THE TARDIGRADA FAUNA OF THE TIHANY PENINSULA.

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(From the Hungarian Biological Research Institute, Tihany, Lake Balaton.)

With 1 Figure and 2 Tables in the text.

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At the request of the late Professor G. Entz, investigations were made as to the water bear fauna of Lake Balaton and surroundings. In the beginning the collections were but occasional. However in June and July, 1943, I had the opportunity of carrying out thorough studies. As a guest of the Hungarian Biological Research Institute at Tihany I made regular collections on the Tihany peninsula (Fig. 1.) and visited the water bodies in the environment. The laboratory work was done at the same Institute. Beside collecting faunistical data attention was given to ecological conditions and to the biology of water bears.

Tardigrada, according to the literature, as well as in my own judgment, might be arranged in the following ecological groups:

1. Xerophil forms, which endure extreme conditions of certain factors, living in moss cushions and *Sedum* "lawn" in very sunny places which are frequently subject to continued dryness.

2. Sciophil forms living in shady and humid habitats, where lasting dryness never occurs.

3. Hygrophil forms from irrigated localities, where water supply is steadily secured and permanent dryness never occurs.

4. Hydrophil forms living in water, among weeds or in detritus well soaked with water.

5. Eurytop forms, capable of adapting themselves to various milieus, at home in water as well as in dry localities.

The habitats of water bears in the peninsula might be grouped according to the chief minimum factor necessary to these animals, which is the degree of moisture.

I. The most divers Tardigrada fauna may be found in localities having extreme conditions in that respect, such as moss cushions grow-

ing on the gravel earth of barren hillsides, on rocky hilltops, on roofs of houses, on meadows and on dry stone walls, all of them well exposed to the sun. Predominant species are *Macrobiotus montanus, M. Hufelandi, Echiniscus canadensis, E. testudo, Hypsibius Oberhäuseri,*

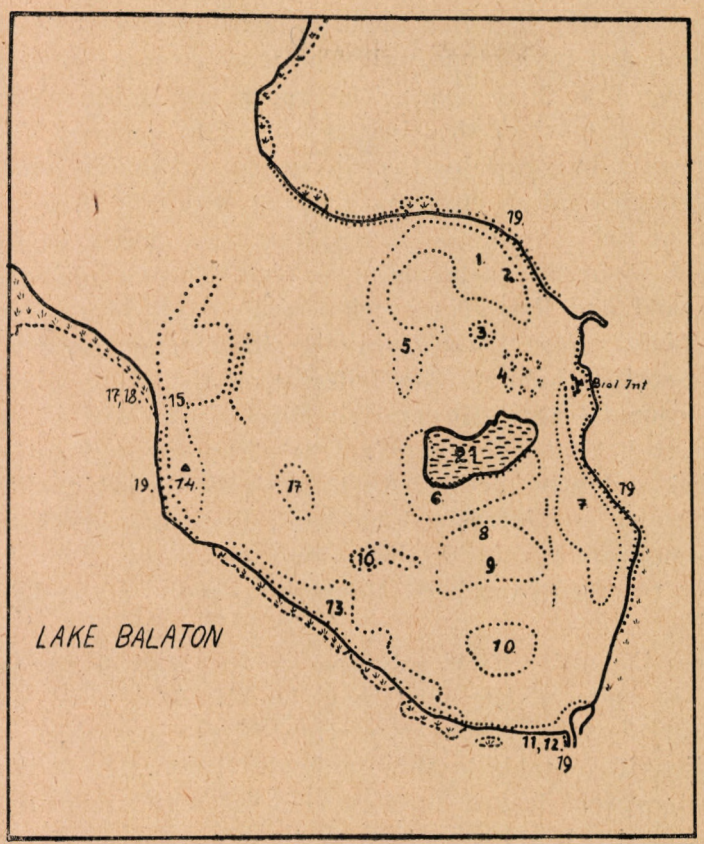

Fig. 1. Map of Tihany peninsula showing localities investigated for Tardigrada. For meaning of numbers see Table II. Border of habitats.....

Milnesium tardigradum. Echiniscus bisetosus, Macrobiotus forciger, Hypsibius brevipes were found only in such habitats. Most of the species are xerophil ones.

II. In thick moss cushions of shady humid habitats, such as tree trunks and soil in woods, fewer species could be enumerated though here conditions of existence would seem to be more favourable. Only one species *(Hypsibius Dujardini)* was found here which did not occur in habitat I. *Pseudechiniscus* species are wanting.

III. In the damp surroundings of the Cyprian spring, located about 100 m distance from the lake shore, only two species could be recorded: *Macrobiotus Richtersii* and another species of the same genus, represented by one single specimen which was not in condition appropiate for identification.

A very interesting and rich fauna is harboured by the lake shores which are protected by a stone wall. The moss cushions scattered here may be arranged in three zones. The upper one is irrigated only in the worst storms, most of the time is subject to dryness. The middle one is frequently irrigated by the waves, but when the wind is still it dries thoroughly. Moss cushions growing here are thick and clear and harbour a rich Tardigrada fauna. The zone closest to the water is submerged when the water level is high. The cushions are filled with mud, sand and lime. No specimens of water bears were found here. *Macrobiotus dispar* and *Hypsibius tetradactyloides* were found only in this sort of habitat. The drifts along the shore might be arranged in Group III also. However it must be noted that drifts are not permanent habitats, they are apt to disappear and gather again through wind and wave action. As to their ecological qualities, they lie between water and terrestrial habitats; they may be characterised by the presence of organic detritus, mud and sand. Two hygrophil forms can be recorded from here, *Macrobiotus macronyx* and *Hypsibius nodosus*.

IV. From the water itself only one species, *Macrobiotus macronyx* was found, in spite of the fact that the abundant plant growth in the margin of the lake, rooted vegetation, filamentous algae, and reed offer conditions favourable to these animals. Samples from the bottom and free waters were looked through also but without positive result. As is known, water bears cannot swim, therefore the specimen recorded from the seston of Lake Balaton (Entz-Kottász-Sebestyén p. 17) was very likely washed into free waters from the shore.

Table I. shows the distribution of Tardigrada according to type of biotop I—IV in the peninsula. *Echiniscus granulatus, Macrobiotus Richtersii, M. Harmsworthi, M. montanus, M. Hufelandi, Hypsibius nodosus, H. Schaudinni, H. convergens, H. Oberhäuseri* and *Milnesium tardigradum* were found in habitribution of all types I—III.

Table II. shows the distribution of Tardigrada according to the various localities in the peninsula (See map).

Pseudechiniscus cornutus, Echiniscus canadensis, Macrobiotus Hufelandi, M. Pullari, M. Harmsworthi, M. montanus, M. furciger, Hypsi-

TABLE I.

Tardigrada fauna of the Tihany peninsula according to type of biotop.

Species	type of biotop											No. of occur.	ecological group
	I. Etxreme sunny dry				II. shadowy humid			III. damp			IV. water		
	1*	2	3	4	5	6	7	8	9	10	11		
1. Echiniscus canadensis *J. Murr.*	+	+	—	+	—	—	—	—	—	—	—	3	xerophil
2. E. bisetosus *Hein.*	—	+	—	—	—	—	—	—	—	—	—	1	xerophil
3. E. granulatus *(Doy.)*	—	—	—	+	—	—	+	—	+	—	—	3	xerophil
4. E. testudo *(Doy.)*	+	+	—	+	—	—	—	—	+	—	—	4	xerophil
5. Pseudechiniscus suillus *(Ehrbg.)*	—	+	—	+	—	—	—	—	—	—	—	2	xerophil
6. P. cornutus *(Richt.)*	—	+	—	+	—	—	—	—	—	—	--	2	xerophil
7. Macrobiotus Richtersii *J. Murr.*	—	+	+	+	—	—	+	+	+	—	—	6	xerophil
8. M. furciger *J. Murr. (?)*	—	—	—	+	—	—	—	—	—	—	—	1	hygr. eurytop
9. M. Harmsworthi *J. Murr.*	—	+	—	—	—	+	—	—	+	—	—	3	eurytop
10. M. montanus *J. Murr.*	+	+	+	+	+	—	+	—	+	—	—	7	eurytop
11. M. Pullari *J. Murr.*	—	+	—	+	—	—	—	—	—	—	—	2	hygrophil
12. M. Hufelandii *S. Schulze*	+	+	+	+	—	+	+	—	+	—	—	7	eurytop
13. M. sp.	—	—	—	—	—	—	—	+	—	—	—	1	?
14. Hypsibius nodosus *(J. Murr.)*	—	—	—	+	—	+	+	—	+	+	—	5	hygrophil
15. H. Schaudinni *Richt.*	—	—	—	+	—	+	—	—	+	—	—	3	hygrophil
16. H. tetradactyloides *(Richt.)*	—	—	—	—	—	—	—	—	+	—	—	1	hygrophil
17. H. annulatus *(J. Murr.)*	—	+	—	+	—	—	—	—	—	—	—	3	hygrophil
18. H. Dujardini *(Doy.)*	—	—	—	—	—	+	—	—	+	—	—	2	hygrophil
19. H. convergens *(Urb.)*	—	—	+	—	—	—	+	—	+	—	—	3	hygrophil
20. H. pallidus *Thulin*	+	—	—	+	—	+	+	—	—	—	—	5	eurytop
21. H. Oberhaeuseri *(Doy.)*	+	+	+	+	+	—	—	—	+	—	—	6	xerophil
22. H. brevipes *Marcus*	—	—	—	+	—	—	—	—	—	—	—	1	xerophil
23. H. Stappersi *(Richt).*	—	+	—	+	—	—	+	—	—	—	—	3	xerophil
24. Milnesium tardigradum *Doy.*	+	+	—	+	+	—	—	—	+	—	—	5	xerophil
25. Macrobiotus dispar *J. Murr. (?)*	—	—	—	—	—	—	—	—	+	—	—	1	hydrophil
26. M. macronyx *Duj.*	—	—	—	—	—	—	—	—	+	+	+**	3	hydrophil
Number of species	7	14	5	18	3	6	8	2	15	2	1		

* 1. roofs; 2. sunny stones and rocks; 3. stone walls; 4. sunny grassy places; 5. tree trunks in woods; 6. stones in the woods; 7. soil in the woods; 8. neighbourhood of spring; 9. stony shore of the lake; 10. drifts on the lake shore; 11. Lake Balaton.

** According to *Daday*.

TABLE II.

Localities on the Tihany peninsula investigated for Tardigrada. (see. map.)

Species	1*	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19 a	19 b	19 c	20	21	22
1. Echiniscus canadensis	—	—	—	—	+	—	—	—	—	+	—	—	—	—	+	+	—	—	—	—	—	—	—	6
2. E. bisetosus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+	—	—	—	+	—	—	—	—	3
3. E. granulatus	—	—	—	+	—	—	+	—	+	—	—	+	+	—	—	—	—	—	—	—	—	—	—	5
4. E. testudo	+	—	—	+	—	+	+	+	+	+	—	—	—	+	—	+	+	+	+	—	—	—	—	29
5. Pseudechiniscus suillus	+	—	—	—	—	—	—	+	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
6. P. cornutus	—	—	—	+	+	—	—	—	—	—	—	—	—	—	+	—	—	—	—	—	—	—	—	4
7. Macrobiotus Richtersii	+	+	—	—	—	+	+	+	+	—	+	—	—	—	—	—	+	—	—	—	—	—	—	11
8. M. furciger	+	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
9. M. Harmsworthi	+	—	—	—	—	—	—	—	—	—	—	—	—	+	+	—	—	—	—	+	—	—	—	7
10. M. montanus	+	—	—	+	—	—	—	—	—	+	+	—	+	+	—	+	+	—	+	+	—	—	—	14
11. M. Pullari	—	—	—	—	+	+	—	+	—	—	—	—	—	—	+	—	—	—	—	—	—	—	—	8
12. M. Hufelandii	+	—	+	+	+	—	+	+	+	+	—	—	+	+	+	+	+	—	+	+	—	—	—	51
13. M. sp.	—	+	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
14. M. dispar	—	—	—	—	—	—	—	—	—	+	—	—	—	—	—	—	—	—	—	—	—	—	—	1
15. M. macronyx	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+	+	+**	—	3
16. Hypsibius nodosus	+	—	+	—	—	—	—	—	—	—	—	—	—	+	—	—	—	—	—	+	+	—	—	7
17. H. Schaudinni	—	—	+	—	—	+	+	—	—	—	+	—	—	—	—	—	+	+	+	+	—	—	—	9
18. H. tetradactyloides	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+	+	—	—	—	—	4
19. H. annulatus	—	—	—	—	—	—	—	+	—	—	—	—	—	—	+	—	—	—	—	—	—	—	—	3
20. H. Dujardini	—	—	—	—	—	—	—	—	—	—	+	—	—	—	—	—	—	+	+	—	—	—	—	3
21. H. convergens	+	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+	—	—	—	4
22. H. pallidus	+	—	—	+	—	—	—	—	—	—	—	—	—	+	+	—	+	+	—	—	—	—	—	6
23. H. Oberhaeuseri	+	—	—	+	—	+	+	+	+	+	—	—	+	+	+	+	+	—	—	—	—	—	—	28
24. H. brevipes	—	—	+	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
25. H. Stappersi	+	—	—	—	—	—	—	+	+	—	—	—	—	+	—	—	—	—	—	—	—	—	—	5
27. Milnesium tardigradum	+	—	—	—	—	—	+	+	+	—	—	+	+	+	+	+	+	+	+	—	—	—	—	22
Number of species	13	2	4	7	4	5	7	9	7	5	5	2	5	9	10	6	8	6	8	7	2	1	—	238

* 1. Óvár; 2. Cyprian spring; 3. Calvary; 4. Village; 5. Kiserdő hill; 6. surroundings of Belső-tó pond; 7. Akasztó hegy, Nyársas hegy hills; 8. Aranyház hill and surroundings; 9. Hármashegy hills; 10. Cserhegy hill; 11. Ferry, wave-washed places; 12. Ferry, dry stones; 13. Szarkádi erdő woods; 14. Csúcshegy hill; 15. Nyereghegy hill; 16. Hosszú hegy hill; 17. Bozsai-öböl bay, wave-washed shores; 18. Bozsai-öböl bay, dry shores; 19. shore of Lake Balaton: a. sunny stones, b. wave-washed stones, c. drifts; 20. Lake Balaton; 21. Belső-tó pond; 22. number of habitats.

** according to DADAY

bius tetradactyloides, H. convergens and *Milnesium tardigradum* were found in *Sedum (acre* and *sexangulare (boloniense)* growing in localities No. 1, 3 and 5 (Table II.) also in the rocks of the stone wall in front of the Institute buildings.

Summarizing the results of this faunistical survey of the Tihany peninsula having localities with divers microclimate, it may be said that during the summer months of 1943, 26 species of Tardigrada were found. Most of them are harboured by dry habitats with extreme condition of existence (21). Among these 8 were not found in habitats of other types (differential species). *Echiniscus testudo, Hypsibius Oberhäuseri, S. Stappersi* and *Milnesium tardigradum,* though occurring elsewhere too, here occur most frequently. In shadowy, humid habitats 13 species were found, none of them characteristic of this type of locality. 16 species representing different ecological groups were harboured by damp habitats. There were three differential species found. In the lake itself only one species was collected, which lives also in habitats group III. — *Pseudechiniscus cornutus,* a xerophil species had not previously been recorded from Hungary.

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