RESEARCH/MANAGEMENT
FINDINGS

"Anyone who starts to look at bryozoans will continue to do so, for their biology is full of interest and unsolved mysteries." — J.S. RYLAND, 1970

T.S. WOOD

Freshwater Bryozoan Records from Wisconsin

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INTRODUCTION

The bryozoans or "moss animals" (phylum Ectoprocta) are entirely colonial organisms consisting of many similar connecting zooids, each with its independent food-gathering structure, mouth, digestive tract, muscles, nervous system, and reproductive ability. The individual zooids, however, share certain tissues and fluids that unify bryozoan colonies physiologically (Ryland 1970, Wood 1989). The generally sessile colonies occur commonly on hard, stationary submerged objects.

The 50 or so freshwater bryozoan species comprise a small percentage of the roughly 4,000 described members of this mostly marine phylum. Most freshwater species are widely distributed throughout the world, with several species having distributions that include more than one continental landmass and with at least four species having cosmopolitan distributions (Bushnell 1973, 1974, Wood 2001a). Twenty-seven freshwater species have been reported from North America (Table 1); twenty-one of these occur in the states bordering the Great Lakes (Wood 2001a, 2001b).

Biologists find bryozoans in the vast majority of ponds, lakes, streams, marshes, and even roadside ditches, when they carefully examine these habitats (Bushnell 1974, pers. obs.). Eggleton (1936) even found evidence of bryozoans in scattered samples from the deep waters of Lake Michigan. Not only do bryozoans occur in the entire range of aquatic habitats, they often become one of the dominant organisms in benthic and epibenthic communities, where they feed on bacteria, desmids, diatoms, flagellates, rotifers, and other minute animals (Ryland 1970, Bushnell 1974). In turn, flatworms, oligochaetes, snails, chironomid larvae, a variety of other invertebrates, and fish feed on bryozoans (Applegate 1966, Wood 2001a, pers. obs.). Aquatic scientists, unfortunately, often fail to recognize fully the importance of bryozoans in the ecology of these systems.

Few, if any, investigators have studied seriously Wisconsin bryozoans. Published records for bryozoans in the state are limited, and relatively few Wisconsin specimens can be found in state museum collections. Here, I review available literature, discuss specimens in the Milwaukee Public Museum (MPM) invertebrate zoology collection, and report personal observations. Hopefully, this initial synthesis will provide a foundation for future investigators.

Table 1. Freshwater bryozoans occurring in North America. Species are listed alphabetically. Symbols indicate species endemic (+) and introduced (^) to North America (Wood 2001a). Species documented in Wisconsin are shown in **bold** type. An asterisk (*) indicates species that likely occur in Wisconsin, based on their occurrence in adjacent states and Lake Michigan (e.g., Engemann and Flanagan 1991, Barnes 1997, Watermolen 1998), but not yet reported here.

Class Phylactolaemata

Family Fredericellidae

Fredericella browni (Rogick 1941)
***Fredericella indica* Annandale, 1909**
Fredericella sultana (Blumenbach, 1779)

Family Plumatellidae

Hyalinella punctata (Hancock, 1850) *
Plumatella bushnelli Wood, 2001
Plumatella coralloides Annandale, 1911
Plumatella casmiana Oka, 1907 *
Plumatella emarginata Allman, 1844 *
Plumatella fruticosa Allman, 1884 *
Plumatella fungosa (Pallas, 1768)
Plumatella nitens (Wood, 1996) + *
Plumatella nodulosa Wood, 2001
Plumatella orbisperma (Kellicott, 1882) +
Plumatella recluse Smith, 1992 +
***Plumatella repens* (Linnaeus, 1758)**
Plumatella reticulata Wood, 1988
Plumatella similirepens Wood, 2001
Plumatella vaihiriae (Hastings, 1929)
Stephanella hina Oka, 1908

Family Lophopodidae

Lophopodella carteri (Hyatt, 1866) ^ *
Lophopus crystallinus (Pallas, 1768) *
***Pectinatella magnifica* (Leidy, 1851)**

Family Cristatellidae

***Cristatella mucedo* Cuvier, 1798**

Class Gymnolaemata

Order Ctenostomata

Family Paludicellidae

Paludicella articulata (Ehrenberg, 1831) *
Pottsiella erecta (Potts, 1884)

Family Victorellidae

Sineportella forbesi Wood and Marsh, 1996 +
Victorella pavida (Kent, 1870)

Above: *Lophopodella*, a nonindigenous bryozoan found in southern Lake Michigan.

WISCONSIN DEPT. OF NATURAL RESOURCES

METHODS

I conducted an extensive review of literature pertaining to Wisconsin's aquatic biota in an attempt to locate bryozoan records from the state. Specimens maintained in the MPM collection were examined and identifications verified. I contacted several other museums in the state, but no bryozoans could be found in their collections. I also contacted a number of academic and government limnologists/freshwater biologists working in Wisconsin and explored thoroughly the Internet in search of additional specimens or records.

Identification of bryozoan species relies on microscopic examination of certain reproductive structures. Asexual reproduction in freshwater bryozoans includes the development of cyst-like structures called statoblasts, which develop from tiny buds of embryonic tissue formed deep in the center of "individual" zooids. A protective casing analogous to a seed covering in plants, and sometimes provided with hooks and floats, is laid down around each of these "buds." The size, shape, and structure of these statoblasts vary for each bryozoan species. I used the statoblasts and the illustrations and keys in Wood (1989, 2001a) to confirm the identifications of specimens in the MPM collection.

WISCONSIN RECORDS AND DISCUSSION

Fredericella indica - Davenport (1904) reported *Fredericella sultana* (Blumenbach, 1779) in collections from Lake Geneva (Walworth County) in 1891 and 1892. Wood (1989), however, pointed out that *F. sultana* is unknown from North America. The valves of *F. sultana* statoblasts are smooth, as shown by Allman (1856), Mundy (1980), and Geimer and Massard (1986). These contrast sharply with the deeply pitted statoblast valves found on North American *Fredericella* (Wood 1979). Biologists now consider the material identified previously by Davenport as *F. sultana* to be *F. indica* Annandale, 1909 (Wood 1979, 1989).

Muttkowski (1918) found that minute growths "belonging to the genus *Fredericella*... occur plentifully on the plants" in Lake Mendota and "frequently on the bottom to a depth of 8 meters." I suspect these were also *Fredericella indica*, which only occurs in lakes and typically forms small, diffuse colonies on large rocks and heavy, old logs that maintain their position over time. Barnes (1997) photographed branching colonies of *F. indica* in southern Lake Michigan. Further investigation will likely show that this species occurs in Wisconsin waters of that lake as well.

Hyalinella punctata - Barnes (1997) photographed colonies of *Hyalinella punctata* (Hancock, 1850) in southern Lake Michigan, but this species has not yet been documented in Wisconsin waters of that lake, although it undoubtedly occurs there.

***Plumatella* spp.** - *Plumatella repens* (Linneaus, 1758) is widespread and occurs on every continent. Muttkowski (1918) reported this species from Dane County's Lake Mendota watershed. He found it encrusting the underside of rocks along rocky shores and in the Yahara spillway, and on the underside of lily-pads (*Nuphar* sp.) upstream in the Yahara River.

Wood (1996) described a related species, *Plumatella nitens*. This species had previously been combined with either *P. repens* or *P. fungosa* (Pallas, 1768), both of which it closely resembles. Wood (1996), however, showed how the shape and surface morphology of its statoblasts distinguish *P. nitens* from the other species of *Plumatella*.

Wood (1996) outlined the distribution of *P. nitens* as the northern half of North America, including Massachusetts, Michigan, Minnesota, Wisconsin, Ontario, and the northern regions of Illinois, Indiana, and Ohio. In listing the specimens he examined (the basis for his species distribution map), however, the only "Wisconsin" specimen was collected from "Gogebic Co., Paul Lake." Gogebic County is located just across the state border in Michigan's Upper Peninsula. As such, there are no confirmed records from Wisconsin. Given its occurrence in Minnesota, Michigan, and Illinois in proximity to the state border, future surveys will likely show that *P. nitens* does indeed occur in Wisconsin. This species occurs exclusively in lentic habitats where it grows mostly on old wood and vegetation and has been found to co-occur with 13 other bryozoan species (Wood 1996).

Matteson and Jacobi (1980) found *Plumatella* sp. colonies growing "common" and "abundant" on the freshwater sponge *Spongilla lacustris* (Porifera: Spongillidae) below the Jordan Pond Dam on the Plover River in Portage County. They characterized the substrate as rubble and boulder-sized rocks. I observed colonies of a species of *Plumatella* on rocks in the East Twin River, just below the dam at Mishicot (Manitowoc County) in September 1992. In July 1993, I found several *Plumatella* colonies along the shores of Lake Noquebay and the Peshtigo and Menominee Rivers in Marinette County. Metzler and Sager (1986) found colonies of *Plumatella* sp. "quite abundant" in the wave swept shores of Lake Michigan in northern Door County. It is difficult to know what species these might be, but they were probably not *Plumatella repens*, which grows best in quiet or slow moving waters and is generally collected from wood substrates. In fact, Jonasson (1963) found that in larger bodies of water, poor colony growth in *P. repens* is linked to vigorous wave action. Similarly, Økland, et al. (2003) found that *P. repens* avoids sites with "poor aquatic vegetation and stony shores" and "medium wave action." *P. emarginata* Allman, 1844 is a more likely possibility, since it is also widely distributed, prefers stone substrates, and tolerates the turbulence of moving water better than other species (Wood 1989).

***Lophopus* sp.** - Muttkowski (1918) referred to some specimens from Lake Mendota as "probably also *Lophopus*." These could have been the relatively rare *Lophopus crystallinus* (Pallas, 1768), colonies of which have not been reported in North America since 1898, or possibly a misidentified related species.

Lophopodella carteri - Barnes (1997) photographed colonies of *Lophopodella carteri* Hyatt, 1868 in Lake Michigan, but this species has not yet been documented in Wisconsin waters of that lake. Biologists believe this nonindigenous species was likely introduced to North America with aquatic plants in the 1930s (Masters 1940, Fuller and Maynard 2004). Although the ecological impact of this introduction has not been thoroughly investigated, Lauer, et al. (1999) suggested that *L. carteri* colonies inhibit zebra mussels, *Dreissena polymorpha* (Mollusca: Dreissenidae), from settling.

Pectinatella magnifica - *Pectinatella magnifica* (Leidy, 1851) occurs throughout eastern North America. Geiser (1934) included Wisconsin in a North American range map for *P. magnifica*, but identified no Wisconsin localities in his state-by-state listing of records. He later reported this species from unspecified Wisconsin localities (Geiser 1937).

Table 2 summarizes collection data for six Wisconsin *P. magnifica* specimens. In addition to the *P. magnifica* specimens listed in the table, there are two additional specimens in the MPM collection, but the information associated with them is uncertain. The museum catalog and a card file in use through the early 1970s indicate *P. magnifica* specimens were collected from Gilbert Lake in Washington County in August 1933, from Puckaway Lake in Green Lake County in October 1936, and from an unspecified site in Forest County in August 1941.

Table 2. Collection information for MPM *Pectinatella magnifica* specimens.

Collection No.*	Waterbody	Collection Date
954	Yellow River/Loon Lake (Burnett Co.)	28 July - 1 August 1909
955	Mississippi River (Pierce Co.)	25 July 1910
1475	Mississippi River (Crawford Co.)	July 1910
1672	unknown water body (Oneida Co.)	6 August 1932
2611	Grant Park Lagoon (Milwaukee Co.)	July 1970
2702	Whitefish Lake (Oneida Co.)	25 July 1972

*Note: MPM no longer assigns collection numbers to non-insect invertebrate specimens.

Notably, all except one of the MPM *P. magnifica* records are for specimens collected in late July or August. In addition, an Internet search of the National Museum of Natural History's invertebrate zoology database in October 2004 (**http://goode.si.edu/webnew/pages/nmnh/iz/Query.php**) shows a specimen collected by P.R. Hoy near Racine in that museum's collection.

Most bryozoan colonies occur as either flat encrustations or grow in upright arborescent patterns (Ryland 1970). *P. magnifica*, however, secretes a gelatinous ball, which grows bigger as the colony increases its number of lophophores (food-gathering structures with ciliated tentacles). Wood (1989) reports massive colonies can exceed 60 cm in diameter. Morse (1930) found that the gelatinous masses are more than 99% water and contain some chitin, calcium, sodium chloride, and a protein similar to egg albumen.

These jelly-balls usually begin on a submerged stick or plant stem but may be broken loose by rough weather and washed ashore (Chelberg 1971, Wood 1989). Chelberg (1971) reports that these large gelatinous masses, some a "foot or more" in diameter, are frequently found in the fall along the St. Croix and Mississippi Rivers. I have observed similar masses washing ashore along Sawyer Harbor, Sturgeon Bay and the bay of Green Bay during the summer months of 1986 through 1991. Barnes (1997) photographed *P. magnifica* colonies in southern Lake Michigan, and Kuchera (2004) reported a group of environmental education students encountering a similar "jelly thing" in Lake Superior's Allouez Bay. Occasionally, concerned citizens inquire at the DNR's service centers when they encounter the unfamiliar gelatinous masses in northern Wisconsin inland lakes (Holtan 2004).

The statoblasts of *P. magnifica* are circular, bent disks with 11-22 marginal spines, each bearing a pair of distal hooks. All of the MPM specimens had statoblasts present, suggesting that this type of reproduction occurs in Wisconsin beginning in July.

Typical substrates for *P. magnifica* colonies include submerged logs and twigs. Brown (1933) found colonies along the stems of coontail (*Ceratophyllum* sp.). Specimens collected in Oneida County were growing on pondweeds (*Potomageton* sp.) and pond-lily (*Nuphar* sp.). Colonies collected in the Grant Park Lagoon were attached to a stick. *P. magnifica* has also been reported to colonize anthropogenic structures (Davenport 1904, Wood 1989) and the shell of the giant floater, *Anodonta grandis* (Mollusca: Unionidae) (Curry, et al. 1981).

Cristatella mucedo - Barnes (1997) photographed colonies of *C. mucedo* Cuvier, 1798 in Lake Michigan, but this species has not yet been documented in Wisconsin waters of that lake. Recently, Freeland, et al. (2000a, 2000b) and Hatton-Ellis, et al. (2002) examined gene flow and genetic variation and diversity in *C. mucedo*. They used specimens collected in the following Wisconsin lakes: Mud (Dane County), Mirror (Sauk County), Catfish and Yellow Birch (Vilas County), and Whitewater (Walworth County).

Paludicella articulata - *Paludicella articulata* (Ehrenberg, 1831) occurs in Lake Michigan (Ward 1896), but has not yet been reported from Wisconsin waters. With further investigation, it will likely be shown to occur here. It probably occurs in Wisconsin's inland lakes as well.

CONCLUSIONS

The conservation status of bryozoans in Wisconsin remains unknown. Neither state nor federal agencies consider any bryozoans to be endangered, threatened, or of "special concern," but biologists have not conducted a statewide, systematic survey for bryozoans. Only four species have been documented and the few available museum specimens are more than 30 years old.

Additional species certainly occur in Wisconsin. The distribution and status, habitat use, water quality relations, ecology, and trophic dynamics of Wisconsin bryozoans remain areas that could benefit from additional investigation. The generally widespread occurrence of bryozoans, the availability of modern taxonomic references (e.g., Wood 2001a), and the relative ease of rearing cultures (see Wood 1971, 1989), make bryozoans ideal subjects for field and laboratory studies.

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