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CHANGES IN THE PHYTOMASS AND PRODUCTION OF THE HERBACEOUS LAYER IN THE QUERCETUM PETRAEAE-CERRIS FOREST AFTER SELECTING BY FORESTERS*

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The paper discusses the production biological examinations of the part of the *Quercetum petraeae-cerris* forest stand of the "Síkfőkút Project" research area (JAKUCS, 1973) in which the foresters carried out selecting in September 1973, with an aim of later deforestation. As a result of opening the canopy to a considerable extent, and of the removal of the shrub layer, the environmental factors changed strongly, especially the quantity of radiation reaching the herbaceous layer.

The number of individuals in the herbaceous layer and the changes in its cover, as well as the changes in the quantity of phytomass and production — by the example of the two dominant plant species — are analysed by means of a comparison with the corresponding data of the natural forest.

It is stated that the number of individuals and the cover for 1 ha increased 6.0—6.5 times to that occurring in the natural forest, and again the quantity of phytomass and production increased to its 10—30 folds.

Introduction

In September 1973, the foresters carried out a selection aiming at deforestation in a 10 ha forest portion belonging and completely corresponding to the intensively investigated forest stand within the framework of the MAB program of Hungary. In the pre-cut area, only about a quarter of the wood stand of the forest was left to ensure the natural regeneration of the forest by means of its a corn crop. While in the natural forest there are 816 oak individuals growing in 1 ha, the number of trees in this 1 ha area is 226 at present. The average distance of the trees from one another has become about 10 m as against about 3 m average trunk distance in the natural forest. The estimated coverage of the foliage dropped below 20%, while formerly it had been 79.9% (MAJER, 1974, JAKUCS—HORVÁTH—KÁRÁSZ, 1975). In the shrub layer of the selected forest there remained only some sprout individuals, which in itself means a considerable structural difference in comparison with the rich shrub layer of the natural forest (KÁRÁSZ, 1976).

The sudden and drastic alteration of the structure of the natural forest ecosystem completely upset the relatively permanently stable functioning

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of the ecosystem. In the herbaceous layer of the closed natural forest, phytomass and production investigations had been carried out continually since 1973. In the second year following the selection, the investigations were extended to the herbaceous layer of the neighbouring pre-cut fores too.

It was by this means that we wanted to obtain data on the reaction of the undergrowth of the remaining forest, which had been deprived of a considerable part of its phytomass and primary production, to the changed environmental effects accompanying the changes in structure. Among these effects the cessation of the radiation screening effect of the closed forest can be judged as the most important. Namely, the quantity of the short and long-wave radiation can penetrate almost without obstacle into the stand which has been thinned and deprived even of its shrub layer, this causes completely different ecological conditions for the herbaceous species which had assimilated to the shaded, slightly mesophyl ecological conditions of the forest.

We are also certain that the causes of the changes to be described below should be found, besides the microclimatic changes indicated above, in the fact that owing to the thinning of the trees and the disappearing of shrubs, the soil an organic matter of the forest ecosystem, which had been in equilibrium for many years, has become virtually immediately usable for the herbaceous layer.

Our investigations are related to the second year following the intervention, that is, to 1975. Since the intervention, which had been begun, has been stopped for a long time — for the very reason of investigating the changed conditions — we intend to repeat our present survey at a later time too.

Here we mention that 1975 in its climatic nature was relatively warm (yearly average 10.7 °C) and rich in moisture (yearly amount 714 mm). Warming up at spring-time started very early (February: 0.7 °C, March: 7.9 °C), and again the permanent warm weather ceased only by the end of September. Precipitation appeared definitely in the midsummer maxima (showers, storms) (June: 145.8 mm, July: 114.3 mm, August: 97.5 mm) and we observed only a very small (a quarter of a fifth) maximum in March and in October. The early strong warming up, the relatively small quantity of precipitation in spring, and the warm period without precipitation in September, as well as the warm moist weather in summer, in comparison with that of the two previous years of a different climatic nature, became expressed also quantitatively in the changes of phytomass and production.

Sampling

The description of the methods of harvest and the monolithic method, or that of the individual plant sampling, had been given earlier (JAKUCS—PAPP, 1974). The method of recording the species count the number of individuals and the coverage data necessary for the recalculations per ha was also similar to that applied in the herbaceous layer of the natural

ecosystem: we counted in 10 randomly marked, 4×4 m areas. We considered the 10 times repetition of the counts enough, because the herbaceous plants in the area closed immediately and appeared no longer in mosaics but approximately in a homogeneous arrangemenet.

The detailed seasonal phytomass examinations were made for two species, *Dactylis polygama* and *Poa nemoralis*, since in our estimation these two species can give 70—80% of the phytomass or production of the area (in the natural forest they give 48—55%, according to our measurements). In the case of *Dactylis polygama*, we applied the individual plant method, while the samples of *Poa nemoralis* were collected by harvesting or monolithic sampling. In both of the areas, the samples were taken at identical points of time.

Results and discussion

Changes in the specimen and the cover conditions

In a comparison between the two areas (natural forest and selected forest), it can be immediately stated that under the effect of the changed environmental factors the herbaceous layer in the thinned forest has completely overgrown the soil surface. The mosaic herb layer, corresponding to the light conditions which is characteristic of the natural closed forest, has completely transformed during the two vegetational periods. The short period that has elapsed is not yet enough to check the changes in species composition, therefore we present first the changes that ensued in the number of individuals in the various species and in their cover (Table 1).

It can be seen from the Table that against 1 539 187 individuals per ha in the natural forest, 9 774 600 plant individuals in 1 ha could be counted

Table 1

Number of individuals and cover of the herbaceous layer per 1 ha of the closed (A) and selected (B) forest

Species	Specimens		Cover (per cent)	
	A	B	A	B
Carex michelii	89 782	148 438	5.7	12.9
Carex montana	68 866	519 750	3.5	29.5
Chrysanthemum corymbosum	76	3 312	0.1	3.4
Dactylis polygama	39 310	309 938	4.1	29.0
Festuca heterophylla	25 417	149 563	1.0	9.0
Fragaria vesca	2 293	16 937	0.7	5.0
Galium schultesii	13 347	92 937	4.0	19.2
Lathyrus niger	912	3 437	0.7	2.9
Lathyrus vernus	199	8 000	0.3	5.1
Melica uniflora	302 806	390 000	3.9	6.5
Poa nemoralis	975 832	7 971 500	6.6	50.8
Other	20 347	160 788	1.4	29.8
Σ	1 539 187	9 774 600	32.0	203.1

in the pre-cut forest. The latter value is 6.35 fold of the former. The cover of the herbaceous layer of the selected forest changed to a similar extent. It became 6.39 times greater (203.1%) than the value measured in the natural forest (31.8%).

In a comparison between the number of individuals and cover data of the various species in the two areas, the following inferences may be mentioned: Among the recorded 11 species, the greatest difference in the number of individuals occurred in *Chrysanthemum corymbosum* in the two areas. In the selected forest the individuals of the species mentioned was about 43 times greater per ha, and again its value of cover 57 times greater. Similarly, the number of individuals of *Lathyrus vernus* was about 40 times greater, whereas its cover value increased only to 20 fold. This may imply that for the increase in *Lathyrus vernus* the changed surroundings were favourable — at least in the first years — while at the same time it developed a much smaller assimilatory surface than in the closed forest. It should also be mentioned that hardly any change occurred in the number of individuals and cover values of *Melica uniflora* (the number of individuals per ha is 1.29, its cover 1.65 times greater). Similarly, hardly any changes could be found in the *Carex michelii* values. Both species responded to the changes rather by developing a larger assimilatory surface.

Finally, we also mention that in the category of "others" the specimen number increased to a much smaller extent than the coverage value. This supports our observation, namely that in the pre-cut area primarily the specimen numbers of species increased whose leaf area is of greater size — mainly that of dicotyledonous species (for example, *Silene vulgaris, Melampyrum nemorosum, Symphytum tuberosum, Campanula trachelium, Trifolium medium, Cynanchum vincetoxicum*, etc.).

The evaluation of phytomass and production as well as certain related indices, on the basis of the two test species

Dactylis polygama

The phytomass data per 1 ha in a breakdown of three fractions in both the closed and the selected forest are summarized in Table 2 and illustrated in Fig. 1.

In the case of the above-ground living fraction, a course of changes with two maxima can be experienced in both areas. The first maximum appeared in the closed forest in the middle of July, the second two months later, in the middle of September. In the herbaceous layer of the thinned forest, this species gives a smaller maximum, as early as the end of May, while the second maximum which represents a greater value of biomass, similarly to the closed forest,

appeared with a two-month delay, by the end of July. The value of the first maximum is 16 times greater, that of the second maximum 27 times greater, in the thinned forest.

The change of course of the above-ground dead fraction was also similar in the two areas. The greatest phytomass values were measured at the sampling after the summer minimum appearing in both areas (in the closed forest in

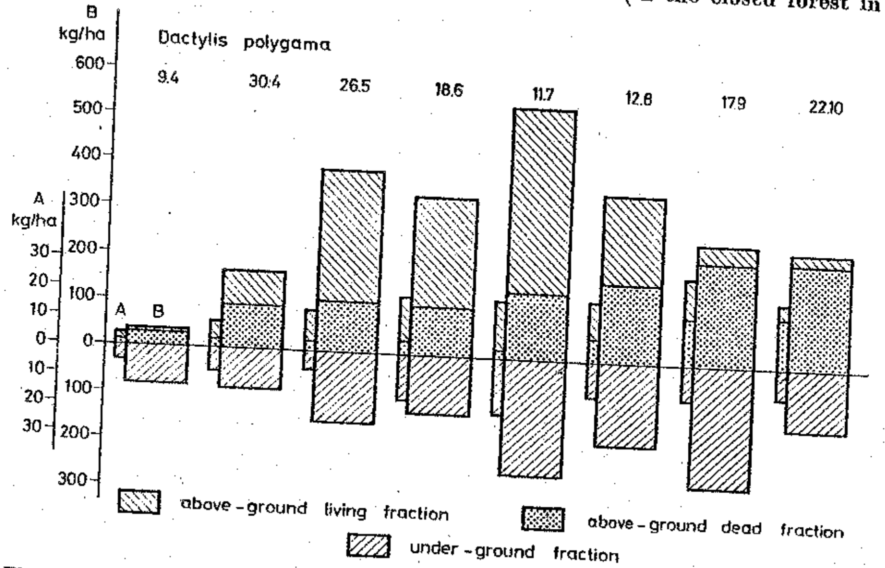

Fig. 1. Monthly changes in the phytomass fractions of *Dactylis polygama* in closed (A) and selected (B) forests — kg/ha

the middle of July, in the thinned forest in the middle of June). The phytomass of the dead fraction was of a value about 13 times greater in the thinned forest.

The root phytomass showed a greater value in the middle and at the end of the vegetative period. In the middle of July its quantity was of a considerable value in both areas, that is 20.10 and 254.49 kg/ha, respectively. The first value (measured in the closed forest) is 13 times smaller than the second.

In the case of the above-ground fraction, the value of the yearly production (the difference between the maximum and minimum phytomass) was calculated that the growth of the dead fraction, measured up to the time of the maximum of the living fraction, was also considered. The concurrently decomposed quantity could not be considered.

While the yearly above-ground production of *Dactylis polygama* plants growing in the closed forest was 19.39 kg/ha, and again its underground pro-