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Source / Izvornik: **Zbornik radova 57. hrvatskog i 17. međunarodnog simpozija agronoma, 2022, 86 - 90**

Conference paper / Rad u zborniku

Publication status / Verzija rada: **Published version / Objavljena verzija rada (izdavačev PDF)**

Permanent link / Trajna poveznica: https://urn.nsk.hr/urn:nbn:hr:204:084053

ORIGINAL SCIENTIFIC PAPER

Estimation of forage value of dry grasslands on the Dinara mountain based on the analysis of the botanical composition

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Abstract
As a part of the project „Dinara back to LIFE“ (LIFE 18 NAT/HR/000847), vegetation was surveyed on 30 grassland habitats on Dinara mountain. A total of 158 taxa was recorded during the survey. The quality and total value of grasslands were estimated using the „Complex Method“. The basic quality index (BQI) was calculated for plants in the green mass and the hay. BQI varied between -6.8 and 16.6 in the green mass and -11.2 and 8.2 in the hay. Generally, it was observed that the grasslands of lower quality (especially in the green mass) are located in the southern central parts of the project area, whereas those of higher quality are situated in the northern and central parts of the area.

Key words: grassland, forage value, complex method, pastures, Dinara

Introduction

It is important to evaluate the quality and the total value of grasslands to determine which grasslands are appropriate for pasture and forage production, as well as to determine what agrotechnical and amelioration methods to use for boosting their quality (Šoštarić-Pisačić and Kovačević, 1974). Numerous authors have proposed methods for the evaluation of grassland quality, ex. Ellenberg (1952), Klapp et al. (1953), Šoštarić-Pisačić and Kovačević (1974), more recently Briemle et al. (2002), Novák (2004), and others. The „Complex Method“ (Šoštarić-Pisačić and Kovačević, 1974) for evaluation of the quality and total value of grasslands and leys is one of the strictest grassland quality evaluation methods, as well as one of the only ones that make a distinction between green mass and hay (considering that the feeding value of many plants changes through drying) and takes into account the weight share of plants. While developing the quality classification, the authors took into consideration fifteen different factors, such as morphology and anatomy of plants, developmental phase, palatability, chemical composition, digestibility, poisonousness, resistance to diseases and parasites, deterioration by haymaking, etc (Šoštarić-Pisačić and Kovačević, 1974). Another reason why „Complex Method“ was particularly suitable for our research is the fact that it contains an extensive list of classified plants belonging to Croatian flora, including Mediterranean plants that grow in our project area but are not present in Central Europe, hence are not listed in the classifications of the other mentioned authors. Dinara mountain is situated in Dalmatian Hinterland and is predominantly covered by grassland habitats – they comprise almost 50% of its' area. Most of those grasslands are submediterranean and epimediterranian dry grasslands (Basrek et al., 2020; OIKON d.o.o., 2004). Historically, the inhabitants of Dinara were cattle breeders and transhumance occurred every season when shepherds took their livestock from the lower parts of Dalmatian Hinterland and Dalmatia where it was too dry and hot during summer months to the pastures on Dinara which were rich in diverse plant species, fresh and often near water. This practice was lost towards the end of the 20th century and now only occurs sporadically (Basrek et al., 2020; Marković, 2003). The project „Dinara back to LIFE“ was launched in 2020. Among

other goals, it is set to develop management plans for the Dinara grasslands and restore them to the condition where it will be possible to use them again as pastures.

Material and methods

Thirty grassland habitats in total were surveyed during the field research, mostly belonging to the submediterranean dry grasslands (*Scorzoneretalia villosae*) (Natura2000 code: 62A0) (Interpretation manual of European Union habitats, 2007). The grasslands were surveyed in groups of ten on three locations within the project area – near the settlement Validžići (Kijevo municipality) in the northern part of the Dinara mountain, near the settlement Ježević in the central part of the project area, and near Vrdovo (settlement Donji Bitelić) in the southern central part of the project area. Thirteen grasslands were in various degrees of succession, mostly by *Juniperus oxycedrus, Fraxinus ornus, Rhamnus intermedia, Quercus pubescens, Carpinus orientalis,* etc. The vegetation survey was conducted using the Barkman scale where the cover of each taxon is marked with a symbol ranging from r (less than 1% of the plot cover, 1-2 individuals) to 5 (more than 75% of the plot cover).

The „Complex Method" was used to estimate the quality of surveyed grassland habitats. Each taxon was sorted into a quality class according to the Complex Method, ranging from Vn (very noxious) to Exc (Excellent). Quality classes and corresponding coefficients can be found in Šoštarić-Pisačić and Kovačević (1974). If a taxon wasn't available in Šoštarić-Pisačić and Kovačević (1974), it was sorted into the quality class of another taxon from its' genus, that was the most similar in morphological characteristics. The symbols from the Barkman scale were transformed into percentages of cover. The basic quality index (BQI) was calculated following this formula:

$$BQI = (1.0* Exc + 0.8* Vg + 0.6 * G + 0.4* M + 0.2* P) – (0.2* dp + 1.0\text{-}2.0*n + 2.5\text{-}4.0* Vn)$$

The statistical analysis was conducted using a t-test (α= 0.05) and one-way ANOVA (α= 0.05) followed by the Bonferroni correction and post hoc test.

Results and discussion

During the vegetation survey, 158 taxa were recorded, out of which 134 species, 8 subspecies, and 16 taxa only determined to the level of genus.

Table 2. Basic quality indices of surveyed grasslands in the green mass (BQI^{gm}) and hay (BQI^{h}); (SD – standard deviation; St. error – standard error; * - grassland in succession)

Validžići			**Ježević**			**Vrdovo**		
Location	BQI^{gm}	BQI^{h}	Location	BQI^{gm}	BQI^{h}	Location	BQI^{gm}	BQI^{h}
AK1	4.8	-0.6	AJ1*	6	8.2	AV1*	3	-1.4
AK2*	0.6	-0.2	AJ2*	16.6	-0.2	AV2*	1.5	-1.1
AK3	1.6	-5.6	AJ3	5	0.2	AV3	0.4	-4.2
AK4	2.6	-4.7	AJ4	-0.8	-3.3	AV4*	-6.8	-10
AK5*	2.2	-1.9	AJ5	3.8	-2.8	AV5*	-1.4	-3
KK1*	2.4	-3	KJ1	1.6	-0.8	KV1	-4.4	-7.1
KK2	1.6	-1.2	KJ2*	3.2	1.5	KV2	3.8	-0.3
KK3	3.4	-3	KJ3	2.4	1	KV3	1.6	-0.8
KK4	1.1	-3.2	KJ4*	8.2	0.3	KV4*	-3	-10
KK5	4	-3.4	KJ5	2.4	-4.9	KV5*	-4.4	-11.2
Mean	2.43	-2.68		4.84	-0.08		-0.97	-4.91
SD	1.32	1.64		4.82	3.38		3.57	4.07
St. error	0.42	0.52		1.52	1.07		1.13	1.29

Calculated BQIs (Table 2) varied between -6.8 (location AV4) and 16.6 (location AJ2) in the green mass and -11.2 (KV5) and 8.2 (AJ1) in the hay.
At the confidence level of 0.95, it was observed that BQIs in the green mass were significantly higher than those in the hay (Table 3).

Table 3. Results of a Paired Two-Sample t-Test show a significant difference in BQI values between green mass and hay (α=0.05).

	Green mass	Hay
Mean	2.1	-2.55667
Variance	17.582069	14.58737
Observations	30	30
df	29	
P(T<=t) two-tail	**2.05×10^{-8}**	

Most of the surveyed grasslands (24) had a positive BQI value in the green mass, whereas only five had a positive BQI value in the hay. This could be explained by the negative impacts of drying, such as the crumbling of leaves, chemical changes (reduction of protein and vitamin contents, decomposition of poisonous substances), etc. (Stjepanović et al., 2008; Šoštarić-Pisačić and Kovačević, 1974).
No significant difference was found between open grasslands and those in succession, either in the green mass or in the hay. It was not expected (Čarni et al., 2021), but can be explained by the fact that most of the grasslands were in the initial stages of succession and/or woody species were only present on the margins.
Results of one-way ANOVA showed significant difference (P< 0.05) in grassland forage quality between three locations,Validžići, Ježević, and Vrdovo both in the green mass and hay (Tables 4 & 5).

Table 4. Results of one-way ANOVA comparing mean BQI values for green mass between Validžići, Ježević, and Vrdovo grasslands (α=0.05).

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	170.414	2	85.207	6.777082	**0.00412**	3.354131
Within Groups	339.466	27	12.57281			
Total	509.88	29				

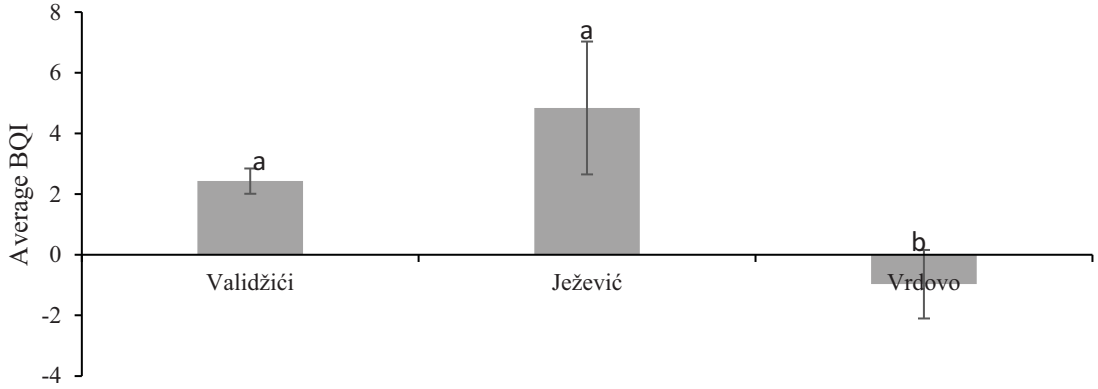
Table 5. Results of one-way ANOVA comparing mean BQI values for hay between Validžići, Ježević, and Vrdovo grasslands (α=0.05).

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	116.8727	2	58.43633	5.153435611	**0.0127134**	3.3541308
Within Groups	306.161	27	11.3393			
Total	423.0337	29				

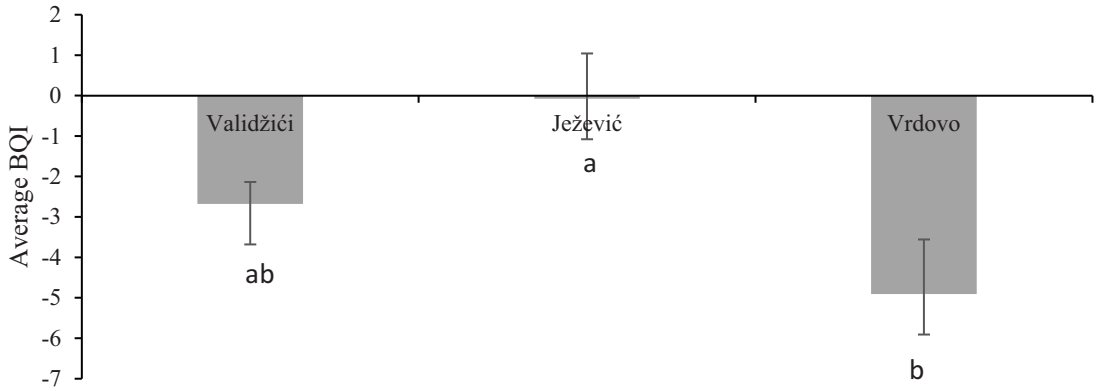
Post hoc analysis showed that, in the green mass, the grasslands from around Vrdovo had significantly lower BQI compared to the grasslands around Ježević and Validžići. In the hay, it was revealed that the grasslands from Ježević had significantly higher BQI than those from Vrdovo (Table 6) (Graph 1 & 2). We presume that the grasslands around Vrdovo show low BQIs because of the high percentage of the plot covered by *Sesleria tenuifolia*, which had in previous studies been identified as contributing to lower pastoral values of grasslands (D' Ottavio et al., 2005) or by *Sesleria autumnalis*, another species of the same genus (they covered 25% or more of the plot cover in eight of ten grasslands surveyed around Vrdovo).

Table 6. Post hoc analysis of differences between locations. * - significant difference (Bonferroni corrected p≤ 0.016666667)

	P value (green mass)	P value (hay)
Validžić vs. Ježević	0.14444846	0.052259042
Ježević vs. Vrdovo	**0.00670294***	**0.013403146***
Validžić vs. Vrdovo	**0.0112595***	0.144379016



Graph 1. Average BQIs for green mass of grasslands at Validžići, Ježević, and Vrdovo. Vertical range bars represent standard error.



Graph 2. Average BQIs for hay of grasslands at Validžići, Ježević, and Vrdovo. Vertical range bars represent standard error.

Conclusions

The results of our research confirm a better nutritional value of green forage than the potential value of the hay. It was found that there was no significant difference in nutritional value between grasslands that were not affected and those that were obviously affected by succession. Differences were found between individual localities with decreasing quality in the direction from north to south, where the average nutritional value of Vrdovo grasslands was the lowest and which was mainly due to the high proportion of *S. tenuifolia*.

Acknowledgement

The results presented in the paper are output from the project „Dinara back to LIFE – Management planning and restoration of Dinara dry grasslands to save biodiversity and support sustainable development“ (LIFE 18 NAT/HR/000847). The project is co-funded by the Environmental Protection and Energy Efficiency Fund.

References

Basrek L., Bedek J., Boršić I., Dumbović Mazal V., Duplić A., Đud L., Hamidović D., Ilijaš I., Jeremić J., Katušić L., Kovač Konrad P., Krivanek G., Leko K., Gambiroža P., Opačić B., Partl A., Pavlinić M., Pintar V., Plavac I., Posavec Vukelić V., Starčević I., Šestani G., Zadravec M., Zwicker Kompar G., Zupan I. Žeger Pleše I., Župan D. (2020). Park prirode Dinara – stručna podloga za zaštitu. Zagreb. Hrvatska: Zavod za zaštitu okoliša i prirode. Available from: http://www.haop.hr/

Briemle G., Nitsche S., Nitsche L. (2002). Nutzungswertzahlen für Gefäßpflanzen des Grünlandes. Schriftenreihe für Vegetationskunde. 38: 203-225. Available from: https://www.ufz.de/

Čarni A., Ćuk M., Krstonošić D., Škvorc Ž. (2021). Study of Forage Quality of Grasslands on the Southern Margin of the Pannonian Basin. Agronomy 11: 2132. Available from: https://www.mdpi.com/

D'Ottavio P., Scotton M., Ziliotto U. (2005). Pastoral value of mountain pastures of Monti Sibillini (Central Apennines. Italy) grazed by sheep. In Sustainable grazing. nutritional utilization and quality of sheep and goat products. Molina Alcaide E., Ben Salem H., Biala K., Morand-Fehr P. (ed.). 93-98. Zaragoza. Spain: CIHEAM-IAMZ.

Ellenberg H. (1952). Wiesen und Weiden und ihre standörtliche Bewertung. Stuttgart. Germany: Ulmer.

Interpretation Manual of European Union Habitats (2013). Brussels. Belgium: European Commission. DG Environment. Available from: https://ec.europa.eu/

Klapp E., Boeker P., König F., Stählin A. (1953). Wertzahlen der Grünlandpflanzen. Das Grünland. Hannover. Germany: Schaper.

Marković M. (2003). Stočarska kretanja na Dinarskim planinama. Zagreb. Hrvatska: Naklada Jesenski i Turk.

Novák J. (2004). Evaluation of grassland quality. Ekológia (Bratislava). 23(2): 127-143.

OIKON d.o.o.(2004): Karta staništa RH. za Ministarstvo kulture. Zagreb. Available from: http://www.haop.hr/

Stjepanović M., Štafa Z., Bukvić G. (2008). Trave za proizvodnju krme i sjemena. Zagreb. Hrvatska: Hrvatska mljekarska udruga.

Šoštarić-Pisačić K., and Kovačević J. (1974). Kompleksna metoda za utvrđivanje kvalitete i sumarne vrijednosti travnjaka i djetelišta. Zagreb. Hrvatska: Poljoprivredni fakultet Zagreb.