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An *Asphodelus ramosus* dominated plant community in Montenegro: fringe or grassland?

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Abstract – Our phytosociological study in Montenegro (Ćemovsko polje) deals with the syntaxonomy of arid grasslands in the Adriatic region and, in particular, different interpretations of plant communities dominated by *Asphodelus ramosus*. The main aims of this study were to contribute to knowledge of the composition of dry grasslands dominated by *Asphodelus ramosus* in Montenegro and to compare instances of *Asphodelus ramosus* dominated vegetation along the Adriatic. Our vegetation dataset included 82 phytosociological relevés: 17 from our recent field work and 72 relevés of South European *Asphodelus ramosus* communities. Ordination analysis (NMDS) was used for comparison of *Asphodelus ramosus* dominated communities in the Adriatic region. The *Asphodelus ramosus* community from Montenegro was classified into *Bromo erecti-Chrysopogonetum grylli*. The analysis revealed two distinct vegetation groups: grassland communities of the vegetation class *Festuco-Brometea* from Montenegro, Croatia and Albania, and edge vegetation of the new class *Charybdido pancratii-Asphodeletea ramosi* from Italy. Comparison with similar vegetation types shows high similarity with associations on the eastern Adriatic coast, where they are treated as grassland communities belonging to the alliance *Chrysopogono grylli-Koelerion splendentis*, order *Scorzoneretalia villosae*, class *Festuco-Brometea*.

Keywords: *Asphodelus ramosus*, *Bromo erecti-Chrysopogonetum grylli*, dry grasslands, *Festuco-Brometea*, Montenegro

Introduction

Secondary dry grassland communities in the Mediterranean have a zoo-anthropogenic origin; they have developed over centuries or even millennia of traditional land use, featuring practices such as mowing, grazing, temporary abandonment of arable fields, and/or other disturbance regimes (Apostolova et al. 2014, Valkó et al. 2018). Mediterranean and sub-Mediterranean dry grasslands are considered to be among the floristically richest vegetation types (Apostolova et al. 2014) and, at the same time, a very important habitat for endangered, rare and endemic species, so they are included in the list of Habitats of European Interest (Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora, 1992), as well as the European Red List of Habitats (Janssen et al. 2016). Compared to other parts of Europe, dry grasslands of the Balkan peninsula are still well preserved (Apostolova et al. 2014).

The Balkan peninsula is well known for its rich flora and well-preserved vegetation, because it was a glacial refuge for animal and plant species (Griffiths et al. 2004). Its biodiversity is considered to be among the highest in Europe (Apostolova et al. 2014). The peninsula is characterized by the presence of a broad spectrum of dry grasslands (e.g., Horvat et al. 1974, Jovanović et al. 1986, Apostolova et al. 2014, Terzi 2015, Aćić et al. 2015, Matevski et al. 2018). In some Balkan countries (Slovenia, Serbia, Bulgaria, Croatia, North Macedonia), dry grassland vegetation has been intensively researched (Apostolova et al. 2014, Matevski et al. 2018). In contrast to these countries, research into this type of vegetation in Montenegro has considerable discontinuity, and comprenhensive studies, especially in the sub-Mediterranean and Mediterranean region, are rare (Pulević and Bulić 2012).

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In our study, we focused on research into *Asphodelus ramosus*-dominated vegetation. *Asphodelus ramosus* is a species native to the Mediterranean and Macaronesian regions: southern Europe, northern Africa, the Middle East, Mediterranean islands and Canary Islands. It can be found in forest edges and grasslands, generally on basic soils of a certain depth, forming very dense populations in grazed areas, from the coast up to 1000 m, occasionally reaching 2150 m in the mountain systems of North Africa (Diaz-Lifante and Valdés 1996). It is unpalatable for grazing animals.

Research into plant communities dominated by *Asphodelus* spp. (and *Asphodelus ramosus* in particular) has become very intensive in recent years, especially in the western and central Mediterranean (Allegrezza et al. 2015, Biondi et al. 2016, 2017). In the Balkan peninsula, similar vegetation has been described from Albania (Fanelli et al. 2015) and Croatia (Horvatić 1934, 1939, 1963, Šegulja 1969, 1970, Hećimović 1984, Jasprica and Ruščić 2013, Jasprica et al. 2016).

Today, there are different opinions about the syntaxonomical classification of *Asphodelus ramosus* dominated vegetation in Europe and its position in the landscape (as grasslands or fringe (saum) communities). In the eastern Adriatic, these communities have been classified within the grassland class *Festuco-Brometea*, while in the central and western Adriatic, they have been classified as heliophilous edge vegetation of *Trifolio-Geranietea sanguinei* (Biondi et al. 2014, Allegrezza et al. 2015) or recently into a new class *Charybdido pancratii-Asphodeletea ramosi* Biondi et al. 2016 (Biondi et al. 2016, 2017).

The aim of this study was to (i) contribute to knowledge of the composition of dry grasslands dominated by *Asphodelus ramosus* in Montenegro and (ii) compare examples of *Asphodelus ramosus* dominated vegetation along the Adriatic and its syntaxonomical classification and classification into Natura 2000 habitat types.

Materials and methods

Study area

Ćemovsko polje is a part of Zetska ravnica plain in Montenegro, between the rivers Morača, Cijevna and Ribnica. It covers 165 km^2 and extends from Podgorica, the capital of Montenegro, to Skadar Lake. The altitude of the investigated area ranges from 12 to 30 m a.s.l. During the Pleistocene period, moraine material eroded from the mountains was carried along the rivers Morača and Cijevna into the area of Ćemovsko polje (Radojičić 2015). The dominant types of soil are eutric cambisol and rendzina, which are formed on fluvio-glacial deposits, and consequently are often shallow and skeletoid (Burić et al. 2017). The area of Ćemovsko polje has a Mediterranean climate with hot summers – Csa (Burić and Micev 2008). A grassland ecosystem is dominant in this area. The studied *Asphodelus ramosus* – dominated vegetation occurs in pastures used for grazing by cattle and sheep. A significant area of Ćemovsko polje is occupied by vineyards and plantations of peach and other kinds of fruit (Radojičić 2015). The area investigated has also recently been heavily impacted by urbanization (Burić et al. 2017).

Although many floristic studies have been performed in the area of Ćemovsko polje (Černjavski et al. 1949, Hadžiablahović 2010, 2018, Stešević et al. 2014), the vegetation has remained poorly studied (Černjavski et al. 1949, Hadžiablahović 2018). Potential natural vegetation of the wider area of Podgorica and Lake Skadar is Apulian-southeast Adriatic meso-supra-Mediterranean *Quercus trojana* forests with *Pistacia* species (Bohn et al. 2000-2003) or precisely Macedonian oak forest '*Quercetum trojanae montenegrinum* Blečić et Lakušić 1975' (recte: *Quercetum trojanae* Em 1958). Illyrian sub-Mediterranean rocky grasslands on shallow calcareous soils of the alliance *Chrysopogono grylli-Koelerion splendentis* Horvatić 1973 prevail in the area of Ćemovsko polje (Hadžiablahović 2010).

Sampling and data analysis

From April to June 2019, we sampled *Asphodelus ramosus*-dominated plant communities on Ćemovsko polje according to the Braun-Blanquet method (Braun-Blanquet 1964). We made 17 relevés and the size of plots was 25 m^2. The minimum distance between plots was 100 m. The minimum coverage value of *Asphodelus ramosus* for it to be considered dominant was 25%. Each plot was visited in April and again in June. Cover values of species and total vegetation cover are based on the summer aspect (Tab. 1, Appendix 1). GPS coordinates were recorded for each plot (Appendix 2). All relevés made during fieldwork and relevés from the literature were entered into the Turboveg (Hennekens and Schaminée 2001) database. Relevés from the literature were used for comparison with vegetation data from our fieldwork (Appendix 3).

We obtained characteristic species of the association *Bromo erecti-Chrysopogonetum grylli* according to Horvatić (1963). Diagnostic taxa of alliance and order were assigned according to Terzi (2015), while the diagnostic taxa of classes were determined according to Terzi (2015) for the class *Festuco-Brometea*, Mucina et al. (2014) for other classes and Biondi et al. (2016) for the class *Charybdido pancratii-Asphodeletea ramosi*.

Non-metric multidimensional scaling (NMDS, Kruskal 1964) was used to examine the overall variation in the species composition in the whole relevé dataset. Hellinger transformation of percentage cover values (5=87.5 %, 4=62.5 %, 3= 37.5 %, 2=12.5 %, 1=2.5 %, +=0.5 %, r=0.1 %) was used and Bray-Curtis as a measure of dissimilarity. NMDS was performed using the R package 'vegan' (Oksanen et al. 2017). For ecological interpretation of vegetation patterns, ecological indicator values (Pignatti et al. 2005) were passively projected onto the NMDS graph. Weighted by species cover, mean indicator values were calculated for each relevé using JUICE software (Tichý 2002).

The nomenclature of taxa is in accordance with Euro+Med (2006) and the nomenclature of higher syntaxa according to Mucina et al. (2014).

The taxonomy of *Asphodelus ramosus* species was sometimes ambiguous. Previously, the species *Asphodelus microcarpus* Viv. was accepted as valid by many authors but, after a taxonomic revision of the genus *Asphodelus* in the western Mediterranean (Diaz-Lifante and Valdés 1996), it has been considered a synonym of *Asphodelus ramosus* L. (Euro+Med 2006).

Results

The *Asphodelus ramosus* plant community from Ćemovsko polje (Montenegro) is represented by 17 relevés in the phytosociological table (Tab. 1). The dominant species of the association are *Asphodelus ramosus* and *Chrysopogon gryllus*, while the most frequent species are *Asphodelus ramosus*, *Sanguisorba minor*, *Poa bulbosa*, *Teucrium capitatum*, *Sideritis romana* subsp. *purpurea*, and *Anacamptis papilionacea*. *Asphodelus ramosus* is also considered to be the only characteristic species of the association. The community develops in two clear phenological aspects. In the spring aspect (Fig. 2A), the dominant species is *Asphodelus ramosus*, while in summer (Fig. 2B), dominance is taken by the tall grass *Chrysopogon gryllus*. The spring aspect is also characterised by high frequency and coverage of *Anemone hortensis*, *Poa bulbosa* and *Sanguisorba minor*, and the summer one by *Bupleurum veronense* and *Teucrium capitatum*.

In addition to the species characteristic for the class *Festuco-Brometea*, there are several species of annual and ephemeral grasslands of the classes *Stipo-Trachynietea distachyae* and *Helianthemetea guttate*, and seasonal perennial and ephemeroid pastures of the class *Poetea bulbosae*, all indicating the Mediterranean and grassland character of the studied plant community. The impact of grazing is evident from the many ruderal species: *Avena barbata*, *Scandix pecten-veneris*, *Daucus guttatus*, *Scolymus hispanicus*, *Bromus squarrosus*, *Euphorbia exigua*, *Sonchus oleraceus* (Tab. 1). The studied stands constitute an open grassland community, which develops on stony soil and is used for grazing (cattle and sheep). Total vegetation coverage is 60 – 80% in the summer aspect. Stones and pebbles have dimensions of up to 20 cm and their cover is 5 – 40%. If the stones are removed and these areas are used for mowing, the vegetation changes into dry grasslands of the alliance *Vulpio-Lotion* (Hadžiablahović 2018).

Using various numerical classifications, we tried to classify the association *Bromo erecti-Chrysopogonetum grylli* into subassociations. This kind of vegetation is fairly uniform in the study area, and there were no ecologically evident/logical subunits.

A comparison of the studied *Asphodelus* community from Montenegro with *Asphodelus ramosus*-dominated communities from around the Adriatic (Fig. 1) revealed two distinct vegetation groups (Tab. 2, Fig. 3). Communities from Albania, Croatia and Montenegro form one group,

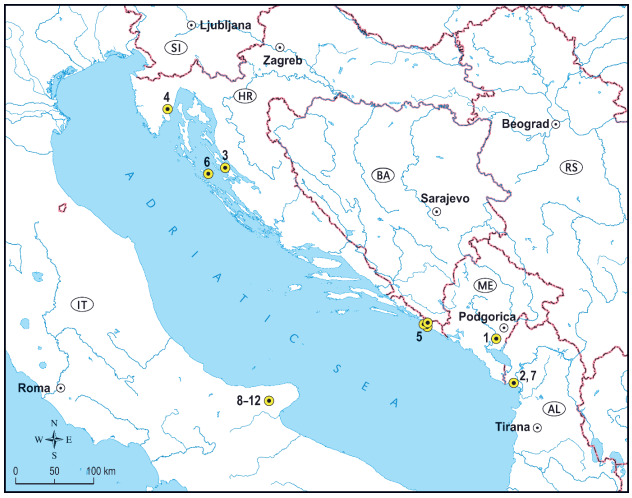

Fig. 1. Localities of data used of *Asphodelus ramosus*-dominated communities. See Tab. 2 for community abbreviations. AL – Albania, BA – Bosnia and Herzegovina, HR – Croatia, IT – Italy, ME – Montenegro, RS – Serbia, SI – Slovenia.

Fig. 2. *Asphodelus ramosus* dominated community on Ćemovsko polje, vicinity of Podgorica, Montenegro. A – spring aspect, B – summer aspect.

Table 1. Phytosociological table of the association *Bromo erecti-Chrysopogonetum grylli* in Ćemovsko polje (Montenegro).

Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	%
Plot size (m²)									25									
Vegetation cover (%)	80	60	80	70	75	60	60	75	60	65	70	70	60	60	60	60	60	
Bromo erecti-Chrysopogonetum grylli																		
Asphodelus ramosus	4	3	4	3	4	3	3	3	3	4	3	3	3	3	4	3	4	17
Chrysopogono grylli-Koelerion splendentis																		
Bupleurum veronense	+	+	+	.	.	+	.	+	.	.	+	.	+	+	+	.	.	9
Carduus nutans subsp. *micropterus*	.	+	.	+	.	.	.	+	.	.	.	.	.	+	.	.	.	4
Scorzoneretalia villosae																		
Chrysopogon gryllus	1	2	2	3	2	2	1	2	.	1	3	2	2	2	2	1	.	15
Eryngium amethystinum	+	+	1	.	1	+	1	+	+	.	1	1	+	1	1	1	1	15
Koeleria lobata	+	+	+	.	+	1	.	.	+	.	1	.	+	1	1	+	1	12
Seseli montanum subsp. *tommasinii*	1	.	.	.	+	.	+	.	+	.	.	1	.	.	+	1	.	7
Satureja subspicata	.	.	.	+	.	.	.	.	+	2	.	.	.	2	2	.	+	6
Festuca stricta subsp. *sulcata*	.	.	.	+	.	+	.	1	2	.	.	+	.	.	.	.	.	5
Medicago prostrata	+	.	.	.	.	.	.	.	.	.	1	+	.	+	.	.	.	4
Plantago holosteum	.	+	+	+	.	.	.	.	.	.	.	+	.	.	.	.	.	4
Bunium alpinum subsp. *montanum*	.	.	+	.	.	.	.	.	+	+	.	.	.	.	+	.	.	4
Scorzonera villosa	.	.	1	+	.	.	.	.	+	+	.	.	.	.	.	.	.	4
Festuco-Brometea																		
Sanguisorba minor	3	2	3	2	2	+	1	2	+	1	2	2	2	1	1	2	1	17
Poa bulbosa	1	1	1	2	1	2	2	1	+	+	1	+	2	1	1	2	1	17
Teucrium capitatum	+	1	1	+	+	1	1	1	2	+	1	2	+	2	2	1	1	17
Hypericum perforatum	+	+	+	+	+	+	.	1	+	.	+	+	+	+	+	1	+	15
Hippocrepis ciliata	+	.	1	.	+	1	+	.	.	1	+	+	+	+	+	+	+	13
Centaurea deusta	+	+	.	.	+	+	+	3	1	+	1	1	1	1	.	3	.	13
Leontodon crispus	.	.	+	+	+	.	.	.	1	1	1	1	1	.	1	+	+	11
Ranunculus millefoliatus	.	+	+	+	.	.	.	+	+	.	.	+	1	+	+	.	+	10
Convolvulus cantabrica	+	.	.	.	2	1	2	.	.	.	1	1	1	+	.	1	.	9
Petrorhagia saxifraga	.	.	.	+	+	+	+	+	.	.	+	+	.	.	+	+	.	9
Linum tenuifolium	.	+	+	.	.	+	.	.	1	.	.	+	+	+	.	.	+	8
Anthyllis vulneraria subsp. *polyphylla*	.	.	+	.	+	+	.	.	+	+	+	+	+	.	.	.	.	8
Carex caryophyllea	.	.	.	1	.	.	.	.	.	.	1	+	+	1	1	1	.	7
Podospermum laciniatum	+	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	+	5
Bothriochloa ischaemum	.	.	.	.	.	.	.	+	1	+	1	.	.	.	1	.	.	5
Anacamptis morio	.	+	.	+	+	.	.	.	.	.	+	.	.	.	.	.	.	4
Trifolium campestre	.	+	.	.	.	.	+	.	.	+	.	.	.	.	.	+	.	4
Ophrys sphegodes	.	.	.	.	.	.	+	.	+	.	.	.	.	.	+	.	.	3
Cuscuta epithymum subsp. *epithymum*	.	.	.	.	+	.	.	.	.	.	+	+	.	.	.	.	.	3
Thymus striatus	.	.	.	.	.	.	.	.	+	.	.	.	.	+	+	.	.	3
Leopoldia comosa	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	3
Chenopodietea																		
Avena barbata	+	+	+	+	1	1	1	.	.	2	.	.	1	.	.	+	+	11
Valantia muralis	.	.	1	.	+	.	.	.	.	1	.	.	.	.	+	.	+	5
Scandix pecten-veneris	.	.	.	.	.	.	.	+	+	.	.	+	.	.	.	.	.	3
Stipo-Trachynietea distachyae																		
Sideritis romana subsp. *purpurea*	+	+	1	+	+	1	+	+	+	+	+	+	+	+	+	+	1	17
Crepis sancta	1	1	+	+	1	1	1	1	+	1	+	+	.	.	.	1	+	14
Arenaria leptoclados	1	.	+	1	+	+	+	.	.	.	.	.	+	+	+	+	.	10
Polygala monspeliaca	.	+	+	.	+	+	+	.	.	+	+	.	.	+	.	1	+	10
Ornithogalum collinum	+	.	.	.	+	+	+	1	+	.	1	1	2	.	.	.	.	9
Tordylium apulum	.	.	.	+	.	+	+	+	.	.	+	.	.	.	.	.	+	6

Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	%
Plot size (m^2)									25									
Vegetation cover (%)	80	60	80	70	75	60	60	75	60	65	70	70	60	60	60	60	60	
Petrorhagia dubia	.	.	+	+	.	.	.	+	.	.	.	.	+	.	.	.	.	4
Filago germanica	+	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	+	4
Ononis reclinata	+	.	.	.	+	+	.	.	.	.	.	.	.	.	.	+	.	4
Trachynia distachya	.	.	+	.	+	.	.	.	.	.	.	1	.	.	.	.	.	3
Neatostema apulum	.	.	.	.	.	.	.	.	.	.	.	.	1	+	+	.	.	3
Helianthemetea guttati																		
Helianthemum salicifolium	1	+	1	+	1	1	2	2	+	1	1	1	1	.	1	1	.	15
Crupina vulgaris	+	+	+	.	+	+	1	.	1	+	+	+	+	+	.	.	.	12
Asterolinon linum-stellatum	+	1	+	+	+	1	1	.	.	.	.	.	+	+	1	+	.	11
Galium divaricatum	1	1	+	+	.	+	.	+	.	.	.	.	.	+	.	+	+	9
Plantago bellardii	+	.	.	.	.	.	+	+	.	+	.	.	1	+	+	.	.	7
Linaria pelisseriana	.	+	.	+	.	.	.	+	+	.	.	.	.	.	.	.	+	5
Filago gallica	.	+	.	.	.	+	.	.	.	.	.	.	+	.	+	.	.	4
Aira elegantissima	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	+	+	4
Trifolium stellatum	+	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	3
Poetea bulbosae																		
Anthoxanthum odoratum	+	2	.	1	+	+	+	.	+	+	.	.	+	+	.	1	+	12
Trifolium subterraneum	+	1	.	1	+	.	+	+	.	.	1	.	+	.	.	1	1	10
Plantago lanceolata	.	+	+	1	.	.	.	+	+	+	.	.	.	.	.	+	+	8
Leontodon tuberosus	.	.	+	+	+	.	+	1	+	.	.	.	.	.	.	.	.	6
Herniaria glabra	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.	4
Prospero autumnale	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	+	.	3
Trifolium nigrescens	.	+	.	.	.	.	.	.	.	1	.	.	.	.	.	.	+	3
Sedo-Scleranthetea																		
Cerastium pumilum subsp. *glutinosum*	+	+	.	1	1	1	.	+	.	.	.	.	1	+	+	1	+	11
Viola kitaibeliana	1	1	+	+	+	+	.	+	.	+	.	.	+	+	.	.	.	10
Clinopodium acinos	.	.	+	.	+	.	1	.	.	.	+	+	+	+	+	.	.	8
Draba verna	+	.	.	+	.	.	.	.	.	.	.	.	+	+	+	+	.	6
Artemisietea vulgaris																		
Daucus guttatus	+	+	+	+	+	1	1	.	.	2	+	.	+	.	.	+	+	12
Scolymus hispanicus	.	+	+	1	.	+	1	1	+	+	+	.	.	.	+	1	.	11
Tyrimnus leucographus	1	.	.	+	.	+	+	1	.	+	.	.	.	.	.	+	+	8
Potentilla recta	.	.	.	+	1	.	+	1	.	.	.	.	.	+	.	.	.	5
Sisymbrietea																		
Geranium columbinum	+	+	.	+	+	+	+	+	+	+	+	.	+	+	.	+	+	14
Erodium cicutarium	+	.	.	1	.	.	.	1	.	.	+	+	1	+	+	.	1	9
Bromus squarrosus	1	.	.	.	.	.	1	+	.	.	1	.	+	.	+	.	.	6
Papaveretea rhoedis																		
Euphorbia exigua	+	.	.	.	+	1	1	.	+	+	+	+	1	1	+	+	+	13
Sherardia arvensis	+	+	.	.	+	+	1	.	+	.	.	.	+	.	.	+	+	9
Anagallis arvensis	.	.	+	+	+	+	1	.	+	1	.	.	.	.	.	+	.	8
Sonchus oleraceus	+	+	.	.	.	+	+	.	.	+	+	.	+	.	.	.	.	7
Euphorbia helioscopia	.	.	.	.	.	.	.	.	+	.	.	+	+	.	.	+	.	4
Euphorbia taurinensis	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	3
Molinio-Arrhenatheretea																		
Serapias vomeracea	.	.	+	.	.	.	.	.	.	.	+	+	.	+	.	+	.	5
Hypochaeris radicata	.	+	.	+	.	.	.	.	.	.	.	.	.	.	+	+	1	5
Ononido-Rosmarinetea																		
Carlina corymbosa	.	.	+	.	1	+	1	.	.	+	+	1	1	+	.	.	1	10

Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	%
Plot size (m^2)									25									
Vegetation cover (%)	80	60	80	70	75	60	60	75	60	65	70	70	60	60	60	60	60	
Lygeo sparti-Stipetea tenacissimae																		
Anacamptis papilionacea	+	+	+	+	+	.	+	+	+	1	1	1	1	1	+	1	+	16
Anemone hortensis	2	2	2	2	2	1	2	1	+	1	1	.	.	.	.	2	.	12
Other species																		
Cynodon dactylon	.	+	+	+	+	+	+	.	+	1	+	+	+	+	+	+	+	15
Allium guttatum subsp. *sardoum*	+	1	.	1	+	.	+	+	.	.	+	.	+	.	+	+	+	11
Cerastium ligusticum subsp. *trichogynum*	2	1	+	1	1	.	.	.	+	.	.	1	.	1	1	.	.	9
Silene italica	.	+	+	+	+	+	.	.	.	.	+	1	.	1	.	.	.	8
Alkanna tinctoria	.	.	.	.	.	+	.	.	.	.	1	1	1	1	1	.	.	6
Hainardia cylindrica	.	.	.	.	.	.	1	.	.	.	.	.	+	+	.	.	.	3
Trifolium scabrum	.	.	.	.	.	.	.	.	.	+	.	+	+	.	.	.	.	3

Table 2. Shortened synoptic table of plant communities with *Asphodelus ramosus*. The original classification indicated by authors is used. Communities: 1. *Bromo erecti-Chrysopogonetum grylli* (Montenegro, new relevés from Ćemovsko polje), 2. *Asphodelo-Chrysopogonetum grylli* (Albania, Fanelli et al. 2015), 3. *Bromo-Chrysopogonetum grylli* subass. *asphodeletosum microcarpi* (Croatia, Horvatić 1934), 4. *Narcisso tazzettae-Asphodeletum microcarpi* (Croatia, Šegulja 1970), 5. *Narcisso tazzettae-Asphodeletum microcarpi* (Croatia, Hećimović 1984), 6. *Narcisso tazzettae-Asphodeletum microcarpi* (Croatia, Jasprica et al. 2016), 7. *Asphodelus ramosus* community (Albania, Fanelli et al. 2015), 8. *Charybdido pancratii-Asphodeletum ramosi* (Italy, Biondi et al. 2016), 9. *Alkanno tinctoriae-Asphodeletum ramosi* (Italy, Biondi et al. 2016), 10. *Euphorbio characiae-Thapsietum garganicae* (Italy, Biondi et al. 2017), 11. *Asphodelo ramosi-Feruletum communis* (Italy, Biondi et al. 2016), 12. *Asphodelino luteae-Feruletum communis* (Italy, Biondi et al. 2016).

Plant community	1	2	3	4	5	6	7	8	9	10	11	12
Number of relevés	17	4	12	8	10	3	3	14	3	5	2	7
Bromo erecti-Chrysopogonetum grylli												
Asphodelus ramosus	100	25	100	100	100	100	100	100	100	60	100	100
Cytisus spinescens	.	.	50	.	.	.	.	.	.	.	.	.
Narcisso tazzettae-Asphodeletum microcarpi												
Narcissus tazetta	.	25	.	100	70	100	.	7	.	.	.	.
Anacamptis papilionacea	94	.	.	75	.	.	.	21	.	40	.	29
Chrysopogono grylli-Koelerion splendentis												
Carduus nutans subsp. *micropterus*	24	25	50	50	50	.	.	.	.	80	.	43
Bupleurum veronense	53	.	42	.	90	.	67	.	.	.	.	.
Centaurea cristata	.	.	.	13	.	.	.	.	.	.	.	.
Salvia officinalis	.	50	8	.	.	.	.	.	.	.	.	.
Scorzoneretalia villosae												
Chrysopogon gryllus	88	100	100	88	.	67	33	.	.	.	.	.
Koeleria lobata	71	25	67	88	40	67	.	.	.	.	.	.
Plantago holosteum	24	25	33	88	.	.	.	.	.	.	.	.
Eryngium amethystinum	88	50	58	88	.	.	33	7	.	60	.	57
Salvia pratensis	.	25	33	88	.	.	.	.	.	.	.	.
Medicago prostrata	24	.	25	.	.	.	.	.	.	.	.	.
Festuca valesiaca	.	.	83	13	.	.	.	.	.	.	.	.
Seseli montanum subsp. *tommasinii*	41	.	.	.	.	.	.	.	.	.	.	.
Satureja subspicata	35	.	.	.	.	.	.	.	.	.	.	.
Potentilla heptaphylla subsp. *australis*	.	.	8	.	.	.	.	.	.	.	.	.
Dorycnium pentaphyllum subsp. *germanicum*	.	.	17	.	.	.	.	.	.	.	.	.
Festuco-Brometea												
Sanguisorba minor	100	25	17	88	.	.	.	29	.	20	.	.
Bothriochloa ischaemum	29	25	.	50	100	.	33	.	.	.	.	.
Bromopsis erecta	.	25	100	75	.	33	.	.	.	.	.	.
Hippocrepis comosa	.	.	17	25	.	.	.	.	.	.	.	.

Plant community	1	2	3	4	5	6	7	8	9	10	11	12
Number of relevés	17	4	12	8	10	3	3	14	3	5	2	7
Linum tenuifolium	47	25	8	63	.	.	.	.	.	.	.	.
Ruta graveolens	.	25	17	75	.	.	.	36	.	.	.	.
Leopoldia comosa	18	.	.	.	70	.	.	.	.	.	.	43
Carex caryophyllea	41	25	.	50	.	.	.	.	.	.	.	.
Satureja montana	.	25	8	.	.	.	33	.	.	.	.	.
Ranunculus millefoliatus	59	.	.	.	.	.	.	.	.	20	.	14
Charybdido pancratii-Asphodeletum ramosi												
Carlina corymbosa	76	50	100	63	.	.	33	50	.	80	100	29
Asparagus acutifolius	6	25	50	100	50	.	.	79	100	60	100	86
Drimia pancration	.	.	.	.	.	.	.	100	67	20	100	57
Anemone hortensis	71	25	.	63	70	.	.	64	.	80	50	57
Asphodeline lutea	.	.	.	.	.	.	.	7	.	60	.	100
Thapsia garganica	.	.	.	.	.	.	.	57	.	100	.	100
Ferula communis	.	.	.	.	.	.	.	.	.	20	100	100
Hypochaeris radicata	29	.	.	.	.	.	.	29	33	.	.	.
Asphodeline liburnica	.	.	.	.	.	.	.	7	.	.	.	.
Other												
Dactylis glomerata subsp. *hispanica*	.	25	100	88	50	100	.	93	67	.	.	.
Plantago lanceolata	47	25	33	100	90	.	.	29	.	.	.	71
Reichardia picroides	.	25	50	75	100	67	.	43	.	40	.	43
Catapodium rigidum	6	50	75	88	100	.	100	.	.	.	.	.
Crepis sancta	82	.	.	.	.	.	.	43	67	.	100	43
Avena barbata	65	.	33	50	.	.	67	.	33	.	100	29
Trifolium scabrum	18	25	25	25	50	.	67	.	.	.	.	.
Helichrysum italicum	.	25	75	50	90	67	33	7	.	.	.	.
Paliurus spina-christi	25	63	.	.	.	.	.	43	.	.	100	.
Olea europaea	17	.	.	.	.	.	.	43	.	.	100	.
Pinus halepensis	.	.	.	.	.	.	.	.	33	20	.	.

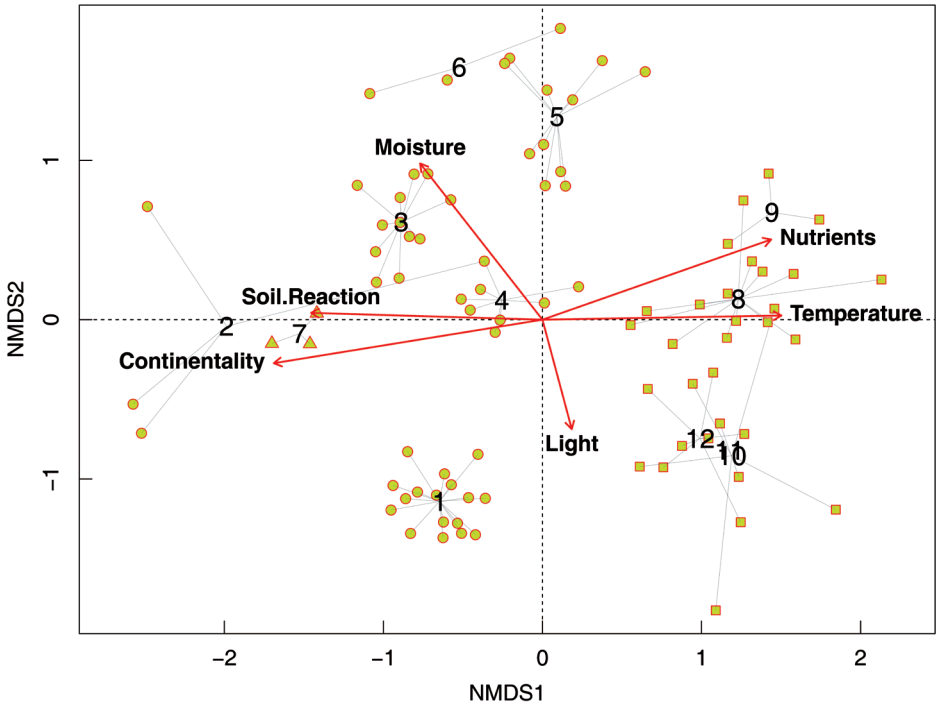

Fig. 3. NMDS ordination of *Asphodelus ramosus*-dominated communities from the Adriatic region with passively projected ecological indicator values. Symbols indicate classification into the classes: ● – *Festuco-Brometea*, ▲ – *Artemisietea vularis*, ■ – *Charybdido pancratii-Asphodeletea ramosi*. Numbers indicate centroids of relevés of particular communities (see Tab. 2).

with abundant grassland species of the class *Festuco-Brometea*, which are not present in the second group of edge communities from Italy. Two dimensional solution of the NMDS ordination attained a minimum stress of 0.21. The NMDS ordination clearly distinguishes the two groups along gradients of nutrients, light and soil reaction. Edge communities from Italy thrive on more nutrient-rich, shaded sites (Fig. 3).

Based on floristic composition and all the comparative analyses, we decided to classify the studied stands dominated by *Asphodelus ramosus* into the already described grassland association *Bromo erecti-Chrysopogonetum grylli.*

Discussion

In recent years, several studies on the distribution and dynamics of plant communities with *Asphodelus ramosus* have been performed, especially in the central and western Mediterranean (Biondi et al. 2016, Biondi et al. 2017). In contrast, this type of vegetation has been poorly studied in Montenegro.

The association *Bromo erecti-Chrysopogonetum grylli* was described for the first time in Croatia (Island of Pag, Horvatić 1934), with two subassociations (*Bromo-Chrysopogonetum grylli dorycnietosum herbacei* and *Bromo-Chrysopogonetum grylli asphodeletosum microcarpi*), and classified in the alliance '*Chrysopogoneto-Satureion subspicatae* Horvat i Horvatić 1934' (recte: *Chrysopogono grylli-Koelerion splendentis*), order '*Brometalia erecti* Br. Bl.' Subsequently, *Bromo-Chrysopogonetum grylli asphodeletosum microcarpi* was raised by Horvatić (1963) to the rank of association, with the name *Asphodelo microcarpi-Chrysopogonetum grylli*, and included in the order '*Scorzonero-Chrysopogonetalia* H-ić et Ht (1956) 1958' (recte: *Scorzoneretalia villosae*). The association has so far been reported in Montenegro and Albania (Černjavski et al. 1949, Fanelli et al. 2015, Hadžiablahović 2018). In his nomenclatural revision of the order '*Scorzonero villosae-Chrysopogonetalia grylli* Horvatić et Horvat in Horvatić 1963', Terzi (2011) considered the associations *Asphodelo-Chrysopogonetum grylli* and *Bromo--Chrysopogonetum grylli* to be valid, while Terzi (2015) later united them and retained the earlier valid name, *Bromo--Chrysopogonetum grylli* (cf. Theurillat et al. 2021).

In Montenegro, *Bromo erecti-Chrysopogonetum grylli* was reported by Blečić and Lakušić (1976) in the coastal part of Montenegro, as well as in the vicinity of Podgorica, and by Černjavski et al. (1949) and Hadžiablahović (2018) in the area of Skadar Lake. These publications were not supported with phytosociological studies and it was not possible to make a comparison with our results from Ćemovsko polje. According to Černjavski et al. (1949), *Bromo-Chrysopogonetum grylli* is developed on stony hills with thin soils, while our researched stands are found in the lowlands of Ćemovsko polje on deeper alluvial soils. According to Černjavski et al. (1949) *Bromo-Chrysopogonetum grylli* is characterized by many species of shrub vegetation (*Paliurus spina-christi*, *Salvia officinalis*, *Rubus ulmifolius*, *Euphorbia veneta*, *Helichrysum italicum*, *Ruscus aculeatus*, *Cyclamen neapolitanum*, *Arum italicum*, *Phlomis fruticosa*, *Cistus villosus*, *Cistus salviaefolius*, *Nephrodium filix-mas*, *Pteridium aquilinum*, etc.) and chasmophytic vegetation (*Asplenium trichomanes*, *Edraianthus tenuifolius*, *Cardamine glauca*, *Silene quadridentata*, *Ceterach officinarum*, *Sedum album*, *Moltkea petraea*, etc.) that were absent from our stands from Ćemovsko polje. Further investigation of the association *Bromo-Chrysopogonetum grylli* reported by Černjavski (1949) is needed to determine whether there are differences in relation to our community from Ćemovsko polje.

Fanelli et al. (2015) reported *Asphodelo-Chrysopogonetum grylli* in Albania in the Buna River protected landscape and it shows high similarity with associations from Montenegro and Croatia. The species *Cytisus spinescens*, which is a characteristic species of the association (Horvatić 1963) is not present in stands from Montenegro and Albania. Stands from Montenegro are also characterized by an absence of species characteristic of dry grasslands of the classes *Festuco-Brometea – Salvia officinalis* and *Bromopsis erecta*.

According to Horvatić (1934, 1939), the development and distribution of *Bromo-Chrysopogonetum grylli asphodeletosum microcarpi* is conditioned by agro-pastoral activities, i.e., moderate grazing. In the case of Ćemovsko polje, it is grazed particularly by sheep and rarely by cattle. Intensive and permanent grazing leads to degradation of this community, which is especially evident from the absence of *Asphodelus ramosus* from relevés on Rab island (Horvatić 1939). Intensive grazing leads to a higher abundance of shrubs (*Helichrysum italicum*, *Cytisus spinescens*, *Euphorbia spinosa*, *Salvia officinalis*) (Horvatić 1934), or ruderal and subruderal species (Fanelli et al. 2015). Overgrazed stands can be included in the order *Carthametalia lanatae* (*Artemisietea vulgaris*) because of abundant therophytes: *Carthamus lanatus*, *Dasypyrum villosum*, *Catapodium rigidum*, *Nigella arvensis*, etc. (Fanelli et al. 2015). On the other hand, stands are abandoned, after which succession leads to *Rhamno-Paliuretum* Trinajstić 1996, or are turned into mowed grasslands of the *Vulpio-Lotion* Horvatić 1963 alliance (Hadžiablahović 2018).

In several localities in Croatia along the Adriatic coast, similar vegetation types with *Asphodelus ramosus* have been reported. *Narcisso tazettae-Asphodeletum microcarpi* was described in Istria (Šegulja 1970). The same association was later reported on the islands of Bobara and Mrkan (Hećimović 1984), Supetar (Jasprica and Ruščić 2013) and Olib (Jasprica et al. 2016). Originally, it was classified into *Scorzonerion villosae*, but was later moved to *Chrysopogono grylli-Koelerion splendentis.* Ecological conditions are different to those of *Asphodelo ramosi-Chrysopogonetum grylli* and it occurs on deep skeletoid soils and under the influence of salt spray (Šegulja 1969). According to Jasprica et al. (2016), the association is considered to be the most thermophilous grassland along the eastern Adriatic coast. The characteristic species of the association are *Asphodelus ramosus*, *Narcissus tezzeta* and *Orchis papilionacea*. Thermophilous grassland communities with domination of

Asphodelus ramosus have a distribution along the eastern Adriatic, influenced by the Mediterranean climate.

There is a different situation along the western Adriatic coast, where *Asphodelus ramosus*-dominated communities are considered to be heliophilous fringe and tall-herb vegetation, which develops after the abandonment of agro-pastoral activities (Tesei et al. 2020). Comprehensive studies on heliophilous edge vegetation have been performed in Italy (Gargano peninsula, central part of the Apennines, northern part of Sardinia) and southern Spain (Biondi et al. 2016, 2017). As a result, a new class of edge vegetation *Charybdido pancratii-Asphodeletea ramosi* was described, focused on areas with a Mediterranean macrobioclimate (Biondi et al. 2016, 2017).

The proposal to update the EuroVegChecklist (Mucina et al. 2014) by adding this new class was provisionally rejected by the European Vegetation Classification Committee of the European Vegetation Survey working group of the International Association of Vegetation Science, due to the lack of evidence concerning a clear floristic delimitation of *Charybdido pancratii-Asphodeletea ramosi* from *Lygeo sparti-Stipetea tenacissimae* and *Trifolio-Geranietea sanguinei* (Biurrun and Willner 2020). Nonetheless, we can accept the existence of a new fringe class replacing *Trifolio-Geranietea* in the Mediterranean, but we are of the opinion that *Bromo erecti-Chrysopogonetum grylli* clearly represents grassland vegetation erroneously classified as fringe vegetation by Biondi et al. (2016). This is clearly indicated by the numerous species of *Festuco-Brometea* present in stands (Tab. 2) from eastern Adriatic *Asphodelus*-dominated communities. Fringe communities with *Asphodelus ramosus* from Italy, due to overgrazing, are dominated by monocotyledons, many of them toxic to animals, while in Montenegro these areas represent pastures. Another difference is the presence of shrub species with higher cover in stands of *Charybdido-Asphodeletea ramosi* (*Paliurus spina-christi*, *Olea europaea*, *Pinus halepensis*), missing in grasslands from the eastern Adriatic.

According to Biondi et al. (2016) the diagnostic species of the newly described class are *Asphodelus ramosus* subsp. *ramosus*, *A. fistlosus*, *A. tenuifolius*, *A. ayardii*, *Charybdis pancration*, *C. maritima*, *C. glaucophylla*, *C. aphylla*, *C. hesperia*, *Thapsia garganica*, *Asparagus acutifolius*, *Ornithogalum etruscum* subsp. *umbratille*, *Anemone hortensis*, *Carlina corymbosa*, *Hypochoeris radicata*, *Iris planifolia*, *I. bicapitata*, *Asphodeline liburnica*, *A. lutea*, *Ferula communis*, *F. communis* subsp. *cardonae*, *F. glauca*, *F. arrigonii* and *Hermodactylis tuberosus*. The diagnostic species group of *Charybdido-Asphodeletea* should also be revised, since many of them are attributed to other vegetation classes (*Festuco-Brometea*, *Lygeo sparti-Stipetea tenacissimae*, *Ononido-Rosmarinetea* etc.) according to Mucina et al. (2014). *Asphodelus ramosus*, *Anemone hortensis*, *Carlina corymbosa* and *Hypochoeris radicata*, which are considered to be character species by Biondi et al. (2016), are also very frequent in grassland vegetation of *Bromo erecti-Chrysopogonetum grylli*.

In terms of Natura 2000 habitat types (Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora, 1992) there are differences between grassland and fringe communities dominated by *Asphodelus ramosus*. Heliophilous *Asphodelus* spp. edge communities in the western and central Mediterranean do not represent any habitats of European Community interest and a progressive increase in *Asphodelus* spp. cover in grasslands can result in the disappearance of grassland habitat types (Tesei et al. 2020). According to a report of habitat types of Montenegro important for the European Union (Petrović et al. 2019), *Bromo erecti-Chrysopogonetum grylli* is classified within the Eastern sub-Mediterranean dry grasslands (*Scorzoneretalia villosae*) habitat type (code 62A0). The same situation applies to *Narcisso tazettae-Asphodeletum microcarpi* in Croatia (Jasprica et al. 2016).

Syntaxonomical scheme

Based on the analyses performed, the following syntaxonomical scheme is proposed for *Asphodelus ramosus*-dominated communities in the Adriatic region.

Festuco-Brometea Br.-Bl. et Tx. ex Soó 1947
- *Scorzoneretalia villosae* Kovačević 1959
  - *Chrysopogono grylli-Koelerion splendentis* Horvatić 1973
    - ***Bromo erecti-Chrysopogonetum grylli* Horvatić 1934**
    - ***Narcisso tazettae-Asphodeletum microcarpi*** Šegulja 1969

Artemisietea vulgaris Lohmeyer et al. ex von Rochow
- ***Asphodelus ramosus community***

Charybdido pancratii-Asphodeletea ramosi Biondi in Biondi et al. 2016
- *Asphodeletalia ramosi* Biondi in Biondi et al. 2016
  - *Charybdido pancratii-Asphodelion ramosi* Biondi et al. 2016
    - ***Charybdido pancratii-Asphodeletum ramosi* Biondi et al. 2016**
    - ***Alkanno tinctoriae-Asphodeletum ramosi* Biondi et al. 2016**
    - ***Euphorbio characiae-Thapsietum garganicae* Biondi et al. 2017**

Asphodelo ramosi-Ferulion communis Biondi et al. 2016
- ***Asphodelo ramosi-Feruletum communis* Biondi et al. 2016**
- ***Asphodelino luteae-Feruletum communis* Biondi et al. 2016**

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References

Aćić, S., Šilc, U., Petrović, M., Tomović, G., Dajić Stevanović Z., 2015: Classification, ecology and biodiversity of Central Balkan dry grasslands. Tuexenia 35, 329–353.

Allegrezza, M., Biondi, E., Ballelli, S., Tesei, G., Ottaviani, C., 2015: The edge communities of *Asphodelus macrocarpus* subsp. *macrocarpus*: the different ecological aspects and a new case study in the central Apennines. Plant Sociology 52, 19–40.

Apostolova, I. Dengler, J., Di Pietro R., Gavilán, R.G., Tsiripidis, I., 2014: Dry grasslands of Southern Europe: syntaxonomy, management and conservation. Hacquetia 1, 5–18.

Biondi, E., Blasi, C., Allegrezza, M., Anzellotti, I., Azzella, M. M., Carli, E., Casavecchia, S., Copiz, R., Del Vico, E., Facioni, L., Galdenzi, D., Gasparri, R., Lasen, C., Pesaresi, S., Poldini, L., Sburlino, G., Taffetani, F., Vagge, I., Zitti, S., Zivkovic, L., 2014: Plant communities of Italy: The Vegetation Prodrome. Plant Biosystems 148, 728–814.

Biondi, E., Pesaresi S., Gaspari, R., Biscotti, N., del Viscio, G., Bonsanto, D., Casavecchia, S., 2017: New contribution to the class *Charybdido pancratii-Asphodeletea ramosi* Biondi 2016. Plant Sociology 54, 137–144.

Biondi, E., Pesaresi, S., Galdenzi, D., Gaspari, R., Biscotti, N., del Viscio, G., Casavecchia, S., 2016: Post-abandonment dynamic on Mediterranean and sub-Mediterranean perenial grasslands: the edge vegetation of the new class *Charybdido pancratii-Asphodeletea ramosi*. Plant Sociology 53, 3–18.

Biurrun, I., Willner, W., 2020: First Report of the European Vegetation Classification Committee. Vegetation Classification and Survey 1, 145–147.

Blečić, V., Lakušić, R., 1976: List of plant communities of Montenegro. Glasnik Republičkog Zavoda za Zaštitu Prirode i Prirodnjačkog Muzeja u Titogradu 9, 57–98 (in Montenegrin).

Bohn, U., Neuhäusl, R., unter Mitarbeit von Gollub, G., Hettwer, C., Neuhäuslová, Z., Schlüter, H., Weber, H. 2000-2003: Karte dernatürlichen Vegetation Europas, Maßstab 1:2.500.000. Landwirtschaftsverlag, Münster.

Braun-Blanquet, J., 1964: Pflanzensoziologie. Grundzüge der Vegetationskunde. Springer Verlag, Wien.

Burić, D., Micev, S., 2008: Köppen climate classification in Montenegro shown in Walter climate diagram. Hidrometeorološki zavod Crne Gore, Podgorica (in Montenegrin).

Burić, M., Fuštić, B., Bulajić, P., 2017: Land atlas of Montenegro. Crnogorska Akademija Nauka i Umjetnosti 3, 7–153 (in Montenegrin).

Černjavski, P., Grebenščikov, O., Pavlović, Z., 1949: On vegetation and flora of the Skadar lake area. Glasnik Prirodnjačkog Muzeja Srpske zemlje, Beograd 1/2, 5–9 (in Montenegrin).

Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora, 1992.

Diaz-Lifante, Z., Valdés, B., 1996: Revisión del género *Asphodelus* (*Asphodelaceae*) en el Mediterraneo occidental. Boissiera 52, 11-189.

Euro+Med, 2006: Euro+Med PlantBase – the information resource for Euro-Mediterranean plant diversity. Retreived July 22, 2019 from http://ww2.bgbm.org/EuroPlusMed/.

Fanelli, G., De Sanctis, M., Gjeta, E., Mullaj, A., Attore, F., 2015: The vegetation of the Buna river protected landscape (Albania). Hacquetia 14, 129–174.

Griffiths, H.I., Kryštofek, B., Reed, J.M. (eds.), 2004: Balkan biodiversity – pattern and process in the European hotspot. Kluwer Academic Publishers, Dordrecht.

Hadžiablahović, S., 2010: The vascular flora of Ćemovsko polje. Natura Montenegrina 9, 7–143 (in Montenegrin).

Hadžiablahović, S., 2018: The diversity of the flora and vegetation of Lake Skadar/Shkodra. In: Pešić, V., Karaman, G., Kostianoy, A. (eds), The Skadar/Shkodra Lake environment. The Handbook of Environmental Chemistry, 203–238. Springer, Cham 80, Switzerland.

Hećimović, S., 1984: Vegetation der Inseln Bobara und Mrkan. Acta Botanica Croatica 43, 109–118.

Hennekens, S., Schaminée, J., 2001: TURBOVEG, a comprehensive data base management system for vegetation data. Journal of Vegetation Science 12, 589–591.

Horvat, I., Glavač, V., Ellenberg, H., 1974: Vegetation Sudosteuropas. Geobotanica selecta, Band 4. Gustav Fischer Verlag. Stuttgart.

Horvatić, S., 1934: Flora and vegetation of island Pag. Prirodoslovna istraživanja 19, 116–372 (in Croatian).

Horvatić, S., 1939: An overview of the vegetation of the island of Rab from aspect of plant sociology. Prirodoslovna Istraživanja Jugoslavenske Akademije 22, 1–96 (in Croatian).

Horvatić, S., 1963: Vegetation map of the island of Pag, with a review of the vegetation units of the coast of Croatia. Acta Biologica (Zagreb) 4, 3–187 (in Croatian).

Janssen, J.A.M., Rodwell, J.S., García Criado, M., Gubbay, S., Haynes, T., Nieto, A., Sanders, N., Landucci, F., Loidi, J., Ssymank, A., Tahvanainen, T., Valderrabano, M., Acosta, A., Aronsson, M., Arts, G., Attorre, F., Bergmeier, E., Bijlsma, R.-J., Bioret, F., Biţă-Nicolae, C., Biurrun, I., Calix, M., Capelo, J., Čarni, A., Chytrý, M., Dengler, J., Dimopoulos, P., Essl, F., Gardfjell, H., Gigante, D., Giusso del Galdo, G., Hájek, M., Jansen, F., Jansen, J., Kapfer, J., Mickolajczak, A., Molina, J.A., Molnár, Z., Paternoster, D., Piernik, A., Poulin, B., Renaux, B., Schaminée, J.H.J., Šumberová, K., Toivonen, H., Tonteri, T., Tsiripidis, I., Tzonev, R., Valachovič, M, 2016: European Red List of Habitats. Part 2. Terrestrial and freshwater habitats. European Commission, Brussels, 1–40.

Jasprica, N., Milović, M., Kovačić, S., Stanković, V., 2016: Phytocoenotic diversity of the NE-Adriatic island of Olib. Plant Sociology 53, 55–81.

Jasprica, N., Ruščić, M., 2013: Flora and vegetation of islet Supetar (Cavtat, South Croatia). Hrvatska misao 46, 111–134 (in Croatian).

Jovanović, B., Lakušić, R., Rizovski, R, Trinajstić, I., Zupančič, M., 1986: Prodromus Phytocoenosum Jugoslaviae: ad mappam vegetationis m 1:200 000. Naučno vijeće vegetacijske karte Jugoslavije, Bribir-Ilok, HR (in Croatian).

Kadereit, G., Ball, P., Beer, S., Mucina, L., Sokoloff, D., Teege, P., Yaprak, A.E., Freitag, H. 2007: A taxonomic nightmare comes true: Phylogeny and biogeography of glassworts (*Salicornia* L., Chenopodiaceae). Taxon 56, 1143–1170.

Kruskal, J.B., 1964: Multidimensional scaling by optimizing goodness of fit to a nonmetric hypothesis. Psychometrika 29, 1–27.

Matevski, V., Čarni, A., Ćušterevska, R., Kostadinovski, M., Mucina, L., 2018: Syntaxonomy and biogeography of dry grasslands on calcareous substrates in the central and southern Balkans. Applied Vegetation Science 21, 488–513.

Mucina, L., Bültman, H., Dierssen, K., Theurillat, J.-P., Dengler, J., Čarni, A., Šumberová, K., Raus, T., Di Pietro, R., Gavilán Garcia, R., Chytrý, M., Iakushenko, D., Schaminée, J.H.J., Bergmeier, E., Santos Guerra, A., Daniëls, F.J.A., Ermakov, N., Valachovič, M., Pigantti, S., Rodwell, J.S., Pallas, J., Capelo, J., Weber, H.E., Lysenko, T., Solomeshch, A., Dimopoulos, P., Aguiar, C., Freitag, H., Hennekens, S.M., Tichý, L., 2016: Vegetation of Europe: Hierarchical floristic classification system of plant, lichen, and algal communities. Applied Vegetation Science 19, 3–264.

Oksanen, J., Blanchet, F. G., Kindt, R., Legendre, P., Minchin, P. R., O'Hara, R. B., Simpson, G. L., Solymos, P., Stevens, M. H.

H., Wagner, H., 2017: Vegan: community ecology package. R Foundation for Statistical Computing, Vienna. Retrieved from http://CRAN.R-project.org/package=vegan.

Petrović, D., Hadžiablahović, S., Vuksanović, S., Mačić, V., Milanović, Đ., Lakušić, D., 2019: Catalogue of habitat types of Monenegro important for European Union. Regional Environmental Center Montenegro, Podgorica-Banja Luka-Beograd (in Montenegrin).

Pignatti, S., Menegoni, P., Pietrosanti, S., 2005: Biondicazione attraverso le piante vascolari. Valori di indi-cazione secondo Ellenberg (Zeigerwerte) per le specie della Flora d'Italia. Braun-Blanquetia 39, 1–97.

Pulević, V., Bulić, Z., 2012: Bibliography on Flora and Vegetation of Montenegro (the third addition). Republički zavod za zaštitu prirode. Special edition. Podgorica. 1-150 (in Montenegrin).

Radojičić, B., 2015: Montenegro – Geographical encyclopedic lexicon. Faculty of Philosophy, University of Nikšić (in Montenegrin).

Šegulja, N., 1969: A contribution to the knowledge of rocky vegetation in Istria. Acta Botanica Croatica 28, 367–371 (in Croatian).

Šegulja, N., 1970: Vegetation of the northeastern part of the Labinština in Istria. Acta Botanica Croatica 29, 157–172 (in Croatian).

Stešević, D., Caković, D., Jovanović, S., 2014: The urban flora of Podgorica (Montenegro, SE Europe): Annotated checklist, distribution atlas, habitats and life-forms, taxonomic, phytogeographical and ecological analysis. Ecologica Montenegrina 4–167 (in Montenegrin).

Terzi, M., 2011: Nomenclatural revision for the order *Scorzonero-Chrysopogonetalia*. Folia Geobotanica 46, 411–444.

Terzi, M., 2015: Numerical analysis of the order *Scorzoneretalia villosae*. Phytocoenologia 45, 11–32.

Tesei, G., D'Ottavio, P., Toderi, Ottaviani, C., Pesaresi, S., Francioni, M., Trozzo L., Allegrezza, M., 2020: Restoration strategies for grasslands colonized by Asphodel-dominant communities. Grassland Science 66, 54–63.

Theurillat, J-P., Willner, W., Fernández-González, F., Bültmann, H., Čarni, A., Gigante, D., Mucina, L. Weber, H., 2021: International Code of Phytosociological Nomenclature. 4th edition. Applied Vegetation Science 24, e12491.

Tichý, L., 2002: JUICE, software for vegetation classification. Journal of Vegetation Science 13, 451–453.

Valkó, O., Venn, S., Zmihorski, M., Biurrun, I., Labadessa, R., Loos, J., 2018: The challenge of abandonment for the sustainable management of Palaearctic natural and semi-natural grasslands. Hacquetia 17, 5–16.

Appendix 1: Species present in only 1 or 2 relevés from Ćemovsko polje in Table 1.

Asparagus acutifolius 17: +; *Catapodium rigidum* 6: +; *Geranium molle* 2: +; *Trifolium angustifolium* 3: +; *Romulea bulbocodium* 2: +; *Sonchus asper* 10: +; *Pyrus amygdaliformis* 3: 1; *Carthamus lanatus* 6: +; *Salvia verbenaca* 16: +; *Teucrium chamaedrys* 17: +; *Geranium purpureum* 7: +; *Alyssum minus* 10: 1; *Ajuga chamaepitys* 12: +, 16: +; *Vicia angustifolia* 9: +; *Crepis foetida* 2: +, 6: +; *Tragopogon porrifolius* 9: +, 11: 1; *Bellis perennis* 4: +; *Parentucellia latifolia* 14: +, 15: +; *Aphanes arvensis* 8: +, 17: +; *Valerianella rimosa* 6: +, 8: +; *Knautia integrifolia* 9: +, 10: +; *Stipa pulcherrima* 3: +, 4: 1; *Cardamine hirsuta* 4: +, 17: +; *Linum bienne* 5: +, 7: +; *Trifolium cherleri* 3: +, 5: +; *Bromus madritensis* 7: +, 16: +; *Trifolium resupinatum* 5: +; *Vulpia myuros* 10: +; *Trigonella gladiata* 1: +; *Veronica arvensis* 17: +; *Reseda phyteuma* 9: +; *Bromus sterilis* 11: +; *Calepina irregularis* 6: +; *Bromus hordeaceus* 3: +; *Orchis ustulata* 11: +; *Orlaya grandiflora* 9: +; *Medicago rigidula* 5: +; *Poa annua* 10: +; *Hyacinthella dalmatica* 5: +; *Matthiola incana* 15: 1; *Lactuca viminea* 3: +; *Aegilops neglecta* 11: +; *Alyssum alyssoides* 7: +; *Alyssum campestre* 11: 1; *Astragalus illyricus* 11: 2, 14: +; *Matricaria chamomilla* 13: +, 14: +; *Onosma echioides* 9: 1, 12: +.

Appendix 2: Relevé dates (year/month/day) and coordinates (WGS84 reference system, in decimal degrees).

1. 2019/04/07, 42.3968090, 19.3021110; 2. 2019/04/07, 42.3964610, 19.3030050; 3. 2019/04/07, 42.3960000, 19.3040000; 4. 2019/04/07, 42.3978055, 19.3048888; 5. 2019/04/07, 42.3985277, 19.3019638; 6. 2019/04/07, 42.4001488, 19.3031944; 7. 2019/04/07, 42.4006410, 19.3023280; 8. 2019/04/07, 42.4021890, 19.3049660; 9. 2019/04/07, 42.3880040, 19.2856690; 10. 2019/04/07, 42.3803160, 19.2743840; 11. 2019/04/09, 42.3708888, 19.2303056; 12. 2019/04/09, 42.3728888, 19.2316944; 13. 2019/04/09, 42.3697222, 19.2339166; 14. 2019/04/09, 42.3705580, 19.2360490; 15. 2019/04/09, 42.3709350, 19.2383990; 16. 2019/04/10, 42.4021370, 19.3210555; 17. 2019/04/10, 42.3885277, 19.3110277.

Appendix 3: Relevés from literature sources (name of the plant community, authors, table and number of relevés from original source paper).

1. *Bromo-Chrysopogonetum grylli* subass. *asphodeletosum microcarpi* (Horvatić 1934), Tab. 23, rels. 11-16, 18-23; 2. *Narcisso tazettae-Asphodeletum microcarpi* (Šegulja 1970), Tab. 2, rels. 1–8; 3. *Narcisso tazettae-Asphodeletum microcarpi* subass. *sisymbrietosum officinalis* (Hećimović 1984), Tab. 5, rels. 1–10; 4. *Narcisso tazettae-Asphodeletum microcarpi* (Jasprica and Ruščić 2013), rel. on the page 128; 5. *Asphodelus ramosus* community (Fanelli et al. 2015), Tab. 41, rels. 15, 70, 492; 6. *Asphodelo-Chrysopogonetum grylli* (Fanelli et al. 2015), Tab. 25, rels. 31–33; 7. *Narcisso tazettae-Asphodeletum microcarpi* (Jasprica et al. 2016), Tab. 11, rels. 1–3; 8. *Charybdido pancratii-Asphodeletum ramosi* (Biondi et al. 2016, Tab. 1, rels. 1–14; 9. *Alkanno tinctoriae-Asphodeletum ramosi* (Biondi et al. 2016), Tab. 2, rels. 1–3; 10. *Asphodelo ramosi-Feruletum communis* (Biondi et al. 2016), Tab. 3, rels. 1–2; 11. *Asphodelino luteae-Feruletum communis* (Biondi et al. 2016), Tab. 4, rels. 1–7; 12. *Euphorbio characiae-Thapsietum garganicae* (Biondi et al. 2017), Tab. 6, rels. 1–5.