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The Protozoa of Silver Lake Bog

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THE PROTOZOA OF SILVER LAKE BOG

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The hanging bog which drains into the southwest corner of Silver Lake in Dickinson County, Iowa, offers an environment which is rich in both O_2 and H_2S. The bog consists of numerous small shallow pools, one to ten feet long, one-half foot to four feet wide, and usually two to six inches deep. (Map, fig. 1). Water from the bottom of these pools has a noticeable odor of hydrogen sulfide. The flora of this bog are being studied by Dr. W. A. Anderson of the botany department of the State University of Iowa.

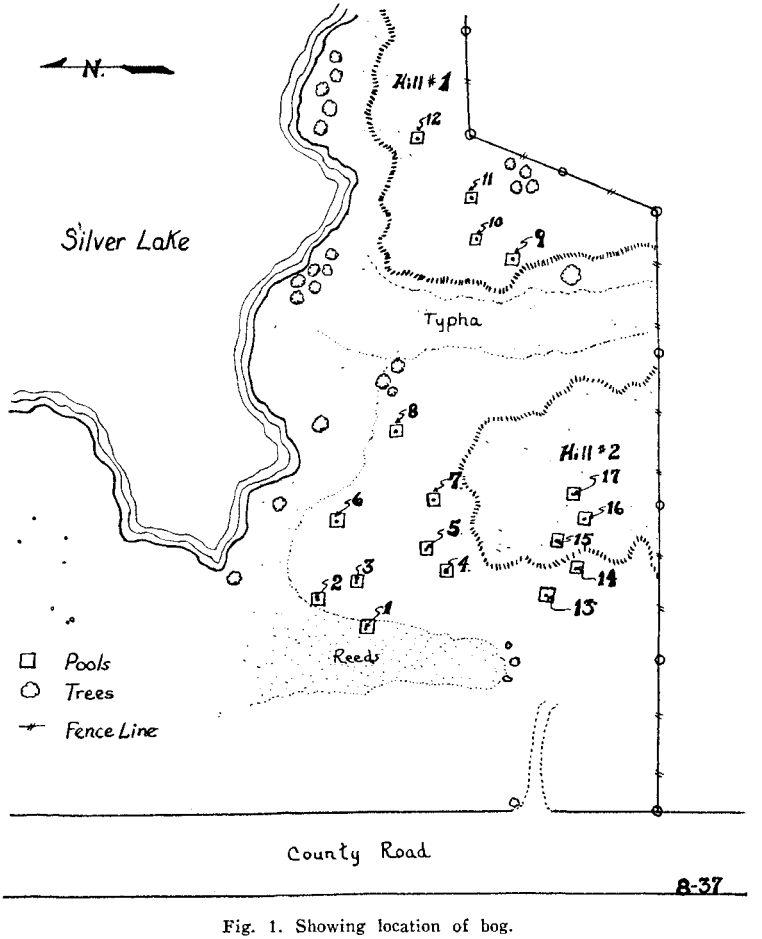

Fig. 1. Showing location of bog.

Surveys of the protozoa which live in this sapropelic type of environment are apparently limited to the studies of Wetzel (4) on a somewhat similar bog at Leipzig, Germany, and to the observations of Lauterborn (3). The present study was undertaken in order to compare the protozoan fauna of Silver Lake bog with those known to occur in similar and in other types of environment.

Chemical analyses of water samples taken by submerging sampling bottles close to the bottom of the pools were made in the field by Professor Benjamin Peterson of Coe College, to whom we are greatly indebted for this information. The temperature varied from 7°C. to 29°C., the pH varied from 6.85 to 7.8 with the majority of the pools slightly alkaline, titratable alkalinity varied from 214 to 408 parts per million, CO_2 from 13 to 74 parts per million, and H_2S from 1.64 to 14.18 parts per million. All samples measured were saturated or supersaturated with O_2. Since the coexistence of H_2S and O_2 is an unstable condition, it seems probable that a microstratification with more O_2 near the surface and more H_2S near the bottom may exist. Wetzel (4) described a similar condition at Leipzig where shallow pools contained no O_2 near the bottom and no H_2S near the surface, but no attempts were made to measure microstratification of Silver Lake bog.

The samples used for determination of the protozoa were taken near the bottom of each pool and a considerable amount of the bottom debris (decaying plants, etc.) was included in each jar. These were taken to the laboratory and examined for protozoa every few days for one to two weeks. Most of the pools were sampled three times during the summer of 1937. The only chemical characteristic of the water which showed a consistent relationship to the protozoan fauna was the H_2S content.

The protozoa which were found in various pools are shown in table 1. The species in the table are arranged so that those found in almost all pools are near the top and those most characteristic of the pools with high hydrogen sulfide content, and the numbers correspond with those on the map. The first six species were found in almost all pools. The species numbered 10 to 20 were found under a variety of hydrogen sulfide concentrations, but not where the sulfide was less than 2.7 parts per million. The species numbered 21 to 36 seemed to be most characteristic of the pools containing large amounts of H_2S, and these species were not found in pools where H_2S was less than 4.2 parts per million. Of this last group of species the members of the genus Metopus seemed to be most numerous and characteristic of the sulfide pools. This is a genus which ordinarily is not found in large numbers in small

Table I

	Pool Numbers															
	1	13	16	10	17	7	11	5	15	3	4	6	14	8	12	2	9
	Hydrogen Sulfide in parts per million																
	1.6	2.6	2.7	2.9	3.4	3.7	3.8	4.2	4.4	4.5	5.5	5.6	6.0	6.8	8.0	9.2	14.2
1. Euglena sp.	x		x	x	x	x	x	x	x			x				x	x
2. Tetramitus sp.	x	x						x		x			x		x		
3. Prorodon ovum		x		x			x					x			x	x	x
4. Cyclidium glaucoma			x			x		x	x	x	x	x		x		x	x
5. Oxytricha chlorelligera			x		x		x		x			x				x	x
6. Aspidisca lynceus Δ			x						x				x	x	x		
7. Paramecium caudatum	x																
8. Onychodromus grandis Δ		x											x			x	x
9. Chilodon dentata Δ		x					x									x	x
10. Urostyla grandis				x											x	x	
11. Amoeba verrucosa						x						x					
12. Bodo sp.					x								x	x	x		
13. Mastigella radicula						x		x									
14. Metopus undulans *						x		x				x		x	x	x	x
15. Vorticella sp.						x									x		
16. Metopus spiralis *							x										x
17. Epalxis mirabilis *								x		x			x	x			
18. Hexamitus inflatus †														x			
19. Urocentrum turbo Δ															x		
20. Frontonia leucas Δ															x		
21. Metopus setosus *								x					x			x	x
22. Urosoma cienkowskii Δ								x							x		x
23. Spirostomum intermedium Δ									x					x	x		x
24. Metopus sp. *												x		x			x
25. Loxodes rostrum Δ															x		
26. Chilodon cucullus Δ															x		x
27. Cyclidium sp.															x	x	x
28. Pelomyxa villosa																x	
29. Peranema trichophora															x	x	x
30. Metopus hyalinus *															x		x
31. Metopus campanala *																x	x
32. Metopus pullus *																x	x
33. Metopus setifer *																x	x
34. Trachelocerca trepida Δ																	x
35. Lacrymaria (Lagynus) elegans*																	x
36. Heteronema acus †																	x

ponds, and the present data indicate that a medium rich in hydrogen sulfide might be one of the prerequisites for the growth of these species. Of the seven species of Metopus found, all were present in pool number 9 where the sulfide content was 14.2 parts per million, and four were not found in pools where the H_2S was less than 5.6 parts per million. No species of Metopus were found where the H_2S was less than 3.7 per million.

Other surveys of protozoa living in media of high H_2S content are those of Lauterborn (3), Lackey (2), and Wetzel (4). Lauterborn and Wetzel studied natural pools comparable to those at Silver Lake and Lackey studied the protozoa of Imhof tanks. Wetzel (4) on the basis of his own observations and those of Lauterborn (3) listed the following organisms as typical of such environments:

Metopus spp.	Saprodinium spp.
Caenomorpha spp.	Lagynus elegans
Plagiopyla spp.	Dactylochlamys hystrix
Epalxis spp.	Chaenia binucleata
Discomorpha spp.	Palamphora (Vasicola) Bütschlii

Many other organisms were present in the upper oxygen-containing layers.

A comparison of this list with table 1 shows that the organisms included in Wetzel's list (marked with asterisk in table) occur mostly in the bottom half of the table. The two flagellates marked with a dagger (†) are listed as sapropelic forms by Lauterborn, and the forms marked with a triangle (Δ) are not listed by Lauterborn or Wetzel but are mentioned as sapropelic species by Kahl (1). It is evident that many of the protozoan organisms found in Silver Lake bog are typical sapropelic forms, and that those which were also found by Wetzel and Lauterborn are apparently limited to the pools of highest H_2S content. Studies of microstratification of H_2S, O_2, and protozoa in some of the pools might further elucidate this relationship.

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NEW IOWA RECORDS OF ACRIDIDAE (ORTHOPTERA)

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Knutson and Jaques (5) have listed 72 valid species of Acrididae found in Iowa. To this number Knutson (4) has added Dissosteira longipennis (Thomas), Spharagemon equale (Say), Metator pardalinus (Saussure), and Melanoplus huroni Blatchley. Previously Hebard (1) recorded Aeropedellus clavatus (Thomas) from Jefferson, Greene Co., and (2) Melanoplus bruneri Scudder from Onawa, Monona Co. Knight (3) reports that Brachystola magna (Girard) has been taken at Council Bluffs, Pottawattamie Co. Together with the five species listed in this note, there are 84 species of short-horned grasshoppers to be found in this state. Since the following species are found in adjoining areas they should be looked for in Iowa: Nomotettix parvus Morse, Truxalis brevicornis Linnaeus, Orphulella pelidna (Burmeister) Stethophyma platyptera (Scudder), Boopedon nubilum (Say), Encoptolophus pallidus subgracilis Caudell, Pardalophora phoenicoptera (Burmeister), Dendrotettix quercus Packard, and Paroxya hoosieri Blatchley.

In the following list the practice of numbering the species as used by Knutson and Jaques (5) has been followed.

93. Amphitornus coloradus (Thomas).

Dickinson County; VIII, 5, 1938, (R. C. King); one female. This western species has been found on the prairies of central Illinois, but until the present record has not been found in Iowa.

127½. Trimerotropis laticincta Saussure.

Little Rock, Lyon County; VIII, 12, 1938, (R. L. King); ten males and four females. (A new eastern record for a species with a wide western distribution.)

147. Hesperotettix speciosus (Scudder).

Harrison County; VIII, 11, 1936; (H. W. Jaques and R. L. King); three males. Pottawattamie County; VIII, 11, 1936; (H. E. Jaques and R. L. King); one male and one female.

This species was erroneously reported from Muscatine County by Somes; his specimens were Campylacantha olivacea olivacea, which is superficially similar. H. speciosus has been found in Illinois in sandy areas, but otherwise has not been found east of the Mississippi.

186. Melanoplus fasciatus (F. Walker).

Ft. Defiance State Park, Emmet County; VII, 23 to VIII, 18, 1936; (R. L. King); six males and two females. Guthrie County; VI, 13, 1936; (H. E. Jaques); one male.

A sylvan species with a wide distribution east and west to the north.

190a. Melanoplus ponderosus viola (Thomas).

Bixby State Park, Clayton County; VIII, 7 to IX, 14, 1937; (R. L. King); 35 males and 29 females.

A southern species; previous records from central Illinois have been questioned. Definitely known only as far north as St. Louis, Missouri and southern Illinois.

Additional notes on distribution have been recorded below for species already known in Iowa.

Paratylotropidia brunneri Scudder.

Previously known from few widespread localities in very small numbers, this species has recently been taken in great numbers in southeastern Iowa. It was recorded by Knutson (4) from Henry, Des Moines and Davis Counties.

Nymphs of this species were first taken at Lacey-Keosauqua State Park, Van Buren County, on May 26, 1935, but were not identified as such. Nymphs were taken as late as July 18 during 1937 at Oakland Mills State Park in Henry County. They are almost white, but have the peculiar inflated pronotum characteristic of the species.

Oakland Mills State Park, Henry County; VII, 4 to IX, 16, 1937; 80 females, of which 13 were macropterous; 36 males; 16 juv. females; four juv. males. Lacey-Keosauqua State Park, Van Buren County; VII, 25, 1937; six females (one macropterous), eight males. Lake Wapello State Park, Davis County; VII, 31; VIII, 1, 1937; eight females (two macropterous), two males.

Melanoplus packardii Scudder.

This species is very common along the western border of Iowa, but has not been taken east of Taylor County previously. The following record is the easternmost record for this common western form.

Lacey-Keosauqua State Park, Van Buren County; VII, 25, 1937; (R. C. King); one female.

Melanoplus punctulatus punctulatus (Scudder).

The arboreal habit of this species makes it extremely difficult to find, but when once found colonies of considerable size are often encountered.

Hills, Johnson County; IX, 27, 1938; (R. L. King) one male. Woodbury County; IX, 1, 1938; (G. Kyl); one male.

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