

Pastoral ecology of Sinjajevina

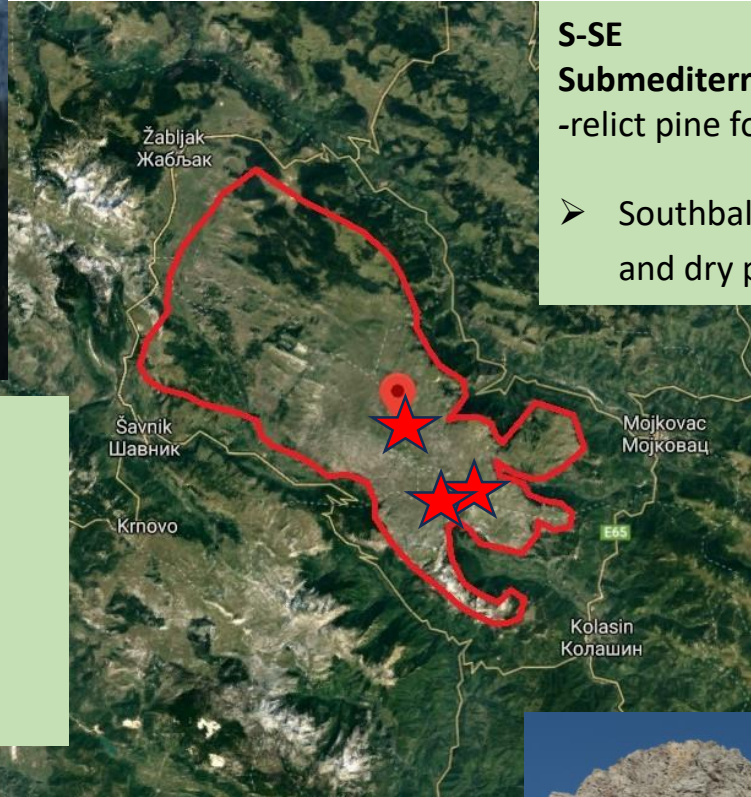
Jelena Lazarević, Dušica Radonjić, Ana Topalović



Savina voda, June 23



Mt. Durmitor



S-SE

**Submediterranean mountain climate Cfws“bx”
-relict pine forest Ass. *Pinetum heldreichii***

- Southbalkan highmountain rocky pastures and dry pastures

N-NW

Humid boreal climate Dfbx“

-coniferous boreal forests

As. Ass. *Picetum abietis montanum*

- European high mountain pastures and rocky pastures



Kuči Mt.



Legend
 Durmitor National Park
 Durmitor National Park
 Durmitor National Park
 Durmitor National Park
 Durmitor National Park

Pastoral ecology of selected katuns on the Sinjajevina

type of community governance - management level

III - Okrugljak still alive and active use of mountain pastures with many families, and herds present

II- Bunarine still alive, low number of families and animals is present

I-Katunina abandoned, for at least 10 years



- on karst
- on kalko-melanosols
- Sumediterranean-Mountain climate (Cfws“bx“)
- graslands *Festuco –Brometea* Br.-Bl. Sr Tx.,1943

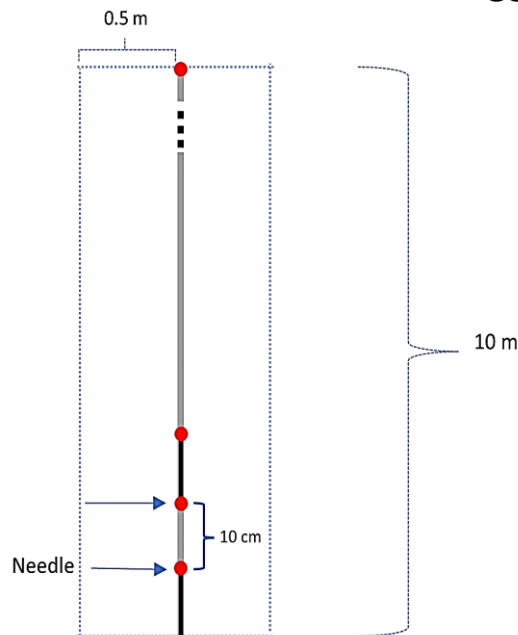
Floristic composition, functional traits and structure of the vegetation

The modified Point Quadrat –pin point methodology of Daget et Poisonet (1971)

(Alados et al., 2004; Arroyo et al. 2015)

Transect length '= 10 m,

Census of species every 10 cm



5 transects per site

In **2022**: june: establishing 4 transects per site

september: control on existing transects

In **2023**: june: control on existing 4 transects+

establishing of 1 new transect per site

september: control on existing transects

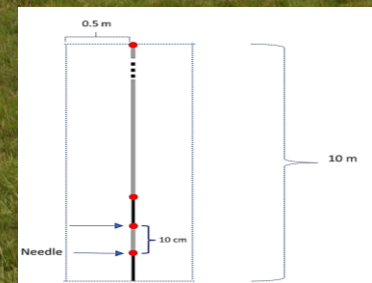
Line transect and the transect-related area of 10 m².

- Functional clusters and value for herds
- Shanon diversity index; Jaccard index

- There are only a few floristic studies of pastures in Montenegro
- Floristic research of pastures on Sinjajevina is missing



The modified Point Quadrat –pin point method



Pastoral phytomass production

Sampling: **june 2023**, 10 locations per site, 0,5 x 0,5 m.

according to protocol: AS-1064, 2012





according to protocol AOAC, 2000
Radonjić et al. 2018

We were determined:

- moisture content (gravimetric method);
- crude protein content (total N, Kjeldahl)
- total cellulose content (Henneberg-Stohmann method)
- total fat content (Soxhlet method);
- total ash content (burning at 540-600 °C).



Laboratory for Animal Nutrition of the Biotechnical Faculty, UoM.

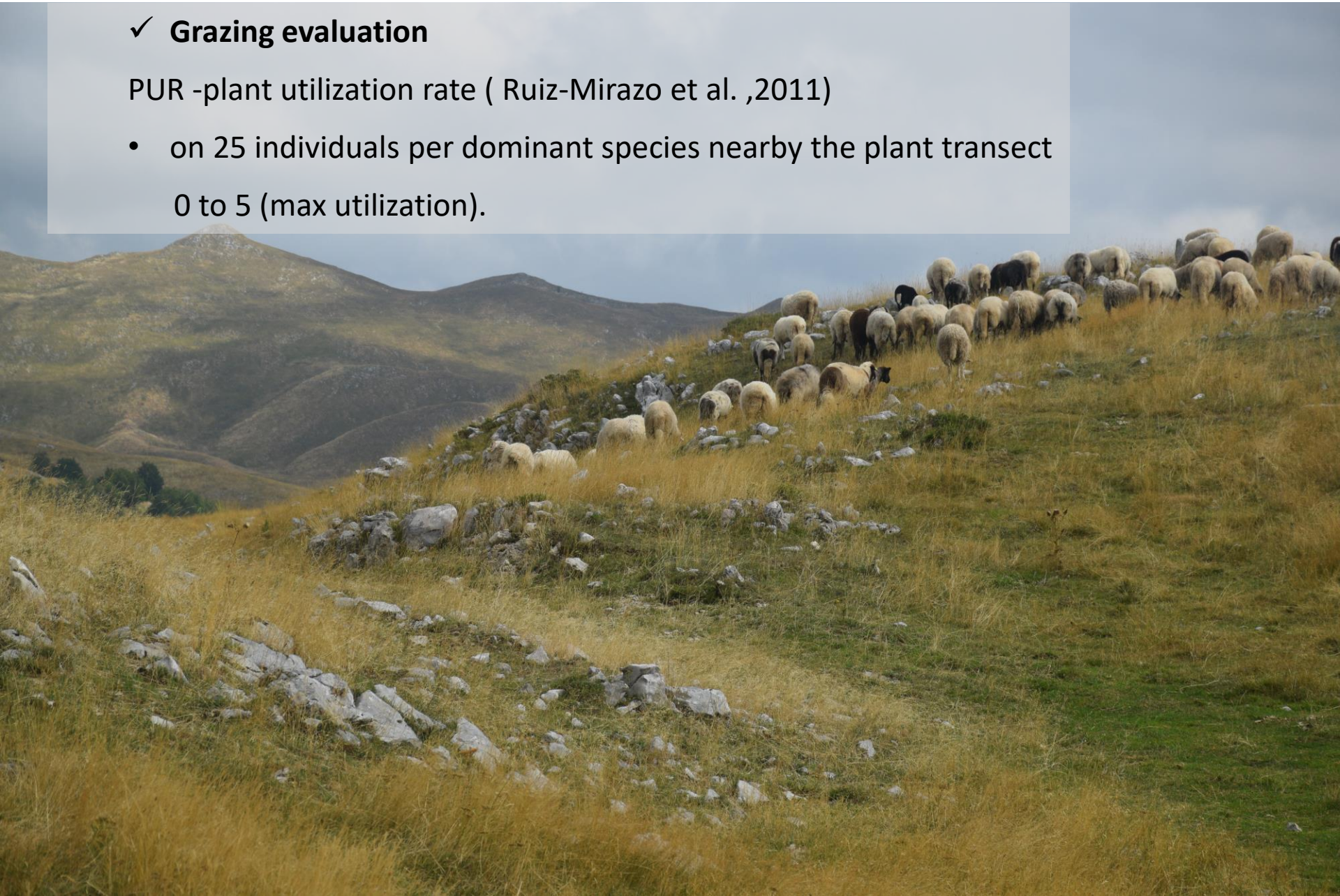
Responsible person: **dr Dušica Radonjić**

Livestock impact on the pastures

✓ Grazing evaluation

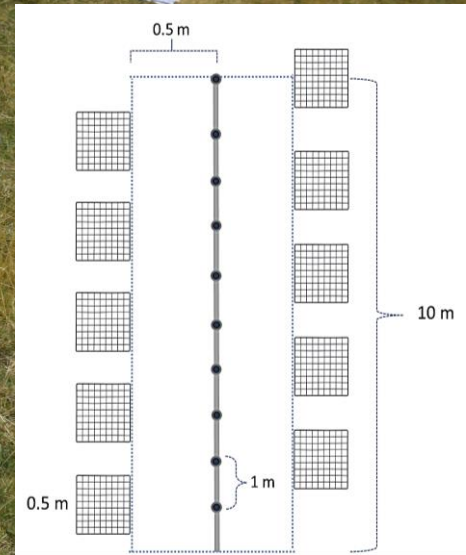
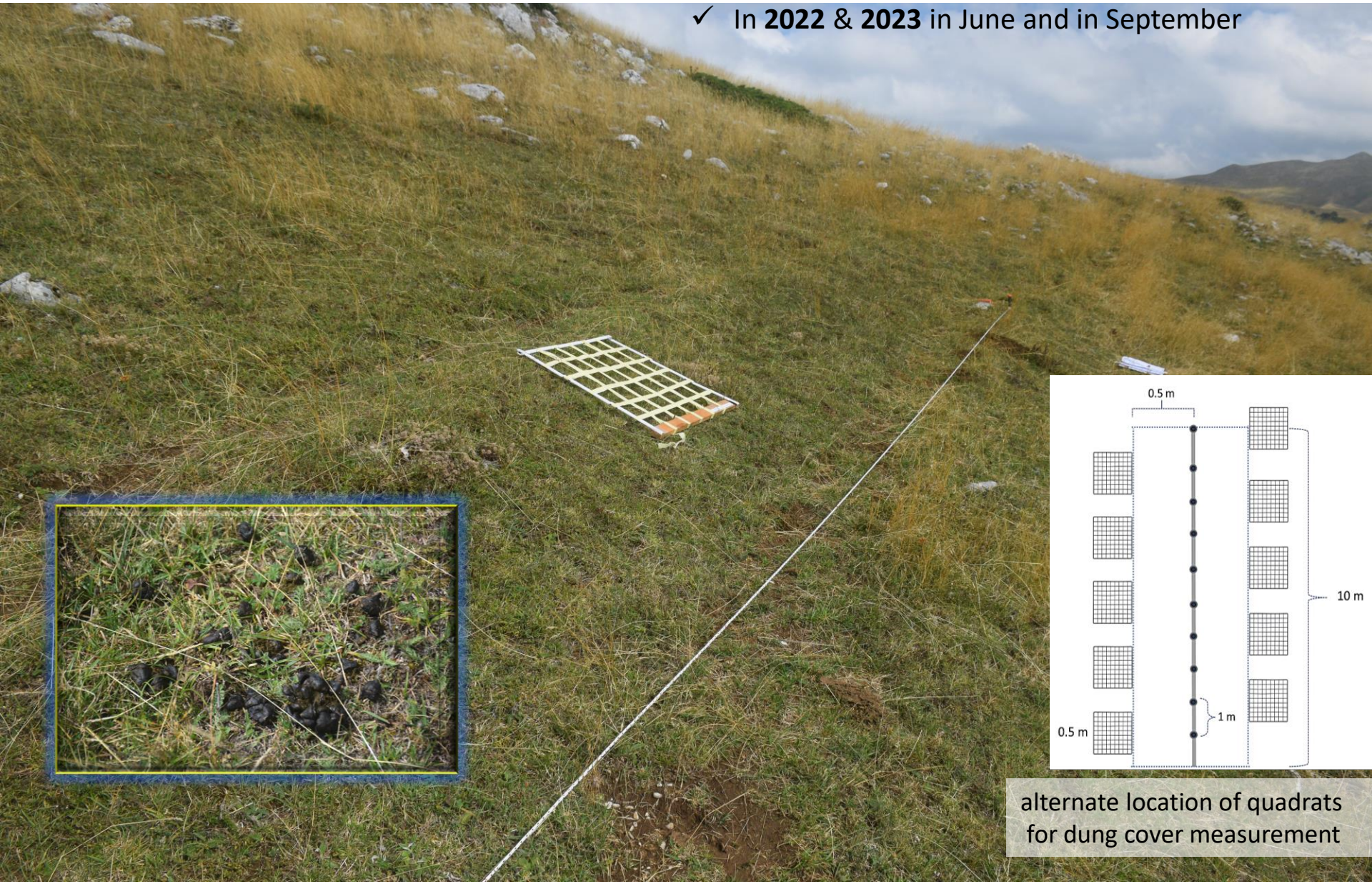
PUR -plant utilization rate (Ruiz-Mirazo et al. ,2011)

- on 25 individuals per dominant species nearby the plant transect
0 to 5 (max utilization).



- ✓ **Dung amount** in quadrats 0,5 x 0,5 m, with network on 10 cm.
- measured at the beginning and at the end of the grazing period.

✓ In **2022 & 2023** in June and in September



alternate location of quadrats for dung cover measurement

Soil assessment

- Soil depth
- Soil bulk density



Samples were taken in sept 2023.

- 36 profiles/ soil samples.
- Two depth (36 +20) = 56 soil samples
- 24 samples in Kopecky cylinders

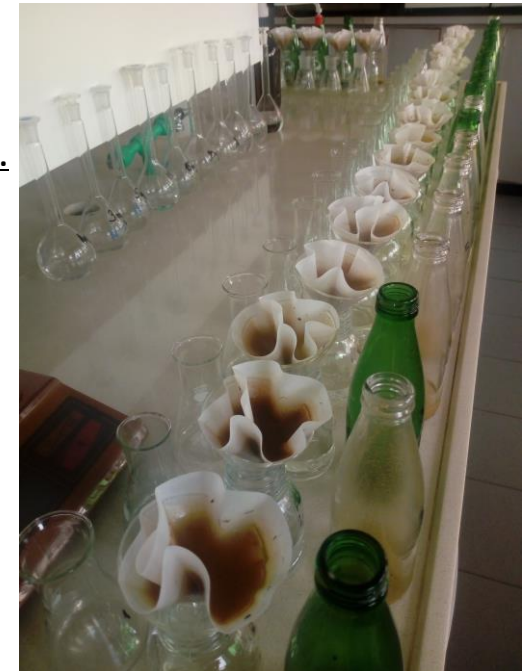


Soil analysis

Laboratory for Agrochemistry and Soil at Biotechnical Faculty, UoM

Responsible person: **Doc. dr Ana Topalović**

- Soil chemical analyses (Topalović 2022).
 - ✓ soil pH -on combined glass-electrode
 - ✓ humus content – by wet oxidation with 0.02 M KMnO_4 .
 - ✓ total nitrogen -by Kjeldahl method
 - ✓ available phosphorus -by spectrophotometry
 - ✓ available potassium- by flame photometry
 - ✓ total carbonates -by the volumetric method
- Soil texture - the sieve and the pipette method (Topalović et al. 2018).



Floristic composition, functional traits and structure of the vegetation

✓ More than 100 plant species were recorded on tree katuns on Sinjajevina

Katunina – 64 species

Shannon diversity index **2,9- 3,2**

Group of dominant species:

I, II, III, V. *Phleum pratense*, *Poa bulbosa*, *Poa ovina*; *Gallium mollugo*, *Geranium rotundifolia*, *Alchemilla hoppeana*

II. Dry variant: *Festuca bosniaca*, *Koeleria macrantha*, *Festuca valesiaca rubra*, *Koeleria macrantha*, *Hieracium pilosela*, *Thymus sepillum*....



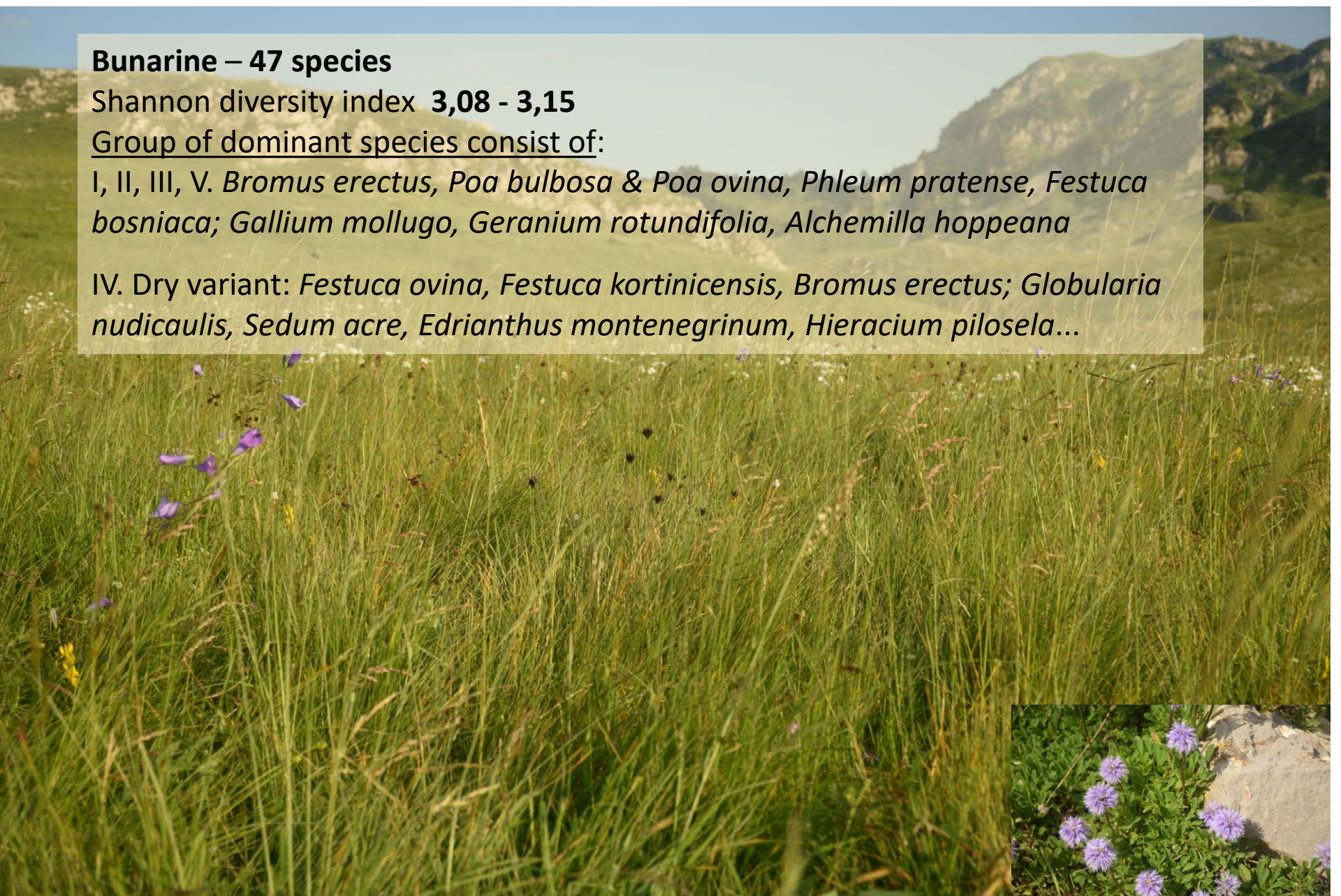
Bunarine – 47 species

Shannon diversity index **3,08 - 3,15**

Group of dominant species consist of:

I, II, III, V. *Bromus erectus*, *Poa bulbosa* & *Poa ovina*, *Phleum pratense*, *Festuca bosniaca*; *Gallium mollugo*, *Geranium rotundifolia*, *Alchemilla hoppeana*

IV. Dry variant: *Festuca ovina*, *Festuca kortinicensis*, *Bromus erectus*; *Globularia nudicaulis*, *Sedum acre*, *Edrianthus montenegrinum*, *Hieracium pilosela*...



Okrugljak – 36 species

Shannon diversity index **2,99- 3,08**

Group of dominant species:

I, II, III, V. *Poa bulbosa*, *Koeleria macrantha*, *Phleum pratense*, *Festuca bosniaca*;
Alchemilla hoppeana, *A. hybrida*, *Gallium mollugo*, *Geranium rotundifolia*...
Medicago falcata, *Trifolium repens*, *Lolium perene* ...

IV. „wet“ variant: *Poa pratense*, *Festuca bosniaca*, *Carex caryophillea*, *C. leavis* ,
Ranunculus bulbosus, *Trifolium repens*/sp.



Chemical composition of pasture phytomass

	Dry Matter %	Crude Protein %	Crude fat, %	Crude fiber, %	Ash, %	Yield kg DM/ha
Katunina	22.51	9.32	1.59	32.21	5.85	2408.02
Bunarine	21.72	12.08	1.37	31.04	6.80	1592.14
Okrugljak	22.63	11.58	1.72	29.09	6.51	2172.21

- depends on floristic composition
- phytomass (yield) are high for natural grasslands (In a dry year, they would be much lower).
- content of DM is expected for the period observed.
- content of cellulose (crude fiber) +/- higher
- content of protein is +/- lower

Research be continued, in different seasons, but also seasonaly (June, July, August)

Sampling: 24-26. 06. 2023
Unusually wet season!

The Standardized Precipitation Index (SPI)



- ✓ Research be continued, in different seasons, but also seasonaly (June, July, August)

Livestock impact on the pastures

Grazing evaluation

PUR -plant utilization rate(Ruiz-Mirazo et al. (2011),

Estimation of PUR, september 2023. Example: locality Okrugljak

Dominant plant species on loc. Okrugljak, in transects (I-V),
with utilization rate (0-5) 5- maxi utilization .

I	II	III	IV	V
<i>Poa</i> 4	<i>Koeleria</i> 4	<i>Koeleria</i> 4	<i>Festuca</i> 4	<i>Poa</i> 4
<i>Koeleria</i> 3	<i>Festuca</i> 4	<i>Festuca</i> 3	<i>Phleum</i> 4	<i>Koeleria</i> 4
<i>Festuca</i> 4	<i>Poa</i> 3	<i>Poa</i> 4	<i>Koeleria</i> 4	<i>Festuca</i> 4
<i>Phleum</i> 3	<i>Thymus</i> 1	<i>Achillea</i> 1	<i>Poa</i> 3	<i>Phleum</i> 3
<i>Alchemilla</i> 0	<i>Achillea</i> 0		<i>Alchemilla</i> 0	<i>Alchemilla</i> 1
	<i>Hieracium</i> 0		<i>Trifolium</i> 4	

Estimated on 25 individuals per dominant species near
the plant transect, 0 to 5

5 referring to max utilization.

Dung amount in quadrats 0.5 x 0.5 m, with network on 0.1 m (25 fields).

results

- 10 quadrats
- measured in **2022 & 2023** in June and in September

Dung amount on locality Okrugljak, an example

Dung type.	I	II	III	IV	V
Sheep IX 22	2/250	10/250	4/250	-	1/250
Cow IX 22		4/250		12/250	-
Sheep IX 23	1/250	5/250	-	4/250	2/250
Cow IX 23	-	6/250	9/250	15/250	25/250
Horse IX 23	-	5/250	-	-	-



Chemical properties of kalkomelanosols on Sinjajevina (range)

results

Soil parameter 0-20 cm	Katunina	Bunarine	Okrugljak
pH (KCl)	5.43-5.87 (5.6)	5.5-5.8 (5.66)	5.4-5.6 (5.5)
Humus (%)	20.-27.1 (23.7)	19-35.6 (28)	17.1-26.9 (22)
N (%)	0.82-1.12 (0.97)	0.77-1.48 (1.16)	0.69-1.11 (0.9)
P ₂ O ₅ (mg/100g)	2.1- 66.52 (22)	1.6-4.1 (2.5)	1.2-3.1 (2.4)
K ₂ O (mg/100g)	13-21.1 (15.8)	11.2-30 (20)	10.3-18.4 (13.2)

20-40 cm	Katunina	Bunarine	Okrugljak
pH (KCl)	5.5-5.73 (5.6)	5.4-6.25(5.8)	5.4-5.65 (5.5)
Humus (%)	12.3-18.7(16.1)	11.1-16.3 (13.7)	11.3-24-1 (17.6)
N (%)	0.48-0.76 (0.65)	0.43-0.65 (0.54)	0.44-0.99 (0.71)
P ₂ O ₅ (mg/100g)	0.8- 51.3	0.9-1.6 (1.25)	0.8-2.1 (1.3)
K ₂ O (mg/100g)	8.5-13 (10.3)	9.4-12.1 (12.1)	7.6-11.2 (9)

- ✓ extended chemical analysis (Ca, Mg, Mn, Zn, Cu)
- ✓ EC

Physical properties of kalkomelanosols on Sinjajevina (selected samples)

		Katunina	Bunarine	Okrugljak
Bulk density (g/cm ³)		1.45-1.62	1.47-1.86	1.62-1.78
Depth (cm)		0-20	0.20	0-25
Particle size (mm)	>2.00	24.22	0.00	0.00
	2.00-0.20	0.13	0.42	1.42
	0.20-0.02	53.62	49.41	33.23
	0.02-0.002	29.70	41.40	40.85
	< 0.002	6.55	8.77	4.50
Total sand		53, 75	49.83	54.65
Silt + Clay		46.25	50.17	45.35
Texture class	loam/ sandy loam			

Expanding new collaborations with French colleagues about important research lines, mainly inexistant in Montenegro today!

- **Dr Florence Mazier and**
- **Dr Marie-Claude Bal**

Environmental Geography laboratory (GEODE)

French National Council for Scientific Research CNRS and the University of Toulouse-Jean Jaurès,

-soil and anthracological sampling (charcoal in the soil) and pollen-based research important for understanding evolution of Sinjajevina upland landscapes

- reconstruct the vegetation cover, defin the age and spatial dynamics of the agro-pastoral landscape





Hvala na pažnji !



June 2023