



УДК / UDC 630
УДК / UDC 635.9
УДК / UDC 674

Online ISSN 1857-9507
www.sf.ukim.edu.mk/sumarski_pregled.htm

ШУМАРСКИ ПРЕГЛЕД FOREST REVIEW

МЕЃУНАРОДНО НАУЧНО СПИСАНИЕ
INTERNATIONAL SCIENTIFIC JOURNAL

80 ГОДИНИ ОД РАЂАЊЕТО НА РАДОСЛАВ РИЗОВСКИ
YEARS OF RADOŠLAV RIZOVSKI'S BIRTH



Шум. преглед (Šum. pregled)
For. review

Год. 46
Vol. 46

Стр. 1-95
Pag. 1-95

Скопје, 2015
Skopje, 2015





УНИВЕРЗИТЕТ „СВ. КИРИЛ И МЕТОДИЈ“ ВО СКОПЈЕ
Ss. CYRIL AND METHODIUS UNIVERSITY IN SKOPJE
ШУМАРСКИ ФАКУЛТЕТ ВО СКОПЈЕ
FACULTY OF FORESTRY IN SKOPJE



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Издавач Publisher

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Излегува еднаш годишно

Published once a year

Интернет-страница

www.sf.ukim.edu.mk/sumarski_pregled.htm

Web page (on-line)

www.sf.ukim.edu.mk/sumarski_pregled.htm

Адреса на издавачот

УКИМ-Шумарски факултет во Скопје
Редакција на Шумарски преглед
Ул. „16 Македонска бригада“ бр. 1
(П. факс 235)
1 000 Скопје
Република Македонија
Е-пошта: sumpregled@sf.ukim.edu.mk
www.sf.ukim.edu.mk

Publisher's address

UKiM Faculty of Forestry in Skopje
Editorial Board of the Forest Review
Ul. 16 Makedonska brigada br. 1
(P.O. box 235)
MK-1000 Skopje
Republic of Macedonia
E-mail: sumpregled@sf.ukim.edu.mk
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УДК 674

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Instructions to Authors

FLORA, HABITATS AND VEGETATION OF CHAMDZHA MANAGED RESERVE, CENTRAL BALKAN RANGE¹VASSILEV K., ²GAVRILOVA A.¹*Institute of Biodiversity and Ecosystem Research – Bulgarian Academy of Sciences, Sofia, Bulgaria*²*Department of Dendrology, Faculty of Forestry, University of Forestry – Sofia., Bulgaria*

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ABSTRACT: Chamdzha reserve is a managed reserve, situated on the southern slopes of Central Balkan Range, which occupies an area of 66.4 ha. The aim of this study was to explore floristic, habitat and vegetation diversity of the reserve. Totally the flora is represented by 51 families, 184 genera and 299 vascular plants (without mosses). The richest families are *Asteraceae*, *Poaceae*, *Fabaceae*, *Rosaceae*, *Caryophyllaceae*, *Brassicaceae*, *Boraginaceae* and *Apiaceae*. One hundred and eleven medical plants and 7 species of conservation concern were found (5 Balkan endemics, 3 included in the Red List of Bulgarian vascular plants and in the National Biological Biodiversity Act). Fourteen relevés were collected during 2014 following to the Braun-Blanquet approach. The vegetation diversity is represented by 5 classes (*Erico-Pinetea*, *Quercu-Fagetea*, *Quercetea pubescentis*, *Koelerio-Corynephoretea* and *Festuco-Brometea*), 4 alliances (*Erico-Fraxinion orni*, *Carpinion orientalis*, *Carpinion betuli*, and *Festucion valesiacae*), 1 association and 5 communities. Woodland vegetation covers 61.2 ha whereas grassland vegetation includes only 0.15 ha. Natural communities represent 5 habitats protected by Directive 92/43/EEC and the Bulgarian Biodiversity Act.

Keywords: managed reserve, Bulgaria, Stara planina, *Erico-Pinetea*, *Koelerio-Corynephoretea*

1 INTRODUCTION

Chamdzha managed reserve has a territory of 66.4 ha. It was established to protect a rare natural formation of black pine (*Pinus nigra* Arnold) in the Balkan Range (Stara planina), situated on its southern slopes. The category “managed reserve” according to the Bulgarian legislation is closest to the definition of the IUCN category IV - Habitat/Species Management Area. Various natural as well as semi-natural and anthropogenic phytocenoses surround the reserve.

The floristic complex of Chamdzha reserve was poorly studied in the past. Some old data about the diversity of vascular plants in the region including the territory of the managed reserve are represented in the studies of [24] and [35]. In addition, some general information about the floristic composition of the natural black pine forests can be found in [24] and [48]. Vegetation diversity in the reserve has not been studied before.

The aim of this study is to reveal the floristic and syntaxonomic diversity of Chamdzha managed reserve and to assess their current condition.

2 MATERIAL AND METHODS

2.1 Study area

The study was conducted in Chamdzha managed reserve, situated in the southern slope of central part of the Balkan Range (Stara planina), near Hristo Danovo village. It covers 66.4 ha at altitude from 550 to 775 m a.s.l. (Fig. 1). Prevailing slope incline is between 15 and 35°. The climate is temperate to continental, characterized by warm summer and cold winter [40]. The precipitation maximum is in May-June and minimum in January and February. The bedrock type is granite and soils are Luvisols and Vertisols [11]

The potential natural vegetation is mostly comprised of south and east Balkan, as well as Crimean-west Caucasian colline Oriental hornbeam-downy oak forests (Mapping unit G34) [43].

The territory of the reserve is also part of NATURA 2000 site BG000494 Centralen Balkan – buffer.

(<http://natura2000.moew.government.bg/Home/ProtectedSite?code=BG0001493&siteType=HabitatDirective>).

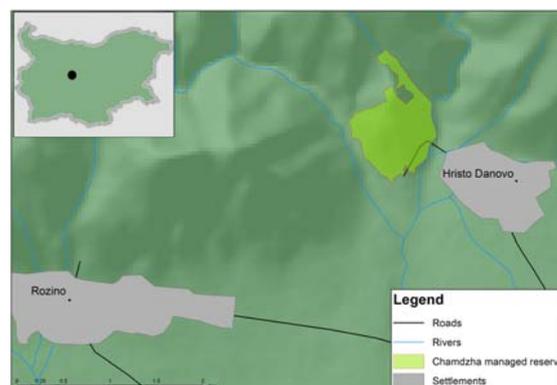


Figure 1: Map of the study area

2.2 Sampling of the flora

The field studies of the flora were conducted in June-August 2014. The transect sampling method was applied. The taxonomic scheme adopted generally follows [9]. Biological types and life-forms are based on field observations and checked with relevant literature sources, e.g. [12, 13, 14, 38, 48, 51]. Conservation status of the species was determined according to [1, 2, 3, 7, 32]. Floristic elements follow [4]. The group of medicinal plants was determined according [8] and Regulation №RD-83/3.02.2014 of the MOEW (Ministry of Environment and Water) regarding the special regimes of protection and management of medicinal plants in 2014 on the territory of the country.

2.3 Vegetation sampling

During the vegetation season 2014 a total of 14 relevés were collected following the Braun-Blanquet approach [26, 54]. The sample plots were set in the most homogenous part of communities in a manner to cover all vegetation types in the study area. We used square-shaped form of sample plots with plot size of 16 m² for

grassy and 100 m² for woody vegetation. All relevés were stored in TURBOVEG database [39] and in the Balkan Vegetation Database (GIVD ID: EU-00-019) [29] and the Balkan Dry Grassland Database (GIVD ID: EU-00-013) [27]

Altitude and location were measured by Garmin eTrex Vista (GPS). The exposition was determined by compass. Slope was assessed visually in categories (1) < 5 °, (2) between 5-10 ° and (3) > 10 °. Soil are classified as shallow (<10 cm depth), (2) moderately deep (10-20 cm) or deep (> 20 cm).

2.4 Data analysis of relevés

The classification was made using the program PC-ORD [6] incorporated in JUICE 7.0 software package [30]. Relative Sorensen was used for calculating of species similarity and flexible beta (-0.25) as distance measure.

2.5 Habitat classification and mapping

Habitat types were determined according to Habitat Directive [25, 44]. Assignment of each vegetation unit to a certain Habitat Directive Code (HDC) was given in the text. Mapping was done using ArcGIS 10.0 software [16]. Spatial data was collected in the field using Garmin eTrex Vista (GPS) and was later overlaid over the most recent orthophoto images available. Outlining the polygons was done manually by using data collected in the field as well as the orthophoto images. Mapping was done in scale 1:5000.

3 RESULTS

3.1 Flora

The flora of Chamdzha managed reserve comprises of 51 families, 187 genera and 299 species, which sums up 32.1% of the family diversity in the country, 20.3 % of the genera and 7.6 % of the species. Most of the inventoried species are spermatophytes – 46 families (90.2%), 179 genera (95.7 %) and 291 species (97.3%). On the territory of Chamdzha managed reserve no representatives of *Lycopodiophyta* or *Equisetophyta* were found. The taxonomic structure of the flora is presented in Tabl.1. *Polypodiophyta* comprises 5.9% of the total number of families, 2.7% of the genera and 2.3% of the species in the reserve. On the other hand *Pinophyta* comprises of 3.9% of all families, 1.6% of the genera and 1.3% of the species and *Magnoliophyta* presents 90.2%, 95.7% and 96.3% families, genera and species respectively. The list of taxa is provided in Annex I.

Table I: Taxonomic structure of the flora

Taxon	no. of species	no. of genera	no. of families
<i>Polypodiophyta</i>	7	5	3
<i>Pinophyta</i>	4	3	2
<i>Magnoliophyta</i>	288	179	46
<i>Magnoliopsida</i>	239	152	42
<i>Liliopsida</i>	49	27	4
Total number	299	187	51

The richest in species families are *Asteraceae* – 42 species (14%), *Poaceae* – 38 species (12.7%), *Fabaceae* – 35 species (11.7%), *Lamiaceae* and *Rosaceae* – 19 species each (6.4%), *Caryophyllaceae* and *Brassicaceae*

– 10 species each (3.3%), *Boraginaceae* and *Apiaceae* – 8 species each (2.7%).

The life forms of the flora of Chamdzha managed reserve is presented in Fig. 2.

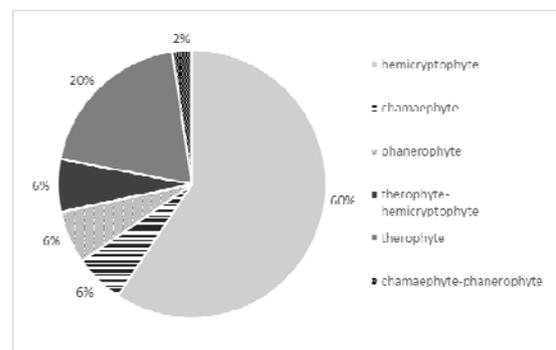


Figure 2: Life forms spectrum of the flora of the Chamdzha managed reserve

The phytogeographic composition of the flora of Chamdzha managed reserve is presented in Table 3.

Table III: Floristic elements in the flora of Chamdzha managed reserve

Floristic element	no. of species	Share (%)
subMed	45	15.1
Eur-Med	41	13.7
Eur-As	37	12.4
Eur	21	7
Boreal	19	6.4
Eur-Sib	18	6
SBoreal	17	5.7
Kos	16	5.4
Pont-Med	10	3.3
subBoreal	7	2.3
Bal	4	1.3
Med	5	1.7
SPont	5	1.7
Others – Eur-OT, Med-As, Ap-Bal, Pan-Bal, Pont-OT, Med-CAs, subBal, Bal-Anat, Eur-Med-CAs, CSEur, Bal-Dac, Carp-Bal, Pont-subMed, Alp-Med, Eur-CAs, Alp-Carp, Pont, Med-OT, SSib, subMed-CAs, subMed-As, Pont-CAs	54	18
Total number	299	100

There are five Balkan endemics [3] – *Anthemis macedonica*, *Scabiosa triniifolia*, *Chamaecytisus jankae*, *Hypericum umbellatum*, *Campanula lanata* found in the reserve. Three species are included in the Bulgarian Red List of vascular plants [2] – *Campanula lanata* (VU), *Jovibarba heuffelii* (NT) and *Minuartia saxifraga* (LC). One species (*Campanula lanata*) is enlisted in App. 3 of [7] and [32] assigned as “endangered”.

3.2 Vegetation

Classification of relevés did not show a great diversity of communities on the territory of Chamdzha managed reserve. The list of established syntaxa consists of 5 classes, 5 orders, 4 alliances, 1 association and 5

communities (clusters 1-12 Fig. 3, Annex II). *Pinus nigra* forests are the most widespread vegetation type and cover more than 63% of the reserve's territory. They are followed by *Quercus dalechampii* woodlands covering 31%.

3.2.1 Ass. *Cetrario aculeatae-Plantaginetum subulatae* (HDC: 8230; 0.09 ha)

This association is locally distributed on the territory of the reserve. Its communities occur on eroded, slightly to moderately inclined slopes (10°-30°) with varying expositions. Soils are shallow and rocky. Stands have open horizontal structure and low amount of accumulated litter. Bedrock type is granite. The most frequent species are *Scleranthus perennis*, *Sedum hispanicum*, *Agrostis capillaris*, *Hieracium pilosella*, *Cladonia foliacea*, *Cetraria aculeata*, *Polytrichum piliferum*, *Racomitrium canescens* agg. This association is found at a small scale within stands of woodland vegetation types. The total cover of vegetation is predominantly between 65-80% as cover of herb and cryptogam layers are almost equal (between 30 and 50%).

3.2.2 *Pinus nigra* community (HDC: 9530; 41.78 ha)

This vegetation type has widest distribution in the reserve and was found on slopes with varying exposition and inclination between 5 and 40°. Soils are shallow to moderately deep. *Pinus nigra* (cover 50-100%) is the dominant species in the tree layer and subdominants are *Quercus dalechampii*, *Carpinus orientalis* and *Quercus cerris* with cover between 10-30%. Shrub layer has cover between 10-25% and is formed by shrubs of the same species as well as *Coryllus avellana*, *Chamaecytisus jankae*, *C. supinus*, *Crataegus monogyna*, *Prunus spinosa* are found. Herb layer has low cover (10-30%) and is formed mainly by *Poa nemoralis*, *Dactylis glomerata*, *Brachypodium sylvaticum*, *Moehringia pendula*, *Lerchenfeldia flexuosa* and *Galium flavescens*.

3.2.3 *Quercus dalechampii* community (HDC: 9170; 7.67 ha)

Communities of *Quercus dalechampii* are found in northern part of the reserve on slopes with north and north-east exposition. Soils are moderately deep. Balkan durmast oak is the dominant species in the tree layer with cover between 60 and 80%, whereas in shrub layer dominant species is *Carpinus betulus* with cover between 20-50%. Single shrubs of *Pinus nigra*, *Quercus cerris*, *Carpinus orientalis*, *Crataegus monogyna*, *Prunus spinosa*, *Chamaecytisus jankae* are forming the shrub layer. Herb layer is formed mainly by *Poa nemoralis*, *Lerchenfeldia flexuosa*, *Festuca heterophylla*, *Galium flavescens*, *Moehringia pendula*.

3.2.4 *Carpinus orientalis-Pinus nigra* community (HDC: 9530)

Communities of *Carpinus orientalis-Pinus nigra* (cluster 10, Fig. 2) have limited distribution on the territory of the reserve. They form transitional vegetation types with *Pinus nigra* community. *Carpinus orientalis-Pinus nigra* communities are found on slightly to moderately steep slopes (10-25°) with southern exposition. Soils are shallow to moderately deep. There is not clear dominant species, but subdominants are *Carpinus orientalis* (30-60%) and *Pinus nigra* (20-60%).

Shrub layer has low cover (10-15%) and is formed by the same species as well as some single shrubs (*Fraxinus ornus*, *Chamaecytisus calcareus*, *Crataegus monogyna*). Herb layer has low cover, which varies between 5-15%. Undergrowth is formed mainly by *Melica uniflora*, *Dactylis glomerata*, *Brachypodium sylvaticum*.

3.2.5 *Carpinus orientalis - Quercus dalechampii* community (HDC: 91M0; 12.68 ha)

This vegetation type is locally found in the reserve on eastern and southern slopes with prevailing inclination 10-15°. The dominant species are *Quercus dalechampii* and *Carpinus orientalis*. Shrub layer is formed by young individuals of above mentioned trees as well as *Crataegus monogyna*, *Prunus spinosa*, *Fraxinus ornus*, *Acer campestre* and *Quercus cerris*. Species with higher cover (5-10%) in herb layer are *Poa nemoralis*, *Lerchenfeldia flexuosa*, *Festuca heterophylla*, *Arabis procurrans*, *A. sagittata*, *Galium flavescens* and *Moehringia pendula*.

3.2.6 *Festuca valesiaca* community (HDC: 6210; 0.06 ha)

This community is locally distributed on slightly inclined, south facing slopes, close to abandoned agricultural areas. Soils are rich, moderately deep. This community has close horizontal structure with total cover of vegetation 90-95%. Dominant species are *Festuca valesiaca*, *Dichanthium ischaemum* and *Koeleria nitidula*. As a result of abandonment of pastures during last 20 years cover of shrubs (*Prunus spinosa*, *Crataegus monogyna*) was increasing and reached 20-25%.

Proposed syntaxonomical scheme:

Cl. Erico-Pinetea Horvat 1959

Ord. Erico-Pinetalia Horvat 1959

All. Erico-Fraxionion orni Horvat 1959
Pinus nigra community

Cl. Quercetea pubescentis (Oberd. 1948) Doing Kraft 1955

Ord. Quercetalia pubescenti-petreae Klika 1933

All. Carpinion orientalis Horvat 1958

Carpinus orientalis-Pinus nigra community
Carpinus orientalis-Quercus dalechampii community

Cl. Quercu-Fagetea Braun-Blanq. et Vlieger in Vlieger 1937

Ord. Fagetalia sylvaticae Pawł. et al. 1928

All. Carpinion betuli Issler 1931

Quercus dalechampii community

Cl. Koelerio-Coryneporetea Klika in Klika et Novák 1941

Ord. Sedo-Scleranthetalia Br.-Bl. 1955

Ass. Cetrario aculeatae-Plantaginetum subulatae
Pedashenko et al. 2013

Cl. Festuco-Brometea Br.-Bl. & Tüxen 1943 ex Soó 1947

Ord. Festucetalia valesiaca Br.-Bl. & Tüxen 1943

All. Festucion valesiaca Klika 1931

Festuca valesiaca community 1952

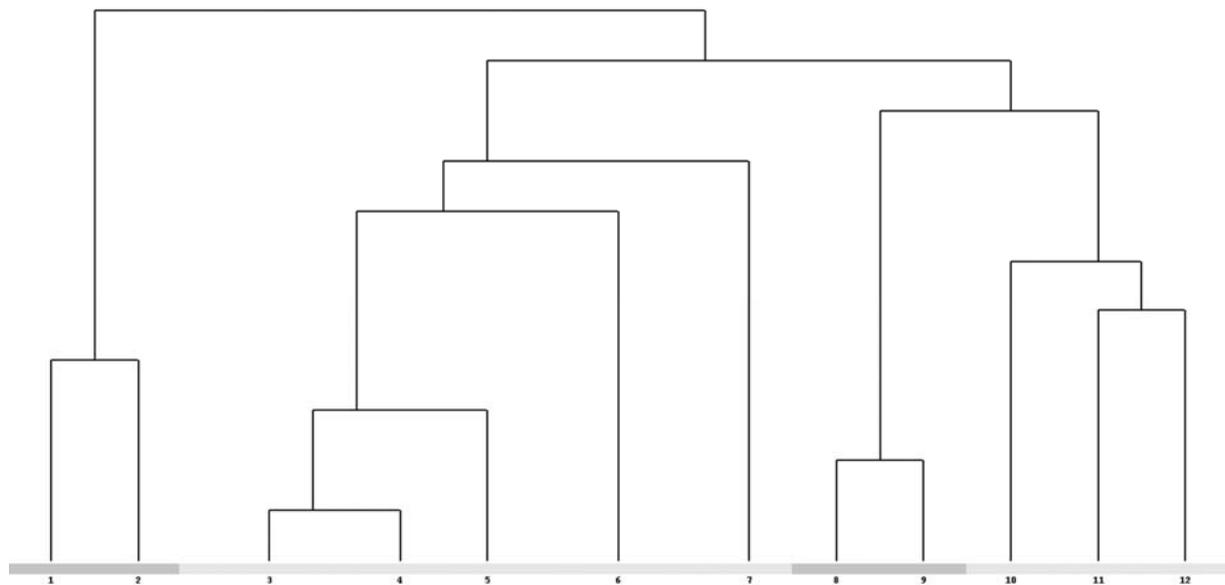


Figure 3: Dendrogram of phytosociological relevés (Relative Sorensen used for similarity and flexible beta (-0.25) as clustering method). Legend: *Cetrario aculeatae-Plantaginetum subulatae* (clusters 1-2), *Pinus nigra* community (clusters 3-7), *Quercus dalechampii* community (clusters 8-9), *Carpinus orientalis-Pinus nigra* community (cluster 10), *Carpinus orientalis- Quercus dalechampii* community (clusters 11-12).

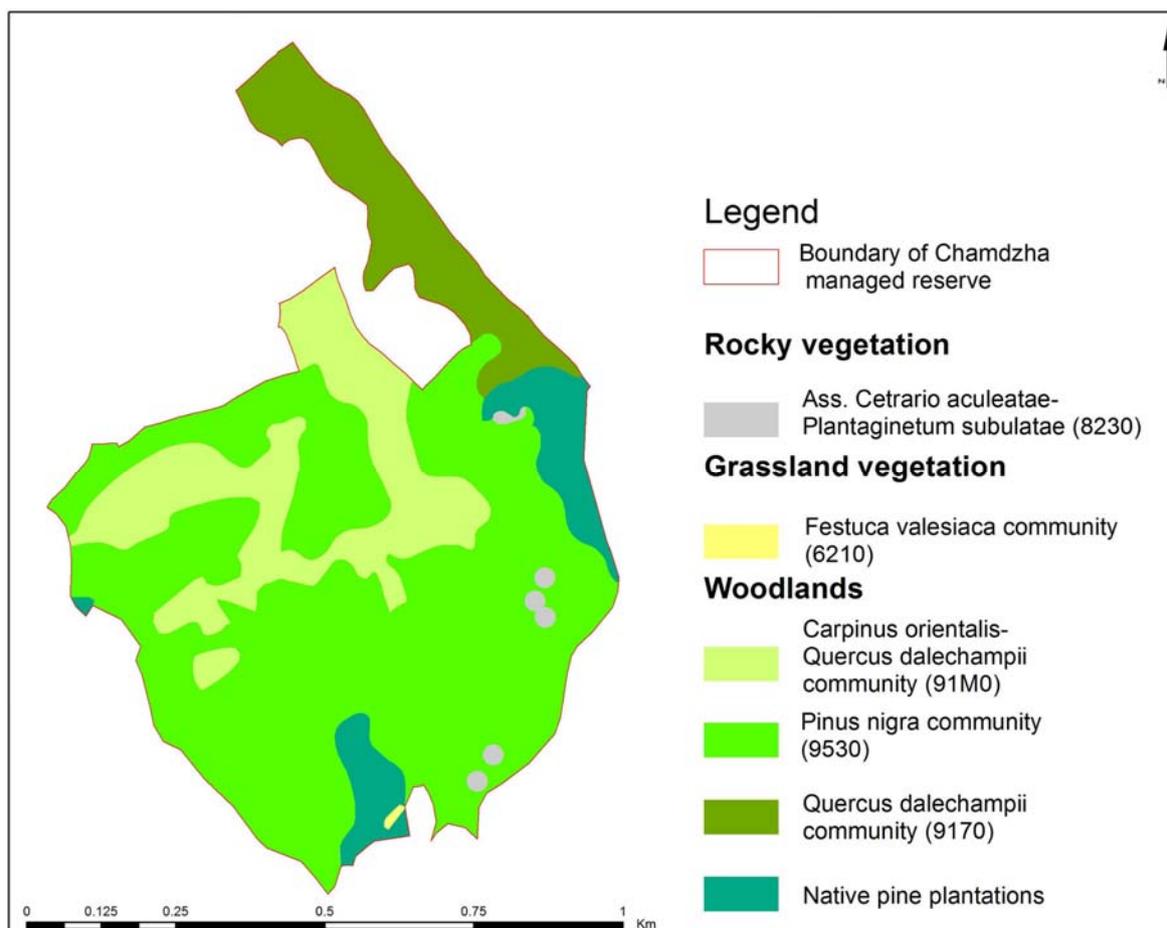


Figure 4: Map of vegetation units of Chamdzha managed reserve. Codes in brackets represent the codes of habitats in the Habitat directive: 8230 – Siliceous rock with pioneer vegetation of the *Sedo-Scleranthion* or of the *Sedo albi-Veronicion dillenii*, 6210 – Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*), 9170 – *Galio-Carpinetum* oak-hornbeam forests, 91M0 – Pannonian-Balkan turkey oak-sessile oak forests, 9530 – *(Sub-) Mediterranean pine forests with endemic black pines

4 DISCUSSION

4.1 Flora

Chamdzha managed reserve comprises 7.6% of the species in the Bulgarian flora. Vascular plant diversity is relatively low compared to some other areas characterized with similar vegetation diversity, e.g. Chervenata Stena Reserve (631 species) in Rhodope Mts [34] and Ali Botush Reserve in Mt. Slavyanka (more than 600 species, unpublished data). This can be explained by the fact that Chamdzha reserve has smaller size and bedrock type is granite but not limestone like in other two reserves. It is well known that calcareous substrates are characterized by rich flora and a lot of endemic and rare plants [15,49]. On the other hand silicate substrates are characterized by poorer flora and less number of endemic and rare plants [15]. According to results about taxonomic structure of flora of the reserve the presence of *Pteridiophyta* is 2.3 % of all species, which is higher from the average for the country [4]. This can be explained by the prevalence of forest and rocky habitats, where environmental conditions are suitable for distribution of such species.

Regarding the presentation of the different families, share of *Rosaceae* and *Caryophyllaceae* is relatively higher compare with the data for the total Bulgarian flora [4]. This can be explained with presence of many woody species of *Rosaceae* and availability of suitable habitats for many species of *Caryophyllaceae*.

The analysis of the biological types in the flora of Chamdzha managed reserve shows the prevalence of hemicriptophytes, which is typical for regions with continental climate in Europe and the Balkans. Also the presence of shrubs and trees, respectively phanerophytes is high because the domination of woody habitats. Therophytes are represented by 18.4%, which is high taking into account the size of the territory covered by grassland vegetation.

The phytogeographical analysis shows that in the flora of Chamdzha managed reserve prevail the following floristic elements – subMediterranean, Euro-Mediterranean, Euro-Asiatic, European, Boreal, subBoreal and Euro-Siberian, which comprise nearly 66.4% of the total flora. This pattern is similar to the pattern in other area in the country [18, 20, 28, 34]. The high number of the subMediterranean, Euro-Mediterranean and Euro-Asiatic groups (41.2 %) is a result of wide distribution of xerothermic vegetation types in the reserve.

The presence of endemic species is low- only 1.7%, comparing with data for the whole country – ca. 11% of the total Bulgarian flora [4]. Endemic species and species of conservation concern represent 2.4% of all species. Some species (*Campanula lanata*, *Jovibarba heuffelii* and *Minuartia saxifraga*) are restricted to rocky cliffs locally found in the reserve. On the other hand *Chamaecytisus jankae* is widespread in shrub layer of woody vegetation types.

4.2 Vegetation

4.2.1 Syntaxonomy

This investigation is the first study about vegetation diversity in Chamdzha managed reserve. Due to the small size of the study area as well as the limited distribution of some vegetation types we were unable to classify them to already described associations, so majority of them were

classified as communities. Black pine and Balkan durmast oak forests are the most widely distributed vegetation types.

Pinus nigra woodlands are distributed and studied mainly in southern part of the country - Rhodope mts [10, 21, 34, 42], West Frontier Mts [20], Pirin mt [45], Mt Slavyanka (unpublished data) and more limited in northern Bulgaria - Vrachanska mt [47]. Similar results were found about the national distribution of habitat 9530 *(Sub-) Mediterranean pine forests with endemic black pines in NATURA 2000 network in Bulgaria [[http://natura2000.moew.government.bg/Home/Protected Site?](http://natura2000.moew.government.bg/Home/ProtectedSite?)]. It is located in 24 NATURA 2000 sites with national coverage of 25045 ha.

From syntaxonomical point of view black pine forest are still poorly studied in the country. All studies have been done following the Dominance approach and provide only descriptive information about communities [10, 20, 21, 22, 34, 41, 42, 45]. This is the first research of syntaxonomy of *Pinus nigra* communities in the country following the Braun-Blanquet approach. Future analysis with other unclassified relevés from other parts of the country will reveal the existing diversity of this vegetation in Bulgaria. However, based on data collected up to now, we found that there are 2 types of *Pinus nigra* communities in Bulgaria based on different bedrock type – “species rich communities” found on calcareous substrates and “species poor communities” distributed on silicate substrates.

Quercus dalechampii forests on the territory of the reserve are belonging to xero-mesophytic type analyzed by [19] from Kongura reserve.

On the other hand there are some transitional vegetation types between *Pinus nigra*, *Quercus dalechampii* and *Carpinus orientalis* phytocoenosis in the reserve. This is also found in West Frontier Mts [17] and Rhodope Mts [22]. *Pinus nigra* forms communities also with *Fagus sylvatica* [10, 41], *Picea abies* [10, 34], *Pinus sylvestris* [34], *P. heldreichii* [45], *Abies alba* [10], *Ostrya carpinifolia* [41], *Juniperus communis* & *Cotinus coggygrya* [21], *Genista carinalis* [22], *Quercus pubescens* [42] and *Festuca balcanica* [47].

Grassland vegetation has limited distribution on the territory of the reserve. *Cetrario aculeatae-Plantaginetum subulatae* association was originally described by [18] from the area of Beklemeto mountain pass, which is only several kilometers away from the managed reserve. It has wider distribution on south slopes of the Balkan Range (Stara planina) on silicate terrains. Future analysis of collected data in Balkan Dry Grassland Database [27] will reveal its actually existing distribution.

4.2.2 Ecology

Agglomerative classification of the data resulted in sorting of relevés along the gradient of soil depth (Fig. 2), which appeared to be the most important environmental factor responsible for their separation. On shallow soils, are found *Cetrario aculeatae-Plantaginetum subulatae* association and *Pinus nigra* communities. On the other vegetation types are found on deeper soils.

Due to the small difference of altitudinal range (225 m.) all vegetation types are found in the belt of Xero-mesophytic oak forests. As a result ecological conditions are similar and there is no much difference in species

composition of shrub and herb layer in different woody vegetation types.

4.2.3 Importance for conservation

Looking from conservational point of view, among all 6 communities at association level, there are 5 habitat types (Fig. 3) protected by Appendix 1 of the Bulgarian Biological Diversity Act (2007) and Directive 92/43/EEC. All habitat types (9530, 9570, 91M0, 8230 and 6210) are widespread on the territory of the country. However, territories covered by habitat 8230 Siliceous rock with pioneer vegetation of the *Sedo-Scleranthion* or of *Sedo albi-Veronicion dilleni* in the country are limited to very small areas. On the territory of the reserve habitat 9530 *(Sub-) Mediterranean pine forests with endemic black pines represents relict locality of this vegetation. All habitats types are well preserved and subjected on low anthropogenic pressure.

5 ACKNOWLEDGEMENTS

Authors are grateful to the project “DIR – 5113325-12-109 Central Balkan – park for everyone”, financed under Priority Axis 3 “Preservation and restoration of biodiversity”, Operational Programme Environment, 2007 – 2013 and Bulgarian Government.

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Annex I: List of taxa, distributed on the territory of Chamdzha managed reserve

POLYPODIOPHYTA

Aspleniaceae: *Asplenium adianthum-nigrum* L., *A. ruta-muraria* L., *A. trichomanes* L., *Ceterach officinarum* DC, *Phyllitis scolopendrium* (L.) Newman; **Athyriaceae:** *Cystopteris fragilis*(L.) Bernh.; **Polypodiaceae:** *Polypodium vulgare* L.

PINOPHYTA

Cupressaceae: *Juniperus oxycedrus* L.; **Pinaceae:** *Abies alba* Mill., *Pinus nigra* Arnold, *P. sylvestris* L.

MAGNOLIOPHYTA

Magnoliopsida

Aceraceae: *Acer campestre* L., *A. platanoides* L.; *A. tataricum* L.; **Anacardiaceae:** *Cotinus coggygia* Scop;

Apiaceae: *Anthriscus sylvestris* (L.) Hoffm., *Bupleurum rotundifolium* L., *Daucus carota* L., *Eryngium campestre* L., *Myrrhoides nodosa* (L.) Cannon, *Orlaya grandiflora* (L.) Hoffm., *Physospermum cornubiense* (L.) DC., *Seseli rigidum* Waldst. & Kit. **Apocynaceae:** *Vinca herbacea* Walds. & Kit. **Araceae:** *Arum maculatum* L. **Araliaceae:** *Hedera helix* L.; **Asclepiadaceae:** *Vincetoxicum hirundinaria* Medic. **Asteraceae:** *Achillea collina* J. Becker ex Reichenb., *A. crithmifolia* Waldst. et Kit., *A. millefolium* L., *A. setacea* Waldst. & Kit., *Anthemis austriaca* Jacq., *A. macedonica* Boiss., *A. tinctoria* L., *Artemisia vulgaris* L., *Carlina vulgaris* L., *Centaurea cyanus* L., *C. deusta* Ten., *C. diffusa* Lam., *Centaurea stoebe* L. (Syn. *C. rhenana* Boreau), *Chamomilla recutita* (L.) Rauschert, *Chondrilla juncea* L., *Cichorium intybus* L., *Cirsium arvense* (L.) Scop., *Crepis sancta* (L.) Bab., *C. setosa* Haller f., *Filago eriocephala* Guss., *Galinsoga parviflora* Cav., *Hieracium glaucinum* gr., *H. hoppeanum* Schultes, *H. olympicum* Frein., *H. praealtum* Vill. Ex Goch., *H. praealtum* Vill. Ex Goch. ssp. *bauchinii*, *H. pilosella* L., *H. piloseloides* Vill., *H. schmidtii* Tausch, *Lactuca perennis* L., *L. saligna* L., *Lapsana communis* L., *Leontodon crispus* Vill., *Logfia arvensis* (L.) Holub, *Mycelis muralis* (L.) Dumort., *Senecio jacobaea* L., *S. vernalis* Waldst. & Kit., *Sonchus arvensis* L., *Taraxacum officinale* F. H. Wigg., *Xanthium strumarium* L., *Xeranthemum annuum* L.; **Betulaceae:** *Carpinus betulus* L., *C. orientalis* Mill., *Corylus avellana* L., *Ostrya carpinifolia* Scop.; **Boraginaceae:** *Buglossoides arvensis* (L.) I. M. Johnst., *B. purpureoacerulea* (L.) I. M. Johnst., *Cynoglossum officinale* L., *Echium vulgare* L., *Myosotis ramosissima* Rochel, *Nonea atra* Griseb., *Symphytum officinale* L., *S. ottomanum* Friv.

Brassicaceae: *Alliaria petiolata* (M.Bieb.) Cavara & Grande, *Alyssum parviflorum* Bieb., *Arabis procurrens* Waldst. & Kit., *A. sagittata* (Bertol) DC., *A. turrata* L., *Berteroa incana* (L.) DC, *Capsella bursa-pastoris* (L.) Medic., *Erophila verna* (L.) Chevall., *Erysimum diffusum* Ehrh., *Thalspi kovatsii* Heuffel; **Campanulaceae:** *Campanula glomerata* L. spp. *hispida* (Witašek) Hayek, *C. persicifolia* L., *C. lanata* Friv., *C. rapunculoides* L., *C. rapunculus* L., *C. trachelium* L., *Jasione heldreichii* Boiss. et Orph.;

Caprifoliaceae: *Sambucus ebulus* L., *S. nigra* L.; **Caryophyllaceae:** *Cerastium luridum* Guss., *Dianthus petraeus* Waldst. & Kit., *Minuartia saxifraga* (Friv.) Graebner, *Moehringia pendula* (Waldst. & Kit.) Fenzl, *Petrorhagia prolifera* (L.) P. W. Ball & Heywood, *Scleranthus perennis* L., *Silene armeria* L., *S. bupleuroides* L. Chater et Walters, *S. italica* (L.) Pers., *Viscaria vulgaris* Röhl. ssp. *atropurpurea* (Griseb.) Stoj.; **Celastraceae:** *Euonymus europaeus* L., *E. verrucosus* Scop.; **Cistaceae:** *Helianthemum nummularium* (L.) Mill.; **Convolvulaceae:** *Convolvulus arvensis* L.; **Cornaceae:** *Cornus mas* L.; **Crassulaceae:** *Jovibarba heuffelii* (Schott) A. et D. Löve, *Sedum album* L., *S. hispanicum* L., *S. urvillei* DC; **Dioscoreaceae:** *Tamus communis* L.;

Dipsacaceae: *Cephalaria transsylvanica* (L.) Roem. & Schult., *Scabiosa triniifolia* Friv.; **Euphorbiaceae:** *Euphorbia amygdaloides* L., *E. cyparissias* L., *Mercurialis perennis* L.; **Fabaceae:** *Astragalus onobrychis* L., *Chamaecytisus jankae* (Velen.) Rothm., *C. supinus* (L.) Link, *Chamaespartium sagittale* (L.) Gibbs, *Coronilla varia* L., *Dorycnium herbaceum* Vill., *Genista januensis* Viv., *G. tinctoria* L., *Lathyrus pratensis* L., *L. tuberosus* L., *L. vernus* Bernh., *Lotus corniculatus* L., *Medicago falcata* L., *M. lupulina* L., *M. minima* (L.) Bartal., *Melilotus alba* Medicus, *Robinia pseudoacacia* L., *Trifolium alpestre* L., *T. angustifolium* L., *T. arvense* L., *T. campestre* Schreb, *T. diffusum* Ehrh., *T. dubium* Sibth., *T. medium* L., *T. ochroleucon* Huds., *T. pratense* L., *T. repens* L., *T. setiferum* Boiss, *T. striatum* L., *Vicia cracca* L., *V. grandiflora* Scop., *V. sativa* L., *V. tetrasperma* (L.) Schreb., *V. varia* Host, *V. villosa* Roth; **Fagaceae:** *Fagus sylvatica* L., *Quercus cerris* L., *Q. Dalechampii* Ten., *Q. pubescens* Willd., *Q. rubra* L.; **Geraniaceae:** *Erodium cicutarium* (L.) L'Hér., *Geranium lucidum* L., *G. molle* L., *G. robertianum* L., *G. rotundifolium* L.; **Hypericaceae:** *Hypericum linarioides* Bosse, *H. perforatum* L., *H. umbellatum* A. Kern.; **Lamiaceae:** *Acinos alpinus* (L.) Moench ssp. *hungaricus* (Simonkai) Sojak, *A. rotundifolius* Pers., *Ajuga reptans* L., *Ballota nigra* L., *Calamintha nepeta* (L.) Savi, *Clinopodium vulgare* L., *Galeopsis ladanum* L., *G. tetrachit* L., *Glechoma hederacea* L., *Marrubium peregrinum* L., *Lamium purpureum* L., *Origanum vulgare* L., *Prunella vulgaris* L., *Satureja coerulea* Janka, *Teucrium chamaedrys* L., *Thymus callieri* Borbas ex Velen., *T. pulegioides* L., *T. sibthorpii* Benth., *T. striatus* Vahl; **Malvaceae:** *Malva sylvestris* L.; **Oleaceae:** *Fraxinus excelsior* L., *F. ornus* L., *Ligustrum vulgare* L.; **Papaveraceae:** *Chelidonium majus* L., *Papaver laevigatum* M. Bieb.; **Plantaginaceae:** *Plantago lanceolata* L.; **Polygonaceae:** *Polygonum aviculare* L., *Rumex acetosa* L., *R. Acetosella* L., *R. crispus* L.; **Primulaceae:** *Lysimachia punctata* L.; **Pyrolaceae:** *Orthilia secunda* (L.) House; **Ranunculaceae:** *Clematis vitalba* L., *Helleborus odorus* Waldst. & Kit.; **Rosaceae:** *Agrimonia eupatoria* L., *Aremonia agrimonoides* (L.) DC., *Crataegus monogyna* Jacq., *Filipendula vulgaris* Moench, *Fragaria vesca* L., *F. Viridis* Duchesne, *Geum urbanum* L., *Potentilla argentea* L., *P. laciniata* Waldst. & Kit. ex Nestl., *P. reptans* L., *Prunus avium* (L.) L., *P. cerasifera* Ehrh., *P. mahaleb* L., *P. Spinosa* L., *Pyrus pyraeaster* Burgsd., *Rosa canina* L., *R. micrantha* Borrer ex Sm., *Rubus discolor* Weihe & Nees, *Sanguisorba minor* Scop. **Rubiaceae:** *Cruciata glabra* (L.) Ehrend., *C. laevipes* Opiz, *Galium aparine* L., *G. flavescens* Borbas, *G. lucidum* All., *G. odoratum* (L.) Scop., *G. pseudoaristatum* Schur, *G. spurium* L., *G. verum* L., *Sherardia arvensis* L.;

Saxifragaceae: *Saxifraga rotundifolia* L.; **Scrophulariaceae:** *Digitalis lanata* Ehrh., *Euphrasia pectinata* Ten., *Verbascum densiflorum* Bertol., *V. lychnitis* L., *V. nigrum* L., *Veronica chamaedrys* L., *V. verna* L., *V. vindobonensis* (M. A. Fisch.) M.

A. Fisch.; **Tiliaceae:** *Tilia cordata* Mill.; **Urticaceae:** *Parietaria officinalis* L., *Urtica dioica* L.; **Verbenaceae:** *Verbena officinalis* L.; **Violaceae:** *Viola arvensis* Murr., *V. canina* L., *V. reichenbachiana* Jord. ex Boreau;

Liliopsida

Cyperaceae: *Carex caryophylla* Latourr., *C. digitata* L., *C. divulsa* Stokes ex With., *C. echinata* Murr., *C. remota* L.; **Juncaceae:** *Luzula campestris* (L.) DC., *L. forsteri* (Sm.) DC., *L. pilosa* (L.) Willd.; **Liliaceae:** *Muscari neglectum* Guss. ex Ten., *M. tenuiflorum* Tausch, *Ruscus aculeatus* L.; **Poaceae:** *Agrostis capillaris* L., *Anthoxanthum odoratum* L., *Apera spica-venti* (L.) P. Beauv., *Arrhenatherum elatius* (L.) P. Beauv. ex J & C. Presl, *Brachypodium pinnatum* (L.) P. Beauv., *B. sylvaticum* (Huds.) P. Beauv., *Bromus commutatus* Schrad., *B. mollis* L., *B. sterilis* L., *Chrysopogon gryllus* (L.) Trin., *Cynodon dactylon* (L.) Pers., *Cynosurus cristatus* L., *C. echinatus* L., *Dactylis glomerata* L., *Dasypyrum villosum* (L.) Cand., *Dichanthium ischaemum* (L.) Roberti, *Elymus repens* (L.) Gould, *Festuca heterophylla* Lam., *F. rubra* L., *F. valesiaca* Schleich. ex Gaudin, *Hordelymus europaeus* (L.) Harz., *Koeleria macrantha* (Ledeb.) Schult., *K. nitidula* Velen., *Lerchenfeldia flexuosa* (L.) Schur, *Lolium perenne* L., *Melica ciliata* L., *M. uniflora* Retz., *Phleum phleoides* (L.) Karsten, *P. pratense* L., *Poa angustifolia* L., *P. annua* L., *P. bulbosa* L., *P. compressa* L., *P. nemoralis* L., *P. sylvicola* Guss., *P. trivialis* L., *Setaria pumila* (Poir.) Schult., *Vulpia myurus* (L.) C. C. Gmel.

Annex II: Synoptic table of vegetation syntaxa of Chamdzha managed reserved. About woody species were used following abbreviations: tr - for tree layer, sh - for shrub layer and juv - for juvenile species.

Relevé No	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Altitude [m]	779	880	748	847	611	924	664	923	920	923	850	582	640	660
Exposure	90	135	45	360	90	180	225	180	135	180	180	90	360	45
Inclination [degree]	15	5	30	10	25	15	30	10	10	10	15	20	30	60
Plot size [m ²]	16	16	100	100	100	100	100	100	100	100	100	100	100	100
Total coverage [%]	70	80	85	80	90	75	85	75	80	85	75	85	85	90
Cover of tree layer [%]	0	0	65	70	80	60	60	50	50	70	70	60	70	60
Cover of shrub layer [%]	0	8	15	10	40	10	50	20	15	5	35	65	60	40
Cover of herb layer [%]	35	80	25	15	30	15	40	35	80	30	5	15	30	20
Cover of mosses [%]	40	20	3	3	2	0	35	1	70	1	0	2	15	70
Cover of lichens [%]	10	0	2	2	0	0	0	0	0	0	0	0	0	0
Latitude	42,73813	42,74239	42,73492	42,73933	42,73296	42,74742	42,73096					42,73137	42,73386	42,73416
Longitude	24,58528	24,58161	24,58913	24,58279	24,59299	24,57252	24,59228					24,59372	24,59178	24,59085
Species number	23	23	16	12	22	13	19	8	10	14	11	24	27	21

Ch. species of cl. *Koelerio-Corynephoretea*

Veronica verna	+	+	.	.	.	.	.	.	.	.	.	.	.	.
Poa bulbosa	+	1	.	.	.	.	.	.	.	.	.	.	.	.
Trifolium arvense	+	1	.	.	.	.	.	.	.	.	.	.	.	.
Scabiosa triniifolia	+	+	.	.	.	.	.	.	.	.	.	.	.	.
Chamomilla recutita	2	2	.	.	.	.	.	.	.	.	.	.	.	.
Ceratodon purpureus	2	1	.	.	.	.	+	.	.	.	.	.	.	.
Scleranthus perennis	3	2	1	.	.	.	2	.	.	.	.	.	.	.
Polytrichum piliferum	1	2	+	.	.	.	2	.	.	.	.	.	.	.
Hieracium pilosella	.	2	.	.	+	.	.	.	.	.	.	.	.	.
Syntrichia ruralis	2	.	.	.	.	.	.	.	.	.	.	.	.	.

Ch. species of cl. *Erico-Pinetea* & all. *Erico-Fraxionion orni*

Pinus nigra (tr)	.	.	3	3	4	4	4	4	2	.	2	4	.	.
Pinus nigra (sh)	.	.	2	.	.	.	2	.	.	.	.	.	.	.

Ch. species of cl. *Quercu-Fagetea* & all. *Carpinion betuli*

Carpinus betulus (sh)	.	.	.	.	.	.	.	.	.	3	2	.	.	.
Quercus dalechampii (tr)	.	.	3	3	2	2	.	.	.	3	4	.	3	4
Quercus dalechampii (sh)	.	.	+	2	2	.	.	2	2	+	2	.	.	.
Melica uniflora	.	.	.	.	.	.	.	.	.	2	2	2	+	.

continuation of Annex II

Ch. species of cl. *Quercetea pubescentis* & all. *Carpinion orientalis*

Carpinus orientalis (sh)	.	.	1	.	1	.	.	+	2	.	.	4	3	4
Acer campestre (sh)	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Prunus mahaleb (juv)	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Tamus communis	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Acer campestre (tr)	.	.	.	.	.	.	.	.	.	.	.	.	2	.
Poa nemoralis	.	.	.	2	.	.	.	.	.	.	+	.	2	+

transgressive ch. species of cl. *Erico-Pinetea* & *Quercetea pubescentis*

Fraxinus ornus (sh)	.	.	+	.	2	1	2	2
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Other species

Fraxinus ornus (juv)	+	+
Ruscus aculeatus	3
Helleborus odorus	+	+	.	.	.
Carpinus orientalis (tr)	2	.	.	.	2
Abies alba (juv)	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Pinus nigra (juv)	1	1	.	.	.	.	.	.	.	.	.	.	.	.
Quercus cerris (tr)	.	.	.	.	.	.	.	.	2	2	.	.	.	.
Lerchenfeldia flexuosa	.	.	2	+	+	2	+	3	2	.	.	.	.	2
Geranium lucidum	.	.	.	.	.	.	.	.	.	+	+	.	.	.
Geranium molle	.	.	.	.	.	.	.	.	.	.	.	+	+	+
Ceterach officinarum	.	.	.	.	+	.	.	.	.	.	.	+	+	+
Campanula rapunculoides	.	.	.	.	.	.	.	.	.	.	.	.	+	+
Porella platyphylla	.	.	.	.	.	.	.	.	.	.	.	+	.	+
Viola reichenbachiana	.	.	.	.	.	.	.	.	.	+	.	+	+	.
Arabis procurrans	.	.	.	.	.	.	.	.	.	.	.	.	+	2
Arabis sagittata	.	.	.	.	.	.	.	.	.	.	.	.	2	+
Galeopsis tetrachit	.	.	.	.	.	.	.	.	.	.	.	+	1	.
Asplenium adiantum-nigrum	.	.	.	.	.	.	.	.	.	.	.	+	.	+
Hypericum linarioides	+	.	.	.	.	.	+	.	.	.	.	.	.	.
Genista januensis (sh)	.	.	+	+	.	.	+	.	.	.	.	.	.	.
Quercus dalechampii (juv)	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Polypodium vulgare	.	.	.	.	.	.	.	+	+	.	.	.	2	.
Achillea collina	+
Quercus cerris (sh)	2
Campanula persicifolia	+	.	.	.	+	.	.
Hieracium olympicum	+	.	+	+

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continuation of Annex II

Lamium purpureum	+	.	.
Sedum hispanicum	+	+	1	1	.
Acer platanoides (sh)	+	.	.
Silene bupleuroides	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Galium flavescens	.	.	.	.	+	.	2	.	.	.	.	.	.	+	.
Dianthus petraeus	.	.	1	.	.	.	+	.	.	.	.	.	.	.	.
Lathyrus vernus	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Bryum argenteum	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Luzula pillosa	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Agrimonia eupatoria	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Lapsana communis	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Hieracium piloselloides	.	.	2	2	+	.	.	.	.	.	.	.	.	.	+
Grimmia pulvinata	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Chamaecytisus jankae (sh)	+	1	+	1	2	2	+	.	.	.	.	.	.	.	.
Hedera helix	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Veronica chamaedrys	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Galium aparine	.	.	.	.	+	+	.	.	.	.	.	.	+	.	+
Phleum phleoides	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Atrichum undulatum	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Festuca heterophylla	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Dactylis glomerata	.	.	.	.	+	.	.	.	.	.	.	.	+	.	+
Quercus rubra (juv)	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Hypnum cupressiforme	.	.	+	1	+	.	.	.	.	.	.	.	+	.	2
Saxifraga rotundifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Viscaria vulgaris	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.
Moehringia pendula	.	.	.	.	2	+	+	.	.	.	.	.	.	+	2
Agrostis capillaris	.	2	.	.	.	.	1	.	.	.	.	.	.	.	.
Carex digitata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Lophocolea minor	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Grimmia anodon	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Jovibarba heuffellii	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Aremonia agrimonoides	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+
Galium pseudaristatum	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+
Tamus communis	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Verbascum lychnitis	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Achillea crithmifolia	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Rosa canina (sh)	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Campanula rapunculus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Melica ciliata	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.



ШУМАРСКИ ПРЕГЛЕД

Меѓународно научно списание
Год. 46 / Стр. 1-95
Скопје, 2015

FOREST REVIEW

International Scientific Journal
Vol. 46 / Pag. 1-95
Skopje, 2015

Online ISSN 1857-9507

УДК 630

УДК 635.9

УДК 674

Online ISSN 1857-9507

UDC 630

UDC 635.9

UDC 674

Издавач

Универзитет „Св. Кирил и Методиј“ во Скопје
Шумарски факултет во Скопје
Декан
Д-р Јане Ацевски

Publisher

Ss. Cyril and Methodius University in Skopje
Faculty of Forestry in Skopje
Dean
Jane Acevski PhD

Главен и одговорен уредник

Д-р Бојан Симовски

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Bojan Simovski PhD, *Ramonda nathaliae*

Излегува еднаш годишно

Published once a year

Интернет-страница

www.sf.ukim.edu.mk/sumarski_pregled.htm

Web page (on-line)

www.sf.ukim.edu.mk/sumarski_pregled.htm

Адреса на издавачот

УКИМ-Шумарски факултет во Скопје
Редакција на Шумарски преглед
Ул. „16 Македонска бригада“ бр. 1
(П. факс 235)
1 000 Скопје
Република Македонија
Е-пошта: sumpregled@sf.ukim.edu.mk
www.sf.ukim.edu.mk

Publisher's address

UKIM Faculty of Forestry in Skopje
Editorial Board of the Forest Review
Ul. 16 Makedonska brigada br. 1
(P.O. box 235)
MK-1000 Skopje
Republic of Macedonia
E-mail: sumpregled@sf.ukim.edu.mk
www.sf.ukim.edu.mk

Шум. преглед (Šum. pregled)
For. review

Год. 46
Vol. 46

Стр. 1-95
Pag. 1-95

Скопје, 2015
Skopje, 2015

