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THE PRODUCTIVITY ASSESSMENT OF THE CRIȘURILOR PLAIN GRASSLANDS

Teodor MARUȘCA[1], Marcela M. DRAGOȘ[2], Cristina C. COMȘIA[3], Cristina PORR[4], Paul M. ZEVEDEI[5]

Abstract. *The grasslands of Crișurilor Plain, the portion between Crișul Negru and Crișul Repede, located on flat lands with normal soils and different stages of salinity, generally have a lower productivity and biodiversity. The average number of cormophyte species is 50 with variations from 16 in Camphorosmetum annuae and Polygano-Plantaginetum tenuiflorae, to around 90 in Festucetum valesiacae, Artemisio and Achilleo - Festucetum pseudovinae. The overall vegetation cover is 86% with 44% forage species and 42% harmful species. The average pastoral value (PV) of the 18 associations is 30.8 (mediocre), the highest was 75.7 (good) in Lolietum perennis and the lowest 2.0 (degraded) in Camphorosmetum annuae. The average production of green mass (GMP) was evaluated at 5 t/ha with very large differences between the associations. At phytosociological alliances level, Festucion rupicolae (47.6 PV and 8.18 t/ha GMP) and Beckmanion erucaeformis (42.5 PV and 9.04 t/ha GMP) had the highest productivity and Cyperio - Spergularion (3.6 PV and 0.29 t/ha GMP) had the lowest. Finally, the productivity evaluation was done at the level of normal and degraded Natura 2000 Habitats (6440, 6240 and 1530). Habitat 6440 normal was rated at 65.7 PV (good) and 13.09 t/ha GMP, which allows for an optimal loading of 1.26 LU/ha (good). The worst results had the Habitat 1530 (degraded) with 5.7 PV and 0.51 t/ha GMP with the most saline soils and irrational use of grasslands. The results of these productivity evaluations of grasslands based on floristic surveys continue to serve for the preparation of pastoral arrangements and their proper management.*

Keywords: lowland grasslands, pastoral value, green mass production, grazing capacity

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[1]PhD. Eng. The Research and Development Institute for Grasslands, Brasov, Romania, Corresponding memebr of the Academy of Romanian Scientists, (email: maruscat@yahoo.com)
[2]Ph.D. Eng. The Research and Development Institute for Grasslands Brasov, Romania, (email: marcela.dragos@pajisti-grassland.ro, marceladragos@yahoo.com)
[3]Eng. The Research and Development Institute for Grasslands Brasov, Romania, (email: cristina.comsia@pajisti-grassland.ro)
[4] Eng.The Research and Development Institute for Grasslands Brasov, Romania, (email: cristina.porr@pajisti-grassland.ro)
[5] PhD.Eng. The Research and Development Institute for Grasslands Brasov, Romania, (email: paul.zevedei@pajisti-grassland.ro)

Introduction

Permanent grasslands in the lowland area are generally located on lands with excess moisture, salinity, sand, gravel, etc., where arable crops were not possible. Such grasslands are found in the Western Plain of our country, of which the Crișurilor Plain is also a part.

The geobotanist authors who studied the vegetation of these grasslands made some general visual assessments of these grasslands production without rigorous determinations or evaluations (Pop 1968; Grigore 1971; Pop 1977; Pătruț 2003; Nicolin 2015) [18, 2, 17, 16, 13].

The new method for evaluating the productivity of grasslands, which is based on the floristic surveys of grasslands associations, allowed the completion of geobotanical studies with economic data necessary for the preparation of pastoral arrangements and further their management (Maruşca 2019) [3].

1. Materials and Methods

In order to evaluate the productivity of the grasslands from the western country, the geobotanical surveys from the book "Flora and vegetation of the Crișurilor Plain (The Crișul Negru - Crișul Repede Interval)" by Ioan Pop, published in 1968 by the Romanian Academy Publishing House, were used [18].

The method for evaluating the productivity of grasslands has been widely presented and used in several works that appeared in these annals, so we do not present it anymore (Maruşca et al. 2019, 2020, 2021a,b, 2022; Maruşca 2021a,b); Păşcuț, Maruşca 2020; Maruşca, Burescu 2021; Maruşca, Vințan 2022; Oprea, Maruşca 2022) [4, 5, 7, 8, 11; 6, 10; 15; 9; 12; 14].

The following cenotaxonomic units were taken for the assessment of grassland productivity:

LAND VEGETATION (*TERRIHERBOSA*)

Non-halophilic grasslands (*Prata genuina*)

Cl. *MOLINIO-ARRHENATHERETEA* R. Tx. 1937
Mesohygrophilous herbaceous vegetation
Ord. *MOLINIETALIA* W.Koch 1926
Orchards and hayfields
Al. ***Agrostion albae*** Soó 1933
Spruce and flooded grasslands
1. As. *Agrostetum albae* Ujv. 1941
2. As. *Lythro-Calamagrostetum epigeii* as. nov.

Cl. *FESTUCO – BROMETEA,* Br-Bl 1943

Xerophilic and xeromesophilic herbaceous vegetation

Ord. *FESTUCETALIA VALESIACAE*, Br-Bl et Tx., 1943

Plain and hill grasslands

Al . ***Festucion sulcatae*** Soó 1940

Steppe and silvosteppe grasslands

3. As. *Festucetum sulcatae* Burduja et colab. 1956
4. As. *Festucetum valesiacae* Burduja et colab. 1956
5. As. *Lolietum perennis* Safta 1943
6. As. *Andropogonetum ischaemi* Krist 1937

Halophile grasslands (*Prata salina*)

Cl. PUCCINELLIO - SALICORNIETEA Țopa 1939

Halophilous herbaceous vegetation

Ord. *PUCCINELLIETALIA* Soó, 1940

Salty grasslands

Al. ***Puccinellion limosae*** (Klika 1937), Wendbg 1943

Secondary grasslands of solonetz

7. As. *Polygono - Plantaginetum tenuiflorae* as. nov.
8. As. *Camphorosmetum annuae* (Rpes 1916), Soó 1933
9. As. *Hordeetum hystricis* Wendbg. 1943
10. As. *Puccinellietum limosae* Rpes 1927

Al. ***Cyperio - Spergularion*** Slavnič 1948

Halophilous grasslands from depressions and dried lakes bottoms

11. As. *Heleochloëtum schoenoidis* Țopa 1939

Al. ***Beckmannion erucaeformis*** Soó 1933

Mesohygrophilous grasslands of salt marshes

12. *Eleochari - Alopecuretum geniculati* Ujvár 1937
13. *Alopecurus pratensis - Rorippa kerneri* Soó 1933
14. *Agrosti - Beckmannietum* Soó 1933

Al. ***Festucion pseudovinae***

Haloxerophilous steppe and silvosteppe grasslands

15. *Achilleo - Festucetum pseudovinae* (Magyar 1928), Soó 1933
16. *Artemisio - Festucetum pseudovinae* (Magyar 1928), Soó 1933
17. *Peucedano - Festucetum pseudovinae* (Rpes 1927), I. Pop n. n.
18. *Artemisietum monogynae* Rpes 1927

From the beginning, the author of the work submits to this study, additionally, a division of grasslands into non-halophilic (genuine) with 2 classes, 2 orders, 2 alliances, 6 associations and halophilic (saline) with only one class, one order, 4 alliances and 12 associations phytosociological.

In establishing grazing capacity an average length of 160 days for a season was agreed, with a slightly longer period on non-halophilic grasslands and a shorter period on halophilic ones.

2. Results and Discussions

For the complex characterization of grasslands vegetation from the Crișurilor Plain, 189 geobotanical surveys were carried out by the author of the work, 150 of them on the halophilous grasslands, which are also the most widespread.

At a first analysis of the halophilic grasslands, they have 46 plant species in the grassy carpet, 10 less than the non-halophilic ones (Table 1)

Table 1. General data on the phytodiversity and general economic value of the species in the grassy carpet of Crișurilor Plain grasslands

No.	Phytosociological association	Number of cormophyte species	Vegetation cover (%)	Species participation (%)	
				Fodder	Harmful
1	*Agrostetum stoloniferae*	60	100	88	12
2	*Lythro - Calamagrostetum epigeii*	39	78	2	76
3	*Festucetum rupicolae*	56	100	84	16
4	*Festucetum valesiacae*	88	100	85	15
5	*Lolietum perennis*	56	89	84	5
6	*Botriochloetum ischaemi*	39	92	22	70
Prata genuina average		**56**	**93**	**61**	**32**
7	*Polygono - Plantaginetum tenuiflorae*	16	81	20	61
8	*Camphorosmetum annuae*	16	58	3	55
9	*Hordeetum hystricis*	34	74	12	62
10	*Puccinellietum limosae*	37	82	50	32
11	*Heleochloëtum schoenoidis*	25	95	6	89
12	*Eleochari - Alopecuretum geniculati*	41	84	6	78
13	*Alopecurus pratensis - Rorippa kerneri*	53	93	78	15
14	*Agrosti - Beckmannietum*	52	92	74	18
15	*Achilleo - Festucetum pseudovinae*	92	95	79	16
16	*Artemisio - Festucetum pseudovinae*	90	85	55	30
17	*Peucedano - Festucetum pseudovinae*	72	90	40	50
18	*Artemisietum monogynae*	27	68	10	58
Prata salina average		**46**	**82**	**36**	**47**
Associations GENERAL AVERAGE		**50**	**86**	**44**	**42**

Regarding the soil cover with vegetation on average in the halophilic grasslands, the grassy carpet reaches 83%, 10% lower than what was recorded in the non-halophilic grasslands.

The participation of forage species in the grass carpet averaged 44%, higher in non-halophilic grasslands (61%) and lower in halophilic grasslands (36%).
The pastoral value (PV) and green mass production (GMP) of the associations is influenced by the degree of participation of forage species in the grass carpet and soil salinity (Table 2).

Table 2. The productivity of the grassland associations in the Crișurilor Plain

No.	Phytosociological association	Pastoral value		Green mass production t/ha	Animal loading LU/ha (160 zile)	% to the average
		ind.	%			
	Agrostion stoloniferae					
1	*Agrostetum stoloniferae*	65.7	213	13.09	1.26	263
2	*Lythro-Calamagrostetum epigeii*	0.9	3	0.15	0.02	4
	Festucion rupicolae					
3	*Festucetum rupicolae*	52.0	169	9.42	0,91	190
4	*Festucetum valesiacae*	50.2	163	6.60	0,63	131
5	*Lolietum perennis*	75.7	246	15.39	1,48	3,08
6	*Botriochloetum ischaemi*	12.5	41	1.30	0,13	27
	***Prata genuina* average**	**42,8**	**x**	**7.66**	**0.74**	**x**
	Puccinellion limosae					
7	*Polygono-Plantaginetum tenuiflorae*	11.9	39	1.27	0.12	25
8	*Camphorosmetum annuae*	2.0	6	0.14	0.01	2
9	*Hordeetum hystricis*	7.9	26	0.64	0.06	13
10	*Puccinellietum limosae*	37.3	121	3.28	0.32	67
	Cyperio - Spergularion					
11	*Heleochloëtum schoenoidis*	3.6	12	0.29	0.03	6
	Beckmannion erucaeformis					
12	*Eleochari-Alopecuretum geniculati*	3,1	10	0,32	0,03	6
13	*Alopecurus pratensis-Rorippa kerneri*	66,9	217	14,03	1,35	281
14	*Agrosti - Beckmannietum*	57,4	186	12,78	1,23	256
	Festucion pseudovinae					
15	*Achilleo - Festucetum pseudovinae*	46.4	151	5.83	0,56	117
16	*Artemisio -Festucetum pseudovinae*	31.8	103	2.92	0,28	58
17	*Peucedano-Festucetum pseudovinae*	22.7	74	2.48	0,24	50
18	*Artemisietum monogynae*	5.5	18	0.38	0,04	8
	***Prata salina* average**	**24,7**	**x**	**3.70**	**0.36**	**x**
	Associations GENERAL AVERAGE	**30,8**	**100**	**5.02**	**0.48**	**100**

Thus, the non-halophilic grasslands have a PV of 42.8 (average) and a GMP production of 7.66 t/ha with an optimal load of 0.74 LU/ha (mediocre) and the halophilic ones more than twice lower, being considered very poor in terms of productivity.

The highest productivity has *Lolietum perennis* with 75.7 PV, 15.39 t/ha GMP, which allows a load of 1.48 LU/ha in 160 days of grazing.

The lowest productivities were in the associations with degraded grass carpet *Lythro-Calamagrostetum epigeii, Camphorosmetum annuae, Heleochloëtum schoenoidis, Eleochari-Alopecuretum geniculati* and *Artemisietum monogynae*, providing fodder for barely 0.01 - 0.04 LU/ha.

However, on average, the grasslands from Crișurilor Plain have a PV index of 30.8 (mediocre) and a production of 5.08 t/ha GMP which can support a load of 0.48 LU/ha (poor) during the pasture.

At the level of phytosociological Alliances, which are often assimilated with Natura 2000 Habitats (Gafta, Mountford 2008) [1], there are very large differences in productivity (Table 3).

Table 3. The productivity of the phytosociological alliances in the Crișurilor Plain and the optimal grazing capacity in 160 days

Phytosociological alliances	Pastoral value		Green mass production t/ha	Animal loading LU/ha
	ind.	%		
Agrostion stoloniferae	33.3	119	6.62	0.64
Festucion rupicolae	47.6	169	8.18	0.79
Puccinellion limosae	14.8	53	1.33	0.13
Cyperio - Spergularion	3.6	13	0.29	0.03
Beckmannion erucaeformis	42.5	151	9.04	0.87
Festucion pseudovinae	26.6	95	2.90	0.28
Alliances GENERAL AVERAGE	**28.1**	**100**	**4.73**	**0.45**

The highest pastoral value was assessed in *Festucion rupicolae (sulcatae)*, 47.6 PV (average) and the highest production in *Beckmannion erucaeformis* with 9.04 t/ha GMP supporting a load of 0.87 LU/ha in 160 grazing days. The worst results were evaluated at *Cyperio - Spergularion* where the possible load of barely 0.03 LU/ha indicates the very advanced stage of degradation of the grassy carpet.

The last assessment of productivity was carried out at the level of Natura 2000 Habitats, where the Habitats 6440 (Alluvial grasslands of river valleys of the *Cnidion dubii*) and 1530 (Pannonic salt-steppes and salt-marshes) were found. (Table 4).

From the very beginning it was found that in the case of lowland grasslands there is no equivalence between alliances and habitats due to the stage of degradation of the grassy carpet caused by salinization and overgrazing.

Table 4. The productivity of grasslands habitats in the Crișurilor Plain

Habitat	Phytosociological composition	Pastoral value ind.	Green mass production t/ha	Animal loading LU/ha	%
6440 normal	*Agrostetum stoloniferae*	**65.7**	**13.09**	**1,26**	**242**
6440 degraded	*Lythro-Calamagrostetum*	0.9	0.15	0,02	4
6240 normal	*Festucetum rupicolae* *Festucetum valesiacae* *Lolietum perennis*	**59.3**	**10.47**	**1,01**	**194**
6240 degraded	*Botriochloetum ischaemi*	12.5	1.30	0,13	25
1530 normal	*Puccinellietum limosae*	**43.8**	**6.89**	**0,66**	**127**
	Alopecurus- Rorippa				
	Agrosti - Beckmannietum				
	Achilleo - Festucetum pseudovinae				
	Artemisio -Festucetum pseudovinae				
	Peucedano-Festucetum pseudovinae				
1530 degraded	*Polygono-Plantaginetum*	5.7	0.51	0,05	10
	Camphorosmetum annuae				
	Hordeetum hystricis				
	Heleochloëtum schoenoidis				
	Eleochari-Alopecuretum geniculati				
	Artemisietum monogynae				
Normal habitats average 1530;6240;6440		**56,3**	**10.15**	**0.98**	**188**
Degraded habitats average 1530;6240;6440		6,4	0.65	0.06	12
GENERAL AVERAGE		**31,4**	**5.40**	**0.52**	**100**

The pastoral value and the highest production have the normal Habitat 6440, with the *Agrostetum stoloniferae* association (65.7 PV and 13.9 t/ha GMP) and the lowest 6440 degraded with the *Lythro-Calamagrostetum* association (0.9 PV and 0.15 t/ha GMP).

The normal 6240 habitat, which belongs to the "genuine prata" (non-halophilic) as well as the previous one, with 59.3 PV and 10.47 t/ha GMP has a fairly good productivity.

Because of Habitat 6240 degradation caused by the dominance of the non-valuable species *Botriochloa ischaemum*, the PV decreases by almost 5 times and the production of GMP t/ha by almost 8 times.

Habitat 1530, which belongs to the "saline prata" (halophiles), also has a normal variant (43.8 PV and 6.80 t/ha GMP) and the degraded version with a productivity of 7.5 times PV and 13.5 times lower GMP due to more pronounced soil salinity and irrational grazing.

On average, habitats 6440, 6240 and 1530 with normal vegetation from the study area reach 56.3 PV and 10.15 t/ha GMP which can maintain almost 1 LU/ha and on the degraded habitats the animal load is reduced by 16 times, being one of the most significant decreases.

This negative result obtained on the degraded grassland habitats raises very seriously the problem of improving the grassy carpet through appropriate hydro-ameliorative measures to eliminate moisture excess, amendment works and rational use by grazing with animals (pasture) or mowing (hayfield).

Conclusions

(1). Crișurilor Plain grasslands are particularly heterogeneous in terms of biodiversity and productivity, due in particular to soil salinity.

(2). The best productivity at the association level was *Agrostetum stoloniferae* (65.7 PV; 13.09 t/ha GMP; 1.26 LU/ha), at alliance level the *Festucion rupicolae* alliance, and at habitat level the Habitat 6440 normal.

(3). The lowest productivity was assessed in the degraded associations due to the irrational use and more pronounced salinization of the soil in the composition of the degraded Habitats 6440, 6240 and 1530, which can provide an average of 6.4 PV; 0.65 t/ha GMP with a load of only 0.06 LU/ha compared to 0.98 LU/ha as provided by normal grass carpet habitats.

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