

An overview on freshwater bryozoan research in Lithuania

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1. Introduction

Freshwater bryozoans are among the most fascinating invertebrate animals, although many aspects of their ecology, physiology and development are still poorly understood (Wood 2005). The most recent published inventory shows 21 species of freshwater bryozoans in Europe (Woss, 2013), with a number of these species being recorded in countries bordering Lithuania (Latvia, Estonia, Poland, and Belarus). From Lithuania what little is known about bryozoans comes mostly from field work conducted during 1931–1933 by Brone Pajiedaite. This work culminated in a Master's thesis in which 7 freshwater bryozoan species were described (Pajiedaite 1933). Since that time no further studies in Lithuania have been conducted on this animal group.

This review article has two aims: (1) to collect and review all available information related to the Lithuanian bryozoans, emphasizing the importance of the bryozoans in ecosystems and human life; and (2) to declare that bryozoan research Lithuania has restarted.



Figure 1. Brone Pajedaite and Veronika Zvironaite
(Photograph courtesy of the Jewish Museum in Vilnius, Lithuania).

2. Biography of Brone Pajedaite

Born in 1910, Brone Pajedaite studied biology and dentistry in two faculties of Vytautas Magnus University. In addition to her work with freshwater bryozoans, she also prepared for a career in dentistry. Friends described her as a dynamic woman with a strong personality. During the WWII Brone Pajedaite, together with other members of Lithuanian academic community Petronele Lastiene and Veronica Zvironaie, participated in the rescue of Jewish children (Kultura, 2011) (Figure 1). In 1945 they were arrested by the Soviets, being part of a group of Lithuanian activists who had signed a petition for Lithuanian independence. Petronele and Veronika were deported to Siberia. Brone Pajedaite was imprisoned and is reported to have died there after about a year. On July 30, 2000, Yad Vashem recognized Brone Pajedaite, Petronele Lastiene and Veronika Zvironaite as “Righteous Among the Nations” (<http://www3.lrs.lt/docs2/WPSGXTXP.PDF>).

3. Review of Brone Pajedaite’s Masters Research

Brone Pajedaite studied freshwater bryozoans in Lithuania during 1931–1933. What prompted her to undertake this work is not known. References in the thesis include several popular works on freshwater biology, and these may have inspired her to seek out bryozoans. She also acknowledges support from her thesis advisor, Tadas Ivanauskas, the most prominent zoologist in Lithuania, although his broad interests were more focused on vertebrates (eg. Ivanauskas 1957).

In any case, Brone Pajedaite collected freshwater bryozoans from widely scattered locations in Lithuania, including lakes, ponds, and rivers (Figure 2). She worked along shorelines as well as swimming from a boat. Some sites were revisited during the second year and any changes were noted. In 1931, for example, she found *Paludicella reticulata* growing on leaves of the yellow water lily (*Nuphar lutea*) and water lilies (*Nymphaea alba*), but the bryozoan had disappeared by 1932. Pajedaite concluded that the cause may be related to changing environmental conditions.



Figure 2. Bryozoan collection sites in Lithuania visited by Brone Pajiedate (1931–1933).



Figure 3. Photo from a representative slide in the Pajiedaite collection showing two plumatellid zooids with developing sperm on the funiculi and an ovary (circled). To our knowledge this is the first and only photograph of a phylactolaemate ovary, which is transitory and seldom seen.

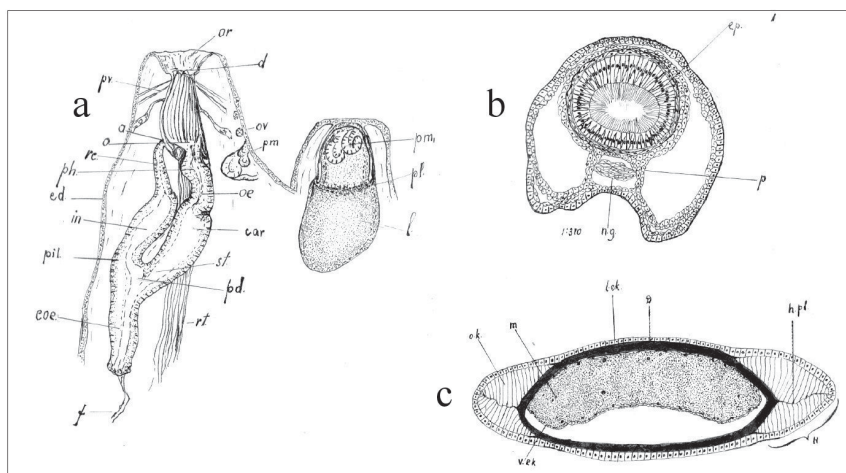


Figure 4. Composite of representative drawings made from sectioned material collected by Brone Pajiedaite. (a) Gut anatomy and developing larva in *Plumatella fungosa*; (b) cross section of a plumatellid zooid just below the lophophore showing esophagus and neural ganglion; (c) lateral section of a plumatellid statoblast. (Modified from Pajiedaite, 1933).

Field specimens were anaesthetized with cocaine and fixed in formalin or alcohol. Back in the laboratory, Pajiedaite recorded observations of living material from an aquarium. She also made permanent microscope mounts of sectioned bryozoan specimens stained with fuchsine, rubin S., haematoxylin, eosin or haematoxylin- eosin (Figures 3-4).

Altogether Brone Pajiedaite identified seven freshwater bryozoan species, including almost all the species known in Europe at that time. She realized, however, that her collection was still too limited for a thorough assessment of the Lithuanian freshwater bryozoan fauna. After two years of her survey, she had still not found *Fredericella sultana* or *Lophopus crystallinus*, which were known to occur in neighbouring countries.

Good sources of information were apparently not easily accessible. Brone seemed to rely heavily on the broad overviews by Braem (1914) and Marcus (1925). She also referenced an obscure Kraepelin (1902) work, but not Loppens, Borg, or Abricosov, who were publishing at that time, nor any of the classic works of the 19th Century, eg. Kraepelin (1887). Exactly at the time of Pajiedaite's work in Lithuania, Mary Rogick was just learning about bryozoans on Lake Erie in the USA. Adriana Vorstman's studies of Indonesian phylactolaemates had been published several years earlier but were unknown to Pajiedaite.

Listed below are the species that were collected and described by Brone Pajiedaite. Most of these were, in her words, "monitored live through a microscope to make characteristic drawings", some of which are presented here (Figure 5). Brone provided descriptions of all species, including morphological variations, drawings of statoblasts (Figure 6). She also characterized the substrates on which the colonies were most commonly found and provided locality data.

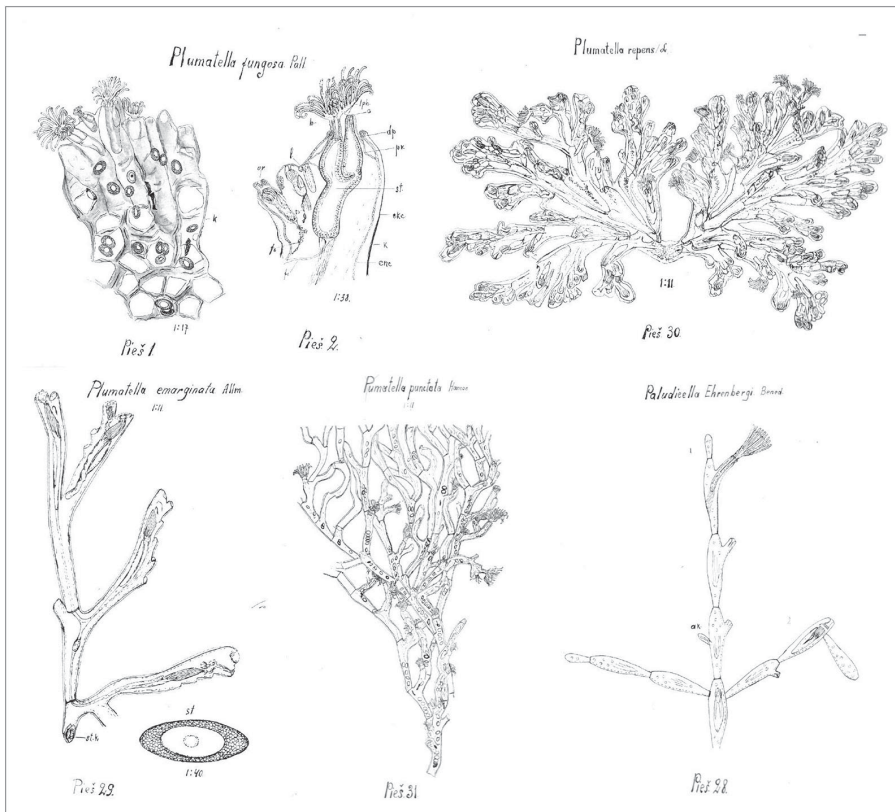


Figure 5. Composite of line drawings made by Bronė Pajėdaite from her specimens collected in Lithuania. (Modified from Pajėdaite, 1933).

Cristatella mucedo Cuvier, 1798

This species was found in Aukatadvaris Lake and Veravos Bogs (Kaunas district) and was also quite common in southern Lithuania. In 1931, it was found abundantly in the Satarecius Pond. Pajėdaite stated that colonies had only immature statoblasts during June and July, but mature statoblasts could be seen in August and September. Pajėdaite noted that statoblasts of this species varied significantly in size among different habitats.

Plumatella fungosa (Pallas, 1768)

According to Pajėdaite this species is common in Lithuania (Figure 4). It was found in Utenos district (Lake Kunigiakiai) and Kaunas district (port Kaunas city and Nevezis River near Raudondvaris). Pajėdaite found that *P. fungosa* prefers standing water and shallow areas, where the water is often not very clean and clear. For example, she noted *P. fungosa* colonies in the old port of Kaunas, where the water was contaminated with steamship oil. Colonies could be found on a variety of submerged substrates, including tree branches (*Alnus*; *Salix*), roots, reeds (*Juncus*), cattails (*Phragmites*), shells (*Anadonta*, *Dreissena*), and stones.

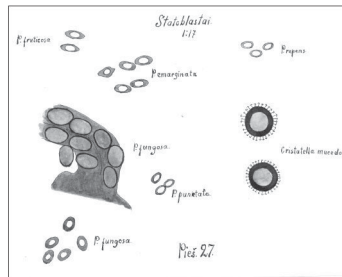


Figure 6. Drawings of statoblasts collected in Lithuania by Bronė Pajiedaite (from Pajiedaite, 1933.)

Plumatella repens (Linnaeus, 1758)

Pajiedaite referred to *P. repens* as one of the most common bryozoan species (Figure 5) in Lithuania, occurring in lakes, rivers, small streams, ponds, and hollows. In contrast to *P. fungosa*, *P. repens* preferred cleaner and more flowing water. Colonies seemed to occur mostly on submerged macrophytes.

Plumatella emarginata Allman, 1844

This species (Figure 4) was reported in Utena District (Lake Paatis, Satarecius Pond), Kaunas District, Sauliai District (Dubysa River), and Lazdijai District (Lake Snaigynas). Colonies of *P. emarginata* were found growing on submerged logs, stones, and mollusc shells (*Viviparus*, *Dreissena*). The study described statoblasts of this species. Colonies of *P. emarginata* were compared with the very similar *P. repens*, highlighting the differences. In Pajiedaite's mind, however, there may have been some confusion regarding this species. Her drawing labelled as *P. emarginata* (Figure 5) appears instead to be *Plumatella fruticosa*, with characteristic stumps on a free branch where fragments have broken off.

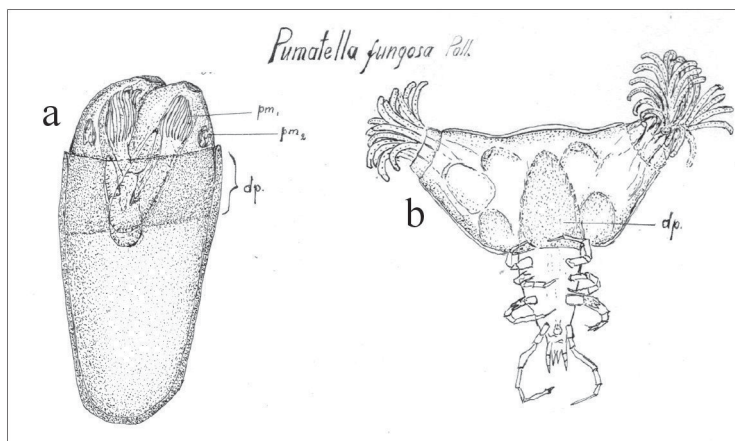


Figure 7. Larvae of *Plumatella fungosa*. (a) Early stage of settlement with mantle starting to pull back from the zooids; (b) Larva having settled on the abdomen of a water mite. (Modified from Pajiedaite, 1933).

Plumatella fruticosa Allman 1844

This species was found in only two locations: River Dubysa (Siauliai district.) and pond Satarecius (Utena district).

Hyalinella punctata (Hancock, 1850)

Brone Pajiedaite referred to this species by its original name, *Plumatella punctata*. She discovered it in Jatkuniskio lakes (Zarasai district) and the River Dubysa (Siauliai district) on the leaves of yellow water-lily (*Numphar lutea*).

While conducting her survey of freshwater bryozoans, Brone Pajiedaite noted how bryozoan distribution may be influenced by water temperature, cleanliness, and vegetation. For example, she realized that in Central Lithuania (around Kaunas) the temperature was a few degrees higher than in the eastern part of the country (around Dusetos). Possibly as a result, *Paludicella* was found only in the eastern and northern parts of Lithuania; *Cristatella mucedo* occurred only in the central and southern part of Lithuania, while species of the genus *Plumatella* were prevalent everywhere.

Brone Pajiedaite made notes on bryozoan associations with other organisms, such as sponges, molluscs, and rotifers. She often found bryozoans colonies gnawed by snails (*Planorbis*, *Lymnea*), and she mentioned that larvae can easily settle on other organisms. One of her illustrations shows a young larval colony of *P. fungosa* growing on a water mite (Figure 7).

In the course of her studies, Brone Pajiedaite prepared at least 70 microscope slides (Figure 3) and an unknown number of whole specimens. Unfortunately, the whole specimens were apparently destroyed during World War II (1941–1945).

4. Bryozoan research in Lithuania after 82 years

No bryozoan research has occurred in Lithuania since 1933, and for nearly 82 years there has been no information about them! In 2007, scientists from the Vytautas Magnus University (Prof. Vida Mildaziene and Sarunas Asmantas) made a popular science video about bryozoans (<https://vimeo.com/25460026>). So far, based on unpublished data from various expeditions in Lithuania, we found several species of bryozoans: *Cristatella mucedo* (in lakes Plateliai, Peraokanas, Snaigynas), *Plumatella repens* and *Plumatella fungosa* (in ponds in surrounding of Kaunas) mentioned in Brone Pajiedaite's study (Figure 8). It should be noted that the authors of this paper will begin to systematically investigate bryozoans from Lithuania, and the first step is to carry out a revision of freshwater bryozoan species in those localities studied by Brone Pajiedaite during 1931–1933.

5. Bryozoan expected to occur in Lithuania

Bryozoan species found in countries neighboring Lithuania are characteristic of

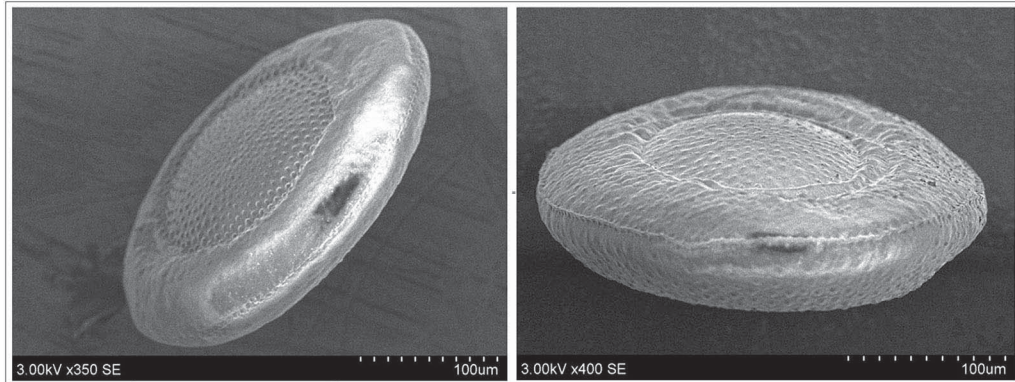


Figure 8. SEM micrographs of the free statoblasts of *Plumatella repens* (left) and *Plumatella fungosa* (right) from recent collections in Lithuania. (Photos by Simona Tuckute).

Europe, but of course the total number of species is now much higher than those recorded by Brone Pajiedaite in 1931–1933. For example, although Pajiedaite did not find *Fredericella sultana* in Lithuania, it has been reported from both Latvia and Estonia (Wöss, 2013). Other species have been discovered or introduced to eastern Europe since 1933, including *Plumatella bombayensis* Annandale, 1908 in Belarus (Wood & Okamura 2005), *Internectella bulgarica* Gruncharova, 1971 in Bulgaria (Gruncharova 1971), *Pectinatella magnifica* (Leidy, 1851) in Poland, Romania, Czech Republic and elsewhere (Balounová *et al.* 2013), and *Plumatella casmiana* Oka, 1907 in Poland, Austria, and Bulgaria (Massard & Geimer 1995). Other species likely to be found in Lithuania are listed by Wood & Okamura (2005), including *Lophopus crystallinus* (Pallas, 1768), *Plumatella geimermassardi* Wood & Okamura, 2004, and possibly even *Plumatella rugosa* Wood *et al.* 1998, *Plumatella reticulata* Wood, 1988, and *Fredericella indica* Annandale, 1909. So it is clear that the Lithuania bryozoan species list is likely to expand and that much future research remains to be done.

Acknowledgments

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