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RESEARCH CONCERNING THE RESILIENCE CAPACITY OF MOUNTAIN GRASSLANDS

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Abstract

In order to determine the resilience capacity, there was used the method elaborated by Gh. Motca (2005), according to which, the stability of the grassland natural ecosystem is emphasized by two indexes: the number of species in the vegetal layer and the share of other varieties from other botanical families (except graminaceae and leguminous). For fertilization and liming work, the field of resilience capacity is marked by the value of 20% variation coefficient for the first indicator and by 30% for the second.

For the derived ecosystem, the stability is expressed by two other indexes: share of dominant graminaceae (as a total) and share of each dominant graminaceae variety. The variation coefficient specific to the field of resilience capacity is of maximum 30% for both indicator.

In Poiana Brasov, the resilience capacity which ensures the stability of natural grasslands types extends in the field of fertilization variants with N 0-90, P_2O_5-80 K_2O-120, and in Blana- Bucegi is conditionned by the shortage of any fertilization and liming.

Variants which are allowed by the resilience of derived types are the ones with organic fertilization (paddocking), organic fertilization+liming (30-60% Ah),organic fertilization+ mineral fertilization (N-50, P_2O_5-50 K_2O-50), organic fertilization+(N-50, P_2O_5-50, K_2O-50)+liming and mineral fertilization (N-150, P_2O_5-50, K_2O-50) effected once in 3-5 years.

INTRODUCTION

Resilience capacity represents the tolerance of an ecosystem to the action of perturbing anthropic factors [3, 5, 6] or the variability field of some defining traits of the ecosystem, within the limits of its stability; for the grasslands it is about the influence factors subordinated to the improvement and exploitation technologies.

Knowledge of resilience capacity of mountain grasslands constitutes one of the most important factors for the application of technologies with minimum impact upon natural and semi-natural ecosystems extended on these surfaces.

In the field of applied ecology of grasslands applied to the grasslands vegetal layer [1, 2, 4], our experimental results bring original contributions to the perfectionning of technological management of grassland ecosystems and of enviromental management for preserving national and comunitary habitats.

MATERIAL AND METHODS

Resilince capacity determination was effected according to the method elaborated by Gh. Motcă, 2005 [3, 6], according to which the stability of the natural grassland ecosystem is emphasized by two indicators: the number of species from the vegetal layer and the share of species from other botanical families (except graminaceae and leguminous). For the fertilization and liming works, the field of resilience capacity is marked by the value of 20% variation coefficient (CV%) for the first indicator and 30% for the second indicator.

For the derived ecosystem, stability is expressed by indicators specific to natural ecosystems, to which, we add 2 aditional indicators: share of dominant graminaceae (as a total) and the share of each dominant graminaceae variety. The variation coefficient specific to the field of resilience capacity reaches a maximum of 30% for both additional indicators.

For the derived types, there are determined as well the *general resilience capacity*, which constitutes a general characteristic of derived kinds, as *specific capacity of resilience* for each derived type.

General resilience capacity of derived grasslands types was determined on the basis of two indicators: an indicator with common use, both for natural types as for derived ones (the total number of species) and an indicator used only for the derived types (total share of dominant graminaceae).

For the specific resilience capacity, it was taken into account only the share of dominant graminaceae which denominate the derived grassland type.

Results were obtained during 2005-2008 in the experimental stations Poiana Braşov (at 950 m altitude, spruce belt) and in Blana-Bucegi (subalpine belt, at 1800 m altitude) belonging to the Institute of Research-Develpment for Grasslands Brasov.

RESULTS AND DISCUSSION

Botanical composition. The natural type of grassland in the experimental stations is edified by the following dominant species: *Nardus stricta* (40%) + *Festuca rubra* (30%), in Poiana Brasov; *Nardus stricta* (40%), in Blana-Bucegi (tables 1 and 2).

Table 1

Botanical composition in the experimental variants from Poiana Brasov (synthesis)

Species groups and dominant species	Control	$N_{50}P_{50}K_{50}$+ Manure 20 t	CaO (30%Ah)	N50P50K50+ CaO (30%Ah)	N50P50K50+ G20+ CaO (30%Ah)	N50P50K50+ CaO(30%Ah)+ Paddocking (3 nights)	CaO(30%Ah)+ Paddocking (3 nights)	$N_{50}P_{50}K_{50}$+ Paddocking (3 nights)	Paddocking (3 nights)
Graminaceae	**94**	**97**	**70**	**96**	**86**	**70**	**56**	**96**	**91**
Nardus stricta	**40**	-	5	-	-	-	-	-	3
Festuca rubra	**30**	10	30	10	10	10	30	20	66
Agrostis capillaris	15	57	20	35	30	30	15	26	10
Poa pratensis	6	30	15	50	43	30	10	50	10
Leguminous	1	1	26	2	12	23	40	2	4
Different species	**5**	**2**	**4**	**2**	**2**	**7**	**4**	**2**	**5**

Table 2

Botanical composition in the experimental variants from Blana-Bucegi (synthesis)

Species groups and dominant species	Control	$N_{150}P_{50}K_{50}$ 2000-2002 (effect during the years 3-5)	Paddocking 2003 (effect during the years 3-5)+CaO (60% Ah) (effect during the years 10-13)	Paddo-cking 2004 (effect during the years 2-4)	Paddo-cking 2005 (effect during the years 1-3)
Graminaceae	**80**	**78**	**60**	**78**	**91**
Nardus stricta	**40**	5	-	8	8
Festuca nigrescens	+	15	12	12	18
Agrostis capillaris	+	18	22	2	12
Agrostis rupestris	12	13	-	15	8
Leguminous	8	7	15	12	3
Different species	**12**	**15**	**25**	**10**	**6**

At the altitude of 950 m, in Poiana Brasov, within the variants with low dosis of chemical fertilizers (N-50 P_2O_5-50 K_2O-50) together with organic fertilization (20 t/ha manure or paddocking with sheep for 3 nights) and with lime (30% Ah), it is established the derived type of *Agrostis capillaris* + *Poa pratensis*; in the absence of mineral fertilization, but with organic fertilization and with lime, the natural type is replaced with the derived type of *Agrostis capillaris* + *Festuca rubra*.

At the altitude of 1800 m, in the mountain Blana from the Bucegi Massif, the derived type is *Festuca nigrescens* + *Agrostis capillaris* + *Agrostis rupestris*, with the predominance of one or another from the three species, depending on the technological variant: *Festuca nigrescens* in the variant with paddocking, during the 1-3 effect years; *Agrostis capillaris*, variants with the effect of remnance during the years 3-5 of higher azote dosis (N-150 P_2O_5-50 K_2O-50) and of paddocking, as well as of liming (60% Ah) combination with paddocking; *Agrostis rupestris*, in the variant with paddocking, during the 2-4 effect years.

Resilience capacity. Depending on the experimented technological variants, the resilience capacity which ensures the stability of natural grasslands types extends in the field of fertilization variants with with N 0-90, P_2O_5-80 K_2O-120, in Poiana Brasov (figure 1) and it is conditionned by the shortage of any fertilization and liming in Blana-Bucegi.

General resilience capacity of the derived grasslands types from Poiana Brasov is framed in the variability field of 20-21% of the total number of species from the vegetal layer, as well as of the total share of dominant graminaceae (figure 2). Variants which are allowed by the resilience of the derived types are the ones with organic fertilization (paddocking), liming (30% Ah), organic fertilization (paddocking) + liming (30% Ah), paddocking + mineral fertilization (N-50, P_2O_5-50 K_2O-50), organic fertilization (20 t/ha manure or paddocking) + mineral fertilization + liming.

Fig. 1. Nardus stricta + Festuca rubra grasslands resilience capacity - Poiana Bra□ov

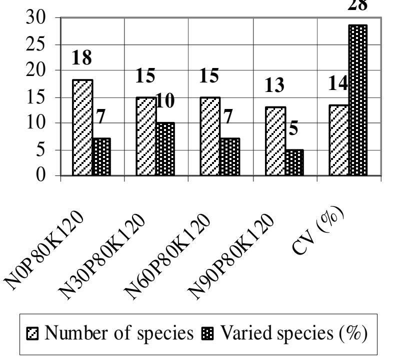
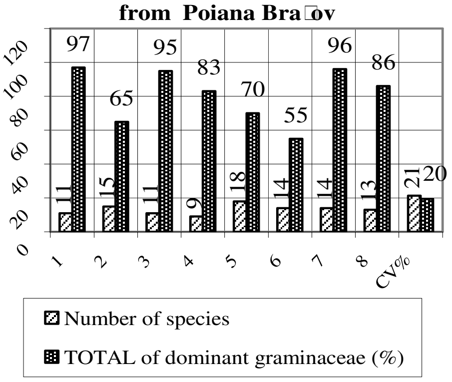
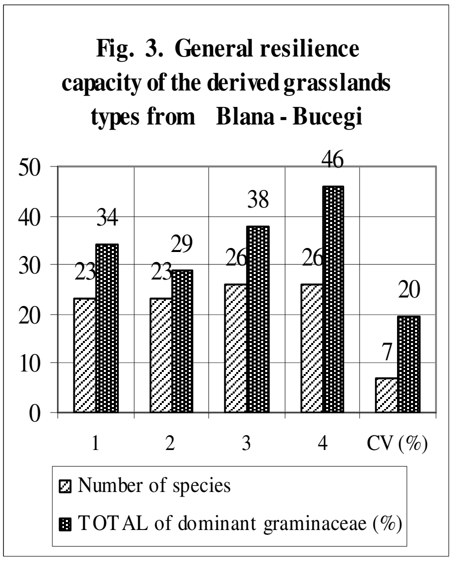
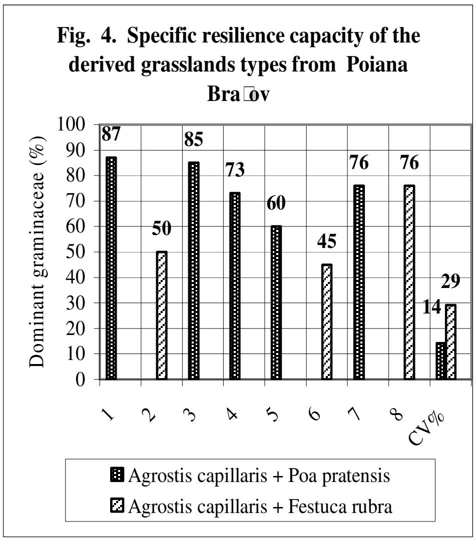


Fig. 2. General resilience capacity of the derived grasslands types from Poiana Bra□ov







In Blana-Bucegi (figure 3), technological variants harmonized with the resilience capacity are: paddocking (with remnant effect up to 5 years), the liming with calculated dosis for the correction of the soil reaction at the level of 60% Ah (with an effect up to 13 years) and dosis of 150 kg/ha N, on the framework of 50 kg/ha P_2O_5 and 50 kg/ha K_2O (applied once for 3-5 years).

Specific resilience capacity was better emphasized in Poiana Brasov than in Blana-Bucegi, due to the more important difference between the 2 derived grasslands types: *Agrostis capillaris* + *Poa pratensis* and *Agrostis capillaris* + *Festuca rubra*. The variation coefficient of dominant graminaceae share was of 14% for the first kind of grassland and of 29% for the second (figure 4).

Potential of feeding use in the field of resilience capacity. In their natural state, the mountain evergreen grasslands achieve between 1.87 t/ha DM and 2.48 t/ha DM, as an average on the whole year. In the fertilization system, allowed by the resilience capacity, the average annual yield increases up to about 3 t/ha DM. Derived types provide yields of 3.2-3.5 t/ha DM. But more important than the yield is its superior quality, on the basis of which, in the conditions from Blana-Bucegi, we may obtain up to 3600 l/ha milk from cattle in comparison with only 1100 l/ha milk from the natural non-improved grassland.

CONCLUSIONS

1. Resilience capacity represents the tolerance of one ecosystem to the action of perturbing anthropic factors. Knowing the resilience capacity of mountain grasslands represents an essential condition for the application of

technologies with minimum impact upon the stability of natural and derived ecosystems.

2. At the spruce belt (Poiana Brasov), the resilience capacity which assures the stability of natural grasslands types is framed in the field of fertilization variants with N 0-90, P_2O_5-80 K_2O-120, while in the subalpine belt (Blana-Bucegi) is conditionned by the absence of any fertilization and liming.
3. Technological variants which are allowed by the resilience of derived types are the ones with organic fertilization (paddocking), organic fertilization + liming (30-60% Ah), organic fertilization + mineral fertilization (N-50, P_2O_5-50 K_2O-50), organic fertilization+ mineral fertilization (N-50, P_2O_5-50, K_2O-50) + liming and mineral fertilization (N-150, P_2O_5-50, K_2O-50) effected once in 3-5 years.
4. In the field of the resilience capacity, comunity and national natural habitats may be preserved even in the conditions of vegetal layer exploitation for animals feeding. For the increase of the economic effectiveness of feed production, in the area of natural and semi-natural grasslands, on narrow areas, it is recommended to create derived types whose benefit, in the cattle milk yield (3600 l/ha) is at least of three times higher in comparison with the origin types.

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