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DRY GRASSLAND TYPES IN THE PRESPA NATIONAL PARK (NW GREECE), INCLUDING THE SOUTHERNMOST OCCURRENCE OF THE PRIORITY HABITAT TYPE "PANNONIC SAND STEPPES" (CODE 6260)

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Abstract

A recently completed project on the Natura 2000 sites of Prespa National Park revealed that the area hosts 49 habitat types according to the EU classification, of which eight have a narrowly restricted distribution in Greece. The priority habitat type "*6260 Pannonic sand steppes" is reported here for the first time for Greece. The new locality represents its southernmost occurrence on the Balkan Peninsula. The aim of this paper therefore is to describe the Greek stands of this habitat type, investigate the factors affecting its occurrence and discuss the associated conservation issues. This is based on a total of 87 relevés sampled for this study and 8 additional relevés from the literature. The relevés were classified by applying TWINSPAN and ordinated using Detrended Correspondence Analysis (DCA). Six vegetation units could be distinguished. One of these corresponds to the habitat type *6260 and was found exclusively on inland sand dunes. Syntaxonomically, we assigned this unit to the alliance *Sileno conicae-Cerastion semidecandri* s.l. of the class *Koelerio-Corynephoretea*. Its occurrence in the study area seems to be determined by climatic factors, as well as by the sandy substrate, while anthropogenic disturbances such as grazing also appear to be beneficial to some degree. Apart from the *Koelerio-Corynephoretea*, another five grassland classes were distinguished in the national park, namely the *Thero-Brachypodietea*, *Stellarietea mediae*, *Festuco-Brometea*, *Daphno-Festucetea* and *Juncetea trifidi*.

Key words: Habitats Directive, *Koelerio-Corynephoretea*, phytosociology, *Sileno conicae-Cerastion semidecandri*, syntaxonomy.

Izvleček

Nedavno končani projekt o območjih Natura 2000 v Narodnem parku Prespa je pokazal, da je na območju po EU klasifikaciji 49 habitatnih tipov, od katerih jih je osem z ozko razširjenostjo v Grčiji. Pojavljanje prednostnega habitata "*6260 Panonske stepe na peščenih tleh" v Grčiji objavljamo prvič. Nova lokacija predstavlja najjužnejše pojavljanje na Balkanskem polotoku. Namen članka je opisati sestoje tega habitatnega tipa v Grčiji, preučiti dejavnike, ki vplivajo na njegovo pojavljanje in razpravljati o vprašanjih, povezanih z njegovim ohranjanjem. Raziskava temelji na 87 vegetacijskih popisih in 8 dodatnih popisih iz literature. Popise smo numerično obdelali s pomočjo TWINSPAN klasifikacije in z uporabo korespondenčne analize z odstranjenim trendom (DCA). Ločili smo šest vegetacijskih enot. Ena ustreza habitatnemu tipu in smo jo našli le na celinskih peščenih sipinah. Sintaksonomsko smo jo uvrstili v zvezo *Sileno conicae-Cerastion semidecandri* s.l. in razred *Koelerio-Corynephoretea*. Njeno pojavljanje v preučevanem območju je pogojeno s klimatskimi dejavniki in peščeno podlago, antropogene motnje, kot na primer paša, pa do neke mere nanjo vplivajo pozitivno. Poleg travišč razreda *Koelerio-Corynephoretea* smo v parku našli še pet travišč iz razredov *Thero-Brachypodietea*, *Stellarietea mediae*, *Festuco-Brometea*, *Daphno-Festucetea* in *Juncetea trifidi*.

Ključne besede: Habitatna direktiva, *Koelerio-Corynephoretea*, fitosociologija, *Sileno conicae-Cerastion semidecandri*, sintaksonomija.

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1. INTRODUCTION

The recently accomplished project to record, assess and map the rangeland and forest habitat types of the Natura 2000 sites of the National Park of Prespa ("Ethnikos Drymos Prespon-GR1340001" and "Ori Varnounta-GR1340003") revealed an exceptional diversity of plant species and habitats. The national park hosts 49 habitat types (19 more than those recorded in 2000), 70 vegetation types and more than 2,100 vascular plant species (almost 30% of the Greek flora) with 194 considered as important according to Annex II of the Habitats Directive (Vrahnakis et al. 2011). Seven habitat types are of conservation priority according to Annex I of the Directive 92/43/EEC (Habitats Directive); they occupy 26% (11,000 ha) of the total area of the national park. Eight of the recorded habitat types have quite restricted distribution in Greece. In the previous report on habitat types of the national park in 2000 (Dafis et al. 2001), three grassland priority habitat types (indicated with "*") from a total of 31 types had been documented. The new mapping in 2011 revealed four dry grassland priority habitat types (*6210, *6220, *6230 and *6260) occupying an area of 8,754 ha.

The present study expands the work carried out during the recent mapping of the national park (Vrahnakis et al. 2011) by means of additional phytosociological sampling. Most importantly it reports for the first time the occurrence of the phytosociological order *Festuco-Sedetalia acris* Tx. 1951 (sensu Dengler 2001 et seq.) and the priority habitat type *6260 (Pannonian sand steppes) in Greece. Therefore, this study specifically aims to describe the floristic composition and ecology of the Greek stands of the *Festuco-Sedetalia acris*, as well as investigate its differentiation from other dry grassland vegetation types occurring in the same national park. Furthermore, the factors determining the occurrence of this regionally rare habitat type are explored and conservation recommendations are made.

2. STUDY AREA

The study area comprised the whole of the Prespa National Park, which is located in northwestern Greece on the frontiers with Albania and the Former Yugoslav Republic of Macedonia. It is characterized by the presence of two lakes, Megali Prespa and Mikri Prespa at approx. 850 m a.s.l., while the surrounding mountains of Varnountas (2334 m), Devas (1372 m), Triklario (1750 m) and Vrondero (1351 m) contribute to the high landscape diversity of the area. The eastern sector of the national park is influenced by the perennial stream of Agios Germanos. The stream was diverted in the 1930s, so as to flow into Lake Megali Prespa instead of Lake Mikri Prespa (Hollis & Stevenson 1997) (Figure 1). The bedrock is siliceous (mostly granitic) in the eastern part of the national park and calcareous in the western part (I. G. M. E. 1983). Alluvial deposits dominate the plain of the basin, whereas sandy soils are found in the southeastern part of Megali Prespa (Figure 2) and on the Slogi islet (Figure 1). The climate of the area experiences both Mediterranean and continental influences and could be characterized as sub-continental Central European (Ristevski 2000). The mean annual temperature is 10.8 °C (Meteorological Station of Pretor; period 1961–1991), with the warmest month being July (19.2 °C) and the coldest January (0.2 °C). The mean annual precipitation for that station is 730 mm; in the lower parts of the national park, precipitation ranges from 600 to 700 mm, while in the mountainous zone it increases to 800–900 mm, and in the higher mountainous areas up to 1400 mm (Ristevski 2000, Fotiadis et al. 2012).

3. METHODS

3.1 Vegetation data

The study covers all grassland types within the area of the national park. Field data were sampled during 2009 and 2010 according to the Braun-Blanquet method (Braun-Blanquet 1964, Dierschke 1994). The plots were selected subjectively, with the aim of having all different grassland types represented in the data set by an adequate number of relevés, i.e. corresponding roughly to the area covered by each vegetation type. Plots were selected so as to be floristically and ecologically homogeneous, as well as representative of the vegetation type in which they were sampled. Plots were square in shape and had an area of 16–25 m^2 each, which is recommended for grasslands (Knapp 1984, Kent & Coker 1992, Chytrý & Otýpková 2003). Only vascular plants were recorded. The modified 9-point Braun-Blanquet scale was applied for species cover estimation

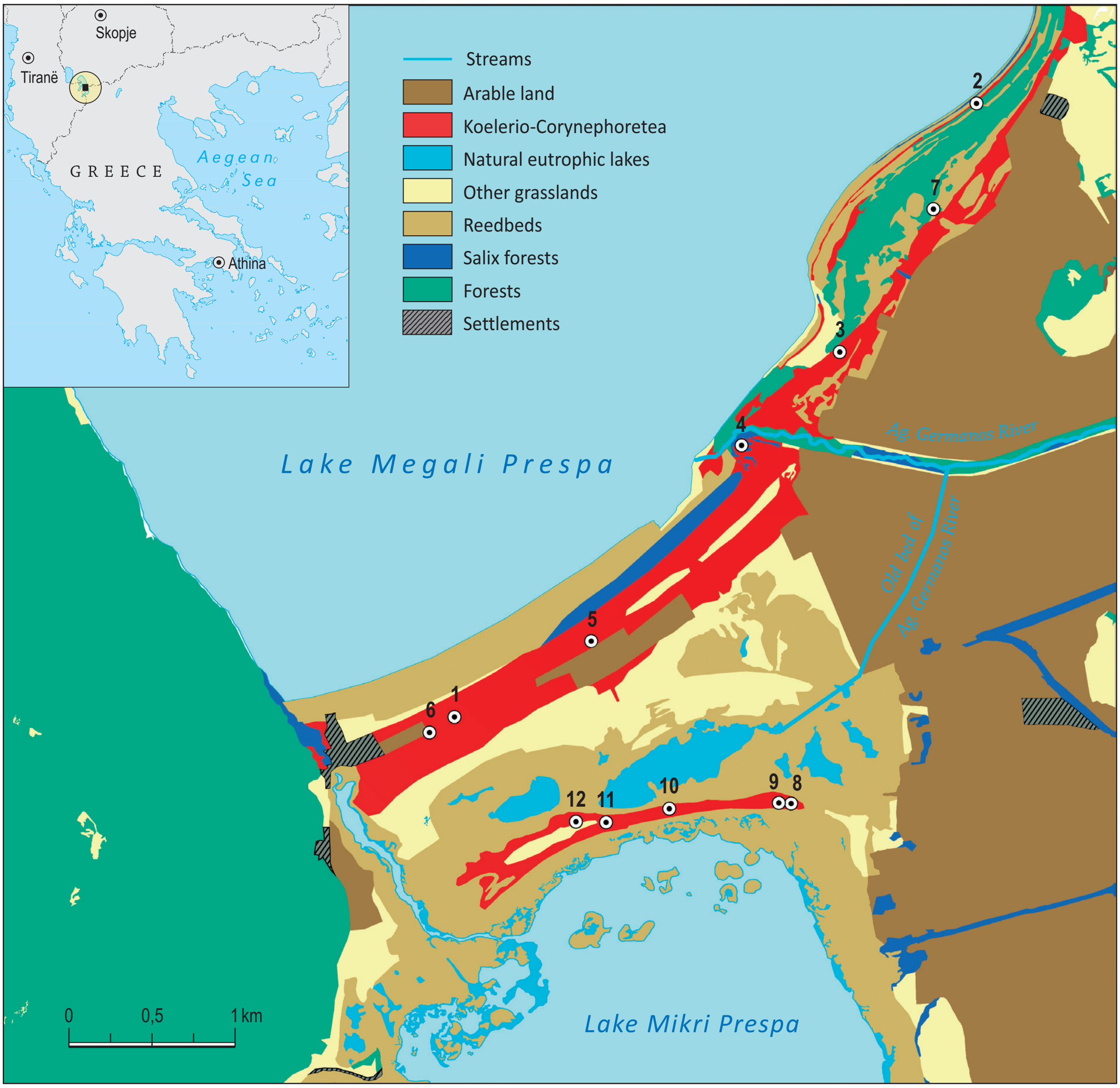

Figure 1: Distribution map of *Koelerio-Corynephoretea* (red colour) vegetation represented by its relevés (black points) in various localities including the Slogi islet (points 8–12).

Slika 1: Karta razširjenosti vegetacije razreda *Koelerio-Corynephoretea* (rdeče območje) s predstavljenimi različnimi lokacijami popisov (črne točke), vključno z otočkom Slogi (točke 8–12).

(Barkman et al. 1964, van der Maarel 1979, Parolly 2003). Besides the floristic data, in each relevé the following parameters were recorded: geological substrate, altitude (in m a.s.l.), exposition (in degrees), slope inclination (as percentage), total vegetation cover as well as cover of shrub and herb layers (the latter three as an estimate in %).

In total, 87 relevés of dry grasslands were sampled in the national park, and eight were used from a previous study from the region (Quézel 1969). All relevés are stored in the Balkan Dry Grassland Database (Vassilev et al. 2012), with code EU-00-013 in the Global Index of Vegetation-Plot Databases (GIVD; Dengler et al. 2011). Nomenclature of taxa follows Dimopoulos et al. (2013). The cited syntaxonomy follows Mucina et al. (1993), Mucina (1997), Schaminée et al. (1996), Dengler (2001), Rodwell et al. (2002), Dengler et al. (2003), Berg et al. (2004) and Chytrý (2007).

Figure 2: Stand of the *Silene frivaldszkyana-Erysimum microstylum* (*Sileno-Cerastion*) community (*Koelerio-Corynephoretea*) at the shores of Lake Megali Prespa.
Slika 2: Sestoj združbe *Silene frivaldszkyana-Erysimum microstylum* (*Sileno-Cerastion*, *Koelerio-Corynephoretea*) na obali jezera Megali Prespa.

3.2 Numerical analyses

The relevés were classified using TWINSPAN (Hill 1979). Three pseudospecies cut-levels (0%, 5%, 25%) were used, and four levels of divisions were applied. Detrended Correspondence Analysis (DCA) was also applied to facilitate the ecological interpretation of vegetation differentiation, as well as to check the discrimination of the groups produced by the classification. For each relevé, the "relative abundances" of the diagnostic species of six phytosociological classes (*Koelerio-Corynephoretea* Klika in Klika et Novák 1941, *Thero-Brachypodietea* Br.-Bl. ex A. de Bolós y Vayreda 1950, *Stellarietea mediae* R. Tx. et al. ex von Rochow 1951, *Festuco-Brometea* Br.-Bl. & Tx. in Br.-Bl. 1949, *Daphno-Festucetea* Quézel 1964 and *Juncetea trifidi* Hadač 1946) were calculated according to the assignment in Mucina (1997). As "relative abundances", we used the summed percentage values corresponding to the mid-points of the respective Braun-Blanquet cover-abundance category raised to the power 0.2. These six classes were used as passive variables in the DCA because they were represented by a significant number of taxa in the data set. This projection also aimed at exploring the relationships between the distinguished vegetation units and certain syntaxa (classes) (see Bergmeier et al. 2009).

Furthermore, an additional DCA was applied, using a partial data set in order to better explore the floristic and ecological affinities of the vegetation unit under study with the most closely related vegetation units. In both numerical analyses (classification and ordinations), species cover abundances were square-root transformed.

Diagnostic taxa were determined using the algorithm of Tsiripidis et al. (2009). This algorithm uses a fidelity threshold based on relative constancy differences of taxa between groups. Its advantage in comparison with other numerical means of diagnostic species determination is that it conducts multiple comparisons between different combinations of vegetation groups. Specifically, the algorithm searches in a data set for a group or a combination of groups that is differentiated by a taxon against another group or combination of groups. In this way it can reveal differentiating structures in a data set (Tsiripidis et al. 2009). As the algorithm is based on differences of relative constancy values, the diagnostic taxa resulting from this algorithm were tested

Table 1: Eigenvalues, length of gradient and total inertia for the DCA axes of the two data sets. Data set A includes all the 95 relevés, while data set B includes the relevés of *Koelerio-Corynephoretea*, *Thero-Brachypodietea* and *Stellarietea mediae* (26 relevés).

Tabela 1: Lastne vrednosti, dolžina gradienta in variabilnost vseh ordinacijskih osi DCA v obeh podatkovnih nizih. Podatkovni niz A vsebuje 95 popisov, niz B pa popise razredov *Koelerio-Corynephoretea*, *Thero-Brachypodietea* and *Stellarietea mediae* (26 popisov).

DATA SET	EIGENVALUES		GRADIENT LENGTH		TOTAL INERTIA
	AXIS 1	AXIS 2	AXIS 1	AXIS 2	
A	0.726	0.477	5.847	4.153	12.242
B	0.470	0.351	3.296	3.112	4.718

with Fisher's exact test. This test compares the absolute constancy of taxa in the group or the groups it differentiates positively, with the one in the groups it differentiates negatively or not differentiating at all. The level of significance chosen in Fisher's exact tests was 0.05. The classification was made using the TWINSPAN algorithm within JUICE ver. 7 (Tichý 2001), and an ordination was carried out with CANOCO ver. 4.5 (ter Braak & Šmilauer 2002).

4. RESULT AND DISCUSSION

4.1 Classification and syntaxonomy

Six vegetation units of grasslands could be distinguished based on the TWINSPAN classification (Table 2). Specifically, from the eight groups produced at the third level of divisions in TWINSPAN, two pairs of groups were fused to one group each, on the basis of their floristic similarity, as well as the DCA ordination diagrams. In Figure 3 the divisions made by TWINSPAN are presented schematically.

The first unit belongs to *Koelerio-Corynephoretea*, as easily concluded from the dominance of *Koelerio-Corynephoretea* diagnostic taxa (see Table 3), and it is well differentiated from the other vegetation units of dry grasslands in the study area. The most frequent species in this vegetation unit are *Silene conica, Bromus rubens, Cruciata pedemontana*, *Trifolium arvense*, *Vulpia myurus, Trifolium arvense* and *Linaria genistifolia*. Most of these species are annuals and diagnostics (according to Mucina 1997, Dengler 2000, Rūsiņa 2005, Kuzemko 2009) for the subclass *Koelerio-Corynephorenea* (Klika in Klika & Novák 1941) Dengler in Dengler et al. 2003 and/or the order *Festuco-Sedetalia acris* sensu Dengler (2003) of the class *Koelerio-Corynephoretea*.

Due to the occurrence of *Silene conica* and *Cerastium semidecandrum* (diagnostic species of the alliance *Sileno conicae-Cerastion semidecandri* Korneck 1974 according to Ellenberg (1988), Dengler et al. (2003) and Faust et al. (2011)), as well as the eastern Balkan endemic species *Silene frivaldszkyana* and *Erysimum microstylum*, all relevés of the first vegetation unit were classified within the alliance *Sileno conicae-Cerastion semidecandri* s.l. and named the *Silene frivaldszkyana-Eysimum microstylum* community. We use here the wide concept of the *Sileno conicae-Cerastion semidecandri*, which in the delimitation of Dengler (2001, 2003) includes all the annual-dominated pioneer grasslands on dry calcareous sands in temperate Europe. Dengler (2001, 2003) also includes the *Bassio laniflorae-Bromion tectorum* (Soó 1957)

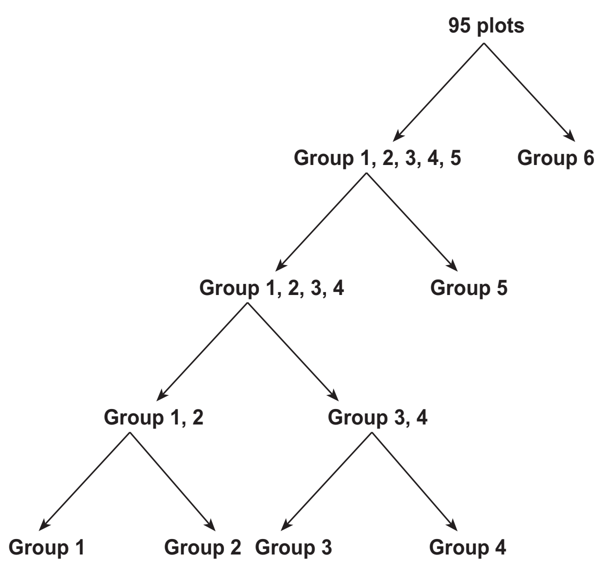

Figure 3: Schematic representation of the divisions made by TWINSPAN.

Slika 3: Shematski prikaz členitve, narejene s programom TWINSPAN.

Borhidi 1996 in the *Sileno-Cerastion* s.l., while other authors (e.g. Rodwell et al. 2002) accept it as a separate alliance. According to its authors, the *Bassio-Bromion* comprises annual-dominated pioneer grasslands of calcareous sands in the Pannonian Basin, thus would be a vicariant alliance to the *Sileno-Cerastion* s. str. distributed further north and west, and also shows some floristic and ecological similarities to our *Silene frivaldszkyana-Erysimum microstylum* community. Until the justification of two separate vicariant alliances of sub-continental sand pioneer grasslands has been proven and their delimitation established, we prefer to assign our community provisionally to the *Sileno conicae-Cerastion semidecandri* in the wide sense, which is also supported by the fact that its two eponymous taxa *Silene conica* and *Cerastium semidecandrum* are widespread in the stands examined in Prespa National Park.

The alliance *Sileno conicae-Cerastion semidecandri* s.l. is classified within the order *Festuco-Sedetalia acris* and *Koelerio-Corynephorenea* subclass of the *Koelerio-Corynephoretea* class (Dengler 2003, Dengler et al. 2003, Berg et al. 2004). Another syntaxonomical issue is that Pedashenko et al. (2013) report *Silene frivaldszkyana* from Bulgaria as typical for several alliances of the *Festuco-Brometea*, but also for the *Koelerio-Corynephoretea* (in the latter with higher abundance). In Prespa National Park, as already mentioned, *Silene frivaldszkyana* is found exclusively and with high abundance in the *Koelerio-Corynephorenea* stands. We therefore decided to classify this vegetation type to a new community, as it is differentiated floristically from all of the associations of the alliance described so far, such as *Erodio-Senecionetum vernalis* Lührs 1993 and *Sileno conicae-Cerastietum semidecandri* Korneck 1974 mentioned by Dengler (2000) for Germany, mainly, because it is rich in Balkan endemic taxa.

The *Sileno conicae-Cerastion semidecandri* s.l. and the *Festuco-Sedetalia acris* according to the *Manual of the European Union Habitats* (European Commission 2013) largely correspond to two habitat types, namely *6120 (Xeric sand calcareous grasslands) and *6260 (Pannonic sand steppes). Although our first thoughts were to include the described community in the former habitat type, we have chosen finally to classify it, at least provisionally, to the *6260 habitat type. The reason for this choice is that *6120 has been identified mainly in central and northern Europe (e.g. Germany and Poland (Ödman et al. 2011), Norway, Sweden (European Commission 2013), Denmark (Silva et al. 2008), Belgium (Demolder et al. 2008)), while *6260 is given for eastern Central Europe (Hungary, Slovakia, Austria and Czech Republic (Šefferova Stanova et al. 2008 and references therein)), but also for Southeast Europe (e.g. Romania (European Commission 2013), Bulgaria (Bulgarian Academy of Sciences 2011) and Serbia (Šefferova Stanova et al. 2008)).

According to Sundseth (2009), complex climatic patterns, formed due to Mediterranean, Carpathian and Alpic influences, cause the Pannonian region to "*exhibit a mosaic vegetation structure instead of the more classic zonal arrangements that one sees in other biogeographical regions*". Moreover, Metzger et al. (2012) in the environmental stratification of the European continent described the stratum Pannonian 2 (PAN2) of semi-arid plains as having three areas of distribution: one in the middle Danube plain, one in the Black Sea lowlands and one in the Valley of the Struma in Bulgaria and Greece. In this sense, the area of Prespa potentially exhibits a Panonian-like character, at least concerning the vegetation of this specific location (study area).

The second column of the TWINSPAN analysis (Table 2) represents the *Thero-Brachypodietea* class, since most of the taxa or plant species are diagnostic of the class (e.g. *Arenaria leptoclados, Plantago holosteum*). It was found in very dry areas of the study area, mostly nearby villages. The class is distinguished from the other classes by annual species, mostly grasses (e.g. *Taeniatherum caput-medusae, Aegilops triuncialis, Catapodium rigidum, Lagurus ovatus*). The third column represents the *Stellarietea mediae* class, which is distinguished from the other classes by synanthropic species such as *Medicago sativa* and *M. rigidula,* and is dominated by diagnostic taxa of the class, such as *Convolvulus arvensis*, *Cerastium glomeratum*, *Echium italicum* and *Geranium molle*. It seems that in the study area both classes, *Thero-Brachypodietea* and *Stellarietea mediae*, are floristically related to the *Koelerio-Corynephoretea*, since they mainly represent annual communities affected by human activities.

Columns 4, 5, 6 represent the *Festuco-Brometea, Daphno-Festucetea* and *Juncetea trifidi* classes, respectively. These three classes are characterized by perennial herbaceous species. The *Festuco-Brometea* is distinguished from other classes by the presence of perennial grasses such as *Phleum phleoides* and *P. pratense*. In the national park, the

Festuco-Brometea is represented by several communities, probably of the order *Astragalo-Potentilletalia* Micevski 1971. These communities are found at intermediate altitudes, on sites with moderate grazing. The *Daphno-Festucetea* is characterized and well differentiated from the other classes by chamaephytes and spiny species (e.g. *Astragalus angustifolius*, *Morina persica*, *Eryngium amethystinum*, *Prunus prostrata*). The *Juncetea trifidi* is well differentiated from the other classes by acidophilic grasses, such as *Nardus stricta*, *Deschampsia flexuosa* and *Alopecurus gerardii* (Table 2).

4.2 Ordination

The first DCA diagram (Figure 4; Table 1) shows that grasslands of the *Koelerio-Corynephoretea* in the national park are clearly discriminated from the *Festuco-Brometea*, *Daphno-Festucetea* and *Juncetea trifidi* classes. On the other hand, the DCA diagram reveals the floristic affinity of *Koelerio-Corynephoretea* with the vegetation units of *Stellarietea mediae* and *Thero-Brachypodietea*. The first axis in the DCA diagram may represent a moisture gradient, with the driest ecological conditions occurring on the left side of the axis. The second DCA axis mainly represents the geological substrate, with the relevés on siliceous substrates occurring in the lower part of the axis and those on calcareous substrates in the upper part of the axis.

The second DCA diagram (Figure 5) shows a clear floristic differentiation of the grasslands of *Koelerio-Corynephoretea* from the vegetation of *Thero-Brachypodietea* and *Stellarietea mediae*. The first DCA axis in this diagram is related to

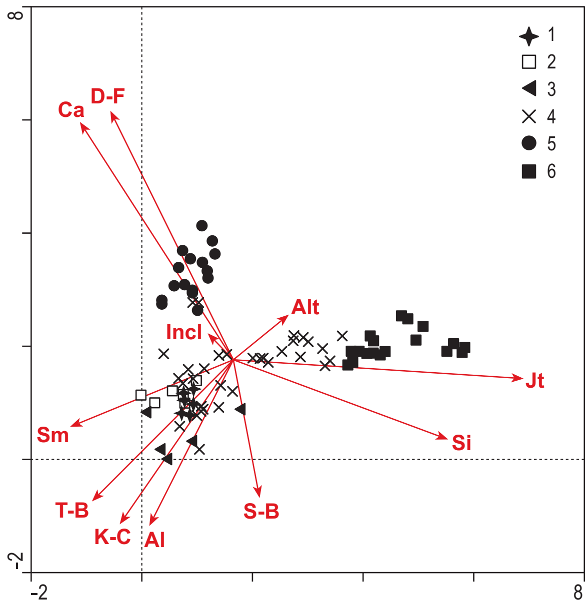

Figure 4: Diagram of all relevés along the first two DCA axes (1: *Koelerio-Corynephoretea*, 2: *Thero-Brachypodietea*, 3: *Stellarietea mediae*, 4: *Festuco-Brometea*, 5: *Daphno-Festucetea*, 6: *Juncetea trifidi*) with explanatory variables passively projected onto the ordination space. The explanatory variables concern the sum per relevé of the relative abundances of the species considered as diagnostic of the classes *Koelerio-Corynephoretea* (K-C), *Thero-Brachypodietea* (T-B), *Stellarietea mediae* (Sm), *Festuco-Brometea* (F-B), *Daphno-Festucetea* (D-F), *Juncetea trifidi* (Jt), as well as the environmental variables inclination (Incl), altitude (Alt) and geological substrate (Al: Alluvial, Si: Siliceous, Ca: Calcareous).

Slika 4: Diagram vseh popisov vzdolž prvih dveh DCA osi (1: *Koelerio-Corynephoretea*, 2: *Thero-Brachypodietea*, 3: *Stellarietea mediae*, 4: *Festuco-Brometea*, 5: *Daphno-Festucetea*, 6: *Juncetea trifidi*) z nedovisnimi spremenljivkami, pasivno projeciranimi na ordinacijski prostor. Neodvisne spremenljivke prikazujejo vsoto relativnih abundanc na popis diagnostičnih vrst razredov *Koelerio-Corynephoretea* (K-C), *Thero-Brachypodietea* (T-B), *Stellarietea mediae* (Sm), *Festuco-Brometea* (F-B), *Daphno-Festucetea* (D-F), *Juncetea trifidi* (Jt) in okoljskih spremenljivk: naklon (Incl), višina (Alt) in geološka podlaga (Al: aluvij, Si: silikat, Ca: karbonat).

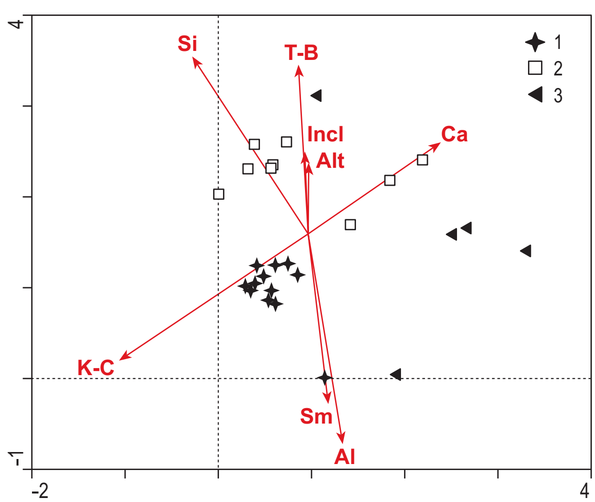

Figure 5: Diagram of the relevés classified within the classes *Koelerio-Corynephoretea* (1), *Thero-Brachypodietea* (2) and *Stellarietea mediae* (3) with explanatory variables passively projected onto the ordination space. For the abbreviations of explanatory variables see Figure 4.

Slika 5: Diagram popisov, uvrščenih v razrede *Koelerio-Corynephoretea* (1), *Thero-Brachypodietea* (2) in *Stellarietea mediae* (3), z neodvisnimi spremenljivkami, pasivno projiciranimi na ordinacijski prostor. Oznake spremenljivk so kot na Sliki 4.

the calcareous substrate and might additionally reflect a disturbance gradient, as the class *Stellarietea mediae* contains anthropogenic vegetation units. The second DCA axis is related to the type of substrate (alluvial sands vs. bedrock), as well as with altitude (the relevés of *Koelerio-Corynephoretea* occur at lower altitudes where the substrate is alluvial). The floristic affinities of the *Koelerio-Corynephoretea* grasslands with those of the *Stellarietea mediae* have also been documented in other studies. Stroh et al. (2002) recorded that ruderal pioneer communities of *Stellarietea mediae* have been established after spontaneous succession in sand grasslands belonging to the *Koelerio-Corynephoretea*, while the important role of therophytes in *Koelerio-Corynephoretea* communities is also supported by Zwaenepoel et al. (2002) and Faust et al. (2011).

4.3 Ecological characteristics of the habitat type *6260 in Greece and conservation issues

The occurrence of the *6260 habitat type has been documented mainly from Hungary, but its distribution extends into Lower Austria, Slovakia, Romania and Bulgaria (Šefferova Stanova et al. 2008). The habitat type holds several vegetation types classified in the order *Festuco-Sedetalia acris*, which represents the subcontinental and continental sand-swards.

It represents dry open grasslands developed on mobile or fixed dunes (alluvial sands, subfossil dune systems) of the Pannonic steppes (European Commission 2013). The sub-continental climate type of the study site, and the sandy shores formed by the active hydrological network in the area offer the two main ecological conditions required for the existence of the *6260 habitat type. Specifically, the *Silene frivaldszkyana-Erysimum microstylum* [*Sileno-Cerastion*] community was found on sandy soils on the south-southeastern shores of Lake Megali Prespa (Figure 2) and on the Slogi islet in Lake Mikri Prespa (Figure 1). The altitude of the localities varies from 849 m a.s.l. (the water level of Megali Prespa was approx. 847 m a.s.l. during the sampling period of this study) to 855 m a.s.l. (water level of Mikri Prespa was approx. 854 m a.s.l.). The sand dunes on the shores of Lake Megali Prespa were formed by the gradual decrease of the water level of the lake over the last 30 years, and partially by mechanical excavation works for sand extraction at specific localities in recent decades. The sandy islet of Slogi is located 1–2 m above the water level of Lake Mikri Prespa and probably resulted from historical alluvial deposits of the Agios Germanos River before its anthropogenic diversion to the larger lake. Grasslands of the *Koelerio-Corynephoretea* are distinguished from those of the *Stellarietea mediae* and *Thero-Brachypodietea*, because they are found in areas with almost flat and deep alluvial sandy soils (Figure 5).

The stands of the *Silene frivaldszkyana-Erysimum microstylum* community are highly influenced by the fluctuations of the water levels of the lakes. The high abundance of *Scirpoides* cf. *holoschoenus* in this community reveals the influence of underground water on this vegetation unit. Moreover, many ephemeral ponds that are occasionally flooded during winter and spring, especially at the isthmus separating the two lakes, favour the dominance of *Azolla filiculoides*. Given on the one hand the high susceptibility of the *6260 to degradation due to competition and, on the other hand, the uniqueness of the habitat for Greece, special conservation measures are needed to ensure its continued survival in the area.

In the study area, the major threats to the habitat type are water level fluctuations caused by anthropogenic influences (e.g. excavations, embankments), invasion of non-native species and the absence of grazing. We assume that any further increase in the water level of the lakes will negatively affect the *6260 habitat type in the study area. However, detailed studies are needed to define a sustainable water level to maintain a balance between safeguarding the habitat type and meeting the irrigation needs of local farmers.

The existence of short, shrub-like trees of *Salix alba* as well as of trees like *Robinia pseudoacacia* and *Morus* spp., planted at the localities of the habitat type, may be a threat because of the possible invasion of these species in the habitat. The invasion of *Robinia pseudoacacia* has been recorded as a serious threat for *6260 in Slovakia (Šefferova Stanova et al. 2008). This species, due to its intensive vegetative spread and its high germination rates after fire, becomes a superior competitor in secondary succession processes. Systematic eradication of such invasive trees is suggested for the study area by means of mechanical cleaning (cutting), subsequent grazing of surviving shoots and monitoring of its regeneration (Kelemen & Warner 1996).

The soil surface of the stands of the community is often covered by a conspicuous cryptogam layer (e.g. lichens of the genus *Cladonia* and xerophytic mosses of the genus *Tortula* s.l.), which is typical for the habitat type in general (Šefferova Stanova et al. 2008). Such relation of inland dunes and dense moss layers has already been indicated for ecologically similar habitat types (e.g. for *6120 by Ödman et al. (2011)). The study area is only occasionally grazed by cattle. Abandonment of grazing may lead to closed grasslands and increased moss cover (Molnár 2003). Animal trampling can prevent the formation of dense moss carpets. However overgrazing must be avoided, as this will enrich the sand with nutrients, facilitating the occurrence of some diagnostic species of *Stellarietea mediae* or *Molinio-Arrhenatheretea*, such as *Plantago lanceolata*. On the other hand, the cessation of grazing on sand dunes is expected to cause increased biomass production and subsequently higher litter and humus accumulation. Such changes will further favour generalists and may cause the local extinction of some open sand grassland species (Onodi et al. 2006). It has been reported that grasslands suitable for open Pannonic sand steppes in Hungary turn to weedy fields due to grassland abandonment (Török et al. 2000). Consequently, a proper stocking rate must be estimated and maintained in the study area for conservation purposes.

5. CONCLUSIONS

This paper reports the southernmost occurrence of the priority habitat type *6260 "Pannonic sand steppes" in the Balkan Peninsula, from sandy soils at the south-southeastern shores of Lake Megali Prespa and on the Slogi islet in Lake Mikri Prespa, in the Prespa National Park of Greece. The prevailing sub-continental climate, the gradual drop of the water level of Lake Megali Prespa over the past few decades, the alluvial deposits of the river Agios Germanos in Lake Mikri Prespa and, to some extent, mechanical excavation works on the shores of Lake Megali Prespa in recent decades are considered as factors that positively influenced this habitat type.

Syntaxonomically, the stands are classified as *Silene frivaldszkyana-Erysimum microstylum* community within the alliance *Sileno conicae-Cerastion semidecandri* s.l. (including *Bassio laniflorae-Bromion tectorum*), the order *Festuco-Sedatalia acris* (= continental grasslands of base-rich, nutrient-poor sands) and the class *Koelerio-Corynephoretea*. One of the most important factors for the sustainability of the habitat type is grazing; undergrazing will probably lead to the dominance of moss carpets, which is a typical feature of the habitat type under no vegetation management, while overgrazing will affect vegetation by increasing nutrient content of the soils, which will probably favour the invasion of diagnostic species of *Stellarietea mediae* or *Molinio-Arrhenatheretea*. Finally, the control of the water level against rising in Lake Mikri Prespa is considered crucial since this will probably favour the invasion of species such as *Phragmites australis* and *Azolla filiculoides* that would eventually alter the vegetation type. In Lake Megali Prespa the water level cannot be artificially controlled, but the areas occupied by the habitat type do not appear threatened by a potential water level rise as they lie 3–5 m above the present water level. Finally, the spread of "aggressive" trees, like *Robinia pseudoacacia*, from plantations must be controlled.

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Table 2: Constancy synoptic table of the differential taxa of the six dry grassland vegetation units. Dark grey color indicates positive differentiation, medium grey color indicates positive-negative differentiation, white color and italic letters indicates negative differentiation and light grey color indicates non-differentiation (see Tsiripidis et al. 2009); 1: overall constancy, 2: *Koelerio-Corynephoretea*, 3: *Thero-Brachypodietea*, 4: *Stellarietea mediae*, 5: *Festuco-Brometea*, 6: *Daphno-Festucetea*, 7: *Juncetea trifidi*. Only species with statistically higher constancy (Fisher's exact test; α = 0.05) in the groups that differentiate positively vs. those that differentiate negatively or not differentiating at all are presented as differential. Species with a constancy lower than 20% in any column, and companion species with overall constancy lower than 10%, have been omitted.

Tabela 2: Sinoptična tabela s stalnostjo razlikovalnih taksonov šestih vegetacijskih tipov suhih travišč. Temno siva barva prikazuje pozitivno razlikovanje, srednje siva barva nakazuje pozitivno-negativno razlikovanje, bela barva in poševna pisava nakazujeta negativno razlikovanje in svetlo siva barva označuje nobenega razlikovanja (Tsiripidis et al. 2009); 1: celotna stalnost, 2: *Koelerio-Corynephoretea*, 3: *Thero-Brachypodietea*, 4: *Stellarietea mediae*, 5: *Festuco-Brometea*, 6: *Daphno-Festucetea*, 7: *Juncetea trifidi*. Samo vrste s statistično visoko stalnostjo (Fisherjev natančni test; α = 0.05) v skupinah, ki se pozitivno razlikujejo napram tistim, ki se razlikujejo negativno ali sploh ne, so prikazane kot razlikovalne. Vrste s stalnostjo, manjšo od 20% v enem stolpcu in spremljevalke s celotno stalnostjo, manjšo od 10%, niso prikazane.

Vegetation unit	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Number of relevés	95	12	9	5	35	14	20
Geology (Sa: sandy, Al: alluvial, Si: siliceous, Ca: calcareous)		Sa	Si, Ca, Al	Al	Si, Ca, Al	Ca	Si
Mean altitude (m a.s.l.)		853	987	976	1300	1490	1900
Altitudinal range (m a.s.l.)		848–857	850–1110	850–1260	850–1940	1310–1760	1730–2060
Mean number of taxa per relevé	33	43.7	44.0	28.0	34.0	43.5	24.0
Differential species (p < 0.01)							
Silene frivaldskyana	13	**100**	.	.	.	.	.
Euphorbia baselicis	9	**75**	.	*20*	.	.	.
Scirpoides cf. *holoschoenus*	9	**75**	.	.	.	.	.
Cruciata pedemontana	24	**100**	*22*	*40*	*17*	*7*	.
Hypericum perforatum	19	**83**	*22*	*20*	*14*	.	.
Torilis arvensis	18	**75**	*11*	20	*6*	29	.
Draba muralis	17	**67**	*11*	*20*	*17*	.	.
Delphinium balcanicum	8	**58**	.	.	.	*7*	.
Medicago minima	12	**42**	11	20	9	7	.
Papaver rhoeas	6	**42**	.	.	*3*	.	.
Verbascum cf. *eriophorum*	7	**42**	*11*	.	.	*7*	.
Vicia lathyroides	9	**42**	*11*	.	*9*	.	.
Linaria genistifolia subsp. *sofiana*	18	**92**	.	**40**	*11*	.	.
Jasione heldreichii	19	**67**	.	.	14	.	**25**
Tordylium maximum	11	**42**	.	.	6	**21**	.
Silene conica	36	**100**	**100**	.	23	36	.
Bromus rubens	27	**100**	**100**	.	*14*	.	.
Erysimum microstylum	31	**92**	**67**	20	20	29	.
Poa bulbosa	59	**92**	**100**	40	63	64	*15*
Filago arvensis	27	**75**	**100**	.	*20*	*7*	.
Centaurea cuneifolia	17	**75**	**33**	20	*9*	.	.
Herniaria incana	16	**50**	**44**	.	14	.	.
Petrorhagia saxifraga	18	**50**	**44**	.	14	14	.
Aira elegantissima	12	**42**	**22**	.	11	.	.
Stachys angustifolia	7	**33**	**22**	.	*3*	.	.
Hypericum olympicum	17	**42**	**33**	.	17	14	.
Trifolium hirtum	21	**42**	**100**	.	*17*	.	.
Trifolium arvense	41	**92**	**100**	*20*	**46**	*14*	.

Vegetation unit	1	2	3	4	5	6	7
Thymus sibthorpii	58	**75**	**67**	40	**77**	*21*	40
Astragalus onobrychis	29	**75**	**44**	.	**40**	*7*	.
Cerastium brachypetalum subsp. *roeseri*	14	**25**	**44**	.	*3*	**36**	.
Avena sterilis	27	**92**	**100**	**40**	*11*	.	.
Cichorium intybus	14	**42**	**22**	**40**	11	.	.
Alyssum chalcidicum	9	**25**	**33**	**20**	6	.	.
Convolvulus cantabrica	9	**25**	**33**	**20**	6	.	.
Anchusa officinalis	18	**83**	*11*	**40**	*11*	.	.
Eryngium campestre	53	**100**	**100**	**60**	**66**	21	.
Vulpia myurus	29	**75**	**44**	**40**	**37**	.	.
Potentilla argentea	15	**25**	11	**20**	**26**	.	.
Bromus hordeaceus	44	**100**	**100**	**40**	**37**	**43**	.
Sanguisorba minor	40	**83**	**67**	**20**	**49**	**29**	.
Achillea coarctata	27	**58**	**56**	**40**	**26**	**21**	.
Bromus squarrosus	24	**58**	**33**	**20**	**23**	**29**	.
Trifolium scabrum	35	**50**	**33**	**20**	**51**	**36**	.
Sedum acre	23	**42**	**56**	**20**	**20**	**29**	.
Galium verum subsp. *verum*	26	**67**	*11*	.	23	**57**	.
Melica ciliata	16	**42**	22	.	9	**36**	.
Anthemis arvensis subsp. *arvensis*	18	**42**	.	**20**	17	**36**	.
Dasypyrum villosum	29	**33**	**100**	.	**23**	**50**	.
Trifolium campestre	29	**25**	**44**	.	**37**	**50**	*5*
Euphorbia myrsinites	46	**83**	**67**	.	**40**	**100**	.
Rumex acetosella	51	**100**	**33**	**40**	**40**	.	**85**
Centaurea alba	13	8	**22**	**40**	**20**	.	.
Hordeum murinum	11	.	**56**	**60**	*6*	.	.
Sedum caespitosum	11	.	**44**	**40**	*11*	.	.
Cynosurus echinatus	28	*17*	**89**	**60**	29	*21*	*5*
Echium italicum	7	8	**22**	**40**	6	.	.
Anthemis cretica subsp. *carpatica*	14	.	**22**	.	**29**	.	5
Bellardia latifolia	14	8	**33**	.	**26**	.	.
Chamaecytisus eriocarpus	26	.	**22**	.	**46**	.	**35**
Dactylis glomerata	17	.	**33**	.	**26**	**29**	.
Xeranthemum annuum	17	.	**22**	.	**23**	**43**	.
Crepis sancta	20	8	**44**	.	**29**	**29**	.
Crupina vulgaris	27	.	**100**	.	20	**71**	.
Arenaria leptoclados	32	.	**100**	20	29	**71**	.
Festuca valesiaca	39	*8*	**33**	.	**57**	**43**	**35**
Taeniatherum caput-medusae	16	33	**67**	20	*6*	*14*	.
Convolvulus elegantissimus	11	.	**78**	*20*	*6*	.	.
Plantago holosteum	11	.	**67**	.	*9*	.	*5*
Aegilops triuncialis	14	.	**56**	20	17	*7*	.
Trifolium glomeratum	4	.	**33**	.	*3*	.	.
Catapodium rigidum	3	.	**33**	.	.	.	.
Lagurus ovatus	3	.	**33**	.	.	.	.
Medicago orbicularis	4	.	**33**	.	*3*	.	.
Convolvulus arvensis	6	*17*	.	**60**	*3*	.	.
Tragopogon porrifolius subsp. *eriospermus*	7	*17*	.	**60**	*6*	.	.
Medicago rigidula	8	.	*11*	**60**	*9*	*7*	.
Medicago sativa	8	.	*11*	**60**	*9*	*7*	.
Centaurea salonitana	11	.	11	**20**	9	**36**	.

Vegetation unit	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Agrostis canina	18	.	.	**20**	14	.	**55**
Pilosella leucopsilon	33	.	.	**20**	**43**	.	**75**
Trisetum flavescens	16	.	.	**20**	**23**	7	**25**
Bromus sterilis	14	17	.	**40**	**26**	.	.
Plantago lanceolata	20	17	22	**60**	**31**	*7*	.
Verbascum longifolium	12	.	11	**20**	**23**	.	5
Hypericum barbatum	23	.	.	.	**26**	*7*	**60**
Phleum phleoides	13	.	.	.	**29**	14	.
Armeria canescens	12	.	11	.	**26**	.	5
Phleum pratense	7	.	.	.	**20**	.	.
Juniperus oxycedrus subsp. *oxycedrus*	9	.	11	.	**23**	.	.
Centaurea solstitialis	20	*8*	.	.	**29**	**50**	*5*
Alyssum montanum subsp. *repens*	16	8	11	.	**23**	**36**	.
Anthyllis vulneraria subsp. *rubriflora*	18	*8*	.	.	*6*	**100**	.
Eryngium amethystinum	17	.	.	.	*6*	**100**	.
Sideritis raeseri subsp. *raeseri*	14	.	.	.	.	**93**	.
Stipa pulcherrima	17	*8*	.	*20*	*6*	**86**	.
Koeleria lobata	15	.	.	.	.	**79**	*15*
Hypericum rumeliacum	16	.	.	.	*11*	**79**	.
Lomelosia argentea	21	.	*11*	20	23	**64**	*5*
Teucrium capitatum	17	.	*22*	.	*14*	**64**	.
Leontodon crispus	12	.	.	.	*9*	**57**	.
Morina persica	8	.	.	.	.	**57**	.
Cerastium decalvans	7	.	.	.	.	**50**	.
Erodium absinthoides subsp. *guiciardii*	9	.	.	.	*6*	**50**	.
Genista cf. *depressa*	7	.	.	.	.	**50**	.
Minuartia attica subsp. *attica*	8	.	.	.	*3*	**50**	.
Teucrium chamaedrys	12	.	22	.	*6*	**50**	.
Achillea holosericea	8	.	*11*	.	.	**50**	.
Sideritis montana subsp. *montana*	13	.	.	.	17	**43**	.
Astragalus angustifolius	6	.	.	.	.	**43**	.
Inula oculus-christi	7	.	.	.	*3*	**43**	.
Prunus prostrata	6	.	.	.	.	**43**	.
Onosma visianii	5	.	.	.	.	**36**	.
Rosa villosa	5	.	.	.	.	**36**	.
Acinos alpinus subsp. *hungaricus*	8	.	.	.	9	**36**	.
Carex kitaibeliana	5	.	.	.	.	**36**	.
Satureja montana	5	.	.	.	.	**36**	.
Bupleurum falcatum subsp. *cernuum*	4	.	.	.	.	**29**	.
Dianthus cruentus	4	.	.	.	.	**29**	.
Orlaya grandiflora	6	.	11	.	*3*	**29**	.
Thymus boissieri	6	.	.	.	6	**29**	.
Trifolium fragiferum	5	.	.	.	.	**29**	5
Draba lasiocarpa	4	.	.	.	.	**29**	.
Herniaria parnassica subsp. *parnassica*	3	.	.	.	.	**21**	.
Pimpinella tragium	3	.	.	.	.	**21**	.
Sedum ochroleucum	3	.	.	.	.	**21**	.
Bromus erectus	4	.	11	.	.	**21**	.
Silene vulgaris subsp. *prostrata*	4	.	.	.	3	**21**	.
Nardus stricta	20	.	.	.	.	.	**95**
Luzula spicata	19	.	.	.	.	.	**90**
Phleum alpinum	14	.	.	.	*3*	.	**60**

Vegetation unit	1	2	3	4	5	6	7
Alopecurus gerardii	13	.	.	.	.	.	**60**
Silene roemeri subsp. *macrocarpa*	13	.	.	.	.	.	**60**
Geranium subcaulescens	16	.	.	.	*6*	*14*	**55**
Avenella flexuosa	11	.	.	.	.	.	**50**
Bellardiochloa variegata	11	.	.	.	.	.	**50**
Geum montanum	9	.	.	.	.	.	**45**
Veronica chamaedrys subsp. *chamaedrys*	12	.	.	.	*6*	.	**45**
Dianthus deltoides	16	.	.	.	17	.	**45**
Campanula spatulata subsp. *spatulata*	9	.	.	.	*3*	.	**40**
Scleranthus perennis subsp. *marginatus*	12	.	.	.	*9*	.	**40**
Thymus stojanovii	8	.	.	.	.	.	**40**
Vaccinium myrtillus	7	.	.	.	.	.	**35**
Viola cf. *velutina*	11	.	.	.	9	.	**35**
Senecio rupestris	12	.	.	.	11	.	**35**
Viola tricolor	6	.	.	.	.	.	**30**
Juniperus communis subsp. *nana*	6	.	.	.	3	.	**25**
Ranunculus sartorianus	7	.	.	.	6	.	**25**
Genista tinctoria	7	.	.	.	3	7	**25**
Dianthus myrtinervius	4	.	.	.	.	.	**20**
Pimpinella saxifraga	4	.	.	.	.	.	**20**
Sagina saginoides	4	.	.	.	.	.	**20**
Trifolium parnassii	4	.	.	.	.	.	**20**
Veronica orsiniana subsp. *orsiniana*	4	.	.	.	.	.	**20**
Thymus praecox subsp. *jankae*	5	.	.	.	3	.	**20**
Other species							
Potentilla recta	39	58	.	20	40	57	35
Achillea nobilis	21	8	11	40	34	7	15
Acinos alpinum	21	17	.	20	26	36	15
Koeleria macrantha	17	.	56	20	17	.	20
Trifolium pratense	14	17	.	40	9	7	25
Lotus corniculatus	19	.	11	20	20	7	40
Marrubium peregrinum	15	8	33	20	20	14	.
Linaria peloponnesiaca	17	.	22	.	20	7	30
Minuartia recurva subsp. *condensata*	15	.	44	.	23	7	5
Veronica arvensis	15	8	11	20	23	7	10
Dianthus pinifolius subsp. *lilacinus*	14	8	11	.	17	36	.
Lactuca serriola	11	8	22	20	14	7	.
Cerastium semidecandrum	12	33	22	.	14	.	.
Trifolium repens	12	.	11	20	11	.	25
Sherardia arvensis	13	33	.	.	17	7	5
Asperula purpurea subsp. *apiculata*	12	.	.	.	9	21	25
Phleum phleoides	13	.	22	20	11	.	.

Table 3: Percentage frequency of diagnostic taxa of different classes in the six distinguished vegetation units (1: *Koelerio-Corynephoretea*, 2: *Thero-Brachypodietea*, 3: *Stellarietea mediae*, 4: *Festuco-Brometea*, 5: *Daphno-Festucetea*, 6: *Juncetea trifidi*).

Tabela 3: Frekvenca v odstotkih diagnostičnih vrst različnih razredov v šestih vegetacijskih tipih (1: *Koelerio-Corynephoretea*, 2: *Thero-Brachypodietea*, 3: *Stellarietea mediae*, 4: *Festuco-Brometea*, 5: *Daphno-Festucetea*, 6: *Juncetea trifidi*).

	Classes					
Diagnostic taxa of (in %):	**1**	**2**	**3**	**4**	**5**	**6**
Koelerio-Corynephoretea	30	19	9	20	6	5
Thero-Brachypodietea	7	26	7	8	4	0
Stellarietea mediae	11	8	21	7	3	0
Festuco-Brometea	18	14	10	22	21	11
Daphno-Festucetea	0	0	0	1	22	0
Juncetea trifidi	0	1	0	2	0	29
Artemisietea vulgaris	5	5	8	5	1	1
Molinio-Arrhenatheretea	1	2	9	5	1	8
Other species	28	24	35	31	40	46

Table 4: Relevés of *Koelerio-Corynephoretea* in the Prespa area. Diagnostic species are according to Mucina (1997), Rūsiņa (2005), Kuzemko (2009) and Pedashenko et al. (2013). The location of the plots is given in Figure 1.

Tabela 4: Popisi razreda *Koelerio-Corynephoretea* iz območja Prespa. Diagnostične vrste so povzete po Mucina (1997), Rūsiņa (2005), Kuzemko (2009) in Pedashenko et al. (2013). Lokacije popisnih ploskev so podane na Sliki 1.

Running number of relevé	1	2	3	4	5	6	7	8	9	10	11	12	Absolute constancy
Original number of relevé	84	93	92	235	236	237	231	263	264	265	266	267	
Plot size (m²)	16	16	25	20	25	16	25	20	20	25	25	25	
Geology	Al	Al	Al	Al	Al	Al	Al	Al	Al	Al	Al	Al	
Altitude (m a.s.l.)	852	848	852	849	854	853	852	855	856	856	857	857	
Exposition (°)	315	293	0	0	0	315	0	5	0	0	157	315	
Inclination (%)	5	5	0	0	0	5	0	90	0	0	5	5	
Cover of vegetation (%)	60	50	90	60	60	60	70	95	70	60	70	90	
Cover of shrubs (%)	0	0	1	0	0	0	1	0	0	0	0	0	
Cover of herbs (%)	60	50	90	60	60	60	70	95	70	60	70	90	
Diagnostic species of *Koelerio-Corynephoretea* (incl. *Festuco-Sedetalia acris*)													
Cruciata pedemontana	+	+	+	+	1	+	+	+	1	1	+	1	12
Rumex acetosella	1	1	1	1	1	1	1	+	1	+	1	1	12
Poa bulbosa	1	+	1	+	1	+	1	.	+	+	1	1	11
Trifolium arvense	+	+	1	1	1	+	1	.	+	1	1	1	11
Linaria genistifolia subsp. *sofiana*	+	+	1	+	1	.	1	1	1	2a	+	+	11
Vulpia myurus	+	1	+	+	.	1	.	1	1	1	2a	.	9
Filago arvensis	+	.	+	1	1	1	+	.	r	.	r	r	9
Petrorhagia saxifraga	r	.	.	r	+	.	.	.	r	.	r	+	6
Trifolium scabrum	+	.	.	+	.	.	+	r	.	.	1	r	6
Medicago minima	r	+	r	.	+	.	.	.	.	r	.	.	5
Aira elegantissima	r	r	r	.	.	r	r	.	.	.	.	.	5
Sedum acre	r	.	.	.	r	.	r	.	.	r	.	r	5
Vicia lathyroides	.	.	+	.	+	+	+	1	.	.	.	.	5
Trifolium campestre	+	.	.	.	+	+	.	.	.	.	.	.	3
Sedum annuum	.	r	.	.	.	.	.	.	r	.	.	r	3
Myosotis ramosissima subsp. *ramosissima*	.	.	+	r	.	.	+	.	.	.	.	.	3
Arenaria serpyllifolia	.	+	.	r	.	.	+	.	.	.	.	.	3
Berteroa incana	.	.	+	+	.	r	.	.	.	.	.	.	3
Potentilla argentea	.	.	+	.	.	.	.	.	.	1	+	.	3
Diagnostic species of *Sileno conicae-Cerastion semidecandri*													
Silene conica	+	1	+	1	1	1	+	+	1	1	+	1	12
Cerastium semidecandrum	r	.	+	.	.	+	+	.	.	.	.	.	4

Running number of relevé	1	2	3	4	5	6	7	8	9	10	11	12	
Diagnostic species of *Silene frivaldszkyana-Erysimum microstylum* comm.													
Erysimum microstylum	+	1	1	1	1	+	1	.	r	+	+	1	11
Silene frivaldszkyana	.	1	+	1	+	.	2a	+	1	1	+	.	9
Diagnostic species of *Stellarietea mediae*													
Bromus rubens	+	+	1	1	+	+	1	3	1	2a	+	1	12
Avena sterilis	1	+	+	1	1	1	r	.	+	+	1	3	11
Bromus squarosus	+	.	.	.	+	+	.	.	r	+	1	2	7
Lupinus angustifolius	r	.	.	.	r	1	.	.	.	.	+	1	5
Anthemis arvensis subsp. *arvensis*	.	.	+	+	+	+	+	.	.	.	.	.	5
Geranium purpureum	.	.	+	r	.	.	r	.	.	.	.	.	3
Bromus sterilis	r	.	.	.	r	.	.	.	.	.	.	.	2
Vicia hirsuta	.	+	.	.	.	.	+	.	.	.	.	.	2
Convolvulus arvensis	.	.	.	.	.	.	.	.	.	+	+	.	2
Diagnostic species of *Artemisietea vulgaris*													
Anchusa officinalis	.	.	1	+	1	1	1	2a	1	+	1	1	10
Cichorium intybus	r	+	.	+	+	.	+	.	.	.	.	.	5
Verbascum pulverulentum	.	+	2a	.	.	.	.	.	.	.	.	.	2
Crepis setosa	.	+	.	.	.	.	+	.	.	.	.	.	2
Cynoglossum officinale	.	.	.	+	.	.	.	+	.	.	.	.	2
Diagnostic species of *Festuco-Brometea*													
Eryngium campestre	1	+	+	1	1	1	1	+	+	+	2a	1	12
Sanguisorba minor	+	+	1	+	+	r	+	.	.	r	r	r	10
Hypericum perforatum	1	.	r	1	+	1	+	.	+	+	1	1	10
Astragalus onobrychis	.	+	+	+	1	.	+	.	r	1	2a	1	9
Galium verum subsp. *verum*	+	+	+	.	+	.	+	1	1	.	+	.	8
Herniaria incana	.	1	+	+	.	.	1	.	+	+	.	.	6
Melica ciliata	+	1	.	.	.	+	+	.	.	.	.	+	5
Helianthemum oelandicum subsp. *canum*	.	.	r	+	.	.	1	.	.	.	.	.	3
Convolvulus cantabrica	.	.	+	1	.	.	.	.	.	.	+	.	3
Lactuca viminea	.	.	r	.	.	.	+	+	.	.	.	.	3
Stipa capillata	.	.	.	.	.	.	.	.	.	+	r	.	2
Hieracium bauhini	r	.	.	.	.	+	.	.	.	.	.	.	2
Diagnostic species of *Thero-Brachypodietea*													
Bromus hordeaceus	3	+	+	1	+	+	+	4	1	+	+	+	12
Trifolium hirtum	r	.	.	1	.	1	.	.	1	.	.	1	5
Taeniatherum caput-medusae	r	.	.	1	+	.	+	.	.	.	.	.	4
Dasypyrum villosum	+	.	.	1	+	.	.	.	.	.	.	r	4
Alyssum chalcidicum	+	+	.	.	.	+	.	.	.	.	.	.	3
Cerastium brachypetalum subsp. *roeseri*	+	.	.	.	r	r	.	.	.	.	.	.	3
Cynosurus echinatus	r	.	.	.	.	.	.	.	r	.	.	.	2
Petrorhagia dubia	.	.	.	+	.	+	.	.	.	.	.	.	2
Diagnostic species of *Molinio-Arrhenatheretea*													
Trifolium pratense	.	.	.	.	.	.	.	+	.	+	.	.	2
Plantago lanceolata	.	.	.	.	.	.	.	2a	.	.	1	.	2
Other species													
Euphorbia myrsinites	r	+	+	1	1	.	1	.	1	1	1	+	10
Thymus sibthorpii	+	+	2a	1	1	+	1	.	.	+	+	.	9
Torilis arvensis	r	.	r	r	r	.	r	+	.	r	r	r	9
Centaurea cuneifolia	.	.	+	+	+	1	+	.	+	+	1	1	9
Draba muralis	r	r	.	+	.	r	.	.	+	+	r	r	8
Scirpoides holoschoenus	2a	.	1	1	3	.	.	3	5	5	3	.	8
Jasione heldreichii	+	.	+	.	1	1	1	.	+	1	.	1	8

Running number of relevé	1	2	3	4	5	6	7	8	9	10	11	12	
Delphinium balcanicum	r	.	r	r	r	.	.	.	.	r	r	+	7
Achillea coarctata	.	.	.	.	+	+	+	.	1	1	1	1	7
Potentilla recta	.	+	.	.	+	.	+	+	1	.	+	+	7
Euphorbia rigida	+	.	.	.	1	+	.	.	.	1	2a	1	6
Papaver rhoeas	+	.	r	.	+	.	r	.	.	1	.	.	5
Tordylium maximum	r	.	r	.	r	.	.	.	.	r	.	r	5
Hypericum olympicum	.	.	.	.	1	.	.	.	+	+	1	+	5
Verbascum cf. *eriophorum*	.	.	.	.	.	.	.	+	1	1	+	1	5
Sherardia arvensis	r	.	+	.	.	.	r	.	.	.	+	.	4
Plantago indica	.	.	+	+	+	.	+	.	.	.	.	.	4
Onosma heterophylla	.	.	.	.	+	.	.	.	+	+	+	.	4
Stachys angustifolia	.	.	.	.	+	.	.	.	.	+	1	1	4
Scabiosa webbiana	.	.	r	.	+	.	+	.	.	.	.	.	3
Tragopogon porrifolius subsp. *eriospermus*	.	+	+	.	.	.	.	.	.	.	.	.	2
Minuartia verna subsp. *collina*	.	.	.	.	+	.	+	.	.	.	.	.	2
Acinos alpinus	.	.	.	.	+	.	+	.	.	.	.	.	2

Taxa in one relevé: *Lathyrus sphaericus* 1: r, *Matricaria chamomilla* 1: +, *Phragmites australis* 2: +, *Petrorhagia prolifera* 2: +, *Rumex tuberosus* subsp. *tuberosus* 2: +, *Alyssum montanum* subsp. *repens* 3: 1, *Centaurea alba* 3: 1, *Astragalus depressus* 3: +, *Salix alba* 3: +, *Crepis sancta* 3: +, *Erodium ciconium* 3: +, *Potentilla recta* subsp. *laciniosa* 3: +, *Veronica verna* 3: +, *Cynodon dactylon* 3: +, *Echium italicum* 3: +, *Vicia villosa* subsp. *villosa* 3: +, *Anthyllis vulneraria* subsp. *rubriflora* 3: +, *Marrubium peregrinum* 4: r, *Saponaria officinalis* 4: +, *Achillea nobilis* 4: +, *Bellardia latifolia* 5: r, *Ajuga chamaepitys* 5: r, *Securigera varia* 5: r, *Galium* cf. *lucidum* 5: +, *Centaurea cyanea* 5: +, *Verbascum nigrum* 6: +, *Rosa canina* 7: 1, *Dianthus stenopetalus* 7: 1, *Dianthus pinifolius* subsp. *lilacinus* 7: +, *Lactuca serriola* 7: +, *Stipa pulcherrima* 7: +, *Mentha spicata* 8: 3, *Vicia grandiflora* 8: 2a, *Galium aparine* 8: 1, *Cirsium eriophorum* 8: 1, *Vicia angustifolia* 8: +, *Vicia lutea* 8: +, *Potentilla reptans* 8: +, *Origanum vulgare* 9: 2a, *Achillea grandifolia* 9: 1, *Centaurea solstitialis* 9: 1, *Plantago major* subsp. *intermedia* 9: +, *Hylotelephium telephium* 10: +, *Silene italica* 10: +, *Veronica arvensis* 10: +, *Tragopogon dubius* 10: +, *Festuca* cf. *varia* 11: 1, *Trifolium tenuifolium* 11: +.