Flora and Vegetation of the Macedonian Steppe

VLADO MATEVSKI, ANDRAŽ ČARNI, MITKO KOSTADINOVSKI,
PETRA KOŠIR, URBAN ŠILC, IGOR ZELNIK

Flora and Vegetation of the Macedonian Steppe

Флора и вегетација на македонската степа

Flora in vegetacija makedonske stepe

Vlado Matevski, Andraž Čarni, Mitko Kostadinovski, Petra Košir, Urban Šilc, Igor Zelnik

Flora and Vegetation of the Macedonian Steppe
Флора и вегетација на македонската степа
Flora in vegetacija makedonske stepe

Urednik Andraž Čarni
Recenzenta Živko Sekovski, Lojze Marinček
Jezikovni pregled Alan McConnell - Duff
Oblikovanje, prelom, kartografija Iztok Sajko

Avtorja fotografij Vlado Matevski, Urban Šilc

Izdajatelj Biološki inštitut Jovana Hadžija ZRC SAZU
Za izdajatelja Matjaž Kuntner
Založnik Založba ZRC, ZRC SAZU
Za založnika Oto Luthar
Glavni urednik Vojislav Likar

Izdajo je finančno podprla Javna agencija za raziskovalno dejavnost RS

CIP - Kataložni zapis o publikaciji
Narodna in univerzitetna knjižnica, Ljubljana

581.9(497.71)(0.034.2)

FLORA and vegetation of the Macedonian steppe [Elektronski vir] = Flora i vegetacija na makedonskata stepa = Flora in vegetacija makedonske stepe / Vlado Matevski ... [et al.] ; [kartografija Iztok Sajko ; avtorja fotografij Vlado Matevski, Urban Šilc]. - El. knjiga. - Ljubljana : Založba ZRC, ZRC SAZU, 2013

Besedilo v angl., uvodna sestavka v mak. in slov.

ISBN 978-961-254-549-9 (pdf)
https://doi.org/10.3986/9789612545499
1. Vzp. stv. nasl. 2. Matevski, Vlado
269513728

Flora

and

Vegetation

of the

Macedonian Steppe

Флора и вегетација
на македонската степа

Flora in vegetacija makedonske stepe

**VLADO MATEVSKI, ANDRAŽ ČARNI, MITKO KOSTADINOVSKI,
PETRA KOŠIR, URBAN ŠILC, IGOR ZELNIK**

Ljubljana 2008

Table of Contents

Флора и вегетација на македонската степа

Во централните делови на Република Македонија, во триаголникот помеѓу Велес, Штип и Неготино, се простира едно големо подрачје, чија површина има изглед на разбранувано море. Тоа подрачје го именувавме како македонска степа, така како што го нарекувале бројни истражувачи, како што се, на пример, Кошанин и сороботниците (1937), Черњавски (1924), кои го истражувале во минатото.

Пределот потсетува на степа, такашто тука наоѓаме бројни степски растенија и степска вегетација. Меѓутоа на ова подрачје не се развива вистинска степа, во која шумската вегетација не може да се развива заради климатските влијанија, туку зборуваме за македонска степа, еден посебен и интересен предел, кој настанал поради неповолните климатски прилики и повеќевековното делување на човекот.

Комплетната монографија е резултат на заедничката соработка на македонските и словенечките истражувачи, кои заедно ја истражуваат флората и вегетацијата повеќе од десет години. Во тој период беше собрано големо градиво (материјал) за флората и вегетацијата на Македонија, меѓутоа во ова дело за прв пат систематски е опфатено и подетално обработено едно посебно подрачје.

Врз основа на обработката и прегледот на целокупното подрачје на македонската степа, обработени се некои најзначајни растителни видови и сите хабитати. Покрај тоа, издвоени се, исто така, посебно богати флористички и вегетациски простори, кои во иднина би требало да бидат заштитени.

На истражуваното подрачје се појавуваат 8 македонски ендемични видови: *Hedysarum macedonicum, Astragalus cernjavskii, Tulipa mariannae, Onobrychis megalophylla, Ferulago macedonica, Heptaptera macedonica, Salvia jurisicii* и *Potentilla tridentula,* од кои 4 се откриени токму на тоа подрачје. Тука се наоѓаат бројни растенија од сувите и солени степи, како што се *Astragalus parnassii, Morina persica, Convolvulus holosericeus, Artemisia maritima, Artemisia annua, Krascheninnikovia ceratoides* и *Camphorosma monspeliaca*. Тие растенија се исто така раширени во македонската и средноазиските степи, а на ова подрачје се сочувани од минатите геолошки периоди.

На тоа подрачје се присутни голем број различни растителни заедници, односно хабитатни типови. Така, на границата на подрачјето, околу реката Вардар, се појавуваат карактеристични крајречни заедници, во внатрешноста на подрачјето наоѓаме различни типови на суви и солени степи, ретки мезофилни ливади, различни грмушести заедници, термофилни шумски и рудерални заедници. Помеѓу хабитатните типови, од Анекс I на Хабитат-директивата, треба да се споменат сувите брдски пасишта од класата *Festuco-Brometea* (брдски пасишта на карбонати и степи на базичен субстрат, како и грчко-балкански степи со видот *Satureja montana*). Посебно треба да се истакнат континенталните солени станишта, кои споменатиот анекс ги приклучува

меѓу посебно значајните (приоритетните) хабитати на просторот на Европската Унија (Пелагониско-Вардарски солени долини со видот *Camphorosma monspeliaca*).

Секако, пред истражувачот се поставува прашањето кога тие растенија се дојдени на ова подрачје и зошто тука се сочувале. Растенијата најверојатно имаат дојдено од Средна Азија уште пред плиоцен, кога на ова подрачје се простирале пустини, и тука исто така го преживеале и леденото доба, слично како и другите терциерни реликти, како што се дивиот костен, платанот и други. Степските растенија имале способност да ги преживеат големите температурни колебања, бидејќи во тој период долината на реката Вардар била под вода и ја регулирала локалната клима. За зачувување на степската вегетација, во последниот временски период припомогнало напасувањето на тој простор, со што се одржувала нешумската вегетација и на крај, исто така воените активности, кои ги попречиле другите активности на тој простор.

На крајот, врз основа на целокупната анализа, оценивме дека следните подрачја – Орлово Брдо, Солена Река, Солен Дол подрачјето помеѓу Неготино и селото Криволак, планината Серта над селото Пепелиште и брдото Богословец над Свети Николе се најзначајни и за нив се предлага посебна законска заштита.

Flora in vegetacija makedonske stepe

V osrednjem delu Republike Makedonije, v trikotniku med Velesom, Štipom in Negotinom, se razprostira veliko območje, katerega površina nekoliko spominja na valujoče morje. To območje smo poimenovali makedonska stepa, tako kot številni raziskovalci, ki so to območje raziskovali v preteklosti, na primer Košanin (1924) in Černjavski s sodelavci (1937).

Pokrajina nam ponuja videz stepe, tu najdemo številne stepske rastline in stepsko vegetacijo. Vendar pa to ni prava stepa, ki se razvije na območjih, kjer drevesna vegetacija zaradi klimatskih dejavnikov ne more več uspevati, ampak govorimo o makedonski stepi, zanimivi in posebni krajini, ki je nastala zaradi neugodnih klimatskih razmer in tisočletnega delovanja človeka.

Celotna monografija je rezultat skupnega dela makedonskih in slovenskih raziskovalcev, ki skupaj raziskujejo floro in vegetacije že več kot desetletje. V tem času je bilo zbrano veliko gradiva o flori in vegetaciji Makedonije, vendar pa je pričujoče delo prvo, ki se sistematično ukvarja z ožjim območjem in ga podrobneje obdeluje.

Na podlagi obdelave in pregleda celotnega območja makedonske stepe smo obdelali nekatere najpomembnejše rastlinske vrste in večino habitatov. Poleg tega pa smo izločili tudi posebej floristično in vegetacijsko bogata območja, ki bi jih bilo potrebno v prihodnosti varovati.

Na obravnavanem območju se pojavlja 8 makedonskih endemičnih rastlinskih vrst: *Hedysarum macedonicum*, *Astragalus cernjavskii*, *Tulipa mariannae*, *Onobrychis megalophylla*, *Ferulago macedonica*, *Heptaptera macedonica*, *Salvia jurisicii* in *Potentilla tridentula*, štiri med njimi so bile prav na tem območju opisane. Najdemo pa tu tudi številne rastline suhih in slanih step, kot so *Astragalus parnassi*, *Morina persica*, *Convolvulus holosericeus*, *Artemisia maritima*, *Artemisia annua*, *Kraschenninikovia ceratoides* in *Camphorosma monspeliaca*. Te rastline so razširjene tudi v maloazijskih in osrednjeazijskih stepah in so se ohranile na tem območju iz prejšnjih obdobij.

Na tem območju najdemo veliko različnih rastlinskih združb oz. habitatnih tipov. Tako se na meji območja ob reki Vardar pojavljajo značilne obvodne združbe, v notranjosti območja pa najdemo različne tipe suhih in slanih step, redka mezofilna travišča, različne grmišče združbe, termofilne gozdne in tudi ruderalne združbe. Med habitatnimi tipi, ki jih omenja tudi Aneks I Habitatne direktive, velja omeniti suha travišča iz razreda *Festuco-Brometea* (trajna travišča na karbonatih in stepe na bazičnem substratu ter grško-balkanske stepe z vrsto *Satureja montana*). Posebej pa so pomembna kontinentalna slanišča, ki jih omenjeni Aneks uvršča celo med posebej pomembne (prioritetne) habitate na območju Evropske unije (Pelagonijsko-Vardarske slane doline z vrsto *Camphorosma monspeliaca*).

Seveda se bralcu zastavlja vprašanje, kdaj so te rastline prišle na to območje in zakaj so se tu ohranile. Rastline so verjetno prišle iz osrednje Azije še pred pliocenom, ko so se na tem območju razprostirale puščave in so tu preživele ledene dobe, podobno kot tudi drugi terciarni relikti, npr. kostanj, platana in še drugi. Stepske rastline so bile sposobne preživeti velika temperaturna nihanja. Lokalno klimo so nekoliko omilile jezerske vodne mase v tistem času potopljene doline Vardar. K ohranitvi stepske vegetecije pa je v zadnjem obdobju pripomogla tudi paša, ki je trajno vzdrževala negozdno krajino in ne nazadnje tudi vojaške aktivnosti, ki so preprečile na tem območju razvoj drugih aktivnosti.

Na koncu smo na podlagi celovitega pregleda flore in vegetacije ocenili, katera območja z naravovarstvenega stališča še posebej pomembna. Ugotovili smo, da so to Orlovo Brdo, Solena Reka, Soleni Dol, območje med Negotinom in vasjo Krivolak, planina Serta nad vasjo Pepelište in planina Bogoslovec nad Svetim Nikolo in za njih predlagamo posebno zakonsko zaščito.

INTRODUCTION

In the central part of the Republic of Macedonia, in the triangle between Veles, Štip and Negotino, there is a special region that is different from the neighbouring regions and used to be called steppe or semi-desert by some researchers that worked there (Košanin 1924, Černjavski et al. 1937). The entire area slightly resembles an undulating sea, as its surface is interrupted by numerous ditches, which makes the region almost impassable.

This natural beauty and the special plant world have attracted the researchers already in the past. The aim of this book is to provide an overview of the present knowledge of the area and give some new information about it. The completed inventory of plant world of the region will give the fundamental information for its evaluation and the basis for its protection. We hope that readers of the book may recognize that the steppe region is one of the pearls of the natural heritage of the Republic of Macedonia and that it deserves a special attention in the future.

Description of the study area

The bedrock is composed of Paleogenic, and more rarely Neogenic sediments. Among them there are sandstones, marly sandstones, clays, sandy clays, carbonates, marls and others. Impermeable bedrock, which is subject to weathering and erosion processes resulting in extremly severe erosion. Water and frost cause some sediment layers to decay into small particles which are later carried away by water.

As all Paleogenic sediments are of marine origin and therefore salt-rich, the marl consequently becomes white from the salt which has crystallised in thin layers. This can be clearly seen during summer rains when the warm and dry winds cause the water to evaporate. The soil in small depressions is even more salinized, because it is carried here from the slopes during rainfall. Special, halophytic vegetation develops on such sites. Climatic conditions in this part of Macedonia are rather unfavourable. The following data are for Veles: annual precipitation is 460 mm, mean annual temperature is 13.3 ºC.

There is very little surface water and even the few wells, which are a rarity there, often dry up during the summer. Springs are even rarer. They are also dirty and can only be found on marshy spots where the underground water comes to the surface. In addition, the water runs across the salt-rich surfaces, so it also tastes bad.

Geographical position of the study area (according to Micevski 1971).

A thin layer of soil has developed on flat and gently sloping surfaces. However, frequently the water carries this soil away during rainfall and uncovers the bedrock. On sites where the thin layer of soil is preserved, characteristic endemic vegetation develops, which grows only on Paleogenic and Neogenic marls or marly sandstones. Humus has been preserved only in depressions overgrown with "oases" of oak forests.

Degradation of forests in this region started very early because in the vicinity there used to be the capital city of Stobi, which was the centre of the Roman province of Macedonia, Secunda. The region was highly populated in antiquity and in the early Middle Ages, and they were intensively changing the landscape, mostly by deforestation because they needed wood for construction purposes as well as for heathing. Most of the forests at that time were destroyed and the surfaces transformed into pastures, which led to erosion that later brought about the development of the "steppe" vegetation.

The region itself is bleak and sparsly populated. There used to be some settlements where the Turks from Asia Minor settled in the time of the Ottoman empire. The Turks moved away after the Balkan wars and in the period 1950–1960. Today only remnants of former settlements can be seen. In the recent past, nomadic shepherds wintered here because of the relatively favourable winter temperatures, and they further cut out the few forest "oases" left. (Micevski 1971, Filipovski et al. 1996, Filipovski 1995–1999)

Thin layer of salt is accumulated on flat and gently sloping surfaces.

Parent material can be seen on eroded slopes.

General view of the vegetation

There is hardly any forest vegetation in this region, and there are even large areas without any tree species at all. Potential natural vegetation of this region are forests consisting mostly of *Carpinus orientalis, Quercus pubescens, Q. frainetto* and *Fraxinus ornus*. For the most part, they are locally distributed today, but individual shrub species occur more often, e.g. *Paliurus spina-christi, Juniperus oxycedrus* and others. *Populus alba* and *Salix alba* dominated forests can develop in some places along water, while the dry eroded surfaces allow for the growth of steppe vegetation. Halophytic vegetation develops on salty surfaces. The erosion in this region has been very intense since deforestation, so the steppe vegetation is well developed. Another factor (apart from the erosion) conducive to its appereance is the favourable geological bedrock – Paleogenic marls.

Steppe vegetation

In terms of biodiversity, this region is important because of the specific factors affecting the living world. As early as in 1924 Košanin believed this region had the characteristics of a steppe, regarding its appearance as well as its floristic composi-

tion. Černjavski and collaborators (1937) thought that the complex of direct and indirect factors functions towards the formation of a herb vegetation whose type is similar to the steppe, and they even talk about steppe vegetation.

Nevertheless, this is not a real steppe. A real steppe is zonal vegetation of the regions with such a small quantity of precipitation that it is impossible for the forest vegetation to develop. It therefore cannot be said that this part of Macedonia is a primary steppe, but only a steppe-like landscape which is a result of anthropogenic influences. This region can therefore only be characterised as a steppe-like region. This also provides the basis for understanding the origin and ecology of the steppe vegetation in Macedonia.

The main reasons why this is not a zonal steppe are as follows:

1. The number of steppe species is too small;
2. Steppe species have a Balkan-Anatolian distribution;
3. The climate of the region is not characteristic for steppe regions;
4. Whereas the steppe species survived the cold periods on lake shores because of the favourable bedrock (Paleogenic marls) and climate, the glaciation on the southern part of the Balkans was not so severe;
5. The entire region, with the exception of salt valleys, was covered with oak forests;
6. We can recognize a reforestation process going on in the region due to less intensive land use.

Within the vegetation some steppe and halophilous species occur and give the landscape a specific appearance which are reminiscent of the steppe.

Steppe flora

Although we have established that there is not any natural steppe vegetation in Macedonia, it is nevertheless possible that there a certain number of steppe species in this vegetation, and among them also some endemic species characteristic for this region.

Within this region there are plants characteristic of salt soil, such as *Artemisia maritima* subsp. *salina*, *Artemisia maritima* subsp. *monogyna*, *Camphorosma monspeliaca*, *Krascheninnikovia ceratoides*, *Convolvulus holosericeus*, *Hedysarum macedonicum*, *Capparis sicula*, *Onobrychis megalophylla* and others. Also important are the steppe species which develop on unsalinised Paleogenic sediments, e.g. *Astragalus parnassi*, *A. cernjavskii*, *Morina persica*, *Onobrychis pindicola* etc.

It remains a question, however, where these steppe elements came from. The prevailing opinion is that most of these species had already existed in this region, while

The region has been mainly deforested for a long time and there has developed vegetation that is similar to a zonal steppe that appears in areas with low precipitation.

some others migrated from the Near and Middle East to Balkan via Asia Minor. In the Pliocene there were Mediterranean-type deserts in the Balkan peninsula and steppe vegetation had already existed there. In the Pleistocene these species were preserved, as were many other Tertiary relics, such as *Pinus peuce, Platanus orientalis, Aesculus hippocastanum*, and even some representatives of the tropical family *Gesneriaceae* – *Ramonda nathaliae* and *Ramonda serbica*. However, it should be taken into consideration that the steppe plants can stand considerable temperature amplitudes. Another factor that partly helped to preserve the steppe flora is also the fact that the valley of the Vardar river used to be filled with water and that the vicinity of water (lake) modified the local climate. (Micevski 1971)

The number of steppe elements found in the vegetation types of this part of Macedonia was established to be relatively small, but their significance in the vegetation cover is proportionally greater than their number.

Altogether 5350 taxa of higher plants occur within the territory of the Republic of Macedonia, 115 of which are endemic species. All of eight endemic species from the studied area are classified among xerothermic (steppe) relics which are the remainder of the steppe flora that developed here during dry and warm periods. Today,

Steep, eroded slopes are often without vegetation cover and parent material can be seen on the surface.

they are found mostly in the steppe region of Macedonia, partly also in certain regions in western Macedonia. (Micevski & Matevski 1987, 2000)

Steppe elements in this region occur within two vegetation types, namely halophytic steppe elements in salt valleys, and steppe elements which are not halotolerant on dry grasslands. Following these findings, two types of steppe vegetation can be distinguished. We have used throughout the book the term dry steppe for vegetation on non-salinised dry habitats and salt steppe for communities appearing on salty soils.

Vegetation which develops on salinised sites is classified into the order *Salicornietalia*, alliance *Artemision maritimae* with the following associations: *Eurotietum ceratoides* and *Artemisio-Camphorosmetum monspeliacae*. The transitional community between both types *Hedysaro-Convolvuletum* and vegetation on non-salinised dry habitats, is classified into the class *Festuco-Bronetea*, order *Astragalo-Potentilletalia*, alliance *Saturejo-Thymion,* with associations *Brachypodio-Onobychetum pinidicolae* and *Astragalo-Morinetum*.

Impact of military acitvities on flora and vegetation

The larger part of the area is intended for military use. This has had a positive effect on the preservation of the biodiversity of the region, because the landuse has not been intensive, which has enabled the preservation of many important plant species and habitats. Moderate sheep pasture, which is still being practised in this area, is another factor (apart from the military activities) that has also enabled to preserve the biodiversity. Moreover, the region was closed to the general public, which also contributed to the preservation of biodiversity.

There are, however, also negative consequences of military activity, such as erosion and consequently degradation of vegetation, or vegetation and soil being compressed as a result of driving or walking. Another factor to be considered are fires caused by shooting. Assessment of military use therefore shows that the activities are a two-edged sword: while they have protected the area from the outside influences on the one hand, they also cause a negative impact on the landscape (e.g. erosion, compression of the vegetation and sites, fires, etc).

General view of the military training camp, shooting (left) and transportation of soldiers and equipment (right). Military activities have a negative impact on vegetation, such as erosion, compression of soil and similar.

METHODS

Floristics

In the field, we collected and determined extensive herbarium material, which presents the basis for the floristic analysis. The determination and nomenclature of the taxa is in accordance with the works of Hayek (1924–1933), Tutin et al. (1964–1980) and Micevski (1985–2005). One of the starting points for the analysis was the database of the literature floristic data at the Faculty of Natural Sciences and Mathematics in Skopje, which comprises material from the entire territory of the Republic of Macedonia.

In the years 2006 and 2007 the research team conducted an intensive field investigation, which involved recording plant species in the field and collecting an extensive herbarium material that was, after the elaboration, deposited in the herbarium of the Faculty of Natural Sciences and Mathematics in Skopje.

Floristic valorization of this region was conducted on the basis of the presence of species which are included in the lists of different international conventions – IUCN Red list of threatened plants (Walter & Gillet 1998), Bern Convention (1979), Habitat Directive (1991), Corine (Devilliers et al. 1991), IPA (Matevski & Melovski 2003, Anderson et al. 2005) and others.

The chorology and condition of the populations of the most important species, which we divided into endemic and very rare species (A), halophytic species (B) and steppe species in a narrower sense (C), were made on selected localities: in some localities in the military training camp of Krivolak, in the region between Negotino and the village of Krivolak, on the mountain pasture Serta above the village of Pepelište and the mountain pasture of Bogoslovec near Sveti Nikole.

Vegetation and habitat types

Habitat is an area inhabited by certain animals and plants. It is characterized as a living space which varies in size according to different organisms: small organisms (e.g. snails, ants) can live on a few centimetres, while large organisms (e.g. birds, bears) usually require very large habitats. To avoid this disproportion, our definition of the habitat type is a surface with specific (uniform) geographical and other biotic and abiotic factors. But as vegetation is the most visible and stabile part of nature, a vegetation type provides the basis for the determination of a habitat type. Vegetation types were established applying the standard method for the study of vegetation. On the basis of the vegetation types, we determined the habitat types

in accordance with the European typology (A classification of Palearctic habitats (Devilliers et al. 1996), EUNIS: European Nature Information System).

A habitat type is therefore a plant and animal community as a characteristic living part of an ecosystem, but related to the non-living factors (the soil, climate, presence and quality of water, light) in a spatially defined area. Moreover, it is therefore a generalization on the physiognomical unit in nature, which provides information on the living world but reflects also all other factors in the landscape (water, soil, relief, aspect, etc.).

So the habitat types are also the basis for nature conservation. Nature conservation involves more than just protection of animals, plants and natural values, but also an efficient protection of living environments together with the processes which preserve them. Once we have obtained accurate biological spatial information, it will be easier to decide on the preservation of the environment or planning the interventions in space. This will also reduce the possibility of conflicts between nature conservation and the planned activities in the area.

We recorded most of the vegetation types in the area. Thus we recorded the species composition of plant communities, determined the vegetation and habitat types and assessed the impact of various factors on them. By comparing individual habitats, we can foresee the future processes in the environment and possible successional development of the vegetation (or habitat type) in the future.

The vegetation in the field was sampled by applying the standard method for vegetation research (Braun-Blanquet 1964). In the landscape we located homogeneous plots and made their floristic inventory, named the relevé: cover of individual plant species was estimated according to the prescribed methodology: r – one or only a few plant specimens, + – a very rare plant, covers less than 5 % of the sample plot, 1 – the species is frequent but has low cover or is rare with higher cover – it covers less than 5 % of the surface, 2 – the species is very common and can cover less than 5 % of the surface, usually between 5 and 25 %, 3 – the species covers between 25 and 50 % of the surface, 4 – the species covers between 51 and 75 % of the surface and 5 – the species covers between 76 and 100 % of the surface. They were then compared with those already classified from the literature, and thus the vegetation types were determined. Following the already established methodology we then translated the vegetation types into habitat types (Rodwell et al. 2002).

All of the localities were georeferenced and presented on the maps. Sometimes the various vegetation types posses the same coordinates although they do not match in the field, due to inaccuracy of the coordinate units (seconds) used.

RESULTS

Floristic inventarisation

The chapter on floristic valorization includes

A. Survey of endemic and very rare species
B. Survey of halophytes
C. Survey of steppe species
D. Survey of rare species
— Floristic analysis
— Floristic survey of the most important species
— Legislation

A Survey of endemic and rare species

Especially important species (IUCN (Walter & Gillet 1998), Corine (Devilliers et al. 1992) with limited distribution are *Tulipa mariannae*, *Astragalus cernjavskii*, *Heptaptera macedonica* and *Salvia jurisicii*, which are found only in the steppe region, almost exclusively in the locality of Orlovo Brdo. This is definitely one of the most interesting botanical localities in the wider region, where another four endemic species grow as well (*Hedysarum macedonicum, Ferulago macedonica, Onobychis magalophylla* and *Potentilla tridentula*). This means that eight endemic species are concentrated in a small area of several ten hectares. Apart from the locality on Orlovo Brdo, *Tulipa mariannae* has only one vital population left – on the hill between Negotino and the village of Krivolak, while *Astragalus cernjavskii* has only one more population apart from this one – the mountain pasture of Serta above the village of Pepelište. Similarly, the species *Heptaptera macedonica* was found outside the steppe region only in Demir Kapija and in the vicinity of Kavadarci, *Salvia jurisicii* grows also in the vicinity of Sv. Nikola – Bogoslovec and in the villages of Mustafino and Vrsakovo. The other four endemic species have a wider area of distribution. *Hedysarum macedonicum* has vital populations in the entire steppe region (it was recorded on more than 10 localities), as well as in the wider surroundings of Negotino, Veles (Gradsko) and Sv. Nikola (Bogoslovec); *Ferulago macedonica* was found on 4 localities in the area of the military training camp, as well as on the mountain pasture of Serta and in the vicinity of Negotino; *Onobychis megalophylla* can be found all over the research area and in several other localities Štip, Kavadarci (Ljubaš), Negotino, Katlanovo, Ovče Pole (Delisinci) and some localities around Veles, *Potentilla tridentula* is known also from the vicinity of Kumanovo (Krasta), Veles, Ovče Pole (Delisinci), Štip and Mariovo. Apart from the above species we included in this group also *Cardopatium corymbosum* and *Galatella villosa*, which is also found in other countries in the region. However, this is its only locality in the Republic of Macedonia.

For each of the analysed species we give the following information:

- registered localities in the steppe area
- literature data for the Republic of Macedonia

A 1. *Hedysarum macedonicum* Bornm.

Registered localities:

- Orlovo Brdo, 41°32'42"N, 22°08'04"E, 194 m, 2. 6. 2007;
- Dlabok Dol, 41°34'34"N, 21°58'27"E, 142 m, 9. 5. 2007;
- Ulanci - Eneševo, 41°35'46"N, 21°59'00"E, 313 m, 9. 5. 2007;
- Solena Reka, 41°34'19"N, 22°05'47"E, 165 m, 4. 6. 2007;
- Tank polygon – Beli Kamen, 41°34'04"N, 22°03'42"E, 215 m, 10. 5. 2007;
- Solen Dol – artillery training ground, 41°34'29"N, 22°01'12"E, 160 m, 2. 6. 2007;
- Stirkaljevo, 41°38'53"N, 22°07'33"E, 663 m, 1. 6. 2007;
- Karaodžali, 41°36'14"N, 22°08'00"E, 476 m, 6. 6. 2007;
- Between Negotino and Krivolak, 41°30'43"N, 22°06'26"E, 131 m, 6. 6. 2007;
- Bogoslovec - Delisinci, 41°45'34"N, 21°59'29"E, 228 m, 30. 5. 2007 (not on the map);
- Serta – above the village of Pepelište, 41°33'07"N, 22°10'16"E, 228 m, 7. 6. 2007.

Hedysarum macedonicum is a plant that is adapted to the severe conditions in the steppe area and has built up many vital populations within the area.

Literature data for Macedonia:
Bornmüller (1925, 1927)
- Krivolak

Micevski (2001: 1372–1373)
- Veles: villages Gradsko, Ulanci, Eneševo;
- Sveti Nikole: village Delisinci;
- Negotino: villages Krivolak, Orlovo Brdo, mountain pasture Serta.

A 2. *Astragalus cernjavskii* Stoj.

Registered localities:
- Orlovo Brdo, 41°32'43"N, 22°08'26"E, 194 m, 2. 6. 2007;
- Serta – above the village of Pepelište, 41° 33'07"N, 22°10'16"E, 228 m, 7. 6. 2007.

Literature data for Macedonia:
Stojanoff (1936: 102)
- Orlovo Brdo, inter Krivolak et Pepelište;

Micevski (2001: 1176)
- Negotino: Orlovo Brdo.




Astragalus cernjavskii has an exceptionally small area of distibution, and is known from only two localities (Orlovo Brdo and Mt. Serta).

A 3. *Tulipa mariannae* Lindtner

Registered localities:

- Orlovo Brdo, 41°32'42"N, 22°08'04"E, 194 m, 16. 3. 2007;
- between Negotino and the village of Krivolak, 41°30'43"N, 22°06'26"E, 131 m, 16. 3. 2007.

Literature data for Macedonia:

Lindtner (1938/39)

- Negotino: Orlovo Brdo.

The other species with a very restricted area is *Tulipa mariannae*. It flowers only a few days in the early spring.

A 4. *Onobrychis megalophylla* Boiss.

Registered localities:

- Between Negotino and the village of Krivolak, 41°30'43"N, 22°06'26"E, 131 m, 6. 6. 2006;
- Bogoslovec-Delisinci, 41°45'37"N, 21°59'37"E, 228 m, 7. 6. 2006 (not on the map);
- Dlabok Dol, 41°34'34"N, 21°58'27"E, 142 m, 9. 5. 2007;
- Infantry training ground – Kavlik, 41°33'50"N, 22°05'13"E, 203 m. 4. 6. 2007;
- Karaodžali, 41°36'14"N, 22°08'00"E, 476 m, 6. 6. 2007;

- Mušanci, 41°34'41"N, 22°00'04"E, 178 m, 5. 6. 2007;
- Orlovo Brdo, 41°32'42"N, 22°08'04"E, 194 m, 2. 6. 2007;
- Rajnički Rid, 41°36'03"N, 21°59'19"E, 358 m, 9. 5. 2007;
- Serta – above the village of Pepelište, 41°33'07"N, 22°10'16"E, 228 m, 7. 6. 2007;
- Solen Dol – artillery training ground, 41°34'29"N, 22°01'12"E, 160 m, 3. 6. 2007;
- Solena Reka, 41°34'19"N, 22°05'47"E, 165 m, 4. 6. 2007;
- Stirkaljevo, 41°38'53"N, 22°07'33"E, 663 m, 1. 6. 2007;
- Tank polygon – Beli Kamen, 41°34'04"N, 22°03'42"E, 215 m, 10. 5. 2007;
- Ulanci-Eneševo, 41°35'46"N, 21°59'00"E, 313 m, 9. 5. 2007.

Onobrychis megalophylla is also a species of steppe origin; its closely related species, *Onobrychis hypargyrea,* grows in Asia Minor.

Literature data for Macedonia:

Bornmüller (1927)
- Štip;

Micevski (2001)
- Kavadarci: Ljubaš;
- Negotino: the villages of Džidimirci, Slatinska Reka, Krivolak,Pepelište and Mt. Serta;
- Skopje: Katlanovo;
- Sveti Nikole: Ovče Pole, Delisinci;
- Veles: Bašino Selo, Gradsko, village Ulanci, village Eneševo.

A 5. *Ferulago macedonica* Micevski & Mayer

Registered localities:

- Orlovo Brdo, 41°32'42"N, 22°08'04"E, 194 m, 2. 6. 2007;
- Karaodžali, 41°36'14"N, 22°08'00"E, 476 m, 6. 6. 2007;
- Mušanci, 41°34'41"N, 22°00'04"E, 178 m, 5. 6. 2007;
- between Negotino and the village of Krivolak, 41°30'43"N, 22°06'26"E, 131 m, 6. 6. 2007;
- Serta – above the village of Pepelište, 41°33'07"N, 22°10'17"E, 228 m, 3. 6. 2007.

Literature data for Macedonia:

Micevski & Mayer (1985)

- Krivolak

Micevski (2005: 1623–1624)

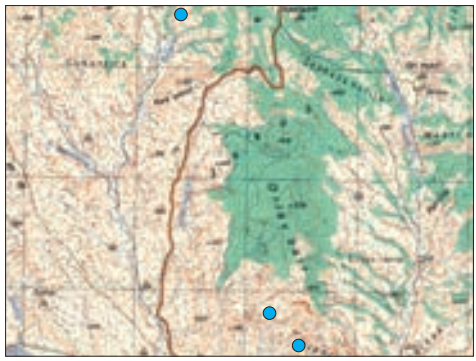
- Negotino: villages of Krivolak and Pepelište, mountain pasture of Serta, Orlovo Brdo.

Ferulago macedonica is also known only from the steppe region.

A 6. *Salvia jurisicii* Košanin

Registered localities:

- Orlovo Brdo, 41°33'07"N, 22°07'57"E, 236 m, 2. 6. 2007;
- Orlovo Brdo, 41°32'48"N, 22°08'20"E, 216 m, 29. 5. 2007;
- Jusuf Koria, 41°436'02"N, 22°06'47"E, 199 m, 7. 6. 2007.



Salvia jurisicii is found in dense stands of *Paliurus spina-christi*.

Literature data for Macedonia:

- Jurišić (1923) – Ovče Pole: Mustafino-Vrsakovo;
- Bornmüller (1925, 1932) – Krivolak, Štip;
- Košanin (1926) – Ežovo Pole: Mustafino-Vrsakovo;
- Lindtner (1938/1939) – Krivolak: Orlovo Brdo;
- Černjavski, Rudski & Soška (1937) – Ovče and Ežovo Pole; Krivolak-Orlovo Brdo;
- Soška (1940) – Štip: Vrsakovo, Bogoslovec;
- Micevski (1969) – Ovče Pole: Delisinci.

A 7. *Potentilla tridentula* Vel.

Registered localities:

- Orlovo Brdo, 41°32'42"N, 22°08'04"E, 194 m, 2. 6. 2007;
- Solena Reka, 41°34'19"N, 22°05'47"E, 165 m, 4. 6. 2007;
- Karaodžali, 41°36'14"N, 22°08'00"E, 476 m, 6. 6. 2007;
- Infantry training ground– Kavlik, 41°33'50"N, 22°05'13"E, 203 m, 4. 6. 2007;
- Mušanci, 41°34'41"N, 22°00'04"E, 178 m, 5. 6. 2007.

Potentilla tridentula is more widely spread over the whole territory of the Republic of Macedonia.

Literature data for Macedonia:
Velenovský (1922)
- Mariovo: Gradešnica;

Micevski (1998: 961–962)
- Kumanovo: Krasta – villages of Pčinja and Kučkarevo;
- Veles: villages of Sujaklari and Nogaevci;
- Sveti Nikole: village of Delisinci;
- Štip: vicinity;
- Negotino: village of Džidimirci, Orlovo Brdo, Solen Dol – village of Eneševo.

A 8. *Heptaptera macedonica* (Bornm.) Tutin

Registered localities:
- Orlovo Brdo, 41°32'42"N, 22°08'04"E, 194 m, 2. 6. 2007.

Literature data for Macedonia:
Soška (1939)
- Kavadarci – Ljubaš, villages: Vataša, Resava, Begnište;

Heptaptera macedonica was recorded only in the central part of the Republic of Macedonia.

Kitanov (1951)
- Negotino: Orlovo Brdo;

Micevski & Matevski (1983)
- Kavadarci – Ljubaš;

Micevski (2005: 1590–1591)
- Kavadarci – Ljubaš;
- Demir Kapija: Krasta.

A 9. *Cardopatium corymbosum* (L.) Pers.

Registered localities:
- Solen Dol – artillery training ground, 41°34'29"N, 22°01'12"E, 160 m, 3. 6. 2007;
- Village of Mušanci, 41°34'41"N, 22°00'04"E, 178 m, 5. 6. 2007.

Cardopatium corymbosum can be found also in South and Southeastern Europe, but localities in the steppe area are the only ones in the Republic of Macedonia.

Literature data for Macedonia:
Micevski (1969) – Gradsko: Ulanci.

So far, this extremely rare Mediterranean plant has been known from only one locality in Macedonia – the village of Ulanci (Micevski 1969). During our research, this rare plant was discovered on two other localities – Solen Dol and the vicinity of the village of Mušanci.

A 10. *Galatella villosa* (L.) Rchb.

Registered localities:
- Solen Dol – artillery training ground, 41°34'29"N, 22°01'12"E, 160 m, 3. 6. 2007.

Literature data for Macedonia:
Micevski (1969)
- Gradsko: between the villages of Ulanci and Eneševo.

Recorded locality of *Galatella villosa* is the only one known in the Republic of Macedonia. This species is native also to Hungary, Romania, Bulgaria and east European countries.

B Survey of halophytes

Halophytes recorded in the list of endemic halophytic flora in this region are very important for the total biodiversity. These are the following species: *Artemisia maritima*, *Krascheninnikovia ceratoides*, *Camphorosma monspeliaca* and *Camphorosma annua*, which were found only in the steppe region. Their ecology differs significantly from the halophytic species which grow on salisols (solončak) on Ovče Polje, because halophytes in the steppe region grow on undeveloped soil, where the erosive processes are even more intense due to the completely degraded forest ecosystems in the region.

B 1. *Artemisia maritima* L.

Registered localities:

- Orlovo Brdo, 41°32'42"N, 22°08'04"E, 194 m, 2. 6. 2007;
- Ulanci-Eneševo, 41°35'46"N, 21°59'00"E, 313 m, 9. 5.2007;
- Mušanci, 41°34'41"N, 22°00'04"E, 178 m, 5. 6. 2007;
- Solena Reka, 41°34'19"N, 22°05'47"E, 165 m, 4. 6. 2007;
- Tank polygon – Beli Kamen, 41°34'04"N, 22°03'42"E, 215 m, 10. 5. 2007;
- Solen Dol – artillery training ground, 41°34'29"N, 22°01'12"E, 160 m, 3. 6. 2007;
- Karaodžali, 41°36'14"N, 22°08'00"E, 476 m, 6. 6. 2007;
- Infantry training ground– Kavlik, 41°33'50"N, 22°05'13"E, 203 m, 4. 6. 2007;
- Bogoslovec-Delisinci, 41°45'34"N, 21°59'29"E, 228 m, 7. 6. 2006 (not on the map).

Literature data for Macedonia:

Černjavski, Rudski & Soška (1937)

- Makedonska Nizina – Macedonian plain (Krivolak);

Micevski (1969)

- Krivolak: Orlovo Brdo, Solen Dol-Eneševo.

Artemisia maritima is a common species on saltish soils. It is widely distributed in the northern hemisphere from Britain, Mediterranean region, southern Russia to Mongolia.

B 2. *Krascheninnikovia ceratoides* (L.) Gueldenst.

Registered localities:

- Bogoslovec-Delisinci, 41°45'34"N, 21°59'29"E, 228 m, 7. 6. 2006 (not on the map);
- Karaodžali, 41°36'14"N, 22°08'00"E, 476 m, 6. 6. 2007;
- Orlovo Brdo, 41°32'42"N, 22°08'04"E, 194 m, 2. 6. 2007;

Krascheninnikovia ceratoides is a characteristic species for the steppe regions from the Mediterranean region and Panonnian basin over the Near East to the Gobi desert in the Far east.

- Rajnički Rid, 41°36'03"N, 21°59'19"E, 358 m, 9. 5. 2007;
- Solen Dol – artillery training ground, 41°34'29"N, 22°01'12"E, 160 m, 3. 6. 2007,
- Solena Reka, 41°34'19"N, 22°05'47"E, 165 m, 4. 6. 2007;
- Ulanci-Eneševo, 41°35'46"N, 21°59'00"E, 313 m, 9. 5. 2007.

Literature data for Macedonia:
Micevski (1995)
- Bogoslovec: Delisinci;
- Veles: villages Ulanci and Eneševo;
- Negotino – the village of Krivolak (Orlovo Brdo).

B 3. *Camphorosma monspeliaca* L.

Registered localities:
- Bogoslovec-Delisinci, 41°45'34"N, 21°59'29"E, 228 m, 7. 6. 2007 (not on the map);
- Infantry training ground– Kavlik, 41°33'50"N, 22°05'13"E, 203 m, 4. 6. 2007;
- Mušanci, 41°34'41"N, 22°00'04"E, 178 m, 5. 6. 2007;
- Solen Dol – artillery training ground, 41°34'29"N, 22°01'12"E, 160 m, 3. 6. 2007;
- Solena Reka, 41°34'19"N, 22°05'47"E, 165 m, 4. 6. 2007;

Camphorosma monspeliaca has a similar distribution pattern to that of other species from salt habitats: *Artemisia, Krascheninnikovia* and *Camphorosma annua*.

- Tank polygon – Beli Kamen, 41°34'04"N, 22°03'42"E, 215 m, 10. 5. 2007;
- Ulanci-Eneševo, 41°35'46"N, 21°59'00"E, 313 m, 9. 5. 2007.

Literature data for Macedonia:
Micevski (1995)
- Negotino-Džidimirci;
- Ovče Pole, Amzabegovo, Delisinci;
- Veles: the villages of Ulanci and Eneševo.

B 4. *Camphorosma annua* Pall.

Registered localities:
- Rajnički Rid, 41°36'03"N, 21°59'19"E, 358 m, 9. 5. 2007;
- Ulanci-Eneševo, 41°35'46"N, 21°59'00"E, 313 m, 9. 5. 2007;
- Solen Dol – artillery training ground, 41°34'29"N, 22°01'12"E, 160 m, 3. 6. 2007.

Literature data for Macedonia:
Micevski (1995)
- Ovče Pole.

Camphorosma annua is also a species of salt habitats.

C Survey of steppe plants

Steppe plant species have been present in the area since the Pliocene, when Asia Minor and the southern part of the Balkan peninsula were still connected. They survived the cold periods on the banks of a lake, because the valley of the Vardar river was inundated and, as such, moderated the unfavourable climatic conditions. All this helped to preserve some steppe plants in this region.

Steppe plants (*Astragalus parnassi*, *Convolvulus holosericeus*, *Morina persica*) are well represented on large surfaces with vital populations.

C 1. *Astragalus parnassi* Boiss.

Registered localities:

- Between Negotino and the village of Krivolak, 41°30'43"N, 22°06'26"E, 131 m, 6. 6. 2007;
- Bogoslovec-Delisinci, 41°45'37"N, 21°59'37"E, 228 m, 7. 6. 2007 (not on the map);
- Dlabok Dol, 41°34'34"N, 21°58'27"E, 142 m, 9. 5. 2007;
- Infantry training ground– Kavlik, 41°33'50"N, 22°05'13"E, 203 m, 4. 6. 2007;
- Karaodžali, 41°36'14"N, 22°08'00"E, 476 m, 6. 6. 2007;
- Mušanci, 41°34'41"N, 22°00'04"E, 178 m, 5. 6. 2007;
- Orlovo Brdo, 41°32'42"N, 22°08'04"E, 194 m, 2. 6. 2007;
- Rajnički Rid, 41°36'03"N, 21°59'19"E, 358 m, 9. 5. 2007;
- Serta – above the village of Pepelište, 41°33'07"N, 22°10'16"E, 228 m, 7. 6. 2007;
- Solen Dol – artillery training ground, 41°34'29"N, 22°01'12"E, 160 m, 3. 6. 2007;
- Solena Reka, 41°34'19"N, 22°05'47"E, 165 m, 4. 6. 2007;
- Stirkaljevo, 41°38'53"N, 22°07'33"E, 663 m, 1. 6. 2007;
- Tank polygon – Beli Kamen, 41°34'04"N, 22°03'42"E, 215 m, 10. 5. 2007;
- Ulanci-Eneševo, 41°35'46"N, 21°59'00"E, 313 m, 9. 5. 2007.

Literature data for Macedonia:

Micevski (2001)

- Demir Kapija: Klisura;
- Kavadarci: Ljubaš, the village of Vataša;
- Kumanovo: villages of Kučkarevo, Pezovo, Pčinja;
- Negotino: Krivolak, villages of Džidimirci, Orlovo Brdo, Crveni Bregovi;
- Radoviš: Mantovo;
- Sveti Nikole: the village of Delisinci;
- Štip: vicinity;
- Veles: villages of Derven, Gradsko, Ulanci, Eneševo, Mušanci, the canyon of the rivers Topolka and Babuna.

Bornmüller (1925)

- Veles: Babuna, Gradsko;

Astragalus parnassi is a spiny semi shrub species with a steppe origin that is distributed in Southern Europe.

C 2. *Morina persica* L.

Registered localities:

- Between Negotino and the village of Krivolak, 41°30'43"N, 22°06'26"E, 131 m, 6. 6. 2007;
- Bogoslovec-Delisinci, 41°45'37"N, 21°59'37"E, 228 m, 7. 6. 2007 (not on the map);
- Dlabok Dol, 41°34'34"N, 21°58'27"E, 142 m, 9. 5. 2007;
- Infantry training ground– Kavlik, 41°33'50"N, 22°05'13"E, 203 m, 4. 6. 2007;
- Karaodžali, 41°36'14"N, 22°08'00"E, 476 m, 6. 6. 2007;
- Mušanci, 41°34'41"N, 22°00'04"E, 178 m, 5. 6. 2007;

- Orlovo Brdo, 41°32'42"N, 22°08'04"E, 194 m, 2. 6. 2007;
- Rajnički Rid, 41°36'03"N, 21°59'19"E, 358 m, 9. 5. 2007;
- Serta – above the village of Pepelište,41°33'07"N, 22°10'16"E, 228 m, 7. 6. 2007;
- Solen Dol – artillery training ground, 41°34'29"N, 22°01'12"E, 160 m, 3. 6.2007;
- Solena Reka, 41°34'19"N, 22°05'47"E, 165 m, 4. 6. 2007;
- Stirkaljevo, 41°38'53"N, 22°07'33"E, 663 m, 1. 6. 2007;
- Tank polygon – Beli Kamen, 41°34'04"N, 22°03'42"E, 215 m, 10. 5. 2007;
- Ulanci-Eneševo, 41°35'46"N, 21°59'00"E, 313 m, 9. 5. 2007.

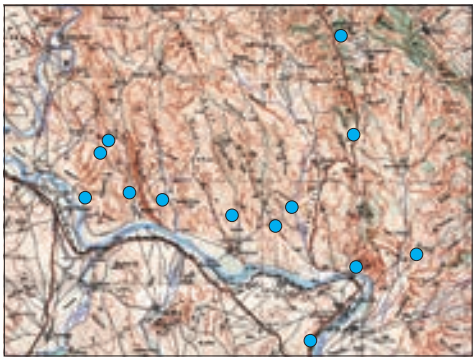
Literature data for Macedonia:

Vandas (1909)
- Demir Kapija, Ulanci, Gradsko, Čičevo;

Bornmüller (1926)
- Veles: Topolka, Babuna, Gradsko, Demir Kapija;

Weber (1951)
- Galičica;

Micevski (1971)
- Negotino, Veles.



Morina persica is a common species in the region and can be found also in the Near East.

C 3. *Convolvulus holosericeus* MB

Registered localities:

- Between Negotino and the village of Krivolak, 41°30'43"N, 22°06'26"E, 131 m, 6. 6. 2007;
- Bogoslovec-Delisinci, 41°45'37"N, 21°59'37"E, 228 m, 7. 6. 2007 (not on the map);
- Dlabok Dol, 41°34'34"N, 21°58'27"E, 142 m, 9. 5. 2007;
- Infantry training ground – Kavlik, 41°33'50"N, 22°05'13"E, 203 m, 4. 6. 2007;
- Mušanci, 41°34'41"N, 22°00'04"E, 178 m, 5. 6. 2007;
- Orlovo Brdo, 41°32'42"N, 22°08'04"E, 194 m, 2. 6. 2007;
- Rajnički Rid, 41°36'03"N, 21°59'19"E, 358 m, 9. 5. 2007;
- Serta – above the village of Pepelište, 41°33'07"N, 22°10'16"E, 228 m, 7. 6. 2007;
- Solen Dol – artillery training ground, 41°34'29"N, 22°01'12"E, 160 m, 3. 6. 2007;
- Solena Reka, 41°34'19"N, 22°05'47"E, 165 m, 4. 6. 2007;
- Tank polygon – Beli Kamen, 41°34'04"N, 22°03'42"E, 215 m, 10. 5. 2007;
- Ulanci-Eneševo, 41°35'46"N, 21°59'00"E, 313 m, 9. 6. 2007.

Literature data for Macedonia:

Bornmüller (1928)

- Štipsko;

Rudski (1943)

- Strumičko-Vodoča;

Matevski (unpublished data)

- Kumanovo: the village of Kučkarevo;
- Negotino: Krivolak, Orlovo Brdo, Stobi, the village of Džumajlija;
- Ovče Pole-Bogoslovec;
- Veles: Gradsko, villages Ulanci and Mušanci, Solen Dol.

Convolvulus holosericeus can be also found in the Near East.

D Other rare plants

Within the steppe region 2 species are found whose wider distribution area is in the southern part of the Balkan peninsula, the Mediterranean or Asia Minor, but which were recorded only in this part of the territory of the Republic of Macedonia: *Cardopatium corymbosum, Galatella villosa*. For 13 taxa for whom the area of the steppe region is only one of five known sites in the Republic of Macedonia: *Aegilops heldreichii, Artemisia maritima, Astragalus gladiatus* var. *leucotrichus, Astragalus monspessulanus* var. *macedonicus, Brassica elongata* subsp. *integrifolia, Cachrys alpina, Callistemma palaestinum* var. *lyratum, Camphorosma annua, Galium rhodopeum, Inula viscosa, Juncus acutus, Krascheninnikovia ceratoides, Lagoecia cuminoides, Malcolmia africana, Vicia hybrida*.

Additionally this region is one of the 15 sites in the Republic of Macedonia for a large number of taxa (over 30), such as: *Anchusa macedonica, Asteriscus aquaticus, Astragalus parnassi, Astragalus sinaicus, Capparis sicula, Centaurea orphanidea, Cerastium pumilum, Chenopodium ambrosioides, Clematis viticella, Crepis zacyntha, Echinophora sibthorpiana, Ephedra fragilis* subsp. *campylopoda, Euphorbia aleppica, Genista sessilifolia, Glycyrrhiza echinata, Knautia degenii, Lepidium perfoliatum, Nonea echioides, Onobrychis pindicola, Opoponax chironium, Osyris alba, Paeonia peregrina, Periploca graeca, Phlomis herba-venti* subsp. *pungens, Alyssum linifolium, Tremastelma palaestinum, Trifolium lapaceum* etc.

Among species that the steppe region is one of five known locatities in the Republic of Macedonia, there are *Ephedra fragilis* subsp. *campylopoda* (right) and *Galium rhodopeum* (left).

Capparis sicula (above) are also rare species and *Genista sessilifolia* (bottom).

Analysis of flora

Floristic analysis has shown that over 600 plant taxa were recorded in the steppe region. The most numerous are taxa from family *Fabaceae*, which can bind nitrogen with symbiontic bacteria from the atmosphere and thus indicate nutrient-poor site conditions.

Number of	Orders	Species
Fabaceae	21	68
Asteraceae	35	54
Poaceae	26	42
Brassicaceae	16	29
Caryophyllaceae	10	29
Apiaceae	17	26
Lamiaceae	12	23
Rosaceae	12	21
Boraginaceae	12	17
Ranunculaceae	7	10
Dipsacaceae	6	10

Taxonomic group	Number
Families	71
Genera	268
Species	510
Total number of species and lower taxa	>600

Floristically most important localities in the region

Following the survey of the entire steppe area and the flora analysis, six – floristically most important localities – were determined: Orlovo Brdo, Solena Reka, Solen Dol – Eneševo, Serta-Pepelište and Negotino village Krivolak, and Bogoslovec. The results are mentioned for each locality separately and are the basis for the proposal for the protection of flora and vegetation (habitat types).

1. ORLOVO BRDO

Endemic species: *Astragalus cernjavskii, Ferulago macedonica, Hedysarum macedonicum, Heptaptera macedonica, Onobrychis megalophylla, Potentilla tridentula, Salvia jurisicii, Tulipa mariannae.*

Halophytes: *Artemisia maritima, Camphorosma monspeliaca, Krascheninnikovia ceratoides.*

Steppe species: *Astragalus parnassi, Convolvulus holosericeus, Morina persica.*

Other rare species: *Anchusa macedonica, Astragalus gladiatus* var. *leucotrichus*, *Astragalus monspessulanus* var. *macedonicus*, *Brassica elongata* subsp. *integrifolia*, *Capparis sicula*, *Centaurea orphanidea*, *Galatella villosa*, *Galium rhodopeum*, *Genista sessilifolia,Clematis viticella, Malcolmia africana*, *Paeonia peregrina*, *Periploca graeca*, *Phlomis herba-venti* subsp. *pungens*, *Tremastelma palaestinum*.

2. SOLENA REKA

Endemic species: *Hedysarum macedonicum, Onobrychis megalophylla, Salvia jurisicii.*
Halophytes: *Artemisia maritima, Camphorosma monspeliaca, Krascheninnikovia ceratoides.*
Steppe species: *Astragalus parnassi, Convolvulus holosericeus, Morina persica.*
Other rare species: *Aegilops heldreichii*, *Astragalus sinaicus, Callistemma palaestinum* var. *lyratum, Capparis sicula*, *Centaurea orphanidea*, *Galium rhodopeum*, *Genista sessilifolia, Inula viscosa*, *Malcolmia africana*, *Nonea echioides, Onobrychis pindicola, Paeonia peregrina*, *Phlomis herba-venti* subsp. *pungens*, *Tremastelma palaestinum.*

3. SOLEN DOL-ENEŠEVO

Endemic species: *Hedysarum macedonicum, Onobrychis megalophylla, Potentilla tridentula.*
Halophytes: *Artemisia maritima, Camphorosma monspeliaca, Camphorosma annua, Krascheninnikovia ceratoides.*
Steppe species: *Astragalus parnassii, Convolvulus holosericeus, Morina persica.*
Other rare species: *Aegilops heldreichii*, *Asteriscus aquaticus*, *Astragalus gladiatus* var. *leucotrichus*, *Astragalus sinaicus, Callistemma palaestinum* var. *lyratum, Capparis sicula*, *Cardopatium corymbosum, Catapodium rigidum, Centaurea orphanidea, Cerastium pumillum, Echinophora sibthorpiana, Euphorbia aleppica, Galium rhodopeum, Galatella villosa*, *Genista sessilifolia,Goniolimon tataricum, Juncus acutus, Knautia degenii, Lagoecia cuminoides, Lepidium perfoliatum, Malcolmia africana, Nonea echioides, Onobrychis pindicola, Pallenis spinosa, Tremastelma palaestinum, Valerianella truncata.*

4. SERTA-PEPELIŠTE

Endemic species: *Astragalus cernjavskii, Ferulago macedonica, Hedysarum macedonicum, Onobrychis megalophylla, Potentilla tridentula.*
Halophytes: none
Steppe species: *Astragalus parnassi, Convolvulus holosericeus, Morina persica.*
Other rare species: *Alyssum pichleri*, *Brassica elongata* subsp. *integrifolia*, *Centaurea orphanidea*, *Genista sessilifolia, Paeonia peregrina*, *Onobrychis pindicola, Phlomis herba-venti* subsp. *pungens, Viola alba* subsp. *thessala.*

5. NEGOTINO-VILLAGE KRIVOLAK

Endemic species: *Ferulago macedonica, Hedysarum macedonicum, Onobrychis megalophylla, Potentilla tridentula, Tulipa mariannae.*
Halophytes: none

Steppe species: *Astragalus parnassi, Convolvulus holosericeus, Morina persica.*

Other rare species: *Anchusa macedonica, Astragalus sinaicus, Brassica elongata* subsp. *integrifolia*, *Capparis sicula*, *Chrozophola tinctoria, Clematis viticella, Crucianella latifolia, Genista sessilifolia, Glycyrhiza echinata, Malcolmia africana*, *Onobrychis pindicola, Phlomis herba-venti* subsp. *pungens, Salsola kali, Scorzonera lanata, Vicia hybrida.*

6. BOGOSLOVEC

Endemic species: *Hedysarum macedonicum, Onobrychis megalophylla, Salvia jurisicii.*

Halophytes: *Artemisia maritima*, *Camphorosma monspeliaca, Krascheninnikovia ceratoides.*

Steppe species: *Astragalus parnassi, Convolvulus holosericeus, Morina persica.*

Other rare species: *Alyssum hirsutum, Alyssum murale, Aegilops heldreichii*, *Anchusa macedonica, Astragalus gladiatus* var. *leucotrichus*, *Astragalus sinaicus, Brassica elongata* subsp. *integrifolia*, *Briza spicata, Bifora testiculata, Biserrula pelecinus, Buffonia tenuifolia, Centaurea orphanidea*, *Clematis viticella, Crocus pallasii, Echinophora sibthorpiana, Falcaria vulgaris, Fumaria vaillantii, Galium rhodopeum, Genista sessilifolia, Hesperis tristis, Malcolmia africana, Neotorturalia torulosa, Onobrychis pindicola, Opoponax hispidus, Paeonia peregrina*, *Phlomis herba-venti* subsp. *pungens, Prunus tenella, Potentilla suskalovicii, Rochelia disperma, Silene dichtoma, Stachys milanii, Viola jordanii.*

Legislation

The IUCN Red list of threatened plants (Walter & Gilet 1998) mentions two species found in the region: *Hedysarum macedonicum* and *Heptaptera macedonica*. On the list of the local Macedonian CORINE (Anon. 2003, 2004; Micevski 2000) species are 2 taxa: *Astragalus cernjavskii* and *Tulipa mariannae*.

Habitat types and vegetation

This chapter gives a presentation of the habitats and vegetation types recorded in this area. The recorded vegetation types were classified into a syntaxonomic system and habitat types in the EUNIS system. All types were classified also in the typology of Palearctic habitats (Devilliers & Devilliers-Terschuren, 1996). The sequence of habitat types follows the EUNIS system, namely A – marine habitats, B – coastal habitats, C – continental surface waters, D – mires, bogs and fens, E – grasslands, heaths and scrubs, G – forests, H – continental habitats without vegetation, I – regularly or recently cultivated agricultural habitats and J – constructed and artificial habitats.

Survey of habitat types

D – Mires, bogs and fens
- D5 – Sedge and reedbeds, normally without free-standing water
- D5.1 – Reed stands, normally without free-standing water
- D5.11 – Common reed stands, normally without free-standing water
- D5.111 – Reed stands in dried up fresh-water beds

E – Grasslands and lands dominated by tall herbs, mosses and lichens
- E1 – Dry grasslands
- E1.2 – Perennial calcareous grasslands and basic steppes
- E1.21 – Greek-Balkan steppes with Winter Savory (*Satureja montana*)
- E3 – Seasonally wet and wet grasslands
- E3.3 – Sub-Mediterranean humid meadows
- E3.31 – Helleno-Moesian riverine and humid meadows, dominated by various species of genus *Trifolium*
- E5 – Woodland fringes and clearings and tall forb stands
- E5.1 – Anthropogenic forb stands
- E6 – Inland salt steppes
- E6.2 – Continental inland salt steppes
- E6.21 – Pannonic salt steppes and saltmarshes
- E6.215 – Pelago-Vardarian salt steppes
- E6.2153 – Pelago-Vardarian salt valleys with *Camphorosma monspeliaca*

F – Heathland, scrub and tundra
- F3 – Temperate and Mediterranean-montane scrub
- F3.2 – Sub-Mediterranean deciduous scrub
- F3.29 – Moesian broom fields
- F6 – Garrigue
- F6.2 – Eastern garrigues
- F6.25 – Prickly juniper garrigues

G – Woodland, forest and other wooded land
- G1 – Broadleaved deciduous woodland
- G1.1 – Riverine and gallery forests with dominant alder, birch, poplar or willow

G1.11 – Riverine willow forests
G1.3 – Mediterranean riverine forests
G1.35 – Mediterranean riverine poplar forests
G1.356 – Poplar gallery forests in Macedonia
G1.7 – Thermophilous broadleaved deciduous forests
G1.7C – Mixed thermophilous forests
G1.7C2 – Oriental hornbeam forests
G1.7C22 – Helleno-Moesian oriental hornbeam forests
G1.76 – Balkan-Anatolian oak forests
G1.762 – Helleno-Moesian Hungarian oak forests
G3 – Coniferous woodland
G3.F – Plantations
G3.F1 – Native conifer plantations
G3.F12 – Native pine plantations

I – Regularly or recently cultivated agricultural, horticultural and domestic habitats

I1 – Arable land and market gardens
I1.5 – Cultivated, fallow or recently abandoned surfaces
I1.53 – Fallow uninundated fields with annual or perennial weed communities

Synsystematic survey

***Stellarietea mediae* Tx. Lohm. et Preising ex Rochow 1951**

Brometalia rubenti-tectorum (Rivas-Goday et Rivas-Martínez 1965) Rivas-Martínez et Izco 1977

Hordeion murini Br.-Bl. ex Br.-Bl. et al. 1936

Peganetum harmalae Matvejeva 1982 ex Matevski et al. ass. nova

Onopordo-Marrubietum peregrini Matvejeva 1982 ex Matevski et al. ass. nova

***Artemisietea vulgaris* Lohm., Preising et Tx. ex Rochow 1951**

Agropyretalia repentis Görs 1969

Inulo viscosae-Agropyrion repentis Biondi et Allegreza 1996

Salvio verbenacae-Avenetum barbatae Matevski et al. ass. nova.

***Puccinelio-Salicornietea* Topa 1939**

Puccinetalia Soó em. Vicherek 1973

Artemision maritimae Micevski 1970

Eurotietum ceratoides Micevski 1970

Artemisio-Camphorosmetum Micevski 1970

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

Phragmitetalia Koch 1926

Phragmition australis Koch 1926

Scirpo-Phragmitetum Koch 1926

***Molinio-Arrhenatheretea* Tx. 1937**
Trifolio-Hordeetalia Horvatić 1963
Trifolion resupinati Micevski 1957
Cynodon dactylon – [*Trifolion resupinati*] community
***Festuco-Brometea* Br.-Bl. et Tx. in Br.-Bl. 1949**
Astragalo-Potentilletalia Micevski 1970
Chrysopogon gryllus – [*Astragalo-Potentilletalia*] community
Saturejo-Thymion Micevski 1970
Brachypodio-Onobrychetum pindicolae Micevski 1971
Hedysaro-Convolvuletum Micevski 1970
Astragalo-Morinetum Micevski 1971
Festuca calleri-valesiaca [*Saturejo-Thymion*] community
***Salicetea purpuraea* Moor 1958**
Salicetalia purpureae Moor 1958
Salicion albae Soó 1930
Salicetum albae s. lat.
***Querco-Fagetea* Br.-Bl. et Vieger in Vlieger 1937**
Populetalia albae Br.-Bl. 1931
Populion albae Br.-Bl. et Tchou 1948
Populetum albae s. lat.
***Quercetea pubescentis* Doing-Kraft ex Scamoni et Passarge 1963**
Orno-Cotinetalia Jakucs 1961
Eryngio campestris-Paliurion spinae-christi (Jovanović 1985) Matevski et al. *all. nova*
Jasmini fruticantis-Paliuretum spinae-christi Matevski et al. ass. nova
Pruno tenellae-Syringion (Jovanović 1980) Čarni et al. 2009
Pistacio terebinthi-Juniperetum oxycedri Matevski et al. ass. nova
Quercetalia pubescenti-petraeae Klika 1933
Carpinion orientalis Horvat 1954
Quercus pubescens-Carpinus orientalis – [*Syringo-Carpinenion*] community
Quercion frainetto Horvat 1954
*Carpino orientalis-Quercetum frainetto (*Rizovski 1978) Matevski et al. ass. nova

Description of vegetation and habitat types

D Mires, bogs and fens
D5 Sedge and reedbeds, normally without free-standing water
D5.1 Phragmites beds, normally without free-standing water
D5.11 Phragmites australis beds, normally without free-standing water
D5.111 Dry freshwater *Phragmites* beds
(Palearctic habitat: 53.1121 Dry freshwater (*Phragmites*) beds)

Stands dominated by *Phragmites australis,* which has a palearctic distribution pattern, grow on sites that are not permanently inundated. They are found in river beds, marshes, on deposits along streams and other water bodies, on the banks of running waters and in other habitats that are influenced by freshwater streams.

Scirpo-Phragmitetum W. Koch 1926

These are species-poor stands consisting of common reed (*Phragmites australis*). Reed reproduces also vegetatively through sprouts on its rhizomes, thus forming thick stands of nutrient-rich sites. The stands occur in warmer parts of Europe (Balátová-Tulačková et al. 1993).

These stands are found also in the studied area on sites influenced by running water. The community occurs also on partly salinised sites, because *Phragmites australis* tolerates a certain amount of salt in the soil (is halotolerant).

Scirpo-Phragmitetum occurs on sites with oozing water.

Relévе 1: Krivolak, a wet site in front of the headquarters of the military training camp, along mown lawn, 41°32'42"N, 22° 07'03"E, altitude: 126 m; aspect S, inclination 5°, cover of vegetation (herb layer) 100 %, sample plot 25 m^2, date 1. 6. 2007.

Phragmites australis	5	*Sonchus arvensis*	+
Cirsium palustre	2	*Elaeagnus angustifolia*	+
Carex puncata	2	*Rubus discolor*	+
Pulicaria dysentherica	+		

E Grasslands and sites dominated by tall forb, mosses and lichens
E1 Dry grasslands
E1.2 Perennial calcareous grasslands and basic steppes
(Palearctic code: 34.31 subcontinental steppe grassland)

***Chrysopogon gryllus* – [*Astragalo-Potentilletalia*] community**

The community occurs on deeper soil than other dry steppe communities. It grows on gentle slopes and plateaus and forms closed stands**.** *Chrysopogon gryllus* grows on warm, dry and sunny sites in the (sub)Mediterranean region of Europe. In Southeastern Europe it is often found mixed with species of the genus *Festuca*, especially with *Festuca vallesiaca*, with which it forms many meadows and pastures in the hilly and montane regions. (Djurdjević et al. 2005)

Dense stand of the species *Chrysopogon gryllus*

A similar combination is found in the study area, as well as in the entire part of Southeastern Europe, with the only difference being that the community on the steppe region includes *Festuca callieri* as well as *Festuca valesiaca*.

After consideration, these habitats were classified only on the 3rd level of EUNIS classification. Another option is to classify these stands further into the category "Moesio-Carpathian feathergrass-fescue steppes" (E1.2221). This category comprises xerophilous grasslands which demonstrate Pontic-Pannonian distribution and are located at the foothills and lower parts of slopes, as well as on plateaus in the region of the eastern Carpathians, in the Balkans and in the continental part of the Dinarides. The habitats under consideration could, of course, also be joint to the other dry steppe habitats in the study area, i.e. to the Helleno-Balkan steppes with *Satureja montana* (E1.21). We could, however, also introduce a special category for such vegetation, so this problem requires further consideration.

Relevé 2: Orlovo Brdo, dry steppe (grassland) on deeper soil, 41°32'44"N, 22°08'19"E, aspect S, inclination 3°, stoniness 5 %, cover of vegetation (herb layer) 90 %, altitude 225 m, sample plot 25 m^2, date 25. 5. 2007.

Chrysopogon gryllus	4	*Erodium cicutarium*	+
Potentilla pedata	2	*Eryngium campestre*	+
Teucrium polium	2	*Ferulago macedonica*	+
Convolvulus cantabrica	1	*Festuca callieri*	+
Dasypyrum villosum	1	*Geranium dissectum*	+
Linum corymbulosum	1	*Helianthemum salicifolium*	+
Plantago lanceolata	1	*Herniaria incana*	+
Sanguisorba minor subsp. *muricata*	1	*Koeleria splendens*	+
Stipa pennata	1	*Leontodon crispus*	+
Aegilops cylindrica	+	*Linum nodiflorum*	+
Aegilops neglecta	+	*Medicago minima*	+
Agropyron cristatum	+	*Minuartia* sp.	+
Ajuga chamaepitys	+	*Muscari racemosum*	+
Althaea hirsuta	+	*Phlomis herba-venti* subsp. *pungens*	+
Alyssum corymobosoides	+	*Polygala monspeliaca*	+
Artemisia maritima	+	*Potentilla tridentula*	+
Asperula aristata	+	*Salvia horminum*	+
Astragalus monspessulanum	+	*Scabiosa sicula*	+
Avena barbata	+	*Sherardia arvensis*	+
Brachypodium distachyon	+	*Sideritis montana*	+
Bromus hordeaceus	+	*Stachys germanica*	+
Carthamus lanatus	+	*Thymus pseudoatticus*	+
Centaurea orphanidea	+	*Tremastelma palaestinum*	+
Crucianella graeca	+	*Trifolium angustifolium*	+

Crupina vulgaris	+	*Trifolium campestre*	+
Cynodon dacylon	+	*Xeranthemum annuum*	+
Dianthus gracilis	+		

Relevé 3: Orlovo Brdo, on the ridge, deeper soil, 41°32'45"N, 22°08'20"E, altitude 235 m, inclination 15°, aspect NE, stoniness 1 %, cover of vegetation (herb layer) 95 %, sample plot 25 m^2, date 29. 5. 2007.

Chrysopogon gryllus	4	*Helianthemum salicifolium*	+
Festuca callieri	3	*Herniaria incana*	+
Melica ciliata	2	*Hieracium bauchinii*	+
Eryngium campestre	1	*Hypericum rumeliacum*	+
Koeleria splendens	1	*Jurinea consanguinea* subsp. *arachnoidea*	+
Plantago lanceolata	1	*Leontodon crispus*	+
Potentilla pedata	1	*Linum corymbulosum*	+
Aegilops neglecta	+	*Linum nodiflorum*	+
Ajuga chamaepitys	+	*Medicago disciformis*	+
Arabis sagittata	+	*Medicago minima*	+
Asperula aristata subsp. *scabra*	+	*Muscari racemosum*	+
Astragalus spruneri	+	*Ononis reclinata*	+
Bromus cappadocicus	+	*Ornithogallum comosum*	+
Bupleurum trichopodum	+	*Potentilla tridentula*	+
Cerastium glomeratum	+	*Sanguisorba minor* subsp. *muricata*	+
Dianthus gracilis	+	*Stachys germanica*	+
Dichanthium ischaeumum	+	*Teucrium polium*	+
Echinops ritro	+	*Thymus pseudoatticus*	+
Erysimum diffusum	+	*Trifolium campestre*	+
Festuca vallesiaca	+	*Trifolium sylvaticum*	+
Galium rhodopeum	+	*Velezia rigida*	+
Geranium dissectum	+		
Hedysarum macedonicum	+		

The community is located also on: Orlovo Brdo 41°32'44"N, 22°08'18"E, altitude 220 m (6. 6. 2006).

E1.21 Greek-Balkan steppes with Winter Savory (*Satureja montana*)
(Palearctic code: 34.311 Helleno-balkanic savory steppes)

Perennial, steppe-like grasslands in the sub-Mediterranean and sub-Pannonian region in the *Quercion frainetto* and *Fagion moesicae* zones in the Balkans, from Greece to Serbia and west Bulgaria.

Synsystematically, this vegetation is classified into a special order *Astragalo-Potentilletalia*. The vegetation order is characterised by numerous species, such as *Astragalus onobrychis* var. *chlorocarpus, Festuca callieri, Erysimum diffusum, Hypericum rumeliacum, Potentilla pedata* and many others (Micevski 1970).

***Brachypodio-Onobrychetum pindicolae* Micevski 1971**

This is an endemic community which is unique to Macedonia and grows only on Paleogenic sea sediments. It grows exclusively on this bedrock. The community is

Onobrychis pindicola is a character species of the *Brachypodio-Onobrychetum pindicolae*, thriving on flat surfaces over shallow soil horizons.

species-rich, but also one of the poorest regarding the biomass, thus resembling similar communities on serpentinite. Soil on these sites is poorly developed and only a few centimetres thick: pH is between 7.6 and 8.35. The community is found on flat or gently sloping sites. It is distributed in the area reaching from Ovče Pole to Demir Kapija. (Micevski 1971)

Relevé 4: Karaodžali, on a saddle along the road, shallow soil, 41°35'19"N; 22°08'05"E, altitude 454 m, aspect WWS, inclination 3°, stoniness 0 %, cover of vegetation (herb layer) 95 %, sample plot 25 m^2, date 1. 6. 2007.

Brachypodium distachyon	4
Cynodon dactylon	2
Aegilops neglecta	1
Dorycnium herbaceum subsp. *macedonicum*	1
Fumana procumbens	1
Plantago lanceolata	1
Polygala major	1
Stachys recta	1
Teucrium polium	1
Teucrium chamaedrys	1
Thymus pseudoatticus	1
Tremastelma palaestinum	1
Veronica jacquinii	1
Achillea coarctata	+
Aegilops cylindrica	+
Agropyron cristatum	+
Asperula aristata	+
Astragalus spruneri	+
Carthamus lanatus	+
Centaurea finazzeri	+
Cerastium glomeratum	+
Chamaecytisus hirsutus	+
Coronilla varia	+
Chrysopogon gryllus	+
Crupina vulgaris	+
Dactylis glomerata	+
Eryngium campestre	+
Festuca callieri	+
Festuca vallesiaca	+
Galium verum	+
Genista lydia	+
Genista sessilifolia	+
Geranium dissectum	+
Hypericum rumeliacum	+
Hippocrepis ciliata	+
Juniperus oxycedrus	+
Koeleria splendens	+
Leontodon crispus	+
Linum hirsutum	+
Linum nodiflorum	+
Linum perenne	+
Lathyrus cicera	+
Medicago minima	+
Bombycilaena erecta	+
Muscari racemosum	+
Odontites glandulosa	+
Onobrychis pindicola	+
Onosma heterophylla	+
Orlaya daucorlaya	+
Poa bulbosa	+
Polygala monspeliaca	+
Potentilla laciniosa	+
Sanguisorba minor subsp. *muricata*	+
Scabiosa sicula	+
Scorzonera hispanica var. *latifolia*	+
Teucrium polium	+
Trifolium angustifolium	+
Trifolium scabrum	+
Trifolium sylvaticum	+
Thymelaea passerina	+
Verbascum sp.	+
Vinca herbacea	+
Ziziphora capitata	+

Relevé 5: Karaodžali, poorly devoped soil layer, between the scrubs dominated by *Juniperus oxycedrus*, 41°38'07"N, 22°07'34"E, altitude 630 m, cover of vegetation (herb layer) 90 %, stoniness 5 %, aspect E, inclination 15°, sample plot 25 m^2, date 7. 6. 2007.

Bromus cappadocicus	3	*Jurinea consanguinea* subsp. *arachnoidea*	+
Onobrychis pindicola	3	*Linum perenne*	+
Thymus pseudoatticus	3	*Medicago falcata*	+
Convolvulus holosericeus	1	*Medicago minima*	+
Dorycnium herbaceum subsp. *macedonicum*	1	*Bombycilaena erecta*	+
Festuca callieri	1	*Odontites glutinosa*	+
Fumana procumbens	1	*Onobrychis megalophylla*	+
Hippocrepis glauca	1	*Onosma heterophylla*	+
Linum tenuifolium	1	*Pyrus pyraster*	+
Acinos hungaricus	+	*Plantago lanceolata*	+
Asperula aristata	+	*Polygala rhodopaea*	+
Carex caryophyllea	+	*Potentilla tridentula*	+
Centaurea finazzeri	+	*Rhamnus rhodopea*	+
Dichanthium ischaeumum	+	*Sanguisorba minor* subsp. *muricata*	+
Echinops ritro	+	*Scabiosa triniifolia*	+
Eryngium campestre	+	*Scutellaria orientalis*	+
Genista sessilifolia	+	*Teucrium chamaedrys*	+
Hypericum rumeliacum	+	*Teucrium polium*	+
Iris sintenisii	+		

The community is located also on: Karaodžali 41°35'37"N, 22°07'59"E, 450 m.

Festuca callieri-valesiaca – [*Saturejo-Thymion*] community

The community occurs on sites with relatively high stoniness. It can be classified into the alliance *Saturejo-Potentilletalia*. Classification into a rank of association would require further analyses, so it is temporarily classified at the level of alliance, in accordance with the methodology proposed by Kopecký et al. (1992). The community occurs on shallow soil on northern aspects. After pasture has been discontinuated, these surfaces are overgrown by cade juniper (*Juniperus oxycedrus*). Further analyses are needed as the relevé indicates a transition between a more mesophilous community, where *Chrysopogon gryllus* dominates and the communities from the alliance *Saturejo-Thymion* (e.g. *Brachypodio-Onobrychetum*).

Relevé 6: Jusuf Koria, an overgrowing pasture on the northern aspect, 41°36'32"N, 22°08'06"E, aspect NNE, inclination 9°, cover of vegetation (herb layer) 70 %, stoniness 20 %, sample plot 25 m^2, altitude 400 m, date 1. 6. 2007.

The *Festuca callieri*-dominated communities need futher investigation in the wider area to define their ecological condition and Synsystematic position.

Festuca callieri	3
Fumana procumbens	2
Thymus pseudoatticus	2
Carex caryophyllea	1
Cynodon dactylon	1
Dorycnium herbaceum subsp. *macedonicum*	1
Festuca valesiaca	1
Juniperus oxycedrus	1
Prunella laciniata	1
Scutellaria orientalis	1
Acinos hungaricus	+
Asperula aristata	+
Berberis vulgaris	+
Chrysopogon gryllus	+
Convolvulus holosericeus	+
Eryngium campestre	+
Hieracium bauchinii	+
Hypericum rumeliacum	+
Hypochoeris radicata	+
Iris sintenisii	+
Lappula barbata	+
Leontodon crispus	+
Linum nodiflorum	+
Linum hirsutum	+
Melampyrum arvense	+
Odontites gladulosa	+
Onobrychis megalophylla	+
Ononis pusilla	+
Polygala major	+
Sangisorba minor subsp. *muricata*	+
Scabiosa triniifolia	+
Teucrium montanum	+
Teucrum chamaedrys	+
Thesium arvense	+
Trifolium campestre	+
Veronica jacquinii	+

***Hedysaro-Convolvuletum* Micevski 1970**

The community presents a transition from the dry to salt steppe, so its classification into the syntaxonomic system is not completely reliable.

Micevski (1970) was the first who pointed out the problem of classification. He classified the community *Hedysaro-Convolvuletum* among the salty soil communities of the alliance *Artemision maritimae* (apart from the community *Hedysaro-Convolvuletum,* the alliance *Artemision maritimae* comprises also the communities *Eurotietum ceratoides* and *Artemisio-Camphorosmetum*) and drew attention to the fact that, regarding its floristic inventory and composition, the association *Hedysaro-Convolvuletum* is more similar to the dry steppe vegetation of the order *Astragalo-Potentilletalia*. This community develops on partly salinised soil and comprises the elements of both salinised and non-salinised sites. Considering our analysis of the site conditions and the floristic inventory of the community we decided to classify the community *Hedysaro-Convolvuletum* into the group of dry steppe vegetation. Other associations occurring on salinised sites, where the elements from dry steppe are not (or are only rarely) found, are classified into the alliance of salt valleys *Artemision maritimae*, proposed by Micevski (1970).

Hedysaro-Convolvuletum is an endemic community which occurs only in the steppe region of Macedonia. The most beautiful stands occur in the central parts of the steppe region in the vicinity of the abandoned village of Eneševo, on the slopes of Orlovo Brdo and in the vicinity of the village of Delisinci. Fragments of this community are located in all the valleys of this region. pH in these stands is between 7.8 and 9.05. (Micevski 1970)

As already established by Micevski, this community comprises a mixture of plants from salinised sites as well as those from the dry steppe, which indicates the transitional character of the community. As we find that the species from the class of dry grasslands/steppe (*Festuco-Brometea*) prevail, we have decided to classify the community among dry steppe. We therefore separated the above-mentioned community from the others from the alliance of salt valleys *Artemision maritimae* which are found at the bottom of salt valleys and in which the species from dry steppe only sporadically occur.

Relevé 7: Orlovo Brdo, 41°32'38"N, 22°08'11"E, aspect SW, inclination 17°, cover of vegetation (herb layer) 40 %, stoniness 30 %, sample plot 25 m^2, altitude 148 m, date 26. 5. 2007.

Agropyron cristatum	3	*Echinops ritro*	1
Bromus cappadocicus	2	*Erynginum campestre*	1
Hedysarum macedonicum	2	*Linum corymbulosum*	1
Brachypodium distachyon	1	*Poa bulbosa*	1
Convolvulus holosericeus	1	*Potentilla tridentula*	1

Hedysaro macedonici-Convolvuletum holosericei is a typical halotolerant association on a sunny slope. In the beginning of June when *Hedysarum* flowers it offers a marvellous view.

Thymus pseudoatticus	1	*Centaurea orphanidea*	+
Aegilops neglecta	+	*Crupina vulgaris*	+
Allium flavum	+	*Dianthus gracilis*	+
Anthyllis vulneraria subsp. *spruneri*	+	*Galium divaricatum*	+
		Hippocrepis ciliata	+
Astragalus monspessulanus	+	*Jurinea consanguinea* subsp. *arachnoidea*	+
Astraglus parnassi	+		
Bombycilaena erecta	+	*Lappula barbata*	+
Bromus squarrosus	+	*Medicago minima*	+
Carduus thoemeri	+	*Medicago rigidula*	+

Muscari racemosum	+	*Thesium macedonicum*	+
Polygala monspeliaca	+	*Trinia glauca*	+
Sonchus arvensis	+	*Xeranthemum annuum*	+
Stipa pennata	+	*Ziziphora capitata*	+

Relevé 8: Orlovo Brdo, a wind-exposed site, stable bedrock, on a ridge, 41°32'40"N, 22°08'12"E, aspect SW, inclination 18°, cover of vegetation (herb layer) 50 %, stoniness 40 %, altitude 158 m, sample plot 25 m^2, date 29. 5. 2007.

Artemisia maritima	3	*Convolvulus holosericeus*	+
Stipa pennata	3	*Dianthus gracilis*	+
Festuca callieri	1	*Eryngium campestre*	+
Hedysarum macedonicum	1	*Ferulago macedonica*	+
Thymus pseudoatticus	1	*Jurinea consanguinea* subsp.	
Allium flavum	+	*arachnoidea*	+
Astragalus monspessulanus	+	*Kraschenninnikovia ceratoides*	+
Bombycilaena erecta	+	*Linum corymbulosum*	+
Brachypodium distachyon	+	*Poa bulbosa*	+
Bromus squarrosus	+	*Ziziphora capitata*	+

Relevé 9: Orlovo Brdo, an eroded southern slope, 41°33'04"N, 22°08'31"E, aspect S, inclination 50°, cover of vegetation (herb layer) 30 %, stoniness 50 %, sample plot 25 m^2, altitude 280 m, date 29. 5. 2007.

Artemisia maritima	2	*Chrysopogon gryllus*	+
Festuca callieri	1	*Convolvulus holosericeus*	+
Hedysarum macedonicum	1	*Euphorbia glabriflora*	+
Kraschenninnikovia ceratoides	+	*Ferulago macedonica*	+
Brassica elongata	+	*Stipa pennata*	+
Campanula lingulata	+	*Thymus pseudoatticus*	+

Relevé 10: Orlovo Brdo, an eroded northern slope, 41°33'04"N, 22°08'29"E, aspect NW, inclination 50°, cover of vegetation (herb layer) 70 %, stoniness 30 %, altitude 210 m, sample plot 25 m^2, date 29. 5. 2007.

Festuca callieri	3	*Bombycilaena erecta*	+
Artemisia maritima	2	*Brachypodium distachyon*	+
Hedysarum macedonicum	2	*Brassica elongata*	+
Stipa pennata	2	*Bromus squarrosus*	+
Ferulago macedonica	1	*Crupina vulgaris*	+
Linum corymbulosum	1	*Echinops ritro*	+

Festuca valesiaca	+	*Polygala monspeliaca*	+
Lappula barbata	+	*Scorzonera hispanica*	+
Leontodon crispus	+	*Trinia glauca*	+
Linum flavum	+	*Ziziphora capitata*	+

The community is located also in: Domuzlija 41°36'03"N, 22°07'01"E, 282 m (6. 6. 2007); eroded terrain in "zone 8" 41°36'08"N, 22°06'18"E, 209 m (6. 6. 2007); Orlovo Brdo 41°32'37"N, 22°08'11"E, 400 m (6. 6. 2006); between Negotino and the village of Krivolak, 41°30'43"N, 22°06'26"E, 131 m (6. 6. 2006).

Astragalo-Morinetum Micevski 1971

Similarly to *Brachypodio-Onobrychetum*, this community is also found on Paleogenic sediments. It develops on steep slopes, where the sites are intensely eroded. The soil is therefore covered with sand and small marl slates of different thickness. Among them is a small amount of the soil which develops through the decay of brittle marl layers. These warm up considerably during the summer, which makes the temperature in the valleys rise. The soil is carbonate-rich, which is understandable, considering that the geological bedrock is composed of sea sediments. Reaction is weakly alkaline (pH is between 7.5 and 8.2).

The association *Astragalo-Morinetum* develops only on steep, eroded slopes. The vegetation covers between 20 and 50 % of the surface, most often between 40 and 50 %. When the erosion is spreading, so is the community, as this increases the suitable surfaces for its colonization. (Micevski 1971)

The community occurs on eroded sites also in the study area. It can be in contact with the *Brachypodio-Onobrychetum* which develops on flat surfaces, while the *Astragalo-Morinetum* develops on steep, eroded slopes.

Relevé 11: village of Delisinci, towards Bregalnica, a steep slope above the road, eroded, 41°45'37"N, 21°59'37"E, aspect SWW, inclination 25°, cover of vegetation (herb layer) 60 %, stoniness 40 %, altitude 228 m, sample plot 25 m^2, date 30. 5. 2007.

Euphorbia glabriflora	3	*Thymus pseudoatticus*	1
Astragalus parnassi	2	*Aegilops neglecta*	+
Bromus cappadocicus	2	*Allium flavum*	+
Melica ciliata	2	*Asperula purpurea*	+
Morina persica	2	*Astragalus spruneri*	+
Scutellaria orientalis subsp. *pinnatifida*	2	*Brassica elongata* subsp. *integrifolia*	+
Echinops ritro	1	*Brachypodium distachyon*	+
Festuca callieri	1	*Bromus squarrosus*	+
Teucrium polium	1	*Centaurea orphanidea*	+

Crupina vulgaris	+	*Leontodon crispus*	+
Dichanthium ischaeumum	+	*Linum perenne*	+
Dianthus gracilis	+	*Medicago minima*	+
Eryngium campestre	+	*Pyrus pyraster*	+
Fumana procumbens	+	*Polygala rhodopea*	+
Galium rhodopeum	+	*Rhamnus rhodopea*	+
Hedysarum macedonicum	+	*Scabiosa rotata*	+
Hieracium bauchinii	+	*Scabiosa sicula*	+
Jurinea consanguinea subsp. *arachnoidea*	+	*Scabiosa triniifolia*	+
Lappula barbata	+	*Thymelaea passerina*	+
		Valerianella coronata	+

Astragalo-Morinetum is a dry steppe community, that develops on eroded slopes.

Comprehensive survey of dry steppe/grasslands on the Krivolak training ground
Dry steppe vegetation can be divided into 3 ecological groups:

1. Dry steppe dominated by *Chrysospogon gryllus*, which develop on deeper soil.
2. Dry steppe, which develop on slightly salinised soil and are classified into the association *Hedysaro-Convolvuletum* with different stages of degradation and transitions to the alliance of salt steppe vegetation of the *Artemision maritimae*.
3. Dry steppe on shallow soil, where the association *Brachypodio-Onobrychetum* develops on flat and gently sloping sites, while the association *Astragalo-Morinetum* develops on steep, eroded surfaces. In this group we can classify also the *Festuca callieri-vallesiaca* community.

E3 Seasonally wet and wet grasslands
E3.3 Sub-Mediterranean humid meadows
E3.31 Helleno-Moesian riverine and humid clover meadows
(Palearctic habitat: 37.61 Helleno-Moesian riverine and humid clover meadows)

Meso-hygrophilous grasslands on inundated areas along rivers and sites with a high water level in the southern part of the Balkans, especially in Bulgaria, Macedonia and northern Greece. Similar disjunct stands are found also in the coastal region of Croatia.

***Cynodon dactylon* – [*Trifolion resupinati*] community**

Mesophilous stands classified into the class *Molinio-Arrhenatheretea* can be found within the forest zone of the alliance *Carpinion orientalis*, but only on sites where water is available to plants during the dry period. The stands are located on river banks, along marshes etc., in places where groundwater level is close to the surface (Horvat et al. 1974).

In the research region such a stand was found in front of the headquarters of the Krivolak military camp, where the lawn is regularly watered and mown.

Relevé 12: Krivolak, in front of the polygon headquarters, a regularly tended lawn, 41°32'43"N, 22°07'08"E, aspect S, inclination 3°, cover of vegetation (herb layer) 100 %, stoniness 0 %, sample plot 25 m^2, altitude 143 m, date 1. 6. 2007.

Cynodon dactylon	4	*Salvia verbenaca*	1
Galium verum	2	*Scorzonera cana*	1
Plantago lanceolata	2	*Arenaria leptoclados*	+
Cichorium intybus	1	*Avena barbata*	+
Hypochoeris radicata	1	*Conyza canadensis*	+
Torilis nodosa	1	*Crepis foetida* subsp. *rhoeadifolia*	+

Echium italicum	+	*Rumex pulcher*	+
Geranium brutium	+	*Sherardia arvensis*	+
Geranium dissectum	+	*Sonchus arvensis*	+
Lens nigricans	+	*Tragopogon pratensis*	+
Lotus corniculatus	+	*Trifolium echinatum*	+
Medicago minima	+	*Ulmus minor*	+
Medicago praecox	+	*Veronica persica*	+
Potentilla reptans	+	*Vulpia ciliata*	+

Meadow vegetation is very rare in the region. On the photo we can see the *Cynodon dactylon* – [*Trifolion resupinati*] community that was found on an irrigated site in front of the headquarters building of the military training camp.

E5 Woodland fringes and clearings, tall forb stands

E5.1 Anthropogenic herb stands

(Palearctic habitat: code not available)

Herb stands which develop on abandoned urban or agricultural surfaces, on the transport system or on/along the areas used for dumping refuse.

***Salvio verbenacae-Avenetum barbatae* Matevski et al. ass. nova**

The community is classified into the class *Artemisietea*, which incorporates perennial ruderal communities. It is further classified into the order *Agropyretalia*, which incorporates anthropogenic tall herb stands on dry sites. Further classification is not definitive and further analysis is required to establish, whether the communities should

be classified into the alliance *Convolvulo arvensis-Agropyrion repentis*, which incorporates perennial stands on the loamy, carbonate-rich soil of Central and Southeastern Europe, or whether they should be included in the alliance *Inulo viscosae-Agropyrion repentis*, which incorporates similar stands in the sub-Mediterranean part of Italy, Southeastern Europe and the Balkans. Considering the number of thermophilous species in the stands, we decided to classify them into the sub-Mediterranean alliance. The species *Inula viscosa* was recorded in the study area.

The order *Agropyretalia* comprises species-poor semi-ruderal communities consisting of rhizome forming species, partly also other perennial herbs, whereas annual plants are relatively rare. These communities can be characterised also as pioneer, because they often develop in successional development of vegetation after cessation of cultivation. The species composition of this vegetation shows its transitional position between weed vegetation (*Stellarietea mediae*), dry grasslands (*Festuco-Brometea*) and mesophilous grasslands (*Molinio-Arrhenatheretea*). (Mucina 1993)

The relevé shows species composition mediating among abandoned meadow and dry pasture, maybe even as a ruderal stand, which corresponds also to the above definition of a vegetation stand.

Salvio verbenacae-Avenetum barbatae can be found on dry and ruderal places.

Relevé 13: Nomenclatural type of the association *Salvio-Avenetum*, *holotypus hoc loco:* Krivolak, central part of the military training camp, abandoned surface behind the warehouse, 41°32'43"N, 22°07'04"E, aspect S, inclination 5°, cover of vegetation (herb layer) 90 %, stoniness 0 %, altitude 146 m, sample plot 15 m², date 1. 6. 2007.

Avena barbata	3	*Marrubium peregrinum*	+
Cynodon dactylon	2	*Medicago minima*	+
Bromus sterilis	1	*Muscari racemosum*	+
Plantago lanceolata	1	*Paliurus spina-christi*	+
Salvia verbenaca	1	*Polygonum arenastrum*	+
Atriplex oblongifolia	+	*Portulaca oleracea*	+
Centaurea finazzeri	+	*Rumex pulcher*	+
Convolvulus arvensis	+	*Sanguisorba minor* subsp. *muricata*	+
Convolvulus cantabrica	+	*Scorzonera laciniata*	+
Geranum brutium	+	*Sonchus arvensis*	+
Herniaria incana	+	*Trifolium scabrum*	+
Leontodon hispidus	+	*Vicia villosa*	+
Malva sylvestris	+	*Vulpia ciliata*	+

E6 Inland salt steppes
E6.2 Continental inland salt steppes
E6.21P Pannonic salt steppes and saltmarshes
E6.215 Pelago-Vardarian salt steppes
E6.2153 Pelago-Vardarian salt valleys with *Camphorosma monspeliaca*
(Palearctic habitat: 15.A154 Pelagonian salt steppe)

Salt steppe formations dominated by *Camphorosma monspeliaca*, distributed mainly in Macedonia along the river Vardar.

Today, the halophytic vegetation is the remnant of former vegetation which used to be widely distributed in Macedonia and was floristically considerably richer at the end of the Tertiary than it is today. Because of the climate change and pedogenetic processes, two halophytic vegetation "oases" have been preserved in Macedonia: Ovče Pole and the steppe region.s

Comparison of the floristic composition of both regions demonstrates considerable differences, although the regions are geographically relatively close. The most common plant species on salt surfaces on Ovče Pole is *Pucinellia convoluta*, but the following are also found: *Suaeda maritima, Camphorosma annua, Lepturus pannonicus, Plantago tenuifolia, Crypsis aculeata, Crypsis schoenoides* and other species that are not found in the steppe region at all. The reason for such differences are the physical and chemical soil properties, as well as the difference in the development of the vegetation in both regions. Halophytic vegetation on Ovče Pole grows on typically

developed soil salisols (solončak), while the communities in the steppe region grow on undeveloped soil (sandstones or marls which have disintegrated into small particles). (Micevski 1965, 1971)

Eurotietum ceratoides Micevski 1970

Stands classified into this association occur on salinised and eroded soil; therefore they are found mostly on slopes and other eroded sites.

Eurotia ceratoides is the synonym for *Krascheninnikovia ceratoides,* but in accordance with the Code of Phytosociological Nomenclature, the original name is preserved in the name of the community.

View of the salt steppe, on flat surfaces there appear the *Artemisio-Camphorosmetum monspeliacae* (front), and the *Eurotietum ceratoides* can be found on eroded slopes (back).

Relevé 14: Solen Dol, artillery range, eroded, salinised site on a slope, 41°34'25"N, 22°01'20"E, aspect E, inclination 30°, cover of vegetation (herb layer) 50 %, stoniness 0 %, sample plot 25 m^2, altitude 150 m, date 5. 6. 2007.

Kraschenninnikovia ceratoides	3	*Eryngium campestre*	+
Festuca callieri	2	*Hieracium bauchinii*	+
Melica ciliata	2	*Lappula barbata*	+
Artemisia maritima	1	*Leontodon hispidus*	+
Hedysarum macedonicum	1	*Linum corymbulosum*	+
Agropyron cristatum	+	*Medicago minima*	+
Bombycilaena erecta	+	*Onobrychis pindicola*	+
Brassica elongata	+	*Polygala monspeliaca*	+
Bromus squarrosus	+	*Potentilla tridentula*	+
Campanula lingulata	+	*Prunus spinosa*	+
Camphorosma monspeliaca	+	*Sanguisorba minor* subsp.	
Carduus thoemeri	+	*muricata*	+
Centaurea orphanidea	+	*Xeranthemum annuum*	+
Cichorium intybus	+		

***Artemisio-Camphorosmetum* Micevski 1970**

The community is found on gently sloping or flat sites at the bottom of salt valleys. Micevski (1970) is of the opinion that the subspecies *Artemisia maritima* subsp. *monogyna*, which used to be much more widely distributed, occurs on the sites.

Relevé 15: Solen dol, flat terrain, 41°34'26"N, 22°01'21"E, aspect SE, inclination 2°, cover of vegetation (herb layer) 60 %, stoniness 0 %, sample plot 25 m^2, altitude 157 m, 5. 6. 2007.

Artemisia maritima	3	*Hippocrepis ciliata*	+
Agropyron cristatum	2	*Lappula barbata*	+
Hedysarum macedonicum	1	*Linum nodiflorum*	+
Thymus pseudoatticus	1	*Linum perenne*	+
Aegilops neglecta	+	*Medicago minima*	+
Astragalus hamosus	+	*Onobrychis alba*	+
Brassica elongata	+	*Plantago lanceolata*	+
Camphorosma monspeliaca	+	*Polygala monspeliaca*	+
Carthamus lanatus	+	*Sanguisorba minor* subsp.	
Centaurea orphanidea	+	*muricata*	+
Cichorium intybus	+	*Scabiosa sicula*	+
Convolvulus holosericeus	+		
Echinops ritro	+		
Eryngium campestre	+		

The *Artemisio-Camphorosmetum monspeliacae* have built extensive communities on salty soils and flat surfaces.

Relevé 16: Solen dol, flat terrain, fine sediment, 41°34'33"N, 22°01'21"E, aspect SE, inclination 1°, cover of vegetation (herb layer) 70 %, stoniness 0 %, altitude 148 m, sample plot 25 m^2, date 5. 6. 2007.

Camphorosma monspeliaca	4	*Brachypodium distachyon*	+
Poa bulbosa	2	*Centaurea orphanidea*	+
Plantago coronopus	1	*Plantago lagopus*	+
Agropyron cristatum	+	*Scorzonera cana*	+
Artemisia maritima	+	*Trigonella monspeliaca*	+
Bombycilaena erecta	+		

F Heathland, scrub and tundra
F3 Temperate and Mediterranean-montane scrub
F3.2 Sub-Mediterranean broadleaved deciduous scrubs
F3.29 Moesian broom fields
(Palearctic habitat: 31.8B33 moesian Christ's thorn brush)

Scrub formations in the hilly region of the Balkan peninsula. They occur in the transition area between the Central-European and Mediterranean climate.

***Jasmini fruticantis-Paliuretum spinae-christi* Matevski et al. ass. nova**

Paliurus spina-christi grows on various, most commonly warm and dry sites up to 600 m a.s.l. It often forms thick monodominant stands, so that other plant species on these sites can only with difficulty assert themselves. The formation could be classified among the so called "šibljak", which are a typical formation for the Balkans. Adamović (1901) already defined it as a scrub formation in the Mediterranean and its margins, formed by one or more – often different – broadleaved deciduous scrub species. Šibljaks are supposed to be the primary vegetation of some parts of the Balkan peninsula which spread into larger surfaces after deforestation (Diklić & Vukićević 1997).

The stands in the study area develop mainly on deeper soil on former fields, where dense and practically impassable *Paliurus spina-christi*- stands have developed.

Similar association have been described as *Euphorbio-Paliuretum spinae-christi* and *Botriochloo-Paliuretum spinae-christi* in Serbia (Jovanović 1997, Kojić et al. 1998), but the community under consideration thrives in the area under influence of the submediterranean climate indicated by appearance of its diagnostic species, such as *Jasminum fruticans, Phillyrea latifolia* etc.

***Eryngio campestris-Paliurion spinae-christi* (Jovanović 1985) Matevski et al. all. nova**

At the same time it should be considered that the alliance *Paliurion moesiacum* is not described according to the International Code of Phytosociological Nomenclature (Art. 10), so we propose the name *Eryngio campestris-Paliurion spinae-christi* (Jovanović 1985) Matevski et al. *all. nova*, and we indicate the nomenclatural type, *holotypus hoc loco: Euphorbio-Paliuretum* Bogojević 1969 (Bogojević 1969).

This alliance includes the continental, deciduous communities, characterisied by the dominance of *Paliurus spina-christi* and differentiated from the geovicariant alliance *Rhamno-Paliurion* appearing in the submediterranean region (Trinajstić 1996) by species indicating drier habitats of the *Eryngio-Paliurion*, such as *Eryngium campestre*, *Xerantemum annuum*, etc. (Trinajstić 1996, Jovanović 1997).

Dense stand of the *Jasmino-Paliuretum spinae-christi*. This association offers shelter for an endemic species *Salvia jurisicii* and therefore a special geographical race can be described var. geogr. *Salvia jurisicii* var. geogr. nova (*holotypus hoc loco*: relevé 17).

Relevé 17: Nomenclatural type of the association *Jasmio-Paliuretum spinae-christi*, *holotypus hoc loco*: Orlovo Brdo, the bottom of a wide gorge, along the road, 41°32'48"N, 22°08'20"E, aspect NE, inclination 5°, total cover 100 %, shrub layer 80 %, herb layer 60 %, stoniness 0 %, sample plot 25 m^2, altitude 216 m, date 29. 5. 2007.

Shrub layer	
Paliurus spina-christi	5
Jasminum fruticans	2
Juniperus oxycedrus	+
Phillyrea latifolia	+
Herb layer	
Inula oculus-christi	2
Salvia jurisicii	2
Brachypodium distachyon	1
Cuscuta epithymum	1
Aegilops neglecta	+
Agropyron repens	+
Arabis sagittata	+
Asparagus acutifolius	+
Avena barbata	+
Bromus squarrosus	+
Bromus sterilis	+
Convolvulus cantabrica	+
Crepis zacyntha	+
Crupina vulgaris	+
Eryngium campestre	+
Galium album	+
Geranium dissectum	+
Hypericum perforatum	+
Hypericum rumeliacum	+
Lappula barbata	+
Lathyrus cicera	+
Linum corymbulosum	+
Linum nodiflorum	+
Medicago disciformis var. *strumensis*	+
Medicago minima	+
Melica ciliata	+
Muscari racemosum	+
Phleum tenue	+
Phlomis herba-venti subsp. *pungens*	+
Plantago lanceolata	+
Polygala major	+
Potentilla pedata	+
Potentilla tridentula	+
Prunella laciniata	+
Sanguisorba minor subsp. *muricata*	+
Scorzonera hispanica	+
Stipa pennata	+
Trifolium angustifolium	+
Trifolium echinatum	+
Vicia angustifolia	+
Xeranthemum annuum	+

The community is located also on: Jusuf Korija, 41°36'02"N, 22°06'47"E, 199 m, *Salvia jurisicii* was also found in the stand (6. 6. 2007).

F6 Garrigues
F6.2 Eastern garrigues
F6.25 Eastern (*Juniperus oxycedrus*) garrigues
(Palearctic habitat: 32.55 Eastern prostratae juniper garrigues)

Garrigues in the eastern-Ionic, Aegean and eastern-Mediterranean coast and inland, dominated by shrubby junipers (*Juniperus oxycedrus, J. communis* and *J. phoenicea*).

***Pistacio terebinthi-Juniperetum oxycedri* Matevski et al. ass. nova**

The association into which the studied *Juniperus oxycedrus* community could be classified has not been described so far. Associations dominated by cade juniper (*Juniperus oxycedrus*) were described on serpentinites in Serbia and Kosovo (*Juniperetum oxycedri serpentinicum* Jovanović 1980 and *Aster albanici-Juniperetum oxycedri* Rexhepi 1990) (Rexhepi 1992, Sarić 1997) and in Greece on carbonate bedrock, where pseudomacchia *Quercus coccifera-Juniperus oxycedrus* (Bergmeier 1990) occurs. However, the stands occurring in the steppe region cannot be classified into any of the previously described associations. Neither can the community be classified into any of the associations described on serpentinites in Serbia and Kosovo (with many serpentinophilous species), nor into the association with a large number of (eu)Mediterranean elements, which was described in the vicinity of Mt. Olympus (Bergmeier 1990). Ecologically, the community belongs to the alliance of scrub vegetation in the canyons of Southeastern Europe, into which it was also synsystematically classified.

Within the study area, these stands occur as stages of reforestation of dry grasslands. There are *Paliurus spina-christi* stands on deeper soil on former fields, and *Juniperus oxycedrus* stands on more shallow soils on former pastures.

Relevé 18: Orlovo Brdo, in a gorge, 41°32'38"N, 22°08'12"E, aspect SSW, inclination 28°, cover of vegetation by layers: total 80 %, shrub 70 %, herb 20 %; stoniness 30 %, altitude 153 m, sample plot 25 m^2, date 29. 5. 2007.

Shrub layer	
Juniperus oxycedrus	3
Phillyrea latifolia	3
Coronilla emeroides	2
Pistacia terebinthus	1
Paliurus spina-christi	+
Herb layer	
Stipa pennata	2
Teucrium polium	2
Krascheninnikovia ceratoides	1
Agropyron cristatum	+
Campanula lingulata	+
Carex caryophyllea	+
Chrysopogon gryllus	+
Convolvulus holosericeus	+
Echinops ritro	+
Eryngium campestre	+
Hedysarum macedonicum	+
Juniperus oxycedrus	+
Lappula barbata	+
Phillyrea latifolia	+
Potentilla tridentula	+
Thymus pseudoatticus	+

Pistacio-Juniperetum oxycedri occurs as a stage of reforestation on shallow soils; on deeper soils there appear *Jasmino-Paliuretum*.

Relevé 19: Nomenclatural type of the association *Pistacio terebinthi-Juniperetum oxycedri, holotypus hoc loco*: Orlovo Brdo, an overgrowing pasture, 41°33'07"N, 22°08'39"E, aspect SE, inclination 11°, cover by layers: shrub 90 %, herb 20 %, total 95 %, stoniness 5 %, altitude 290 m, sample plot 25 m^2, date 29. 5. 2007.

Shrub layer			
Juniperus oxycedrus	5	*Campanula lingulata*	+
Phillyrea latifolia	3	*Centaurea finazzeri*	+
Pistacia terebinthus	2	*Galium album*	+
Paliurus spina-christi	1	*Hedysarum macedonicum*	+
Jasminum fruticans	+	*Jurinea consanguinea* subsp. *arachnoidea*	+
Herb layer		*Lonicera etrusca*	+
Teucrium chamaedrys	1	*Melica ciliata*	+
Carex caryophyllea	1	*Phyllirea latifolia*	+
Asparagus acutifolius	+	*Salvia jurisicii*	+

G Woodland, forest habitats and other wooded land
G1 Broadleaved deciduous woodland
G1.1 Riverine and gallery forests, dominated by alder, birch, poplar or willow
G1.11 Riverine willow forests
(44.13 Middle European white willow forest)

Periodically inundated willow forests or shrubs above the running water level. They develop on fresh alluvial deposits.

In the steppe area there are only two rivers, the Bregalnica and the Vardar river, forming the western boundary of the research area where riparian forests can be found.

***Salicetum albae* s. lat.**

This white willow community occurs on small surfaces along streams, where it develops under the direct influence of the stream, right above its mean water level, so it is frequently inundated. The soil is undeveloped, without clear soil horizons. Despite the considerable amount of litter and debris there is little humus, because it is covered by new riverine sediments every year.

The community *Salicetum albae* grows on the bank of the river Vardar.

Relevé 20: along the Vardar, 41°32'29"N, 22°05'45"E, cover by layers: tree layer 100 %, shrub layer 5 %, herb layer 100 %, sample plot 200 m^2, inclination 0°, altitude 119 m, date 4. 6. 2007.

Tree layer		*Crepis paludosa*	+
Salix alba	5	*Erigeron annuus*	+
		Galium aparine	+
Shrub layer		*Lactuca serriola*	+
Humulus lupulus	+	*Lolium perenne*	+
Ulmus minor	+	*Lycopus europaeus*	+
Morus alba	+	*Morus alba*	+
Acer negundo	+	*Myosotis palustris*	+
		Phalaris arundinacea	+
Herb layer		*Plantago major*	+
Poa palustris	3	*Polygonum hydropiper*	+
Urtica dioica	2	*Ranunculus repens*	+
Poa trivialis	1	*Robinia pseudaccacia*	+
Aethusa cynapium	+	*Rorippa sylvestris*	+
Artemisia vulgaris	+	*Rumex obtusifolius*	+
Bidens tripartita	+	*Solanum dulcamara*	+
Bromus hordeaceus	+	*Stellaria media*	+
Bryonia alba	+	*Taraxacum officinale*	+
Chenopodium polyspermum	+	*Tordylium maximum*	+
Cirsium lanceolatum	+	*Torilis japonica*	+
Conyza canadensis	+	*Ulmus minor*	+

G1.3 Mediterranean riverine woodland
G1.35 Mediterranean riverine poplar forests
G1.356 Poplar gallery forests in Macedonia
(Palearctic habitat: 44.615 East Mediterranean poplar galleries)

Poplar forests which develop along rivers in Macedonia.

***Populetum albae* s. lat.**

The community occurs on the river banks above the sites of the site willow community (*Salicetum albae*). Compared to the *Platanus*-stands (*Platanus orientalis*), the water on these sites does not oscillate as much, so the water stays close to the surface even in the summer. Similar stands were described in the south of France and are incorporated into the alliance of white poplar riverine forests (*Populion albae*). (Horvat et al. 1974)

Like willow communities, the white poplar community is located only on the edge of the steppe region along the river Vardar. Immediately along the river there is a narrow belt formed by white willows, while a white poplar community grows on an alluvial terrace.

These communities were described as association *Populetum albae balcanicum* Karpati 1962, but futher consideration will be needed to determine whether the description on association level is floristically founded, or whether it would be better to distinguish the communities only as a geographical race.

Populetum albae occurs on the bank of the river Vardar above the belt formed by *Salix alba.*

Relevé 21: slightly higher on a slope, 41°32'31"N, 22°05'48"E, inclination 0°, cover of vegetation: total 100 %, tree layer 80 %, shrub layer 20 %, herb layer 100 %, altitude 136 m, sample plot 200 m^2, date 4. 6. 2007.

Tree layer		*Arum maculatum*	+
Populus alba	5	*Asparagus tenuifolius*	+
		Ballota nigra	+
Shrub layer		*Bromus sterilis*	+
Ulmus minor	2	*Calystegia sepium*	+
Populus alba	1	*Cirsium lanceolatum*	+
Rubus sanguineus	1	*Dactylis glomerata*	+
Juglans regia	+	*Dactylorhiza* sp.	+
Prunus spinosa	+	*Lactuca serriola*	+
Rosa sp.	+	*Poa pratensis*	+
		Populus × *nigra*	+
Herb layer		*Rumex crispus*	+
Poa trivialis	3	*Rumex obtusifolius*	+
Galium aparine	1	*Solanum dulcamara*	+
Phragmites australis	1	*Taraxacum officinale*	+
Tamus communis	1	*Torilis japonica*	+
Vinca major	1	*Tragopogon pratensis*	+
Aethusa cynapium	+	*Vicia sativa* subsp. *nigra*	+

G1.7 Thermophilous deciduous woodland
G1.7C Mixed thermophilous woodland
G1.7C2 Oriental hornbeam forests
G1.7C22 Helleno-Moesian oriental hornbeam woods
(Palearctic habitat: Helleno-pelagonide oriental hornbeam forest)

Oriental hornbeam forests (*Carpinus orientalis*) on the Balkan peninsula, spreading southwards to Greece.

***Quercus pubescens-Carpinus orientalis* – [*Syringo-Carpinenion*] community**

This is a climazonal community of the sub-Mediterranean region, reaching up to 600 m a.s.l. The community is floristically rich and is characterised by tree species, such as pubescent oak (*Quercus pubescens*), cerris *(Q. cerris*) and oriental hornbeam (*Carpinus orientalis*). Because of the anthropogenic influences, the community is often degraded and frequently develops in scrub formations (Jovanović et al. 1986). In the steppe region the community is fragmentarily developed, but is gradually expanding on account of cessation of traditional management (abandoned Turkish villages, military training ground).

Querco-Carpinetum orientalis is climazonal vegetation of the area, often degraded because of the human impact.

These communities have been studied in Macedonia by Rizovski (1978) and are similar to those found in northern Greece (Oberdorfer 1947, Bergmeier 1990, Amanatidou 2005). The community was formerly known under the name *Querco-Carpinetum orientalis macedonicum* (Horvat 1954). Poldini (1988) separated the thermophilous deciduous forest vegetation in the southern Balkan into a separate suballiance *Syringo-Carpinienion* Jakucs 1959.

Relevé 22: Jusuf Koria, on the northern border of the polygon, a thin forest up to 5 m high, 41°38'32"N, 22°07'20"E, cover by layers: total 100 %, tree 20 %, shrub 100 %, herb 20 %, moss 0 %, total 100 %, aspect NE, inclination 20°, sample plot 250 m^2, altitude 663 m, date 1. 6. 2007.

Tree layer		*Acer monspessulanum*	+
Quercus pubescens	2	*Arabis turrita*	+
Carpinus orientalis	+	*Carpinus orientalis*	+
		Chamaecytisus hirsutus	+
Shrub layer		*Dactylis glomerata*	+
Carpinus orientalis	4	*Euonymus verrucosa*	+
Acer monspessulanum	2	*Festuca valesiaca*	+
Coronilla emeroides	2	*Galium album*	+
Euonymus verrucosa	+	*Galium verum*	+
Fraxinus ornus	+	*Helianthemum nummularium*	+
Juniperus oxycedrus	+	*Hypericum rumeliacum*	+
Lonicera etrusca	+	*Koeleria pyramidata*	+
		Lonicera etrusca	+
Herb layer		*Orchis purpurea*	+
Carex umbrosa	1	*Thymus thracicus* subsp. *stribrnyi*	+
Coronilla emeroides	1	*Viola hirta*	+
Teucrium chamaedrys	1		

Relevé 23: Serta, eastern part of the military training camp, Paleogenic marl, 41°33'03"N, 22°10'13"E, aspect NW, inclination 30°, cover of vegetation: total 100 %, tree 60 %, shrub layer 60 %, herb layer 10 %, height of the tree layer 4 m, sample plot 300 m^2, altitude 236 m, date 7. 7. 2006.

Tree layer		*Pistacia terebinthus*	+
Quercus pubescens	4	*Rhamnus rhodopea*	+
Fraxinus ornus	2		
Carpinus orientalis	1		
		Herb layer	
Shrub layer		*Aster amellus*	1
Juniperus oxycedrus	3	*Dictamnus albus*	1
Quercus pubescens	2	*Achillea tanacetifolia*	+
Coronilla emeroides	1	*Anemone nemorosa*	+
Fraxinus ornus	1	*Asparagus acutifolius*	+
Phillyrea latifolia	1	*Carex umbrosa*	+
Berberis vulgaris	+	*Coronilla scorpioides*	+
Cotinus coggygria	+	*Dorycnium herbaceum* var. *macedonicum*	+
Paliurus spina-christi	+		

Eryngium campestre	+	*Melampyrum pratense*	+
Fragaria vesca	+	*Polygala major*	+
Galium album	+	*Scabiosa sp.*	+
Genista sessilifolia	+	*Stachys recta* subsp. *subcrenata*	+
Helianthemum nummularium	+	*Teucrium chamaedrys*	+
Hieracium bauchinii	+	*Thymus tosevii*	+
Hypericum rumeliacum	+	*Hedysarum macedonicum*	r

The community is found also on the locality: Jusuf Korija 41°36'06"N, 22°07'09"E, 326 m (6. 6. 2007).

G1.76 Balkano-Anatolian thermophilous (*Quercus*) forests
G1.762 Helleno-Moesian *Quercus frainetto* forests
(Palearctic habitat: 71.762 Helleno-Moesian *Quercus frainetto* forest)

Helleno-Moesian *Quercus frainetto* forests.

***Carpino orientalis-Quercetum frainetto* (Rizovski 1978)**
Matevski et al. ass. nova

Within the oriental hornbeam zone (*Carpinus orientalis*), stands of Italian oak (*Quercus frainetto*) appear as well. They are frequently found on northeastern aspects on sites with deeper soil. When regressive succession takes place, the floristic composition of the *Quercus frainetto* forests gradually becomes similar to zonal oriental hornbeam forests, and Italian oak disappears as well in the end, thus allowing the forests to change into oriental hornbeam forests. In progressive succession during reforestation of fields, however, the first to colonize the area are either *Juniperus oxycedrus* or *Paliurus spina-christi*. Although these two scrub species are not economically relevant, they have a perfect regenerative ability and enable the successional development of oriental hornbeam forests (*Carpinus orientalis*), and in the end also of Italian oak (*Quercus frainetto*) forests. (Rizovski 1978)

Italian oak stands are located also in the steppe region, extrazonally on colder aspects with more favourable microclimatic conditions for their growth, as Italian oak forms climazonal vegetation above 600 m a.s.l.

The association was not described (Rizovski 1978) according to the Code of International Phytosociological Nomenclature (Art. 1), so we propose a new azonal association dominated by *Quercus frainetto* as *Carpino orientalis-Quercetum frainetto* ass. nova.

Carpino-Quercetum frainetto occurs only extrazonally while it appears zonally above the altitude of 600 m.

Relevé 24: Nomenclatural type of the association *Carpino-Quercetum frainetto*, *holotypus hoc loco*: Jusuf Koria, a slightly higher and more developed forest, 5 m tall, 41°36'33"N, 22°08'05"E, cover of vegetation: total 100 %, tree layer 70 %, shrub layer 70 %, herb layer 30 %, moss layer 0 %, aspect NNE, inclination 10°, stoniness 0 %, sample plot 250 m^2, altitude 424 m, date 1. 6. 2007.

Tree layer		*Buglossoides purpurocaerulea*	+
Quercus frainetto	3	*Carex umbrosa*	+
Fraxinus ornus	1	*Dactylis glomerata*	+
		Fraxinus ornus	+
Shrub layer		*Galium album*	+
Quercus frainetto	2	*Genista lydia*	+
Acer monspessulanum	1	*Haplophyllum suaveolens*	+
Fraxinus ornus	1	*Hypericum rumeliacum*	+
Carpinus orientalis	+	*Iris sintenisii*	+
Coronilla emeroides	+	*Melampyrum arvense*	+
Juniperus oxycedrus	+	*Platanthera bifolia*	+
		Prunus spinosa	+
Herb layer		*Rosa arvenis*	+
Chamaecytisus hirsutus	1	*Sorbus torminalis*	+
Coronilla emeroides	1	*Stachys scardica*	+
Rosa gallica	1	*Teucrium chamaedrys*	+
Tanacetum corymbosum	1	*Viola hirta*	+
Asparagus acutifolius	+	*Viola* sp.	+
Brachypodium sylvaticum	+		

G3 Coniferous woodland
G3.F Plantations
G3.F1 Native conifer plantation
G3.F12 Native pine plantations
(Palearctic habitat: 83.3112 native pine plantation)

Pine plantations native to the Palearctic region, but planted outside their natural distribution area.

Pinus nigra plantations

In the past some surfaces were planted with species that are not native to the region, e. g. *Pinus nigra*. These plantations are only sporadic in the region.

One of the plantations on the military training camp is located behind the warehouse, 41°32'43"N, 22°07'07"E, altitude 140 m.

I Regularly or recently cultivated agricultural, horticultural and domestic habitats
I1 Arable land and market gardens
I1.5 Cultivated, fallow or recently abandoned arable land
I1.53 Fallow uninundated fields with annual and perennial weed communities
(Palearctic habitat: 8 Agricultural land and artificial landscapes)

***Peganetum harmalae* Matvejeva 1982 ex Matevski et al. ass. nova**

The occurrence of this community in Macedonia is connected exclusively with the bedrock. It is found only on Paleogenic and Neogenic sea sediments. The stands of this association occur on moderately rich sites, along paths and uncultivated fields, as well as in settlements. The community can spread to large surfaces (Matvejeva 1982). *Peganum harmala* is an interesting plant, classified into the Irano-Turanian floral element. Its origin can be traced in the deserts, semi-deserts and steppes of the west Asia, from north India to the Mediterranean. The plant is one of the oldest medicinal herbs that used to be used as a drug. It contains harmaline, which is a sedative, antidepressant, aphrodisiac and in larger quantities also a hallucinogenic substance.

On the border of the steppe region the community is widely distributed on the flatland along the Vardar river.

The association was not described according to the Code of Phytosociological Nomenclature (Weber et al. 2000) (Art. 3o, Art. 5). So we designated the nomenclatural type, *lectotypus hoc loco*: Matvejeva (1982) in Tab. 7 relevé 2. The tables in Matvejeva (1982) are not complete, but nevertheless there are some relevés where the number of species indicated in the header matches with the number of species in the table itself.

Relevé 25: Džidimirci, along the road, a ruderal site on the flatland along the river Vardar, 41°33'04"N, 22°03'37"E, aspect S, inclination 2°, cover of vegetation (herb layer) 80 %, altitude 252 m, sample plot 25 m^2, date 5. 6. 2007.

Peganum harmala	4	*Geranium molle*	+
Tribulus terrestris	2	*Malva neglecta*	+
Chenopodium album	1	*Marrubium peregrinum*	+
Erodium ciconium	1	*Melilotus* sp.	+
Hordeum leporinum	1	*Portulaca oleracea*	+
Rumex pulcher	1	*Scorzonera laciniata*	+
Aegilops neglecta	+	*Silybum marianum*	+
Cirsium vulgare	+	*Trifolium subterraneum*	+
Echinochloa crus-galli	+		

Peganum harmala is a common weed originating from the Near East. It appears in the fields along the Vardar river.

***Onopordo-Marrubietum peregrini* Matvejeva 1982 ex Matevski et al. ass. nova**

A moderately nitrophilous community located on road verges, pastures and abandoned agricultural surfaces, distributed also in villages, more rarely even on the outskirts of the town (Matvejeva 1982).

In the steppe region the community is distributed on ruderal sites on the entire area, but does not form as large, closed stands as the *Peganetum*.

The association was not described according to the Code of Phytosociological Nomenclature (Weber et al. 2000) (Art. 3o, Art. 5). So we designated a nomenclatural type, *lectotypus hoc loco*: Matvejeva (1982): in Tab. 6 relevé 15. The tables in Matvejeva (1982) are not complete, but nevertheless there are some relevés where the number of species indicated in the header matches with the number of species in the table itself.

Relevé 26: Karaodžali, ruderal site, 41°34'31"N, 22°06'50"E, aspect E, inclination 5°, cover 70 %, stoniness 0 %, altitude 228 m, sample plot 25 m^2, date 5. 6. 2007.

Marrubium peregrinum	4	*Crepis foetida* subsp. *rhoeadifolia*	+
Atriplex patula	2	*Delphinium balcanicum*	+
Rumex pulcher	2	*Erodium cicutarium*	+
Tribulus terrestris	2	*Eryngium campestre*	+
Amaranthus lividus	1	*Herniaria incana*	+
Chenopodium album	1	*Hordeum leporinum*	+
Consolida regalis	1	*Hippomarathrum cristatum*	+
Cynodon dactylon	1	*Koeleria splendens*	+
Geranium pusillum	1	*Lactuca serriola*	+
Malva neglecta	1	*Lolium perenne*	+
Portulaca oleracea	1	*Medicago minima*	+
Aegilops neglecta	+	*Plantago lanceolata*	+
Allium spherocephalon	+	*Potentilla pedata*	+
Arenaria leptoclados	+	*Potentilla reptans*	+
Astragalus hamosus	+	*Rostraria cristata*	+
Bromus sterilis	+	*Rumex obtusifolius*	+
Capsella bursa-pastoris	+	*Sisymbrium orientale*	+
Carduus pycnocephalus	+	*Trifolium scabrum*	+
Centaurea solstitialis	+	*Vicia cracca*	+
Coronopus squamatus	+	*Vulpia ciliata*	+

Marrubium peregrinum, stand and a typical location of the stands.

Legislation

The basis for the evaluation was Annex I of the Habitat Directive 92743/EC, Treaty of Accession 2003. (http://eur-lex.europa.eu/ – accessed on November 24, 2008). The Annex lists the habitat types of Community interest whose conservation requires the designation of special areas of conservation. Priority habitats are marked specially in the Annex.

Within the steppe region, the following habitats can be included in Annex I:

Optimally developed habitats on larges surfaces:

Important habitats:

- Semi-natural grasslands of the class *Festuco-Brometea* – or dry calciphilous grasslands (EUNIS classification E1.2 – Perennial calcareous grasslands and basic steppes (including classification E1.21).
- Arborescent matorral with *Juniperus* spp. (EUNIS classification: F6.25 – Eastern (*Juniperus oxycedrus*) garrigues).
- *Quercus frainetto* woods (EUNIS classification G1.762 – Helleno-Moesian *Quercus frainetto* forests).

Priority habitats:

- Continental saltlands (EUNIS classification: E6.2153 – Pelago-Vardarian salt valleys with *Camphorosma monspeliaca*).

Other important habitats, thriving on small surfaces:

- Submediterrane humide meadows: lowland meadows occurring only fragmentarily within the steppe region (EUNIS classification: E3.31 – Helleno-Moesian riverine meadows).
- *Salix alba* and *Populus alba* galleries (EUNIS classification: G1.11 – Riverine willow forests, G1.356 – Poplar gallery forests in Macedonia).

SUGGESTED MEASURES FOR PRESERVATION OF PRIORITY SPECIES AND HABITATS

We propose six localities within the steppe region which should be given a specific status and legal protection in order to preserve the important species and habitats (Orlovo Brdo, Solena Reka, Solen Dol, Negotino-Krivolak, Serta and Bogoslovec). Constant monitoring should be introduced, at the very least in these regions.

Orlovo Brdo is one of the most interesting botanical localities in the wider region, where all the endemic species of the region are concentrated on a small surface – *Tulipa mariannae, Astragalus cernjavskii, Heptatera macedonica, Salvia jurisicii, Onobrychis megalophylla, Hedysarum macedonicum, Ferulago macedonica* and *Potentilla tridentula*. The most important populations of *Tulipa mariannae* and *Astragalus cernjavskii* are also found on this locality. In addition, there are well preserved dry grasslands, communities *Hedysaro-Convolvuletum* and *Brachypodio-Onobrychetum*, as well as *Chrysopogon gryllus* comm. and *Festuca valesiaca* comm. We propose that access to this region be restricted and the region itself be protected. Agriculture, which is on the rise from the lowland upwards in the Orlovo Brdo area, is one of the problems. Another

Orlovo Brdo, locality where eight endemic species can be found in a small area.

problem is presented by visitors and plant collectors who are attracted because there are classic localities (locus classicus) of 4 endemic species – *Tulipa mariannae*, *Astragalus cernjavskii, Ferulago macedonica* and *Hedysarum macedonicum*. Specimens from the classic localities are especially important and interesting, which is why the area is so popular with both botanical amateurs and experts who come here to collect them.*

Flora and vegetation on Orlovo Brdo is endangered by expanding of agriculture.

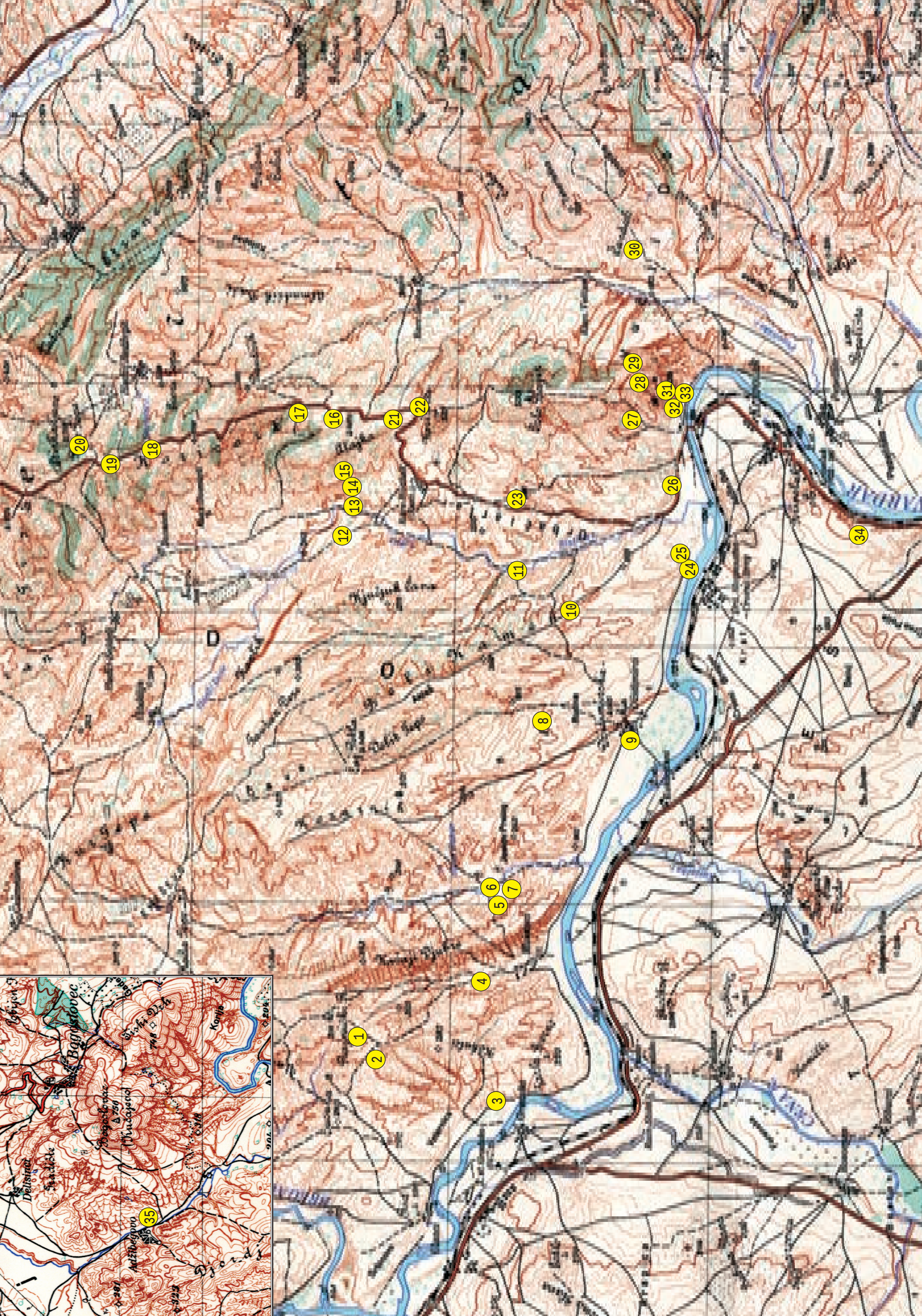
Similar to Orlovo Brdo, there are other three localities: the area between Negotino and the village of Krivolak, on the mountain pasture Serta above the village of Pepelište and the mountain pasture of Bogoslovec near Sveti Nikole. In these localities the number of endemic, steppe and other rare species is not so high as on the locality Orlovo Brdo, but can form a certain resource of genetic material.

Solen Dol, Solena Reka – The area of Solen Dol needs special protection between the artillery training ground and the village of Eneševo, while the locality of Solena Reka needs to be protected up to the polygon of Karaodžali. These localities are the home of endemic halophytic vegetation with the following halophytes: *Artemisia maritima, Krascheninnikovia ceratoides, Camphorosma monspeliaca* and *Camphorosma annua*, which form characteristic halophytic communities known so far only within these two localities. The species themselves are found on some other localities in the vicinity. Their populations are vital and abundant, only *Camphorosma annua* is rare in this region. When preparing the management plan it is essential that special attention be paid to the populations of these halophytic species. Their preservation, i.e. preservation of their habitats and halophytic vegetation, should be carefully planned.

---

* Locus classicus of *Salvia jurisicii* is Ovče Pole, locus classicus of *Onobrychis megalophylla* is Štip-Kavadarci, locus classicus of *Heptatera macedonica* is Demir Kapija and locus classicus of *Potentilla tridentula* is Gradešnica.

Solen Dol, typical halophytic vegetation (above), salt on the surface (bottom).



1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
D
O

Localities of species and vegetation types

Summary

Flora and vegetation of the Macedonian steppe

In the central part of Macedonia, in the triangle between Veles, Štip and Negotino, there is a vast area, different from the rest of the country. The entire area slightly resembles an undulating sea, as its surface is interrupted by numerous ditches, which makes the region almost impassable. Erosion is extremely severe. Water and frost cause some sediment layers to decay into small particles which are later carried away by water.

The work deals with a survey of the flora and vegetation. After the analysis, some important species and vegetation types/habitats have been established.

There are eight endemic plant species in the study area: *Hedysarum macedonicum, Astragalus cernjavskii, Tulipa mariannae, Onobrychis megalophylla, Ferulago macedonica, Heptaptera macedonica, Salvia jurisicii* and *Potentilla tridentula*. There appear also some significant steppe (*Astragalus parnassi, Morina persica* and *Convolvulus holosericeus*) and halophytic plant species *(Artemisia maritima, Artemisia annua, Krascheninnikovia ceratoides* and *Camphorosma monspeliaca*), as well as numerous other, rare plant species.

Among the habitat types also referred to in Annex I of the Habitats Directive, there are dry grasslands from the class *Festuco-Brometea* (perennial calcareous grasslands and basic steppes, as well as Greek-Balkan grass steppes with the species *Satureja montana*). Particularly important are the continental saltlands which are classified among the priority habitats in the EU area according to the above-mentioned Annex (Pelagonian and Vardar salt valleys with the species *Camphorosma monspeliaca*).

It was established that the most important areas in terms of plant species and vegetation are Orlovo Brdo, Solena Reka, Solen Dol, area between Negotino and the village of Krivolak, on the mountain pasture of Serta above the village of Pepelište and the mountain pasture of Bogoslovec near Sveti Nikole. Special protection is proposed for these areas.

References

Adamović L. 1901: Die Šibljak-Formation, ein wenig bekanntes Buschwerk der Balkanländer. Engler's Bot. Jahrbücher (Leipzig) 31(1): 1–29.

Amanatidou D. 2005: Analysis and evaluation of a traditional cultural landscape as a basis for its conservation management – a case study in Voikos-Aoos national park – Greece. Disseration, Fakultät für Forst- und Umweltwissenschaften, Albert-Ludwigs Universität, Freibug im Breisgau.

Anderson S., Kusik T & Radford E. (eds.) 2005: Important plant areas in central and eastern Europe. Plantlife International, Salisbury.

Anon. 2003: Studija za sostojbata so biološkata raznovidnost vo Republika Makedonija. Ministerstvo za životna sredina i prostorno planiranje, Skopje.

Anon. 2004: Strategija i akcionen plan za zaštita na biološkata raznovidnost na Republika Makedonija. Ministerstvo za životna sredina i prostorno planiranje, Skopje.

Balátová-Tuláčková E., Mucina L., Ellmauer E. & Wallnöfer S. 1993: *Phragmiti--Magnocaricetea.* – In: Mucina L., Grabherr G., Ellmauer T. Pflanzengesellschaften Österreichs. Teil II. Natürliche waldfreie Vegetation, Gustav Fischer Verlag, Jena, p. 79–130.

Bergmeier E. 1990: Wälder und Gebüsche des Niedrigen Olympos (Kato Olimbos, NO-Thesalien). Ein Beitrag zur systematischen und orographischen Vegetationsgliederung Griechenlands. Phytocoenologia 18: 161–342.

Bern Convention: Convention on the Conservation of European wildlife and natural habitats, Bern, 1979.

Braun-Blanquet J. 1964. Pflanzensoziologie. Grundzüge der Vegetationskunde. 3. Aufl., Springer, Wien, New York.

Bogojević R. 1969: *Euphorbio-Paliuretum spinae christi* R. Bog., nova termofilna zajednica drača (*Paliurus spina christi* Mill.) i mlečike (*Euphorbia pannonica* Host.) na Višnjičkoj kosi kraj Beograda. Acta Biologica Jugoslavica ser. D 4 (2): 217–224.

Bornmüller J. 1925: Beiträge zur Flora Mazedoniens, I. Engler's Bot. Jahrbücher (Leipzig) 59: 294–504.

Bornmüller J. 1925: *Hedysarum macedonicum* Bornm. Mitt. Thüring. Bot. Vereins, N.F., Heft 36: 43–44.

Bornmüller J. 1926: Beiträge zur Flora Mazedoniens, II. Engler's Bot. Jahrbücher (Leipzig) 60: 1–125.

Bornmüller J. 1927: Bearbeitung der von H. Burgeff und Th. Herzog in den Kriegsjahren 1916/18 in Macedonien gesamelten Pflanzen, II. Allg. Bot. Z. Syst. 33 (1–12): 25–38.

Bornmüller J. 1928: Beitrag zur Flora Mazedoniens III. Engler's Bot. Jahrbücher (Leipzig) 61: 1–195.

Bornmüller J.1932: Bearbeitung der von H. Burgeff und Th. Herzog in den Kriegsjahren 1916/18 in Macedonien gesammelten Pflanzen, III. Repert. Spec. Nov. Regni Veg. 30: 337–362.

Braun-Blanquet J. 1964: Pflanzensoziologie. Grundzüge der Vegetationskunde. 3. Aufl., Springer Verlag, Wien.
Černjavski P., Rudski I., Soška T. 1937: Kratak pregled vegetacije južne Srbije, Spomenica 25-god. osl. juž. Srb., Skopje, p. 135–159.
Devilliers P., Devilliers-Terschuren J., Ledant J.-P. 1991: Corine biotops manual, habitats of the European community, Comission of European communities, Luxembourg.
Devilliers P. & Devilliers-Terschuren J., 1996: A classification of Palearctic habitats. Nature and Environment 78.
Diklić N., Vukičević E. 1997: Razred šibljaka drače. In: Sarić M. Vegetacija Srbije II. Šumske zajednice 1. Srpska akademija nauka i umjetnosti, Beograd, p. 339–390.
Djurdjević L., Mitrović M., Pavlović P., Šerišić S., Mačukanović-Jocić M. 2005: Total phenolics and phenolic acid content in low (*Chrysopogon gryllus*) and mediocre quality (*Festuca vallesiaca*) forage grasses of Deliblato Sands meadow-pasture communities in Serbia. Czeh J. of Anim. Sci. 20: 54–59.
EUNIS biodiversity database, European Environmental Agency (http://eunis.eea.europa.eu).
Filipovski G. 1995–1999: Počvite na Republika Makedonija 1–4. MANU, Skopje.
Filipovski G., Rizovski R., Ristevski P. 1996: Karakteristiki na klimatsko-vegetacisko-počvenite zoni (regioni) vo Republika Makedonija. MANU, Skopje.
Jurišić Ž. 1923: Prilog flori južne Srbije. Spom. SKA, 1–45.
Habitat Directive: Council directive 92/43/EEC of 21 may 1992 on the conservation of natural habitats and wild fauna and flora.
Hayek A. 1924–1933: Prodromus Florae peninsulae Balcanicae, I–III. Feddes Repertorium, Beih.
Horvat I. 1954: Pflanzengeographische Gliederung Südosteuropas. Vegetatio 5: 434–447.
Horvat I., Glavač V., Ellenberg H. 1974: Vegetation Südosteuropas. Geobotanica selecta 6. Gustav Fischer Verlag, Stuttgart.
Kitanov B. 1951: *Tulipa pavlovii* Kitan.- edin nov vid lale ot Istočna Makedonija. Odd. otp. Blg. Akad. Nauk, 2:177–180
Kojić M., Popović R., Karadžić B. 1998: Sintaksonomski pregled vegetacije Srbije. Institut za biološka istraživanja »Siniša Stanković«, Beograd.
Kopecký K., Hejný S. 1992: Ruderální společenstva bylin České republiky. Stud. Českoslov. Akad. Věd 1992/1: 1–128
Košanin N. 1924: Geološki i geografski momenti u razviću flore južne Srbije. Zbornik radova posvećen J. Cvijiću, p. 591–603
Košanin N. 1926: Les espèces nouvelles dans la flore de la Serbie du sud (Macédoine). Glas. Srpske Kralj. Akad. 69(54):19–29, Beograd
Jovanović B., Jovanović R., Zupančič M. 1986: Prirodna potencialna vegetacija Jugoslavije (Rezime). DO Paralele, Ljubljana.
Jovanović B. 1997: Razred šibljaka drače *Paliuretea* Trinajstić 1978. In: Sarič M. (ed): Vegetacija Srbije II, šumske zajednice 1. Srpska akademija nauka i umjetnosti, Beograd, p. 349–352.

Jurišić Ž. 1923: Prilog flori južne Srbije. Spom. Srpske Kralj. Akad., 60: 1–45, Beograd.
Lindtner V. 1938/1939: Eine neue Tulpe der Flora Südserbien-mit einem Vorfruhlings-Aspect des Orlovo Brdo (Krivolak). Bull. Soc. Scientif. Skoplje 20(7): 137–140.
Matvejeva J. 1982: Ruderalna vegetacija na SR Makedonija. Odd. biol. i med. nauk., Makedonska akademija na naukite i umetnostite, Skopje.
Micevski B. 2000: CORINE Biotopes Macedonia. LIS Files of Macedonian CORINE sites, Manuscript, Skopje.
Matevski V. & Melovski L. 2003: Analysis of a potential IPA network – Republic of Macedonia. Manuscript, Skopje.
Micevski K. 1965: Halofitska vegetacija Ovčeg polja. Acta Musei macedonici scientarum nat. 10(3): 67–90.
Micevski K. 1969: Prilog za zapoznavanje florata na Makedonija V. Godišen zbornik 22: 167–178.
Micevski K. 1970: Nov endemičen sojuz vo vegetacijata na Makedonija – *Artemision maritimae* Micevski foed. nov. Godišen zbornik 22: 157–166.
Micevski K. 1970: *Astragalo-Potentilletalia*, nov vegetaciski red na brdskite pasišta vo Makedonija. Prilozi, Odd. Za prir. mat. nauki, MANU 2(2): 15–23.
Micevski K. 1971: »Stepska« vegetacija vo Makedonija. Godišen zbornik 23: 131–150
Micevski K. 1985*:* Flora na Republika Makedonija. MANU, 1(1):1–152
Micevski K. 1993: Flora na Republika Makedonija. MANU, 1(2):153–391
Micevski K. 1995: Flora na Republika Makedonija. MANU, 1(3):401–772
Micevski K. 1998: Flora na Republika Makedonija. MANU, 1(4): 781–1113.
Micevski K. 2001: Flora na Republika Makedonija. MANU, 1(5): 1121–1430.
Micevski K. 2005: Flora na Republika Makedonija. MANU, 1(6): 1437–1715.
Micevski K., Matevski, V., 1983: Retki i slabo poznati rastenija vo florata na Makedonija I. God. Zb. Biol. 36:149–153.
Micevski K., Matevski V. 1987: Teritorijalna podela endema u SR Makedoniji i problem njihove ugroženosti. Posebna izdanja ANU BiH. Odd. prir. nauka 14: 199–207.
Micevski K., Matevski V. 2000: Natural monuments in Proeva. In: Natural and cultural monuments. Ministry of information, Skopje, p. 9–26.
Micevski, K., Mayer, E. 1985: *Ferulago macedonica* Micevski et Mayer spec. nova – eine Neue endemische Art der Balkanhalbinsel. Acta. Bot. Croat. 44: 77–81.
Mucina L. 1993: *Artemisietea.* In: Mucina L., Grabherr G., Ellmauer T. Pflanzengesellscahften Österreichs. Teil II. Natürliche waldfreie Vegetation, Gustav Fischer Verlag, Jena, p. 169–202.
Poldini L. 1988: Übersicht des Verbandes *Ostryo-Carpinion orientalis* (*Quercetalia pubescentis*) in SO Europe. Phytocoenologia 16: 125–143.
Rexhepi F. 1992: Fitocenoza *Astero-Juniperetum oxycedri* Rexhepi 1990. Glasnik Prirodnjačkog muzeja u Beogradu B 47: 35–42.
Rizovski R. 1978: Šumite na dabot ploskač (*Quercus farnetto* Ten.) vo južnite kraišta na SR Makedonija. Dissertation, Univerzitet »Kiril i Metodij«, Skopje, 122 p.
Rodwell J. S., Schaminée J. H. J., Mucina L., Pignatti S. Dring J., Moss D. 2002: The diversity of European vegetation. An overview of phytosociological alliances

and their relationships to EUNIS habitats. European Environmental Agency, Wageningen.
Rudski I. 1943: Prilog za poznavanju flore okoline Strumice. Ohridski zbornik II, 136: 205–238.
Sarić M. (ed) 1997: Vegetacija Srbije II, šumske zajednice 1. Srpska akademija nauka i umetnosti, Beograd, 474 p.
Soška T. 1939: Beitrag zur Kenntnis der Schluchtenfloren von Südserbien, III. Bull. Soc. Scientif., Skoplje, 20(7): 167–191.
Soška T. 1940: Beitrag zur Kenntnis der Schluchtenfloren von Südserbien, IV. Bull. Soc. Scientif., Skoplje, 22(8): 169–181.
Stojanoff, N. 1936: Eine neue *Astragalus* –Art aus Mazedonien. Izvest. BЪlg. Botan. Druz. 7: 100–107.
Trinajstić I. 1996: Syntaxonomisch-nomenklatorische revision der ostadriatischen Vegetation mit *Paliurus* (*Rhamno-Paliurion* Trinjastić, nom. nov). Ann. Mus. Civ. Rovereto Suppl. II vol. 11: 209–215.
Tutin T. G., Heywood V. H., Burges N. A., Moore D. M., Valentine D. H., Walters S. M., Webb D. A. 1964–80. Flora Europaea. Volume 1–5. Cambridge University Press, Cambridge, London, New York, New Rochelle, Melbourne, Sydney.
Vandas C. 1909: Reliquiae Formánekianae. Enumeratio critica plantarum vascularum, quam itineribus in Haemo peninsula et Asia Minore (Bithynia) factis collegit Dr. Ed. Formánek. Brunae [Brno]: Hjos Jelinek, viii+623+xxxiii p.
Velenovsky J. 1922: Reliquiae Mrkvickanae. Pragae: Fr. Rivnac, p. 1–32.
Walter K. S., Gillett H. J. 1998: 1997 IUCN Red List of Threatened Plants. Compiled by the World Conservation Monitoring Centre. IUCN – The World Conservation Union, Gland, Switzerland and Cambridge, UK.
Weber F. 1951: Botanická vycháazka do pohori Galičica. Sborn. klub. Prirodov. Brne 29: 1–11.
Weber H. E., Moravec J., Theurillat J. P. 2000: International Code of Phytosociological Nomenclature. 3rd edition. Journal of Vegetation Science 11: 739–768.

Acknowledgements

We would like to thank Lieutenant Colonel Drago Andrijanić and senior sergeant Zoran Dimitrušev for their help in the field. We also thank Barbara Šuštar for data management and Iztok Sajko for making the maps and formatting the final version of the text.

The core of the results presented is based on the project *Assessment of the environmental impact of the military training ground Krivolak for the purpose of its ecological rehabilitation* (M1-1057), which was conducted by Dr. Boštjan Pokorny from Erico Velenje, and of the incorporated subproject *Landscape within the military training ground Krivolak in Macedonia, its natural characteristics, anthropogenic impact and possibilities for sustainable development of the region*, which was conducted by the Institute of Biology at the Scientific Research Centre of the Slovenian Academy of Sciences and Arts in Ljubljana, together with colleagues from the Faculty of Natural Sciences and Mathematics at the University of Ss. Cyril and Methodius in Skopje. The project was funded by the Slovenian Research Agency.

Authors

Vlado Matevski, professor of systematic botany at the Faculty of Natural Sciences and Mathematics, University of Ss. Cyril and Methodius in Skopje; main scientific interest: taxonomy and floristics.

Andraž Čarni, researcher at the Institute of Biology, Scientific Research Center of the Slovenian Academy of Sciences and Arts and lecturer of botany at the University of Nova Gorica; main scientific interest: scrub and fringe vegetation.

Mitko Kostadinovski, professor of phytogeography and phytosociology at the Faculty of Natural Sciences and Mathematics, University of Ss. Cyril and Methodius in Skopje; main scientific interest: taxonomy and phytogeography.

Petra Košir, researcher at the Institute of Biology, Scientific Research Center of the Slovenian Academy of Sciences and Arts; main scientific interest: forest vegetation.

Urban Šilc, researcher at the Institute of Biology, Scientific Research Center of the Slovenian Academy of Sciences and Arts; main scientific interest: weed vegetation.

Igor Zelnik, researcher at the Institute of Biology, Scientific Research Center of the Slovenian Academy of Sciences and Arts; main scientific interest: grassland vegetation.

The reasearch team in the field, from left to right Mitko Kostadinovski, Urban Šilc, Igor Zelnik, Petra Košir, Vlado Matevski, Robert Angelov and Andraž Čarni.

Cena 15 €

ISBN 978-961-254-105-7

ZALOŽBA ZRC