Food Cycles in Sphagnous Bogs

by

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(with 1 fig.)

Sphagna produce the bulk of the plant production in bogs. Yet extremely few consumers of the sphagna are known. We found (SMIRNOV 1958, 1959) that there are no abundant species of animals specialized on the nutrition by the emersed sphagna. We also undertook the collection of the population of the submersed sphagnum to find if there are animals consuming it. The results of this part of work are published here.

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As a typical water body overgrown by the submersed sphagnum the borrow pit on the raised bog on the northern shore of the lake Poletskoye was chosen (73 km West from Moscow). This borrow pit was 20 years old. It is almost entirely overgrown by *Sphagnum riparium* ÅNGSTR. with only small spaces of clear water. All the samples were taken from the same place of this borrow pit. The depth in the place of sampling is 1.8 m, the surface pH in summer 6.4. The sphagnum is submersed with only the heads emerging and standing 1—2 cm one from another. The length of the submersed parts is about 70 cm, the upper 12 cm are green, lower the leaves become brown. Under 50 cm the brown leaves and branches fall off.

Numerous algae are present among the sphagnum: filamentous *Oedogonium* sp., *Mougeotia* sp., *Gymnozyga moniliformis* EHRENB., desmids- *Staurastrum, Cosmarium, Xanthidium, Pleurotaenium,* naviculoid diatoms, protococcous *Oocystis borgei* SNOW. In places *Calla palustris* L. and sedges grow on the sphagnum. On the shores

the usual bog Angiosperms are to be found: *Chamaedaphne calyculata* MOENCH., *Ledum palustre* L., *Andromeda poliifolia* L., *Vaccinium uliginosum* L., *Oxycoccos quadripetalus* GILIB., *Eriophorum vaginatum* L., *Carex* sp. sp., *Drosera rotundifolia* L., *Pinus silvestris* L., *Betula* sp., *Populus tremula* L.

Many large-sized predators live among the submersed sphagnum – *Odonata* larvae, *Hemiptera*, sometimes beetles and their larvae. The submersed sphagnum is also inhabited by Chironomid larvae. *Cladocera* are abundant: *Acroperus harpae* (BAIRD), *Chydorus sphaericus* (O. F. MÜLLER), *Graptoleberis testudinaria* (FISCHER), *Rhynchotalona rostrata* (KOCH), *Ceriodaphnia setosa* MATILE, *Scapholeberis mucronata* (O. F. MÜLLER), *Simocephalus vetulus* (O. F. MÜLLER), *Acantholeberis curvirostris* (O. F. MÜLLER). *Cyclopoida*, *Rotatoria* (*Lecane* sp., *Monostyla* sp., *Trichocerca* sp., *Asplanchna* sp., *Bdelloidea*) are also present. *Rhizopoda* were abundant in all our samples.

As possible consumers of the sphagnum might be present only among Chironomid larvae we studied this group closer. To get the idea of the numbers of *Chironomidae* in the submersed sphagnum we washed the sphagnum from 1/4 m^2 (by small bundles) in a pail of water. Then the water with the washed off material was filtered through 0.5 mm mesh sieve. All the animals from the sieve were preserved in formalin and subsequently carefully picked out from the remnants of the sphagnum using the stereoscopic microscope. The numbers for separate species of the larvae are shown in table I.

The fluctuations of the numbers in this case may be explained by the emergence of the imagines, by the uneven distribution of the larvae, and by the difficulty of the complete collection of the larvae from the matted sphagnum stems. *Psectrocladius ex gr. psilopterus*, *P. ex gr. dilatatus*, *Chironomus plumosus* were also found in borrow pits by PANCRATOVA (1954).

To find the consumers of Sphagnum the *Nematocera* larvae were dissected and the food items in the gut contents were aproximately evaluated (SMIRNOV 1959a) (table II). The figures in the table designate the part of the corresponding food items from the whole volume of the food.

It is seen from the table that *Psectocladius ex gr. psilopterus* was the only consumer of the submersed sphagnum. Sphagnum constituted only 0.16 even in the food of this species, being present in the food only of 1/3 of the larvae. Only once the food consisted completely of the pieces of the living leaves of Sphagnum, twice they constituted 0.9 of the food, once 0.7. The most part of the food of *P. ex gr. psilopterus* (0.8) consisted of the filamentous algae. The other algae were present in many cases but in small quantity (*Stau-*

TABLE I.

Species composition and per cent ratio of Nematocera larvae collected among Sphagnum riparium.

year	1957				1958			
date	VII.8	VII.15	VIII.19	IX.5	VII.24	VIII.3	VIII.14	VIII.19
t°C of water	19	26.5	20	16.5	27	23	17.5	17
total number of larvae collected on 1/4 m²	351	17	107	608	264	215	63	46
Ablabesmyia ex gr. monilis L.	33	—	67	38	28	38	57	9.1
A. ex. gr. lentiginosa FRIES.	—	—	—	0.1	4.6	7.5	—	—
Psectrocladius ex gr. psilopterus KIEFF.	36	18	13	41	23.4	22.4	19	68
P. ex gr. dilatatus V.D. WULP.	—	—	—	—	0.4	—	—	—
Corynoneura celeripes WINN.	21	18	1	—	12.1	14	1.6	4.6
Corynoneura sp.	2.3	5	—	1.2	12	3.3	4.8	2.3
Chironomus plumosus L.	7.7	59	19	19	18	12	14.4	11.4
larva of the group Palpomyia, Bezzia, Alluaudomyia	—	—	—	0.7	—	2.8	3.2	4.6
Chaoborus crystallinus DE GEER	—	—	—	—	1.5	—	—	—

TABLE II.

Composition of food of non-predating Chironomidae larvae in the submersed Sphagnum riparium

\+ present in small quantity

1-mean for all larvae with food in the gut, 2-mean for the larvae with the given food item, 3-occurence per cent of the larvae with the given food item of all larvae with food

larva	number dissected, length, dates of collecting	index	living Sphagnum	*Oedogonium sp.*	*Gymnozyga moniliformis*	*Mougeotia sp.*	other algae	detritus	pollen	animal fragments
Psectrocladius	27	1	0.16	0.38	0.44		+	0.02	+	
ex gr. psilopterus	2—3.5 mm	2	0.44	0.4	0.49		+	0.3	+	
KIEFF.	57.VII.8	3	35.7	75	82		46	4	25	
P. ex gr. dilatatus V. D. WULP.	1 6.5 mm 58.VII.24				0.2	0.8				
Chironomus plumosus L.	20	1	0.04	0.03	0.01	0.001	+	0.86	+	0.06
	2.5—6.5 mm	2	0.14	0.23	0.03	0.06	+	0.86	+	1
	57.VII.8, VII.15, IX.5 58.VIII.14, VIII.19	3	21	29	11	5	52	95	18	9
Corynoneura celeripes WINN.	20	1		0.15			+	0.85	+	
	1.5—2.5 mm	2		0.3			+	0.85	+	
	57.VII.8,58. VIII.19	3		46			21	100	14	
Corynoneura sp.	12	1		0.07	0.02		0.2	0.71	+	
	1—1.5 mm	2		0.05	0.1		0.4	0.71	+	
	57.VII.8	3		50	17		50	100	17	

rastrum sp., *Xanthidium* sp., *Euastrum* sp., *Oocystis borgei*, navicu-naviculoid diatoms). Pollen grains were also present.

The food of *Chironomus plumosus*, *Corynoneura celeripes*, and *Corynoneura* sp. consisted mostly of the detritus with the admixture of algae.

Of the predating chironomids *Ablabesmyia ex gr. monilis* were most numerous in the submersed sphagnum. In the borrow pit they fed on *Cladocera*, chironomid larvae, and other small arthropods (18 larvae dissected, length 2.5—5 mm, from the collection of 57.VII.8). The other predating *Nematocera* larvae were present in small numbers (*Ablabesmyia ex gr. lentiginosa*, *Chaoborus crystallinus*, *Heleidae*).

Thus the submersed sphagnum is consumed very little. The same is true of the emersed sphagnum. The main food sourses for non predators in the submersed sphagnous growths are the algae growing among Sphagnum and the detritus. The detritus-feeders in the raised bogs are some chironomid larvae, *Cladocera*, and *Rotatoria* (*Keratella*, *Polyarthra*) (HARNISCH 1929, 1949, ZERNOV 1934, 1949, BEREZINA 1953). JÄRNEFELT (1956) is of opinion that the detritus of the raised bog waters is of phytoplanktonic origin. If this is so then the nutrition of the detritus-feeders is based ultimately on the algae, and not on the sphagnum.

The bladderwort rather abundantly growing in the borrow pit catches *Crustacea* and chironomid larvae (RODIONOVA 1959).

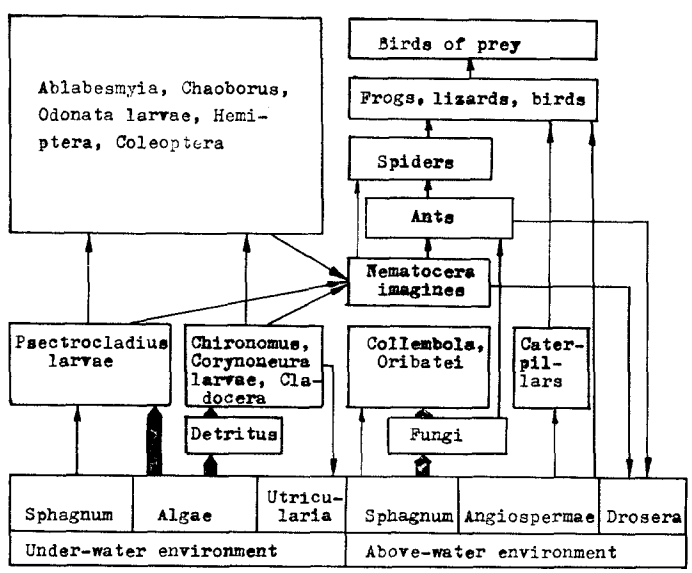

fig. 1.

For aerial environment of the sphagnous bogs there are the following data on the food interrelations. We showed (SMIRNOV 1958, 1959) that the dominating invertebrates living in the emersed sphagnum feed on the fungi growing on the decomposing sphagnum. The shrubs are eaten by caterpillars (PEUS 1932). The ants consume partly the fungi, partly *Diptera* and other invertebrates (SKWARRA 1929, MAAVARA 1955, 1955b). The spiders catch the small *Nematocera*, and after SKWARRA (1929) also the ants.

More than 3/4 of the catch of *Drosera rotundifolia* L. is not longer than 0.5—2 mm (MAAVARA 1955a, OLBERG 1955) and consists of the imagines of *Chironomidae*, *Heleidae*, *Lycoriidae* and *Hymenoptera* (FRIDOLIN 1932, MAAVARA 1955). WASMANN (1914) and SKWARRA (1929) observed that *Drosera rotundifolia* may catch the ants.

The frogs and lizards in the raised bogs consume insects and Angiosperms, berries and seeds including (KREN 1937, MAAVARA 1955a). The birds feed on insects, spiders, and berries. Some of the birds feed on the vertebrates (KREN 1937, KUMARI 1951, 1953). All described above data give reason to represent the main food interrelations in the sphagnous bog as shown in fig. 1.

SUMMARY

The submersed sphagnum is populated by *Odonata* and *Chironomidae* larvae, *Hemiptera*, *Cladocera*, *Cyclopoida*, *Rotatoria* and *Rhizopoda*. Sphagnum-eaters might be found among *Nematocera* larvae. To find them the food cymposition of this group was studied. The dissections demonstrated that of 9 species of *Nematocera* larvae Sphagnum was present in the food only of *Psectrocladius ex gr. psilopterus*, the quantity of Sphagnum being 0.16 of the food volume. The main food of *non predating Nematocera* larvae living in the submersed Sphagnum consists of the algae and the detritus. The emersed Sphagnum is also eaten but little. The springtails dominating here feed mainly on the fungi growing on the decomposing Sphagnum. Our data and the data by other authors gave a possibility to respresent the main food interrelations in the sphagnous bogs as shown in fig. 1.

Выводы

Подводные заросли сфагнума населены личинками стрекоз, хирономид, полужесткокрылыми, ветвистоусыми и веслоногими рачками, коловратками и корненожками. Поскольку возможными потребителями сфагнума могли быть личинки

двукрылых, обследовано их питание. Вскрытия показали, что из найденных 9 личинок *Nematocera* сфагнум присутствовал в пище только у *Psectrocladius ex gr. psilopterus* в количестве 0,16 от объёма пищи. Основной пищей не хищных личинок *Nematocera,* живущих в погружённом сфагнуме являются водоросли и детрит. В надводных зарослях сфагнума поедание его также невелико. Преобладающие здесь вилохвостки питаются в основном грибами, развивающимися на отмирающем сфагнуме. Полученные данные и данные других авторов позволили наметить схему основных пищевых связей в сфагновых болотах (рис. I).

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