

## PRODUCTION AND QUALITY OF MEADOW ASSOCIATIONS IN FOREST HUNTING GROUNDS IN SERBIA

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**Abstract:** Determination of meadow associations was done on three locations: enclosed section of the hunting ground "Posavsko lovište Karakuša" (Forest holding Sremska Mitrovica), enclosed breeding ground i.e. area "Miloševa voda" (Sokolovica) and enclosed breeding ground "Lomnička reka" (Veliki Jastrebac). Phytocenological records were used to determine number and cover, and in samples the presence of plant species was determined and based on this analysis to which plant associations they belong. In determined associations the share in percentages of grass and leguminous species of high, medium and poor quality was determined, as well as species of other families, conditionally useful, bad, worthless, harmful and slightly poisonous. On the first location the following associations were established: *Agrostio-Juncetum effusi* Cinc. 1959., *Trifolio-Agrostietum stoloniferae* L.J. Mark. 1973., *Agrostietum vulgaris* Z.Pavl. 1955. sensu lato. On the second location, on both meadows, the association *Festuco-Agrostietum* Horv. (1952) 1982.em Trinajest. 1972. was established, whereas on the third location, association *Agrostio-Festucetum vallesiaca* Gajić 1961 was established. In investigated associations, the production of green mass and dry matter was established, as well as main parameters of the quality of grass mass (crude proteins, crude fibre, crude lipids, NFE and mineral matters).

**Key words:** meadows, production, hunting ground

### Introduction

Species of large game throughout Europe cause serious damage and economical losses in forestry management and agriculture. Damages caused by bark removal and biting on forest young trees represent serious problem in forest management, especially within enclosed parts of hunting grounds and breeding grounds for large game.

Damage caused by large game in forest management in Serbia has never been systematically determined, although their incidence has been registered (*Jović*,

1968, Gačić et al., 2006/a,b). Because of that, there are no reliable information on size and frequency of cause damages, not only at the national level, but also in different regions, years and tree species. Since types/species of large game, especially from the family of deer (*Cervidae*), are considered as major herbivores, in majority of forest eco systems, and considering their numerous impacts on the structure of forest and composition, it is very important to define ecological characteristics of habitats and evaluate their suitability for breeding of large game, primarily feeding potential of the hunting ground.

Objective of the research was to determine phytocenological composition, productivity and quality of natural meadow and pasture associations, which are at the disposal to reared species of large wild game (deer and wild hog) and are located on following locations: (1) enclosed section of the hunting ground "Posavsko lovište Karakuša"; (2) enclosed breeding ground i.e. area "Miloševa voda"; and (3) enclosed breeding ground i.e. area "Lomnička reka".

## Materials and methods

Investigation of the phytocenological composition, productivity and quality of natural meadows and pastures was carried out on three locations: enclosed section of the hunting ground "Posavsko lovište Karakuša" (Forest holding Sremska Mitrovica), enclosed breeding ground i.e. area "Miloševa voda" (Forest holding "Toplica" from Kuršumlija) and enclosed breeding ground "Lomnička reka" (Forest holding "Rasina" from Kruševac). Also, phytocenological study in numerous forest sastojina, which differ in regard to mixture, origin and age. On stated locations recordings were made in two or three repetitions and average result presented.

Meadow and pasture associations are described according to principles and methodology of Swiss-French phytocenological school (*Braun-Blanquet, 1964*), using scale describing number and cover (*Braun-Blanquet, 1928*). Presence of quality plant species was determined according to data presented by *Kojić et al. (2001)*, by their separation from the sample taken from area of 1m<sup>2</sup> during spring of 2008., subsequent weighing and calculation of their share in percentages. Quality plant species were grouped in following categories: quality grasses, quality leguminous plants, and useful and conditionally useful plant species. Weeds were grouped in two categories – very poisonous and slightly poisonous (*Caputa, 1966; Šoštarić–Pisačić, Kovačević, 1974; Klapp, 1986; Kojić et al., 2001*). Additionally, meadow associations were determined based on results obtained in earlier phytocenological researches on the territory of Serbia (*Kojić et al., 2004*). Quality parameters were determined using standard chemical laboratory analyses.

## Results and discussion

Main criteria for evaluation if certain plant is weed or not is if the livestock and wild game consuming it or not, also what is its nutritious value and digestibility, is it poisonous and to what degree, and if it is suitable in regard to the morphological structure for use by domestic and wild animals.

Presented results with two recordings are given in average for determined associations and as a review according to groups of plants, which are divided into categories according to belonging of plants to two main families *Poaceae* and *Fabaceae*. Also, other plants were divided according to which family they belong and their quality in regard to ruminant nutrition, in this case, deer game (Tomić *et al.*, 2008). Results are presented in table 1.

On the first location three associations were determined: (1) ass. *Argostio-Juncetum effusi* Cinc. 1959.; (2) *Trifolio-Agrostietum stoloniferae* Lj. Mark. 1973.; and (3) ass. *Agrostietum vulgaris* Z. Pavl. 1955. sensu lato.

In ass. *Argostio-Juncetum effusi* Cinc.1959. 36 plant species have been determined, of which 8 grass species, 7 leguminous species, whereas 23 species belonged to other categories. The most present were following species: *Agrostis capillaris* L., *Juncus effusus* L., *Poa pratensis* L., *Agropyrum repens* L. and *Medicago falcata* L. Grasses of high and medium quality were present with 36,4%, whereas the poor quality and worthless species only with 1,8%. Leguminous plants of high and medium quality were determined in presence of 8,9%, of which the highest presence of *Vicia cracca* L. (4,0%) was established. Three species of useful and three species of conditionally useful species were determined, whereas poor quality and worthless species 13 were registered with the highest presence of species *Juncus effusus* L. (27,9%). Harmful and slightly poisonous species were two, predominant was *Mentha aquatica* L. (3,1%).

In ass. *Trifolio-Agrostietum stoloniferae* Lj. Mark. 1973., 43 plant species were present, of which 7 species were grass and 7 species were leguminous plants, 29 species belonged to other plant categories. The highest number and cover were determined for: *Trifolium repens* L., *Agrostis stolonifera* L., *Lathyrus sylvestris* L., *Agrostis capillaris* L. and *Bromus inermis* Leyss. Grasses of high and medium quality were present with 13,96%, whereas poor quality and worthless with only 2,33%. Leguminous plants of high and medium quality were present in almost same share as grasses (13,95), with the highest presence of *Trifolium repens* L. (5,4%). The highest presence was determined for poor quality and worthless species 41,86% with species *Juncus effusus* L. There were 5 harmful and slightly poisonous species, predominant was *Mentha longifolia* L. (7,2%).

**Table 1. Presence of main groups of plant species in investigated associations**

Species	<i>Argostio-Juncetum effusi</i> Cinc. 1959.		<i>Trifolio-Agrostietum stoloniferae</i> Lj. Mark. 1973.		<i>Agrostietum vulgaris</i> Z. Pavl. 1955. sensu lato.		<i>Festuco-Agrostietum</i> Horv.(1952) 1982. em Trinajest. 1972.		<i>Arostio-Festucetum valesiacaе</i> Gajić 1961.	
	n	%	n	%	n	%	n	%	n	%
GRASSES										
High quality	2	5,56	1	2,33	2	5,71	4	12,12	3	8,82
Medium quality	4	11,11	5	11,63	6	17,14	4	12,12	4	11,76
TOTAL grasses of high and medium quality	6	16,57	6	13,96	8	22,85	8	24,24	7	20,59
Poor quality and worthless	2	5,56	1	2,33	-	-	3	9,09	3	8,82
LEGUMINOUS							-	-		
High quality	2	5,56	4	9,30	3	8,57	2	6,06	3	8,82
Medium quality	4	11,12	2	4,65	-	-	2	6,06	1	2,94
TOTAL leguminous plants of high and medium quality	6	16,67	6	13,95	3	8,57	4	12,12	4	11,76
Poor quality and worthless	1	2,77	1	2,33	-	-	-	-	1	2,94
OTHER FAMILIES										
Useful plants	3	8,33	6	13,95	3	8,57	4	12,12	4	11,76
Conditionally useful species	3	8,33	-		2	5,71	4	12,12	3	8,82
Total useful and conditionally useful species	6	16,67	6	13,95	5	14,29	8	24,24	7	20,59
Poor quality and worthless	13	36,11	18	41,86	18	51,43	9	27,27	10	29,41
Harmful and slightly poisonous	2	5,56	5	11,63	1	2,86	1	3,03	2	5,88
TOTAL PLANTS	36		43		35		33		34	

In ass. *Agrostietum vulgaris* Z. Pavl. 1955. sensu lato, the lowest number of species was determined (35), of which number 8 were grasses, 3 leguminous plants and 24 species from other families. The highest number and cover was determined for species *Agrostis capillaris* L. (34,3%). Grasses of high and medium quality were present with 22,85%, whereas poor quality and worthless grass species were not established. Leguminous plants of high quality were determined with 8,57%, mainly *Trifolium repens* L., whereas *Lotus corniculatus* L. and *Trifolium pratense* L. appeared in traces. Useful and conditionally useful species from other families were 5, and poor quality and worthless species were 18, with the highest presence of *Ranunculus repens* L. Harmful and slightly poisonous species was *Mentha longifolia* L, like in previous association

In phytocenological study which included 20 locations in Serbia (Cincović, 1959), and where number and cover of species were analyzed, also the association *Argostio-Juncetum effusi* Cinc.1959 was determined. As characteristic species of this association, authors stated *Juncus effusus* L., *Juncus articulatus* L. and *Agrostis alba* L., but the highest number and cover has the *Juncus effusus* L. (od 1.1 do 5.4).

In enclosed breeding ground „Lomnička reka“, which was in unfavourable situation for sampling and determination of production, because the single natural meadow was grazed by large game (deer and wild hogs). Data presented in table show that the highest share in percentages was determined for poor quality and worthless species 29,41%, whereas grasses of high and good quality participate with 20,59%, among which are: *Agrostis capillaris* L., *Festuca rubra* L., *Festuca vallesiaca* L., *Poa pratensis* L., *Festuca pratensis* Huds. and *Cynodon dactylon* L. Of leguminous species of high quality the presence of *Medicago lupulina* L., *Trifolium repens* L. and *Trifolium pratense* L. was established. Of harmful and slightly poisonous species the following two were established: *Rubus cescius* L. and *Mentha longifolia* L.

In earlier studies of meadow eco systems on the territory of Veliki Jastrebac (*Jovanović-Dunjić et al.* 1986) eight associations were established, among which *Festuco-Hordeestum secalini* and *Agrostio-Chrysopogonetum grylli*. Their utilization (anthropogenic factor) caused change of floristic composition, so on the meadow (which used to be forest nursery) located in enclosed breeding ground "Lomnička reka" ass. *Agrostieto-Festucetum vallesiaca* with 34 species is predominant, whereas previously stated associations had 31 and 45 species.

In table 2., data on production and quality of investigated associations on hunting ground on Jastrebac is presented.

Average production of green mass on grassland of ass. *Agrostio-Juncetum effusi* Cinc. 1959. was  $4,00 \text{ tha}^{-1}$ , and of dry matter  $1,25 \text{ tha}^{-1}$ . Content of crude proteins was 7,0%, crude lipids 1,7%, crude fibre 31,0%, and NFE 47,2%.

Grassland of ass. *Trifolio-Agrostietum stoloniferae* Lj. Mark. 1973. had production of green mass of  $4,43 \text{ tha}^{-1}$ , and of dry matter -  $1,42 \text{ tha}^{-1}$ . Crude protein content was 12,0%, content of crude lipids was 2,2%, of crude fibre 30,4%, and NFE 37,5%. This association is slightly more productive and of better quality due to increased presence of useful leguminous plants - *Trifolium repens* L. (5,4%), and had the highest content of crude proteins.

Association *Agrostietum vulgare* Z. Pavl. 1955. sensu lato realized production of green mass of  $3,15 \text{ tha}^{-1}$ , and of dry matter  $1,10 \text{ tha}^{-1}$ . Content of crude proteins was 10,0%, crude lipids 2,3%, crude fibre 29,8%, and NFE 41,7%. It realized the lowest production in regard to green mass and dry matter, but in regard to content of crude proteins it was on the second place, and on the first place in regard to content of crude lipids. Such poor quality of grassland can be improved with one of the agro-technical measures which is mineral fertilizations with main nitrogen, phosphorus and potassium nutrients. Beside the increase of production, grassland with mineral fertilization is transformed into more productive and high quality associations. So, ass. *Danthonietum calycinae*, by NPP fertilization in

different ratios of stated nutrients, is transformed into more productive grassland of higher quality with predominant species *Festuca rubra* L. and *Agrostis capillaris* L., (Lazarević et al. 2009).

On the territory of Stara Planina mountain (Tomić et al., 2005 a), the share in percentages of useful grasses, leguminous plants and other useful species was determined – from 70,1 to 85,8% on four locations of ass. *Agrostietum vulgaris*. Presence of useful grasses was 47,8–62,8%, and useful leguminous plants 12,4–30,8%. In research by Kojić et al. (1992), in the same association on Rudnjan plateau, the highest number and cover of the following species was established: *Agrostis vulgaris* L. (5.5), *Agropyrum repens* L. (3.3), *Poa nemoralis* L. (2.2), and *Festuca rubra* L. (1.1). Of leguminous species with somewhat higher number and cover the following were determined: *Trifolium repens* L. and *Trifolium campestre* Schreb. (1.1). According to some authors (Đorđević, Mijatović, 1963), total number of species in ass. *Agrostietum vulgaris* on different locations - Ljig, Suvobor, Gorski Kotar, Kopaonik and Golija, varied from 56 to 116 species. The highest number of grass and leguminous species was on the location Golija (13 and 10 species, respectively). In the review of meadow association Radočela (Mrfat-Vukelić et al., 1988), the greatest areas were under ass. *Agrostietum vulgaris* with 62 species.

On location "Miloševa voda", on the first meadow, average green mass production of ass. *Festuco-agrostietum* Horv. (1952) 1982. em Trinajest. 1972. of  $7,25 \text{ tha}^{-1}$  was established and of dry matter -  $2,93 \text{ tha}^{-1}$ . Content of crude proteins was 8,7%, of crude lipids 1,8%, of crude fibre 32,1%, and NFE 40,8%. This association was the most productive, whereas according to the content of crude proteins it was on the third place. The same association on the second meadow showed yield of green mass of  $6,55 \text{ tha}^{-1}$ , of dry matter  $2,34 \text{ tha}^{-1}$ , whereas content of crude proteins was the lowest of all investigated populations - 5,78%.

Obtained results relating to quality in our research show that the content of crude proteins of investigated grasslands was bellow the level of crude protein content in investigated domestic and foreign cultivars of perennial grasses (Tomić et al. 2002), and perennial cultivars of leguminous plants used for livestock feed (Tomić et al. 2005 a,b,c.)

**Table 2. Production and chemical composition of samples taken from natural meadows of enclosed part of hunting ground "Posavsko lovište Karakuša" (1., 2. and 3.) and enclosed breeding ground "Miloševa voda" (4. and 5.)**

	Associations	Green mass prod. $tha^{-1}$	DM prod. $tha^{-1}$	Min. mat. %	Moisture %	Crude protein %	Crude lipids %	NFE %	Crude fibre %
1	<i>Ass. Argostio-Juncetum effusi</i> Cinc. 1959.	4,00	1,25	5,12	7,98	7,02	1,69	47,18	31,05
2	<i>Ass. Trifolio-Agrostietum stoloniferae</i> Lj. Mark. 1973.	4,43	1,42	9,09	8,82	12,01	2,21	37,47	30,40
3	<i>Ass. Agrostietum vulgaris</i> Z. Pavl. 1955. sensu lato	3,15	1,10	8,33	7,82	10,04	2,28	41,71	29,82
4	<i>Ass. Festuco-agrostietum</i> Horv. (1952) 1982. em Trinajest. 1972.	7,25	2,93	8,53	8,01	8,70	1,80	40,83	32,13
5	<i>Ass. Festuco-agrostietum</i> Horv. (1952) 1982. em Trinajest. 1972.	6,55	2,34	4,93	7,74	5,78	1,23	41,26	39,05

## Conclusion

On investigated locations five associations were determined: *Agrostio-Juncetum effusi* Cinc. 1959., *Trifolio-Agrostietum stoloniferae* LJ. Mark. 1973., *Agrostietum vulgaris* Z.Pavl. 1955. sensu lato, *Festuco-Agrostietum* Horv. (1952) 1982.em Trinajest.1972. and *Agrostio-Festucetum vallesiaca* Gajić 1961. Number of species in associations was from 33 to 43. The most productive was ass. *Festuco-Agrostietum* Horv. (1952) 1982.em Trinajest. 1972. with 2.93 t ha<sup>-1</sup>, and the highest content of crude proteins of 12.01% was established in ass. *Trifolio-Agrostietum stoloniferae* LJ. Mark. 1973., in which also the leguminous species were the majority.

For the purpose of revitalization of investigated meadows it is necessary to apply on all three locations agro-technical melioration measures – drainage, fertilization with mineral fertilizers and in-planting of seed of adequate species and cultivars for preparation of hay and grazing. Also, correct utilizations of these meadows, i.e. timely cutting in the pheno-stage of beginning of spike forming in grasses, and beginning of blooming in leguminous plants, will contribute to increase of yield and quality of hay.

For the purpose of increase of potential from the aspect of nutrition, improvement of the quality of pasture areas is recommended and all forest clear

areas in enclosed breeding ground "Miloševa voda", as well as establishment of new areas under green feed in enclosed breeding ground "Lomnička reka", which could satisfy the needs of deer game in nutritious substances, and this would most probably prevent (or considerably reduce) striping of bark from beech trees.

## **Produkcija i kvalitet livadskih asocijacija u šumskim lovištima Srbije**

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### **Rezime**

Determinacija livadskih asocijacija utvrđena je na tri lokaliteta: ograđeni deo lovišta "Posavsko lovište Karakuša" (Šumsko gazdinstvo Sremska Mitrovica), ograđeno uzgajalište "Miloševa voda" (Sokolovica) i ograđeno uzgajalište "Lomnička reka" (Veliki Jastrebac). Fitocenološkim snimcima je utvrđena brojnost i pokrovnost, a u uzorcima je utvrđena zastupljenost biljnih vrsta, na osnovu čega je određena pripadnost biljnim zajednicama. U determinisanim asocijacijama utvrđeno je procentualno učešće vrsta trava i leguminoza visokog, srednjeg i lošeg kvaliteta, kao i vrsta ostalih familija, uslovno korisne, loše, bezvredne, škodljive i slabo otrovne. Na prvom lokalitetu utvrđene su asocijacije: *Agrostio-Juncetum effusi* Cinc. 1959., *Trifolio-Agrostietum stoloniferae* LJ. Mark. 1973., *Agrostietum vulgaris* Z.Pavl. 1955. sensu lato. Na drugom lokalitetu, na obe livade utvrđena je asocijacija *Festuco-Agrostietum* Horv. (1952) 1982.em Trinajest. 1972., dok je na trećem lokalitetu utvrđena asocijacija *Agrostio-Festucetum valesiaca* Gajić 1961. U ispitivanim asocijacijama utvrđena je produkcija zelene mase i suve materije, kao i osnovni parametri kvaliteta travne mase (sirovi proteini, sirova celuloza, sirove masti, BEM i mineralne materije).

### **References**

- BRAUN-BLANQUET J. (1928): Pflanzensoziologie. Grundzugedie. Vegetationskunde. Biologische Studienbucher 7. 1. Ed. Berlin.
- BRAUN-BLANQUET, J. (1964) Pflanzensoziologie – Grundzuge die Vegetationskunde. Wein – New York
- CAPUTA J. (1966): Contribution a l etude de croissance du gazon de paturages nat differentes altitudes. Recherche agron. En Suisse 5: 293–426.



- CINCOVIĆ T. (1959): Livadska vegetacija u rečnim dolinama zapadne Srbije. Doktorska disertacija. Beograd.
- GAČIĆ D., KRSTIĆ M., LAKETIĆ M. (2006a): Uticaj krupne divljači na šume rasta kitnjaka u Nacionalnom parku „Đerdap“. Šumarstvo 1-2: 21–33.
- GAČIĆ D., KRSTIĆ M., MIJATOVIĆ J. (2006b): Oštećivanje sastojina od naseljene jelenske divljači u ograđenom uzgajalištu „Lomnička reka“. Šumarstvo 4: 25–36.
- JOVIĆ D. (1968): Problemi usklađivanja šumskog i lovnog gazdovanja. Jelen 7: 5–38.
- JOVANOVIĆ - DUNJIĆ R., STEFANOVIĆ K., POPOVIĆ R., DIMITRIJEVIĆ J. (1986): Prilog poznavanju ekosistema na području Velikog Jastrepa. Glasnik Instituta za botaniku i botaničke bašte Univerziteta u Beogradu, 7–14.
- KLAPP E. (1986): Wiesen und Weiden. Verlag Paul Parey, Berlin–Hamburg.
- KOJIĆ M., MRFAT-VUKELIĆ S., DAJIĆ Z., AJDER S., STOŠIĆ M., LAZAREVIĆ D. (1992): Livadska vegetacija Rudnjanske visoravni i Radočela. Medicinske komunikacije, Beograd i Institut za krmno bilje, Kruševac, 5-114.
- KOJIĆ M., MRFAT – VUKELIĆ S., DAJIĆ Z., ĐORĐEVIĆ-MILOŠEVIĆ S. (2004): Livade i pašnjaci Srbije. Vizarti, Beograd.
- LAZAREVIĆ D., STOŠIĆ M., DAJIĆ Z., TERZIĆ M., PETROVIĆ P. (2009): Productivity and quality of plant mass of meadow ass. *Danthonietum calicinae* depending on the fertilization and utilization. *Biotechnology in Animal Husbandry* Vol.25 1-2: 133–142.
- ĐORĐEVIĆ V., MIJATOVIĆ M. (1963): Contribution to the study of natural meadows and pastures on Golija Mountain. *Arhiv za poljoprivredne nauke* 16: 3–29.
- MRFAT-VUKELIĆ S. (1988): Uticaj primene različitih doza mineralnih đubriva na promene livadske vegetacije. Magistrarski rad. Pmf Novi Sad, p.1-65.
- TOMIĆ Z., MRFAT-VUKELIĆ S., D. SOKOLOVIĆ, IGNJATOVIĆ S., ŽUJOVIĆ M., NEGOVANOVIĆ D., KRNJAJA V., NEŠIĆ Z., VORKAPIĆ M. (2002): Hemijski sastav domaćih i stranih sorti višegodišnjih trava po otkosima za stočnu hranu. *Biotehnologija u stočarstvu*, 15 Inovacije u stočarstvu, 14-15.novembar 2002, 251-256.
- TOMIĆ Z., MRFAT - VUKELIĆ S., ŽUJOVIĆ M., NEŠIĆ Z., KRNJAJA V. (2005a): Useful species as quality factor of meadow vegetation on Stara Planina Mountain. *Grassland Science in Europe* 10: 240–243.
- TOMIĆ Z., MRFAT-VUKELIĆ S., ŽUJOVIĆ M., NEŠIĆ Z., KRNJAJA V. (2005b): Presence of leguminous species in ass. *Agrostietum vulgaris* and ass. *Festucetum valesiaca* on Stara planina mountain. *Proceedings of XL Croatian Symposium on Agriculture with International Participation*, 15th -18th February 2005. Opatija. Croatia. 637–638.
- TOMIĆ Z., NEŠIĆ Z., MRFAT-VUKELIĆ S., ŽUJOVIĆ M. (2005c): Quality and plant association structure of grasslands on Stara Planina Mountain. 8th

International Symposium Modern Trends in Livestock Production. Biotechnology in Animal Husbandry 5-6: 253–258. TOMIĆ Z., NEŠIĆ Z., VILOTIĆ D., GAČIĆ D. (2008): Phytocenological investigation of grassland associations in hunting grounds in Serbia. International Scientific Conference „Forestry in achieving millennium goals“. ILFE, IUFRO. Novi Sad. Book of abstracts, 44.

ŠOŠTARIĆ-PISAČIĆ K., KOVAČEVIĆ J. (1974): Kompleksna metoda za utvrđivanje kvaliteta i sumarne vrednosti travnjaka i detelišta. Poljoprivredni fakultet, Zagreb.