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Checklist of vegetation classes of Bosnia and Herzegovina: How much do we know?

Ček-lista vegetacijskih klasa Bosne i Hercegovine: Koliko znamo?

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ABSTRACT

The beginnings of vegetation research of Bosnia and Herzegovina (B&H), according to Braun-Blanquet's approach, date back to early 1930s, culminated in the period of 60s-70s, and declined until the end of 20th century. Twenty years after the war B&H vegetation science hasn't still achieved the pre-war level.

The starting point for the preparation of the checklist of vegetation classes was the vegetation database of Bosnia and Herzegovina, which contains 6823 relevés, which were digitized and imported in TURBOVEG database for storage of large relevé datasets. Total of 4780 relevés were collected from 123 references (2906 regularly published, 1331 from grey literature and 543 from manuscripts), while 2043 are unpublished relevés, mainly recorded by the team of the Department of Forest Ecology at the Faculty of Forestry in Banja Luka.

Analysis of this dataset suggests that vegetation of Bosnia and Herzegovina comprises 60 classes. According to the overviews of vegetation of Bosnia and Herzegovina published so far, the vegetation dominated by vascular plants numbers 33 and 39 classes respectively. This discrepancy can be partially attributed to different syntaxonomic concepts used in these overviews compared to the latest Checklist compiled at the European level (EuroVegChecklist), which was our guideline, but also to uneven level of elaboration of different vegetation types and geographical regions in B&H.

Six classes of forest vegetation share almost 60% of the total number of relevés, while another six classes of various grasslands take another 25%. The other 15% is divided among the rest of 48 classes.

Some of the classes without relevés are, in our own opinion, present in B&H, but still need to be confirmed, while the others, even though mentioned in literature, couldn't be confirmed at the field after extensive research.

Key words: *European Vegetation Survey, phytosociology, relevé database, syntaxonomy, vegetation classification.*

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INTRODUCTION - Uvod

There are many different approaches to classification of vegetation (Mueller-Dombois & Ellenberg, 1974; Peet & Roberts, 2013), but Bosnia and Herzegovina (B&H) was among the first European countries to accept the method based on total floristic composition of the plant community that reflects ecological conditions and biogeographic background of the stand (Braun-Blanquet, 1928). This method, that was introduced at the beginning of the 20th century (Braun-Blanquet, 1921) is now known as Braun-Blanquet approach, the standard Central European phytosociological method or phytosociological method of Zurich-Montpelier school, and although it has been most extensively applied in Europe, important achievements have also been made throughout the world (De Cáceres et al., 2015, 2018; Guarino, Willner, Pignatti, Attorre, & Loidi, 2018). This approach provides methods for sampling (sample known as a vegetation *relevé*), describing and classifying regular groupings of plant species which are put into conceptual phytosociological units called *syntaxa* and arranged into a hierarchical system (syntaxonomy) (Braun-Blanquet, 1964; Dengler, Chytrý, & Ewald, 2008). The basic syntaxon is called association, which are further united into alliances, orders and classes. The rules for formal description and naming of syntaxa are given in the International code of phytosociological nomenclature (ICPN) (Weber, Moravec, & Theurillat, 2000).

Vegetation research in B&H according to this method started fairly early (Horvat, 1930, 1931, 1933, 1941; Horvat & Pawlowski, 1939; Tregubov, 1941) and the number of published relevés, as well as the number of papers with at least one relevé showed steady growth until 1960s (Figures 1-2). However, after this period, the numbers showed a continuous decline, which was quite opposite to the global European trend (Chytrý et al., 2016), only to touch the bottom in the years during and after the Bosnian Civil War 1992–1995. Situation improved a little bit in the last ten to fifteen years with additional 2000 relevés being collected, but these only sums up to a total of a little bit over 6800 relevés for the entire country. Having in mind that B&H flora and vegetation are amongst the richest in Europe (Lubarda, Stupar, Milanović, & Stevanović, 2014; Redžić, 2012) this number can be considered extremely low.

In a meantime, an enormous quantity of phytosociological relevés has been gathered in a better part of Europe. According to Chytrý et al. (2016), as of 30 June 2015, there were more than two million presumably non-duplicated plots contained in the European databases registered in the Global Index of Vegetation-Plot Databases (GIVD; Dengler et al., 2011). There are several countries with more than 100,000 relevés (Czech Republic, France, and Germany) with Netherlands having more than 600,000 relevés, and much more countries with several tens of thousands of relevés. In B&H neighbourhood, Serbia, Croatia and Slovenia stand out with more than 10,000 relevés (Chytrý et al., 2016).

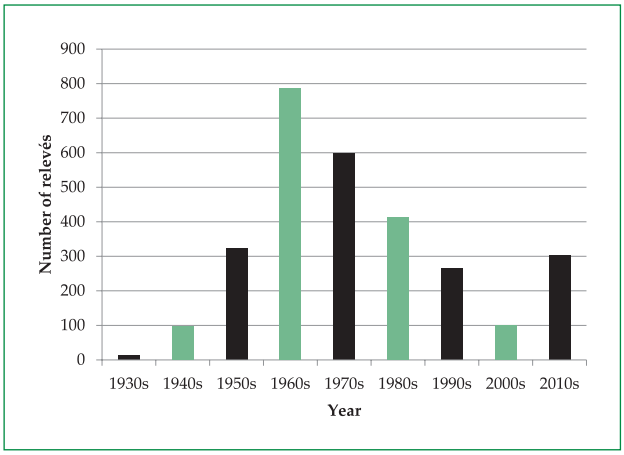

Figure 1. Number of published relevés

Slika 1. Broj objavljenih fitocenoloških snimaka

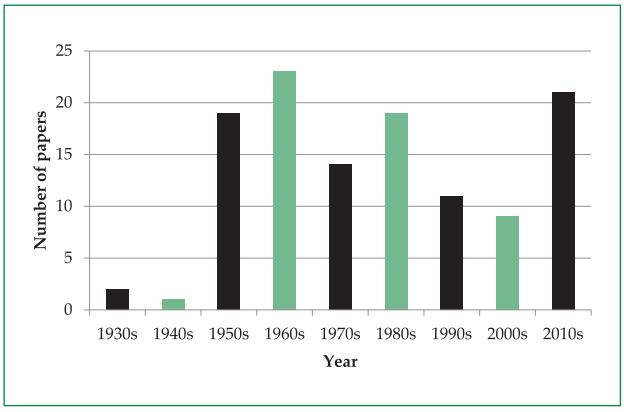

Figure 2. Number of published papers containing at least one relevé

Slika 2. Broj objavljenih radova koji sadrže barem jedan fitocenološki snimak

In the last two decades, thanks to the large amount of data at disposal, new syntaxonomic overviews (at least at the level of alliance) emerged for the most of European countries (Jiménez-Alfaro, Chytrý, Rejmánek, & Mucina, 2014). Furthermore, after several efforts to unify the European vegetation classification system (Mucina, 1997; Rodwell et al., 2002), the first comprehensive and consistent syntaxonomic system of alliances, orders and classes for vascular plants, bryophytes and lichens, as well as for the algal communities of Europe has been established (Mucina et al., 2016).

If we exclude the reviews of Southeast-European (Horvat, Glavač, & Ellenberg, 1974) and ex-Yugoslav vegetation (Jovanović, Lakušić, Rizovski, Trinajstić, & Zupančič, 1986) where the vegetation of B&H has been included, the first draft overview of syntaxa of B&H was given by Lakušić, Pavlović, Abadžić, & Grgić (1978). Although there were attempts by an eminent late Bosnian botanist and phytosociologist Prof. Sulejman Redžić to further develop this syntaxonomical concept (Redžić, 2007a, 2007b), the most comprehensive overview of B&H vegetation up to date was given by Barudanović, Macanović, Topalić-Trivunović, & Cero (2015). However, this conspectus was not in accordance with the ICPN (Weber et al., 2000) nor with the framework of the new European syntaxonomic system (Mucina et al., 2016) to which every European country will aspire to harmonize, as was the case with Croatia (Škvorc et al., 2017).

Therefore, the aims of this paper are: 1) to compile the list of vegetation classes dominated by vascular plants in B&H in accordance to new European syntaxonomic system (Mucina et al., 2016), 2) to present the level of elaboration of every class in terms of number of relevés recorded, and 3) to identify the main problems and gaps in knowledge of the vegetation of B&H.

MATERIAL AND METHODS – Materijal i metode

The starting point for the preparation of this checklist were published and unpublished relevés recorded in B&H that were at our disposal. After the inspection of all available relevant literature we collected 4780 relevés. Data was collected from the total of 132 references containing at least one relevé, including published papers, books and monographs (109), PhD thesis (8), Master thesis (3), unpublished manuscripts (2), as well as unpublished studies, reports and similar (10). We also included 2043 not published relevés that were collected by the team from the Department of Forest Ecology, Faculty of Forestry in Banja Luka, during intensive field work in the last ten to fifteen years.

Total of 6823 relevés were collected, digitized and inserted into Turboveg database (Hennekens & Schaminée, 2001). A part of the database, with forest and shrub relevés, was registered in GIVD (Dengler et al., 2011) as Forest vegetation database of Bosnia and Herzegovina, with the ID EU-BA-001.

Apart from relevés database, this paper also includes information about vegetation types of B&H published in different sources, but without relevés, as well as those vegetation types occurring in B&H according to our own knowledge and experience. Classes, which are quite possible to exist in B&H but without concrete evidence, as well as those mentioned in literature but their existence is rather dubious are marked by an asterisk (*) (Table 1, Appendix).

The syntaxonomic scheme and nomenclature of classes follows the syntaxonomic system EuroVegChecklist (Mucina et al. 2016), and in particular its part for communities dominated by vascular plants (EVC1). We also used this reference for providing classes with brief descriptions and for grouping them into broad informal groups (see Appendix). Apart from accepted names of classes, whenever we found appropriate, we also gave synonyms, especially those that have been frequently used in domestic literature.

Although class *Charetea*, dominated by green algae, traditionally has been featured in syntaxonomic systems dominated by vascular plants (e.g., Barudanović et al., 2015), it is not part of EVC1, so we excluded it from this review.

RESULTS AND DISCUSSION – Rezultati i diskusija

Our results suggest that the vegetation of B&H consists of 60 classes (Table 1, Appendix). This number is higher compared to most European countries (Jiménez-Alfaro et al., 2014) which is related to high floristic, macroclimatic, geological and geomorphological diversity of B&H (Redžić, 2012). This also puts B&H in line with other countries with high vegetation diversity that are divided by two biogeographical regions (Eurosiberian and Mediterranean) such as Italy, France, Spain and Croatia. But, on the other hand, the overall number of relevés is quite low, which puts B&H at the European bottom. From the countries in the region, only Macedonia, Montenegro and Albania have less relevés recorded.

This checklist comprises 27 classes more than noted by Lakušić et al. (1978) and 21 more than listed by Barudanović et al. (2015). Such large discrepancy could be explained by different syntaxonomic concepts applied in the respective papers. For example, former class *Querco-Fagetea* was split up into five separate classes, while *Quercetea ilicis, Mulgedio-Aconitetea* and *Thlaspietea rotundifolii* were divided in two. Furthermore, largely differing concepts of classes in the group of anthropogenic vegetation have led to larger number of classes in this group. However, on the other hand, four classes have been merged into *Molinio-Arrhenatheretea*, while *Festuco-Brometea* and *Papaveretea rhoeadis* consist of two formerly independent classes.

Table 1. List of vegetation classes of Bosnia and Herzegovina with number of relevés
Tabela 1. Lista vegetacijskih klasa Bosne i Hercegovine sa brojem fitocenoloških snimaka

No	Class	Number of relevés			%
		Literature	Ours	Total	
1	*Carpino-Fagetea sylvaticae*	1610	295	1905	27.92
2	*Quercetea pubescentis*	389	493	882	12.93
3	*Molinio-Arrhenatheretea*	394	221	615	9.01
4	*Vaccinio-Piceetea*	406	49	455	6.67
5	*Festuco-Brometea*	248	113	361	5.29
6	*Elyno-Seslerietea*	220	38	258	3.78
7	*Erico-Pinetea*	176	37	213	3.12
8	*Phragmito-Magnocaricetea*	64	149	213	3.12
9	*Asplenietea trichomanis*	86	95	181	2.65
10	*Quercetea robori-petraeae*	124	57	181	2.65
11	*Scheuchzerio palustris-Caricetea fuscae*	61	99	160	2.35
12	Nardetea strictae	122	18	140	2.05
13	*Alno glutinosae-Populetea albae*	56	78	134	1.96
14	*Mulgedio-Aconitetea*	88	25	113	1.66
15	*Artemisietea vulgaris*	91	10	101	1.48
16	*Potamogetonetea*	64	29	93	1.36
17	*Juncetea trifidi*	78	2	80	1.17
18	*Drypidetea spinosae*	44	17	61	0.89
19	*Roso pendulinae-Pinetea mugo*	51	7	58	0.85
20	*Papaveretea rhoeadis*	56	0	56	0.82
21	*Oxycocco-Sphagnetea*	53	0	53	0.78
22	*Salicetea purpureae*	8	35	43	0.63
23	*Thlaspietea rotundifolii*	19	22	41	0.60
24	*Epilobietea angustifolii*	26	13	39	0.57
25	*Betulo carpaticae-Alnetea viridis*	37	0	37	0.54
26	*Loiseleurio procumbentis-Vaccinietea*	29	6	35	0.51
27	*Crataego-Prunetea*	23	6	29	0.43
28	*Alnetea glutinosae*	15	11	26	0.38
29	*Bidentetea*	10	13	23	0.34
30	*Rhododendro hirsuti-Ericetea carneae*	18	4	22	0.32
31	*Isoëto-Nanojuncetea*	6	13	19	0.28
32	*Polygono-Poetea annuae*	17	2	19	0.28

No	Class	Number of relevés			%
		Literature	Ours	Total	
33	*Montio-Cardaminetea*	6	12	18	0.26
34	*Sedo-Scleranthetea*	8	8	16	0.23
35	*Carici rupestris-Kobresietea bellardii*	13	2	15	0.22
36	*Digitario sanguinalis-Eragrostietea minoris*	13	0	13	0.19
37	*Salicetea herbaceae*	11	0	11	0.16
38	*Lemnetea*	10	0	10	0.15
39	*Lygeo sparti-Stipetea tenacissimae*	1	9	10	0.15
40	*Polypodietea*	3	7	10	0.15
41	*Quercetea ilicis*	6	4	10	0.15
42	*Helianthemetea guttati*	0	9	9	0.13
43	*Robinietea*	7	2	9	0.13
44	*Franguletea*	0	9	9	0.13
45	*Cymbalario-Parietarietea diffusae*	0	8	8	0.12
46	*Chenopodietea*	4	3	7	0.10
47	*Calluno-Ulicetea*	5	1	6	0.09
48	*Adiantetea*	0	5	5	0.07
49	*Brachypodio pinnati-Betuletea pendulae*	1	3	4	0.06
50	*Trifolio-Geranietea sanguinei*	0	3	3	0.04
51	*Ononido-Rosmarinetea*	2	0	2	0.03
52	*Ruppietea maritimae*	1	0	1	0.01
53	*Stipo-Trachynietea distachyae*	0	1	1	0.01
54	*Sisymbrietea*	0	0	0	0.00
55	*Koelerio-Corynephoretea**	0	0	0	0.00
56	*Zosteretea**	0	0	0	0.00
57	*Halodulo wrightii-Thalassietea testudinum**	0	0	0	0.00
58	*Nerio-Tamaricetea**	0	0	0	0.00
59	*Juncetea maritimi**	0	0	0	0.00
60	*Crithmo-Staticetea**	0	0	0	0.00
	Total	**4780**	**2043**	**6823**	

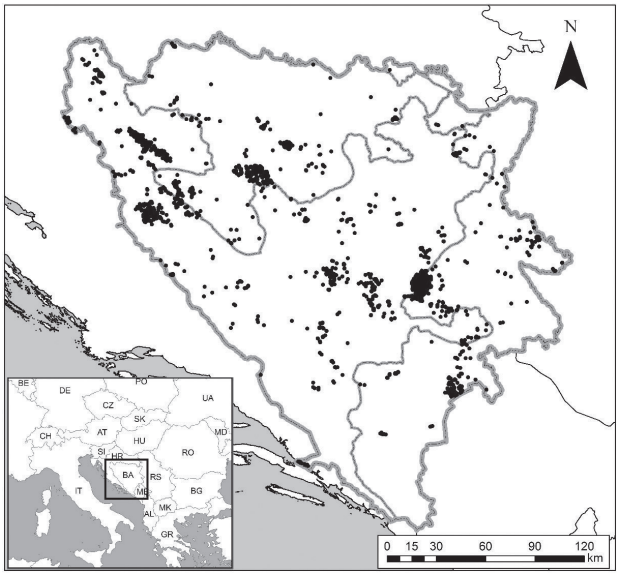

Figure 3. Relevés from literature

Slika 3. Položaj fitocenoloških snimaka crpljenih iz literature

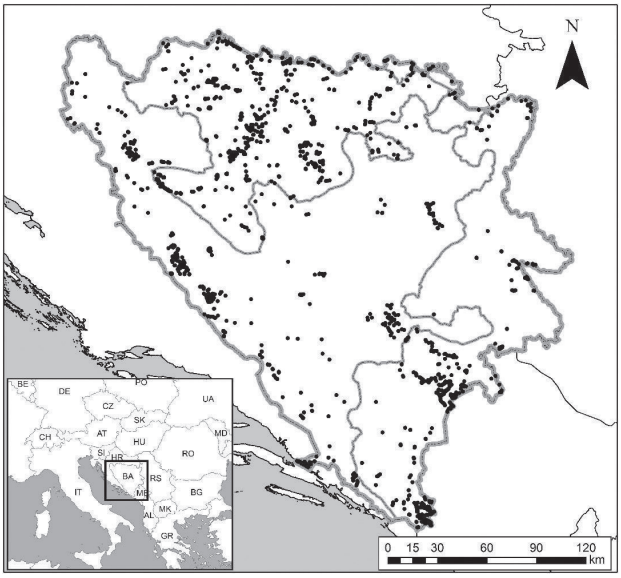

Figure 4. Unpublished relevés, mainly ours, recorded in the last fifteen years

Slika 4. Neobjavljeni, uglavnom autorski, fitocenološki snimci uzeti u zadnjih 15 godina

The other reason for the discrepancy could be disproportion in the level of elaboration of different vegetation types, as shown in Table 1. While some classes are well represented by relevés, others simply haven't been studied enough or even noted at all. This is the case with some of the classes from the vegetation of rock crevices and screes (e.g. *Cymbalario-Parietarietea diffusae*, *Polypodietea*) as well as intrazonal mediterranean scrub, grasslands and herblands (*Lygeo sparti-Stipetea tenacissimae, Helianthemetea guttati, Stipo-Trachynietea distachyae*) for which we found very few or no literature data. In addition, B&H was regionally discriminated, having researchers preferring Dinaric part of the country to the south and north (Figure 3). Only lately have this issue been addressed and partially corrected (Figure 4). At the present, the main problem seems to be the lack of financial support for this kind of research leading to small number of active researchers conducting the fieldwork.

Disproportion in the level of elaboration of different vegetation types is clearly shown in Table 1. Only six classes of forest vegetation share almost 60% of the total number of relevés, while another six classes of various grasslands take another 25%. The other 15% is divided among the rest of 48 classes. This should serve as a road map for the future investigations of the B&H vegetation.

Some of the classes without relevés and marked with an asterisk (*) are, in our own opinion, present in B&H, but still need to be confirmed (e.g., *Zosteretea, Halodulo wrightii-Thalassietea testudinum*), while the others, even though mentioned in literature, couldn't be confirmed at the field after extensive research. This is the case with *Juncetea maritimi* (Lakušić et al., 1978), *Koelerio-Corynephoretea* (Barudanović et al., 2015). In any case, the further research is needed to confirm or rule out these syntaxa.

In summary, we tried to make the checklist of vegetation classes dominated by vascular plants in B&H that is in accordance with the EuroVegChecklist (Mucina et al., 2016) and thus with the common European standards. Along the way, we pointed out at the several most conspicuous problems and gaps in B&H syntaxonomy and phytosociology, which should be dealt with in order to continue with the elaboration of the B&H vegetation. Hopefully, in the near future this will be solved and B&H will have complete and comprehensive synopsis of syntaxa at alliance and association level, which will, in turn, help facilitate broad range of activities, such as biodiversity inventory and mapping, nature conservation, spatial planning and sustainable use of natural resources, to name just a few.

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SAŽETAK

Počeci istraživanja vegetacije u Bosni i Hercegovini (BiH), prema Braun-Blanquetovom pristupu, datiraju iz ranih 1930-ih godina, kulminaciju dosežu u periodu 60-ih i 70-ih godina i opadaju do kraja 20. stoljeća. I danas dvadeset godina nakon rata nauka o vegetaciji u BiH još uvijek nije postigla predratni nivo.

Polazna tačka za ček-liste vegetacijskih klasa bila je baza podataka o vegetaciji Bosne i Hercegovine koja sadrži 6823 fitocenološka snimka, koja su digitalizirana i uvezena u bazu podataka TURBOVEG za čuvanje većih skupova podataka. Ukupno je prikupljeno 4780 fitocenološka snimka iz 123 literaturna izvora (2906 redovito objavljenih, 1331 iz sive literature i 543 iz rukopisa), dok su 2043 nepublikovani fitocenološki snimci, uglavnom prikupljeni od strane tima Odsjeka za ekologiju šuma Šumarskog fakulteta u Banjaluci.

Analiza ovog skupa podataka sugerira da vegetacija Bosne i Hercegovine obuhvaća 60 klasa. Prema dosad objavljenim pregledima vegetacije u Bosni i Hercegovini, vegetacija kojom dominiraju vaskularne biljke broji 33, odnosno 39 klasa. Ova se neusklađenost može djelomično pripisati različitim sintaksonomskim konceptima koji se koriste u ovim pregledima u odnosu na najnoviji sinopsis vegetacije Evrope (EuroVegChecklist), koji nam je bio smjernica, ali i na neravnomjeran nivo istraženosti različitih tipova vegetacije i geografskih regija u BiH.

Gotovo 60% od ukupnog broja snimaka odnosi se na šest klasa šumske vegetacije, dok 6 klasa vegetacije travnjaka zauzima dodatnih 25%. Ostalih 15% snimaka podijeljeno je između ostalih 48 klasa.

Neke od prikazanih vegetacijskih klasa nisu predstavljene nijednim ftocenološkim snimskom, a prema našem mišljenju su prisutni u BiH, ali ih ipak treba potvrditi, dok druge, iako se spominju u literaturi, nisu mogle biti potvrđene na terenu nakon opsežnih istraživanja.

APPENDIX - Dodatak

List of Vegetation Classes

1. ZONAL AND INTRAZONAL VEGETATION
1.1. VEGETATION OF THE ARCTIC ZONE
1.1.1. ZONAL VEGETATION OF POLAR DESERT AND TUNDRA

***Carici rupestris-Kobresietea bellardii* Ohba 1974**
Circum-arctic fellfield and dwarf-scrub graminoid tundra, and relict wind-exposed short grasslands on base-rich substrates in the alpine and subnival belts of the European boreal and nemoral mountain ranges

***Loiseleurio procumbentis-Vaccinietea* Eggler ex Schubert 1960**
Arctic-boreal tundra scrub and relict alpine acidophilous dwarf-heath mountain tundra of Eurasia and North America

1.2. VEGETATION OF THE BOREAL AND HEMIBOREAL ZONE
1.2.1. ZONAL BOREAL AND HEMIBOREAL FORESTS

***Vaccinio-Piceetea* Br.-Bl. in Br.-Bl. et al. 1939**
Holarctic coniferous and boreo-subarctic birch forests on oligotrophic and leached soils in the boreal zone and at high-altitudes of mountains in the nemoral zone of Eurasia

***Brachypodio pinnati-Betuletea pendulae* Ermakov et al. 1991**
Hemiboreal pine and birch-pine herb-rich open forests on fertile soils of the Southern Urals and Southern Siberia, and relict birch-poplar forests of Europe

1.3. VEGETATION OF THE NEMORAL FOREST ZONE
1.3.1. ZONAL TEMPERATE BROAD-LEAVED FORESTS

***Carpino-Fagetea sylvaticae* Jakucs ex Passarge 1968**
(syn. *Querco-Fagetea sylvaticae* Br.-Bl. et Vlieger in Vlieger 1937)
Mesic deciduous and mixed forests of temperate Europe, Anatolia, the Caucasus and Southern Siberia

***Quercetea pubescentis* Doing-Kraft ex Scamoni et Passarge 1959**
Oak, mixed deciduous and conifer woods of warm regions in the cool-temperate nemoral zone of Central and Southern Europe and in the supramediterranean belt of the Mediterranean, Asia Minor and Middle East

***Quercetea robori-petraeae* Br.-Bl. et Tx. ex Oberd. 1957**
Acidophilous oak and oak-birch forests on nutrient-poor soils of Europe

1.3.2. INTRAZONAL SCRUB AND WOODLANDS OF THE NEMORAL ZONE

***Crataego-Prunetea* Tx. 1962 nom. conserv. propos.**
(syn. *Rhamno-Prunetea* Rivas Goday et Borja Carbonell 1961)
Scrub and mantle vegetation seral or marginal to broad-leaved forests in the nemoral zone and the submediterranean regions of Europe

***Robinietea* Jurko ex Hadač et Sofron 1980**
Seral forest-clearing and anthropogenic successional scrub and thickets on nutrient-rich soils of temperate Europe

1.3.3. INTRAZONAL BOREO-TEMPERATE GRASSLANDS AND HEATH

***Calluno-Ulicetea* Br.-Bl. et Tx. ex Klika et Hadač 1944**
Heath on acidic nutrient-poor soils in the lowland to montane belts of the temperate and boreal zones of Europe

***Nardetea strictae* Rivas Goday et Borja Carbonell in Rivas Goday et Mayor López 1966 nom. conserv. propos.**
Secondary mat-grass swards on nutrient-poor soils at low and mid-altitudes of the temperate, boreal and subarctic regions of Europe

Koelerio-Corynephoretea* Klika in Klika et Novak 1941
Dry grasslands on sandy soils and on rocky outcrops of the temperate to boreal zones of Europe, the North Atlantic islands and Greenland

***Sedo-Scleranthetea* Br.-Bl. 1955**
Pioneer vegetation on shallow soils on rocky siliceous outcrops on siliceous rocks of temperate and boreal Europe

***Trifolio-Geranietea* sanguinei T. Müller 1962**
Thermophilous forest fringe and tall-herb vegetation in nutrient-poor sites in the submediterranean to subboreal zones of Europe and the Macaronesia

***Molinio-Arrhenatheretea* Tx. 1937**
(syn. *Arrhenatheretea* Br.-Bl. ex Br.-Bl. et al. 1952, *Molinio-Juncetea elatioris* Br.-Bl. ex Br.-Bl. et al. 1952, *Agrostietea stoloniferae* Oberd. in Oberd. et al. 1967, *Plantaginetea majoris* Tx. et Preising in Tx. 1950 p.p.)
Anthropogenic managed pastures, meadows and tall-herb meadow fringes on fertile deep soils at low and mid-altitudes (rarely also high altitudes) of Europe

1.3.4. VEGETATION OF THE NEMORAL OROSYSTEMS

***Erico-Pinetea* Horvat 1959**
Relict pine forests and related scrub on calcareous and ultramafic substrates of the Balkans, the Alps, the Carpathians and Crimea

***Roso pendulinae-Pinetea mugo* Theurillat in Theurillat et al. 1995**
Pine krummholz in the subalpine belts of the nemoral mountain ranges of Europe
***Rhododendro hirsuti-Ericetea carneae* Schubert et al. 2001**
Supramontane to subalpine low heath on calcareous skeletal soils, rocky outcrops, lapiés and boulders of the Alps, the Apennines and the Dinarides
***Betulo carpaticae-Alnetea viridis* Rejmánek ex Bœuf, Theurillat, Willner, Mucina et Simler in Bœuf et al. 2014**
Subalpine and subarctic herb-rich alder and willow scrub and krummholz of the Alps, the Carpathians, the Hercynicum, the Balkans, the Caucasus, Northern Europe and Greenland
***Mulgedio-Aconitetea* Hadač et Klika in Klika et Hadač 1944**
(syn. *Betulo-Adenostyletea* Br.-Bl. et Tx. 1943 p.p.)
Tall-herb vegetation in nutrient-rich habitats moistened and fertilized by percolating water at high altitudes of Europe, Siberia and Greenland
***Juncetea trifidi* Hadač in Klika et Hadač 1944**
Acidophilous grasslands in the alpine belt of the nemoral zone of Europe, the Caucasus and in the boreo-arctic and arctic zones of Northern Europe and Greenland
***Elyno-Seslerietea* Br.-Bl. 1948**
Alpine and subalpine calcicolous swards of the nemoral mountain ranges of Europe

1.4. VEGETATION OF THE STEPPE ZONE
1.4.1. ZONAL STEPPE GRASSLANDS
***Festuco-Brometea* Br.-Bl. et Tx. ex Soó 1947**
(syn. *Thero-Brachypodietea* Br.-Bl. in Br.-Bl. et al. 1947 p.p.)
Dry grassland and steppe vegetation of mostly base- and colloid-rich soils in the submediterranean, nemoral and hemiboreal zones of Europe

1.5. VEGETATION OF THE MEDITERRANEAN ZONE
1.5.1. ZONAL MEDITERRANEAN FORESTS AND SCRUB
***Quercetea ilicis* Br.-Bl. ex A. Bolòs et O. de Bolòs in A. Bolòs y Vayreda 1950**
Thermo-mesomediterranean pine and oak forests and associated macchia of the Mediterranean
***Ononido-Rosmarinetea* Br.-Bl. in A. Bolòs y Vayreda 1950**
(syn. *Erico-Cistetea* Trinajstić 1985)
Mediterranean scrub (tomillar, espleguer, romeral, garrigue, phrygana, batha) on base-rich substrates

1.5.2. INTRAZONAL MEDITERRANEAN SCRUB
Nerio-Tamaricetea* Br.-Bl. et O. de Bolos 1958
Circummediterranean and Macaronesian riparian scrub
1.5.3. INTRAZONAL MEDITERRANEAN GRASSLANDS AND HERBLANDS
***Lygeo sparti-Stipetea tenacissimae* Rivas-Mart. 1978 nom. conserv. propos.**
(syn. *Thero-Brachypodietea* Br.-Bl. in Br.-Bl. et al. 1947 p.p.)
Circum-mediterranean pseudosteppes on calcareous rocky substrates and relict edaphic steppes on deep clayey soils
***Helianthemetea guttati* Rivas Goday et Rivas-Mart. 1963**
Mediterranean and submediterranean-atlantic annual low-grown ephemeral herb- and grass-rich vegetation on acidic substrates
***Stipo-Trachynietea distachyae* S. Brullo in S. Brullo et al. 2001**
Mediterranean calciphilous annual and ephemeroid swards and grasslands

2. AZONAL VEGETATION
2.1. ALLUVIAL FORESTS AND SCRUB
***Alno glutinosae-Populetea albae* P. Fukarek et Fabijanić 1968**
Riparian gallery forests of the Eurosiberian and Mediterranean regions
***Salicetea purpureae* Moor 1958**
Willow and tamarisk scrub and low open forests of riparian habitats in the temperate to arctic zones of Europe and Greenland

2.2. SWAMP FORESTS AND SCRUB
***Alnetea glutinosae* Br.-Bl. et Tx. ex Westhoff et al. 1946**
European mesotrophic regularly flooded alder carr and birch wooded mires
***Franguletea* Doing ex Westhoff in Westhoff et Den Held 1969**
Willow carr of Western Europe, Fennoscandia and the subatlantic regions of Central Europe

2.3. VEGETATION OF COASTAL CLIFFS AND DUNES
***Crithmo-Staticetea* Br.-Bl. in Br.-Bl. et al. 1952**
Rupicolous vegetation of salt-sprayed coastal cliffs of the Atlantic and Mediterranean seaboards of Europe, North Africa and Middle East

2.4. VEGETATION OF ROCK CREVICES AND SCREES
***Adiantetea* Br.-Bl. et al. 1952**

Relict chomophytic and chasmophytic vegetation in the shaded and water-splashed habitats of the Mediterranean, the Atlantic islands, North Africa and Middle East

***Polypodietea* Jurko et Peciar ex Boşcaiu, Gergely et Codoreanu in Raţiu et al. 1966**

Chomophytic, chasmophytic and epiphytic vegetation of fern- and moss-rich communities in crevices and on the surface of rocky cliffs of temperate and mediterranean Europe

***Asplenietea trichomanis* (Br.-Bl. in Meier et Br.-Bl. 1934) Oberd. 1977**

Chasmophytic vegetation of crevices, rocky ledges and faces of rocky cliffs and walls of Europe, North Africa, Middle East, the Arctic archipelagos and Greenland

***Cymbalario-Parietarietea diffusae* Oberd. 1969**

Thermophilous chasmophytic vegetation of walls of the Mediterranean and the winter-mild atlantic to subcontinental regions of temperate Europe, Middle East and North Africa

***Thlaspietea rotundifolii* Br.-Bl. 1948**

Vegetation of scree habitats and pebble alluvia of the temperate, boreal and oromediterranean Europe and the Arctic archipelagos

***Drypidetea spinosae* Quézel 1964**

Vegetation of scree habitats and pebble alluvia of in the submediterranean montane and supra-oromediterranean belts of the Central and Eastern Mediterranean and the Black Sea seaboards

2.5. VEGETATION OF ARCTIC-ALPINE VEGETATION OF SNOW-RICH HABITATS

***Salicetea herbaceae* Br.-Bl. 1948**

Arctic and alpine-subnival snow-bed vegetation at high altitudes of the mountain ranges of Eurasia and the Arctic Ocean islands

2.6. VEGETATION OF SALINE AND BRACKISH WATERS AND SWAMPS

***Zosteretea* Pignatti 1953**

Vegetation of sea-grass meadows on muddy and sandy submerged substrates of the temperate and subarctic seas surrounding Europe

***Halodulo wrightii-Thalassietea testudinum* Rivas-Mart. et al. 1999**

Vegetation of eel-grass swards on muddy and sandy substrates of subtropical and tropical seas fringing Atlantic Ocean

***Ruppietea maritimae* J.Tx. ex Den Hartog et Segal 1964**

Submerged rooted herbaceous vegetation of brackish waters of the World

Juncetea maritimi* Br.-Bl. in Br.-Bl. et al. 1952

Perennial grasslands and herb-rich vegetation of coastal and inland salt-marshes and sea-cliffs of the Mediterranean Sea and the Atlantic and Arctic Oceans

2.7. FRESHWATER AQUATIC VEGETATION

***Lemnetea* O. de Bolòs et Masclans 1955**

Free-floating duckweed vegetation of still and relatively nutrient-rich freshwater bodies of the Holarctic

***Potamogetonetea* Klika in Klika et Novák 1941**

Vegetation of rooted floating or submerged macrophytes of stagnant mesotrophic, eutrophic and brackish freshwater bodies and slowly flowing shallow streams of Eurasia

2.8. VEGETATION OF FRESHWATER SPRINGS, SHORELINES AND SWAMPS

***Montio-Cardaminetea* Br.-Bl. et Tx. ex Klika et Hadač 1944**

Vegetation of water springs of Europe, the European Arctic archipelagos and Greenland

***Isoëto-Nanojuncetea* Br.-Bl. et Tx. in Br.-Bl. et al. 1952**

Pioneer ephemeral dwarf-cyperaceous vegetation in periodically freshwater flooded habitats of Eurasia

***Phragmito-Magnocaricetea* Klika in Klika et Novák 1941**

Reed swamp, sedge bed and herbland vegetation of freshwater or brackish water bodies and streams of Eurasia

2.9. VEGETATION OF BOGS AND FENS

***Scheuchzerio palustris-Caricetea fuscae* Tx. 1937**

Sedge-moss vegetation of fens, transitional mires and bog hollows in the temperate, boreal and Arctic zones of the Northern Hemisphere

***Oxycocco-Sphagnetea* Br.-Bl. et Tx. ex Westhoff et al. 1946**

Dwarf-shrub, sedge and peat-moss vegetation of the Holarctic ombrotrophic bogs and wet heath on extremely acidic soils

3. ANTHROPOGENIC VEGETATION

***Papaveretea rhoeadis* S. Brullo et al. 2001 nom. conserv. propos.**

(syn. *Stellarietea mediae* Tx. et al. in Tx. 1950, *Secalinetea* Br.-Bl. in Br.-Bl. et al. 1952)

Annual weed segetal vegetation of arable crops, gardens and vineyards in the cool-temperate and boreal zones of Eurasia

***Sisymbrietea* Gutte et Hilbig 1975**

Zoo-anthropogenic and modern anthropogenic vegetation of animal shelters and disturbed ruderal sites in cool- and cold-temperate regions of Eurasia

***Chenopodietea* Br.-Bl. in Br.-Bl. et al. 1952**

Winter-annual weed segetal and ruderal vegetation of man-made habitats of the Mediterranean, the mild-winter Atlantic seaboards and Macaronesia

***Digitario sanguinalis-Eragrostietea minoris* Mucina, Lososová et Šilc 2016**

Thermophilous grass-rich anthropogenic vegetation rich

in summer-annual C4 species in the southern nemoral, mediterranean, steppe and semi-desert zones of Europe

***Polygono-Poetea annuae* Rivas-Mart. 1975**

(syn. *Plantaginetea majoris* Tx. et Preising in Tx. 1950 p.p.)

Subcosmopolitan therophyte-rich dwarf-herb vegetation of trampled habitats

***Artemisietea vulgaris* Lohmeyer et al. in Tx. ex von Rochow 1951**

(syn. *Agropyretea intermedio-repentis* T. Müller et Görs 1969)

Perennial (sub)xerophilous ruderal vegetation of the temperate and submediterranean regions of Europe

***Epilobietea angustifolii* Tx. et Preising ex von Rochow 1951**

Tall-herb semi-natural perennial vegetation on disturbed forest edges, nutrient-rich riparian fringes an in forest clearings in the temperate and boreal zones of Eurasia

***Bidentetea* Tx. et al. ex von Rochow 1951**

Summer-annual pioneer vegetation of seasonally flooded nutrient-rich river alluvia, lacustrine banks and heavily nutrient-loaded anthropogenic habitats of boreo-temperate Europe and North Africa ●