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Membership is open to anyone interested in its aims: conservation of all native plants; education of the public to appreciate and preserve plant life; sponsorship of research and publication on the plant life of the state and the Great Lakes area in general, both in the USA and in Canada; sponsorship of legislation to promote the preservation of Michigan's native flora; establishment of suitable sanctuaries and natural areas, and cooperation in programs concerned with the wise use and conservation of all natural resources and scenic features.

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EDITOR'S NOTE

At the beginning of my editorship of The Michigan Botanist, it is worth reflecting on the history of the journal and the needs that it has fulfilled. The Michigan Botanist was established by the Michigan Botanical Club in 1962 under the initial editorship of Prof. Edward Voss, of the University of Michigan, who served for the first 15 years and established the standards and character that The Michigan Botanist has followed ever since. I first want to recognize all the previous editors, who have worked so hard to maintain and improve the reputation of the journal: Edward Voss, Howard Crum, Nancy and Jim Weber, Barbara Dyko, Richard Rabeler, Gary L. Hannan, Barbara J. Madsen, Neil Harriman, and Todd J. Barkman.

At the beginning, the intent was to issue a journal "devoted to all phases of plant life in Michigan," as stated in the Announcement at the beginning of the first issue. However, it was not long before the journal endeavored not only to cover Michigan plants, but to be an outlet for articles on all phases of plant life in the Great Lakes region. Over the years, many articles on the plants and plant communities of Wisconsin, Indiana, Ohio, Minnesota, Ontario, and Illinois have appeared.

No periodical publication can remain stagnant. It is necessary to continue to attract high quality articles and, at the same time, to retain the attention of a sufficient number of subscribers to provide both a reason for the publication's existence and a funding base for its continued production. Although a number of longer-term changes are contemplated, the following changes are being implemented immediately with the current issue.

Noteworthy Collections. The format of the Noteworthy Collections reports will be changed slightly so that a very brief statement of the significance of the collection will appear at the very beginning of each report. This will make it easier for the reader to determine at a glance the reason for a particular report.

Instructions to Authors. The "Instructions to Authors" available on the journal's website are now substantially expanded, primarily to enforce a greater stylistic consistency from article to article and from issue to issue. Because of space limitations, the summary on the inside back cover refers to the longer set of instructions on the website for more complete details.

As editor, I have two principal objectives. One is to maintain the journal as a first-rate peer-reviewed journal of Great Lakes botany. The second is to recruit and publish content that will appeal to the broader membership of the Michigan Botanical Club and other Great Lakes area readers, many of whom are amateurs who have a deep interest in plants, conservation, and natural history, but who are often not interested in reading technical articles addressed to professional botanists. Because this population forms the principal basis of support for The Michigan Botanist, pursuing this second objective is also critical to the long-term health of the journal.

The first principal objective already has a strong foundation. We will also continue seeking out and recruiting high-quality articles from authors and broadening both the subject matter of scientific articles we publish and the population from which contributions can be drawn. This is a synergistic process—as high standards are maintained and improved, we can attract a higher quality of contributed articles; and the high quality of articles is itself a critical component of the professional reputation and quality of the journal.

To meet the second objective, some immediate steps can be taken. For example, I plan to begin each issue with a short "Editor's Note" that will briefly describe the contents of the issue that I hope will pique the interest of nonprofessional readers in articles that, while scientific, may nevertheless be of interest to a wider audience.

In the longer term, however, I plan to encourage articles and other content of a broader interest. Among areas under consideration are conservation; explanations of changes in the scientific names of well-known plants; descriptions of the work of botanical and nature institutions in the Great Lakes regions as well as of floristic projects, online plant atlases, and similar initiatives; rare plants; invasives; and other topics.

IN THIS ISSUE

The first article in this issue is an interesting study of the algae in the beautiful Lake of the Clouds in the western Upper Peninsula of Michigan. This was a class project in an algae course taught by Patrick Kociolek and Rex Lowe at the University of Michigan Biological Station. This paper adds significantly to our knowledge of the algae in this lake, including observations of habitat and abundance and an enumeration of the species present. An added point of interest is the description of three new species of diatoms.

Roger Hedge and Emily Stork then present a report of the rediscovery in northwestern Indiana of the rare sedge, *Rhynchospora nitens*, which is one of a number of remarkable species known in the western Great Lakes region, but whose primary distribution is on the Atlantic coastal plain of the eastern and southeastern United States.

There follow two additional contributions to our Noteworthy Collections series. The first of these, by Justin Heslinga, reports on the first occurrence in Michigan of a potentially invasive shrub and a significant range extension of a critically imperiled species of sedge. Then David Schimpf and Steve Garcke add another installment to their series of important additions to the flora of the greater western Lake Superior region with seven new reports (see The Michigan Botanist 48: 49–60 and 50: 26–38 for previous installments).

Tony Reznicek remembers Robert Preston, a prominent Michigan biologist with a strong interest in ferns who contributed to the Pteridophyte section of Michigan Flora Online.

Finally, Emmet Judziewicz, no mean floristician himself, provides us with an enlightening review of one of the most significant floristic works on Great Lakes plants to appear in recent years.

Michael Huft

ALGAL DIVERSITY IN, AND THE DESCRIPTION OF THREE NEW DIATOM (BACILLARIOPHYTA) SPECIES FROM, LAKE OF THE CLOUDS, PORCUPINE MOUNTAINS WILDERNESS STATE PARK, MICHIGAN USA

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ABSTRACT

The Lake of the Clouds, located inside the Porcupine Mountains and two miles away from Lake Superior, is a famous vista site within the Porcupine Mountains Wilderness State Park, Michigan. Even though several fishery surveys of the lake were released by the Michigan Department of Natural Resources in the 1940s, no known algal studies have been conducted. The Porcupine Mountains Wilderness State Park has experienced a relatively low level of anthropogenic disturbance compared to other regions of the Great Lakes, which makes it an appealing site for algal studies. This paper reports the exploratory research done by professors and students at the University of Michigan Biological Station on the algal diversity of the Lake of the Clouds. Water chemistry shows this lake to be slightly acidic and with low nutrients and low conductivity. In this study, fresh samples of algae and cleaned diatom samples were investigated. From the living algal samples, 7 algal divisions were observed. The inventory showed that, based on the number of genera recorded, the Chlorophyta is more diverse than other algal divisions. A total of 78 genera (excluding diatoms) and 29 species of algae were identified from the living samples. Nearly 150 species in 58 genera of diatoms (Bacillariophyta) were also recorded from the cleaned samples. Among the diatoms, three species new to science were identified and are described here. These are **Brachysira ontonageniana** Kociolek & Lowe, **B. gatesii** Kociolek & Lowe, and **Gomphonema porcupiniana** Kociolek & Lowe. This rich list of algal taxa is only the first step in exploring the algal diversity, microhabitats, and ecosystem of the Lake of the Clouds. The diversity of algal taxa found in this study suggests that further algal research on the Lake of the Clouds is warranted.

KEY WORDS: Algal diversity, Lake of the Clouds, new diatom species, *Brachsira*, *Gomphonema*

INTRODUCTION

Although there are large-scale surveys of the algal flora of Michigan (e.g., Prescott 1962), and individual groups of algae have been documented from specific sites or habitats (Ackley 1929, 1932), there are few surveys of the entire algal flora from individual sites. In particular, we know of no previous work on

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the algal flora of lotic (flowing water) or lentic (still water) ecosystems in the Porcupine Mountains, which is located in the northwestern part of the Michigan's Upper Peninsula.

The Porcupine Mountains contain one of North America's largest stands of northern hardwoods, stretching over 31,000 acres of old growth forest (Davis 1993). The Porcupine Mountain range is on the southern edge of the Canadian Shield, a vast region of common geologic origin (Larson and Schaetzl 2001; Derouin et al. 2007). The bedrock in and around the Porcupine Mountains is primarily Precambrian, making it over 3.5 billion years old (Ojakangas and Matsch 1982).

Porcupine Mountains Wilderness State Park was established in 1945 and has experienced relatively little human disturbance. The first European contact resulted from the fur trade in the 1700-1800s, although this attracted settlers in only small numbers compared to subsequent waves of miners. Between 1845 and 1910, 45 copper mines operated on present day parkland. Most mines went bankrupt or closed before the mid 1900s. The area is still extremely rich in copper ore, in part because the copper particles are particularly fine and difficult to mine. White pines along the shore of Lake Superior were targeted by loggers for their ease of harvest and drew contact to the area in the early 1900s (Davis 1993).

The Lake of the Clouds, one of the four lakes in the Porcupine Mountains Wilderness State Park, is located in Section 22 of Township 51 North, Range 43 West in Ontonagon County of Michigan's Upper Peninsula (Taube 1949) and is a part of the Carp River Valley. The lake, which is approximately 330 meters above sea level and is overlooked by an escarpment rising an additional 120 meters overhead (Taube 1949), has a surface area of 133 acres and a maximum depth of 4 meters (Moffett 1940). Lake of the Clouds drains into Lake Superior to the north. The lake has sufficient levels of dissolved oxygen to support fish life at all depths, a circumneutral acidity, and a soft water composition at approximately 25 ppm dissolved salts (Moffett 1940). Around two dozen species of vascular aquatic plants occupy the littoral zone, of which three-way sedge (*Dulichium arundinaceum*), spike rush (*Eleocharis* sp.), yellow water lily (*Nuphar* sp.), and a pond weed (*Potamogeton angustifolius*) are the most prevalent macroflora species. Perch, smallmouth bass, and brook trout are the most common species of fish in the lake (Moffett 1940).

No previous effort to catalog the algal diversity of Lake of the Clouds is known. Due to the lake's unknown algal flora and its relatively short history of human interaction, Lake of the Clouds presents an ideal environment for conducting a survey of algal diversity.

MATERIALS AND METHODS

On July 9, 2012, a survey of the algal diversity in the Lake of the Clouds was conducted. Five different microhabitats were sampled to include epiphytic, epipelic, epilithic, deep benthic, and planktonic algae.

Collection Sites

Five collection sites were chosen for this study. Four of them were located nearly equidistantly across an approximately1290 meter transect along the southern shore of Lake of the Clouds. Sites 1-

4 were located at ca. 300 m, 600 m, 900 m and 1290 m from the outflow. Site 1 was a sheltered cove with emergent aquatic vegetation; Site 2 was an exposed site with obvious benthic algal production; Site 3 had a gravel bottom with epilithic algae evident; and Site 4 was at a small spit at which evident wave action was present. The fifth site was located at the bridge over the outflow of the lake (Carp River Outflow), and thus had flowing water. The five sites were chosen to include a diversity in vegetative density, amount of current flow, sunlight intensity, substrate availability, and similar factors. Spacing out the collection sites was necessary for gaining a fair representation of the entire lake.

Sampling Processes Algae

Epiphytic algae were collected by squeezing liquid and associated algae out of aquatic plants into 100 mL Whirlpaks®. A small sample of each plant was also collected. Epipelic algae were sampled from the upper few millimeters of the sediment with a turkey baster. Planktonic algae were collected with a size 25 plankton net with 64-μm mesh openings.

Each sample of epilithic algae (algae attached to rock), epidendric algae (algae attached to wood) and deep benthic algae (algae living in the sediment surface of the lake) was collected from sites 2 - 3 meters below lake surface. For sampling the epilithic algae and epidendric algae, a pocketknife was used for scraping algal specimens from the substrate. A snorkel, diving goggles, and a turkey baster were used for diving into the lake and collecting all samples from these three algal habitats. Each sample was placed into a 100 mL resealable Whirlpaks. A total of 25 samples were brought back to the lab on ice for analysis and stored in a refrigerator to slow down the biological processes of the organisms and prevent their degradation.

Sampling Process for Water Temperature, pH and Water Chemistry

At each site, temperature and pH were measured and recorded. A Fisher Scientific Accumet® portable meter was used to measure both pH and the temperature. A water sample was taken in a 1 L plastic Nalgene bottle, kept on ice, and returned to the University of Michigan Biological Station for analysis by standard methods with an autoanalyzer. The following environmental variables were measured: Total phosphorus, total nitrogen, silica, chloride, conductivity, alkalinity, dissolved organic carbon and turbidity.

Samples Analysis—Living Algae

Samples were examined microscopically using microscope slides, pipettes, cover glasses, American Optical Spencer light microscopes and an Olympus BX-51 light microscope. Genera and species were documented by site number and habitat, and photomicrographs were taken to document taxa. Soft algae (non-diatom) were identified at 400X magnification. Identification of the algal taxa was based on Canter-Lund and Lund 1995; Croasdale et al. 1983; Dillard 1989a, 1989b, 1990, 1991a, 1991b, 1993, 1999; Komarek and Anagnostidis 1999, 2005 Prescott, 1962, 1978; Prescott *et al.* 1972, 1975, 1977, 1981, 1982; Wehr & Sheath 2003; West and West 1904, 1905, 1908, 1912; and West *et al.* 1912.

Identified genera and species were recorded on a master list. Photomicrographs of specimens were taken with the cellSens® entry program and the Olympus microscope. Approximately 5 mL of several rich samples were preserved with glutaraldehyde so that the soft algae could be further analyzed over time.

Additional subsamples were allocated for cleaning of diatoms.

Sample Analysis—Cleaned Diatoms

Subsamples of the living algae were cleaned by the method of van der Werff (1955). After cleaning, the diatom valves were mounted in Naphrax®, and specimens were observed using an Olympus BX51 light microscope. Diatoms were viewed at 1000x, and light micrographs of the specimens were captured with an Olympus DP71 camera. Cleaned specimens were mounted onto coverslips, coated with gold-palladium, and prepared for observations with scanning electron microscopy (SEM). Electron micrographs were obtained by using a JEOL 7401F field emission scanning electron microscope and the microscope JEOL software. Stria densities were measured at the valve margin at the valve center across a full length of 10 microns. Cleaned diatoms and permanent slides have been deposited in the Kociolek Collection at the University of Colorado Herbarium (COLO).

RESULTS

Living Algae Samples

Samples containing living algae from Lake of the Clouds contained a wide variety of taxa. A total of 7 divisions and 88 genera from the 5 collection sites were identified. The division with the most genera was Chlorophyta, with 48 genera. Eighteen genera of Cyanophyta and 11 genera of Bacillariophyta were identified prior to cleaning. In addition, 4 genera of Euglenophyta, 4 genera of Pyrrophyta, 3 genera of Chrysophyta and 2 genera of Xanthophyta were identified. The complete list of taxa from these samples is presented in Table 1.

Four genera, *Microcystis, Staurastrum, Mougeotia, and Desmidium*, were found in all five collection sites. Of these, *Microcystis* and *Mougeotia* were found in several different microhabitats among the sites. Eleven genera were found in 4 of the 5 collection sites; these included the diatoms *Fragilaria and Tabellaria,* the chlorophytes *Bulbochaete, Closterium, Cosmarium, Hyalotheca, Pediastrum, Pleurotaeniu and, Zygnema,* and the cyanophytes *Gloeotrichia,* and *Oscillatoria.* Of those found in four sites, *Fragilaria, Tabellaria, Closterium, Cosmarium, Hyalotheca, Pediastrum*, and *Zygnema* were found in several different microhabitats among the sites.

Microhabitats

Community richness was also analyzed as a function of the various algal microhabitats—epiphytic, epipelic, epilithic, epidendric, deep benthic, metaphytic and planktonic. The largest number of genera, 68, was found in epiphytic microhabitats. In addition, 38 genera were found in metaphytic microhabitats, 22 genera in deep benthic microhabitats, 21 genera in epipelic microhabitats, 18 genera in planktonic microhabitats, and 15 genera in epidendric habitats. The genera found in epilithic microhabitats were mainly diatoms.

Cleaned Diatoms

A total of 147 diatom taxa from 58 different genera were identified from the cleaned material. Three species new to science are included in this list. Formal descriptions are presented later in this article. Genera with the most taxa represented in this survey included *Navicula* (10), *Gomphonema* (9), *Eunotia* (9), *Neidium* (8), and *Stauroneis* (8). Several monoraphid genera were also well represented (e.g., *Psammothidium*, *Planothidium*). Although there were some planktonic species present in our samples (e.g., *Fragilaria crotonensis*, *Stephanodiscus superiorensis*), the vast majority of the species were from benthic microhabitats. The cumulative list of diatoms encountered from the 5 sites is presented in Table 2.

TABLE 1. List of algal taxa from live samples collected from Lake of the Clouds. For each taxon, the habitat or habitats in which it was collected at each site is indicated by the following letters: E=epiphyton, M-metaphyton, PL=plankton, B=benthic, PE=epipelon and D-epidendron.

Taxa Sites	1	2	3	4	5
CHLOROPHYTA					
Chaetophorales					
Aphanochaete sp.	M				
Chaetophora sp.		E		E, D	
Chlamydomonales					
Eudorina sp.	M				
Chlorellales					
Zoochlorella sp.					PE
Chlorococcales					
Characium sp.	E				
Coelastrum sp.					PE
Dictyosphaerium sp.	E, M				
Dictyosphaerium pulchellum Wood	E				
Nephrocytium sp.					
Radiofilum flavescens G.S. West	E				
Coleochaetales					
Chaetosphaeridium sp.	E				
Coleochaete sp.	E				
Desmidiales					
Bambusina sp.	E, M				E, PE
Closterium sp.	E	B	B		E, PE
Closterium kutzingii Brébisson	E				
Cosmarium sp.	E, M	PL		E, D	PE
Cosmocladium sp.	M				
Desmidium sp.	E, PE	B	E, PE	E	E
Desmidium grevillii (Kützing) De Bary				E, D	E
Euastrum sp.	E, M				E
Euastrum dubium Nägeli	E				E
Gonatozygon sp.	E				
Hyalotheca sp.	E	PL		E, M, PL	E, PE
Hyalotheca mucosa (Dillwyn) Ehrenberg	E	PL		E, M, PL	
Micrasterias sp.	E, M	E			E
Micrasterias laticeps Nordstedt	E				
Micrasterias radiata Hassall	E				
Onychonema sp.	E				
Pleurotaenium sp.	E	B	E, B	E	E
Pleurotaenium ehrenbergii (Brébisson) De Bary	E				
Pleurotaenium trabecula (Ehrenberg) Nägeli		B			
Sphaerozosma sp.	E, M	E		E, D	
Sphaerozosma vertebratum (Brébisson) Ralfs		E		E, D	
Spondylosium sp.	E, M		E		PE
Spondylosium aubertianum var. archerii (Gutwinski) W. & G.S. West				E, M, PL	
Staurastrum sp.	E, M, PL	B	E, PL	E, M, PL	E, PE
Triploceras sp.	PE				
Xanthidium sp.	E, M	B			E
Xanthidium brebissonii Ralfs	M	B			

TABLE 1. (Continued).

Taxa Sites	1	2	3	4	5
CHLOROPHYTA (Continued)					
Glaucocystales					
Glaucocystis nostochinearum (Itzigsohn) Rabenhorst	E, M				
Microsporales					
Microspora sp.	M				
Oedogoniales					
Bulbochaete sp.	E	E	E	E, D	
Oedogonium sp.		E			
Sphaeropleales					
Ankistrodesmus sp.	E, M				PE
Gloeocystis sp.		M		PL	
Kirchneriella lunaris (Kirchner) Möbius	E				
Pediastrum sp.	E, PL	B	E, PL		E, PE
Pediastrum boryanum (Turpin) Meneghini		B			
Pediastrum duplex Meyen	E, M				
Quadrigula sp.	E				
Scenedesmus sp.	E, M, PE		E, B		E, PE
Scenedesmus quadricauda (Turpin) Brébisson in Brébisson et Godey	E				
Sorastrum americanum (Bohlin) Schmidle	E				
Tetraedron sp.	E				
Tetraedron minimumm (A. Braun) Hansgirg	E				
Ulotrichales					
Ulothrix sp.		PL		M, PL	
Ulothrix variabilis Kützing		PL			
Volvocales					
Pandorina sp.	E, M				
Volvox sp.			PL		
Zygnematales					
Cylindrocystis sp.	E				
Mougeotia sp.	E, M, PL	E, B	E, D	E, M, PL	E
Netrium sp.	E		E, D		E
Spirogyra sp.	E, M	B		E	PE
Zygnema sp.	E,M	B		E	PE
CYANOPHYTA					
Chroococales					
Aphanothece sp.	E, M			E	PE
Chroococcus sp.	E, M			E	
Dactylococcopsis fascicularis Lemmermann	E			PE	
Microcystis sp.	E, M, PL	B, PL	B, PL	M, PL	E
Nostocales					
Amphithrix sp.			E, D		
Anabaena sp.	E, M	B, PL	D, PE, PL		
Dolichospermum spiroides (Kleb.) Wacklin, L.Hoffm. & Komárek		B			
Calothrix sp.	E		E, D	E	

TABLE 1. (Continued).

Taxa Sites	1	2	3	4	5
CYANOPHYTA (Continued)					
Hapalosiphon sp.	E				
Nostoc sp.	E	E			
Stigonema sp.	E				E
Tolypothrix sp.	E				
Oscillatoriales					
Lyngbya sp.	E			E	
Oscillatoria sp.		B	B	E, B	E
Pseudanabaenales					
Spirulina sp.	M				
Synechococcales					
Aphanocapsa	E, M	E			
Coelosphaerium sp.	E				
Coelosphaerium kutzingianum Nägeli	E				
Merismopedia sp.	E, M		E		
CHRYSOPHYTA					
Chromulinales					
Chrysosphaerella sp.	M				
Dinobryon sp.	M		PL		
Hibberdiales					
Derepyxis sp.	E				
EUGLENOPHYTA					
Euglenales					
Euglena sp.	E, PE, PL				PE
Euglena acus Ehrenberg	E				
Lepocinclis acuta Prescott in Prescott et al.		PE			
Phacus sp.		PL		E	
Trachelomonas sp.	E				
PYRROPHYTA					
Gonyaulacales					
Ceratium sp.		B, PL	PL	E	
Ceratium hirudinella (O.F. Müller) Dujardin		B, PL		E	
Peridiniales					
Peridinium sp.	E				
Phytodinales					
Cystodinium sp.	E				
Stylodinium sp.	E				
XANTHOPHYTA					
Mischococcales					
Ophiocytium sp.	E, M				
Ophiocytium bicuspidatum (Borge) Lemmermann	E				
Trebouxiales					
Botryococcus braunii Kützing	E	E			

TABLE 2. Inventory of the Diatom Taxa Identified from Lake of the Clouds, All Sites Combined.

Achnanthidium exiguum (Grunow) Czarnecki
Achnanthidium exiguum var. *heterovalvum* (Krasske) Czarnecki
Achnanthidium minutissimum (Kützing) Czarnecki
Amphipleura pellucida (Kützing) Kützing
Amphora pediculus (Kützing) Grunow
Asterionella formosa Hassall
Aulacoseira italica (Ehrenberg) Simonsen
Brachysira gatesii Kociolek et Lowe, sp. nov.
Brachysira ontonageniana Kociolek et Lowe, sp. nov.
Brachysira serians (Brébisson) Round et Mann
Brachysira vitrea (Grunow) Ross
Brachysira zellensis (Grunow) Round & Mann
Caloneis bacillum (Grunow) Cleve
Caloneis lewisii Patrick
Caloneis silicula (Ehrenberg) Cleve
Caloneis tenuis (Gregory) Krammer
Cavinula cocconeiformis (Gregory ex Greville) Mann et Stickle
Cavinula jaernefeltii (Hustedt) Mann et Stickle
Cavinula pseudoscutiformis (Hustedt) Mann et Stickle
Chamaepinnularia mediocris (Krasske) Lange-Bertalot
Cocconeis placentula var. *euglypta* (Ehrenberg) Grunow
Cocconeis pseudothumensis Reichardt
Craticula cuspidata (Kützing) Mann
Cyclotella comensis Grunow
Cymbella aspera (Ehrenberg) Cleve
Cymbella ehrenbergii Kützing
Cymbella lanceolata (Agardh) Agardh
Cymbopleura hybrida (Grunow) Krammer
Decussata placenta (Ehrenberg) Lange-Bertalot
Diploneis elliptica (Kützing) Cleve
Diploneis marginestriata Hustedt
Discostella stelligera (Cleve et Grunow) Houk et Klee
Encyonema elginense (Krammer) Mann
Encyonema hebridicum Grunow ex Cleve
Encyonema lunatum (Smith) Van Heurck
Encyonema minutum (Hilse) Mann
Encyonopsis microcephala (Grunow) Krammer
Entomoneis alata (Ehrenberg) Ehrenberg
Eolimna minima (Grunow) Lange-Bertalot
Eucocconeis alpestris (Brun) Lange-Bertalot
Eunotia didyma Grunow in Moller
Eunotia formica Ehrenberg
Eunotia implicata Nörpel, Alles et Lange-Bertalot
Eunotia incisa Smith ex Gregory
Eunotia monodon Ehrenberg
Eunotia naegelii Migula
Eunotia pectinalis var. *undulata* (Ralfs) Rabenhorst
Eunotia praerupta Ehrenberg
Eunotia tetraodon Ehrenberg
Fragilaria crotonensis Kitton
Fragilaria vaucheriae (Kützing) Petersen
Fragilariforma constricta (Ehrenberg) Williams et Round
Frustulia krammeri Lange-Bertalot et Metzeltin
Frustulia saxonica Rabenhorst
Frustulia vulgaris (Thwaites) De Toni
Frustulia weinholdii Hustedt

TABLE 2. Continued.

Geissleria paludosa (Hustedt) Lange-Bertalot et Metzeltin
Gomphonema acuminatum Ehrenberg
Gomphonema affine Kützing
Gomphonema augur Ehrenberg
Gomphonema brebissonii Kützing
Gomphonema intricatum Kützing
Gomphonema parvulum (Kützing) Kützing
Gomphonema patricki Kociolek et Stoermer
Gomphonema porcupiniana Kociolek et Lowe, sp. nov.
Gomphonema truncatum Ehrenberg
Gomphosphenia grovei (M. Schmidt) Lange-Bertalot
Gyrosigma sp.
Handmannia radiosa (Grunow) Kociolek & Khursevich
Hantzschia amphioxys (Ehrenberg) Grunow
Hippodonta capitata (Ehrenberg) Lange-Bertalot, Metzeltin et Witkowski
Karayevia clevei (Grunow) Bukhtiyarova
Karayevia laterostrata (Hustedt) Bukhtiyarova
Karayevia suchlandtii (Hustedt) Bukhtiyarova
Meridion circulare (Greville) Agardh
Navicula aboensis (Cleve) Cleve-Euler
Navicula angusta Grunow
Navicula constans Hustedt
Navicula laterostrata Hustedt
Navicula pseudoventralis Hustedt
Navicula radiosa Kützing
Navicula rhynchocephala Kützing
Navicula schadei Krasske
Navicula tridentula Krasske
Navicula viridula (Kützing) Kützing
Neidiopsis levanderi (Hustedt) Lange-Bertalot et Metzeltin
Neidium affine (Ehrenberg) Pfitzer
Neidium affine var. *humerus* Reimer
Neidium amphigomphus (Ehrenberg) Pfitzer
Neidium apiculatum Reimer
Neidium bisulcatum (Lagerstedt) Cleve
Neidium firma (Kützing) Pfitzer
Neidium hitchcockii (Ehrenberg) Cleve
Neidium productum (Smith) Cleve
Nitzschia dissipata (Kützing) Grunow
Nitzschia recta Hantzsch ex Rabenhorst
Nupela impexiformis (Lange-Bertalot) Lange-Bertalot
Nupela sp.
Opephora olsenii Møller
Pinnularia biceps Gregory
Pinnularia microstauron (Ehrenberg) Cleve
Pinnularia nodosa (Ehrenberg) Smith
Pinnularia viridis (Nitzsch) Ehrenberg
Placoneis clementis (Grunow) Cox
Placoneis gastrum (Ehrenberg) Mereschkowsky
Planothidium apiculatum (Patrick) Lange-Bertalot
Planothidium dubium (Grunow) Round et Bukhtiyarova
Planothidium joursacense (Héribaud) Lange-Bertalot
Planothidium lanceolatum (Brébisson ex Kützing) Lange-Bertalot
Planothidium peragalli (Brun et Héribaud) Round et Bukhtiyarova
Planothidium pseudotanense (Cleve-Euler) Lange-Bertalot
Psammothidium bioretii (Germain) Bukhtiyarova et Round

TABLE 2. Continued.

Psammothidium chlidanos (Hohn et Hellerman) Lange-Bertalot
Psammothidium didymum (Hustedt) Bukhtiyarova et Round
Psammothidium rossii (Hustedt) Bukhtiyarova et Round
Psammothidium subatomoides (Hustedt) Bukhtiyarova et Round
Psammothidium ventralis (Krasske) Bukhtiyarova et Round
Pseudostaurosira brevistriata (Grunow) Williams et Round
Pseudostaurosira elliptica (Schumann) Edlund, Morales et Spaulding
Reimeria sinuata (Gregory) Kociolek et Stoermer
Rhopalodia gibba (Ehrenberg) Müller
Rossithidium pusillum (Grunow) Round et Bukhtiyarova
Sellaphora americana (Ehrenberg) Mann
Sellaphora laevissima (Kützing) Mann
Sellaphora pupula (Kützing) Meresckowsky
Stauroneis anceps fo. *gracilis* Rabenhorst
Stauroneis anceps var. *americana* Reimer
Stauroneis kriegeri Patrick
Stauroneis livingstonii Reimer
Stauroneis phoenicenteron (Nitzsch) Ehrenberg
Stauroneis smithii Grunow
Stauroneis stodderi Greenleaf
Staurosira construens Ehrenberg
Staurosirella pinnata (Ehrenberg) Williams et Round
Stenopterobia anceps (Lewis) Brébisson ex Van Heurck
Stenopterobia curvula (Smith) Krammer
Stenopterobia delicatissima (Lewis) Van Heurck
Stephanodiscus superiorensis Stoermer & Theriot in Theriot & Stoermer
Surirella angusta Kützing
Surirella brebissonii Krammer et Lange-Bertalot
Surirella minuta Brébisson
Surirella tenera var. *nervosa* Schmidt
Tabellaria fenestrata (Lyngbye) Kützing
Tabellaria flocculosa (Roth) Kützing
Tryblionella victoriae Grunow
Ulnaria delicatissima (W. Smith) Aboal et Silva

Water Chemistry

At the time of collection, the water temperature was 23°C, and the pH ranged from 6.92 to 7.70. Nutrients were relatively low, with total P measured at 8.7 µg/L and total N at 0.157 mg/L. Soluble SiO_2 was 2 mg/L and chloride was 0.3 mg/L. Alkalinity (measured as mg $CaCO_3$/L) was 24.2 and conductivity was 42.6 µS at 25°C), indicating rather dilute water. Dissolved organic carbon was 10.4 mg/L, and turbidity, as measured in Jackson units, was 20, which together indicate the water was relatively clear.

DISCUSSION

Lake of the Clouds Water Profile

Circumneutral pH often coincides with high algal diversity. According to the research results, Lake of the Clouds satisfied this correlation. Its moderate temperature is also a probable cause of the wide range of genera of Chlorophyta that were observed (Denicola 1996).

Lake of the Clouds Algal Flora

Based on the number of genera observed, diatoms were by far the dominant algal group in Lake of the Clouds. This is typical of alkaline to circumneutral bodies of water in North America (Stevenson et al. 1996). The discovery of three species new to science leads us to believe that there may be more undescribed diatoms that our initial survey did not detect.

Desmidiales was the most abundant order among the Chlorophyta found in Lake of the Clouds. Desmids can indicate good water quality, because they do not prefer anthropogenically disturbed or extremely eutrophic bodies of water (Ngearnpat and Peerapornpisal 2007). Most of the samples collected were from the eulittoral zone, the relatively shallow portions of the lake. This study suggests that Lake of the Clouds has a soft water quality because an abundance of desmids in the eulittoral zone can indicate a calcium poor water body (Stevenson et al. 1996). The lake's geology is a potential cause of its lack of calcium. The lake's bedrock is part of the Canadian Shield, which contributes monovalent cations instead of divalent cations to water bodies. A higher divalent cation concentration would lead to harder water, reduce the occurrence of desmids, and increase the prevalence of cyanobacteria (Molot and Dillon 2008).

Based on the number of genera, Chlorophyta was the most diverse non-diatom algal division in the samples. The abundance of Chlorophyta is typical for the soft water chemistry of the lake, since soft water lakes often have algal distributions characterized by *Mougeotia* and other filamentous genera as well as *Cosmarium*, and *Staurastrum* (Stevenson et al. 1996).

Based on the number of genera, Cyanophyta was the second most diverse non-diatom algal division. A few genera of Cyanophyta, such as *Microcystis* and *Anabaena*, produce toxic metabolites that can be hazardous to the ecosystem (Burgess 2001). These two genera were observed only in relatively small numbers. Other indicator taxa, such as desmids (which prefer soft water and a lower calcium level) and members of the Zygnemataceae (which also dominate the littoral zone of soft water lakes), were more common than Cyanophyta (Stevenson et al. 1996).

Comparison of Algal Taxa Between Lake of the Clouds and Other Lakes in the Midwest

Comparison of our results with other published records for the state of Michigan or the Midwest region is difficult, since there are few studies of all algal groups from specific ecosystems, especially where taxa are treated to the level of species. Unlike in Lake of the Clouds, *Bambusina* and *Desmidium* were not observed in great numbers in other Michigan lakes such as Wycamp Lake, Lark's Lake, Paradise Lake, Monro Lake, Lancaster Lake, Walloon Lake, Burt Lake, Long Lake, and Douglas Lake (unpublished, Warren 1995). *Scenedesmus, Oscillatoria*, and *Anabaena*, which were reported to be abundant in Douglas Lake

(Gulley and Kennedy 1987), were not found in Lake of the Clouds in large numbers. Similarly, *Anabaena*, *Oscillatoria,* and *Schizothrix*, which were abundant in Northern Lower Michigan groundwater springs and seeps (Smith 1995) were not common in Lake of the Clouds.

The description of three new species of diatoms from this lake in the midwestern United States, one of the more intensively studied regions of the country, suggests that this oligotrophic lake may harbor other new species of algae. Unlike other algal groups (e.g., Prescott 1962), the diatoms of Michigan, especially the Upper Peninsula, are not well known. Further study of the algal flora of the region is warranted and may result in the description of other new taxa.

Sources of Error and Possible Future Study

A few possible error sources should be addressed and considered for future investigations. A more comprehensive floral survey could have incorporated more diversity in collection sites. For instance, the northern shoreline of the lake and the inflow have not yet been investigated for algal flora. Considering that the inflow is a transition point from a river to lake ecosystem, algae may be present due to changes in both biotic and abiotic conditions. Additionally, it may be interesting to compare inflow taxa data with the outflow data. Collecting near the landslide on the northern shoreline could show what impact this particular disturbance has on the flora, and the area could be a unique habitat for algae.

The abundance and distribution of algal species will vary seasonally in the lake. This is partly due to the availability of various nutrients, such as nitrogen and phosphorus, which are necessary in different quantities for different taxa. The abundance of a nutrient might benefit one alga more than another, conferring a competitive advantage. For example, an aquatic system low in nitrogen greatly limits the ability of green algae (Chlorophyta) to photosynthesize and thus to grow and reproduce, but does not affect some blue-green algae (Cyanophyta), since they have the ability to fix their own nitrogen through use of a heterocyte (Canter-Lund and Lund 1995). Sampling at various times throughout the season would increase the likelihood of finding more taxa of algae, leading to a more complete floral record and understanding of the algal ecology in the lake.

CONCLUSION

Since no previous algal floristic studies have been conducted in Lake of the Clouds, the location was suitable for a biodiversity survey. In this research, the diatoms were the most abundant and diverse in genera. However, the presence of several taxa of Chlorophyta indicated that Lake of the Clouds has a soft water body and relatively low levels of pollutants. The results showed that the lake is a clean water body with a relatively rich algal community. Our records of the rich algal taxa is consistent with the history of relatively few anthropogenic activities in the Porcupine Mountains Wilderness State Park. Because this study is not exhaustive, we recommend further algal diversity research on Lake of the Clouds.

TAXONOMIC TREATMENT

Brachysira ontonageniana Kociolek et Lowe, sp. nov.

Description: Valves lanceolate-clavate, apices not protracted, rounded at the headpole and footpole. Length 16–40 µm, breadth 4.5–5.5 µm. Axial area narrow, straight, forming a small, indistinct, narrowly lanceolate central area. An elongated areola may be positioned on one side of the central area. Raphe filiform, straight, with external proximal raphe ends dilated, round. Striae distinctly punctate, areolae within a stria appear slightly offset from neighboring striae. Striae radiate the entire length of the valve. Striae number 28-31/10 µm.

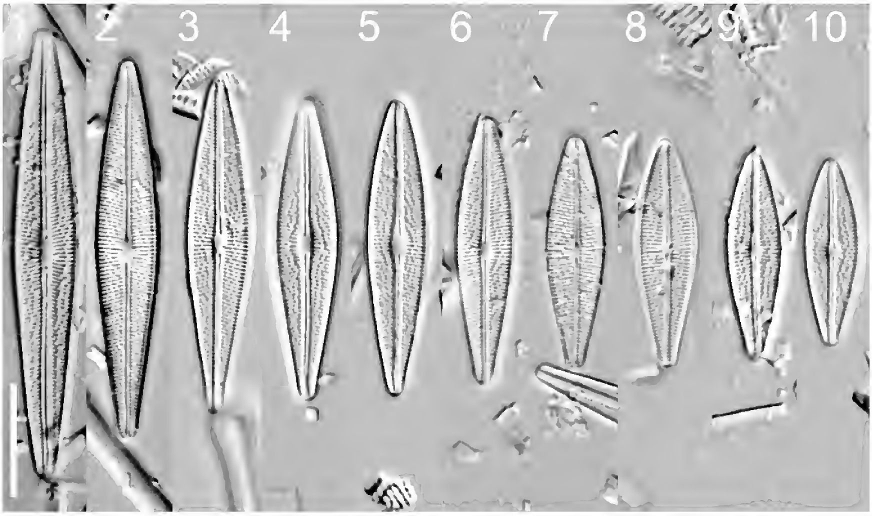
Holotype: JPK Collection, slide number 273055, University of Colorado (COLO)

Etymology: This species is named for the Michigan county in which it is found.

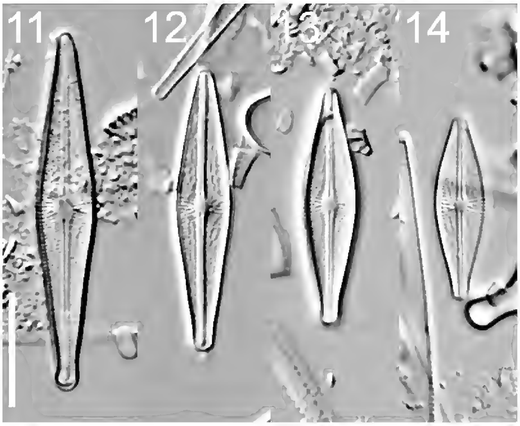
Figures 1–10, 15, 16; Figure 1 is of the holotype.

Brachysira gatesii Kociolek et Lowe, sp. nov.

Description: Valves lanceolate, barely clavate, with headpole rounded and footpole protracted, broadly rounded. Length 16–32 µm, breadth 4-5 µm. Axial area narrow, straight, forming a small but distinct, rounded central area, bordered on both sides by shortened striae the shortest being in the middle. Raphe fili-



FIGURES 1–10. LM, *Brachysira ontonageniana*, sp. nov. Valve view, size diminution series. Scale bar = 10 µm. Figure 1 is of the holotype.



FIGURES 11–14. LM. *Brachysira gatesii*, sp. nov. Valve view, size diminution series. Scale bar = 10 μm. Figure 11 is of the holoytpe.

form, external proximal raphe ends not rounded. Striae distinctly punctate, areolae within a stria slightly offset from those in neighboring striae giving the impression of longitudinal undulations. Striae radiate throughout the length of the valve, numbering 29-32/10 μm.

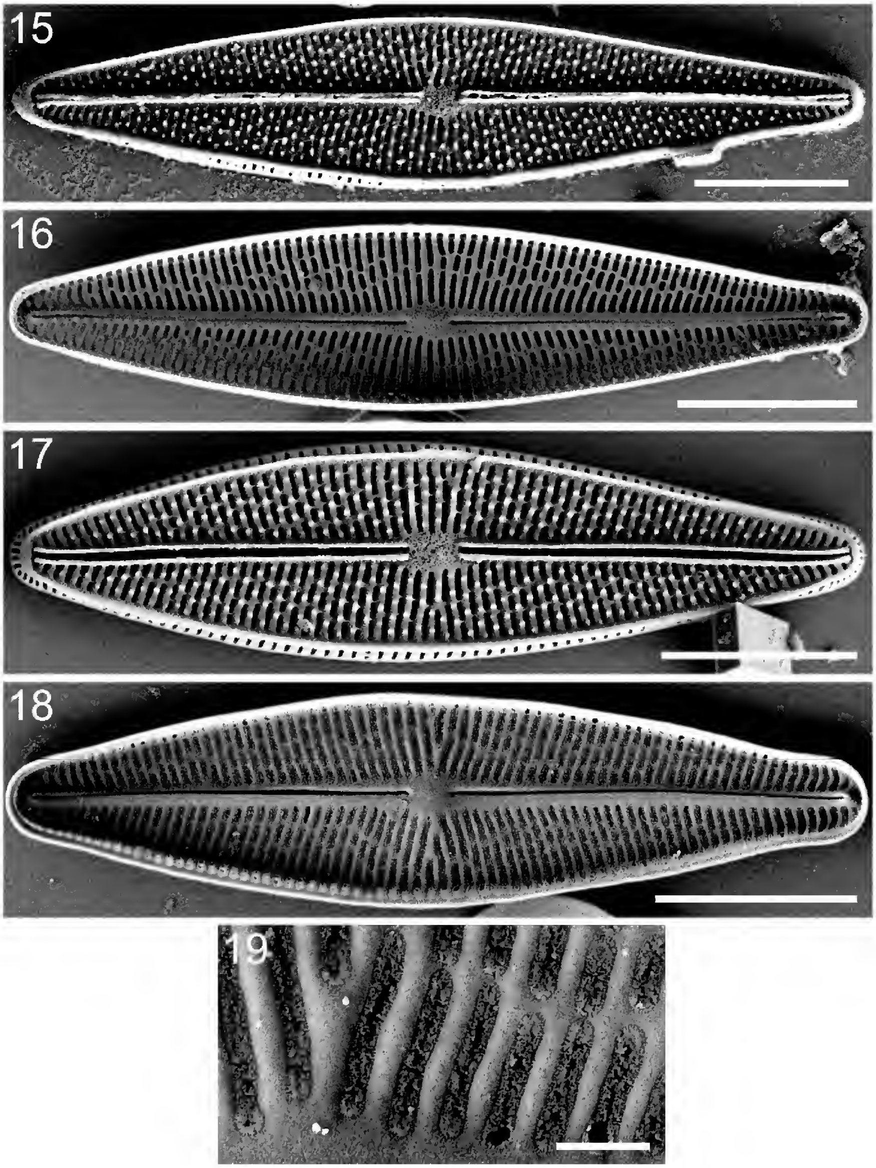
Holotype: JPK Collection, slide number 273056, University of Colorado (COLO)

Etymology: The species is named for former UMBS director, Dr. David Gates.

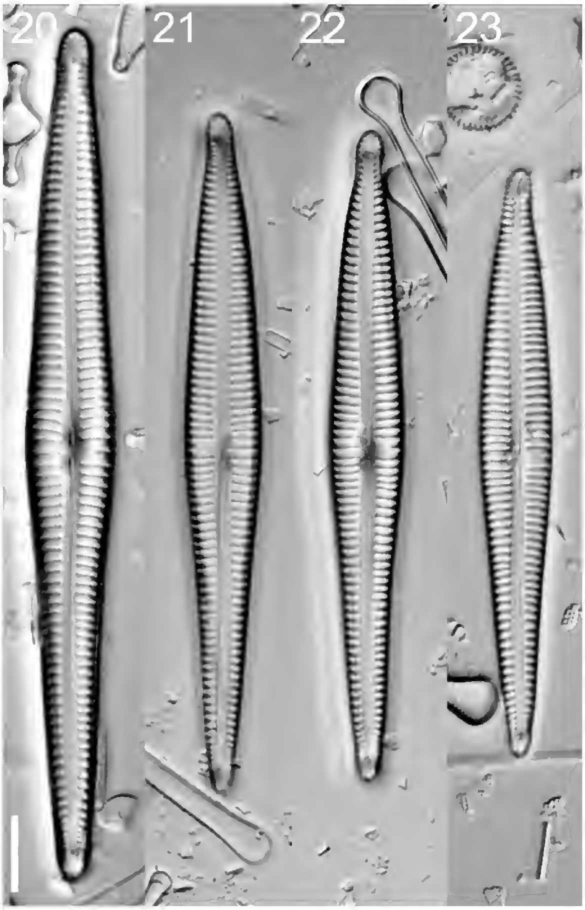
In the SEM, both *Brachysira ontonageniana* (Figures 15, 16) and *B. gatesii* (Figures 17, 18) have valve exteriors with a thick marginal ridge along each side of the valve with the raphe bordered on both sides by longitudinal ribs. The valve face has elongated to ellipsoidal areolae that are covered internally by hymens (Figure 19). Siliceous nodules ("warts" of Round et al. 1990, p. 540) are found scattered along the interstriae. Elongated areolae occur on the mantle of the valve. The elongated areolae are evident internally. The central nodule is small and barely elevated internally. At the poles are indistinct helictoglossae.

Brachysira gatesii differs from *B. ontonageniana* in the shape of the valve, striae of the central area, and undifferentiated external proximal raphe ends.

These two species possess the features typical for the genus *Brachysira* (Round et al. 1990). In addition, they are slightly asymmetrical to the transapical axis, and this feature has been documented for other *Brachysira* species. Lange-Bertalot and Moser (1994) illustrate several species of the genus with this asymmetry, including species from New Caledonia (e.g. *B. microclava* Lange-Bertalot & Moser, *B. archibaldi* Coste & Ricard among others), the Philippines (e.g. *B. irawanae* (Podzorski & Håkansson) Lange-Bertalot & Moser), and Australia (*B. archibaldii* var. *crassistriata* Lange-Bertalot). A similar asymmetry is not well known in the northern hemisphere. Lange-Bertalot and Moser (1994) illustrate unnamed species from the Rocky Mountains (see plate 31, figs. 20, 21



FIGURES 15–19. SEM. Figs 15, 16. *Brachysira ontonageniana*, sp. nov. Figure 15, External valve view. Note thickened siliceous rib bordering the raphe and scattered nodules oriented along the striae. Scale bar = 5 µm. Figure 16. Internal valve view. Scale bar = 5 µm. Figures 17–19, *B. gatesii*. Figure 17. External valve view. Note thickened siliceous rib bordering the raphe and scattered nodules oriented along the striae Striae on the mantle are elongated areolae. Scale bar = 5 µm. Figure 18. Internal valve view. Note that the areolae are occluded by hymenate coverings. Scale bar = 5 µm. Fig. 19. Close up of areolae showing the fine hymenate occlusions. Scale bar = 0.5 µm



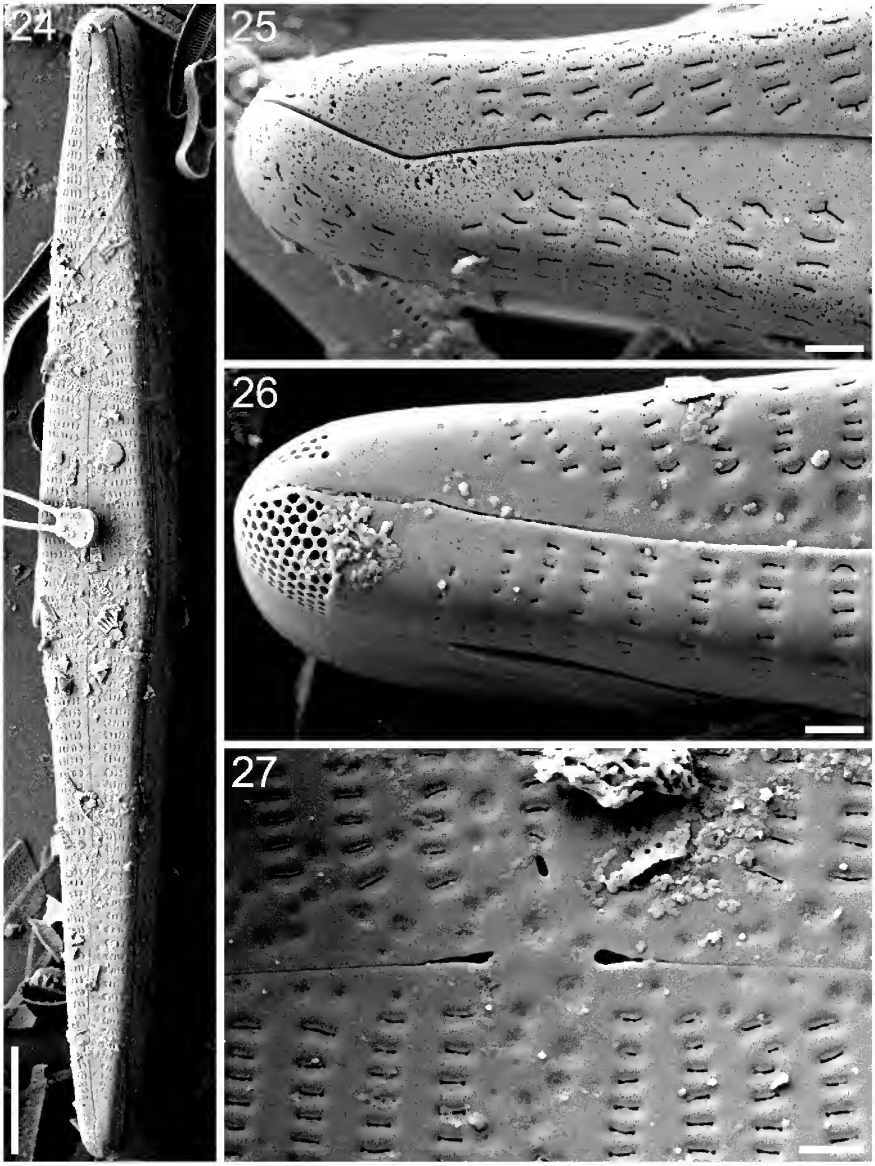
FIGURES 20–23. LM. *Gomphonema porcupiniana*, sp. nov. Valve view, size diminution series. Scale bar = 10 µm. Figure 20 is of the holotype.

and plate 46, fig. 26 therein) that resemble these species from Lake of the Clouds.

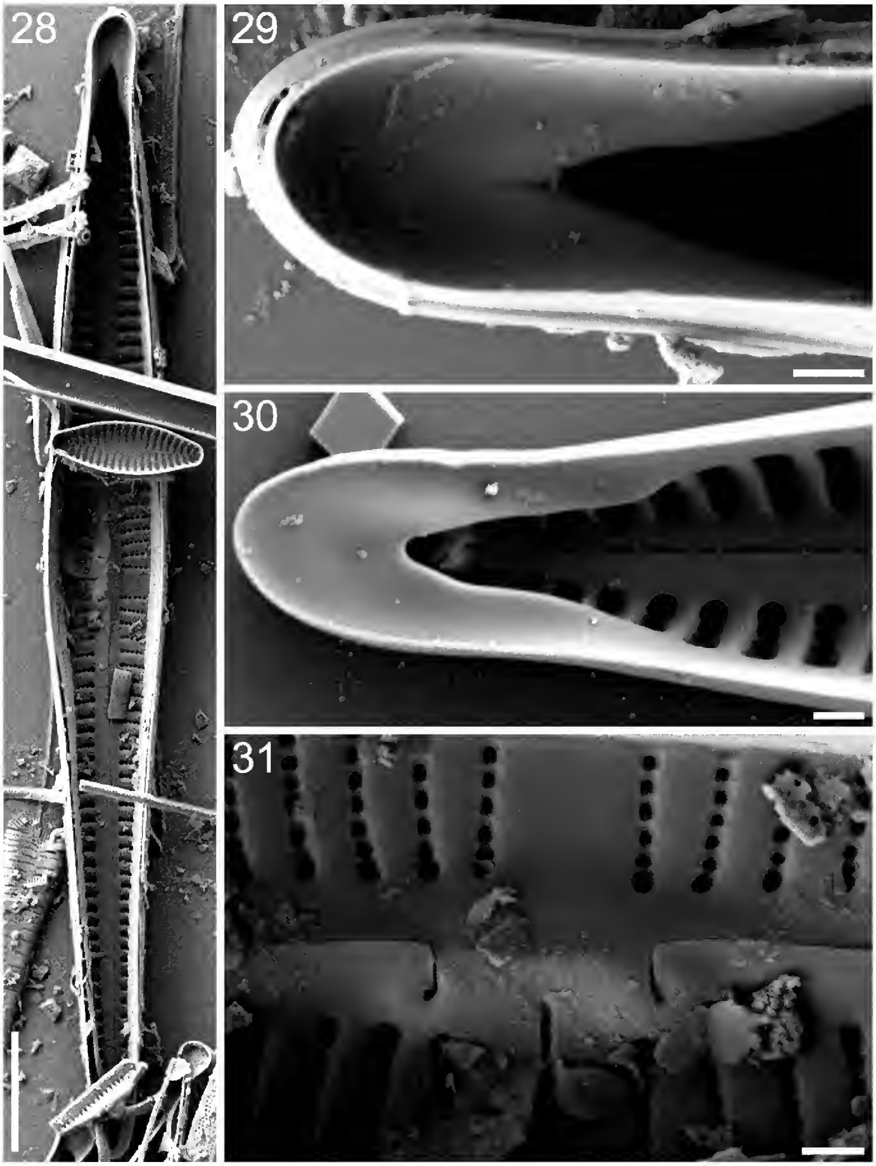
Figures 11–14, 17–19; Figure 11 is of the holotype.

Gomphonema porcupiniana Kociolek et Lowe, sp. nov.

Description: Valves large, length 77–110 µm, breadth 9–12 µm. Valves linear-clavate with headpole protracted, sometimes bent to one side and rounded, footpole. Axial area straight, forming a unilaterally expanded central area bordered by 2–4 shortened striae. On the other side of the central area is a small, rounded stigma positioned at the end of the central stria. The central nodule is large and prominent. Raphe distinctly lateral, slightly undulate, with external distal raphe ends deflected towards the same side of the valve, opposite the stigma. Striae are distinctly punctate, radiate about the center becoming strongly radiate near the poles. Striae continue around the headpole. Striae number 7–8/10 µm in the mid-



FIGURES 24–27. SEM. *Gomphonema porcupiniana*. External views. Figure 24. Valve view showing outline of the valve. Scale bar =10 µm. Figure 25. Headpole, with deflected distal raphe end. Areolae are narrow slits. Scale bar = 1 µm. Figure 26. Footpole with porelli of the apical pore field physically separate and morphological distinct from the areolae. Distal raphe end bisects the pore field. Scale bar = 1 µm. Figure 27. Central area with dilated external proximal raphe ends. Stigmal opening is elliptical. Striae are narrow slits. Scale bar = 1 µm.



FIGURES 28–31. SEM. *Gomphonema porcupiniana*. Internal views. Figure 28. Valve view showing outline of the valve. Scale bar = 10 μm. Figure 29. Large septum present at the headpole. Scale bar = 1 μm. Figure 30. Footpole, with large pseudoseptum and below it a helictoglossa offset from the raphe branch. Scale bar = 1 μm. Figure 31. Central nodule, with recurved proximal raphe ends and slit-like stigma opening. Scale bar = 1 μm.

dle of the valve, 11–13/10 μm at the apices. A distinct, bilobed apical pore field is positioned at the footpole on the valve face. Septa and pseudosepta are present at both poles.

Holotype: JPK Collection, slide number 273054, University of Colorado (COLO)

Etymology: This species is named for the Porcupine Mountains of Michigan, where it is found.

In the SEM, the valve exterior is covered with narrow, slit-like areolae that may be bifurcated (Figures 24–27). The headpole shows the distal raphe ends to be deflected on the mantle (Figure 25). At the footpole (Figure 26), the apical pore fields are comprised of round porelli, that are physically separate and differentiated from the slit-like areolae. The pore field extends from the valve face to the mantle, and appears to be asymmetrical, with one side being more extensive than the other. Small depressions are evident in the central area of the valve (Figure 27). The proximal raphe ends are dilated and tear-drop shaped, and the stigma opening is elongated, quite different as compared to the slit-like areolae. The slit-like appearance of the areolae is unlike most "typical" *Gomphonema* species that typically have "c"-shaped openings (Kociolek and Kingston 1999; Round *et al.* 1990; Reichardt 1999, 2001). The slit-like areolae in *G. porcupinensis* appear to differ from the lineolate striae seen in *G. reimeri* Kociolek & Kingston (Kociolek & Kingston 1999).

Internally, there is a large septum associated with the girdle band (Figures 28-30), especially at the headpole. The central nodule is elongate and bears recurved proximal raphe ends and at the base of the central nodule an elongate stigma opening (Figure 31). Striae have fine siliceous struts oriented perpendicular to the striae (Figure 31).

This species resembles *G. sagitta* Schumann in overall shape, but is much larger. Patrick & Reimer (1975) report the length of *G. sagitta* (as *G. subtile* Ehrenberg var. *sagitta* (Schumann) Cleve) to be 40-51 μm; a similar size range is given by Krammer and Lange-Bertalot (1986), though they lump *G. sagitta* with *G. subtile*. Krammer and Lange-Bertalot (1986) suggest tropical forms may be up to 70 μm in length, but these are still smaller than this Lake of the Clouds endemic.

Figures 20–31; Figure 20 is of the holotype.

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REDISCOVERY OF *RHYNCHOSPORA (PSILOCARYA) NITENS* (CYPERACEAE) IN INDIANA

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ABSTRACT

In 2012 the authors rediscovered *Rhynchospora (Psilocarya) nitens* in Porter County at its only known site of occurrence in Indiana, providing the first documentation of the species for the site and the state in over 50 years. Prior to the 2012 discovery, the species had been collected in the state only twice since 1899. An Atlantic and Gulf Coastal Plain disjunct, this sedge is represented by only two occurrences in the Great Lakes region: Allegan County, Michigan and Porter County, Indiana.

INTRODUCTION

Rhynchospora nitens (Vahl) A. Gray is an Atlantic and Gulf Coastal Plain sedge that ranges in the U.S. from Texas to Massachusetts and that has disjunct occurrences in Indiana and Michigan. Farther south it occurs in the West Indies and Central America (Kral 2002). In the Atlantic Coastal Plain states in the U.S. the species is listed as "vulnerable" to "critically imperiled" in 8 of the 14 states where it occurs, namely Texas, Georgia, North Carolina, Delaware, Maryland, New Jersey, New York, and Massachusetts, and as "possibly extirpated" in Virginia (NatureServe 2014). It is listed as "apparently secure" in Louisiana and Mississippi (NatureServe 2014). Although NatureServe (2014) indicates that the species has not been ranked or is still under review in Alabama, Florida, South Carolina, and Michigan Rothrock (2009) states it is "deemed secure from extirpation in Florida and Mississippi" and Reznicek (1999) notes that it is primarily a southern coastal plain plant that is very rare in the northern parts of its range.

In the Great Lakes region, *R. nitens* was known only from Porter County, Indiana, until its discovery in 1999 in Allegan County, Michigan (Reznicek 1999). The Michigan record represented the only extant occurrence in the Great Lakes region at the time of its discovery, since the species was considered long extirpated in Indiana (Indiana Natural Heritage Data Center 2013). On September 27, 2012, however, the authors found *R. nitens* while conducting a botanical survey of wetlands in the Dune Acres Unit of the Indiana Dunes National Lakeshore in Porter County, Indiana.

TAXONOMY

Rhynchospora nitens is strikingly similar to *R. scirpoides* (Torr.) Griseb. As noted by Reznicek (1999), *R. nitens* has a greyish cast to the spikelets in contrast to the brown spikelets of *R. scirpoides*. The grey spikelet color in *R. nitens* is due to the scale apices possessing wider hyaline margins (Figure 1). Although this character may be helpful in searching for this species in the field, it can be very subtle. The achene body of *R. nitens* has a pronounced cross rugulose pattern, whereas the achenes of *R. scirpoides* are smooth to only slightly rough. Reznicek (1999) also notes that the nearly mature achenes of *R. scirpoides* have a conspicuous pale border that is lacking in those of *R. nitens*. The tubercles, however, are quite diagnostic and easily separate the two species. In *R. nitens* the tubercle is noticeably short (less than 0.5 mm), crescent-shaped, and distinctly wider than tall. The tubercle of *R. scirpoides* is at least as tall or taller than wide (0.5 mm or greater) and triangular (Figure 2). Reznicek (1999) also states that the longer tubercle of *R. scirpoides* gradually tapers "into the more or less persistent style", whereas that of *R. nitens* is deciduous. *Rhynchospora scirpoides* is a state-threatened species in Indiana (Indiana Natural Heritage Data Center 2013). *Rhynchospora nitens* and *R. scirpoides*, along with the primarily tropical *R. eximia* (Nees) Boeck., are annual species that were formerly included in the genus *Psilocarya*. They can be separated from other *Rhynchospora* species by their lack of perianth bristles and the presence of several achenes per spikelet

FIGURE 1. Spikelets of *Rhynchospora nitens*. Photo by Emily J. Stork.

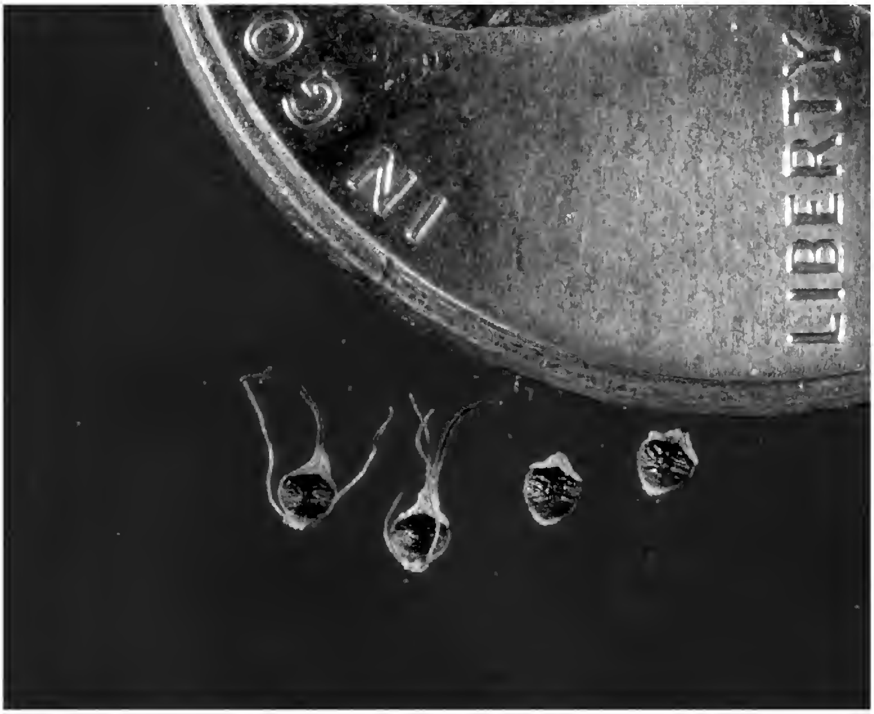

FIGURE 2. Achenes of *Rhynchospora scirpoides* (the 2 achenes on the left with longer tubercles) and *R. nitens* (the 2 achenes on the right with short tubercles). Photo by John Maxwell.

(Rothrock 2009). *Rhynchospora nitens* and *R. scirpoides* superficially resemble *Fimbristylis autumnalis* (L.) Roem. & Schult. and are typical associates of that species in the field. In contrast to the two *Rhynchospora* species, *F. autumnalis* has achenes that lack distinct tubercles and is generally a smaller plant overall, having smaller inflorescences and spikelets (Rothrock 2009).

LOCATIONS AND HABITAT

The general area of all known historical records of *Rhynchospora nitens* in Indiana is within approximately one mile of Lake Michigan near the common boundary of the Portage and Dune Acres USGS quadrangles in the Lake Michigan Border Section of the Northwestern Morainal Natural Region (Homoya et al. 1985). In the broader context, this area lies within the Eastern Broadleaf Forest (Continental) Province (Bailey 1995). Our 2012 discovery is approximately 1300 meters east of historic Goose Lake where some earlier collections were made. Dune Park, also mentioned as an early collecting site for this species, was farther west, approximately two miles beyond Goose Lake. It is possible that

FIGURE 3. Dry lake bed of Little Lake, one of the locations where *Rhynchospora nitens* was found. The plants were in the vegetation on the left side of photo. Photo by Emily J. Stork.

some botanists may have ascribed this name to the general area that includes Goose Lake, since they contained similar wetland communities (Pavlovic, pers. comm.). Dune Park was also the site of an historic train stop along the Chicago South Shore and South Bend Railroad in the Indiana Dunes, and it, along with Goose Lake, has long been lost to industrial development.

The extant wetlands occupied by *R. nitens* are shallow and relatively flat-bottomed with sandy and peaty substrates (Figure 3). These features align closely with those ascribed to the Michigan site by Reznicek (1999). When water levels are low, such wetlands may support a diverse flora that includes a variety of annuals and short-lived perennials, many of which are Atlantic and Gulf Coastal Plain disjuncts. In addition to *Rhynchospora nitens*, other rare coastal plain species known or previously reported from the area include *Ludwigia sphaerocarpa* Elliott, *Rhynchospora macrostachya* Torr. Ex A. Gray, *Rhynchospora scirpoides* (Torr.) Griseb., *Scleria reticularis* Michx., *Schoenoplectus purshianus* (Fernald) M. T. Strong, *Juncus pelocarpus*, *Juncus scirpoides* Lam., *Panicum verrucosum* Muhl., *Polygonella articulata* (L.) Meisn., *Utricularia purpurea* Walter, *Eleocharis melanocarpa* Torr., and *Fuirena pumila* (Torr.) Spreng. (Reznicek 1994, Lamerson 1950, Indiana Natural Heritage Data Center 2013). Many of the species persist in permanent seed banks and germinate when water levels drop and mud and sand flats are exposed (Keddy and Reznicek 1982).

Indiana experienced widespread heat and drought in 2012, and the wetlands

FIGURE 4. Site (referred to in the text as "unnamed wetland") where *Rhynchospora nitens* was first found in 2012. Photo by Emily J. Stork.

surveyed in the target area were completely dry with the exception of a single, small ponded area. On September 27, 2012, a locally abundant population of *R. scirpoides* was closely scrutinized, revealing a single clump of *R. nitens* in a small unnamed wetland just north of Little Lake (Figure 4). On October 2, additional plants, perhaps hundreds were found in this small wetland and Little Lake. *Rhynchospora nitens* associates included *Rhynchospora scirpoides*, *Rhynchospora macrostachya* A. Gray, *Panicum verrucosum* Muhl., *Scleria reticularis* Michx., *Dichanthelium spretum* (Schult.) Freckmann, *Dulichium arundinaceum* (L.) Britton, *Fimbristylis autumnalis*, *Hypericum boreale* (Britton) E. P. Bicknell, *Proserpinaca palustris* L., *Eupatorium serotinum* Michx., and *Cephalanthus occidentalis* L. These wetlands also contain stands of the non-native invasive grass *Phragmites australis* (Cav.) Steud. Further encroachment of this species and *Cephalanthus occidentalis* potentially threatens *R. nitens* and associated coastal plain flora. Following this discovery, although additional sites believed to have potential for *R. nitens* were checked elsewhere in Porter County as well as in Elkhart, Jasper, and St. Joseph counties, Indiana, no additional populations of *R. nitens* were found.

NOTES ON HISTORIC RECORDS

The earliest collections of *Rhynchospora nitens* in Indiana and the Great Lakes region appear to have been on October 20, 1897 in Porter County by

Agnes Chase and E. J. Hill. Although Hill's collections were from Dune Park and/or Goose Pond [Lake] and Chase's reads "Northwest of Porter," these locations likely pertain to the same general area, and it seems plausible that the two botanists were together on that date. The greatest number of collections ever taken in Indiana was in 1898, and all were from the same area(s) described above on the respective dates August 4 (Hill), August 18 (A. Chase, Hill), August 29 (Hill), and September 19 (Virginius H. Chase). A single collection was made in 1899 on September 12 by L. M. Umbach, also from Dune Park, in a habitat described as "slough." This collection had been believed to have been the last time the species was seen in Indiana (Deam 1940; Swink and Wilhelm 1994; Rothrock 2009).

However, following our 2012 discovery, the authors learned about two additional unpublished records of *R. nitens* in Indiana, both taken in the twentieth century and from the same location as the records referenced above from the late 1800s. On August 8, 1953, F. A. Swink unknowingly collected a single specimen of *R. nitens*. This specimen attached to the same collection sheet as a specimen of *R. scirpoides* is at the Field Museum herbarium in Chicago (F). The label on the sheet reads "Porter Co.: In moist open ground near Goose Lake NW of Baileytown" (Niezgoda, pers. comm.). This specimen was annotated by A. A. Reznicek in 2002 as *R. nitens* (Reznicek, pers. comm.). Another collection was made on "wet ground on border of Mud [Goose] Lake marsh, Baileytown, Porter County" on September 19, 1959 by H. R. Bennett (ILL) and indentified on the label as *Fimbristylis caroliniana* (Lambert) Fernald forma *pycnostachya* Fernald. It was annotated by R. Kral in 1967 as *Psilocarya [Rhynchospora] nitens* (Phillippe, pers. comm.).

DOCUMENTATION

Although the authors did not examine any additional collections of *Rhynchospora nitens*, personnel from the following herbaria were contacted regarding this species' occurrence in Indiana: BUT, F, GH, ILL, ILLS, IND, MICH, MO, MOR, NY, PUL, US, and WIS. Herbarium abbreviations are those of Holmgren et al. (1990). All known Indiana collections of *R. nitens* are cited below. All collections are from Porter County, Indiana. Note that E. J. Hill sometimes assigned the same collection number to specimens collected on different dates during the same year.

INDIANA: PORTER CO. Northwest of Porter, drying slough, 20 Oct 1897, *Agnes Chase 686* (ILL – 2 sheets); Goose Pond or Dune Park, wet or damp sands, 20 Oct 1897, *E. J. Hill 195, 1897* (GH, ILL); 4 Aug 1898, *E. J. Hill 154, 1898* (ILL); 18 Aug 1898, *Agnes Chase 920* (F, ILL – 2 sheets, MICH, US), *E. J. Hill 154(2), 1898* (F – 2 sheets [2nd sheet an apparent duplicate, but lacks a collection number and has habitat information as sand], ILL); 18, 29 Aug 1898, *E. J. Hill 154, 1898* (GH). [Note 2 separate dates as per label on sheet]; 29 Aug 1898, *E. J. Hill 154(3) 98* (F), *E.J. Hill 154, 1898* (ILL); East of Dune Park, sandy swamp, 19 Sept 1898, *Virginius H. Chase 292* (ILL); Dune Park, slough, 12 Sept 1899, *L. M. Umbach s.n.* (F, GH, IND, NY, US, WIS); Near Goose Lake NW of Baileytown, moist open ground, 8 Aug 1953, *Floyd A. Swink 2542* (F); On border of Mud [Goose] Lake marsh, Baileytown, wet ground, 19 Sept 1959, *H. R. Bennett 6940* (ILL); Dune Acres Unit, Indiana Dunes National Lakeshore, at unnamed wetland, N ½ of NE ¼ of NW ¼ of SW ¼ of Section 22, T 37N, R6W, 1-10 plants growing in sand flat with *Rhynchospora scirpoides, Scleria reticularis, Dulichium arundinaceum, Proserpinaca palustris, Dichanthelium spretum, Hypericum boreale, Panicum verrucosum, Rhynchospora macrostachya, Fimbristylis autumnalis, Cephalanthus occidentalis, Eupatorium serotinum,* 27 Sept 2012, *R L. Hedge & E. Stork 12-09-27-101*(F, Hedge personal collection), 2 Oct 2012, *R L. Hedge et al. 12-10-02-127* (NY, WIS); At Little Lake, 101-1000 plants estimated growing in sand flat with *Rhynchospora scirpoides, Rhynchospora macrostachya, Panicum verrucosum, Fimbristylis autumnalis, Cephalanthus occidentalis*, 2 Oct 2012, *R L. Hedge et al. 12-10-02-135* (MO, MOR, MICH).

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NOTEWORTHY COLLECTIONS

MICHIGAN

Molinia caerulea (L.) Moench subsp. *arundinacea* (Schrank) Paul ex Grabherr
Poaceae
Purple moor grass.

Significance of the Report. First report of this non-native species for the state of Michigan.

Previous Knowledge. *Molinia caerulea* is a cespitose perennial grass native to Europe, North Africa, Caucasus and Siberia (Taylor et al. 2001). It is a common and sometimes dominant species across much of its native range (Taylor et al. 2001; Dančák et al. 2012). The species has increased in abundance on peatlands in Europe (Chambers et al. 1999) and is sometimes subjected to control actions there (Marrs et al. 2004). *Molinia caerulea* grows well above 20% of full sunlight and is a significant competitor with tree seedlings in European forests (Gaudio et al. 2011). It is tolerant of a wide range of pH levels, with peaks of abundance on both highly acidic soils (pH < 4.0) and moist to wet calcareous soils of pH > 7.0 (Grime et al. 1988). It is scarce or absent from dry calcareous soils, though, apparently because it is unable to obtain adequate phosphorus in the presence of high levels of calcium carbonate (James 1962). Taylor et al. (2001) concluded that the species forms a persistent seed bank, but Pons (1989) gave a contrary view. A dense tussock is the usual architecture, but Jefferies (1915) found a large area in which *M. caerulea* grew as a diffuse sward.

In the fall, the leaves of *M. caerulea* form an abscission layer at the junction of the sheath and blade, which causes the blades to drop off after they die (Salim et al. 1988). Long considered rare among grasses and other herbaceous plants (citations in Salim et al. 1988), structural features fostering leaf abscission may be an overlooked prerequisite for tussock formation in grasses (Röser and Heklau 2011). *Molinia caerulea* produces large amounts of litter each year, which may increase the intensity and frequency of fire (Brys et al. 2005). Brys et al. (2005) found that fire increased aboveground biomass, seed set, and seed germination of *M. caerulea* in a Belgian heathland.

The taxonomy of *M. caerulea* has long been a subject of debate (Dančák et al. 2012). Traditionally, two subspecies have been recognized (Tutin 1980; Dančák et al. 2012). Subspecies *caerulea* occurs on acid, sandy or peaty soils that are at least seasonally wet, at least in Britain (Taylor et al. 2001). It generally inhabits open habitats, including bogs, acidic and calcium-rich fens, grasslands, cliffs and lakeshores (Taylor et al. 2001; Dančák et al. 2012). Subspecies *arundinacea* occurs in tall, often dense vegetation, in sun or partial shade, and on somewhat base-rich mineral soils with a fluctuating water table (Taylor et al. 2001). Typical habitats include intermittently waterlogged oak and pine forests, calcium-rich fens, heathlands, meadow springs, seasonally wet grasslands, dry grass-

FIGURE 1. *Molinia caerulea* at Sidnaw, Michigan, July 23, 2013. The panicle branches are appressed to the rachis at this phenological stage, but are somewhat spread later in the growing season and during the following winter. Photograph by Steven C. Garske.

lands, and human-influenced sites such as roadside ditches and secondary forests (Dančák et al. 2012). Both subspecies are found nearly throughout the native range, although subsp. *caerulea* is more widespread and common, at least in Europe (Tutin 1980; Taylor et al. 2001).

Flow cytometry analysis of *M. caerulea* samples from across continental Europe found that morphologically, tetraploid ($2n$ = 36) plants corresponded to subsp. *caerulea* and dodecaploid ($2n$ = 108) plants to subsp. *arundinacea*, with octoploid ($2n$ = 72) plants intermediate in most characteristics (Dančák et al. 2012). Dančák et al. (2012) also concluded that previous reports of decaploid ($2n$ = 90) plants were probably in error. They have proposed dividing the species into two: *Molinia caerulea* (L.) Moench, a predominantly tetraploid species incorporating very rarely reported hexaploid and perhaps also diploid plants, and *M. arundinacea* Schrank, with higher cytotypes ($2n = 8x$, $12x$). *Molinia arundinacea* would consist of two subspecies: a dodecaploid subspecies and the octoploid subsp. *arundinacea*. For purposes of this report, however, *Molinia arundinacea* is treated as a subspecies of *M. caerulea*.

Molinia caerulea was first collected outside of cultivation in North America in Philadelphia, Pennsylvania in 1878 (Dix 1945). It is now established in the northeastern states from Pennsylvania and New Jersey northward (excluding New Hampshire), and in Wisconsin and western Oregon (Barkworth 2003; USDA NRCS 2013). It also occurs in the provinces of Nova Scotia, Quebec and Ontario, and the French territorial collectivity of Saint Pierre and Miquelon (USDA NRCS 2013). A number of cultivars of both subspecies are planted for their variegated foliage, their compact growth form, or their stiffly ascending or arching architecture (Darke 1999).

Three *Molinia* sites are known from west-central and northwestern Wisconsin (UWSP 2013). The first was a 1986 collection from a bog in Monroe County, which had been partly harvested for sphagnum the previous two years (Freckmann et al. 1988). Populations have since been found in Wood and Ashland Counties (UWSP 2013). The Ashland County population (on the north side of Glidden) dominates several hectares of an old field, spreading from there to nearby roadsides, fields, and regenerating open woods (Garske, personal observation).

Discussion. A large population of *M. caerulea* in west central Upper Michigan appears to represent the first report for the state. In 2011, scattered small colonies were found along Highway M-28, just east of the town of Sidnaw. A larger colony was found along Forest Road 2200, a gravel road running north from M-28, just east of Sidnaw. Forest Road 2200 borders the east end of a grassy airstrip (Prickett-Grooms Airfield) immediately north of Sidnaw. A search in 2012 found *M. caerulea* bordering most of the airstrip. North of the west end of the airstrip, *M. caerulea* dominated more than 5 ha of open wetland, bordered by forest of *Larix laricina, Picea mariana, Pinus banksiana* and *Pinus strobus*. Widely scattered individuals were found along the M-28 corridor, from Sidnaw east almost to the town of Watton.

Because of the aggressiveness displayed by *M. caerulea* in peatland vegetation in its native range, we urge that land managers practice precaution and control the few populations known to occur in the upper Great Lakes area. Boreal peatlands are abundant in much of this region and represent some unique elements of North American biological diversity (e.g., Wright et al. 1992). These peatland ecosystems seem to have been invaded by fewer non-native taxa than have most other regional habitats.

Diagnostic Characters. *Molinia caerulea* produces a dense, long-lived root system that can penetrate up to 1 m deep (Aerts 1993, cited in Brys et al. 2005). The culms possess a second node above the basal leaf tuft (Tutin 1980; Taylor et al. 2001). The basal internodes are about 5 cm long, become widest below the middle, and store carbohydrates and other nutrients through the winter, during which their upper portion remains green (Jefferies 1915). The flat leaves are produced in profusion at the culm base, and another series of several leaves are produced from the top of the basal internode (Jefferies 1915). The ligule consists of a tuft of short hairs. The long upper culm supporting the inflorescence usually remains attached through the winter, when high winds are more likely to disperse the seeds long distances (Jefferies 1915).

Subspecies *caerulea* is generally a smaller plant than subsp. *arundinacea*, with leaves 3-6 (-10) mm wide, culms usually < 90 cm long, panicles usually < 30 cm high, and with relatively short, stiffly ascending branches (Tutin 1980; Taylor et al. 2001). The lowest lemmas are 3 (–4) mm long and subobtuse. Subspecies *arundinacea* encompasses tussock-building plants with culms usually 65-125 (-250) cm long, spreading panicles mostly 30–60 cm long (Figure 1) and leaves 8-12 mm wide. The lowest lemmas are 4–6 mm long and long-acute. The Michigan plants were as tall as 1.8 m, with slightly drooping inflorescence branches. The lower lemmas were predominantly about 5 mm long and clearly narrowed to a point. Therefore these plants appear to belong to subsp. *arundinacea*.

In the upper Great Lakes region, large populations of *M. caerulea* subsp. *arundinacea* could be confused at a distance with any of several other tall grasses. *Molinia caerulea* turns straw-colored in fall, but with a lighter golden-yellow quality that appears slightly brighter than most other fall grasses (Garske, personal observation). Two common grasses that might be mistaken for *M. caerulea* are the introduced reed canarygrass (*Phalaris arundinacea*) and the native switch grass (*Panicum virgatum*). From a distance, reed canarygrass can appear to form dense colonies that cover large (often seasonally wet) areas with straw-colored stalks in the fall. However, its strongly rhizomatous growth form and leafy stems will easily distinguish it from *M. caerulea* at close range. *Molinia caerulea* plants growing along the roadside are probably most likely to be confused with the tussock-forming switch grass. However, switch grass has leafy culms with several internodes of similar length, in contrast to the short basal and long terminal internode of *M. caerulea*. The inflorescence of switch grass is also more diffuse than that of *M. caerulea*, having longer, more spreading branches.

Specimen Citations. Michigan. Houghton Co.: Duncan Township, NW¼ of NW¼ Sec. 4, T47N, R35W, flowering in roadside ditch, August 30, 2011, *Garske 851* (MICH, Ottawa National Forest Herbarium); Duncan Township, NE¼ of SW¼ Sec. 32, T48N, R35W, coming into bloom in open, degraded wetland, July 23 2013, *Garske 903* (MICH, MSC, OSH).

MINNESOTA

Rosa glauca Pourr.
Rosaceae
Redleaf rose.

Significance of the Report. The first published report of this non-native species from the upper Great Lakes region.

Previous Knowledge. The deciduous shrub *Rosa glauca* is native to the mountains of central and southern Europe (Klášterský 1968). Major works have also used the names *R. rubrifolia* (e.g., Bailey 1949; Rehder 1960) and *R. ferruginea* (e.g., [as *R. ferruiginea*] Kartesz 2013; USDA NRCS 2013) for this species. Redleaf rose has been planted for the ornamental merits of its distinctively colored foliage (Bailey 1949; Rehder 1960). This species has been reported to escape from cultivation in widely scattered locations in the United States and eastern Canada, but evidently not previously from the upper Great Lakes region (Kartesz 2013). Olga Lakela collected it once (cited below), from among native shrubs at the edge of northern hardwood forest in Duluth, Minnesota in 1950, but did not include it in her flora of northeastern Minnesota (Lakela 1965). Major twentieth-century floras and manuals for the parts of North America where the species is now best known (Fernald 1950; Scoggan 1978; Gleason and Cronquist 1991) did not mention redleaf rose, perhaps an indication that its escape was less frequent in the past.

Discussion. *Rosa glauca* has been found growing in the wild in seven locations in northeastern Minnesota, evidence that establishment away from cultivation is not unusual for the species in this area. We propose that *R. glauca* be considered part of the wild flora of Minnesota. Most individuals that were found growing in shallow soils lacked flowers or fruits, while most of those found in deep soils were collected in flower or fruit. Evidence for reproduction by these escapes from cultivation is slight. Only one of the plants collected (*Schimpf 642*) had smaller conspecifics close to it (two in this case), which could be its progeny. Fruits were filled with what appeared to be well-developed seeds. As with other species of *Rosa* with similar fruits (Van Dersal 1938), fruits of *R. glauca* may be eaten by birds or mammals, thereby facilitating seed dispersal by defecation or by avian oral ejection after the seeds are used as grit. Lakela's 1950 collection site is probably not suitable habitat now because of construction, so persistence or reproduction of *R. glauca* there can not be fairly assessed. The species has been described as naturalized in several countries (Randall 2012).

Diagnostic Characters. *Rosa glauca* has glaucous leaves and young stems that are described by various authors as purplish, bluish-green, red-tinged, or maroon in appearance. The plants thereby stand out from surrounding vegetation because of the color contrast. The abaxial surface of some leaflets on each of the specimens cited is distinctly bicolored, one lateral half exhibiting a more normal green color. The fruits were described as red by most authors, or as brownish-red (Klášterský 1968); those of the fruiting specimens cited here have a maroon cast over green tissue. The long, narrow sepals are attached to the fruits in *Lakela*

10748, *Schimpf 641* and *Schimpf 642*, but had abscised in *Schimpf 694*, which may have been taken at a more mature stage, in that the fruits measured somewhat larger than those of the other specimens. The sepals are described by Rehder (1960) as "deciduous, " by Bailey (1949) as "persisting for a time, " and by Klášterský (1968) as "usually entire, erect and persistent after anthesis" (describing the section of the genus that includes *R. glauca*.) Although Klášterský (1968) described the sepals as glabrous, they are adaxially tomentose in all of the specimens cited that have sepals, and the margins and abaxial surfaces bear stalked dark glands. The other authors examined did not address the pubescence of the sepals. Sessile obtuse dark glands were observed on the tips of many of the teeth closer to the base of the leaflets as well as on the margins of some stipules; these features were not described in the literature cited.

Specimen Citations. Minnesota. Carlton Co.: Carlton, Sec. 7, T48N R16W, nonflowering on graywacke hogback, July 13, 2011, *Schimpf 629* (DUL, MIN); Lake Co.: Little Marais, Sec. 16, T57N R6W, fruiting in power line right-of-way along highway, August 2, 2011, *Schimpf 641* (DUL, MIN); Sec. 30, T57N R6W, fruiting along highway, August 2, 2011, *Schimpf 642* (DUL, MIN); St. Louis Co.: Duluth, Sec. 14, T50N R14W, flowering and fruiting, July 18, 1950, *Lakela 10748* (DUL); NE¼ Sec. 6, T49M R14W, nonflowering on roadside at base of large bedrock exposure, July 10, 2011, *Schimpf 625* (DUL, MIN); Sec. 33, T50N R14W, nonflowering at base of small bedrock exposure, July 14 2011, *Schimpf 631* (DUL, MIN); Sec. 12, T50N R14W, nonflowering on large bedrock exposure, May 21, 2012, *Schimpf 675* (DUL, MO), fruiting on large bedrock exposure, July 27, 2012, *Schimpf 694* (DUL, MIN).

Rumex thyrsiflorus Fingerh.
Polygonaceae
Narrow-leaved sorrel.

Significance of the Report. The first documented report of this species from the state of Minnesota.

Previous Knowledge. The dioecious perennial forb *Rumex thyrsiflorus* is native from central Europe to central Russia (Akeroyd 1993; Mosyakin 2005) and has spread to other places. Randall (2012) lists it as being cultivated. In North America, it is known from eastern and central Canada and northern Michigan (Kartesz 2013) and more recently from Douglas County in the northwestern corner of Wisconsin (Schimpf et al. 2009). The Wisconsin population was noted as being substantial, evidence of local naturalization in disturbed non-forested habitats (Schimpf et al. 2009).

Mosyakin (2005) commented that its similarity in appearance to garden sorrel (*R. acetosa*) may cause the presence of *R. thyrsiflorus* to be overlooked, since *R. acetosa* may escape from cultivation. However, some major European treatments (e.g., Rechinger 1964; Akeroyd 1993) apply the name *R. rugosus* to cultivated and sometimes escaping garden sorrel, regarding *R. acetosa* as a wild species. *Rumex thyrsiflorus* has also been treated as *R. acetosa* subsp. *thyrsiflorus* (Fingerh.) Čelak.

Discussion. A population of *R. thyrsiflorus* in north-central Minnesota appears to be the first in the state to be documented by specimens. Hundreds of plants were found in the city of Cass Lake, seeming to thrive in sandy, well-drained, shade-free sites that were otherwise dominated by a thin cover of grasses that were shorter than the *Rumex* plants. Rechinger (1964) associated this species with dry sites in Europe. The Minnesota population included some individuals in ditches, although the ditches did not appear to be persistently wet. Some of the plants were in early-flowering phenophase in mid-July to mid-August. Although this could represent re-development after mowing, some nearby conspecifics that we would expect to have been mowed at the same time were well into fruiting. Shoots were up to 10 dm tall, vigorous, and green, despite recent dry conditions. The frequency of plants visible from the highways dwindled to zero just beyond the Hubbard County line to the west, just before the Chippewa National Forest boundary to the east, and a few km beyond the city limits to the south.

If *R. thyrsiflorus* is capable of invading and thriving in tallgrass prairie vegetation, we conjecture that it may prove difficult to eradicate because of its massive roots. Because there are extensive prairie preserves and restorations about 120 km to the west-northwest of Cass Lake in the U. S. Highway 2 corridor and connecting roads (e.g., Minnesota DNR 2013; Nature Conservancy 2013), this population should be monitored for any future spreading or be considered for control action.

Diagnostic Characters. In temperate North America, *Rumex thyrsiflorus* is most readily confused with *R. acetosa* and *R. rugosus*, both of which, like *R. thyrsiflorus*, have sagittate leaf blades. *Rumex acetosa* may be distinguished from the other two species by its simple inflorescence branching, flowering that begins 2-6 weeks earlier, shallow roots, and leaf margins that are generally not undulate. *Rumex rugosus* may be distinguished from *R. thyrsiflorus* by its upper cauline leaf blades that are no more than four times as long as wide, in contrast to the narrower leaf blades of *R. thyrsiflorus*. In addition, the leaf blades of *R. rugosus* have been described as pale green, in contrast to the dark green leaf blades of *R. thyrsiflorus*. The distinctions offered here represent an attempt to synthesize the treatments of Löve and Löve (1957), Rechinger (1964), Akeroyd (1993), and Mosyakin (2005). Although Voss and Reznicek (2012) contrast the bright pink tepals of *R. thyrsiflorus* with the green or pink-tinged tepals of *R. acetosa*, tepals in this Minnesota population were predominantly pale green. An attempt was made to collect the range of variation in gross morphology of the inflorescence, but the 11 plants that were collected were all later found to be pistillate. Populations of *Rumex thyrsiflorus* in the flowering stage in Europe exhibit a strong predominance of pistillate individuals, as do those of *R. acetosa* (citations in Stehlik et al. 2007).

Specimen Citations. Minnesota. Cass Co.: Cass Lake (city), Sec. 9, T145N R31W, along U. S. Highway 2, July 20, 2012, *Schimpf 689* (DUL, MIN); Pike Bay Township, Sec. 21, T145N R31W, along State Highway 371, August 17, 2012, *Schimpf 701* (DUL, MIN).

Spergularia salina J. Presl & C. Presl
Caryophyllaceae
Salt-marsh sand-spurrey.

Significance of the Report. The first report of this species from the state of Minnesota.

Previous Knowledge. *Spergularia salina* is a small annual forb native to saline soils in Eurasia and North America that has subsequently spread to other areas along roads treated with de-icing salts (Hartman and Rabeler 2005). The name *S. marina* has often been applied to this species (e.g., Kartesz 2013). Minnesota is one of only six states in the contiguous U. S. from which the species had not been reported (Kartesz 2013). The others are Arkansas, Kansas, South Dakota, Tennessee, and Vermont (Hartman and Rabeler, 2005).

Discussion. These collections of *Spergularia salina* from a gritty roadside at an interstate highway rest stop are apparently the first from Minnesota. The plants were not numerous or widespread, and were far outnumbered by *S. rubra* at this location.

Diagnostic Characters. Along roadsides in the upper Great Lakes region, populations of *Spergularia* are unlikely to be other than *S. media, S. rubra*, or *S. salina* (Hartman and Rabeler 2005). *Spergularia salina* typically has two or three stamens, whereas the other two species have nine to ten and six to ten stamens per flower, respectively (Hartman and Rabeler 2005). The flowers of *S. salina* were open only in bright light for part of the day, and these collections never had more than one flower open per plant. When open flowers are not available for examination, *S. rubra* may be excluded from this trio of possibilities if the leaves are longer than 1.5 cm.

Specimen Citations. Minnesota. Washington Co.: Forest Lake, SE¼ of SW¼ Sec. 7, T32N R21W, flowers closed, June 8, 2011, *Schimpf 611* (DUL, MIN); flowers open, July 30, 2011, *Schimpf 640* (DUL, MIN).

Elaeagnus umbellata Thunb.
Elaeagnaceae
Autumn-olive.

Significance of the Report. The first report of a collection of this invasive non-native species from the state of Minnesota.

Previous Knowledge. The tall deciduous shrub *Elaeagnus umbellata* is native to eastern Asia (Gleason and Cronquist 1991). It fixes atmospheric nitrogen in its roots and has often been planted to provide cover on infertile disturbed ground (Bradshaw and Chadwick 1980), as wildlife habitat (Yoakum and Dasmann 1971), and for the silvery look of the foliage (Bailey 1949; Rehder 1960). Other forms of human exploitation of autumn-olive have included spurring tree growth in plantations through nitrogen enrichment (e.g., Funk et al. 1979), providing nectar for honey production (G. Sternberg, cited in Catling et al. 1997), and extracting lycopene from the fruit (Black et al. 2005). Birds have spread autumn-olive considerably in eastern North America in recent decades, where it is now regarded as undesirable by many (e.g., Catling et al. 1997; Voss and

Reznicek 2012) and is regulated by several states (USDA NRCS 2013). Kartesz (2013) indicates its occurrence in Brown County in south-central Minnesota, but our examination revealed no collections of this species from Minnesota deposited at either MIN or DUL.

Discussion. One individual of *E. umbellata* was found in extreme southeastern Minnesota and may be an escape from cultivation. This individual was growing at a long-abandoned quarry near a ridge top at the end of a remote jeep trail, and so could have been planted deliberately. Because of the invasive potential and difficulty of control of *E. umbellata* (Catling et al. 1997), it seems prudent to report this possibly first collection for Minnesota.

Diagnostic Characters. Among the species of *Elaeagnus* known in eastern North America, *E. multiflora* Thunb. is most similar to *E. umbellata*, but the latter has a notably longer hypanthium and a shorter fruiting pedicel than *E. multiflora* (Gleason and Cronquist 1991).

Specimen Citation. Minnesota. Houston Co.: Crooked Creek Township, SE¼ Sec. 23, T102N R4W, flowering in dry cobbly soil, April 28, 2012, *Schimpf 665* (DUL, MIN).

WISCONSIN

Lactuca hirsuta Muhl. ex Nutt. var. *sanguinea* (Bigelow) Fernald
Asteraceae
Hairy lettuce.

Significance of the Report. The first report of *Lactuca hirsuta* from Wisconsin.

Previous Knowledge. *Lactuca hirsuta* is a biennial forb native to eastern and central North America, from Nova Scotia to Ontario, south to Georgia, and west to Michigan, Illinois, Missouri, Louisiana and Texas (USDA NRCS 2013). In addition, *L. hirsuta* var. *sanguinea* has been collected from a railroad prairie in Cerro Gordo County, Iowa in 1983 (*Eddy 3019* OSH). Eddy returned to that site in 2012, but was unable to relocate *L. hirsuta* (Neil Harriman, personal communication). Radloff (1961) attributed *L. hirsuta* to northern Minnesota on the basis of a single collection, *Lakela 5120* (see also USDA NRCS 2013). According to Anita Cholewa, curator and collections manager at the Bell Herbarium (MIN), however, *Lakela 5120* is actually a specimen of *Lactuca canadensis* (Neil Harriman, personal communication).

Three varieties of *L. hirsuta* are recognized in recent works (Strother 2006; USDA NRCS 2013). The glabrous to somewhat hairy var. *sanguinea* is found throughout the range of the species (USDA NRCS 2013). The hirsutely pilose var. *hirsuta* has a more limited distribution and is generally less common, having been recorded from Maine, from Ontario and New York south to Virginia, and from Missouri, Arkansas, and Louisiana. The white-flowered var. *albiflora* (Torrey & A. Gray) Shinners is known only from Alabama and Texas. All degrees of intermediates between var. *hirsuta* and var. *sanguinea* have been reported (Fernald 1938; Radloff 1961). Radloff (1961) reduced these three vari-

FIGURE 2. *Lactuca hirsuta* in Wascott Township, Douglas County,Wisconsin, July 11, 2011. The arrangement of the heads is typically less congested than that of its more common congener *Lactuca canadensis*. Photograph by Steven C. Garske.

eties to formas, and included a fourth forma, f. *calvifolia* Fernald, which represents the entirely glabrous extreme of var. *sanguinea*.

In his study of the genus in North America, Radloff (1961) concluded that the species of *Lactuca* with elongate achene beaks form a monophyletic group (Section *Galathenium*). He suggested that they may really represent one quite variable species, which could be divided into four subspecies. Yet he also noted that in their typical forms they are distinct from one another and easily recognized. They are separated from other North American species of *Lactuca* in having strongly flattened, winged achenes with a filiform beak and a single strong nerve (occasionally flanked by two obscure nerves) running down the middle of each face (Radloff 1961; Strother 2006).

Lactuca hirsuta typically inhabits dry, more or less open ground, including oak-pine savanna on old dunes, clearings among jack pines, sandy bluffs and banks, prairie-like areas, roadsides, and clearings (Voss and Reznicek 2012). It is listed as either "threatened" or "endangered" in Illinois, Ohio, Vermont, New York and Maryland (USDA NRCS 2013).

Discussion. A population of *L. hirsuta* var. *sanguinea* in northwest Wisconsin appears to represent the first report of this species for the state. In 2011 a colony of roughly 20 flowering plants and at least as many rosettes was found in cut-over woods. The soil at this site (as in most of southeastern Douglas County) was sandy and well-drained. Though heavily disturbed by logging, much of the site was never plowed and still supported a few large individuals of the indigenous *Pinus strobus* and *P. resinosa.* Resprouting individuals of *Quercus macrocarpa* and *Q. ellipsoidalis* were scattered around the site along with scattered *Abies balsamea* trees and saplings. Common herbaceous associates observed at the site include *Pteridium aquilinum*, *Eurybia macrophylla*, *Carex pensylvanica*, *Danthonia spicata*, *Uvularia sessilifolia*, and *Campanula rotundifolia. Lactuca hirsuta* inhabited mostly openings between low patches of *Corylus cornuta.* In July 2012 this site was revisited and the population relocated. Though not counted, both rosettes and flowering/fruiting plants seemed about as abundant as they were the previous year. One or two coppery flowers were noted on one plant. Subsequent searching revealed scattered colonies of one or two plants, one of which consisted of one fruiting plant and eight rosettes, along local roads up to 4.5 km from the original site. Despite searching several areas of open woods on foot, no plants were found any distance from road corridors. In all, ten flowering or fruiting plants and nine rosettes were found in 2012 at eight locations along gravel and paved county roads. The nearest known population of *L. hirsuta* is in the Shakey Lakes Savanna in Menominee County, Michigan (*Henson 2253* MICH, collected in 1986) (Voss and Reznicek 2012), some 320 km east-southeast of the Wisconsin locality.

Diagnostic Characters. As with other members of the tribe Cichorieae, the heads of *L. hirsuta* contain only ligulate florets. The heads are elongate, with involucres reported as measuring 15–21 mm (Voss and Reznicek 2012), 15–22 mm (Gleason and Cronquist 1991), 12–18+ mm (Strother 2006) or 13–20 mm long (Radloff 1961). The heads have 12–24+ florets (Strother 2006). The achenes are strongly flattened, with a body 4.5–5+ mm long and a filiform beak 2.5–3.5 mm long (Strother 2006). The pappus length has variously been reported as 6.5–8.0 (-10+) mm (Strother 2006), 7–9 mm (Radloff 1961), 8–10 (–14) mm (Voss and Reznicek 2012), and 8–12 mm (Gleason and Cronquist 1991). The leaves are deeply lobed and scarcely prickly, with lobes of at least the lowermost leaves usually more than 1 cm wide and broadest above the base (Gleason and Cronquist 1991). The margins of the leaf blades are entire to somewhat denticulate, and the leaves are somewhat basally disposed. The plants range from 15-80 (-120) cm tall (Strother 2006).

Among the species of *Lactuca* known from northwestern Wisconsin, *L. hirsuta* var. *sanguinea* is probably most similar to prairie lettuce, *L. ludoviciana*, the range of which lies mostly west of the range of *L. hirsuta*, reaching its northeastern limit in Wisconsin (Strother 2006). In contrast to *L. hirsuta*, *L. ludoviciana* has leaves that are clearly prickly-toothed, and heads that have 20-56 florets (Gleason and Cronquist 1991). The florets of *L. ludoviciana* are usually yellow but occasionally blue or lilac (Gleason and Cronquist 1991), whereas those of *L. hirsuta* var. *sanguinea* are yellow to copper-colored (Radloff 1961) or brick red (Hilty 2013).

Lactuca hirsuta is also similar to the fairly common and widespread Canada lettuce, *L. canadensis.* With its deep reddish to reddish-purple stems and involucres (Steyermark 1963; Hilty 2013) and more cylindrical, racemiform inflorescence with relatively few heads (Radloff 1961, Figure 2), *L. hirsuta* var. *sanguinea* is readily separable from *L. canadensis*, which usually has green stems and a much more congested inflorescence. *Lactuca canadensis* generally has smaller floral parts than *L. hirsuta*, with involucres 10–12+ mm, achenes (including the beak) 5–6 mm long, and pappi 5–6 mm long. *Lactuca canadensis* can reach 4.5 m in height, much exceeding the maximum height of 1.2 m reported for *L. hirsuta* (Strother 2006). The stems of *L. canadensis* are often somewhat glaucous (Radloff 1961; Gleason and Cronquist 1991), whereas the stems of *L. hirsuta* are at most only slightly glaucous on the upper half (Hilty 2013).

Specimen Citations. Wisconsin. Douglas Co.: Wascott Township, SW¼ of SW¼ Sec. 12, T43N, R11W, ripening fruit, August 1, 2011, *Garske 838* (DUL, OSH); Wascott Township, NW¼ of NW¼ Sec. 21, T43N, R11W, ripening fruit, July 27, 2012, *Garske 879* (WIS).

Malus baccata (L.) Borkh. var. *baccata*
Rosaceae
Siberian Crab-apple.

Significance of the Report. The first report of this naturalized species from the state of Wisconsin.

Previous Knowledge. The small deciduous tree *Malus baccata* is native to much of Asia (Cuizhi and Spongberg 2003) and is cultivated in North America for its white floral display (Bailey 1949; Rehder 1960). It has also been used for shelterbelt planting (Crossley 1974). Although the fruits have been eaten by people in its native range (Uphof 1959), they seem to be too small to get much culinary use in wealthier societies; their size fosters seed dispersal by a variety of frugivorous bird species (Harris et al. 2002). This species has been reported as naturalized in North America and Europe (Randall 2012). *Malus baccata* has seemingly not been reported from outside of cultivation in Wisconsin (UWSP 2013; Wisflora 2013). That it escapes to the wild in the western Great Lakes region has been documented from several counties in Michigan (Voss and Reznicek 2012), two counties in northeastern Illinois (Kartesz 2013), and one in Minnesota, near the western tip of Lake Superior (Schimpf et al. 2007).

Discussion. Collections of *M. baccata* from the wild in Trempealeau County, Wisconsin appear to be the first for the state. Three trees were seen growing in shallow medium-textured soil where a fine-grained sandstone bed is exposed at the top of a steep, vegetated north-facing soil bank along State Highway 93. The trees which were several cm in diameter near the base and ca. 3-4 m tall, were shaded by deciduous trees and shrubs. The vegetation upslope from their position consisted of a tall deciduous thicket, and no *M. baccata* trees that might be a remnant of cultivation were seen nearby. The few fruits that remained on the August collection date were concentrated in the lower crowns of two of the three trees, and there were no fruits remained on the tree from which the two earlier collections were made (*Schimpf 666, 677*). However, a few underdeveloped fruits from the previous year remained on the tree from which a flowering branch was collected in April 2012 (*Schimpf 666*). The fruits seen in August (*Schimpf 697*) bore a few well-developed seeds, but most locules lacked them. A few trees of about the same size that appeared to be *Malus* hybrids (*Schimpf 698*: DUL, WIS) were in similar settings just a few meters away. Whereas their long-hairy fruiting pedicels and the carpels projecting beyond the free end of the hypanthium suggest hybrid parentage, the small size of their calyx-free fruits leads us to speculate that *M. baccata* could be one of their parent species.

Diagnostic Characters. In autumn and late summer, *M. baccata* trees have lustrous, subglobose, red and yellow pomes that lack sepals and are 7-11 mm in diameter, glabrous green pedicels to 4 cm, and unlobed, sharp-toothed, essentially glabrous leaf blades (Cuizhi and Spongberg 2003; Rehder 1960). Earlier in the growing season the leaves may have pubescence that is not tomentose. This combination of traits serves to distinguish *M. baccata* from other species of *Malus* likely to be encountered in North America, except perhaps the Chinese native *M. hupehensis*. The latter differs in having calyx lobes no longer than the hypanthium and three, or rarely four, carpels and styles (in contrast to four, or rarely five, in *M. baccata*). *Malus baccata* var. *baccata* is distinguished from other varieties of *M. baccata* by its branches, which are neither pendulous nor upright, and by styles that are longer than the stamens (Rehder 1960).

Specimen Citations. Wisconsin. Trempealeau Co.: Albion Township, SW¼ Sec. 35, T24N R9W, in flower, April 29, 2012, *Schimpf 666* (DUL, WIS); same tree, fruit very small and sepals fallen, May 30, 2012, *Schimpf 677* (DUL, WIS); same tree, fruit gone, August 8, 2012, *Schimpf 696* (DUL, WIS); other tree at same location, fruit ripe, August 8, 2012, *Schimpf 697* (DUL, WIS).

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NOTEWORTHY COLLECTIONS

MICHIGAN

Viburnum sieboldii Miq.
Adoxaceae
Siebold's Arrowwood.

Significance of the Report. First known naturalized occurrence in Michigan of a potentially invasive species.

Previous Knowledge. *Viburnum sieboldii* is a large shrub or small tree native to Japan, where it occurs in thickets in lowlands and low mountains (Ohwi 1965). It was introduced to eastern North America in the late nineteenth century as a landscape ornamental, and is known to escape occasionally from cultivation in its introduced range (Kunstler 1993, Gleason and Cronquist 1991). Prior to this collection, naturalized populations of *V. sieboldii* were known in North America primarily from the Mid-Atlantic region of the United States, from Virginia north to New York and Massachusetts (USDA NRCS 2014), although more recently it has also been reported from eastern and southern Ohio (Vincent et al. 2011). Escaped populations are known to establish in a variety of habitats, including mesic forests, stream edges, and suburban parks, and have been reported as abundant or invasive in New Jersey, New York, and Pennsylvania (Kunstler 1993, DeCandido and Lamont 2004, Pennsylvania Department of Conservation and Natural Resources 2014, Central New Jersey Invasive Species Strike Team 2014). On the other hand, Widrlechner and Iles (2002) found that *V. sieboldii* was at relatively low risk of naturalizing in Iowa because of climatic differences between there and the native habitat of *V. sieboldii* in Japan. However, it is unknown whether or how ornamental cultivars may differ from native genotypes in invasive potential. The genus *Viburnum* was long included in the Caprifoliaceae, but is now considered to belong to the Adoxaceae.

Discussion. This collection represents the first known naturalized occurrence of *V. sieboldii* in Michigan or elsewhere in North America outside the Mid-Atlantic states and Ohio. In addition to this occurrence in Kent County, a second population of several individuals was observed and photographed by Sue Tepatti in 2012 (S. Tepatti, pers. comm.) in a floodplain forest along the Rouge River near Inkster in Wayne County, Michigan. Given the evidence from the Mid-Atlantic region of the ability of *V. sieboldii* to become invasive, the presence of naturalized populations in Michigan raises concerns about the potential spread and impact of the species on native plant communities. As a precaution, land managers and others should consider including *V. sieboldii* in statewide early-detection and rapid-response efforts for invasive species.

Diagnostic Characters. *Viburnum sieboldii* is a shrub or small tree with opposite branching and simple, unlobed, ovate to obovate leaves with simple or forked lateral veins that each extend to a tooth (Figure 1; Gleason and Cronquist

FIGURE 1. *Viburnum sieboldii* at Blandford Nature Center, Kent County, Michigan.

1991). The deciduous leaves have a prominent foul odor when crushed, readily distinguishing *V. sieboldii* from other species of *Viburnum* with unlobed leaves. In spring and early summer, it bears many small white flowers in cymes, which are often abundant in ornamental cultivars. Red drupes are formed in late summer and turn blue-black in the fall. Neither flowers nor fruits were observed in the Michigan populations.

Specimen Citation. Kent County: Blandford Nature Center, Grand Rapids, Michigan. On August 18, four individuals were observed in the understory of a mesic forest. Associated species: *Acer saccharum*, *Fagus grandifolia*, *Fraxinus americana*, *Lindera benzoin*, *Carex blanda*, and *Toxicodendron radicans*. Heslinga 12 (MICH).

Carex squarrosa L.
Cyperaceae
Squarrose sedge.

Significance of the Report. Significant range extension of a species with critically imperiled status in Michigan.

Previous Knowledge. *Carex squarrosa* is a clumped sedge of moist woods, wet depressions, and ditches, including disturbed and successional habitats (Michigan Natural Features Inventory 2007; Voss and Reznicek 2012). Carex squarrosa is a native of North America, the known range of which extends from the Great Plains east to Rhode Island and Virginia, and from Georgia and Louisiana north to Michigan, Minnesota, and Ontario (USDA NRCS 2014). Despite the broad geographic distribution of the species, *C. squarrosa* is uncommon throughout much of its range (e.g., Graves et al. 1910; Michigan Natural Features Inventory 2007; New York Flora Association 2014). Prior to this collection, the known distribution of *C. squarrosa* in Michigan was restricted to Lenawee, Monroe, Oakland, St. Clair, Washtenaw, and Wayne Counties in the southeast corner of the state (Voss and Reznicek 2012), with the exception of a dubious historical record from 1888 in Keweenaw County (Herman 1951). The nearest record relative to this Berrien County occurrence is from Porter County in northwest Indiana, at least 25 miles away (USDA, NRCS 2014).

Discussion. Although globally, *C. squarrosa* is considered apparently secure (G4) to secure (G5), it is listed as critically imperiled (S1) in Michigan and as a species of special concern (Michigan Natural Features Inventory 2007). This occurrence fills a gap in our knowledge of the geographic distribution of the species and substantiates our understanding of its habitat requirements, specifically its ability to persist in relatively open successional habitats. Also, the isolation of this occurrence of *C. squarrosa* relative to others raises interesting questions on the metapopulation and dispersal ecology of uncommon species in disjunct populations. For example, if *C. squarrosa* is able to occupy a variety of forested and early successional habitats but remains uncommon throughout its range, is dispersal the most important limiting factor in the establishment of *C. squarrosa*, as is the case with several other *Carex* species (Velland et al. 2000)? If so, what is the primary dispersal mechanism of *C. squarrosa* and related sedges? What is the rate of genetic exchange between disjunct populations of *C. squarrosa*? How, if at all, do the answers to these questions influence future conservation efforts of *C. squarrosa* and other rare species?

Diagnostic Characters. *Carex squarrosa* is a clumped sedge with leaves 3-6 mm wide and with erect, ovoid spikes with numerous spreading perigynia (Figure 2). Spikes are typically solitary on each stem and staminate on the lower portion only (Gleason and Cronquist 1991). The slightly inflated perigynia contain a narrowly ellipsoid achene that is a little more than twice as long as wide and that has a persistent, strongly sinuous style. In contrast, the closely-related *C. typhina* (once considered to be a variety of *C. squarrosa* [*C. squarrosa* L. var. *typhina* (Michx.) Nutt.]) has achenes that are less than twice as long as wide and straight or slightly bent styles (Gleason and Cronquist 1991, Voss and Reznicek 2012).

FIGURE 2. *Carex squarrosa* at Chikaming Township Park and Preserve, Berrien County, Michigan.

Specimen Citation. Berrien County: Chikaming Township Park and Preserve, 1.3 miles east of Lakeside, Michigan, 0.1 miles southeast of the crossing of Warren Woods Road and I-94. On August 28, 2012, several fruiting individuals were observed in a canopy opening within an early-successional wet-mesic forest. Associated species: *Fraxinus pensylvanica*, *Toxicodendron radicans*, *Agrimonia parviflora*, *Fragaria virginiana*, *Juncus effusus*, *Solidago rugosa,* and *Rosa multiflora.* Heslinga 13 (MICH).

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I would like to thank Scott Namestnik and Tony Reznicek for assistance with and confirmation of the identification of *Viburnum sieboldii*. Cardno JFNew allowed me time to work on this report, and Michael Huft and anonymous reviewers provided comments that led to its improvement.

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IN MEMORIAM—ROBERT E. PRESTON

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FIGURE 1: Bob Preston in 1999. Photo courtesy of Jessica Preston.

Robert Eyre Preston passed away at Tendercare Greenview in Alpena, Michigan on Friday, January 17, 2014 at the age of 74.

Robert was born in Ann Arbor, Michigan, on March 29, 1939 to William and Sarah (Eyre) Preston. He received a B.A. in Biology from Oberlin College and pursued his Ph.D. in amphibian ecology at St. Louis University. He was an accomplished oboist and throughout his life was devoted to both classical music and nature. He moved to Alpena in 1983 with his second wife, Carolyn Koppenol, M.D., and youngest daughter, Jessica. For many years he was an active member of Immanuel Lutheran Church in Alpena. He loved the northeastern Michigan area and was active in the Michigan Karst Conservancy as well as the local Audubon Society and the Michigan Botanical Club. He was employed as a Biology instructor at Alpena Community College for a few years but more recently had been very involved at the University of Michigan Herbarium (MICH), where he was a Visiting Researcher.

At the Herbarium, he worked closely with Herb Wagner on ferns of the Great Lakes region and worked especially diligently on Michigan Pteridophytes, specializing particularly in *Botrychium* and the lycopods. For some years, he provided critical determinations for specimens from all over the northeastern United States and adjacent Canada. In addition, he provided the initial text for the Pteridophyte portion of the Michigan Flora Online: (http://www.michiganflora.net/ferns.aspx). Bob also conducted field work and assiduously collected ferns all over Michigan for the Herbarium. He was free with his knowl-

FIGURE 2: Bob Preston on the Keweenaw Peninsula in 2004. Photo courtesy of Carolyn Koppenol

edge and conducted classes and led field trips, including at Michigan Botanical Club Forays, educating people about ferns.

He was preceded in death by his parents. Surviving are his sister, Dr. Elizabeth Wood of Crystal Falls, Michigan; his three children and three grandchildren: Eric (Kim) Preston and grandson, Anders, of Madison, Wisconsin; Jennifer (Lance) McCue and granddaughters, Maxine and Chloe, of Ann Arbor; and Jessica Preston of Alpena.

BOOK REVIEW

Edward G. Voss and Anton A. Reznicek. 2012. *Field Manual of Michigan Flora.* The University of Michigan Press, Ann Arbor. xiii + 990 pp. ISBN 978-0-472-11811-3. Hardback. $25.00.

Recommending "Field Manual of the Michigan Flora" (FMMF) to Midwestern botanists is as easy to do as praising the benefits of good food, love and travel. Its merits are so self-evident that I come up flat-footed in straining to find sufficient praise for it. Generations of Michigan professional and amateur botanists (and also those of Wisconsin, eastern Minnesota, northern Indiana, northern Ohio, and Ontario) have grown up regarding its predecessors, the three "Michigan Flora" (MF) volumes, produced by Ed Voss in 1972, 1985 and 1996, as the "bibles" of Great Lakes plant identification. And now we have FMMF. It is an outstanding, comprehensive, and ridiculously inexpensive ($22.50 when I checked Amazon.com this morning) single hard-cover volume with updated nomenclature and keys, and the generous addition of many species of cultivated and infrequently escaping plants. The outstanding sets of excellent keys, including the difficult graminoids and aquatic macrophytes, are peerless.

The nomenclature is completely up-to-date and includes many new segregate genera and families that will be unfamiliar to the amateur botanist unaware of the advances in plant classification made in recent decades. Fortunately, FMMF includes an appendix (pages 939-941) listing Michigan plant genera whose family assignments have changed. For genera that have been split up into segregates, such as *Aster* (page 372), the paragraph under the generic treatment helpfully lists these segregates (in this case into *Canadanthus, Doellingeria, Eurybia, Oclemena, Sericocarpus*, and—the largest segregate—*Symphyotrichum*). I will admit that it takes some time getting used to seeing old favorites in "new" genera, such as the pale corydalis in *Capnoides* and the Asian bleeding-heart in *Lamprocapnos*! The authors even indulge in some defensible hunches in anticipating future changes—for example, that we will eventually not need to lump *Hepatica* into *Anemone*. At the family level, among the biggest changes that the long-time botanist will note is the segregation of the Liliaceae into 11 families (helpfully noted on page 175-176 under that family), with only the trout-lilies (*Erythronium*) and the true lilies (*Lilium*) remaining from the broad, traditional Liliaceae. On the other hand, the authors could have noted (but did not) on page 891 that the traditional Scrophulariaceae has been "blown up" with major chunks assigned to the Orobanchaceae and Plantaginaceae, and odd bits to the Linderniaceae and Phrymaceae.

FMMF treats 2,719 species—an increase of 254 species since the MF volumes, and includes the recognition of 39 native species as new to Michigan. Some of these new records reflect the recent "splitting" of long-known native species, such as the recent segregation of the sedge *Carex echinodes* from *C. tenera*, and the giant blue cohosh *Caulophyllum giganteum* from *C. thalictroides*. Many new county records have been added.

Generously, FMMF now includes such often long-persistent cultivated plants as Norway spruce (*Picea abies*) and (in passing) Colorado blue spruce (*P. pungens*)—species that always frustrate my plant taxonomy students, since they are not included in standard regional floras such as Gleason & Cronquist (1991). I heartily recommend that future floristic works follow FMMF's lead and include, if possible, ubiquitous long-persistent cultivated plants that are such important parts of our landscapes.

In order to accommodate the entire seed plant flora in one volume, some reductions were necessary. The three MF volumes totaled 1,887 pages (including material paginated with Roman numerals), while FMMF comes in at 1,003 pages (xiii + 990). Thirty-five pages of introductory material in MF Volume I have been reduced to just over two pages. The largest cuts were to the illustrations. MF had a total of 24 color photograph plates illustrating 147 species, as well as a generous number of line drawings; for example, of the 169 species of *Carex* known in Michigan in 1972, the first volume of MF provided illustrations for 83 of them. This is perhaps the biggest limitation of the FMMF, but is mitigated by the fact that the University of Michigan Herbarium (http://www.lsa.umich.edu/herb/) offers all three of the original MF volumes for a total cost of $25.00 (while supplies last). In the Amazon.com reviews, some have lamented the lack of a treatment of pteridophytes (which were also not include in MF), but these are readily available on Michigan Flora Online (http://michiganflora.net/), which also has much of the content of FMMF and is continuously updated.

Michigan's right "arm"—the Upper Peninsula—drapes over Wisconsin's northeastern shoulder like a protective sibling and hints at the two states' close floristic similarities. Of all of the Wolverine State's neighbors, the Badger State has benefited the most from the MF/FMMF series. We "Sconnie" botanists have long used these volumes as our primary go-to floristic resource.

That challenged me to attempt to quantify FMMF's completeness of coverage of Wisconsin's approximately 1,800 native species of seed plants. In the southwest half of our state, roughly south of our Tension Zone, only 59 native Wisconsin species are *not* treated in FMMF—thus, the book has a coverage rate of about 97% in that area. In the northeastern half of Wisconsin (the side fronting the Upper Peninsula and roughly north of our Tension Zone), there are only 18 native species not covered in FMMF—a 99% coverage rate! Looked at in more practical terms, if one were to collect a native plant at random in Central Wisconsin, for example, I believe the chances would be 99.999% (or better!) that it would be treated in FMMF.

It's a guilty pleasure to point out a small way in which a future edition of this book could be improved. I prefer and applaud the use of the alphabetical-by-family-genus-species approach, but it has its shortcomings, too. Perhaps my biggest (albeit still minor) frustration in using the book involves the genus *Carex*. If I recognize that an unknown sedge is related to (say) *Carex stricta*, I can easily look up that species in the book in seconds. But, if I want to get a list of related congeners in the same section, and do not remember that *C. stricta* is a member of section *Phacocystis*, then I need to leaf through 21 pages of keys in order to determine that it belongs in that section along with seven other congeners—a process that takes more time than it should. I suggest that in the next edition, each *Carex* species entry should have its sectional placement mentioned at the end of the species entry to facilitate ease of "backtracking."

Finally, I must salute Tony Reznicek and the late Ed Voss for this marvelous accomplishment. How lucky we are to be contemporaries of these master natural plant historians, worthy successors to Asa Gray, Merritt Fernald, and Arthur Cronquist, who have so generously shared their knowledge of the Great Lakes region in print, and in person.

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INSTRUCTIONS TO AUTHORS

Refer to http://quod.lib.umich.edu/m/mbot/submit for more detailed instructions, especially for formatting, style conventions, literature cited, and voucher specimen requirements. Please contact the editor with any questions.

1. Create text in 12-point Times New Roman font and double space paragraphs throughout. Research articles should be organized as follows: Title, Author(s) and address(es), Abstract with up to 5 keywords, Introduction, Materials and Methods, Results, Discussion, Acknowledgements, Literature Cited, Tables, Figure Legends, and Figures. Sections may be omitted if not relevant. All pages should be numbered.

2. For noteworthy collections, manuscripts should be formatted as follows. The title, "Noteworthy Collections," should begin each submitted manuscript, followed on the next line by the State or Province for the species reported. The next line should list the taxon of interest using the following format: Species Author(s) (Family). Common name. The rest of the manuscript should include the following named sections: (i) Significance of the Report, (ii) Previous Knowledge, (iii) Discussion, (iv) Diagnostic Characters (if desired), (v) Specimen Citations, (vi) Acknowledgements (if desired), and (vii) Literature Cited. Each of these sections is largely self-explanatory; however, the "Significance of the Report" section should be limited to a brief sentence or phrase indicating the significance of the collection(s), and this may be expanded upon in the "Discussion" section; the "Specimen Citations" section should include the relevant label data from the voucher specimen(s) including location data, collector(s), collection number, etc., as well as the Index Herbariorum acronym(s) of the herbarium or herbaria where the specimen(s) are deposited. The manuscript should end with the name and address of the author(s).

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CONTENTS

On the cover: Lake of the Clouds, Porcupine Mountains Wilderness State Park, Ontonagon County, Michigan.
Photo by Carla Kociolek