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BIOSYNTHESIS OF THE DRY MATTER WITH CONIFEROUS SPECIES FROM THE CĂLIMANI GROUP OF MOUNTAINS

ANTOHE ANCA*, MURARIU ALEXANDRINA*, PISICĂ DONOSE ALISA*

Mots clé: *Pinus mugo, P. cembra, Picea abies*, substance sèche

Résumé: La substance sèche présente une importance particulière ou qu'elle offre la possibilité de connaitre indirectement le rythme de biosynthèse pendant la saison végétative. Parmi les facteurs d'ambience qui influencent ce processus, les plus importants sont la température et la lumière qui agissent sur la période de végétation active en la modifiant-au sens du racourcissement de celle-ci avec l'accroissement de l'altitude. Les espèces qui poussent et se développement dans une telle ambiance biosynthétisent des quantités presqu'identiques de substance sèche. C'est le cas même de l'espèce *Pinus mugo* qui posse à la lisière supérieure de la forêt et dans les buissons de pin alpestre. Pour ... qui est de la région avec des les buissons de pin alpestre les feuilles nécessitent un quantum fotosynthétique plus grand, afin de réaliser la même quantuté de substance sèche qu'a la lisière supérieure de la forêt, parce que la lumière et la température s'assimilent plus difficilement. C'est le cas de l'espèce *Picea abies*. L'espèce *Pinus cembra* relève une bonne adaptation écologique à la lisière suppérieure de la forêt et dans les buissons de pin alpestre, en étant illustrée par des valeurs presqu'identiques de substance sèche.

Dry matter's synthesis and accumulation are of special importance, as providing the means for a possible, indirect knowledge of the biosynthesis rhytm during the vegetative season [1, 2].

Among the environmental factors influencing such process, special mention should be made of temperature and light [2, 3, 4, 5].

The optimum local conditions for the occurence of photosynthesis succeed in partially reducing the negative conditions of the climate's getting cold with the increase of altitude and, implicitly, shortening of the active vegetation period. In this way a positive metabolic result is attained [1, 5].

Material and methods

The investigations have been performed in the Călimani mountain mass, in three different zones, namely: juniper bushes, forest's upper limit and spruce fir forest.

Three species have been considered for the study, as follows: *Pinus mugo, Pinus cembro, Picea abies*.

Biosynthesis of the dry matter has been analyzed between 1982-1985, on the following organs: annual and pluriannual leaves, annual and pluriannual branches, in June, July, September and October each year.

The dry matter was determined by drying in vacuum at a temperature of 105°C, followed by repeated weighings, until constant weight.

*Institutul de Cercetări Biologice

Results and Discussions

Analysis of the data obtained (as plotted in Figures 1 to 6) evidences, on one hand, the general characteristics of the dry matter content dynamics and also of the amplitude of its variation and, on the other hand, the differences recorded, regarding the influence of the environmental factors and the species'characteristics.

As to the common features of the dry matter's accumulation in the leaves and branches of the 3 species, an alternance has-been observed between the period of active vegetation in the summer time and the repause of the winter period.

Annual leaves, representing organs in full growing and development are characterized by a more intense accumulation of the dry matter's as well as by a higher amplitude of its variation.

In the annual leaves of the *Pinus mugo* species from juniper bushes and forest's upper limit, the values of the dry matter are approximately equal-around 32-35% (Figs. 1, 4).

The low content of dry matter in the 1 year old leaves in June (below 30%) indicates an intense hydratation of these organs, inducing the occurence of some active processes of synthesis and energy release.

With the advance of autumn, the dry matter accumulations do not exceed 50%, which assumes prolongation of their metabolic activity.

In the case of *Pinus cembra*, dynamics of dry matter in the annual leaves is similar at the forest's upper limit and in the spruce fir one, higher average values being recorded at the forest's upper limit (Figs. 2, 6).

Depending on the species considered, significant differences may be observed for *Picea abies*. In the spruce fir forest, the annual leaves appear in the middle of June, while in the forest's upper limit - in May. In the beginning of the physiologically active period, the accumulations of dry matter in the annual leaves are different. Nevertheless in spruce fir bushes, the spruce fir trees come to accumulate, towards the end of the vegetation season, almost the same amount of dry matter in the annual leaves as in the upper limit forest (Fig. 5).

For the coniferous species considered for the leaves study, the values of the dry matter content in the annual leaves are always lower than those of the pluriannual leaves. The phenomenon may be correlated, too, with a higher amount of water in the annual leaves – especially in the beginning of the active vegetation season –, which is indicative of a more rapid metabolism, leading finally to their ripening.

The content of dry matter evidences a tendency of progressive growth towards autumn, when it attains values quite close to those of the pluriannual leaves.

In the annual branches (Figs. 1-6) the dry matter's dynamics is similar to that of the annual leaves. In the end of the vegetative season, its values ranging between 27 and 37% – show no significant differences both as to the species considered and *versus* the altitudinal factor.

The amount of dry matter of the annual branches is equal, or exceeds only slightly that of the 1 year leaves. In pluriannual leaves (Figs. 1 to 6), the dry matter content

varies more significantly in the beginning and closing of the vegetation season. The leaves acquire-increased amounts of dry matter, accumulated towards autumn, or from the previous year (spring) while, in the summertime, the dry matter takes lower values, as due to the leaves, as due to the leaves more intense hydration in such a period.

Accumulation of the dry matter in pluriannual leaves in the and of an active vegetation season takes values ranging between 40-47%, no significant differences appearing among the species under study: juniper tree (44-45%) *Picea abies* (42-43%), and spruce fir (40-44%).

In the pluriannual branches (Figs. 1 to 6) regardless of species to which they belong the lowest amplitude of the dry matter's variation is recorded and the highest values during the whole vegetaive season, observed as increasing in winter; this fact assumes a stable metabolism of such organs.

In the juniper bushes and the forest's upper limit the *Pinus mugo* species synthesizes and accumulates about the same amount of dry matter (Table 1), a sing of a corresponding adaptation to the environmental conditions involved.

Table 1
Dry matter of the coniferous species from the Călimani mountain mass (annual average values)

Year	Organ	*Pinus mugo*		*Pinus cembra*		*Picea abies*	
		A	B	B	C	B	C
1982	annual leaves	36.25	36.52	37.07		35.59	
	pluriann. leav.	45.10	45.27	44.56		47.29	
	ann. branch	34.85	35.85	33.52		36.57	
	pluriann. branch	44.52	42.48	43.92		41.05	
	TOTAL	149.72	160.12	156.07		160.50	
1983	annual leaves	35.34	32.70	30.36	27.31	40.63	25.57
	pluriannn. leav.	33.70	44.45	42.84	40.32	46.81	43.39
	ann. branch	30.70	35.69	35.51	30.53	35.53	25.57
	pluriann. branch.	42.50	38.69	43.04	38.70	40.19	43.13
	TOTAL	142.24	151.53	151.75	136.86	163.19	137.66
1984	annual leaves	36.30	36.74	33.07	31.90	35.94	34.15
	pluriann.leav.	48.26	47.46	43.48	45.02	49.56	48.21
	ann. branch.	38.75	37.34	38.25	39.08	34.69	37.06
	pluriann. branch.	46.07	46.73	45.49	47.11	48.40	52.56
	TOTAL	169.38	168.27	160.29	163.11	168.59	171.98
1985	annual leaves	32.36	35.50	26.84	29.79	33.10	24.22
	pluriann.leav.	46.17	45.01	13.12	44.73	47.14	47.04
	ann. branch.	45.27	26.27	24.70	26.98	33.36	23.52
	pluriann.branch.	42.35	40.05	46.00	41.93	44.42	46.12
	TOTAL	166.15	147.23	140.66	143.43	158.02	140.90
years'average		156.72	156.78	150.90	149.80	163.26	150.18

A = juniper bushes; B = forest's upper limit; C = spruce fir forest

At the upper limit of the forest, the *Pinus cembra* species has a richer contents of dry matter than in the spruce fir bushes (Table 1), which may be explained by a shorter vegetation period in the upper limit forest and prolongation of the leaves' metabolic activity in the spruce fir bushes. The metabolic effort here is mainly supported by the annual leaves and branches.

The differences between the dry matter's synthesis and accumulation in the upper limit forest and in spruce fir forest are better evidenced with the *Picea abies*, with, by an increased metabolic effort attains a lower content of dry matter in the spruce fir bushes.

Conclusions

1. The content of dry matter accumulated in a vegetative cycle assures getting over the cold season, as well as the reserves necessary for starting of vegetation in the following year.

2. The environmental factors – especially light and temperature – influence the period of active vegetation they reduce it with the increase of altitude.

3. Under such circumstances, the *Pinus mugo* species, known as growing and developing in similar environmental conditions, biosynthesize almost equal amounts of dry matter.

4. In spruce fir forests, the existing environmental factors (especiallly light and temperature) are more difficulty assimilated, once the leaves require an increased photosyntetic quantum, for synthesizing the same amount of dry matter as in the upper limit forest. This phenomenon is illustrated by the *Picea abies*, species which – in the upper limit forest – synthesizes a higher amount of dry matter than in the spruce fir one a possible suggestion for extending spruce fir towards forest's upper limit.

5. By the approximately equal values of the dry matter it biosynthesizes, the *Pinus cembra* species evidences a good ecological adaptation in both upper limit forest and spruce fir one.

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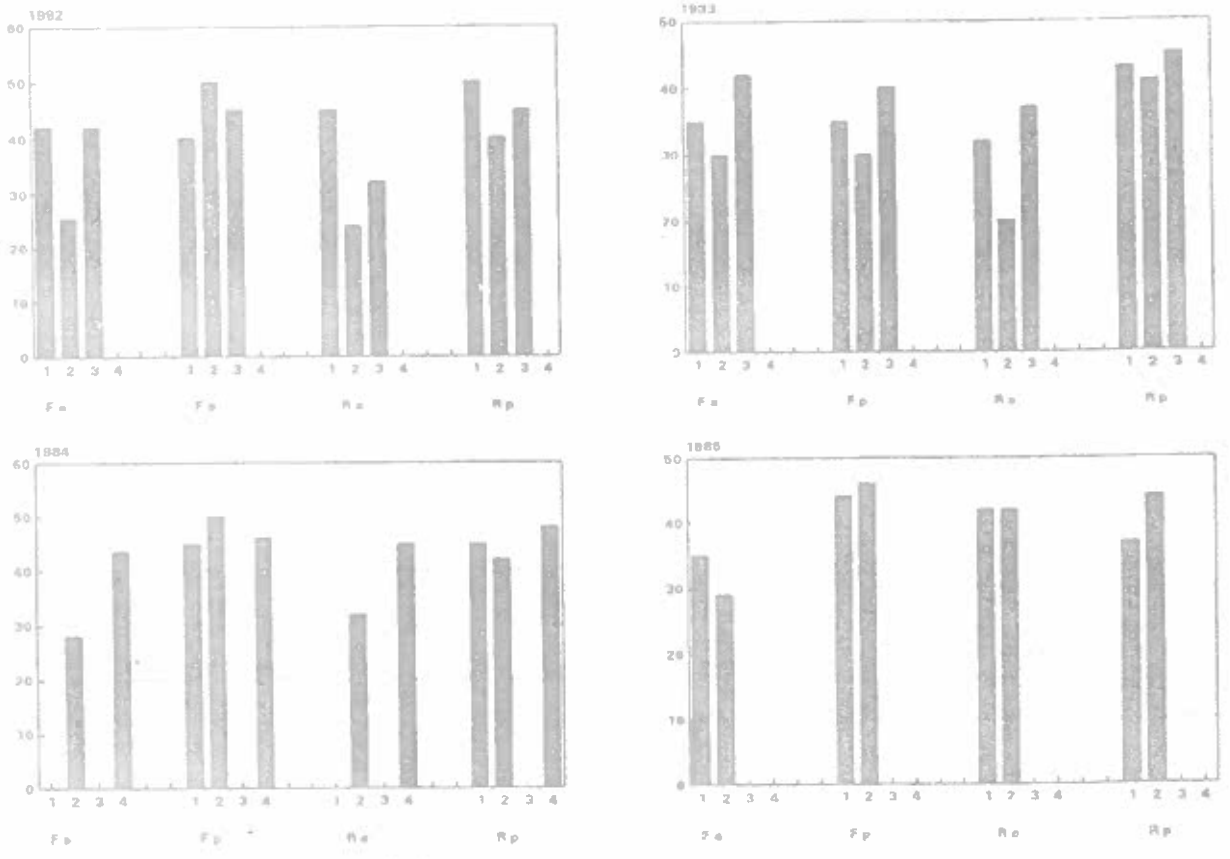


Fig. 1 – Accumulation and dynamics of the dry matter in jumper bushes from the *Pinus mugo* species
Fa = annual leaves; Fp = pluriannual leaves; Ra = annual branches; Rp = pluriannual branches
1 = 0.6; 2 = 0.7; 3 = 0.9; 4 = 10

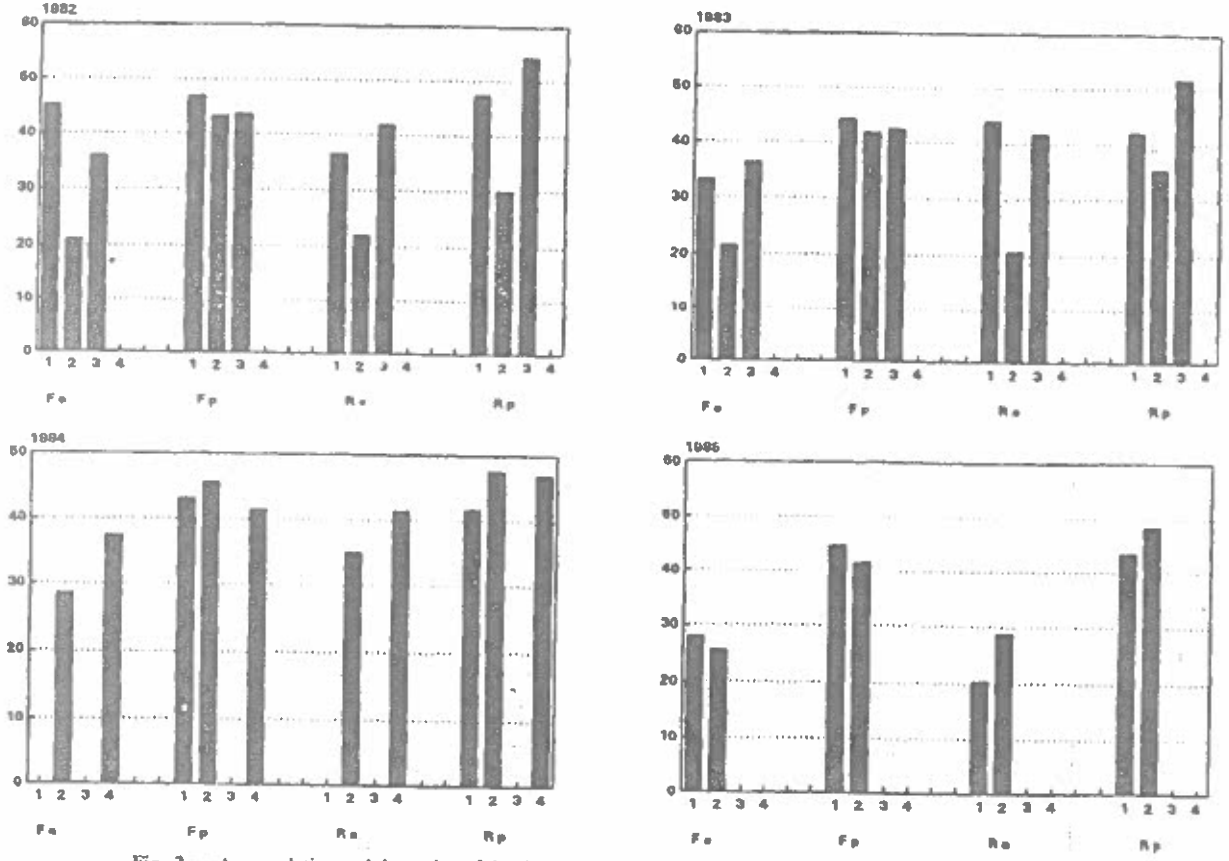


Fig. 2 – Accumulation and dynamics of the dry matter in upper limit forest from the *Pinus cembra* species
Fa = annual leaves; Fp = pluriannual leaves; Ra = annual branches; Rp = pluriannual branches
1 = 0.6; 2 = 0.7; 3 = 0.9; 4 = 10

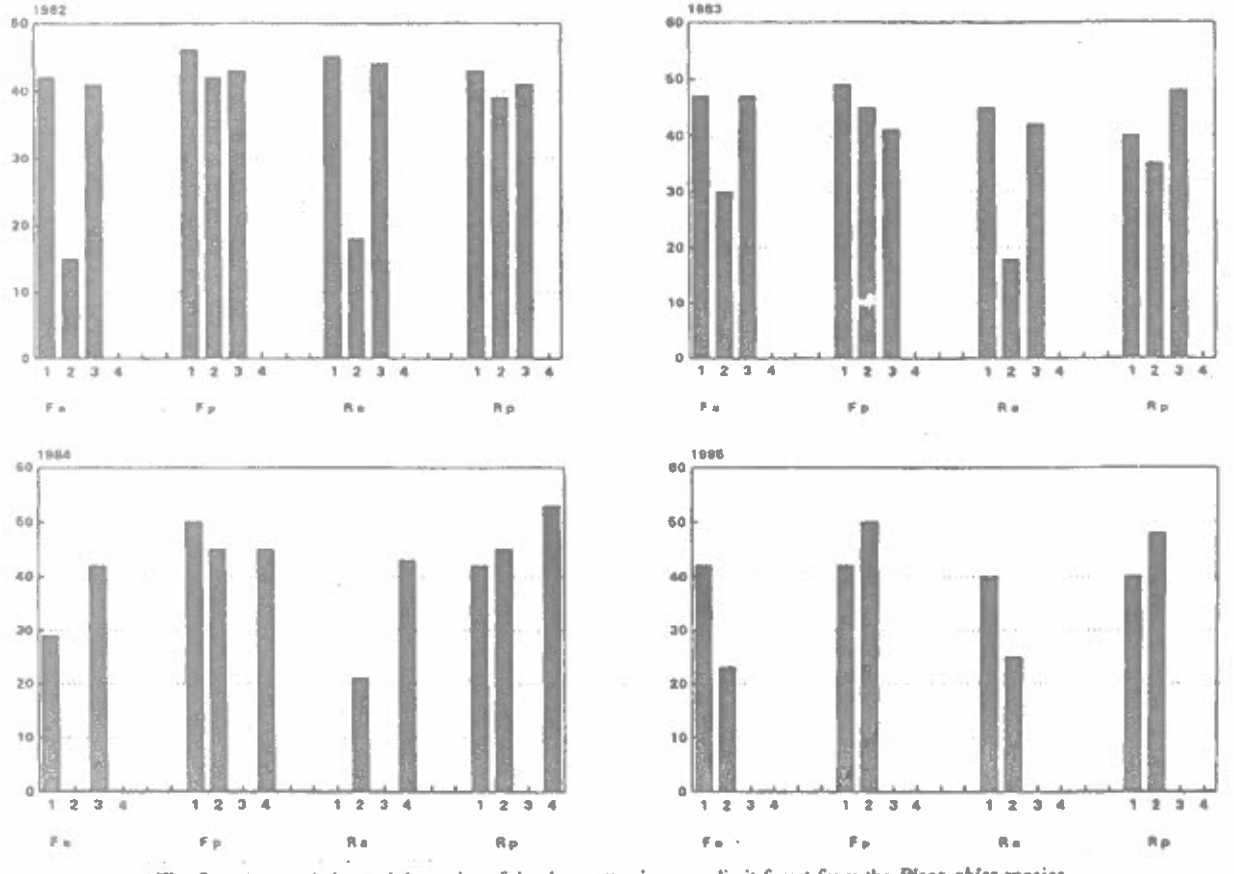


Fig. 3 – Accumulation and dynamics of the dry matter in upper limit forest from the *Picea abies* species
Fa = annual leaves; Fp = pluriannual leaves; Ra = annual branches; Rp = pluriannual branches
1 = 0.6; 2 = 0.7; 3 = 0.9; 4 = 10

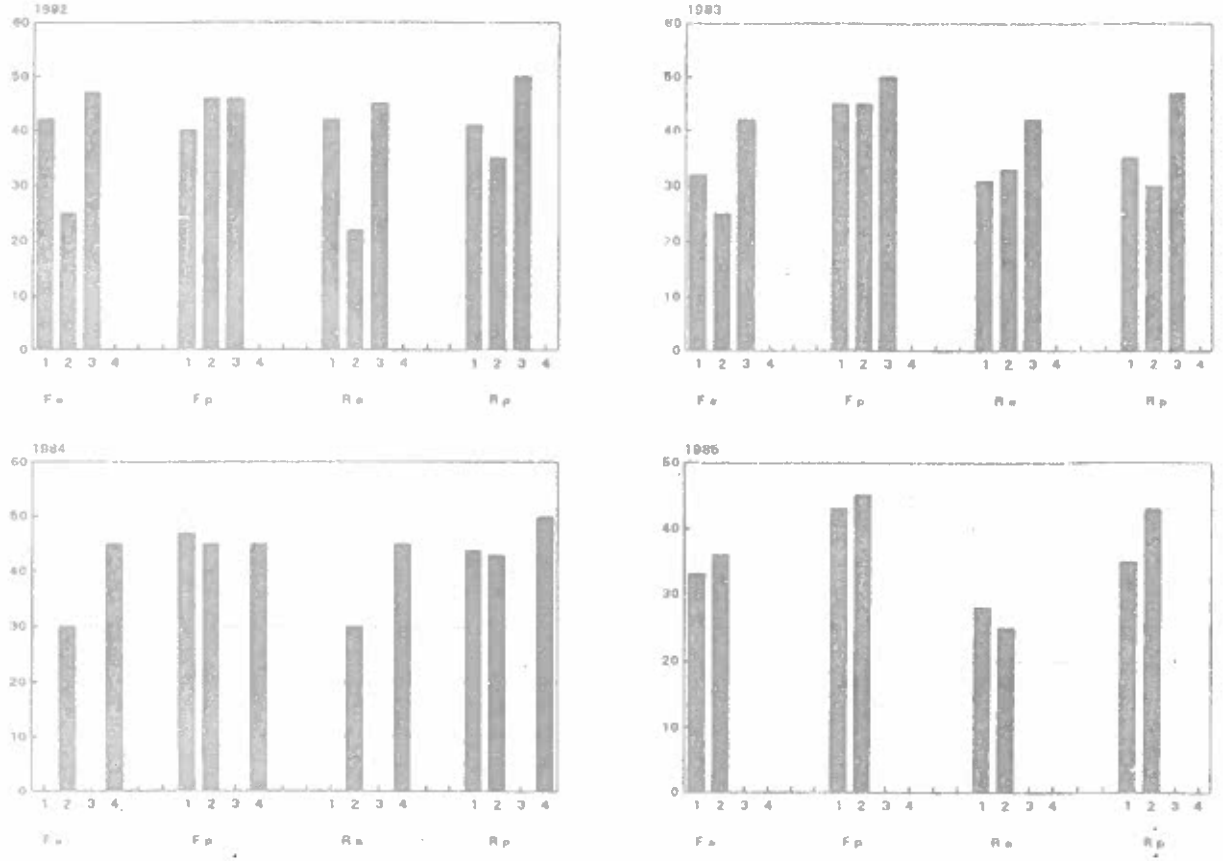


Fig. 4 – Accumulation and dynamics of the dry matter in upper limit forest from the *Pinus mugo* species
Fa = annual leaves; Fp = pluriannual leaves; Ra = annual branches; Rp = pluriannual branches
1 = 0.6; 2 = 0.7; 3 = 0.9; 4 = 10

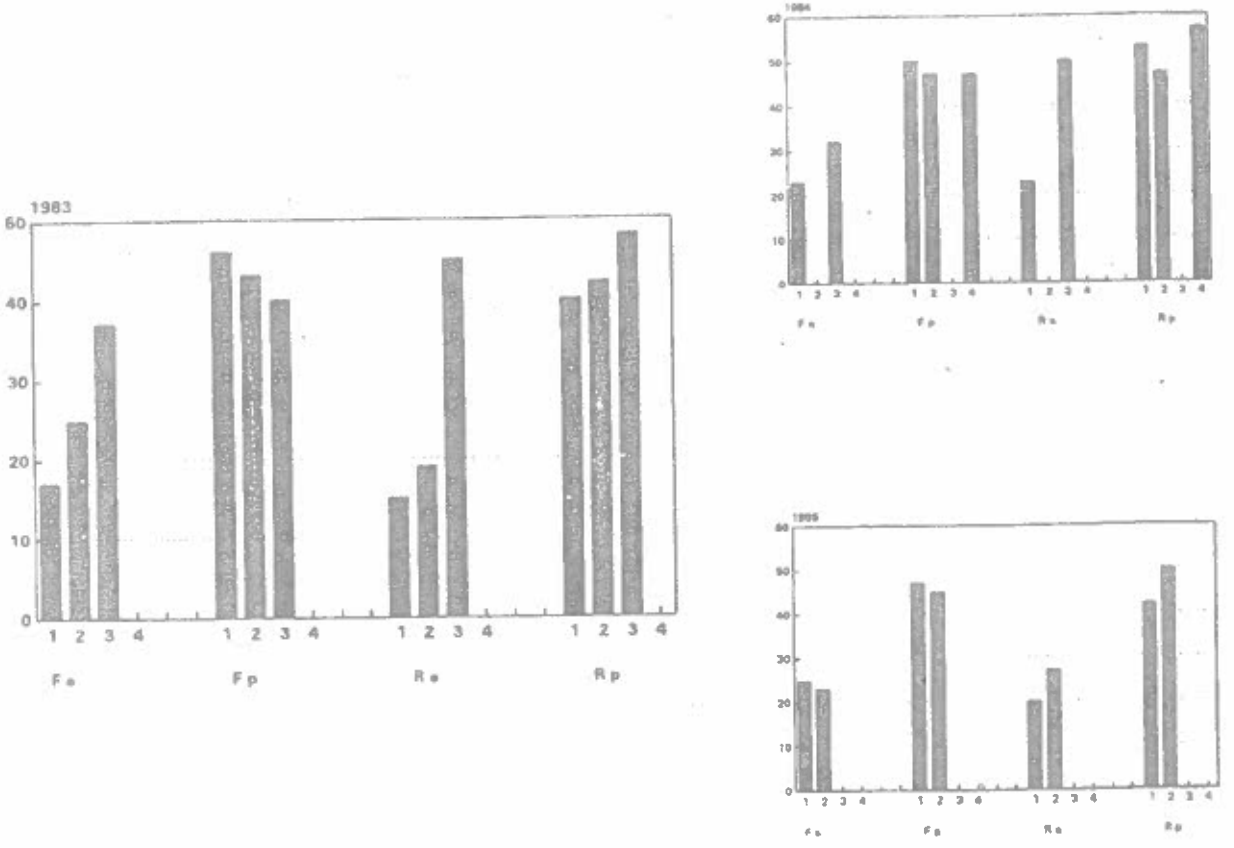
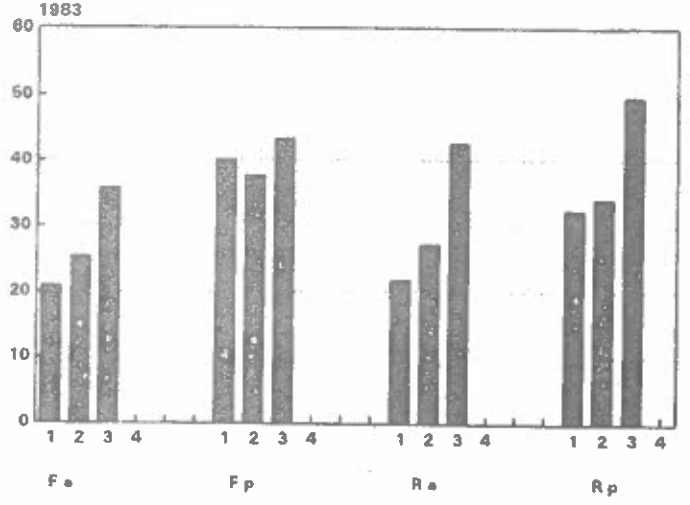
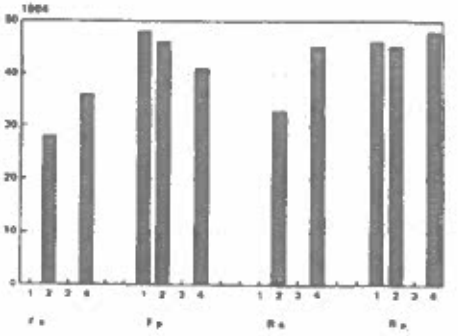


Fig. 5 – Accumulation and dynamics of the dry matter in spruce fir forest from the *Picea ables* species
Fa = annual leaves; Fp = pluriannual leaves; Ra = annual branches; Rp = pluriannual branches
0.6; 2 = 0.7; 3 = 0.9; 4 = 10





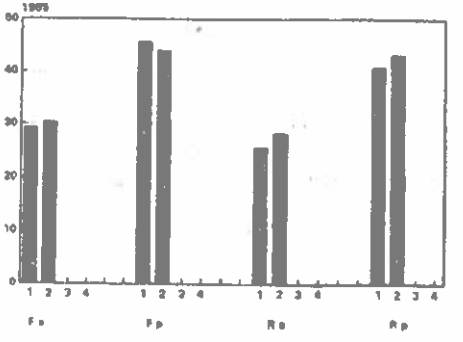


Fig. 6 – Accumulation and dynamics of the dry matter in spruce fir forest from the *Pinus cembra* species
Fa = annual leaves; Fp = pluriannual leaves; Ra = annual branches; Rp = pluriannual branches
1 = 0.6; 2 = 0.7; 3 = 0.9; 4 = 10