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DISTRIBUTION OF FRESHWATER SPONGES AND BRYOZOANS IN NORTHWEST INDIANA

David K. Barnes: Department of Biology, Purdue University – North Central; Westville, Indiana 46391-9528 USA

Thomas E. Lauer: Aquatic Biology and Fisheries Center, Department of Biology, Ball State University, Muncie, Indiana 47306-0440 USA

ABSTRACT. Current biogeographical distributions of freshwater sponges (Porifera) and bryozoans (Ectoprocta and Entoprocta) are poorly known in Indiana. Although seemingly ubiquitous in many aquatic communities, neither group has received much notoriety in this state, nor the midwestern United States. In an initial effort to begin the systematic taxonomic distribution of these groups in Indiana, this study identified 2 sponges and 13 bryozoans in northwest Indiana lakes. The recent appearance of the zebra mussel (*Dreissena polymorpha*) in the Great Lakes has focused new attention on the sessile benthic communities, as significant changes in benthic community structure are expected with the introduction of this exotic species. Without knowing the historical and current distribution of native invertebrates, such as the sponges and bryozoans, it is not possible to identify changes in community composition over time.

Keywords: Porifera, Ectoprocta, Entoprocta, freshwater bryozoan, freshwater sponge

The distribution and taxonomy of freshwater sponges (Porifera: Spongillidae) in North America has not received widespread attention, although some notable works exist for the entire United States (Penney & Racek 1968), and regions surrounding the Great Lakes (Potts 1887; Smith 1921; Old 1931; Jewell 1935; Neidhoefer 1940; Eshleman 1950; Ricciardi & Reiswig 1993). Ricciardi & Reiswig (1993) found 15 different species and suggested that additional taxa could be identified in eastern Canada with further study. Sponges may be more ubiquitous than the available scientific literature indicates; and the absence or limited ranges of some species may not reflect their true zoogeographical distribution, but rather a lack of observation (Frost 1991). We have only been able to find six published records of sponge distributions in Indiana (Evermann & Clark 1920; Kintner 1938; Early et al. 1996; Lauer & Spacie 1996; Early & Glonek 1999; Lauer et al. 2001), and these are limited in scope.

Although bryozoans (Ectoprocta and Entoprocta) are widely distributed in epibenthic and littoral communities (Rogick 1934, 1957; Bushnell et al. 1987; Ricciardi & Lewis 1991), little is known about their zoogeographical status. There are 25 species known in North American freshwater (Wood 2001; Smith 1992), and the distribution of many of these species is thought to be ubiquitous (Bushnell 1974). In the Great Lakes region, some taxonomic records exist (Brown 1933; Rogick 1934; Bushnell 1965a, 1965b, 1965c; Maciorowski 1974; Ricciardi & Reiswig 1994). However, no published documentation could be found for this taxonomic group in Indiana except for these recent studies in the northern part of the state (Wood 1996; Lauer et al. 1999; Last & Whitman 1999/2000).

Without knowing the historical and current distribution of native sponges and bryozoans, it is not possible to identify changes in community composition over time. Rapid modification in the quantity and diversity of benthic species has been observed in the Great Lakes with the appearance of non-indigenous species, such as the zebra mussel (*Dreissena polymorpha*). These invasions have threatened the biotic integrity of native organisms and negatively affected the ecosystem stability of sessile benthic communities (Hebert et al. 1991; Mills et al. 1994).

The objectives of this study were to determine the biogeographical distribution of fresh-

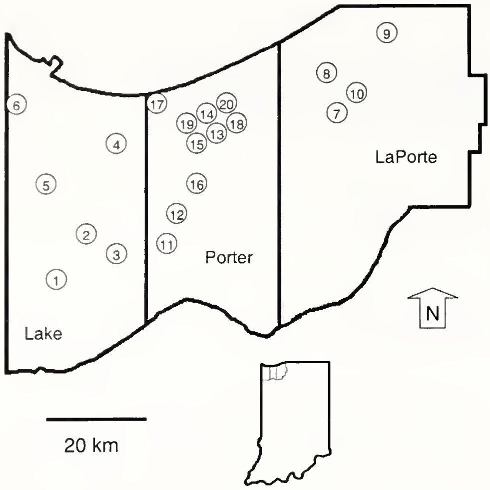

Figure 1.—Lakes studied in Lake, Porter and LaPorte Counties, Indiana. Numbers indicate lake location and correspond to the lake names: 1. Cedar; 2. Francher; 3. Holiday; 4. Lakeland; 5. Lemon; 6. Wolf; 7. Clear; 8. Pine; 10. Saugany; 11. Big Bass; 12. Eliza; 13. Flint; 14. Long; 15. Loomis; 16. Louise; 17. Minnehaha; 18. Round; 19. Spectacle; 20. Wahob.

water sponges and bryozoans in the lakes of Lake, Porter and LaPorte counties, Indiana (excluding Lake Michigan), and to identify the water quality habitats of both bryozoans and freshwater sponges where they are found.

METHODS

Twenty lakes in three northwest Indiana counties were sampled for freshwater sponges and bryozoans during the summer of 1998 (Fig. 1). The lakes sampled were public, freshwater natural lakes remnant from the geological activity that occurred during the Pleistocene glaciation approximately 12,000 years ago (reviewed by Hutchinson 1957). The size and maximum depths of the lakes varied (Table 1). In each lake, a single collection effort occurred in June–July and typically included 2–4 man-hours of shallow water wading and snorkeling at each site. For small lakes, the collection effort encompassed the entire littoral area, while for larger lakes, the collection sites included all available habitat types. No sampling was performed at the lake outlets. Scuba diving was used in deeper waters when warranted. Sticks, plants, rocks, and other similar hard substrate were examined for the sponges and bryozoans. Collections entailed picking or scraping the organisms from the substrate, or removing the organism with the substrate still attached. Sponge identification is based largely on spicule morphology and care was taken to collect specimens bearing gemmules, as well as somatic tissue. Similarly, bryozoan identification typically requires the inspection of statoblasts in addition to the vegetative colony, and both were collected when possible. Most species are large enough to observe with the naked eye, but a hand lens was used to validate colonies that were small or non-descript. Samples were preserved immediately upon collection with 70% ethyl alcohol, and returned to the laboratory for taxonomic identification.

Laboratory preparation of sponge spicules (megascleres, microscleres, and gemmoscleres) was performed using an acid digestion, followed by washings in water and ethyl alcohol. The alcohol was evaporated, and the spicules were mounted in Permount. This technique creates a permanent mount and allows the microscopic examination of the spicules as described in Pennak (1989). Species were identified using the taxonomic keys of Pennak (1989), Frost (1991), and Ricciardi & Reiswig (1993).

Bryozoan colonies and statoblasts were examined using a binocular microscope at 10× magnification and identified using the taxonomic keys of Pennak (1989), Wood (1989, 2001), Ricciardi & Reiswig (1994) and Wood (1996).

Water quality measurements were taken at each location at the time of biological sampling to characterize the habitat where bryozoans and sponges were found. Physical and chemical parameters measured were: temperature, pH, Secchi, conductivity, hardness, calcium, magnesium, total dissolved solids, and dissolved oxygen. Chemistry analysis was completed within 6 h of collection using Hach Company methodology (Hach Chemical Company 1988, 1990) for oxygen (DO), hardness, calcium, magnesium, and total dissolved solids (TDS). A digital Marine Systems meter was used for pH measurements, while conductivity and temperature were taken on site using a Hach Model 44600 conductivity meter.

RESULTS

Thirteen bryozoans (3 classes, 7 families) were identified in the 20 study lakes (Table 2)

Table 1.—Lake basin morphometry, and physical and chemical measurements of the water found at each of the 20 sampling locations during 1998. Water samples were collected at the time of sponge and bryozoan sampling.

				Water quality parameter								
County/Lake	Date	Max. size (ha)	Max. depth (m)	Temp °C	pH S.U.	Secchi m	D.O. mg/l	Hard. mg/l	Ca mg/l	Mg mg/l	Cond. µmhos/cm	TDS mg/l
Lake												
1. Cedar	7/10	316	5.0		8.7	4.0	7.8	74	29.6	10.8	911	456
2. Francher	7/10	4.0	12	27.3	8.6	1.0	8.2	78	31.2	11.4	386	193
3. Holiday	7/6	77	5.5	31.0	7.8	0.3	6.9	76	30.4	11.1	394	198
4. Lakeland	7/8	2.8	10	27.3	8.7	4.0	7.8	74	29.6	10.8	911	456
5. Lemon	7/10	13	4.1	27.3	7.3	0.2	6.5	29	11.6	4.2	416	212
6. Wolf	7/13	156	2.5	31.6	8.8	1.8	8.0	65	26.0	9.5	289	147
LaPorte												
7. Clear	6/22	43	3.5	28.9	9.4	1.0	9.0	60	24.0	8.8	653	331
8. Pine	6/24	228	16	29.8	9.0	2.0	9.3	39	15.6	5.7	293	148
9. Saugany	7/3	30	20	28.4	8.5	5.0	7.5	47	18.8	7.0	432	218
10. Stone	6/23	51	11	28.4	8.7	3.0	8.0	54	21.6	7.9	259	136
Porter												
11. Big Bass	7/6	28	3.4	28.1	7.8	0.3	4.0	71	28.4	10.4	338	170
12. Eliza	7/15	18	14	28.0	9.4	0.4	10.7	61	24.4	8.9	267	134
13. Flint	6/29	36	20	29.4	8.7	1.5	7.0	67	26.8	9.8	351	175
14. Long	6/30	26	8.2	26.9	7.8	1.0	5.8	27	10.8	4.0	221	111
15. Loomis	6/30	25	17	29.1	8.4	0.5	5.8	53	21.2	7.8	361	181
16. Louise	7/16	92	7.6	28.2	8.4	1.6	7.5	75	30.0	11.0	334	168
17. Minnehaha	7/13	8.9	11	29.6	8.6	5.0	8.3	78	31.2	11.4	550	276
18. Round	6/29	0.7	5.5	29.1	7.5	2.1	6.0	41	16.4	6.0	352	219
19. Spectacle	6/30	12	3.0	29.5	8.5	1.4	5.8	57	22.8	8.4	412	201
20. Wahob	6/29	8.0	15	28.8	7.5	3.0	6.1	44	17.6	6.4	271	136

Table 2.—Sponges and bryozoans found in Lake, Porter, and LaPorte counties, Indiana. The lake site number corresponds to the corresponding lake number in Figure 1.

	Lake number
Bryozoans	
Phylum Ectoprocta	
Class Phylactolaemata	
Family Fredericellidae	
Fredericella indica Annandale 1909	2, 3, 6, 17
Fredericella browni (Rogick 1945)	8, 10
Family Plumatellidae	
Hyalinella punctata (Hancock 1850)	2, 17
Plumatella casmiana (Oka 1907)	3
Plumatella emarginata Allman 1844	3
Plumatella fungosa (Pallas 1768)	1
Plumatella orbisperma (Kellicott 1882)	9
Plumatella nitens Wood 1996	1, 6, 12
Plumatella reticulata Wood 1988	1, 2, 3, 8, 10, 12, 13, 16
Family Pectinatellidae	
Pectinatella magnifica (Leidy 1851)	3, 11, 12, 18, 20
Family Cristatellidae	
Cristatella mucedo Cuvier, 1798	7, 8, 9, 10, 13, 16, 18, 20
Class Gymnolaemata	
Family Paludicellidae	
Paludicella articulata (Ehrenberg 1831)	13, 17
Phylum Entoprocta	
Family Urnatellidae	
Urnatella gracilis Leidy 1851	1
Sponges	
Phylum Porifera	
Family Spongillidae	
Eunapius fragilis Leidy 1851	3, 13, 20
Spongilla nr. *aspinosa* Potts 1880	16, 18, 20

and represent the first published account of these species from Indiana. Twelve of them are in the Phylum Ectoprocta and follow the classification scheme outlined by Wood (2001), while a single species, *Urnatella gracilis*, is in the Phylum Entoprocta.

Two freshwater sponge species, *Eunapius fragilis* and *Spongilla aspinosa*, were also found. *Eunapius fragilis* has been found previously in the Indiana waters of Lake Michigan (Lauer & Spacie 1996), while *Spongilla aspinosa* is a new record for Indiana.

Physical and chemical measurements (Table 1) provided some reference to the environmental limits of the bryozoans and sponges. Although the samples for measurement were collected at the 1 m depth, they provided some indication of the range of tolerance of these species. This is particularly true of some species, such as *Cristatella mucedo*, that were found at multiple sites.

DISCUSSION

Finding 12 ectoproct bryozoan species (2 classes, 6 families) in a relatively limited three-county area in northwest Indiana was unexpected. As a comparison, Bushnell (1965a) sampled 122 sites in 48 counties in Michigan over four years and found 13 species, while Wood (1989) found 13 species from 60 locations in Ohio, and Ricciardi & Reiswig (1994) found 14 species from 80 localities in eastern Canada. Other investigators found similar numbers of species (Lake Erie, Rogick (1934); Ottawa River, Ricciardi & Lewis (1991); Louisiana, Everitt (1975)), although some recent changes in ectoproct classifications (see Wood 1996, 2001) may alter the number of species. Our findings suggest that the 20 lakes surveyed in Lake, Porter and LaPorte Counties have a diverse environmental character and support a wide variety of ectoproct bryozoan species despite the small biogeographical area surveyed.

The most common ectoproct species by distribution were *Fredericella indica*, *Plumatella reticulata*, *Pectinatella magnifica*, and *Cristatella mucedo* (Table 2). The first three species are widely distributed in Ohio (Wood 1989) and Michigan (Bushnell 1965a), while *C. mucedo* is found throughout North America, but less frequently (Bushnell 1965a; Smith 1985; Wood 1989; Ricciardi & Reiswig 1994). *Pectinatella magnifica* colonies can grow to a large size (> 50 cm) and are readily found as a gelatinous matrix, particularly late in the summer. Although our specimens were not this large (10–30 cm), they were readily seen during collections. Wood (1989) states that this species also has a wide tolerance for water quality characteristics, but appears to be thermophilic, as growth of statoblasts into colonies is limited below 20° C. Water temperatures at the time of our collections in all 20 lakes were above this limit and did not appear to be inhibiting growth of this species.

Fredericella indica, *Plumatella casmiana*, *Plumatella emarginata*, *Plumatella repens* and *Paludicella articulata* are widely distributed in the midwestern United States and North America (Brown 1933; Bushnell 1965a; Wood 1989; Ricciardi & Lewis 1991; Ricciardi & Reiswig 1994); and their occurrences in northwest Indiana were not unexpected.

Despite the apparent widespread distribution throughout the U.S. (Wood 2001), *Urnatella gracilis* was found only in Cedar Lake in our study. Wood (2001) suggested this species does well in areas where there are extensive water movements, either flowing water or the shallow area of large lakes. Cedar Lake was the largest lake in the study (316 ha) and is shallow (maximum depth 5 m) (Indiana Department of Natural Resources 1966).

Two species of sponges, *Eunapius fragilis* and *Spongilla* nr. *aspinosa*, were found in 5 of the 20 lakes (Table 2). *Eunapius fragilis* is a common species in the midwestern U.S. (Old 1931; Jewell 1935; Lauer & Spacie 1996). It has been found on all continents and climates and is described as truly cosmopolitan by Harrison (1974). As might be expected, this species exhibits a wide tolerance to environmental conditions (summarized by Harrison 1974), well within the water quality measurements we observed (Table 1). The sponge has a preference for growing in areas where the canal system is not clogged by siltation (Potts 1887), with growth typically being enhanced on the underside of hard substrates (Lauer & Spacie 1996). *Spongilla* nr. *aspinosa* is far less common than *E. fragilis* and has been reported only from waters that have low pH (Potts 1887; Eshleman 1950; Ricciardi & Reiswig 1993). Identification of *S.* nr. *aspinosa* was tentative, as gemmules are required for positive confirmation; and we could not find any. Gemmules are over-wintering structures and typically used as a protection against adverse conditions. However, *S.* nr. *aspinosa* is environmentally tolerant and rarely produces gemmules as part of its life history strategy (Potts 1887). Although some question in identification remains for this species, this is probably the correct name for this organism.

Associating water quality parameters with specific organism species was a bit difficult from our results with the limited sampling effort of this survey. However, these lakes are generally characterized as being eutrophic, with extensive anthropogenic inputs.

Both the sponges and the bryozoans in this study represent new records for Indiana. These records should not be considered range extensions or changes in habitats where they were found, but rather, simply an initial assessment of the sponge and bryozoan biogeographical distributions in Indiana. Many of these species are found throughout the geographical region, and might be expected. Considering the relative ease with which these organisms can be found, the paucity of studies on these organisms in Indiana or even nationwide does not suggest they have a limited distribution, but rather that they have not been studied. Our limited mid-summer sampling effort may have also missed some species that are present due to seasonal fluctuations or variations in the growth and development of these organisms. More intense and complete works on the subject, e.g., Wood (1989) and Ricciardi & Reiswig (1993, 1994), support this hypothesis. This study identified the biogeographical distribution of these little known groups in northwest Indiana, and by doing so, initialized an effort to more fully understand the significance and ecological importance of sponges and bryozoans to this region.

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