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*Data Descriptor*

# Biodiversity of Terrestrial Testate Amoebae in Western Siberia Lowland Peatlands

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**Abstract:** Testate amoebae are unicellular eukaryotic organisms covered with an external skeleton called a shell. They are an important component of many terrestrial ecosystems, especially peatlands, where they can be preserved in peat deposits and used as a proxy of surface wetness in paleoecological reconstructions. Here, we represent a database from a vast but poorly studied region of the Western Siberia Lowland containing information on TA occurrences in relation to substrate moisture and WTD. The dataset includes 88 species from 32 genera, with 2181 incidences and 21,562 counted individuals. All samples were collected in oligotrophic peatlands and prepared using the method of wet sieving with a subsequent sedimentation of aqueous suspensions. This database contributes to the understanding of the distribution of testate amoebae and can be further used in large-scale investigations.

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**Keywords:** testate amoebae; Western Siberia Lowland; peatlands; diversity



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## 1. Summary

Testate amoebae (TA) are a large polyphyletic group of microorganisms with a complicated systematic position that regularly renews [1–3]. They are characterized by the presence of a rigid external cell cover called a shell. Over the past 200 years of investigations, about 2000 species have been described. Most of them are freshwater, but they are widely observed in almost all types of terrestrial ecosystems [4].

TA are the most abundant and diverse component of microbial communities in peatlands [5] and can constitute up to 50% of the total microbial biomass [6]. They include bacterivorous, mixotrophic and even predatory organisms and might form complex multilevel trophic chains [7]. TA are characterized by a unique set of features such as a worldwide distribution, diverse and decay-resistant shells, high sensitivity and quick responses to environmental changes that make them useful bioindicators of past and present conditions [8,9]. The most important environmental factor affects the species structure of TA assemblages is substrate moisture, as has been demonstrated in numerous studies [10–13].

In particular, the surface moisture in mire ecosystems greatly depends on the water table depth (WTD), which varies along the microtopography determining TA distribution [14,15]. Therefore, the provided dataset contains information on TA occurrences in relation to substrate moisture and WTD.

Boreal peatlands are widely distributed in Northern America, Northern Europe and Western Siberia. However, the study of the distribution of testate amoebae in these regions is extremely uneven. For example, the vast Siberian regions remain a blank spot on the map [16–22]. This dataset description is based on testate amoebae data published in Mazei et al., 2017 [23]. Thus, the main aim of this contribution is to provide a dataset on the distribution of testate amoebae in relation to surface wetness and related characteristics in peatlands in the Western Siberia Lowland (WSL).

## 2. Data Description

### 2.1. Dataset Description

The dataset is organized according to GBIF requirements for "Occurrence Data" type [24], and it follows Darwin Core standard of Biodiversity Information Standards (historical "TDWG"—Taxonomic Databases Working Group) and uses terms of "Occurrence" [25]. In the dataset, each observation includes basic information on the location (latitude/longitude), date of observation, name of the observer, substrate moisture and a comment on the sampling point location (microtopography of the sampling point). The coordinates were determined in situ using a GPS device (Table 1).

**Table 1.** Description of the dataset.

| Column Label | Column Description |
|---|---|
| eventID | An identifier for the set of information associated with an Event |
| occurrenceID | An identifier for the occurrence (as opposed to a particular digital record of the occurrence) |
| basisOfRecord | The specific nature of the data record |
| eventDate | The date when material was collected or the sampling period |
| Kingdom | The full scientific name of the Kingdom in which the taxon is classified |
| scientificName | The full scientific name, including the genus name and the lowest level of taxonomic rank with the authority |
| Family | The full scientific name of the Family in which the taxon is classified |
| Class | The full scientific name of the Class in which the taxon is classified |
| taxonRank | The taxonomic rank of the most specific name in the scientificName |
| decimalLatitude | The geographic latitude of a location in decimal degrees |
| decimalLongitude | The geographic longitude of a location in decimal degrees |
| countryCode | The standard code for the country in which the location is found |
| individualCount | The number of individuals present at the time of the occurrence |
| organismQuantity | A number or enumeration value for the quantity of organisms (counted shells) |
| organismQuantityType | The type of quantification system used for the quantity of organisms |
| measurementType | The nature of the measurement, fact, characteristic, or assertion (substrate moisture) |
| measurementUnit | The units associated with the dwc:measurementValue (%) |
| measurementValue | The value of the measurement, fact, characteristic, or assertion |
| locationRemarks | Comments or notes about the dcterms:Location (microtopography) |

### 2.2. Species Diversity and Community Structure in the Dataset

The dataset presents information on 88 species of testate amoebae belonging to 14 families except for *incertae sedis* and 32 genera found in the WSL (Tyumen region and Yamalo-Nenets Autonomous okrug) (Table 2). The total number of occurrences was 2181 (localization of an individual of the same species, as well as the total number of samples reviewed), and the number of counted individuals was 21,562. The most diverse families in terms of genus number were Hyalospheniidae (6), Centropyxidae (4) and incertae sedis (5—genera *Ellipsopyxis, Paraquadrula, Physochila, Tracheleuglypha* and *Trigonopyxis*). The greatest number of species were observed in the families Euglyphidae (16), Centropyxidae (15) and Hyalospheniidae (11).

**Table 2.** Species diversity of testate amoeba families in the dataset.

| Families | Number of Genera | Number of Species | Number of Occurrences |
|---|---|---|---|
| Amphitremidae Poche, 1913 | 1 | 1 | 44 |
| Arcellidae Ehrenberg, 1843 | 2 | 9 | 131 |
| Assulinidae Lara et al., 2007 | 2 | 3 | 180 |
| Centropyxidae Jung, 1942 | 4 | 15 | 284 |
| Cryptodifflugiidae Jung, 1942 | 1 | 1 | 46 |
| Difflugiidae Wallich, 1864 | 1 | 3 | 50 |
| Euglyphidae Wallich, 1864, emend. Lara et al., 2007 | 2 | 16 | 489 |
| Heleoperidae Jung, 1942 | 1 | 2 | 20 |
| Hyalospheniidae Schultze, 1877 emend. Kosakyan and Lara, 2012 | 6 | 11 | 177 |
| Incertae sedis (Class: Tubulinea) | 5 | 7 | 109 |
| Lesquereusiidae Jung, 1942 | 2 | 3 | 48 |
| Netzeliidae Kosakyan et al., 2016, emend. Gonzales-Miguens et al., 2021 | 2 | 5 | 49 |
| Phryganellidae Jung, 1942 | 1 | 2 | 84 |
| Sphenoderiidae Chatelain et al., 2013 | 1 | 2 | 9 |
| Trinematidae Hoogenraad & De Groot, 1940, emend Adl et al., 2012 | 2 | 8 | 461 |
| **Total** | **32** | **88** | **2181** |

The most abundant species in the Western Siberia peatlands is *Trinema lineare* (25.4% of the total individual counts). The following species are also abundant and constitute more than 1%: *Corythion dubium* (7.26%), *Assulina muscorum* (6.46%), *Euglypha laevis* (5.59%), *Centropyxis aerophila* (5.29%), *Trinema enchelys* (3.89%), *Phryganella hemisphaerica* (3.41%), *Trinema complanatum* (2.98%), *Euglypha rotunda* (2.53%), *Nebela tincta* (2.32%), *Lesquereusia epistomium* (1.93%), *Centropyxis aerophila sphangicola* (1.84%), *Corythion orbicularis* (1.70%), *Cryptodifflugia oviformis* (1.70%), *Cyclopyxis arcelloides* (1.54%), *Assulina seminulum* (1.47%), *Bullinularia indica* (1.37%), *Euglypha tuberculata* (1.32%), *Euglypha strigosa glabra* (1.3%), *Arcella rotundata* (1.28%), *Trigonopyxis arcula* (1.16%), *Archerella flavum* (1.09%) and *Centropyxis orbicularis* (1.02%). The other 66 species (Table 3) were less abundant than 1% of the total counts. *T. lineare* is the most common species (found in 94% of all sampling points). The following species have been encountered in more than 20% of samples: *A. muscorum* (83%), *E. laevis* (74%), *C. dubium* (66%), *C. aerophila* (52%), *T. complanatum* (52%), *E. tuberculata* (51%), *P. hemisphaerica* (50%), *T. enchelys* (50%), *E. strigosa glabra* (48%), *C. orbicularis* (46%), *B. indica* (46%), *N. tincta* (36%), *C. oviformis* (32%), *Euglypha strigosa* (32%), *A. flavum* (31%), *T. arcula* (29%), *Galeripora catinus* (29%), *Euglypha compressa* (29%), *A. seminulum* (28%), *E. rotunda* (26%), *C. aerophila sphangicola* (26%), *Galeripora arenaria* (22%), *Euglypha ciliata* (22%), *Alabasta militaris* (20%), *Nebela collaris* (20%). *Centropyxis sylvatica minor, Paraquadrula irregularis, Arcella megastoma, Centropyxis constricta, Euglypha compressa glabra, Padaungiella lageniformis, Padaungiella wailesi, Plagiopyxis minuta, Planocarina marginata, Sphenoderia lenta* and *Trinema grandis* were found in a single sample and are therefore considered rare. The other 52 species were found in less than 20% but more than 1% of samples.

**Table 3.** Abundance (in %) and occurrences (samples) per study area of testate amoeba species from the dataset. Species names are listed in alphabetical order; study area codes are described in the Methods section. ab.—abundance; occ.—number of occurrences.

| Taxa | Study Area | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | |
| | ab. | occ. | ab. | occ. | ab. | occ. | ab. | occ. | ab. | occ. | ab. | occ. |
| *Alabasta longicollis* (Penard 1890) Duckert, Blandenier, Kosakyan & Singer 2018 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.04 | 1 | 0.45 | 2 | 0.00 | 0 |
| *Alabasta militaris* (Penard 1890) Duckert, Blandenier, Kosakyan & Singer 2018 | 2.46 | 10 | 0.67 | 1 | 1.18 | 8 | 0.14 | 8 | 0.22 | 1 | 0.00 | 0 |
| *Arcella gibbosa* Penard, 1890 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.02 | 1 | 0.00 | 0 | 0.30 | 5 |
| *Arcella hemisphaerica* Perty, 1852 | 0.00 | 0 | 0.92 | 1 | 0.00 | 0 | 0.11 | 4 | 0.00 | 0 | 0.75 | 7 |
| *Arcella rotundata* Playfair, 1918 | 0.76 | 1 | 3.91 | 2 | 0.00 | 0 | 0.11 | 4 | 8.91 | 6 | 1.14 | 7 |
| *Archerella flavum* (Archer, 1877) Loeblich and Tappan, 1961 | 0.00 | 0 | 1.58 | 3 | 0.59 | 2 | 0.61 | 17 | 2.45 | 5 | 2.16 | 17 |
| *Assulina muscorum* Greeff, 1888 | 7.19 | 16 | 11.4 | 10 | 5.84 | 10 | 5.71 | 45 | 5.01 | 7 | 6.25 | 30 |
| *Assulina seminulum* Ehrenberg, 1848 | 0.12 | 2 | 0.08 | 1 | 7.74 | 10 | 1.58 | 26 | 0.11 | 1 | 0.00 | 0 |
| *Awerintzewia cyclostoma* Schouteden, 1906 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.02 | 1 | 0.00 | 0 | 0.33 | 7 |
| *Bullinularia indica* (Penard, 1907) Deflandre, 1953 | 0.76 | 5 | 0.58 | 3 | 2.95 | 11 | 0.91 | 28 | 0.33 | 2 | 2.31 | 17 |
| *Centropyxis aculeata* (Ehrenberg, 1838) Stein, 1859 | 0.06 | 1 | 0.00 | 0 | 0.00 | 0 | 0.04 | 2 | 0.00 | 0 | 0.00 | 0 |
| *Centropyxis aculeata oblonga* Deflandre, 1929 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.99 | 6 |
| *Centropyxis aerophila* Deflandre, 1929 | 0.76 | 4 | 0.00 | 0 | 3.28 | 10 | 11.38 | 50 | 0.78 | 1 | 1.23 | 9 |
| *Centropyxis aerophila* sphangicola Deflandre, 1929 | 3.04 | 8 | 2.41 | 2 | 0.07 | 1 | 3.08 | 21 | 0.33 | 2 | 0.12 | 3 |
| *Centropyxis cassis* (Wallich, 1864) Deflandre, 1929 | 0.12 | 1 | 0.00 | 0 | 3.41 | 6 | 0.21 | 6 | 0.00 | 0 | 0.00 | 0 |
| *Centropyxis constricta* (Ehrenberg, 1841) Penard, 1890 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.03 | 1 |
| *Centropyxis ecornis* (Ehrenberg, 1841) Leidy, 1879 | 0.00 | 0 | 0.00 | 0 | 0.26 | 1 | 0.00 | 0 | 0.00 | 0 | 0.18 | 5 |
| *Centropyxis gibba* Deflandre, 1929 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.90 | 7 |
| *Centropyxis orbicularis* Deflandre, 1929 | 0.35 | 3 | 5.16 | 3 | 0.00 | 0 | 0.05 | 3 | 3.56 | 5 | 1.29 | 9 |
| *Centropyxis platystoma* (Penard, 1890) Deflandre, 1929 | 0.12 | 1 | 0.00 | 0 | 0.00 | 0 | 0.23 | 8 | 0.00 | 0 | 0.15 | 4 |

**Table 3.** *Cont.*

| Taxa | Study Area | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | |
| | ab. | occ. | ab. | occ. | ab. | occ. | ab. | occ. | ab. | occ. | ab. | occ. |
| *Centropyxis sylvatica* (Deflandre, 1929) Bonnet and Thomas, 1955 | 5.09 | 11 | 2.58 | 4 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.09 | 1 |
| *Corythion dubium* Taranek, 1871 | 6.90 | 13 | 4.25 | 5 | 16.08 | 12 | 9.10 | 47 | 1.89 | 6 | 2.79 | 12 |
| *Corythion orbicularis* (Penard, 1910) Iudina, 1996 | 2.98 | 12 | 0.58 | 2 | 2.10 | 8 | 2.00 | 30 | 0.56 | 4 | 1.08 | 10 |
| *Cryptodifflugia oviformis* Penard, 1902 | 2.51 | 7 | 0.58 | 2 | 0.20 | 3 | 0.58 | 11 | 1.45 | 4 | 4.39 | 19 |
| *Cyclopyxis arcelloides* (Penard, 1902) Deflandre, 1929 | 1.29 | 2 | 3.83 | 4 | 0.00 | 0 | 0.00 | 0 | 11.58 | 3 | 1.47 | 10 |
| *Cyclopyxis eurystoma* Deflandre, 1929 | 0.58 | 4 | 0.92 | 2 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 |
| *Cyclopyxis kahli* (Deflandre, 1929) | 1.23 | 1 | 0.17 | 1 | 0.00 | 0 | 0.04 | 2 | 0.00 | 0 | 0.00 | 0 |
| *Cylindrifflugia bacillariarum* (Perty, 1849) González-Miguéns et al., 2022 | 0.00 | 0 | 0.00 | 0 | 0.26 | 1 | 0.02 | 1 | 1.00 | 3 | 0.42 | 9 |
| *Cylindrifflugia elegans* (Penard, 1890) González-Miguéns et al., 2022 | 0.00 | 0 | 2.08 | 4 | 0.00 | 0 | 0.00 | 0 | 1.11 | 3 | 0.18 | 2 |
| *Difflugia bacillifera* Penard, 1890 | 0.00 | 0 | 0.00 | 0 | 0.72 | 2 | 0.16 | 6 | 0.00 | 0 | 0.24 | 4 |
| *Difflugia globulosa* Dujardin, 1837 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.35 | 8 | 0.00 | 0 | 0.36 | 8 |
| *Difflugia penardi* Cash and Hopkinson, 1909 | 0.00 | 0 | 0.00 | 0 | 1.05 | 5 | 0.28 | 9 | 1.56 | 4 | 0.18 | 4 |
| *Ellipsopyxis pauliani* Bonnet, 1965 | 0.18 | 1 | 0.00 | 0 | 0.26 | 1 | 0.19 | 8 | 0.00 | 0 | 1.17 | 13 |
| *Euglypha acanthophora* Ehrenberg, 1841 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.02 | 1 | 0.67 | 3 | 0.00 | 0 |
| *Euglypha capsiosa* Coûteaux, 1978 | 0.00 | 0 | 0.17 | 1 | 0.92 | 7 | 0.09 | 5 | 0.11 | 1 | 0.00 | 0 |
| *Euglypha ciliata* Ehrenberg, 1848 | 0.76 | 6 | 0.00 | 0 | 0.26 | 4 | 0.19 | 8 | 0.00 | 0 | 0.81 | 14 |
| *Euglypha ciliata glabra* Wailes, 1915 | 0.29 | 3 | 0.33 | 1 | 0.20 | 1 | 0.37 | 10 | 0.00 | 0 | 0.18 | 3 |
| *Euglypha compressa* Carter, 1864 | 1.40 | 6 | 0.83 | 3 | 0.13 | 1 | 0.47 | 18 | 0.11 | 1 | 0.42 | 12 |
| *Euglypha compressa glabra* Wailes, 1915 | 0.06 | 1 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 |
| *Euglypha cristata decora* Jung, 1942 | 0.00 | 0 | 0.00 | 0 | 0.20 | 1 | 0.05 | 2 | 0.00 | 0 | 0.09 | 1 |
| *Euglypha cristata* Leidy, 1874 | 0.00 | 0 | 0.00 | 0 | 0.52 | 2 | 0.23 | 10 | 0.00 | 0 | 2.58 | 9 |

**Table 3.** *Cont.*

| Taxa | Study Area | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | |
| | ab. | occ. | ab. | occ. | ab. | occ. | ab. | occ. | ab. | occ. | ab. | occ. |
| *Euglypha denticulata* Brown, 1912 | 0.29 | 3 | 0.00 | 0 | 0.00 | 0 | 0.04 | 2 | 0.00 | 0 | 0.00 | 0 |
| *Euglypha laevis* (Ehrenberg, 1845) Perty, 1849 | 1.17 | 9 | 1.75 | 2 | 6.76 | 12 | 6.25 | 48 | 8.35 | 8 | 6.82 | 27 |
| *Euglypha rotunda* Ehrenberg, 1845 | 11.93 | 12 | 5.49 | 7 | 1.57 | 6 | 0.04 | 2 | 0.00 | 0 | 2.01 | 10 |
| *Euglypha simplex* Decloitre, 1965 | 0.06 | 1 | 0.33 | 1 | 0.66 | 5 | 0.04 | 2 | 0.00 | 0 | 0.12 | 4 |
| *Euglypha strigosa* (Ehrenberg, 1848) Leidy, 1878 | 1.05 | 9 | 0.00 | 0 | 1.77 | 11 | 1.02 | 25 | 0.00 | 0 | 0.03 | 1 |
| *Euglypha strigosa glabra* Wailes, 1898 | 0.76 | 7 | 0.25 | 2 | 1.90 | 12 | 1.87 | 33 | 0.45 | 2 | 0.93 | 13 |
| *Euglypha tuberculata* Dujardin, 1841 | 1.23 | 7 | 0.50 | 2 | 1.25 | 9 | 1.98 | 41 | 1.89 | 5 | 0.42 | 9 |
| *Galeripora arenaria* (Greeff, 1866) González-Miguéns et al., 2021 | 0.47 | 2 | 0.00 | 0 | 0.00 | 0 | 0.46 | 11 | 0.56 | 2 | 1.92 | 17 |
| *Galeripora arenaria compressa* (Chardez, 1957) González-Miguéns et al., 2021 | 0.53 | 3 | 0.00 | 0 | 0.00 | 0 | 0.16 | 8 | 0.00 | 0 | 0.21 | 3 |
| *Galeripora arenaria sphagnicola* (Deflandre, 1928) González-Miguéns et al., 2021 | 0.00 | 0 | 0.00 | 0 | 0.07 | 1 | 0.05 | 1 | 0.00 | 0 | 0.00 | 0 |
| *Galeripora catinus* (Penard, 1890) González-Miguéns et al., 2021 | 0.99 | 3 | 0.58 | 2 | 1.57 | 7 | 0.18 | 7 | 1.67 | 7 | 1.65 | 15 |
| *Galeripora discoides* (Ehrenberg, 1871) González-Miguéns et al., 2021 | 0.00 | 0 | 0.00 | 0 | 0.07 | 1 | 0.00 | 0 | 0.22 | 1 | 0.03 | 1 |
| *Galeripora megastoma* (Penard, 1902) González-Miguéns et al., 2021 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.03 | 1 |
| *Gibbocarina galeata* (Penard, 1890) Kosakyan et al., 2016 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.02 | 1 | 3.56 | 5 | 2.25 | 20 |
| *Heleopera sphagni* Leidy, 1874 | 0.00 | 0 | 0.25 | 1 | 0.07 | 1 | 0.54 | 6 | 0.00 | 0 | 0.00 | 0 |
| *Heleopera sylvatica* Penard, 1890 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.11 | 1 | 1.50 | 11 |
| *Hyalosphenia elegans* Leidy, 1874 | 0.12 | 1 | 1.08 | 3 | 0.59 | 1 | 0.12 | 5 | 0.00 | 0 | 0.00 | 0 |
| *Hyalosphenia papilio* Leidy, 1874 | 0.70 | 2 | 1.33 | 2 | 1.05 | 6 | 0.04 | 2 | 1.78 | 3 | 0.42 | 10 |
| *Lesquereusia epistomium* Penard, 1902 | 0.06 | 1 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 6.90 | 5 | 6.43 | 19 |
| *Nebela collaris* (Ehrenberg, 1848) sensu Kosakyan et Gomaa, 2013 | 0.00 | 0 | 0.00 | 0 | 1.31 | 8 | 0.75 | 18 | 0.00 | 0 | 0.06 | 2 |

**Table 3.** *Cont.*

| Taxa | Study Area | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | |
| | ab. | occ. | ab. | occ. | ab. | occ. | ab. | occ. | ab. | occ. | ab. | occ. |
| *Nebela tincta* (Leidy, 1879) Awerintzew, 1906 | 10.12 | 12 | 0.08 | 1 | 6.30 | 10 | 0.68 | 15 | 0.67 | 4 | 0.57 | 9 |
| *Netzelia oviformis* (Cash, 1909) Ogden, 1979 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.89 | 3 | 2.10 | 9 |
| *Netzelia wailesi* (Ogden, 1980) Meisterfeld, 1984 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.81 | 8 |
| *Padaungiella lageniformis* Penard, 1890 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.03 | 1 |
| *Padaungiella wailesi* Deflandre, 1936 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.02 | 1 | 0.00 | 0 | 0.00 | 0 |
| *Paraquadrula irregularis* Wallich, 1863 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.04 | 1 | 0.00 | 0 | 0.00 | 0 |
| *Phryganella acropodia* (Hertwig & Lesser, 1874) Hopkinson, 1909 | 0.00 | 0 | 0.33 | 1 | 0.00 | 0 | 0.68 | 10 | 0.45 | 1 | 0.00 | 0 |
| *Phryganella hemisphaerica* Penard, 1902 | 5.73 | 10 | 2.33 | 4 | 2.89 | 10 | 5.08 | 43 | 2.45 | 3 | 0.24 | 2 |
| *Physochila griseola* (Penard, 1911) Jung, 1955 | 0.00 | 0 | 1.42 | 1 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 1.59 | 13 |
| *Placocista spinosa* Penard, 1899 | 0.18 | 2 | 0.00 | 0 | 0.13 | 1 | 0.51 | 15 | 0.00 | 0 | 0.21 | 4 |
| *Plagiopyxis callida* Penard, 1910 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.60 | 9 |
| *Plagiopyxis minuta* Penard, 1910 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.03 | 1 |
| *Planocarina carinata* (Archer 1867) Kosakyan et al., 2016 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.05 | 3 | 0.00 | 0 | 0.00 | 0 |
| *Planocarina marginata* (Archer 1867) Kosakyan et al., 2016 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.02 | 1 | 0.00 | 0 | 0.00 | 0 |
| *Scutiglypha scutigera* (Penard, 1911) Foissner & Schiller, 2001 | 0.23 | 2 | 0.33 | 1 | 0.00 | 0 | 0.07 | 2 | 0.00 | 0 | 0.00 | 0 |
| *Sphenoderia fissirostris* Penard, 1890 | 0.00 | 0 | 0.00 | 0 | 0.07 | 1 | 0.05 | 2 | 0.00 | 0 | 0.51 | 5 |
| *Sphenoderia lenta* Schlumberger, 1845 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.02 | 1 | 0.00 | 0 | 0.00 | 0 |
| *Tracheleuglypha dentata* (Vejdovsky, 1882) Deflandre, 1928 | 0.23 | 1 | 0.17 | 1 | 0.46 | 2 | 0.21 | 3 | 0.00 | 0 | 0.51 | 4 |
| *Trigonopyxis arcula major* Chardez, 1960 | 0.35 | 2 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 |
| *Trigonopyxis arcula* Penard, 1912 | 2.69 | 8 | 0.50 | 2 | 2.43 | 9 | 1.02 | 10 | 0.89 | 5 | 0.36 | 7 |
| *Trigonopyxis minuta* Schönborn and Peschke, 1988 | 1.35 | 4 | 0.00 | 0 | 1.90 | 6 | 0.82 | 3 | 0.33 | 1 | 0.15 | 3 |

**Table 3.** *Cont.*

| Taxa | Study Area | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | |
| | ab. | occ. | ab. | occ. | ab. | occ. | ab. | occ. | ab. | occ. | ab. | occ. |
| *Trinema complanatum* Penard, 1890 | 0.64 | 5 | 0.67 | 4 | 1.18 | 4 | 4.99 | 40 | 4.12 | 3 | 2.10 | 18 |
| *Trinema enchelys* Ehrenberg, 1838 | 0.70 | 5 | 0.00 | 0 | 4.72 | 11 | 5.27 | 38 | 0.00 | 0 | 5.23 | 17 |
| *Trinema grandis* (Chardez, 1960) Golemansky, 1963 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.02 | 1 | 0.00 | 0 | 0.00 | 0 |
| *Trinema lineare* Penard, 1890 | 19.18 | 15 | 39.54 | 12 | 13.06 | 13 | 28.06 | 57 | 22.27 | 8 | 25.42 | 29 |
| *Trinema lineare truncatum* Chardez, 1964 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.35 | 11 | 0.22 | 1 | 0.06 | 2 |
| *Trinema penardi* Thomas & Chardez, 1958 | 0.12 | 1 | 0.00 | 0 | 0.00 | 0 | 0.19 | 5 | 0.00 | 0 | 0.00 | 0 |

## 3. Methods

### 3.1. Study Area

The materials for the study were collected in six study areas along the latitudinal gradient at the WSL (Figure 1) in July 2008 and June 2009. All sampling sites were represented by various types of mire ecosystems located in the geographical range of 58° to 66° N and 68° to 79° E.

Study area 1 (N 58.79°, E 68.79°) is located on the east bank of the Irtysh River and was represented by two mires. Both of them are forested peatlands ('ryam') with *Pinus sibirica* or *Betula* sp. in the tree stand. The shrub cover is dominated by *Rhododendron tomentosum* and *Rubus chamaemorus*; the moss layer is formed by *Sphagnum* species, *Pleurozium schreberi*, *Dicranum* spp., *Cladonia* lichens, *Hylocomnium splendens* and *Polytrichum commune*.

Study area 2 (N 58.23°, E 68.22°) is located further south on the east bank of the Irtysh River and is represented by two mires. The vegetation cover is similar to the previous study site, with a denser *Betula* sp. canopy, the presence of *Rhododendron tomentosum* with *Andromeda polifolia* and sedges and a moss cover primarily formed by *Sphagnum* mosses.

Study area 3 (N 66.4°, E 79.02°) is located in the far north of the WSL, near the eastern bank of the Pur River. This site is an open tundra peatland with low vegetation of *Betula nana*, *Rhododendron tomentosum* and *Oxycoccus palustris* underlined by *Sphagnum*, *Cladonia* and *Pleurozium schreberi*.

Study area 4 (N 65.58°, E 77.58°) is located to the west of the Pur River in the vicinity of the town of Urengoi. It includes three sites: (1) an open permafrost peatland with *Betula nana, Salix, Rhododendron tomentosum, Rubus chamaemorus* and *Sphagnum* species and brown mosses including *Polytrichum strictum* and *Polytrichum commune*; (2) a lake-margin mat with dominated *Eriophorum* spp. with *Andromeda polifolia* and *Rhododendron tomentosum* and *Sphagnum* in the moss cover; (3) a shrub-dominated peatland with *Betula*, *Salix*, sedges, *Polytrichum commune* and *Sphagnum*.

Study area 5 (N 60.12°, E 71.50°) is in the middle taiga zone in the center of the WSL, south of the River Ob. The petaland is covered by *Pinus sylvestris*, *Rhododendron tomentosum, Chamaedaphne calyculata, Rubus chamaemorus* and *Sphagnum*.

Four sites were chosen in Study area 6 (N 58.23°, E 68.22°) on the east bank of the Irtysh River in the vicinity of the town of Tobolsk. Two of the peatlands are 'ryams' with *Pinus*, abundant *Rhododendron tomentosum* and *Andromeda polifolia* among shrubs and *Pleurozium schreberi* and sparse *Sphagnum* mosses. Two other peatlands are sedge-dominated, with an extensive cover of *Carex* species, *Oxycoccus palustris*, *Sphagnum* mosses and rare *Betula* trees.

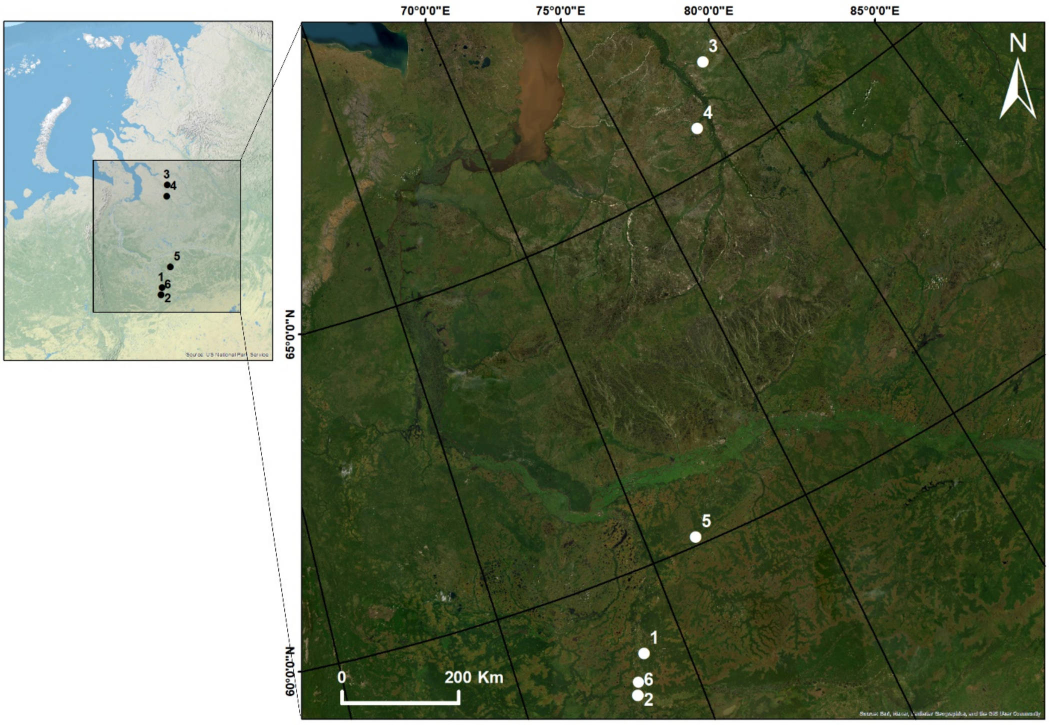


**Figure 1.** Map of the study areas. Numbers are study areas described in Methods.

### 3.2. Sample Collection and Treatment

Samples for the study were collected in an attempt to cover the diversity of habitat types in each study site, taking into account the microtopography of peatland, i.e., hummocks, lawns and hollows. The sampled substrates represented either mosses (if present) or plant litter (if mosses are not dominant or absent) of approximately 5 cm depth and 25 $cm^3$ volume. Each sample was carefully removed and immediately placed in sealed plastic bags to avoid contamination and moisture loss. Further, it was refrigerated as soon as possible at 5 °C until laboratory processing and analyses to avoid major post-sampling changes in the community structure [26]. WTD was measured in situ during fieldwork. Holes for WTD were made at the sampling point and settled for 30 minutes before the measurement using a ruler.

Samples were divided into two parts in the laboratory. One of them was used for testate amoebae extraction following the method based on suspension in water, physical agitation and subsequent sedimentation described by Mazei et al. (2011) [17]. Samples (1 $cm^3$) were soaked in water for 24 hours, stirred for 30 minutes and filtered through a 500 µm mesh. The suspension was left to settle for the other 24 hours and the supernatant was decanted off. No back-filtering step was used as this leads to the loss of small taxa and a relatively large mesh size (500 µm) was used to retain the largest tests [20,27]. Samples were examined using a light microscope and shells were identified to the highest possible taxonomic resolution at 400× and 200× magnification using Mazei and Tsyganov (2006) until a minimum count of 150 shells in each sample [28]. The taxonomic classification at the genus level is based on the revisions of Kosakyan et al. (2016a, b) [2] as summarized in Tsyganov et al. (2016) [29], González-Miguéns et al. (2021) [3] and González-Miguéns et al. (2022) [30].

Moisture content was determined from the other part of the sample. Wet subsamples were weighed and placed in an oven at 105 °C for eight hours. Further, samples were cooled in the desiccator to room temperature and then weighed again. Percentage moisture was calculated based on the difference between the wet and dry sample weights.

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