PRODUCTIVITY OF NATURA 2000 GRASSLAND HABITATS FROM BUCEGI NATURAL PARK

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Abstract. *This study covers the geobotanical and grassland productivity assessment of an area within Bucegi Natural Park spanning 6,275 hectares (65% of the total area). Within this area, the *Potentillo ternatae-Nardion* phytosociological alliance (degraded Habitat 6520) accounts for 66% of the surface; the *Juncion trifidi*, *Oxytropion-Elynion*, and *Seslerion bielzii* alliances (Habitat 6150) cover 30%; the *Cynosurion* alliance (Habitat 6520, typical) covers approximately 1%; and the *Rhododendro myrtifolii-Vaccinion* alliance (shrublands) accounts for 3%. These grassland habitats are degraded by water and wind erosion (15%), rocky outcrops (13%), scrub and tree saplings (12%), and nitrophilous field weeds (4%), accounting for a total of 44% of the area. Across the two habitats (6150 and 6520), covering 6,055 hectares of grassland (excluding the *Rhododendro-Vaccinion* alliance), grazing with young cattle can yield a live weight gain of 237 tonnes—valued at €760,000—translating to €126 per hectare. Utilizing habitat 6520 (4,150 ha) for dairy cows and habitat 6150 (1,905 ha) for young cattle allows for the production of 18,138 hl of milk (valued at €907,000) and nearly 69 tonnes of live weight gain in young cattle (valued at €219,000)—a total value of €1,126,000. This represents a 48% higher economic value compared to the scenario of using the land exclusively for young cattle.*

Keywords: Natura 2000 grassland habitats 6150 and 6520, productivity, economic value, live weight gain (young cattle), milk production (dairy cows)

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1. Introduction

The grasslands of the Bucegi Mountains have previously been studied from both geobotanical [1, 10, 11] and rational use and improvement perspectives [10].
Following the establishment of the Bucegi Natural Park, studies were initiated regarding the degradation status of the herbaceous cover of these grasslands [4].
After our country's accession to the European Union, the need arose for productivity studies on Natura 2000 grassland habitats to enable comparisons with other EU countries [3].
The present paper is a continuation of these earlier studies.

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2. Materials and methods

The grasslands in the Bucegi Natural Park, covering an area of approximately 11,300 hectares, are mostly of secondary origin, resulting from the clearing of forests (700-1,800 m alt.) and junipers (1,800-2,200 m alt.) and of primary origin in the alpine zone (over 2,200-2,300 m alt.) up to 2,505 m on Omu Peak.

A study was conducted on the identification and inventory of grasslands in 3 cadastral plots, namely:

1. L 35 – 87 Db – 9,055 hectares
2. L 35 – 87 Dd – 9,053 hectares
3. L 35 – 99 Bb – 9,089 hectares

Satellite images at a scale of 1:25,000 and cadastral maps at the same scale were used for identification.

These 3 trapezoids, covering an area of 27,197 ha, are the „ core″ of the Bucegi Nature Park, covering an area of 32,663 ha.

The contour of the grassland areas was established by computer, and within each polygon the phytosociological alliance and the stage of degradation of the grassy carpet of natural (primary) and semi-natural (secondary) grasslands were determined.

The area of grasslands determined by the computer in the 3 cadastral plots was:

1. L 35 – 87 Db – 2,403 hectares – 26.5% of the total
2. L 35 – 87 Dd – 4,128 hectares – 45.6% of the total
3. L 35 – 99 Bb – 815 hectares – 9.0% of the total

TOTAL 7,346 hectares – 27.0% of the trapezium area

Thus, the area of grasslands in these 3 trapezoids represents 65% of the total area of grasslands in the study area.

Floristic surveys were conducted on these sites using the geobotanical transect method, with the resulting data classified into phytosociological associations and alliances [2].

These phytosociological alliances were subsequently assigned to Natura 2000 grassland habitat types [3].

Research regarding plant and animal productivity relies on more recent methods, also presented in the current volume (2026), which are not reiterated here [7, 9].

The milk and meat prices were taken from Ministry of Agriculture and Rural Development [12].

3. Results and discussions

On first approximation n, five phytosociological alliances and one shrubbery alliance were determined [2] as follows:

1. *Potentillo ternatae – Nardion* (PON), Subalpine oligotrophic pastures on acidic soils, having as recognition and edifying species: *Nardus stricta, Festuca nigrescens, Festuca airoides, Poa media, Potentilla ternata, Campanula abietina, Geum montanum, Ligusticum mutellina, Deschampsia flexuosa, Viola declinata* and others.
2. *Seslerion bielzii* (SEB), Primary subalpine pastures of basic soils, as species of recognition and edification: *Sesleria bielzii, Sesleria rigida ssp. haynaldiana, Festuac amethystina, Festuca saxatilis, Festuca versicolor, Linum extraaxilare, Dianthus spiculifolius, Carex sempervirens, Aster alpinus* and others.
3. *Oxytropido-Elynion* (OXE), Alpine primary pastures of basic soils, with the recognition species: *Oxytropis carpatica, Elyna mysuroides, Erigeron uniflorus, Dianthus glacialis, Cerastium lanigerum, Pinguicula alpina, Pedicularis vercillata, Salix reticulata, Dryas octopetala, Polygonum viviparum, Genţiana nivalis* and others.
4. *Juncion trifidi* (JUT), Primary alpine pastures of acid soils with the species of recognition and edification: *Juncus trifidus, Carex curvula, Oreochloa disticha, Campanula alpina, Primula minim, Minuartia sedoides, Armeria alpina* and others.
5. *Cynosurion* (CYN), Hilly-montane mesophilous grasslands on well-drained soils, having as recognition species: *Agrostis capillaris, Cynosurus cristatus, Festuca rubra, Festuca pratensis, Lolium perenne, Phleum pratense, Trifolium repens* and others.
6. *Rhododendron myrtifoli-Vaccinion* (RHV), Myrtle bushes, with edifying species: *Rhododendron myrtifolium, Vaccinum gaultherioides, Vaccinum myrtillus, Vaccinum vitis-idae, Loisleureia procumbens, Soldanella pusilla, Juniperus sibirica* and others.

The distribution of these grassland units and mapping in the three cadastral traps is presented in Table 1.

From these data it follows that the most significant share is held by grasslands dominated by the species *Nardus stricta* and *Festuca airoides,* marked on the map with PON, which cover 2/3 of the surface, indicating the very advanced stage of degradation of the grassy carpet.

Next are the SEB rock grasslands with 23% of the surface, the alpine pastures on the highest peaks OXE and the rest JUT and CYN with barely 1%.

Table 1. Distribution of grassland units in Bucegi Natural Park

No.	Polygon L 35	Surface (Ha)	Phytosociological Alliance					
			PON	SEB	OXE	JUT	CYN	RHV
1	87 Db (North)	2,435	1,380	475	435	40	-	105
2	87 Dd (Midfielder)	3,025	1,955	955	-	-	-	115
3	99 Bb (South)	815	790	-	-	-	25	-
Total		6,275	4.125	1,430	435	40	25	225
%		100	65.7	22.8	6.9	0.6	0.4	3.6

It is worth noting the fairly good representation of RHV stinking bushes, which reach 3.6% of the total area of grasslands analysed.

From the field studies on the stage of grassland degradation, it resulted that only 6,275 ha have the grassy carpet that would determine their classification in this use category, the remaining 1,071 ha (14.5% of 7,346 ha outlined by the computer) have moved to another use category because they have over 60-80% woody vegetation cover or are on cliffs.

In addition, of the 6,275-ha established on the map in the field, approximately 15% are affected by surface and deep soil erosion, 13% are on rocks, 12% are covered in varying proportions by juniper bushes and spruce saplings in areas where pastures are in various stages of abandonment.

Nitrophilous weeds as a result of over-cultivation are not to be neglected (Table 2).

Table 2. The stage of degradation of grasslands in Bucegi Natural Park

No.	Polygon L 35	Surface (Ha)	Rocks (P)	Erosion (E)	Shrubbery (T)	Weeds, Sheepfold (I)	TOTAL	
							Degraded (Ha)	%
1	87 dB (North)	2,435	330	355	290	70	1,045	43
2	87 Dd (Midfielder)	3,025	470	510	430	90	1,500	50
3	99 Bb (South)	815	10	70	50	90	220	27
TOTAL		6,275	810	935	770	250	2,765	44
%		100	12.9	14.9	12.2	4.0	44.0	*

Thus, in the 3 analysed trapeze of 7,346 ha of grasslands established by the computer according to satellite images and 6,275 ha outlined through observations directly on the ground, an area of 3,836 ha of grasslands is highly degraded due to soil erosion, the presence of rocks on the surface, the invasion of woody vegetation, overgrazing and other causes, respectively 52.2% of the total, which is of extreme severity.

If we add to this the degradation of the grassland carpet through the establishment of the *Nardus stricta* species to the point of dominance instead of other more valuable grassland types such as *Agrostis capillaris, Festuca rubra* and others at 700-2200 m altitude, valuable grasslands barely reach 5-10% of the surface.

Studies evaluating green mass (GM) productivity based on floristic surveys [7] and the duration of the grazing season relative to altitude [9] have enabled the determination of optimal livestock stocking rates (Table 3). The grazing season lasts 55–85 days in the alpine–subalpine zone, with an optimal capacity of 0.68–0.83 LU/ha for Habitats 6150 and 6520 (degraded by *Nardus stricta*) and 1.89 LU/ha for Habitat 6520 with normal *Festuca rubra* and *Agrostis capillaris* vegetation.

Table 3. Grasslands production of habitats and grazing capacity

Habitat Nature 2000 (Alliance)	Altitude (m)	Grazing season duration (days)	MV production		Loading with animals (LU/ha)
			t/ha	%	
6150 (JUD, OXE, SEB)	1,800-2,400	55	2.97	54	0.83
6520 D * (PON)	1,700-2,000	70	3.09	56	0.68
6520 N ** (CYN)	1,600-1,800	85	10.43	189	1.89
Average	**1,850**	**70**	**5.50**	**100**	**1.38**

N* - normal; D* - degraded

On a first approximation, GM production in Carpathian Mountains of Habitat 6150 was 2.66 t/ha, very close to the results from Bucegi (2.97 t/ha) [8].

Habitat 6520 degraded from Carpathians was evaluated at 2.16 t/ha, only 70% compared to the similar one from Bucegi (3.09).

Pastoral value from Bucegi Mountains of Habitat 6150 was 36.6, at 92% of the Carpathian Mountains average (39.6) [8] (Table 4).

Table 4. Possible livestock production of grassland habitats in Bucegi

Habitat	Value Pastoral Value (ind.)	Weight gain			Cow's milk		
		Consumption MV/1kg	kg/ha	%	Consumption MV/1L	L/ha	%
6150	36.6	83	36	50	-	-	-
6520 D	46.0	77	40	56	7.2	429	100
6520 N	61.2	69	151	210	5.9	1,768	412
Average	**47.9**	**76**	**72**	**100**	**X**	**X**	**X**

Habitat 6520 normal from Bucegi has a PV index of 61.2 and reaches 94% of the Carpathian average, a relatively similar result [8].

Once the pastoral value (PV) index was established, it was possible to determine the amount of green matter (GM) required to produce 1 kg of live weight gain in young cattle or 1 litter of cow's milk.

Thus, GM consumption ranges from 69–83 kg per 1 kg of weight gain and from 5.9–7.2 kg per litter of milk, depending on forage quality.

Based on the GM yield per hectare, the potential output per hectare was estimated at 36–151 kg of weight gain and 429–1,768 litters of milk, depending on grass yield and quality across the two habitats.

Ultimately, it was possible to determine the economic value of livestock output - expressed as weight gain in both habitats (6150 and 6520) or as milk production solely in habitat 6520, where cattle grazing is feasible (Table 5).

Table 5. Evaluation of livestock production of young cattle and dairy cows with economic value in the grazing season

Habitat	Alliance	Surface (Ha)	Production per hectare		Total animal production	
			Gain (kg/ha)	Milk (L/ha)	Gain (tons)	Milk (Hl)
6150	JUTE, OXE, SEB	1,905	36	-	68.58	-
6520 D	PON	4,125	40	429	165.00	17,696
6520 N	CYN	25	151	1,768	3.77	442
Total		6,055	X	X	237.35	18,138
Full economic value (0.5 €/L milk or 3.2 €/kg gain)					€760 thousand	€907 thousand
Per 1 ha of grassland					€126	€186*

* * calculated from the cumulative values of weight gain and milk production across all three habitats

The economic value per hectare for the two habitats, based on grazing with young cattle across the entire 6,055-hectare area, amounts to €760,000, or €126 per hectare.

Utilizing grasslands belonging to habitat type 6520 for dairy cows at altitudes of up to 2,000 m generates €907,000 across 4,150 hectares; adding the value of weight gain in young cattle from habitat type 6150 (at altitudes of 1,800–2,400 m)—amounting to €219,000 across 1,905 hectares of grassland—yields a total of €1,126,000 (or €186/ha). This figure is 48% higher than the value obtained through exclusive use by young cattle.

From the presentation of these preliminary studies as a general conclusion, it can be stated that the grasslands in the Bucegi Natural Park are in a very advanced stage of degradation, requiring further detailed studies on the areas, types of grasslands, productivity, possible animal load and other measures to stop the

degradation, the ecological reconstruction of the degraded grassland and the conservation of biodiversity before it is too late [5, 6].

Conclusions

(1)The grasslands in Bucegi Natural Park are in a very advanced state of degradation, particularly those belonging to Habitat 6520 (Mountain hay grasslands), due to the invasion and dominance of the *Nardus stricta* specie (at altitudes of 1,700–2,000 m).

(2)Satellite studies conducted in 3 cadastral traps, covering an area of 27.2 thousand hectares, highlighted the existence of 7.3 thousand ha (27%) of grassland areas.

(3)According to field observations, 1.1 thousand ha (14.5%) were identified as being covered with woody vegetation of over 60-80% or located on cliffs.

(4)Of what remains, namely 6.3 thousand ha (approx. 85% of the total), soil erosion is 15%, surface stones – 13%, bushes – 12%, and weeds – 4%, ultimately resulting in over 52% degraded grasslands due to soil conditions, bush invasion and nitrophilous weeds.

(5)Through the exclusive use of young cattle for grazing across both habitats (6150 and 6520), covering an area of 6,055 hectares, a live weight gain of 237.35 tonnes is achieved, valued at €760,000, which equates to €126/ha.

(6)Using grazing dairy cows on pastures within habitat 6520 and young cattle on habitat 6150 generates a total of €1,126,000, equating to €186/ha, which is 48% higher than the return from using the land exclusively for young cattle raised for live weight gain.

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