Relation between boundaries of protected areas and the distribution of vulnerable natural habitats – a case study from Sharri National Park, SE Europe

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Abstract. A growing threat to areas designed to protect habitats with high biodiversity has been noticed. In order to assess the present level of threat, the correlation between the factual situation of natural habitats and the boundary of protected area was studied in the massif of Luboten, Sharri NP. 45 phytosociological relevès were made in the studied site, all habitat types were recorded and notes on presence of rare and endemic plant taxa were taken. It was noticed that within the massif of Luboten, Sharri NP, an endangered natural habitat of subalpine moist tall herbs is not covered within the strictly protected area. The Moesian hogweed tall herb communities with *Cirsium appendiculatum* Griseb., as the most distinctive plant species, are known to harbor several endemic and rare plant species. To further add conservation importance, in these habitats with narrow distribution and fragile environment, there is one South-European Orophilous plant species (*Willemetia stipitata*), as well as 12 Balkan endemic plant taxa. The corresponding recorded plant association is *Doronico gigantei-Cirsietum appendiculati* Horv. ex Quez. Based on the obtained data on the situation of this habitat, we highly suggest extending the strictly protected area for 0.56 km^2 into the NW direction of the western slope.

Keywords: EUNIS, habitat disturbance, Kosovo, nature conservation, phytosociology, diversity.

1. Introduction

The role and function of protected areas is of critical importance to our understanding, since it is directly related to the efficiency of conserving biodiversity as well as sustaining the local livelihoods. One of the utmost biodiversity conservation promotions from The World Conservation Union (IUCN) is the establishment of the protected areas. They are defined as "a clearly defined geographical space, recognized, dedicated and managed through legal or other effective means to achieve the long-term conservation of nature with associated ecosystem services and cultural values" (Dudley, 2008). As of 2007 IUCN estimates that are

more than 100.000 protected areas worldwide that fall into one of six categories of conservation, extending from strictly protected areas where human activity is limited to those that permit sustainable human use (IUCN, 2007).

Numerous protected areas that belong to the developing countries are characterized with a unique developmental pattern, which is related to the local people dependency on natural resources for their very existence (Wilshusen et al., 2003). Anyhow, this complex matrix of dependency and development that encompasses grasslands, agriculture, forests as well as varying unprotected sites is characterized with many surrounding pressures (Terborgh & van Schaik, 2002) towards natural resources that may either continuously or intermittently challenge conservation of protected areas. Due to these pressures and the dependency matrixes and known complex processes that entail natural habitats and resources, protected areas represent an important strategy towards protecting and conserving natural habitats (Brown et al., 2009).

Anyhow, so far there have been only few assessments of the ecological effectiveness of protected areas (Gaston et al., 2006) despite of their widespread popularity. Those few studies that have attempted to assess of protected areas towards preserving environment against degradation, include interview based qualitative assessments (Barber et al., 2012), assessments on the degree of forest cover change from one time period to another (DeFries et al., 2005), and change in abundance for certain target taxa and their potential threats (Tuya et al., 2006) among few other studies. From many studies made so far (Rowell, 1993; Jones, 2000; Hockings, 2003) in regard to the strategies used by implementing organizations that additionally assess the effectiveness of protected areas management, it can be concluded that it represents a complex interconnectivity of different dynamic subfields in order to achieve a practical and useful management of protected areas.

If the objective of protection zones within the National Park is to conserve biodiversity, then we need to make sure that the boundaries of strictly protected area are properly set in order to reach real protection goals.

Functional and taxonomic diversity as components of biodiversity generally concern the range of roles that organisms play on their communities and ecosystems. Either though the concept of functional diversity itself remains largely complex and many definitions for it exist (Bengtsson, 1998; Diaz & Cabido, 2001), a more specific definition was offered by Tilman (2001) defining it as "the value and range of certain species and organismal traits that influence ecosystem functioning".

These chosen variables are believed to serve as effective representatives for ecological effectiveness of protected areas and they are not easily measured with frequently used monitoring tools such as satellite imagery. It is well known that biodiversity plays a crucial role in regulating ecosystem processes and functions, while it conveys much information about the extent and degree of environmental changes within a given system (Tilman, 1999; Chapin et al., 2000; Hooper et al., 2005). Additionally, taxonomic diversity has been the primary form for measuring the biodiversity. Recently, functional diversity - which measures the range of roles that organisms play in a community - has gained increasing prominence for assessing species diversity (Petchey & Gaston, 2002, 2006).

Our study aims were to: *a*) identify key plant communities within and outside the strictly protected area, *b*) conduct a comparative functional and taxonomic diversity assessment between those communities, *c*) evaluate the presence of rare and endangered plant taxa within these plant communities, *d*) verify the boundaries of strictly protected areas and their compliance with the extent of certain, fragile plant communities and *e*) presence and quality of certain natural habitats and the interrelation between same habitats under different pressure conditions on site.

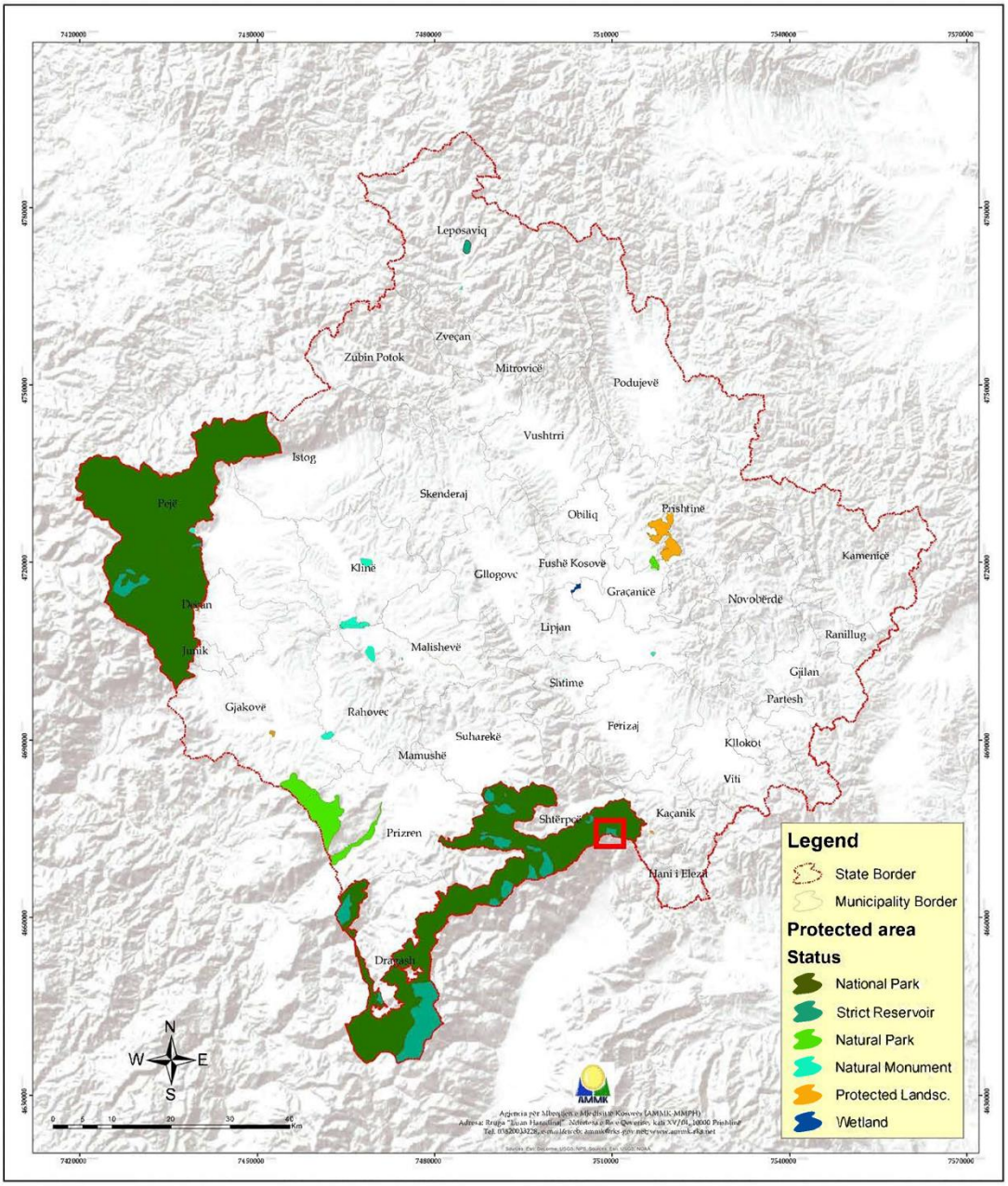

Figure 1. Map of protected areas in Kosovo. Red square indicates the position of the Mt. Luboten, within Sharri National Park (SE). Source: Kosovo Environmental Protection Agency (KEPA)

2. Material and Methods

2.1. Study area

In Kosovo, the Law on Nature Protection (Law No. 03/L-233) is compiled partially in accordance with the IUCN Protected Area Categories System (Dudley, 2008) and classifies the protected areas into seven categories: Strict nature reserve, National park, Special protected area, Nature Park, Nature monument, Protected landscape and Park architecture

monument. In MESP (2017) it was estimated that 10.9% of Kosovo's land area is protected, located within a total of 116 sites altogether covering an area of almost 120.000 ha.

Within these protected areas, besides others (Fig. 1), there are two declared National Parks (NP): "Sharri NP" and "Bjeshkët e Nemuna NP" – that comprise majority of all protected areas.

It is well known that in Luboten there is a great presence of endemic and endangered plant species (Rexhepi, 1984, Berisha et al., 2020), with 26 taxa enlisted in the Red book of vascular flora of Kosovo (Millaku ed., 2013) – out of whom, 5 species are critically endangered ones (CR – IUCN). These data make Luboten an important center for Kosovo's biodiversity and a key part of the Sharri National Park. Therefore, we used mountain massif of Luboten, as a case study to address questions concerning the ecological effectiveness of protected areas in developing countries like Kosovo.

The research was conducted in the mountain massif of Luboten which is located between 42º11' – 42º13' N and 21º07' – 21º09' E in Kosovo. It represents the initial mountain massif in the chain of mountains from the southern part of Sharri NP. The designated park area of Luboten consists of more than 2.000 ha – where beech forests are dominant up to 1550 m a.s.l. and from there up to the summit (2498 m a.s.l.) it is predominantly made out of grasslands – along with debris, quarries and some rocky cliffs. Annual rainfall ranges is between 900 and 1100 mm (Ivanović et al., 2016). The studied area consists of upper mountain zone, in particular areas close to water sub-alpine springs and along the water streams. For comparison reasons, we have studied also plant communities from phytosociological and floristic aspects in the summit of the mountain, as well as analyzed its natural habitat types. This due to that they constitute habitats of the strictly protected area of the National Park.

2.2. Sampling design and data collection

Vegetation sampling was carried out from April to August 2019. The studied area was divided into three parts: natural water spring habitats (NWH), degraded water spring habitats (DWH), grasslands (GRAS). Parts with NWH and DWH are located outside and GRAS is within strictly protected area. In total 45 phytosociological relevés (30 relevès 50 m^2 and 15 relevés 100 m^2) were collected, in all three studied parts. The first set of 30 relevés were all situated within the same habitats (natural: 15 relevés, and degraded: 15 relevés) along water streams down to the montane beech forests where these habitats ended. The other set of 15 relevès were conducted in the grasslands of the upper part of the massif, all within the strictly

protected area. In each area of relevé, all plant taxa were identified to species level and besides of phytosociological analysis they were counted (for taxonomic diversity indices). Phytosociological studies were conducted according to the classical methodology of the Zürich-Montpellier school (Braun-Blanquet, 1964), where for each relevé notes were taken concerning: inclination (in degree), exposition, altitude (m a.s.l.), total plant cover (in %), substrate type and locality coordinates. In addition to the phytosociological aspect, and as a result of group work (and careful marking of relevés on site), as well as due to repeated on-field measurements in many time periods, it was managed to include in calculations all plant species that grow in these habitats during the entire vegetation period.

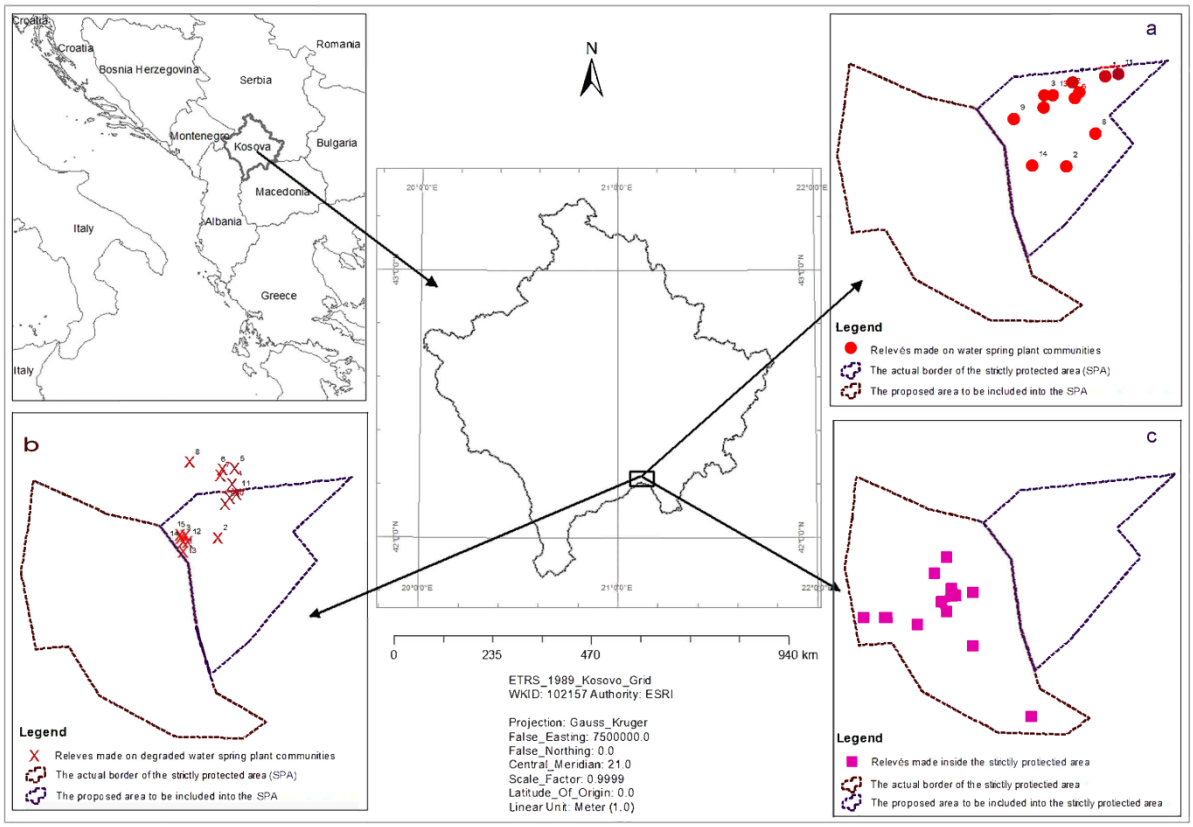

Figure 2. Depiction of relevés made on a) natural water spring habitats, b) degraded water spring habitats and c) grasslands. Encircled in red is the actual border of the Strictly protected area while in bluish (right side) is the area proposed for inclusion within the strictly protected area

2.3. Data analysis

For identification, description and classification of plant communities, comprehensive vegetation tools and analysis were used (EEA, 2014; Moss, 2008). Main criteria for

classifying the vegetation were: physiognomy (growth and life form), floristic properties (dominant species), environment (habitat type, soil), geographical location and community succession stage (Ellenberg, 1973).

Three different indices were used to characterize species diversity in different surveyed habitats (NWH, DWH, GRAS). They were: (*S*) species richness - the number of species for 50 m^2 (in relevés with 100 m^2, the obtained value was divided by 2), (*H*) Shanon's diversity index $H' = -\sum_{i=1}^{s} P_i \log_2 P_i$ - a mathematical measure of species diversity in a community. Where: *p* is the proportion (N) of individuals of one particular species found (*n*) divided by the total number of individuals found (*N*), *ln* is the natural log, *Σ* is the sum of the calculations, and *s* is the number of species. And third, the inverse of Simpson's index, SI = 1/λ – as a measure of diversity which emphasizes differences in common species and additionally takes into account the number of present species as well as each species' relative abundance (Magurran, 2004).

For Shannon's diversity index and inverse of Simpson's plots species richness separate paired t-tests (between NWH and DWH; and GRAS and DWH) were made. The paired t-tests were also applied in order to analyze the effects of human disturbance on plant species richness. In order to examine diversity along the transect habitats between two zones of protection, for three habitat types (Shannon's DI) single classification ANOVA was performed.

3. Results

3.1. Vegetation analysis and corresponding natural habitats

Studied vegetation includes tall-herb vegetation on acidic soils along mountain streams and water springs at high altitudes (*Cirsion appendiculati* Horvat et al. 1937). On this group, we have two, floristically distinctive entities, one that is natural and the other one that is heavily degraded. Both of these plant communities are not incorporated within the strictly protected area of the mountain. For comparison and study reasons, due to their situation inside of the strictly protected area, we have studied the high mountain grasslands (one dominated by *Festuca adamovicii* (St.-Yves) Markgr.-Dann. and the other by *Dryas octopetala* L.).

Herein, a general description of these communities is provided.

The first group of natural water spring habitats (NWH – Annex I) constitute a unique habitat type – E5.5721 Moesian Balkan thistle tall herb communities (Moss, 2008), with

Cirsium appendiculatum Griseb., as the most distinctive plant species. Syntaxonomically, this plant community belongs to the Class: *Mulgedio-Aconitetea* Hadač et Klika in Klika et Hadač 1944, Order: *Adenostyletalia alliariae* Br.-Bl. 1930 and the Alliance: *Cirsion appendiculati* Horvat et al. 1937 - that encompasses all of the tall-herb vegetation on acidic soils along mountain streams and water springs at high altitudes of the Eastern and Central Balkans. The plant association *Doronico gigantei-Cirsietum appendiculati* Horvat ex Quezel 1969 – Quezel, 1969. From 15 collected relevés a total of 76 plant taxa were recorded, with a range of taxa per relevé from 42 to 53. The average plant cover was 89%. Besides of *C. appendiculatum* as the most distinctive plant species, there were the following as dominant ones: *Eriophorum latifolium* Hoppe, *Cardamine pratensis* L. and *Helianthemum nummularium* (L.) Mill. From 76 recorded taxa, 12 are Balkan endemics and out of them, 5 are listed into the Red Book of Vascular flora of the Republic of Kosovo: *Achillea chrysocoma* Friv. (EN), *Pinguicula balcanica* Casper (NT), *Gymnadenia frivaldii* Hampe ex Griseb. (NT), *Pedicularis brachyodonta* Schloss. & Vuk. (LC) and *Phyteuma pseudorbiculare* Pant. (LC). This plant community is situated outside of the strictly protected area of the mountain.

The second group consists of degraded water spring habitats (DWH – Annex I), that features an altered floristic and physiognomic composition. Due to the degraded nature it possesses, it is rather hard to accurately define its EUNIS habitat type. It resembles to the F2.231 Mountain *Juniperus nana* scrubs. Syntaxonomically, though they need to be analyzed in more detail and compared further, initially they were classified under the class: *Vaccinio-Piceetea* Br.-Bl. in Br.-Bl. et al. 1939. From 15 collected relevés a total of 49 plant taxa were recorded, with a range of taxa per relevé from 30 to 36. The average plant cover was 79%. Dominant taxa were: *Rubus idaeus* L., *Salix caprea* L., *Epilobium angustifolium* L., and *Helianthemum nummularium* (L.) Mill. From 49 recorded taxa, 5 are Balkan endemics: *Bupleurum karglii* Vis., *Cirsium appendiculatum* Griseb., *Viola aetolica* Boiss. & Heldr., *Onobrychis montana* subsp. *scardica* (Griseb.) P. W. Ball and *Dianthus integer* Vis. This plant community is also situated outside of the strictly protected area of the mountain (Fig. 2, b.).

The third group encompasses grasslands that are situated inside of the strictly protected area of the mountain. Within this group, two distinctive plant entities were observed, one where *Festuca adamovicii* (St.-Yves) Markgr.-Dann. was dominant, on silicate base soils and the other, rather scattered, *Dryas octopetala* L. dominated on limestone substrates.

Silicate base grasslands of *F. adamovicii* were recorded at high altitudes > 1880 m a.s.l., where the following species were also abundant: *Bromopsis erecta* (Huds.) Fourr., *Helianthemum nummularium* (L.) Mill. and *Onobrychis montana* subsp. *scardica* (Griseb.) P. W. Ball, among other taxa (Annex I, Grasslands (*Festuca* gr.)). They represent closed type of plant community that grows at high altitudes, which are relatively rich on endemic plant species. Despite of endemic species present, they are also distinguished with many moss and lichen species. In total, 54 plant taxa were recorded on this plant community. Average number of taxa per relevé was 40. Out of 54 plant taxa, 9 are Balkan endemics, with *Hieracium naegelianum* subsp. *ljubotenicum* O. Behr & al. as unique plant taxa described from Luboten. Provisional syntaxonomic position of this group is related with the Class: *Juncetea trifidi* Hadač in Klika et Hadač 1944 and the Order: *Seslerietalia comosae* Simon 1958. EUNIS Habitat category for this plant community would be: E4.3927 Balkan sub-alpine and alpine *Festuca adamovicii* grasslands on silicate. This plant group is situated inside of the strictly protected area of the mountain (Fig. 2, c.).

Another set of five relevès were made on *Dryas octopetala* L. dominated plant communities, that were characterized with more scarce distributional pattern within the strictly protected area. Anyhow, it had a significantly larger number of plant taxa (95) in comparison to the previous group. From them, 17 are Balkan endemics (all endemics are noted in Annex I with **), 7 out of 17 are enlisted in the Red Book of Vascular flora of the Republic of Kosovo, where *Achillea chrysocoma* Friv. is endangered (EN) species. Provisional syntaxonomic position of this group is related with the Class: *Elyno-Seslerietea* Br.-Bl. 1948 and the Order: *Seslerietalia tenuifoliae* Horvat 1930. Except of *D. octopetala*, with high degrees of presences and coverage here were recorded: *Carex kitaibeliana* Bech., *Helianthemum canum* (L.) Baumg., *Juniperus communis* subsp. *nana* Syme and *Oxytropis halleri* subsp. *korabensis* (Kümmerle & Jáv.) Chrtek & Chrtková. They comprise the typical EUNIS Habitat of E4.41 Closed calciphile alpine grassland. This plant community as a whole is very important from the biodiversity point of view as its plant species: *D. octopetala* L., *Arctostaphylos uva-ursi* (L.) Spreng. and *J. communis* subsp. *nana* are categorized as protected into NATURA 2000 Network and as a habitat, the European Union Habitats (European Commission, 2013) categorizes them as “Alpine and Boreal Heaths – 4060 – PAL.CLASS.: 31.4” - that should be preserved and properly protected.

3.2. Species diversity

Species richness (Fig. 3; *The Paired Samples t Test – P = 0.013*) as well as Shannon's diversity (Fig. 4; *The Paired Samples t Test – P = 0.049*) were significantly higher inside the natural water spring habitats (NWH) than in degraded water spring habitats (DWH). Though, this was not a fact between the NWH and the grasslands (GRAS). Simpson's diversity was significantly different between the NWH and the DWH (Fig. 5; *The Paired Samples t Test – P = 0.037*). For obtaining these results, corrected α values were applied. Although there have been significantly high environmental degradation in the natural tall herb communities, in certain parts even denaturing them entirely, the remaining ones (Fig. 2a.) have managed to maintain higher taxonomic diversity.

3.3. Endangered and endemic plant taxa

A total of 24 Balkan endemic taxa were recorded in the studied area. Out of them, 9 are enlisted into the Red Book of Vascular flora of the Republic of Kosovo (Millaku ed., 2013), evaluated under three risk assessment values (Table 1). The richest communities in terms of endemics and endangered taxa were the Grasslands on limestone substrate, dominated by *D. octopetala* followed by the NWH. While, logically as expected the DWH had the smallest number of taxa in this respect, only 4. From the 8 Red Book enlisted taxa, 4 are categorized as Least Concern (LC), 4 are Near Threatened (NT) and only 1 is Endangered (EN) plant taxa:
Achillea ageratifolia (Sm.) Ben. & Hook. f.

Table 1. List of recorded Balkan endemics and endangered plant tax.

No.	Plant taxa	NWH	DWH	GR-*F.*	Gr-*D.*	R.B.
1.	*Achillea abrotanoides* (Vis.) Vis.				●	
2.	*Achillea ageratifolia* (Sm.) Ben. & Hook. f.				●	NT
3.	*Achillea chrysocoma* Friv.	●		●	●	EN
4.	*Alchemilla viridiflora* Rothm.	●				
5.	*Anthyllis aurea* Host				●	
6.	*Bupleurum karglii* Vis.		●		●	
7.	*Campanula spatulata* Sm.				●	
8.	*Cirsium appendiculatum* Griseb.	●	●			
9.	*Dianthus integer* Vis.	●	●	●	●	
10.	*Dianthus scardicus* Wettst.				●	NT
11.	*Dianthus sylvestris* subsp. *bertisceus* Rec. f.				●	
12.	*Festuca adamovicii* (St.-Yv.) Mark.-Dann.	●			●	
13.	*Gymnadenia frivaldii* Hampe ex Griseb.	●				NT
14.	*Hieracium naegelianum* subsp. *ljubotenicum* O. Behr & al.			●	●	
15.	*Lilium albanicum* Griseb.			●		LC
16.	*Onobrychis montana* subsp. *scardica* (Griseb.) P. W. Ball	●			●	

17.	*Oxytropis halleri* subsp. *korabensis* (Kümmerle & Jáv.) Chrtek & Chrtková			●	●	
18.	*Pedicularis brachyodonta* Schloss. & Vuk.	●			●	LC
19.	*Phyteuma pseudorbiculare* Pant.	●			●	LC
20.	*Pinguicula balcanica* Casper	●			●	NT
21.	*Saxifraga scardica* Griseb.			●	●	LC
22.	*Trifolium velenovskyi* Vandas			●		
23.	*Viola aetolica* Boiss. & Heldr.	●	●			
24.	*Willemetia stipitata* subsp. *albanica* (Kümmerle & Jáv.) Kirschnerová	●				

Explanations: NWH – Natural Water Spring Habitats, DWH – Degraded Water Spring Habitats, GR-*F*.- Grasslands – *Festuca* gr., GR-*D*. – Grasslands – *Dryas* gr. and R.B. – Red Book of Vascular flora of the Republic of Kosovo (Millaku ed. et al., 2013).

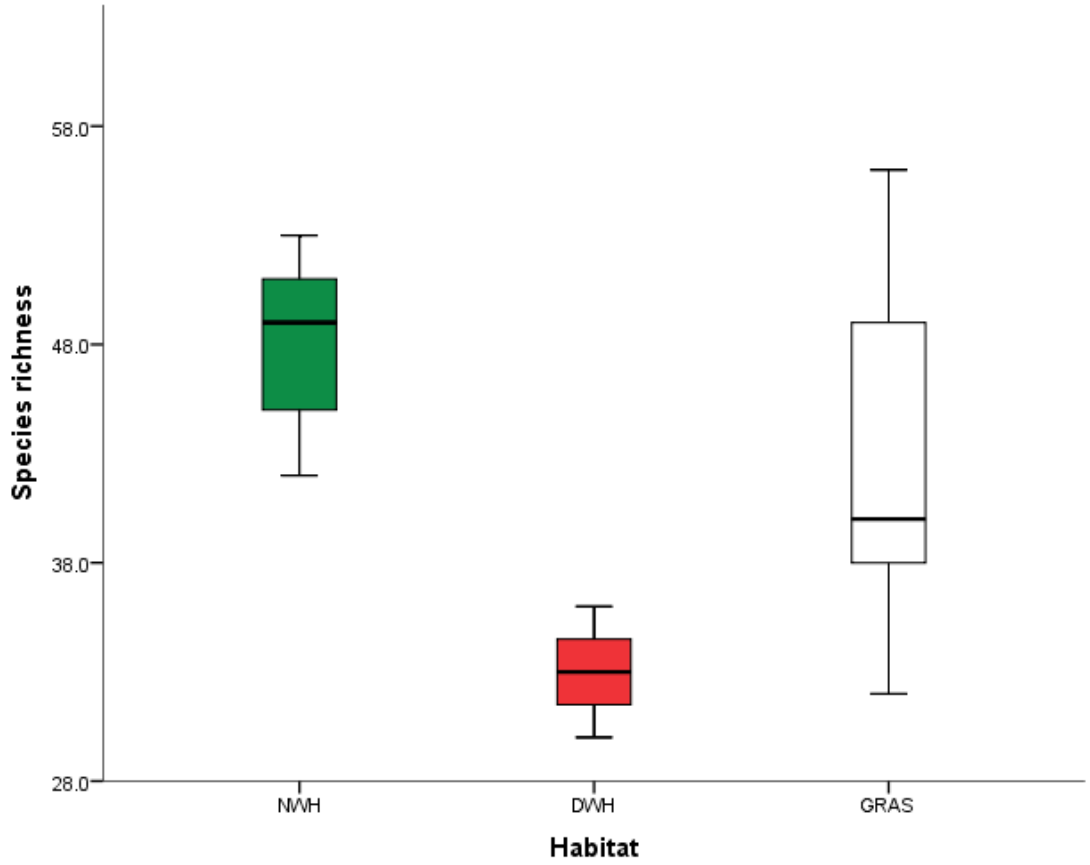

Figure 3. Boxplots of species richness (S) metrics, outlining medians, lower and upper quartiles as well as maximum and minimum data values. NWH – Natural Water Spring Habitats, DWH – Degraded Water Spring Habitats and GRAS – Grassland communities

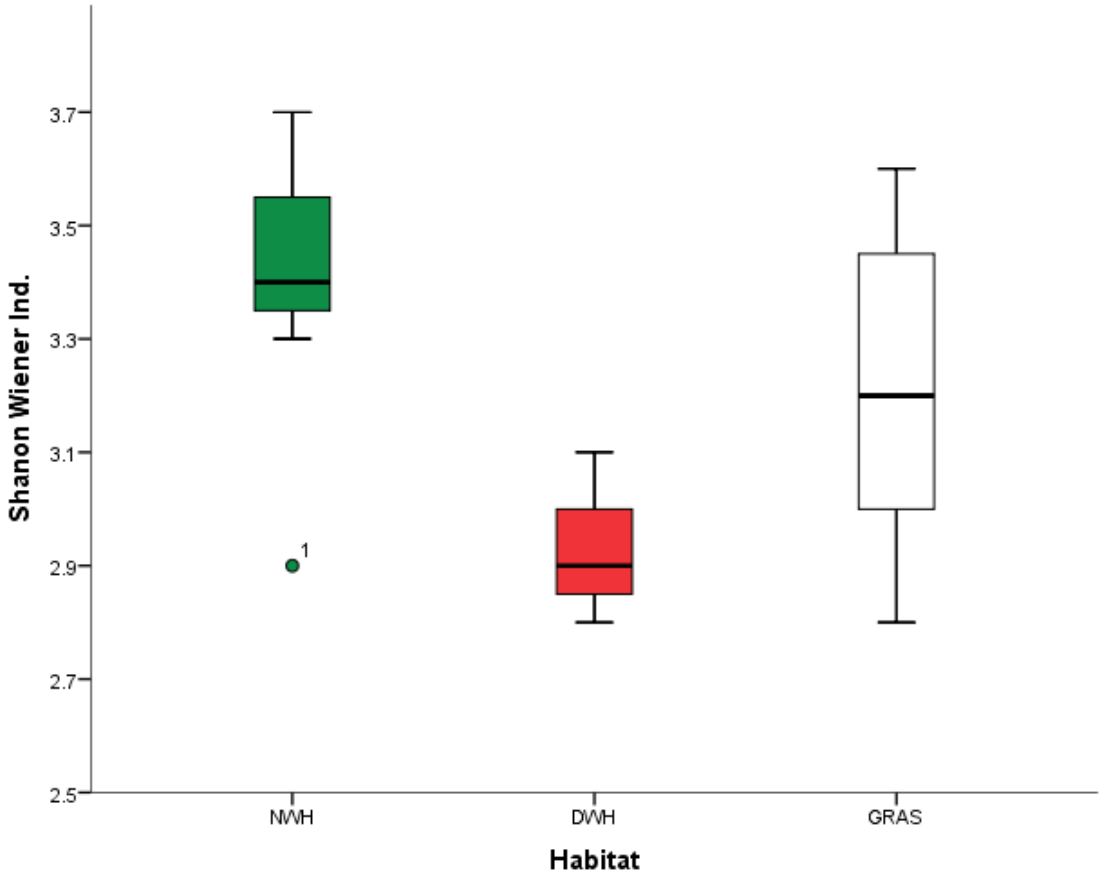

Figure 4. Boxplots of Shanon's Diversity Index (H), outlining medians, lower and upper quartiles as well as maximum and minimum data values. NWH – Natural Water Spring Habitat, DWH – Degraded Water Spring Habitat, expressed a low diversity value and GRAS – Grassland communities belonging to the strictly protected area

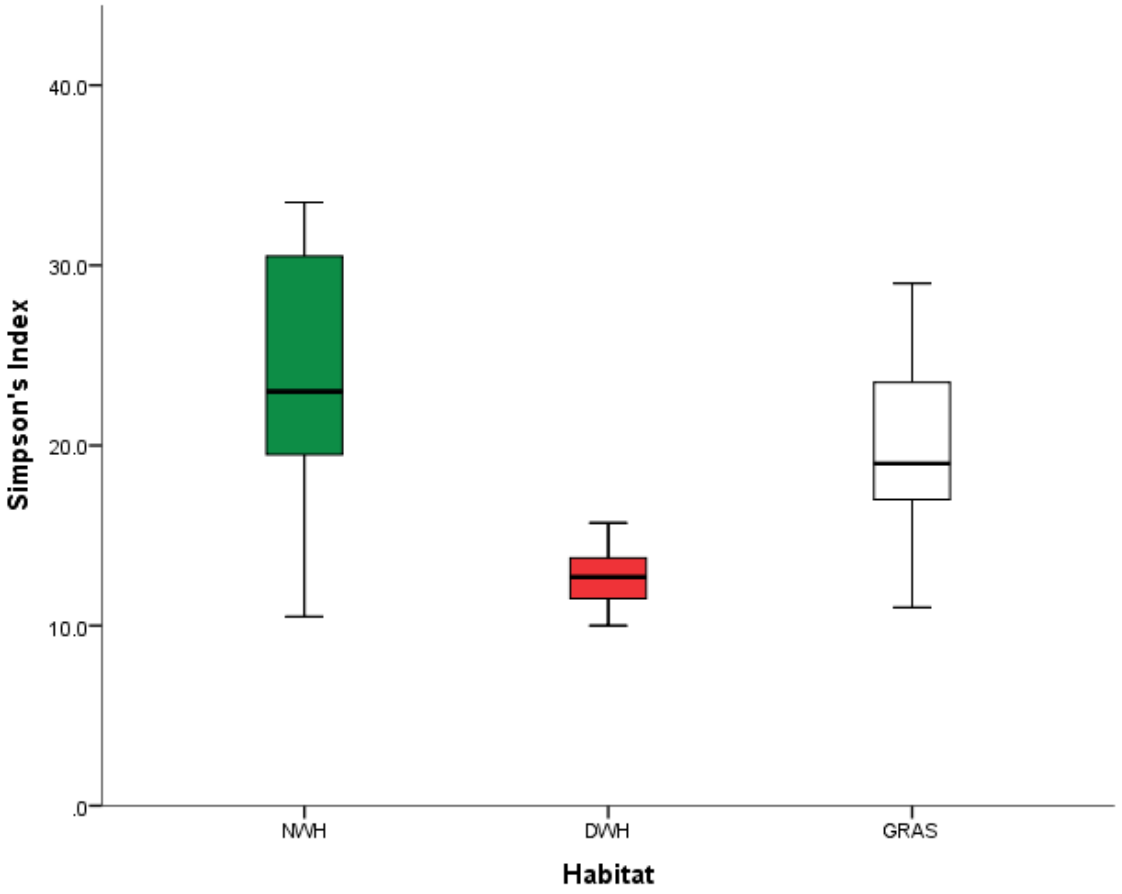

Figure 5. Boxplots of Simpson's index (SI). outlining medians, lower and upper quartiles as well as maximum and minimum data values. NWH – Natural Water Spring Habitat, DWH – Degraded Water Spring Habitat, expressed a low SI metrics and GRAS – Grassland communities belonging to the strictly protected area

4. Discussion

The conducted diversity pattern analysis in between the three studied habitats revealed that there were significant differences in their diversity composition as well as in regard to their species richness constitution. Moreover, the range of species richness was again higher in natural tall herb communities than in the habitats belonging to the strictly protected area.

The conducted analysis on a continuous basis revealed far higher biodiversity inside the tall herb communities than in degraded ones and also, generally higher diversity compared to the communities belonging the strictly protected area within the massif of Luboten. It is known that freshwater ecosystems compared to others, are characterized with high biodiversity of flora and fauna (Springer & Stevens, 2009; Warncke, 1980) and globally many of these ecosystems face variety of severe direct or indirect threats (Juutinen, 2011; Puczko et al., 2018).

In terms of vegetation cover and species constitution, there are many distinct and rare plant communities as well as particular plant taxa that require proper protection and conservation measures within the studied massif of the National Park. *Willemetia stipitata* (Jacq.) Dalla Torre, as a South-European Orophilous plant species is found only in these small and endangered habitats in Luboten and has never been recorded elsewhere in Kosovo. Additionally, same habitats have *Pinguicula balcanica* Casper, a Balkan endemic species, characteristic for Habitat E5.5721 (or equivalently, the plant association *Doronico gigantei-Cirsietum appendiculati* Horvat ex Quezel 1969 – Quezel, 1969) and enlisted in the Red Book of Vascular Flora of Kosovo (Millaku ed., 2013) as Near Threatened (NT) species; *Gymnadenia friwaldii* Rchb., categorized in the same list as NT due to very scarce distribution on fragile habitats and *Phyteuma pseudorbiculare* Pant., categorized as LC (Least Concern) because this species has only six small populations in Kosovo (Millaku ed., 2013). In comparison, the degraded tall herb communities, besides lower diversity values discussed in the previous paragraph, had a considerably smaller number of plant taxa present (49) and they were completely altered into a new and apparent transitory habitat. There, all of the characteristic species of phytocenosis *Orphanideo-Cirsietum appendiculati* Ht. 1960 were absent, notably *Rubus idaeus* L., *Salix caprea* L. and *Epilobium angustifolium* L. were predominant species (Annex I, Degraded subalpine moist tall herbs plant communities). This came as a direct result of human disturbance into the natural habitat, where the water source had completely been taken over through the pipes down to the villages and no water was left to flow down in its natural course. We have to point out that water springs in the mountains, particularly those at higher altitudes, are not only important sources of water but also a source of key resources such as minerals, energy and supporting backbone for a wide array of agricultural products (Negi & Joshi, 2002; Caine, 2012; Bundi & Peter, 2010). Additionally and most importantly, they represent a very subtle storehouse for a unique set of biological diversity.

Although rationales for national parks across the globe are very diverse and widely complex (Michel, 2017), each having its own specifications, the main goal is to offer proper services for nature conservation and to potentially contribute to local economies through tourism (IUCN, 2017; Mayer et al., 2010; Adams, 2010; Thévenot et al., 2000; Küpfer, 2000). When it comes to protected areas in Sharri NP, we have noticed that the effectiveness in preserving and protecting biodiversity is not always the case. Nevertheless, boundaries and zones within NP Sharri, in Luboten area are noticed that not always were set and established with exact conservation aims, based on field pressures and threats. Instead, it seems they were

chosen based on a variety of other factors including remoteness, areas of least economic value, and habitats with high exquisite aesthetical value (Abukari & Mwalyosi, 2018; Terborgh & van Schaik, 2002). Through this we would like to highly encourage the responsible authorities to do alter and fix protection zone borders in accordance with on-field situation of endangered plant taxa and their corresponding habitats.

Additionally, from the conducted study using primarily phytosociological data, we realized that one of the key applications that vegetation studies could yield, besides synsystematics, floristics and other aspects, is that they can provide a sound scientific basis for international measures towards nature protection (Rodwell et al., 2002).

5. Conclusion

At the moment, particularly on species-rich *Festuca* grasslands, there were no detectable threats posed to them of any kind. In contrast, tall herb vegetation along water springs (with exceptional high diversity), faced with a direct threat, the human induced absence of water. A major part of these habitats has already been recorded to be completely destroyed. The factual situation urges us to strongly suggest the extension of 1PA for at least 0.56 km^2 into the northwestern direction of the western slope (Fig. 2. Coordinates: 42º12.952 N; 21º08.337 E) in the massif of Luboten. The only way to save these degrading habitats at the moment would be conduct strict protection, continuous monitoring as well as further studies on other ecological aspects and trends would be of aid.

Such anthropogenic activities represent a serious threat to tall herb vegetation habitats and the whole ecosystem in that area of Sharri National Park. These activities, if not properly handled, in the near future could cause an undesirable cascade of natural changes and in large scale a loss of rare and endangered plant taxa along with their corresponding communities.

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Annex I. Phytosociological relevès

Natural Water Spring Habitats (NWH)															
Number of relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Plot area	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Inclination in degree	18	10	15	15	10	20	15	18	10	18	15	14	15	15	15
Exposition	E	SE	SE	SE	SE	NW	NW	NW	N	NW	N	NW	NW	NW	SE
Altitude (m.a.s.l)	1737	1732	1718	1686	1664	1974	1989	1989	1802	1989	1884	1901	1909	1911	1847
Covering (%)	98	98	80	80	90	85	85	85	85	85	95	90	95	85	98
Substrate	Silicate	Silicate	Silicate	Silicate	Silicate	Silicate	Silicate	Silicate	Silicate	Silicate	Silicate	Silicate	Silicate	Silicate	Silicate
Locality	Luboten	Luboten	Luboten	Luboten	Luboten	Luboten	Luboten	Luboten	Luboten	Luboten	Luboten	Luboten	Luboten	Luboten	Luboten
Number of species per relevé	43	42	40	42	45	52	44	45	46	50	53	50	52	49	50
Date	10.06. 2019	10.06. 2019	10.06. 2019	10.06. 2019	10.06. 2019	07.07. 2019	10.07. 2019	10.07. 2019	18.07. 2019	18.07. 2019	05.07. 2019	05.07. 2019	05.07. 2019	05.07. 2019	05.07. 2019
GPS Coordinates	42°12.916 N; 021° 08.216 E;	42°12.911 N; 021° 08.225 E;	42°12.902 N; 021° 08.256 E;	42°12.901 N; 021° 08.312 E;	42°12.903 N; 021° 08.356 E;	42°12.799 N; 021° 06.935 E;	42°12.674 N; 021° 06.942 E;	42°12.904 N; 021° 08.228 E;	42°13.344 N; 021° 07.817 E;	42°12.781 N; 021° 06.927 E;	42°12.903 N; 021° 08.536 E;	42°12.955 N; 021° 08.386 E;	42°12.949 N; 021° 08.270 E;	42°12.959 N; 021° 08.396 E;	42°12.905 N; 021° 08.234 E;
Cirsium appendiculatum **	2	3	2	2	3	+	1	3	3	2	4	3	4	3	4
Eriophorum latifolium	+	1	+	+	2	3	2	2	2	3	3	2	2	1	2
Cardamine pratensis	+	1	1	1	+	1	+	+	2	1	3	2	2	2	2
Helianthemum nummularium	2	+	+	3	2	+	+	2	+	+	1	1	2	1	1
Pinguicula balcanica **	1	.	+	+	1	1	3	1	1	1	1	1	1	2	1
Luzula sylvatica	1	+	+	.	+	+	+	+	.	+	.	1	+	.	+
Dactylorhiza maculata	+	1	+	.	.	1	+	.	1	1	2	1	1	1	+
Carex curvula	+	+	+	.	1	1	1	1	1	+	1	2	1	1	+
Bromopsis erecta	+	+	+	+	1	1	+	1	+	1	1	+	1	+	+
Alchemilla hybrida	+	+	+	+	+	+	+	+	+	+	1	2	1	2	1
Musci sp.	+	1	+	+	.	+	+	.	1	+	+	+	+	+	
Pimpinella saxifraga	+	+	+	.	+	+	+	+	+	+	+	+	.	+	+
Geum coccineum	+	+	+	+	.	+	+	+	+	.	+	+	+	1	2
Trifolium badium	+	+	.	+	+	+	+	.	+	.	.	1	+	1	1
Calamagrostis varia subsp. varia	+	1	2	2	1	+	+	.	+	+	+	.	.	.	.

Caltha palustris	+	1	1	+	+	+	.	.	1	+	+	+	+	+	+
Mentha longifolium	+	+	1	1	1	+	.	+	+	+	+	+	+	+	+
Oenanthe peucedanifolia	+	+	1	+	.	+	+	+	+	+	+	+	+	+	.
Stellaria alsine	+	+	.	+	+	.	+	.	+	.	+	+	+	+	+
Doronicum austriacum	+	+	.	+	+	.	.	+	+	+	+	+	.	.	.
Veratrum lobelianum	+	+	+	.	+	+	+	+	+	+	+	1	.	+	+
Phleum alpinum	+	+	.	.	+	+	+	+	+	+	.	.	.	.	+
Ranunculus breyninus	+	+	.	+	+	+	+	+	+	.	.	+	.	+	1
Rhamnus alpina susbp. fallax	+	+	+	.	+	+	+	.	+	+	+	+	+	1	+
Alchemilla viridiflora **	+	+	+	.	+	+	+	.	+	+	+	.	+	+	.
Juncus effusus	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Blysmus compressus	+	+	.	.	.	+	+	.	.	+	+	1	.	+	2
Festuca adamovicii **	+	1	+	.	.	.	.	+	1	.	+	+	+	+	.
Juniperus communis subsp. *nana*	+	+	1	.	+	+	.	.	+	.	+	.	+	.	+
Arabis ciliata	+	+	.	.	.	+	.	+	.	+	+	.	+	+	+
Veronica chamaedrys	+	+	.	.	1	+	.	+	+	.	+	+	.	.	+
Plantago lanceolata	+	+	+	.	+	+	+	.	+	.	+	.	.	+	+
Geranium sylvaticum	+	.	+	+	.	+	+	.	.	.	+	+	+	.	.
Trifolium repens	+	.	+	.	.	+	+	+	.	+	+	+	+	.	.
Myosotis sylvatica	+	.	+	.	+	+	+	.	.	+	+	+	.	+	+
Athyrium filix-femina	+	.	+	+	.	+	+	.	+	.	+	.	.	+	.
Onobrychis montana subsp. *scardica* **	+	.	+	+	.	.	+	+	.	.	.	+	.	+	.
Stachys alopecurus	+	.	+	.	.	.	+	.	.	+	+	.	+	+	+
Salix caprea	+	.	+	+	+	.	.	+	.	+	.	.	+	+	1
Poa molinerii	+	.	.	+	1	.	.	.	.	.	.	.	+	.	.
Primula elatior	+	.	.	+	+	+	.	+	.	+	+	+	+	.	+
Fragaria vesca	+	.	.	+	.	+	+	.	.	+	+	.	+	+	+
Saxifraga rotundifolia	+	.	.	.	.	+	+	+	.	+	+	2	+	1	1
Daphne mezerum	+	.	.	.	.	+	+	+	.	.	.	.	+	+	.
Silene pusilla	.	+	+	.	+	+	+	+	+	+	+	+	.	+	+
Bistorta vivipara	.	+	+	.	.	+	+	+	+	+	+	+	+	+	+
Juncus thomasii	.	+	+	.	.	+	+	+	+	+	+	.	+	+	+
Viola aetolica **	.	+	.	+	2	+	+	+	+	+	+	+	+	+	.

Deschampsia cespitosa	.	+	.	+	+	+	.	+	+	+	.	.	.	.	+
Dianthus integer **	.	+	.	+	.	.	.	.	+	.	+	.	+	.	.
Rumex acetosa	.	+	+	.	+	.	+	+	+	+	.	+	+	+	+
Willemetia stipitata subsp. *albanica* **	.	+	+	.	.	.	+	.	.	+	1	+	.	+	.
Galium palustre	.	+	+	+	+	.	+	.	+	.	.	.	+	+	+
Urtica dioica	.	+	.	+	+	.	.	+	.	.	+	+	+	.	.
Viola gracilis	.	+	.	+	+	.	.	+	+	.	.	+	.	.	+
Carex kitaibelliana	.	+	.	+	.	.	.	.	+	+	.	.	+	+	.
Thalictrum aquilegifolium	.	+	.	+	.	.	.	.	.	+	.	+	+	.	+
Gymnadenia frivaldii	.	.	+	.	.	+	.	.	.	+	+	+	.	.	+
Thymus praecox sbusp. *zygiformis*	.	.	+	.	.	.	.	+	+	.	.	.	+	.	.
Rubus idaeus	.	.	+	+	+	+	.	.	.	+	+	.	+	+	+
Ornithogalum gussonei	.	.	+	+	+	.	+	.	+	.	.	+	+	+	.
Agrostis canina	.	.	+	.	.	+	.	+	+	.	+	+	.	.	+
Veronica serpyllifolia	.	.	.	+	+	+	.	+	.	+	.	+	+	+	.
Achillea chrysocoma **	.	.	.	+	.	.	.	.	.	+	+	.	+	.	+
Geranium robertianum	.	.	.	+	+	+	.	+	+	.	+	+	.	+	.
Clinopodium acinos	.	.	.	+	.	.	+	+	.	+	.	+	+	+	+
Cystopteris fragilis	.	.	.	+	.	+	+	.	.	.	.	.	.	.	+
Saxifraga adscendens	.	.	.	+	+	+	.	+	.	+	+	+	.	+	.
Pedicularis brachyodonta **	.	.	.	+	+	.	+	+	+	.	+	.	+	+	+
Phyteuma pseudorbiculare **	.	.	.	.	+	+	.	.	.	+	.	.	+	+	+
Senecio squalidus subsp. rupestris	.	.	.	.	+	.	.	.	.	+	+	+	.	.	.
Leontodon crispus	.	.	.	.	+	+	.	.	.	.	.	+	+	.	.
Epilobium montanum	.	.	.	.	.	+	+	+	+	.	+	.	+	.	+
Myosotis suaveolens	.	.	.	.	.	.	.	+	.	+	+	+	.	+	+
Anemonastrum narcissiflorum	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.
Senecio nemorensis	.	.	.	.	.	.	.	.	+	+	.	.	+	.	+
Degraded Water Spring Habitats (DWH)															
Number of relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Plot area	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50

Inclination in degree	15	10	12	15	10	10	10	15	15	10	15	15	10	15	15
Exposition	N	N	NE	N	NW	N	N	N	NE	N	NW	N	N	N	N
Altitude (m.a.s.l)	1801	1795	1815	1749	1766	1704	1788	1727	1809	1795	1747	1750	1738	1712	1722
Covering (%)	80	75	80	70	85	75	80	80	90	85	75	70	80	85	75
Substrate	Silicate	Silicate	Silicate	Silicate	Silicate	Silicate	Silicate	Silicate	Silicate	Silicate	Silicate	Silicate	Silicate	Silicate	Silicate
Locality	Luboten	Luboten	Luboten	Luboten	Luboten	Luboten	Luboten	Luboten	Luboten	Luboten	Luboten	Luboten	Luboten	Luboten	Luboten
Number of species per relevé	35	31	32	34	30	32	35	33	36	30	33	35	34	30	33
Date	10.06. 2019	10.06. 2019	10.06. 2019	10.06. 2019	10.06. 2019	25.06. 2019	25.06. 2019	25.06. 2019	25.06. 2019	06.07. 2019	06.07. 2019	06.07. 2019	06.07. 2019	06.07. 2019	06.07. 2019
GPS Coordinates	42°13.156 N; 021° 08.012 E;	42°13.193 N; 021° 08.038 E;	42°13.157 N; 021° 08.016 E;	42°13.327 N; 021° 07.838 E;	42°13.378 N; 021° 07.846 E;	42°13.378 N; 021° 07.797 E;	42°13.358 N; 021° 07.786 E;	42°13.398 N; 021° 07.654 E;	42°12.866 N; 021° 08.205 E;	42°12.888 N; 021° 08.224 E;	42°12.899 N; 021° 08.259 E;	42°13.146 N; 021° 08.044 E;	42°13.149 N; 021° 08.025 E;	42°13.164 N; 021° 08.031 E;	42°13.162 N; 021° 08.011 E;
Rubus idaeus	4	4	3	4	4	3	4	4	4	4	3	4	4	4	3
Salix caprea	2	3	2	2	3	3	3	1	3	1	1	2	3	3	3
Epilobium angustifolium	2	1	3	2	2	2	2	3	2	3	3	2	2	2	2
Helianthemum nummularium	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Achillea atrata	1	1	1	+	1	+	+	1	1	+	+	+	+	1	1
Ptilostemon afer	+	+	1	+	.	1	1	+	+	1	+	+	1	.	+
Achillea setacea	+	.	+	1	1	+	1	1	1	+	1	1	1	1	1
Carduus acanthoides	+	+	+	+	+	1	+	2	+	+	1	+	1	+	+
Juniperus communis subsp. *nana*	+	+	.	+	+	+	+	1	.	+	.	+	+	+	+
Carlina acaulis	+	+	.	+	+	+	+	+	+	.	+	.	+	+	+
Senecio nemorensis	+	+	+	+	+	+	+	+	+	+	.	+	+	+	.
Bupleurum karglii **	+	+	+	+	+	+	+	.	+	+	+	+	+	+	.
Trinia dalechampii	+	+	+	.	+	.	.	+	+	+	+	.	.	+	+
Veratrum lobelianum	+	+	+	+	+	+	+	+	+	+	+	+	.	+	.
Neotinea maculata	+	+	+	+	.	+	+	+	+	+	.	+	+	.	+
Cirsium appendiculatum **	+	+	+	.	+	+	.	.	.	.	+	.	.	+	+
Luzula sudetica	+	+	+	+	+	+	+	+	+	+	+	+	+	+	.
Deschampsia caespitosa	+	.	+	+	.	.	+	.	+	.	+	+	+	.	+
Phleum alpinum	+	+	.	+	+	.	+	+	+	+	+	+	+	+	+
Sesleria juncifolia	+	+	+	.	.	+	.	+	.	+	+	.	.	.	+

Caltha palustris	+	+	+	+	+	.	+	+	+	.	.	+	+	+	.
Gentiana utriculosa	+	+	+	+	.	+	+	.	+	.	.	+	+	.	+
Ranunculus montanus	+	+	+	.	+	+	.	+	+	+	+	.	.	+	+
Sedum ochroleucum	+	+	+	+	.	+	+	+	+	.	+	+	+	.	.
Saxifraga adscendens	+	+	+	+	+	+	+	+	+	+	.	+	+	+	.
Parnassia palustris	+	.	+	+	.	+	+	.	.	.	.	+	+	.	+
Hypericum perforatum	+	+	+	+	+	.	+	+	+	+	+	+	+	+	+
Saxifraga aizoides	+	+	.	+	+	+	+	+	.	.	+	+	.	+	.
Populus tremula	+	+	+	+	.	+	+	.	+	+	+	.	+	.	+
Viola aetolica **	+	.	+	+	+	.	+	.	+	+	+	+	+	+	+
Genista depressa	+	+	+	.	+	+	.	+	.	.	.	.	.	+	+
Trifolium badium	+	+	.	+	+	.	+	+	+	.	+	+	+	+	.
Onobrychis montana subsp. *scardica* **	+	+	+	+	.	+	+	.	+	.	+	.	+	.	.
Trifolium repens	+	.	+	+	+	.	+	+	+	+	+	+	+	+	+
Geum montanum	+	+	+	.	+	+	.	.	.	.	.	.	.	+	+
Rosa pendulina	.	+	.	+	.	.	+	+	+	+	+	+	+	.	+
Rhamnus alpina subsp. *fallax*	.	.	+	+	+	+	+	.	+	+	+	+	+	+	.
Geum coccineum	.	.	+	+	.	+	+	+	+	.	+	+	+	.	+
Acer platanoides	.	.	.	+	+	.	+	.	.	+	.	+	+	+	+
Daphne mezerum	.	.	.	+	+	+	+	+	+	.	+	+	+	+	+
Phyllolepidium rupestre	.	.	.	.	+	.	.	+	.	.	+	.	.	+	.
Rumex acetosella	.	.	.	.	.	+	+	.	+	+	+	+	+	.	+
Dianthus integer **	.	.	.	.	.	+	.	+	.	.	.	+	.	+	+
Scleranthus perennis	.	.	.	.	.	.	+	.	+	+	+	+	+	.	+
Silene vulgaris	.	.	.	.	.	.	.	+	+	.	+	.	.	.	.
Vaccinium uliginosum	.	.	.	.	.	.	.	+	.	+	+	+	.	.	+
Galium pumillum	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.
Noccaea bellidifolia	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Veronica chamaedrys	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Grasslands *(Festuca* gr.) - belonging to the Strictly Protected Area															
Number of relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Plot area	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Inclination in degree	25	15	18	15	18	18	20	15	16	18	25	20	15	10	15
Exposition	E	SE	E	E	E	E	SE	E	SE	SE	NE	NE	NE	NE	N
Altitude (m.a.s.l)	1982	2283	2270	2196	2211	2311	1994	2109	2403	2326	2115	1979	2009	2034	2053
Covering (%)	90	98	95	95	95	95	90	95	90	90	85	98	98	95	95
Substrate	Silicate	Silicate	Silicate	Silicate	Silicate	Silicate	Silicate	Silicate	Silicate	Silicate	Limest.	Limest.	Limest.	Limest.	Limest.
Locality	Luboten	Luboten	Luboten	Luboten	Luboten	Luboten	Luboten	Luboten	Luboten	Luboten	Luboten	Luboten	Luboten	Luboten	Luboten
Number of species per relevé	47	37	39	38	40	45	36	38	38	39	53	52	44	51	56
Date:	21.07. 2019	21.07. 2019	23.07. 2019	23.07. 2019	23.07. 2019	01.08. 2019	01.08. 2019	01.08. 2019	12.08. 2019	12.08. 2019	23.07. 2019	05.08. 2019	05.08. 2019	05.08. 2019	05.08. 2019
GPS Coordinates	42°12.182 N; 021° 08.139 E;	42°12.560 N; 021° 07.390 E;	42°12.584 N; 021° 07.396 E;	42°12.573 N; 021° 07.480 E;	42°12.589 N; 021° 07.399 E;	42°12.497 N; 21°07.278 E;	42°12.257 N; 21°07.330 E;	42°12.502 N; 21°07.504 E;	42°12.352 N; 21°06.921 E;	42°12.268 N; 21°07.137 E;	42°12.560 N; 021° 07. 412 E;	42°12.989 N; 021° 07. 915 E;	42°12.981 N; 021° 07. 873 E;	42°12.956 N; 021° 07. 855 E;	42°12.984 N; 021° 07. 762 E;
Festuca adamovicii **	3	1	4	3	3	3	1	4	3	3	.	.	.	.	.
Bromopsis erecta	2	1	2	2	2	2	2	2	3	2	.	.	.	.	.
Helianthemum nummularium	1	1	+	1	3	1	1	+	+	1	.	.	.	.	.
Onobrychis montana subsp. *scardica* **	1	3	3	2	2	1	4	2	2	3	.	.	.	.	.
Campanula spatulata	1	+	+	+	+	1	1	+	1	1	.	.	.	.	.
Primula veris	1	.	.	+	+	1	.	.	1	1	.	.	.	.	.
Dryas octopetala	+	+	.	+	+	+	+	.	1	+	.	.	.	.	.
Campanula rotundifolia	+	+	+	+	+	+	+	+	1	+	.	.	.	.	.
Pimpinella saxifraga	+	+	+	+	+	+	+	+	+	+	.	.	.	.	.
Cerastium cerastoides	+	+	+	+	+	+	+	+	+	+	.	.	.	.	.
Festuca panciciana	+	+	+	+	+	+	+	+	+	+	.	.	.	.	.
Vaccinium myrtillus	+	+	+	+	+	+	+	+	+	+	.	.	.	.	.
Cerastium decalvans	+	+	.	+	+	+	+	.	+	+	.	.	.	.	.
Trifolium repens	+	+	+	+	+	+	+	+	+	+	.	.	.	.	.
Carduus candicans	+	+	.	+	+	+	+	.	+	+	.	.	.	.	.
Dianthus integer **	+	+	+	+	+	+	+	+	+	+	.	.	.	.	.
Veronica austriaca subsp. *jacquinii*	+	+	+	+	+	+	+	+	+	+	.	.	.	.	.
Veronica chamaedrys	+	+	+	+	+	+	+	+	+	+	.	.	.	.	.
Myosotis alpestris	+	+	+	+	+	.	+	+	+	+	.	.	.	.	.

Lilium albanicum **	+	.	+	.	+	+	.	+	.	+	.	.	.	.	.
Asperula cynanchica	+	.	+	+	.	+	.	+	+	.	.	.	.	.	.
Arctostapyhlos uva-ursi	+	.	+	.	.	+	.	+	.	.	.	.	.	.	.
Juniperus communis subsp. *nana*	+	.	.	+	+	+	.	.	1	+	.	.	.	.	.
Carex kitaibeliana	+	.	+	+	.	+	.	+	+	.	.	.	.	.	.
Phleum montanum	+	+	+	.	+	+	+	+	.	+	.	.	.	.	.
Saxifraga scardica **	+	.	.	+	+	+	.	.	+	+	.	.	.	.	.
Bistorta vivipara	+	.	+	+	+	+	.	+	+	+	.	.	.	.	.
Alchemilla plicatula	+	+	+	.	.	+	+	+	.	.	.	.	.	.	.
Koeleria eriostachya	+	.	.	+	+	+	.	.	+	+	.	.	.	.	.
Leontodon crispus	+	.	+	.	.	+	.	+	.	.	.	.	.	.	.
Hieracium naegelianum subsp. *ljubotenicum* **	+	.	+	+	+	+	.	+	+	+	.	.	.	.	.
Trifolium badium	+	+	+	.	+	+	+	+	.	+	.	.	.	.	.
Ranunculus montanus	+	+	.	+	.	+	+	.	+	.	.	.	.	.	.
Scabiosa columbaria	+	+	+	.	+	+	+	+	.	+	.	.	.	.	.
Trifolium noricum	+	+	+	+	.	+	+	+	+	.	.	.	.	.	.
Senecio squalidus subsp. *rupestris*	+	+	+	.	.	+	+	+	.	.	.	.	.	.	.
Myosotis sylvatica	+	+	+	+	+	+	+	+	+	+	.	.	.	.	.
Galium anisophyllon	+	+	.	+	.	+	+	.	+	.	.	.	.	.	.
Dianthus sylvestris	+	+	+	.	.	+	+	+	.	.	.	.	.	.	.
Trifolium velenovskyi **	+	+	.	+	+	+	+	.	+	+	.	.	.	.	.
Saxifraga paniculata	+	.	+	+	+	+	.	+	+	+	.	.	.	.	.
Cyanus triumfettii	+	+	+	.	.	+	+	+	.	.	.	.	.	.	.
Geum montanum	+	.	.	.	+	+	.	.	.	+	.	.	.	.	.
Polygala major	+	+	+	.	.	+	+	+	.	.	.	.	.	.	.
Trifolium alpestre	+	.	+	+	.	+	.	+	+	.	.	.	.	.	.
Sedum ochroleucum	+	+	.	+	.	+	+	.	+	.	.	.	.	.	.
Achillea chrysocoma **	+	+	.	.	.	.	+	.	.	.	.	.	.	.	.
Arctostaphylos uva-ursi	.	+	+	+	+	.	+	+	+	+	.	.	.	.	.
Iberis sempervirens	.	+	+	.	.	.	+	+	.	.	.	.	.	.	.
Helianthemum canum	.	+	+	.	+	.	+	+	.	+	.	.	.	.	.
Nardus stricta	.	.	+	+	+	.	.	+	+	+	.	.	.	.	.

Oxytropis halleri subsp. *korabensis* **	.	.	.	+	+	.	.	.	+	+	.	.	.	.	.
Phleum alpinum	.	.	.	+	+	.	.	.	+	+	.	.	.	.	.
Ranunculus breyninus	.	.	.		+	.	.	.		+	.	.	.	.	.
Grasslands (*Dryas* gr.) - belonging to the Strictly Protected Area															
Dryas octopetala	.	.	.	.	.	.	.	.	.	.	3	4	3	3	3
Carex kitaibeliana	.	.	.	.	.	.	.	.	.	.	2	3	.	2	3
Helianthemum canum	.	.	.	.	.	.	.	.	.	.	2	1	1	2	1
Juniperus communis subsp. *nana*	.	.	.	.	.	.	.	.	.	.	1	1	3	2	1
Oxytropis halleri subsp. *korabensis* **	.	.	.	.	.	.	.	.	.	.	1	.	.	+	+
Sesleria nitida	.	.	.	.	.	.	.	.	.	.	+	1	1	1	+
Arctostaphylos uva-ursi	.	.	.	.	.	.	.	.	.	.	+	.	1	.	+
Onobrychis montana subsp. *scardica* **	.	.	.	.	.	.	.	.	.	.	+	1	.	+	+
Festuca pancicana	.	.	.	.	.	.	.	.	.	.	1	+	+	+	+
Festuca adamovicii **	.	.	.	.	.	.	.	.	.	.	+	1	+	1	+
Alchemilla plicatula	.	.	.	.	.	.	.	.	.	.	+	1	1	1	+
Antennaria dioica	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.
Dianthus integer **	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+
Bupleurum karglii **	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.
Koeleria splendens	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.
Bistorta vivipara	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+
Sesleria juncifolia	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+
Poa molinierii	.	.	.	.	.	.	.	.	.	.	+	+	+	+	1
Scabiosa columbaria	.	.	.	.	.	.	.	.	.	.	+	+	1	.	+
Phleum montanum	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+
Erysimum comatum	.	.	.	.	.	.	.	.	.	.	+	.	+	.	+
Carduus candicans	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+
Pimpinella saxifraga	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+
Hypericum richeri subsp. *grisebachii*	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.
Silene saxifraga	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.

Alchemilla hybrida	.	.	.	.	.	.	.	.	.	.	+	.	1	+	+
Achillea ageratifolia **	.	.	.	.	.	.	.	.	.	.	+	+	.	+	+
Geum montanum	.	.	.	.	.	.	.	.	.	.	+	+	.	+	+
Hieracium naegelianum subsp. *ljubotenicum* **	.	.	.	.	.	.	.	.	.	.	+	+	.	+	+
Galium anisophyllon	.	.	.	.	.	.	.	.	.	.	+	+	.	+	+
Trifolium repens	.	.	.	.	.	.	.	.	.	.	+	+	.	+	+
Asperula cynanchica	.	.	.	.	.	.	.	.	.	.	+	+	.	+	+
Helianthemum nummularium	.	.	.	.	.	.	.	.	.	.	+	+	.	+	+
Campanula rotundifolia	.	.	.	.	.	.	.	.	.	.	+	+	.	+	+
Bromopsis cappadocica subsp. cappadocica	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+
Anthyllis aurea **	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.
Minuartia verna	.	.	.	.	.	.	.	.	.	.	+	.	+	.	+
Oxytropis campestris	.	.	.	.	.	.	.	.	.	.	+	.	+	+	1
Trifolium badium	.	.	.	.	.	.	.	.	.	.	+	.	+	.	+
Salix caprea	.	.	.	.	.	.	.	.	.	.	+	.	+	.	+
Dianthus sylvestris subsp. *bertisceus* **	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+
Thymus praecox subsp. *zygiformis*	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+
Cerastium cerastoides	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+
Eadrianthus graminifolius	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+
Oenanthe peucedanifolia	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Fragaria vesca	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Pinus peuce	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Arabis alpina	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Jasione orbiculata	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Dianthus scardicus **	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Saxifraga scardica **	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Hieracium villosum	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Rubus idaeus	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Trifolium noricum	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+
Primula veris	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+
Euphrasia rostkoviana	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.
Cerastium decalvans	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+

Primula elatior	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.
Gymnadenia nigra	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.
Salix reticulata	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.
Aster alpinus	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+
Koeleria eriostachya	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.
Achillea abrotanoides **	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+
Trinia glauca	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+
Veronica chamaedrys	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+
Vaccinium uliginosum	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+
Hypericum perforatum	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+
Myosotis sylvatica	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.
Stachys alpina	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.
Luzula campestris	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.
Lotus corniculatus	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.
Rumex acetosa	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.
Crepis aurea	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.
Luzula spicata	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+
Pedicularis brachyodonta **	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+
Saxifraga moschata	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Hieracium pilosum	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.
Gentiana utriculosa	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+
Bupleurum falcatum	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+
Gentianella bulgarica	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Achillea chrysocoma **	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Vaccinium myrtillus	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Achillea setacea	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Phleum alpinum	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Silene ciliata	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Neotinea maculata	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+
Anthyllis vulneraria	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Pinguicula balcanica **	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Linum capitatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Saxifraga paniculata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Campanula spatulata **	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+

Luzula forsteri	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Phyteuma pseudorbiculare **	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Leontodon crispus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Ranunculus breyninus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+