

CHAPTER 4-7b

INVERTEBRATES: ROTIFER TAXA – MONOGONONTA

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Figure 1. *Lecane stokesii*, a monogonont rotifer that can be found among bryophytes. Photo by Michael Plewka <www.plingfactory.de>, with permission.

Taxa on Bryophytes, Ploimida continued

Lecanidae

The **Lecanidae** were represented by the second highest number of species among rotifers in the reservoirs in Spain (de Manuel Barrabin 2000) and their species are well represented among those rotifers collected with bryophytes as well (*e.g.* Jersabek *et al.* 2003). One reason for this is that the family has only one, but a very large, genus – *Lecane*. The genus *Lecane* is the second largest genus of rotifers, with at least 160 species (Segers 1995).

Not surprisingly, there are a number of *Lecane* species living in *Sphagnum* (Figure 1, Figure 2). One of the early reports including *Sphagnum* dwellers was that of Haring (1915) in Panama. These included *L. bifurca* (Figure 3; see also Myers 1942), *L. flexilis* (Figure 4-Figure 5; see

also Bielańska-Grajner *et al.* 2011), *L. inermis* (Figure 7-Figure 8), *L. monostyla* (Figure 9; see also Bielańska-Grajner *et al.* 2011), and *L. tenuiseta* (Figure 10; see also Bielańska-Grajner *et al.* 2011). The *Sphagnum* associates include those in bogs and fens. Błedzki and Ellison (2002) found *Lecane pyriformis* (Figure 11) and *L. lunaris* (Figure 44-Figure 45) to be among the abundant *Sphagnum* dwellers in their study. To these, Bielańska-Grajner *et al.* (2011) added *L. bulla* (Figure 12-Figure 13), *L. intrasinuata* (Figure 14), *L. luna* (Figure 15), and *L. perpusilla* as bog dwellers. But *Sphagnum* fauna records must be viewed with caution. Methods using pore water often miss the relatively immobile rotifers that live on mosses (Sakuma *et al.* 2002).



Figure 2. *Sphagnum* and *Potentilla tridentata*, home for many kinds of rotifers. Photo by Nancy Leonard, with permission.

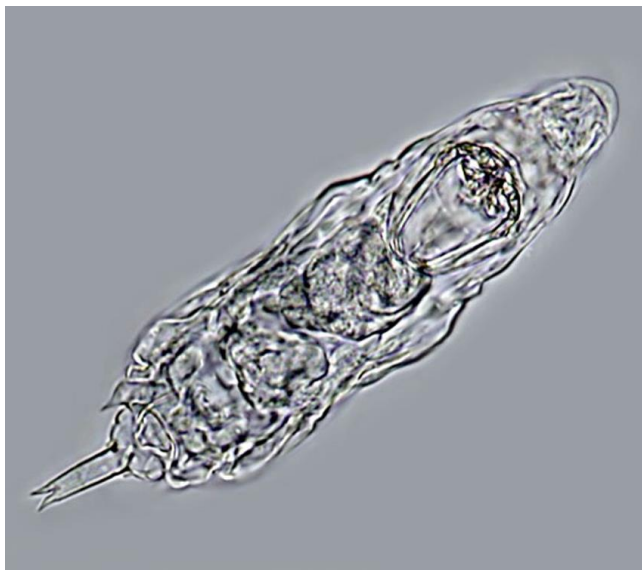


Figure 3. *Lecane bifurca* lives among mosses, including *Sphagnum*. Photo by Michael Plewka <www.plingfactory.de>, with permission.

Hingley likewise found *Lecane flexilis* (Figure 4-Figure 5; see also Bielańska-Grajner *et al.* 2011) among *Sphagnum* (Figure 2), but Jersabek *et al.* (2003) further reported it from the floating thallose liverwort, *Riccia fluitans* (Figure 6). This rotifer species occurs infrequently in the plankton, preferring instead the littoral (near shore) zone (de Manuel Barrabin 2000). It occurs more frequently in alkaline habitats (Pejler 1962; Koste 1978) in a pH range of 6.64-7.87, although Koste and Shiel (1990) found it in slightly acidic water. Its wide temperature range (9.50-21.13°C) permits it to be cosmopolitan (de Manuel Barrabin 2000).



Figure 4. *Lecane flexilis*, a species known from bogs and from the thallose liverwort *Riccia fluitans* in ponds. Photo by Jersabek *et al.* 2003, with permission.



Figure 5. *Lecane flexilis*, a species known from *Riccia fluitans* in ponds. Photo by Jersabek *et al.* 2003, with permission.



Figure 6. *Riccia fluitans*, a floating liverwort that is home to *Lecane flexilis*. Photo by Jan-Peter Frahm, with permission.

In *Lecane inermis* (Figure 7-Figure 8), a *Sphagnum* (Figure 2) dweller, **mictic** (producing eggs that without fertilization develop into males but with fertilization form resting eggs that later develop into amictic females) females have the longest lives of 11.1 ± 0.28 days, followed by amictic females with a lifespan of 8.9 ± 0.11 days, and the shortest lifespan in males at 5.7 ± 0.07 days (Miller 1931). In males, death of 83% of the population occurs in the four to six days. Sexual females lay one egg every 8.6 hours, whereas the **amictic** (producing eggs that

develop without fertilization) female lays one every 7.5 hours. Amictic females usually die within 24-36 hours after laying the last egg, but among the mictic females, 19% live six more days after depositing eggs. Typically, *Lecane inermis* is a littoral species that also occurs in warm water such as thermal springs and geysers (de Manuel Barrabin 2000). Its typical temperature is around 19.4°C, but it can be found near geysers at temperatures up to 62.5°C. Its environmental pH is usually around 7.3.

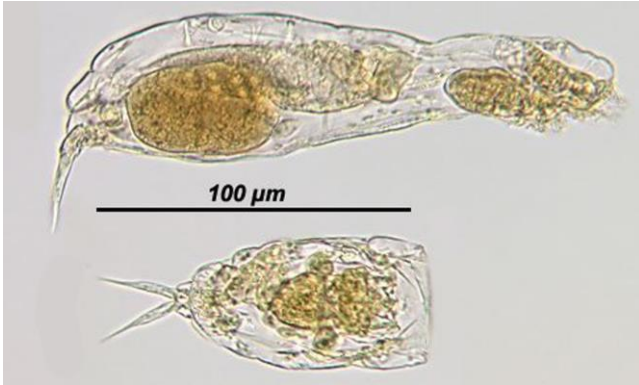


Figure 7. *Lecane inermis*, a *Sphagnum* dweller. The upper image is in the extended state, the lower one in the contracted state. Photo by Jersabek *et al.* 2003, with permission.



Figure 8. *Lecane inermis*, a *Sphagnum* dweller. Photo by Michael Plewka <www.plingfactory.de>, with permission.



Figure 9. *Lecane monostyla*, a *Sphagnum* dweller. Photo by Jersabek *et al.* 2003, with permission.

Lecane tenuiseta (Figure 10) is typically a littoral species, known from a pH around 7.9 and a temperature around 13.5°C (de Manuel Barrabin 2000). Although it is cosmopolitan, its restricted habitat requirements make it relatively rare.



Figure 10. *Lecane tenuiseta*, typically a littoral species, sometimes living among *Sphagnum*. Photo by Michael Plewka <www.plingfactory.de>, with permission.

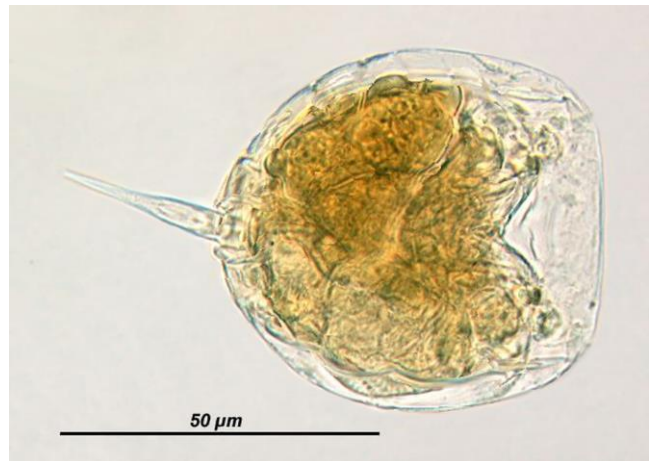


Figure 11. *Lecane pyriformis*, an abundant bog dweller. Photo by Jersabek *et al.* 2003, with permission.

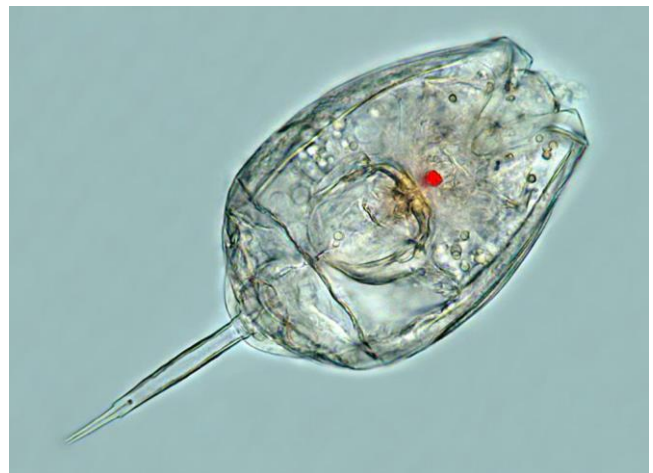


Figure 12. *Lecane bulla* from leaf litter, also a *Sphagnum* dweller. Photo by Michael Plewka <www.plingfactory.de>, with permission.



Figure 13. *Lecane bulla* resting egg inside its deceased mother. Photo by Michael Plewka <www.plingfactory.de>, with permission.

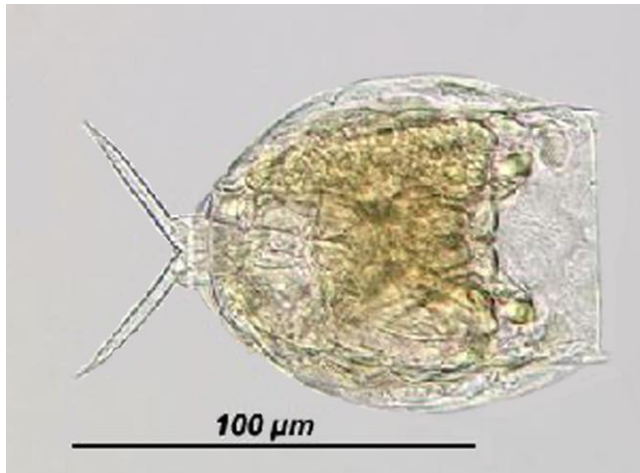


Figure 14. *Lecane intrasinuata*, a *Sphagnum* dweller. Photo by Jersabek *et al.* 2003, with permission.



Figure 15. *Lecane luna* from among water plants, also a *Sphagnum* dweller. Photo by Michael Plewka <www.plingfactory.de>, with permission.

One of the most extensive treatments of North American rotifers is that of Myers (1942) for the Poconos in Pennsylvania, USA. He considered *Lecane obtusa*

(Figure 16), *L. opias* (Figure 17; see also Bielańska-Grajner *et al.* 2011), and *L. subulata* (Figure 18-Figure 19) to be small species that are common among *Sphagnum* (Figure 2). In that same publication, he reported *L. depressa* (Figure 20-Figure 21; see also Hingley 1993), *L. formosa*, *L. furcata* (Figure 22), *L. niothis*, *L. pumila* (Figure 23), *L. rhytida*, *L. scutata* (Figure 24; see also Koste & Shiel 1990; Bielańska-Grajner *et al.* 2011), *L. subtilis* (Figure 25; see also Bielańska-Grajner *et al.* 2011), *L. tryphema* (Figure 26), and *L. verecunda* (Figure 27) from *Sphagnum*. He also reported *L. dysoarata* (Figure 28) from the emergent species *Sphagnum cuspidatum* (Figure 29). Horkan (1981) reported *L. quadridentata* (Figure 30-Figure 31) from bog pools.



Figure 16. *Lecane obtusa*, a *Sphagnum* dweller. Photo by Jersabek *et al.* 2003, with permission.

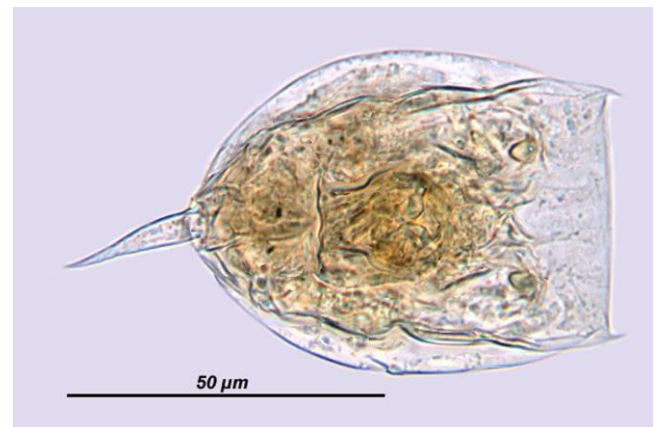


Figure 17. *Lecane opias*, a *Sphagnum* dweller. Photo by Jersabek *et al.* 2003, with permission.



Figure 18. *Lecane subulata* from among *Sphagnum* (Myers 1942). Photo by Jersabek *et al.* 2003, with permission.



Figure 19. *Lecane subulata* from among *Sphagnum*. Photo by Jersabek *et al.* 2003, with permission.



Figure 20. *Lecane depressa*, a species known from *Sphagnum* bogs. Photo by Jersabek *et al.* 2003, with permission.

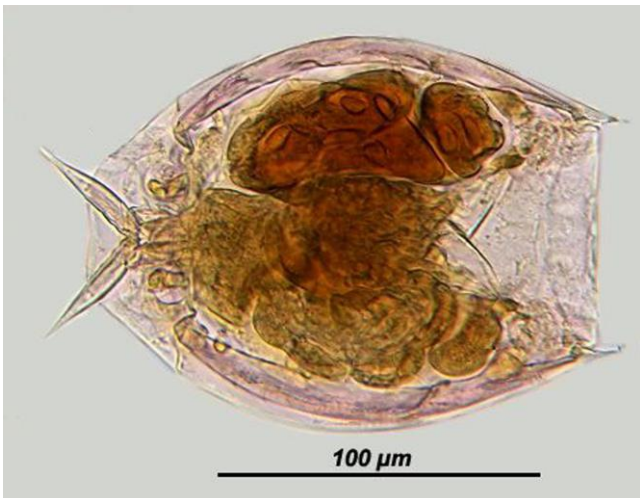


Figure 21. *Lecane depressa*, a species known from *Sphagnum* bogs. Photo by Jersabek *et al.* 2003, with permission.

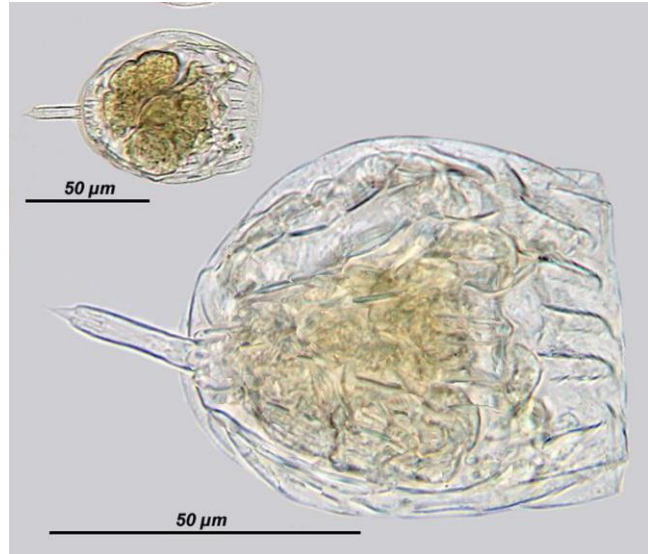


Figure 22. *Lecane furcata*, a *Sphagnum* dweller. Photo by Jersabek *et al.* 2003, with permission.



Figure 23. *Lecane pumila*, a *Sphagnum* dweller. Photo by Jersabek *et al.* 2003, with permission.

Lecane scutata (Figure 24) occurs in the littoral zone of lakes where it lives on plant surfaces (de Manuel Barrabin 2000). It is an acidophile, commonly living among *Sphagnum* (Figure 2) (Myers 1942; Koste & Shiel 1990), but it is cosmopolitan and probably not restricted to strongly acid habitats (de Manuel Barrabin 2000).

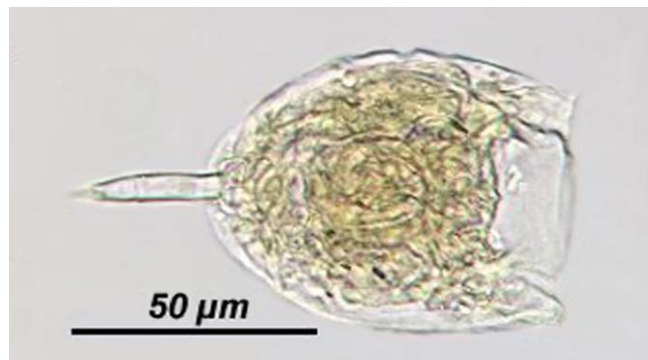


Figure 24. *Lecane scutata*, a *Sphagnum* dweller and acidophile. Photo by Jersabek *et al.* 2003, with permission.

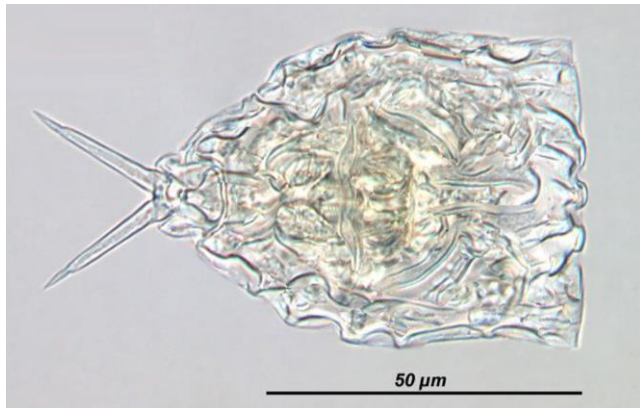


Figure 25. *Lecane subtilis*, a *Sphagnum* dweller. Photo by Jersabek *et al.* 2003, with permission.



Figure 26. *Lecane tryphema* in a *Sphagnum* bog. Photo by Jersabek *et al.* 2003, with permission.

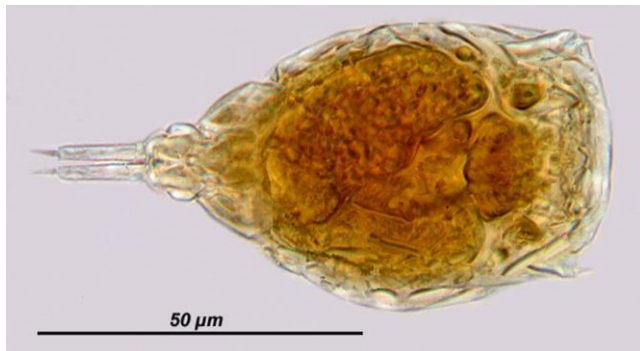


Figure 27. *Lecane verecunda*, a *Sphagnum* dweller. Photo by Jersabek *et al.* 2003, with permission.



Figure 28. *Lecane dysoarata*, a *Sphagnum cuspidatum* dweller. Photo by Jersabek *et al.* 2003, with permission.

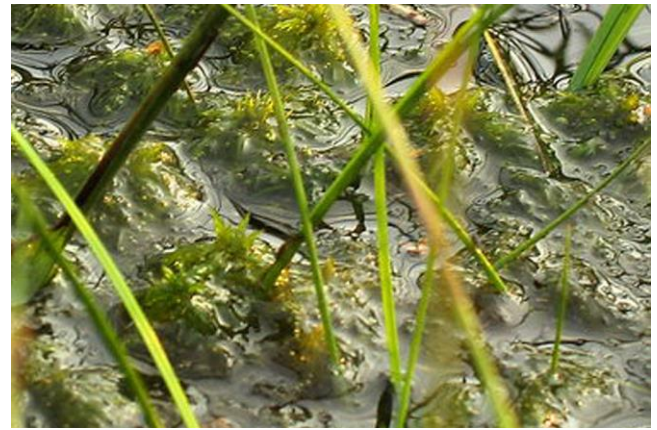


Figure 29. *Sphagnum cuspidatum*, home for *Lecane quadridentata*. Photo by Andrew Spink, with permission.



Figure 30. *Lecane quadridentata*, a *Sphagnum* dweller. Photo by Michael Plewka <www.plingfactory.de>, with permission.

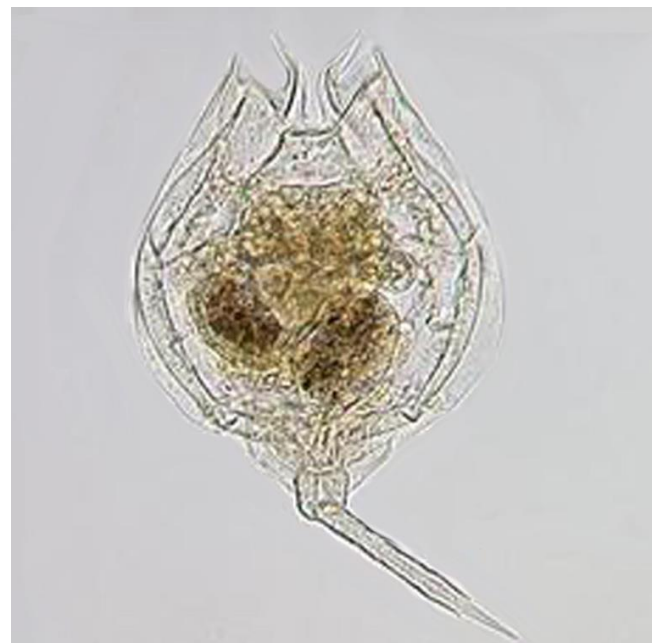


Figure 31. *Lecane quadridentata* from a lake in Pennsylvania, USA. This species has been collected from bryophytes and from bog pools. Photo by Jersabek *et al.* 2003, with permission.

Hingley (1993) published a manual on the microscopic life in *Sphagnum* (Figure 2), including the rotifer fauna. Her records included *L. agilis* (Figure 32), *L. clara* (Figure 33-Figure 34; see also Bielańska-Grajner *et al.* 2011), *L. closteroerca* (Figure 35-Figure 36; see also Bielańska-Grajner *et al.* 2011), *L. cornuta* (Figure 37-Figure 39), *L. galeata* [Figure 40-Figure 41; see also Jersabek *et al.* 2003 from *Sphagnum subsecundum* (Figure 42) and Bielańska-Grajner *et al.* 2011], *L. hamata* (Figure 43; see also Bielańska-Grajner *et al.* 2011), *L. lunaris* (Figure 44-Figure 45; see also Madaliński 1961; Bielańska-Grajner *et al.* 2011), *L. pyrrha* (Figure 46), *L. signifera* (Figure 47), *L. signifera ploenensis* (Figure 48), and *L. stichaea* (Figure 49-Figure 50).

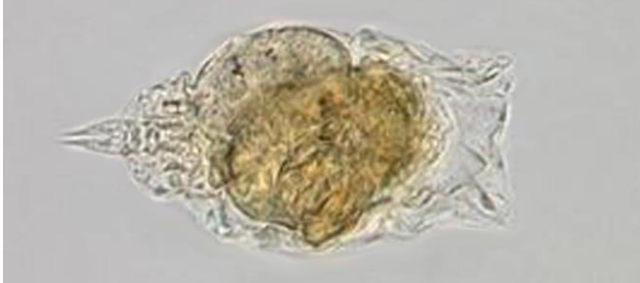


Figure 32. *Lecane agilis*, a species known from *Sphagnum*. Photo by Jersabek *et al.* 2003, with permission.



Figure 33. *Lecane clara*, a *Sphagnum* dweller. Photo by Michael Plewka <www.plingfactory.de>, with permission.



Figure 34. *Lecane clara*, a species known from bryophytes. Photo by Jersabek *et al.* 2003, with permission.

Lecane closteroerca (Figure 35-Figure 36) is a species known from bryophytes, including *Sphagnum* (Figure 2). This cosmopolitan littoral species is common in the plankton in a pH range of 6.7-9.1 and temperatures of 7.8-24°C (de Manuel Barrabin 2000). Despite its common presence in freshwater, it has a wide tolerance of salinity.



Figure 35. *Lecane closteroerca*, a *Sphagnum* dweller. Photo by Michael Plewka <www.plingfactory.de>, with permission.



Figure 36. *Lecane closteroerca*, a *Sphagnum* dweller with fused toes. Photo by Jersabek *et al.* 2003, with permission.



Figure 37. *Lecane cornuta*, a *Sphagnum* dweller. Photo by Michael Plewka <www.plingfactory.de>, with permission.

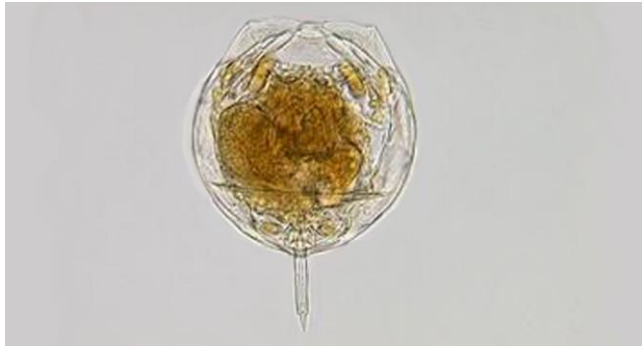


Figure 38. *Lecane cornuta*, a species known from bryophytes, with foot extended. Photo by Jersabek *et al.* 2003, with permission.

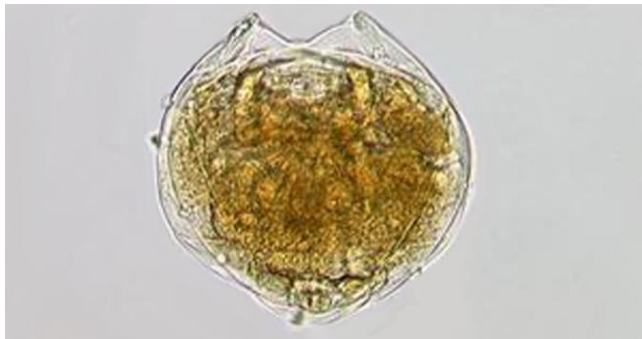


Figure 39. *Lecane cornuta*, with foot retracted. Photo by Jersabek *et al.* 2003, with permission.



Figure 40. *Lecane cf galeata*, a species known from *Sphagnum subsecundum* (Figure 42) in bogs. Photo by Jersabek *et al.* 2003, with permission.



Figure 41. *Lecane cf galeata*, a species known from *Sphagnum subsecundum* (Figure 42) in bogs. Photo by Jersabek *et al.* 2003, with permission.



Figure 42. *Sphagnum subsecundum*, home of *Lecane galeata*. Photo by Michael Lüth, with permission.

Lecane hamata (Figure 43) is a cosmopolitan, littoral species living on plant substrata and known from bryophytes (de Manuel Barrabin 2000), including *Sphagnum* (Figure 2; Hingley 1993). It occurs at pH levels around 7.9 with a known from a temperature range of 11.9-13.5°C (de Manuel Barrabin 2000).



Figure 43. *Lecane hamata*, a species known from *Sphagnum*. Photo by Jersabek *et al.* 2003, with permission.

Lecane lunaris (Figure 44-Figure 45) is a cosmopolitan littoral species that is frequent in the plankton (de Manuel Barrabin 2000) and is known to inhabit bryophytes, including *Sphagnum* (Figure 2; Hingley 1993). It is known from water that is rich in nutrients with a pH of 6.3-9.2 and a temperature range of 7.2-26.2°C (de Manuel Barrabin 2000).



Figure 44. *Lecane lunaris*, a *Sphagnum* dweller. Photo by Jersabek *et al.* 2003, with permission.



Figure 45. *Lecane lunaris*, a species known to inhabit bryophytes, including *Sphagnum*. Photo by Jersabek *et al.* 2003, with permission.



Figure 46. *Lecane pyrrha*, a species known from *Sphagnum* bogs. Photo by Jersabek *et al.* 2003, with permission.



Figure 47. *Lecane signifera*, a species known to live among *Sphagnum*. Photo by Jersabek *et al.* 2003, with permission.



Figure 48. *Lecane signifera ploenensis* from among *Sphagnum*. Photo by Jersabek *et al.* 2003, with permission.

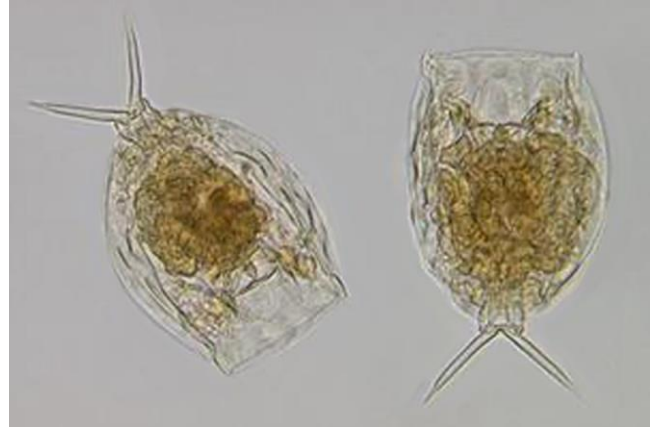


Figure 49. *Lecane stichaea*, a species known from among *Sphagnum*. Photo by Jersabek *et al.* 2003, with permission.

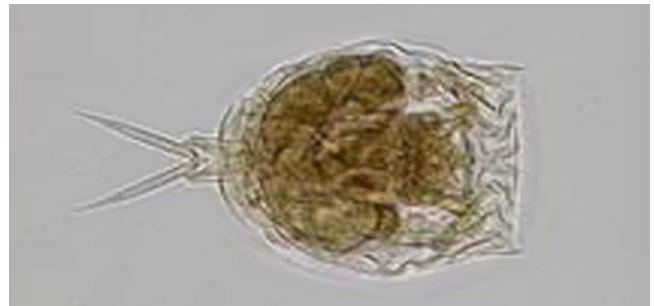


Figure 50. *Lecane stichaea*, a rotifer associated with *Sphagnum*. Photo by Jersabek *et al.* 2003, with permission.

To these studies, Jersabek *et al.* (2003) added species from records at the Academy of Natural Sciences of Philadelphia. The *Sphagnum* (Figure 2) associates included *Lecane calcaria* (Figure 51), *L. copeis* (Figure 52), *L. curvicornis* (Figure 53), *L. depressa* (Figure 54), *L. mira* (Figure 55), *L. mitis* (Figure 56), *L. pertica* (Figure 57-Figure 58), *L. psammophila* (Figure 59), *L. satyrus* (Figure 60), and *L. thalera* (Figure 61-Figure 62). Plewka (2016) included *L. acus* (Figure 63) and *L. arcula* (Figure 64), two *Sphagnum* dwellers not included on the other lists here. Jersabek *et al.* (2003) reported *L. lauterborni* (Figure 65) from *Sphagnum wheeleri* in Hawaii (Figure 66).

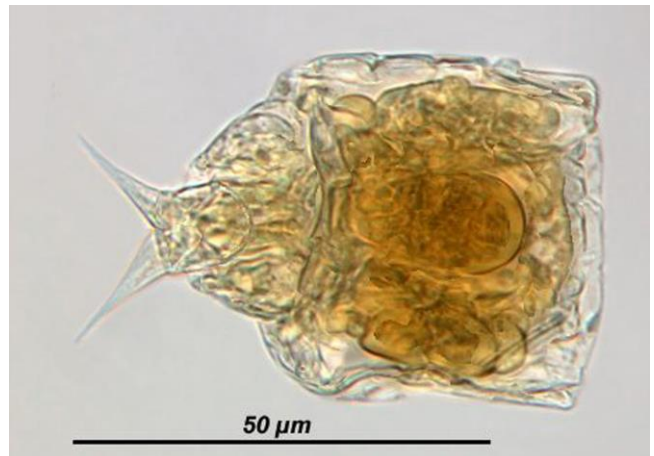


Figure 51. *Lecane calcaria*, a *Sphagnum* dweller. Photo by Jersabek *et al.* 2003, with permission.

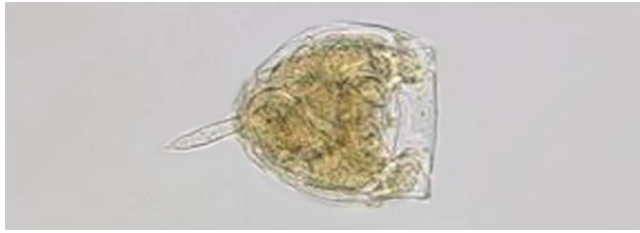


Figure 52. *Lecane copeis* from among *Sphagnum*. Photo by Jersabek *et al.* 2003, with permission.



Figure 56. *Lecane mitis* from among *Sphagnum*. Photo by Jersabek *et al.* 2003, with permission.

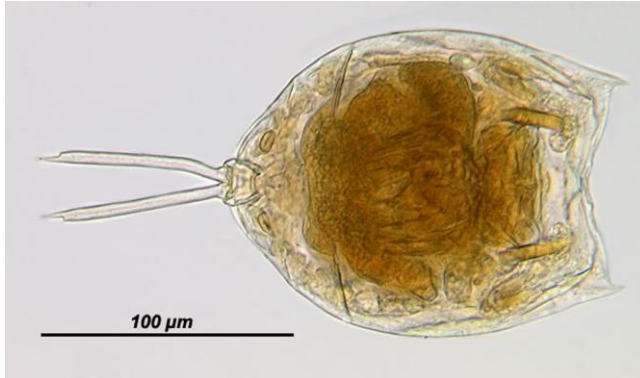


Figure 53. *Lecane curvicornis*, a *Sphagnum* dweller. Photo by Jersabek *et al.* 2003, with permission.



Figure 57. *Lecane pertica* from among *Sphagnum*. Photo by Jersabek *et al.* 2003, with permission.



Figure 54. *Lecane depressa* from among *Sphagnum*. Photo by Jersabek *et al.* 2003, with permission.

Lecane mira (Figure 55-Figure 56) is a cosmopolitan species that lives on aquatic plants, including *Sphagnum*, and is common in somewhat acid waters, but can also be common at a pH around 7.2 (de Manuel Barrabin 2000). It is known from a temperature around 10.8°C.



Figure 55. *Lecane mira* from among *Sphagnum*. Photo by Jersabek *et al.* 2003, with permission.

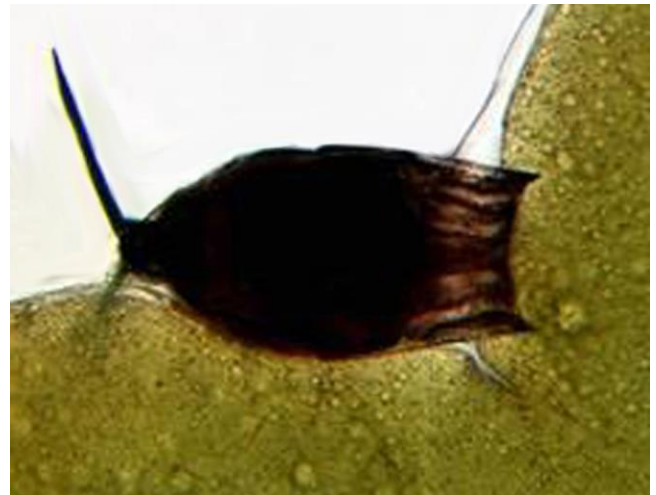


Figure 58. *Lecane pertica*, shown here on duckweed (*Lemna*), but it also occurs among *Sphagnum*. Photo by Jersabek *et al.* 2003, with permission.

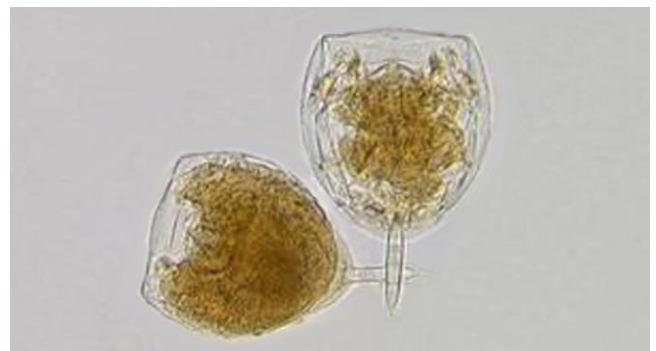


Figure 59. *Lecane psammophila* from among *Sphagnum*. Photo by Jersabek *et al.* 2003, with permission.

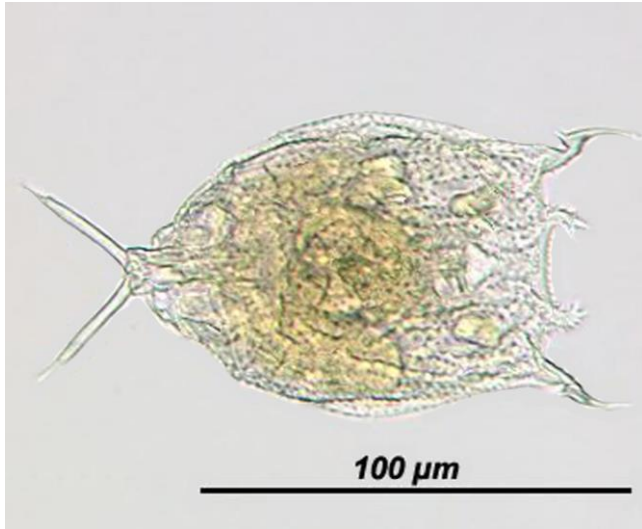


Figure 60. *Lecane satyrus* from among *Sphagnum*. Photo by Jersabek *et al.* 2003, with permission.



Figure 63. *Lecane acus*, a *Sphagnum* dweller. Photo by Michael Plewka <www.plingfactory.de>, with permission.

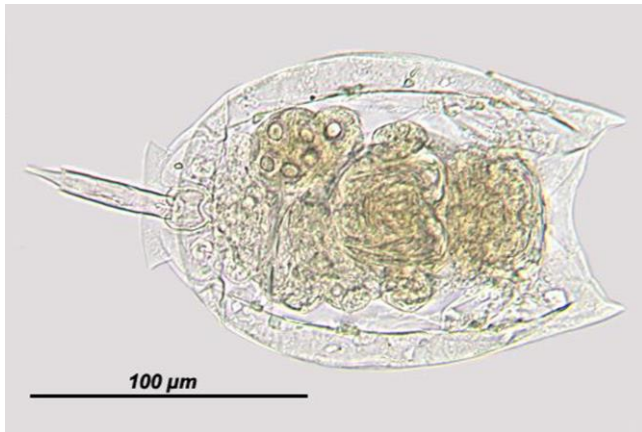


Figure 61. *Lecane lamellata/thalera*, a *Sphagnum* dweller. These two species are difficult to distinguish and might hybridize. Photo by Jersabek *et al.* 2003, with permission.



Figure 64. *Lecane arcula*, a *Sphagnum* dweller. Photo by Michael Plewka <www.plingfactory.de>, with permission.



Figure 62. *Lecane thalera* from among *Sphagnum*. Photo by Jersabek *et al.* 2003, with permission.



Figure 65. *Lecane lauterborni* from among *Sphagnum wheeleri* in Hawaii and *Sphagnum* in Pennsylvania, USA. Photo by Jersabek *et al.* 2003, with permission.



Figure 66. *Sphagnum wheeleri*, Home for *Lecane lauterborni* in Hawaii. Photo by Jersabek *et al.* 2003, with permission.

Some researchers include *Sphagnum* (Figure 2) and "moss" (perhaps meaning *Sphagnum*) as the rotifer habitats. Among these are *Lecane elasma* (Figure 67; Jersabek *et al.* 2003; Bielańska-Grajner *et al.* 2011), *L. ligona* (Figure 68; Jersabek *et al.* 2003), and *L. stokesii* (Figure 69) living between mosses (Plewka 2016).



Figure 67. *Lecane elasma* from among mosses and *Sphagnum*. Photo by Jersabek *et al.* 2003, with permission.

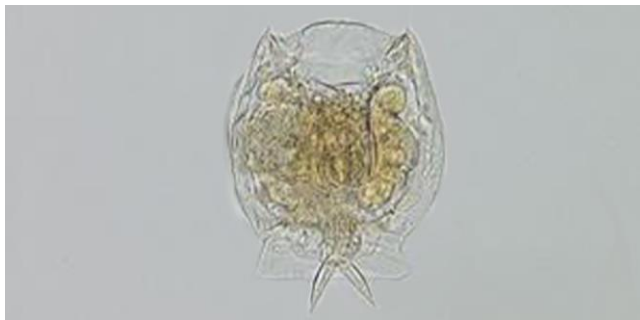


Figure 68. *Lecane ligona* from a *Sphagnum* pool. Photo by Jersabek *et al.* 2003, with permission.

A few reports simply list "moss": *L. climacois* (Figure 70; Myers 1942; Jersabek *et al.* 2003), *L. rhopalura* (Figure 71) on submerged moss (Jersabek *et al.* 2003), *L. unguolata* (Figure 72-Figure 74; Madaliński 1961). *Lecane*

arcuata occurs among submerged mosses in trenches of Alaskan polygons (Segers *et al.* 1996) and wet mosses on Svalbard (De Smet 1993).



Figure 69. *Lecane stokesii* from between mosses, including *Sphagnum*. Photo by Michael Plewka <www.plingfactory.de>, with permission.



Figure 70. *Lecane climacois* from among mosses. Photo by Jersabek *et al.* 2003, with permission.



Figure 71. *Lecane rhopalura* from among submerged moss in a pond. Photo by Jersabek *et al.* 2003, with permission.



Figure 72. *Lecane unguolata*, a species known to inhabit bryophytes. Photo by Jersabek *et al.* 2003, with permission.



Figure 73. *Lecane unguolata*, a species known to inhabit bryophytes. Photo by Jersabek *et al.* 2003, with permission.

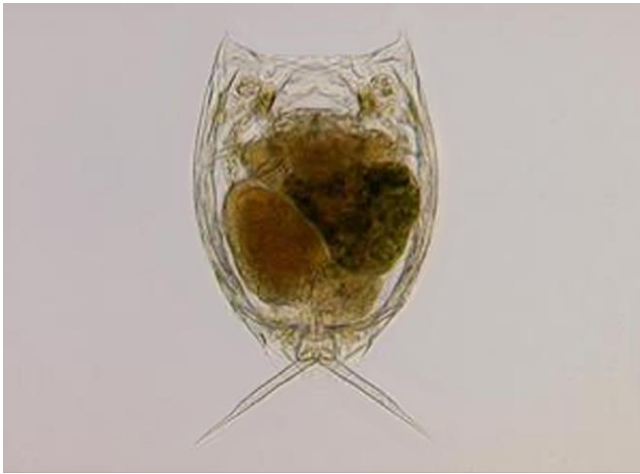


Figure 74. *Lecane unguolata* var. *tenuior*, a species known to inhabit bryophytes. Photo by Jersabek *et al.* 2003, with permission.

One of the undersampled habitats seems to be waterfalls. *Lecane martensi* was discovered on wet mosses as a new species in this habitat by Savatnalinton and Segers in 2008. What seems to be most lacking is records of this large genus associated with terrestrial bryophytes.

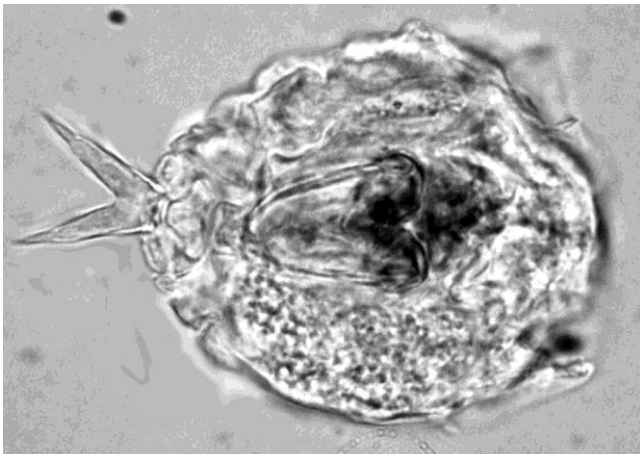


Figure 75. *Lecane martensi*, a species that was discovered among mosses in a waterfall. Photo by Savatnalinton & Segers 2008, through Creative Commons.

Ituridae

This small family, with only one genus, seems to have little written about it beyond species lists and taxonomic distinctions. Even the map of its distribution showed nothing. I could find only one species, *Itura aurita* (Figure 76-Figure 77), that had been collected from mosses, including from bogs (Horkan 1981). De Smet (1993) reported it from submerged mosses on Svalbard.

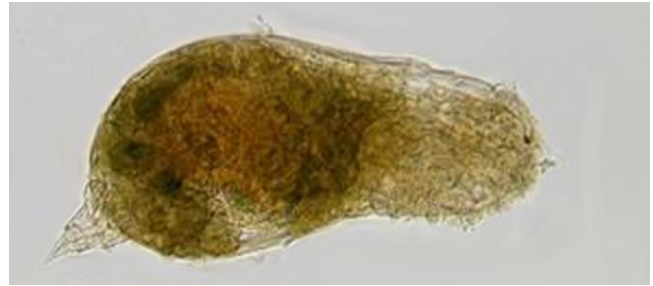


Figure 76. *Itura aurita* from Pocono Lake, Pennsylvania, USA. This species is known from bryophytes and from bogs. Photo by Jersabek *et al.* 2003, with permission.



Figure 77. *Itura aurita*, a moss dweller, with green food in its gut. Photo by Michael Plewka <www.plingfactory.de>, with permission.

Lepadellidae

Many of the **Lepadellidae** are cosmopolitan, often occurring in freshwater habitats (Baribwegure & Segers 2001). In particular, the genera *Colurella* (Figure 78-Figure 86, Figure 88), *Lepadella* (Figure 91-Figure 112), and *Squatinella* (Figure 116-Figure 126) are widespread. These same three genera are well represented among bryophyte collections. A fourth genus, *Paracoleurella* (Figure 114-Figure 115), also is known from bryophytes.

Colurella

Colurella adriatica (Figure 78-Figure 79) is an uncommon species that may be cosmopolitan (de Manuel Barrabin 2000). It is a planktonic species in small water bodies that lives among plants in the littoral zone and is known from bryophytes. It seems to prefer basic water around pH 8.4 and is known from temperatures around 23.5°C. It is known from bryophytes (Madaliński 1961)

and occurs among submerged mosses on Svalbard (De Smet 1990, 1993). *Colurella colurus* has similar requirements, but is known from a pH level around 7.1 and temperature of 9.7°C (de Manuel Barrabin 2000). It is known from bryophytes (Madaliński 1961) and occurs among submerged mosses and in plankton on Svalbard (De Smet 1993).



Figure 78. *Colurella adriatica*, a species known from bryophytes and bog pools. Photo by Jersabek *et al.* 2003, with permission.



Figure 79. *Colurella adriatica*, a species that lives among plants in the littoral zone and is known from bryophytes. Photo by Jersabek *et al.* 2003, with permission.

Colurella clausa (Figure 80), *C. denticauda* (Myers 1942) and *C. obtusa* (Figure 81-Figure 83; Horkan 1981; Hingley 1993; Błedzki & Ellison 2003; Plewka 2016), and *Colurella tessellata* (Figure 84-Figure 85; Horkan 1981; Hingley 1993; Jersabek *et al.* 2003) occur with *Sphagnum* (Figure 2). *Colurella obtusa* occurs on Svalbard, where one can find it among submerged mosses and plankton (De Smet 1993). *Colurella hindenburgi* (Figure 86) occurs with *Sphagnum subsecundum* (Figure 87) (Myers 1942; Jersabek *et al.* 2003), but it also occurs among terrestrial bryophytes (Bielańska-Grajner *et al.* 2011) and in submerged mosses and plankton on Svalbard (De Smet 1993). Segers *et al.* (1996) found *Colurella uncinata* among submerged mosses in trenches of Alaskan polygons.



Figure 80. *Colurella clausa* from a *Sphagnum* bog. Photo by Jersabek *et al.* 2003, with permission.

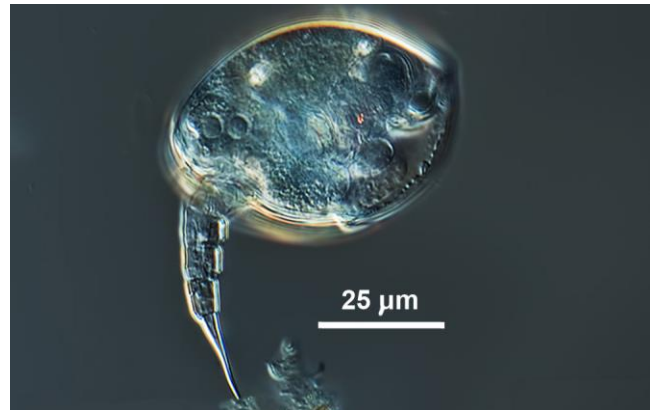


Figure 81. *Colurella obtusa*, a bog and *Sphagnum* dweller. Photo by Michael Plewka <www.plingfactory.de>, with permission.

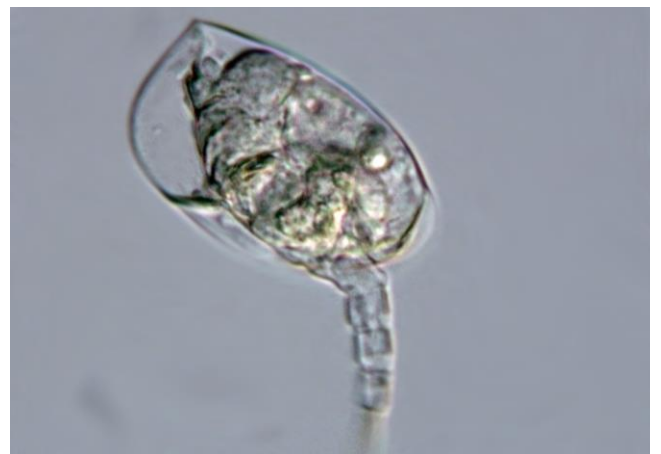


Figure 82. *Colurella obtusa*, a bog and *Sphagnum* dweller. Photo by Yuuji Tsukii, with permission.



Figure 83. *Colurella obtusa*, a species known from bryophytes and bogs. Photo by Jersabek *et al.* 2003, with permission.



Figure 84. *Colurella tessellata* side view, a species known from *Sphagnum* bogs. Photo by Jersabek *et al.* 2003.



Figure 85. *Colurella tessellata*, a species known from more than one location of *Sphagnum* bogs. Photo by Jersabek *et al.* 2003, with permission.

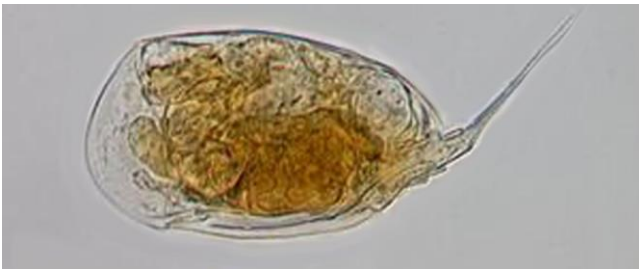


Figure 86. *Colurella hindenburgi* from among *Sphagnum subsecundum* (Figure 87). Photo by Jersabek *et al.* 2003, with permission.



Figure 87. *Sphagnum subsecundum* emerged in a fen. Photo by Michael Lüth, with permission.

The genus *Colurella* has several species associated with terrestrial bryophytes. *Colurella geophila* (Figure 88) lives on epiphytic mosses (Plewka 2016). *Colurella hindenburgi* (Figure 89) lives on mosses on the dry habitat of granite rocks (Colurella 2016) as well as in bogs and fens (in Poland; Bielańska-Grajner *et al.* 2011). Bielańska-Grajner *et al.* (2011) likewise found *C. adriatica* (Figure 78-Figure 79) and *C. colurus* in these bogs and fens. *Colurella paludosa* (Figure 90) lives in *Sphagnum* ponds (Figure 29) (Plewka 2016).



Figure 88. *Colurella geophila*, a species that lives on epiphytic moss. Photo by Michael Plewka <www.plingfactory.de>, with permission.



Figure 89. *Colurella hindenburgi*, a species that lives on mosses on granite rocks. Photo by Michael Plewka <www.plingfactory.de>, with permission.



Figure 90. *Colurella paludosa*, a species of *Sphagnum* pools. Photo by Michael Plewka <www.plingfactory.de>, with permission.

Lepadella

Lepadella species include several that live among bryophytes. Myers (1942), working in the Poconos, Pennsylvania, USA, listed *Lepadella apsicora* (Figure 91), *L. akrobeles* (Figure 92-Figure 93), *L. latusinus* (Figure 94), *L. ovalis* (Figure 95-Figure 96; see also Bielańska-Grajner *et al.* 2011 from Poland), and *L. zigzag* (Figure 97) as *Sphagnum* (Figure 2) associates (Myers 1942).



Figure 91. *Lepadella apsicora*, a *Sphagnum* dweller. Photo by Jersabek *et al.* 2003, with permission.



Figure 92. *Lepadella akrobeles* from among *Sphagnum*. Photo by Jersabek *et al.* 2003, with permission.



Figure 93. *Lepadella akrobeles* from among *Sphagnum*. Photo by Jersabek *et al.* 2003, with permission.

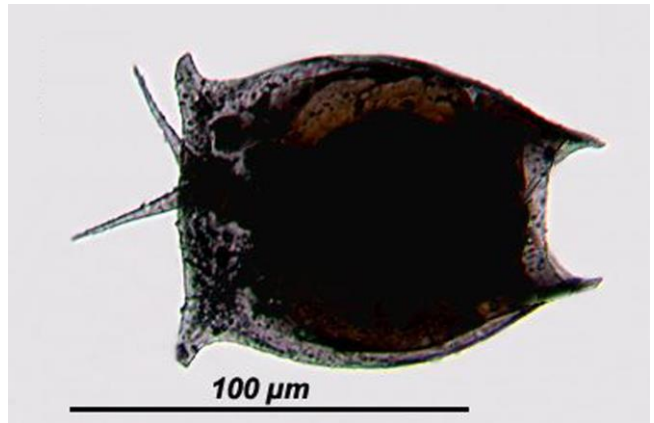


Figure 94. *Lepadella latusinus*, a species that lives among *Sphagnum*. Photo by Jersabek *et al.* 2003, with permission.

Lepadella ovalis (Figure 95-Figure 96) is a cosmopolitan species (de Manuel Barrabin 2000). It is a plankton species that occurs among macrophytes in the littoral zone and it can inhabit bryophytes. It is known at pH levels of 8.58-9.14 and from the temperature range of 23.6-24°C.



Figure 95. *Lepadella ovalis*, a bryophyte dweller. Photo by Michael Plewka <www.plingfactory.de>, with permission.



Figure 96. *Lepadella ovalis* is a plankton species that can inhabit bryophytes. Photo by Jersabek *et al.* 2003, with permission.



Figure 97. *Lepadella zigzag*, from *Sphagnum* in a pool. Photo by Jersabek *et al.* 2003, with permission.

Lepadella patella (Figure 98-Figure 99) is a littoral species known to inhabit bryophytes (de Manuel Barrabin 2000), including submersed mosses on Svalbard (De Smet 1990, 1993) and on submersed mosses in trenches of Alaskan polygons (Segers *et al.* 1996). This cosmopolitan species lives primarily on plant substrata, but occasionally occurs in the plankton of reservoirs, rivers, and ponds. It is uncommon in large bodies of water. It is known from a pH of 6.7-9.3 and temperatures of 9.1-22.3. Bielańska-Grajner *et al.* (2011) and Plewka (2016) reported it from *Sphagnum* (Figure 2) peatlands (bogs or fens).



Figure 98. *Lepadella patella*, a littoral species known to inhabit bryophytes, but also can be found in *Sphagnum* bogs. Photo by Jersabek *et al.* 2003, with permission.

Plewka (2016) and others include several additional species as *Sphagnum* (Figure 2) associates. *Lepadella acuminata* (Figure 100-Figure 101; Hingley 1993; Bielańska-Grajner *et al.* 2011) [also with submersed mosses on Svalbard (De Smet 1993)], *L. elliptica* (Bielańska-Grajner *et al.* 2011); *L. heterostyla* (Figure 102; Plewka 2016), *L. pterygoida* (Figure 103; Hingley 1993; Jersabek *et al.* 2003), *L. triba* (Figure 104; Hingley 1993; Jersabek *et al.* 2003), *L. triptera* (Figure 105-Figure 108; Horkan 1981; Hingley 1993), and *Lepadella whitfordi* (Figure 109; Myers 1942) all are associated with *Sphagnum* or occur in bogs. Both *L. triba* and *L. triptera* occur among submersed mosses on Svalbard (De Smet 1993). *Lepadella beyensi* was described from submersed mosses in a puddle in the high Arctic (De Smet 1994). *Lepadella deridderae* subsp. *alaskae* lives on submersed mosses in trenches of Alaskan polygons (Segers *et al.* 1996). *Lepadella minuta* occurs among submersed mosses on Svalbard (De Smet 1993).



Figure 99. *Lepadella patella*, a rotifer known from a *Sphagnum* bog. Photo by Michael Plewka <www.plingfactory.de>, with permission.

Lepadella acuminata (Figure 100-Figure 101) is a species known to inhabit bryophytes as well as other plant substrata and is only occasionally found among the plankton (de Manuel Barrabin 2000). It occurs with submersed mosses on Svalbard (De Smet 1993). This species does best in water that is slightly acid (Koste 1978) [pH 6.8-8.3 (de Manuel Barrabin 2000)] and has a temperature range of 7.8-19°C (Koste 1978).

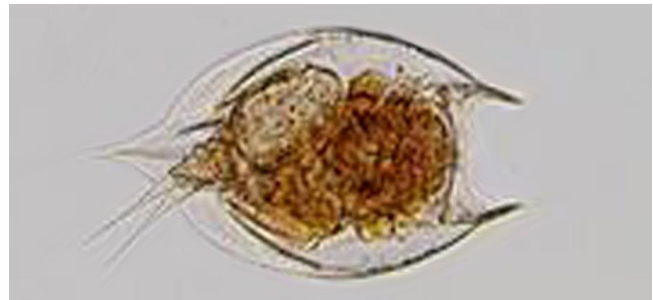


Figure 100. *Lepadella acuminata* is a species known to inhabit *Sphagnum* as well as other plant substrata. Photo by Jersabek *et al.* 2003, with permission.



Figure 101. *Lepadella acuminata*, a species that sometimes occurs on bryophytes. Photo from Michael Plewka <www.plingfactory.de>, with permission.



Figure 102. *Lepadella heterostyla*, a *Sphagnum* dweller. Photo by Michael Plewka <www.plingfactory.de>, with permission.



Figure 103. *Lepadella pterygoida* from among *Sphagnum*. Photo by Jersabek *et al.* 2003, with permission.



Figure 104. *Lepadella triba*, a species known to live among *Sphagnum*. Photo by Michael Plewka <www.plingfactory.de>, with permission.

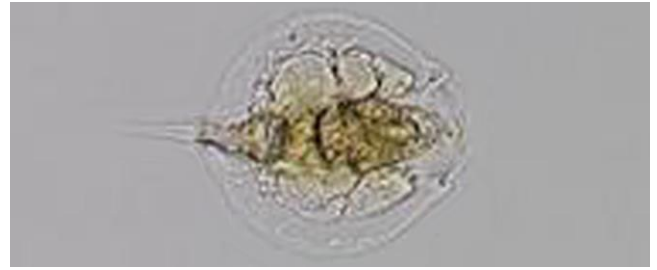


Figure 105. *Lepadella triptera*, a species known to inhabit bryophytes and that can occur in bogs. Photo by Jersabek *et al.* 2003, with permission.



Figure 106. *Lepadella triptera*, a species known from *Sphagnum*. Photo by Michael Plewka <www.plingfactory.de>, with permission.



Figure 107. *Lepadella triptera*, a species known to inhabit bryophytes. Photo by Jersabek *et al.* 2003, with permission.

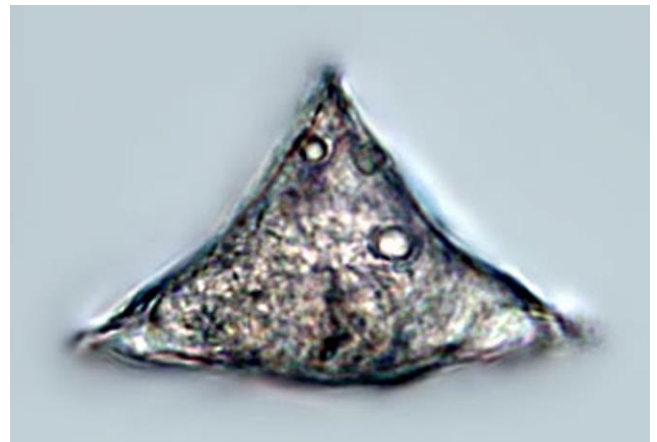


Figure 108. *Lepadella triptera* showing three wings of the lorica. Photo by Michael Plewka <www.plingfactory.de>, with permission.

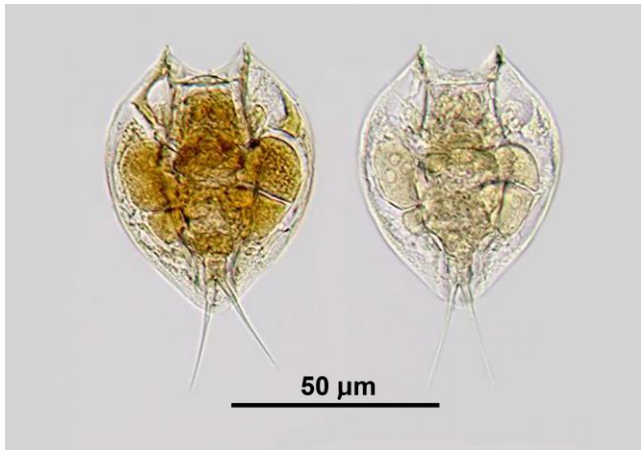


Figure 109. *Lepadella whitfordi*, a *Sphagnum* dweller. Photo by Jersabek *et al.* 2003, with permission.

Lepadella venefica (Figure 110-Figure 111) lives on emersed *Sphagnum subsecundum* (Figure 87) and in *Sphagnum* (Figure 2) bogs (Jersabek *et al.* 2003).

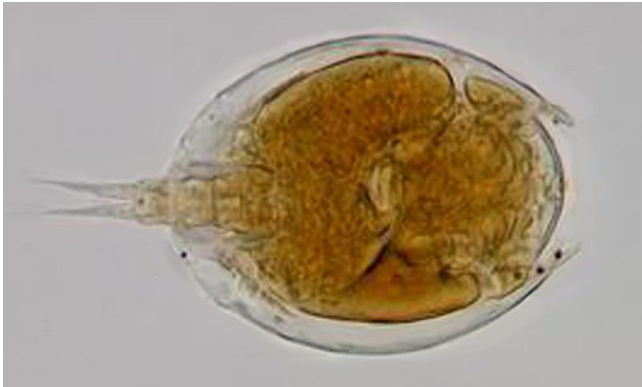


Figure 110. *Lepadella venefica* from emersed *Sphagnum subsecundum*. Photo by Jersabek *et al.* 2003, with permission.



Figure 111. *Lepadella venefica* from among emersed *Sphagnum subsecundum*. Photo by Jersabek *et al.* 2003, with permission.

Lepadella eurysterna (Figure 112) is perhaps the only *Lepadella* species known from the aquatic moss *Fontinalis novae-angliae* (Figure 113) (Myers 1942).



Figure 112. *Lepadella eurysterna*, a species that lives among the aquatic moss *Fontinalis novae-angliae*. Photo by Jersabek *et al.* 2003, with permission.



Figure 113. *Fontinalis novae-angliae*, home for *Lepadella eurysterna*. Photo by Janice Glime.

Paracolurella

Paracolurella is among the many rotifer genera represented among the *Sphagnum* (Figure 2). It is a genus of only two species, *P. aemula* (Figure 114) and *P. logima* (Figure 115), and both of these occur among *Sphagnum* (Jersabek *et al.* (2003).



Figure 114. *Paracolurella aemula* from among *Sphagnum*. Photo by Jersabek *et al.* 2003, with permission.



Figure 115. *Paracolurella logima* from among *Sphagnum*. Photo by Jersabek *et al.* 2003, with permission.

Squatinella

More rotifers from the genus *Squatinella* occur on or among *Sphagnum* (Figure 2). Myers (1942) reported only *S. bifurca* (Figure 116) as a *Sphagnum* associate. Hingley (1993) reported *S. lamellaris* [Figure 117-Figure 121, typically a periphyton species (Plewka 2016)], *S. longispinata* (Figure 122), *S. microdactyla* [Figure 123; typically a plankton species (Plewka 2016)], and *S. rostrum* (Figure 124-Figure 125; see also Bielańska-Grajner *et al.* 2011). Jersabek *et al.* (2003) added the additional species *S. retrospina* (Figure 126) from a *Sphagnum* bog.



Figure 116. *Squatinella bifurca* from among *Sphagnum*. Photo by Jersabek *et al.* 2003, with permission.



Figure 117. *Squatinella lamellaris* f. *mutica* from a *Sphagnum* bog. Photo by Jersabek *et al.* 2003, with permission.



Figure 118. *Squatinella lamellaris* from a *Sphagnum* bog. Photo by Jersabek *et al.* 2003, with permission.



Figure 119. Side view of *Squatinella lamellaris* from a *Sphagnum* bog. Photo by Jersabek *et al.* 2003, with permission.



Figure 120. *Squatinella lamellaris*, a member of the periphyton, including *Sphagnum* as a substrate. Photo by Michael Plewka <www.plingfactory.de>, with permission.

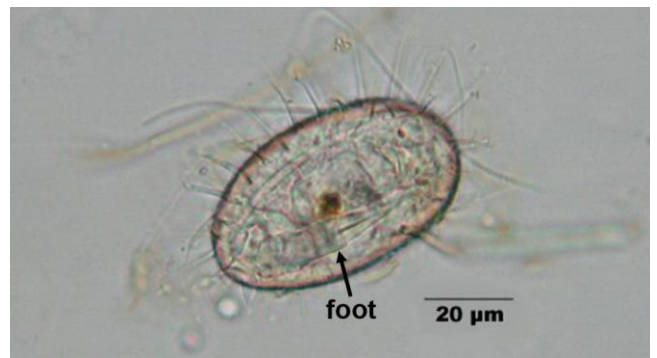


Figure 121. *Squatinella lamellaris* f. *tridentata* egg, showing foot and mastax, a *Sphagnum* dweller. Photo by Ralf Wagner, with permission.

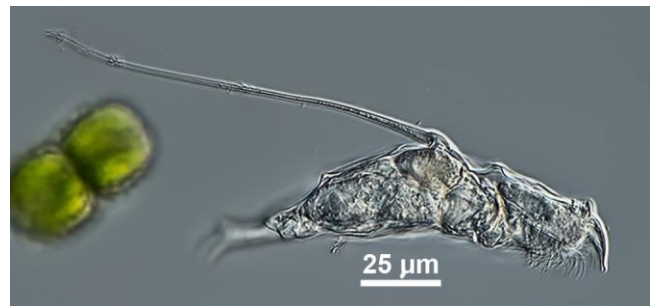


Figure 122. *Squatinella longispinata*, a *Sphagnum* dweller. Photo by Michael Plewka <www.plingfactory.de>, with permission.



Figure 123. *Squatinella microdactyla*, typically a plankton species, but one that also occurs among *Sphagnum*. Photo by Michael Plewka <www.plingfactory.de>, with permission.



Figure 124. *Squatinella rostrum*, a *Sphagnum* associate. Photo by Ralf Wagner <www.dr-ralf-wagner.de>, with permission.



Figure 125. *Squatinella rostrum*, a *Sphagnum* associate. Photo by Ralf Wagner <www.dr-ralf-wagner.de>, with permission.



Figure 126. *Squatinella retrospina* from among *Sphagnum* in bog. Photo by Jersabek *et al.* 2003, with permission.

Lindiidae

This is a small family with only one genus and at least fifteen species (De Smet 2005). Three of these occur in salt water. Three species are known from bryophytes. *Lindia annecta* (Figure 127) is a periphytic species that occurs among *Sphagnum* in bogs (de Manuel Barrabin 2000). In reservoirs of Spain it is known at temperatures around 7.9 and a pH of around 6.8. Jersabek *et al.* (2003) also reported a collection of this species from a lake in the Pocono Mountains, Pennsylvania, USA.



Figure 127. *Lindia annecta* is a periphytic species that commonly occurs in *Sphagnum* bogs. Photo from Jersabek *et al.* 2003, with permission.

Lindia pallida (Figure 128) is likewise a *Sphagnum* (Figure 2) dweller, living anywhere that wet or partly submerged *Sphagnum* occurs (Harrington & Myers 1922). To quote Harrington and Myers, "in such locations it may be collected at any time and any place."



Figure 128. *Lindia pallida* from *Sphagnum*. Photo by Christian Jersabek, with permission.

Lindia torulosa (Figure 129-Figure 133) is a large rotifer (>500 μm) that is cosmopolitan, including records from one sub-Antarctic and four Antarctic locations (Dartnall 1995). *Lindia torulosa* is aquatic, but it also inhabits submersed mosses (de Beauchamp 1913) and wet terrestrial mosses (De Smet, pers. comm. 13 November 2016), where it eats the *Cyanobacteria Oscillatoria* (Figure 130-Figure 131) and *Anabaena/Nostoc* (Figure 132) (Koste 1979; Plewka 2016). Its trophi are specialized for eating *Cyanobacteria*.



Figure 129. *Lindia torulosa*, a species known to inhabit bryophytes. Photo by Michael Plewka <www.plingfactory.de>, with permission.



Figure 130. *Lindia torulosa*, shown here preparing to eat *Oscillatoria*. Photo by Michael Plewka <www.plingfactory.de>, with permission.



Figure 131. *Lindia torulosa* consuming *Oscillatoria*, using its specialized trophi. Photo by Michael Plewka <www.plingfactory.de>, with permission.



Figure 132. *Lindia torulosa* with *Anabaena* or *Nostoc* in its gut. Photo by Michael Plewka <www.plingfactory.de>, with permission.



Figure 133. *Lindia torulosa* showing cilia. Photo by Michael Plewka <www.plingfactory.de>, with permission.

Microcodidae

This family has only one genus, and only a single species, *Microcodon clavus* (Figure 134-Figure 135), a plankton species, is also known from bryophytes (Horkan 1981; Hingley 1993; Jersabek *et al.* 2003). It has no **lorica** (shell) and is shaped like a cone with a long, ventral foot (Naberezhnomu 1984).



Figure 134. *Microcodon clavus* from among *Sphagnum* in bogs. Photo by Jersabek *et al.* 2003, with permission.



Figure 135. *Microcodon clavus*, a plankton dweller that can occur among *Sphagnum*. Photo by Michael Plewka <www.plingfactory.de>, with permission.

Mytilinidae

The **Mytilinidae** are **loricate** rotifers (Koste & Shiel 1989). That is, they have a shell. This lorica is triangular to rhombic in cross section and there is often a double keel on the dorsal side. The species are littoral bottom-dwellers, rarely occurring in the plankton. There are only two genera, but only *Mytilina* (Figure 136), a genus with 37 species, is represented among bryophytes, with three species thus far reported here.

Mytilina macrocera (Figure 137) is a *Sphagnum* (Figure 2) dweller (Jersabek *et al.* 2003). *Mytilina mucronata* (Figure 138-Figure 139) occurs on various substrata, including algal filaments (Figure 138; Photo by Jersabek *et al.* 2003), submerged mosses in trench of Alaskan polygons (Segers *et al.* 1996), and among *Sphagnum* in bogs (Horkan 1981; Hingley 1993); on Svalbard, it occurs on wet mosses, but also in the plankton (De Smet 1993). *Mytilina brevispina* (Figure 141-Figure 140) is a bryophyte dweller on *Sphagnum* (Hingley 1993; Plewka 2016).



Figure 136. *Mytilina*, a genus with three species known from bryophytes. Note the triangular (top to bottom) shell and dorsal keel. Photo by Jean-Marie Cavanilhac, with permission.

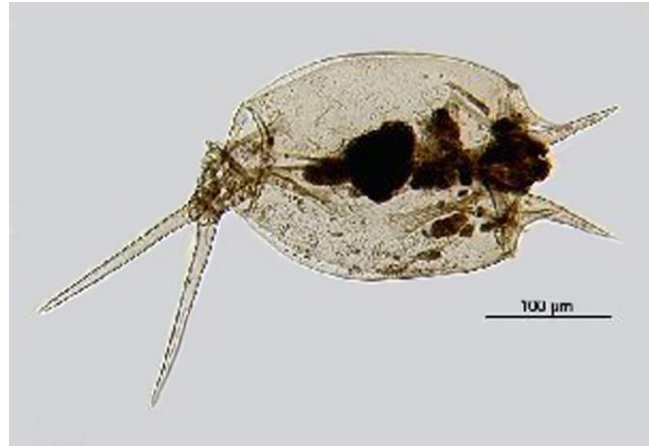


Figure 137. *Mytilina macrocera*, a *Sphagnum* dweller. Photo by Jersabek *et al.* 2003, with permission.



Figure 138. *Mytilina mucronata*, a species known to inhabit bryophytes and to live in bogs. Photo by Jersabek *et al.* 2003, with permission.



Figure 139. *Mytilina mucronata* on the filamentous alga *Oedogonium*. It also inhabits bryophytes and lives among *Sphagnum*. Photo by Michael Plewka <www.plingfactory.de>, with permission.



Figure 140. *Mytilina brevispina*, a species known to inhabit bryophytes. Photo by Jersabek *et al.* 2003, with permission.



Figure 141. *Mytilina brevispina* from *Sphagnum*. Photo by Michael Plewka <www.plingfactory.de>, with permission.

Summary

The monogonont order **Ploimida** is continued here from the previous sub-chapter. The **Lecanidae** is a large family with only one genus, *Lecane*. *Lecane* has many species associated with bryophytes. The **Ituridae** has one species known from bryophytes. The **Lepadellidae** is a cosmopolitan family of freshwater with four genera known from bryophytes. The **Lindiidae** is a small family with only one documented species among bryophytes. The **Microcodidae** has only one species and it occurs with bryophytes. The **Mytilinidae** are littoral species. Three species of *Mytilina* occur among bryophytes.

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