Samples consisted of macrophytes lifted from the bottom and placed in plastic whirlpacks. *Chara* sp. was used in pond 1A, whereas *Najas guadalupensis* was used in the other three ponds. On the sampling day whole macrophytes totaling about 4 m in length per sample were placed in a solution of hydrogen peroxide and potassium dichromate to remove organic matter from the diatom frustules, as well as to remove diatoms from the macrophytes (9). Diatoms from each sample were mounted on glass slides with Hyrax mounting medium. Five to six hundred frustules per slide were counted and identified by species (varieties and forms where possible) according to Hustedt (10) and Patrick and Reimer (11) under 1000x oil immersion lens of a microscope. The conventional criteria of frustule size, shape, and ornamentation were used to identify diatoms. Frustules were counted as one whether they were together or separated. The valve view was commonly used for identification purposes, but many girdle views were also identified and counted. Scanning three columns on each slide was done under 100x magnification to account for any diatoms missed in the first counts and their presence was indicated by a (+). In this way presence and relative abundance of nearly all diatom taxa epiphytic on pond bottom macrophytes was recorded. All diatom slides used in this study are at WQML in Durant, Oklahoma.

RESULTS AND DISCUSSION

Over 1000 diatoms/slide were present in complete and fragmented forms and oriented in valve views and girdle views. Frequently debris concealed a critical part of the diatom and prevented identification. Undoubtedly, I missed some taxa. The counts for each taxon represented only the relative abundance of each taxon in relation to each other on a 4-m length of macrophyte and were not absolute values. Table 2 contains the average abundance of taxa for the five samples in each pond. These numbers were converted to diversity indices to give an expression of the diatom community which was correlated with physicochemical parameters (12).

I counted 20,883 diatoms representing 130 taxa in 25 genera in the 40 samples. The genus *Navicula* had the most species (thirty-seven) followed by *Nitzschia* (fifteen and *Pinnularia* (eleven). Fifty-seven taxa not previously reported for the state of Oklahoma were found.

Achnanthes linearis and *Cocconeis placentula* were the most abundant species. In each pond *A. linearis* populations were larger in May than in August, especially May samples from the model ponds, which had at least three times as many diatoms as did the August samples. Populations of *A. linearis* in pond 1A did not change much and were lower than those at the other ponds. *Cocconeis placentula* also was more abundant in May than in August samples in the farm ponds; the reverse was true in the model ponds. There was nearly a twofold difference in populations for all the ponds between the May and August samples. In May these two codominant species, *A. linearis* and *C. placentula,* were represented by over 280 diatoms in the farm ponds and over 440 diatoms in the model ponds. In August samples the codominants together did not total 200 diatoms, except in pond 9, which had a combined total of 425 diatoms. In August other species seemed like codominants, including *Epithemia zebra* var. *porcellus,* which composed nearly half the diatoms in pond 8, and *Navicula accomoda,* which composed one-fourth of the diatoms in pond 15. In the August samples of pond 1A, *Cocconeis placentula, Achnanthes linearis, Navicula cryptocephala, Nitzschia fonticola,* and *Synedra rumpens* var. *familiaris* made up over 350 diatoms (Table 2). Other taxa, *Achnanthes linearis f. curta, Nitzschia frustulum* and *Rhopalodia gibba,* were found in relatively low numbers in all ponds on both dates. Some other diatoms, which were prevalent in just one pond in May and August, were *Cocconeis placentula* var. *euglypta* and *Eunotia pectinalis* var. *minor f. impressa* (pond 1A) and *Navicula heufleri* var. *leptocephala* and *Nitzschia amphibia* (pond 15).

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TABLE 2. *Listing of all diatoms in association with bottom macrophytes and the average number of individual diatoms of the five stations sampled in ponds in May (m) and August (a). Numbers represent the proportion of diatoms of the 500 counted for each station.*

	Pond Designation and Date							
	1A		15		8		9	
Taxon	m	a	m	a	m	a	m	a
Achnanthes exigua Grun.								1
Achnanthes lanceolata (Breb.) Grun.							+	
Achnanthes linearis (W. Sm.) Grun.	68	51	105	62	454	144	231	42
[a]*Achnanthes linearis* f. *curta* H. L. Sm.	7	12	32	6	11	4	22	5
Achnanthes minutissima Kütz		2						
Amphipleura pellucida Kütz.	6	4	7	10				
[a]*Amphiprora ornata* Bailey	1	1						
Amphora ovalis Kütz.		+	1	+	2	2		+
Caloneis bacillum (Grun.) Cl.				+				
Caloneis lewisii Patr.								+
Caloneis schumanniana (Grun.) Cleve.							+	+
[a]*Caloneis ventricosa* var. *alpina* (Cl.) Patr.								+
Cocconeis placentula Ehr.	217	84	178	37	1	53	210	383
Cocconeis placentula var. *euglypta* (Ehr.) Cl.	77	33	+	+		+	3	2
[a]*Cyclotella Kutzingiana* var. *planetophora* Fricke				+				
Cyclotella Meneghiniana Kütz.			+					
[a]*Cyclotella Meneghiniana* var. *laevissima* (van Goor) Hust.				3				
Cyclotella stelligera Cl. u. Grun.			+					
Cymatopleura elliptica (Bréb.) W. Sm.							+	+
[a]*Cymatopleura elliptica* var. *nobilis* (Hantzsch) Hust.			+					
Cymatopleura solea (Bréb.) W. Sm.					+	1		
Cymbella aspera (Ehr.) Cleve.				+				
[a]*Cymbella Brehmii* Hust.	2	5	1	6				
[a]*Cymbella Hauckii* van Heurck								+
[a]*Cymbella tumidula* Grun.	+			1	+			
Cymbella ventricosa Kütz.	3	4	1	5	+			
Cymbella sp.	+							
Diploneis oculata (Bréb.) Cl.	+							
Diploneis puella (Schum.) Cl.							+	1
Epithemia zebra var. *porcellus* (Kütz.) Grun.	+	+	4	40	1	244	8	73
Eunotia curvata (Kütz.) Lagerst	2	7						
[a]*Eunotia formica* Ehr.	+							
[a]*Eunotia pectinalis* var *minor* f. impressa Ehr.	34	20						
Eunotia valida Hust.	+	+						
Frustulia sp.					+			
[a]*Gomphonema apicatum* Ehr.	+							
[a]*Gomphonema augur* Ehr.			+	5				
Gomphonema gracile Ehr.	1	10	5	2	3	3		
[a]*Gomphonema helveticum* Brun.	+				5	5	1	3
Gomphonema longiceps var. *subclavata* Grun.		1			2	1		
[a]*Gomphonema olivaceum* var. *calcarea* Cleve.	3	1						
Gomphonema parvulum (Kütz.) Grun.	3	3	4	8	1	2		+
Gyrosigma spencerii (W. Sm.) Cleve.	2	1	2	1	1	1	+	1
Hantzschia amphioxys (Ehr.) Grun.		+			+			
Melosira granulata (Ehr.) Ralfs		8	3	1				
[a]*Navicula accomoda* Hust.	18	19	12	128	+	2		
[a]*Navicula atomus* (Kütz.) Grun.				+				
[a]*Navicula bergenensis* Hohn.		+						
[a]*Navicula confervacea* var. *peregrina* (W. Sm.) Grun.		4						
Navicula cryptocephala Kütz.	33	55	19	9	5	4	3	+
Navicula cryptocephala var. *veneta* (Kütz.) Rabh.		3	6	2	5	1	+	
Navicula cuspidata (Kütz.) Kütz.	+	1	1	+	1	1		+
[a]*Navicula cuspidata* var. *major* Meist.	+							
Navicula elginensis (Greg.) Ralfs	1	1	+	1			+	+
Navicula sp.	+							
Navicula halophila (Grun.) Cl.					+			
[a]*Navicula halophila* f. *tenuirostris* Hust.		1	+		1	+		
[a]*Navicula heufleri* Grun.		+	1	1				+

	Pond Designation and Date							
	1A		15		8		9	
	m	a	m	a	m	a	m	a
[a]*Navicula heufleri* var. *leptocephala* (Bréb. ex Grun.) Patr.			71	20	2	+		
Navicula lanceolata (Ag.) Kütz.	+	3	1	+		+		+
[a]*Navicula longirostris* Hust.	5	4	1	+				
Navicula minima Grun.		3	7	2				
[a]*Navicula minnewaukonensis* Elm.			6	1				
Navicuula mutica Kütz.	1	+	+					
[a]*Navicula mutica* var. *cohnii* (Hilse) Grun.			+					
[a]*Navicula mutica* var. *ventricosa* (Kütz.) Cleve.	+				+			
Navicula pupula Kütz.	4	5	2	2	1	2		
[a]*Navicula pupula* var. *elliptica* Hust.					1	+		
Navicula pupula var. *rectangularis* (Greg.) Grun.	1	3	1	+				
Navicula radiosa Kütz.	2	1	8	5			1	1
[a]*Navicula rhynchocephala* var. *germainii* (Wallace) Patr.			+					
[a]*Navicula sabiniana* Patr.	+		+					
Navicula salinarum var. *intermedia* (Grun.) Cl.			1	1				
[a]*Navicula Schonfeldii* Hust.			+					
[a]*Navicula seminulum* var. *hustedtii* Patr.		2				+		
Navicula subfasciata Patr.		1					+	2
Navicula tenera Hust.	1	+						
[a]*Navicula tridentula* Krasske	+	1						
Navicula tripunctata (O. F. Müll.) Bory	+				1	1		1
[a]*Navicula vitabunda* Hust.	+							
Navicula sp. 1		+						
Navicula sp. 2								+
[a]*Neidium affine* var. *amphirhynchus* (Ehr.) Cl.	+	1			+	+		
Neidium iridis (Ehr.) Cl.				+		+		
[a]*Neidium productum* (W. Sm.) Cl.			1			+		
Nitzschia acicularis W. Sm.	2	2						
Nitzschia amphibia Grun.			23	23		+		+
Nitzschia angustata (W. Sm.) Grun.			+			+		
Nitzschia apiculata (Greg.) Grun.			+			4		+
Nitzschia dissipata (Kütz.) Grun.			+	+				
Nitzschia filiformis (W. Sm.) Hust.	1				+			
Nitzschia fonticola Grun.		92		14	+			
Nitzschia frustulum (Kütz.) Grun.	7	6	12	32	1	+	27	2
Nitzschia gracilis (Hantzsch)	2	2	+			20		1
[a]*Nitzschia Hantzschiana* Rabh.	+	+						
Nitzschia hungarica Grun.	+		1		3		+	
[a]*Nitzschia romana* Grun.		+	1	+				
Nitzschia sigma (Kutz.) W. Sm.	+	+			+	+	+	+
Nitzschia sublinearis Hust.	2	3				7		
Nitzschia sp.	+	+	+		+	1		
[a]*Pinnularia biceps* Greg.	+	1						1
Pinnularia borealis Ehr.		+						
[a]*Pinnularia braunii* var. *amphicephala* (A. Mayer) Hust.	1	1						
[a]*Pinnularia gibba* var. *mesogongyla* (Erh.) Hust.		+						
[a]*Pinnularia laterittata* var. *domingensis* Cl.	+	1						
[a]*Pinnularia maior* var. *transvera* (A. S.) Cl.	+	1				+		
[a]*Pinnularia mesolepta* (Ehr.) W. Sm.	1							
[a]*Pinnularia obscura* Krasske	+	+						
[a]*Pinnularia subcapitata* Greg.	1	1						
Pinnularia viridis (Nitz.) Ehr.		+						
Pinnularia sp.			+					
Rhopalodia gibba (Ehr.) O. F. Müll.	1	1	2	71	6	5	2	4
Stauroneis anceps Ehr.		+						
[a]*Stauroneis anceps* f. *gracilis* Rabh.		1						+
[a]*Stauroneis nobilis* var. *baconiana* (Stodd.) Reim.	1	1						
Stauroneis phoenicenteron (Nitz.) Ehr.	+	1						+
[a]*Stauroneis phoenicenteron* f. *gracilis* (Ehr.) Hust.		+						
Surirella elegans Ehr.	+							
[a]*Surirella gracilis* (W. Sm.) Grun.	1	1		+	1	+		
Surirella ovata Kütz.					+			
[a]*Surirella robusta* Ehr.	+			+				

	Pond Designation and Date							
	1A		15		8		9	
	m	a	m	a	m	a	m	a
Surirella robusta var. *splendida* (Ehr.) van Heurck			+	+				
[a]*Synedra acus* var. *angustissima* Grun.	1	1		2	1	+	4	2
[a]*Synedra radians* Kütz.					+			
Synedra rumpens Kütz.			+		+			
[a]*Synedra rumpens* var. *familiaris* (Kutz.) Hust.	1	61	1	4	+		1	+
[a]*Synedra rumpens* var. *fragilarioides* Grun.				+				
[a]*Synedra rumpens* var. *meneghiniana* Grun.	+							
[a]*Synedra tenera* W. Sm.	1	1		1				
Synedra ulna (Nitz.) Ehr.	1	1	+	3	3	2	+	+

+Indicates presence of a taxon with a value less than one.
[a]Diatoms new to Oklahoma.

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