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# Investigations on the growth and dying-back dynamics of *Sphagnum palustre* L. populations

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Abstract

The investigation on the productiveness of mosses *Sphagnum palustre* was carried. In the course of the two-years observations of the biomass increment of sphagnum in the vegetation season certain regularities were remarked. Both in sphagnum and in the vascular plants a rapid increase of green biomass is observed from spring to July, and from August intensive dying-back of the organisms.

## INTRODUCTION

The present paper is one of a series of studies on the productiveness of mosses and their contribution to the production of organic matter. As material for observation served pure carpets of the moss *Sphagnum palustre*.

The investigations were carried out on the Łąki Sierakowskie meadows in the north-eastern part of the Kampinos forest and in Korfowe in the central part of the Kampinos National Park.

## METHODS

The method of "binding" was applied. In early spring (April) 1971 on the Sierakowskie meadows, and in 1972 (March) also at the locality Korfowe on 5 sites 30 sphagnum individuals were tied together just under the head. At the same time next to them a round patch of moss of 100 $cm^2$ was cut out. Each sample was analysed separately, separated into particular plants, and the number of individuals was counted and the length of the green and white nonassimilating parts of the shoots was measured in 30 randomly chosen moss individuals with an accuracy up to 1 mm. As green parts of the shoots were considered the main and lateral shoots covered with leaves containing chlorophyll and capable of assimilation. On the other hand,

the white parts of them stem consist of the parts of the main and lateral shoots covered with white leaves uncapable of assimilation.

In autumn the plants tied together were collected. At the same time in their neighbourhood, similarly as in spring, rounded 100 $cm^2$ moss patches were cut out. In the laboratory the number of individuals in the particular moss sample was counted. Measurements of the annual length increment of the green and white nonassimilating parts were performed on the bound material.

Beside application of this method, on the Sierakowskie meadows immediately after measurement of the plant biomass, five times during the vegetation season 1971 and six times in 1972, five round patches of a 100 $cm^2$ surface area were cut out. From among the samples 30 individuals were randomly chosen and the length of their green parts was measured.

Then the number of individuals was counted in each group, and the green and white nonassimilating parts were separated. Material thus prepared was dried at 80°C for 48 h weighed with an accuracy of $\pm 0.0001$ g.

## RESULTS

### Growth of sphagnum

In the course of the two year observations of the length increment of sphagnum individuals in the vegetation season certain regularities were remarked. From spring to June elongation of the green parts occurs (Table 1), whreas from August to

Table 1

List of mean results in measurements of the length, number and weight of the green parts of *Sphagnum palustre* on the Sierakowskie meadows

| Year | Date | Length of green parts cm | No. of specimens per 100 $cm^2$ | Weight of 30 plants g | Weight of plants g/100 $cm^2$ |
|---|---|---|---|---|---|
| 1971 | 22. IV | 5,0 | 134 | 0,5463 | 2,4401 |
| | 19. V | 6,3 | 174 | 0,5685 | 3,2893 |
| | 25. VI | 6,2 | 182 | 0,6583 | 3,9931 |
| | 24. VIII | 5,8 | 185 | 0,6462 | 3,9849 |
| | 21. IX | 5,2 | 111 | 0,6418 | 2,3747 |
| Mean | | 5,7 | 157 | 0,6122 | 3,3607 |
| 1972 | 28. III | 6,1 | 120 | 0,5570 | 2,2284 |
| | 14. VI | 6,3 | 152 | 0,6210 | 3,1468 |
| | 10. VIII | 5,4 | 158 | 0,5220 | 2,7628 |
| | 28. IX | 3,5 | 197 | 0,2704 | 1,7761 |
| | 17. X | 4,5 | 222 | 0,2690 | 1,7215 |
| | 9. XI | 3,2 | 192 | 0,1977 | 1,4630 |
| Mean | | 4,8 | 174 | 0,4062 | 2,1831 |

November the older and currently elongated stem parts die back. In spring sphagnum specimens showed the smallest length of white nonassmilating shoots (Figs 1 and 2) amounting from 1.8 cm (Sieraków 1972) to 2.5 cm (Sieraków 1971). At the same time the length of the green shoots varied from 6.1 cm (Sieraków 1972) to 6.3 cm (Korfowe 1972) constituting on the average 71—77 per cent of the total length. The proportion of the green and white parts in autumn is reversed. The length of white parts increases, the shoots which were green in spring and some of the new shoots become white. The average length of these nonassimilating white parts in autumn specimens is always relatively large amounting to 6.5—8 cm that is 51—67 per cent of the total length of the plant. Of this length 9—13 per cent falls to the current year's green parts which have withered (1.2—1.6 cm).

The differences between the length of the white parts in autumn and spring suggest that the process of disintegration, of passing to the brown parts is most intensive in winter. It seems also that n this period further withering of the green parts occurs. On the other hand (Fig. 1), it is seen from the results that the length

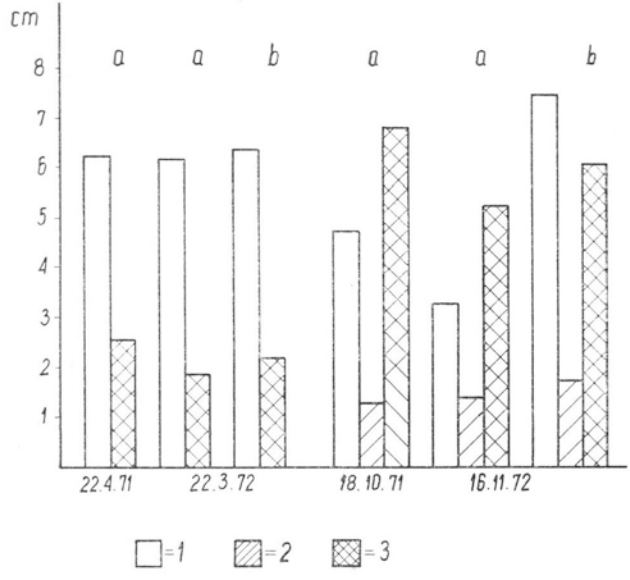


Fig. 1. Mean lengths of green and white parts of shoots of *Sphagnum palustre* in spring and in autumn

1 — green shoots, 2 — white shoots, 3 — current-year white shoots, a — Sierakowskie meadows, b — Korfowe

of the spring specimens from Sierakowskie meadows (1971, 1972) exceeds the data for the autumn. It is, therefore, probable that the green shoots of sphagnum elongate in winter.

It was possible by the method of "binding" to measure accurately the individual length increment of sphagnum specimens in the vegetation period from early spring to late autumn. *Sphagnum palustre* specimens on the Sierakowskie meadows in 1971

exhibited a length increment of 5.9 cm and in 1972 of 4.5 cm, while on Korfowe in 1972 it reached as much as 9 cm in the course of the vegetation period.

The elongation growth of sphagnum depends in the first place, according to Kulczyński (1939, 1940), on the water conditions. In conditions of a positive water balance, for instance in south Sweden, the length increment reached up to 25 cm yearly (Szafran 1966). Tiuremnow (1957) reports a 2—10 cm length increment of the shoots for certain sphagnum species.

## State of green biomass

Table 2 gives the mean values for the state of the green dry biomass expressed in g/m². The weight of dry green biomass of 30 individuals, the mean density of shoots per 100 cm² and the means length of the green parts of individuals are shown in table 1.

Table 2

State of green biomass in the particular months on Sierakowskie meadows, in g/m²

| Months Year | III | IV | V | VI | VIII | IX | X | XI |
|---|---|---|---|---|---|---|---|---|
| 1971 | — | 244,0 | 328,9 | 399,3 | 398,5 | 237,5 | — | — |
| 1972 | 222,8 | — | — | 314,7 | 276,3 | 177,6 | 172,2 | 146,3 |

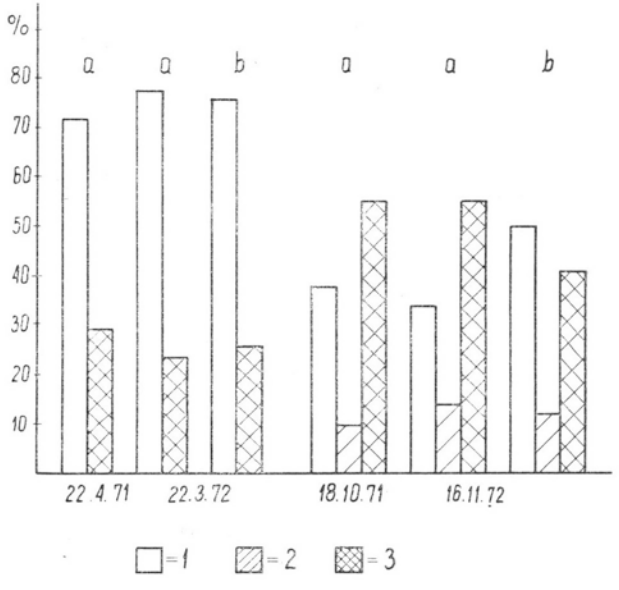


Fig. 2. Percentual proportion of length of green and white parts of shoots in spring and in autumn
1 — green shoots, 2 — white shoots, 3 — current year white shoots,: a — Sierakowskie meadows, b — Korfowe

The course of changes in dry biomass for 30 specimens and per 1 $m^2$ in the course of the year are illustrated by figs. 3 and 4.

Both in the first and second year of the study a distinct increment of the dry green biomass of sphagnum is visible from the beginning of the vegetation period till June (Fig. 4). Up to August the weight of the plants seems to remain at the same level, and then a drastic fall occurs.

The biomass increment in the first period of vegetation is parallel with the elongation growth of the particular plants and their relatively low degree of dying-back. In the second period the rate of disintegration is accelerated and individual growth becomes negligible.

The weight of the green parts for 30 individuals (Fig. 3) shows a different dynamics. After an increase which reaches its maximum in June the weight falls gradually up

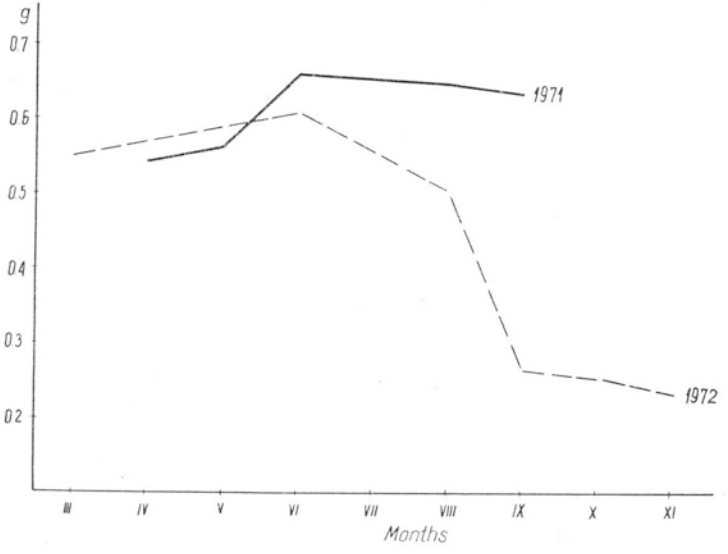


Fig. 3. Mean weights of 30 green individuals

to August, and then continues to fall rapidly. This decrease was particularly pronounced in 1972. These results are analogous to those of mean length measurement of green parts of the individuals (Table 1) where the lengths markedly decrease in the second part of the vegetation season.

The increase in the weight of sphagnum green parts is directly related with the rate of growth of the current year's green parts, the individual weight, the density of the carpet and the rate of distintegration. The greater number of sphagnum individuals does not, however, always contribute to an increase in the weight of the green parts. This largely depends on the inner structure of the particular individuals, mainly on the number of branches in the bunches forming on the main stem, within the limits specific to the particular species. In *Sphagnum palustre* there are 3—5 branches. When the carpet is very dense, the single individuals are poorly

developed and the distances between the bunches of branches increase. Then the weights of the plants do not reach high values.

The number of plants in the investigated populations per 100 cm² in both vegetation periods varied. In the first and second year up till August a gradual increase

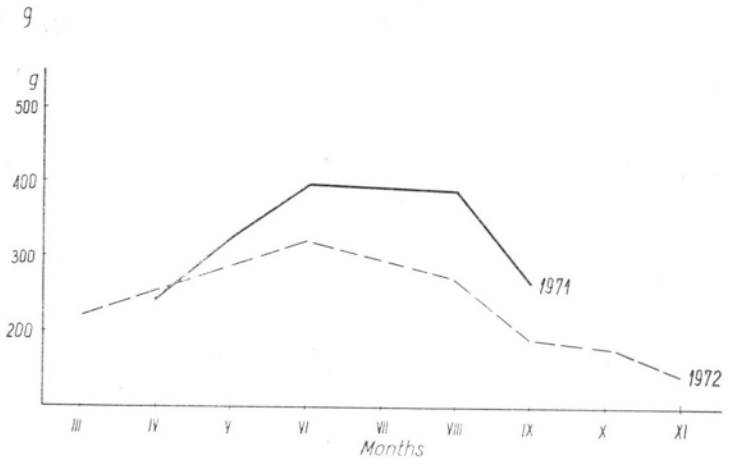


Fig. 4. State of green biomass in the particular months, g/m²

in population density was observed, but in September 1971 (Table 1) a rapid fall was noted, in the subsequent year a further increase in number of plants in the same period. It is difficult after two years of observation to explain the seasonal variations in the density of he plants. If we analyse, however, the amoun of precipitation, the decrease in the sphagnum cover density may be ascribed in September 1971 to the then prevailing drought (July — 12.4 mm, August — 34.3 mm, Sept. — 65.0 mm). In the analogous period of 1972 the precipita ion amount was 4 times higher (July — 114.7 mm, August — 130.4 mm Sept. — 81.6 mm). The drough prevailing in 1971 probab y inhibited the development of the sphagnum carpet, the weaker individuals withered and the population became less dense. All the more so, as *Sphagnum palustre* belongs to species with a rather wide ecological scale, it is capable of growing in stagnant water but it also can stand drought. The variations in ground water level on the areas investigated are rather wide so that the vegetation mainly utilized water from precipitation.

## CONCLUSIONS

Investigations carried on for two years on the growth and dying-back of *Sphagnum palustre* individuals demonstrated that maximum dry green biomass values were attained as regards this species in June. These value amounted to 399.3 g/m² in 1972 and to 314.7 g/m² in the next year.

The dynamics of the annual changes in the state of green biomass in both vegetation periods was similar. It was also analogous to the development of vascular plants growing in similar ecological conditions (Traczyk 1968). Both in sphagnum and in the vascular plants a rapid increase of green biomass is observed from spring to July, and from August intensive drying-back of the organisms.

The dynamics of linear growth of sphagnum shoots corresponds to the state of the biomass. In July the length of the green parts of *Sphagnum palustre* was highest attaining 6.3 cm. Growth and dying-back of the green parts of plants are closely interrelated. In spring the length of the green shoots is three times that of the white parts. In autumn this ratio is reversed. The length of white nonassimilating parts of the shoots constitutes 67 per cent of the total length of the individual, 11 per cent falling to the current year's green shoots which have already died.

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## *Badania nad dynamiką wzrostu i zamierania populacji Sphagnum palustre L.*

Streszczenie

Dwuletnie badania prowadzone nad wzrostem i zamieraniem osobników *Sphagnum palustre* wykazały, że maksymalne wartości suchej biomasy zielonej dla tego gatunku przypadały na miesiąc czerwiec. Wyniosły one w roku 1971—399, 3g /m² zaś w następnym 314,7 g/m².

Przebieg rocznych zmian stanu biomasy zielonej w obydwóch okresach wegetacyjnych był podobny. Wykazał on również zgodność i podobieństwo do rozwoju roślin naczyniowych żyjących w zbliżonych warunkach ekologicznych (Traczyk 1968). Zarówno u torfowca jak i roślin naczyniowych obserwuje się od wiosny do lipca szybki wzrost biomasy zielonej, od sierpnia intensywne zamieranie organizmów.

Dynamika wzrostu liniowego pędów torfowców jest także zbieżna ze stanem biomasy. W miesiącu czerwcu długość zielonych części *Sphagnum palustre* była najwyższa, to jest 6,3 cm. Stosunki wzrostu i zamierania części zielonych torfowców są ze sobą ściśle powiązane. Wiosną długość pędów zielonych jest trzykrotnie większa niż części białych. Jesienią stosunek ten ulega odwróceniu. Długość białych — nie asymilujących części pędów wynosi 67% całej wysokości osobnika. W tym 11% przypada na obumarłe tegoroczne pędy zielone.