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STANDING CROP AND CONSUMPTION OF HERB LAYER PLANTS IN THE FRESH CONIFEROUS FOREST*

ABSTRACT: Studies were done with the use of the plot-harvest method in the fresh coniferous forest (*Vaccinio myrtilli-Pinetum*) during the four seasons of years 1973–1975. The standing crop of ground vegetation varied from 72.09 to 151.02 g of dry weight/m^2, depending upon season. The total annual consumption by herbivores amounted to 3.03 g of dry weight/m^2 in young plantations, 1.43 g of dry weight/m^2 in pole-sized stands, and 4.82 g of dry weight/m^2 in timber stands, while the consumption by deer calculated from differences in consumption on accessible and enclosed areas amounted to 2.71, 0.86, and 2.71 g of dry weight/m^2, respectively. Plants dominating in the ground vegetation contributed most to consumption by deer, although certain scarce ones were exploited to a serious extent.

Contents

1. INTRODUCTION

Recent studies on the productivity of forest herb layer showed that the standing crop and species composition varied in relation to the forest site type, age of stand, and season of year,

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but these studies, in general, did not include the consumption by big herbivores (H. Traczyk and T. Traczyk 1967, T. Traczyk 1967, Aulak 1970, Moszyńska 1970, Plewczyńska 1970, Wójcik 1970). With the aid of direct observations (Dzięciołowski 1969) and rumen analyses (A. Siuda, Żurowski and H. Siuda 1969, Dzięciołowski 1970, and others) it was found that forest herb layer plants constitute, besides of browse, an important component of deer diet, and plants of individual species are consumed to various degree during individual seasons of year. Detailed work determining resources and the utilization of browse has been done already in certain forest communities with the aid of harvest technique on enclosed and accessible plots (Bobek and Dzięciołowski 1972, Bobek, Weiner and Zieliński 1972, and others), but such work on the grazing on herb layer plants is lacking.

Studies did not pay a due attention to the impact of phytophagous animals upon all components of biogeocenosis (Dinesman 1967) and research aimed at the detailed analysis of feeding through clipping and measuring plants on fenced and accessible areas, due to a high variation of elements studied requires a great number of samples, is highly labour-consuming and, therefore, rarely used (Van Dyne 1968).

Fresh coniferous forest (*Vaccinio myrtilli-Pinetum*) presents a forest type most numerously represented in Poland and constituting 38.6% of the total forest area. This forest type was selected for these studies aiming at the determination of the standing crop of herb layer plants, which may provide deer with food, as well as of the extent of its utilization by these animals. Besides, the purpose of work was to determine differences in the standing crop and in the utilization of herb layer plants during individual seasons of year and in developmental stages of forest stand.

2. STUDY AREA, PROCEDURES, MATERIAL

Studies were done in a compact forest tract, called the "Dulowska Forest" with the area of about 2,300 ha, situated in the western, flat portion of the Krzeszowice Rift Valley, about 30–40 km to the west from Cracow. The tract includes following forest types: fresh coniferous forest, moist coniferous forest, moist mixed coniferous forest, and, locally, moist mixed deciduous forest, moist deciduous forest, and a proper alderwood (Sikorska 1973). 97% of the area is under pine stands or those with pine predominance. Big herbivorous animals are represented in the Dulowska Forest by 3 species from deer family (*Cervidae*), namely: moose (*Alces alces* L.), red deer (*Cervus elaphus* L.), and roe deer (*Capreolus capreolus* L.). Density of these herbivores amounted to 0.4 moose, 0.65 red deer, and 6.5 roe deer per 100 ha (Pucek et al. 1975) and was slightly higher than average one to be met in Poland on similar areas.

In 1973 sample areas (two in each young plantation, pole-sized, and timber stand) representing the fresh coniferous forest were selected in 6 forest compartments. They served for studies until 1975. The areas were surrounded by pole fences with dimensions 24 × 3 m and the height of 2.20 m (Fig. 1), which made it impossible to get in for animals of the size of roe deer and bigger. Accessible control areas were located in the direct neighbourhood of these enclosures. On areas of both types there were located plots for the harvest of plants during individual seasons of year. Plots have been located along straight lines, the centre of plot being located at 3-m intervals. Plots had 0.25 m^2 area (delimited with the aid of compasses with 283 mm radius)

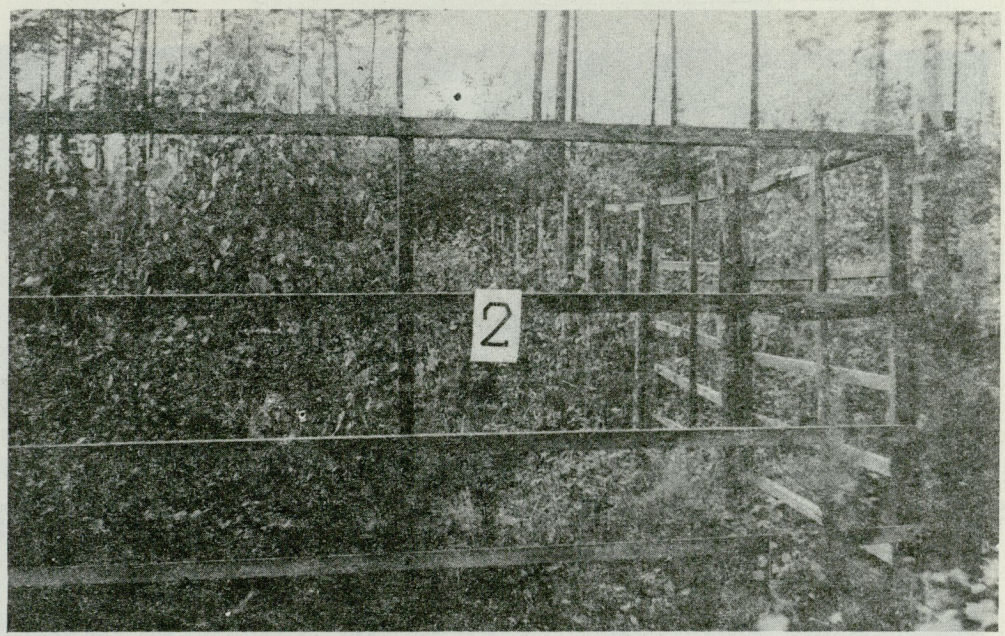

Fig. 1. Enclosed study area in a young plantation (photo by J. Zwoliński)

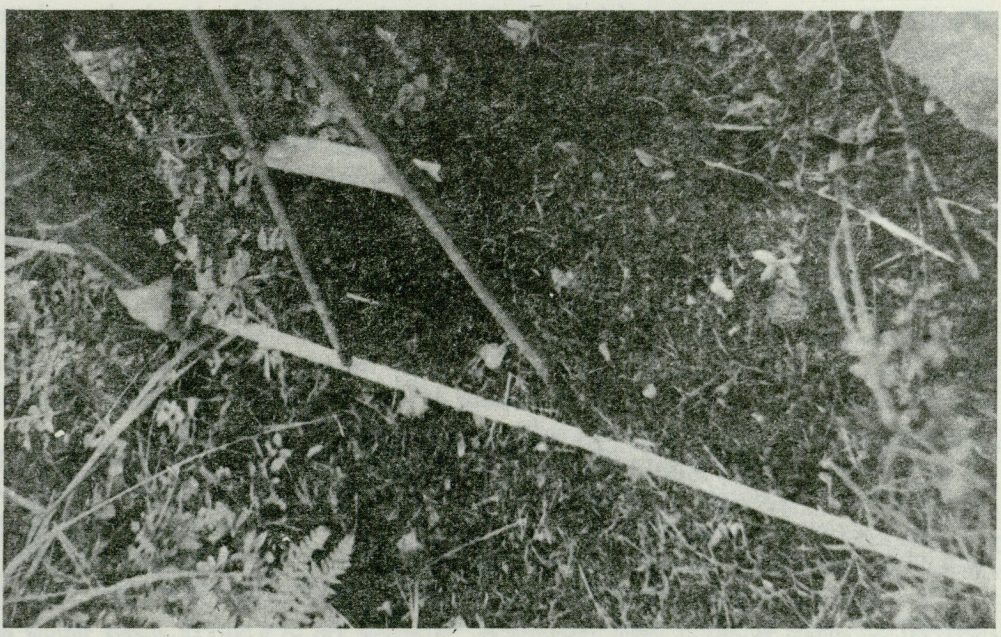

Fig. 2. Delineated plot with an area of 0.25 m^2 following to the harvest of herb layer plants (photo by J. Zwoliński)

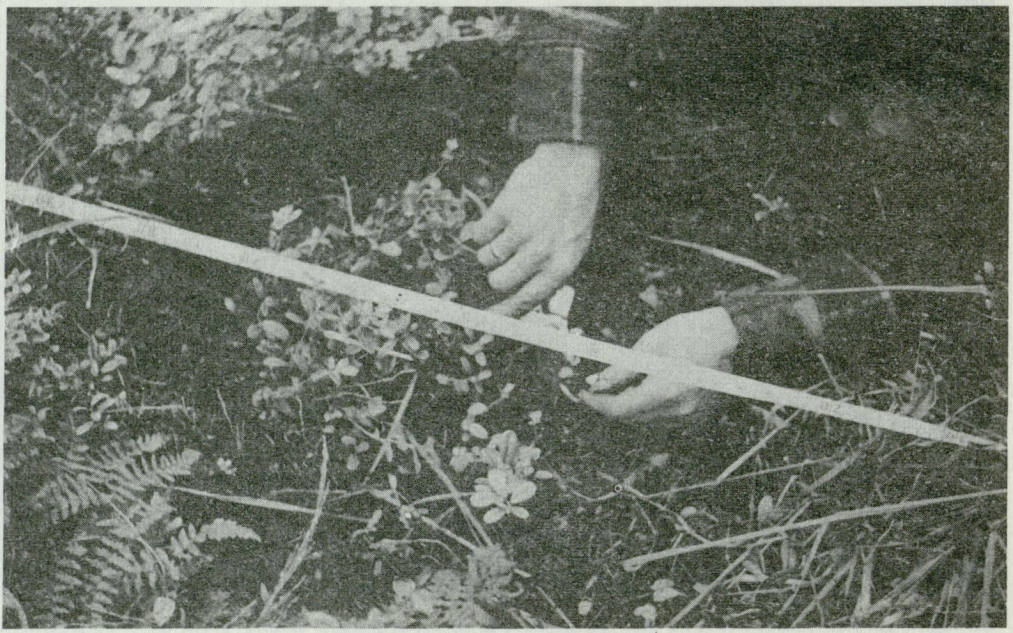

Fig. 3. Clipping herb layer plants (photo by J. Zwoliński)

(Fig. 2). All herb layer plants, including herbaceous plants, dwarf-shrubs, shrubs, and tree saplings up to 50 cm high, have been cut on these areas just above the ground level (Fig. 3). Plants cut were segregated according to species (botanical nomenclature follows that in Szafer, Kulczyński and Pawłowski 1967), and individuals revealing signs of fresh grazing originated after the last harvest, were isolated. Each fraction of damaged and undamaged plants broken into species, was transported in foil bags to laboratory, dried to the dry state and weighed with the accuracy to 0.1 g. The extent of damage on plants has been estimated during the harvest by comparing with growing besides undamaged plants of the same size and expressed in per cents of plant biomass lacking (Fig. 4). It was assumed that the biomass calculated on such basis represents the consumption of herb layer plants.

Harvests were performed on following dates: (1) spring (May – the flowering of *Anemone nemorosa* L.), (2) summer (July, beginning of August – fructification of *Vaccinium myrtillus* L.), (3) autumn (beginning of November – falling of leaves from trees), and (4) winter (March, beginning of April – following to snow melt and before the onset of vegetation).

It was assumed that the consumption recorded during individual seasons comes from the period between the current and previous harvest. So, the calculated consumption included: two months in spring (from mid-March until mid-May), two months in summer (from mid-May to mid-July), four months in autumn (from mid-July to mid-November), and four months in winter (from mid-November to mid-March). The consumption by deer was calculated from the difference in consumption between fenced and accessible areas.

Twenty-four samples were taken along each transect (fenced and accessible one). Altogether 2,674 samples (circular plots) were collected – 2,304 during 1974 and 1975 and 370 in 1973.

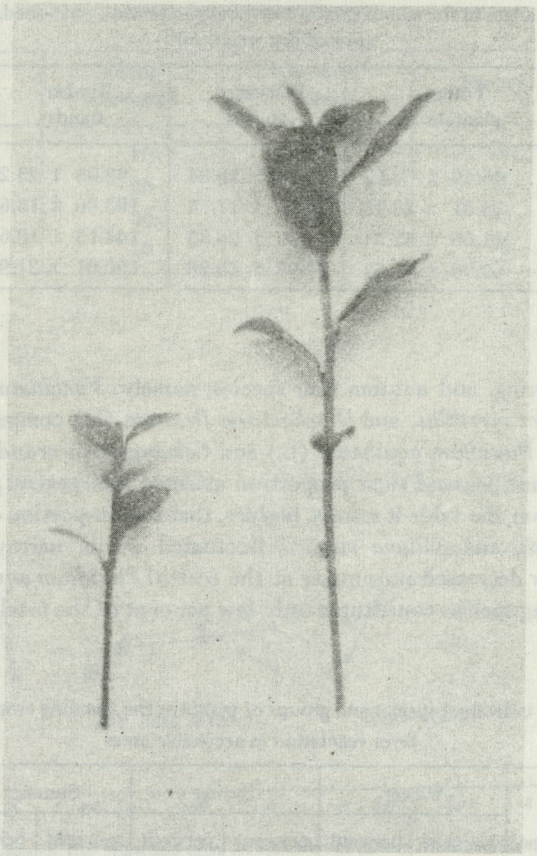

Fig. 4. Comparison of grazed and undamaged plant with a similar size (photo by J. Zwoliński)

Results of studies from 1973–1975 were presented jointly, the standing crop and consumption of herb layer plants being given in an annual cycle.

3. RESULTS

3.1. Standing crop of herb layer plants

The standing crop of above-ground parts of forest herb layer plants in the fresh coniferous forest was subjected to seasonal fluctuations – on average from 72.09 to 151.02 g of dry weight/m^2 (Table I). Throughout developmental stages of a forest stand is attained its minimum in winter, increased during spring to maximum in summer, and then decreased during autumn to the winter status. Greatest differences in the standing crop of herb layer plants between winter and summer seasons occurred in young plantations (45.49 g of dry weight/m^2 in winter versus 211.68 g of dry weight/m^2 in summer), lesser in timber stands (92.05 versus 144.15 g of dry weight/m^2), and least ones in pole-sized stands (77.97 versus 97.60 g of dry weight/m^2).

Table I. Seasonal changes in the standing crop in young plantations, pole-sized, and timber stands (in g of dry weigth/m^2)

Season	Young plantations	Pole-sized stands	Timber stands	On average
Winter	45.49 ± 9.12	78.74 ± 20.84	92.05 ± 23.24	72.09 ± 14.90
Spring	74.31 ± 28.78	80.48 ± 17.75	103.90 ± 13.67	86.23 ± 11.32
Summer	211.68 ± 42.54	97.60 ± 26.85	144.15 ± 18.65	151.02 ± 16.91
Autumn	62.96 ± 7.52	77.97 ± 15.28	120.01 ± 21.97	86.91 ± 7.83

During winter, spring, and autumn four species, namely: *Vaccinium vitis-idaea* L., *Calluna vulgaris* L., *Vaccinium myrtillus*, and *Deschampsia flexuosa* (L.) comprised about 90% of herb layer biomass, while *Pteridium aquilinum* (L.) and *Calamagrostis arundinacea* (L.) appeared in summer in great quantities and their proportion attained then several per cent of the standing crop (Table II). From the table it results, besides, that the proportion of *Vaccinium myrtillus*, *Deschampsia flexuosa*, and *Calluna vulgaris* fluctuated within narrow limits, while that of *Vaccinium vitis-idaea* decreased in summer at the cost of *Pteridium aquilinum* and various tree species. The remaining species constituted only few per cent of the total standing crop.

Table II. Proportion of individual species and groups of plants in the standing crop and consumption of herb layer vegetation in accessible areas

Species, group of plants	Winter		Spring		Summer		Autumn	
	per cent of standing crop	per cent of consumption	per cent of standing crop	per cent of consumption	per cent of standing crop	per cent of consumption	per cent of standing crop	per cent of consumption
Vaccinium vitis-idaea	54.5	30.7	39.8	7.0	27.0	8.7	41.1	15.9
Vaccinium myrtillus	19.2	28.8	19.3	43.0	12.9	64.8	16.0	37.3
Calluna vulgaris	11.3	8.6	15.0	13.9	11.3	2.6	21.5	5.7
Deschampsia flexuosa	8.8	2.6	13.8	5.2	14.3	2.8	17.0	0.4
Gramineae	0.5		6.4		15.2		1.1	
Pteridium aquilinum	–	–	1.4	0.2	16.8	4.2	–	–
Trees and shrubs	5.6	29.3	3.5	30.5	1.6	7.6	2.8	40.7
Remaining	0.1	–	0.8	0.2	0.9	9.3	0.5	–

The comparison of plant biomass between fenced and accessible areas failed to reveal any significant differences. This evidences that the exclusion of deer feeding with the aid of fencing did not result in changes of herb layer resources (Fig. 5).

The highest number of species was recorded during summer in young plantations and the lowest one – in pole-sized stands (Table III). It was also in young plantations, where the greatest fluctuations in the number of species occurred during individual seasons of year.

Table III. Number of herb layer plant species found in individual phases of stand during four seasons of year

Season	Young plantation	Pole-sized stand	Timber stand
Winter	13	8	10
Spring	26	12	21
Summer	35	15	22
Autumn	26	12	18

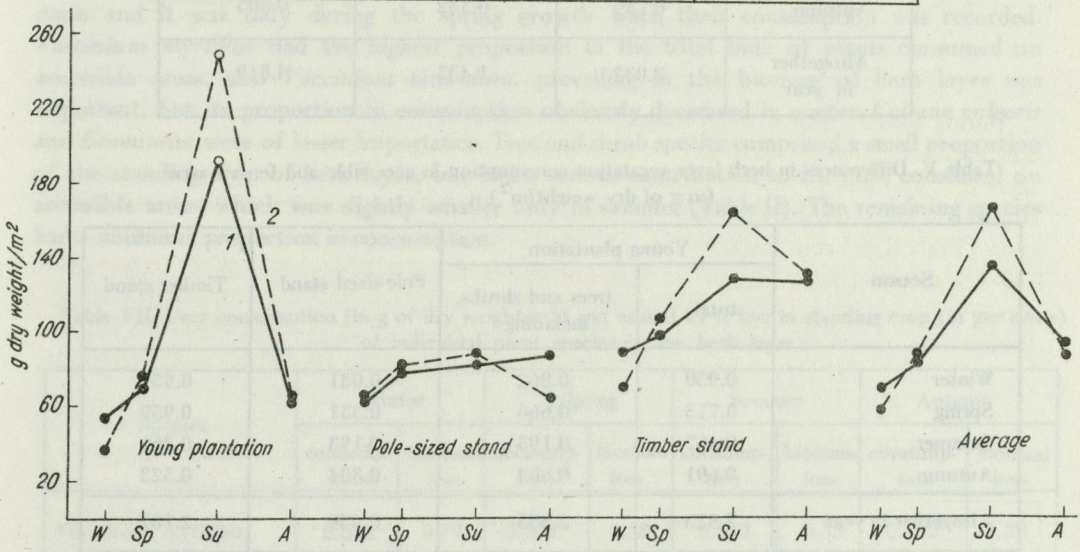

Fig. 5. Comparison of changes in the standing crop of herb layer plants on accessible (*1*) and fenced (*2*) areas
W – winter, *Sp* – spring, *Su* – summer, *A* – autumn

3.2. Consumption of herb layer plants

Signs of feeding have been found on herb layer plants both in fenced and in accessible areas. The calculated total biomass of consumed parts of plants or the consumption by herbivores throughout a year amounted in timber stands to 4.82 g of dry weight/m^2, in young plantations – to 3.03 g of dry weight/m^2, and in pole-sized stands – to 1.43 g of dry weight/m^2 (Table IV). During summer it was highest in timber stands (1.65 g of dry weight/m^2) and lowest in pole-sized stands, where it did not exceed 0.39 g of dry weight/m^2 in any season.

The consumption of herb layer plants was always greater in accessible areas and the difference between accessible and enclosed areas amounted throughout a year to 2.82 g of dry weight/m^2 in young plantations, 2.71 g of dry weight/m^2 in timber stands, and 0.86 g of dry weight/m^2 in pole-sized stands (Table V). The consumption of tree saplings and shrubs classed into herb layer (up to 50 cm of height) prevailed in young plantations, but was negligible in pole-sized and timber stands with very poor understory and regeneration. The difference in the consumption of herbaceous plants and dwarf-shrubs on accessible and fenced areas was in timber stands highest from autumn until spring and in young plantations in summer. In pole-sized stands the difference was slight throughout a year.

Table IV. Consumption of herb layer on accessible areas (in g of dry weight/m^2)

Season	Consumption		
	young plantation	pole-sized stand	timber stand
Winter	0.974	0.381	1.505
Spring	0.790	0.391	1.061
Summer	0.539	0.331	1.648
Autumn	0.729	0.332	0.605
Altogether in year	3.032	1.435	4.819

Table V. Differences in herb layer vegatation consumption in accessible and fenced areas (in g of dry weight/m^2)

Season	Young plantation		Pole-sized stand	Timber stand
	total	trees and shrubs, including		
Winter	0.950	0.862	0.031	0.959
Spring	0.715	0.666	0.331	0.959
Summer	0.467	0.193	0.193	0.266
Autumn	0.691	0.664	0.304	0.523
Altogether in year	2.823	2.385	0.859	2.707

The loss of herb layer plants caused by consumption constituted a small percentage of their standing crop. The consumption on accessible areas constituted 0.3–1.9% and on fenced ones – 0.1–0.8% of the standing crop of plants (Table VI). The standing crop was at most reduced in accessible young plantations and timber stands during winter, and at least on fenced young plantations during summer. The utilization of the standing crop was in all developmental phases of a stand obviously lower in fenced areas than on accessible ones.

Table VI. Caused by consumption loss in the standing crop of herb layer (in per cents) on fenced and accessible areas

Season	Young plantations		Pole-sized stands		Timber stands		Total	
	fenced	accessible	fenced	accessible	fenced	accessible	fenced	accessible
Winter	0.06	1.90	0.53	0.60	0.78	1.67	0.52	1.41
Spring	0.09	1.12	0.07	0.49	0.09	1.07	0.09	0.90
Summer	0.03	0.28	0.14	0.38	0.85	1.27	0.32	0.62
Autumn	0.26	1.16	0.04	0.31	0.06	0.47	0.06	0.59

From among 48 plant species, which occurred on the areas studied, signs of grazing were recorded on 17 species, out of which only 5 (3 dwarf-shrubs and 2 tree saplings) indicated use during all seasons of year. Browsing reduced the standing crop of species prevailing in the herb layer, except of *Vaccinium myrtillus*, to a very slight extent, but on the other hand species with not numerous occurrence (*Trientalis europaea* L., *Glechoma hederacea* L., *Taraxacum officinale* Web., *Veronica chamaedrys* L., *Stellaria holostea* L., *Leontodon hispidus* L.) were used frequently to a considerably higher degree, and artificially introduced oak (*Quercus* sp.) was consumed in 4.45–18.87% of its standing crop (Table VII). A high degree of utilization was noted on herbaceous plants during spring and summer, but *Gramineae* were utilized at minimum and it was only during the spring growth when their consumption was recorded. *Vaccinium myrtillus* had the highest proportion in the total bulk of plants consumed on accessible areas, also *Vaccinium vitis-idaea*, prevailing in the biomass of herb layer was important, but its proportion in consumption obviously decreased in winter. *Calluna vulgaris* and *Gramineae* were of lesser importance. Tree and shrub species comprised a small proportion of the standing crop of herb layer, but had a serious contribution to the bulk consumed on accessible areas, which was slightly smaller only in summer (Table II). The remaining species had a minimum proportion in consumption.

Table VII. Deer consumption (in g of dry weight/m^2) and caused by it loss in standing crop (in per cents) of individual plant species in the herb layer

Species	Winter		Spring		Summer		Autumn	
	consumption	biomass loss	consumption	biomass loss	consumption	biomass loss	consumption	biomass loss
Vaccinium myrtillus	0.082	0.79	0.300	1.88	0.050	0.33	0.182	1.28
Vaccinium vitis-idaea	0.108	0.26	0.030	0.10	0.30	0.08	0.069	0.18
Calluna vulgaris	0.067	0.99	0.095	0.35	0.015	0.08	0.031	0.16
Pteridium aquilinum	–	–	0.002	0.15	0.054	1.66	–	–
Veronica chamaedrys	–	–	0.0016	0.76	–	–	–	–
Taraxacum officinale	–	–	0.0003	1.33	–	–	–	–
Trientalis europaea	–	–	0.0001	0.19	–	–	–	–
Melampyrum pratense L.	–	–	–	–	0.042	22.95	–	–
Leontodon hispidus	–	–	–	–	0.012	64.35	–	–
Stellaria holostea	–	–	–	–	0.003	10.87	–	–
Glechoma hederacea	–	–	–	–	0.0006	2.08	–	–
Deschampsia flexuosa	0.001	0.02	–	–	–	–	0.02	0.01
Calamagrostis arundinacea and other *Gramineae*	–	–	0.025	4.16	0.016	0.06	–	–
Quercus sp.	0.191	9.86	0.193	18.87	0.044	4.45	0.173	16.30
Populus tremula L.	0.038	2.73	0.035	2.08	0.021	3.04	0.029	4.58
Frangula alnus Mill.	0.006	1.35	–	–	0.002	1.14	0.019	6.98
Salix caprea L.	0.052	15.16	–	–	–	–	–	–

The comparison of proportions of individual species in the consumed plant biomass on fenced and accessible areas indicates that on accessible areas the proportion of trees and shrubs was high. In fenced areas they were consumed only during autumn and even then to a slight degree. The consumption of *Calluna vulgaris* was also greater on accessible areas.

4. DISCUSSION

Studying of consumption via comparisons of biomass requires numerous replications (Van Dyne 1968), but the present 3-year long studies rendered possible the collection of sufficient data and the calculation of standing crop of plants in the fresh coniferous forest and its consumption by herbivorous animals.

The calculated standing crop of above-ground parts of herb layer plants from the groups of herbs, dwarf-shrubs, tree saplings, and shrubs up to 50 cm high, amounted on the areas studied to 197.60–211.68 g of dry weight/m^2 during summer (Table I) and was then similar to that found also in the fresh coniferous forest – 192.74 g of dry weigh/m^2 (H. Traczyk and T. Traczyk 1967) and in the moist coniferous forest – 169.29 g of dry weight/m^2 (Moszyńska 1970), and also in the mixed coniferous forest – 172.98 g of dry weight/m^2 (H. Traczyk and T. Traczyk 1967), lower than in alderwood – 410.05 g of dry weight/m^2, but higher than that found in oakwood – 109.45 g of dry weight/m^2 (H. Traczyk and T. Traczyk 1967) and in dry coniferous forest – 22.70 g of dry weight/m^2 (Wójcik 1970), and in savannah – 81.7 g of dry weight/m^2 and oakwood in Minnesota – 60.0 g of dry weight/m^2 (Ovington, Heikamp and Lowrence 1963).

Similarly as in other associations (T. Traczyk 1967, 1968, Aulak 1970, Plewczyńska 1970, Wójcik 1970), also in the fresh coniferous forest studied only several species, which found here their ecological optimum (*Vaccinium myrtillus*, *V. vitis-idaea*, *Calluna vulgaris*, *Deschampsia flexuosa*, and in summer *Pteridium aquilinum* – Table VII) comprised the fundamental plant biomass. The occurrence of herb layer during all seasons of year, since even the lowest standing crop (during winter in pole-sized stands) amounted to about 40 g of dry weight/m^2, was important for herbivores. On the other hand in deciduous forests and alderwoods herb layer vegetation disappears entirely during winter or is negligible comprising 3–4% of the summer standing crop (T. Traczyk 1967, 1968).

Evident damage to plants rendered it possible to estimate the loss of bulk of herb layer plants as a consumption and the comparison of consumption from accessible and fenced (in a way precluding the entering of big mammals) areas may be considered as consumption by big herbivores, and in this case that by deer (red deer, roe deer, moose). The consumption was always lower in fenced areas, what should be attributed to the elimination of these animals. Red and roe deer were observed on several occasions, while feeding on control areas during studies and their presence was confirmed also by droppings. It was assumed that small herbivores (hares, rodents) were feeding to the same degree on enclosed and accessible areas.

While comparing the composition of feeding on plants on enclosed and accessible areas one can conclude that deer consume in the fresh coniferous forest the same plant species as remaining herbivores do and an obvious difference occurs only in the case of browse, which is distinctly preferred by deer.

Considering the calculated consumption it seems that the low degree of the utilization of standing crop (Table VI) most probably does not affect to any serious degree the biomass of herb layer plants, the more, that as indicated by P i n d e r (1975), the extermination of dominant species results in an increased production by the remaining species. The calculated consumption of herb layer vegetation by deer (jointly during the four seasons – 0.84 g of dry weight/m^2 in pole-sized stands, 2.82 g of dry weight/m^2 in young plantations, and 2.71 g of dry weight/m^2 in timber stands) indicates that herb layer plants provide an important component of their diet. The high consumption in young plantations by deer results first of all from an intensive feeding on tree saplings and shrubs which sparsely occur in pole-sized and timber stands. Feeding of deer on dwarf-shrubs, more intensive in timber and pole-sized stands than in young plantations, merits attention.

Timber and pole-sized stands, due to their high areal proportion offer more food for herbivorous animals, but young plantations have during summer more differentiated and attractive food for deer in respect to plant species. The proportion of herbs in deer consumption increases, therefore, during summer.

It is assumed also that herbaceous plants improve digestibility of fodder (L e R e s c h e and D a v i s 1973). Consumption by deer was found for the same species, which D z i ę c i o ł o w s k i (1969) indicated as a result of research with the use of direct methods. The total consumption of *Vaccinium vitis-idaea* was in the forest type studied higher than that of *Vaccinium myrtillus*, probably due to more numerous occurrence of the former. On the other hand the degree of the use of *Vaccinium myrtillus* standing crop (in per cent) was by far greater during spring, summer, and autumn, while the utilization of *Vaccinium vitis-idaea*, which retains leaves, was increased only during winter (Table II). The high degree of utilization of herbaceous species with not numerous occurrence indicates that they are readily consumed, although their significance in the food balance of deer was low. Perhaps an increased exploitation of these species may to some extent affect the species composition of the herb layer. Tree saplings and shrubs were readily eaten. They constitute an importent item in deer diet, what was confirmed by studies indicating a considerable utilization of browse (B o b e k, W e i n e r and Z i e l i ń s k i 1972).

On the basis of energetic requirements of roe deer (W e i n e r 1975) and adequate conversion factors (G o l l e y 1961) it was possible to calculate its consumption on 250 kg of dry weight/year. While assuming that red deer consume four and moose eight times more food, the aproximate requirement by deer in the Dulowska Forest would amount to 3.15 tons of dry weight/100 ha per year. On the other hand the calculated consumption in timber, pole-sized stands, any young plantations, with the proportion of 52, 35, and 6% of acreage, respectively (7% was under thickets, practically deficient of herb layer) would amount on average to 1.56 tons of dry weight/100 ha per year in the fresh coniferous forests of the tract studied. This estimate indicates that herb layer would meet the annual food requirements of deer in 50%, what would be concordant with the recent research (D z i ę c i o ł o w s k i 1969, A. S i u d a, Ż u r o w s k i and H. S i u d a 1969).

The comparison of standing crop on accessible and enclosed areas (Fig. 5) did not create possibilities of the calculation of consumption due to the low degree (0.3–1.9%) of its utilization. Numbers describing the loss of standing crop by consumption are contained within standard deviation of the calculated standing crop. Therefore, the method of the calculation of consumption via comparison of standing crop, useful for the calculation of browse (B o b e k and D z i ę c i o ł o w s k i 1972), is useless in the case of studying the consumption of herb layer plants.

5. SUMMARY

Studies were carried out during 1973–1975 in the three developmental phases of forest stand, namely: young plantations, pole-sized, and timber stands of the fresh coniferous forest (*Vaccinio myrtilli-Pinetum*). Each year along 12 transects in enclosed and accessible areas circular plots (altogether 2,674) with the area of 0.25 m^2 each have been located. From these plots herb layer vegetation, namely: herbs, dwarf-shrubs, tree saplings and shrubs up to 50 cm high, have been cut at the ground level. The plants were segregated to species, the loss of biomass was determined on browsed individuals, and after drying to a dry state and weighing the plants collected, consumption was estimated. Differences in losses of plants from accessible and fenced areas were accepted as deer consumption.

The standing crop of herb layer plants was subjected to seasonal fluctuations, on average from 72.09 to 151.02 g of dry weight/m^2 (Table I). The following 4 species: *Vaccinium myrtillus*, *V. vitis-idaea*, *Calluna vulgaris*, and *Deschampsia flexuosa*, and in summer additionally *Pteridium aquilinum* and *Calamagrostis arundinacea* had the highest proportion from among 48 species (Table II). Plants have been consumed both on accessible and on fenced areas, former ones consistently revealing higher consumption amounting to 4.82 g of dry weight/m^2 per year in timber stands, to 3.03 g of dry weight/m^2 in young plantations, and 1.43 g of dry weight/m^2 per year in pole-sized stands (Table IV), what comprised from 0.3 to 1.9% of the standing crop (Table VI). Consumption by deer amounted to 2.82 g of dry weight/m^2 in young plantations, 2.71 g of dry weight/m^2 in timber stands, and 0.86 g of dry weight/m^2 in pole-sized stands on an annual basis (Table V). Consumption was found on 17 plant species, but the most numerous species had the fundamental share. On the other hand certain herbaceous plants, tree saplings, and shrubs were used to a high degree (Table VII), despite their slight proportion in the total consumption (Table II).

It was found that the method of the comparison of food standing crop on accessible and enclosed plots, applied in the calculation of browse consumption, should not be used in studies on herb layer vegetation consumption (Fig. 5), due to the slight extent of consumption, lower than the standard deviation of the standing crop calculated.

6. POLISH SUMMARY (STRESZCZENIE)

Badania wykonano w latach 1973–1975 w trzech fazach rozwojowych drzewostanu w borze świeżym (*Vaccinio myrtilli-Pinetum*): uprawach, drągowinach i starodrzewiach. Na powierzchniach grodzonych i nie grodzonych wyznaczono corocznie na 12 transektach powierzchnie kołowe o wielkości 0.25 m^2 (łącznie 2674), z których ścinano przy gruncie roślinność runa: zioła, krzewinki oraz drzewa i krzewy do wysokości 50 cm. Rośliny segregowano na gatunki, określano ubytek masy osobników żerowanych i na tej podstawie, po wcześniejszym wysuszeniu do suchej masy i zważeniu zebranych roślin, oznaczono konsumpcję. Różnice ubytków roślin z powierzchni nie grodzonych i grodzonych przyjęto za konsumpcję jeleniowatych.

Zapas roślin w runie ulegał sezonowym wahaniom, przeciętnie od 72.09 do 151.02 g suchej masy/m^2 (tab. I); największy udział posiadały w nim 4 gatunki spośród 48: *Vaccinium myrtillus*, *V. vitis-idaea*, *Calluna vulgaris*, *Deschampsia flexuosa*, a w lecie dodatkowo *Pteridium aquilinum* i *Calamagrostis arundinacea* (tab. II). Rośliny były konsumowane zarówno na powierzchniach nie grodzonych jak i grodzonych, przy czym na tych pierwszych konsumpcja była zawsze wyższa i wynosiła rocznie 4.82 g suchej masy/m^2 w starodrzewiach, 3.03 g suchej masy/m^2 w uprawach i 1.43 g suchej masy/m^2 w drągowinach (tab. IV), co stanowiło od 0.3 do 1.9% zapasu (tab. VI). Konsumpcja jeleniowatych wynosiła w ciągu roku 2.82 g suchej masy/m^2 w uprawach, 2.71 g suchej masy/m^2 w starodrzewiach i 0.86 g suchej masy/m^2 w drągowinach (tab. V). Konsumpcję stwierdzono na 17 gatunkach roślin, lecz podstawowy udział miały w niej gatunki najliczniejsze, natomiast niektóre rośliny zielne oraz drzewa i krzewy były eksploatowane w wysokim stopniu (tab. VII), chociaż ich udział w całkowitej konsumpcji był niewielki (tab. II).

Stwierdzono, że metoda porównania zapasu żeru na działkach nie grodzonych i grodzonych, stosowana do obliczania konsumpcji pędów, nie powinna być stosowana do badań konsumpcji runa (fig. 5) ze względu na niewielki rozmiar konsumpcji, niższy od odchylenia standardowego obliczonego zapasu.

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