ACTA MYCOLOGICA
vol. X (1): 143-158
1974

# Preliminary analysis of productivity of fruiting fungi on Strzeleckie meadows

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Sadowska B., *Preliminary analysis of productivity of fruiting fungi on Strzeleckie meadows*. Acta Mycol. X (1): 143-158.

Analysis demonstrated that the fresh and dry weight as well as the ash content of fungal fruit bodies collected on a forest-surrounded unmown meadow (*Stellario-Deschampsietum* Freitag 1957 and *Caricetum elatae* W. Koch 1926) were lower than the same values for a plot of exploited mown meadow and higher than on an exploited unmown meadow (*Arrhenatheretum medioeuropaeum* (Br.-Bl.) Oberd. 1952).

## INTRODUCTION

Investigations on the productivity of fruiting fungi on the Strzeleckie meadows in the Kampinos Forest near Warsaw are a further step studies on the productivity of meadow ecosystems, undertaken by the Department of Ecology of the Polish Academy of Sciences within the framework of the International Biological Program and performed by the Group for Studies on Mycology and Algology, Institute of Botany, Warsaw University.

## DESCRIPTION OF MEADOWS EXAMINED

The landscape of the Kampinos Forest is characterized by a parallel zonal structure. It consists of three parallelly running terraces: the middle flood-land, the erosion terrace on the south side and the largest third dune terrace which forms the essential part of the forest (Kaczorowska, 1926; J. and R. Kobendza, 1957). On this terrace two dune belts alternate with two bog belts. The dunes are overgrown with pine forest and in the sodden areas an alder forest developed in natural pri-

meval conditions (Kobendza 1930). At present the alder forest has remained on small areas only, most of it has been cut down and the boggy land has been turned into meadows (ac. to Herz — Traczyk, 1971). The south part of the meadows is known as Łąki Strzeleckie (clear-felled around 1910). These meadows at present are included in the reservation Sieraków on the side neighbouring the villages Sieraków and Dziekanów Leśny.

The soil of Strzeleckie meadows formed from loose and slightly loamy alluvial sands in conditions of periodical innundation, under the influence of meadow-bog vegetation. The differences in the surface relief of this area, and constant fluctuation in the ground water level found their reflection in two kinds of bog soil. On the higher situated areas the water level is always below the soil surface and rises only after torrential rain, causing the development of black muck soil from loose slightly loamy soils. Owing to periodically high long lasting moisture and constant supply of organic matter in the upper layers of the soil, a large amount of humus is accumulated forming a surface mulch accumulation horizon. Accumulation of vegetable earth, one of the main components of the sorption complex, greatly increases the total sorption capacity. With its increase a biological accumulation of alkaline cations (Ca, K, Na, Mg) occurs. The sorption complex is saturated mainly (77.3-86.9%) with alkaline cations, and the remaining part of the sorption complex (13.1-22.7%) is saturated with hydrogen ions (Czerwiński, 1971).

On lower areas with a high ground water level stagnant for the greater part of the year hydromorphic soils are found such as shallow peat, decomposed to a high degree mulchy, silt bog soils and gley soils. In early spring water innudates the ground surface or rises just under it. In the course of the summer the ground water falls reaching its lowest level in August or September.

Retention of plant detritus on the forest-surrounded Strzeleckie meadows is high. Since these meadows are not mown, the entire mass of above-ground vegetation remains in the autumn in the ecosystem and decomposes in the next year. From early spring to July rather rapid growth of the green biomass occurs here, and from August to late autumn mass dying off of plants is observed. The contribution of green plants in the over-all biomass of the meadows is low (around 15%, whereas the store of plant detritus is large amounting on the average to 35-40 per cent. The contribution of mosses to the over-all biomass is considerable reaching 57 per cent (Traczyk, 1971).

The meteorological data concerning air temperature and precipitation in 1971 in Dziekanów Leśny and its environs are given according to the meteorological station (Fig. 1). The highest mean temperature was noted in August (20.3°C) and the lowest in July (19.8°C). The lowest mean

amount of precipitation was recorded in July (12.4 mm), it was somewhat higher in August (34.4 mm) and highest in June (123.3 mm). The high temperature in July and August with simultaneous low amount of rainfall did not favour profuse fruiting of fungi in these months. The conditions were better in June and in September so that the fruit bodies harvested were more numerous.

Air temperature on the meadows is to some extent dependent on the amount of water accumulated in the soil and on the character of the vegetal cover. During summer heat the temperature is higher on the open meadows area than on afforested surfaces. In early spring and late autumn the temperature is lower on them and mist over the lower situated parts is frequent.

## METHODS

A phytosociologically defined fragment of the forest-surrounded Strzeleckie meadows was chosen for the investigations, overgrown with a plant community classified to the association *Stellario-Deschampsietum* Freitag 1957, of the order *Molinietalia* W. Koch 1926 (plots I-III) and the community classified to the association *Caricetum elatae* W. Koch 1926, a typical variant of the order *Phragmitetalia* W. Koch 1926 (plot IV; Traczyk, 1966).

The chosen meadow area (100 m²) was divided into four equal rectangular plots lying rather close (150 m) to one another. All the plots (25 m² each) were not mown during the time of observation. Their elongated shape (1 m width) allowed precise inspection without the necessity of treading on the plants. In the choice of the plots not only the plant community was taken into account but also the terrain relief and different soil and water conditions.

The investigations were started in May and ended in November 1971. Every two weeks the plots were inspected so that a total of 14 inspections was made. The fruit bodies found were collected by twisting them out. Further analysis was performed by the method described in the preceding paper (Sadowska 1973).

## DESCRIPTION OF THE PLOTS

Plot I lies at the northern edge of the meadows. It is overgrown with vegetation of *Stellario-Deschampsietum* type. It also includes mosses which in a compact weft cover the entire soil surface. On the north and east the plot borders on a fragment of oak-hornbeam forest with predominance of *Quercus robur*, less numerous are *Carpinus betulus*, *Tilia cor-*

*data, Betula pubescens* and in the undergrowth *Corylus avellana*. In spring and autumn this plot was periodically inundated with ground water. Seasonal temperature and precipitation variations only slightly changed the soil acidity (pH 6-7). The soil is mulchy-gleyey containing much humus.

The vicinity of the oak-hornbeam forest caused the occurrence of numerous fungi typical for forest flora.

Plot II lies 150 m west of plot I. The same plant association *Stellario-Deschampsietum* is found here. The soil is mulchy, gleyey of the same acidity (pH 6-7). The southern border of the plot is somewhat shaded by a specimen of *Betula pubescens* growing here. Like on plot I the entire soil surface is overgrown with a dense moss weft.

Other habitat conditions (greater moisture, more profuse moss cover) were favourable to the growth of a more abundant fungal flora not only typical for meadows but also associated with the presence of the birch.

Plot III was chosen in the middle of the open meadow area at a distance of 150 m south of the second plot. The same plant association grows on it as on the two preceding sites. The soil conditions are also the same, with acidity varying slightly periodically (pH 6-7). Since plot III lies somewhat higher than the two preceding ones, the water conditions are quite different here. During the entire vegetation period it hardly ever was innundated so its surface was dry. The moss cover is much less dense so that humus accumulation is also reduced.

The different conditions on this site, as compared with the previously described ones in spite of the occurrence of the same vegetal cover, gave an opportunity to the meadow fungal flora to appear, however, in a much smaller quantity.

Plot IV lies much lower than the three other ones, close to draining ditch so that, over almost the entire observation period, moisture was high on it and from time to time it was submerged with ground water. It is covered with vegetation of the *Caricetum-elatae* association. The soil is strongly gleyey of mulchy and peaty type. Acidity is high and varies according to the season (pH 5-6). The soil surface is not profusely covered with moss and among vascular plants bog species predominate.

The different type of vegetation, and particularly the high soil moisture did not favour the development of fungal flora producing fruit bodies.

## PRODUCTIVITY OF FUNGI

During the period of investigation 407 fruit bodies were collected from the entire surface area. The greatest number was harvested in September (188), somewhat less in June (132). In these months the air tem-

perature was rather high and rainfall abundant (September 11.4°C and 65.0 mm, in June 16.4°C and 132.3 mm) thus, it was warm and moist what favourably affected the development of fungi. Two maxima of fruiting were observed (Fig. 1). The smallest number of fruit bodies were collected in August owing to the heat and relatively low amount of precipitation (20.3°C and 34.4 mm). In the several preceding months a constant rise of temperature was noted (maximum in August), and simultaneously a decreasing amount of precipitation (minimum in July). The soil moisture conditions facilitated stronger evaporation and drying up of the surface layer, this inhibiting formation of fungal fruit bodies to such an extent that for instance on plot I situated at the border of the meadows somewhat lower than plots II and III, in spite of relatively better moisture conditions, barely one fruit body of *Inocybe jacobi* was found.

The harvest of fruit bodies collected from the particular plots lying

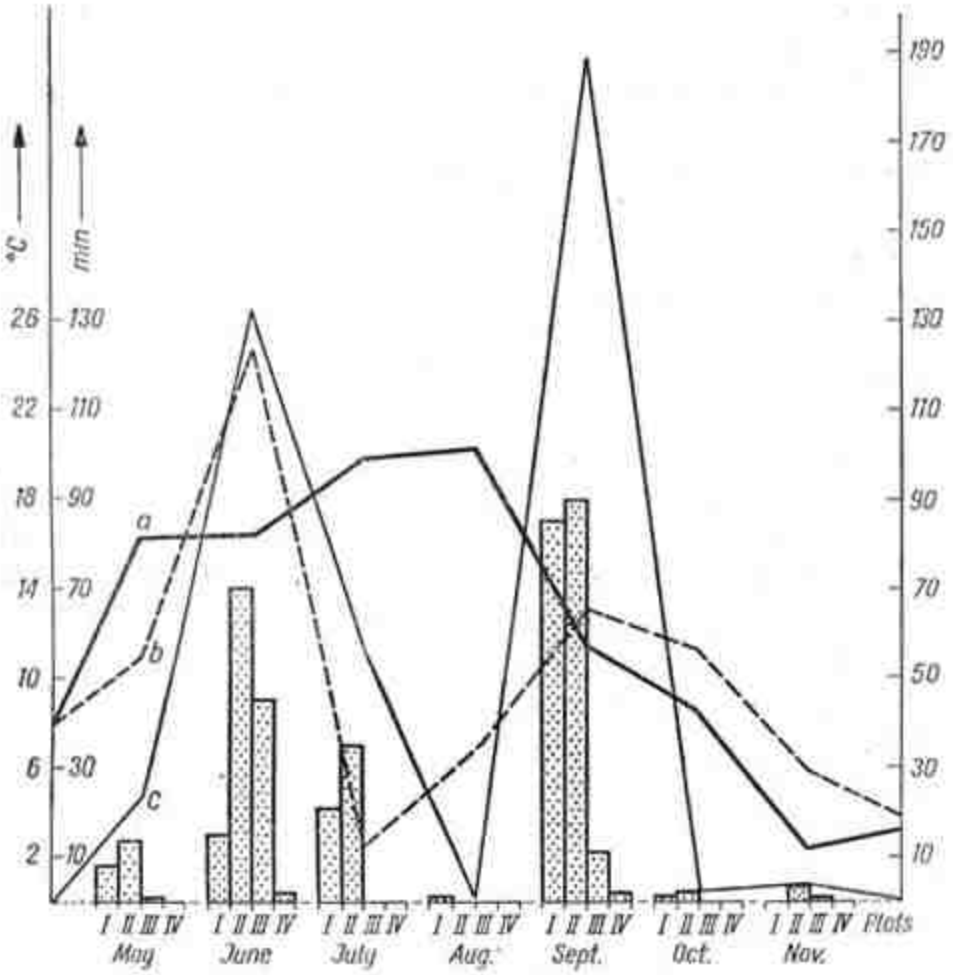


Fig. 1. Appearance of fungi in dependence on temperature and precipitation: *a* — temperature; *b* — precipitation; *c* — number of carpophores according to months. Bars denote the number of carpophores on the plots

close to one another but differing somewhat in habitat conditions differed both qualitatively and quantitatively. Plots I and II were overgrown by the same vegetation and had a thick moss ground cover. The presence of trees near plot I contributed to a somewhat higher soil moisture (shading) than on plot II. Nevertheless less fruit bodies (131) were found on the former, and those collected belonged mostly to forest species. On plot II, on the other hand, lying near a single birch, almost twice as many fruit bodies were found (214) with predominance of species typical for open areas. Somewhat less fruit bodies were collected on plot III situated on a site without shade, but overgrown with the same vegetation as the preceding plots. Much less humus was accumulated here as compared with the previously discussed sites, and fungi did not produce fruit bodies in abundance. The smallest number of fruit bodies (only 4) was found on plot IV on a much lower level than the remaining ones and submerged from time to time with ground water. Frequent stagnance of water on the plot surface increased the acidification of the medium and prevented access of air, thus inhibiting fruit body production. The plot was overgrown with bog vegetation and peatmoss.

The fruit bodies from the whole experimental area were unevenly distributed on the particular plots (Fig. 1). In the period of the first maximal development of fungi (June) fruit bodies were most numerous on plot II (70) and plot III (45). At the time of the second maximum (September), most fruit bodies were also found on plot II (90), and somewhat less on plot I (85), whereas on plot III only 11 were collected. In both periods of maximum appearance only 2 fruit bodies were found on plot IV. Thus, plots I and II lying close to forest trees proved most fertile in fungi, while plot IV, the moistest of all and frequently submerged was poorest in fruiting bodies.

In the period of observation 255.25 g fresh weight of fruiting bodies (without any worms) were collected from the whole experimental area, that is 2.55 g/m² (Table 1). Fresh weight of fungi on plot II was highest (173.78), more than twice that on plot I (72.58 g), and lowest on plot IV (0.23 g). In this respect plot II was found to be most advantageous for the development of pileate fungi. After drying of all the fruit bodies 22.13 g of dry weight (0.22 g/m²) remained, the greatest part was obtained from plot II (13.09 g) and smallest from plot IV (0.11 g). Thus plot II produced also the greatest amount of dry weight (0.52 g/m²).

After burning and incineration of all the dry matter there remained 3.88 g ash. Analysis of this gave different results than the previous ones. The greatest amount of ash was obtained not from plot II on which fruit bodies were most numerous and fresh weight highest, but plot I yielded almost two times more (2.21 g). This seems to indicate, in view of the much smaller number of fruit bodies, a more intensive uptake of mineral

compounds by the fungi on plot I, and also, perhaps, specific requirements of the particular species. It should be mentioned that the fungal flora on both these plots was different.

Table 1

Productivity of fungi in 1971 on plots I-IV

| Surface 25 $m^2$ | Fresh weight | | Dry weight | | Ash | |
|---|---|---|---|---|---|---|
| | g | $g/m^2$ | g | $g/m^2$ | g | $g/m^2$ |
| I | 72.58 | 2.90 | 8.01 | 0.32 | 2.21 | 0.09 |
| II | 173.78 | 6.95 | 13.09 | 0.52 | 1.39 | 0.06 |
| III | 8.66 | 0.34 | 0.92 | 0.04 | 0.23 | 0.01 |
| IV | 0.23 | + | 0.11 | + | 0.05 | + |
| 100 $m^2$ | 255.25 | 2.55 | 22.13 | 0.22 | 3.88 | 0.04 |

+ Values lower than 0.01

If we consider the monthly productivity of fungi on each of these plots as regards fresh and dry weight and ash content, we see that the results confirm that the most favourable month for fruiting of most pileate fungi is September (Table 2). In this month much more fresh and dry mass was produced on plot II than on the remaining ones. Of course this was associated with the largest number of fruiting bodies (Fig. 1) found on this plot, owing to very favourable atmospheric conditions. The fruit bodies collected at this time on plot II had a more compact consistence — the fungi accumulated then the greatest amount of organic and inorganic matter. On this plot, beside other species, fungi with a relatively very fleshy consistence produced fruit bodies, such as *Cortina-*

Table 2

Productivity of fungi in the particular months of 1971 on plots I-IV

| Months | Fresh weight $g/m^2$ | | | | Dry weight $g/m^2$ | | | | Ash $g/m^2$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Plots | | | | Plots | | | | Plots | | | |
| | I | II | III | IV | I | II | III | IV | I | II | III | IV |
| V | 0.16 | 0.01 | + | - | 0.03 | + | + | - | 0.02 | + | + | - |
| VI | 0.01 | 0.11 | 0.04 | + | + | 0.03 | + | + | + | 0.01 | + | + |
| VII | 0.54 | 0.04 | - | - | 0.06 | 0.02 | - | - | 0.02 | 0.01 | - | - |
| VIII | + | - | - | - | + | - | - | - | + | — | - | - |
| IX | 2.19 | 6.79 | 0.29 | + | 0.23 | 0.47 | 0.04 | + | 0.05 | 0.04 | 0.01 | + |
| X | + | + | - | - | + | + | — | - | + | + | - | - |
| XI | - | + | 0.01 | - | - | + | + | - | - | + | + | - |
| | 2.90 | 6.95 | 0.34 | + | 0.32 | 0.52 | 0.04 | + | 0.09 | 0.06 | 0.01 | + |

+ Values lower than 0.01

*rius porphyropus* (42 specimens), *Lactarius pubescens* (18) and *Russula alutacea* (1). The presence of these species typical for forest areas affected variously the over-all result. On plot I there were but few forest fungi (*Cortinarius porphyropus* — 2, *C. junghuhni* — 25), therefore a smaller amount of dry and fresh mass was obtained.

The total ash content obtained in September from plot I (0.05 g/m²) was only slightly more than from plot II (0.04 g/m²).

In June the productivity of fungi was somewhat lower. As compared with September, the air temperature was much higher and precipitation rather abundant (Fig. 1). It should, however, be borne in mind that this month is the period of intensive development of mycelium in the soil. Similarly as in the period of the second maximum the productivity of plot II was the highest. In this period the largest number of specimens was found on plot III (fungi with a compact consistency but containing more water, from the genera *Galerina* and *Rhodophyllus* produced fruit bodies here).

A certain, if only indirect, influence on fruiting of fungi must have been exerted by the over-all surface area of their caps: the larger it was the more spores it supplied, the greater were the possibilities of development of a new mycelium and of formation of new fruit bodies. The over-all surface area of the caps of all fruit bodies was not large (0.10 m²). The covering of the soil with the caps of the fungi collected was greatest in September (0.08 m²). It reflected not only the occurrence in this month of the largest number of fruit bodies (188), but also their more vigorous growth (in June with 132 fruit bodies it was much lower — 0.01 m²).

A total of 36 species of pileate fungi was found: of the order *Agaricales* — 34 and *Aphyllophorales* — 2 (Table 3). The single appearance on the meadows of representatives of *Aphyllophorales*, *Polyporus ciliatus* and *Cerrena unicolor* is somewhat accidental. Plot I on which they were found lies in the neighbourhood of an oak-hornbeam forest, therefore the litter is richer in fallen tree branches which constitute a good substrate for lignicolous fungi.

During the entire vegetation period, the meadow was not mown, therefore remains of rotting annual plants were relatively abundant. The intensity of their decomposition and humis formation — as indirectly indicated by the results — differed, however, on the particular plots, this influencing the fungal flora on them.

The greatest contribution to the productivity came from the dominating fungal species not only as regards the number of fruit bodies, but also fresh and dry weight: *Laccaria laccata*, *Cortinarius porphyropus*, *C. junghuhnii* and *Lactarius pubescens* (Table 4). These fungi are mostly found in forest plant associations in the neighbourhood of trees with which they may form mycorrhizae. That is probably why they were

only found on the first two plots. On plot I near the oak-hornbeam stand *Laccaria laccata* (59 fruit bodies-0.13 g/m² dry mass) and *Cortinarius junghuhnii* (25-0.07 g/m²), and on plot II: *Cortinarius porphyropus* (42-0.32 g/m²) *Lactarius pubescens* (18-0.12 g/m²) and *Galerina pumila* (105-0.02 g/m²). The weight of the fresh and dry mass of the remaining species did not exceed 1 g/m², therefore their contribution to the productivity of fungi in this season was negligible.

The weight of the dry mass of the dominating species largely decided

Table 3

Productivity of fungi on Łąki Strzeleckie meadows

| Plots | Species | Number of carpophores | Production | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | fresh weight | | dry weight | | Ash | |
| | | | g | g/m² | g | g/m² | g | g/m² |
| I, - - - | Laccaria laccata /Scop.ex Fr./Bk. Br. | 59 | 36,76 | 0.37 | 4.50 | 0.04 | 0.90 | 0.01 |
| -,II,--- | Lactarius pubescens Fr. | 18 | 38.80 | 0.39 | 3.12 | 0.03 | 0.72 | 0.01 |
| I,II,- - | Cortinarius porphyropus Fr. | 44 | 123.79 | 1.24 | 8.01 | 0.08 | 0.53 | + |
| I, - - - | Cortinarius junghuhnii /Fr./ Fr. | 25 | 24.75 | 0.25 | 1.80 | 0.02 | 0.21 | + |
| I,II,- - | Rhodophyllus sericeus /Bull.ex Fr./Quel. | 17 | 9.44 | 0.09 | 1.37 | 0.01 | 0.28 | + |
| I, - - - | Polyporus ciliatus Fr.ex Fr.sensu Kreisel | 7 | 3.28 | 0.03 | 0.65 | 0.01 | 0.35 | + |
| I,II,III,- | Galerina pumila /Pers.ex Fr./ M.Lge | 147 | 2.09 | 0.02 | 0.51 | + | 0.16 | + |
| -,II, - - | Russula alutacea Fr. em.Melz. Zv. | 1 | 3.42 | 0.03 | 0.40 | + | 0.15 | + |
| -,II, - - | Rhodophyllus subradiatus Kulm. Romagn. | 5 | 2.54 | 0.02 | 0.26 | + | 0.09 | + |
| - - III,- | Psathyrella leucotephra /Bk. Br./Orton | 4 | 7.10 | 0.07 | 0.48 | + | 0.09 | + |
| I, - - - | Cerrena unicolor /Bull.ex Fr./ Murr. | 1 | 0.75 | 0.01 | 0.21 | + | 0.10 | + |
| -,II,III,- | Galerina laevis /Pers./ Sing. | 19 | 0.61 | 0.01 | 0.05 | + | 0.02 | + |
| - - III,IV | Psathyrella obtusata /Fr./Konr. Maubl. | 2 | 0.29 | + | 0.20 | + | 0.02 | + |
| - - III,- | Stropharia albo-cyanea /Desm./ Quél. | 4 | 0.28 | + | 0.12 | + | 0.05 | + |
| -,II, - - | Galerina paludosa /Fr./ Kühn. | 17 | 0.28 | + | 0.06 | + | 0.01 | + |
| -,II, - - | Rhodophyllus grisco-cyjaneus /Fr./Quél. | 1 | 0.25 | + | 0.05 | + | 0.01 | + |
| I, - - - | Naucoria subconspersa Kühn. | 1 | 0.21 | + | 0.05 | + | 0.01 | + |
| - - -,IV | Psathyrella subnuda /Karst./A.H.Smith | 1 | 0.12 | + | 0.05 | + | 0.01 | + |
| I, - - - | Inocybe jacobi Kühn. | 1 | 0.11 | + | 0.10 | + | 0.05 | + |
| -,II,- - | Galerina sphagnorum /Pers. ex Fr./ Kühn. | 1 | 0.06 | + | 0.02 | + | 0.01 | + |
| - - -,IV | Pholiota conissans /Fr./ Mos. | 1 | 0.05 | + | 0.04 | + | 0.02 | + |
| -,II,- - | Rhodophyllus lanicus Romagn. | 1 | 0.05 | + | 0.02 | + | 0.01 | + |
| - - -,IV | Psathyrella trepida /Fr./ Gill. | 1 | 0.03 | + | 0.02 | + | 0.01 | + |
| -,II,- - | Hydrocybe miniata /Fr./ Kummer | 1 | 0.15 | + | 0.02 | + | + | + |
| I,II,- - | Tuberia pellucida /Bull.ex Fr./Gill.ex Lge. | 5 | 0.06 | + | 0.01 | + | + | + |
| I,-,III,- | Naucoria scolecina /Fr./ Quél. | 4 | 0.04 | + | 0.02 | + | + | + |
| I, - - - | Omphalina grisella//Weinm./ Mos. | 4 | 0.03 | + | 0.01 | + | + | + |
| I, - - - | Mycena avenacea /Fr./ Quél. | 2 | 0.02 | + | 0.01 | + | + | + |
| -,II,- - | Rhodophyllus infula /Fr./ Quél. | 1 | 0.02 | + | + | + | + | + |
| -,II,- - | Rhodophyllus cancrinus /Fr./ Quél. | 1 | 0.01 | + | + | + | + | + |
| I, - - - | Psathyrella gyroflexa /Fr./ | 1 | 0.01 | + | + | + | + | + |
| I, - - - | Galerina hypnorum /Schrank.ex Fr./Kühn. | 3 | 0.01 | + | + | + | + | + |
| I, - - - | Crepidotus variabilis /Pers.ex Fr./Kummer | 4 | 0.01 | + | + | + | + | + |
| I, - - - | Henimycena delicatella /Peck./ Sing. | 1 | + | + | + | + | + | + |
| I, - - - | Mycena sanguinolenta /A. S.Fr./Kummer | 1 | + | + | + | + | + | + |
| - -,III,- | Psathyrella atomata /Fr./ Quél. | 1 | + | + | + | + | + | + |
| | Total | 407 | 255,25 | 2.55 | 22.13 | 0.22 | 3.88 | 0.04 |

+ values lower than 0.01

of the yield of the successive plots in the particular months. On plot I in July *Laccaria laccata* dominanting with dry mass (0.06 g/m²) contributing almost the entire productivity of fungi in this month. In September many more fruit bodies of this species were harvested what gave a correspondingly greater dry mass (0.12 g/m²). *Cortinarius junghuhnii* (0.07 g/m²) also fruited profusely there. On plot II, on the other hand, during almost the entire vegetation period *Galerina pumila* predominated (a total of 105 fruit bodies were collected — 0.02 g/m² of dry mass). Moreover the very delicate and minute *Galerina paludosa* produced fruit bodies here in June, and so did *Cortinarius porphyropus* and *Lactarius pubescens* in September. On plot III the dominating fungus in this season (May-June) was only *Galerina pumila*, but in both cases its productivity as regards dry mass did not exceed 1 g/m². On plot IV there were no dominating species, dry mass could be obtained only in June here (*Psathyrella trepida* and *P. subnuda*) and in September (*Psathyrella obtusata* and *Pholiota conissans*).

Table 4

Productivity of dominating species in 1971 on plots I–IV

| Plots | Species | Months | Number of carpophores | Fresh weight | | Dry weight | | Ash | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | g | g/m² | g | g/m² | g | g/m² |
| I | Laccaria laccata | VIII-IX | 59 | 36.76 | 1.37 | 4.50 | 0.18 | 0.90 | 0.04 |
| | Cortinarius junghuhnii | IX | 25 | 24.75 | 0.99 | 1.80 | 0.07 | 0.21 | 0.01 |
| II | Galerina pumila | V-VIII | 80 | 1.51 | 0.06 | 0.36 | 0.02 | 0.11 | + |
| | | IX-XI | 25 | 0.06 | + | 0.05 | + | 0.01 | + |
| | Cortinarius porphyropus | IX | 42 | 123.48 | 4.94 | 7.90 | 0.32 | 0.45 | 0.02 |
| | Lactarius pubescens | IX | 18 | 38.80 | 1.55 | 3.12 | 0.12 | 0.72 | 0.03 |
| | Galerina paludosa | VI | 17 | 0.28 | 0.01 | 0.06 | + | 0.01 | + |
| III | Galerina pumila | V-VI | 34 | 0.43 | 0.02 | 0.07 | + | 0.03 | + |
| IV | - | - | - | - | - | - | - | - | - |

\+ values lower than 0.01

Comparison of the plots from the point of view of occurrence of various fungal species showed that only *Galerina pumila* was common to the first three plots overgrown with one type of plant community. This species produced a larger number of fruit bodies on plot II and exhibited a higher productivity.

Analysis of the productivity of fungi on the meadows investigated only gave preliminary orientation in the conditions prevailing in the mycoflora in the given vegetation season. In 1971 distinct differences

were observed in the mycoflora of the chosen plots. A more differentiated fungal flora of fungi fruiting profusely was found on plot II, no wonder therefore that the productivity was highest here. Plot I at the edge of the meadow had better moisture conditions. On account of the proximity of the oak-hornbeam stand, forest species predominated on this plot. Notwithstanding this, fruit bodies were less numerous here and productivity was lower than on plot II. The solitary birch close to the latter gave a mild shading making possible the occurrence of fungi mycorrhizally associated with this tree. The thick moss ground cover maintained good soil moisture. Beside forest species, fungi typical for open spaces produced fruit bodies here. Plot III was much poorer in fungi. Situated somewhat higher than the other two and unshaded, it was overgrown with the same vegetation but moss was not so dense here. Strong insolation caused rapid drying so that the rotting processes occurred here much slower and fungi did not fruit profusely. Species typical for meadows were mainly collected here, but since they were not very numerous and their consistency was less compact, the amount of dry mass obtained from this plot was much smaller than from the preceding two. On all these plots soil acidity was within the limits of pH 6-7.

The smallest number of species and lowest productivity were noted on plot IV overgrown with bog vegetation and in a smaller degree with mosses. Frequent innundation with ground water not only caused acidification of the soil (pH 5-6) but also greatly reduced air access to the upper soil layer what was unfavourable for mycelium development and made production of fruit bodies difficult.

## PRODUCTIVITY OF FRUITING FUNGI ON EXPLOITED MEADOWS AND THOSE SURROUNDED BY A FOREST RESERVATION

If we compare the productivity of fungi on the chosen areas of the Strzeleckie meadows (surrounded by forest) with that on the Kazuń meadows (exploited), rather pronounced differences appear. Fruit bodies were much more numerous (695) on the exploited meadows than on the forest ones (407), whereas the macroflora of the latter was much more diversified (36 species). The fragment of the Kazuń meadows was divided into two instead of four equal plots (mown — k and unmown — nk), therefore for obtaining comparable results they were reduced by one half (Table 5).

When comparing the harvest from equal unmown surface areas of Kazuń (plot nk) and Strzeleckie meadows, it was found that many more species and fruit bodies occurred on the forest-surrounded meadow. Therefore the productivity of fungi was almost two times higher than

Table 5

Productivity of fungi producing fruit bodies in 1971 on Kazuń meadows /k and nk/ and on Strzeleckie meadows

| Surface | | Number of species | Number of carpophores | Production | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | fresh weight | | dry weight | | ash | |
| | | | | g | g/m² | g | g/m² | g | g/m² |
| Kazuń | K | 18 | 683 | 551.73 | 11.05 | 69.52 | 1.39 | 27.21 | 0.54 |
| | nk | 6 | 12 | 24.44 | 0.45 | 3.73 | 0.07 | 0.30 | + |
| Strzeleckie | * | 18 | 203 | 127.62 | 1.27 | 11.06 | 0.11 | 1.94 | 0.02 |

K - mown plot
nk - unmown plot
* values reduced by one half
+ values lower than 0.01

in Kazuń. When the data for Strzeleckie meadows were, however, compared with those for the mown plot in Kazuń, it appeared that the number of species was the same on both plots, but fruit bodies were much more numerous on the mown plot. Correspondingly, the productivity of fungi was here almost three times greater that on the Strzeleckie meadows.

Both types of meadows were overgrown with a different plant association and the habitat conditions were different. The soil of Strzeleckie meadows (pH 6-7) contained much more humus and the decomposition processes were much more rapid in the soil. In Kazuń on the other hand, the soil (pH 5-6) was very compact, and although plant detritus abounded, particularly on the unmown plot, relatively little humus accumulated. Fungi fruited less profusely on this plot, whereas on the mown on the harvest was much larger.

If we compare all the data for both meadows in the particular months, it appears that in the vegetation period 1971 two fruiting maxima appeared: in June (Strzeleckie) and in July (Kazuń) (Table 6). In July productivity of fungi was higher on the Strzeleckie than on the Kazuń meadows if the mowed meadows are taken into account. Similar relations were found when the productivity of fungi was compared in the period of the second maximum. Although mowing changes in some extent the habitat conditions it favours fruit body production. On the mown plot a high production of the mass of fruit bodies was noted. July was a rather hot and dry month, while in preceding months precipitation had been high, much higher on Strzeleckie (123.3 mm) than on the Kazuń meadows (57.4 mm). The vicinity of forest on the Strzeleckie meadows ensured a higher soil moisture. The habitat conditions were more favourable here for fruit body production than on

the open Kazuń meadows. In September on both the meadow areas the weather was rather warm and moist. The fungi fruited profusely, particularly in Kazuń on the mown plot.

Of all the species collected only five proved to be common for both the types of meadow: *Mycena avenacea, M. sanguinolenta, Pholiota conissans, Psathyrella gyroflexa* and *P. subnuda*. Dominant were *Mycena avenacea* and *Psathyrella gyroflexa*. Most numerous fruit bodies of the former species were collected in Kazuń (20 on plot k) and only two on Strzeleckie meadows, the fruiting bodies of the second species were somewhat less numerous (11 in Kazuń plot k), on Strzeleckie meadows fruit bodies of this species were found only once. Their contribution to the productivity of fungi was small since in view of the small number of fruiting bodies found and their consistency the dry mass values were very low (less than 0.01 g/m²).

Table 6
Variations in number of fruit bodies and fungal mass production according to months on Kazuń meadows /k and nk/ and on Strzeleckie meadows /S/

| Months 1971 | Number of carpophores | | | Production g/m² | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | fresh weight | | | dry weight | | | ash | | |
| | Kazuń | | S* | Kazuń | | S* | Kazuń | | S* | Kazuń | | S* |
| | k | nk | | k | nk | | k | nk | | k | nk | |
| V | - | - | 23 | - | - | 0.08 | - | - | 0.01 | - | - | + |
| VI | 26 | - | 132 | 0.08 | - | 0.08 | 0.04 | - | 0.01 | + | - | + |
| VII | 265 | 1 | 56 | 1.20 | 0.03 | 0.29 | 0.45 | 0.02 | 0.04 | 0.26 | + | 0.01 |
| VIII | 65 | - | 1 | 3.06 | - | + | 0.29 | - | + | 0.13 | - | + |
| IX | 196 | 9 | 188 | 4.93 | 0.42 | 4.63 | 0.55 | 0.05 | 0.37 | 0.15 | + | 0.05 |
| X | 39 | 1 | 3 | 0.03 | + | + | 0.02 | + | + | + | + | + |
| XI | 92 | 1 | 4 | 1.75 | + | + | 0.04 | + | + | + | + | + |
| | 683 | 12 | 407 | 11.05 | 0.45 | 5.08 | 1.39 | 0.07 | 0.43 | 0.54 | + | 0.16 |

k - mown plot
nk - unmown plot
* - values reduced by one half
+ - values lower than 0.01

The present comparison of the productivity of fungi on the forest-surrounded meadows and the exploited ones enabled a certain orientation in the conditions prevailing in the mycoflora in 1971. It was found that on these meadows the fungi produced fruit bodies more abundantly and gave almost twice more dry mass than on the unmown exploited meadows (Table 5). Nevertheless, when these results were compared with the data for the mown plot it appeared that more fruiting bodies were found on it and that the productivity was almost ten times higher, although the year 1971 was not favourable for development of fungi because of the wide temperature and precipitation variations. It should be added that the results are affected not only by the number of fruit bodies harvested, but also by their size and consistency.

As seen in the natural environment (forest-surrounded meadows) the mycoflora was richer (both as regards quality and quantity) than on the unmown plot of the exploited meadows, but it was much poorer, than on the mown plot of the Kazuń meadows. In order to obtain a more precise knowledge of the mycoflora of the latter meadows, to confirm the relations deduced and to obtain further more representative results further investigations on these and other types of meadows are planned.

## CONCLUSIONS

1. The forest-surrounded meadow was richer as regards the number of fungal species.

2. The exploited meadow showed less diversified species, but the number of fruit bodies on it was much higher.

3. Mowing of the exploited meadow had a positive effect on the production of fruiting bodies by fungi.

4. The consistency of the fruit bodies on the exploited mown meadow was more compact than on the unmown plot and the forest-surrounded meadow. Owing to this, production of fresh mass, dry mass and of ash was highest here.

5. The particular fungal species, especially the dominant ones, should be analyzed in respect to fresh and dry mass and ash production.

The author wishes to thank professor dr A. Skirgiello for guidance in the course of this work and critical remarks. The advice and suggestions of dr W. Rudnicka-Jezierska are gratefully acknowledged.

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## Wstępna analiza produktywności grzybów owocnikowych na łąkach Strzeleckich

Streszczenie

Na łąkach Strzeleckich wytypowano powierzchnię 100 m² podzieloną na 4 jednakowe poletka w odległości 150 m od siebie po 25 m², w obrębie zespołów *Stellario-Deschampsietum* i *Caricetum elatae*. Owocniki zbierano co dwa tygodnie, ważono w stanie świeżym i suchym, spalano i wyprażano na popiół do stałej wagi. Z całej powierzchni zebrano 407 owocników (188 we wrześniu, 132 w czerwcu). Wystąpiły 2 maksima rozwoju grzybów, przy czym liczba owocników rozkładała się nierównomiernie na poszczególnych poletkach.

Z całej powierzchni zebrano 255,25 g świeżej masy wszystkich owocników; z niej otrzymano 22,13 g masy suchej. Najwięcej owocników i odpowiednio masy świeżej oraz suchej zebrano na poletku II, a najmniej na poletku IV podmokłym. Po spaleniu i wyprażeniu całego suszu uzyskano 3,88 g popiołu. Najwięcej otrzymano go nie z poletka II, które dało największą produkcję masy owocników, ale z poletka I. Wskazuje to na większą dostępność oraz intensywność pobierania związków mineralnych przez grzyby występujące na poletku I, a także na specyficzne — być może — wymagania poszczególnych gatunków.

Powierzchnia kapeluszy wszystkich owocników wynosiła 0,10 m², w tym — we wrześniu — 0,08 m², co jest odbiciem wystąpienia w tym miesiącu największej liczby owocników i najbujniejszego ich rozwoju.

Ogółem zebrano 36 gatunków grzybów kapeluszowych z *Agaricales* i *Aphyllophorales*. Największy udział w produktywności odegrały gatunki dominujące pod względem liczby owocników, a także ich masy świeżej i suchej: *Laccaria laccata*, *Cortinarius porphyropus*, *C. junghuhnii* i *Lactarius pubescens*. Gatunkiem wspólnym dla pierwszych 3 poletek, o jednym typie zbiorowiska roślinnego, okazała się *Galerina pumila*. Wystąpiła ona w większej liczbie owocników (105) i odznaczała się wyższą produkcją masy suchej (0,02 g/m²) na poletku II.

Porównano produktywność grzybów na badanej powierzchni łąk Strzeleckich (śródleśne) i Kazuńskich (użytkowe). Znacznie więcej gatunków i owocników znaleziono na łąkach śródleśnych i dlatego stwierdzono tam produkcję masy owocników dwukrotnie większą niż na łąkach użytkowych. Po porównaniu tych danych z wynikami uzyskanymi z poletka koszonego w Kazuniu okazało się, że przy tej samej liczbie gatunków znacznie więcej owocników znaleziono na łąkach użytkowych; dało to produkcję masy owocników odpowiednio trzy razy większą niż na łąkach śródleśnych.

Na obu łąkach w 1971 r. wystąpiły 2 maksima owocnikowania (czerwiec — Strzeleckie, lipiec — Kazuńskie i obydwie — wrzesień). W obu wypadkach produktywność grzybów była wyższa na łąkach śródleśnych, ale przy uwzględnieniu koszenia — na łąkach użytkowych.

Ze wszystkich zebranych gatunków tylko 5 okazało się wspólnych dla obu badanych łąk: *Mycena avenacea*, *M. sanguinolenta*, *Pholiota conissans*, *Psathyrella gyroflexsa* i *P. subnuda*. Udział tych gatunków w produktywności grzybów był nie-

wielki, gdyż ze względu na stosunkowo małą liczbę owocników i ich konsystencję otrzymane wartości masy suchej były mniejsze od 0,01 g/m².

Produktywność grzybów na łące śródleśnej pod względem masy suchej była prawie dwukrotnie wyższa niż na łące użytkowej, nie koszonej. Mimo to, po porównaniu tych wyników z danymi uzyskanymi z poletka koszonego okazało się, że produktywność grzybów była tu prawie dwudziestokrotnie wyższa niż na łące śródleśnej. Jak widać, w środowisku naturalnym (łąki Strzeleckie) mikoflora była bogatsza niż na poletku nie koszonym łąk Kazuńskich, ale po porównaniu z poletkiem koszonym była ona znacznie uboższa. Należałoby powtórzyć te obserwacje na tych i innych typach łąk.