

# THE VEGETATION OF THE BUNA RIVER PROTECTED LANDSCAPE (ALBANIA)

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## Abstract

The vegetation of Buna River Protected Landscape is described. The area comprises both the alluvial plain of the lower course of the Buna river that marks the boundary between Montenegro and Albania, and a carbonatic range. The vegetation is characterized by a high  $\beta$ -diversity (27 alliances and 46 associations), especially in wetlands and dry grasslands. In the area it is possible to distinguish 1 dunal and 4 hygro-sequences in the alluvial plain and 3 xeroseries in the carbonatic range. Associations *Clematido viticellae-Punicetum granati* and *Periploco graecae-Alnetum glutinosae* are described as new.

**Key words:** aquatic vegetation, Albania, Buna River, alluvial forests, dry grasslands, marshlands, shrublands, xerothermophilous forests.

## Izvešček

V članku je opisana vegetacija v zavarovanega območja ob reki Buna. Območje obsega aluvialno ravnino ob spodnjem teku reke Buna, ki predstavlja mejo med Črno goro in Albanijo in karbonatnim hribovjem. Za vegetacijo je značilna visoka  $\beta$  diverziteta (27 zvez in 46 asociacij), še posebej pa mokrišča in suha travišča. V območju smo izločili 1 sekvenco na sipinah, 4 higro sekvence na aluvialni ravnici in 3 ksero serije na karbonatnem masivu. Asociaciji *Clematido viticellae-Punicetum granati* in *Periploco graecae-Alnetum glutinosae* sta novo opisani.

**Ključne besede:** vodna vegetacija, Albanija, reka Buna, poplavni gozdovi, suha travišča, močvirja, gmnišča, kserotermofilni gozdovi.

## 1. INTRODUCTION

The Buna River Protected Landscape extends for about 20000 ha and is located between the last 15 km of the northern Albanian coast and the Buna river, which here forms the border with Montenegro (Figure 1). The Buna river is the outflow of the Skadar Lake and has the Drin River, the longest river in Albania, as main tributary. The strong river flow created one of the most important wetland systems in Albania providing important habitats for many animal and plant species. The sediments of Buna have an important role for the

morphology of the coastline, which is subject to strong erosion. According to old descriptions (Reiser & Fuhrer 1896, Kárpáti & Kárpáti 1961, Kárpáti 1962), the Buna Landscape was an impressive wilderness area. However, likewise other Mediterranean wetland areas it has been strongly transformed during the last decades. Between 1947 and 1980 about 36 km<sup>2</sup> of agricultural lands were reclaimed, extending the only 2 km<sup>2</sup> agricultural land that existed before. In the early '70s a system of hydrovors was installed functional to the new drainage-irrigation canal system. In the '80s three dams and a huge hydropower reservoir

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were built along the Drin River. These works have deeply changed the hydrogeological system and the land-use of the area: the Buna flooding and the amount of water greatly decreased and much of the inner land was converted into agricultural use. However, as in some other Albanian border areas, the area was under military protection until 1991, and due to this status, was effectively protected. In 1991, the status of the area changed, and a rapid development of touristic infrastructures began especially along the coast.

Despite these changes the Buna river area still hosts a great diversity of important habitats and species deserving careful conservation policies. For this purpose the Albanian government in 2005 decided to establish the Buna River Protected Landscape for which an integrated and systemic management plan is in preparation (Guillet et al. 2012). The analysis of the plant communities represents important information for the elaboration of such plan. However, existing literature about vegetation is rather sparse and heterogeneous with few phytosociological studies (Kárpáti & Kárpáti 1961, Kárpáti 1962, Mullaj 1986, Mullaj et al. 2000). The study of the vegetation of Albania begun, apart from a few pioneering works (Markgraaf 1932), in the late '80s (e.g. Buzo 1990). However, only recently Albanian authors adopted the Zürich-Montpellier method (e.g. Kalajnxhiu et al. 2011) and a first synthesis based on this approach can be found in Dring et al. (2002). Nonetheless the phytosociology of Albania is still imperfectly known and this study represents a significant contribution to the knowledge of the vegetation of this country.

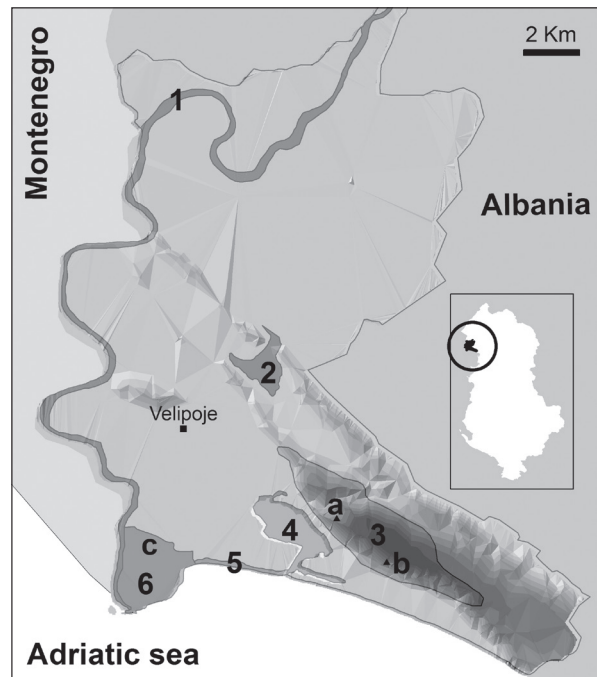
## 2. METHODS

### STUDY AREA

The Buna River Protected Landscape includes the area along the Buna river, after the confluence with the Drin near the Skadar Lake, its delta on the Adriatic Sea and the area around the Viluni lagoon (Figure 1).

The protected area includes three main land unit systems:

- 1) an alluvial plain composed of holocenic loams deposited by the Buna river (Frasheri et al. 2006) with marshlands, alluvial and riverine forests, and lagoons;
- 2) a carbonatic outcrop with arid Mediterranean



**Figure 1:** Location of the Buna River Protected Landscape. 1: Buna River; 2: Domni marsh; 3: Black Peak (Maja e Zezë); 4: Viluni lagoon; 5: Rjolla Beach (Bacs Rrjoli); 6: Velipojë Reserve; a: Black Peak; b: Mount Nikgionih (Mali i Nikgjonit); c: Campo di Marina (Kampi veror).

**Slika 1:** Lokacija zavarovanega območja ob reki Buna. 1: reka Buna; 2: močvirje Domni; 3: Črni vrh (Maja e Zezë); 4: laguna Viluni; 5: plaža Rjolla Beach (Bacs Rrjoli); 6: rezervat Velipojë; a: Črni vrh; b: gora Nikgionih (Mali i Nikgjonit); c: Campo di Marina (Kampi veror).

- vegetation. The carbonatic range extends in SE–NW direction and is composed of upper Cretaceous–Paleocene limestones and dolomites; at the base there are layers of upper Oligocene flysch with intercalations of clays. The range reaches 500 m of altitude in the Black Peak (Maja e Zezë);
- 3) a coastal holocenic dune system, composed of sands deposited by the Buna river.

The climate is Mediterranean, characterized by dry-hot summers and mild-wet winters. The wind of murrilan, which is very characteristic of the area, makes the winters harsh; whereas in the summer the wind of Shiroku brings humidity. Mean annual rainfall and temperature are 1075 mm and 15,3 °C respectively. Precipitation is concentrated in the period from November to April (70–80% of total annual). In January mean temperature is between 5 and 8 °C while in July it can range between 24 and 26 °C (PHARE 2002).

## DATA COLLECTION AND ANALYSIS

Phytosociological investigation was performed according to Braun-Blanquet (1964) and Westhoff & van der Maarel (1978). Data on vegetation were obtained through 188 relevés (for a total of 389 vascular plant taxa) carried out in June–July and September 2012–2013. At each site the relevés were selected in relation to the homogeneity of physical features and vegetation structure. Plot sizes ranged from 150 m<sup>2</sup> to 1 m<sup>2</sup> (Table 4) depending on the plant community. Cover/abundance data for all vascular plants were recorded in the field using a modified Braun-Blanquet scale (Barkman et al. 1964).

Vascular plants were identified using the “Flora e Shqipërisë” (Paparisto et al. 1988, Qosja et al. 1992, 1996, Vangjeli et al. 2000), “Flora ekskursioniste e Shqipërisë” (Demiri 1983) and “Flora Europaea” (Tutin et al. 1964–80, 1993), taxon nomenclature follows the latter, except for *Asphodelus* (Diaz-Lifante & Valdés 1996), *Bupleurum* (Snogerup & Snogerup 2001), *Salicornia* (Kadereit et al. 2007, Kadereit et al. 2012) and *Bolboschoenus* (Hroudová et al. 2007).

A database was created in TURBOVEG (Henekens & Schaminée 2001) and data were then exported as percentages for further analyses.

The names of identified syntaxa have been chosen according to the nomenclatural rules codified in the Third Edition of the International Code of Phytosociological Nomenclature (Weber et al. 2000) and the syntaxonomic scheme has been formulated according to the current knowledge about Albanian vegetation and that of neighboring regions.

The data collected were used to create a plots-vs-species matrix. Plant communities of marshlands, aquatic vegetation and sand dunes which are characterized by mono- or paucispecific composition were identified only according to expert knowledge and scientific literature. Conversely two classification procedures were performed on ecologically homogeneous aspects such as the alluvial forests and the vegetation of the carbonatic outcrop. Using the program Syn-Tax v. 5.0 (Podani 2001) a hierarchical agglomerative clustering was used, with Euclidean distance as the similarity coefficient and complete linkage as the method for grouping the formation. Data were log transformed (base 10) in order to reduce skewness and kurtosis (e.g. Johnson & Wichern 2007). Since the syntaxonomy of Albanian veg-

etation is still to be completely defined, in order to support the phytosociological interpretation of the plant communities of the Buna Landscape we identified diagnostic species also using the fidelity coefficient of Tichý & Chytrý (2006) with a simultaneous calculation of Fisher's exact test in the JUICE program with  $P < 0.001$ . To avoid phi coefficient being dependent on the size of the target site group, group size was standardized to equal the average size of all groups present in the entire data set (Tichý & Chytrý 2006).

## 3. RESULTS AND DISCUSSION

Through the analysis of the relevés 46 plant communities have been identified and classified in 27 alliances, 23 orders and 17 classes. They are distributed in 1 dunal and 4 hygro-sequences in the alluvial plain and 3 xeroseries in the carbonatic range. Below these communities and the vegetation sequences are described and discussed in the same order of the syntaxonomical scheme.

### BRACKISH AND HALOPHILOUS VEGETATION

***Ruppium cirrhosae* Iversen 1934** (Table 1)  
= ass. *Ruppia maritima* Hocquette 1927, *Ruppium spiralis* Hocquette 1927 corr. Iversen 1934

In the Viluni lagoon the vegetation of the shallow waters is represented mainly by dense populations of *Ruppia cirrhosa* together with undetermined filamentous algae. The association is abundant close to the mouth of the Lagoon where there is an inflow of salt water, and rarer on the northern coast, where waters are less brackish.

The community is widespread in European lagoons (e.g. Schaminée et al. 1996, Rivas-Martinez et al. 2001) and has been reported for Albania by Mullaj (1989) and Ruci et al. (1995).

***Salicornietum venetae* Pignatti 1966** (Table 2)  
= *Salicornietum emerici* O. de Bolòs ex Brullo & Furnari 1976

On the shores of the Viluni lagoon, in particular near the mouth that connects the lagoon to the sea, there are mud-flats with extensive, almost monospecific populations of *Salicornia*. Closer to the water, where the inundation is prolonged, the dominant species is the tetraploid *Salicornia procumbens* (= *S. emerici*, *S. dolichostachya*, *S. veneta*, *S. stricta*). Beyond this belt, where inundation

is shorter, the dominant species is the diploid *Salicornia perennans* (= *S. patula*, *S. prostrata*). The two vegetation belts are particularly evident in October–November, when *Salicornia procumbens* becomes brilliant red, whereas *Salicornia perennans* remains dirty green.

The vegetation of *Salicornia procumbens* is represented by dense populations 20–30 cm tall. They usually are monospecific (rel. 100), but it is often possible to observe a transitional belt with *Limonium vulgare* subsp. *serotinum*.

The taxonomy of annual *Salicornia* is notoriously difficult, and this complicates the syntaxonomy of the annual halophilous vegetation, based largely on the distinction between the many microspecies (Loidi et al. 1999). Recently, molecular phylogenetics has greatly clarified the taxonomical problems of *Salicornia* (Kadereit et al. 2007, 2012). Although a few problems remain, the classification proposed by these authors is much simpler than earlier attempts (e.g. Ball & Akeroy 1993, Iberite 1996), recognizing only one tetraploid taxon, *Salicornia procumbens*, and two diploid taxa in Europe, *Salicornia europaea* in the Atlantic coasts and *Salicornia perennans* in the Mediterranean basin and in East Europe. The many tetraploid species recognized so far (*Salicornia veneta*, *Salicornia dolichostachya*) are only growth forms of a single species and, in fact, they are morphologically and ecologically similar (Teege et al. 2011). This fact has important consequences for the syntaxonomy, since it means that many associations are probably synonyms.

In study area, *Salicornietum venetae*, considered endemic of the Venice Lagoon (Géhu et al. 1984b, Géhu & Biondi 1996), is in fact a synonym of *Salicornietum emerici*, widespread in the Mediterranean basin (Bolòs 1962, 1967, Brullo et al. 1988, Loidi et al. 1999, Frondoni & Iberite 2002). *Salicornia veneta* is a luxuriant growth-form of *Salicornia procumbens*, but the poor floristic composition is similar in the two associations. In the future it will be advisable to mutate the name according to modern taxonomy, but for the time being we refrain from proposing a *nomen mutatum*, first because Art. 45 dictates that a *nomen mutatum* should be proposed only if the name of taxon on which the association is based is no longer in use for at least 20 years (Weber et al. 2000), second because adopting the name *Salicornia procumbens* for all tetraploid species will cause *Salicornietum venetae* to fall in synonymy with *Salicornietum dolichostachyae* Géhu & Géhu-

Franck 1984, widespread on the Atlantic coasts in intertidal mud flats and therefore with a different ecology (Ellenberg 1996).

The Association *Limonium vulgare* + *Salicornia europaea* (Buzo 1990), described from Poro, Se-man and Divjaket (Southern Albania) in retrodunal depressions, is with all probability identical to our community even if it is not possible to identify with certainty which annual *Salicornia* is reported in the table.

***Suaedo spicatae*-*Salicornietum patulae* (Brullo & Furnari 1976) Géhu & Géhu-Franck 1984. corr. Alcaraz, Ríos, De la Torre, Delgado & Inocencio 1998**

= *Salicornietum patulae* Brullo & Furnari 1976 non Christiansen 1955, *Suaedo vulgaris*-*Salicornietum patulae* (Brullo & Furnari) Géhu & Géhu-Franck 1984; *Suaedo maritimae*-*Salicornietum patulae* Brullo & Furnari ex Géhu & Géhu-Franck 1984 corr. Rivas-Martínez 1990

*Salicornia perennans* vegetation is not widespread in the Velipoje area. It occurs only in the Viluni lagoon in sites with shorter inundation than those of *Salicornietum venetae* and in Campo di Marina (Kampi veror) lagoon. We did not carry out relevés of these monospecific stands, but they can be referred to rather fragmentary aspects of *Suaedo spicatae*-*Salicornietum patulae*.

***Puccinellio festuciformi*-*Aeluropetum litoralis* (Corb 1968) Géhu & Costa 1984 (Table 3)**

This community refers to a low scrub vegetation with grasses and succulent chenopods that develops extensively on saline muds surrounding the Viluni lagoon. These perennials occupy a belt back of the annual *Salicornia* stands near the water. The community is absent in Campo di Marina (Kampi veror), where the zonation of the shore vegetation is otherwise similar to that of the Viluni lagoon. Floristically this community is characterized by the co-occurrence of *Aeluropus littoralis*, *Halimione portulacoides* and *Suaeda maritima*.

Among the many associations that have been described in the Mediterranean basin, often on the base of subtle differences (Brullo et al. 1988, Rivas-Martínez et al. 2001) and in the Danube delta and Black Sea (summarized in Tzonev et al. 2008), our relevés are more similar to the *Puccinellio-Aeluropetum litoralis*, although *Puccinellia festuciformis* is lacking, and particularly to the relevés 1–5 in Table 21 in Géhu et al. (1984a) from Ferrara (Italy).

***Juncetum maritimo-acuti* Horvatić 1934**  
(Table 4)

This association grows on muds on the shores of the Viluni lagoon and on smaller brackish ponds not far from the sea. It is characterized by the dominance of *Juncus acutus* and *Juncus maritimus*, among which succulents grow such as *Halimione portulacoides*, *Artemisia coerulescens* and *Limonium vulgare* subsp. *serotinum*. The floristic composition matches in some way the *Limonio-Artemisietum coerulescentis* Horvatić (1933) 1934 corr. Géhu & Biondi 1996, the only distinction being the presence of an upper layer dominated by *Juncus acutus*.

*Juncus acutus* and *Juncus maritimus* communities are widespread in the Mediterranean basin and along the Southern Atlantic coasts (Molinier & Tallon 1965), with a rather constant composition. We can refer without any doubt our association to *Juncetum maritimo-acuti*, that has been described from Dalmatia (Horvatić 1934, 1963), but also reported with similar aspects in Italy both along the Adriatic coast (Pignatti 1966 sub *Juncetum maritimi* Pignatti 1953, Brullo et al. 1988, Poldini 1989, Pirone 1995a sub *Juncetum acuti* Molinier & Tallon 1970) and in the central Tyrrhenian coast (Frondoni & Iberite 2002). In Albania it has been already reported for Lalzi Bay near Durres (Imeri et al. 2010a).

***Juncus maritimus* and *Lippia nodiflora* community** (Table 5)

This community develops on the shores south of the Viluni lagoon, in retrodunal depressions characterized by moderately brackish waters. This community is dominated by *Juncus acutus* and *Juncus maritimus*, but the coverage is lower than that of *Juncetum maritimo-acuti* and the floristic composition characterized by species such as *Lippia nodiflora* and *Inula viscosa*. The retrodunal depressions where this community occurs have been partly dismantled by erosion, so that there is an ingression of elements from sand-dunes (*Euphorbia paralias*, *Elymus farctus*). Other halophytes are *Crypsis aculeata*, *Sonchus maritimus*, *Artemisia coerulescens* and *Plantago crassifolia*, suggesting a synclassification in *Plantaginion crassifoliae*. This community shows many similarities with *Juncetum acuti* Molinier & Tallon 1970 from Camargue in France, (Molinier & Tallon 1970), but there *Lippia nodiflora* is lacking.

The community is strongly disturbed by erosion and grazing by cattle, and therefore we refrain from a formal description.

PSAMMOPHILOUS VEGETATION

***Cakilo-Xanthietum italicae* Pignatti 1953**  
(Table 6)

= *Salsolo kali-Cakiletum maritimae xanthietosum* (Pignatti 1953) Géhu & Scoppola 1984 in Géhu et al. 1984

This community develops on the foredunes near the shore in correspondence with the mouth of the Buna River. Structurally, it is a sparse grassland, 20–30 cm tall, dominated by succulent species. The floristic composition is typical, with *Cakile maritima*, *Salsola kali*, *Polygonum maritimum*, *Xanthium orientale* subsp. *italicum*, and a few species from *Ammophiletalia* such as *Sporobolus pungens* and *Echinophora spinosa*.

This association was described for the Venice Lagoon (Pignatti 1953) and is distinct from other *Cakiletea* associations mainly by the presence of *Xanthium orientale* subsp. *italicum*. *Cakilo-Xanthietum* is present on the Adriatic and Ionian coasts of Italy (e.g. Biondi et al. 1989, Corbetta et al. 1989 sub *Salsolo-Cakiletum aegyptiacae* Costa et Manzanet 1981 sub *salsolo xanthietosum* Géhu et Scoppola 1984) and Greece (Sykora et al. 2003); it seems to be lacking in France and on the Tyrrhenian coasts of Italy (Braun-Blanquet et al. 1952). The association is reported from Albania by Imeri et al. (2010a) with the incorrect name of *Cakilo-Xanthietum strumarium* (Beg. 1941) Pign. 1958 and under the name *Salsola kali-Xanthium strumarium* association by Buzo (1990).

In our relevés two subspecies of *Salsola kali* occur together in equal proportions, *Salsola kali* subsp. *kali* and *Salsola kali* subsp. *tragus*. Subspecies of *S. kali* are rarely reported in the phytosociological literature, being rather difficult to distinguish, but they are probably ecologically quite distinct.

FRESHWATER AQUATIC VEGETATION

***Hydrocharitetum morsus-ranae* van Langendonck 1935** (Table 8)

This community occurs in several canals and ditches near Velipoje with clear, slowly flowing water. It is characterized by the dominance of *Hydrocharis morsus-ranae*, a species classified as vulnerable in Albania (Vangjeli et al. 1995).

The association is widespread in Europe, in mesotrophic slowly flowing waters (Šumberová 2011a).

***Nymphaetum albae* Vollmar 1947** (Table 9)

The community mainly occurs along the drainage canals in very slow-flowing waters about 1 meter deep. It is dominated by *Nymphaea alba* and a few other species. *Nymphaetum albae* is characteristic of mesotrophic waters and has a strong capacity of filling of the water-bodies due to the high biomass production (Šumberová 2011b).

This community was probably much more widespread in the past. The description in Kárpáti (1962) seems to indicate that *Nymphaeion* communities were very frequent on the floodplain of the Buna. The terrestrialization of the floodplain may be related to natural phenomena of succession, but also to the lowering of the water table due to the artificial drainage.

***Trapaetum natantis* Kárpáti 1963** (Table 10)

This community occurs in a canal of the Domni marsh. It is characterized by the dominance of *Trapa natans*, which covers completely the water, and is accompanied by a few other species. This association has already been reported for the Buna river near the Shkodra Lake and is very rare in Albania (Schneider-Jacoby et al. 2006).

***Potamogetonetum denso-nodosi* O. de Bolòs 1957** (Table 11)

= *Potametum nodosi* (Soó 1960) Segal 1964

This community develops in the Buna River, close to the shore where the water is 60 cm deep. From a floristic point of view, as a community of submerged hydrophytes, it is rather rich with many *Potamogeton* species dominated by *Potamogeton nodosus*; this richness is probably due to low turbidity of the waters of the Buna.

The community is typical of rivers and other habitats with flowing waters, and is generally widespread but rarer in southern Europe (Bolòs 1962, Šumberová 2011b).

***Potamogetonetum pectinati* Carstensen ex Hilbig 1971** (Table 12)

This community is widespread in the Buna river. It occurs in relatively deep water (1–3 m), where it forms extensive populations, but also close to the shore where the slope of the river bank is steep. The floristic composition is dominated by *Potamogeton pectinatus*, with low frequency of other *Potamogeton* (*P. crispus*, *P. nodosus*, *P. perfoliatus*).

This association has a rather broad ecological range, but usually occurs in mesotrophic to

eutrophic waters (Testi et al. 2009, Šumberová & Chytrý 2011).

***Elodeetum canadensis* Nedelcu 1967** (Table 13)

*Elodea canadensis* community can be found along the Buna river, where this species forms a dense population. The community substitutes the *Potametum denso-nodosi* in disturbed areas. In Albania the association has been also reported for the Ohrid lake (Imeri et al. 2010b).

### SWAMP VEGETATION OF FRESH AND BRACKISH WATERS DOMINATED BY GRAMINOIDS AND SEDGES

***Typhetum angustifoliae* Pignatti 1953** (Table 14)

This community is one of the most striking physiognomies of the study area. It occurs in Domni marsh and in other sites of the alluvial plain where populations of *Typha angustifolia* form dense swards about 2 m tall. The community is more or less monospecific, and develops on soils inundated in winter, but that dry out in summer, leaving a thin veil of water on the damp ground. The vegetation is subjected to fires set on by farmers to open the vegetation for grazing, but this practice does not seem to negatively affect *Typha angustifolia* but, on the contrary, to increase its cover.

The wide diffusion of *Typha angustifolia* is probably related to the draining of the marshland. *Typha angustifolia* typically grows in deeper still waters, particularly in lakes and closed ditches (Pignatti 1953, Šumberová & Chytrý 2011).

***Typhetum latifoliae* Nowiński 1930** (Table 15)

= *Typhetum latifoliae* Soó 1927 nom. nudum, *Typhetum latifoliae* Lang 1973

This vegetation is characterized by a dense reed-bed, 150–160 cm tall. It grows on the banks of the Buna river where the water depth is about 10–20 cm. The community develops in an intermediate belt between the *Phragmites australis* and *Bolboschoenus maritimus* communities.

The community is widespread in Europe, in particular, in eutrophic waters in ditches and along river banks (e.g. Chytrý et al. 2011).

***Phragmitetum australis* Savič 1926 nom. mut. prop.** (Table 16)

This vegetation occurs along the Buna river in particular where the flow is slow, but also on

the shores of the Viluni lagoon, where the water is less brackish; in fact *Phragmites australis* is only weakly halotolerant (Pignatti 1952, 1953). The species needs almost constant inundation and rather deep waters (50–100 cm).

This community is a dense reed-bed 1.7–3 m tall, characterized by the dominance of *Phragmites australis*, which is accompanied by a few species (*Bolboschoenus maritimus*, *Iris pseudacorus* and *Rumex hydrolapathum*). In many stretches, the community is monospecific.

The community is very widespread (Šumberová & Chytrý 2011) and in the Mediterranean basin has been referred to a different association, *Typho angustifoliae-Phragmitetum australis* (Tüxen & Preising 1942) Rivas-Martínez, Bácscones, T.E. Díaz, Fernández-González & Loidi 1991 = *Scirpo-Phragmitetum mediterraneum* Tüxen & Preising 1942 (Braun-Blanquet et al. 1952, Rivas-Martínez et al. 2001). However the floristic composition is so poor that it is difficult to make distinctions, although ecological differences certainly exist between water bodies in temperate and Mediterranean Europe.

#### ***Scirpetum lacustris* Chouard 1924** (Table 17)

= *Schoenoplectetum lacustris* Chouard 1924 nom. mutatum prop.

This community is restricted to the Buna river, near the banks, in the first helophytic belt at a water depth of 0.3–0.5 m, where it forms tall, dense stands. The association is usually mesotrophic to slightly eutrophic (Šumberová & Chytrý 2011).

The association is widespread, but usually referred to a facies of *Scirpo-Phragmitetum* Koch 1926 and therefore its distribution is imperfectly known.

#### ***Glycerio-Sparganietum neglecti* Koch 1926**

(Table 18)

This plant community is generally found in the alluvial plain near Velipoje, in clear, slowly flowing waters, 30–40 cm deep. The community forms a dense reed-bed 120–130 cm tall. *Sparganium erectum* is dominant, but other helophytes are frequent. The association is floristically interesting, in particular for the presence of two species rare in Albania, *Butomus umbellatus* and *Hydrocharis morsus-ranae* (Ruci et al. 2000).

This association is widespread in Europe (e.g. Schaminée et al. 1996), where is often reported under the pseudonyms *Sparganietum ramosi* Roll 1938 or *Sparganietum erecti* Zutshi 1975 (Dengler

et al. 2004, Šumberová & Chytrý 2011) and has been reported for Albania in the Ohrid lake (Imeri et al. 2010b).

#### ***Scirpetum maritimo-litoralis* (Br.-Bl. in Br.-Bl., Roussine & Nègre 1952) O. de Bolòs 1962**

(Table 19)

= *Scirpetum maritimo-litoralis* Br.-Bl. 1931 nomen nudum, *Scirpetum compacto-litoralis* (Br.-Bl. in Br.-Bl., Roussine & Nègre 1952) O. de Bolòs 1962 corr. Rivas-Martínez, Costa, Castroviejo & E. Valdés 1980

This association is a relatively sparse reed-bed, 100–170 cm tall, that grows in the brackish water on the northern side of the Viluni lagoon and at the mouth of the Buna river. It occupies an intermediate belt between the *Phragmites australis* and the *Scirpus litoralis* communities in water with a depth between 15 and 20 cm.

The floristic composition is poor, and is characterized by the dominance of *Bolboschoenus maritimus*, often associated with *Phragmites australis*.

A number of associations with *Bolboschoenus maritimus* have been described around the Mediterranean basin and in continental Europe (e.g. Rivas-Martínez et al. 2001). These are usually floristically poor, and their interpretation is therefore difficult. Probably different aspects, related to different ecological conditions occur.

Our relevés are very similar to those from Provence (Braun-Blanquet et al. 1952), Catalonia (Bolòs 1962) and the coasts of Croatia (Horvatić 1963). They are instead quite different from those of the association *Scirpetum maritimi* Tüxen 1937, described for the Venice lagoon (Pignatti 1966), that after Géhu & Biondi (1996) should be referred to a different association.

This association is reported for Albania (Mullaj et al. 2000, Imeri et al. 2010a) under the pseudonym *Bolboschoenetum maritimi* Eggler 1933 = *Bolboschoenetum yagarae* Eggler 1933 corr. Hroudova et al. 2009, which instead corresponds to a different freshwater vegetation (Hroudová et al. 2009).

The taxonomy of *Bolboschoenus* has been recently reviewed (Hroudová et al. 2009) and *Scirpus compactus* has fallen in synonymy with *Bolboschoenus maritimus*. This makes superfluous the correction of Rivas-Martínez et al. (2001) of *Scirpetum maritimo-litoralis* (Br.-Bl. in Br.-Bl., Roussine & Nègre 1952) O. de Bolòs 1962 into *Scirpetum compacto-litoralis* (Br.-Bl. in Br.-Bl., Roussine & Nègre 1952) O. de Bolòs 1962 corr. Rivas-Martínez, Costa, Castroviejo & E. Valdés 1980.

***Scirpetum litoralis* Pignatti 1953** (Table 20)

This community has been found in the north of the Viluni lagoon, where waters are less saline, and forms a rather sparse reed-bed dominated by *Scirpus litoralis*, in deeper waters than the back-standing *Scirpetum maritimo-litoralis*.

The association is reported for the Venice lagoon, Southern Italy and Tunisia, in slightly brackish, almost still waters (Pignatti 1966).

MEADOWS AND PASTURES OF MOISTER SOILS

***Schoeno-Erianthetum ravennae* Pignatti 1953** (Table 21)

This community grows in depressions north of the Viluni lagoon, and in fragmentary aspects in retrodunal depressions near the sea. It is characterized by large tufts of *Erianthus ravennae* that can be up to 1,7 m tall. A lower layer is dominated by *Schoenus nigricans*, and these two dominant species are accompanied by a number of species of wetlands characterized by a long drought period (*Pulicaria vulgaris*, *Carex punctata* and *Centaureum spicatum*). Also a few subruderal and ruderal subhygrophilous species are present (*Aster squamatus*, *Lotus tenuis*).

The association was described for the Venice lagoon, and is widespread along the Italian coasts (Lucchese & Pignatti 1990, Géhu & Biondi 1996). In Albania it has been reported for the Lalzi bay (Imeri et al. 2010a).

***Paspalo-Agrostidetum* Br.-Bl. 1936 (1952)** (Table 22)

This community has been recorded in the Domni marshland, in an intermediate position between *Typhetum angustifoliae* and *Trifolio-Cynodontetum*, in correspondence with conditions almost as wet as those favouring *Typha angustifolia* but in heavily disturbed areas.

The community of Velipoje is poorer in species

than that of Provence where it has been originally described (Braun-Blanquet et al. 1952), dominated by *Paspalum paspalodes* accompanied with ruderal species such as *Plantago major* and *Rumex conglomeratus*. It is also present in the urban area of Rome with even poorer, almost monospecific aspects (Fanelli 2002).

***Trifolio fragiferi-Cynodontetum* Br.-Bl. & O. de Bolòs 1957** (Table 23)

In the alluvial plain of the Domni marsh, the dense reed beds of *Typha angustifolia* leave place in some spots to a heavily grazed lawn. This lawn is 2–4 cm tall and formed by dense mats of the creeping rhizomatous *Trifolium fragiferum* and *Cynodon dactylon* accompanied by *Mentha pulegium* and *Plantago lanceolata*. The lawn develops where the soil is relatively dry. This condition is less suitable for *Typha angustifolia*, which becomes vulnerable to disturbance and is replaced by the lawn species. This community is highly productive and favoured by cattle, since the nitrogen-fixing *Trifolium* allows a high production of proteins.

This association has been described from Provence, on the floodplain along large rivers (Braun-Blanquet et al. 1952, Bolòs 1962, 1967), but has been reported also from the Danube Plain in Bulgaria (Tzonev 2009). The association is poorly characterized and probably is more widespread than the scanty reports in literature may suggest.

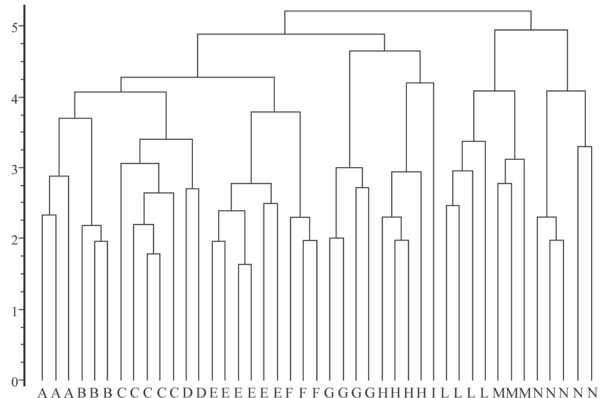
VEGETATION OF THE CARBONATIC OUTCROP

The hierarchical classification identified twelve groups (Figure 2). They include dry grasslands and xerothermophilous forests and shrubs described hereafter. One crevice and one ruderal

**Figure 2:** Dendrogram of the carbonatic range vegetation. The capital letters indicate cluster membership.

**Slika 2:** Dendrogram vegetacije na karbonatnem hribovju. Velike črke predstavljajo uvrstitve v klaster.

- A: *Rhamno-Paliuretum*; B: *Quercio-Carpinetum orientalis*;
- C: *Seslerio-Ostryetum carpiniifoliae*; D: *Acer monspessulanum* community;
- E: *Salvio-Phlomidetum fruticosae*; F: *Brachypodio-Cymbopogonetum hirti*;
- G: *Clematido viticellae-Punicetum granati*; H: *Quercetum trojanae*;
- I: *Seslerio-Putorietum calabrica*;
- L: *Asphodelo-Chrysopogonetum grylli*; *Asphodelus ramosus* community;
- N: *Stipo-Salvietum officinalis*.





community have been also identified and discussed in their specific section.

#### CREVICE VEGETATION OF LIMESTONE FISSURES

##### *Seslerio-Putorietum calabricae* Horvatić 1963 (Table 7; Figure 2, Cluster I)

This single relevé has been carried out on an almost vertical slope of rather friable carbonates, with southern aspect. *Putoria calabrica* was abundant nearby, but on the less steep parts of the slope. The vegetation was rather sparse, with low cover, characterized by the presence of *Sesleria robusta* subsp. *skanderbeggii* and *Moltkia petraea*.

This community can be referred to *Seslerio-Putorietum calabricae* (Horvatić 1963), a coastal association described from Dubrovnik. *Moltkia petraea* has been indicated from a number of associations under different orders and alliances (Lakušić 1968, Georgiou et al. 2000).

#### PERENNIAL GRASSLANDS OF THE MEDITERRANEAN REGION

##### *Stipo-Salvietum officinalis* Horvatić 1958 (Table 24; Figure 2, Cluster N)

This community occurs on steep slopes (20–30°) usually with a W–SW aspect. Soil is very stony (20–80 % rocks and stones) and shallow. It is a grassland relatively sparse and rather tall (on average 80 cm) and dominated by *Stipa bromoides* and *Asphodelus ramosus*. These two species are accompanied by many chamaephytes (*Micromeria juliana*, *Satureja montana*, *Teucrium polium* subsp. *capitatum*). Therophytes are also abundant, in particular the illyric *Bupleurum veronense*. Other therophytes (*Avena barbata*, *Dasyphyrum villosum*, *Carthamus lanatus*) are related to the enrichment of nutrients probably by sheep and goats.

Relevés 62 and 71 represent a transitional aspect with *Bromo-Chrysopogonetum grylli*, since the floristic composition is similar to *Stipo-Salvietum*, but the dominant species is *Chrysopogon gryllus*. This aspect occurs on gentler slopes than typical *Stipo-Salvietum*, on a northern aspect, but again in the lower belt. A few species of *Festuca-Brometea* are restricted to this aspect (*Koeleria splendens*, *Leontodon crispus*); these species indicate a tendency toward cooler conditions.

The association is widespread, in an almost identical aspect, in Dalmatia (Horvatić 1963).

##### *Asphodelo-Chrysopogonetum grylli* Horvatić (1936) 1958 (Table 25; Figure 2, Cluster L)

This community is characterized by the dominance of *Chrysopogon gryllus* that is accompanied by relatively few species of dry grasslands, in particular *Galium lucidum*, *Helianthemum apenninum*, *Stachys recta*, *Onosma arenaria*, *Agropyron elongatum*, *Scabiosa triniifolia* and *Satureja montana*, often with low cover or frequency. *Salvia officinalis* is sometimes rather abundant, whereas therophytes are relatively poorly represented.

This community occurs on slopes steeper than those of *Stipo-Salvietum* (20–40°), usually with a S–W aspect. Stones and rocks have on average a cover of about 30–40%. It occupies an upper belt with respect to *Stipo-Salvietum* (see chapter on zonation).

The association is described from Dalmatia (Horvatić 1958, 1963), and is reported as widespread in Albania by Buzo (1990) (under association *Asphodelus ramosus* + *Chrysopogon gryllus*).

##### *Brachypodio-Cymbopogonetum hirti* Horvatić 1961 (Table 26; Figure 2, Cluster F)

This association is characterized by the dominance of *Hyparrhenia hirta* together with perennial species of Mediterranean dry grasslands, such as *Convolvulus elegantissimus* and *Carlina coymbosa*. A few suffruticose species, probably related to fire, such as *Teucrium polium* subsp. *capitatum*, *Micromeria juliana*, *Petrorhagia saxifraga* are in common with *Stipetum*, but more abundant here.

This association develops on moderate slopes (10–15°) on S or W aspects; bare rock has a very high cover (70–90%) and this community is more stony than any other community of grasslands or garrigues in the study area.

The association can be referred to *Brachypodio-Cymbopogonetum hirti*, described for the southern Dalmatia (Korčula, Hvar, Pag, in Horvatić 1962, 1963). A few associations with *Hyparrhenia hirta* have been described for Catalunya and Italy (Bolòs 1962, Biondi et al. 1988, Fanelli 2002). The community of Velipoje is actually easily distinguished by species with a more or less eastern barycentre of distribution, such as *Convolvulus elegantissimus* and *Micromeria juliana*, but it is ecologically, structurally and floristically very closely related to the communities present in Italy. Buzo (1990) describes for Sarandes an association with *Hyparrhenia hirta* + *Dasyphyrum villosum* that seems different.

***Salvio-Phlomidetum fruticosae* Barbagallo, Brullo & Fagotto 1979** (Table 27; Figure 2, Cluster E)

The floristic composition of this community is characterized by the dominance of *Phlomis fruticosa*, accompanied by a few species of stony dry grasslands, in particular *Stipa bromoides* and *Melica ciliata*, which also occur in *Stipetum*. Other species are typical of garrigues and probably related to fire: *Micromeria juliana*, *Petrorhagia saxifraga* and *Teucrium polium* subsp. *capitatum*.

This community presents two aspects. The first one is more floristically interesting, presenting species such as the subendemic *Ballota macedonica*, *Satureja calamintha*, *Geranium pusillum* and *Osyris alba* together with therophytes such as *Sideritis romana* (in a transitional form between subsp. *romana* and subsp. *purpurea*) and *Catapodium rigidum*. The other aspect presents many suffruticose species that are in common with *Cymbopogonetum*: *Salvia officinalis*, *Teucrium chamaedrys*, *Satureja montana*, and a few species of stony dry grasslands: *Orlaya grandiflora*, *Cephalaria transylvanica*, *Allium sphaerocephalon*. Stones and rocks have a higher cover in the latter aspect, that is identical to *Salvio-Phlomidetum fruticosae* (Barbagallo et al. 1989) described for Eastern Sicily in the surrounding of Siracusa. *Phlomis fruticosa* communities are present also in the Apennines (Pirone 1995b) and in Greece (Raus 1979), but they are quite distinct, with a more pronounced nitrophilous character, a higher number of therophytes and few suffruticose species. Moreover, they usually grow in deeper and less rocky soils.

The association is widespread in Albania on dry, calcareous hills along the coasts and on the southern mountains (Buzo 1990, Hoda & Mersinllari 2000). Buzo (1990) reports a number of associations (*Phlomis fruticosa* + *Asphodelus ramosus*, *Phlomis fruticosa*-*Psilurus incurvus*, *Phlomis fruticosa*-*Urginea maritima*, *Phlomis fruticosa*-*Salvia officinalis*) that are distinguished only by the dominant species.

**XEROTHERMOPHILOUS FORESTS AND SCRUBS OF EASTERN SUB-MEDITERRANEAN REGIONS**

***Rhamno-Paliuretum* Trinajstić 1996** (Table 28, Figure 2, Cluster A)  
= *Paliuretum adriaticum* Horvatić 1963 nom. illeg., *Rhamno-Paliuretum* (Horvatić) Brullo, Minissale, Spampinato 1997

*Paliurus spina-christi* shrubs are widespread in the carbonatic range, but are usually quite fragmented. *Paliurus spina-christi* is accompanied by a few *Quercetea ilicis* species such as *Phillyrea latifolia*, *Euphorbia characias* and *Clematis flammula*, and many species of submediterranean fringes such as *Bupleurum praealtum*.

A number of associations with *Paliurus spina-christi* have been described for Italy, Catalunya, Anatolia and the former Yugoslavia (Horvatić 1963, Géhu & Uslu 1989, Biondi 1999, Blasi & Di Pietro 2001). Our relevés can be referred to the dalmatic *Rhamno-Paliuretum* (Horvatić 1963)

***Clematido viticellae-Punicetum granati* ass. nova hoc loco** (Table 29; Figure 2, Cluster G)

Holotypus Table 34, rel. 27.

This community is widespread in the study site, in particular in the lower part of the carbonatic range, where limestone is in contact with the alluvial plain. It is characterized by the dominance of *Punica granatum*, which forms a thick bush on average 3m tall, with many lianas (*Rosa sempervirens*, *Clematis flammula*, *C. viticella*) with *Crataegus monogyna* and *Paliurus spina-christi* as shrubs, and an herb layer not very developed but rich in relatively mesophilous species typical of fringes such as *Viola odorata* and *Geum urbanum*.

This community is syngenetically very interesting: *Punica granatum* is a Tertiary relict, with a distribution from former Yugoslavia to Afghanistan (Meusel & Jäger 1992), but other relictual species are present, in particular *Clematis viticella*.

The community is well characterized and was provisionally proposed in Dring et al. (2002). We therefore proceed to a formal description.

***Quercu-Carpinetum orientalis* Horvatić 1939** (Table 30; Figure 2, Cluster B)

This community is characterized by the dominance of *Carpinus orientalis*. *Acer campestre*, *Celtis australis*, *Quercus pubescens* and *Fraxinus ornus* are particularly important among trees and shrubs. Rel. 19 presents a few rather mesophilous species: *Tilia cordata*, *Corylus avellana*, *Cornus mas*. It was carried out in a ravine, and is probably transitional to a mesophilous community that is not fully developed in the study area. The herb layer is poor.

This community develops usually on rather steep slopes (15–40°); the structure is a thick bushland 3–4 m tall. It develops mainly on the southern slope of the carbonatic range, at lower altitudes than *Quercetum trojanae* and the commu-

nity with *Acer monspessulanum*; nonetheless often these three associations are in contact and form a complex mosaic that is difficult to tease apart.

A number of communities with *Carpinus orientalis* have been described from former Yugoslavia, mainly with illegitimate names (Blečić & Lakušić 1967, Horvat et al. 1974, Poldini 1988) as well as in central Italy (Blasi et al. 2001). However, the variability is poorly known mainly because this vegetation is usually heavily degraded. This community presents also some affinity with *Phillyreo-Carpinetum* (Bergmeier & Dimopoulos 2008), that is more mediterranean.

***Acer monspessulanum* community** (Table 31; Figure 2, Cluster D)

This community is close to the preceding one, but is floristically poorer. It is characterized by the dominance of *Acer monspessulanum* with a shrub layer of *Paliurus spina-christi*. This community grows on the northern slopes of the carbonatic range, a few meters higher in altitude than *Carpinetum orientalis*. It forms a mosaic with *Rhamno-Paliuretum*.

*Acer monspessulanum* is generally indicated as a species typical of woodlands dominated by *Carpinus orientalis* (Horvat et al. 1974, Bergmeier & Dimopoulos 2008), but in our analysis *Acer monspessulanum* community is clearly distinct from them; the situation is similar in Italy. The herb layer is nonetheless very poor so as it is very difficult to characterize this heavily disturbed community from a phytosociological point of view.

***Quercetum trojanae* Em 1958** (Table 32; Figure 2, Cluster H)

*Quercus trojana* is present in two distinct physiognomic and ecological aspects in the carbonatic range. On the steep southern slopes of the range, toward the sea, it is represented by large, sparse trees, often centuries old but not taller than 15–18 m. The shrubland layer is absent, and under the trees the herb layer is represented by grasses such as *Chrysopogon gryllus* and *Stipa bromoides* so as to have a savannah-like structure. On the north-eastern, gentler slopes of the range, trees are much younger, thinner and smaller, usually no more than 15 m, but they form a rather dense degraded forest. In this forest both species of the evergreen forest (*Asparagus acutifolius*, *Phillyrea latifolia*, *Clematis flammula*) and species of the deciduous woodlands (*Quercus petraea*, *Quercus pubescens*, *Fraxinus ornus*, *Brachypodium sylvati-*

*cum*, *Oenanthe pimpinelloides*, *Dactylis polygama*) occur. The presence of *Quercus petraea*, so close to the sea, is particularly noticeable. This forest is protected from grazing with fences realized with the branches of *Paliurus spina-christi*, which represents an important source of wood for fire.

The ecology of this eastern Mediterranean oak species, therefore, is in some way analogous to the western Mediterranean *Quercus suber* that occurs both in “dehesa” or “montado” open formations and in dense forests together with mesophilous species (Testi & Lucattini 1994). Both species are relictual, being evolved probably in the Tertiary in a climate warmer and moister than today.

Three associations with *Quercus trojana* have been described in the Balkans and Italy: *Quercetum trojanae* Em 1958 for Macedonia, *Euphorbio apii-Quercetum trojanae* Bianco, Brullo, Minissale, Signorello & Spampinato 1998 and *Teucrio siculic-Quercetum trojanae* Biondi, Casavecchia, Guerra, Medagli, Beccarisi & Zuccarello 2004 for Apulia in Italy (Horvat et al. 1974, Bianco et al. 1998, Biondi et al. 2004). *Euphorbio apii-Quercetum trojanae* seems to be a degradative or ecotonal stage, whereas *Teucrio-Quercetum trojanae* is very similar to our association, in particular for the presence of *Carpinus orientalis*, *Quercus pubescens* s.l. and *Oenanthe pimpinelloides* together with species of *Quercetea ilicis*. Nonetheless, *Quercus petraea* is lacking and species of *Quercus cerris* woodlands, such as *Teucrium siculum* are present. *Quercetum trojanae* is described for Macedonia, where it is present in aspects clearly more mesophile than our relevés. Our community is therefore intermediate between *Quercetum trojanae* and *Teucrio-Quercetum trojanae* and probably deserves further investigation. The main diagnostic character is the co-occurrence of *Quercus pubescens*, *Quercus petraea* and *Quercus trojana*. We refrain from a formal description because the area that we have studied is too small to quantify the variability of the community. Moreover, albeit woodlands with *Quercus trojana* are widespread in Albania (Proko 1997), but with heavily degraded aspects, a comprehensive analysis is still lacking.

***Sesleria autumnalis-Ostryetum carpinifoliae* Horvat & Horvatić ex Horvat et al. 1974** (Table 33; Figure 2, Cluster C)

On the top of the Black Peak, above about 400 m a.s.l., a woodland occurs that is dominated by *Ostrya carpinifolia*, *Quercus cerris*, *Fraxinus ornus* and occasionally by *Quercus trojana*. The herb layer is characterized mainly by *Sesleria autumn-*

*nalis* and other species such as *Ornithogalum pyrenaicum*, *Viola odorata*, *Geum urbanum* and *Poa sylvicola*. This woodland is heavily coppiced, but nemoral species nonetheless predominate. It can be referred to *Seslerio-Ostryetum*, a community widespread in Dalmatia at intermediate altitudes (400–800 m) near the coast (Horvat et al. 1974). The species variability of this association is poorly known; in the north it is rich in Illyrian species such as *Mercurialis ovata* and *Spiraea chamaedrifolia* that lack in our southern relevés.

### RIPARIAN AND FLOODPLAIN FORESTS

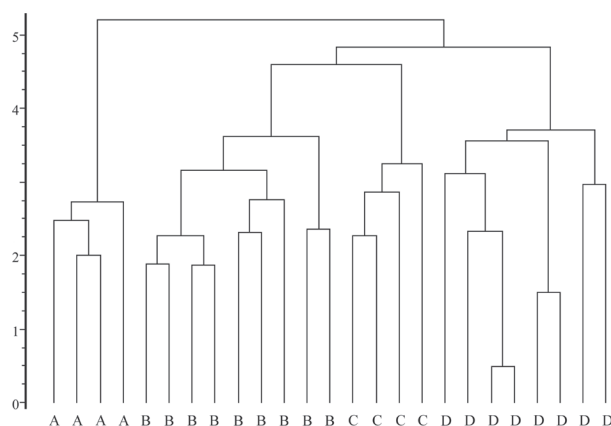
Hierarchical classification identified four groups of alluvial forests discussed hereafter (Figure 3).

#### *Junco-Fraxinetum parvifoliae* I. Kárpáti & V. Kárpáti 1961 (Table 34; Figure 3, Cluster D)

This association grows in depressions of the Velipoje Reserve subjected to long inundation. Physiognomically, it is characterized by the dominance of *Fraxinus angustifolia* subsp. *oxycarpa*, with a herb layer dominated by *Juncus maritimus* and other wetland species: *Apium nodiflorum*, *Iris pseudacorus*, *Samolus valerandi* and others. The association has been reported for alluvial areas close to the sea in Northern Albania including Velipoje by Kárpáti & Kárpáti (1961) and Kárpáti (1962). These authors emphasize the presence of species such as *Juncus maritimus* and *Samolus valerandi* that they interpret as halophytes. Conversely these can be considered as halotolerant species, that, although preferring moderate levels of salinity, are generally related to strong fluctuations of the water level, from completely dried out to completely inundated. These strong fluctuations are characteristic of the climate of Albania, where winter and autumn rainfall are very high, as already noticed by Kárpáti (1962).

Kárpáti & Kárpáti (1961) and Kárpáti (1962) also report a different community with dominant *Fraxinus oxycarpa* from the Buna river area: *Echinodoro-Fraxinetum parvifoliae* I. Kárpáti & V. Kárpáti 1961. The association occupied depressions where water is present all the year round, and is characterized by species typical of ponds and lakes, such as *Baldellia ranunculoides*, *Iris pseudacorus* and *Nymphaea alba*.

After a careful investigation, we could not find this association. It has probably disappeared because of the lowering of the water table after



**Figure 3:** Dendrogram of alluvial forest vegetation. The capital letters indicate the cluster membership of each relevé. **Slika 3:** Dendrogram poplavnih gozdov. Velike črke predstavljajo uvrstitev posameznega popisa v klaster. A: *Quercus robur* and *Carpinus betulus* community; B: *Periploca graecae*-*Alnetum glutinosae*; C: *Populetum albae*; D: *Junco-Fraxinetum parvifoliae*.

the drainage of the marshlands. In Horvat et al. (1974) a picture is reported that shows a physiognomy no more present in the area, with huge *Fraxinus angustifolia* subsp. *oxycarpa* among abundant *Iris pseudacorus*.

#### *Populetum albae* Br.-Bl. ex Tchou 1948 (Table 35; Figure 2, Cluster C)

The association is present along the Buna river, but is heavily disturbed. The floristic composition is poor, with many species that are transgressive from other communities (*Fraxinus angustifolia* subsp. *oxycarpa*, *Periploca graeca*) or indicators of disturbance (*Carduus acanthoides*). The community is highly invaded by *Amorpha fruticosa*.

The association has been already reported for the area under the name *Populetum albae balcanicum* (Kárpáti 1962), however, it is difficult to distinguish it from the typical *Populetum albae* Tchou 1948 described for Southern France (Tchou 1948, Braun-Blanquet et al. 1952).

#### *Quercus robur* and *Carpinus betulus* community (Table 36; Figure 2, Cluster A) = *Quercus roboris*-*Carpinetum betuli submediterraneum* Bertović ex Horvat 1974 nom. illeg.

This forest develops locally in small fragments near the mouth of the Buna river delta where it grows in the drier areas of the forest.

The species composition is characterized by the dominance of *Carpinus betulus* and *Quercus robur*, this last being present with an allegedly

endemic variety *scutariensis*. The composition is typical of mesophile forests: *Viola reichenbachiana*, *Aristolochia pallida*, *Arum italicum*. Hygrophilic trees such as *Fraxinus angustifolia* subsp. *oxycarpa* and *Populus alba* are related to catenal contacts.

This community represents a Mediterranean outpost of planitial forests, widespread in central Europe, that in the Mediterranean basin retreats near rivers and occurs relictually in the drier parts of alluvial plains (Dierschke 1980). In these extrazonal sites, the floristic composition changes, showing a transitional character between *Quercus-Fagetea* and *Populetea albae*, leading to the definition of a separate alliance, *Alno-Quercion roboris* (Horvat 1938, Kárpáti 1962). Many syntaxa have been referred to this alliance, in particular in the former Yugoslavia (Raus 1993, Raus & Vukelić 1993), but the alliance is imperfectly known (see the synthesis in Brullo & Spampinato 1999), and the classification of our relevés is provisional.

***Periploca graecae-Alnetum glutinosae* Rudski in Horvat et al. ex Fanelli, De Sanctis, Gjeta, Mullaj & Attore ass. nova hoc loco** (Table 31; Figure 2, Cluster B)

= validation of *Periploca-Alnetum* Rudski in Horvat et al. 1974 nom. nudum (art. 3b Horvat et al. 1974: p. 174)

Holotypus Table 31, rel. 55

This community develops in the alluvial plains along the coast, from the mouth of the Buna river southwards. It is present also in the floodplain east of the Viluni lagoon, where no relevé has been carried out. This forest is rather dense, but the trees are not very tall, up to 12 m. The floristic composition is characterized by a large number of lianas: *Periploca graeca*, *Cynanchum acutum*, *Humulus lupulus*. Beside *Alnus glutinosa* the most important trees and shrubs are *Ulmus minor*, *Cornus mas*, *Ligustrum vulgare* and *Ficus carica*, while the herb layer is rather scarce.

*Periploca graeca*, *Cynanchum acutum* and *Ficus carica* are species with subtropical affinity, and indicate to the possible relictual character of this alluvial forest. This hypothesis is also supported by the abundance of lianas. The presence of *Periploca graeca* seems to differentiate this black alder association from any other.

Kárpáti & Kárpáti (1961) report three relevés similar to our association from the west bank of the Shkodra lake under the name *Alno-Fraxinetum parvifoliae* Tchou 1949; the first of these three relevés being the holotype of *Aristolochio*

*tundae-Alnetum glutinosae* (Brullo & Spampinato 1999). The latter name must be corrected since the *Aristolochia* is undoubtedly *Aristolochia pallida* (*Aristolochio pallidae-Alnetum glutinosae* Brullo & Spampinato 1999 corr. hoc loco). This association is different from the black alder forests of the mouth of the Buna and seems intermediated between *Periploca-Alnetum* and *Quercus-Carpinetum*. It is possible that the relevés are heterogeneous, including different belts, but, given the accuracy of the Hungarian authors, it is more probable that a lowering of the water-table led to a change to the zonation of vegetation along the Buna River.

Rudski (in Horvat et al. 1974, pag. 174) describes a *Periploca-Alnetum* nom. nud. for Macedonia that is very similar in the composition of lianas (*Hedera helix*, *Periploca graeca*) but quite different in the herb layer, probably because it develops on more acidic granites.

The "association" with *Alnus glutinosa*, *Periploca graeca* and *Hedera helix* described in Mersinliari & Hoda (1985) from the surroundings of Durres is identical to this association.

**TAMARISK SCHRUBLANDS OF MOIST PLACES**

***Vitici-Tamaricetum africanae* Horvatić 1960** (Table 38)

This community develops on the shores of the Viluni lagoon and in other brackish ponds in particular in Campo di Marina (Kampi veror) and in the Velipoje Reserve. The vegetation is dominated by *Tamarix africana* that forms stands 2–5 m tall. *Vitex agnus-castus* is present when the vegetation is less dense. Species of the herb layer are mainly characteristic of *Juncetalia maritima*.

The community forms a large belt between the *Juncetum maritimo-acuti* and the mud flats with succulent chenopods near the water.

The association *Vitici-Tamaricetum africanae* has been described in Dalmatia (Horvatić 1963), and also reported for Albania (Dring et al. 2002).

**RUDERAL AND SUB-RUDERAL HERBACEOUS VEGETATION**

***Bromo villosi-Haynaldietum villosae* Pignatti 1953** (Table 39)

This community occurs on retrodunal sands in the Rjolla beach (Backs Rjollji) in disturbed sites among settlements. It is a rather sparse grassland,

about 50 cm tall. The composition is rich in species of *Brometalia rubenti-tectorum* (*Dasyphyrum villosum*, *Bromus madritensis*, *Avena barbata*) *Hordeion* (*Lepidium graminifolium*, *Sisymbrium officinale*, *Carduus pycnocephalus*) and *Brachypodietalia distachyae* (*Trifolium scabrum*, *Medicago minima*). It is very close to *Laguro-Dasyphyretum villosi* Fanelli 1998 (Fanelli 1998) widespread along the coasts of the Italian Peninsula, but is distinguished by the lack of the characteristic species of the associations and the presence of a few rather continental species such as *Kochia prostrata*. Moreover, instead of the Western Mediterranean *Vicia pseudocracca*, *Vicia villosa* subsp. *eriocarpa* is present.

#### ***Centaureetum calcitrapae* Fanelli & Menegoni 1997** (Table 40)

= *Centaureo calcitrapae-Lolietum perennis* Blasi et al. 2009

At the conjunction between the carbonatic range and the alluvial plain, in abandoned sheep pens, a vegetation develops that is dominated by *Centaurea calcitrapa* or *Scolymus hispanicus*, spiny *Asteraceae* typical of heavily grazed and nitrophile sites in the Mediterranean basin. The vegetation is about 90 cm tall, very dense with a relatively rich floristic composition: *Rumex pulcher*, *Cichorium intybus*, *Bromus hordeaceus*, *Avena barbata* and others. Soils are loamy and compacted by trampling.

This vegetation can be referred to *Centaureetum calcitrapae* described from the surroundings of Rome (Fanelli & Menegoni 1997, Fanelli 2002, Blasi et al. 2009), although a few continental species are present such as *Anthemis austriaca*.

#### ***Asphodelus ramosus* community** (Table 41; Figure 2; Cluster M)

This community develops on gentle north-western slopes of the carbonatic range. It forms a mosaic with *Paliuretum*, and is dominated by *Asphodelus ramosus* with many ruderal and subruderal therophytes: *Carthamus lanatus*, *Dasyphyrum villosum*, *Catapodium rigidum* and *Nigella arvensis*. It is an open community growing on a stony soil and subjected to heavy grazing.

The syntaxonomy of this community is difficult to be defined. It shows similarities with *Carthametalia lanatae* described for the ruderal communities on clays in Sicily (Brullo & Marcenò 1985). The associations described for this order are rather different, and this is probably related to the different lithology (clays instead of limestone) and to the imperfect knowledge of the order.

#### ***Carduetum acanthoidis* Felföldy 1942** (Table 42)

This community is widespread in the Domni marshland and in the fields near Velipoje, on raised terrains of the alluvial plain and shuffled carbonatic soils. It is characterized by the dominance of tall thistles such as *Carduus acanthoides*, *Cirsium vulgare* and *Cirsium italicum*, together with other ruderal perennial species as *Agrostis stolonifera*, *Galega officinalis* and *Potentilla reptans*. The vegetation is tall (1.7–1.8 m) and presents a high cover.

This association can be referred to *Carduetum acanthoidis*, reported for Germany, Slovakia and Romania. This community is considered a basal community by Jarolimek et al. (1997), since *Carduus acanthoides* occurs with high frequency in other communities of *Dauco-Melilotion* and *Onopordion acanthi*. In the study area it seems well characterized.

## VEGETATION SERIES AND SEQUENCES

### DUNES

The alluvial plain of the area is fringed seawards by a wide system of dunes that today are heavily degraded by strong erosion and the building of touristic settlements. As a consequence, natural vegetation is fragmented and localized, in particular at the mouth of the Buna river.

What remains of the dune vegetation can be ordered in the following sequence (R1):

- on the foredunes near the sea the *Cakilo-Xanthietum italici* can be found. This association is present today only in the Velipoje Reserve, near the mouth of the Buna river, where is rather well developed;
- back of the foredunes there are strongly eroded embryonic dunes, with fragments of psammophilous communities with *Euphorbia paralias* or *Elytrigia juncea*, too degraded to be described. The embryonic dunes are scarcely developed and rise only a few dm above the sea;
- back of the embryonic dunes, sand-dunes with *Ammophila* are lacking and interdunal depressions develop instead. The vegetation of these interdunal depressions is heavily affected by human impact, and is represented by fragments of populations of *Juncus acutus* and *Vitex agnus-castus*, that derive respectively from

*Juncetum maritimo-acuti* and the *Vitici-Tamaricetum* associations that are well developed around the lagoons. These fragments, in particular the populations of *Vitex agnus-castus*, often occur directly on the shore, where the erosion has destroyed the foredunes and embryonic dunes;

- back of the interdunal depressions a few fragments of retrodunal vegetation still exist, in particular secondary vegetation with *Dasyphyrum villosum* and *Aegilops triuncialis*, two ruderal species typical of sandy or gravelly habitats. This vegetation is represented only by small patches among the recently built touristic settlements.

Before the retrodunal depression there is a large plantation of *Pinus pinea*, which probably replaces a belt with *Ammophila*.

Buzo (1990) and Mersinllari & Hoda (1985) describe a similar zonation respectively for southern Albania and Durres.

## BRACKISH WATERS

Brackish waters are extensively present in Velipoje. The most important water body is the Viluni lagoon, but many smaller, sometimes temporary ponds are also occurring.

The vegetation of this unit is diverse and complex. Nonetheless, patterns are highly repetitive and recurrent, and it is possible to reconstruct a sequence, with a variant, along an environmental gradient determined by increasing time of inundation and salinity, more or less complete or truncated.

**Table 43:** Vegetation sequences of the lagoons.

**Tabela 43:** Vegetacijske sekvence v laguni.

Series	H1	H1a
I	<i>Fraxinus angustifolia</i> subsp. <i>oxycarpa</i>	<i>Alnus glutinosa</i>
II	<i>Phragmites australis</i>	<i>Phragmites australis</i>
III	<i>Typha latifolia</i>	<i>Scirpus litoralis</i> (inflow of freshwater)
IV	<i>Bolboschoenus maritimus</i>	
V	<i>Juncus maritimus</i> - <i>Juncus acutus</i>	
VI	<i>Tamarix africana</i> - <i>Vitex agnus-castus</i>	
VII	<i>Halimione portulacoides</i> - <i>Aeluropus litoralis</i>	
VIII	<i>Salicornia perennans</i>	
IX	<i>Salicornia procumbens</i>	
X	<i>Ruppia cirrhosa</i>	

↓  
Salinity  
Inundation

## LAGOONS

Hereafter a few case studies are described.

### *Campo di Marina (Kampi veror)*

This is a large temporary pond, with saline waters, near the Buna river. The zonation of the vegetation is in form of concentric belts. Outside the pond, *Alnus glutinosa* woody patches extensively develop. The first outer belt of the pond is represented by rather sparse treelets of *Tamarix dalamatica*. Then a vegetation belt dominated by *Juncus acutus*, *Juncus maritimus*, with many halophytes such as *Limonium vulgare* subsp. *serotinum* and *Inula crithmoides* appears, often interrupted because of the grazing by cattle. In the centre of the pond there is a large population of *Salicornia perennans*.

### *Small ponds in the Velipoje Reserve*

The brackish ponds in the Velipoje Reserve are important for wildlife, especially migrating birds. Close to the Buna river there is a large belt of *Phragmitetum*. This is followed by a narrower belt of *Scirpetum compacto-litoralis*, and then by an interrupted belt of *Tamarix*; mixed with *Tamarix*, but extending further inward, there are large populations of *Juncus acutus* with *Amorpha fruticosa*. In this case the water is only slightly brackish, and the halophile character increases in the drier areas, due to intense evaporation that concentrates the salts.

### *Viluni lagoon*

The Viluni lagoon is rather large, and tends to be more brackish near the sea, where there is an inflow of sea water, and less brackish inwards, where there are many channels bringing freshwater.

In the part near the sea, the shores are characterized by mud colonized by halophytes: close to the shore there is a vegetation belt with locally large stands of *Salicornia procumbens*, followed by a vegetation dominated by *Salicornia perennans*. Inward a belt with *Halimione portulacoides* and *Aeluropus litoralis* can be found preceding stands of *Juncus maritimus*.

In the drier parts, seaward, there are also populations of *Euphorbia paralias* or *Elytrigia juncea* and other dunal species that indicate the presence of embryonic sand dunes.

The water body is colonized by a dense population of submerged *Ruppia cirrhosa*, together with many filamentous algae.

In the intermediate part, between the mud-flats and the water there is a belt with *Tamarix africana*.

In the inner part of the lagoon the zonation is rather different. The mud-flats are lacking, and from the shores to the water it is possible to observe three belts: first *Phragmitetum*, then *Scirpetum maritimo-litoralis*, and finally *Scirpetum litoralis*. Behind the lagoon, in the north, there is a plain with damp soils where extensive populations of *Juncus maritimus* develop, fringed by woodlands with dominant *Alnus glutinosa*. In areas with more water, *Phragmites australis* appears again.

Part of this plain has been reclaimed and destined to agriculture, while in the few areas where there is still natural vegetation, interesting examples of *Schoeno-Erianthetum ravennae* are present.

## FRESHWATERS

The zonation of freshwaters is more complex than that of brackish waters. It is possible, in fact,

to distinguish three sequences and a variant, according to a gradient from still to flowing waters.

### Domni marsh

The Domni marsh is characterized by a tall reed-bed dominated by *Typha angustifolia* and *Phragmites australis* forming monospecific large stands. This dominant vegetation types is probably the result of the drainage of a natural marsh. In fact, where pits have been excavated, the vegetation is dominated by *Nymphaea alba* and *Potamogeton* spp. that probably represent relics of formerly deeper still waters.

Where *Typha angustifolia* is not present, mainly because it has been destroyed for providing pasture for cattle, secondary vegetation appears with *Paspalum paspalodes* in moister sites and *Trifolium-Cynodontetum* in dryer sites. On artificial risings of the ground level along unpaved roads, a rich ruderal vegetation dominated by *Carduus acanthoides* grows.

## BUNA RIVER

The vegetation along the water course of the Buna river is still rather well preserved. It is possible to observe the typical sequence of river banks (H2), that begins with two belts of floating submerged macrophytes, an outer belt on deep waters with dominant *Potamogeton pectinatus* and an inner belt in less deep waters with dominant *Potamogeton nodosus*, and locally, in disturbed sites, *Elodea canadensis*. More close to river bank four belts of helophytes develop: in deeper waters the rather sparse *Scirpus lacustris*, then *Iris pseudacorus*, *Typha angustifolia* and finally *Phragmites australis*.

**Table 44:** Vegetation sequences of the freshwaters.

**Tabela 44:** Vegetacijske sekvence v celinski vodi.

Series	H2	H3	H4	H4b	Water depth ↓
	<u>Flowing waters</u>	<u>Slowly flowing channels</u>	<u>Still water</u>	<u>Disturbed</u>	
I				<i>Carduus acanthoides</i>	
II	<i>Populus alba</i>	<i>Quercus robur-Carpinus betulus</i>		<i>Trifolium fragiferum-Cynodon dactylon</i>	
III	<i>Phragmites australis</i>			<i>Paspalum distichum</i>	
IV	<i>Typha angustifolia</i>	<i>Typha angustifolia</i>	<i>Typha angustifolia</i>		
V	<i>Iris pseudacorus</i>	<i>Sparganium erectum</i>			
VI	<i>Schoenoplectus lacustris</i>				
VII	<i>Potamogeton nodosus-crispus (Elodea)</i>	<i>Hydrocharis morsus-ranae</i>	<i>Nymphaea alba</i>		
VIII	<i>Potamogeton pectinatus</i>	<i>(Trapa natans)</i>			



These belts are often lacking or intermixed, due to the changing profile of the river bank; when the profile is steep, the sequence is less developed with respect to areas with a gentler profile. In some areas populations of *Bolboschoenus maritimus* are present, probably indicating some mixing with seawaters.

Beyond the helophytic belts, the remnant of an alluvial forest vegetation can be found, that has attracted the attention of botanists since a long time (Kárpáti & Kárpáti 1961, Kárpáti 1962).

#### Woodland vegetation of the Buna river alluvial plain

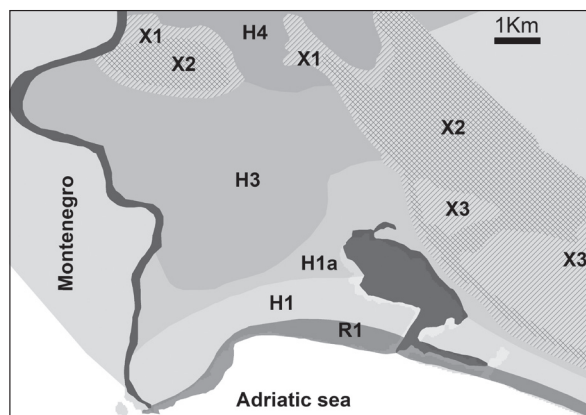
The zonation of the vegetation of the alluvial forest is rather simple, with the different associations ordered along a single gradient of increasing moisture from the *Quercus-Carpinetum*, that grows in relatively dry soils, to the *Alnetum* that is influenced by the high water table but is rarely inundated, to the *Populetum* that develops close to the river and is often subjected to flooding, to *Fraxinetum* that grows in areas with permanent or prolonged inundation. A similar zonation is described by Mersinllari & Hoda (1985) for areas near Durres. The spatial distribution of these associations is highly fragmented with frequent ecotonal belts due to the complex dynamism of the delta of the Buna river in the Holocene. This in turn determined a complex morphology, with depressions and risings, and a variable water table level creating the “catenas” indicated in the rows of Table 6.

Kárpáti & Kárpáti (1961) describe the succession at the mouth of the Buna river as leading from *Nymphaeion albae* to *Echinodoro-Fraxinetum* up to *Alno-Fraxinetum*. We could not find examples of the latter two associations. This probably means that the water table has been lowered, with the disappearance of an entire sequence.

#### SPATIAL DISTRIBUTION OF THE SEQUENCES OF THE ALLUVIAL PLAIN

When the sequences of the alluvial plain are mapped, an interesting coincidence with the geological map appears (Figure 4). Series H1 of brackish waters is related to the “marshland deposits” near the sea; series H1a of less brackish waters to “marshland deposits” farther from the sea, series H3 of slowly flowing waters is related with “lagoon deposits”, and series H4 of still wa-

ters with “alluvial-marshland deposits”. These four belts are parallel to the sea, and probably are related the progression of the delta of the Buna river in the Holocene: belts farther from the sea are older while belts near the sea are younger. The advancement of the delta of the Buna created a mosaic of environments (brackish and freshwaters, still and flowing waters) that enhances the great complexity of this landscape.



**Figure 4:** Map of the vegetation series and sequences of the Buna river Protected Landscape. H1: series of brackish and halophilous vegetation related to the “marshland deposits”; H1a: series of less brackish waters farther from the sea; H3: series of slowly flowing waters related with “lagoon deposits”; H4: series of still waters related with “alluvial-marshland deposits”; X1: moister carbonatic series of *Carpinetum orientalis* at the base of the south-western slope; X2: dryer carbonatic series on north-east slopes; X3: carbonatic series of the upper, steep slopes of the Black Peak (Maja e Zezë).

**Slika 4:** Karta vegetacijskih serij i sekvenc v zavarovanem območju ob reki Buna. H1: serija brakične in halofilne vegetacije na “močvirnih naplavinah”; H1a: serija manj brakičnih voda oddaljenih od morja; H3: serija počasi tekočih voda na “naplavinah lagune”; H4: serija stoječih voda na “aluvialno-močvirnih naplavinah”; X1: vlažna karbonatna serija *Carpinetum orientalis* ob vznožju jugozahodnega pobočja; X2: suha karbonatna serija na severovzhodnem pobočju; X3: karbonatna serija na zgornjem, strmem pobočju Črnega vrha (Maja e Zezë).

#### CARBONATIC RANGE

##### Forest vegetation

It is difficult to reconstruct the zonation of the forest and shrub vegetation, given the present state of heavy degradation. In the vegetation below 400 m a.s.l., at the base of the carbonatic range, there are three physiognomic units: 1) a lower belt of *Punica granatum*; 2) on the steep southern slopes

a sparse savanoid woodland with *Quercus trojana*, that at lower altitudes and on gentler slopes presents an heavily grazed undergrowth of *Carpinus orientalis*; 3) on north-eastern slopes a mixed, heavily degraded woodland with *Carpinus orientalis*, *Quercus pubescens*, *Celtis australis*, *Pistacia terebinthus*, *Paliurus spina-christi*, *Phillyrea latifolia*, and, locally, *Quercus trojana* and *Quercus petraea*.

These physiognomic units are nonetheless the result of a long history of disturbance, in particular grazing, coppicing and fire. The areas with more developed vegetation are protected from grazing with fences made with branches of *Paliurus spina-christi*, probably to preserve a source of wood for charcoal; in the other sites pigs and goats are allowed to graze everywhere.

The phytosociological analysis of the table of relevés reveals a different situation, with three woodland and two shrub associations. Such a high  $\beta$ -diversity suggests that more than one series of vegetation is present, today homogenized and partly destroyed by the human impacts. Probably, two series were present: a moister series (X1), in particular at the base of the south-western slope, and a dryer series (X2) on north-east slopes:

Series X1: *Carpinetum orientalis* → *Punicetum granatae* → *Asphodelus ramosus*

Series X2: *Quercetum trojanae* → *Acer monspessulanum* → *Paliuretum* → *Salvio-Phlomidetum* → *Stipo-Salvietum officinalis*.

On the upper, steep slopes of the Black Peak there is a different woodland type, *Seslerio-Ostryetum carpinifoliae*, belonging to a third series:

Series X3: *Seslerio-Ostryetum carpinifoliae* → *Asphodelo-Chrysopogonetum grylli*.

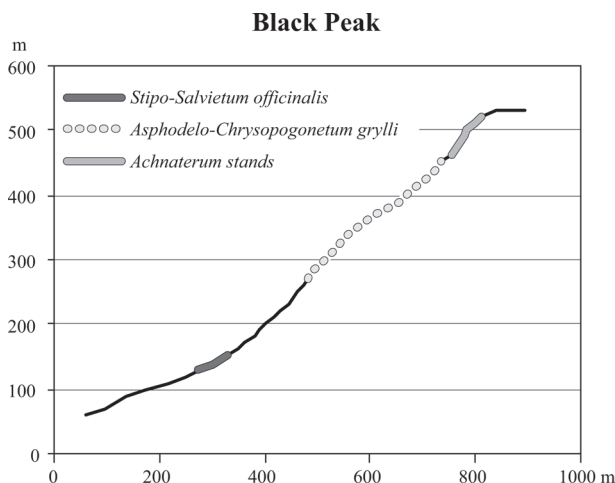
In order to support such an interpretation few hints can be presented:

- 1) in *Carpinetum orientalis* a few mesophile species occur: *Tilia cordata*, *Acer campestre*;
- 2) a few species of *Quercetalia pubescentis* occur both in *Carpinetum orientalis* and *Punicetum* but not in both *Quercetum trojanae* and in the community with *Acer monspessulanum*: *Crataegus monogyna*, *Lithospermum purpureo-coeruleum*, *Viola odorata*;
- 3) spiny species such as *Asparagus acutifolius*, *Paliurus spina-christi* are more frequent in *Acer monspessulanum* and *Quercetum trojanae* than in *Carpinetum orientalis*.

The distinction between the two series is probably related to differences in the soils. The legend of the geologic map (Halili 1985) shows that both dolomites and limestones are present in the carbonatic range. However, there is no information on the distribution of these two lithotypes, but our direct observations seem to show that limestones are prevalent at the base of the range, whereas dolomites are prevalent at higher altitudes, above 90–100 m on the northern slope, above 150 m on the southern slope. This is suggested by the rather brisk break of slope at these altitudes. Significantly, in correspondence with this slope break *Carpinus orientalis* disappears or becomes less abundant. This observation is particularly evident on the southern slopes of the Black Peak near Blacs-Rjolli. The associations of series X1 develop at lower altitudes than the associations of the series X2, so it is probable that the former develops on limestones, the latter on dolomites. Limestone is calcium carbonate, whereas dolomite contains also magnesium, and this leads to different chemical and pedological properties of soils. This topic is little studied from a vegetational and ecophysiological point of view, but it is well known. For instance, many Mediterranean pines grow mainly on dolomites (Barbero et al. 1998), whereas a few grassland types are restricted to this rock, for instance in the Causses, in Southern France, where on dolomites develops even an endemic alliance, *Armerion junceae* Br.-Bl. in Br.-Bl., Roussine & Nègre 1952 (Braun-Blanquet et al. 1952). It is possible that dolomites induce a sort of xerophytism in the vegetation that develops on soils derived from this rock.

## GRASSLANDS

The carbonatic range is 561 m in altitude with rather steep slopes on the southwest side, and gentler on the eastern side. There is a clear zonation of the grassland vegetation related to altitude and variation in steepness. As an example, the south-western slope of the Black Peak is rather gentle at the beginning, than becomes steeper up to the top where the steepness can be up to 50°. The flora is structured in four belts (Figure 5). At the base, where the slopes are about 20°, there is a belt dominated by *Stipa bromoides*; other species are *Linum nodiflorum*, *Lolium rigidum* subsp. *lepturoides*, *Stachys recta*, *Aurinia petraea* and *Campanula lingulata*. Higher up, there is a transitional belt, and thereafter, where the slopes are about



**Figure 5:** Vegetation belts of Black Peak (Maja e Zezë).  
**Slika 5:** Vegetacijski pasovi na Črnem vrhu (Maja e Zezë).

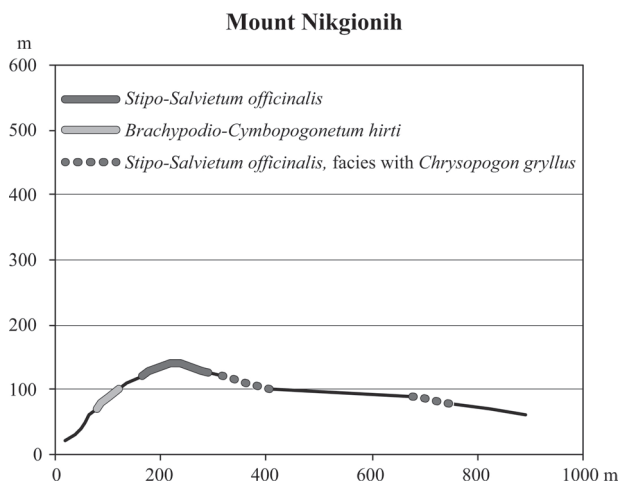
30–40°, a belt where *Chrysopogon gryllus* becomes dominant. Here a few, relatively rare species are abundant: *Centaurea salonitana*, *Onosma arenaria* and *Scabiosa triniifolia*. Near the top the slope is very steep, and also small vertical cliffs are present. Here the dominant species is *Achnatherum calamagrostis*, usually in monospecific stands, and on the slopes *Putoria calabrica*, *Moltkia petraea* and *Sesleria robusta* subsp. *skanderbegii* occur.

Northwards, on the southern slopes of Mount Nikgionih, the slope is very steep at the base (about 40°) and gentler higher up (10–25°). On the steeper belt the dominance of *Hyparrhenia hirta* can be observed, whereas on gentler slopes it is possible to observe the dominance of *Stipa bromoides*. The northern slope is gentle (15–30°) and a transitional belt with the dominance of *Chrysopogon gryllus* occurs, but with dominated species similar to *Stipo-Salvietum officinalis* (Figure 6).

In summary it is possible to observe the following sequence according to an increasing steepness:

*Asphodelus microcarpus* → *Stipo-Salvietum officinalis* → *Stipo-Salvietum officinalis* with *Chrysopogon gryllus* → *Asphodelo-Chrysopogonetum gryllus* → *Achnatherum calamagrostis* → *Brachypodio-Cymbopogonetum hirti* → *Seslerio-Putorietum calabricae*

Steepness is the distal ecological factor; it covaries with soil thickness and rockiness, and indirectly with water and nutrient availability. In fact, there is an interaction with aspect. Typical *Stipo-Salvietum* occurs at the base of the southern slope, whereas higher up *Chrysopogonetum* develops; the transitional facies of *Stipo-Salvietum* with dominant *Chrysopogon gryllus* occurs at the



**Figure 6:** Vegetation belts of Mt. Nikgionih (Mali i Nikgjonit).  
**Slika 6:** Vegetacijski pasovi na gori Nikgionih (Mali i Nikgjonit).

base of the moister, cooler north-eastern slopes. In Croatia, the two associations are strongly differentiated: *Stipo-Salvietum* grows on thin soils on stony hills; *Chrysopogonetum* grows in plain on deep soils (Horvat 1962, Horvat et al. 1974).

Moreover, it is possible that the break of slope is related also to lithotype, since both dolomites and limestones are present in the carbonatic range. Dolomite is less erodible, and can form very steep slopes, like in the eponym range of Dolomites, whereas limestones are more erodible and tend to form gentler slopes. Unfortunately, information on the detailed distribution of lithotypes is lacking.

#### 4. CONCLUSIONS

Although strongly modified by human activities, the Buna River Protected Landscape is still characterized by a high diversity of community types classified in 46 associations, 27 alliances, 23 orders and 17 classes.

This diversity is related not to the richness of the flora, that is not exceptional for a Mediterranean area, but to a complex interaction between morphological and geological features. In turn, this complexity determined the presence of 1 dunal and 4 hygro-sequences, related to the age of deposits of Buna River, in relationship to the advancement of the delta in the Holocene, and of 3 xeroseries in the carbonatic range, related to lithological differences and altitudinal gradient.

The vegetation is very interesting, with many

communities with a probably relictual character, as shown by species such as *Periploca graeca*, *Clematis viticella*, *Punica granatum*, *Ficus carica*, *Laurus nobilis*.

Despite the heavy environmental modifications caused by the land reclamation works of the second half of the last century, the conservation status of the remnant vegetation is still relatively good. Nonetheless, the area is subjected to a process of increasing human impact that is particularly evident when comparing the present alluvial vegetation with the description made by Kárpáti & Kárpáti (1961) and Kárpáti (1962); a few types have disappeared or are nowadays rare, in particular those related to permanent freshwaters.

More recently, the touristic development is threatening the coastal environments. The Rjolla beach (Backs Rrjollli) presented, probably not far ago, interesting examples of dunal vegetation that have today almost completely disappeared.

#### *Syntaxonomic list*

RUPPIETEA MARITIMAE J. Tüxen. ex Den Hartog & Segal 1964

*RUPPIETALIA* J. Tüxen ex Den Hartog & Segal 1964

**Ruppion maritimae** Br.-Bl. ex Westhoff in Bennema, Sissingh & Westhoff 1943

*Ruppietum cirrhosae* Iversen 1934

THERO-SALICORNIAETEA STRICTAE Tüxen in Tüxen & Oberdorfer 1958

*THERO-SALICORNIAETALIA STRICTAE* Pignatti 1952

**Thero-Salicornion strictae** Br.-Bl. 1933

*Salicornietum venetae* Pignatti 1966

*Suaedo spicatae-Salicornietum patulae* (Brullo & Furnari 1976) Géhu & Géhu-Franck 1984. corr. Alcaraz, Ríos, De la Torre, Delgado & Inocencio 1998

JUNCETEA MARITIMI Br.-Bl. in Br.-Bl., Roussine & Nègre 1952

*JUNCETALIA MARITIMI* Br.-Bl. ex Horvatić 1934

**Agropyro-Artemision coerulescentis** Pignatti 1953

*Puccinellio festuciformis-Aeluropetum litoralis* (Corb. 1968) Géhu & Costa 1984

**Juncion maritimi** Br.-Bl. ex Horvatić 1934

*Juncetum maritimo-acuti* Horvatić 1934

**Plantaginion crassifoliae** Br.-Bl. in Br.-Bl., Roussine & Nègre 1952

*Juncus maritimus* and *Lippia nodiflora* community

CAKILETEA MARITIMAE Tüxen & Presing ex Br.-Bl. & Tüxen 1952

*EUPHORBIAETALIA PEPLIDIS* Tüxen ex Oberdorfer 1949

**Euphorbion peplis** Tüxen ex Oberdorfer 1952

*Cakilo-Xanthietum italicae* Pignatti 1953

LEMNETEA O. de Bolòs & Masclans 1955

*LEMNETALIA MINORIS* Tüxen ex O. de Bolòs & Masclans 1955

**Hydrocharition morsus-ranae** (Passarge 1964) Westhoff & den Held 1969 = *Lemno minoris-*

*Hydrocharition morsus-ranae* Rivas-Martínez, Fernández-González & Loidi 1999, [*Hydrocharition morsus-ranae* Passarge 1996, non Rübel 1933]

*Hydrocharitetum morsus-ranae* van Langendonck 1935

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- POTAMOGETONETEA Klika in Klika & Novak 1941  
**POTAMOGETONETALIA** W. Koch 1926  
**Nymphaeion albae** Oberdorfer 1957  
*Nymphaeetum albae* Vollmar 1947  
*Trapaetum natantis* Kárpáti 1963.  
**Potamogetonion** Miljan 1933 = *Magnopotamion* (Vollmar 1947) den Hartog & Segal 1964,  
*Parvopotamion* (Vollmar 1947) den Hartog & Segal 1964; *Potamion pectinati* (Koch 1926)  
 Görs 1977  
*Potamogetonetum denso-nodosi* O. de Bolòs 1957  
*Potamogetonetum pectinati* Carstensen ex Hilbig 1971  
*Elodeetum canadensis* Nedelcu 1967
- PHRAGMITI-MAGNOCARICETEA Klika in Klika & Novak 1941  
**PHRAGMITETALIA COMMUNIS** W. Koch 1926  
**Phragmition communis** W. Koch 1926  
*Typhetum angustifoliae* Pignatti 1953  
*Typhetum latifoliae* Nowiński 1930  
*Phragmitetum australis* Savič 1926 *nom. mut. prop.*  
*Scirpetum lacustris* Chouard 1924  
*Glycerio-Sparganietum neglecti* Koch 1926  
**SCIRPETALIA MARITIMI** Heijny in Holub, Heijny, Moravec & Neuhäusl 1967  
**Scirpion maritimi** Dahl & Hadač 1941  
*Scirpetum maritimo-litoralis* (Br.-Bl. in Br.-Bl., Roussine & Nègre 1952) O. de Bolòs 1962  
*Scirpetum litoralis* Pignatti 1953
- MOLINIO-ARRHENATHERETEA Tüxen 1937  
**HOLOSCHOENETALIA** Br.-Bl. *ex* Tchou 1948  
**Molinio-Holoschoenion** Br.-Bl. *ex* Tchou 1948  
*Schoeno-Erianthetum ravennae* Pignatti 1953  
**PASPALO-HELEOCHLOETALIA** Br.-Bl. in Br.-Bl. et al. 1952  
**Paspalo-Agrostidion** Br.-Bl. in Br.-Bl. et al. 1952  
*Paspalo-Agrostidetum* Br.-Bl. 1936 (1952)  
**Trifolio-Cynodontion** Br.-Bl. & O. de Bolòs 1957  
*Trifolio fragiferi-Cynodontetum* Br.-Bl. & O. de Bolòs 1957
- ASPLENIETEA TRICHOMANIS (Br.-Bl. in Meier & Br.-Bl. 1934) Oberdorfer 1977  
**MOLTKIETALIA PETREAE** Lakušić 1968  
**Seslerion tenuifoliae** Horvat 1930  
*Seslerio-Putorietum calabricae* Horvatić 1963
- FESTUCO-BROMETEA Br.-Bl. & Tüxen *ex* Klika & Hadeč 1944  
**SCORZONERO-CHRYSOPOGONETALIA** Horvatić & Horvat in Horvatić 1963  
**Chrysopogono-Saturejion** Horvat & Horvatić in Horvatić 1934  
*Stipo-Salvietum officinalis* Horvatić 1958  
*Asphodelo-Chrysopogonetum grylli* Horvatić (1936) 1958
- THERO-BRACHYPODIETEA RAMOSI Br.-Bl. *ex* A. et O. de Bolòs 1950 (= *Lygeo-Stipetea tenacissimae*  
 Rivas-Mart. 1978 *nom. cons. prop.*)  
**CYBBOGONO HIRTI-BRACHYPODIETALIA RAMOSI** Horvatić 1958  
**Cymbopogono hirti-Brachypodion ramosi** Horvatić 1958  
*Brachypodio-Cymbopogonetum hirti* Horvatić 1961
- CISTO-MICROMERIETEA JULIANAE Oberdorfer 1954  
**CISTO-ERICETALIA** Horvatić 1958  
**Cisto-Ericion manipuliflorae** Horvatić 1958  
*Salvio-Phlomidetum fruticosae* Barbagallo, Brullo & Fagotto 1979

## QUERCETEA PUBESCENTIS Doing-Kraft ex Scamoni et Passarge 1959

*FRAXINO ORNI-COTINETALIA* Jakucs 1960**Paliuro-Carpinion orientalis** Crisorean & Țeculescu 1968*Rhamno-Paliuretum* Trinajstić 1996*Clematido viticellae-Punicetum granati* ass. nova hoc loco*QUERCETALIA PUBESCENTI-PETREAE* Klika 1933**Carpinion orientalis** Horvat 1954*Quercu-Carpinetum orientalis* Horvatić 1939*Acer monspessulanum* community*Quercetum trojanae* Em 1958*Seslerio autumnalis-Ostryetum carpinifoliae* Horvat & Horvatić ex Horvat et al. 1974

## POPULETEA ALBAE Br.-Bl. 1962

*FRAXINETALIA* Scamoni & Passarge 1959**Lauro-Fraxinion angustifoliae** I. Kárpáti et V. Kárpáti 1961 = *Fraxinion angustifoliae* Pedrotti 1970 nom. prov.*Junco-Fraxinetum parvifoliae* I. Kárpáti & V. Kárpáti 1961*POPULETALIA ALBAE* Br.-Bl. ex Tchou Yen-Tcheng 1948**Populion albae** Br.-Bl. ex Tchou Yen-Tcheng 1948*Populetum albae* Br.-Bl. ex Tchou 1948**Alno-Quercion roboris** Horvat 1938*Quercus robur* and *Carpinus betulus* community*Periploco graecae-Alnetum glutinosae* Rudski in Horvat et al. ex Fanelli, De Sanctis, Gjeta, Mullaj, Attore ass. nova hoc loco

## NERIO-TAMARICETEA Br.-Bl. &amp; O. de Bolòs 1958

*TAMARICETALIA AFRICANAE* Br.-Bl. & O. de Bolòs 1958**Tamaricion africanae** Br.-Bl. & O. de Bolòs 1958*Vitici-Tamaricetum africanae* Horvatić 1960

## STELLARIETEA MEDIAE Tüxen Lohmeyer et Preising in Tüxen ex von Rochow 1951

*BROMETALIA RUBENTI-TECTORUM* Rivas Mart. & Izco 1977 = *Thero-Brometalia annuae* (Rivas Goday & Rivas Mart. ex Esteve 1973) O. de Bolòs 1975**Laguro ovati-Bromion rigidi** Géhu & Géhu-Franck 1985 nom. nud.*Bromo villosi-Haynaldietum villosae* Pignatti 1953*SISYMBRIETALIA OFFICINALIS* J. Tüxen ex W. Matuszkiewicz 1962**Hordeion murini** Br.-Bl. in Br.-Bl., Gajewski, Wraber & Walas 1936*Centaureetum calcitrapae* Fanelli & Menegoni 1997*CARTHAMETALIA LANATAE* Brullo in Brullo & Marcenò 1985*Asphodelus ramosus* community

## ARTEMISIETEA VULGARIS Lohmeyer, Preising &amp; Tüxen ex von Rochow 1951

*ONOPORDETALIA ACANTHII* Br.-Bl. & Tüxen ex Klika & Hadač 1944**Dauco-Melilotion** Görs 1966 ex Rostański & Gutte 1971*Carduetum acanthoidis* Felföldy 1942

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## 7. APPENDIX

### Coordinates and date of vegetation relevés

rel. 01: N 4635488.67, E 366422.98, 26/06/2012;	rel. 18: N 4641126.37, E 370654.22, 27/06/2012;
rel. 02: N 4635473.54, E 366393.02, 26/06/2012;	rel. 19: N 4640378.36, E 370214.78, 27/06/2012;
rel. 03: N 4634077.49, E 365346.05, 26/06/2012;	rel. 20: N 4639576.28, E 370903.21, 27/06/2012;
rel. 06: N 4642898.92, E 370341.97, 27/06/2012;	rel. 21: N 4639597.16, E 370910.26, 27/06/2012;
rel. 07: N 4642893.37, E 370344.94, 27/06/2012;	rel. 22: N 4639155.30, E 371246.68, 27/06/2012;
rel. 08: N 4642902.13, E 370359.14, 27/06/2012;	rel. 23: N 4635139.35, E 373019.20, 27/06/2012;
rel. 09: N 4642895.72, E 370365.44, 27/06/2012;	rel. 24: N 4642309.22, E 366473.43, 27/06/2012;
rel. 10: N 4642808.34, E 370130.74, 27/06/2012;	rel. 25: N 4642305.37, E 366448.69, 27/06/2012;
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rel. 241:	N 4635244.00,	E 365210.00,	19/06/2013;	rel. 493:	-	-	01/06/2013.

**Table 1 (Tabela 1):** *Ruppium cirrhosae* Iversen 1934

Relevé number	35	45
Relevé area (m <sup>2</sup> )	20	5
Cover total (%)	20	100
Water depth (cm)	50	100
Char. And diff. species of the ass.		
<i>Ruppia cirrhosa</i>	2b	5

**Table 2 (Tabela 2):** *Salicornietum venetae* Pignatti 1966

Relevé number	36	37	74	94	100
Relevé area (m <sup>2</sup> )	5	3	5	300	80
Cover herb layer (%)	80	80	60	100	90
Char. and diff. species of the ass.					
<i>Salicornia procumbens</i>	2b	4	3	5	5
Other species					
<i>Halimione portulacoides</i>	4	+	.	.	.
<i>Juncus maritimus</i>	+	+	.	+	.
<i>Aeluropus littoralis</i>	2a	+	.	.	.
<i>Limonium vulgare</i> subsp. <i>serotinum</i>	+	+	2a	+	.
<i>Salsola soda</i>	.	.	.	+	.

**Table 3 (Tabela 3):** *Puccinellio festucaeformi-Aeluropetum littoralis* (Corb 1968) Géhu & Costa 1984

Relevé number	39	111	485	486
Relevé area (m <sup>2</sup> )	3	20	5	7
Cover herb layer (%)	100	75	80	80
Char. and diff. species of the ass.				
<i>Aeluropus littoralis</i>	5	2m	3	3
Other species				
<i>Halimione portulacoides</i>	+	.	+	.
<i>Salicornia patula</i>	.	3	1	.
<i>Suaeda maritima</i>	.	+	+	.
<i>Limonium vulgare</i> subsp. <i>serotinum</i>	.	+	.	.
<i>Salsola soda</i>	.	.	.	+
<i>Artemisia caerulescens</i>	.	.	.	+

**Table 4 (Tabela 4):** *Juncetum maritimo-acuti* Horvatić 1934

Relevé number	38	41	42	57	90	96	101	103	108	113
Relevé area (m <sup>2</sup> )	25	30	60	15	120	30	25	40	25	20
Cover herb layer (%)	90	100	90	90	100	95	100	100	0	100
Char. and diff. species of the ass.										
<i>Juncus acutus</i>	.	4	3	.	+	.	4	.	+	5
<i>Juncus maritimus</i>	5	.	+	4	5	5	2b	5	3	+
Other species										
<i>Halimione portulacoides</i>	1	+	.	.	.	+	+	.	.	.
<i>Limonium vulgare</i> subsp. <i>serotinum</i>	1	3	3	2b	2b	1	+	1	5	2b
<i>Asparagus maritimus</i>	.	r	+	.	.	.	.	.	.	.
<i>Phragmites australis</i>	.	+	.	.	.	.	.	+	.	+
<i>Aeluropus littoralis</i>	.	+	.	+	.	.	.	.	.	.
<i>Elymus athericus</i>	.	+	2b	.	.	.	.	.	.	.
<i>Aster tripolium</i>	.	.	+	+	.	.	.	2m	.	.
<i>Scirpus maritimus</i>	.	.	+	.	.	.	.	.	.	.
<i>Juncus gerardi</i>	.	.	+	.	.	.	.	.	.	.
<i>Lotus tenuis</i>	.	.	+	.	.	.	.	.	.	.
<i>Bolboschoenus maritimus</i>	.	.	.	1	.	.	.	+	.	.
<i>Salicornia patula</i>	.	.	.	.	+	.	.	.	.	+
<i>Artemisia caerulescens</i>	.	.	.	.	+	.	+	.	+	.
<i>Salicornia procumbens</i>	.	.	.	.	.	2b	2b	.	.	.
<i>Salsola soda</i>	.	.	.	.	.	+	+	.	.	.
<i>Atriplex latifolia</i>	.	.	.	.	.	.	+	+	+	+
<i>Elymus farctus</i>	.	.	.	.	.	.	+	+	+	1
<i>Sonchus maritimus</i>	.	.	.	.	.	.	.	.	+	.
<i>Juncus subulatus</i>	.	.	.	.	.	.	.	.	.	+
<i>Crypsis aculeata</i>	.	.	.	.	.	.	.	.	.	+

**Table 5:** *Juncus maritimus* and *Lippia nodiflora* community

**Tabela 5:** Združba z vrstama *Juncus maritimus* in *Lippia nodiflora*

Relevé number	2	91	93	97	99	Relevé number	2	91	93	97	99
Relevé area (m <sup>2</sup> )	60	80	30	35	45	<i>Euphorbia paralias</i>	.	+	.	+	.
Cover herb layer (%)	90	90	100	60	85	<i>Plantago crassifolia</i>	.	+	.	.	.
Char. and diff. species of the ass.											
<i>Juncus maritimus</i>	.	2a	3	.	3	<i>Sonchus maritimus</i>	.	+	+	.	.
<i>Lippia nodiflora</i>	.	+	.	+	+	<i>Aeluropus littoralis</i>	.	+	.	.	.
<i>Inula viscosa</i>	.	2b	.	+	+	<i>Cynodon dactylon</i>	.	+	.	.	.
Other species											
<i>Potentilla reptans</i>	+	.	.	.	.	<i>Artemisia caerulescens</i>	.	+	2m	.	.
<i>Amorpha fruticosa</i>	2a	+	.	.	.	<i>Elymus farctus</i>	.	+	+	.	+
<i>Periploca graeca</i>	2a	.	.	.	.	<i>Arthrocnemum perenne</i>	.	.	+	.	.
<i>Cynanchum acutum</i>	1	.	.	.	.	<i>Inula crithmoides</i>	.	.	+	.	.
<i>Juncus acutus</i>	4	4	3	3	2b	<i>Limonium vulgare</i> subsp. <i>serotinum</i>	.	.	2m	.	.
<i>Agrostis stolonifera</i>	+	.	.	.	.	<i>Bolboschoenus maritimus</i>	.	.	+	.	.
<i>Phragmites australis</i>	+	.	.	.	.	<i>Polypogon monspeliensis</i>	.	.	.	+	.
<i>Elymus athericus</i>	+	.	.	.	.	<i>Crypsis aculeata</i>	.	.	.	+	2m
						<i>Dittrichia graveolens</i>	.	.	.	+	.
						<i>Scirpoides holoschoenus</i>	.	.	.	+	.

**Table 6 (Tabela 6):** *Cakilo-Xanthietum italicae* Pignatti 1953

Relevé number	3	242	243	246
Relevé area (m <sup>2</sup> )	30	20	5	5
Aspect (degrees)	160	-	-	-
Slope (degrees)	4	-	-	-
Cover herb layer (%)	45	40	40	10
Char. and diff. species of the ass.				
<i>Cakile maritima</i>	+	.	.	.
<i>Xanthium strumarium</i>	2b	3	1	2a
<i>Polygonum maritimum</i>	1	+	.	+
<i>Salsola kali</i> subsp. <i>kali</i>	2a	.	.	.
Other species				
<i>Echinophora spinosa</i>	1	1	2a	+
<i>Sporobolus pungens</i>	+	.	.	.
<i>Atriplex prostrata</i> subsp. <i>latifolia</i>	+	.	.	.
<i>Salsola kali</i> subsp. <i>tragus</i>	+	.	.	.
<i>Eryngium maritimum</i>	.	+	.	.
<i>Catapodium marinum</i>	.	+	1	.
<i>Euphorbia paralias</i>	.	.	+	.
<i>Pseudorlaya pumila</i>	.	.	+	.
<i>Hedypnois cretica</i>	.	.	+	.
<i>Plantago cynops</i>	.	.	+	+
<i>Elymus farctus</i> subsp. <i>farctus</i>	.	.	2a	.
<i>Euphorbia peplus</i>	.	.	.	+
<i>Stachys maritima</i>	.	.	.	1
<i>Lagurus ovatus</i>	.	.	.	+

**Table 7 (Tabela 7):** *Seslerio-Putorietum calabrica* Horvatić 1963

Relevé number	34
Relevé area (m <sup>2</sup> )	15
Altitude (m a.s.l.)	482
Aspect (degrees)	180
Slope (degrees)	80
Cover herb layer (%)	5
Cover bare rock (%)	100
Char. and diff. species of the ass.	
<i>Moltkia petraea</i>	1
<i>Sesleria robusta</i> subsp. <i>skanderbeggii</i>	+
Other species	
<i>Ficus carica</i>	+
<i>Pistacia terebinthus</i>	+
<i>Punica granatum</i>	+
<i>Satureja montana</i>	+
<i>Achnatherum calamagrostis</i>	1

**Table 8 (Tabela 8):** *Hydrocharitetum morsus-ranae* van Langendonck 1935

Relevé number	58	219	224	225	234
Relevé area (m <sup>2</sup> )	18	6	5	7	15
Cover herb layer (%)	95	90	90	85	70
Water depth (cm)	60	100	110	85	70
Char. and diff. species of the ass.					
<i>Hydrocharis morsus-ranae</i>	4	4	5	.	5
Other species					
<i>Myriophyllum spicatum</i>	3	2a	+	.	.
<i>Potamogeton natans</i>	2b	.	.	.	.
<i>Potamogeton crispus</i>	.	3	.	.	.
<i>Phragmites australis</i>	.	+	.	.	.
<i>Lemna minor</i>	.	.	+	.	.
<i>Apium nodiflorum</i>	.	.	.	+	.
<i>Alisma plantago-aquatica</i>	.	.	.	+	.
<i>Sparganium erectum</i>	.	.	.	5	.
<i>Typha angustifolia</i>	.	.	.	+	.
<i>Typha latifolia</i>	.	.	.	.	+

**Table 9 (Tabela 9):** *Nymphaetum albae* Vollmar 1947

Relevé number	6	216	217	218	220	233	240
Relevé area (m <sup>2</sup> )	30	4	6	6	7	10	8
Cover herb layer (%)	80	60	60	100	70	80	90
Water depth (cm)	100	90	75	90	120	100	110
Char. and diff. species of the ass.							
<i>Nymphaea alba</i>	3	3	4	5	4	5	5
Other species							
<i>Myriophyllum spicatum</i>	2b	.	.	4	.	.	.
<i>Potamogeton perfoliatus</i>	1	.	.	.	.	.	.
<i>Typha angustifolia</i>	1	.	.	.	+	.	.
<i>Elodea canadensis</i>	.	+	.	.	.	.	.
<i>Potamogeton pectinatus</i>	.	+	1	.	+	+	.
<i>Lemna minor</i>	.	+	+	.	2a	.	+
<i>Paspalum paspalodes</i>	.	+	+	.	.	.	.
<i>Typha latifolia</i>	.	.	.	.	.	+	.

**Table 10 (Tabela 10):** *Trapetum natantis* Kárpáti 1963

Relevé number	11	223
Relevé area (m <sup>2</sup> )	7	12
Cover herb layer (%)	90	90
Water depth (cm)	160	200
Char. and diff. species of the ass.		
<i>Trapa natans</i>	5	5
Other species		
<i>Phragmites australis</i>	+	.
<i>Lemna minor</i>	2b	+
<i>Sparganium erectum</i>	+	.
<i>Typha angustifolia</i>	+	.

**Table 11 (Tabela 11):** *Potamogetonetus denso-nodosi* O. de Bolòs 1957

Relevé number	84	488	489
Relevé area (m <sup>2</sup> )	4	8	6
Cover herb layer (%)	100	100	100
Water depth (cm)	60	80	100
Char. and diff. species of the ass.			
<i>Potamogeton nodosus</i>	5	4	4
Other species			
<i>Potamogeton perfoliatus</i>	1	+	.
<i>Potamogeton crispus</i>	+	.	.
<i>Typha latifolia</i>	+	.	.
<i>Potamogeton natans</i>	.	.	+

**Table 12 (Tabela 12):** *Potamogetonetus pectinatus* Carstensen ex Hilbig 1971

Relevé number	53	78	80	83	88	89	199
Relevé area (m <sup>2</sup> )	10	15	4	5	7	30	10
Cover herb layer (%)	100	100	100	100	100	100	100
Water depth (cm)	100	150	200	100	300	200	150
Char. and diff. species of the ass.							
<i>Potamogeton pectinatus</i>	5	3	5	5	5	5	4
Other species							
<i>Potamogeton nodosus</i>	r	.	.	.	.	.	.
<i>Myriophyllum spicatum</i>	.	+	.	.	.	1	.
<i>Potamogeton perfoliatus</i>	+	r	2a	.	.	.	.
<i>Potamogeton crispus</i>	.	+	.	+	.	.	.
<i>Elodea canadensis</i>	.	.	.	+	.	.	2b

**Table 13 (Tabela 13):** *Elodeetum canadensis* Nedelcu 1967

Relevé number	87	487
Relevé area (m <sup>2</sup> )	10	8
Cover herb layer (%)	100	100
Water depth (cm)	100	80
Char. and diff. species of the ass.		
<i>Elodea canadensis</i>	5	5
Other species		
<i>Potamogeton crispus</i>	1	+
<i>Potamogeton natans</i>	.	+

**Table 14 (Tabela 14):** *Typhetum angustifoliae* Pignatti 1953

Relevé number	8	13	221	479	480
Relevé area (m <sup>2</sup> )	30	40	5	10	15
Cover herb layer (%)	100	100	100	100	100
Char. and diff. species of the ass.					
<i>Typha angustifolia</i>	5	5	5	5	5
Other species					
<i>Alisma plantago-aquatica</i>	+	1	+	.	+
<i>Paspalum paspalodes</i>	3	.	.	.	.
<i>Spartanium erectum</i>	.	1	2a	.	.
<i>Phragmites australis</i>	.	.	+	.	.
<i>Butomus umbellatus</i>	.	.	.	+	.

**Table 15 (Tabela 15):** *Typhetum latifoliae* Nowinski 1930

Relevé number	105	109	235	244
Relevé area (m <sup>2</sup> )	30	25	4	13
Cover herb layer (%)	70	100	85	80
Char. and diff. species of the ass.				
<i>Typha latifolia</i>	3	5	5	5
Other species				
<i>Phragmites australis</i>	+	+	+	.
<i>Bolboschoenus maritimus</i>	.	.	.	+
<i>Scrophularia nodosa</i>	.	.	+	.
<i>Baldellia ranunculoides</i>	.	.	+	.
<i>Alisma plantago-aquatica</i>	.	.	+	.
<i>Myriophyllum spicatum</i>	.	.	.	+
<i>Elymus farctus</i> subsp. <i>farctus</i>	+	.	.	.
<i>Tamarix africana</i>	+	.	.	.
<i>Atriplex prostrata</i> subsp. <i>latifolia</i>	2m	.	.	.

**Table 16 (Tabela 16):** *Phragmitetum australis* Savic 1926 nom. mut. prop.

Relevé number	75	236	245	85	227	110
Relevé area (m <sup>2</sup> )	15	10	10	5	6	20
Cover herb layer (%)	100	100	100	95	95	100
Water depth (cm)	100	50	70	40	30	80
Char. and diff. species of the ass.						
<i>Phragmites australis</i>	5	5	5	1	5	5
Other species						
<i>Iris pseudacorus</i>	.	.	.	5	.	.
<i>Scirpus lacustris</i>	.	.	.	.	.	1
<i>Bolboschoenus maritimus</i>	.	.	.	.	.	+
<i>Rumex hydrolypium</i>	.	.	+	.	.	.
<i>Eupatorium cannabinum</i>	.	.	+	.	.	.



**Table 17 (Tabela 17):** *Scirpetum lacustris* Chouard 1924

Relevé number	79	81	86
Relevé area (m <sup>2</sup> )	15	6	5
Cover herb layer (%)	100	100	100
Water depth (cm)	50	50	30
Char. and diff. species of the ass.			
<i>Scirpus lacustris</i>	5	5	1
Other species			
<i>Typha latifolia</i>	.	+	.
<i>Bolboschoenus maritimus</i>	.	+	+
<i>Iris pseudacorus</i>	.	.	5

**Table 18 (Tabela 18):** *Glycerio-Sparganietum neglecti* Koch 1926

Relevé number	59	215	228
Relevé area (m <sup>2</sup> )	10	2	6
Cover herb layer (%)	100	90	95
Water depth (cm)	35	40	25
Char. and diff. species of the ass.			
<i>Sparganium erectum</i>	5	5	4
Other species			
<i>Alisma plantago-aquatica</i>	.	+	+
<i>Phragmites australis</i>	.	+	+
<i>Butomus umbellatus</i>	+	.	.
<i>Hydrocharis morsus-ranae</i>	+	.	.
<i>Potamogeton natans</i>	+	.	.
<i>Typha angustifolia</i>	+	.	.
<i>Scirpus lacustris</i>	+	.	.
<i>Oenanthe fistulosa</i>	.	+	.
<i>Pulicaria odora</i>	.	+	.
<i>Lemna minor</i>	.	+	.
<i>Apium nodiflorum</i>	.	.	2b

**Table 19 (Tabela 19):** *Scirpetum maritimo-litoralis* (Br.-Bl. in Br.-Bl., Roussine & Nègre 1952) O. Bolòs 1962

Relevé number	1	43	237	106
Relevé area (m <sup>2</sup> )	3	0	15	10
Cover herb layer (%)	90	80	100	100
Water depth (cm)	20	15	25	20
Char. and diff. species of the ass.				
<i>Bolboschoenus maritimus</i>	4	4	5	5
Other species				
<i>Phragmites australis</i>	+	2b	.	+
<i>Typha angustifolia</i>	2a	.	+	.
<i>Scirpus lacustris</i>	+	.	.	.
<i>Paspalum paspalodes</i>	+	.	.	.
<i>Alisma plantago-aquatica</i>	.	.	+	.
<i>Agrostis stolonifera</i>	+	.	.	.

**Table 20 (Tabela 20):** *Scirpetum litoralis* Pignatti 1953

Relevé number	481	482	44
Relevé area (m <sup>2</sup> )	15	7	10
Cover herb layer (%)	80	75	70
Char. and diff. species of the ass.			
<i>Scirpus litoralis</i>	4	5	4
Other species			
<i>Phragmites australis</i>	+	.	.
<i>Scirpus lacustris</i>	.	+	.

**Table 21 (Tabela 21):** *Schoeno-Erianthetum ravennae* Pignatti 1953

Relevé number	102	107	95
Relevé area (m <sup>2</sup> )	40	30	30
Cover herb layer (%)	90	100	100
Char. and diff. species of the ass.			
<i>Erianthus ravennae</i>	5	3	3
<i>Schoenus nigricans</i>	+	+	.
Char. species of upper syntaxa			
<i>Scirpus holoschoenus</i>	1	.	1
<i>Sonchus maritimus</i>	.	+	.
<i>Aster squamatus</i>	+	+	+
<i>Lotus tenuis</i>	+	+	.
Other species			
<i>Lythrum salicaria</i>	+	+	+
<i>Carex punctata</i>	+	3	1
<i>Inula viscosa</i>	+	1	+
<i>Centaurium spicatum</i>	.	+	+
<i>Pulicaria vulgaris</i>	+	.	+
<i>Phragmites australis</i>	+	+	+
<i>Juncus acutus</i>	2m	+	.
<i>Amorpha fruticosa</i>	+	.	.
<i>Bromus hordeaceus</i>	+	.	.
<i>Clematis flammula</i>	.	.	+
<i>Cynanchum acutum</i>	.	+	.
<i>Equisetum arvense</i>	+	.	.
<i>Euphorbia paralias</i>	.	.	+
<i>Juncus maritimus</i>	.	+	.
<i>Mentha aquatica</i>	+	.	+
<i>Petroselinum segetum</i>	.	+	+
<i>Populus alba</i>	+	.	.
<i>Rubus ulmifolius</i>	.	.	+
<i>Samolus valerandi</i>	.	+	.
<i>Sporobolus pungens</i>	.	.	+
<i>Trifolium repens</i>	+	.	.
<i>Vulpia membranacea</i>	.	.	+

**Table 22 (Tabela 22):** *Paspalo-Agrostidetum* Br.-Bl. 1936 (1952)

Relevé number	9	12	214
Relevé area (m <sup>2</sup> )	5	5	5
Cover herb layer (%)	100	100	90
Char. and diff. species of the ass.			
<i>Paspalum paspalodes</i>	5	5	5
Other species			
<i>Plantago major</i>	.	.	+
<i>Rumex conglomeratus</i>	+	.	.
<i>Alisma plantago-aquatica</i>	+	.	.
<i>Trifolium repens</i>	.	.	+
<i>Eleocharis palustris</i>	.	.	+
<i>Juncus</i> sp.	.	.	+

**Table 24:** *Stipo-Salvietum officinalis* Horvatić 1958. Species with phi-value above 0.50 (only species with a statistically significant affinity to a cluster according to Fisher's exact test with P <0.001 are included) are in bold.

**Tabela 24:** *Stipo-Salvietum officinalis* Horvatić 1958. Krepko so označene vrste z phi>0,50 (vključene so samo vrste, ki so statistično značilno navezane na klaster glede na Fisherjev eksaktni test, p <0,001).

Relevé number	29	73	72	62	71
Relevé area (m <sup>2</sup> )	60	10	15	10	4
Altitude (m a.s.l.)	144	152	138	83	125
Aspect (degrees)	110	90	100	330	140
Slope (degrees)	20	32	20	15	18
Cover herb layer (%)	80	75	80	100	100
Cover bare rock (%)	0	5	20	90	70
Cover stones (%)	80	45	30	0	0

Char. and diff. species of the ass.					
<b><i>Bupleurum veronense</i></b>	+	+	1	+	+
<b><i>Asperula aristata</i> subsp. <i>scabra</i></b>	+	.	+	+	+
<i>Satureja montana</i>	+	.	+	2a	+
<i>Salvia officinalis</i>	2b	2a	+	.	.
<i>Convolvulus elegantissimus</i>	+	+	+	.	.
<b><i>Koeleria splendens</i></b>	.	.	.	2a	+
<b><i>Leontodon crispus</i></b>	.	.	.	+	+
Other species	.	.	.	.	.
<i>Dasypyrum villosum</i>	.	.	+	r	2m
<i>Asphodelus ramosus</i>	.	3	+	2b	+
<i>Stipa bromoides</i>	+	3	4	.	2a
<i>Chrysopogon gryllus</i>	+	.	+	3	5
<i>Micromeria juliana</i>	1	.	1	+	+
<i>Teucrium polium</i> subsp. <i>capitatum</i>	+	.	+	2a	1
<i>Avena barbata</i>	.	+	.	+	+
<i>Brachypodium distachyon</i>	2m	.	.	+	+
<i>Petrorhagia saxifraga</i> subsp. <i>saxifraga</i>	+	.	+	.	+
<i>Teucrium chamaedrys</i>	+	+	+	.	.

**Table 23 (Tabela 23):** *Trifolio fragiferi-Cynodontetum* Br.-Bl. et O. de Bolòs 1957

Relevé number	7	212	213
Relevé area (m <sup>2</sup> )	2	2	2
Cover herb layer (%)	98	100	100
Char. and diff. species of the ass.			
<i>Trifolium fragiferum</i>	3	2a	3
<i>Cynodon dactylon</i>	3	5	3
Other species			
<i>Mentha pulegium</i>	+	+	2a
<i>Plantago lanceolata</i>	.	+	1
<i>Oenanthe fistulosa</i>	+	.	.
<i>Matricaria chamomilla</i>	+	.	.
<i>Paspalum paspalodes</i>	2a	.	.
<i>Plantago macrorhiza</i>	.	+	.
<i>Setaria viridis</i>	.	+	.
<i>Juncus species</i>	.	+	.
<i>Rumex conglomeratus</i>	.	.	+
<i>Potentilla reptans</i>	.	.	+
<i>Cirsium vulgare</i>	.	.	+

Relevé number	29	73	72	62	71
<i>Bromus erectus</i>	+	+	.	.	.
<i>Briza maxima</i>	.	+	.	+	.
<i>Carlina corymbosa</i>	.	+	2b	.	.
<i>Catapodium rigidum</i>	+	+	.	.	.
<i>Eryngium amethystinum</i>	.	+	.	1	.
<i>Melica ciliata</i>	.	+	+	.	.
<i>Quercus trojana</i>	+	.	+	.	.
<i>Aegilops geniculata</i>	.	.	.	+	.
<i>Aethionema saxatile</i>	.	+	.	.	.
<i>Allium guttatum</i> subsp. <i>guttatum</i>	.	.	+	.	.
<i>Bituminaria bituminosa</i>	+	.	.	.	.
<i>Carthamus lanatus</i>	.	.	.	.	+
<i>Centaurea alba</i> subsp. <i>deusta</i>	.	.	.	r	.
<i>Cynosurus echinatus</i>	.	+	.	.	.
<i>Dactylis glomerata</i> subsp. <i>glomerata</i>	.	.	+	.	.
<i>Dactylis glomerata</i> subsp. <i>hispanica</i>	.	+	.	.	.
<i>Dorycnium hirsutum</i>	.	.	+	.	.
<i>Echium plantagineum</i>	2m	.	.	.	.
<i>Erysimum repandum</i>	.	+	.	.	.
<i>Euphorbia spinosa</i>	.	.	.	+	.
<i>Festuca rupicola</i>	.	.	.	.	+
<i>Helichrysum italicum</i> subsp. <i>italicum</i>	.	.	.	.	+
<i>Hyparrhenia hirta</i>	.	.	+	.	.
<i>Hypericum humifusum</i>	.	+	.	.	.
<i>Hypericum perforatum</i> subsp. <i>veronense</i>	.	.	.	+	.
<i>Inula viscosa</i>	+	.	.	.	.
<i>Linum trigynum</i>	.	.	.	+	.

Relevé number	29	73	72	62	71
<i>Orlaya grandiflora</i>	.	.	.	+	.
<i>Paliurus spina-christi</i>	+	.	.	.	.
<i>Pistacia terebinthus</i>	+	.	.	.	.
<i>Potentilla aurea</i>	.	.	.	.	+
<i>Potentilla recta</i>	.	.	.	+	.
<i>Prunus spinosa</i>	+	.	.	.	.
<i>Sanguisorba minor</i> subsp. <i>muricata</i>	.	.	.	+	.
<i>Securigera cretica</i>	.	.	+	.	.
<i>Silene vulgaris</i> subsp. <i>vulgaris</i>	.	+	.	.	.
<i>Teucrium montanum</i>	2m	.	.	.	.
<i>Thesium divaricatum</i>	.	.	.	+	.
<i>Tragopogon pratensis</i>	.	.	.	+	.
<i>Trifolium angustifolium</i>	.	.	+	.	.
<i>Trifolium campestre</i>	.	.	+	.	.
<i>Urospermum picroides</i>	.	.	.	.	+
<i>Verbascum phlomoides</i>	+	.	.	.	.

**Table 25:** Asphodelo-Chrysopogonetum grylli Horvatić 1957. Species with phi-value above 0.50 (only species with a statistically significant affinity to a cluster according to Fisher's exact test with  $P < 0.001$  are included) are in bold.

**Tabela 25:** Asphodelo-Chrysopogonetum grylli Horvatić 1957. Krepko so označene vrste z  $\phi > 0,50$  (vključene so samo vrste, ki so statistično značilno navezane na klaster glede na Fisherjev eksaktni test,  $p < 0,001$ ).

Relevé number	31	30	32	33
Relevé area (m <sup>2</sup> )	25	30	8	20
Altitude (m a.s.l.)	353	277	483	484
Aspect (degrees)	200	120	150	140
Slope (degrees)	23	40	25	25
Cover herb layer (%)	80	60	95	95
Cover bare rock (%)	0	30	0	35
Cover stones (%)	20	40	30	40

Char. and diff. species of the ass.

<b><i>Chrysopogon gryllus</i></b>	3	3	5	4
<b><i>Galium lucidum</i></b>	+	.	+	+
<b><i>Linum trigynum</i></b>	+	+	.	+
<b><i>Helianthemum apenninum</i></b>	.	.	+	+
<b><i>Coronilla scorpioides</i></b>	+	.	.	+
Other species				
<i>Teucrium polium</i> subsp. <i>capitatum</i>	+	.	.	+
<i>Stachys recta</i> subsp. <i>labiosa</i>	+	.	.	.
<i>Anthemis austriaca</i>	+	+	.	+
<i>Onosma arenaria</i>	.	+	.	.
<i>Salvia officinalis</i>	.	2a	+	+
<i>Bituminaria bituminosa</i>	+	.	+	.
<i>Brachypodium distachyon</i>	2b	+	.	.
<i>Convolvulus elegantissimus</i>	+	.	.	+
<i>Dactylis glomerata</i> subsp. <i>glomerata</i>	+	.	+	.
<i>Satureja montana</i>	.	1	.	+
<i>Sideritis romana</i>	+	.	.	+

Relevé number	31	30	32	33
<i>Stipa bromoides</i>	1	.	+	.
<i>Aethionema saxatile</i>	+	.	.	.
<i>Elymus elongatus</i>	.	+	.	.
<i>Althaea hirsuta</i>	.	.	.	+
<i>Bromus erectus</i>	+	.	.	.
<i>Carlina corymbosa</i>	.	.	.	+
<i>Catapodium rigidum</i>	.	+	.	.
<i>Dorycnium herbaceum</i>	.	+	.	.
<i>Eryngium amethystinum</i>	.	+	.	.
<i>Linum nodiflorum</i>	.	+	.	.
<i>Pistacia terebinthus</i>	.	+	.	.
<i>Quercus trojana</i>	.	.	+	.
<i>Micromeria juliana</i>	1	.	.	.
<i>Scabiosa triniifolia</i>	.	.	+	.
<i>Teucrium montanum</i>	.	+	.	.
<i>Verbascum phlomoides</i>	+	.	.	.

**Table 26:** *Brachypodio-Cymbopogonetum hirti* Horvatić 1961. Species with phi-value above 0.50 (only species with a statistically significant affinity to a cluster according to Fisher's exact test with  $P < 0.001$  are included) are in bold.

**Tabela 26:** *Brachypodio-Cymbopogonetum hirti* Horvatić 1961. Krepko so označene vrste z  $\phi > 0,50$  (vključene so samo vrste, ki so statistično značilno navezane na klaster glede na Fisherjev eksaktni test,  $p < 0,001$ ).

Relevé number	67	493	69
Relevé area (m <sup>2</sup> )	5	15	3
Altitude (m a.s.l.)	70	90	102
Aspect (degrees)	50	50	180
Slope (degrees)	15	15	10
Cover herb layer (%)	50	70	95
Cover bare rock (%)	70	70	90
Cover stones (%)	30	25	15

Char. and diff. species of the ass.

<b><i>Hyparrhenia hirta</i></b>	2b	3	4
<b><i>Aethionema saxatile</i></b>	+	+	+
<b><i>Crupina vulgaris</i></b>	+	+	.
<b><i>Sherardia arvensis</i></b>	+	+	.
<b><i>Hypericum perforatum</i> subsp. <i>veronense</i></b>	.	+	+
Other species			
<i>Convolvulus elegantissimus</i>	+	.	+
<i>Carlina corymbosa</i>	+	.	+
<i>Teucrium polium</i> subsp. <i>capitatum</i>	2b	+	1
<i>Petrorhagia saxifraga</i> subsp. <i>saxifraga</i>	+	+	+
<i>Micromeria juliana</i>	+	+	2a
<i>Cynosurus echinatus</i>	+	+	.
<i>Arenaria leptoclados</i>	+	+	.
<i>Brachypodium distachyon</i>	2a	.	+
<i>Anthemis austriaca</i>	.	.	+
<i>Asphodelus ramosus</i>	.	.	1
<i>Avena barbata</i>	.	+	+
<i>Bromus intermedius</i>	+	.	.

Relevé number	67	493	69
<i>Bupleurum veronense</i>			+
<i>Chrysopogon gryllus</i>	+		
<i>Dasyphyrum villosum</i>	+		
<i>Euphorbia spinosa</i>		+	
<i>Phlomis fruticosa</i>	+		
<i>Quercus trojana</i>	+		
<i>Satureja montana</i>			+
<i>Sedum rupestre</i>		+	
<i>Sideritis romana</i>	+		
<i>Stachys recta</i> subsp. <i>recta</i>		+	
<i>Thesium divaricatum</i>		+	

**Table 27:** *Salvio-Phlomidetum fruticosae* Barbagallo, Brullo & Fagotto 1979. Species with phi-value above 0.50 (only species with a statistically significant affinity to a cluster according to Fisher's exact test with  $P < 0.001$  are included) are in bold.

**Table 27:** *Salvio-Phlomidetum fruticosae* Barbagallo, Brullo & Fagotto 1979. Krepko so označene vrste z  $\phi > 0,50$  (vključene so samo vrste, ki so statistično značilno navezane na klaster glede na Fisherjev eksaktni test,  $p < 0,001$ ).

Relevé number	68	65	21	66	60	61
Relevé area (m <sup>2</sup> )	20	50	50	20	70	30
Altitude (m a.s.l.)	91	-	-	44	-	-
Aspect (degrees)	120	150	135	130	160	140
Slope (degrees)	25	15	25	20	15	40
Cover herb layer (%)	70	70	75	95	60	80
Cover bare rock (%)	10	95	0	10	70	100
Cover stones (%)	0	0	70	75	50	0

Char. and diff. species of the ass.

<b><i>Phlomis fruticosa</i></b>	4	4	3	4	2b	4
<b><i>Stipa bromoides</i></b>	+	+	2b	+	+	1
<i>Melica ciliata</i>	+	.	1	.	+	+
<i>Micromeria juliana</i>	+	.	+	+	+	.
<i>Petrorhagia saxifraga</i> subsp. <i>saxifraga</i>	.	+	+	+	+	.
Other species						
<i>Teucrium polium</i> subsp. <i>capitatum</i>	.	.	1	+	+	.
<i>Ballota macedonica</i>	+	1	.	.	.	.
<i>Satureja calamintha</i>	.	1	.	.	.	.
<i>Geranium pusillum</i>	+	.	.	.	.	.
<i>Sideritis romana</i>	.	.	+	1	.	.
<i>Osyris alba</i>	.	.	+	+	.	.
<i>Catapodium rigidum</i>	.	.	+	+	.	.
<i>Salvia officinalis</i>	.	.	.	+	+	+
<i>Teucrium chamaedrys</i>	.	.	+	+	+	+
<i>Satureja montana</i>	.	.	+	.	2a	+
<i>Orlaya grandiflora</i>	.	.	.	.	+	+
<i>Cephalaria transylvanica</i>	.	.	.	.	+	.
<i>Allium sphaerocephalon</i>	.	.	.	.	.	+
<i>Brachypodium distachyon</i>	+	.	+	+	+	.
<i>Aethionema saxatile</i>	.	.	.	+	+	.
<i>Anthemis austriaca</i>	.	.	.	.	+	+

Relevé number	68	65	21	66	60	61
<i>Briza maxima</i>	.	.	+	.	+	.
<i>Dactylis glomerata</i> subsp. <i>glomerata</i>	+	.	+	.	.	.
<i>Phillyrea latifolia</i>	.	.	1	.	.	+
<i>Punica granatum</i>	+	.	.	+	.	.
<i>Rhus coriaria</i>	.	.	.	.	2b	+
<i>Arenaria leptoclados</i>	.	.	.	.	+	.
<i>Asparagus acutifolius</i>	.	.	.	.	.	+
<i>Asperula aristata</i> subsp. <i>scabra</i>	.	.	.	.	.	+
<i>Asphodelus ramosus</i>	.	+	.	.	.	.
<i>Avena barbata</i>	.	.	.	.	+	.
<i>Bituminaria bituminosa</i>	.	.	.	.	.	+
<i>Carex hallerana</i>	.	.	.	.	+	.
<i>Carlina corymbosa</i>	+	.	.	.	.	.
<i>Carthamus lanatus</i>	.	.	+	.	.	.
<i>Convolvulus cantabrica</i>	.	.	.	.	.	+
<i>Convolvulus elegantissimus</i>	.	.	.	+	.	.
<i>Cynosurus echinatus</i>	.	.	+	.	.	.
<i>Filago germanica</i>	.	.	.	+	.	.
<i>Fraxinus ornus</i>	.	.	.	.	+	+
<i>Linum trigynum</i>	.	.	.	.	.	+
<i>Origanum vulgare</i>	.	.	.	.	.	2a
<i>Paliurus spina-christi</i>	.	.	+	.	.	.
<i>Phillyrea latifolia</i>	.	.	.	+	.	.
<i>Pistacia terebinthus</i>	.	.	.	.	+	1
<i>Sedum rupestre</i>	.	.	.	.	+	.
<i>Sherardia arvensis</i>	.	.	+	.	.	.
<i>Urospermum picroides</i>	+	.	.	.	.	.

**Table 28:** *Rhamno-Paliuretum* Trinajstić 1996. Species with phi-value above 0.50 (only species with a statistically significant affinity to a cluster according to Fisher's exact test with  $P < 0.001$  are included) are in bold.

**Tabela 28:** *Rhamno-Paliuretum* Trinajstić 1996. Krepko so označene vrste z  $\phi > 0,50$  (vključene so samo vrste, ki so statistično značilno navezane na klaster glede na Fisherjev eksaktni test,  $p < 0,001$ ).

Relevé number	16	491	169
Relevé area (m <sup>2</sup> )	50	15	20
Altitude (m a.s.l.)	50	32	25
Aspect (degrees)	20	30	-
Slope (degrees)	10	5	-
Cover shrub layer (%)	100	100	100
Cover herb layer (%)	5	5	35
Height (highest) shrubs (m)	3	3	4
Height lowest shrubs (m)	1	1	1,5

Char. and diff. species of the ass.

<i>Paliurus spina-christi</i>	5	4	3
<b><i>Phillyrea latifolia</i></b>	+	3	5
<b><i>Euphorbia characias</i></b>	+	+	+
<b><i>Clematis flammula</i></b>	+	+	+

Relevé number	16	491	169
<b><i>Bupleurum praealtum</i></b>	+	+	.
Other species			
<i>Asparagus acutifolius</i>	+	+	+
<i>Pistacia terebinthus</i>	.	2a	2b
<i>Carthamus lanatus</i>	+	+	.
<i>Rubus ulmifolius</i>	2b	1	.
<i>Rhus coriaria</i>	.	1	+
<i>Ruscus aculeatus</i>	+	.	3
<i>Scolymus hispanicus</i>	+	+	.
<i>Dactylis glomerata</i> subsp. <i>glomerata</i>	+	.	+
<i>Carpinus orientalis</i>	1	.	.
<i>Crataegus monogyna</i>	.	.	+
<i>Oenanthe pimpinelloides</i>	+	.	.
<i>Quercus trojana</i>	.	.	+

**Table 29:** *Clematido viticellae-Punicetum granatae* ass. nova hoc loco. Species with phi-value above 0.50 (only species with a statistically significant affinity to a cluster according to Fisher's exact test with  $P < 0.001$  are included) are in bold. **Tabela 29:** *Clematido viticellae-Punicetum granatae* ass. nova hoc loco. Krepko so označene vrste z  $\phi > 0,50$  (vključene so samo vrste, ki so statistično značilno navezane na klaster glede na Fisherjev eksaktni test,  $p < 0,001$ ).

Relevé number	20	27*	28	22
Relevé area (m <sup>2</sup> )	80	60	50	60
Altitude (m a.s.l.)	13	-	25	18
Aspect (degrees)	180	-	-	120
Slope (degrees)	15	-	-	15
Cover shrub layer (%)	90	100	100	100
Cover herb layer (%)	10	20	5	60
Height (highest) shrubs (m)	17	35	30	40
Cover stones (%)	0	0	0	10

Char. and diff. species of the ass.

<b><i>Punica granatum</i></b>	5	5	4	5
<b><i>Clematis viticella</i></b>	+	+	+	.
<i>Rosa sempervirens</i>	1	+	+	.
<b><i>Asplenium onopteris</i></b>	.	+	+	+
<b><i>Geum urbanum</i></b>	+	+	+	.
Other species				
<i>Paliurus spina-christi</i>	+	1	2b	.
<i>Ruscus aculeatus</i>	.	1	1	.
<i>Viola odorata</i>	.	2a	.	2b
<i>Clematis flammula</i>	+	+	.	.
<i>Carex distachya</i>	+	.	.	+
<i>Crataegus monogyna</i>	.	+	1	.
<i>Carpinus orientalis</i>	.	.	2a	.
<i>Catapodium rigidum</i>	+	.	.	.
<i>Consolida ajacis</i>	.	.	.	+
<i>Dactylis glomerata</i> subsp. <i>glomerata</i>	.	.	.	2b

Relevé number	20	27*	28	22
<i>Hedera helix</i>	.	.	.	+
<i>Lathyrus aphaca</i>	.	.	.	+
<i>Buglossoides purpureocaerulea</i>	.	2a	.	.
<i>Phillyrea latifolia</i>	1	.	.	.
<i>Phlomis fruticosa</i>	+	.	.	.
<i>Stipa bromoides</i>	+	.	.	.
<i>Torilis arvensis</i> subsp. <i>arvensis</i>	.	.	.	+
<i>Torilis nodosa</i>	+	.	.	.
<i>Brachypodium retusum</i>	+	.	.	.
<i>Brachypodium sylvaticum</i>	.	.	.	3
<b><i>Bupleurum praealtum</i></b>	.	+	.	.

**Table 30:** *Carpinetum orientalis* Horvat 1939. Species with phi-value above 0.50 (only species with a statistically significant affinity to a cluster according to Fisher's exact test with  $P < 0.001$  are included) are in bold.

**Tabela 30:** *Carpinetum orientalis* Horvat 1939. Krepko so označene vrste z  $\phi > 0,50$  (vključene so samo vrste, ki so statistično značilno navezane na klaster glede na Fisherjev eksaktni test,  $p < 0,001$ ).

Relevé number	18	19	192
Relevé area (m <sup>2</sup> )	80	50	100
Altitude (m a.s.l.)	24	-	-
Aspect (degrees)	-	180	-
Slope (degrees)	-	15	-
Cover tree layer (%)	80	100	80
Cover shrub layer (%)	2	90	2
Cover herb layer (%)	3	10	10
Cover bare rock (%)	5	0	0
Height (highest) trees (m)	6	8	7
Height lowest trees (m)	3	4	6
Height (highest) shrubs (m)	2	2	3

Char. and diff. species of the ass.

<i>Carpinus orientalis</i>	4	5	4
<i>Ruscus aculeatus</i>	+	2b	2b
<i>Fraxinus ornus</i>	+	2a	+
<i>Quercus pubescens</i>	+	+	.
<i>Crataegus monogyna</i>	+	+	.
<b><i>Acer campestre</i></b>	2b	.	2a
<b><i>Celtis australis</i></b>	+	+	.
Other species			
<i>Hedera helix</i>	.	+	+
<i>Asparagus acutifolius</i>	.	+	+
<i>Clematis vitalba</i>	+	.	.
<i>Vitis vinifera</i> subsp. <i>sylvestris</i>	+	.	.
<i>Phillyrea latifolia</i>	+	.	.
<i>Buglossoides purpureocaerulea</i>	.	+	.
<i>Asplenium onopteris</i>	.	+	.
<i>Corylus avellana</i>	.	+	.
<i>Clematis flammula</i>	.	+	.

Relevé number	18	19	192
<i>Acer campestre</i>	.	2a	.
<i>Paliurus spina-christi</i>	.	+	.
<i>Tilia cordata</i>	.	+	.
<i>Punica granatum</i>	.	+	.
<i>Cornus mas</i>	.	+	.
<i>Fraxinus ornus</i>	.	4	.
<i>Dactylis polygama</i>	.	+	.
<i>Carpinus orientalis</i>	.	.	+
<i>Ulmus minor</i>	.	.	+
<i>Aristolochia pallida</i>	.	.	+
<i>Anemone apennina</i>	.	.	+
<i>Ranunculus lanuginosus</i>	.	.	+
<i>Rosa canina</i>	.	.	+
<i>Crataegus monogyna</i>	.	.	+
<i>Vicia tetrasperma</i>	.	.	+
<i>Geranium purpureum</i>	.	.	+
<i>Viola odorata</i>	.	.	1
<i>Cornus mas</i>	.	.	2b
<i>Ligustrum vulgare</i>	.	.	1
<i>Tamus communis</i>	.	.	+
<i>Luzula forsteri</i>	.	.	+
<i>Chaerophyllum temulentum</i>	.	.	+

**Table 31:** *Acer monspessulanum* community.

**Tabela 31:** Združba z vrsto *Acer monspessulanum*.

Relevé number	26	17
Relevé area (m <sup>2</sup> )	80	50
Altitude (m a.s.l.)	12	16
Cover tree layer (%)	50	30
Cover shrub layer (%)	15	50
Cover herb layer (%)	20	10
Cover bare rock (%)	5	50
Height (highest) trees (m)	6	5
Height (highest) shrubs (m)	2,5	3
Char. and diff. species of the ass.		
<i>Acer monspessulanum</i>	3	2b
<i>Paliurus spina-christi</i>	2a	2b
<i>Phillyrea latifolia</i>	+	2b
<i>Asparagus acutifolius</i>	+	+
Other species		
<i>Quercus pubescens</i>	.	2a
<i>Carpinus orientalis</i>	2a	.
<i>Rosa sempervirens</i>	1	.
<i>Celtis australis</i>	+	.
<i>Clematis flammula</i>	+	.
<i>Cruciata glabra</i>	+	.
<i>Dactylis glomerata</i> subsp. <i>glomerata</i>	.	2b
<i>Fraxinus ornus</i>	.	2a
<i>Punica granatum</i>	.	+
<i>Ruscus aculeatus</i>	2b	+
<i>Salix caprea</i>	1	.

**Table 32:** *Quercetum trojanae* Em 1958. Species with phi-value above 0.50 (only species with a statistically significant affinity to a cluster according to Fisher's exact test with P <0.001 are included) are in bold.

**Tabela 32:** *Quercetum trojanae* Em 1958. Krepko so označene vrste z phi>0,50 (vključene so samo vrste, ki so statistično značilno navezane na klaster glede na Fisherjev eksaktni test, p <0,001).

Relevé number	63	64	170	208
Relevé area (m <sup>2</sup> )	80	20	50	90
Altitude (m a.s.l.)	53	55	100	362
Cover tree layer (%)	100	100	100	100
Cover shrub layer (%)	3	50	0	0
Cover herb layer (%)	15	60	50	70
Height (highest) trees (m)	6	10	12	13
Height lowest trees (m)	0	6	10	5
Height (highest) shrubs (m)	4	2	3	2
Height lowest shrubs (m)	1	1	0,5	0

Char. and diff. species of the ass.

<b><i>Quercus trojana</i></b>	3	4	2a	2b
<b><i>Quercus petraea</i></b>	.	2b	4	2a
<i>Dactylis glomerata</i> subsp. <i>aschersoniana</i>	+	2b	.	+
<i>Cornus sanguinea</i>	+	.	+	+
Other species				
<i>Carpinus orientalis</i>	4	2b	5	2b
<i>Asparagus acutifolius</i>	+	3	+	.
<i>Clematis flammula</i>	+	1	+	.
<i>Ruscus aculeatus</i>	2b	+	3	.
<i>Fraxinus ornus</i>	.	.	+	3
<i>Hedera helix</i>	.	2b	2a	.
<i>Paliurus spina-christi</i>	+	1	.	.
<i>Quercus pubescens</i>	+	1	.	.
<i>Phillyrea latifolia</i>	.	1	.	.
<i>Brachypodium sylvaticum</i>	+	.	.	.
<i>Oenanthe pimpinelloides</i>	.	+	.	.
<i>Dactylis glomerata</i> subsp. <i>glomerata</i>	.	.	.	+
<i>Acer monspessulanum</i>	.	.	.	+
<i>Aremonia agrimonoides</i>	.	.	.	+
<i>Aristolochia pallida</i>	.	.	.	+
<i>Aristolochia rotunda</i>	.	.	.	+
<i>Buglossoides purpureoerulea</i>	.	.	.	2b
<i>Festuca heterophylla</i>	.	.	.	+
<i>Lathyrus montanus</i>	.	.	.	+
<i>Ligustrum vulgare</i>	.	.	1	.
<i>Milium effusum</i>	.	.	.	+
<i>Origanum vulgare</i>	.	.	.	+
<i>Pistacia terebinthus</i>	.	+	.	.
<i>Potentilla species</i>	.	.	.	+
<i>Quercus cerris</i>	.	.	2a	.
<i>Rosa sempervirens</i>	.	.	+	.
<i>Sesleria autumnalis</i>	.	.	.	3
<i>Stachys scardica</i>	.	.	.	+

Relevé number	63	64	170	208
<i>Teucrium chamaedrys</i>	.	.	.	+
<i>Thymus pulegioides</i>	.	.	.	+
<i>Vincetoxicum hirundinaria</i>	.	.	.	+
<i>Viola odorata</i>	.	.	.	2a

**Table 33:** *Seslerio-Ostryetum carpinifoliae* Horvat & Horvatić 1950. Species with phi-value above 0.50 (only species with a statistically significant affinity to a cluster according to Fisher's exact test with  $P < 0.001$  are included) are in bold.

**Tabella 33:** *Seslerio-Ostryetum carpinifoliae* Horvat & Horvatić 1950. Krepko so označene vrste z  $\phi > 0,50$  (vključene so samo vrste, ki so statistično značilno navezane na klaster glede na Fisherjev eksaktni test,  $p < 0,001$ ).

Relevé number	151	152	207	209	210
Relevé area (m <sup>2</sup> )	100	80	100	90	90
Altitude (m a.s.l.)	514	520	432	483	468
Aspect (degrees)	-	-	-	30	30
Slope (degrees)	-	-	-	4	4
Cover tree layer (%)	90	80	60	90	90
Cover shrub layer (%)	30	25	35	5	5
Cover herb layer (%)	10	60	50	80	60
Cover bare rock (%)	0	35	0	0	90
Height (highest) trees (m)	9	12	12	10	12
Height lowest trees (m)	8	8	8	6	10
Height (highest) shrubs (m)	2	2	4	2	4
Height lowest shrubs (m)	1	0,5	2	0,5	1
Char. and diff. species of the ass.					
<b><i>Ostrya carpinifolia</i></b>	5	2b	2a	5	5
<b><i>Sesleria autumnalis</i></b>	.	2a	1	4	2b
<b><i>Viola odorata</i></b>	1	2b	1	+	+
<b><i>Ornithogalum pyrenaicum</i></b>	+	+	.	+	+
<i>Geum urbanum</i>	1	2a	.	.	+
<b><i>Poa trivialis</i> subsp. <i>sylicola</i></b>	+	.	+	.	.
Other species					
<i>Dactylis glomerata</i> subsp. <i>glomerata</i>	+	2a	+	+	+
<i>Fraxinus ornus</i>	2a	3	2b	2a	2b
<i>Geranium purpureum</i>	+	.	+	+	+
<i>Quercus trojana</i>	+	3	2b	.	+
<i>Acer monspessulanum</i>	+	+	.	.	.
<i>Cornus sanguinea</i>	.	.	+	.	+
<i>Fragaria vesca</i>	.	.	2a	.	+
<i>Hieracium piloselloides</i>	.	.	.	+	+
<i>Melica arrecta</i>	.	+	+	.	.
<i>Milium effusum</i>	.	.	+	.	+
<i>Mycelis muralis</i>	.	.	+	.	+
<i>Poa nemoralis</i>	+	2a	.	.	.
<i>Teucrium chamaedrys</i>	.	.	+	+	.
<i>Quercus cerris</i>	+	.	.	.	.
<i>Agrimonia eupatoria</i>	.	+	.	.	.
<i>Aremonia agrimonoides</i>	.	.	+	.	.
<i>Aristolochia pallida</i>	.	.	2a	.	.
<i>Brachypodium sylvaticum</i>	.	.	1	.	.
<i>Campanula rapunculus</i>	+	.	.	.	.
<i>Carex spicata</i>	+	.	.	.	.
<i>Carpinus orientalis</i>	.	.	2a	.	.

Relevé number	151	152	207	209	210
<i>Carya species</i>	.	.	+	.	.
<i>Clematis vitalba</i>	+	.	.	.	.
<i>Clinopodium vulgare</i>	.	<b>2a</b>	.	.	.
<i>Cornus mas</i>	.	+	.	.	.
<i>Cornus sanguinea</i>	.	.	.	.	+
<i>Geranium columbinum</i>	.	.	+	.	.
<i>Hedera helix</i>	.	.	.	.	+
<i>Hieracium murorum</i>	.	.	.	.	+
<i>Platanthera bifolia</i>	.	.	.	.	+
<i>Potentilla recta</i>	.	+	.	.	.
<i>Quercus petraea</i>	.	.	.	+	.
<i>Ranunculus bulbosus</i>	.	.	+	.	.
<i>Rubus hirtus</i>	+	.	.	.	.
<i>Satureja montana</i>	.	+	.	.	.
<i>Stachys officinalis</i>	.	+	.	.	.
<i>Stachys scardica</i>	.	.	.	+	.
<i>Thalictrum aquilegifolium</i>	.	.	.	+	.
<i>Torilis arvensis</i> subsp. <i>arvensis</i>	.	.	+	.	.
<i>Trifolium ochroleucon</i>	.	+	.	.	.
<i>Trifolium pignanii</i>	.	.	.	+	.
<i>Veronica spicata</i>	.	.	<b>2a</b>	.	.
<i>Vincetoxicum hirsutaria</i>	+	.	.	.	.

**Table 34:** *Junco-Fraxinetum angustifoliae* Kárpáti I. & Kárpáti V. 1961. Species with phi-value above 0.50 (only species with a statistically significant affinity to a cluster according to Fisher's exact test with  $P < 0.001$  are included) are in bold.

**Table 34:** *Junco-Fraxinetum angustifoliae* Kárpáti I. & Kárpáti V. 1961. Krepko so označene vrste z  $\phi > 0,50$  (vključene so samo vrste, ki so statistično značilno navezane na klaster glede na Fisherjev eksaktni test,  $p < 0,001$ ).

Relevé number	76	77	168	193	197	204	211	238
Relevé area (m <sup>2</sup> )	80	70	80	90	90	110	80	100
Cover tree layer (%)	90	95	75	95	95	80	90	95
Cover shrub layer (%)	15	3	0	0	0	5	5	0
Cover herb layer (%)	70	15	40	10	10	60	60	95
Height (highest) trees (m)	14	17	10	11	11	15	15	13
Height lowest trees (m)	12	13	4	5	5	4	13	4
Height (highest) shrubs (m)	2	2	0	0	0	3	6	2
Height lowest shrubs (m)	1	1	0	0	0	1	4	1

Char. and diff. species of the ass.

<b><i>Fraxinus angustifolia</i> subsp. <i>oxycarpa</i></b>	4	5	5	5	5	5	5	5
<i>Juncus acutus</i>	+	+	<b>2b</b>	.	+	+	+	4
<b><i>Iris pseudacorus</i></b>	+	+	.	+	+	1	1	+
<b><i>Carex remota</i></b>	<b>2b</b>	+	.	1	+	.	.	.
<i>Oenanthe fistulosa</i>	.	.	.	.	.	+	+	+
Other species								
<i>Agrostis stolonifera</i>	+	+	.	.	.	3	3	<b>2b</b>
<i>Carex otrubae</i>	.	+	<b>2b</b>	+	+	.	.	+
<i>Mentha aquatica</i>	.	+	+	.	.	+	+	.
<i>Samolus valerandi</i>	1	+	.	.	.	+	+	.
<i>Alnus glutinosa</i>	1	.	.	.	.	+	+	.
<i>Oenanthe pimpinelloides</i>	+	.	+	.	.	.	.	+
<i>Ulmus minor</i>	.	+	+	.	.	.	.	+
<i>Aegopodium podagraria</i>	.	.	.	.	.	<b>2a</b>	<b>2a</b>	.



Relevé number	76	77	168	193	197	204	211	238
<i>Callitriche stagnalis</i>	.	.	.	.	.	+	+	.
<i>Circaea lutetiana</i>	.	.	.	+	+	.	.	.
<i>Cornus sanguinea</i>	.	.	.	2a	2b	.	.	.
<i>Crataegus monogyna</i>	.	.	.	2a	2a	.	.	.
<i>Cynanchum acutum</i>	.	.	.	+	+	.	.	.
<i>Galium species</i>	.	.	.	.	.	+	+	.
<i>Lycopus europaeus</i>	.	.	+	.	.	.	.	+
<i>Lysimachia nummularia</i>	.	.	.	+	+	.	.	.
<i>Periploca graeca</i>	.	.	.	+	+	.	.	.
<i>Polygonum hydropiper</i>	.	.	.	+	+	.	.	.
<i>Populus alba</i>	+	.	.	+	.	.	.	.
<i>Potentilla reptans</i>	.	.	.	+	+	.	.	.
<i>Ranunculus flammula</i>	.	.	.	.	.	+	+	.
<i>Rubus ulmifolius</i>	2b	+	.	.	.	.	.	.
<i>Ulmus minor</i>	.	.	.	.	.	+	+	.
<i>Veronica anagallis-aquatica</i>	.	.	.	.	.	+	+	.
<i>Acer campestre</i>	.	.	.	.	1	.	.	.
<i>Ajuga reptans</i>	+	.	.	.	.	.	.	.
<i>Amorpha fruticosa</i>	.	.	.	.	.	.	.	+
<i>Apium nodiflorum</i>	+	.	.	.	.	.	.	.
<i>Berberis vulgaris</i>	.	.	.	+	.	.	.	.
<i>Bidens tripartita</i>	.	+	.	.	.	.	.	.
<i>Blackstonia perfoliata</i>	+	.	.	.	.	.	.	.
<i>Carex distans</i>	.	.	.	.	.	.	.	+
<i>Carex sylvatica</i>	.	.	.	.	+	.	.	.
<i>Carpinus betulus</i>	.	.	.	.	+	.	.	.
<i>Cornus sanguinea</i>	+	.	.	+	.	.	.	.
<i>Crataegus monogyna</i>	.	.	.	.	+	.	.	.
<i>Eupatorium cannabinum</i>	+	.	.	.	.	.	.	.
<i>Fraxinus ornus</i>	.	.	.	.	.	+	.	.
<i>Galium elongatum</i>	.	.	.	.	.	.	.	+
<i>Galium rotundifolium</i>	.	+	.	.	.	.	.	.
<i>Inula viscosa</i>	.	.	.	.	.	.	.	+
<i>Juncus bufonius</i>	+	.	.	.	.	.	.	.
<i>Ligustrum vulgare</i>	.	.	.	.	+	.	.	.
<i>Limonium vulgare subsp. serotinum</i>	.	.	+	.	.	.	.	.
<i>Lotus species</i>	.	.	.	.	.	.	.	+
<i>Periploca graeca</i>	.	+	.	.	.	.	.	.
<i>Polygonum hydropiper</i>	+	.	.	.	.	.	.	.
<i>Plantago major</i>	.	.	.	.	.	.	.	+
<i>Prunella vulgaris</i>	.	+	.	.	.	.	.	.
<i>Prunus spinosa</i>	.	.	.	+	.	.	.	.
<i>Pulicaria dysenterica</i>	.	.	.	.	.	.	.	+
<i>Ranunculus arvensis</i>	.	.	+	.	.	.	.	.
<i>Rubus ulmifolius</i>	.	.	+	.	.	+	1	.
<i>Sparganium erectum</i>	.	.	.	+	.	.	.	.
<i>Tamarix africana</i>	.	.	3	.	.	.	.	.
<i>Tamus communis</i>	.	.	.	.	.	.	.	+
<i>Ulmus minor</i>	2b	1	+	.	.	.	.	.
<i>Vincetoxicum hirsutinaria</i>	.	.	.	.	.	.	.	+
<i>Viola reichenbachiana</i>	.	.	.	.	+	.	.	.
<i>Vitex agnus-castus</i>	.	.	+	.	.	.	.	.
<i>Alisma plantago-aquatica</i>	.	+	+	.	.	2a	2a	+

**Table 35:** *Populetum albae balcanicum* Kárpáti I. & Kárpáti V. 1961 nom. illeg. Species with phi-value above 0.50 (only species with a statistically significant affinity to a cluster according to Fisher's exact test with  $P < 0.001$  are included) are in bold.

**Tabela 35:** *Populetum albae balcanicum* Kárpáti I. & Kárpáti V. 1961 nom. illeg. Krepko so označene vrste z  $\phi > 0,50$  (vključene so samo vrste, ki so statistično značilno navezane na klaster glede na Fisherjev eksaktni test,  $p < 0,001$ ).

Relevé number	56	194	202	203
Relevé area (m <sup>2</sup> )	100	90	90	95
Cover tree layer (%)	100	100	80	80
Cover shrub layer (%)	3	0	10	10
Cover herb layer (%)	7	25	15	20
Height (highest) trees (m)	22	35	22	25
Height lowest trees (m)	0	7	12	6
Height (highest) shrubs (m)	25	0	4	3
Height lowest shrubs (m)	1	1,5	1	1

Char. and diff. species of the ass.

<b>Populus alba</b>	5	5	5	5
<b>Pulicaria odora</b>	.	+	1	+
<i>Aegopodium podagraria</i>	1	.	+	2a
Other species				
<i>Fraxinus angustifolia</i> subsp. <i>oxycarpa</i>	4	+	+	+
<i>Ulmus minor</i>	+	+	+	.
<i>Rubus ulmifolius</i>	+	+	1	2a
<i>Hedera helix</i>	+	+	2a	.
<i>Ficus carica</i>	+	.	+	.
<i>Arum italicum</i>	+	+	.	.
<i>Humulus lupulus</i>	1	.	+	.
<i>Agrostis stolonifera</i>	.	.	2a	1
<i>Alnus glutinosa</i>	.	.	+	2b
<i>Carex otrubae</i>	.	.	+	2a
<i>Periploca graeca</i>	+	.	.	.
<i>Carduus acanthoides</i>	2m	.	.	+
<i>Amorpha fruticosa</i>	+	+	.	.
<i>Fallopia convolvulus</i>	.	+	+	.
<i>Ligustrum vulgare</i>	+	+	.	.
<i>Rosa sempervirens</i>	+	.	.	+
<i>Samolus valerandi</i>	.	.	+	+
<i>Viola odorata</i>	.	+	.	1
<i>Acer campestre</i>	.	+	.	.
<i>Alisma plantago-aquatica</i>	.	.	+	.
<i>Bidens tripartita</i>	.	.	.	+
<i>Carex sylvatica</i>	.	+	.	.
<i>Carpinus betulus</i>	.	+	.	.
<i>Carpinus orientalis</i>	.	+	.	.
<i>Cornus mas</i>	.	+	.	.
<i>Crataegus monogyna</i>	1	.	.	.
<i>Cynanchum acutum</i>	.	+	.	.
<i>Eupatorium cannabinum</i>	.	.	+	.
<i>Geum urbanum</i>	.	+	.	.

Relevé number	56	194	202	203
<i>Humulus lupulus</i>	1	.	.	.
<i>Oenanthe pimpinelloides</i>	.	.	.	+
<i>Primula vulgaris</i>	.	+	.	.
<i>Punica granatum</i>	+	.	.	.
<i>Quercus robur</i>	.	+	.	.
<i>Rubus caesius</i>	.	+	.	.
<i>Rumex sanguineus</i>	.	.	.	+
<i>Ruscus aculeatus</i>	.	2a	.	.
<i>Viola reichenbachiana</i>	.	+	.	.

**Table 36:** *Quercus roboris-Carpinetum betuli submediterraneum* Bertović ex Horvat 1974 nom. illeg. Species with phi-value above 0.50 (only species with a statistically significant affinity to a cluster according to Fisher's exact test with  $P < 0.001$  are included) are in bold.

**Tabela 36:** *Quercus roboris-Carpinetum betuli submediterraneum* Bertović ex Horvat 1974 nom. illeg. Krepko so označene vrste z  $\phi > 0,50$  (vključene so samo vrste, ki so statistično značilno navezane na klaster glede na Fisherjev eksaktni test,  $p < 0,001$ ).

Relevé number	51	191	195	196
Relevé area (m <sup>2</sup> )	150	60	120	110
Cover tree layer (%)	80	100	100	100
Cover shrub layer (%)	10	20	2	2
Cover herb layer (%)	60	75	70	70
Height (highest) trees (m)	20	18	18	30
Height lowest trees (m)	12	5	8	6
Height (highest) shrubs (m)	3	2	3,5	4

Char. and diff. species of the ass.

<b>Quercus robur</b>	4	5	3	5
<b>Viola reichenbachiana</b>	+	+	+	1
<b>Carpinus betulus</b>	1	.	3	2a
<b>Arum italicum</b>	+	+	+	+
<i>Aristolochia pallida</i>	.	.	+	+
Other species				
<i>Clematis viticella</i>	.	+	+	.
<i>Carpinus orientalis</i>	4	2a	3	3
<i>Hedera helix</i>	+	+	2a	2b
<i>Ruscus aculeatus</i>	4	3	3	3
<i>Acer campestre</i>	+	.	+	+
<i>Cornus mas</i>	+	2b	.	+
<i>Crataegus monogyna</i>	1	+	+	.
<i>Ligustrum vulgare</i>	.	1	+	+
<i>Primula vulgaris</i>	.	+	1	+
<i>Viola odorata</i>	+	.	+	+
<i>Ajuga reptans</i>	.	.	+	+
<i>Asparagus acutifolius</i>	.	+	+	.
<i>Carex sylvatica</i>	.	+	.	+
<i>Fallopia convolvulus</i>	.	+	.	+

Relevé number	51	191	195	196	Relevé number	51	191	195	196
<i>Rubus ulmifolius</i>	.	+	.	+	<i>Carex depauperata</i>	.	.	+	.
<i>Acer monspessulanum</i>	.	+	.	.	<i>Carex distans</i>	+	.	.	.
<i>Fraxinus angustifolia</i> subsp. <i>oxycarpa</i>	+	.	.	.	<i>Carpinus orientalis</i>	4	.	.	.
<i>Populus alba</i>	2b	.	.	.	<i>Clematis vitalba</i>	.	.	.	+
<i>Ulmus minor</i>	.	.	.	1	<i>Dactylis glomerata</i>	.	.	+	.
<i>Aristolochia lutea</i>	+	.	.	.	<i>Geranium purpureum</i>	.	.	.	+
<i>Brachypodium sylvaticum</i>	.	.	+	.	<i>Tamus communis</i>	.	.	.	+

**Table 37:** *Periploca graecae-Alnetum glutinosae* Rudski in Horvat et al. ex Fanelli, De Sanctis, Gjeta, Mullaj, Attore ass. nova hoc loco. Species with phi-value above 0.50 (only species with a statistically significant affinity to a cluster according to Fisher's exact test with  $P < 0.001$  are included) are in bold.

**Tabella 37:** *Periploca graecae-Alnetum glutinosae* Rudski in Horvat et al. ex Fanelli, De Sanctis, Gjeta, Mullaj, Attore ass. nova hoc loco. Krepko so označene vrste z  $\phi > 0,50$  (vključene so samo vrste, ki so statistično značilno navezane na klaster glede na Fisherjev eksaktni test,  $p < 0,001$ ).

Relevé number	52	54	55*	200	201	230	231	232	241
Relevé area (m <sup>2</sup> )	50	50	60	105	110	150	90	120	95
Cover tree layer (%)	100	95	98	85	95	95	95	95	95
Cover shrub layer (%)	15	10	15	60	40	10	10	2	2
Cover herb layer (%)	1	35	5	5	15	50	35	3	15
Height (highest) trees (m)	8	12	12	12	10	12	12	13	13
Height lowest trees (m)	4	3	6	10	8	9	9	8	10
Height (highest) shrubs (m)	3	3	2	3	5	2	2	0	0
Height lowest shrubs (m)	1,5	2	1	1	1	1,5	1,5	0,8	1,3

Char. and diff. species of the ass.

<b><i>Alnus glutinosa</i></b>	5	5	5	5	5	5	5	5	5
<b><i>Periploca graeca</i></b>	+	+	+	+	2m	+	1	.	.
<b><i>Circaea lutetiana</i></b>	.	+	.	+	.	+	+	.	.
<i>Humulus lupulus</i>	2m	2m	+	+	+	.	.	.	+
<i>Cornus sanguinea</i>	.	2a	2m	+	2a	+	+	.	.
<i>Ficus carica</i>	.	1	+	+	+	.	.	.	2a
<i>Cynanchum acutum</i>	+	+	.	.	+	.	.	.	+
Other species									
<i>Rubus ulmifolius</i>	2b	2a	+	3	.	2a	2a	+	+
<i>Fraxinus angustifolia</i> subsp. <i>oxycarpa</i>	.	+	+	+	.	+	2a	2a	.
<i>Ulmus minor</i>	+	+	+	.	+	.	.	+	2a
<i>Bidens tripartita</i>	+	.	.	+	1	1	2a	.	.
<i>Hedera helix</i>	.	2a	1	+	2a	.	.	.	+
<i>Ligustrum vulgare</i>	.	+	+	2a	2a	.	.	.	+
<i>Iris pseudacorus</i>	.	.	.	+	.	+	+	+	.
<i>Crataegus monogyna</i>	.	2a	+	+	2a	.	.	.	.
<i>Lycopus europaeus</i>	.	+	.	.	+	1	+	.	.
<i>Quercus robur</i>	.	+	+	.	+	.	.	.	.
<i>Mentha aquatica</i>	.	.	.	.	.	+	+	.	+
<i>Oenanthe pimpinelloides</i>	.	.	.	.	+	+	2a	.	.
<i>Rumex sanguineus</i>	.	.	.	.	.	+	+	+	.
<i>Carex remota</i>	.	.	.	.	.	.	.	+	2a
<i>Agrostis stolonifera</i>	.	.	.	.	1	.	+	.	.
<i>Alisma plantago-aquatica</i>	.	.	.	.	.	+	.	+	.
<i>Amorpha fruticosa</i>	1	.	.	+	.	.	.	.	.
<i>Apium nodiflorum</i>	.	.	.	.	.	+	1	.	.

Relevé number	52	54	55*	200	201	230	231	232	241
<i>Carex spicata</i>	.	.	.	.	.	+	+	.	.
<i>Carex distans</i>	.	+	.	.	+	.	.	.	.
<i>Carex otrubae</i>	.	.	.	.	.	3	.	+	.
<i>Carex</i> sp.	.	.	.	+	.	.	+	.	.
<i>Fallopia convolvulus</i>	.	.	.	+	+	.	.	.	.
<i>Galium elongatum</i>	.	.	.	.	.	+	+	.	.
<i>Polygonum hydropiper</i>	.	.	.	.	.	+	+	.	.
<i>Salix alba</i>	.	+	.	+	.	.	.	.	.
<i>Vitis vinifera</i>	.	.	.	.	.	+	+	.	.
<i>Arum italicum</i>	.	.	.	.	+	.	.	.	.
<i>Carduus acanthoides</i>	.	.	+	.	.	.	.	.	.
<i>Carex sylvatica</i>	.	.	.	.	.	.	.	.	+
<i>Clematis vitalba</i>	.	+	.	.	.	.	.	.	.
<i>Clematis viticella</i>	.	.	.	.	1	.	.	.	.
<i>Cornus mas</i>	.	.	.	.	.	.	.	.	+
<i>Cynanchum acutum</i>	.	.	.	.	+	.	.	.	.
<i>Galium debile</i>	.	.	.	.	+	.	.	.	.
<i>Geum urbanum</i>	.	2a	.	.	.	.	.	.	.
<i>Buglossoides purpureo-caerulea</i>	.	+	.	.	.	.	.	.	.
<i>Lysimachia nummularia</i>	.	.	.	.	.	+	.	.	.
<i>Poa nemoralis</i>	.	.	.	.	.	+	.	.	.
<i>Potentilla reptans</i>	.	.	.	.	.	.	+	.	.
<i>Prunella vulgaris</i>	.	.	.	.	.	+	.	.	.
<i>Rosa sempervirens</i>	.	.	.	.	+	.	.	.	.
<i>Samolus valerandi</i>	.	.	.	.	.	.	.	+	.
<i>Vincetoxicum canescens</i>	.	.	.	.	.	+	.	.	.
<i>Vincetoxicum hirsutinaria</i>	.	.	.	.	.	.	+	.	.
<i>Viola reichenbachiana</i>	.	+	.	.	.	.	.	.	.

**Table 38 (Tabela 38):** *Vitici-Tamaricetum africanae* Horvatić 1960.

Relevé number	23	40	104	112
Relevé area (m <sup>2</sup> )	80	15	25	30
Cover shrub layer (%)	75	95	90	75
Cover herb layer (%)	75	2	0	45
Height (highest) shrubs (m)	5	3	5	3
Height lowest shrubs (m)	2	0	0	2
Char. and diff. species of the ass.				
<i>Tamarix africana</i>	4	5	5	4
<i>Vitex agnus-chastus</i>	+	.	.	+
<i>Atriplex prostrata</i> subsp. <i>latifolia</i>	+	+	.	+
Other species				
<i>Aster tripolium</i>	+	.	.	.
<i>Juncus acutus</i>	4	.	.	+
<i>Phragmites australis</i>	+	.	+	.
<i>Cladonia portentosa</i>	+	.	.	.
<i>Elymus athericus</i>	+	.	.	.
<i>Limonium vulgare</i> subsp. <i>serotinum</i>	.	+	.	3
<i>Salsola soda</i>	.	.	.	+
<i>Polypogon monspeliensis</i>	.	.	.	+

Relevé number	23	40	104	112
<i>Crypsis aculeata</i>	.	.	.	1
<i>Suaeda species</i>	.	.	.	+
<i>Elymus farctus</i> subsp. <i>farctus</i>	.	.	.	+
<i>Bolboschoenus maritimus</i>	.	.	.	+

**Table 39 (Tabela 39):** *Bromo villosi-Haynaldietum villosae* Pignatti 1953.

Relevé number	49	50
Relevé area (m <sup>2</sup> )	8	3
Altitude (m a.s.l.)	330	-
Slope (degrees)	5	-
Cover herb layer (%)	60	80
Char. and diff. species of the ass.		
<i>Dasypyrum villosum</i>	1	4
<i>Bromus madritensis</i>	+	+
<i>Vulpia membranacea</i>	+	+
<i>Vulpia myuros</i>	2a	+
<i>Kochia prostrata</i>	+	+
<i>Aegilops triuncialis</i>	1	+

Relevé number	49	50
Other species		
<i>Medicago minima</i>	1	2a
<i>Lagurus ovatus</i>	+	1
<i>Lepidium graminifolium</i>	.	+
<i>Sisymbrium officinale</i>	.	+
<i>Carduus pycnocephalus</i>	.	+
<i>Vicia villosa</i> subsp. <i>eriocarpa</i>	+	.
<i>Avena barbata</i>	+	.
<i>Trifolium scabrum</i>	1	1
<i>Daucus carota</i>	2b	.
<i>Lolium perenne</i>	+	+
<i>Briza maxima</i>	+	+
<i>Bromus rigidus</i>	+	.
<i>Bromus tectorum</i>	+	.
<i>Salsola soda</i>	.	+
<i>Verbascum banaticum</i>	.	+
<i>Scolymus hispanicus</i>	.	+
<i>Bromus hordeaceus</i>	.	+
<i>Cynodon dactylon</i>	.	+

**Table 40 (Tabela 40):** *Centaureetum calcitrapae* Fanelli & Menegoni 1997.

Relevé number	24	25	490
Relevé area (m <sup>2</sup> )	80	0	10
Altitude (m a.s.l.)	-	-	-
Cover herb layer (%)	100	100	90
Char. and diff. species of the ass.			
<i>Centaurea calcitrapa</i>	5	.	4
<i>Scolymus hispanicus</i>	2a	5	1
<i>Rumex pulcher</i>	+	.	+
Other species			
<i>Bromus hordeaceus</i>	+	+	.
<i>Avena barbata</i>	.	+	+
<i>Anthemis austriaca</i>	2m	.	+
<i>Filago germanica</i>	2m	.	+
<i>Matricaria disciformis</i>	2m	.	+
<i>Vicia villosa</i> subsp. <i>eriocarpa</i>	.	+	+
<i>Cichorium intybus</i>	.	+	.
<i>Carduus acanthoides</i>	+	.	.
<i>Vulpia ciliata</i>	+	.	+
<i>Hordeum hystrix</i>	+	.	.
<i>Cynodon dactylon</i>	+	.	.
<i>Trifolium campestre</i>	.	.	+
<i>Trifolium scabrum</i>	.	.	+
<i>Agrostis stolonifera</i>	.	.	+

**Table 41:** *Asphodelus ramosus* community.

**Tabela 41:** Združba z vrsto *Asphodelus ramosus*.

Relevé number	15	70	492
Relevé area (m <sup>2</sup> )	5	2	8
Altitude (m a.s.l.)	-	125	50
Aspect (degrees)	40	60	50
Slope (degrees)	3	10	5
Cover herb layer (%)	90	70	60
Cover bare rock (%)	0	35	0
Cover stones (%)	40	70	40
Char. and diff. species of the ass.			
<i>Asphodelus ramosus</i>	4	3	3
<i>Carthamus lanatus</i>	+	+	.
<i>Catapodium rigidum</i>	+	+	+
<i>Nigella arvensis</i>	.	+	+
Other species			
<i>Teucrium polium</i> subsp. <i>capitatum</i>	2b	2b	2a
<i>Sideritis romana</i>	+	+	+
<i>Petrorhagia saxifraga</i> subsp. <i>saxifraga</i>	1	+	+
<i>Crepis zacintha</i>	+	+	.
<i>Arenaria leptoclados</i>	2m	.	1
<i>Sedum hispanicum</i>	+	.	+
<i>Bupleurum veronense</i>	1	+	.
<i>Medicago praecox</i>	+	.	+
<i>Trifolium scabrum</i>	1	.	+
<i>Daucus aureus</i>	1	.	+
<i>Centaurea solstitialis</i>	1	.	1
<i>Crepis foetida</i>	+	.	+
<i>Aegilops geniculata</i>	+	.	.
<i>Avena barbata</i>	+	.	+
<i>Filago gallica</i>	+	.	+
<i>Melica ciliata</i>	.	+	+
<i>Brachypodium distachyon</i>	.	+	+
<i>Dasyphyrum villosum</i>	.	1	+
<i>Carex distachya</i>	.	+	+
<i>Micromeria juliana</i>	.	+	+
<i>Asperula aristata</i> subsp. <i>condensata</i>	1	.	.
<i>Anthemis austriaca</i>	+	.	.
<i>Carlina corymbosa</i>	+	.	.
<i>Rostraria cristata</i>	+	.	.
<i>Bothriochloa ischaemum</i>	+	.	.
<i>Medicago minima</i>	.	+	.
<i>Trifolium campestre</i>	.	+	.
<i>Eryngium amethystinum</i>	.	+	.
<i>Satureja montana</i>	.	+	.
<i>Helichrysum italicum</i> subsp. <i>italicum</i>	.	+	.
<i>Dactylis glomerata</i> subsp. <i>glomerata</i>	.	+	.
<i>Gastridium ventricosum</i>	.	+	.
<i>Chrysopogon gryllus</i>	.	+	.
<i>Sanguisorba minor</i> subsp. <i>muricata</i>	.	+	.
<i>Plantago bellardii</i>	.	+	.
<i>Carya cordiformis</i>	.	.	+
<i>Sanguisorba minor</i> subsp. <i>muricata</i>	.	.	+
<i>Trifolium campestre</i>	.	.	+

**Table 42 (Tabela 42):** *Carduetum acanthoidis*  
Felföldy 1942.

Relevé number	10	14
Relevé area (m <sup>2</sup> )	15	20
Cover herb layer (%)	100	100
Char. and diff. species of the ass.		
<i>Carduus acanthoides</i>	5	4
<i>Cirsium italicum</i>	+	2b
<i>Cirsium vulgare</i>	+	+
Other species		
<i>Cirsium vulgare</i>	+	+
<i>Galega officinalis</i>	+	+
<i>Medicago lupulina</i>	+	+
<i>Rumex conglomeratus</i>	+	+
<i>Convolvulus arvensis</i>	+	+
<i>Agrostis stolonifera</i>	+	+
<i>Potentilla reptans</i>	+	.
<i>Euphorbia platyphyllos</i>	+	.
<i>Daucus carota</i>	+	.
<i>Galium elongatum</i>	+	.
<i>Scolymus hispanicus</i>	+	.
<i>Phragmites australis</i>	+	.
<i>Satureja calamintha</i>	+	.
<i>Paspalum paspalodes</i>	+	.
<i>Atriplex patula</i>	.	+
<i>Prunella vulgaris</i>	.	+