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SPHAGNUM MICROFAUNA IN TWO PEAT-BOGS OF THE FRENCH MASSIF CENTRAL

RAHKASAMMALTEN PIENELÄIMISTÖ KAHDELLA RANSKAN KESKIYLÄNGÖLLÄ SIJAITSEVALLA SUOLLA

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The composition and the seasonal fluctuations of the *Sphagnum* microfauna in two peat-bogs of the Puy-de-Dôme (France) are described and the author attempts to show the importance of the dominant groups in the functioning of the peat-bog ecosystem.

Key words: peat-bog, mire ecosystem, microfauna, French Massif Central

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INTRODUCTION

While there have been a number of floristic and phytosociological studies of the peat-bogs of France (those of Royer et al. 1978, Bidault 1982 and Thébaud 1983, being the most recent) little attention has been paid to the fauna of this ecosystem. Among the microinvertebrates it would seem that only the *Protozoa* and the *Rotatoria* have aroused any interest (Batut 1965, Pourriot 1965, Moraczewski & Bonnet 1969, Grolière 1977, 1978).

In 1981 we studied the *Rotatoria* and the *Cladocera* populations of two peat-bogs in the French Massif Central, and at the same time attempted to see in what microfaunial context these two groups develop during the different stages of the formation of the peat-bog.

This article describes the composition and the seasonal dynamics of the microfauna encountered and attempts to show its importance in the ecosystem of the peat-bog.

STUDY AREAS AND METHODS

The peat-bogs of Chambedaze and La Godivelle are about 70 km south of Clermont-Ferrand in the Puy-de-Dôme, not far from the small market town of Besse-en-Chandesse, at an altitude approaching 1200 m. They were formed as peat vegetation gradually filled up a glacial lacustrine depression.

La Godivelle is a less homogeneous site since in the past peat was cut there and a part of the bog is still mown.

Samples were taken from May to November 1981 in three study sites chosen according to the stages of evolution of the peat-bog. They are given here with their main *Sphagnum* species:

1) mesotrophic fen: *S. teres* and *S. warnstorfii*
2) oligotrophic fen: *S. angustifolium* and *S. flexuosum*
3) ombrotrophic bog: *S. nemoreum* and *S. rubellum.*

For further details on the vegetation and the physical chemistry, the reader will refer to the work of Mollet et al. (1985).

Sampling material was made up of five small samples of live *Sphagna* (depth ~ 10 cm) over a surface of about 1 m². With this method we were able to obtain in all cases at least 50 ml of imbibition water. The results were then converted into the m².

The *Sphagna* collected were pressed then rinsed in distilled water; the water recovered from these two operations (repeated 3 times) was filtered (aperture size 55 μm). This method is based on a procedure recommended by Haigh (1963) for Bdelloid Rotifers which in our study were defined by species (Francez 1984a). It is an interesting compromise between a technique which samples each group separately, and is time consuming, and a simple pressing method which Grolière (1977) considers nevertheless effective in estimating correctly the number of *Ciliata* in the *Sphagna*.

Given the relatively low numbers the whole of the sample was analysed. The different animals were sorted live under the microscope. All groups of the microfauna were listed except for the *Protozoa*. The arthropoda of a size bigger than 4 mm were not considered.

We used the Ruttner-Kolisko (1977) method to estimate the biomasses of the *Rotatoria*. For the other groups we extrapolated from values given in the literature which give only an approximate indication therefore. We used the work of Hallas (1975) for the *Tardigrada* and that of Vilkamaa (1981) for the *Enchytreidae*, the *Nematoda* and the *Oribatei*. The biomass of the *Harpacticoida* was calculated, according to the length, by a formula suggested by Dumont et al. (1975); dry weight was estimated to be 13,5 % of fresh weight.

RESULTS

Sphagnum microfauna is characterized by the presence of large numbers of animal groups which are able to encyst when conditions become unfavourable.

The sphagnous facies in which *Nematoda* and *Bdelloidea* are mostly dominant contrast with the aquatic facies which mainly comprise *Monogononta*, *Cladocera* and *Cyclopoida* (Fig. 1). Overall the *Turbellaria* and the *Ostracoda* are the groups which figure the least; they are only found in the *Sphagna* of the fen when there is flooding.

The study of the seasonal dynamics of the main groups shows the convergences and the differences in the cycles of the sites and the stages of development we considered (Fig. 2). In the mesotrophic fen the fluctuations in numbers revealed two periods which were favourable to the development of *Tardigrada*, *Acarina* and *Crustacea*. The *Rotatoria* and the *Nematoda* also had these two seasonal peaks at Chambedaze, while in the raised bog of La Godivelle they had maximum density in August.

Table 1 clearly shows that despite a small average number of individuals the *Enchytreidae* represent a large portion of the microfaunal biomass of the *Sphagna*. This parameter diminishes, however, from the fen to the raised bog. This same trend was observed in the peat-bog of Chambedaze for the *Rotatoria* and *Nematoda* but not at La Godivelle where the values were higher in the raised bog *(Nematoda)* and approximately the same for all the facies *(Rotatoria)*.

DISCUSSION AND CONCLUSIONS

For each stage of evolution studied, there were characteristic compositions, seasonal fluctuations, numbers and average biomasses of the microfauna. This is in agreement with the conclusions we had already reached for the *Rotatoria* and the *Cladocera* (Francez 1984b, Francez & Dévaux 1985).

The mesotrophic fen is similar in its microfaunal structure to the aquatic facies (littoral lake zone or artificial pool) with peaks in numbers in spring and summer (cf. Francez 1984a). The seasonal variations in the bog are more irregular but there is a clear tendency towards high peaks in summer. This phenomenon is accentuated at La Godivelle and can be explained by the disturbance caused by human activity, which, in the case of the *Rotatoria* community, is most clearly seen in the close similarity at a structural level of the most developed facies (cf. Francez 1986). However, results from Chambedaze and La Godivelle show that this group is large in number and contains many species (Francez 1984a).

Like Batut (1965) we observed that the *Cyclopoida* avoided all but the wettest sphagnous facies for the copepodit stages, but conversely Bothar and Oertel (1977) noted the presence of 5 species (3 of which are found on the list established by Batut, op. cit.) in 4 *Sphagnum* observation points in a peat-bog in Hungary. In a small peat bog lake in Michigan, Welch (1936) found only a small number of *Cyclopoida*.

According to Grolière (1978), the biomass of *Ciliata* is greater in artificial pools than in

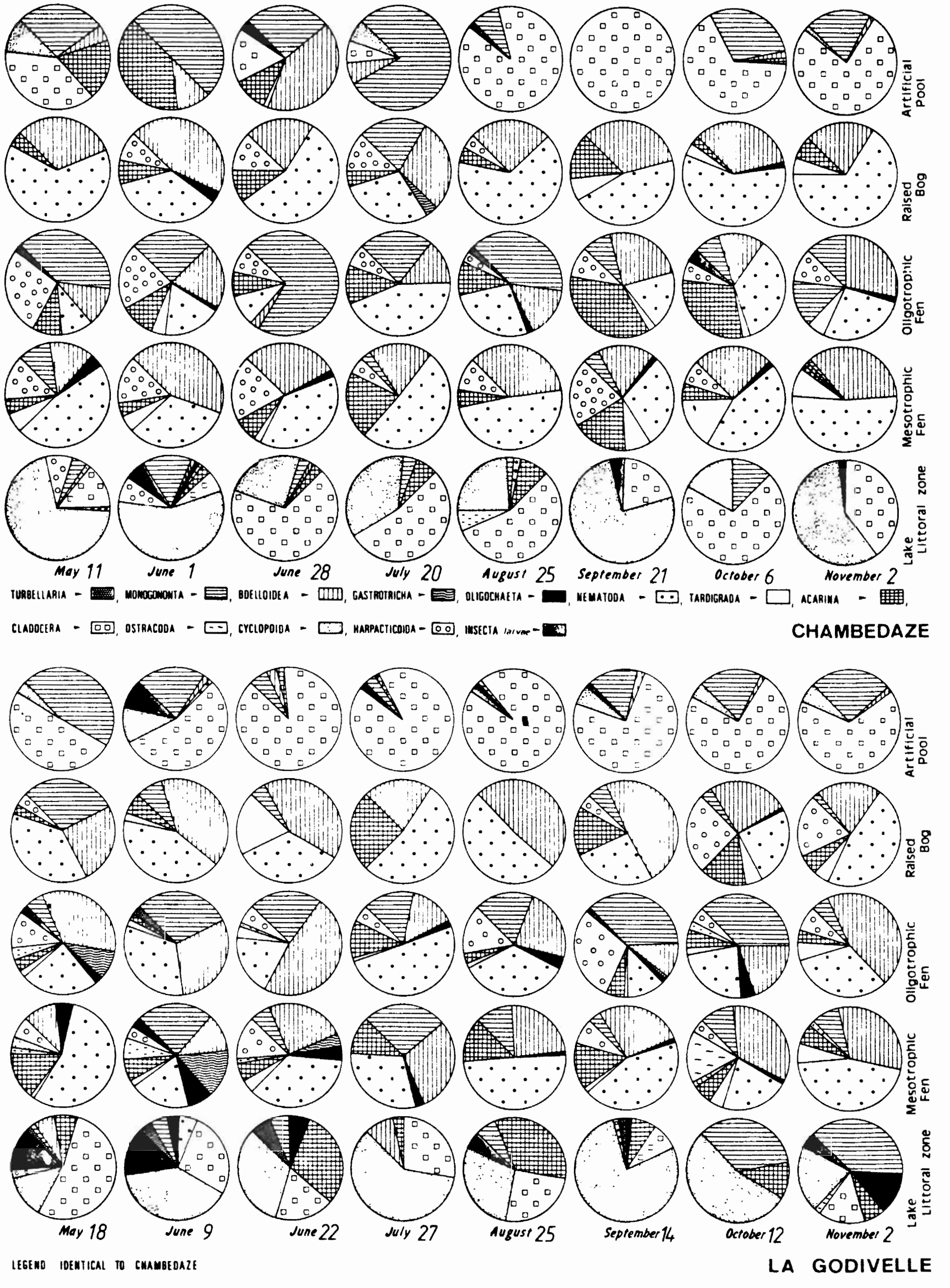

Fig. 1. Comparative distribution (%) of the microinvertebrate numbers in Chambedaze (upper) and La Godivelle (lower).

Kuva 1. Pieneläinryhmien suhteelliset jakaumat eri ajankohtina Chambedaze- (ylempi) ja La Godivelle-suolla (alempi). Turbellaria = *värysmadot,* Monogononta *ja* Bdelloidea = *rataseläimiä,* Gastrotricha = *sukaspintaiset,* Oligochaeta = *harvasukamadot,* Nematoda = *sukkulamadot,* Tardigrada = *karhukaiset,* Acarina = *punkit,* Cladocera = *vesikirput,* Ostracoda = *raakkuäyriäiset,* Cyclopoida = *kyklooppiäyriäiset,* Harpacticoida = *ryömijähankajalkaiset,* Insecta larvae = *hyönteistoukat.*

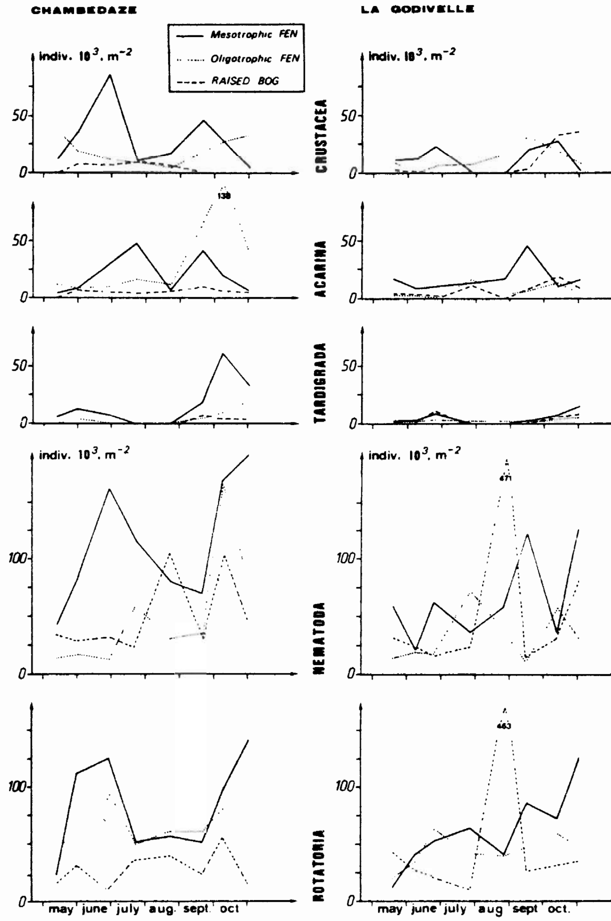

Fig. 2. Seasonal fluctuations of the main groups of microfauna in the three sphagnous facies.

Kuva 2. Pääpieneläinryhmien touko-lokakuun välinen määrän vaihtelu (tuhatta yksilöä/m²) kohosuolla sekä oligo- ja mesotrofisella nevalla. Rotatoria = *rataseläimet,* Nematoda = *sukkulamadot,* Tardigrada = *karhukaiset,* Acarina = *punkit,* Crustacea = *äyriäiset.*

Table 1. Average numbers and biomasses (fresh weight) of the dominant groups of microfauna in the different sphagnous facies. 1 = mesotrophic fen, 2 = oligotrophic fen, 3 = raised bog.

Taul. 1. Pääpieneläinryhmien keskimääräiset yksilömäärät (kpl/m²) ja tuorepainot (mg/m²) tutkittujen soiden valtakasvustotyypeillä. 1 = mesotrofinen neva, 2 = oligotrofinen neva, 3 = ombrotrofinen kohosuo.

	CHAMBEDAZE						LA GODIVELLE					
	ind. m^{2}			mg m^{-2}			ind. m^{-2}			mg m^{-2}		
	1	2	3	1	2	3	1	2	3	1	2	3
Rotatoria, *rataseläimet*												
Monogononta	4000	38963	1875	2,71	14,48	0,22	16788	26375	5000	10,13	6,50	1,66
Bdelloidea	78400	32075	27250	55,32	29,31	29,52	45163	23625	78500	33,20	31,39	41,18
Total, *yhteensä*	82400	71038	29125	58,03	43,79	29,74	61951	50000	83500	43,33	37,89	42,84
Nematoda, *sukkulamadot*	114125	51913	50750	21,90	9,96	9,74	65000	32250	86500	12,47	6,19	16,60
Enchytreidae, *änkyrimadot*	2800	875	375	392,00	122,50	52,50	366	225	125	51,24	31,50	17,50
Tardigrada, *karhukaiset*	16750	4500	1625	15,07	4,05	1,46	4213	2000	3250	3,79	1,80	2,92
Oribatei, *kuoripunkit*	20688	37750	5625	258,60	471,87	70,31	17000	5375	6625	212,50	67,19	82,81
Harpacticoida, *ryömijähankajalkaiset*	29875	19338	3750	199,41	141,71	27,48	7463	10750	9125	54,71	81,05	66,83

Sphagna but is small in comparison with forest or prairie ponds: the highest values obtained by this author for two peat-bogs in the Puy-de-Dôme were 68 and 4.5 $\mu g.ml^{-1}$ respectively for a pool and *Sphagnum nemoreum.*

In Finland, Vilkamaa (1981) analysed the microinvertebrates and soil macroarthropoda of virgin and ameliorated peat-bogs. The groups common to this study and our own are found in much greater number. The average biomass and numbers of *Enchytreidae* and *Nematoda,* in the case of fertilized areas, are equal to or greater than those observed in forest soils in the same country (Huhta & Koskenniemi, 1975). However, the results obtained by Raevaara (1981) for *Nematoda* in three Scandinavian wooded pine mires are close to those which we recorded.

It is difficult to establish categorically to what extent human activity modifies the dynamics of the microfaunal development and community even though there are variations between the results obtained at Chambedaze and La Godivelle. Markkula (1982) showed that ameliorations brought about by addition of NPK after drainage varied according to the animals and the microbiotopes in the peat-bog. While the numbers of *Prostigmata, Collembola* and *Enchytreidae* increased in the *Sphagnum angustifolium* hollows, they decreased in the hummocks of the same bog. The author explains this difference by a change in the humidity rate, a factor we have also noted in Rotifer distribution (Francez & Devaux 1985). Hallas (1975) points out the importance of moisture rate in mosses for the number of *Tardigrada* whose vertical distribution is clearly due to this factor.

Although we cannot dismiss the influence of the sampling method used, it would seem that there are significant differences between the upper sphagnous stratum (living *Sphagna*) and the underlying peaty soil, which is much more buffered (cf. Matthey 1964). Surface fluctuations in temperature and humidity are greater and create drastic living conditions for the animals which develop only sporadically and/or in small numbers.

Research carried out by Standen (1978) in GreatBritain showed that certain macroarthropoda such as *Diptera Tipulidae* (larvae) can check the development of microfaunal populations (*Enchytreidae* in particular) exercising a kind of control over microbial activity which is normally favoured by the increase in the biomass of the microfauna.

The difference recorded might also be due to the fact that the peat-bogs of the French Massif Central are on the fringe of the great peat formations of Northern Europe. One should probably take into consideration all the factors we have listed, however, in order to bring out the real importance of the microfauna and its representatives in the functioning of this ecosystem.

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TIIVISTELMÄ:

RAHKASAMMALTEN PIENELÄIMISTÖ KAHDELLA RANSKAN KESKIYLÄNGÖLLÄ SIJAITSEVALLA SUOLLA

Artikkelissa esitetään päätulokset rahkasammalvaltaisten yhteisöjen pieneläimistön rakenteesta ja kasvukauden aikaisesta vaihtelusta kahdelta suolta Puy-de-Dômen alueelta Keski-Ranskasta. Toinen soista (La Godivelle) on ihmistoiminnan (niitto, turpeenotto) vuoksi jonkin verran häiriintynyt kehittyneimmiltä osiltaan. Chambedaze-suo on häiriintymätön. Tutkimus tehtiin v. 1981 kolmella eri ravinteisuustasoa edustavalla osalla soita, joita voidaan kuvata pohjakerroksen valtalajien avulla: mesotrofinen neva (*Sphagnum teres* + *S. warnstorfii*), oligotrofinen neva (*S. angustifolium* + *S. flexuosum*) ja ombrotrofinen kohosuo (*S. nemoreum* + *S. rubellum*).

Rataseläimet ja sukkulamadot muodostivat yksilömäärältään suurimman osan eläimistöstä koko kasvukauden ajan (Kuvat 1, 2). Huolimatta pienestä yksilömäärästään, änkyrimadot muodostivat suuren osan kokonaisbiomassasta (Taul. 1).

Kasvukauden aikaiset vaihtelut pieneläimistön määrissä olivat samankaltaiset mesotrofisella nevalla sekä saman kasvupaikan allikoissa. Yksilömäärien huiput olivat keväällä ja syksyllä. Kohosuolla kasvukautiset vaihtelut olivat epäsäännöllisemmät, mutta yleensä yksilömäärähuiput osuivat kesään. Näin oli varsinkin rataseläinten ja sukkulamatojen kohdalla La Godivelle-suolla. (Kuva 2).

Yleensä pieneläimistön yksilömäärät ja biomassat pienenivät sukkession edetessä (mesotrofia → oligotrofia → ombrotrofia). La Godivellen suolla tämä suunta ei ollut kuitenkaan niin selvä kuin Chambedazen suolla.

Tarkastelussa keskitytään pieneläimistön merkityksen pohtimiseen suoekosysteemissä. Kirjoittaja korostaa suoyhteisöjen reliktiluonnetta Ranskan Keskiylängöllä, jolla saattaa olla oma vaikutuksensa pieneläinyhteisöjen rakenteeseen.

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