ASSESSMENT OF GRASSLAND PRODUCTIVITY IN MARINE SAND DUNE AREAS OF THE DANUBE DELTA

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Abstract

The permanent grasslands on the Chituc and Periteașca-Leahova marine sandbars have very low productivity, with an average vegetation coverage of 75-78% and a participation of forage species of 17-23%. On Chituc Sandbar productivity is higher due to the greater participation of the species Elymus elongatus and Chrysopogon gryllus, with a production of 3 t/ha of green fodder and a load of 0.35 LU/ha in 130 days of grazing season, a pastoral value of 13.1 and a milk production of 1,040 liters per hectare. With the vegetation being dominated by the species Bromus tectorum and Puccinellia spp, on the Periteașca-Leahova Sandbar the green fodder production is 0.68 t/ha. With an optimal load of 0.08 LU/ha and a pastoral value of 9.8, the milk production can be 780 l/ha in 130 days of grazing season. By evaluating the productivity of grasslands on marine sandbars or of other origins such as fluvial and continental ones, grazing capacity can be optimized, thus contributing to the conservation of biodiversity and the achievement of superior economic performance.

Keywords: marine sandbars, grassland vegetation, pastoral value, productivity

INTRODUCTION

The vegetation that can be assimilated to permanent grasslands in the evaluated area has been studied from a geobotanical perspective by several researchers (Popescu et al. 1997, et al. 2002, Petrescu 2007, Făgăraș et al. 2008a, Făgăraș et al. 2008b, Sanda et al. 2008, Doroftei et al. 2011, Doroftei & Covaliov 2013, Făgăraș 2015, Făgăraș et al. 2015).

In terms of productivity, there is less research on these grasslands, especially those on the sandbars, although they are used for grazing animals belonging to local communities. The grasslands on the sandbars fall into the group of non-zonal ones on saline soils and are thus affected by alkalization, a phenomenon that causes the degradation of the vegetal layer of these areas through the proliferation of harmful species (Oprea et al. 2022; Marușca 2023; Marușca et al. 2024). The evaluation of green fodder production per hectare and of the pastoral value are basic indicators for establishing the optimal animal load during the grazing season, an essential element for preserving biodiversity and avoiding the degradation of the more

sensitive vegetal layer on the sand dunes (Marușca 2022). This paper presents the evaluation of the productivity of natural grasslands on the Chituc and Periteașca-Leahova sandbars in the Danube Delta.

MATERIAL AND METHOD

To evaluate the productivity of natural grasslands developed on coastal sands, two representative sandbars were studied both in terms of habitat conservation status and accessibility. The studied areas are partially in strictly protected areas, in the case of the Chituc Sandbar, and entirely in strictly protected areas, in the case of the Periteașca - Leahova Sandbar. (Figure 1).

Fig. 1 – Studied area

Access to strictly protected areas was based on research permits issued by the Danube Delta Biosphere Reserve Administration.

The two studied areas are located in the southern part of the Danube Delta Biosphere Reserve, the substratum of the evaluated surfaces being generally represented by unfixed sands of marine origin for the Chituc Sandbar and phreatic - humid sandy psamosoils (on marine deposits) frequently salinized for the Periteașca - Leahova Sandbar, the fertility of these soils being very low (Munteanu & Curelariu 1996).

For the vegetation study, 13 floristic surveys were carried out, according to the Klapp-Ellenberg percentage method (Mueller-

Dombois & Ellenberg 1974, Maruşca 2019) of cormophyte participation in the vegetal layer, the data being collected between 2023-2024. The area evaluated in each sample station was 100 sq m.

The evaluation of grassland productivity was carried out according to the new method based on floristic survey proposed by Maruşca (2019).

The potential milk production per hectare was determined after pastoral evaluation and application of a conversion coefficient established in dairy cow grazing experiences by Maruşca et al (2018).

RESULTS AND DISCUSSIONS

In a first stage, 3 surveys were carried out on Chituc Sandbar, being determined 33 species of cormophytes (Table 1). The dominant species were *Elymus elongatus*, *Chrysopogon gryllus* and Artemisia tschernieviana each in one of the 3 relevee's. The most common species represented in the 3 surveys is *Euphorbia sequeriana* at 11.7%, which indicates the advanced stage of degradation of the vegetal layer of these grasslands.

The first survey, dominated by 34% *Elymus elongatus*, 15% *Seseli tortuosum* and 10% *Melilotus albus*, indicates excess humidity during some periods of the year.

Table 1

The floristic composition of the grasslands of the Chituc marine sandbar

No.sp.	Species	Relevee no.			Average %
		1	2	3	
	Vegetation coverage(%)	95.6	78.3	51.5	75.1
	***Poaceae* family species**				
1	*Elymus elongatus*	34.0			11.3
2	*Elymus farctus*	10.0			3.3
3	*Apera spica venti*	0.5			0.2
4	*Chrisopogon gryllus*		15.0		5.0
5	*Bromus sterilis*		1.0		0.3
6	*Bromus hordeaceus*		0.5		0.2
7	*Calamagrostis epigeios*		0.1		0.1
	***Fabaceae* family species**				
8	*Melilotus albus*	10.0			3.3
9	*Lotus tenuis*	3.0			1.0
10	*Medicago lupulina*			5.0	1.7
11	*Astragalus varius*			0.5	0.2
	Species from other families				
12	*Seseli tortuosum*	15.0	2.0		5.7
13	*Gypsophilla perfoliata*	10.0	0.5		3.5
14	*Euphorbia seguieriana*	5.0	15.0	15.0	11.7
15	*Centaurea arenaria*	2.0	1.0	2.0	1.7
16	*Scabiosa argentea*	2.0	7.0	0.5	3.2
17	*Silene borysthenica*	2.0	0.5	2.0	0.8

18	*Crepis foetida*	1.0	0.1		0.4
19	*Conyza canadensis*	0.5			0.2
20	*Astrodaucus littoralis*	0.5			0.2
21	*Asparagus littoralis*	0.1			0.1
22	*Scirpoides holoschoenus*		15.0		5.0
23	*Plantago maritima*		5.0		1.7
24	*Juncus maritimus*		5.0		1.7
25	*Inula salicina*		5.0		1.7
26	*Teucrium pollium*		3.0		1.0
27	*Dianthus polymorphus*		2.0		0.7
28	*Linaria genistifolia*		0.5	2.0	0.8
29	*Rumex crispus*		0.1		0.1
30	*Artemisia tschernieviana*			16.0	5.3
31	*Linum austriacum*			5.0	1.7
32	*Teucrium chamaedryis*			3.0	1.0
33	*Convolvulus lineatus*			0.5	0.2

The absence of the species *Puccinellia distans* ssp. *limosa* and *Juncus gerardii* from the Chituc sand dunes grasslands indicates a lower degree of soil salinization compared to the Periteașca - Leahova Sandbar.

The vegetal layer of these grasslands is better consolidated, with an average coverage of almost 78%, being 3% higher than on Chituc Sandbar. The share of forage and harmful species in the vegetal layer reflects the advanced stage of degradation of these grassland (Table 3). On average, the proportion of forage species is 19.6%, higher in Chituc (22.5%) and lower in Periteașca - Leahova (16.6%), here the highest proportion of harmful species being also recorded (61.1%).

The highest production of green fodder was estimated on the Chituc Sandbar grasslands, being almost 3 t/ha, which allows an average load of 0.35 LU/ha in the 130-day optimal grazing season. Being dominated by species with a smaller habitus, a production of 0.68 t/ha was estimated on the Periteașca - Leahova Sandbar, 4.5 times lower than on Chituc, which allows a very low livestock load of 0.08 LU/ha. The average pastoral value for these meadows was barely 11.5, which allows the production of 910 liters of cow's milk per hectare in 130 days of grazing season, with a load of 0.22 LU/ha or, more clearly expressed, almost one dairy cow per 5 hectares of grassland. With the present floristic composition, on the Chituc Grind can be obtained a quantity of 1,040 liters of milk per hectare and on the Periteașca - Leahova Grind 25% less, respectively 780 liters per hectare.

Observations made during field trips showed that although it is a completely protected area, the anthropogenic impact is more pronounced in the Periteașca - Leahova Sandbar, this being mainly due to the extensive, irrational grazing, which is allowed both for

domestic animals - cows, and especially for animals that have escaped from control - wild horses. Therefore, an interesting phenomenon, highly appreciated by tourists, namely herds of horses running free, tends to become a problem that can endanger the integrity of the vegetation and even the survival of some emblematic plant species. For the future, taking into consideration the optimal livestock load assessments based on floristic surveys and the appropriate duration of the grazing season, limited in this area by extended drought, can substantially improve the phytodiversity of the evaluated areas.

Table 3

Productivity and grazing capacity of grasslands located on marine sand dunes in the Danube Delta

andbar	Floristic composition structure (%)		Green fodder production		Optimum load in 130 days (LU/ha)	Pastoral value (ind.)	Cow milk production	
	Forage	Harmful	t/ha	%			L/ha	%
1. Chituc	22.5	52.6	2.99	163	0.35	13.1	1040	114
2. Periteașca - Leahova	16.6	61.1	0.68	36	0.08	9.8	780	86
Average	19.6	56.8	1.84	100	0.22	11.5	910	100

Table 2

The floristic composition of the Periteașca - Leahova marine sand dunes

No.sp.	Species	Relevee no.										Average(%)
		1	2	3	4	5	6	7	8	9	10	
	Vegetation coverage (%)	86	80	100	86	71	100	75	51	47	81	77.7
	***Poaceae* family species**											
1	*Bromus tectorum*	10.0	19.0		15.0	10.0			10.0	15.0		8.0
2	*Cynodon dactylon*	1.0	3.0		0.5	3.0	3.0	2.0		0.5		1.3
3	*Puccinellia distans spp limosa*		0.5	2.0	5.0			3.0				1.1
4	*Bromus secalinus*			1.0								0.1
5	*Puccinellia festuciformis*					3.0	3.0					0.6
6	*Bromus sterilis*						5.0				20.0	2.5
7	*Phragmites australis var humilis*									0.1		0.1
	Fabaceae family species											
8	*Medicago minima*	3.0	0.5		1.0	0.1					2.0	0.7
9	*Trifolium campestre*						0.5		0.5		2.0	0.3
10	*Medicago falcata*						0.1					0.1
11	*Medicago lupulina*							1.0				0.1

12	*Vicia cracca*							0.5				0.1
	Species from other families											
13	*Juncus maritimus*	35.0	15.0	71.0	20.0		45.0	33.0			0.1	22.0
14	*Draba verna*	5.0	2.0	5.0	10.0	2.0	2.0	2.0			2.0	3.0
15	*Artemisia santonicum*	5.0	5.0	7.0	10.0	3.0	7.0	5.0	5.0	3.0		5.0
16	*Silene conica*	5.0			2.0							0.7
17	*Gypsophilla perfoliata*	3.0	2.0	3.0	2.0	1.0	3.0	5.0				1.9
18	*Senecio vernalis*	3.0	1.0		1.0	0.5	1.0	2.0	5.0	5.0		1.9
19	*Verbascum banaticum*	3.0	3.0		0.5	1.0		1.0	2.0		1.0	1.2
20	*Minuartia viscosa*	3.0	2.0	0.5				2.0				0.8
21	*Myosotis stricta*	2.0		3.0	7.0			2.0				1.4
22	*Plantago lanceolata*	2.0	1.0				0.5	1.0			2.0	0.7
23	*Limonium gmelinii*	2.0	1.0	2.0	2.0	5.0	3.0	2.0				1.7
24	*Centaurea arenaria*	2.0	1.0		1.0	1.0		1.0			0.1	0.6
25	*Euphorbia seguieriana*	0.5	2.0			0.5					5.0	0.8
26	*Teucrium scordium*	0.5				1.0		1.0		0.5	7.0	1.0
27	*Linum austriacum*	0.5	0.5		1.0							0.2
28	*Eryngium campestre*	0.1	0.5									0.1
29	*Elaeangus angustifolia*	0.1	15.0	0.5				2.0				1.8
30	*Schoenus nigricans*		3.0		3.0	5.0	5.0	5.0				2.1
31	*Syrenia cana*		2.0									0.2
32	*Carex colchica*		0.5	5.0	0.5	0.5	1.0	2.0				1.0
33	*Gallium humifusum*		0.5									0.1
34	*Onosma arenaria*		0.1									0.1
35	*Sonchus arvensis*		0.1		5.0							0.5
36	*Cichorium intybus*			0.5								0.1
37	*Juncus effusus*					18.0						1.8
38	*Cirsium arvense*					5.0						0.5
39	*Polygonum maritimum*					3.0						0.3
40	*Carex distans*					3.0						0.3
41	*Myosotis arvensis*					2.0	1.0					0.3
42	*Linaria genistifolia ssp euxina*					2.0	2.0	1.0				0.5
43	*Stachys recta*					1.0						0.1
44	*Senecio vulgaris*					0.5						0.1
45	*Juncus gerardii*						17.0					1.7
46	*Galium aparine*						2.0			0.5		0.3
47	*Cirsium vulgare*							2.0		2.0		0.4
48	*Xanthium strumarium*								13.0	10.0		2.3
49	*Rumex dentatus*								7.0	2.0	2.0	1.1
50	*Alyssum minutum*								5.0	5.0	17.0	2.7
51	*Argusia sibirica*								2.0	2.0		0.4
52	*Glaucium flavum*								1.0			0.1
53	*Crambe maritima*								0.1			0.1
54	*Ceratocarpus arenarius*									1.0		0.1
55	*Polytrichum sp (mușchi)*										20.0	2.0
56	*Taraxacum besarabicum*										1.0	0.1

CONCLUSIONS

The permanent grasslands located on the sandbars of the Danube Delta are in a stage of low productivity due to the existence of 22-25% gaps in vegetation and a low participation, of only 17-23%, of forage species in the vegetal layer. The production of green fodder was evaluated at 0.68 t/ha on the Periteașca - Leahova Sandbar and 3 t/ha on the Chituc Sandbar, allowing a livestock load of 0.08-0.35 LU/ha in an optimal grazing season of 130 days.

The average pastoral value is 11.5, which allows for an average production of 910 liters of milk per hectare, respectively 1040 l/ha on the Chituc Sandbar and 780 l/ha on the Periteașca - Leahova Sandbar. Taking into consideration the optimal annual grazing period and grassland's carrying capacity can be important measures for the efficient management of sand dunes vegetation and can contribute to the conservation of biodiversity and also to enhance the productivity of these sensitive areas.

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