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Ecological differentiation of turbellarians in Harsz-Lake

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1. Introduction

The lake turbellarians studies were begun by du Plessis (1878—84) and Forel (1879). They were interested chiefly in morphology and faunistic problems.

In Poland, the systematics and morphology of turbellarians were examined by Schmidt (1858), Jaworowski (1889), Fuliński (1915—33) and Gieysztor (1926—39); this author presents the general review of the research works on this field up to his time. As far as Polish turbellarian fauna is concerned that of Tatra-Mountains lakes is the best known. The earliest records of turbellarians of Tatra lakes were presented by Wierzejski (1882—83) and Minkiewicz (1914). Then, Gieysztor (1934—38) devoted some works exclusively to turbellarians in general and in particular to the turbellarians of Tatra-Mountains lakes. He gives the list of species occurring in the lakes. His investigations were held only in summer.

From the lakes of Lowland of Poland, Wigry lake was examined by Gieysztor (1938—39). He studied chiefly psammonic habitat, *Chara* aggregations and the gravel littoral zone of this lake.

There is as far as we know one work dealing exclusively with the occurrence and distribution of turbellarians in one particular lake. It is „Zur Turbellarian Fauna des Lago Maggiore und des Lago di Como" by O. Steinböck (1949). The author discusses the occurrence of turbellarians in relations to the depth of the lake. One may see that there are two groups of the turbellaria species: 1) those occurring in shallow water (down to 20 m.) and 2) the ubiquistic species which for the most part compose the fauna of profundal zone. It was only Riedl (1953), who carried out the quantitative studies of marine turbellarians, using the underwater breathing apparatus.

There are no works in literature dealing with the occurrence of turbellarians in particular lake habitats. We have poor knowledge of their occurrence in

the particular periods of the year. Especially there is a lack of researches concerning their yearly life-cycle. I intend to show in the present work the distribution of the turbellarian species in particular habitats in the course of successive year seasons. My studies were carried out on Harsz Lake in Mazurian District. I base on the material representing all the habitats of the lake in their whole yearly cycle*.

2. The description of the lake

Harsz Lake belongs to Mamry Lake complex. It consists of two parts: "Wielki Harsz" which is of greater dimensions and is rather deep, and "Mały Harsz" which is small and shallow (Map 1)**. The lake-shore is flat. There is wood on the northern coast of the lake.

"Wielki Harsz" has rather long basin (the length along the axis is about 2.8 km., and the average breadth about 0.5 km.). The area of "Wielki Harsz" is 180 ha. The SE corner of the lake is near the village; in the northern corner is large, shallow bay, cut off from the lake by a belt of reeds. The bay pas s into the alder wood which grows on the floating mat of entangled plants. The maximal depth of the lake is found in the middle of its basin (48 m). The northern part of the lake is not deep (less than 15 m.). The littoral sandbanks (their breadth is up to 50 m.) in some cases are separated from the central parts of the lake by a belt of emergent vegetation.

"Mały Harsz" is a small (about 35 ha), rather shallow lake; its slopes are mild. On the western coast there are two small bays. One of them is greater (the depth about 5 m.); the other is very small and shallow. "Mały Harsz" and "Wielki Harsz" are joined by means of a strait. Its length is about 500 m., its breadth — 100 m. The greatest depth is 6 m.

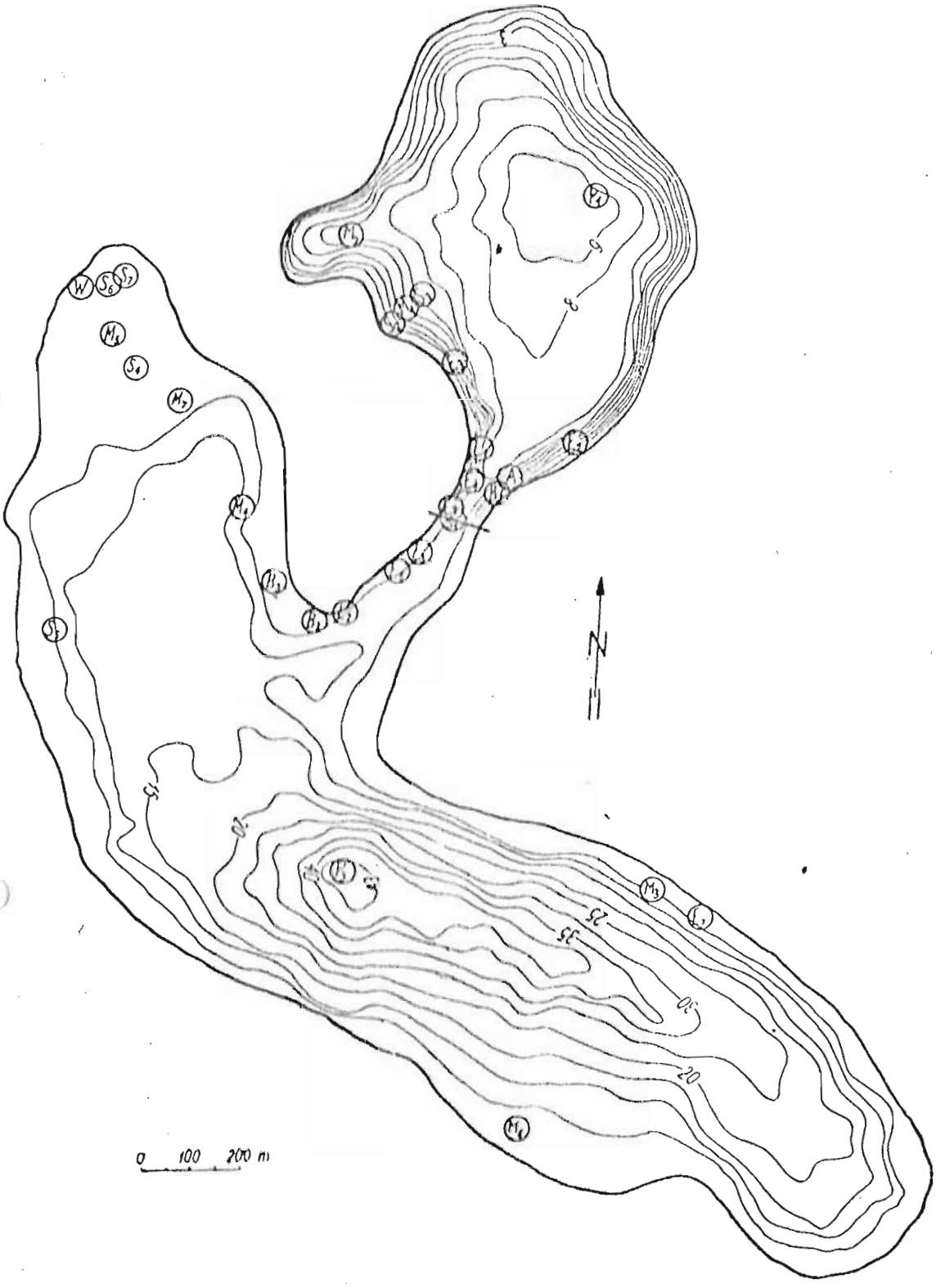
"Wielki Harsz" is alpha-mesotrophic lake, as it is stated by O l s z e w s k i (1953), who examined it at the end of July 1949. He came to this conclusion basing on the degree of the oxygen concentration in the water. The characteris feature of "Wielki Harsz" is the epilimnion rather small and hypolimnion cold and large. The thermocline is situated in the depth 5—17 m. The temperature in the depth below 20 m. is more or less constant (7.6°—7.5°C). The oxygen saturation in the deepest strata is about 30% (July). The transparency of dark-green water is fairly good (5.6 m.).

The chemical character of "Mały Harsz" water is strongly influenced by that of "Wielki Harsz". Bottom water-strata of "Mały Harsz" Lake are more

* The present work has been done in Laboratory of Hydrobiology, Warsaw University, in Polish Muzeum of Zoology and finished in Nencki Institute of Experimental Biology, under the guidance of Professor M. G i e y s z t o r, whom I am grateful for encouragement of my research and many precious suggestions.

** The data above are taken from the bathymetric plan drawn by dr S. B e r n a t o w i c z, whom I am very grateful for them, as well as for some help during fieldwork.

eutrophic than surface layer, because the waters of "Mały Harsz" and "Wielki Harsz" constantly mix. It improves the development conditions of organisms, because the food-resources are ample, the thermal conditions are good and oxygen-content at the same time is sufficient.



Map 1. Harsz Lake. Bathymetric Plan. Dots indicate sand-banks. Inside the circles-symbols denoting habitats. The situation of the lake: 21°46,'25" E lat., 54°9' N long. It is elevated 118,1 m. above M. S. L. The area of the lake is about 228, 1 ha

We may distinguish the following vegetation-zones in Harsz Lake (Map. 2)

1. The zone of shoreline vegetation. This vegetation is of two kinds: a) the vegetation growing on sand, between the spikerushes (*Heleocharis palustris* and *Schoenoplectus lacustris*) belt and the shoreline; b) the vegetation growing on non-sandy substratum between the zone of emergent vegetation and the coast-line (*Carex rostrata, Hydrocharis morsus ranae, Lemna trisulca*).

2. The zone of vegetation growing on submerged sand-banks. Here the following plants may be enumerated: *Chara aspera, Potamogeton filiformis,* as well as *Polygonum amphibium, Ceratophyllum demersum* and sometimes even *Potamogeton perfoliatus.*

3. The zone of emergent vegetation (Sedges), in which *Carex rostrata* and other species and *Heleocharis palustris* grow.

4. The zone of proper emergent vegetation, which consists in 95% of reeds. In this zone occur, too, *Typha angustifolia* and *Schoenoplectus lacustris.*

5. From May to July on the slope of sand-banks exists the distinct "hedge" of *Batrachium circinatum,* disappearing in the beginning of Summer. Instead of it, *Ceratophyllum* and *Myriophyllum,* as the species of submergent vegetation "meadows" develop. Their size and density are not so great as those of the "hedge" vegetation.

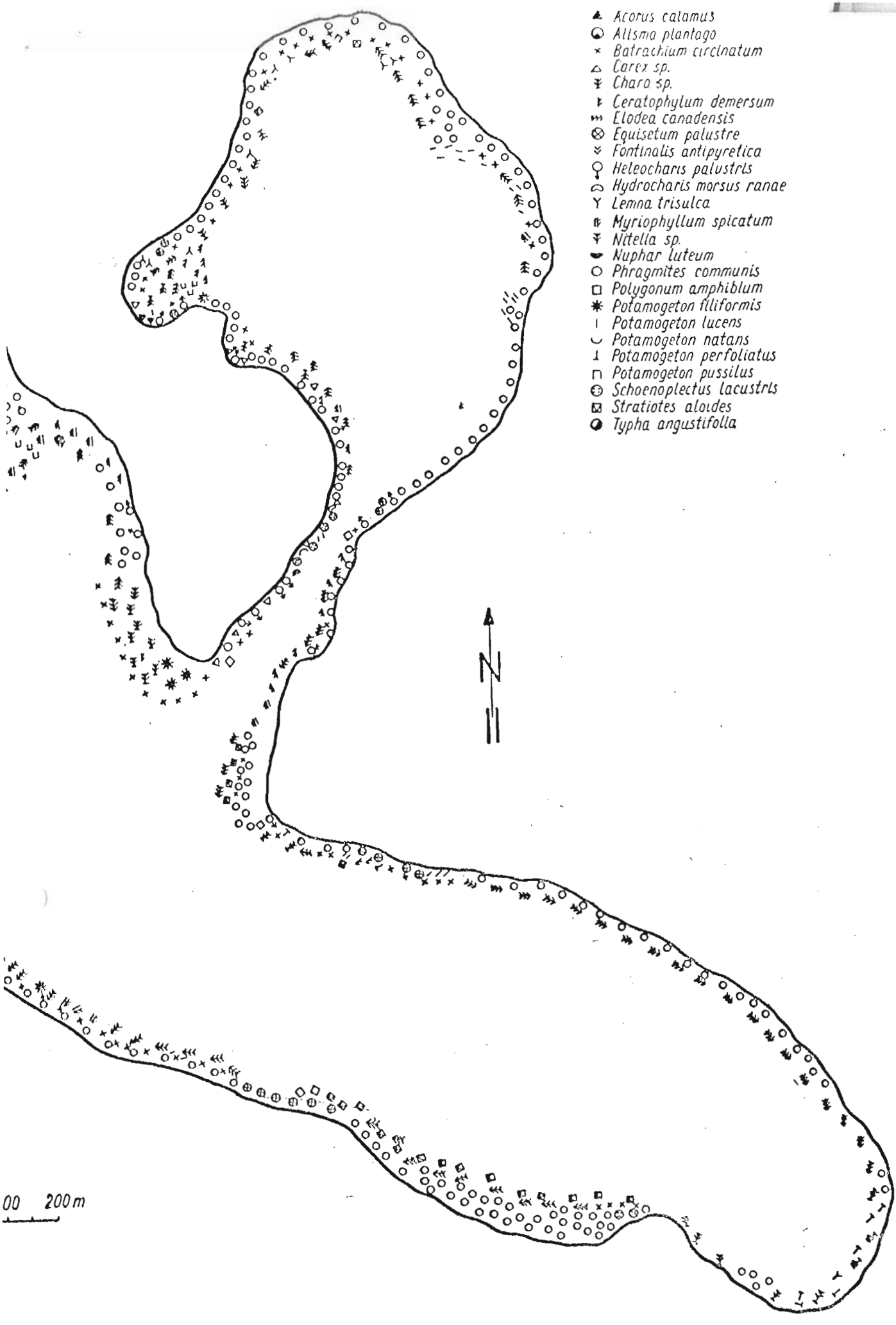
6. In the submergent vegetation zone, from the number of plants, which may reach the surface-level besides the water crowfoot (*Batrachium circinatum*), *Potamogeton lucens* is found.

7. In the zone of rooted plants with floating leaves there is a lack of water-lilies *(Nymphea)*. In some stands *Nuphar luteum* occurs. *Potamogeton natans* as the plant with floating leaves, forms the floating mat in the northern part of the lake.

8. The zone of the submergent "meadows". There are three kinds of them: a) the "meadows" of various submerged plants: *Elodea canadensis, Ceratophyllum demersum, Myriophyllum spicatum, Potamogeton pussilus* and rarely *Nitella.* There is only one stand, in which all those plants occur together. Usually, only two or three of the species occur and then, *Elodea* or *Ceratophyllum* is a dominant; b) the Chara-"meadows". *Chara* occur in dense aggregations in shallow and calm bays (chiefly *Chara intermedia* and *Chara ceratophylla*); c) the "meadows" of water soldier (*Stratiotes aloides*), which occur in mats in the depth 2—3 m.

3. The methods of work

I began my researches at the beginning of April 1953. For the just three months I have examined the lake. It allowed me to define habitats. This was done in July, when the plants were grown enough. Up from that time the samples have been taken from those habitats once a month. It has been done



Map 2. Harsz Lake. Distribution of plants. The symbols of plants — according to Bernatowicz 1952 (completed)

y means of the plankton net with a bucket. The net was made of bolting oth nr 13. The length of the netting-period was constant, in order to get the mparable material. The specimens from the psammonic zone have been ken directly into the testing-tubes; those from the profundal zone were get ith the net slightly loaded, as to get the surface-layer of mud.

The samples were preserved in the laboratory in the normal, room tempeture. As the oxygen saturation of samples diminished the turbellarians were ming to the water-surface. Then, they were examined with the magnifying ss and the turbellarians were taken for microscopic studies.

In the report of the defined species their abundance in a sample is shown five-degree scale (Classes of Abundance):

1 = only 1 individual present (single),
2 = 2—3 individuals (not numerous),
3 = 4—10 individuals (numerous),
4 = 10—20 individuals (very numerous),
5 = more than 20 (in abudance).

The second indicator is so called "Constancy of Occurrence". This term aken directly from plant ecology (B r a u n-B l a n q u e t 1928). I reckon percentage of samples in which the specimens of the given species are pre- t in relation to the number of all samples taken from the habitat.

Five classes of "Constancy" were distinguished:

1 ..... 0—20%
2 ..... 20—30%,
3 ..... 30—40%,
4 ..... 40—50%,
5 ..... > 50%.

4. Turbellarian fauna of Harsz Lake

L i s t o f S p e c i e s

ve found in Harsz Lake the following species:

Ordo Catenulida

fam. *Catenulidae*

tenostomum leucops (Dugès)
tenostomum unicolor O. Schmidt

Ordo Macrostomida

fam. *Macrostomidae*

lacrostomum phytophilum Beklemichev
lacrostomum hystricinum Beklemichev

Mesostoma rhynchotum M. Braun
Bothromesostoma esseni M. Braun
Bothromesostoma personatum (O. Schmidt)
Olisthanella halleziana (Veydovsky)
Olisthanella truncula (O. Schmidt)
Olisthanella sp. (n. sp.?)

fam. *Gyratricidae*

Gyratrix hermaphroditus Ehrenberg

Nemertini

Prostoma clepsinoides (Dugès)

In the small bodies of water, connected with the littoral zone of the lake, ave found the following turbellarians from the family *Dalyellidae*:

Dalyellia (*Scoparia*) *scoparia* (O. Schmidt)
Macrodalyellia nanella (Beklemichev)
Opistomum pallidum O. Schmidt.

Those pools are produced by the spring flooding, as the water-level of lake creases. Between them and the proper littoral zone of the lake, drift of plant-posits is formed. In those pools beside the turbellarians mentioned above, characteristic species of small ponds, i.e. *Lynceus* (*Euphyllopoda — chostraca*) occurs.

Remarks concerning taxonomy of some species

Stenostomum leucops (Dugès) and *Stenostomum unicolor* O. Schmidt.

The particular species of the genus *Stenostomum* were defined according the key by Graff (1913). The basic feature in defining the species is the pe of light-refracting body. The genus was examined by J. W. Nuttycombe and A. J. Waters (1932—38). They established new classification ed on the anatomy of the animal. The classification of mine seems to be ner inadequate. Therefore, *Stenostomum leucops* in my work may be treated a group of species. In the arenal zone of Harsz Lake are certainly some er species of this genus. But this zone has not been examined carefully by me.

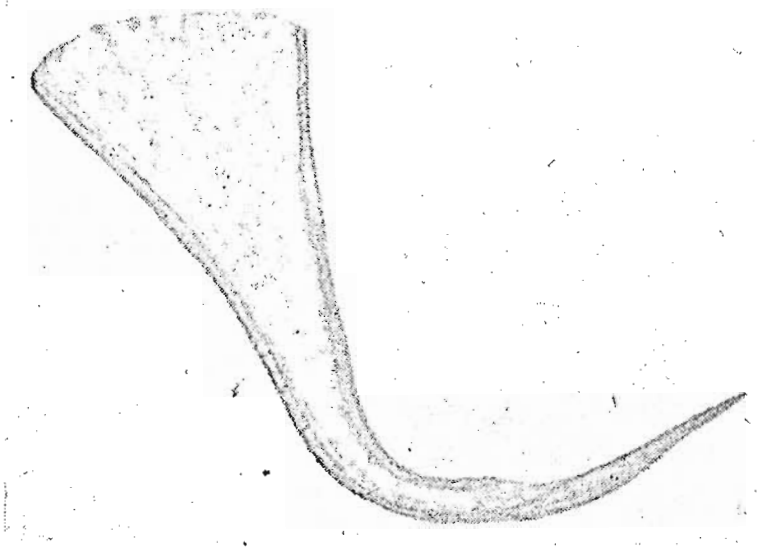
Macrostomum phytophilum Beklemichev (phot. 1)

The name is derived from Beklemichev's work (1951). Probably the species which up to his time was known as *Macrostomum viridae* Beneden. It is difficult to prove it now.

Macrostomum hystricinum Beklemichev (phot. 2)

The name is given according to Beklemichev's work. Primarily Fabricius had described the species *Macrostomum appendiculatum*.

This species has been divided by Beklemichev into several others The most typical species from this group has been described as *M. hystricinum* Up to this time the species has been known as *M. appendiculatum* f. *typica*



Phot. 1. *Macrostomum phytophilum*, copulatory apparatus

Phot. 2. *Macrostomum hystricinum*, copulatory apparatus

Gieysztoria lugubris wigrensis (Gieysztor) (fig. 1)

The total size of the body as well as the dimension of the copulatory apparatus are similar to the description given by Gieysztor (1938a). The size of an animal 0.5 mm. The copulatory apparatus: thickness of the ring 0.003—0.004 mm.; the length of the spines about 0.014 mm.; the diameter of the ring about 0.0023 mm.

Phaenocora megalops (Dugès) (fig. 2)

I have perceived great variability of shape of animals in the specimens taken from the same station at the same time.

Gieysztoria triquetra

1. Summer species. It occurs in VII and VIII; the most numerous in VIII; mature eggs in VII and in VIII; Abundance: 2.

2. It occurs in two strata: from 0 to 1.5 m., from 4 to 7 m.; the distinct break in 1.5—4 m.

3. It occurs in the habitats of sedges, horsetails, common reeds, *Batrachium* and especially in the submergent plant "meadows" Abundance: 2.

4. In sedge — and common reed taxocenes as well as in that of submergent plant "meadows", it is adominant.

Gieysztoria virgulifera

1. Summer-autumn species. It occurs from VI to X; the most numerous VIII—X; Abundance: 3; mature eggs from VII to IX.

2. It occurs in the littoral zone, from 0—7 m.; the most numerous in the depth 4—7 m. (Abundance: 3).

3. It occurs chiefly in the habitat of submergent plant "meadows" (Abundance: 4) and in submergent vegetation habitat.

4. It is the characteristic species of submergent plant "meadows". In other taxocenes its occurrence is probably connected with the presence of submergent plant "meadows". In those cases it appears as adominant (Abundance: 2 or 3; Constancy: 2 or 3).

Gyratrix hermaphroditus

1. The species of full vegetation period. It occurs from IV to X. The most numerous in VII and VIII. Mature eggs from V to VIII.

2. It occurs in all the strata (0—48 m.); eurybathic species. One distinct maximum of occurrence (4—10 m.) on the border of deep littoral and profundal zone; Abundance: 4; another maximum not so distinct, in shallow littoral zone; Abundance: 2.

3. Ubiquistic species. Maximum of its Abundance in submergent-plant "meadows" and in profundal habitat. Abundance: 3—4; generally — only 2.

4. It occurs in all the taxocenes, except "swampy" and bulrushes ones. In the profundal and the submergent-plant "meadows" taxocenes it is dominant. In other taxocenes it occurs as an adominant.

Macrostomum hystricinum

1. The species of full vegetation period. It occurs in IV and in VIII—IX; the most numerous in IV. Its Abundance is 3. Probably two generations occur.

2. Occurrence depth 0—60 cm. In spring it has been found in deep water-strata, in summer it migrates up. The data referring to the species are very poor.

3. It occurs in cupsammon as well as on *Fontinalis* plants, which float near the shore-line.

4. In psammonic taxocene, as an adominant. Probably, it occurs in other taxocenes, too. This should be verified.

Macrostomum phytophilum

1. The species of full vegetation period. It occurs in IV; later on in VII, VIII, IX. The most numerous in VIII. Abundance: 3 or 2. The mature individuals are recorded in IV and in VIII.

2. It occurs in two strata: from 0 to 160 cm. and 2.6 to 7 m.; the most numerous in the 1 m. depth.

3. It occurs in psammonic-, sedges- and submergent-plant "meadows" habitats. It does not occur in the zone between the sedges-belt and the submergent-plant "meadows".

4. It occurs in psammonic- and sedges taxocenes as well as in the submergent-plant "meadows", as an adominant.

Mesostoma ehrenbergi

1. Summer species. It occurs from VII to IX. The most numerous in VII and in VIII. Abundance: 2. Mature individuals are recorded in VII and in VIII; the specimens with eggs in VII.

2. It occurs in the depth 0—1.5. m. and 2.6—7 m.; the most numerous in the deeper strata (Abundance: 2). Similarly to *Macrostomum phytophilum*, there is a break in its occurrence in the middle layers of littoral zone.

3. It occurs in "swampy" littoral and in horsetail zone as well as in the submergent-plant "meadows". Here is the most numerous.

4. In "swampy" and reed taxocene is adominant. In the taxocene of submergent-plant "meadows" it occurs in greater number and more often.

Mesostoma lingua

1. The species of full vegetation period. It occurs in V—VIII. Mature eggs in VII. No exact data referring to this species.

2. The species occurs in the depth 8—48 m. exceptionally one specimen has been found in the depth 0—15 cm. In spring — greater Abundance in the deep layer; in summer — in shallower strata.

3. It occurs in profundal habitat (Abundance: 2). Once, it has been found in the habitat of floating leaves of *Batrachium*, on the water-surface.

4. The characteristic species of the profundal taxocene. Here it occurs as nondominant.

Microdalyellia brevimana

1. Late-summer species. It occurs in VIII and in IX; the most numerous in VIII. Mature eggs in VIII.

2. It is recorded in the depth 0—160 cm.; the most numerous in the stratum 0—15 cm.

3. It occurs in "swampy" habitat and in submergent-plant "meadows". The characteristic break exists in the intermediate habitats, similar to that observed in the occurrence of *Macrostomum phytophilum*.

4. In "swampy" taxocene and in taxocene of submergent plant "meadows" it is adominant.

Microstomum lineare

1. All-the-year species. The most numerous in V, VIII and IX. Mature individuals are recorded in IV, VIII and XI; specimens with eggs in VIII.

2. Eurybathic species; it occurs in all the strata of the lake.

3. It is ubiquistic and eurytopic species (in Dargin Lake it occurs as a planctonic species).

4. It occurs in all the taxocenes. In the taxocene of sandy-beaches and in the submergent plant "meadows" is dominant; in other — is adominant.

Olisthanella haleziana

1. The species of full vegetation period. Very small number of the specimens was found in IV, V and X.

2. They were found in the depth of 0—15 cm.

3. It occurs in arenal habitat (Eupsammon).

4. Probably the characteristic species of psammonic taxocene (Abundance: 3).

Olisthanella truncula

1. Early-spring species. It was found in IV. Too little is known about the species for discussion.

2. It was found in the depth greater than 40 m.

3. The specimen was found in profundal habitat.

4. No data.

Olisthanella sp. (n. sp.?)

1. Summer-autumn species. It occurs in VII—X; the most numerous in IX. Mature individuals are recorded in VII.

2. In summer it occurs in the depth 0—15 cm. (Abundance: 2); in autumn 60—160 cm.

3. It occurs in arenal habitat (Eupsammon and Hygropsammon) and in the zone of submergent vegetation (*Potamogeton lucens*).

of water soldier leaves (Abundance: 3). In general, it is the species of submergent plant "meadows".

4. Nondominant in submergent plant "meadows" taxocene; adominant in sedges taxocene and in that of rooted plants with floating leaves.

Polycelis nigra

1. All-the-year species; the most numerous in II—VI; Abundance: 3.

2. It occurs in the depth 0—1.5 m.; once it has been found in the stratum 4—7 m. (1 specimen only). Similarly to *Bothromesostoma personatum* it migrates in summer and in autumn down to the bottom, in winter it begins to move up to the water-surface.

3. It occurs in "swampy" habitat, in sedges, spike rushes, horsetail habitats and in littoral-plants-in-wood. It lives near the shoreline.

4. Together with *Bothromesostoma personatum* it is the characteristic spec. of "swampy" and sedges taxocenes. In sedges taxocene it is dominant. In "swampy" taxocene is nondominant; in common reed taxocene — adominant.

Prostoma clepsinoides

1. Summer-autumn-winter species. It occurs in VII—III; maximum of its occurrence in VIII, IX and X. Mature individuals up from VIII.

2. It occurs in the stratum 0—1.5 m. In winter it occurs rather in deeper stands: 60 cm. to 1.5 m.

3. It occurs in sedges, spike rushes and bulrushes habitats. One specimen has been found in Hygropsammon. In spring their larvae migrate to all the habitats.

4. In sedges and in bulrushes taxocenes is adominant. It is the characteristic species of bulrushes taxocene.

Comparison of turbellarian fauna of Harsz Lake with that of Wigry Lake

The best known turbellarian fauna in Poland is that of Wigry Lake (Gieysztor 1939). From May to July, 1930, he investigated the turbellarians of *Chara* sp. aggregation of Wigry Lake. Table IX presents the data concerning Harsz Lake compared with those from Wigry Lake. The component species in both cases are nearly the same, but two species are lacking in Wigry Lake; *Gieysztoria triquetra* and *Rhynchomesostoma rostratum*. But there is a lot of species in Wigry Lake that are absent in Harsz Lake. E. g. *Macrostomum appendiculatum* (*hystricinum*) scarcely occurs in Harsz Lake; it is recorded only in arenal zone on the mosses *Fontinalis antipyretica*. *Gieysztoria lugubris wigrensis* has been found only in sedges zone; *Castrada viridis* occurs in Harsz Lake exclusively in sandy substratum habitats; *Mesostoma lingua* in profundal zone (only one specimen has been found in submergent plant "meadows").

teristic species of submergent plant "meadows" in Harsz Lake is *virgulifera*; it rarely occurs in Wigry Lake.

er group of habitats which have been more carefully investigated nes. Table X shows the comparison of those habitats in both lakes. found in psammonic fauna of Harsz Lake the following species ır in Wigry Lake; *Rhynchoscolex simplex*, *Gieysztoria cuspidata*, *na limicola* and *Olisthanella truncula*.

ıst numerous specimens, which have been found in arenal zone of ;, belong to the genus *Stenostomum*. Besides that, the characteristic those habitats belong to the genus *Olisthanella*.

Summary

spri l-st, 1953 to the end of June, 1954, the ecology of turbellarians, Harsz Lake, was examined.

month or once a fortnight the samples have been taken from 32 They were situated in all the habitats of the lake; map I and II;

antitative data, referring to turbellarians of that lake are presented gree-scale of Abundance. In description of the materials, the term Constancy" is introduced.

llowing are the results of this work:

species of turbellarians and 1 fresh-water Nemertine (found for the in Poland) have been described (see: List of species.)

appearing and disappearing of turbellaria species populations in their is presented (table IV).

tical distribution of turbellarian species has been investigated and V).

urrence of turbellarian species in 32 habitats has been examined).

existence of 9 coexisting groups of turbellarian species have been hed. They are called "taxocenes" and they are parts of association I and VIII).

e ecological characteristics of species occurring in Harsz Lake are

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