KOMITET EKOLOGICZNY - POLSKA AKADEMIA NAUK

EKOLOGIA POLSKA - SERIA A

Tom XV Warszawa 1967 Nr 46

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TENTATIVE ESTIMATION OF THE PRODUCTION OF HERB LAYER*

The paper presents a preliminary attempt of the production estimation (simplified Ovington's (1962) method adjusted for IBP) for herb layer in four forest communities. The size of production of nanophanerophytes and hemicryptophytes was calculated from the difference of standing crops at the period of their full development (summer) and their initial standing crop at spring. The maximal standing crop of early spring geophytes during the period of fructification was accepted as their production. The estimate of herb layer production was referred to the plant cover found in samples. To production estimate there was introduced a correction which employed an index of average cover, obtained in special samples taken randomly from the whole phytocoenosis of communities studied. The great importance of the way of the selection of sampling places upon the final results has been stressed.

1. COMMUNITIES

Communities studied were examined phytosociologically before the starting of works on the productivity of herb layer. Results, detailed floristic and ecological data, and the map of associations were published in a separate paper (Traczyk and Traczyk 1965).

Studies included six hectares of forest situated to the south from the Field Station of the Institute of Ecology, Polish Academy of Sciences at Dziekanów Leśny near Warsaw. The area occupies northern parts of compartments 28 and 29 in the forest-district Laski, in Kampinos National Park.

It consists of four forest associations identified as:

1. *Tilio-Carpinetum*,

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This study was carried out under the Small Mammal Project of the International Biological Programme in Poland.

2. *Pino-Quercetum* – variant with *Scorzonera humilis*[1],
3. *Vaccinio myrtilli-Pinetum molinietosum*,
4. *Carici elongatae-Alnetum*.

Stands of these associations are rather young. Alder is 25–45 years old, while pine and oak – 45–55 years old. Similar age-class indicate also admixture species, as: birch, hornbeam, lime, trembling aspen, and rowan tree. The high density of crowns is distinctly reflected by a poor cover by ground vegetation. Unproper forest management exerted also certain influence upon the floristic impoverishment and disturbances in the species composition of herb layer. The selection of this area was justified by the fact that zoologists, who needed even rough estimate of primary production, carried out their studies on the secondary production of small forest rodents just on this area.

2. METHOD

In general, the procedure suggested for IBP by Ovington (1962) (compare also Rajchel (1965)) was used, however, with serious simplifications. Studies on the production of underground parts were given up, while the analysis of above-ground material of herb layer was limited to samples taken during spring and summer. These restrictions were brought about mainly by possible work outlay and the necessity of ground vegetation estimation in four communities.

Twenty sites were chosen in spring in each association. From each site there were taken two, adjacent to each other samples, one in spring (April 28), another one in the full swing of summer (July 8), i.e. after 65 days. The first date of sampling aimed at the measurement of the maximal increment of early spring geophytes and the beginning of development of hemicryptophytes and nanophanerophytes. On the second date of sampling we expected to measure the maximal standing crop of most of hemicryptophytes and nanophanerophytes.

Samples had circular shape with the area of $1/6$ m^2 (46 cm in diameter). This size has been accepted after scientists from the Cracow centre. The cover by herbaceous plants and mosses in samples have been accurately recorded before clipping. Plants were clipped just at the soil level. When individuals were counted, each species was separately dried at the temperature of 85°C during some 48 hours, and subsequently weighed with the accuracy to 0.01 g. Mosses from these samples were analyzed separately.

Since samples have been taken from places with rather considerable cover (on an average 60–70%) there arose the question to what extent they reflect

[1]Latin names of plant species after Szafer, Kulczyński and Pawłowski (1953).

Frequency, density and biomass from spring and summer samples in the herb layer of *Tilio-Carpinetum* (data from 20 samples = 3.32 m^2)

Tab. I

Species	Frequency		Density		Biomass (g)	
	April	July	April	July	April	July
Geophytes:						
Anemone nemorosa	15	6	7,828	35	8.53	0.13
Paris quadrifolia	1	1	19	1	0.12	0.01
Hemicryptophytes:						
Oxalis acetosella	13	20	291	2,054	0.86	17.49
Vaccinium myrtillus	9	8	49	71	10.64	13.75
Majanthemum bifolium	11	15	60	398	0.96	12.89
Milium effusum	4	15	127	174	3.00	11.18
Galeobdolon luteum	4	10	18	251	1.43	10.54
Stellaria holostea	12	15	84	164	1.38	10.40
Ajuga reptans	1	5	—	109	0.09	4.99
Viola silvestris	3	10	11	42	0.44	3.38
Convallaria maialis	1	2	5	11	0.38	2.32
Stellaria nemorum	1	2	2	11	0.01	0.36
Dryopteris spinulosa	1	2	1	1	0.03	0.06
Carex div. sp.	1	1	1	20	0.12	1.65
Luzula pilosa	2	2	7	11	0.69	0.73
Lysimachia nummularia	1	1	1	7	0.01	0.42
Deschampsia caespitosa	2	2	1	6	1.02	0.17
Fragaria vesca	1	1	1	2	0.06	0.13
Geum urbanum	2	—	9	—	1.00	—
Rubus sp.	2	—	2	—	0.96	—
Gramineae div. sp.	1	—	35	—	0.52	—
Glechoma hederacea	1	—	2	—	0.41	—
Pirola rotundifolia	1	—	—	—	0.12	—
Galium Schultesii	1	—	—	—	0.05	—
Stellaria media	1	—	3	—	0.02	—
Vaccinium vitis-idaea	3	—	3	—	0.60	—
Athyrium filix-femina	—	3	—	20	—	13.13
Frangula alnus	—	3	—	5	—	2.05
Stellaria palustris	—	4	—	44	—	1.23
Polygonatum multiflorum	—	1	—	2	—	0.82
Melica nutans	—	1	—	17	—	0.70
Potentilla erecta	—	1	—	3	—	0.40
Trientalis europaea	—	3	—	15	—	0.38
Crepis paludosa	—	1	—	1	—	0.36
Sorbus aucuparia	—	1	—	2	—	0.22
Urtica dioica	—	1	—	2	—	0.17
Hieracium Lachenalii	—	1	—	5	—	0.15
Prunella vulgaris	—	1	—	10	—	0.10
Filipendula ulmaria	—	1	—	3	—	0.10
Pirola minor	—	1	—	1	—	0.05
Carpinus betulus	—	1	—	4	—	0.02
Ranunculus flammula	—	1	—	1	—	0.02
Ranunculus repens	—	1	—	6	—	0.01
Scorzonera humilis	—	1	—	1	—	0.01
Festuca ovina	—	1	—	3	—	0.01
Mosses	2	4	—	—	6.93	1.75
Total					40.38	112.28

Frequency, density and biomass from spring and summer samples in the herb layer of *Pino-Quercetum* (data from 20 samples = 3.32 m^2)

Tab. II

Species	Frequency		Density		Biomass (g)	
	April	July	April	July	April	July
Geophytes:						
Anemone nemorosa	11	5	56	9	1.12	0.23
Hemicryptophytes:						
Vaccinium myrtillus	18	20	285	371	63.32	139.90
Oxalis acetosella	5	5	124	293	0.83	4.72
Vaccinium vitis-idaea	9	6	23	28	4.06	4.49
Majanthemum bifolium	2	10	20	97	0.20	2.46
Equisetum silvaticum	2	3	4	8	0.14	1.90
Luzula pilosa	5	3	7	9	1.14	0.24
Potentilla erecta	1	2	1	7	0.01	0.10
Festuca ovina	2	2	12	5	0.17	0.58
Stellaria holostea	1	1	1	7	0.03	0.40
Carpinus betulus	4	1	4	1	0.41	0.06
Carex div. sp.	1	1	—	1	0.13	0.02
Lycopodium annotinum	1	—	12	—	12.40	—
Sorbus aucuparia	1	—	1	—	0.64	—
Gramineae div. sp.	3	—	2	—	0.42	—
Veronica chamaedrys	1	—	—	—	0.22	—
Populus tremula	1	—	1	—	0.17	—
Sedum sp.	1	—	1	—	0.03	—
Calamagrostis arundinacea	1	—	3	—	0.20	—
Potentilla alba	1	—	1	—	0.01	—
Molinia coerulea	—	6	—	88	—	6.22
Quercus robur	—	1	—	1	—	2.95
Convallaria maialis	—	5	—	9	—	2.67
Melampyrum pratense	—	8	—	13	—	1.58
Solidago virga-aurea	—	3	—	3	—	1.35
Hieracium umbellatum	—	1	—	3	—	0.87
Trientalis europaea	—	14	—	85	—	0.84
Pirola secunda	—	1	—	7	—	0.68
Frangula alnus	—	6	—	12	—	0.37
Pinus silvestris	—	3	—	6	—	0.25
Pteridium aquilinum	—	1	—	1	—	0.10
Rubus saxatilis	—	1	—	1	—	0.10
Veronica officinalis	—	1	—	1	—	0.10
Calamintha vulgaris	—	2	—	3	—	0.03
Mosses	16	17	—	—	35.51	147.41
Total					120.98	320.62

the average cover in the whole stand ot the association studied. For this purpose 50 special samples of herb layer cover have been carried out in each of the associations studied. In these samples cover of herbaceous plants and mosses were treated separately. These evaluations were done in randomly selected places.

Samples for cover had 4 m² in area (2 × 2 m square). They were additionally divided into smaller quadrats to improve the accuracy of evaluation. For each association the average evaluation of herb layer cover was obtained from random samples with the total area of 400 m².

3. ELABORATION OF MATERIAL

The estimate of maximal increment has been calculated for early spring geophytes and for nanophanerophytes and hemicryptophytes, separately. Since

Frequency, density and biomass from spring and summer samples in the herb layer of *Vaccinio myrtilli-Pinetum molinietosum* (data from 20 samples = 3.32 m²)

Tab. III

Species	Frequency		Density		Biomass (g)	
	April	July	April	July	April	July
Geophytes:						
Anemone nemorosa	—	1	—	1	—	0.02
Hemicryptophytes:						
Vaccinium myrtillus	20	20	333	413	106.71	177,73
Vaccinium vitis-idaea	11	14	31	46	4.70	5.98
Luzula pilosa	2	3	3	2	0.19	0.30
Festuca ovina	2	1	3	2	0.13	0.23
Viola silvestris	1	—	2	—	0.05	—
Molinia coerulea	—	12	—	113	—	5.47
Frangula alnus	—	4	—	5	—	1.27
Trientalis europaea	—	12	—	44	—	0.42
Populus tremula	—	2	—	3	—	0.41
Majanthemum bifolium	—	10	—	23	—	0.38
Melampyrum pratense	—	5	—	5	—	0.33
Pirola uniflora	—	3	—	7	—	0.14
Sorbus aucuparia	—	1	—	1	—	0.04
Dryopteris spinulosa	—	1	—	1	—	0.02
Mosses	20	20	—	—	113.98	187.50
Total					225.76	380.24

the first plant group regenerates its aerial portions entirely, sampling during the period of their fructification, with the maximal standing crop, yielded at the same time the evaluation of their maximal, current year increment, i.e. values very close to net production. The calculation of increments for plants from the second group has been carried out on the basis of the difference between their maximal crop in the period of their full development (results of summer series) and the initial crop of biomass found in samples during the end of April. When the crop of hemicryptophytes and nanophanerophytes biomass from April is deducted from their standing crop in July, one receives

Frequency, density and biomass from spring and summer samples in the herb layer of *Carici elongatae-Alnetum* (data from 20 samples = 3.32 m^2)

Tab.IV

Species	Frequency		Density		Biomass (g)	
	April	July	April	July	April	July
Hemicryptophytes:						
Carex div. sp.	17	19	15	156	46.48	296.36
Iris pseudoacorus	8	5	8	12	5.42	16.19
Deschampsia caespitosa	2	1	—	—	3.45	16.10
Dryopteris thelypteris	1	6	3	72	0.07	13.05
Galium palustre	10	11	44	115	0.78	10.80
Caltha palustris	10	9	7	33	2.96	9.60
Peucedanum palustre	3	9	—	45	0.25	7.83
Comarum palustre	1	2	—	12	0.19	1.15
Equisetum limosum	1	1	1	1	0.09	0.67
Lysimachia nummularia	2	3	15	6	0.25	0.56
Different green parts	1	7	—	—	0.01	0.37
Glyceria fluitans	2	—	4	—	0.59	—
Juncus effusus	1	—	2	—	0.38	—
Gramineae div. sp.	3	—	—	—	0.27	—
Hottonia palustris	1	—	3	—	0.08	—
Different dead parts	—	1	—	—	—	6.20
Poa trivialis	—	6	—	31	—	5.91
Scutellaria galericulata	—	11	—	37	—	5.46
Frangula alnus	—	7	—	14	—	5.23
Galium uliginosum	—	2	—	55	—	4.48
Lycopus europaeus	—	12	—	38	—	4.18
Mentha palustris	—	1	—	20	—	2.10
Lysimachia vulgaris	—	1	—	1	—	1.24
Poa nemoralis	—	1	—	—	—	0.92
Lythrum salicaria	—	1	—	—	—	0.85
Viola palustris	—	1	—	7	—	0.27
Calamagrostis canescens	—	1	—	—	—	0.18
Ranunculus repens	—	2	—	1	—	0.13
Lysimachia thyrsiflora	—	3	—	6	—	0.09
Viburnum opulus	—	1	—	—	—	0.07
Majanthemum bifolium	—	1	—	5	—	0.05
Ranunculus flammula	—	1	—	1	—	0.01
Mosses	13	14	—	—	31.94	36.15
Total					93.215	446.20

the size of biomass, which roughly could be determined as the increment of biomass (net production), although, in reality, it presents only the difference in standing crop.

The moss production has been approximately calculated in following manner. From the biomass of mosses found in spring and summer series there has been calculated the mean biomass per definite area. Afterwards, on the basis of analysis of moss increment carried out on meadow and on several species

Coefficientes of similarity for spring and summer samples from four forest associations studied*

Tab. V.

No. of samples	*Tilio-Carpinetum*				*Pino-Quercetum*				*Vaccinio myrtilli-Pinetum*				*Carici elongatae-Alnetum*			
	a	*b*	*c*	*S*	*a*	*b*	*c*	*S*	*a*	*b*	*c*	*S*	*a*	*l*	*c*	*S*
1	3	4	2	57	5	5	3	54	2	5	2	57	3	7	3	60
2	6	5	3	55	2	2	1	50	2	3	2	80	6	8	5	71
3	3	6	3	67	8	7	3	40	2	5	2	57	6	7	3	46
4	7	14	6	57	3	5	2	50	2	5	2	57	2	7	2	44
5	6	6	2	33	4	9	4	61	3	6	2	44	5	8	5	83
6	4	7	2	36	4	8	1	16	3	4	2	57	7	11	4	44
7	5	4	2	44	2	8	1	20	3	7	2	40	3	7	2	40
8	5	8	4	61	6	7	4	61	3	5	3	75	4	5	1	22
9	6	7	4	61	4	6	3	60	3	8	3	54	3	7	3	60
10	3	6	2	44	4	8	4	66	2	7	2	44	4	12	3	37
11	4	6	4	80	3	5	3	75	3	6	3	66	6	12	5	55
12	4	5	4	89	5	7	3	50	2	6	2	50	3	6	2	44
13	5	9	4	57	6	9	4	53	3	6	3	66	2	4	2	66
14	5	8	4	61	5	5	2	40	2	4	2	66	2	6	1	25
15	5	7	3	50	3	7	2	40	3	5	3	75	4	2	2	66
16	4	7	3	55	5	6	2	36	4	6	4	80	3	5	2	50
17	4	8	2	33	4	6	3	60	3	6	3	66	4	10	3	42
18	6	6	4	66	4	2	2	66	3	5	3	75	4	6	3	60
19	7	6	2	30	6	9	4	53	4	5	3	66	4	6	3	60
20	5	7	3	50	4	8	4	66	3	5	2	50	2	3	2	80

* Explanations of symbols: *a* – number of species in spring sample, *b* – number of species in summer sample, *c* – number of species common to both samples, *S* – coefficient of similarity in percentages $\left(S = \frac{2c}{a+b} \times 100\right)$.

in forest, it was determined that circa 35% of moss biomass constitute current year increments. The general biomass found in samples was reduced by the value of this index. If, for example, in *Pino-Quercetum* the standing crop of moss biomass was determined on 27.55 g of dry material per 1 m^2, then 35% of this value, or 9.62 g/m^2 comprise the current year increment of mosses, or their production.

In Tables I–IV there were presented values of frequency, density, and biomass of individual species in two sample series from April and July for the herb layer of four associations studied.

In order to determine the floristic similarity among individual samples in series there was calculated the coefficient of similarity (*S*) in percents, with the use of Jaccard's formula:

$$S = \frac{2c}{a+b} \times 100 \qquad (1)$$

Biomasses of samples in the herb layer of definite associations in spring and summer 1964 (expressed in grammes of ovendry weight per 3.32 m²)

Tab. VI

No. of samples	*Tilio-Carpinetum*		*Pino-Quercetum*		*Vaccinio myrtilli-Pinetum*		*Carici elongatae-Alnetum*	
	spring	summer	spring	summer	spring	summer	spring	summer
1	0.46	1.00	6.77	9.59	11.70	25.54	8.54	8.25
2	1.22	10.60	7.92	6.68	7.30	19.35	3.89	20.79
3	2.61	9.55	7.64	4.22	5.54	14.38	4.87	12.48
4	2.88	3.42	5.79	13.12	17.77	18.48	6.84	18.26
5	1.17	7.25	4.31	10.53	2.56	15.31	5.47	9.55
6	0.98	5.44	2.96	20.87	15.15	7.99	2.44	36.62
7	1.98	3.25	1.50	12.61	7.70	21.03	3.39	15.76
8	6.88	3.96	0.42	5.58	8.99	27.56	3.75	26.05
9	2.27	6.68	5.92	13.23	12.69	25.11	5.60	25.54
10	0.96	4.66	8.63	27.49	6.09	7.09	2.01	22.32
11	0.98	4.10	11.66	25.27	12.27	10.55	4.34	14.94
12	2.73	4.68	7.47	53.28	10.64	12.09	0.44	24.12
13	0.83	4.49	9.25	27.10	9.06	37.14	14.09	27.82
14	1.32	6.10	7.65	19.91	19.95	17.48	2.02	50.43
15	0.70	5.12	14.80	18.40	10.49	22.36	6.48	44.00
16	0.91	2.38	4.04	12.78	16.05	23.92	2.49	24.50
17	1.60	5.07	1.26	3.22	29.25	42.43	3.87	20.82
18	1.13	5.37	6.32	10.40	7.09	16.95	5.93	5.12
19	2.72	11.92	4.80	15.35	12.60	6.74	3.00	14.44
20	6.05	7.24	1.87	10.99	2.87	8.74	3.75	24.39
Total in g/3.32 m²	40.38	112.28	120.98	320.62	225.76	380.24	93.21	446.20
Total in g/m²	12.16	33.82	36.43	96.57	68.00	114.53	28.07	134.40

where: c – number of species common for both samples compared, a – number of species in spring sample, b – number of species in summer sample.

Results of this analysis are presented in Table V.

Table VI presents generally biomasses of individual samples also from two series taken, irrespectively to the proportion of biomasses of individual species. Finally, in Table VII there are compared calculations illustrating standing crops and increments of herbaceous plants and mosses in four associations studied. Since values obtained refer to 20 samples with the total area of 3.32 m² they should be divided by this value to produce data per 1 m².

It should be reminded that production estimate from 20 circular samples referred to strictly determined cover by herb layer. Assuming that along with herb layer cover there changes the density of individuals, and particularly

Standing crops and growth of vegetation in the herb layer of *Tilio-Carpinetum* (*T-C*), *Pino-Quercetum* (*P-Q*), *Vaccinio myrtilli-Pinetum* (*V-P*) and *Carici elongatae-Alnetum* (*C-A*)

Tab. VII

Standing crops and growth of vegetation	*T-C*	*P-Q*	*V-P*	*C-A*
Standing crops of hemicryptophytes on July 8 in g/3.32 m²	109.49	172.98	192.74	410.05
Standing crops of hemicryptophytes on April 28 in g/3.32 m²	24.80	84.35	111.78	61.27
Growth of hemicryptophytes in g/3.32 m²	84.69	88.63	80.96	348.78
Growth of geophytes in g/3.32 m²	8.65	1.12	–	–
Total growth of herbs in g/3.32 m²	93.34	89.75	80.96	348.78
Total growth of herbs in g/m²	28.11	27.03	24.38	105.00
Total growth of mosses in g/m²	0.46	9.62	12.25	3.59

their biomass, there was introduced a correction of production estimation by the value obtained from the analysis of average covering from 400 m². Simple proportion was used here according to the formula:

$$Bf = \frac{Bc \times Cf}{Cc} \quad (2)$$

where: Bf – calculated biomass correlated with the cover Cf, Cf – the size of average covering calculated from the area of 400 m² (50 samples), Bc – the biomass from 20 samples, Cc – average covering from 20 samples.

If, for example, in *Tilio-Carpinetum* the standing crop of herb layer from 20 samples revealed the increment amounting to 28.11 g/m² with the average covering of 60%, while the average covering from 50 random samples with the area of 400 m² amounted only to 29%, then the biomass (increment) with 29% covering is equal to:

$$\frac{28.11 \times 29}{60} = 13.59 \text{ g/m}^2$$

In this way there were calculated remaining values in the column B of Table VIII.

Net production of herbs in the herb layer of four forest associations

Tab. VIII

Association	A* (g/m²)	B** (g/m²)	C*** $\left(\frac{B}{A}, \%\right)$
Tilio-Carpinetum	28.11	13.59	48
Pino-Quercetum	27.03	17.93	65
Vaccinio myrtilli-Pinetum	24.38	15.44	62
Carici elongatae-Alnetum	105.00	94.98	91

* Production estimate from 20 circular samples with higher density.
** Production estimate after the introduction of correction (see text).
*** $C = \frac{B}{A} \times 100$.

The average covering from 50 random samples was following:
in *Tilio-Carpinetum* – 29%,
in *Pino-Quercetum* – 39.8%,
in *Vaccinio myrtilli-Pinetum* – 38%,
in *Carici elongatae-Alnetum* – 54%.

The average degree of herb layer covering in given associations is therefore rather low in seriously deviates from the covering in circular samples and the one in stands utilized for phytosociological records. Owing, however, to the big area of samples (400 m²) taken completely randomly, values obtained from them should be considered objective.

4. RESULTS AND DISCUSSION

Although sample series were not taken at monthly intervals, as it is suggested by Ovington's (1962) instruction, still the principle of this method has been observed assuming that two series – the spring and summer one – reflect well the peak standing crops of geophytes, as well as minimal and maximal standing crop of nanophanerophytes and hemicryptophytes. The estimation of herb layer increment could be calculated from the difference between the maximal and minimal standing crop of hemicryptophytes and nanophanerophytes, adding to it the peak standing crop of early spring geophytes.

In the two associations studied, where geophytes occurred, the standing crop of their biomass, as well as their frequency and density at spring, were decidedly higher during spring, than in summer. Until July there remained only single individuals with a very low biomass, what evidence that these populations completed already their development during this period. One can expect that sampling during the fructification of these species gives the possibility of measuring their maximal production.

The problem of production estimate for remaining species is entirely different. In an analysis of their increment in both series we found that their total biomass in summer samples (at the full swing of development) is always higher, than at the beginning of vegetation at spring. No doubt that this fact results from the increment of biomass, but whether only due to it? Answer to this question gives the analysis of the proportion of biomasses of individual species in herb layer of definite association within these two series of samples (compare Tab. I–IV and Tab. V, illustrating the degree of floristic similarity of samples). It appears that, e.g. out of 45 herbaceous species forming the herb layer in *Tilio-Carpinetum* there were only 18 common species, 8 which occurred exclusively in spring samples, while 19 species have been recorded exclusively in summer samples; altogether there were not less, than 27 various species.

On the basis of an analysis of standing crops of these three groups of species one can expect that in summer series the higher standing crop of species common for both series might present the result of the increment of their biomass. It cannot, however, be accepted that standing crops of species different in both series could present the increment. These same reservations refer to the analysis of standing crop in remaining associations. On this basis one can draw a general and very important conclusion, that the increase in standing crop of plants found in summer is a result of not only actual growth, but also spatial variation in specific composition, numbers and biomass of plants. It should be stressed that next sample series are taken from ever other places, than previous ones. Since the variation in herb layer, its heterogeneity is enormous, hence results obtained in this way are unreliable. And this is, perhaps, the greatest drawback of this techniques. In order to prevent this, the number of samples within each series should be considerably increased to the number statistically sufficient. This in turn, due to the enormous labour consumption of the harvest method, makes impossible to meet this requirement.

Without going into a detailed analysis we find (on the basis of data from Table VI) that individual summer samples in most cases (although not always) reveal the higher standing crop, when compared with spring samples. In result the total standing crop of the summer series is always greater, than that in spring one, what could be, with serious reservations, considered as results of increment.

It needs to be added that the calculation of increments on the basis of minimal and maximal standing crop provides another difficulty, because we do not know when studies should be started and when completed to assure that the minimal crop is equivalent to the beginning of vegetation development, while the maximal one – to the full swing of this development. Clipping of all species in samples at one date, even if repeated at monthly or shorter intervals, is only the determination of standing crops, and the standing crop is, as it was evidenced above, affected to a serious extent by the spatial variation in biomass. Sometimes few samples with a high standing crop might decidedly affect the overestimation of results.

It appeared that the production of herbaceous plants in herb layer amounts from 24.38 g/m² in *Vaccinio myrtilli-Pinetum molinietosum* up to 105 g/m² (1050 kg/ha) in *Carici elongatae-Alnetum*, while moss production from 0.46 g/m² in *Tilio-Carpinetum* to 12.25 g/m² in *Vaccinio myrtilli-Pinetum molinietosum* (more detailed data in Tab. VII). These results, of course, concern stands with definite density and plant cover. If, however, one would introduce corrections resulting from the analysis of average cover in whole phytocoenoses (50 random samples), then the value of production would be considerably lower and amount from 48 to 91% of the estimate obtained from 20 circular samples with the higher, average covering by herb layer (compare Tab. VIII). In this Table the column *A* gives the estimate of production from 20 circular samples with higher density, the column *B* – the estimate of production after the introduction of correction, while column *C* – the percent ratio of these two values $\left(\frac{B}{A} \times 100\right)$. Latter calculations prove how great significance in production estimate has the selection of samples for analysis. The selection of places for sampling, concerning requirements used in the preparation of phytosociological records, gives in result mostly values deviating from average, actual floristic and quantitative relations prevailing in herb layer. This is why methods employing a very great number of samples taken in entirely random way are worthy recommendation. Having this in mind we repeated the estimate in these same stands of ground vegetation in following vegetation seasons with considerably modified procedure, more simple, but rather more accurate at the same time (Traczyk 1967).

REFERENCES

1. Ovington, I. D. 1962 – Outline of general procedure to determine organic production of woodlands – (mimeographed).
2. Rajchel, R. 1965 – Net primary productivity of the herb layer in the forest associations of the Ojców National Park (Southern Poland) – Fragm. Flor. Geobot. 11: 121–150.
3. Szafer, W., Kulczyński, S., Pawłowski, B. 1953 – Rośliny polskie – Warszawa, 1020 pp.

4. Traczyk, T. 1967 – Studies on herb layer production estimate and the size of plant fall – Ekol. Pol. A, 15: 837–867.
5. Traczyk, H., Traczyk, T. 1965 – Charakterystyka fitosocjologiczna terenów badawczych Instytutu Ekologii PAN w Dziekanowie Leśnym (Puszcza Kampinoska) – Fragm. Flor. Geobot. 11: 547–562.

PRÓBA OCENY PRODUKCJI RUNA LEŚNEGO

Streszczenie

W pracy podano wstępną próbę oceny produkcji runa w czterech zbiorowiskach leśnych Kampinoskiego Parku Narodowego: *Tilio-Carpinetum*, *Pino-Quercetum* (wariant ze *Scorzonera humilis*), *Vaccinio myrtilli-Pinetum molinietosum*, *Carici elongatae-Alnetum*. Do badań zastosowano uproszczoną metodę opracowaną przez Ovingtona (1962) dla potrzeb Międzynarodowego Programu Biologicznego. Wielkość produkcji nanefanerofitów i hemikryptofitów wyliczono z różnicy stanów w okresie ich pełnego rozwoju (lato) oraz stanu minimalnego (wiosna). Za produkcję geofitów wczesnowiosennych uznano ich stan maksymalny w okresie owocowania. Ocena produkcji runa odnosiła się do ściśle określonego pokrywania stwierdzonego w próbach. Wprowadzono również poprawkę do tej oceny przez zastosowanie wskaźnika przeciętnego pokrywania, uzyskanego ze specjalnych prób pobieranych losowo z całej fitocenozy badanych zespołów. Wskazano na duże znaczenie, jakie posiada sposób doboru miejsc dla pobrania prób, jeśli chodzi o ostateczne wyniki oceny.

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