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Monitoring methodology and protocols for 20 habitats, 20 species and 20 birds

Twinning Project MK 13 IPA EN 02 17

Strengthening the capacities for effective implementation of the acquis in the field of nature protection

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1. Introduction

Summary

Inventory and monitoring is integral part to collect information on habitats and species for purposes to fill Standard data forms of each Natura 2000 area and while reporting on conservation status of habitats and species to EU commission at 6 year period according to Article 17 of the Habitats directive. Data on habitats and species is also needed for national purposes like to follow changes of biodiversity. In this twinning project monitoring protocols have been created for 20 habitats, 20 bird species and 20 other species of plants and animals of the Habitats Directive. For most of the species (except birds) and habitats active searching is the most efficient way to make observations. Some species of invertebrates, however, cannot be effectively monitored without proper traps and other inventory equipment. In this report, the main inventory and monitoring methods are listed and shortly described. At the end of the report selected 40 Annex species of the Habitats and Bird Directives and 20 habitat of Annex I of the Habitats Directive are introduced in “fact sheet” pages. Also draft assessments of conservation status (except for the birds) are given in the fact sheets. This assessment follows the principles of the reporting format of Article 17 of the Habitats directive and Article 12 of the Birds directive.

Fig 1. *Ourapteryx sambucaria* is one of the most impressive Geometrid moths in Europe. The larvae feeds on the leaves of elderberries (*Sambucus spp*). The species is nocturnal and sometimes it can be found in light traps.

Overview

Implementation of habitats and birds directive requires sufficient data from large number of habitats and species. In this project data gathering is strengthened by producing monitoring protocols for the selected species of habitats, birds and other species. The main interest in this work is in the "*species of community interest*" (Annex I habitat types and Annex II and IV species of the habitats directive) and in bird species – especially the species in the Annex I of the Birds directive. In addition, species of national interest (endemic species and species with high international conservation value) have been taken into account in planning the monitoring protocols.

The first step is to collect inventory data from selected areas and test how different inventory methods work in local conditions. The methods tested have been used in the inventories and monitoring of the species in other parts of Europe. However, even if the methods have been used in other areas, not all methods are necessarily cost effective in local conditions. For this reason, the final list of recommended methods will not contain all methods tested during the project.

One challenge in the work is the shortage of old data from several taxonomic groups and habitat types. Some taxonomic groups (plant species, birds and mammals) are well studied, whereas some taxonomically demanding groups have not been studied almost at all. Another challenge is the availability of data. "Open access" in not commonly adopted in the Republic of North Macedonia yet. Also potential to use citizen science in the data production is rather limited. For the establishment of Natura 2000 network, there is a need to get comprehensive data from all bird species and the Annex II species and Annex I habitats of the habitats directive. Gathering sufficient data from all relevant taxonomic groups will be a challenge.

Fig 2. Long series of wintering water bird monitoring data is available from Prespa Lake. Prespa Lake is an "*Important Bird Area*" (IBA) and also a wetland conservation area based on Ramsar convention. It is important wintering area for large amounts of water birds and during summer season numerous bird species are nesting in the shoreline of the lake. Photo Petri Ahlroth.

Establishment of Natura 2000 network and the process of site selection

While preparing Natura 2000 network, a member state needs to have proper data from the species and habitats of community interest. The data must cover whole territory of the country and also biogeographic zones inside each member states should be took into account. The final site selection must be done following the guidance rules accepted by the Habitats committee (*Doc. Hab. 97/2 rev. 4 18/11/97*): https://bd.eionet.europa.eu/activities/Natura_2000/crit. The sufficiency of Natura 2000 will be assessed in "*Biogeographical seminar*". The sufficiency will also be assessed for each biogeographical region separately.

Preparation of reference lists for the species and habitats

At the early phase of Natura 2000 process each member state has to prepare reference lists of Annex habitats and species in the country. In the reference list a member state provides a list of annex II and IV species living in the country separately for each biogeographical region. The list includes those species which have permanent population in the country. Also species extinct in the country, migratory species, occasional visitors, invasive and alien species are indicated in the list but with separate markings. Reference lists are also required in the preparation of the reports according to Article 17 of the Habitats directive and Article 12 of the birds Directive.

Data on Habitat Directive and Bird Directive annex species is available at University collections, within collections and notebooks of individual experts and on literature, but not yet in public or non-public database in the Republic of North Macedonia. In the beginning to establish Natura 2000 network it is recommentable to gather existing information on different species groups of Habitat Directive annexes together. This helps to direct inventories into right places. During this project a national reference list of Habitat Directive vascular plant and bryophyte species was compiled by national experts from UNDP project and twinning experts.

Needs for data

The data from the species and habitats in each Natura 2000 site is collected and included in the Natura 2000-database. The legal basis for the designation of Natura 2000 site is based on Annex II species of the Habitats Directive, but also Annex IV (and V) species and species of national interest are included in the list of "other species" in the *standard data form*. The database has "Standard data forms" (SDF) for each site. Some fields of SDF can be filled according to observations from the single site, but in most cases part of the SDF fields can be finalized only after the inventories in the larger number of sites or even after the data has been collected from the whole country.

Another need for the data appears from the requirements to prepare every sixth year reports on all bird species under Article 12 of the birds Directive, and habitats (Annex I) and other species of community interest (Annex II, IV and V) under Article 17 of the Habitats directive. This document provides recommendations for the monitoring of selected species and habitats.

In addition, assessments of conservation status for the selected species and habitats are given. However, these assessments in this document are based mainly on the data from the selected (2) areas (Pelister National Park and Prespa lake conservation areas). For this reason these assessments are only an exercise demonstrating how the assessments of conservation status should be carried out. In real national assessments the data is needed from the

whole country. The conservation status in this document is assessed using same principles which are used in the assessments of Article 17 reporting of the habitats and species and Article 12 of the Bird directive.

Fig.3. Data is needed also from many species which are common and not under threat. The Lake frog *Pelophylax ridibundus* (syn. *Rana ridibunda*) for example, is included in the Annex V of the Habitats Directive. Annex V contains animal and plant species of community interest those taking in the wild and exploitation may be subject to management measures. Even if Annex V species do not reguire special conservation measures from the Member States, there is still a need to prepare "light version" report species according to Article 17 of the Habitats Directive. These Annex V species can also be added into table 3.3. of the Standard data form of each Natura 2000 area. Photo Kimmo Syrjänen.

Protocols for the monitoring of birds

For the monitoring, methods used for the inventories can be applied for nearly all bird species exploiting the habitats. Two main methods used are:

1) Point counts of so-called land birds

2) Round count of waterfowl, covering together most species.

3) Raptor species are an exception as their population densities are usually low, and the advisable method is active searching of territories or nests.

Fig. 4. Red-backed Shrike *Lanius collurio* has dense population in traditionally managed agricultural areas. The species is very visible and it is easy to observe during the inventories. It is a species of Bird Directive Annex I. For these species Member States must conserve their most suitable territories in number and size as Special Protection Areas (SPAs). Status of the species need to be reported under the Article 12 of the Birds Directive. Photo Petri Ahlroth.

Point counts of breeding land birds

In many countries point counts are the main method in monitoring the population changes of breeding landbirds. For instance in most Nordic countries annually over 250 routes per country are carried out. The data enables yearly changes of bird populations, differences in species composition between habitats and abundance patterns of species. Besides land birds, also rails and waders are counted.

Following groups are not gounted in point counting:

- Ducks, Grebes and Divers
- Gulls and Terns
- Coot

Good identification skills, including knowledge of songs, calls and alarm notes of birds.

The time needed is at least 3– 4 morning hours / route.

Point count form or notebook, pen, stopwatch, binoculars, GPS or alternatively a compass and a map.

Choosing of a counting route and points:

- One may plan the route and points freely for the first count.
- The same points are censused in subsequent years. The best comparable results are achieved if the observer remains the same.
- Points are located in habitats as uniform as possible.
- Surrounding of the point within at least 50 m should be of the same habitat type. The observations are devided to inside and outside of 50 m range.
- Moving between points is free: on foot, by bicycle or car etc.
- Minimum distance between points is 250 m in forest and 350 m in open areas, to reduce double-counting the same individuals.
- Same individuals are counted although heard in more than one point.
- Up to 20 points on each route.
- Observation time exactly 5 min at each point.

Census period and time of day

- In North Macedonia the same route could be censused both for the early breeding species in latter half of April and for late breeding species in mid-May.
- Same observer may count several routes during one spring.
- The best time for censusing is starting at sunrise and continuing up to ca. 5 hours.

Weather

- The best censusing weather is calm (on nearly windless).
- If the wind is moderate or strong, or if it is rainy or cold, no point countings should be done.

Interpreting observations

- The census unit is a pair.
- Pairs are interpreted as following:
    - Male heard or seen
    - Pair
    - Single female (if male not around)
    - Party of fledglings
    - Nest

Interpreting observations – flocks

- Small flocks of e.g. early breeders are interpreted as fledgling flocks (Crossbill, Starling, House Sparrow, Hooded Crow, Siskin): 1-6 individuals = 1 pair, 7-12 ind. = 2 pairs, etc.
- Small flocks of late breeders (e.g. swallows), unlikely including fledglings, can be divided by two: 1-2 ind. = 1 pair, 3-4 ind. = 2 pairs, etc.
- Birds flying by are also taken into account, but not clearly migrating ones.

Repeating the count

- The same observer should census the same route each year if possible.
- The timing of the census should not differ by more than ± 7 days from the date of the first count.
- Take the phenology of the spring into account so that the chosen day is comparable with earlier censuses.
- The start of the count should not differ by more than ± 30 min from that of the first year.
- More information: https://www.luomus.fi/en/methods-bird-monitoring

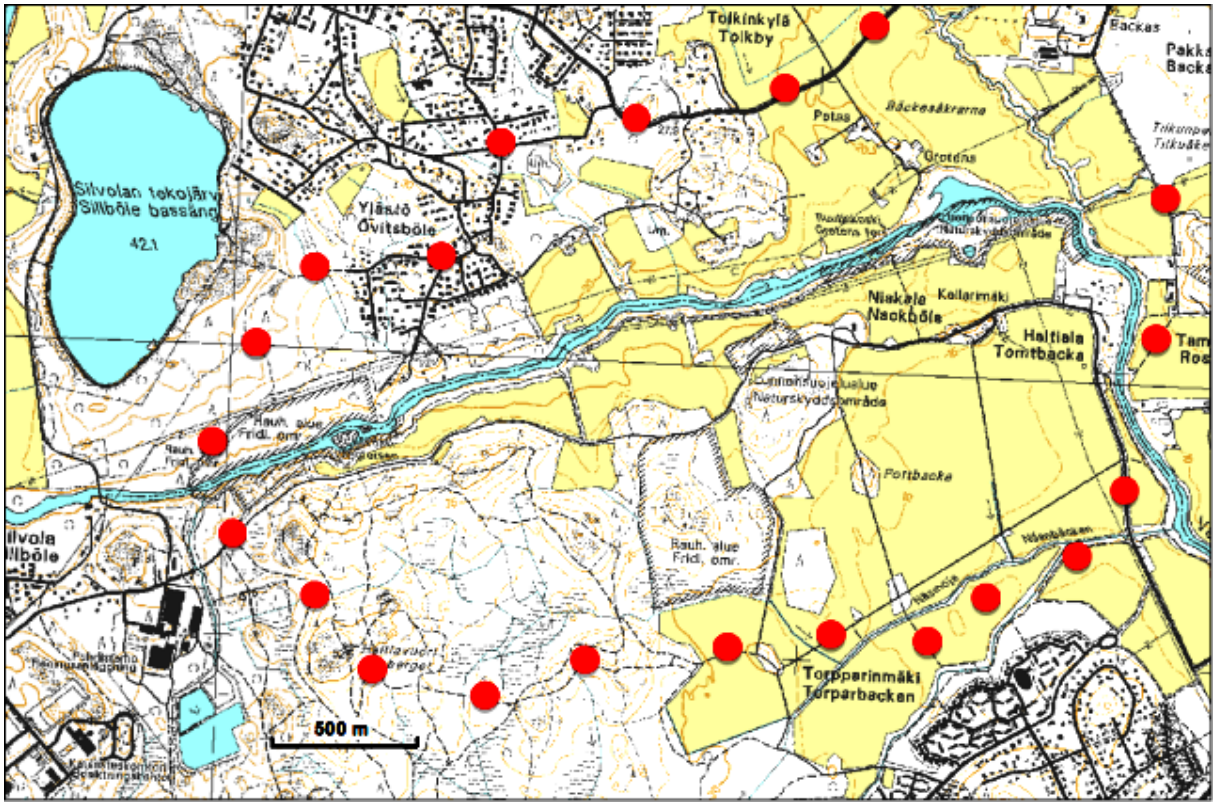

Fig. 5. An example of point counting line from southern Finland. There is recommended to be up to 20 counting points per line. Minimum distance between points is 250 m in forest and 350 m in open areas, to reduce double-counting the same individuals.

Round counts of waterfowl

The aim of round counts is to collect data on the population size and abundance of waterfowl over entire waterbodies (fig. 6). Divers, grebes, swans, geese, ducks, gulls, terns and the Coot are the main subjects. In larger waterbodies like Prespa Lake the recommended practise is counting by boat.

Fig. 6. An example of round count of waterfowls along Prespa Lake at area of the Republic of North Macedonia. Counting of birds is often necessary to do out from long distances. For this reason, good binoculars and in some cases also telescopes are needed. Here counting is done from motorboat with binoculars and it is a cost effective method to cencus waterfowls. However, this method also needs good capacity to recognize bird species.

Other recommended inventory methods for land birds are the line transect census and the mapping census, and for waterfowl the waterfowl point counts.

For full guidance see:

https://www.luomus.fi/en/methods-bird-monitoring

http://www.ebcc.info/methods-2018/

For the bird species, fact sheets have prepared from 20 species. Birds Directive does not recognize term "conservation status" parallel to Habitats directive, so the assessment of the status of selected bird species is based on those main parameters which are used in the reporting under Atricle 12 of the Birds directive. For the monitoring protocols selection of only 20 species is artificial, but these fact sheets provides examples on diffent kind of birds protected under the Bird Directive. Methods used for the inventories of birds can be applied for nearly all species living in the same kind of habitat. Two main method 1) point line counting of land birds and 2) counting of water birds cowers nearly all species. Only raptor birds are an exception as their population densities are usually low. Counting raptor birds is usually based on active searching of territories or nesting sites.

Table 1. Selected 20 bird species of birds for the fact sheets and assessments.

1. Goosander *Mergus merganser*
2. Hazel Grouse *Bonasa bonasia*

3. Black-necked Grebe *Podiceps nigricollis*
4. Pygmy Cormorant *Microcarbo pygmaeus*
5. Dalmatian Pelican *Pelecanus crispus*
6. Little Egret *Egretta garzetta*
7. Short-toed Eagle *Circaetus gallicus*
8. Montagu's Harrier *Circus pygargus*
9. Golden Eagle *Aquila chrysaetos*
10. Booted Eagle *Hieraaetus pennatus*
11. Coot *Fuliga atra*
12. Turtle Dove *Streptopelia turtur*
13. Common Kingfisher *Alcedo atthis*

14. Black Woodpecker *Dryocopus martius*
15. *Middle Spotted Woodpecker Dendrocopos media*
16. *White-backed Woodpecker Dendrocopos leucotos*
17. Woodlark *Lullula arborea*
18. Barred Warbler *Sylvia nisoria*
19. Red-backed Shrike *Lanius collurio*
20. Red-billed Chough *Pyrrhocorax pyrrhocorax*

Term *Bird species status and trends* is used in the reporting of bird species under Article 12 of the Birds Directive instead of term "*Conservation status*" used in Habitats directive. Birds Directive does not recognize term "*Conservation status*" at all.

Parameters for the reporting of Birds directive (Article 12) are as follows:

(For bull guidance see: http://cdr.eionet.europa.eu/help/birds_art12)

***Bird species "status and trends"*:**

Population size (min/max) Number-number

Population trend

Short term (last 12 years) Text

Long term (ca 1980-2018, or a period as close as possible to that) Text

Breeding distribution (map and size): Number

Breeding distribution trend

Short term (last 12 years) Text

Long term (ca 1980-2018, or a period as close as possible to that) Text

Progress of species action and management plans

Text

Main pressures and threats: List

Conservation measures: Text

Natura 2000 (SPA) coverage: Area

Information related to Art 7 (huntable) species: Text

Hunting bag (statistics min/max): Number-number

Bird species status and trends:

Population size (min/max)

Population trend

- Short term (last 12 years)
- Long term (ca 1980-2018, or a period as close as possible to that)

Breeding distribution (map and size)

Breeding distribution trend

- Short term (last 12 years)
- Long term (ca 1980-2018, or a period as close as possible to that)

Progess of species action and management plans

Main pressures and threats

Conservation measures

Natura 2000 (SPA) coverage

Information related to Art 7 (huntable) species

- Hunting bag (statistics min/max)

See *Parus cristatus* as an example species: https://bd.eionet.europa.eu/article12/summary?period=1&subject=A327

Protocols for the monitoring of habitat types

Habitat monitoring is mainly based on the use of data from remote sensing and field inventories. Field inventories provide also data for the monitoring of plant species especially, but additionally data from several other taxonomic groups can be collected at the same time.

Data on Annex I habitats should be collected and saved following the requirements of table 3.1 of the Natura 2000 Standard data form. Data sheets for the field inventories and instructions to fill them are included in the report "Draft 5 year biodiversity program" of this project. Also all data sheets are listed as annexes at the end of this report. Proper preparation of Standard data form requires not only the data from the site but also wider understanding of the status of the habitats in the whole country.

"Relative surface:", for example, can be assessed only by comparing the surface of habitat (in the site) with habitats of the whole country. In assumption of representativity, habitat interpretation manual (European commission 2013) provides a definition of habitat type and indication of characteristic species that can be compared to habitat type at each site. Habitat fact sheets will provide help to representativity assumption because they contains information on definion of the habitat type based on EU's interpretation manual (European commission 2013), EUNIS classification (Evans & Roekaerts 2015) and data on structure and function of each habitat type as well as nationally typical vegetation types and species of the habitat. In Habitat type fact sheets (20) information on the national vegetation types and local species composition were composed together with twinning and national (UNDP) experts (Table 2).

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Table 2. In twinning project fact sheets and assessments of conservation status have been prepared for the following 20 Annex I Habitat types of the Habitats Directive. Priority habitat types are shown by asterisk *.

FRESHWATER HABITATS

1. 3150 Natural eutrophic lakes with Magnopotamion or Hydrocharition -type vegetation
2. 3130 Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoëto-Nanojuncetea
3. 3260 Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation

TEMPERATE HEATH AND SCRUB

4. 4060 Alpine and Boreal heaths

SCLEROPHYLLOUS SCRUB (MATORRAL)

5. 5130 Juniperus communis formations on heaths or calcareous grasslands

NATURAL AND SEMI-NATURAL GRASSLAND FORMATIONS

6. 6220 * Pseudo-steppe with grasses and annuals of the Thero-Brachypodietea
7. 6260 * Pannonic sand steppes
8. 62D0 Oro-Moesian acidophilous grasslands
9. 6430 Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels

RAISED BOGS AND MIRES AND FENS

10. 7140 Transition mires and quaking bogs
11. 7160 Mineral-rich springs and springfens
12. 7220 * Petrifying springs with tufa formation (Cratoneurion)

ROCKY HABITATS AND CAVES

13. 8130 Caves not open to public
14. 8220 Siliceous rocky slopes with chasmophytic vegetation
15. 8150 Medio-European upland siliceous screes

FORESTS

16. 91 E0 * Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)
17. 91AA * Eastern white oak woods Quercus pubescens
18. 91W0 Moesian beech forests
19. 91BA Moesian silver fir forests
20. 95A0 High oro-Mediterranean pine forests

Contents of standart data form for habitat types of Annex I of the Habitats Directive

Minimum requirements for monitoring data of Habitat types should contains information that is need while filling and updating Standard Data Forms of each Natura 2000 areas and while reporting on conservation status of Habitat Directive habitats under the article 17 to EU commission. This information is needed separately for each biogeographic zone of member state. In the Republic of North Macedonia this means continental and alpine zones.

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These requirements are involved by making inventories to identify and mapping Habitat Direcitive habitat types inside planned or existing Natura 2000 sites. Futhermore data on habitat types from the whole country is needed for reporting under article 17 of the Habitat Directive.

In SDF Table 3.1 is for reporting Habitat types present on the site and assessment for them:

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Annex I Habitat

Code	PF	NP	Cover [ha]	Cave [number]	Data quality

Code: Enter here the four character code of the habitat types of Annex I to Directive 92/43/EEC.

PF: Priority habitat type

NP: Non-presence

Cover: the area of the habitat type in hectares

Cave: the number of caves can be entered if estimated surface area is not available

Data quality; G = 'Good' (e.g. based on surveys); M = 'Moderate' (e.g. based on partial data with some extrapolation); P = 'Poor' (e.g. rough estimation).

Site assessment:

A|B|C|D	A|B|C		
Representativity	Relative Surface	Conservation	Global

Representativity: A: excellent, B: good, C: significant, D: non-significant

Criterion A(a) of Annex III should be linked to the interpretation manual[1] of Annex I habitat types since this manual provides a definition, an indication of characteristic species and other relevant elements. The degree of representativity gives a measure of 'how typical' a habitat type is. If need be, this assessment should likewise take into account the representativity of the habitat type concerned on the site in question, either for a group of habitat types or for a particular combination of different habitat types.

Relative surface: A: 100 – 15 %, B: 15 – 2 %, C: less than 2 %.

RELATIVE SURFACE: = A(b) of Annex III: Area of the site covered by the natural habitat type in relation to the total area covered by that natural habitat type within the national territory. Theoretically, to assess criterion A(b) one needs to measure the surface covered by the habitat type in the site, and the total surface of the national territory that is covered by the same habitat type. Although this is evident, it can be extremely difficult to make these measurements, especially those concerning the reference national surface.

[1] European commission 2013: The Interpretation Manual of European Union Habitats - EUR28. – European Commission DG Environment. Nature ENV B.3. 144 pp. http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/Int_Manual_EU28.pdf.

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DEGREE OF CONSERVATION: = A(c) of Annex III: Degree of conservation of the structure and functions of the natural habitat type, concerned and restoration possibilities. : A / B / C

(i) degree of conservation of the structure; (I) excellent structure, (II) structure well conserved, (III) average or partially degraded structure

(ii) degree of conservation of the functions; (I) excellent prospects, (II) good prospects, (III) average or unfavourable prospects

(iii) restoration possibility; (I) restoration easy, (II) possible with an average effort, (III) difficult or impossible

DEGREE OF CONSERVATION:

A: excellent conservation

= excellent structure, independent of the grading of the other two sub-criteria,

= structure well conserved and excellent prospects (functions) independent of the grading of the third criterion.

B: good conservation

= structure well conserved and good prospects independent of the grading of the third sub-criterion,

= structure well conserved and average/maybe unfavorable prospects and restoration easy or possible with average effort,

= average structure/partially degraded, excellent prospects and restoration easy or possible with average effort,

= average structure/partially degraded, good prospects and easy restoration.

C: average or reduced conservation

= all other combinations.

GLOBAL ASSESSMENT = A.d) of Annex III: Global assessment of the value of the site (The 'best expert judgment' may be used to assess this global value.)

A: excellent value

B: good value

C: significant value

This criterion should be used to assess the previous criteria in an integrated way and taking into consideration the different weights they may have for the habitat under consideration. Other aspects may be considered regarding the evaluation of the most relevant elements in order to globally assess their positive or negative influence on the conservation of the habitat type. The 'most relevant' elements may vary from habitat type to habitat type; they may include the human activities, both in the site or in its neighboring areas, that are likely to influence the conservation status of the habitat type, the ownership of the land, the existing legal status of the site, the ecological relations between the different habitat types and species, etc.

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All relevant national inventory data (including historical data) on habitats should be collected in one place and processed in a form that it serves monitoring and later reporting of habitats. Historical background data on land use is valuable also while planning measures of those habitats which require management activities in the field.

In habitat type inventories and mapping remote sensing technics can be used combined with field inventories. Field inventory data should especially be collected from sites those are designed to be monitored. In remote sensing technics satellite images can provide data to recognize particular habitats and it can also provide structural information on quality of habitats. Scanner in airplane can provide more fine scaled data on structure of habitat and also video by drone may be very useful while searching and mapping habitats. For example vegetation types of extensive wetland areas is possible to map and monitore quickly with drones. Remote sensing technics can save time and money, but it usually needs combined field work to find out species composition and all vegetation types. The quality of habitats (structures and functions, need of measures, presence of alien species, etc.) can best be seen during the visits in the field.

In many countries, forest sector maintain large inventory databases which have been planned to serve forestry purposes. These database, however, usually include data which allow typifying of forest habitats – at least at some general level. There can be also important information on structure of habitats (tree species composition, age, volume etc.). Data on the quality of habitats, in stead, may require more field work. Wetlands, for comparision, can be sometimes identified in general level from the satellite images. Many wetlands, however, can be named exactly only according to vegetation type. Vascular plants and mosses usually play important role in the identification on nutrient levels of mires and other peatlands.

Grassland types are the most demanding group in the identification of habitat types. Some of the grassland types cannot be identified from the satellite images and even in the field identification of some types can be demanding even for very experienced experts.

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Fig. 7. Typifying of alpine grasslands requires good knowledge of plant communities. Priority type 6230 * "Species-rich Nardus grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe)" is a rare type in alpine parts of Pelister National Park among dominating type 62D0 "Oro-Moesian acidophilous grasslands". One locality of type 6230 * to southeast of Golemo Ezero in late autumn. Photo: Kimmo Syrjänen

Basic information from water bodies can be found from different data resources; already the information on water chemistry (pH, alkalinity, conductivity, Secchi depth) with remote sensing data on physiognomy of vegetation are very useful while typifying different waterbodies. In many cases, however, it is necessary to visit the water body to determine vegetation types, before the final identification of habitat type can be decided. Also, an assessment of structures and functions of water ecosystem in the site can be done only during the field visits. Monitoring of water bodies and their habitat types is recommended to be done with implementation and monitoring under the Water Framework Directive. Monitoring protocol (shortened definition and data sheet) for wetlands (and small water bodies) is different from other habitat types. Monitoring protocol and data sheets for streams and rivers have been developed already in earlier co-operation project between Macedonia and Greece. Methodology and sheets are defined in the report:

Vrahnakis, M.S. & Fotiadis, G. 2009: Inventory and Assessment of Riparian Forest Vegetation of the Prespa Area of Greece and FYROM with the use of the i) QBR (Qualitat del Bosc de Ribera / Riparian Forest Quality) Index and ii) Riparian Macrophyte Protocol (RMP).

https://www.spp.gr/report_text_vrahnakis_fotiadis_dec2009_mv_gf_final.pdf

In extensive wetlands with difficult accessibility drone fotos and videos will be a good method to map and classify vegetation.

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Protocols for the monitoring of species

Data flow of species observations

Data sheets for the field inventories of different grops of species are included in the report "*Draft 5 year biodiversity program*" of this project and are also listed as annexes at the end of this report. Field observation sheets for species are based on field forms those have been used by Finnish Environment Addministration through several decades. Data is available in common database.

All single observations from the monitoring should be saved in national biodiversity database of the Republic of North Macedonia. If this database is not yet available, the data can be downloaded in Global Biodiversity Information Facility (GBIF). In GBIF the data is available for anyone. GBIF follows supports the principles of open access.

The minimum requirement is to save following information:

- Species name
- Name of the site (or area)
- Coordinates
- Date (or period)
- Name and contact ifromation of a person who has done observation.

For the Annex species more information is necessary to collect. The observations of Annex II species especially should be collected using the table 3.2 of the Natura 2000 database ("*Species referred to in Article 4 of Directive 2009/147/EC and listed in Annex II to Directive 92/43/EEC and site evaluation for them*"). The columns of table are the following in the Standard Data Form (SDF):

Species information:

- Group
- Code
- Scientific name
- Sensitivity of observation
- Present or not (in the case of monitoring, not in the case of first inventory)

Population information:

- Type (permanent, reproducing, concentration or wintering)
- Size (Min and Max)
- Unit (individuals, pairs or other units according to the standardized list of population units and codes in accordance with Articles 12 and 17 reporting in the "*reference portal*"
- Abundance categories (common, rare, very rare, present or data deficient)
- Data quality (good, moderate or poor)

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Site assessment:

- AIBICID (Pop)
- AIBIC: (relative surface, conservation, global)

Monitoring protocols for vascular plants and bryophytes

There are altogether 21 Fact sheets for species prepared by twinning project. On these four sheets are for plants and these are done in cowork with UNDP national experts. These Fact sheets have been done for such Annex II and IV species those were met by twinning project at study area in Pelister National Park or Prespa Lake conservation areas.

Vascular plants of Habitat Directive Annexes II and IV of the Republic of North Macedonia contains following species: *Aldrovanda vesiculosa, Anacamptis pyramidalis, Angelica palustris, Echium russicum,* ***Fritillaria gussichiae, Himantoglossum caprinum****, Klasea lycopifolia, Lindernia procumbens, Marsilea quadrifolia, Pulsatilla slavica, Ramonda serbica* and ***Tozzia carpathica****,* and following bryophytes: ***Buxbaumia viridis****, Hamatocaulis vernicosus* and *Mannia triandra*. Fact sheets are available for species shown by bold in preceding list.

Vascular plants and mosses will be observed using traditional methods: most of the observations will be made by active searching. Vascular plant samples are taken only if the sampling is needed for the identification of the species or for scientific purposes (taxonomic research etc.). Otherwise new observations of Annex II and IV species of the habitats directive (as well as threatened and endemic species) can be documented by using digital cameras. Same should be applied to bryophyte species those are possible to recognize from foto, like the Green shield moss *Buxbaumia viridis*.

Othervise it is recommended with bryophytes – especially when species is met somewhere at the first time – to take a small sample without harming population. After determination sample should be labeled and delivered into a public scientific herbaria. Bryophyte samples should be collected in paper bags and they should be let to dry in open air (not heating, nor pressing needed). In plastic bags samples are easily contaminated and decayed. In field hand lens is essential while identifying bryophytes, at lab microscopes (preparation microskope and light microscope) and relevant literature are needed.

Person carrying out the inventories of vascular plants and bryophytes must have good knowledge of identification and ecology of the species. Also experience to collecting and pressing vascular plants to make proper herbarium specimens are needed. In the field Field observation form is good tool to collect information, but also a notebook is useful. Notebook is used while writing up collection numbers of samples and other information on the site. While collecting samples it is important that it is permitted in the area and species of question and if there are restrictions for collecting species, adequate licences must be in order. Collections can be done only if it is not harmful for local population.

Use of Field observation forms for vascular plants and bryophytes provides simple tool to monitore occurrences (populations) of these plants. After first inventory repeated visits and filled field forms are base for monitoring. Monitoring visits are recommended to do about same time of growing season in two or three consecutive years. In longer period repeated visits give figure on changes of the population. Monitoring visits will give also data on threats of populations. If there is reason for more carefull scientific monitoring (population regeneration, life cycle stages, growth rate) permanent monitoring plots are recommended.

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It is important that information on collected specimens and filled field forms will be added to database, preferably as soon as possible after the field work. It is recommended to have digital application of Field observation form at field on tablet or computer so, that information can be added to database already in the field.

For making inventories and monitoring based on field inventory forms it is possible to collect data from about 1 - 7 localities per day. It is also important to fill Field observation forms even if the species is not observed at site where it is supposed to occur. Negative observations and reasons why species was not met are important while observing trend of species and in conservation status assessment.

Table 3. List of species (Habitats Directive Annexes II and IV) from which the Fact sheets containing monitoring protocols and assessments of conservation status has been prepared.

1. *Cordulegaster heros*
2. *Parnassius mnemosyne*
3. *Lycaena dispar*
4. *Maculinea arion*
5. *Euphydryas aurinia*
6. *Eriogaster catax*
7. *Gallimorpha quadripunctaria*
8. *Cucujus cinnaberinus*
9. *Morimus funereus*
10. *Cerambyx cerdo*
11. *Rosalia alpina*
12. *Lucanus cervus*
13. *Hyla arborea*
14. *Bombina variegata*
15. *Testudo hermanni*
16. *Emus orbicuraris*
17. *Lutra lutra*
18. *Fritillaria gussichiae*
19. *Tozzia carpathica*
20. *Himantoglossum carpinum*
21. *Buxbaumia viridis*

Inventory methods and equipment for animals

Vertebrates: mammals, reptiles and amphibians will be mostly observed using traditional active searching (binoculars, telescopes, digital cameras, maps, GPSs, bat detectors, nets, traps etc.) In some demanding cases, songs of some birds can be recorded, but only in the case the recording is truly needed for the identification of the species.

Efficient inventory and monitoring of invertebrates usually requires several different methods. The list of methods includes methods also for several species which have not been found in the Republic of North Macedonia (at least yet), but which potentially could be found in the area.

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1. Active searching (usually with insect net, pond net, or sweeping net and camera): all taxonomic groups
2. Sieving methods: Molluscs, Pseudoscorpions and Insects
3. Window traps: Insects, mainly beetles
4. Pitfall traps: Molluscs, Pseudoscorpions and Insects
5. Tape traps: Pseudoscorpions and Insects
6. Folio traps: Molluscs, Pseudoscorpions and Insects, mainly beetles
7. Light traps: Insects, mainly moths and some beetle species
8. Odour traps: Insects, mainly butterflies and moths

The effort required for the inventories and monitoring (traps and other sampling effort and seasonal allocation, for example) and allocation of resources (time for active searching) depend on the size of study area and diversity of habitat types inside the area. Only an experienced expert can estimate the reasonable volume of activities for each area. During the first inventory in the area it is still possible to adjust the volumes of using different method. The first inventory round is an important possibility to test which methods work best and which volumes are reasonable. Later in the monitoring of areas the volume should be kept close to same to allow the comparison of results between years.

When comparing the results between years, the differences between years may appear due to several reasons. Weather conditions, for example, strongly affect the trapping results of invertebrates. Differences between two years are not necessarily in relation with the changes in the environment or populations of different species. Only long time series provide better overview of impacts of changes in the environment. To fully understand the real impacts of different factors requires statistical analyses of the data.

Monitoring protocol (general definition) for species that require active searching

(*Lycaena dispar, Euphydryas aurinia, Hypodryas maturna, Maculinea arion, Parnassius mnemosyne, Gallimorpha quadripunctaria,Eriofaster catax (*larvae*) Cordulegaster heros* (adults), *Lindenia tetraphylla* (adults), *Laucorrhinia* species (adults), *Morimus funereus, Lucanus cervus, Cucujus cinnaberinus, Cerambyx cerdo, Rosalia alpina, Osmoderma* species)

Efficient active searching requires regular visits of experts in the area during the whole season. Some species are active only short period (many butterflies, moths and dragonflies, for example) whereas some long living species and species with several generations per year can be observed during rather long period.

Field works can be effectively carried out only if the personnel are well trained for the identification and ecology of the species under inventories or monitoring. In the best case, one person can carry out inventories of several taxonomic groups at the same time.

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Fig. 8 a-b. "Active searching" is an effective way to collect observations from different taxonomic groups. Effective working, however, should be done by an expert who has wide knowledge on the ecology of large number of species. Best experts can carry out inventory and monitoring of several taxonomic groups at the same time. An expert (Olli Pihlajamaa) in the photo is using different types of equipment in the field including sweeping net and pond net. Also camera is available all the time. Usually camera with GPS options is very useful tool for the documentation of the observations in the field. Parts of the vertebrate fauna (mainly herpetofauna and some mammal species) can be monitored at the same time with invertebrate monitoring.

Monitoring protocol for invertebrate species living or overwintering in hollow trees or other decomposing material: Sieving

*Anthrenochernes stellae**, *Phryganophilus ruficollis**, *Osmoderma* species

* Potential species, no observations in the Republic of North Macedonia

During the field works one expert can collect sieving material from around 8-15 sites per day. If the sieving samples are taken in winter animals do not activate easily in the sample and they are usually difficult to observe. For this reason the sample is good to take from the sieving box and put it inside fabric bag. Fabric bags need to be dense enough to keep all animals inside. Plastic bags are not as useful as fabric bags as the may collect carbon dioxide inside and kill the animals.

After a field trip each sample should be handled as soon as possible. Easy way to check the samples is to take plastic boxes (also covers are needed). The bottom of each box is covered by soft kitchen paper that takes in part of the moisture (if there is moisture in the sample). The sample is put on the papers and after taking the most active animals from the sample the whole sample is again covered by several layers of kitchen paper. After covering the sample with paper layers the whole box is closed. After some hours animals have activated and they are climbing on the papers. Animals are easy to see on papers and also easy to pick in the tubes. The checking of papers is usually done 2-5 times / day. After five days most of the animals have been found and the rest of the sieving material (detritus) can be thrown away.

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Fig. 9 a-b. Material from the sieving boxes under investigation. Sieving material can be collected from different kinds of organic material, including the bark and branches of dead trees, soil detritus, organic litter inside hollow trees, etc. It is effective method for finding beetles, bugs and pseudoscorpions, for example.

Monitoring protocol for flying saproxylic species: Window traps

Buprestis splendens, *Cucujus cinnaberinus, Cerambyx cerdo, Rosalia aplina, Aradus angularis**

* Potential species, no observations in the Republic of North Macedonia

Usually recommended number of window traps in forest area is between 4 and 8. If there are several types of forests in the study area equal number of traps should be located in each. This number provides only basic data of common species but only small part of the rare species can be randomly found. To found most of the species in the area would require massive amount of traps. Such amounts of traps collect enormous numbers of individuals and identification work can be difficult to arrange.

Window traps are built from a funnel over which are put two pieces of (40 x 40 cm) plastic “windows” crossing each other. Under the funnel is a bottle which is usually filled with ethylene-glycol (the same liquid is used as an engine coolant liquid in cars). At the side of the bottle is a hole cowered with dense plastic net. This hole allows water to go out in rainy weather.

Window traps should be emptied around once per week. If weather is dry the time period between checking can be longer (2 weeks). Usually period longer than two weeks causes problems. The funnel often collects falling leaves, branches and other material which may prohibit animals to fall in the bottle.

During the checking the bottle is emptied on fabric net. If the ethylene-glycol is not diluted in rain, it can be collected and re-used. The fabric net with insect samples is moved to an empty bottle and the bottle is filled with ca 70% alcohol. A label with date and place is put inside the bottle.

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Fig 10 a-b. Window trap on dead beech (*Fagus sylvatica*). Window traps are mainly used to collect species living in dead, dying or hollow trees. Large number of the invertebrate species in the Annexes II and IV of the Habitats Directive are dependent on dead wood material (saproxylic species). In the photo (a) local ranger (Jonce Gagovski) is checking the trap at the southern parts of Pelister National Park. Click beetles (Elateridae), for example, are often found in window trap material. The species in the photo (b) is *Lacon punctatus*.

Monitoring protocol for ground living invertebrates: Pitfalls

Bolbelasmus unicornis, Carabus variolosus**

* Potential species, no observations in the Republic of North Macedonia

Pitfall traps can be used in many types of habitats. Usually they are put in long lines; typical distance between cups is about one meter. Pitfall cup can be cowered by shelter. The shelter is attractive to some species and it prevents the dilution of preservation liquid (often ethylene-glycol). Sometimes water with salt is used instead of ethylene glycol.

Pitfall traps should be checked about once per week. In rainy weather pitfall cups may be filled with rain water and the cups should be checked more frequently. In each checking the quality of preserving liquid (ethylene glycol) should be checked.

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Fig. 11 a-b. Pitfall traps are very commonly used in studies on ground beetles (Carabidae), and other insect and spider species living on ground. Typical pitfall trap is a plastic cup which is put in ground. The upper side of cup is at the level of ground surface. Ethylene glycol or salt water can be used in the cup to preserve the samples during the trapping period.

Monitoring protocols for species climbing along trees and walls of caves: Tape traps

*Erannis anceraria** female, *Leptodirus hochenwarti**, *Duvalius* species

* Potential species, no observations in the Republic of North Macedonia

Winglessness is commonly adopted life strategy in cold conditions. In general, females are more often wingless than males. The proportion of wingless species increases towards north and towards high altitudes (mountain tops). Species which are active in late autumn, in winter or early spring are more often wingless species than flying species which are more active during warm season. Also species living deep in the caves are often wingless.

Tape traps can be used in the inventories and monitoring of wingless species. Tape trap is simply wide tape which has been set around the lower parts of the tree. The tape is set the sticky surface outside from the tree. Common packing tape is cheap and it works properly couple of days before the glue in tape surface gets too dry.

In caves tape is put around a stone and stone is located in place potential for the study species. In cave habitats non selective traps should be used only if they are not a risk for the small populations of cave inhabiting species.

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Fig 12 a-b. Juvenile Psocoptera captured by tape trap. Tape traps are commonly used, for example when collecting wingless females of some moth species. Winglessness of some moth species is usually related to cold climate conditions. Wingless moth species occur in early spring, late autumn or winter. Also some species living in high mountains or in very northern conditions are wingless. Tape traps can be used also in caves (b).

Monitoring protocol for cave inhabiting species and species inhabiting hollow trees: Folio traps

Osmoderma species, *Anthrenochernes stellae**

* Potential species, no observations in the Republic of North Macedonia

Folio traps can be used in caves, but the volume of trapping must be in relation with the size of cave habitat. Both in caves and in hollow trees aluminium folio can be formed in a shape that follows the form of the background. In cave habitats use of any traps must be carefully planned. In small caves populations of species can be very small in size, and capturing samples by unselective traps may cause threat for small populations of cave species.

Fig. 13 a-b. Folio trap is an effective method for the inventories and monitoring of hollow trees (a) and cave habitats (b).

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Monitoring protocol for species attracted by light: Light trap

Eriogaster catax, Erannis anceraria (*male*), Dioszeghyana schmidtii*, Lucanus cervus* females

* Potential species, no observations in the Republic of North Macedonia

Usually two light traps are located in each study area. Traps should be located in different types of habitats. Typical place is the edge of closed and open habitats. Many moths fly along edges of habitats. In North Macedonian climate conditions, reasonable period to start using light traps starts when snow is still melting. In mountain areas the period starts in March and ends in December. In low altitudes light traps can be in use around the year. Even if they do not collect much material in winter, the material collected in winter time may include species of community interest (*Erannis anceraria* males, for example).

Fig. 14 a-b. Light trap (a) can be used for the inventories and monitoring of moths, but it may bring additional information from some beetle species too. *Lucanus cervus* females, for example, are nocturnal and can be attracted by light. With one light trap it is possible to find 200 – 700 species of moths (from "Macrolepidoptera" groups) per site every year. Light traps have been uses for inventories and monitoring of fauna. Also, light trap materials provide very useful scientific data for climate change studies. If the collected material is in good shape, DNA from the specimens can be used for studies on taxonomy and in phylogenetic analyses.

Monitoring protocol for species attracted by smell: Odor traps

*Nymphalis vaualbum, Dioszeghyana schmidtii **

* Potential species, no observations in the Republic of North Macedonia

Odour based traps are used mainly to attract butterflies and moths, but in addition they attract large numbers of insects from other taxonomic groups (beetles, flies, lace wings, scorpion flies, etc.).

At least two different kinds of liquids can be use in attracting insects 1) Red wine 50 % and vinegar 50 % or 2) Beer (2-3 bottles), yeast, and 0,5 -1,0 kg sugar or brown sugar. Soft plastic foam (superlon) pieces are dipped in sweet liquid. Lover parts of foam pieces can be put inside a plastic cup and when the cup is filled with the same liquid the foam does not evaporate and dry too fast. In every case condition of foam pieces should be checked frequently.

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Attractive foam in cup is put on funnel, which is cowered by plastic shelter. Under the funnel is a can with insecticides and pieces of empty egg cells and / or kitchen paper. The bottom of can is cowered by plastic foam (superlon). Under the foam layer should be small holes to let rain water to escape. Traps should be emptied 1-3 times per week depending on weather conditions, flying activity of insects and the effectiveness of insecticide in the trap. If possible the tap could be emptied every morning, but in remote areas this is often not possible to arrange. The more often the traps are emptied, the better condition the samples usually are.

Fig. 15 a-b. Odour based traps are used in the inventories and monitoring of butterflies and moths. *Nymphalis* species are often found in the traps. *Nymphalis polychloros* (b) is not rare in the study materials.

Fact sheets and conservation status

Fact sheets cover the basic biological information from selected species (see below). Also the status in the species in Habitats Directive, Bern Convention and in the Red Listing of IUCN has been indicated in the Fact sheet. The recommended monitoring methods are given in the fact sheet.

The conservation status has been assessed as a part of the fact sheet. Assessments follow the principles of Article 17 reporting of habitats directive and Article 12 of Birds directive. The challenge is to assess conservation status for the species from the basis of insufficient data. In the project data has been collected from two pilot sites Pelister National Park and Prepa Lake area (Pelister National Monument and Ezerani conservation area). Assessment of conservation status for species and habitat types, however, should be based on the data from the whole biogeographical region within the country.

Following parameters are used in the assessment of the **species** listed in the Annexes of the Habitats directive:

- Range (size of distribution area)
- Population (size)

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- Quality of habitat for the species
- Future prospect

⇨ Overall assessment*

** Overall assessment* is based on the principles listed in the guidance document for the reporting of the species and habitats of the Habitats directive.

Following parameters are used in the assessment of the **habitats** listed in the Annexes of the Habitats directive:

- Size of distribution
- Size of area (for the habitat)
- "Structures and Functions" (quality of habitat)
- Future prospect

⇨ Overall assessment*

Classes used in the assessments are:

- Favorable FV
- Unfavourable, inadequate U1
- Unfavourable, bad U2
- Unknown XX
- Does not exist in the region NN

Additional markings used in some exceptions

- Occasional species occ
- New, invasive species (not alien*) arr
- Marginal (for habitats only) mar

* Member states (MS) are not required to prepare assessments from alien species. However, Annex species which are aliens in the MS are still indicated in the reporting of Article 17 of Habitats directive.

The direction of change is indicated by following markings:

- Improving (+)
- Worsening (-)
- Stable (=)
- Unknown (x)

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Field forms

1. Field observation sheet for Vascular plants
2. Field observation sheet for Bryophytes
3. Field observation sheet for Mammals
4. Field observation sheet for Birds
5. Field observation sheet for Reptiles and amphibians
6. Field observation sheet for Fish and crayfish
7. Field observation sheet for Invertebrate species
8. Field observation sheet for Fungi and lichen species
9. Inventory and monitoring methods for the Forests
10. Inventory and monitoring methods for the Grasslands and other open habitats
11. Inventory and monitoring methods for the Water courses and wetlands

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Table 1: Field observation sheet for vascular plants.

FIELD OBSERVATION SHEET OF SPECIES MK / MOEPP * Obligatory fields		**VASCULAR PLANTS**	**Comments**
SPECIES (scientific name):	*		
Code (habitat directive)			
Quality of information	*		
OBSERVER			
Name:	*		
Date:	*		
Address:			
Phone:			
First visit (yes/no)			
Monitoring visit (yes/no)			
LOCATION			
Site name:			
Province:			
Municipality:	*		
Village:			
Name of protected area:			
Code of area:			
Land-owner (private/public/unknown):			
Name:			
Real estate number:			
Description of location:			

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Altitude (m.a.s.l.):			
GPS coordinates:	*		
GPS polygon(s):			
SITE DESCRIPTION			
Habitat type:			
Code:			
Precise location:			
Extent of suitable habitat:			
Description of habitat:			
Accompanying common/typical species:			
Competing species:			
Alien species:			
Rare/threatened species:			
CONSERVATION MEASURES			
Threat factors at site: (SDF classes)			
Recommendations for restoration and management:			
Comparison to earlier inventory(ies), changes:			
POPULATION CHARACTERISTICS			
Area of population (m^2/ha):			
Nr. 1 x 1 m grid occupied by species:			
Number of adult individuals (vegetative, generative)			
Seedlings observed:			
Condition of adult individuals:			
Phase of flowering:			
Previous year individuals (present/not/amount):			
Herbivory present (degree):			
Fungal infections present (degree):			

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Earlier information on population:			
OTHER INFORMATION			
specimens collected + location:			
photos (by whom and where stored)			
free comments:			
SPECIES WAS NOT OBSERVED IN MONITORING			
Site has been disappeared			
How:			
Site has been changed			
How:			
Species was not found:			
Because:			
OTHER RELEVANT INFORMATION:			

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Table 2: Field observation sheet for Bryophytes.

FIELD OBSERVATION SHEET OF SPECIES MK / MOEPP * Obligatory fields		**Bryophytes**	**Comments**
SPECIES (scientific name):	*		
Code (habitat directive)			
Quality of information	*		
OBSERVER			
Name:	*		
Date:	*		
Address:			
Phone:			
First visit (yes/no)			
Monitoring visit (yes/no)			
LOCATION			
Site name:			
Province:			
Municipality:	*		
Village:			
Name of protected area:			
Code of area:			
Land-owner (private/public/unknown):			
Name:			
Real estate number:			
Description of location:			
Altitude (m.a.s.l.):			
GPS coordinates:	*		

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GPS polygon(s):			
SITE DESCRIPTION			
Habitat type:			
Code:			
Precise location:			
Extent of suitable habitat:			
Description of habitat:			
Accompanying common/typical species:			
Competing species:			
Alien species:			
Rare/threatened species:			
CONSERVATION MEASURES			
Threat factors at site: (SDF classes)			
Recommendations for restoration and management:			
Comparison to earlier inventory(ies), changes:			
POPULATION CHARACTERISTICS			
Area of population (m^2/ha):			
Nr. 1 x 1 m grid occupied by species:			
Condition of population			
Sporangiums			
Damages by animals			
Fungal infections present (degree):			
Earlier information on population:			
OTHER INFORMATION			

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specimens collected + location:			
photos (by whom and where stored)			
free comments:			
SPECIES WAS NOT OBSERVED IN MONITORING			
Site has been disappeared			
How:			
Site has been changed			
How:			
Species was not found:			
Because:			
OTHER RELEVANT INFORMATION:			

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Table 3: Field observation sheet for mammals

FIELD OBSERVATION SHEET OF SPECIES MK / MOEPP * Obligatory fields		**MAMMALS**	**Comments**
SPECIES (scientific name):	*		
Code (habitat directive)			
Quality of information	*		
OBSERVER			
Name:	*		
Date:	*		
Address:			
Phone:			
First visit (yes/no)			
Monitoring visit (yes/no)			
LOCATION			
Site name:			
Province:			
Municipality:	*		
Village:			
Name of protected area:			
Code of area:			
Land-owner (private/public/unknown):			
Name:			
Real estate number:			
Description of location:			
Altitude (m.a.s.l.):			
GPS coordinates:	*		

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GPS polygon(s):			
SITE DESCRIPTION			
Habitat type:			
Code:			
Precise location:			
Extent of suitable habitat:			
Description of habitat:			
Accompanying common/typical species:			
Competing species:			
Alien species:			
Rare/threatened species:			
CONSERVATION MEASURES			
Threat factors at site: (SDF classes)			
Recommendations fomanagement activities:			
Comparison to earlier inventory(ies), changes:			
POPULATION CHARACTERISTICS			
Alive / dead individua observed	*		
Number of obseved individuals	*		
Number of adult individuals			
Number of (young) offspring			
Size of population:			
Earlier information on population:			
OTHER INFORMATION			
Type of observation: (individuals seen/ trapped / photographed / faeces / traces)	*		
photos (by whom and where stored)			
Recorded voices (of bats)			

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Programs used for the automatic identification of voices			
free comments:			
SPECIES WAS NOT OBSERVED IN MONITORING			
Site has been disappeared			
How:			
Site has been changed			
How:			
Species was not found:			
Because:			
OTHER INFORMATION:			

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Table 4: Field observation sheet of birds.

FIELD OBSERVATION SHEET OF SPECIES MK / MOEPP * Obligatory fields		BIRDS	Comments
SPECIES (scientific name):	*		
Code (habitat directive)			
Quality of information	*		
OBSERVER			
Name:	*		
Date:	*		
Address:			
Phone:			
First visit (yes/no)			
Monitoring visit (yes/no)			
LOCATION			
Site name:			
Province:			
Municipality:	*		
Village:			
Name of protected area:			
Code of area:			
Land-owner (private/public/unknown):			
Name:			
Real estate number:			
Description of location:			
Altitude (m.a.s.l.):			
GPS coordinates:	*		

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GPS polygon(s):			
SITE DESCRIPTION			
Habitat type:			
Code:			
Precise location:			
Extent of suitable habitat:			
Description of habitat:			
Accompanying common/typical species:			
Competing species:			
Alien species:			
Rare/threatened species:			
CONSERVATION MEASURES			
Threat factors at site: (SDF classes)			
Recommendations for restoration and management:			
Comparison to earlier inventory(ies), changes:			
POPULATION CHARACTERISTICS			
Number of observed individuals			
type of obsevation (singing males, seen or photographed individuas, etc.)			
Area of suitable habitat			
Earlier information on population:			
OTHER INFORMATION			
Method (active searching, counting, etc.)			
photos (by whom and where stored)			
free comments:			

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SPECIES WAS NOT OBSERVED IN MONITORING			
Site has been disappeared			
How:			
Site has been changed			
How:			
Species was not found:			
Because:			
OTHER INFORMATION:			

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Table 5: Field observation sheet for reptiles and amphibians.

FIELD OBSERVATION SHEET OF SPECIES MK / MOEPP * Obligatory fields		**REPTILES and AMPHIBIANS**	**Comments**
SPECIES (scientific name):	*		
Code (habitat directive)			
Quality of information	*		
OBSERVER			
Name:	*		
Date:	*		
Address:			
Phone:			
First visit (yes/no)			
Monitoring visit (yes/no)			
LOCATION			
Site name:			
Province:			
Municipality:	*		
Village:			
Name of protected area:			
Code of area:			
Land-owner (private/public/unknown):			
Name:			
Real estate number:			
Description of location:			
Altitude (m.a.s.l.):			
GPS coordinates:	*		

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GPS polygon(s):			
SITE DESCRIPTION			
Habitat type:			
Code:			
Precise location:			
Extent of suitable habitat:			
Description of habitat:			
Accompanying common/typical species:			
Competing species:			
Alien species:			
Rare/threatened species:			
CONSERVATION MEASURES			
Threat factors at site: (SDF classes)			
Recommendations for restoration and management:			
Comparison to earlier inventory(ies), changes:			
POPULATION CHARACTERISTICS			
Area of population (m^2/ha):			
Number of (observed) adult individuals			
Number of (observed) young individuals			
Estimation of population size			
Earlier information on population:			
OTHER INFORMATION			
Type of observation (seen, trapped, photographed)	*		
specimens collected + location:			

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photos (by whom and where stored)			
free comments:			
SPECIES WAS NOT OBSERVED IN MONITORING			
Site has been disappeared			
How:			
Site has been changed			
How:			
Species was not found:			
Because:			
OTHER INFORMATION:			

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Table 6: Field observation sheet for fish and crayfish.

FIELD OBSERVATION SHEET OF SPECIES MK / MOEPP * Obligatory fields		FISH and CRAYFISH	Comments
SPECIES (scientific name):	*		
Code (habitat directive)			
Quality of information	*		
OBSERVER			
Name:	*		
Date:	*		
Address:			
Phone:			
First visit (yes/no)			
Monitoring visit (yes/no)			
LOCATION			
Site name:			
Province:			
Municipality:	*		
Village:			
Name of protected area:			
Code of area:			
Land-owner (private/public/unknown):			
Name:			
Real estate number:			
Description of location:			
Altitude (m.a.s.l.):			
GPS coordinates:	*		

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GPS polygon(s):			
SITE DESCRIPTION			
Habitat type:			
Code:			
Precise location:			
Extent of suitable habitat:			
Description of habitat:			
Accompanying common/typical species:			
Competing species:			
Alien species:			
Rare/threatened species:			
CONSERVATION MEASURES			
Threat factors at site: (SDF classes)			
Recommendations for restoration and management:			
Comparison to earlier inventory(ies), changes:			
POPULATION CHARACTERISTICS			
Area of population (m^2/ha):			
Nr. 1 x 1 m grid occupied by species:			
Number of (observed) adult individuals			
Number of (observed) young individuals			
Estimation of population size			
Earlier information on population:			
OTHER INFORMATION			
Method			
specimens collected + location:			

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photos (by whom and where stored)			
free comments:			
SPECIES WAS NOT OBSERVED IN MONITORING			
Site has been disappeared			
How:			
Site has been changed			
How:			
Species was not found:			
Because:			
OTHER INFORMATION:			

Funded by the European Union

Table 7: Field observation sheet for invertebrate species.

FIELD OBSERVATION SHEET OF SPECIES MK / MOEPP * Obligatory fields		**INVERTEBRATES**	**Comments**
SPECIES (scientific name):	*		
Code (habitat directive)			
Quality of information	*		
OBSERVER			
Name:	*		
Date:	*		
Address:			
Phone:			
First visit (yes/no)			
Monitoring visit (yes/no)			
LOCATION			
Site name:			
Province:			
Municipality:	*		
Village:			
Name of protected area:			
Code of area:			
Land-owner (private/public/unknown):			
Name:			
Real estate number:			
Description of location:			
Altitude (m.a.s.l.):			
GPS coordinates:	*		

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GPS polygon(s):			
SITE DESCRIPTION			
Habitat type:			
Code:			
Precise location:			
Extent of suitable habitat:			
Description of habitat:			
Rare/threatened species:			
CONSERVATION MEASURES			
Threat factors at site: (SDF classes)			
Recommendations for restoration and management:			
Comparison to earlier inventory(ies), changes:			
POPULATION CHARACTERISTICS			
Number of obseved individuals			
Size of population (estimation)			
Lifestage of observed individuals			
Size of population (estimation)			
Earlier information on population:			
OTHER INFORMATION			
Method (trap, active searching, other)	*		
specimens collected + location:			
photos (by whom and where stored)			
free comments:			
SPECIES WAS NOT OBSERVED IN MONITORING			
Site has been disappeared			

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How:			
Site has been changed			
How:			
Species was not found:			
Because:			
OTHER INFORMATION:			

Funded by the European Union

Table 8: Field observation sheet for fungi and lichen species:

FIELD OBSERVATION SHEET OF SPECIES MK / MOEPP * Obligatory fields		**FUNGI and LICHEN**	**Comments**
SPECIES (scientific name):	*		
Code (habitat directive)			
Quality of information	*		
OBSERVER			
Name:	*		
Date:	*		
Address:			
Phone;			
First visit (yes/no)			
Monitoring visit (yes/no)			
LOCATION			
Site name:			
Province:			
Municipality:	*		
Village:			
Name of protected area:			
Code of area:			
Land-owner (private/public/unknown):			
Name:			
Real estate number:			
Description of location:			
Altitude (m.a.s.l.):			
GPS coordinates:	*		

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GPS polygon(s):			
SITE DESCRIPTION			
Habitat type:			
Code:			
Precise location:			
Extent of suitable habitat:			
Description of habitat:			
Other species in the surrounding			
Species living on tree / wood material			
Host species			
Stage of host species (alive /dead tree)			
Stage of decomposition (1-4)			
Size of host species (diameter)			
Moisture of wood material			
Rare/threatened species:			
CONSERVATION MEASURES			
Threat factors at site: (SDF classes)			
Recommendations for restoration and management:			
Comparison to earlier inventory(ies), changes:			
POPULATION CHARACTERISTICS			
Size of population (fruiting bodies):			
Nr. 1 x 1 m grid occupied by species:			

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Condition of fruiting bodies			
Dead fruiting bodies			
Fsigns of fungivores			
Infections by other fungi			
Earlier information on population:			
OTHER INFORMATION			
specimens collected + location:			
photos (by whom and where stored)			
free comments:			
SPECIES WAS NOT OBSERVED IN MONITORING			
Site has been disappeared			
How:			
Site has been changed			
How:			
Species was not found:			
Because:			
OTHER INFORMATION:			

Funded by the European Union

Table 9: Inventory and monitoring format for the forest habitats.

Inventory form MOEPP / Forests and other wooded habitats

Name: **Code:**

EUNIS name: **EUNIS code(s):**

General information

Name, surname		**Site / plot / polygon nr.**	
Date		Polygon coordinates (WGS84)	
Altitude (masl).		**Corner N:E**	
Vegetation type(s)		**Size (ha)**	

Projective coverage of vegetation (0-100%)		
Tree layer	%	
Scrub layer	%	
Grass cover	%	
Herb cover	%	
Moss cover	%	
Lichen cover	%	
Bare soil cover	%	
Litter cover	%	
Rock cover	%	
Stone /Boulder cover	%	

Coarse dead wood (>20 cm) estimation per hectare or (1- single, 2- scarse, 3- abundant)	
Dead tree	
Snag	
Log	

Old alive trees (underline)	**Multiaged stand** (underline)
No, Single, Scarse, Abundant	Yes No

Logs at different decay stages estimation per hectare or (1- single, 2- scarse, 3- abundant)	
I stage	
II stage	
III stage	
IV stage	
V stage	

Openings (Y/N)	
Fire marks (Y/N)	
Natural regeneration (Y/N)	
Stand age (years)	

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Soil disturbances no - 0, minor – 1, moderate – 2, intensive - 3	
Trampling	
Trails	
Roads	
Animals	
Other	
Selective cuttings	
Clearcuts	

Allien species	
Species	Coverage

Position in relief forms	
Šlope exposition (underline)	N, NE, E, SE, S, SW, W
Incline	o
Drainage (Y/N)	

Threats minor – 1, moderate – 2, intensive - 3	
Code	Point

Code	Point

Remarks

Tree species, layer (c=canopy, i=intermediate, s=sapling), abundance

Species	Layer	%	Species	Layer	%	Species	Layer	%	Species	Layer	%	Species	Layer	%

Species, abundance (1-5)

ACTA SPI								
ALLI URS								
ANEM RAN								

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Recommended conservation / restoration actions	
Type of action	Detailled description (intensity, extent,continuity of action)
Support of certain tree species based on management plan	
Increase of natural structures and regeneration	
Other actions / conservation measures needed at the site to maintain and improve biodiversity and ecosysten services of this particular habitat	

Remarks on species values (all species groups)	
Annex II and IV species	
Annex V species and other species with commercial and/or medicinal values	
Balkan and Nationsl Endemic / Red listed species	
Other important species	

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Representativity of site 1 = excellent, 2 = good 3 = average (or slightly degraded) 4= bad, degraded, restoration impossible	
Structure	
Function	
Restoration possibilities	
Typical species composition	
Overall representativity of site/habitat **A: excellent** **B: good** **C: significant** **D: non-significant**	

Table 10: Inventory and monitoring format for the open habitats.

Inventory form MOEPP / Open habitats - grassland, heath and scrub **Annex I name:** **Code:** **EUNIS name:** **EUNIS code(s):**			
General information			
Name, surname		**Site / plot / polygon nr.**	
Date		Polygon coordinates (WGA 84)	
Altitude (masl).		**Corner N:E**	
Vegetation type(s)		**Size (ha)**	

Projective vegetation coverage estimation (0-100%)		**Disturbances of soil** no - 0, extensive – 1, moderate – 2, intensive - 3		**Way of current use** no - 0, extensive – 1, moderate – 2, intensive - 3	
Trees	%	Fire		Mowing	
Shrubs	%	Trampling		Grazing	
Grasses	%	Trails		Woody vegetation removal	
Herbs	%	Roads			
Mosses	%	Animal disturbance			

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Lichens	%
Bare soil	%
Litter	%
Rocks	%
Boulders, stones	%

Other/Comments (point out)	

Human disturbance	
Ditches (Y/N)	
Buildings (Y/N)	
Excavations (Y/N)	
Dumping places (Y/N)	

Overgrowt
no - 0, slow – 1, moderate – 2, intensive - 3

Trees	
Bushes	
Schrub	
Grasses	
Other/Comments (point out)	

Allien species

Species	Coverage /abundance if possiblre
	%
	%
	%
	%
	%

Position in relief forms

Slope exposition (N, NE, E, SE, S, SW, W)	
Incline (°)	

Threats
extensive – 1, moderate – 2, intensive - 3

Code	Point	Code	Point

General remarks

Species, abundance

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Remarks on species values (all species groups)	
Annex II and IV species	
Annex V species and other species with commercial and/or medicinal values	
Balkan and Nationsl Endemic / Red listed species	
Other important species	

Recommended conservation actions	
Type of action	Detailled description (intensity, extent,continuity of action)
Removal of schrubs and trees	
Grazing /mowing	
Other actions / conservation measures needed at the site to maintain and improve ecosysten servises of this particular site7habitat	

Representativity of site
1 = excellent, 2 = good 3 = average (slightly degraded) 4= bad, degraded, restoration impossible

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Structure	
Function	
Restoration possibilities	
Typical species composition	
Overall representativity of site/habitat **A: excellent** **B: good** **C: significant** **D: non-significant**	

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Table 11. Inventory and monitoring format for the wetland habitats.

Inventory form MOEPP / wetland habitats - mires, bogs lakes and rivers

Annex I name: **Code:**
EUNIS name: **EUNIS code(s):**

General information

Name, surname		**Site / plot / polygon nr.**	
Date		Polygon coordinates (WGA 84)	
Altitude (masl).		**Corner N:E**	
Vegetation type(s)		**Size (ha)**	

Projective vegetation coverage estimation (0-100%)	
Trees (if any)	%
Shrubs	%
Grasses	%
Herbs	%
Mosses	%
Lichens	%
Bare soil	%
Litter	%
Rocks	%
Boulders, stones	%

Disturbances of hydrology no - 0, extensive – 1, moderate – 2, intensive - 3	
Taking of water	
Dams	
Hydropower	
Ditches	
Roads	
Other/Comments (point out)	

Way of current use no - 0, extensive – 1, moderate – 2, intensive - 3	
Fishing	
Taking of water	
other	

Human disturbance	
Dumping places (Y/N)	
Buildings (Y/N)	
Excavations (Y/N)	
Other	

Alien species no - 0, slow – 1, moderate – 2, intensive - 3	

Owegrowth	
Species	Coverage /abundance if possiblre

Other biological aspects taken into account	

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Trees			%
Bushes			%
Schrub			%
Grasses			%
Other/Comments (point out)			%

Threats
extensive – 1, moderate – 2, intensive - 3

Code	Point	Code	Point

General remarks

Species, abundance

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Remarks on species values (all species groups)	
Annex II and IV species	
Annex V species and other species with commercial and/or medicinal values	
Balkan and Nationsl Endemic / Red listed species	
Other important species	

Recommended conservation actions	
Type of action	Detailled description (intensity, extent,continuity of action)
Support of certain species based on management plan, restriction for water use, etc.	
Increase of natural structures and functions (natural flooding dynamic, for example), like removing of dams ot other man made structures	
Other actions / conservation measures needed at the site to maintain and improve ecosysten servises of this particular site or habitat	

Representativity of site 1 = excellent, 2 = good 3 = average (slightly degraded) 4= bad, degraded, restoration impossible	
Structure	
Function	
Restoration possibilities	
Typical species composition	

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Overall representativity of site/habitat **A: excellent** **B: good** **C: significant** **D: non-significant**	

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2. Fact Sheets for Bird Species

Prepared by Pekka Rusanen and Markku Mikkola-Roos

2.1. Goosander (*Mergus merganser*)

Status in Europe		
EU Birds Directive Annex II		
CMS Appendix II		
Threat status in Europe:	Least Concern (IUCN)	LC

Justification for assessment of conservation status

Considered isolated or relict populations, breeding areas are restricted to the transboundary Ohrid and Prespa Lakes. These are the southernmost breeding populations in the Western Palearctic, consisting of only some tens of pairs. A significant part of the populations overwinter in the breeding area. Conservation of the populations is considered very important in a European context.

Fig 1. The Goosander is a northern species with small and isolated breeding populations restricted to the Ohrid and Prespa Lakes. Photo: Petri Ahlroth.

Ecology

In the isolated area the species nests mainly in crevices and cavities at the freshwater precipitous limestone cliffs. In most of the European breeding area the species favours wooden nest-holes, both natural and man-made. This is a non-migratory or partially migratory species.

Methods for inventory and monitoring

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The recommended methods for both the breeding and wintering populations are round-counts by boat or extensive point-counts.

Proposed conservation actions

Human disturbance should be minimized at specific important nesting places by establishing a buffer zone restricted from speedboats approx. 100 meters from the shores, and establishing no-access zones on land.

Breeding status and trends in RNM		
Population size (min/max)	30-50 breeding pairs	
Population trend		
Short term (last 12 years)		Stable
Long term (ca 1980-2018, or a period as close as possible to that)		Unknown
Breeding distribution (map and size)		Not available
Breeding distribution trend		
Short term (last 12 years)		Stable
Long term (ca 1980-2018, or a period as close as possible to that)		Unknown
Progress of species action and management plans		None
Main pressures and threats		
Recreation activities nearby nesting cliffs. Bycatch in fishing nets with mesh size greater than 5 cm can be a threat for this small population.		
Conservation measures		Some
Hunting of the species is prohibited. Hunting is prohibited at Prespa Lake.		
Natura 2000 (SPA) coverage Area		
Information related to Art 7 (huntable) species		Not huntable
Hunting bag (statistics min/max)	0-0	

References

BirdLife International (2018) *Species factsheet: Mergus merganser*.

Catsadorakis G, Avramovski O, Bojadzi A, Nikolaou H (2016) *The status of an isolated population of Goosander Mergus merganser in the Balkans*. Wildfowl 66: 159–175.

Catsadorakis G, Aleksi P, Avramoski O, Bino T, Bojadzi A, Brajanoski Z, Fremuth W, Kazoglou Y, Koutseri I, Logotheti A, Malakou M, Nikolaou H, Nikolaou L, Putilin K, Shumka S,Uzunova D, Velevski M (2013) *Waterbirds wintering at the Prespa lakes as revealed by simultaneous counts in the three adjoining littoral states.* Macedonian Journal of Ecology and Environment. 15(1): 23–32.

Funded by the European Union

2.2. Hazel Grouse (*Bonasa bonasia*)

Status in Europe		
EU Birds Directive Annex I and II		
Threat status in Europe:	Least Concern (IUCN)	LC

Ecology

The species favours dense, mixed forests with rich and varied undergrowth, both on plains and in mountainous areas. A non-migratory species.

Methods for inventory and monitoring

The recommended methods for a breeding population are line-transect counts and point-counts.

Fig. 2. The Hazel Grouse is exclusively a forest species all year-round. Photos: Petri Ahlroth.

Proposed conservation actions

Forestry practices should be integrated with habitat conservation. In countries on the edge of its range, such as North Macedonia, protected areas may be effective in preventing population decline. Exploitation of these small populations should be sustainable.

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Breeding status and trends in RNM		
Population size (min/max)	100-500 breeding pairs	
Population trend		
Short term (last 12 years)		Unknown
Long term (ca 1980-2018, or a period as close as possible to that)		Unknown
Breeding distribution (map and size)		Not available
Breeding distribution trend		
Short term (last 12 years)		Unknown
Long term (ca 1980-2018, or a period as close as possible to that)		Unknown
Progress of species action and management plans		None
Main pressures and threats		
The species is very sensitive to habitat changes, particularly modern forestry practices, due to the specific habitat structure requirements. Intensified hunting may lead to vulnerability on a local scale.		
Conservation measures		Some
Hunting season is limited to the period 10. October - 15. December		
Natura 2000 (SPA) coverage Area		
Information related to Art 7 (huntable) species		Hunting season
Hunting bag (statistics min/max)	?-?	Unknown

References

BirdLife International (2018) *Species factsheet: Bonasa bonasia*.

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2.3. Black-necked Grebe (*Podiceps nigricollis*)

Status in Europe		
Threat status in Europe:	Least Concern (IUCN)	LC

Justification for the assessment of conservation status

It is frequent, that the wintering population of the transboundary Prespa Lakes exceeds the 1 % threshold of the biogeographical flyway population, thereby fulfilling the Ramsar- and IBA-criterion. The wintering population of transboundary Prespa Lakes has comprised approx. 600–1.400 individuals during the 2000's, and still in mid-April 2018 approx. 1.500 staging individuals were counted at the Greater Prespa Lake.

Fig. 3. The Black-necked Grebe is wintering in significant numbers at Prespa Lake, but breeding is quite rare in North Macedonia. Photo: Petri Ahlroth.

Ecology

The species favours small and shallow, highly eutrophic pools with lush vegetation in the breeding season. Outside the breeding season the species inhabits a wide variety of waterbodies. A migratory bird species.

Methods for inventory and monitoring

The recommended methods for both breeding and wintering populations are round-counts by boat or extensive point-counts.

Proposed conservation actions

The key international sites should be protected and monitoring of fluctuations in population numbers implemented.

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Wintering status and trends in RNM		
Population size (min/max)	500-1.500	
Population trend		
Short term (last 12 years)		Stable
Long term (ca 1980-2018, or a period as close as possible to that)		Unknown
Breeding distribution (map and size)		Not available
Progress of species action and management plans		None
Main pressures and threats		
Pollution or other environmental changes, which might reduce the primary food sources in winter.		
Conservation measures		Some
Hunting is prohibited at Prespa Lake, the main wintering area.		
Natura 2000 (SPA) coverage Area		
Information related to Art 7 (huntable) species		Not huntable
Hunting bag (statistics min/max)	0-0	

References

BirdLife International (2018) *Species factsheet: Podiceps nigricollis*.

Catsadorakis G, Aleksi P, Avramoski O, Bino T, Bojadzi A, Brajanoski Z, Fremuth W, Kazoglou Y, Koutseri I, Logotheti A, Malakou M, Nikolaou H, Nikolaou L, Putilin K, Shumka S,Uzunova D, Velevski M (2013) *Waterbirds wintering at the Prespa lakes as revealed by simultaneous counts in the three adjoining littoral states*. Macedonian Journal of Ecology and Environment 15(1): 23–32.

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2.4. Pygmy Cormorant (Microcarbo pygmaeus)

Status in Europe		
EU Birds Directive Annex I		
Bern Convention Appendix II		
Convention on Migratory Species Appendix I		
AEWA – African-Eurasian Waterbird Agreement		
Threat status in Europe:	Least Concern (IUCN)	LC

Ecology

This bird species favours reedbeds with willow trees (*Salix spp*.) as nesting habitats. Outside the breeding season the species inhabits a wide variety of waterbodies. A partially migratory species.

Methods for inventory and monitoring

The recommended methods for wintering populations are round-counts by boats or extensive point-counts. Breeding populations should be mapped.

Fig. 4. The Pygmy Cormorant breeds in small numbers in North Macedonia. It disperses to feed at Prespa Lake from its breeding grounds at Lesser (Micro) Prespa Lake in Greece. Photo: Petri Ahlroth.

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Proposed conservation actions

Improved management of wetlands and increased regulation in limiting water pollution.

Breeding status and trends in RNM		
Population size (min/max)	60-120 breeding pairs	
Population trend		
Short term (last 12 years)		Unknown
Long term (ca 1980-2018, or a period as close as possible to that)		Unknown
Breeding distribution (map and size)		Not available
Breeding distribution trend		
Short term (last 12 years)		Unknown
Long term (ca 1980-2018, or a period as close as possible to that)		Unknown
Progress of species action and management plans		
Management plan of Prespa Lake is in progress.		Progressing
Main pressures and threats		
Disturbance, habitat destruction and poaching. The species is particularly vulnerable to being caught as bycatch in gillnets, and is vulnerable to biocides and pesticides released from agriculture.		
Conservation measures		Some
The main breeding areas are protected. Hunting is prohibited at Prespa Lake.		
Natura 2000 (SPA) coverage Area		
Information related to Art 7 (huntable) species		Not huntable
Hunting bag (statistics min/max)	0-0	

References

BirdLife International (2018) *Species factsheet: Microcarbo pygmaeus*.

Catsadorakis G, Aleksi P, Avramoski O, Bino T, Bojadzi A, Brajanoski Z, Fremuth W, Kazoglou Y, Koutseri I, Logotheti A, Malakou M, Nikolaou H, Nikolaou L, Putilin K, Shumka S,Uzunova D, Velevski M (2013) *Waterbirds wintering at the Prespa lakes as revealed by simultaneous counts in the three adjoining littoral states*. Macedonian Journal of Ecology and Environment 15(1): 23–32.

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2.5. Dalmatian Pelican (Pelecanus crispus)

Status in Europe		
EU Birds Directive Annex I		
Bern Convention Appendix II		
CMS Appendix I and II		
CITES Appendix I		
Threat status in Europe:	Least Concern (IUCN)	LC
Threat status Globally	Near Threatened (IUCN)	NT

Ecology

The species favours small islands in freshwater lakes or dense aquatic vegetation as breeding habitats, mainly at inland freshwater wetlands. Large lakes are important stop-over sites during migration. A dispersive bird species.

Fig. 5. Dalmatian Pelicans resting together with Great Cormorants (*Phalacrocorax carbo*). The species is the largest of all pelicans and is classified globally as near-threatened. The Lesser Prespa Lake in Greece accommodates the world's largest breeding colony, from which hundreds of birds disperse to feed at Prespa Lake in North Macedonia. Photo: Petri Ahlroth.

Methods for inventory and monitoring

The recommended methods for non-breeding populations are round-counts by boat or extensive point-counts.

Funded by the European Union

Wintering status and trends in RNM		
Population size (min/max)	5-500 individuals	
Population trend		
Short term (last 12 years)		Stable
Long term (ca 1980-2018, or a period as close as possible to that)		Unknown
Progress of species action and management plans		None
Main pressures and threats		
Disturbance, destruction of wetlands, and water pollution.		
Conservation measures		Some
Hunting is prohibited at Prespa Lake.		
Natura 2000 (SPA) coverage Area		
Information related to Art 7 (huntable) species		Not huntable
Hunting bag (statistics min/max)	0-0	

References

BirdLife International (2018) *Species factsheet: Pelecanus crispus*.

Catsadorakis G, Aleksi P, Avramoski O, Bino T, Bojadzi A, Brajanoski Z, Fremuth W, Kazoglou Y, Koutseri I, Logotheti A, Malakou M, Nikolaou H, Nikolaou L, Putilin K, Shumka S,Uzunova D, Velevski M (2013) *Waterbirds wintering at the Prespa lakes as revealed by simultaneous counts in the three adjoining littoral states*. Macedonian Journal of Ecology and Environment 15(1): 23–32.

Funded by the European Union

2.6. Little Egret (Egretta garzetta)

Status in Europe		
EU Birds Directive Annex I		
Bern Convention Appendix II		
Threat status in Europe:	Least Concern (IUCN)	LC

Ecology

The species inhabits fresh, brackish or saline wetlands showing preference for shallow waters. It nests both in trees and on the ground. A migratory bird species.

Methods for inventory and monitoring

The recommended method for small populations is active searching of breeding territories and nests.

Fig. 6. The Little Egret is a rare breeding species in North Macedonia. Photo: Petri Ahlroth.

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Breeding status and trends in RNM		
Population size (min/max)	10-30 breeding pairs	
Population trend		
Short term (last 12 years)		Unknown
Long term (ca 1980-2018, or a period as close as possible to that)		Unknown
Breeding distribution (map and size)		Not available
Breeding distribution trend		
Short term (last 12 years)		Unknown
Long term (ca 1980-2018, or a period as close as possible to that)		Unknown
Progress of species action and management plans		None
Main pressures and threats		
Wetland degradation and area loss caused by drainage for agriculture and logging of trees used for nesting.		
Conservation measures		None
Natura 2000 (SPA) coverage Area		
Information related to Art 7 (huntable) species		Not huntable
Hunting bag (statistics min/max)	0-0	

References

BirdLife International (2018) *Species factsheet: Egretta garzetta*.

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2.7. Short-toed Eagle (Circaetus gallicus)

Status in Europe		
EU Birds Directive Annex I		
Threat status in Europe:	Least Concern (IUCN)	LC

Ecology

The Short-toed Eagle inhabits a variety of habitats, but it requires some extent of tree cover. A migratory species.

Methods for inventory and monitoring

The recommended method is active searching inside breeding territories.

Fig. 7. The Short-toed Eagle has specialized in feeding on snakes and other reptiles. Photos: Petri Ahlroth.

Funded by the European Union

Breeding status and trends in RNM		
Population size (min/max)	120-150 breeding pairs	
Population trend		
Short term (last 12 years)		Stable
Long term (ca 1980-2018, or a period as close as possible to that)		Unknown
Breeding distribution (map and size)		Not available
Breeding distribution trend		
Short term (last 12 years)		Unknown
Long term (ca 1980-2018, or a period as close as possible to that)		Unknown
Progress of species action and management plans		None
Main pressures and threats		
Changes in agriculture and land use may limit the availability of suitable hunting habitats and reduce prey such as populations of snakes.		
Conservation measures		None
Natura 2000 (SPA) coverage Area		
Information related to Art 7 (huntable) species		Not huntable
Hunting bag (statistics min/max)	0-0	

References

BirdLife International (2018) *Species factsheet: Circaetus gallicus*.

Funded by the European Union

2.8. Montagu's Harrier (Circus pygargus)

Status in Europe		
EU Birds Directive Annex I		
Threat status in Europe:	Least Concern (IUCN)	LC

Ecology

The species favours open lowland areas with tall meadow vegetation, including crop fields. A migratory species.

Methods for inventory and monitoring

The recommended methods are active searching inside breeding territories and point-counts.

Fig. 8. Female and male of Montagu's Harrier. A major part of the North Macedonian population breeds in the Pelagonia Valley. Photos: Petri Ahlroth.

Funded by the European Union

Breeding status and trends in RNM		
Population size (min/max)	100-140 breeding pairs	
Population trend		
Short term (last 12 years)		Stable
Long term (ca 1980-2018, or a period as close as possible to that)		Unknown
Breeding distribution (map and size)		Not available
Breeding distribution trend		
Short term (last 12 years)		Unknown
Long term (ca 1980-2018, or a period as close as possible to that)		Unknown
Progress of species action and management plans		None
Main pressures and threats		
The conversion of original habitats to agricultural land, where harvesting causes frequent breeding failures.		
Conservation measures		None
Natura 2000 (SPA) coverage Area		
Information related to Art 7 (huntable) species		Not huntable
Hunting bag (statistics min/max)	0-0	

References

BirdLife International (2018) *Species factsheet: Circus pygargus*.

Funded by the European Union

2.9. Golden Eagle (Aquila chrysaetos)

Status in Europe		
EU Birds Directive Annex I		
Threat status in Europe:	Least Concern (IUCN)	LC

Ecology

This species requires undisturbed nesting areas such as mountain forests or large woodlands. Hunting activity takes place in open habitats. Breeding sites are entirely on the ground at mountain cliffs in North Macedonia. A non-migratory or partially migratory species.

Methods for inventory and monitoring

The recommended method is active searching in breeding territories.

Fig. 9. The Golden Eagle breeds in undisturbed areas. Photo: Petri Ahlroth.

Funded by the European Union

Breeding status and trends in RNM		
Population size (min/max)	60-100 breeding pairs	
Population trend		
Short term (last 12 years)		Decreasing
Long term (ca 1980-2018, or a period as close as possible to that)		Unknown
Breeding distribution (map and size)		Not available
Breeding distribution trend		
Short term (last 12 years)		Unknown
Long term (ca 1980-2018, or a period as close as possible to that)		Unknown
Progress of species action and management plans		None
Main pressures and threats		
Habitat loss, persecution and poisoning.		
Conservation measures		Some
A few vulture feeding stations are also used by this species.		
Natura 2000 (SPA) coverage Area		
Information related to Art 7 (huntable) species		Not huntable
Hunting bag (statistics min/max)	0-0	

References

BirdLife International (2018) *Species factsheet: Aquila chrysaetos*.

Funded by the European Union

2.10. Booted Eagle (Hieraaetus pennatus)

Status in Europe		
EU Birds Directive Annex I		
Threat status in Europe:	Least Concern (IUCN)	LC

Ecology

The Booted Eagle favours open woodland areas, often close to mountains. Nesting takes place in trees. A migratory species.

Methods for inventory and monitoring

The recommended method is active searching of breeding territories.

Fig. 10. The Booted Eagle is a rare breeding species present in certain areas of North Macedonia. Pictures illustrate a pale and a dark morph. Photos: Petri Ahlroth.

Funded by the European Union

Breeding status and trends in RNM		
Population size (min/max)	15-25 breeding pairs	
Population trend		
Short term (last 12 years)		Stable
Long term (ca 1980-2018, or a period as close as possible to that)		Unknown
Breeding distribution (map and size)		Not available
Breeding distribution trend		
Short term (last 12 years)		Unknown
Long term (ca 1980-2018, or a period as close as possible to that)		Unknown
Progress of species action and management plans		None
Main pressures and threats		
Habitat loss and persecution.		
Conservation measures		None
Natura 2000 (SPA) coverage Area		
Information related to Art 7 (huntable) species		Not huntable
Hunting bag (statistics min/max)	0-0	

References

BirdLife International (2018) *Species factsheet: Hieraaetus pennatus*.

Funded by the European Union

2.11. Coot (Fulica atra)

Status in Europe		
Threat status in Europe:	Least Concern (IUCN)	LC

Justification for the assessment of conservation status

It is frequent that the wintering population of transboundary Prespa Lakes exceeds the 1% threshold of the biogeographical flyway population fulfilling the Ramsar- and IBA-criterion. The wintering population in the transboundary Prespa Lakes has consisted of approx. 21.000–29.000 individuals during the 2000's.

Fig. 11. The Coot breeds often in small colonies in waterbodies with lush vegetation. Photo: Petri Ahlroth.

Ecology

The Coot favours areas with eutrophic or mesotrophic water and lush vegetation. A partially migratory species.

Methods for inventory and monitoring

The recommended methods for both the breeding and wintering populations are either round-counts by boat or extensive point-counts.

Funded by the European Union

Breeding status and trends in RNM		
Population size (min/max)	500-1.000 breeding pairs	
Population trend		
Short term (last 12 years)		Unknown
Long term (ca 1980-2018, or a period as close as possible to that)		Unknown
Breeding distribution (map and size)		Not available
Breeding distribution trend		
Short term (last 12 years)		Unknown
Long term (ca 1980-2018, or a period as close as possible to that)		Unknown
Progress of species action and management plans		None
Main pressures and threats		
Water pollution.		
Conservation measures		Some
Hunting is prohibited at Prespa Lake, the main wintering area.		
Natura 2000 (SPA) coverage Area		
Information related to Art 7 (huntable) species		Huntable
Hunting bag (statistics min/max)	?-?	

References

BirdLife International (2018) *Species factsheet: Fulica atra.*

Catsadorakis G, Aleksi P, Avramoski O, Bino T, Bojadzi A, Brajanoski Z, Fremuth W, Kazoglou Y, Koutseri I, Logotheti A, Malakou M, Nikolaou H, Nikolaou L, Putilin K, Shumka S,Uzunova D, Velevski M (2013) *Waterbirds wintering at the Prespa lakes as revealed by simultaneous counts in the three adjoining littoral states*. Macedonian Journal of Ecology and Environment 15(1): 23–32.

Funded by the European Union

2.12. Turtle Dove (Streptopelia turtur)

Status in Europe		
EU Birds Directive Annex II		
CMS Appendix II		
Threat status in Europe:	Vulnerable (IUCN)	VU

Ecology

The species uses a wide variety of woodland, as well as steppe and semi-desert habitats, exploiting agricultural land for feeding. A migratory species.

Methods for the inventory and monitoring

The recommended methods are line-transect counts and point-counts.

Fig. 12. The Turtle Dove breeds in large numbers in North Macedonia, but has drastically decreased in Europe during recent decades. Photo: Petri Ahlroth.

Funded by the European Union

Breeding status and trends in RNM		
Population size (min/max)	20.000-60.000 breeding pairs	
Population trend		
Short term (last 12 years)		Decreasing
Long term (ca 1980-2018, or a period as close as possible to that)		Decreasing
Breeding distribution (map and size)		Not available
Breeding distribution trend		
Short term (last 12 years)		Unknown
Long term (ca 1980-2018, or a period as close as possible to that)		Unknown
Progress of species action and management plans		None
Main pressures and threats		
Transformation of agricultural land and hunting.		
Conservation measures		None
Natura 2000 (SPA) coverage Area		
Information related to Art 7 (huntable) species		Huntable
Hunting bag (statistics min/max)	?-?	

References

BirdLife International (2018) *Species factsheet: Streptopelia turtur*.

Funded by the European Union

2.13. Common Kingfisher (Alcedo atthis)

Status in Europe		
EU Birds Directive Annex I		
Threat status in Europe:	Vulnerable (IUCN)	VU

Ecology

The species favours still or gently flowing waters with plenty of small fish. A partially migratory species.

Methods for inventory and monitoring

The recommended method is active searching for breeding territories.

Fig. 13. The Common Kingfisher breeds sparsely on riversides, excavating nest-holes in sandbanks. Photo: Petri Ahlroth.

Funded by the European Union

Breeding status and trends in RNM		
Population size (min/max)	20-100 breeding pairs	
Population trend		
Short term (last 12 years)		Unknown
Long term (ca 1980-2018, or a period as close as possible to that)		Unknown
Breeding distribution (map and size)		Not available
Breeding distribution trend		
Short term (last 12 years)		Unknown
Long term (ca 1980-2018, or a period as close as possible to that)		Unknown
Progress of species action and management plans		None
Main pressures and threats		
Severe conditions during winters and water pollution.		
Conservation measures		None
Natura 2000 (SPA) coverage Area		
Information related to Art 7 (huntable) species		Not huntable
Hunting bag (statistics min/max)	0-0	

References

BirdLife International (2018) *Species factsheet: Alcedo atthis.*

Funded by the European Union

2.14. Black Woodpecker (Dryocopus martius)

Status in Europe		
EU Birds Directive Annex I		
Bern Convention Appendix II		
Threat status in Europe:	Least Concern (IUCN)	LC

Ecology

The species is found in all types of mature forests. Mainly non-migratory.

Methods for inventory and monitoring

The recommended methods are line-transect counts and point-counts.

Fig. 14. The Black Woodpecker requires old trees for excavating nest-holes. Photo: Petri Ahlroth.

Funded by the European Union

Breeding status and trends in RNM		
Population size (min/max)	1.500-5.000 breeding pairs	
Population trend		
Short term (last 12 years)		Stable
Long term (ca 1980-2018, or a period as close as possible to that)		Unknown
Breeding distribution (map and size)		Not available
Breeding distribution trend		
Short term (last 12 years)		Unknown
Long term (ca 1980-2018, or a period as close as possible to that)		Unknown
Progress of species action and management plans		None
Main pressures and threats		
Forestry management.		
Conservation measures		None
Natura 2000 (SPA) coverage Area		
Information related to Art 7 (huntable) species		Not huntable
Hunting bag (statistics min/max)	0-0	

References

BirdLife International (2018) *Species factsheet: Dryocopus martius*.

Funded by the European Union

2.15. Middle Spotted Woodpecker (Dendrocopos medius)

Status in Europe		
EU Birds Directive Annex I		
Bern Convention Appendix II		
Threat status in Europe:	Least Concern (IUCN)	LC

Ecology

The species is restricted to mature deciduous forests, preferring Oak forests. A non-migratory species.

Methods for inventory and monitoring

The recommended methods are line-transect counts and point-counts.

Fig. 15. The Middle Spotted Woodpecker is an all-year specialist inhabiting mature oak forests. Photo: Petri Ahlroth.

Funded by the European Union

Breeding status and trends in RNM		
Population size (min/max)	3.000-10.000 breeding pairs	
Population trend		
Short term (last 12 years)		Unknown
Long term (ca 1980-2018, or a period as close as possible to that)		Unknown
Breeding distribution (map and size)		Not available
Breeding distribution trend		
Short term (last 12 years)		Unknown
Long term (ca 1980-2018, or a period as close as possible to that)		Unknown
Progress of species action and management plans		None
Main pressures and threats		
Forestry management.		
Conservation measures		None
Natura 2000 (SPA) coverage Area		
Information related to Art 7 (huntable) species		Not huntable
Hunting bag (statistics min/max)	0-0	

References

BirdLife International (2018) *Species factsheet: Dendrocopos medius*.

Funded by the European Union

2.16. White-backed Woodpecker (Dendrocopos leucotos)

Status in Europe		
EU Birds Directive Annex I		
Bern Convention Appendix II		
Threat status in Europe:	Least Concern (IUCN)	LC

Ecology

The species favours old-growth and over-mature, relatively open deciduous and mixed forests that have a high proportion of dead or decaying trees. Mainly non-migratory.

Methods for inventory and monitoring

The recommended methods are line-transect counts and point-counts.

Fig. 16. The White-backed Woodpecker requires decaying trees to survive. Photo: Petri Ahlroth.

Funded by the European Union

Breeding status and trends in RNM		
Population size (min/max)	200-400 breeding pairs	
Population trend		
Short term (last 12 years)		Unknown
Long term (ca 1980-2018, or a period as close as possible to that)		Unknown
Breeding distribution (map and size)		Not available
Breeding distribution trend		
Short term (last 12 years)		Unknown
Long term (ca 1980-2018, or a period as close as possible to that)		Unknown
Progress of species action and management plans		None
Main pressures and threats		
Unfavourable forest management practices.		
Conservation measures		None
Natura 2000 (SPA) coverage Area		
Information related to Art 7 (huntable) species		Not huntable
Hunting bag (statistics min/max)	0-0	

References

BirdLife International (2018) *Species factsheet: Dendrocopos leucotos*.

Funded by the European Union

2.17. Woodlark (Lullula arborea)

Status in Europe		
EU Birds Directive Annex I		
Threat status in Europe:	Least Concern (IUCN)	LC

Ecology

The species inhabits a variety of open and semi-open habitats on well-drained soils. A partially migratory species.

Methods for inventory and monitoring

The recommended methods are line-transect counts and point-counts.

Fig. 17. The Woodlark is a species of open terrain. Photo: Petri Ahlroth.

Funded by the European Union

Breeding status and trends in RNM		
Population size (min/max)	5.000-15.000 breeding pairs	
Population trend		
Short term (last 12 years)		Unknown
Long term (ca 1980-2018, or a period as close as possible to that)		Unknown
Breeding distribution (map and size)		Not available
Breeding distribution trend		
Short term (last 12 years)		Unknown
Long term (ca 1980-2018, or a period as close as possible to that)		Unknown
Progress of species action and management plans		None
Main pressures and threats		
Habitat loss and degradation.		
Conservation measures		None
Natura 2000 (SPA) coverage Area		
Information related to Art 7 (huntable) species		Not huntable
Hunting bag (statistics min/max)	0-0	

References

BirdLife International (2018) *Species factsheet: Lullula arborea*.

Funded by the European Union

2.18. Barred Warbler (Sylvia nisoria)

Status in Europe		
EU Birds Directive Annex I		
Bern Convention Appendix II		
CMS Appendix II		
Threat status in Europe:	Least Concern (IUCN)	LC

Ecology

The species favours semi-open bushland habitats, such as meadows and pastures with Common Juniper. A partially migratory species.

Methods for inventory and monitoring

The recommended methods are line-transect counts and point-counts.

Fig. 18. The Barred Warbler breeds often sympatric with Red-backed Shrike (*Lanius collurio*). Photo: Petri Ahlroth.

Funded by the European Union

Breeding status and trends in RNM		
Population size (min/max)	1.000-2.500 breeding pairs	
Population trend		
Short term (last 12 years)		Unknown
Long term (ca 1980-2018, or a period as close as possible to that)		Unknown
Breeding distribution (map and size)		Not available
Breeding distribution trend		
Short term (last 12 years)		Unknown
Long term (ca 1980-2018, or a period as close as possible to that)		Unknown
Progress of species action and management plans		None
Main pressures and threats		
Loss of habitats.		
Conservation measures		None
Natura 2000 (SPA) coverage Area		
Information related to Art 7 (huntable) species		Not huntable
Hunting bag (statistics min/max)	0-0	

References

BirdLife International (2018) *Species factsheet: Sylvia nisoria*.

Funded by the European Union

2.19. Red-backed Shrike (Lanius collurio)

Status in Europe		
EU Birds Directive Annex I		
Bern Convention Appendix II		
Threat status in Europe:	Least Concern (IUCN)	LC

Ecology

The species inhabits a wide variety of semi-open bushy areas. A migratory species.

Methods for inventory and monitoring

The recommended methods are line-transect counts and point-counts.

Fig. 19. Female Red-backed Shrike. The species breeds commonly in half-open areas in North Macedonia. Photo: Petri Ahlroth.

Funded by the European Union

Breeding status and trends in RNM		
Population size (min/max)	15.000-50.000 breeding pairs	
Population trend		
Short term (last 12 years)		Unknown
Long term (ca 1980-2018, or a period as close as possible to that)		Unknown
Breeding distribution (map and size)		Not available
Breeding distribution trend		
Short term (last 12 years)		Unknown
Long term (ca 1980-2018, or a period as close as possible to that)		Unknown
Progress of species action and management plans		None
Main pressures and threats		
Loss of habitats.		
Conservation measures		None
Natura 2000 (SPA) coverage Area		
Information related to Art 7 (huntable) species		Not huntable
Hunting bag (statistics min/max)	0-0	

References

BirdLife International (2018) *Species factsheet: Lanius collurio*.

Funded by the European Union

2.20. Red-billed Chough (Pyrrhocorax pyrrhocorax)

Status in Europe		
EU Birds Directive Annex I		
Bern Convention Appendix II		
Threat status in Europe:	Least Concern (IUCN)	LC

Ecology

The species favours high mountain pastures with rocky crags. A non-migratory species.

Methods for inventory and monitoring

The recommended method for the small populations is mapping.

Fig. 20. The Red-billed Chough is a rare breeding species in the mountainous areas of North Macedonia. Photo: Petri Ahlroth.

Funded by the European Union

Breeding status and trends in RNM		
Population size (min/max)	50-80 breeding pairs	
Population trend		
Short term (last 12 years)		Unknown
Long term (ca 1980-2018, or a period as close as possible to that)		Decreasing
Breeding distribution (map and size)		Not available
Breeding distribution trend		
Short term (last 12 years)		Unknown
Long term (ca 1980-2018, or a period as close as possible to that)		Decreasing
Progress of species action and management plans		None
Main pressures and threats		
Changes in grazing regimes, conversion of grazing habitat to forest, intensive farming and recreational disturbance.		
Conservation measures		None
Natura 2000 (SPA) coverage Area		
Information related to Art 7 (huntable) species		Not huntable
Hunting bag (statistics min/max)	0-0	

References

BirdLife International (2018) *Species factsheet: Pyrrhocorax pyrrhocorax*.

Grubač B &Velevski M (2016) *The Red-billed Chough Pyrrhocorax pyrrhocorax (Linnaeus, 1758) in Serbia and Macedonia*. Nature Conservation 66(2): 5–17.

Funded by the European Union

3. Habitat types

Prepared by Petri Ahlroth, Dragan Arsovski, Kimmo Syrjänen, Vlado Matevski and Renata Ćušterevska

3.1.1. Freshwater habitats

3.1.1.1. Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or Isoeto-Nanojuncetea

Status in Europe		
Habitats directive, Annex I	Habitat type:	**3130**
Threat status in EU28+	Least concern	LC
Threat status in EU28	Least concern	LC
EU conservation status by biogeographical region		
Alpine	Favourable	FV
Atlantic	Unfavourable-Inadequate	U1
Black Sea	Favourable	FV
Boreal	Unfavourable-Inadequate	U1
Continental	Unfavourable-Bad	U2
Macaronesian	Unfavourable-Inadequate	U1
Mediterranean	Unfavourable-Inadequate	U1
Pannonian	Unfavourable-Inadequate	U1
Steppic	Favourable	FV

Definition

The Interpretation Manual of European Union Habitats (EU Commission 2013*): 22.12 x 22.31 - aquatic to amphibious short perennial vegetation, oligotrophic to mesotrophic, of lake, pond and pool banks and water-land interfaces belonging to the Littorelletalia uniflorae order. 22.12 x 22.32 - amphibious short annual vegetation, pioneer of land interface zones of lakes, pools and ponds with nutrient poor soils, or which grows during periodic drying of these standing waters: Isoeto-Nanojuncetea class. These two units can grow together in close association or separately. Characteristic plant species are generally small ephemerophytes.*

Description according to EUNIS (Evans & Roekaerts2015) C1.1 Permanent oligotrophic lakes, ponds and pools: *Waterbodies with a low nutrient (nitrogen and phosphorus) content, mostly acid (pH 4-6). Includes oligotrophic waters of medium or high pH, e.g. calcareous and basic unpolluted nutrient-poor lakes and pools, which are rare in much of Europe and noted as a habitat of charophytes (C1.14). Excludes peaty, dystrophic waters (C1.4). Because of the low nutrient status, beds of vascular plants are often sparse and open. Plant communities: Charion fragilis, Nitellion flexilis, Nelumboion nuciferae, Scorpidio-Utricularion minoris, Oenanthion aquaticae, Zannichellion pedicellatae, Parvopotamion, Potamion graminei, Nitellion syncarpae-tenuissimae, Sphagno-Utricularion, Ranunculion aquatilis, Hyperico elodis-Sparganion, Charion vulgaris, Potamion. Species: Callitriche sp. Chara sp, Isoetes sp, Nitella sp, Potamogeton sp, Sparganium sp, Eleocharis quinqueflora, Eleocharis ovata.*

Funded by the European Union

C3 Littoral zone of inland surface waterbodies C3.4 Species-poor beds of low-growing water-fringing or amphibious vegetation. Includes isoetids of the shores of oligotrophic lakes, Nasturtium aquaticum by streams, mediterranean dwarf Scirpus swards, and other species-poor but dissimilar types of vegetation.

Plant communities: Deschampsion litoralis, Littorellion uniflorae, Lobelion dortmannae, Rorippion islandicae, Subularion aquaticae.

Fig. 21. The Golemo Ezero (Big Lake) is a clear water oligotropic alpine lake of glacial origin. It belongs to HD type 3130. Photo: Kimmo Syrjänen.

EUNIS includes oligotrophic water bodies C 1.1 following EU Habitats Directive Annex I habitat types:

2190 Humid dune slacks, 3110 Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae), 3120 Oligothrophic waters containing very few minerals generally on sandy soils of the West Mediterranean, with Isoetes spp., 3140 Hard oligo-mesotrophic waters with benthic vegetation of Chara spp. C3.4 Species-poor beds of low-growing water-fringing or amphibious vegetation contains following EU habitat types: 1150, 3110, 3120, 3130 and 3170.

There is a significant overlap in EU's lake habitats and the co-occurrence of two or more habitats in several lakes is possible. EU's interpretations of habitats 3110, 3130, 3140, 3150 and 3160 are somewhat vague and have caused confusion across Member States (O´Connor 2015). In Pelister National Park lakes Golemo and Malo Ezero belong entirely to type 3130. Some pools along east slope of Mt. Pelister may also belong to this type. A couple of small ponds at springy mires close to Malo Ezero will belong into 3160 Natural dystrophic lakes and ponds. Some oligotrophic pools may represent temporary pools (more continental than mediterranean type) but there are also characteristics of 3130 Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or Isoeto-Nanojuncetea in certain pools close to Golemo and Malo Ezero.

Vascular plant communities and typical species of 3110 in the Pelister National Park

Funded by the European Union

In the Pelister National Park there are two unique glacial lakes: Golemo and Malo Ezero. They belong to the habitat 3110 with their clear oligotrophic water, although they lack submerged vascular vegetation. These lakes do not have any larger plants and the primary production of the lake ecosystem is based on algae. Alluvial shoreline belt is characterized by species poor water fringing vegetation with *Deschampsia cespitosa* and *Carex leporina* as constant species.

Habitat directive and other important species

These lake ecosystems contain unique invertebrates.

Inventory and Monitoring

Monitoring should include data on hydrology (annual dynamics) and water chemistry in addition to inventories of species. Inventories and species list of pools at the eastern slope of the Baba Mountains are also needed.

Fig. 22. Shallow oligo-mesotrophic pool at a slope of the Golemo Ezero also belong into 3130. In water *Eleocharis palustris* and *Callitriche sp.,* at moist shore *Eleocharis acicularis, Carex macedonica* and *Deschampsia cespitosa* etc. Photo: Kimmo Syrjänen.

Threats and pressures

In principle there are no severe threats because both lakes are inside the National Park of Pelister which is a strictly protected zone. Especially Golemo Ezero is actively visited by tourists, a cause for eutrophication to this small lake (Avramoski 2006a). The illegal introduction of fishes into this lake a few decades ago may have had negative effects on the ecosystem and species composition of this lake. A mountain hut is located next to the shore at the Golemo Ezero and its active use by Jeeps and other off-road vehicles increases the chances of oil and gasoline relateds accidents to the lake.

Funded by the European Union

Range

This habitat type is very rare in North Macedonia.

Area

Area of the Golemo Ezero is 3.7 hectares and 0.66 hectares of the Malo Ezero (Avramoski 2006a). In addition, some oligo-mesotrophic pools in the surrounding area should be added to this habitat type.

Structure and function

These two lakes are formed by the interaction of erosion and accumulative glacial processes. They are concave ellipsoid pools without outflow. Waters of the Golemo Ezero discharge through moraine/gravelly bank at fountainheads of the Ezerska River, a left tributary of the river Sapuncica. Golemo Ezero is located in 2.218 m altitude, it covers an area of 3.7 hectares, and the catchment area will gather a total of 185,374 m^3 of water annually. Maximum depth of lake is 14.5 m, and it is the third deepest natural lake and deepest mountain lake in the Republic of North Macedonia. The Malo Ezero is at 2180 m a.s.l., covers 0.66 hectares and is only 2.6 m deep, it is a fountainhead of the Crvena river. These two lakes get water from melting snow, precipitation and as ground water. Structure and function of these lake ecosystems is in good order. As a consequence of climate warming, longer warmer periods can increase the productivity and eutrophication of both lakes and the shallower Malo Ezero can dry up partially or completely during warm summers in the future.

Management principles

Management actions have not been needed so far and managing these lakes would be difficult if it were deemed necessary. There may already be behavioural adaptations of crustaceans and other water invertebrates to the presence of fish. Poisoning of fishes with rotenone (a nonselective piscicide) is not recommended because it can be harmful to other water animals that have inhabited these lakes over thousands of years.

Conservation status (a draft based on the Twinning project study area)	
Range (of the distribution area)	FV
Area	FV
Structure and function	FV
Future prospects	U1-
Overall assessment of Conservation Status	**U1-**

References:

Avramoski, O. (ed.) 2006a: *The Plan of Management for Pelister National Park. – Pelister National Park & Pelister Mountain Conservation Project.* Swiss Agency for Development and Cooperation (SDC) through the Pelister Mountain Conservation Project. 67 pp.

Avramoski, O. (ed.) 2006b: *The Plan of Management for Pelister National Park - Supplement. – Pelister National Park & Pelister Mountain Conservation Project.* Swiss Agency for Development and Cooperation (SDC) through the Pelister Mountain Conservation Project. 112 pp.

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3.1.2. Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation

Status in Europe		
Habitats directive, Annex I	Habitat type:	3150
Threat status in Europe EU28+	Near threatened	NT
Threat status in EU28	Near threatened	NT
EU conservation status by biogeographical region		
Alpine	Unfavourable-Bad	U2
Atlantic	Unfavourable-Bad	U2
Black Sea	Unfavourable-Inadequate	U1
Boreal	Unfavourable-Bad	U2
Continental	Unfavourable-Inadequate	U1
Macaronesian	Unknown	XX
Mediterranean	Unfavourable-Inadequate	U1
Pannonian	Unfavourable-Inadequate	U1
Steppic	Favourable	FV

Definition

The Interpretation Manual of European Union Habitats (EU Commission 2013): "Lakes and ponds with mostly dirty grey to blue-green, more or less turbid, waters, particularly rich in dissolved bases (pH usually > 7), with free-floating surface communities of the Hydrocharition or, in deep, open waters, with associations of large pondweeds (Magnopotamion)."

This is the most common and typical HD habitat type at the Prespa Lake. At the Prespa Lake this vegetation type includes both submerged pondweed (Magnopotamion) vegetations at a depth of about 0.5 - 5 m and floating frog-bit (Hydrocharition) communities in still and shallow shoreline waters, ponds and pools. Open water areas with typical water chemistry and species composition of aquatic and benthic fauna and flora belong to this habitat type as well. In addition to submerged pondweed vegetation, reed beds (*Phragmites australis*) growing in water and other water growing tall helophyte stands (*Schoenoplectus lacustris*, *Typha* spp., *Iris pseudacorus*) along shores of eutrophic lakes, ponds and pools are included to this same type. Sometimes these stands of tall helophytes almost fill an entire pool and Hydrochariton-type vegetation covers only small areas.

Vascular plant communities and typical species of 3150 in the Prespa Lake

At the Lake Prespa the submerged Magnopotamion vegetation contains *Potameto-Najadetum* vegetation (Matevski 2008 in BioEco 2009) that typically includes submerged plant species: *Najas marina*, *Potamogeton perfoliatus*, *Zannichellia palustris*, *Ceratophyllum demersum*, *Potamogeton lucens*, *Myriophyllum verticillatum*, *Potamogeton pectinatus* and *Potamogeton crispus*. This type seems to be common and abundant at several places especially along the western shore of the lake. Spiny Naiad (*Najas marina*) is a characteristic species for Prespa. It favours neutral and brackish water and is probably of ancient origin in Lake Prespa.

Ponds and pools at Prespa shore and in wetland marshes above in the Ezerani protected area are characterized by Hydrocharition-type vegetation. It includes Frog-bit and Yellow Floatingheart (*Hydrochari-Nymphoidetum peltatae*) that form a vegetation community in the area (Matevski 2008 in BioEco 2009). It is dominated by Frog-bit (*Hydrocharis morsus-ranae*) and Yellow Floatingheart (*Nymphoides peltata*).

In the shallow shore waters among reed beds grows occasionally communities of Lesser-Duckweed (*Lemna minor*) and Giant Duckweed (*Spirodela polyrhiza*). This community with waterwheel plant (*Aldrovanda vesiculosa*) is very rare in Prespa (Micevski1969). The dominant plant species among the floating vegetation of this community consist of the following: *Spirodela polyrrhiza*, *Lemna minor*, *Aldrovanda vesiculosa*, *Salvinia natans*, *Hydrocharis morsus*

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ranae, *Phragmites australis* and *Utricularia neglecta* (Matevski 2008 in BioEco 2009). This vegetation community seems to have suffered from drainage of the wetland area.

The community of pondweed (*Potamogeton sp*.) and tape grass (*Vallisneria spiralis*) is present in shallow shore waters of the lake Prespa (Matevski 2008 in BioEco 2009). Typical species include: *Vallisneria spiralis*, *Myriophyllum spicatum*, *Najas minor*, *Potamogeton trichoides*, *Potamogeton perfoliatus*, *Utricularia neglecta*, *Ceratophyllum demersum*, *Potamogeton fluitans*, *Alisma plantago-aquatica*, *Oenanthe aquatica* and *Scirpus lacustris.*

Along ponds and pools at Ezeri wetland (especially within the former fishponds) Bulrush and Common Reed (Scirpeto-Phragmitetum) vegetation can be found (Matevski 2008 in BioEco 2009) that typically includes *Phragmites australis*, *Scirpus lacustris*, *Typha latifolia*, *Typha angustifolia*, *Juncus effusus*, *Cirsium arvense*, *Lythrum salicaria*, *Lycopus europaeus*, *Lysimachia vulgaris*, *Alisma plantago-aquatica*, *Iris pseudacorus*, *Mentha aquatica*, *Mentha pulegium*, *Potentilla reptans*, *Galium verum*, *Cichorium intybus*, *Stachys palustris*, *Butomus umbellatus*, *Daucus carota*, *Matricaria trichophylla*, *Salix alba*, *Picris hieracioides*, *Tanacetum vulgare*, *Dipsacus laciniatus*, *Rorippa amphibia*, *Cirsium palustre* and *Alnus glutinosa.* Large part of this vegetation is included in the 3150 habitat.

Fig. 23. 3150 Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* - type vegetation is the most common and typical Habitat Directive habitat at the Prespa Lake. **a)** Magnopotamion with pondweeds (*Potamogeton spp*.) and reed bed in front of the Stenje village. **b)** Submerged plants *Potamogeton pectinatus*, *Potamogeton crispus*, *Myriophyllum sp*. etc. Photos: Kimmo Syrjänen.

Habitat directive species and other important species

Waterwheel Plant (*Aldrovanda vesiculosa*), a species of the Habitat Directive Annex II and IV (Micevski1969, BioEco 2009, Jovanovska et al. 2017), grows in the habitat type 3150 found at the ponds and along shoreline reedbeds of the Prepa Lake at the Ezerani protected area. In BioEco report (2009) there is a comprehensive list of plant species found on the Ezerani protected area.

3150 habitat type is important for several other Habitat Directive Annex II and IV species of reptiles and amphibians including *Hyla arborea*, *Natrix tessellata*, *Emys orbicularis*, *Rana dalmatina* and *Triturus macedonicus*. Reed beds and water areas are also important for bats.

Reed beds and open water areas are also important for many overwintering, migrating and breeding birds, including several species of the Bird Directive. The lake ecosystem of Prespa hosts several fish species, crustaceans, molluscs and bivalvia and other fauna and algal flora with great ecological and economic importance and high conservation value with several endemic species. For example 11 endemic fish species are recorded from the Prespa Lake

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(Talevski et al. 2014). All these animal and plant species and open water areas are an integral part of the conservation status of habitat 3150 at the Prespa Lake.

Inventory and Monitoring

The inventory of a habitat type should be based both on remote sensing technics (satellite images, aerial photos, digital beam and drone material) and field inventories (including vegetation mapping, species lists and permanent monitoring plots). Remote sensing technics are important when monitoring the change of helophytic macrophyte communities at sites that are difficult to access. Permanent vegetation plots and/or transects of submerged vegetation should also be used and done by diving. Information on aquatic and benthic fauna needs to be collected in inventories and during monitoring. Monitoring of the Prespa Lake habitats should be planned so that it can be done together with the monitoring of Water Framework Directive (WFD Guidelines 2016). Information obtained from monitoring of hydrology and water chemistry is essential while analysing changes and making reports to the EU commission for both HD and WFD Directives.

Fig. 24. 3150 Natural eutrophic lakes with Magnopotamion or Hydrocharition - type of vegetation. **a)** Hydrochariton-type pool with *Typha latifolia* and *Phragmites australis* shoreline vegetation at the Asamati village in the Ezeri protected area. **b)** Young Tree Frog found beside breeding pool at the end of June in 2018. These pools are very important for e.g. reptiles and amphibians including the Habitat Directive species European Pond Terrapin (*Emys orbicularis*) and Tree Frog (*Hyla arborea*). Photos: Kimmo Syrjänen.

Threats and pressures

Eutrophication due to nutrient flow from the catchment area in Resen and from nearby countries is a major threat to habitat 3150 in and around the Prespa Lake. Eutrophication leads to decreased water transparency and increased competition with submerged vascular plants and phytoplankton algae. This has and will cause a decrease of the HD habitat area and change the structure and function of the Magnopotamion communities. Hydrocharition communities have also suffered from the decrease of water level and eutrophication (BioEco 2009). Reed beds along shores of the Prespa Lake have been occasionally burned, affecting negatively to lake and shoreline vegetation and species. Water is hypertrophic especially at the northern shore and metabolism at the bottom of reed beds is partly anaerobic.

There is conflicting interests between the current land use and conservation efforts of wetlands at the Prespa Lake area. Expanding apple orchards threat wetlands physically and the uptake of groundwater for irrigation has a negative effect on wetlands. Restoring wetlands is very difficult especially when the expanding orchards are at same

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height level with wetlands. For example in 2018 part of a dried up wetland in the Ezerani protected area was burned, causing the destruction of certain Habitat Directive Annex II and IV species including *Hyla arborea* and *Emys orbicularis*.

Surface of the Lake Prespa has been decreasing over several decades since 1988 (BioEco 2009) that has also negatively affected the water quality and wetland habitat types. This, together with the dredging of the Golemo Reka and inoperative dam construction has increased the destruction of wetlands and marshes at the northern shore of the Prespa Lake. Several vegetation communities have suffered and decreased in size and e.g. Water Milfoil and White Waterlily (Myriophyllo-Nupharetum) communities have already disappeared from Ezerani (Matevski 2008 in BioEco 2009).

Pesticide use in the region is at a very high level, with at least 15 sprayings of orchards per growing season (BioEco 2009). Intensive use of insecticides at orchards close to the Lake Prespa leads to the decrease of several insect groups, e.g. dragonflies, that should be typical for this habitat type, but the negative impacts extend to other species groups as well at the Prespa Lake (BioEco 2009).

Introduced fish species (Talevski et al. 2014) and invasive plants including *Azolla filiculoides* (BioEco 2009, Strid, A. & al. 2017) and especially *Elodea canadensis* are a severe threat to the Prespa Lake ecosystem. Submerged perennial plant Canadian pondweed (*Elodea canadensis*) was observed for first time in the Prespa Lake in the 2018 inventories (Fotiadis et al. 2018). In 2019 it was found submerged at a few places of the Brajcino River close to the lake by the Twinning project. It is probably already more wide spread at the Lake than previously known. The Canadian Pondweed can be a very harmful species and while spreading it will increase eutrophication of the lake.

Range

This habitat type is found in several lakes of Macedonia. Currently it is known to be present in the lakes Prespa, Ochrid and Dojran (Micevski 1969, BioEco 2009).

Area

In the Prespa Lake the habitat 3150 includes submerged Magnopotamion vegetation and reed beds around the lake but the open water area and benthic ecosystems are also included in it. The total area of this habitat at the Prespa Lake type is 17 630 hectares and this entire area including the benthic and pelagic ecosystems belongs into habitat 3150. Vegetation at old fishponds and the surrounding helophyte vegetation between the villages of Sirhan and Asamati belong partly to this type, mainly in Hydrochariton communities with tall helophytes. Also the reed dominated wetlands at the Nacolec-Sthrobovo district and close to the Stenje village belongs for the most part to this type. Shallow water plant communities found at depth 0.05 - 4 m covers 531.75 hectares and includes an entire belt of Magnopotamion vegetation that is a characteristic vegetation of habitat 3150 (Fotiadis et al. 2018).

Structure and function

As described in threats and pressures, the continued decrease of water level of the Lake Prespa and eutrophication have affected the structure and function of this habitat type. This has probably caused the expansion of reed beds at the cost of submerged communities. It remains to be seen whether these reed beds in front of the Ezerani conservation area will form new alluvial wetland marshes in the future. The area and function of submerged vegetation communities has also been negatively affected due to the decreased Secchi depth and the changes in competitive interactions. So far blue - green alga blooming is not typical at the Prespa Lake but in the future along with increasing eutrophication they can have a large impact on the entire lake ecosystem.

Management principles

Management actions that take the entire catchment area into account are important. These include attempts to decrease eutrophication, management of sewer waters, decrease of pesticide use and every possible solution to solve the conflict between current land use and conservation measures. Management should be based on careful planning together with administration, environment specialists and representatives of all stakeholders around the lake.

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Drained wetland habitats should be restored and water uptake and ditching should be avoided and/or compensated at small separate wetlands on the shoreline of the Prespa Lake.

Management of dense reed beds at the shoreline should be taken into consideration. Mowing and depositing removed reed in a way that nutrients do not re-enter the lake should be planned and new practices should be introduced. Removal of reed beds can only be done at specific parts around the lake and grazing of these reed beds at certain places in the Ezerani and at east shore would be beneficial.

All attempts to decrease the spread of *Elodea canadensis* are needed.

Conservation status (a draft based on the Twinning project study area)	
Range (of the distribution area)	FV
Area	U1
Structure and function	U1
Future prospects	U2
Overall assessment of Conservation Status	**U2**

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3.1.3. Water courses of plain to montane levels with the *Ranunculion fluitantis* and Callitricho-Batrachion vegetation

Status in Europe			
Habitats directive, Annex I		Habitat type:	**3260**
Threat status in Europe EU28+	Vulnerable		VU
Threat status in EU28	Vulnerable		VU
EU conservation status by biogeographical region			
Alpine	Unfavourable-Inadequate		U1
Atlantic	Unfavourable-Bad		U2
Black Sea	Unfavourable-Inadequate		U1
Boreal	Unfavourable-Bad		U2
Continental	Unfavourable-Inadequate		U1
Macaronesian	Not present		-
Mediterranean	Unfavourable-Bad		U2
Pannonian	Unfavourable-Inadequate		U1
Steppic	Favourable		FV

Definition

The Interpretation Manual of European Union Habitats (EU Commission 2013): *"1) Water courses of plain to montane levels, with submerged or floating vegetation of the Ranunculion fluitantis and Callitricho-Batrachion (low water level during summer) or aquatic mosses." "2) Plants: Ranunculus saniculifolius, R. trichophyllus, R. fluitans, R. peltatus, R. penicillatus ssp. penicillatus, R. penicillatus ssp. pseudofluitantis, R. aquatilis, Myriophyllum spp., Callitriche spp., Sium erectum, Zannichellia palustris,* Potamogeton *spp., Fontinalis antipyretica."*

*"*4) This habitat is sometimes associated with *Butomus umbellatus* bank communities. It is important to take this point into account in the process of site selection."

According to EUNIS (Evans & Roekaerts2015) this type includes all kind of spring brooks and streams without depending on trophic status or flowing velocity of water course:

C2.18 Acid oligotrophic vegetation of spring brooks.

C2.19 Lime rich oligotrophic vegetation of spring brooks

C2.1A Mesotrophic vegetation of spring brooks

C2.1B Eutrophic vegetation of spring brooks

C2.25 Acid oligotrophic vegetation of fast flowing streams

C2.26 Lime rich oligotrophic vegetation of fast flowing streams

C2.27 Mesotrophic vegetation of fast flowing streams

C2.28 Eutrophic vegetation of fast flowing streams

C2.33 Mesotrophic vegetation of slow-flowing streams

C2.34 Eutrophic vegetation of slow-flowing streams

Occurrence of habitat type and related types in Pelister National Park and Prespa Lake

Most brooks and streams at the Pelister National Park and the Prespa Lake belong to the habitat type 3260. Oligotrophic brooks and streams are typical at upper reaches of water courses running from the Pelister National

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Park towards east or into the Prespa Lake. Vegetation that is more related to mesotrophic and eutrophic brooks and streams is found at medium and especially at lower parts of brooks and streams entering the Prespa Lake.

Shorelines of brooks and streams are typically 6430 “Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels”. At the upper courses in the Pelister National Park this habitat is diverse and contains a lot of conservation values in vascular plants (Čarni & Matevski 2010) and other species groups (Avramoski 2006a, b). Along spring affected brooks and in areas with high groundwater stands of *Alnus glutinosa* belong to 91E0 “*Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae)”. This habitat type is occasionally found at lower part of streams. At lower shoreline habitats that run towards the Prespa Lake nitrophilic vegetation can be found and these part of rivers belong either to 3280 “Constantly flowing Mediterranean rivers with Paspalo-Agrostidion species and hanging curtains of *Salix* and *Populus alba”* or to 3290 “Intermittently flowing Mediterranean rivers of the Paspalo-Agrostidion”.

Fig. 25. 3260 Water courses of plain to montane levels with the *Ranunculion fluitantis* and Callitricho-Batrachion vegetation are common habitat types in brooks and rivers running to the Prespa Lake at the Pelister National Park. At slopes of the Pelister National Park these brooks and streams have clear oligotrophic water and submerged vegetation is characterized mainly by water bryophytes like *Fontinalis antipyretica*. At the shorelines of mountain brooks and streams there is usually tall herb fringes with diverse flora. Rotino river. Photo: Kimmo Syrjänen.

Vascular plant communities and typical species of 3260

The following plant species were found at the upper part of the Capari River in zone of Oro-Mediterranean *Pinus peuce* forest: *Cirsium appendiculatum*, *Athyrium filix-femina*, *Epilobium parviflorum*, *Heracleum sphondylium* subsp. *verticillatum*, *Rumex alpinus*, *Geranium reflexum*, *Doronicum austriacum*, *Telekia speciosa*, *Angelica pancicii*, *Brachythecium rivulare*, *Scapania undulata*, *Hygrohypnum duriusculum*, *Porella cordaeana*, *Chiloscyphus polyanthos* and *Pellia neesiana.*

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Mesotrophic and eutropic vegetation is available at lower parts. *Callitriche spp.* is occasionally present in streams and *Epilobium hirsutum* is common at shores. Closer to the Prespa Lake *Phragmites australis*, *Iris pseudacorus*, *Alisma plantago-aquatica*, *Solanum dulcamara*, *Bidens frondosus* and sometimes the rare and protected *Beckmannia eruciformis* are present along streams.

Habitat directive species and other important species of 3260

Carpathian Tozzia (*Tozzia carpathica*) is a HD species of annexes II and IV and it grows on the shoreline fringes of the subalpine brooks in the Pelister National Park (Čarni & Matevski 2010, Matevski et al. 2019). The Otter (*Lutra lutra*) is a HD mammal species living in these streams and brooks. Bats are also typical for stream habitats. At lower reaches the Kingfisher (*Alcedo atthis*) is also present in the Golemo Reka.

The Pelagonide Trout (*Salmo pelagonicus*) is a fish species with a high conservation value in these brooks and streams of the Pelister National Park (Avramoski 2006a). It is present in streams running eastward from the Pelister National Park and found from Lower Vardar (Crna system) and upper Aliakmon drainages (Macedonia and Greece) (Kottelat & Freyhof 2007). It is listed as threatened (vulnerable, VU) at global Red List of IUCN (Freyhof & Kottelat 2008). At streams running to the Prespa Lake from the Pelister National Park, spawns even more threatened trout, namely the Prespa Trout (*Salmo peristericus*) that is classified as Endangered (EN) at global Red List of IUCN (Crivelli 2006). The Prespa Trout is endemic for the Prespa Lake and it is only found in the Agios Germanos river (Greece), the Brajcinska river, the Kranska river and the Leva Reka stream (a tributary of the Golemo Reka) (Vrahnakis & Fotiadis 2009).

This habitat type is very important for other fish species, crustaceans, molluscs and other invertebrates as well as for clear water algae. Avramoski (2006a) lists for example the rare Ostracode Crab (*Eucypris kurtdiebeli*) and the Amphipode Crab (*Niphargus pancici pancici*) from springs and spring brooks of the Pelister National Park. Several amphibians are dependent on this habitat type including HD annex amphibians *Rana graeca* and *Rana dalmatina*. *Salamandra salamandra* is commonly found along brooks and streams in the Pelister National Park. They are also important water sources and habitats for several mammals and birds.

Fig. 26. a) 3260 at the alpine part of the Pelister National Park with clear oligotrophic spring water at a slope below the Golemo Ezero. **b)** The Magarevska River at 1600 m a.s.l. with several water mosses (e.g. *Fontinalis antipyretica*) and tall herb fringe. Photos: Kimmo Syrjänen.

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Inventory and Monitoring

Currently there is no Standard Field Inventory Form for riparian habitats. Inventory information should be collected on GPS marked polygons/transects along river or sampling plots inside the studied river. Repeated visits and an iteration of the inventory at the same site is a basic method of monitoring. Suitable monitoring period is between 5-10 years for this habitat type. Transects along different altitudinal parts of a river should be included in monitoring. The methodology used by Vrahnakis & Fotiadis (2009) for land use analyses and vegetation would be a good method for monitoring streams. In addition to monitoring vegetation, water flow and analyses of water chemistry are needed. Monitoring of fishes and invertebrate fauna would also provide important information on the development of conservation status of this habitat type.

Fig. 27. Eutrophicated lower reach of the Brajcinska river at the Prespa Lake National Monument. Photo: Kimmo Syrjänen.

Threats and pressures

There are several threats and pressures towards this habitat including erosion and sedimentation by forest cutting and road construction inside and outside of the protected areas. Eutrophication and pollution due to waste waters (coming mainly outside of the protected areas) are severe threats. Dredging of water courses and the construction of hydropower plants (the River Semnica inside the Pelister National Park, the River Brajcino outside of border of the National Park) has caused deterioration of the habitat and these negative impacts are continuing in certain extent. There is some amount of water abstraction inside the National Park, but water uptake forms a more severe threat outside the park. Increase of tourism can also be a threat to water quality. Fish pools of rainbow trout along the Brajcinska River (Avramoski 2006a) can cause a threat to natural fauna. Climate warming will probably have negative impacts on this habitat type now and in the future.

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Range

In the study area this habitat type is found at the Pelister National Park and widely at the Prespa Lake catchment area. It is a common habitat type in Macedonia (Bregalnica River catchment – Kriva Lakavica among others (Matevski et al. 2018)).

Area

Area of this habitat type appears to be rather stable in the Pelister National Park, but it may decrease due to a hydropower plant in the river Semnica that has caused deterioration of this habitat type between Kazan and Malovishte villages. Inside the Prespa Lake National Monument and the Ezerani conservation area situation is stable, but the lower parts of this habitat type have already changed due to eutrophication and habitat changes. The ength of the streams is 306 kilometers in the Pelister National Park (intermittent streams 118 km and streams 188 km). It is estimated that 50 hecteres of this habitat type exist inside the National Park. There is only 0,5 - 1 hectares of this habitat type at the Prespa Lake area.

Structure and function

This habitat is dependent on surface and ground water. The structure and function are close to optimal at the upper reaches in the Pelister National Park. Some extra sediment may be gathered by waters running from mountain- and forest roads to brooks. Local forest cuttings at the lower part of the Park can increase erosion and sedimentation of streams. Outside the conservation areas water courses are affected by waste waters of villages and the Resen town, as well as fertilizers and pesticides from agriculture. Irrigation and the uptake of groundwater have negative impacts on this habitat type. Watercourses entering to the Lake Prespa have eutrophicated at the lower part of their reaches during a long time period. These lower parts of streams have also naturally more nutrients than the upper parts, but most of eutrophication is human induced. Dredging of the lower parts of water courses have also affected negatively on the structure and function of this habitat type.

Management principles

This habitat type should be left intact and excavation, road construction and forest cutting etc. activities at shorelines should be avoided. All management actions that prevent the accumulation of sediments into natural brooks and streams and decrease eutrophication are encouraged. More attention should be paid to improve the water quality and conservation status of the habitat especially at streams between the Pelister National Park and the Prespa Lake where the Prespa Trout spawns. These ecological corridors with entire riparian vegetation and large enough buffers should be included in conservation. Conditions of these streams may need to be improved by restoration/management actions when they are needed (see analyses of land use by Vrahnakis & Fotiadis 2009). The four small hydro power plants: Šemnica (Malovište) Kažani, Brajčino-1 and Brajčino-2, which cover the waters of Brajčinska Reka and the river Šemnica, affect the quality and flow regime of water, and negative impacts the habitat quality and species richness.

Effects of hydropower plants on biodiversity should be analysed and the negative impacts compensated by owner companies. The required biological minimum should be restored in the river, so that the ecosystems can be recovered. The current biological minimum is set at 10 % of the average of the annual flow. It should be reassessed considering the high ecological sensitivity of the area. Clearing all unnatural obstacles from the riverbed is needed. A thorough restoration of damaged habitats should be done and forests should be re-established where they have been cut.

Conservation status (a draft based on the Twinning project study area)	
Range (of the distribution area)	FV
Area	U1

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Structure and function	U2
Future prospects	U1
Overall assessment of Conservation Status	**U2**

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3.2. Temperate heath and scrub

3.2.1. Alpine and Boreal heaths

Status in Europe			
	Habitats directive, Annex I	Habitat type:	4060
	Threat status in Europe EU 28+	Least concern	NT
	Threat status in EU28	Least concern	NT
EU conservation status by biogeographical region			
	Alpine	Favourable	FV
	Atlantic	Unfavourable-Bad	U2
	Black Sea	Not present	-
	Boreal	Unfavourable-Inadequate	U1
	Continental	Favourable	FV
	Macaronesian	Favourable	FV
	Mediterranean	Unknown	XX
	Pannonian	Not present	-
	Steppic	Not present	-

Definition

The Interpretation Manual of European Union Habitats (EU Commission 2013): *"Small, dwarf or prostrate shrub formations of the alpine and sub-alpine zones of the mountains of Eurasia dominated by ericaceous species, Dryas octopetala, dwarf junipers, brooms or greenweeds; Dryas heaths of the British Isles and Scandinavia."*

This habitat type consists of several subtypes. These four can be recognized from Pelister National Park:

31.43 - Mountain dwarf juniper scrub.

31.46 - Bruckenthalia heaths

31.4A - High mountain dwarf bilberry heaths

31.4B - High mountain greenweed heaths

Description according to EUNIS (Evans & Roekaerts 2015): "F2 Arctic, alpine and subalpine scrub

F2.2 Evergreen alpine and subalpine heath and scrub, F2.26 Bruckenthalia heaths Description:

Formations of *Bruckenthalia spiculifolia*, often accompanied by *Juniperus nana*, *Vaccinium myrtillus* and herbaceous alpine grassland species, occupying damp, non-calcareous substrates of high mountains of the Balkan Peninsula and northern Anatolia. Plant communities: *Bruckenthalion spiculifoliae*

Species: *Bruckenthalia spiculifolia*, *Juniperus nana*, *Vaccinium myrtillus*."

There is already a fact sheet available of this habitat type for the Republic of Macedonia (Matevski et al. 2017). Here is presented the current situation for Pelister National Park.

Occurrence of habitat type and subtypes in Pelister National Park

The habitat type 4060 "Alpine and Boreal heaths" is present at the Pelister National Park. It is fairly common and abundant at subalpine and alpine areas of the park at altitudes 1600 – 2300 m a.s.l. It mostly occurs at alpine areas above natural upper forest boundary, but there are remnants of this habitat type also inside the forest zone in

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overgrowing pastures or burned sites. Different subtypes of alpine and boreal heaths often form mosaics with each other. At lower parts of the alpine zone there are low-growing *Juniperus communis* heaths (*Juniperus nana / sibirica*) that change to *Vaccinium myrtillus* and *Bruckenthalia spiculifolia* dominated heaths towards higher elevations. Especially at higher altitudes these heaths form mosaics with alpine grasslands. At subalpine parts small heaths with broom(s) *Chamaecytisus* spp. are also found mixed with grasslands and other heath types. *Juniperus communis* shrubs that grow tall (over 0.5-1 m) at subalpine areas or lower parts of the Pelister National Park on overgrowing grasslands belong to type 5130 "*Juniperus communis* formations on heaths or calcareous grasslands", not to alpine heaths.

Fig. 28. 4060 Alpine and Boreal heaths is a common habitat type at subalpine and alpine parts of the Pelister National Park. **a)** Dwarf mountain juniper heath at slope of the Mt. Pelister. **b)** *Pinus peuce* is spreading quickly upwards to Alpine and Boreal heaths in certain northern slopes of the Mt. Pelister.

Vascular plant communities and typical species of 4060 in Macedonia

Typical species of the habitat 4060 in the Pelister National Park include: *Juniperus communis*, *Vaccinium myrtillus*, *Calamagrostis arundinacea*, *Bruckenthalia spiculifolia*, *Deschampsia flexuosa*, *Vaccinium uliginosum*, *Rubus idaeus*, *Epilobium angustifolium*, *Sesleria comosa*, *Thymus jankae*, *Luzula spicata*, *Festuca* spp., *Carex kitaibeliana*, *Lilium albanicum*, *Galium breviramosum*, *Gentiana lutea* subsp. *symphiandra*, *Crepis viscidula*, *Tephroseris papposa*, *Podospermum roseum* spp. *peristericum*, *Pedicularis orthantha*.

Habitat directive and other important species

4060 is important for several alpine animal species including the hazel grouse *Tetrastes bonasia* with its southernmost localities in Europe at middle Balkan. Alpine heaths together with grasslands provide summertime grazing areas for Chamois *Rupicapra rupicapra* in the Pelister National Park.

Inventory and Monitoring

Standard Field Inventory Form for grasslands should be used in inventories and during monitoring. Inventory information should be collected on GPS marked polygons/ sampling plots inside the studied heathland stands. Repeated visits and iteration of inventory at the same site is basic method of monitoring. Suitable monitoring period is between 5-10 years for this habitat type. Different subtypes should be taken into account during monitoring. Both managed and unmanaged stands should be monitored at different altitudes and in different successional stages of occurrences of this habitat type.

Threats and pressures

In the Pelister National Park the Alpine and Boreal heaths are suffering from overgrowth. Lower growing subtypes are overgrown by higher ones i.e. *Juniperus communis* is overgrowing *Vaccinium myrtillus* and *Bruckenthalia*

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spiculifolia dominated heaths. At the same time wooden species are spreading to alpine heaths. At upper parts of the forest zone there are overgrown heaths inside expansive forests and high juniper shrub. *Pinus peuce* seems to colonise alpine heaths and grasslands quickly at certain areas in the Pelister National Park. In addition to the common juniper, deciduous trees and scrubs (*Prunus* spp., *Betula pendula*, *Acer obtusum*, *Rubus* spp., *Rosa* spp.) are colonizing subalpine parts of heaths in certain parts of the Pelister National Park. Dense colonies of bracken (*Pteridium aquilinum*) are also spreading to mountain heaths at places. Climate warming will most likely enhance these negative changes. Although overgrazing is a threat to this habitat type, some amount of management and grazing is needed to keep it up. Possible threats to this habitat type are also the construction of mountain roads and buildings, consequences of massive tourism (construction of infrastructure, trampling) and eutrophication caused by airborne pollutants (mainly nitrogen).

Fig. 29. Spike heath (*Bruckenthalia spiculifolia*) is an evergreen shrub native to Southeast Europe and Asia Minor. Bruckenthalia heath is a subtype of 4060 Alpine and Boreal heaths. This habitat is typical for mountains of the Balkan peninsula. Photo: Kimmo Syrjänen.

Range

This habitat type is found in several sites in the Pelister National Park and Macedonia. In addition to the Pelister National Park it occurs in many other mountains of Macedonia including Shar Planina, Korab, Deshat, Jablanica, Galichica, Kozuf, Nidze, Ilinska Planina, Plakenska Planina, Bigla, Stogovo, Bistra, Jakupica, Skopska Crna Gora, Kozjak, Osogovo, Plachkovica, Vlaina, Maleshevski Planinski and Belasica (Matevski et al. 2017).

Area

The size of this habitat is probably decreasing in the Pelister National Park due to overgrowth. It is also possible that heaths colonize alpine grasslands at the same time with some extent. The total area 4060 is estimated to be at the Pelister National Park about 1900 hectares.

Structure and function

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Slopes of Pelister contain large areas of Alpine and Boreal heaths. The present distribution of these heaths is probably a consequence of historical land-use including cutting of mountain forests at the Ottoman Empire period and long lasting grazing since then before the establishment of the Pelister National Park. Overgrazing leads to the expansion of grassland at the cost of heaths. Currently grazing pressure on heaths has remained low for the past several decades. Due to this heaths are slowly spreading to alpine grasslands and at the same time there is overgrowth in the lower parts. Formations of these low-growing shrub habitats are dependent also on hard winds and harsh wintertime conditions of mountains (including the level of snow cover). Right now Alpine and Boreal heaths at many parts of the Pelister National Park are subject to heavy overgrowth and more or less natural succession towards forests. Macedonian pine (*Pinus peuce)* is also spreading quickly to Alpine and Boreal heaths at Pelister. This trend may increase due to climate warming. Juniper heaths and *Juniperus communis* shrubs are competitively superior over low growing heath types and seem to be spreading as well.

The habitat of Alpine and Boreal heaths is extremely important for the stability of the slopes on which it develops. It also provides high biodiversity and high productivity and affects positively to the hydrology of the mountain.

Fig. 30. a) *Bruckenthalia* heaths form mosaics with other heath types and alpine grasslands at the slopes of the Mt. Pelister. b) *Bruchenthalia* together with blueberry *Vaccinium myrtillus* Photos: Kimmo Syrjänen.

Management principles

Sustainable grazing regimes in particular can facilitate high diversity, reduce evapo-transpiration and increase runoff without causing erosion, grazing benefits to the highlands that are often unrecognised (Zagbi 2008). Inside the Pelister National Park grazing pressure at Alpine and Boreal heaths is at present mainly too low to keep up this habitat type. Especially *Bruckenthalia* heaths are a characteristic habitat type for Southeast Europe and should therefore have a high conservation value in Macedonia and in the Pelister National Park. Management with clearing of trees and part of junipers with moderate grazing is needed to maintain *Bruckenthalia* and *Vaccinium* heaths at their present positions. Management actions to maintain and improve *Bruckenthalia* and *Vaccinium* heaths are needed soon. High biodiversity, reduction of transpiration and the reduction of erosion can be best achieved with sustained grazing regimes. Also, the Alpine and Boreal heaths are attractive for some recreational activities such as hiking and wintertime freeride.

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Conservation status (a draft based on the Twinning project study area)	
Range (of the distribution area)	FV
Area	U1
Structure and function	U1
Future prospects	U2
Overall assessment of Conservation Status	**U2**

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3.3. Sclerophyllous Scrub (Matorral)

3.3.1. *Juniperus communis* formations on heaths or calcareous grasslands

Status in Europe			
Habitats directive, Annex I		Habitat type:	**5130**
Threat status in Europe EU28+	Least concern		LC
Threat status in EU28	Least concern		LC
EU conservation status by biogeographical region			
Alpine	Unfavourable-Inadequate		U1
Atlantic	Unfavourable-Inadequate		U1
Black Sea	Not present		-
Boreal	Unknown		XX
Continental	Favourable		FV
Macaronesian	Not present		-
Mediterranean	Unknown		XX
Pannonian	Unfavourable-Inadequate		U1
Steppic	Not present		-

Definition

The Interpretation Manual of European Union Habitats (EU Commission 2013): *"Formations with Juniperus communis of plain to montane levels. They mainly correspond to phytodynamic succession of the following types of vegetation: a) generally, mesophilous or xerophilous calcareous and nutrient poor grasslands, grazed or let lie fallow, of the Festuco-Brometea and Elyno-Seslerietea. b) more rarely, heathlands of the Calluno vulgaris-Ulicetea minoris (31.2)." Plants: Juniperus communis, Crataegus spp., Rosa spp., Prunus spinosa. For a) typical species of the Festuco-Brometea and Elyno-Seslerietea.*

For b) Calluna vulgaris, Vaccinium myrtillus, Empetrum nigrum, Erica tetralix, Deschampsia flexuosa, Nardus stricta."

Description according to EUNIS (Evans & Roekaerts2015): "F3.16 Juniperus communis scrub. Temperate and mediterranean-montane communities dominated by Juniperus communis, mostly Juniperus-dominated variants of units F3.11, F3.13, F3.22-F3.24. Calluna vulgaris, Crataegus spp., Pinus sylvestris, Quercus petraea, Bromus erectus and Festuca rupicola are also present." "Plant communities: Vaccinio-Juniperion communis. Species: Juniperus communis, Crataegus spp., Rosa spp., Prunus spinosa." "Associated habitat types: Most often found as a succession from mesophilous or xerophilous calcareous and nutrient poor grasslands, such as Festuco-Brometea and Elyno-Sesleretea, or more rarely, heathlands of the Calluno vulgaris-Ulicetea minoris."

Occurrence of habitat type in the Pelister National Park and the Prespa region

"5130 *Juniperus communis* formations on heaths or calcareous grasslands" are common in Macedonia and in the study area in the Pelister National Park and around the Prespa Lake. *Juniperus communis* is a typical component of several habitat types of (dry) grasslands and rocky habitats. Description of this type is mainly based on the abundance of juniper. *Juniperus communis* formations with long continuity are often characterized by grazing sensitive herbs and ferns as well as pleucarpic mosses in undergrowth.

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Fig. 31. 5130 *Juniperus communis* formations on heaths or calcareous grasslands are commonly found at Macedonia and the study area. *Juniper communis* formation on acidic soil above Malovishte village at Pelister National Park. Slow succession towards a forest is going on. Photo: Kimmo Syrjänen.

Most sites of this habitat type are of rather recent origin. Cessation of traditional use (usually grazing and management of pastures by burning or removing junipers) has lead on to the formation and overgrowth of these habitats. At lower altitudes in the study area *Juniperus communis* is usually accompanied by *Juniperus oxycedrus* and stands of 5130 often include both juniper species. At these parts of the study area *Juniperus communis* is naturally a component of 6220 "*Pseudo-steppe with grasses and annuals of the Thero-Brachypodietea" but it is also one of the most important colonizing scrubs and often the main cause of overgrowth of this habitat type. In Pelister National Park *Juniperus communis* is overgrowing 6210 "Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia)" that is usually present in small fragments at forest zones and subalpine slopes. 5130 *Juniperus communis* formations are common around villages, especially at slopes between meadows and forests (fig. 31). At lower parts of the alpine area and more typically at the subalpine parts of Pelister National Park there are overgrowing stages of 4060 "Alpine and Boreal heaths" and to some extent also 62D0 "Oro-Moesian acidophilous grasslands", that have already changed into 5130 habitat type. *Juniperus communis* is also found along siliceous screes and rocky slopes in Pelister National Park. Sometimes there are a lot of junipers at open forests and some of these occurrences are transitions to forest vegetation (including oak-, beech- and Macedonian pine forests). This habitat type is also related to the habitat 5210 Arborescent matorral with *Juniperus* spp.

Vascular plant communities and typical species of 5130 in Macedonia

In the Pelister National Park substrates are mainly acidic whereas at the western shore of the Prespa Lake they are calcareous. This affects the species composition. Typical species of 5130 in the Pelister National Park include: *Juniperus communis*, *Juniperus oxycedrus*, *Arceuthobium oxycedri*, *Dryopteris filix-mas*, *Rubus idaeus*,

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Calamagrostis arundinacea, *Rosa* spp., *Festuca* spp., *Festuca valesiaca*, *Chrysopogon gryllus*, *Odontites luteus*, *Plantago bellardii*, and *Pyrus spinose.*

Fig. 32. a) Slowly overgrowing pseudo-steppe grassland – *Juniperus communis* formation at sun exposed slope near the village Nitze Pole. **b)** Subalpine colonizing junipers along a path to the Golemo Ezero from Nize Pole.

Habitat directive and other important species

5130 is often an overgrowing phase, but it's still an important habitat for many species of 6220* and 6210 including orchids such as *Spiranthes spiralis, Orchis papilionacea* and *Dactylorrhiza sambucina.* 5130 is a foraging environment for Wood lark *Lullula arborea* and Red-backed shrike *Lanius collurio* at the study area.

Inventory and Monitoring

Standard Field Inventory Form for grasslands can be used in inventories and monitoring. Inventory information should be collected on GPS marked polygons/ sampling plots inside the studied scrubland stands. Repeated visits and iteration of inventory at the same site is a basic monitoring method. Suitable monitoring period is between 5-10 years for this habitat type. Both managed and unmanaged stands should be monitored at different altitudes and at different successional stages.

Threats and pressures

5130 *Juniperus communis* formations on heaths or calcareous grasslands consist mainly of successional habitat types at the study area. In certain parts of the Pelister National Park there is also degradation of this habitat type because of overgrowth by trees. However, this habitat is now present at many places and its size is probably increasing. Beside natural dynamics there are no severe threats to this habitat type.

Range

This habitat type is quite common in North Macedonia including the Pelister National Park and the Prespa region. It has scattered occurrences though the country.

Area

Area of this type is probably increasing in the Pelister National Park and in the Prespa region due to cessation of traditional use. The total area in the Pelister National Park is estimated to be about 450 hectares and a couple of hectares in the Prespa area.

Structure and function

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5130 is for the most part a successional habitat type and often part of an overgrowth process. The occurrences of juniper formations have probably replaced earlier successional stages of another habitat types. However, on nutrient poor and dry soils and rocky areas this type can remain rather open for a long time and host habitat patches of dry grasslands and their typical species. In some sites *Juniperus communis* can grow in a decade and form dense thickets that will eventually grow into a forest.

Fig. 33. Juniper dwarf mistletoe (*Arceuthobium oxycedri*) is an evergreen hemiparasite of junipers. It is a rather common species in the Pelister National Park and grows mainly on *Juniperus oxycedrus* (above) and sometimes on *J. communis* at juniper scrub. The species is related to European mistletoe (*Viscum album*) and they belong to the same family (Santalaceae). Photo: Kimmo Syrjänen.

Management principles

During the past period since 1948, there was a law banning the breeding of sheep and grazing in the protected areas that contributed to the advanced succession of many bush formations in the lowland and subalpine belt of the National Park Pelister, including the habitat with *Juniperus communis*. Today the consequences of this law are obvious, so that many areas of the belt of the hilly and mountain pastures are covered by this habitat.

Management of 5130 needs careful planning of conservation actions. Maintenance of *Juniperus communis* formations may need management time after time. Sites with long persistence of junipers and dry open grassland at the same site have higher conservation value than new successional stands. Occasional clearing and removal of junipers and other shrubs and young trees are needed to maintain this habitat type. In most habitats, especially in the overgrown prioritized * HD habitats, it would be more important to direct conservation actions so that earlier successional habitats are restored. *Juniperus communis* shrub is competitively superior over dry grasslands and low growing heath types. Some bushes of junipers needs to be left intact in management, but their abundance and cover should be highly decreased. Also grazing is needed to restore former grassland types.

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5130 seems to be spreading in the study area and the speed of this process may be increased by climate warming. Maintaining this type can be a conservation goal at sites where there is long continuity of junipers and/or not possibilities to organize sustainable management and grazing regimes. These can include rocks and rocky slopes with junipers as well as other sites where overgrowth process is slow. In most sites the original habitat type should be a target of management action. Habitats types 6220*, 6120*, 6120, 62D0 and 4060 should be prioritized over 5130 in management planning and actions.

Fig. 34. a) *Juniperus communis* and **b)** *Juniperus oxycedrus* are both typical for 5130 in North Macedonia. *Juniperus communis* is the dominant species of this habitat type. Photos: Kimmo Syrjänen.

Conservation status (a draft based on the Twinning project study area)	
Range (of the distribution area)	FV
Area	FV
Structure and function	FV
Future prospects	FV
Overall assessment of Conservation Status	**FV**

References:

EUNIS Fact Sheet: Juniperus communis formations on heaths or calcareous grasslands

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3.4. Natural and semi-natural grassland formations

3.4.1. Pseudo-steppe with grasses and annuals of the Thero-Brachypodietea

Status in Europe		
Habitats directive, Annex I	Habitat type:	**6220***
* Priority habitat type		
Threat status in Europe EU28+	Vulnerable	VU
Threat status in EU28	Vulnerable	VU
EU conservation status by biogeographical region		
Alpine	Unknown	XX
Atlantic	Unfavourable-Bad	U2
Black Sea	Unfavourable-Inadequate	U1
Boreal	Not present	-
Continental	Unfavourable-Inadequate	U1
Macaronesian	Not present	-
Mediterranean	Unfavourable-Inadequate	U1
Pannonian	Not present	-
Steppic	Not present	-

Definition

The Interpretation Manual of European Union Habitats (EU Commission 2013): *"1) Meso- and thermo-Mediterranean xerophile, mostly open, short-grass annual grasslands rich in therophytes; therophyte communities of oligotrophic soils on base-rich, often calcareous substrates. Perennial communities - Thero-Brachypodietea, Thero-Brachypodietalia: Thero-Brachypodion. Poetea bulbosae: Astragalo-Poion bulbosae (basiphile), Trifolio-Periballion (silicolous). Annual communities - Tuberarietea guttatae Br.-Bl. 1952 em. Rivas-Martínez 1978, Trachynietalia distachyae Rivas-Martínez 1978: Trachynion distachyae (calciphile), Sedo-Ctenopsion (gypsophile), Omphalodion commutatae (dolomitic and silico-basiphile). In France a distinction can be made between: (a) annual herbaceous vegetation of dry, initial, low-nitrogen soils ranging from neutro-basic to calcareous: Stipo capensis-Brachypodietea distachyae (Br-Bl. 47) Brullo 85; (b) vegetation of more or less closed grasslands on deep, nitrocline and xerocline soil: Brachypodietalia phoenicoidis (Br-Bl. 31) Molinier 34. In Italy this habitat mainly exists in the South and on the islands (Thero-Brachypodietea, Poetea bulbosae, Lygeo-Stipetea). 2) Plants: Brachypodium distachyum, B. retusum*."

According to EUNIS (Evans & Roekaerts 2015) this habitat type is included in: E1.3 Mediterranean xeric grassland that contains only one Annex I type (6220*) with the same description as above.

Plant communities according to EUNIS (Evans & Roekaerts 2015) include: Diantho humilis-Velezion rigidae, Cymbopogoni-Brachypodion ramosi, Plantagini-Catapodion marini, Moricandio-Lygeion sparti, Dauco-Catananchion luteae, Sedo-Ctenopsion gypsophilae, Trachynion distachyae, Thero-Brachypodion, Armerion girardii, Omphalodion commutatae, Stipion retortae.

Typical plant species (Evans & Roekaerts 2015): *Brachypodium distachyum*, *B. retusum*, *B. fasciculatus*, *B. madritensis*, *B. rubens*, *B. alopecuros*, *Aegilops neglecta*, *A. geniculata*, *A. triuncialis*, *Avena sterilis*, *A. barbata*, *Lagurus ovatus*, *Cynosurus echinatus*, *Stipa capensis*, *Hyparrhenia hirta*, *Andropogon distachyos*, *Cynodon dactylon*, *Dactylis hispanica*, *Urginea maritima*, *Asphodelus microcarpus*, *Lloydia graeca*, *Anacamptis pyramidalis*.

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Fig. 35. 6220 * Pseudo-steppe with grasses and annuals of the Thero-Brachypodietea is a priority habitat type that is present at several sites in North Macedonia. This habitat type has occurrences both at the Pelister National Park and along the Prespa Lake. Grazed dry grassland of 6220* between Dihovo and Nize Pole villages at the border of the Pelister National Park. Photo: Kimmo Syrjänen

Vascular plant communities and typical species of 6220 in study areas

Avramoski (2006b) lists for the Pelister National Park Mediterranean xeric grassland E1.3, East Mediterranean xeric grassland E1.33, Helleno-Balkanic short grass and therophyte communities Trifolion cherleri [K. Micevski 1970] E1.332. Class: Festuco-Brometea Br.-Bl. et R. Tx. 1943 Order: Astragalo-Potentilletalia K. Micevski 1970, Alliance: Trifolion cherleri K. Micevski 1970.

The dry grasslands on siliceous geological bedrock on the territory of the Republic of Macedonia have been assigned to the class Festuco-Brometea, order Astragalo-Potentilletalia and alliance Trifolion cherleri (Ćušterevska et al. 2012) This vegetation type belongs to 6220*.

In the classification scheme, as adopted by the EuroVegChecklist (Mucina et al., 2016), the Trifolion cherleri represents submediterranean therophyte communities in the Southern Balkans (Submediterranean silicicolous therophytic swards of Macedonia and Southern Bulgaria) classified in the Helianthemetalia guttati Br.-Bl. in Br.-Bl. & al. 1940 (Helianthemetea guttati Rivas Goday et Rivas-Mart. 1963).

Typical species in pseudo-steppe at lower parts of Pelister National Park include: *Agrimonia eupatoria*, *Allium vineale*, *Arenaria serpyllifolia*, *Avena fatua*, *Avena sterilis*, *Bothriochloa ischaemum*, *Carex caryophyllea*, *Centaurea grisebachii*, *Cerastium semidecandrum*, *Chrysopogon gryllus*, *Cladonia convoluta*, *Dianthus pinifolius*, *Dichanthium ischaemum*, *Echinaria capitata*, *Eryngium campestre*, *Erysimum diffusum*, *Festuca valesiaca*, *Hypericum perforatum* subsp. *veronense*, *Hypericum rumeliacum*, *Juniperus communis*, *Juniperus oxycedrus*, *Linaria genistifolia*, *Linum catharticum*, *Odontites luteus*, *Odontites rubra*, *Orchis papilionacea*, *Parvotrisetum myrianthum*, *Petrorhagia dubia*, *Phleum phleoides*, *Plantago bellardii*, *Plantago holosteum*, *Poa bulbosa*, *Sanguisorba minor* subsp. *balearica*, *Scleranthus perennis*, *Spiranthes spiralis*, *Stipa* spp., *Syntrichia ruralis*, *Taeniatherum caput-medusae* subsp. *asperum*, *Teucrium chamaedrys*, *Thymus thracicus*, *Trifolium cherleri* and others.

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Fig. x. *Spiranthes spiralis* orchid lives in this habitat. Photo: Kimmo Syrjänen.

Habitat directive and other important species

This habitat type is important for many reptiles of the Habitat Directive, including *Podarcis erhardii, P. muralis, P. tauricus, Lacerta trilineata* and *Lacerta viridis* as well as snake species at the Prespa Lake and the Pelister National Park. Rare orchid *Spiranthes spiralis* occurs mainly in this habitat type at the Pelister National Park. It is also important for diverse insect fauna of thermophile sun exposed habitats. It is a foraging environment for the Wood lark (*Lullula arborea*) and the Red-backed shrike (*Lanius collurio*) at the study area.

Inventory and Monitoring

Standard Field Inventory Form for grasslands should be used in inventories and monitoring. Inventory information should be collected on GPS marked polygons/ sampling plots inside of the studied dry grassland stands. Drone photos or other aerial images may be useful as well while following and analysing monitoring results. Repeated visits and iteration of inventory of vegetation at the same site is a basic method of monitoring. Suitable monitoring period is between 5-10 years for this habitat type. Different kind of vegetation (sub) types should be included in monitoring. Both altered (overgrown, restored) and presently representative sites should be monitored.

Threats and pressures

This habitat type is dependent on some extent on human disturbance, especially grazing. Without management these dry grasslands turn into shrub, dominated mainly by *Juniperus communis* and/or *Juniperus oxycedrus*. Bracken *Pteridium aquilinum*, *Rubus* spp., *Prunus* spp. and *Rosa* spp. can be involved in overgrowth. Also other bushes and tree species, including *Pinus sylvestris* and *Pinus peuce* will disperse into this habitat type that will eventually develop into a forest. Construction of roads and buildings can be harmful locally. Overgrazing, erosion and wildfires can be a threat, but this habitat type can recover from these kinds of disturbances if they are not too severe.

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Fig. 36. a) 6220 * Pseudo-steppe with grasses and annuals of the Thero-Brachypodietea habitat type has several representative occurrences connected to the Pelister National Park. 6220* near the Ljubojno village. **b)** 6220* is prone to overgrowth by bushes and trees, badly overgrown site near the Nize Pole village. Photos: Kimmo Syrjänen.

Range

In Macedonia this habitat type is quite widely distributed (see Ćušterevska et al. 2012) and it is present in the study area both at the Pelister National Park and occasionally along the Prespa Lake. There are large and representative pseudo-steppes at the western slopes of the Pelister National Park between park and the Prespa Lake, mainly outside of the conservation areas.

Area

In the Pelister National Park this habitat type is present in the lower parts of the park and in several places at close vicinity outside of present park border. Many occurrences are rather small patches and in many sites there is overgrowth going on. At the Pelister National Park there are representative occurrences at the slopes of nearby villages Dihovo, Nize Pole, Kazani – Maloviste and Ljubojno at least. The total area is approximately 100 hectares in the Pelister National Park.

In the vicinity of the Nizepole village there are small stands, fragments of plant community dominated by the *Chrysopogon gryllus*. These stands are partly actively maintained by goat grazing and there are some elements of meadows. In front of the village of Malovishte (between Kazani and Malovishte) a registered population of donkey exist. In the plant community *Tunicio-Trisetetum myrinathi* subass. *sanguisorbetosum muricatae* (Micevski, 1971), the characteristics and associations of different species are present, species including the alliance *Trifolion cherlerli* - *Parvotrisetum myrianthum, Petrorhagia dubia, Sanguisorba minor* subsp. *balearica, Bothriochloa ischaemum, Echinaria capitata, Taeniatherum caput-medusae* subsp. *asperum, Phleum phleoides* and *Hypericum perforatum* subsp. *Veronense*. The presence of the *Tunicio-Trisetetum myrinathi* subass. *sanguisorbetosum muricatae* in the investigated area means that the distribution of this plant community is extended in south west parts of the Republic of Macedonia.

Structure and function

This habitat type is typically present at sun exposed grazed slopes in thermophilic sites both at rocky and gravelly soils. It is dependent on management including grazing and clearing. Without management it will often turn to habitat type 5130 "*Juniperus communis* formations on heaths or calcareous grasslands" and further develop into a forest.

Management principles

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Management should be based on careful planning and it can include clearing of bushes and young trees, grazing and controlled small scale burnings. Overgrazing needs to be avoided. Management target is to maintain high quality sites and to restore overgrown sites back to a more improved condition with a high biodiversity value.

Conservation status (a draft based on the Twinning project study area)	
Range (of the distribution area)	FV
Area	U1
Structure and function	U1
Future prospects	U2
Overall assessment of Conservation Status	**U2**

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3.4.2. Pannonic sand steppes

Status in Europe		
Habitats directive, Annex I	Habitat type:	6260*
Threat status in Europe EU28+	Critically endangered (IUCN)	CR
Threat status in EU28	Critically endangered (IUCN)	CR
EU conservation status by biogeographical region		
Alpine	Not present	-
Atlantic	Not present	-
Black Sea	Not resent	-
Boreal	Not present	-
Continental	Unfavourable-Bad	U2
Macaronesian	Not present	-
Mediterranean	Not present	-
Pannonian	Unfavourable-Inadequate	U1
Steppic	Not present	-

Definition

The Interpretation Manual of European Union Habitats (EU Commission 2013): *"1)* Formations dominated by medium or tall perennial tuft-forming grasses or suffrutescents, with lacunar ground cover, together with their associated therophyte communities developed on mobile or fixed sands (alluvial sands, subfossil dune systems) within the range of the Pannonic steppes (34.91), thus in the Pannonic basin and the areas dominated by its communities. Also includes similar communities in the West Pontic basin (34.A2)" "2) Plants: *Carex arenaria, Chondrilla juncea, Festuca vaginata, Helychrysum arenarium, Dianthus serotinus, Gypsophila fastigiata, G.paniculata, Koeleria glauca, Alyssum montanum ssp. gmelinii, Bassia laniflora, Centaurea scabiosa ssp. sadleriana, C. jacea ssp. angustifolia, Erysimum diffusum, Poa bulbosa, Saponaria officinalis, Scrophularia canina, Silene conica, Stipa capillata, S. pulcherrima,Cynodon dactylon, Festuca pseudovina. Verbascum thapsiforme, Vulpia bromoides,*

Animals: insects - *Gampsocleis glabra, Myrmeleotettrix antennatus, *Callimorpha quadripunctaria, Cletis maculosa, Zygaena laeta, Z. punctum, Scythris kasyi*."

According to EUNIS (Evans & Roekaerts 2015) this habitat type is included in: E1.2 Perennial calcareous grassland and basic steppes. "Perennial grasslands, often nutrient-poor and species-rich, on calcareous and other basic soils of the nemoral and steppe zones and of adjacent parts of the subboreal and submediterranean zones. Includes the calcareous grasslands of central and western Europe, alvar grasslands of the Baltic region, and basic grasslands of the steppe zone."

There are a lot of dry sandy grasslands with perennial herbs, grasses and therophytes around the shoreline of the Prespa Lake, both on the western side (especially around the Stenje village and less around Kojnze) and more widely scattered along the eastern shore (in and between of Dolno Dupeni, Nakolec, Sthrobovo, Krani and Asamati). Composition of vegetation communities is somewhat variable. On the western shore sandy habitats are mainly calcareous and on the eastern shoreline nutrient-poor and of silicate origin. Some of these sandy areas are strongly affected by human activities such as uptake of sand, apple orchards, villages, beaches, roads, constructions and wastelands, but there are also representative examples of this priority habitat type available. For the most part these sandy habitats are of recent origin following the water level decrease of the Prespa during the last 30 years,

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but plant species and communities are probably derived from older sandy shoreline habitats. There is a vast potential of managed sandy habitats along shores that are possible to restore into priority habitat types. The terrestrial areas surrounding the Prespa Lake may also exhibit other habitat types with characters of Pannonian and/or inland dune vegetation. In Greek Natura 2000 site of the Prespa National Park are the southernmost occurrences of 6220 type (Fotiadis et al. 2014). This habitat type is closely related to 6220 * "Pseudo-steppe with grasses and annuals of the Thero-Brachypodietea" and to 6120 * "Xeric sand calcareous grasslands" (see Fotiadis et al. 2014).

Fig. 37. 6260 * Pannonic sand steppes is a priority habitat type that has its southernmost occurrences in Europe along coasts of the Prespa Lake. **a)** Sand steppe close to the village Sthrobovo. **b)** *Silene frivaldszkyana* is a typical species of this habitat type at the Prespa. It is a Balkan endemic plant and has a rather narrow distribution at Albania, North Macedonia, Greece, Bulgaria and European part of Turkey. Photos: Kimmo Syrjänen.

Vascular plant communities and typical species of 6260 in the Prespa Lake

Plant communities in sensu lato include: Sileno conicae-Cerastion semidecandria and Festuco-Sedetalia acris.

Typical species in the dry sandy grasslands at the study area along Prespa Lake include: *Silene frivaldszkyana*, *Jasione montana*, *Silene conica*, *Bromus tectorum*, *Poa bulbosa*, *Eryngium campestre*, *Trifolium arvense*, *Taeniatherum caput-medusae*, *Linaria genistifolia*, *Syntrichia ruralis var. arenicola*, *Herniaria glabra*, *Cichorium intybus*, *Scirpoides holoschoenus*, *Saponaria officinalis*, *Alyssum montanum*, *Cynodon dactylon*, *Lactuca viminalis* and *Verbascum* spp.

Habitat directive species

This habitat type is important for many reptiles of the Habitat Directive, including *Podarcis erhardii*, *P. muralis*, *P. tauricus*, *Lacerta trilineata* and *Lacerta viridis*. It is a foraging environment for the Wood lark *Lullula arborea* and the Red-backed shrike *Lanius collurio* at the study area.

Inventory and Monitoring

Standard Field Inventory Form for grasslands should be used in inventories and monitoring. Inventory information should be collected on GPS marked polygons/ sampling plots inside the studied dry grassland stands. Drone photos may also be useful while following and analysing monitoring results. Repeated visits and iteration of inventory of vegetation at same site is a basic method of monitoring. Suitable monitoring period is between 5-10 years for this

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habitat type. Different kind of vegetation (sub) types should be taken into account during monitoring. Both altered (overgrowing, exploited) and presently representative sites should be monitored at least in five different positions along the Prespa Lake.

Threats and pressures

There are a lot of anthropogenic changes going on inside areas of this habitat type at the Prespa area. Active land use including excavation of sand and the establishment of new apple orchards are the most serious threats to this habitat type. Sand excavation site may not recover because they can be further used as a dumping ground. Some of the typical species may be affected by increased use of groundwater, but drainage is not usually a serious threat to this particular habitat type. Instead, invasion of non-native species is a severe threat to this habitat type in the near future. Invasive alien *Robinia pseudacacia* is common and abundant at the Prespa shoreline. In Resen *Amorpha fruticosa* is also a common alien species and can spread to sandy shoreline habitats. *Ailanthus altissimus* is present and locally spreading at Sirhan, but has not yet colonized dry sandy shores. Eutrophication of lake and the increase of reed bed volume may affect negatively on the formation of new dry nutrient poor sandy shoreline habitats. Eutrophication can benefit *Salix alba* and *Populus* spp. at shoreline vegetation and change successional dynamics. Intensive use of pesticides in surroundings of the Prespa Lake will affect negatively on insect populations of these priority habitats. However, this habitat type needs some level of human induced disturbance. Without substantial level of grazing or trampling tall vegetation will overgrow the site.

Fig. 38. a) 6260* Pannonic sand steppes close to Nakolec. Certain amount of human disturbance (e.g. grazing) is beneficial for this habitat type. **c)** Sand steppe vegetation close to Krani. Large excavations of sand, road constructions, overgrazing, dumping places and establishment of new orchards at sites of this habitat type are harmful for conservation status. Photos: Kimmo Syrjänen.

Range

In North Macedonia this habitat type is currently found only at the Prespa Lake. Due to local (subcontinental) climatic conditions it is probably not present at other parts of the country.

Area

In the Prespa lake, type 6260* is found at several places along lake shorelines. Area is around 195.25 hectares (Fotiadis et al. 2018). Of this about 50 - 70 of the sites are in good condition, rest have decreased value but having a high potential for restoration. Area may be decreasing due to continuing exploitation and overgrowth. There is also changed vegetation that is not included into this habitat type but may still be restored.

Structure and function

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Large parts of present shoreline sand steppes are probably formed after the decrease of water level of the Prespa during the last three decades (see BIOECO 2009). Some of the currently representative sites are former beaches. In Greek it is stated that anthropogenic disturbances such as grazing appear to be beneficial for this type to some extent and maintenance of this priority type is based on management (Fotiadis et al. 2014). Without management these kinds of habitats will be overgrown by taller vegetation.

Management principles

High quality sites of this habitat have to be protected from overexploitation and destruction. Being a priority habitat type these sites should be included into the Natura 2000 network. Management actions can include grazing and moderate amount of trampling (e.g. by cattle, humans or even vehicles) and should be based on careful planning and participation of local stakeholders.

Conservation status (a draft based on the Twinning project study area)	
Range (of the distribution area)	FV
Area	U1
Structure and function	U1
Future prospects	U2
Overall assessment of Conservation Status	**U2**

References:

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3.4.3. Oro-Moesian acidophilous grasslands

Status in Europe		
Habitats directive, Annex I	Habitat type:	62D0
Threat status in Europe EU28+	Least concern (IUCN)	LC
Threat status in EU28	Least concern (IUCN)	LC
EU conservation status by biogeographical region		
Alpine	Unfavourable-Inadequate	U1
Atlantic	Not present	-
Black Sea	Not present	-
Boreal	Not present	-
Continental	Unfavourable-Inadequate	U1
Macaronesian	Not present	-
Mediterranean	Not present	-
Pannonian	Not present	-
Steppic	Not present	-

Definition

The Interpretation Manual of European Union Habitats (EU Commission 2013): *"Alpine and sub-alpine grasslands developed over crystalline rocks and other lime-deficient substrates or on decalcified soils at 1600 – 2900 m above sea level on high mountains of the Central Balkan Peninsula, including the Balkan Range, Rila, Pirin, Slavyanka, the Central Rhodopes, Osogovska Planina. Belasitza. The communities are dominated by grasses such as Festuca paniculata, Bellardiochloa violacea, Festuca airoides, Calamagrostis arundinacea, Festuca nigrescens and Agrostis capillaris. The Balkan endemics Festuca balcanica, F. riloensis, F.valida, Sesleria comosa and Carex bulgarica also occur in these communities."*

"2) Plants: Festuca airoides, Festuca balcanica, Festuca nigrescens, Festuca paniculata, F. riloensis, Festuca valida, Bellardiochloa violacea, Calamagrostis arundinacea, Sesleria comosa, Aquilegia aurea, Lilium jankae, Gentiana lutea, Gentiana punctata, Viola rhodopaea, Primula deorum, Carex bulgarica"

According to EUNIS (Evans & Roekaerts 2015) this EU habitat type is included as part of "E4.3 Acid alpine and subalpine grassland." with description: "Alpine and subalpine grasslands developed over crystalline rocks and other lime-deficient substrates or on decalcified soils of mountains. On boreal mountains, Carex bigelowii and Juncus trifidus often dominate. The acid alpine grasslands of central Europe are more mixed, with Armeria alpina, Armeria alliacea (Armeria montana), Euphrasia minima, Gentiana alpina, Geum montanum, Juncus trifidus, Lychnis alpina, Pedicularis pyrenaica, Phyteuma hemisphaericum, Pulsatilla alpina ssp. *sulphurea, Ranunculus pyrenaeus, Sempervivum montanum, Botrychium lunaria."*

And with following plant communities: "Agrostion alpinae, Agrostion schraderanae, Anemonastro sibirici-Festucion ovinae, Anemonion speciosae, Calamagrostion arundinaceae, Calamagrostion villosae, Campanulion albanicae, Campanulo herminii-Nardion strictae, Carici-Juncion trifidi, Carici macrostyli-Nardion, Caricion curvulae, Equiseto-Galion borealis, Festucion eskiae, Festucion macratherae, Festucion supinae, Festucion variae, Festucion versicoloris, Festucion woronowii, Festucion xanthinae, Juncion trifidi, Kobresion capilliformis, Kobresio-Dryadion, Nardo-Caricion rigidae, Poion violaceae, Potentillo montenegrinae-Festucion paniculatae, Potentillo ternatae-Nardion, Potentillo-Polygonion vivipara, Ranunculo pollinensis-Nardion strictae, Sesamoido pygmaeae-Poion violaceae, Seslerion comosae, Trifolion parnassii, Trisetion fusci"

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There is already a fact sheet available of this habitat type for the Republic of Macedonia (Matevski et al. 2017). Presented here is the situation of habitat type in the Pelister National Park. According to Avramoski (2006a, b) the alpine ecosystems of Pelister National Park include eight alpine and sub-alpine plant communities that are mainly considered to belong into this habitat type 62D0: Festucetum paniculatae, Centaureo-Festucetum variae, Geranio-Poetum violaceae, Genisto-Nardetum, Jasioni-Caricetum curvulae, Jasioni-Festucetum supinae, Diantho myrtinervius-Festucetum and Lino-Seslerietum.

On these vegetation communities, Diantho myrtinervius-Festucetum is considered to be endemic to Macedonia occurring only within the zone between Pelister and Nidze Kajmakcalan (Avramoski 2006a), and it is typical habitat for the locally endemic *Dianthus myrtinervius (*Macedonian: polegnat karanfil). In addition to this, the following grass communities of Pelister alpine grasslands are considered to be Balkan endemics: Geranio-Poetum violaceae, Festucetum panniculatae and Centaureo-Festucetum variae (Avramoski 2006a).

Fig. 39. 62D0 Oro-Moesian acidophilous grasslands are common at alpine and subalpine part of the Pelister National Park. These alpine grasslands form mosaics of different grassland vegetation communities and with subalpine heaths. This habitat type is typical for central Balkan mountains and contains many species with high conservation value. Photo: Kimmo Syrjänen.

Occurrence of the habitat type and related types in the Pelister National Park

Alpine grasslands of the Pelister National Park have high conservation value and they are characteristic for the Park (Avramoski 2006a). This habitat type is rather complex and contains several vegetation communities. Part of *Nardus stricta* communities growing at alpine zone are related to: “6230 * Species-rich Nardus grasslands, on siliceous

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substrates in mountain". Pure representatives of this type are found also at the Pelister National Park. *Nardus stricta* is often present at part of high altitude Poion violaceae vegetation communities. Oro-Moesian grassland vegetation is present in many alpine rocky slopes where it shifts to 8220 "Siliceous rocky slopes with chasmophytic vegetation" (with vegetation community Asplenio-Silenetum lerchenfeldianae) (Avramoski 2006a). At lower elevations sites of alpine grasslands are mixed or often form small scale mosaics with 4060 "Alpine and boreal heaths". Related habitats in the Pelister National Park may also include "6150 Siliceous alpine and boreal grasslands".

Vascular plant communities and typical species of 62D0

Acidophilous grasslands of the alpine and subalpine belts are classified within Juncetea trifidi (Mucina et al., 2016). These grasslands in the Balkan Peninsula belong to the endemic order Seslerietalia comosae. Within this habitat type there are two sub-habitats. The first sub-habitat type is represented by communities (alliance Poion violaceae) from the subalpine belt that develop on deep acidic soils and are usually wind-sheltered. The stands are dense and fairly uniform. In being overgrazed, these communities are converted to Potentillo ternatae-Nardion (Horvat 1960). The second sub-habitat type includes communities on deep soils from the subalpine and alpine Belt of Pelister Mt that develop in wind-exposed habitats (alliance Seslerion comosae) (Čarni and Matevski, 2015). These communities appear on ridges that are exposed to wind, where the bedrock is without carbonates (Horvat 1935).

Fig. 40. *Dianthus myrtinervius* is an endemic species of the North Macedonia and Northwest Greece. It is a characteristic species of the vegetation community *Diantho myrtinervius-Festucetum,* which is considered to be an endemic community with a very restricted distribution (only within the zone between Pelister and Nidze Kajmakcalan) (Avramoski 2006a). *Dianthus myrtinervius* is a common tussock-forming species at the highest alpine grasslands of Mt. Pelister. Photo: Kimmo Syrjänen.

Characteristic species for this habitat type in the Republic of Macedonia include (Matevski et al 2017): *Bellardiochloa violacea*, *Campanula alpina*, *Carex curvula*, *Deschampsia flexuosa*, *Festuca airoides*, *Festuca halleri*, *Gentiana lutea*, *Gentiana punctata*, *Geum montanum*, *Homogyne alpina*, *Jasione orbiculata*, *Juncus trifidus*,

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Ligusticum mutellina, *Linum capitatum*, *Luzula spicata*, *Minuartia recurva*, *Nardus stricta*, *Potentilla aurea* and *Sesleria comosa*.

In the Pelister National Park many of these species are often found among others in Oro-Moesian acidophilic grasslands: *Antennaria dioica*, *Armeria alpina*, *Botrychium lunaria*, *Calamagrostis arundinacea*, *Campanula rotundifolia*, *Carex curvula*, *Carex kitaibeliana*, *Deschampsia flexuosa*, *Dianthus integer, Dianthus myrtinervius*, *Euphrasia pectinata*, *Festuca airoides*, *Festuca paniculata*, *Geranium cinereum* subsp. *subcaulescens*, *Geum montanum*, *Hieracium hoppeanum*, *Juncus trifidus*, *Lilium albanicum*, *Luzula spicata*, *Linum capitatum*, *Luzula spicata*, *Minuartia recurva*, *Nardus stricta*, *Pimpinella saxifraga*, *Poa variegata*, *Potentilla ternata*, *Primula minima*, *Sesleria comosa*, *Thymus jankae*, *Trifolium pilczii*, *Veronica bellidifolia* and *Viola doerfleri*. Scattered shrubs including *Vaccinium myrtillus* and *Vaccinium uliginosum* can be found in low numbers among grasses and herbs at alpine grasslands.

Habitat directive and other important species

Alpine grasslands of Pelister are important summertime pastures for the Balkan Chamois (*Rupicapra rupicapra balcanica*) that has currently a very small population at the Pelister National Park due to history of pouching. The Chamois is listed in Annexes II and IV of the Habitat Directive. The Pelister population is valuable because it can be connected to Greek populations and all attempts to increase the population viability of the Balkan chamois at the Pelister National Park are welcome. Alpine grassland communities of the Pelister include many local, Macedonian and Balkan endemic vegetation communities which support high diversity of species, including several endemic, relict and rare plant and animal species (Avramovski 2006a). These plants include e.g. *Crocus pelistericus*, *Dianthus myrtinervius*, *Trifolium pilczii*, *Viola doerfleri* and *Viola eximia*. This habitat type is also important for Annex V species *Gentiana lutea* and *Gentiana punctata.*

Inventory and Monitoring

Standard Field Inventory Form for grasslands should be used in inventories and during monitoring. Inventory information should be collected on GPS marked polygons/ sampling plots inside the studied grassland stands. Repeated visits and iteration of inventory at the same site is a basic method of monitoring. Suitable monitoring period is between 5-10 years for this habitat type. Different subtypes should be taken into account during monitoring. Both managed and unmanaged (grazed) stands should be monitored at different altitudes and at different successional stages.

Threats and pressures

At lower parts of alpine grasslands juniper bushes are spreading actively. *Pinus peuce* is also spreading to alpine grasslands, where individual trees remains stunted and dwarf due to wind exposed conditions at higher altitudes. Grazing and management is needed to keep up this habitat type, but overgrazing is a threat and can increase erosion. Overgrowth of this habitat type is a rather slow process because of harsh wintertime wind-exposed conditions and summer droughts. Climate warming can increase change and degradation of the habitat. Uncontrolled large scale fires can also damage this habitat, but grasslands have a natural tendency to recovery from this kind of disturbances. Road constructions, buildings and tourism can be a threat to this habitat type (see also Matevski et al. 2017).

Range

This habitat type is often found at alpine parts of the Pelister National Park and also in several other places along the North Macedonian mountains e.g. in Jakupica, Shar Planina, Bistra, Korab, Desat, Stogovo, Jablanica, Dobra Voda, Ilinska Planina, Galichica, Nidze, Kozuf and Osogovo (Matevski et al. 2017). The Republic of North Macedonia has a clear European responsibility to conserve and maintain this central Balkan habitat type.

Area

Area of this habitat type is assumed to be stable or slowly decreasing in the Pelister National Park. At lower parts of alpine grasslands boreal heaths, shrubs and trees are spreading and currently the grazing pressure is too low to

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maintain this habitat type. The total area of grasslands in the Pelister National Park was estimated earlier (see Avramoski 2006a) to be 3500 hectares, where approximately 2600 hectares are alpine or subalpine grasslands and pastures. Around 11 511 hectares of mountain pastures are estimated to exist on the Baba massif. During the

Twinning project the estimation was done together with experts of Macedonian Ecological Society and is about 1800 hectares. This is much less than previously and may be a consequence of overgrowth or different kind of interpretation of habitat type.

Structure and function

These extensive alpine grasslands of Pelister are partly due to long continuity of grazing since before the Ottoman period. At Yugoslavian time the grazing pressure was dropped in a dramatic way. According to Avramoski (2006a) grazing around Mt. Baba has been traditionally sheep grazing and there were around 3200 sheep in the Park at that time, grazed by nearby villages. Grazing pressure during the past decades is considered to be way below the capacity of the pastures, which is about three sheep per hectare making it 8400 sheep in total (Avramovski 2006a). There is also natural grazing in the area (red deer, roe deer, Chamois and wild horses). Traditionally livestock breeding at Mt. Baba included a system of pasture management, that included regular and controlled burning of the pastures, cutting of bushes and young trees and other measures that are almost non-existing nowadays (Avramoski 2006a).

Management principles

Recommendations were given in the 2006 management plan (Avramoski 2006a). It is important to have a grazing and management plan for the subalpine and alpine grasslands of the Pelister National Park (also boreal and alpine heaths should be regarded at the same time). Grazing is often beneficial at highland ecosystems (Zagbi 2008) and controlled sustainable grazing regime is clearly needed to maintain the alpine grasslands in the long run, while avoiding overgrazing. In addition to sheep grazing, other nature management measures such as clearing of bushes (especially junipers) and young trees (mainly *Pinus peuce*) should be implemented at alpine and subalpine grasslands and heaths. Targeted burning of overgrown grasslands and former meadows can be also function as a possible management action. At species-rich sites mowing and raking might be beneficial. These management actions need careful planning and should be implemented on small plots at a time.

Conservation status (a draft based on the Twinning project study area)	
Range (of the distribution area)	FV
Area	FV
Structure and function	U1
Future prospects	U1
Overall assessment of Conservation Status	**U1**

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3.4.4. Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels

Status in Europe		
Habitats directive, Annex I	Habitat type:	6430
Threat status in Europe EU28+	Least concern (IUCN)	LC
Threat status in EU28	Least concern (IUCN)	LC
EU conservation status by biogeographical region		
Alpine	Unfavourable-Inadequate	U1
Atlantic	Unfavourable-Bad	U2
Black Sea	Not present	-
Boreal	Unfavourable-Inadequate	U1
Continental	Unfavourable-Inadequate	U1
Macaronesian	Not present	-
Mediterranean	Unfavourable-Inadequate	U1
Pannonian	Unfavourable-Bad	U2
Steppic	Favourable	FV

Definition

The Interpretation Manual of European Union Habitats (EU Commission 2013): *1) 37.7 - Wet and nitrophilous tall herb edge communities, along water courses and woodland borders belonging to the Glechometalia hederaceae and the Convolvuletalia sepium orders (Senecion fluviatilis, Aegopodion podagrariae, Convolvulion sepium, Filipendulion). 37.8 - Hygrophilous perennial tall herb communities of montane to alpine levels of the Betulo-Adenostyletea class.*

2) Plants: 37.7 - Glechoma hederacea, Epilobium hirsutum, Senecio fluviatilis, Filipendula ulmaria, Angelica archangelica, Petasites hybridus, Cirsium oleraceum, Chaerophyllum hirsutum, Aegopodium podagraria, Alliaria petiolata, Geranium robertianum, Silene dioica, Lamium album, Lysimachia punctata, Lythrum salicaria, Crepis paludosa; 37.8 - Aconitum lycoctonum (A. vulparia), A. napellus, Geranium sylvaticum, Trollius europaeus, Adenostyles alliariae, Peucedanum ostruthium, Cicerbita alpina, Digitalis grandiflora, Calamagrostis arundinacea, Cirsium helenioides.

The interpretation Manual also states “Similar communities to 37.8, with a weak development, occur at lower altitude along rivers and forest borders (in Wallonia -Belgium for example). Nitrophilous edge communities comprising only basal, common species in the region have no conservation priority. These tall herb communities could also develop in wet meadows, let lie fallow, without any cutting. Large areas of wet meadows let lie fallow and neophyte communities with Helianthus tuberosus, Impatiens glandulifera, should not be taken into account.”

Description according to EUNIS (Evans & Roekaerts2015): **E5 Woodland fringes and clearings and tall forb stands E5.4** Moist or wet tall-herb and fern fringes and meadows. Tall-herb and fern vegetation of the nemoral and boreal zones, including stands of tall herbs on hills and mountains below the montane level. Tall herbs are often dominant along watercourses, in wet meadows and in shade at the edge of woodlands.

Plant communities: Aegopodion podagrariae, Althaeion officinalis, Archangelicion litoralis, Arunco-Petasition albae, Cynancho-Convolvulion sepium, Deschampsion cespitosae, Dorycnio recti-Rumicion conglomerati , Euphorbion palustris, Filipendulo-Petasition, Impatienti noli-tangere-Stachyion sylvaticae, Ipomoeo acuminatae-Ageratinion

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adenophorae, Lythro-Euphorbion, Nardosmion laevigatae, Petasition officinalis, Senecionion fluviatilis, Senecionion samniti.

Fig. 41. 6430 Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels are typical along brooks and streams of the Pelister National Park. In montane and alpine areas there are species rich habitats of this type with high representativity. A tall herb fringe on the side of a brook at the Sapundica river valley. *Veratrum album, Cirsium appendiculatum, Doronicum austriacum* and *Angelica pancicii* can be seen in the photo. Photo: Kimmo Syrjänen.

E5.5 Subalpine moist or wet tall-herb and fern stands

Luxuriant tall herb formations of deep, humid soils in the montane to alpine, but mostly subalpine, levels of the higher mountains.

Plant communities: Adenostylion alliariae, Cirsion appendiculati, Cirsion flavispinae, Delphinion elati, Doronicion corsici, Dryopterido-Athyrion distentifolii, Mulgedion alpine, Polemonio acutiflori-Veratrion lobeliani, Rumicion alpine, Triseto sibiricae-Aconition septentrionalis

Species: *Cicerbita alpina*, *Cicerbita alpina plumieri*, *Cirsium helenioides*, *Cirsium spinosissimum*, *Cirsium flavispina*, *Geranium sylvaticum*, *Polygonatum verticillatum*, *Ranunculus platanifolius*, *Aconitum vulparia*, *Aconitum napellus*, *Aconitum nevadense*, *Adenostyles alliariae*, *Senecio elodes*, *Veratrum album*, *Trollius europaeus*, *Peucedanum ostruthium*, *Doronicum austriacum*, *Pedicularis foliosa*, *Eryngium alpinum*, *Leuzea rhapontica (Centaurea rhapontica)*, *Valeriana pyrenaica*, *Tozzia alpina*.

EUNIS includes the following EU Habitats Directive Annex I habitat types in this same type E5.4 Moist or wet tall-herb and fern fringes and meadows: 3280 constantly flowing Mediterranean rivers with Paspalo-Agrostidion species and hanging curtains of Salix and Populus alba and 6430 Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels. 6430 is divided into two EUNIS type, E5.5 Subalpine moist or wet tall-herb and fern stands.

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Technically all the tall herb fringes surrounding springs and at shoreline of streams of the Pelister National Park and riparian habitats along rivers running into the Prespa Lake belong into this habitat type. Stream and river mainly belongs to 3260 Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation. The lower parts of rivers running from the Pelister National Park and along the Golemo Reka are nitrified and without conservation priority.

Vascular plant communities and typical species of 6430 in the Pelister National Park

The Tall Herb Fringe Community habitats on the Pelister mountain develop along the mountain streams, in the vertical belt of 1280 m a.s.l. (Prespa side of Pelister - Brajcinska Reka) to 2180 m a.s.l. (Golemo Ezero). This habitat on Mount Pelister is represented by the following phytosociological communities (Čarni & Matevski, 2010):

1. *Doronico austriacae-Cirsietum appendiculati* Horvat ex Čarni et Matevski 2010 subass. *typicum* (Diagnostic species: *Cirsium appendiculatum*, *Angelica pancicii, Heracleum sphondylium* subsp. *verticillatum, Anthriscus fumarioides*). Ecological circumstances: tall herb vegetation along brooks from the montane to the subalpine zone in the Pelister Mountain, between 1375 to 1960 m a.s.l.. This community is present beside Crvena Reka, Nizhepole, Ezerska Reka, Caparska Reka and Magarevska Reka.
2. *Doronico austriacae-Cirsietum appendiculati* Horvat ex Čarni et Matevski 2010 subass. *telekietosum* (Diagnostic species: *Brachythecium rivulare, Equisetum arvense, Geranium reflexum, Geranium robertianum, Mentha spicata* subsp. *spicata, Pellia epiphylla, Telekia speciosa, Vicia sepium*). Ecological circumstances: the subassociation is found at lower altitudes, between 1230 to 1675 m a.s.l.. This community is present beside Brajcinska River, Shemnica, Caparska River, Sapundzica.
3. *Geo coccinei-Rumicetum alpini* Čarni et Matevski 2010 (Diagnostic species: *Rumex alpinus*, *Cirsium appendiculatum, Alchemilla indivisa, Angelica pancicii, Geum coccineum*). Ecological circumstances: tall herb vegetation along streams in the altimontane and the subalpine zones, between 1500 to 2180 m a.s.l.. This community is present beside Sapundzica, Crvena Reka, Ezerska Reka, Magarevska Reka and Golemo Ezero.

The vegetation is thus well developed on Pelister, where the bedrock is silicate and there are quite a few strong springs. Syntaxonomically, these communities belong to the alliance *Cirsion appendiculati,* order *Adenostyletalia* and classis *Mulgedio-Aconitetea* Hadac et Klika 1944.

Characteristic species of the alliance, order and classis are the follow: *Angelica pancicii*, *Alchemilla indivisa*, *Caltha palustris* subsp*. laeta*, *Carduus personata*, *Cirsium appendiculatum*, *Doronicum austriacum*, *Geranium sylvaticum*, *Geum coccineum*, *Rumex alpinus, Rumex arifolius, Scrophularia scopolii, Veratrum album*.

Tall herb fringe communities of plains differ from those at mountains and alpine areas. For example along river Semnica between Kazan and Maloviste there are tall herb communities including *Epilobium hirsutum*, *Phalaris arundinacea*, *Mentha aquatica*, *Lythrum salicaria* and *Athyrium filix-femina* but also *Urtica dioica* that prefers increased amount of nutrients in water (Fig. 42). *Convolvulus sepium* is a natural species of this habitat, but it also benefits of eutrophication. Invasive alien species *Robinia pseudacacia* colonizes shoreline habitats of rivers effectively and can change the original habitat type. In Prespa at the Ezerani shoreline the habitat of Golemo Reka is nitrified and contains *Urtica dioica*, *Artemisia vulgaris*, *Amorpha fruticosa* and the invasive *Bidens frondosa* together with native species *Phalaris arundinacea*, *Iris pseudacorus*, *Phragmites australis*, *Beckmannia eruciformis* etc.

Habitat directive and other important species

This habitat type is very rich in vascular plant species and it includes vegetation types with high conservation value. *Tozzia carpathica* is a species of this habitat type. This type can contain several endemic species to Balkan e.g. *Alchemilla peristerica*, *Cardamine raphanifolia* subsp. *acris*, *Pedicularis limnogena*, *Pinguicula balcanica*, *Carex rigida var. macedonica* as well as *Geum coccineum*, *Angelica pancicii* and *Alchemilla indivisa* (Čarni & Matevski 2010). On these plant species *Alchemilla peristerica* is endemic for North Macedonia and the only known

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population is located in the Pelister National Park. Amphibians and reptiles are also present in this habitat type (*Rana dalmatina*, *Rana graeca*, *Salamandra salamandra*).

Fig. 42. Shoreline tall herb fringes at the Semnica River between Kazan and Molovishte villages. This habitat belongs to type 6430, but its representativity is low. Human influenced eutrophicated fringes with only common species in the shoreline habitats have no conservation priority. Hydrology and species composition of the River Semnica are also disturbed because of a hydropower plant inside the Pelister National Park. Photo: Kimmo Syrjänen.

Inventory and Monitoring

Inventory and monitoring of hydrophilous tall herb fringe communities should be done simultaneously with 3260 "Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion" vegetation so that an entire stream with its shoreline vegetation is covered. So far there is no Standard Field Inventory Form for riparian habitats. Inventory information should be collected on GPS marked polygons/transects along a river or sampling plots inside the studied river. Information on parts belonging to 6430 should be documented separately from the 3260. Repeated visits and iteration of inventory at the same site is a basic method of monitoring. Suitable monitoring period is between 5-10 years for this habitat type. Transects along different altitudinal parts of river should be taken into account during monitoring. In addition to stream and fringe the surrounding vegetation as well (usually forests) and the topography of the site should be described. The methodology used by Vrahnakis & Fotiadis (2009) for land use analyses and vegetation would be a good method for monitoring streams and should be applied also for 6240.

Threats and pressures

Technically there are no severe threats of this habitat type inside the Pelister National Park in montane or alpine parts. In certain streams and springs there is uptake of water that can have a negative impact especially during dry years or on a long run. At lower parts of streams and outside of the park land use (forest cutting, building activities, eutrophication, hydropower plants) has affected negatively to this type. Climate warming can cause detoriation of this habitat type at alpine and montane areas.

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Range

This habitat type is present along several mountain streams in North Macedonia. In addition to the Pelister National Park there are high quality alpine tall herb fringe communities at the Mavrovo National Park.

It is questionable whether this habitat type is present at lowlands in the study area. Tall herb fringes are suffering from eutrophication and increased amount of nitrogen especially at the Prespa lake area and this shoreline vegetation is no more included into this habitat type.

Area

There are some tens of streams with sidebrooks of this type of vegetation at the Pelister National Park. The length of the intermittent streams is 118 km and streams 188 km, totalling 306 km in the Pelister National Park. There is approximately 40 hectares of tall herb fringes along the streams. In the Prespa Lake area this habitat type has been altered and is very small in size.

Structure and function

The basic structure and function of this habitat type is in good condition at alpine and montane conifer parts of the Pelister National Park. In the lower part of these streams the structure has been changed by dredging, building and management of shorelines. In addition, eutrophication, pollution and water uptake has affected negatively on this habitat type at lower parts of the streams.

Management principles

Management includes the restoration of altered environments, and road constructions and tree cuttings in the vicinity of rivers should be avoided both inside and outside of conservation areas by establishing a wide enough buffer zone.

Conservation status (a draft based on the Twinning project study area)	
Range (of the distribution area)	FV
Area	FV
Structure and function	U1
Future prospects	U1
Overall assessment of Conservation Status	**U1**

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More information on Project: “Inventory of the riparian forest vegetation along rivers hosting the endemic trout in Prespa”

https://www.spp.gr/index.php?option=com_content&view=article&id=75&Itemid=75&lang=el?&lang=en

Tryfon, E. 2016: E5.5 Subalpine moist or wet tall-herb and fern fringe

https://forum.eionet.europa.eu/european-red-list-habitats/library/terrestrial-habitats/e.-grasslands/e5.5-subalpine-moist-or-wet-tall-herb-and-fern-fringe

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3.5. Raised bogs, mires and fens

3.5.1. Transition mires and quaking bogs

Status in Europe		
Habitats directive, Annex I	Habitat type:	**7140**
D2.2b Relict mires of Mediterranean mountains		
Threat status in EU28+	Near threatened (IUCN)	NT
Threat status in EU28	Vulnerable (IUCN)	VU
EU conservation status by biogeographical region		
Alpine	Favourable	FV
Atlantic	Unfavourable-Bad	U2
Black Sea	Not present	-
Boreal	Unfavourable-Inadequate	U1
Continental	Unfavourable-Inadequate	U1
Macaronesian	Not Present	-
Mediterranean	Unfavourable-Inadequate	U1
Pannonian	Not present	-
Steppic	Not present	-

Definition

The Interpretation Manual of European Union Habitats (EU Commission 2013): *"1) Peat-forming communities developed at the surface of oligotrophic to mesotrophic waters, with characteristics intermediate between soligenous and ombrogenous types. They present a large and diverse range of plant communities. In large peaty systems, the most prominent communities are swaying swards, floating carpets or quaking mires formed by medium-sized or small sedges, associated with sphagnum or brown mosses. They are generally accompanied by aquatic and amphibious communities. In the Boreal region this habitat type includes minerotrophic fens that are not part of a larger mire complex, open swamps and small fens in the transition zone between water (lakes, ponds) and mineral soil.*

These mires and bogs belong to the Scheuchzerietalia palustris order (oligotrophic floating carpets among others) and to the Caricetalia fuscae order (quaking communities). Oligotrophic water-land interfaces with Carex rostrata are included."

Plants: *Eriophorum gracile*, *Carex chordorrhiza*, *Carex lasiocarpa*, *Carex diandra*, *Carex rostrata*, *Carex limosa*, *Scheuchzeria palustris*, *Hammarbya paludosa*, *Liparis loeselii*, *Rhynchospora alba*, *R. fusca*, *Menyanthes trifoliata*, *Epilobium palustre*, *Pedicularis palustris*, *Sphagnum* spp. (*S. papillosum*, *S. angustifolium*, *S. subsecundum*, *S. fimbriatum*, *S. riparium*, *S. cuspidatum*), *Calliergon giganteum*, *Drepanocladus revolvens*, *Scorpidium scorpioides*, *Campylium stellatum* and *Aneura pinguis*.

Macedonian occurrences of 7140 do not fit to the EUNIS categories easily. In Evans & Roekaerts (2015) Annex I type 7140 in located into D2.3 Transition mires and quaking bogs with following description: "Incompletely terrestrialized wetlands occupied by peat-forming vegetation with acid groundwater or (for vegetation rafts) acid underlying pool or lake water. Included in this habitat type are rafts of Sphagnum spp. and Eriophorum spp. (D2.38) and quaking rafts of Molinia caerulea (D2.3D). Excluded are stands of vegetation fringing water bodies (C3.2) unless the vegetation raft is sufficiently extensive to count as a habitat in its own right." Habitat Directive habitat types 7140 Transition mires and quaking bogs and 7150 Depressions on peat substrates of the Rhynchosporion are both included into this EUNIS type.

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Fig. 43. Oligotrophic alpine mire with tussocks of *Sphagnum* spp. and sedges (*Carex* spp.), close to the Golemo Ezero. Type 7140 "Transition mires and quaking bogs" is a common and widespread habitat type in Europe, but is considered favourable only at the alpine zone. These vegetation communities have high conservation value in North Macedonia (and Europe), because this type of habitat consist mainly of EUNIS habitat type "Pelagonide Macedonian sedge fens" which is endemic for Balkan. Photo: Kimmo Syrjänen.

However, Macedonian alpine mires should be in EUNIS classification in D2 Valley mires, poor fens and transition mires; D2.2 Poor fens and soft-water spring mires; D2.22 *Carex nigra, Carex canescens, Carex echinata* fens. EUNIS description for D2.2812 "Pelagonide Macedonian sedge fens" is not included in Evans & Roekaerts (2015). These D2 habitats have no corresponding Habitat directive habitat types in EUNIS.

Plant communities according to EUNIS (Evans & Roekaerts 2015) include: *Caricion canescenti-fuscae*, *Sphagno-Caricion canescentis*, *Caricion lasiocarpae*, *Rhynchosporion albae.*

Typical plant species (Evans & Roekaerts 2015): *Eriophorum gracile*, *Carex chordorrhiza*, *C. lasiocarpa*, *C. diandra*, *C. rostrata*, *C. limosa*, *Scheuchzeria palustris*, *Hammarbya paludosa, Liparis loeselii, Rhynchospora alba*, *R. fusca, Menyanthes trifoliata, Epilobium palustre, Pedicularis palustris*, *Sphagnum* spp. (*S. papillosum, S. angustifolium*, *S. subsecundun*, *S. fimbriatum*, *S. riparium*, *S. cuspidatum)*, *Calliergon giganteum*, *Drepanocladus revolvens*, *Scorpidium scorpioides*, *Campylium stellatum*, *Aneura pinguis*, *Dactylorhiza curvifolia*, *Ophrys insectifera*, *Orchis palustris*, *Cladium mariscu*.

Vascular plant communities and typical species of 7140 in study area

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In Avramoski (2006b), the Pelister National Park has Valley mires, poor fens and transition mires D2; Poor fens and soft-water spring mires [Caricetalia fuscae W.Koch 1926 emend. Nordhagen 1937] D2.2; Illyrio-Moesian acidic fens D2.28; Pelagonide fens [Caricion canescentis-nigrae Nordhagen 1937] D2.281, Pelagonide Macedonian sedge fens [Caricetum macedonicae Ht. 1936] D2.2812.

Class: Scheuchzerio-Caricetea fuscae (Nordh. 1936) R. Tx. 1937; Order: Caricetalia fuscae W.Koch 1926 emend. Nordhagen 1937 Alliance: Caricion canescentis-nigrae Nordhagen 1937 ass. Caricetum macedonicae Ht. 1936. EUNIS habitat type code D2.2812 Pelagonide Macedonian sedge fens contains following description: “Acidic fen communities of the Jakupica and Bistra ranges of the F.Y.R. of Macedonia, and of the Varnous and Voras ranges of northern Greece, dominated by Carex macedonica.” These vegetation communities seem to belong most closely to 7140.

Fig. 44. 7140 Transition mires and quaking bogs can contain areas with **a)** almost ombrotrophic nutrient poor tussock vegetation with *Sphagnum capillifolium*, *Nardus stricta* and *Carex macedonica* as well as **b)** oligo-mesotrophic flarks of spring mires with *Pinguicula balcanica*, *Sphagnum subsecundum*, *Sphagnum contortum, Eleocharis quinqueflora*, *Carex serotina, Parnassia palustris* and *Warnstorfia exannulata*. Photo: Kimmo Syrjänen.

In the study area 7140 Transition mires and quaking bogs is a rare habitat type with few occurrences in the alpine part of the Pelister National Park close to the Malo Ezero and Golemo Ezero. These habitats are associated with mountain springs and spring brooks and contain spring fen vegetation. These mires are peat forming ecosystems with Sphagnum mosses and sedges. They are representing characteristics of both ombrotrophic and oligo-minerotrophic mire habitats. At springs and along spring brooks that are connected to these mires there are species and characteristics of “7160 Fennoscandian mineral-rich springs and spring-fens” and “6430 Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels.”

Typical species of 7140 “Transition mires and quaking bogs” in the Pelister National Park include: *Allium sibiricum*, *Aulacomnium palustre*, *Bruckenthalia spiculifolia*, *Carex echinata*, *Carex macedonica*, *Carex serotina*, *Dactylorhiza cordigera*, *Deschampsia cespitosa*, *Eleocharis quinqueflora*, *Epilobium palustre*, *Juncus effusus*, *Luzula sudetica*, *Nardus stricta*, *Oenanthe fistulosa*, *Parnassia palustris*, *Pedicularis limnogena*, *Pinguicula balcanica*, *Sphagnum angustifolium*, *Sphagnum capillifolium*, *Sphagnum compactum*, *Sphagnum contortum*, *Sphagnum inundatum*, *Sphagnum platyphyllum*, *Sphagnum subsecundum*, *Sphagnum teres*, *Vaccinium uliginosum* and *Warnstrofia exannulata*.

In springs that are connected to these mires *Saxifraga stellaris* subsp. *alpigena*, *Philonotis* spp., and *Epilobium alsinifolium* are typically found and tall herbs such as *Caltha palustris*, *Geum coccineum*, *Cirsium appendiculatum*,

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Veratrum album, *Doronicum austriacum* and *Rumex alpinus* are commonly found along the outflows of springs and spring books (see Čarni & Matevski 2010).

Habitat directive and other important species

This habitat type is important for Sphagnum species. All *Sphagnum spp.* belong to Annex V of Habitat Directive. However, there is no commercial use of Sphagnum in the Pelister National Park or in the Republic of North Macedonia and regulation of use is not needed.

These alpine mires with a vegetation community of a Balkan endemic vegetation type have a high conservation value. In a floristic composition, there are certain Balkan endemic and boreal species in more or less isolated positions at the southernmost part of their distribution range.

Fig. 45. 7140 Transition mires and quaking bogs at the Pelister National Park. **a)** Oligo-mesotrophic spring-fen as part of a larger transition mire complex below the Golemo Ezero. **b)** Oligotrophic *Sphagnum-Carex echinata* mire with small oligotrophic pools close to the Malo Ezero. Photos: Kimmo Syrjänen.

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Inventory and Monitoring

All mires and fens at the Pelister National Park should be inventoried (as already proposed by Avramoski 2006a). There is no Standard Field Inventory Form for mires but a modified grassland form can be used in inventories and monitoring. Description of the site, area, types of vegetation and species compositions should be done for each site of this habitat type. Inventory information should be collected on GPS marked polygons/ sampling plots inside the studied mire system. Drone photos may also be useful while following vegetation changes and analysing monitoring results. Repeated visits and iteration of inventory of vegetation at the same site is a basic method of monitoring. Suitable monitoring period is between 5-10 years for this habitat type. All occurrences of this habitat type should be taken into account during monitoring.

Threats and pressures

There are no severe threats identified so far. Increasing tourism, trampling or overgrazing can pose a risk in the future. Climate warming can also pose a threat by decreasing the outflow of springs or through other indirect effects (warming of waters, desiccation, and competition between species).

Range

This habitat type is most likely present in a few of places at the western and northern mountains in North Macedonia. Range is presently unknown and may need inventories at mountain areas. In the study area this type is currently found only at the alpine part of the Pelister National Park.

Area

In the Pelister National Park this habitat type is present in the alpine area. Known occurrences are very small and the total cover is approximately 1-2 hectares.

Structure and function

This habitat type is typically present at the northern slopes of Mt. Pelister at places with groundwater seepage. Habitat is at least partly dependent on springs and spring brooks. Occurrences are in natural condition and they have representative vegetation structure and species composition.

Management principles

There is no need for management. In the Golemo Ezero mires are located close to hiking tracks, but there are no marks of trampling or other destruction so far.

Conservation status (a draft based on the Twinning project study area)	
Range (of the distribution area)	FV
Area	FV
Structure and function	FV
Future prospects	XX
Overall assessment of Conservation Status	**FV**

References:

Avramoski, O. 2006a: The Plan of Management for Pelister National Park. – Pelister National Park &

Pelister Mountain Conservation Project. Swiss Agency for Development and Cooperation (SDC) through the Pelister Mountain Conservation Project. 67 pp.

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3.5.2. Mineral-rich springs and springfens (Fennoscandian mineral-rich springs and springfens)

Status in Europe		
Habitats directive, Annex I	Habitat type:	7160
C2.1a Base-poor spring and spring brook		
Threat status in Europe	Vulnerable (IUCN)	VU
Threat status in EU	Near threatened (IUCN)	NT
EU conservation status by biogeographical region		
Alpine	Favourable	FV
Atlantic	Not present	-
Black Sea	Not present	-
Boreal	Unfavourable-Bad	U2
Continental	Unfavourable-Bad	U2
Macaronesian	Not present	-
Mediterranean	Not present	-
Pannonian	Not present	-
Steppic	Not present	-

Definition

The Interpretation Manual of European Union Habitats (EU Commission 2013): *".*Springs and springfens are characterized by continuous flow of ground-water. The water is cold, of even temperature, and rich in oxygen and minerals, due to the rapid percolation. Springs may have a basin where the water wells up and an adjacent outflow with typical vegetation. In springfens the water seeps up through the ground and the accumulated peat, enhancing the growth of specialized vegetation. Since the water originates from deeper layers, these springs often have running water during the winter even if the surrounding areas are frozen and snow-covered. The invertebrate fauna is often very specific to this habitat and the flora rich in northern species."

Plants: *Cardamine amara*, *Chrysosplenium* spp., *Carex appropinquata*, *C. capillaris*, *C. paniculata*, *Epilobium hornemanni*, *E. davuricum*, *E. laestadii*, *E. alsinifolium*, *Montia fontana*, *Poa alpigena*, *P. remota*, *P. trivialis*, *Ranunculus lapponicus*, *R. hyperboreus*, *Stellaria alsine*, *S. calycantha*, *S. nemorum*.

Bryophytes: *Brachythecium rivulare*, *Bryum weigelii*, *B. pseudotriquetrum*, *B. schleicherii*, *Calliergon giganteum*, *C. sarmentosum*, *Philonotis* spp., *Pohlia wahlenbergii*, *Plagiomnium undulatum*, *Rhizomnium* spp., *Scapania* spp., *Warnstorfia exannulata*.

Description according to EUNIS (Evans & Roekaerts 2015) C2.1 Springs, spring brooks and geysers C2.111 Fennoscandian mineral-rich springs and spring fens.

This habitat type is reported from alpine, boreal and continental Europe (see EUNIS Fact Sheet). Although originally considered as Fennoscandian, the type has wide distribution especially in montane Europe but also in the lowlands i.e. in the Baltic States. In the Balkan Peninsula there are representatives of this habitat type with high conservation values especially at the alpine zone of mountains. In the Pelister National Park mineral rich springs and spring fens are usually found at the alpine areas of Mt. Pelister usually above 2000 m. a.s.l., but scattered occurrences are found at lower altitudes. For example there are springs and spring brooks of this habitat type along the slopes of Mt. Pelister in the forest zone.

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Alpine springs and spring fens often form complex habitat types. Spring and spring brook borders are usually the habitat type 6430 “Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels”. The role of tall herbs is often high in relation to bryophytes when comparing sites of this type at lower elevations to those at the alpine elevations. In the alpine areas close to springs and spring brooks there may be *Sphagnum* spp. dominated peat that forms more or less oligotrophic mire vegetations that belong to the 7140 “Transition mires and quaking bogs”. In the Pelister National Park forest zone small springs are occasionally fens with *Eriophorum latifolium*, *Blysmus compressus* and *Carex davalliana*. These probably belong to type 7230 “Alkaline fens”.

Fig. 46. 7160 Mineral-rich springs and spring fens are common especially at the alpine zone of the Pelister National Park (Mt Baba /Pelister) at sites where mountain brooks and rivers starts to run. There are also springs and spring brooks of this habitat type along the slopes of Mt. Pelister. These habitats have specific flora with boreal and alpine species and several endemic species to Balkan. This habitat type is very important for river ecosystems and hosts typical invertebrate species. Photo: Kimmo Syrjänen, Golemo Ezero.

Vascular plant communities and typical species of 7160 in Macedonia

Čarni & Matevski (2010) have collected information on the vegetation of springs and brooks in the Pelister National Park. Typical vascular plants of spring affected environments include *Alchemilla indivisa*, *Angelica pancicii*, *Cardamine raphanifolia* subsp. *acris*, *Carex rigida* var. *macedonica*, *Carex echinata*, *Chrysosplenium alternifolium*, *Dactylorhiza cordigera*, *Equisetum arvense*, *Epilobium* spp., *Geum coccineum*, *Montia fontana*, *Parnassia palustris*, *Pedicularis limnogena*, *Pinguicula balcanica*, *Saxifraga stellaris* subsp. *alpigena*, *Silene asterias*, *Stellaria alsine* (see Čarni & Matevski 2010) and bryophytes *Brachythecium rivulare*, *Bryum pseudotriquetrum*, *Chiloscyphus polyanthos*, *Marchantia aquatica*, *Philonotis* spp., *Pellia epiphylla*, *Plagiomnium undulatum*, *Pohlia wahlenbergii*, *Scapania undulata* and *Warnstorfia exannulata*. In the tall herb fringe along springs there are often *Angelica pancicii*,

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Athyrium filix-femina, *Caltha palustris*, *Cirsium appendiculatum*, *Deschampsia cespitosa*, *Doronicum austriacum*, *Myosotis scorpioides*, *Rumex alpinus* and *Veratrum album* among others (Čarni & Matevski 2010).

Habitat directive and other important species

Angelica pancicii, *Carex macedonica*, *Dactylorhiza cordigera* subsp. *bosniaca*, *Pinguicula balcanica* and *Silene asterias* are all endemic species to the Balkans. This habitat type is also important for several rare invertebrates. Springs and spring brooks are important also as a drinking place for many mammals.

Fig. 47. a) *Dactylorhiza cordigera* is an orchid species that typically grows along springs and spring fens at the Pelister National Park. **b)** *Silene asterias* is a tall herb that grows often as accompanying species but has wider distribution in springy habitats in the Pelister National Park. Both of these species are endemic vascular plants of the Balkan Peninsula. Photo: Kimmo Syrjänen.

Inventory and Monitoring

There is no standard Field Inventory Form for springs available as of yet. Collected data should include GPS coordinates, description of the vegetation types and information on their area. A list of typical plants with abundance information is needed. Repeated visits and iteration of inventory at the same site is a basic method of monitoring. Suitable monitoring period is between 5-10 years for this habitat type.

Threats and pressures

Inside the Pelister National Park there are no severe threats to this habitat type. In several places there are constructed structures for water uptake for hikers and other people moving in the national park. These well structures are for the most part not harmful for this habitat type. Trampling can cause minor damage to small springs. Groups of wild boar (*Sus scrofa*) may cause damage to springs by disturbing the typical vegetation, but can also decrease the water quality, an important aspect especially for humans. So far the uptake of ground water is

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not going on at the alpine part of the Pelister National Park. Warming climate can cause warming of ground water and decrease the outflow in the future. Construction of roads can be harmful locally.

Range

This habitat type is found in several sites in the Macedonian mountains. In addition to the Pelister National Park it occurs in most mountain chains, especially in the west where precipitation is higher.

Area

Area is stable in the Pelister National Park. There can be as many as a hundred springs at the alpine area of the Pelister National Park. Total area is 0,2 – 2 hectares.

Fig. 48. a) Well structures from Yugoslavian era are present in many springs at the Pelister National Park. Similar structures in springs with Slavic Orthodox tradition are also common in the Park along mountain paths and in vicinity of the monasteries. These are built to protect drinking water sources from Wild boars. For the most part these are not harmful for spring biodiversity and can even decrease human trampling pressure. **b)** Tall herb fringe vegetation is common in springs especially at the subalpine parts of the Pelister National Park. Species in the photos are *Silene asterias*, *Veratrum album, Geum coccineum* and *Angelica pancicii* among others. Photos: Kimmo Syrjänen, Yorgov kamen.

Structure and function

Springs are dependent on the continuous formation of ground water. Accumulation and slow melting of north exposed snow beds are important for some springs. Climate warming can affect negatively on the spring vegetation and biodiversity.

Management principles

Keeping springs in a natural condition is important. Restoration may be needed if hydrology of a spring has been changed due to contractions or ditching. Most of the springs at the Pelister National Park are in a natural condition and management is not required.

Conservation status (a draft based on the Twinning project study area)	
Range (of the distribution area)	FV
Area	FV
Structure and function	FV
Future prospects	FV
Overall assessment of Conservation Status	**FV**

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References:

Avramoski, O. 2006: The Plan of Management for Pelister National Park. – Pelister National Park & Pelister Mountain Conservation Project. Swiss Agency for Development and Cooperation (SDC) through the Pelister Mountain Conservation Project. 67 pp.

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3.5.3. Petrifying springs with tufa formation (Cratoneurion)

Status in Europe		
Habitats directive, Annex I	Habitat type:	7220*
C2.1b Calcareous spring and spring brook		
Threat status in EU28+	Vulnerable (IUCN)	VU
Threat status in EU28	Vulnerable (IUCN)	VU
EU conservation status by biogeographical region		
Alpine	Unfavourable-Inadequate	U1
Atlantic	Unfavourable-Bad	U2
Black Sea	Unfavourable-Inadequate	U1
Boreal	Unfavourable-Inadequate	U1
Continental	Unfavourable-Inadequate	U1
Macaronesian	Not present	-
Mediterranean	Unfavourable-Bad	U2
Pannonian	Unfavourable- Inadequate	U1
Steppic	Not present	-

Definition

The Interpretation Manual of European Union Habitats (EU Commission 2013): *"*Hard water springs with active formation of travertine or tufa. These formations are found in such diverse environments as forests or open countryside. They are generally small (point or linear formations) and dominated by bryophytes (Cratoneurion commutati)."

Plants: *Arabis soyeri*, *Cochlearia pyrenaica* (in sites with heavy metals), *Pinguicula vulgaris*, *Saxifraga aizoides*. Mosses: *Catoscopium nigritum*, *Cratoneuron commutatum*, *C. commutatum* var. *falcatum*, *C. filicinum*, *Eucladium verticillatum*, *Gymnostomum recurvirostrum*. In the Boreal region also *Carex appropinquata*, *Epilobium davuricum*, *Juncus triglumis*, *Drepanocladus vernicosus*, *Philonotis calcarea*, *Scorpidium revolvens*, *S. cossoni*, *Cratoneuron decipiens* and *Bryum pseudotriquetum*.

Description according to EUNIS (Evans & Roekaerts 2015) C2.12 Hard water springs. Springs rich in calcium, typically due to calcareous tufa formation. Species-rich habitats with high moss cover, a high dominance of the moss *Cratoneuron commutatum* is typical. Plant communities: Cratoneurion commutati, Lycopodo-Cratoneurion commutati. Subtype C2.121 Petrifying springs with tufa or travertine formations is 7220: Petrifying springs with tufa formation (Cratoneurion).

This habitat type is widespread in Europe (see EUNIS Fact Sheet). However, habitat conservation status is unfavourable through the range of this habitat. In the Pelister National Park and at the Prespa Lake this type is found in small occurrences. Based on literature *Cratoneuron filicinum* and *Palustriella commutata* grows on several places in North Macedonia and there are several occurrences with better representation of this type in the country.

Vascular plant communities and typical species of 7220 in Macedonia

In the Pelister National Park and at the Prespa Lake this habitat is characterized by the presence of *Cratoneuron filicium* and/or *Palustriella commutata* and *Palustriella falcata*. Size of these habitats are usually 10 m^2 or less. Accompanying species include *Bracythecium rivulare*, *Bryum pseudotriquetrum*, *Carex remota*, *Conocephalum*

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conicum, *Dactylorhiza cordigera*, *Epipactis palustris, Ranunculus ophioglossifolius*, *Scirpus sylvaticus*, *Silene asterias*, *Veronica anagallis-aquatica* and *Veronica beccabunga*.

Fig. 49. 7220 * Petrifying springs with tufa formation (Cratoneurion) are rare both at the Pelister National Park (Sapundiza, Gjavato) and at the Prespa Lake (Oteshevo, Sirhan). These sites are characterized by the presence of *Cratoneuron filicinum* or *Palustriella* spp. moss species and hard alkaline water. Tufa formation is not strong and these sites are not very representative. **a)** *Cratoneuron* -spring close to lake Prespa, Oteshevo. **b)** *Cratoneuron filicinum* growing at the Pelister National Park. Photos: Kimmo Syrjänen.

Habitat directive and other important species

This habitat contains species of calcareous springs and may include rare mollusks.

Inventory and Monitoring

There is no standard Field Inventory Form for springs available so far. Collected data should include GPS coordinates, description of vegetation types and information on their area. A list of typical plants with abundance information is needed. Assessment of threats should be determined. Repeated visits and iteration of inventory at the same site is a basic method of monitoring. Suitable monitoring period is between 5-10 years for this habitat type.

Threats and pressures

Inside the Pelister National Park there are no severe threats to this habitat type. In several places there are constructed structures for water uptake for hikers and other people moving in the national park. These well structures are not harmful for the most part for this habitat type. Trampling can decrease water quality in small springs. Groups of wild boar (*Sus scrofa*) can damage the typical vegetation including bryophytes and decrease water quality, an important aspect for hikers and other people. So far the uptake of ground water is not going on in the alpine part of the Pelister National Park, but it can pose a threat in the future. Warming climate can cause warming of ground water and subsequently decrease the outflow during summertime. Construction of roads or buildings can be harmful locally. At the Prespa Lake one location is very close to a road at Sirhan.

Range

This habitat type is probably present in several sites in North Macedonia. It can occur in all of the calcareous areas that have springs. In literature there are more data on occurrences of *Palustriella* spp. and *Cratoneuron filicinum* in North Macedonia. These observations can give a hint for the presence of Cratoneurion. For example, A. Martinčič (2009) lists *Palustriella commutata* from 1) Baba near Pletvar, 1200–1300 m a.s.l.; 2) Korab, 2100 m a.s.l.; Korab,

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peak, 2700 m a.s.l.; 3) V. Krčin, 1800 m a.s.l.; 4) valley of river Radika between Mavrovo and Žirovnica village, 900 m a.s.l. and *Palustriella decipiens* from 1) Korab, 2100 m a.s.l. and 2600 m a.s.l.; 2) V. Krčin, 1800 m a.s.l. and more sites for *Cratoneuron filicinum*, which are areas that may host the 7220 habitat type. *Palustriella falcata* is also found in Macedonia, based on Papp et al. (2015) "Towards Galičnik, at Toni voda meadows on the way to Lazaropole village".

Area

Area of this type is stable in the Pelister National Park. At the Prespa Lake occurrences should be confirmed. In both sites the total area is very small, only a couple of 10 m^2.

Structure and function

Springs are dependent on the continuous formation of ground water. Water uptake and climate warming can affect negatively on the spring vegetation and biodiversity.

Management principles

There is a need to assess the presence of this habitat type in entire North Macedonia based on literature information, herbarium materials and field surveys. All representative springs of this type should be protected, if they are not already inside nature conservation areas. It is important to keep springs in a natural condition. Restoration may be needed if hydrology of a spring has been changed due to building, road construction or ditching. Most of the springs at the Pelister National Park are in a natural condition and management is not required.

Conservation status (a draft based on the Twinning project study area)	
Range (of the distribution area)	FV
Area	FV
Structure and function	U1
Future prospects	U1
Overall assessment of Conservation Status	**U1**

References:

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EUNIS Fact Sheet: Petrifying springs with tufa formation (Cratoneurion)

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3.6. Rocky habitats

3.6.1. Siliceous rocky slopes with chasmophytic vegetation

Status in Europe		
Habitats directive, Annex I	Habitat type:	**8220**
H3.1c Temperate, lowland to montane siliceous inland cliff		
Threat status in Europe	Least concern (IUCN)	LC
Threat status in EU	Least concern(IUCN)	LC
EU conservation status by biogeographical region		
Alpine	Favourable	FV
Atlantic	Unknown	XX
Black Sea	Favourable	FV
Boreal	Favourable	FV
Continental	Unfavourable-Bad	U2
Macaronesian	Unfavourable-Bad	U2
Mediterranean	Unknown	XX
Pannonian	Unfavourable Inadequate	U1
Steppic	Not present	-

Definition

The Interpretation Manual of European Union Habitats (EU Commission 2013): *"1) Vegetation of fissures of siliceous inland cliffs, which presents many regional sub-types, described under point 2."*

This habitat type consists of several subtypes. One of the most relevant for Balkan and Macedonia:

"2) Plants: 62.25 - Helleno-Carpatho-Balkanic siliceous cliff vegetation (Silenion lerchenfeldianae): *Silene lerchenfeldiana*, *Silene dinarica*, *Senecio glaberrimus*, *Jovibarba heuffelii*, *Veronica bachofenii*, *Potentilla haynaldiana*, *Saxifraga juniperifolia* ssp. *juniperifolia (Saxifraga pseudosancta)*, *Saxifraga pedemontana* ssp. *cymosa*, *Rhodiola rosea (Sedum rosea)*, *Dianthus henteri*, *Minuartia bulgarica*, *Haberlea rhodopensis*, *Symphyandra wanneri*, *Carex kitaibeliana (Carex laevis)*."

Description according to EUNIS (Evans & Roekaerts 2015): *"Dry non-calcareous inland cliffs. Specific plant associations colonize montane and Mediterranean cliffs. Most of the subdivisions refer to them. Northern lowland cliffs usually support fragments of other less specialized communities."*

Occurrence of the habitat type and its subtypes in the Pelister National Park and the Prespa Lake

The habitat type 8220 "Siliceous rocky slopes with chasmophytic vegetation" is common and characteristic for the Pelister National Park. There are different sizes of siliceous cliffs in this vegetation type and it includes sun exposed and shaded cliffs which differ in species composition. It includes siliceous rocks in the forest zone as well as in the alpine cliffs and rocks. Most of the siliceous rocks are acidophilic but some are mesotrophic with *Homalothecium sericeum*, *Cystopteris fragilis* and *Asplenium trichomanes*.

Vascular plant communities and typical species of 4060

Typical species of 8220 in Pelister National Park include: *Asplenium trichomanes*, *Asplenium septentrionale*, *Sempervivum marmoreum*, *Sempervivum octopodes*, *Silene lerchenfeldiana*, *Silene waldsteinii*, *Jovibarba heuffelii*, *Centaurea deustiformis*, *Sedum stefco* and *Anthemis cretica* subsp. *carpathica*.

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Fig. 50. 8220 Siliceous rocky slopes with chasmophytic vegetation is a common habitat type at the Pelister National Park. **a)** Sun exposed siliceous rock outcrops near Kazan. **b)** Siliceous cliff wall at Yorgov Kamen. Photos:

Habitat directive and other important species

8220 is important for floral and vegetational biodiversity. The floral composition of this specific chasmophytic habitat (8220) is relatively poor. Its composition includes plant species and plant communities, adapted to extreme environmental conditions. The limited genetic exchange between taxa from different mountains also has a significant influence on the floral composition; hence there are favorable conditions for endemic speciation, leading to the presence of North Macedonian and Balkan endemic species within this habitat type.

The vegetation on silicate rocks is united in one Dacian-Balkan alliance *Silenion lerchenfeldianae* (Androsacetalia vandellii, Asplenietea trichomanis) (Horvat et al., 1974) that occurs in a very wide vertical range, from the mountain foothills (700–1000 m a.s.l.) up to 2700 m a.s.l.. The floristic composition of the coenoses differs according to the altitude and the exposure.

Many vascular plants of conservation value live in the chasmophytic communities on silicate rocks icluding: *Athyrium distentifolium*, *Cerastium decalvans*, *Clematis alpina*, *Gentiana acaulis*, *Jovibarba heuffelii*, *Silene lerchenfeldiana*, *Ranunculus incomparabilis*, *Sempervivum marmoreum* and *Sempervivum octopodes*.

Siliceous cliffs are also important for several lichen and bryophyte species. *Mannia triandra* is a Habitat directive annex II bryophyte species that has been found on soil on a slope of siliceous cliff at Golemo Ezero.

8220 is important for several birds by providing nesting sites. Especially raptors prefer high silicate cliffs that are difficult to access by potential predators. The red-billed chough (*Pyrrhocorax pyrrhocorax*) nests in this habitat type at the Pelister National Park. Habitat is important also for the chamois (*Rupicapra rupicapra*) population of the Pelister National Park.

Inventory and Monitoring

There is no Field Inventory Form for rocky habitats. Inventories and monitoring should include description of the habitat type and area of inventoried surface, list of chasmophytic plant species with abundance information and list of litophytes and their abundances (by functional groups if species identification is not possible). There are little changes to be expected in these habitats inside conservation areas. Monitoring can be repeated in a 10-20 year period. However, these is a clear need to get more information on species composition of this habitat type at different parts of the Pelister National Park. There are endemic and rare species living in this habitat type.

Threats and pressures

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In the Pelister National Park no severe threats exist for this habitat type. Yorgov Kamen is a popular vantage point and there are considerable amount of trampling, but that does not affect the representativity of this habitat type. Construction projects such as building of roads may affect some sites. Growing tree cover in front of an open siliceous rock cliff can change the species composition of chasmophytic vegetation. At alpine parts climate warming can cause changes in the dynamics and species composition of siliceous cliffs during a long time span.

Fig. 51. **a)** Siliceous rocks have diverse flora of chasmophytic vascular plants, lichens and bryophytes at alpine parts of the Pelister National Park. Species composition is different when compared to siliceous rocks at lower altitudes. **b)** *Sempervivum octopodes* is a Crassulacean species with extremely limited range at North Macedonia and Northern Greece. Type locality of the species is from Pelister National Park, where this endemic plant grows as chasmophyte at siliceous rock walls above the Golemo Ezero Lake. Photos: Kimmo Syrjänen.

Range

This habitat type is found in several sites in the Pelister National Park and in North Macedonia. In addition to the Pelister National Park it occurs in several places both inside and outside conservation areas ranging from 1300-2600 m a.s.l..

Area

Area of this habitat type is stable in the Pelister National Park and the total area is about 915 hectares.

Structure and function

Structure of vegetation at siliceous rocks consists mainly on chasmophytes on cracks with mineral soil and litophytes (mainly lichen and bryophytes) attached directly to the stone surface. Dynamics at siliceous rocks are

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mainly related to disturbance dynamics caused by weathering, flow of rain water and biotic activities of different animals including herbivores.

Management principles

This habitat does not normally need management. Possible stands of alien tree species (mainly *Robinia pseudacacia)* at front of siliceous walls should be removed.

Conservation status (a draft based on the Twinning project study area)	
Range (of the distribution area)	FV
Area	FV
Structure and function	FV
Future prospects	FV
Overall assessment of Conservation Status	**FV**

References:

EUNIS Fact Sheet: Siliceous rocky slopes with chasmophytic vegetation

https://eunis.eea.europa.eu/habitats/10166

European commission 2013: The Interpretation Manual of European Union Habitats - EUR28. – European Commission DG Environment. Nature ENV B.3. 144 pp.

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3.6.2. Medio-European upland siliceous screes

Status in Europe		
Habitats directive, Annex I	Habitat type:	**8150**
H2.5 Temperate, lowland to montane siliceous scree		
Threat status in EU28	Least concern (IUCN)	LC
Threat status in EU28+	Least concern (IUCN)	LC
EU conservation status by biogeographical region		
Alpine	Unknown	XX
Atlantic	Unknown	XX
Black Sea	Not present	-
Boreal	Not present	-
Continental	Unfavourable-Inadequate	U1
Macaronesian	Not present	-
Mediterranean	Unknown	XX
Pannonian	Favourable	FV
Steppic	Not present	-

Definition

The Interpretation Manual of European Union Habitats (EU Commission 2013): *"Siliceous screes of hills of western and central Europe, with Epilobium collinum, Galeopsis segetum, Senecio viscosus, Anarrhinum bellidifolium, Cryptogramma crispa. Upland siliceous screes, often resulting from quarry activity, and colonised by very impoverished forms of the Alpine communities, usually rich in mosses, lichens and sometimes ferns, notably Cryptogramma crispa, are included, but should not be taken into account. Plants: Epilobium collinum, Galeopsis segetum, Senecio viscosus, Anarrhinum bellidifolium, Cryptogramma crispa"*

Description according to EUNIS (Evans & Roekaerts2015): "H2.3 Temperate-montane acid siliceous screes. Plant communities Androsacion alpinae, Chaerophyllion humilis, Dryopteridion oreadis, Scrophulario minimae-Symphyolomion graveolens, Senecionion leucophylli" H2.31: Androsace alpina, Achillea nana, Oxyria digyna, Geum reptans, Saxifraga bryoides, Ranunculus glacialis, Linaria alpina, Oreochloa disticha, Silene acaulis H2.32: Epilobium collinum, Galeopsis segetum, Acetosella vulgaris, Dalanum ladanum, Petasites albus, Tussilago farfara, Senecio viscosus, Anarrhinum bellidifolium, Cryptogramma crispa H2.33: Saxifraga bryoides, Saxifraga adscendens, Saxifraga oppositifolia, Oxyria digyna, Androsace hedraeantha, Poa cenisia, Cryptogramma crispa, Vaccinium spp., Polygonum alpinum, Pleuropteropyrum undulatum, Lerchenfeldia flexuosa, Senecio rupestris."

In EUNIS EU Habitats Directive Annex I 8110 "Siliceous scree of the montane to snow levels" (Androsacetalia alpinae and Galeopsietalia ladani) and 8150 "Medio-European upland siliceous screes" are both included into H2.4. It seems that characteristics of these two habitat type are somewhat overlapping also in the Pelister National Park.

Occurrence of the habitat type and its subtypes in the Pelister National Park

The habitat type 8150 "Medio-European upland siliceous screes" is a common and characteristic to the Pelister National Park. All boulder scree habitats at the slopes and at the summit area of Baba mountains are included into habitat 8150. Stone rivers of the Pelister National Park also belong to this habitat type. There are differences in the species composition at the alpine summits when compared to the subalpine slopes but more work is needed to define vegetation types in more detail. Boulder scree habitats are very important especially for lichens and bryophytes and this habitat type includes rare species with boreal and alpine distribution. In the summit area

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siliceous screes were affected by constructions during World War I which increased cultural and historical value of these sites.

Siliceos boulder screes are related and sometimes connected to 8220 “Siliceous rocky slopes with chasmophytic vegetation” and can occasionally have same species. They may also get species of surrounding habitat types including 95A0 “High oro-Mediterranean pine forests”, 4060 “Alpine and boreal heaths” and 62D0 “Oro-Moesian acidophilous grasslands”.

Fig. 52. 8150 Medio-European upland siliceous screes. **a)** A siliceous boulder scree at Magarevska river valley close to the path to Jorgov kamen. **b)** Medio-European upland siliceous scree at alpine part of the Pelister National Park close to the Malo Ezero. Photos: Kimmo Syrjänen.

Vascular plant communities and typical species of 8150 in Macedonia

At lower elevations screes are surrounded by forests, mainly *Pinus peuce* forests with scattered beeches, *Acer heldreichii* and *Sorbus aria* at borders of these screes. *Juniperus communis* can also be present at borders or scattered at screes. At lowermost parts of screes *Geranium macrorrhizum* can be found on a boulder of a scree. *Calamagrostis arundinacea* and *Lerchenfeldia flexuosa* are often present. *Rubus idaeus* and several fern species are also typical. Ferns include *Polypodium vulgare*, *Dryopteris filix-mas*, *Dryopteris expansa*, *Athyrium filix-femina*, *Phegopteris connectilis*, *Gymnocarpium dryopteris*, in alpine areas also *Athyrium distentifolium*, *Cryptogramma crispa* and *Polystichum lonchitis* can be found among boulders.

The following list of bryophytes and vascular plants were collected from a boulder scree at the Magarevska river valley close to the path to Jorgov Kamen: *Racomitrium heterostichum*, *Pterigynandrum filiforme*, *Hypnum cupressiforme*, *Polytrichum piliferum*, *Polytrichum juniperinum*, *Grimmia artmanii*, *Barbilophozia hatcheri*, *Barbilophozia lycopodioides*, *Grimmia muehlenbeckii*, *Dicranum scoparium*, *Isothecium alopecuroides*, *Pseudoleskea saviana*, *Hymenoloma crispulum*, *Pohlia cruda*, *Ceratodon purpureus*, *Athyrium filix-femina*, *Polypodium vulgare*, *Dryopteris filix-mas*, *Cystopteris fragilis*, *Asplenium trichomanes*, *Polystichum lonchitis*, *Geranium macrorrhizum*, *Geranium robertianum*, *Silene vulgaris*, *Rubus idaeus*, *Calamagrostis arundinacea*, *Poa nemoralis*, *Milium effusum* and *Poa* sp.

Habitat directive species and other important species

8150 is important for several rare lichen, bryophyte and vascular plant species. Among these is *Andreaea rupestris* moss that is nationally protected and rare in Macedonia. According to the literary data, this species was known only of the mountains Jakupica and Shar Planina (Цекова, 2005) and the Pelister National Park (Papp & Erzberger 2012). It is a rather typical inhabitant of siliceous boulder screes in the Pelister National Park. They also provide shelter for mammals and birds. South facing sun exposed screes are important habitats for lizards and snakes.

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Inventory and Monitoring

So far there is no Standard Field Inventory Form for siliceous screes, but a form for grasslands can be applied for this habitat type. Borders of this habitat type are rather easy to limit. Inventory information should be collected on GPS marked polygons/ sampling plots inside the studied siliceous scree area. Repeated visits and iteration of inventory at the same site is a basic method of monitoring. Suitable monitoring period is 10 years for this habitat type. Different subtypes should be taken into account during monitoring with different altitudinal positions.

Fig. 53. a) *Cryptogramma crispa* is a small fern that grows in the alpine parts of the Pelister National Park at siliceous rocks and screes. **b)** Siliceous boulder scree is an important habitat for many bryophytes and lichens such as *Arctoparmelia centrifuga.* Photos: Kimmo Syrjänen.

Threats and pressures

Many screes are affected by World War I are constructions in the alpine area in the Pelister National Park. Chains of trenches with stony dugouts are running through summit screes. These constructions have not affected the species composition much but provide historical and cultural values to these habitats. Screes are now in a natural stage at the alpine area and currently there are no pressures. In the forest zone there is also some evidence of World War I era construction. There seems to be accumulation of organic material from surrounding habitats and slow overgrowth locally and the change into a forest habitat is going on at certain sites at lower altitudes. Atmospheric nitrogen can also increase accumulation of organic material on screes.

Range

This habitat type is found in several sites in the Pelister National Park and other North Macedonian mountains. However, this habitat in its most typical form is present on Pelister Mt.

Area

Area of this habitat type is probably staying quite stable in the Pelister National Park despite the occasional overgrowth. The total area in the Pelister National Park is about 2100 hectares.

Structure and function

Slopes and summit areas of the Pelister National Park contain extensive siliceous boulder screes. In some parts of the area there is a slow overgrowth going on and this trend may be increased by climate warming.

The overgrowth of this habitat, mainly with individual trees of *Pinus peuce*, is more pronounced in the lower parts of the “stony rivers” (like between Pali snopje and Kopanki), as well as along the river Magarevska. However, the impact is not assumed to be so quick that conservation status would deteriorate. However, this change needs to be monitored.

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Management principles

It is possible to remove accumulated litter and plant biomass to prevent overgrowth in particular screes. Management requirements should be evaluated.

Conservation status (a draft based on the Twinning project study area)	
Range (of the distribution area)	FV
Area	FV
Structure and function	FV
Future prospects	FV
Overall assessment of Conservation Status	**FV**

References:

Papp, B. & Erzberger, P. 2012: Contribution to the Bryophyte Flora of the Former Yugoslav Republic of Macedonia. Polish Botanical Journal 57(1): 205–221, 2012.

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https://eunis.eea.europa.eu/habitats/10162

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Матевски, В., Костадиновски, М., Ќуштеревска, Р. 2017: СЕЛЕКТИРАНИ ЖИВЕАЛИШТА (ХАБИТАТИ) ОД ANNEX 1 ОД ДИРЕКТИВАТА ЗА ЖИВЕАЛИШТА ВО РЕПУБЛИКА МАКЕДОНИЈА. – Selected Habitats from Annex I of Habitat Directives from The Republic of Macedonia. Skopje 2017.

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3.6.3. Caves not open to public

Status in Europe		
Habitats directive, Annex I	Habitat type:	**8310**
H1.1 Cave		
Threat status in EU28+	Least concern (IUCN)	LC
Threat status in EU28	Least concern (IUCN)	LC
EU conservation status by biogeographical region		
Alpine	Unfavourable-Inadequate	U1
Atlantic	Unfavourable-Inadequate	U1
Black Sea	Unfavourable-Inadequate	U1
Boreal	Favourable	FV
Continental	Unfavourable-Inadequate	U1
Macaronesian	Favourable	FV
Mediterranean	Unfavourable-Inadequate	U1
Pannonian	Unfavourable-Inadequate	U1
Steppic	Unfavourable-Inadequate	U1

Definition

The Interpretation Manual of European Union Habitats (EU Commission 2013): *"Caves not open to public, including their water bodies and streams, hosting specialised of high endemic species, or that are of paramount importance for the conservation of Annex II species (e.g. bats, amphibians)."*

In EUNIS classification (https://eunis.eea.europa.eu/habitats/323) several types of caves have been described and classified. Description of inland caves according to EUNIS (Evans & Roekaerts 2015): *H1 Terrestrial underground caves, cave systems, passages and waterbodies; Natural caves, cave systems, underground waters and subterranean interstitial spaces. Caves and their associated waters harbour varied, but species poor, communities of animals, fungi and algae that are restricted to them (troglobiont organisms), or are physiologically and ecologically capable of conducting their entire life cycle within them (troglophile organisms), or are dependent on them for part of the life cycle (subtroglophile organisms). Underground waters not associated with caves (stygon) and interstitial spaces harbour distinctive faunas.*

Fauna and flora

In North Macedonia, the cave diversity is extensive ranging from several different types to different sizes. They have a very rich fauna and even small caves or even holes can maintain rich and valuable species diversity. Usually larger caves are connected to each other with numerous small holes and a large part of the fauna cannot be seen during inventories. In North Macedonia cave fauna includes species from several orders of invertebrates (spiders, harvestmen, pseudoscorpions, millipeds, isopods, beetles, flies, etc.) Vertebrates found in caves are mostly bats and amphibians. Cave fauna often means important conservation values. Cave systems may be very isolated, meaning a high potential for endemism. There is still a very high potential to find a large number of new and non-described species from the caves In North Macedonia.

Due to the lack of light, plants do not grow in dark caves, but in calcareous humid rocks at cave entrances there is typically a diverse vascular and bryophyte flora. Entranced may be covered by ferns, mosses and liverworts. In the study area at Prespa on a calcareous cliff between Stenje and Kojnsko and in the Golem Grad there are several small caves. *Pseudofumaria alba* and *Campanula versicolor* often grow in cave entrances.

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Beside the entrance of some of those smaller caves, between villages Stenje and Konjsko, along the coast line of Prespa Lake, the classic locality (Locus classicus) of the endemic species *Centaurea galicicae* is located (Micevski, 1985).

Fig 54. Small cave, close to shore line of the Prespa Lake, S-E from the Stenje village. Photo: Petri Ahlroth.

Physical conditions in the caves influence the structure and diversity of the cave fauna. Moisture, structure of limestone, temperature and turnover of air and the presence or absence of larger animals (bats and other mammals) influences the biodiversity of a cave.

Inventory and Monitoring

Inventories and monitoring of cave fauna should be based on active searching and species observed should be documented using a camera. Non-selective traps should be avoided because populations of cave species can be very small and vulnerable for taking samples. If insect traps are used they should be either non-lethal or used only for a short time to avoid harming the local population.

Threats and pressures

The main pressure for large caves is tourism. Mining, road building or taking ground water may also change or destroy cave fauna. Cave fauna is sensitive to capturing or killing of individuals. Small populations of cave fauna should be protected from people that collect samples without understanding the conservation needs of cave fauna. Littering can be a problem, if a cave is close to a town, a village or a road. Sink holes, for example, can attract people to dispose garbage inside.

Structure and function

Caves differ much in their physical features, such as stone material, but there is also considerable variation within a cave when moving deeper from the entrance. This results in a rapid change of fauna during the first meters travelling away from the cave entrance. Small caves especially can be either very dry or very moist. Temperature and other physical conditions may vary, but usually in deep caves the temperature is low and stable – at least in the deeper parts of the cave. In the entrance humid conditions favours bryophytes and ferns. Sometimes roots of trees can be seen even tens of meters inside a cave. Deeper in the caves diversity of life is limited to animal and fungi kingdom and different types of microbial organisms.

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Energy resources are limited in a cave. Bats and other mammals inhabiting a cave drop faeces and larger mammals may bring pieces of dead animals in to the cave. Organic litter feeds other trophic layers. A large number of insects overwinter in the caves and night active moths may use caves as a shelter during day time. Insects provide food for spiders and other small predators. Top predators of caves, however, usually can live only in small populations, because the energy flows in the food network are limiting their population size.

Fig 55. Even small caves can maintain rich and specialized cave fauna. In small caves of Stenje area, caves maintain populations of Diptera (Mycetophilidae, Tipulidae), Orthoptera (Gryllidae, Raphidophoridae) and Lepidoptera species. Lepidoptera fauna in caves include species that overwinter or spend day time in cave habitats (**a)** *Hypena palpalis* and **b)** *Alucita hexadactyla,* for example). The caves of Stenje are also important for bats. Photos: Petri Ahlroth.

Management principles

Management of caves is not usually needed. In a few instances, however, there may be a need to prevent the access of people inside the caves. If there is a need to close a cave from public, it should be done without causing other, potentially negative changes in the conditions of the cave.

Conservation status (a draft based on the Twinning project study area)	
Range (of the distribution area)	FV
Area	U1-
Structure and function	U1
Future prospects	U1-
Overall assessment of Conservation Status	**U1-**

References:

EEA / EUNIS: Caves not open to the public

https://eunis.eea.europa.eu/habitats/10170

https://eunis.eea.europa.eu/habitats/323

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Tryfon, E. 2016: H1.1 Cave https://forum.eionet.europa.eu/european-red-list-habitats/library/terrestrial-habitats/h.-sparsely-vegetated/h1.1-cave

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3.7. Forests

3.7.1. Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)

Status in Europe		
Habitats directive, Annex I	Habitat type:	**91E0***
G1.2a Alnus woodland on riparian and upland soils		
Threat status in EU28+	Least concern (IUCN)	LC
Threat status in EU28	Least concern (IUCN)	LC
EU conservation status by biogeographical region		
Alpine	Unfavourable-Bad	U2
Atlantic	Unfavourable-Bad	U2
Black Sea	Unfavourable-Inadequate	U1
Boreal	Unfavourable-Bad	U2
Continental	Unfavourable-Bad	U2
Macaronesian	Unknown	XX
Mediterranean	Unfavourable-Inadequate	U1
Pannonian	Unfavourable-Inadequate	U1
Steppic	Favourable	FV

Definition

The Interpretation Manual of European Union Habitats (EU Commission 2013): "Riparian forests of Fraxinus excelsior and Alnus glutinosa, of temperate and Boreal Europe lowland and hill watercourses (44.3: Alno-Padion); riparian woods of Alnus incanae of montane and sub-montane rivers of the Alps and the northern Apennines (44.2: Alnion incanae); arborescent galleries of tall Salix alba, S. fragilis and Populus nigra, along medio-European lowland, hill or sub-montane rivers (44.13: Salicion albae). All types occur on heavy soils (generally rich in alluvial deposits) periodically inundated by the annual rise of the river (or brook) level, but otherwise well-drained and aerated during low-water. The herbaceous layer invariably includes many large species (Filipendula ulmaria, Angelica sylvestris, Cardamine spp., Rumex sanguineus, Carex spp., Cirsium oleraceum) and various vernal geophytes can occur, such as Ranunculus ficaria, Anemone nemorosa, A. ranunculoides, Corydalis solida."

"This habitat includes several sub-types: ash-alder woods of springs and their rivers (44.31 – Carici remotae-Fraxinetum); ash-alder woods of fast-flowing rivers (44.32 - Stellario-Alnetum glutinosae); ash-alder woods of slow-flowing rivers (44.33 - Pruno-Fraxinetum, Ulmo-Fraxinetum); montane grey alder galleries (44.21 - Calamagrosti variae-Alnetum incanae Moor 58); sub-montane grey alder galleries (44.22 - Equiseto hyemalis-Alnetum incanae Moor 58); white willow gallery forests (44.13 - Salicion albae). The Spanish types belong to the alliance Osmundo-Alnion (Cantabric atlantic and southeast Iberia peninsula)."

Description according to EUNIS (Evans & Roekaerts2015): G1.1 Riparian and gallery woodland, with dominant Alnus, Betula, Populus or Salix. G1.11 Riverine Salix woodland. Bush or arborescent formations dominated by willow (Salix spp), lining flowing water and submitted to periodic flooding, developed on recently deposited alluvion. Willow brushes are particularly characteristic of rivers originating in major mountain ranges. Shrubby willow formations also constitute an element of lowland and hill riverine successions in all major biomes, often making the belt closest to the water course. Taller arborescent willow formations often constitute the next belt landwards in riverine successions of lowland western nemoral, eastern nemoral and warm-temperate humid forest regions, and a large

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part of the less diverse riverine systems of the steppic, mediterranean and cold desert zones. These habitats may be affected by the invasive alien species such as *Solidago canadensis*, *Aster novi-belgii*, *Aster novi-anglii* and *Impatiens glandulifera.*

Fig. 56. Alluvial forests 91E0* in Gjavato at the Pelister National Park. Springy forests with *Scirpus sylvaticus*, *Carex remota*, *Filipendula ulmaria*, *Lycimachia vulgaris* etc. In the Pelister National Park this priority habitat type is connected with springs and spring brooks. Photo:

This priority habitat type is present both at the Pelister National Park and at the Prespa Lake. In the Pelister National Park it is characterized by springs inhabited by *Alnus glutinosa* stands mainly at lower parts of slopes of Mt. Pelister and always at springy sites from the lower border of the park to about 1600 m a.s.l.. The modest communities of this habitat type consist of stripes of *Alnus glutinosa* along spring brooks, whereas several more large *Alnus glutinosa* stands are present in the northern slopes of Mt. Pelister at the Gjavato region. At the Prespa Lake there are several stands of alluvial forests that belong to this habitat type. For example in the Ezerani protected area there are representative examples of both alluvial *Salix alba* galleries and of *Alnus glutinosa* woods as well as their admixtures. Along the eastern shore of the Prespa and beside the Golemo Reka there are some woods belonging to this type also. Most stands at the eastern shore of the Prespa have suffered from decreased water table levels and are changing into other type of vegetations.

Vascular plant communities and typical species of 91BA in Pelsiter and Prespa

Typical species of 91E0* in the Pelister National Park include at least *Alnus glutinosa*, *Carex remota* and *Brachythecium rivulare.* At one site in Gjavato, Turska Cesma (lat. 41.063750, long. 21.111312) following species were listed: *Athyrium filix-femina*, *Lysimachia punctata*, *Rubus* spp., *Carex remota*, *Stachys sylvatica*, *Equisetum*

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pratense, *Telekia speciosa*, *Lythrum salicaria*, *Prunus* spp., *Oxalis acetosella*, *Circaea lutetiana*, *Mentha aquatica*, *Pyrus pyraster* and *Brachythecium rivulare*. In the same region at the NW corner of the National Park Pelister these is a representative springy *Alnus glutinosa* forest of this HD habitat type with the following species: *Carex remota*, *Scirpus sylvaticus*, *Mentha aquatica*, *Veronica beccabunga*, *Ranunculus ophioglossifolius*, *Lythrum salicaria*, *Solanum dulcamara*, *Juncus effusus*, *Lysimachia vulgaris*, *Filipendula ulmaria*, *Glyceria fluitans*, *Rubus discolor*, *Rubus caesius* and *Ranunculus repens*. In the surrounding alder wood there is usually *Viburnum opulus*, *Crataegus monogyna*, *Acer campeste*, *Sorbus torminalis*, *Cornus mas*, *Euonymus europaeus*, *Circaea lutetiana*, *Viola odorata*, *Primula vulgaris*, *Galeobdolon luteum*, *Polygonatum multiflorum*, *Brachypodium sylvaticum* and in trees climbing vines including *Clematis vitalba*, *Humulus lupulus* and *Lonicera periclymenum*.

Fig. 57. Alluvial forests 91E0* at the Prespa Lake in the Ezerani protected area near the village Dolno Perovo consist of both *Salix alba* dominated forests (in the photo) and *Alnus glutinosa* dominated stands. Also *Populus alba* and *Populus nigra* are present in these forests. Photo: Kimmo Syrjänen.

Alnus glutinosa comm. is a mesophilic forest community that has formed a compact population in the Prespa region (on the locality Korija, in the vicinity of the village Ezerani). It should be noted that *Alnus glutinosa* on the territory of the Republic of North Macedonia has a fairly high vertical distribution (100-1500 m a.s.l.) (Em, 1964, 1967) and forms several communities in combination with various species (*Periploca graeca*, *Geum coccineum*, *Fraxinus angustifolia*, *Carex* spp. etc.). Plant species composition is quite different in the springy sites at the Pelister when compared to the lowland alluvial forests of the Prespa region. In recent inventory part of these alluvial forests with *Salix alba* were included in 92A0 *Salix alba* and *Populus alba* galleries (Fotiadis et al. 2018). Here all alluvial forests of the Prespa region are included in 91E0*.

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At the Prespa lake in the Ezerani protected area below Dolno Perovo village in *Salix alba* forest following species are present: *Salix alba*, *Salix cinerea*, *Salix fragilis*, *Salix amplexicaulis*, *Populus alba*, *Rubus caesius*, *Rubus sanguineus*, *Phragmites australis*, *Humulus lupulus*, *Iris pseudacorus*, *Carex riparia*, *Epilobium hirsutum*, *Carex pseudocyperus*, *Alisma plantago-aquatica*, *Pulicaria dysenterica*, *Lysimachia vulgaris*, *Lythrum salicaria*, *Carex sp.*, *Mentha aquatica*, *Hypericum tetrapterum*, *Mentha longifolia*, *Solanum dulcamara*, *Rumex hydrolapathum*, *Galium palustre*, *Lycopus europaeus*, *Polygonum amphibium*, *Ranunculus repens*, *Ulmus minor*, *Ligustrum vulgare*, *Cornus sanguinea*, *Cucubalus baccifer*, *Drepanocladus aduncus* and *Amblystegium serpens*.

Habitat directive and other important species

91E0* is important for amphibians including *Rana dalmatina* and *Rana graeca* in both conservation areas and for *Hyla arborea* at the Prespa Lake. This habitat type is important also for many birds including the Turtle Dove (*Streptopelia turtur*) that has been decreasing widely in Europe but has a viable population at the Prespa Lake area.

Inventory and Monitoring

Standard Field Inventory Form for forests should be used in inventories and monitoring. Inventory information should be collected on polygons inside the studied forest stands. Stands are often small and the entire stand can be placed inside a monitoring polygon. Repeated visits and iteration of inventory at the same site is a basic method of monitoring. Suitable monitoring period is between 5-10 years for this habitat type.

Threats and pressures

Inside the Pelister National Park selective cuttings can be a threat if these habitats are not took into account in a management plan. There are no natural threats for this habitat type in the Pelister National Park. At the Prespa Lake this habitat type has been suffering from drainage, decrease of water level in the lake, uptake of groundwater and dredging of the river Golemo Reka. The sandy banks along the shore of the Prespa at Ezerani that naturally keep water in alluvial woods have been ditched. Cutting of firewood and illegal burnings of dried wetlands will also affect negatively on the quality of this habitat in the Prespa Lake conservation areas.

Range

This habitat type is found in several sites in the study area and also elsewhere in North Macedonia along river valleys and mountains.

Area

Area of this type is stable in the Pelister National Park but probably decreasing in the Prespa Lake. Area at the Pelister National Park is about 10-20 hectares. In the Prespa Lake there are 128.76 hectares of 91E0* and 491.71 hectares of 92A0 observed in a recent inventory (Fotiadis et al. 2018) whereas in the Pelister National Park the area of 91E0* is estimated to be around 70 hectares.

Structure and function

Alluvial forests 91E0 * depend on ground water that discharges through springs or on regular annual changes in the water table level due to flooding (especially in winters and springs). Tree species composition include flood tolerant species like *Alnus glutinosa*, *Salix alba*, *Salix fragilis*, *Populus nigra*, *Populus alba* and bush forming *Salix* spp. Forests in low elevations or near pools typically have wetland vegetation and sometimes floating hydrophyte communities. In natural and near-to-natural conditions there can also be old deciduous trees, coarse dead wood and regeneration at mounds and tussocks of old trees.

Management principles

Inside the Pelister National Park black alder (*Alnus glutinosa*) stands should be left aside from all forestry actions and if their hydrology has been altered then restoration of hydrology should be performed. In the Prespa Lake some stands will deteriorate in a long run because of the decreased water table of the Prespa Lake. There are still possibilities to enhance the situation e.g. at the Ezerani by restoration (filling ditches between alluvial woods and

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the lake) and by directing waters of the Golemo Reka through this habitat type. As a long term management plan it is important to create near to natural dynamics with old trees and decaying wood. Cutting of alluvial forests for firewood or other purposes inside conservation areas should be prohibited.

Conservation status (a draft based on the Twinning project study area)	
Range (of the distribution area)	FV
Area	U1
Structure and function	U1
Future prospects	U2
Overall assessment of Conservation Status	**U2**

References:

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3.7.2. Eastern white oak woods*

Status in Europe		
Habitats directive, Annex I	Habitat type:	91AA*
G1.Aa Carpinus and Quercus mesic deciduous woodland		
Threat status in EU28+	Near threatened (IUCN)	NT
Threat status in EU28	Near threatened (IUCN)	NT
EU conservation status by biogeographical region		
Alpine	Unknown	XX
Atlantic	Not present	-
Black Sea	Unfavourable-Inadequate	U1
Boreal	Not present	-
Continental	Unfavourable-Bad	U2
Macaronesian	Not present	-
Mediterranean	Unfavourable-Bad	U2
Pannonian	Not present	-
Steppic	Unfavourable-Inadequate	U1

Definition

The Interpretation Manual of European Union Habitats (EU Commission 2013): *"1) Azonal white-oak dominated woods with a submediterranean flora, occupying thermic oases within the sub-continental Quercion frainetto and Carpinion illyricum zones. Includes the subtypes: 41.7371 Thracian white oak-oriental hornbeam woods Quercus pubescens - Quercus virgiliana woods of the Black Sea plains and hills of Turkey in Europe, and of the northern Thracian plain of southern and southeastern Bulgaria, where they are represented by mostly insular patches, particularly in the middle Maritsa and Tundja hills, the eastern and northern Rhodope foothills. The oaks are accompanied by Carpinus orientalis, Fraxinus ornus, Acer campestre or Tilia tomentosa and by sub-Mediterranean floral elements.*

41.7372 Moesian white oak woods Thermophilous, sub-Mediterranean Quercus pubescens and Quercus virgiliana woods of the southern Dinarides, the Balkan Range, and neighbouring regions including south eastern and southern Romania. 2) Plants: Quercus pubescens, Q. virgiliana, Ostrya carpinifolia, Carpinus orientalis, Carpinus betulus, Fraxinus ornus, Gallium dasypodium, Paeonia peregrina."

Description according to EUNIS (Evans & Roekaerts 2015): "*Description: Forests or woods of submediterranean climate regions and supramediterranean altitudinal levels, and of western Eurasian steppe and substeppe zones, dominated by deciduous or semideciduous thermophilous Quercus species or by other southern trees such as Carpinus orientalis and Ostrya carpinifolia . Thermophilous deciduous trees may, under local microclimatic or edaphic conditions, replace the evergreen oak forests in mesomediterranean or thermomediterranean areas, and occur locally to the north in central and western Europe. Plant communities: Aceri granatensis-Quercion fagineae, Aceri tatarici-Quercion, Genisto germanicae-Quercion, Junipero excelsae-Quercion pubescentis, Quercion broteroi, Quercion ilicis, Quercion pyrenaicae, Quercion pubescenti-sessiliflorae, Querco rotundifoliae-Oleion sylvestris."*

"*Species G1.73: Ostrya carpinifolia, Carpinus orientalis, C. betulus, Fraxinus ornus, Quercus pubescens, Quercus virgiliana. G1.74: Quercus cerris, Q. petraea, Ostrya carpinifolia, Carpinus orientalis, C. betulus, Fraxinus ornus. G1.7C2: Carpinus orientalis, Fraxinus ornus, Cotinus coggygria, Oryzopsis holciformis, Oxytropis virescens, Stachys leucoglossa, Paeonia peregrina, Salvia ringens, Cornus mas, Quercus pubescens."*

Several EU Habitats Directive Annex I types with thermophilous oak woods are included into this wide EUNIS type: 91AA* Eastern white oak woods, 91B0 Thermophilous Fraxinus angustifolia woods, 91H0 Pannonian woods with

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Quercus pubescens, 91I0 Euro-Siberian steppic woods with Quercus spp, 91M0 Pannonian-Balkanic turkey oak – sessile oak forests, 91N0 Pannonic inland sand dune thicket (Junipero-Populetum albae), 91Z0 Moesian silver lime woods, 9230 Galicio-Portuguese oak woods with Quercus robur and Quercus pyrenaica, 9240 Quercus faginea and Quercus canariensis Iberian woods, 9250 Quercus trojana woods, 9310 Aegean Quercus brachyphylla woods and 9350 Quercus macrolepis forests.


Fig. 58. 91AA *Eastern white oak woods above Brajcino. Old trees especially have a great importance for biodiversity. Photos: Kimmo Syrjänen.

Occurrence of the habitat type in the Pelister National Park

European White oak woods contain species of *Quercus* section *Quercus* with non-bitter acorns that ripe within 6 months and leaves of the species have rounded leaf lobes. These species include the sessile oak *Quercus petraea*, the pedunculate oak *Q. robur*, the Pyrenean oak *Q. pyrenaica* and the downy oak (or pubescent oak) *Q. pubescens*. *Q. pyrenica* does not grow in the Balkans. *Q. robur* grows in a few places in Macedonia but it is very rare in the Pelister National Park. On the other hand, *Quercus petraea* and *Q. pubescens* are rather common in the Park. White oak woods are located in lower altitudes and close to the borders of the Pelister National Park. They are characterized by the presence of *Quercus pubescens* and *Quercus petraea*, but the Turkey oak (or Austrian oak)(*Quercus cerris*) and the Hungarian (or Italian) oak (*Quercus frainetto*) occur often in these forests.

In the Pelister National Park the Eastern white oak woods are connected and partly mixed/overlap with 9280 “Quercus frainetto woods” that are mainly present at the more higher elevation of the oak zone just below and sometimes mixed with the Moesian beech forests 91W0. These woods with several *Quercus frainetto* tree individuals in a stand belong to the 9280 “Quercus frainetto woods”. The Hungarian oak is typical for the Balkans and it grows on acidic soils that are common at the Pelister National Park. This may be the reason for the typical mixed stands with white oaks in the region. *Ostrya carpinifolia*, *Fraxinus ornus* and *Carpinus betulus* can sometimes be characteristic for the Eastern white oak woods. *Ostrya* and *Fraxinus* are specific in most thermophilic slopes with more or less stunted white oaks in surroundings.

In an article by Čarni (2016) on the Balkan deciduous forests these both HD habitat types are handled among thermophilous forests dominated by *Carpinus orientalis*, *Ostrya carpinifolia*, *Quercus cerris*, *Q. frainetto*, *Q. petraea* and *Q. pubescens*. According to Čarni (2016) these forests are classified within *Quercetea pubescentis* and *Quercetalia pubescenti-petraeae*. During 2018 Twinning and UNDP experts visited an oak wood above the village Rotino with *Quercus petraea* (and *Q. cerris*) living on acidic soil. In Čarni (2016) acidophilous oak dominated forests are classified into the group of acidophilous oak and birch-oak forests on nutrient poor soils, Quercetea roboris-petraeae. We include this stand of Rotino also into the Eastern white oak woods based on definition of Čarni (2016) ”…while in the eastern part acido-thermophilous oak forests belong to the group of thermophilous deciduous

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forests and are classified within the class Quercetea pubescentis." Technically all oak woods at the Pelister National Park could be described as Eastern white oak woods. This would be a practical solution while mapping, monitoring and managing oak woods.

Fig. 59. Old, large and hollow living or dead oak trees have a very high conservation value and importance for biodiversity. These "habitat trees" produce habitats for birds, mammals (including bats), lichens, bryophytes, fungi and a vast amount of invertebrate species. Oak woods have a lot of specialist species including insects, fungi (mycorrhizal, saprophytes) and lichens. Maintenance and formation of forests with old trees and decaying wood should be improved by management planning and actions. Photo: Kimmo Syrjänen.

Vascular plant communities and typical species of 91AA* in Macedonia

In the past, some of the plant communities of the cl. *Quercetea pubescentis* are taxonomically revised and harmonized with the Code for Phytocenological Nomenclature (Matevski et al., 2008, 2011).

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Plant communities: *Quercetea pubescentis* Doing-Kraft ex Scamoni et Passarge 1959, *Quercetalia pubescenti-petraeae* Klika 1933, *Carpinion orientalis* Horvat 1958 (ass. *Querco cocciferae-Carpinetum orientalis* Oberd. 1948 em. Ht. 54, ass. *Querco-Carpinetum orientalis* Horv. 1954*, ass. Quercetum trojanae* Horvat 1959*, ass. Phillyreo latifoliae-Carpinetum orientalis* Bergmeier & Dimopoulos 2008, ass. *Querco pubescentis-Ostryetum carpinifoliae* Horvat 1938); *Fraxino orni-Ostryion* Tomažič 1940 (*Seslerio robustae-Ostryetum* Matevski et al. 2011); *Quercion confertae* Horvat 1958 (ass*. Carpino orientalis-Quercetum frainetto* (Rizovski 1978) Matevski et al. 2008, ass. *Quercetum frainetto-cerris* Horvat 1954); *Quercion petraeo-cerridis* Lakušić et B. Jovanović in B. Jovanović et al. ex Čarni et Mucina 2015 (ass. *Fraxino orni-Quercetum petraeae* Em 1968, ass. *Ostryo carpinifoliae-Quercetum cerris* Redžepi et Ružić ex Matevski et al. 2011, ass. *Fraxino orni-Quercetum cerris* Stefanović 1968.)

Typical species: *Quercus pubescens*, *Quercus cerris*, *Quercus virgiliana*, *Quercus frainetto*, *Quercus petraea*, *Cornus mas*, *Malus florentina*, *Ostrya carpinifolia*, *Sorbus torminalis*, *Melica uniflora*, *Acer tataricum*, *Aremonia agrimonoides*, *Clinopodium vulgare*, *Fraxinus ornus*, *Galium pseudoaristatum*, *Geum urbanum*, *Lathyrus niger*, *Lathyrus venetus*, *Poa nemoralis*, *Potentilla micrantha*, *Helleborus odorus*, *Lychnis coronaria*, *Silene italica*, *Symphitum tuberosum*, *Tamus communis* and *Trifolium pignantii*.

Fig. 60. An oak wood at an acidic soil above the Rotino village. Tree layer includes *Quercus petraea* and *Q. cerris.* Saplings of *Pinus peuce* and *Abies borisii-regis* are spreading into this forest. This stand is included into the Eastern white oak woods. At bottom *Carex brizoides* is common species. Photo: Kimmo Syrjänen.

Habitat directive species and other important species

91AA* is important for many insect species of the Habitat Directive including *Morimus funereus*, *Cerambyx cerdo*, *Rosalia alpina* and *Lucanus cervus*. It is important for many epiphytic lichens and bryophytes such as *Lobaria pulmonaria*, *Peltigera colllina*, *Pertusaria flavida* and *Collema* spp. Old hollow trees are important also for bats and oaks host a large amount of mycorrhizal, polypore and many other fungi. *Cephalanthera longifolia* orchid seems to favour white oak woods at the Pelister National Park.

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Inventory and Monitoring

The Standard Field Inventory Form for forests should be used in inventories and monitoring. Inventory information should be collected on GPS polygons/monitoring plots inside the studied forest stands. These polygons should be based on a forestry plan of the Pelister National Park. Repeated visits and iteration of inventory at the same site is a basic method of monitoring. Suitable monitoring period is between 5-10 years for this habitat type. Forests stands with different ages, management history, forestry activity and altitudinal position should be taken into account during monitoring.

Fig. 61. *Cephalanthera longifolia* grows in oak woods at the Pelister National Park. Photo: Kimmo Syrjänen.

Threats and pressures

Present oak woods usually have a historical background as being more open due to grazing. In some places the dispersal of more shade tolerant species like *Abies borisii-regis* can slowly change the oak wood stands. At the northern slope of the Pelister National Park *Pinus peuce* and *Fagus sylvatica* also produce saplings under oak stands and can replace oaks given long enough. Formations of oak stands with large trees and the accumulation of dead trees are prevented by selective and sanitary cuttings and sites with ancient woodland characteristics are nowadays scarce. At the northern part of the Pelister National Park in Gjavato there are planted conifer stands at sites that are typically oak woods. Even selective cuttings can be harmful to oak woods because mainly large trees are removed and no big old trees are formed, and decaying logs and dead standing trees are easily smashed in cuttings if they are present.

Range

This habitat type is found scattered at several parts of the Pelister National Park. It is not present at the Prespa Lake conservation area, but is found in the vicinity of the Galitcitca National Park. There are also stands of the Eastern white oak woods at the western slopes of the Baba massif that are outside of the Pelister National Park.

Area

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Area of this habitat type seems to be stable in the Pelister National Park. The total area of oak woods in the Pelister National Park is about 1400hectares and about 1100 hectares belong to 91AA* and 300 ha to 9280.

Structure and function

Oak forests are present at the lower part of the Pelister National Park and they have been used intensively since prehistorical and historical times and even after the establishment of the Park. Old management of oak forests may have included coppicing, pollarding and trimming of oak trees (Ellenberg 1988). Oak woods at the Pelister National Park may be of ancient origin, but primary forests with very long continuity of canopy forming trees do not exist and also old-grown secondary forests are rare. Oaks need light to grow into large individuals with a wide canopy. Growth of these trees has usually taken place at a more open location than is possible inside the present stands. The number of old stands with large dead trees, very old, big and living or partly decaying individuals is very small at the Pelister National Park. Oak woods with old growth characteristics are mainly present nearby monasteries and these sites have a high importance for biodiversity.

There are no severe threats to this habitat type at the Pelister National Park, excluding forestry.

Oak woods that have old trees that are either dead or alive should be left intact or managed in a way that supports formation of old oaks in the Pelister National Park.

Management principles

Highest priority should be given to management plans that encourage the formation of old oak woods with ample amount of decaying wood. All forestry actions in oak woods should be based on plans to increase biodiversity. At the northern part of the Pelister National Park in Gjavato coniferous plantations should be removed and let to change into oak woods naturally or by planting oaks in order to speed up the natural succession.

There are stands of Eastern white oak close to the borders of the Pelister National Park that should be included into the Natura 2000 area. Some naturally formed young stands are also present between the Prespa Lake and the Pelister National Park that form corridors between these two conservation areas.

Conservation status (a draft based on the Twinning project study area)	
Range (of the distribution area)	FV
Area	U1
Structure and function	U2
Future prospects	U1
Overall assessment of Conservation Status	**U2**

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3.7.3. Moesian beech forests

Status in Europe		
Habitats directive, Annex I	Habitat type:	**91W0**
G1.6b Fagus woodland on acid soils		
Threat status in EU28+	Near threatened (IUCN)	NT
Threat status in EU28	Near threatened (IUCN)	NT
EU conservation status by biogeographical region		
Alpine	Unfavourable-Inadequate	U1
Atlantic	Not present	-
Black Sea	Not present	-
Boreal	Not present	-
Continental	Unfavourable-Inadequate	U1
Macaronesian	Not present	-
Mediterranean	Not present	-
Pannonian	Not present	-
Steppic	Not present	-

Definition

The Interpretation Manual of European Union Habitats (EU Commission 2013): *"1) Fagus sylvatica or Fagus moesiaca forests of the Balkan Range, the southern Dinarides, the Moeso-Macedonian mountains, the Pelagonids and the Rhodopids of the alliance Doronico orientalis-Fagion moesiaci (syn. Fagion moesiacum). Fagus sylvatica is accompanied, at the higher altitudes and latitudes, by Abies alba and Picea abies. The forests have, even in the south of their range, a pronounced medio-European character, marked by the frequency of species such as Acer pseudoplatanus, Quercus petraea, Fragaria vesca & Oxalis acetosella."*

"2) Plants: Fagus moesiaca, Fagus sylvatica, Luzula luzuloides, Luzula sylvatica, Lerchenfeldia flexuosa, Calamagrostis arundinacea, Prenanthes purpurea, Festuca drymea, Dicranum scoparium, Galium odoratum, Cardamine bulbifera, Lamiastrum galeobdolon, Impatiens noli-tangere, Pulmonaria rubra, Mercurialis perennis, Symphytum tuberosum, Sanicula europaea, Lunaria rediviva, Oxalis acetosella, Allium ursinum."

There is already a fact sheet available of this habitat type for the Republic of Macedonia (Matevski et al. 2017). Presented here is the situation for the Pelister National Park.

Occurrence of the habitat type and related types in the Pelister National Park

Habitat type 91W0 "Moesian beech forests" is very common and abundant in the Pelister National Park covering approximately 30% (3286 ha) of the territory of the Park (Avramoski 2006a). Beech mainly grows in pure stands at Pelister but also in mixed forests with beech as a co-dominant species. Mixed beech-oak forests (Fagus–Quercus) and beech-silver fir forests (Fagus–Abies borisii-regis) are present at the Pelister National Park. Beech forests form mosaics with oak forests especially at the southern and western slopes of the Pelister Mountain, where in the upper parts of the oak zone mixed stands exist. Some of these stands belong to the habitat type 9280 "Quercus frainetto woods". Mixed stands with fir are rare in the Pelister National Park. Due to the presence of *Abies borisii-regis* as the only fir species in the area, these mixed forests belong to the type 9270 "Hellenic beech forests with *Abies borisii-regis*". In ravines and brook valleys beech forests integrate into forests with *Carpinus betulus, Acer* spp., *Tilia cordata* or more rarely with scattered elms *Ulmus glabra* and *Ulmus laevis.* These stands belong often to the 9180* "Tilio-Acerion forests of slopes, screes and ravines." At sun exposed rocky slopes there are small stands of low growing *Ostrya carpinifolia*, *Fraxinus ornus* (Ostryo-Carpinion orientalis) and *Quercus pubescens* in middle of the

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beech forests. The latter stands belong mostly into the 91AA* “Eastern white oak woods”. Occasional trees and more often saplings of beech are found widely at coniferous forests of Pelister. Sometimes there are stands of aspen (*Populus tremula*) inside a Moesian beech forest in the Pelister National Park. With old and decaying trees also these aspen stands have a high conservation value.

Fig. 62. Old and large living, hollow or dead beech trees are extremely important for biodiversity. These “habitat trees” produce habitats for birds, mammals (including bats), lichens, bryophytes, fungi and a vast amount of invertebrate species. These structural components are commonly present in beech forests with natural dynamics. Their formation in selectively cut stands should be enhanced by leaving retention trees and retention tree groups in forestry planning and practices. Photos: Kimmo Syrjänen.

Vascular plant communities and typical species of 91W0

In accordance with the new classification system presented in the monograph "Vegetation of Europe: hierarchical floristic classification system of vascular plant, bryophyte, lichen, and algal communities" (Mucina et al., 2016) the belonging of beech forests from the territory of the Republic of Macedonia is within the class Carpino-Fagetea sylvaticae Jakucs ex Passarge 1968 (Syn.: Querco-Fagetea Br.Bl. et Vliegar 1937), order Fagetalia sylvaticae Pawl. 1928; alliance Geranio striati-Fagion Gentile 1970 and Fagion sylvaticae Luquet 1926. The sub-mountain Beech region is present between 1100-1300 m a.s.l. (area of the climate-zonal community, ass. *Festuco heterophyllae-Fagetum*) while the mountain Beech belt spreads between 1300 and 1800 m a.s.l. (the area of the climatogenic ass. *Calamintho grandiflorae-Fagetum*) and is formed by various communities of Beech and Beech-Fir forests.

The “Beech region” covers the mountainous areas between 1000-1700 m a.s.l. (about 22% of the total forested area in Republic of North Macedonia). It may be differentiated into a sub-mountain and a mountain belt. The sub-mountain Beech region is present between 1000-1300 m a.s.l. (an area of the climate-zonal community, ass. *Festuco heterophyllae-Fagetum*), but on warmer sites they can reach up to 1500 m a.s.l. and on shaded sites up to 800 m a.s.l.. According to Matevski et al. (2011), forests of ass. *Festuco heterophyllae-Fagetum* grow on deep, fresh soil with plenty of nutrients over carbonate or silicate bedrocks. Only on sites where bedrock comes to the surface is it replaced by *Aceri obusati-Fagetum*. In *Festuco heterophyllae-Fagetum* the dominant species is beech, but

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sometimes it is codominated by *Acer obtusatum* (Rizovski & Džekov 1990). Typical vascular species in the sub-mountain Beech region are: *Fagus sylvatica*, *Festuca heterophylla*, *Brachypodium sylvaticum*, *Euphorbia amygdaloides*, *Melica uniflora*, *Poa nemoralis*, *Doronicum columnae*, *Cephalanthera damasonium*, *Anemone nemorosa*, *Aremonia agrimonoides* and others.

The mountain belt spreads between 1300 and 1700 m a.s.l. (the area of the climatogenic ass. *Calamintho grandiflorae-Fagetum*) with the next species composition: *Fagus sylvatica*, *Clinopodium grandiflorum*, *Festuca drymea*, *Galium odoratum*, *Cardamine bulbifera*, *Neottia nidus-avis*, *Secale montanum*, *Actea spicata*, *Sanicula europaea*, *Lamium galeobdolon*, *Rubus hirtus*, *Lathyrus venetus* and others.

According to Matevski et al. (2011), *Calamintho grandiflorae-Fageteum* is the most widespread beech forest community. It forms the montane forests in North Macedonia in a vegetation belt from 1300 to 1700 m a.s.l.. On northern slopes it can be found even lower, as well as at higher altitudes on southern sites. In the montane vegetation belt, dry periods do not appear during summer, and the winter frost is not so hard either. Fogs often appear and snow lies till late spring. These are the right site conditions for beech forests. These forests can be found in all aspects and on various bedrocks. The only requirement is that the soil layer is deep and fresh and that there are sufficient amount of nutrients. These forests are very productive, fairly well preserved and easy to approach; they rejuvenate successfully and are an important source of wood (Rizovski & Džekov 1990). As already said, it has been decided to follow the widely accepted syntaxonomical scheme in the region, and therefore we validate the name in current use.

Typical vascular plant species of beech forests in the Pelister National Park include *Fagus sylvatica*, *Rubus* spp., *Symphytum tuberosum*, *Euphorbia amygdaloides*, *Sanicula europea*, *Lamium (Lamiastrum) galeobdolon*, *Galium odoratum*, *Lapsana communis*, *Prenanthes purpuraea*, *Neottia nidus-avis*, *Lathyrus laxiflorus*, *Helleborus odorus*, *Mycelis muralis*, *Dryopteris filix-mas*, *Aremonia agrimonioides*, *Fragaria vesca*, *Corylus avellana*, *Sedum magellense*, *Cyclamen hederifolium*, *Brachypodium sylvaticum*, *Milium effusum*, *Epilobium montanum*, *Calamagrostis arundinacea*, *Poa nemoralis*, *Festuca altissima*, *Luzula sylvatica* and *Hedera helix.*

Habitat directive and other important species

Especially beech woods with old and decaying trees are of high ecological importance due to their role as significant habitats for a number of threatened species. These forests together with old oak forests host for example the Habitat Directive beetle species *Morimus funereus* and *Rosalia alpina* in the Pelister National Park. These extensive beech forest stands are also important for large carnivores like the brown bear (*Ursus arctos*) and the wolf (*Canis lupus*) and their prey species at the Pelister National Park. Old trees are important for many lichens and fungi and old hollow trees are important for bats.

Inventory and Monitoring

Standard Field Inventory Form for forests should be used in inventories and monitoring. Inventory information should be collected on GPS polygons/monitoring plots inside the studied forest stands. These polygons should be based on a forestry plan of the Pelister National Park. Repeated visits and iteration of inventory at the same site is a basic method of monitoring. Suitable monitoring period is between 5-10 years for this habitat type. Forest stands with different ages, management history, forestry activity and altitudinal position should be taken into account during monitoring.

Threats and pressures

Beech is a shade tolerant climax tree that is a good competitor at montane and subalpine areas. There are no severe threats to this habitat type at the Pelister National Park, excluding forestry. Even selective cuttings can be harmful to this habitat type because large trees are removed preventing big old trees to form, while decaying logs and dead standing trees are easily smashed if they are present. Beech forests managed with traditional shelterwood systems are of relatively low value for the conservation of most species groups (Brunet et al. 2010). In addition to forest cuttings, construction of forest roads and hydroelectric powerplants has negatively impacts to this habitat type at the Pelister National Park. Effects of climate warming on this habitat type are not entirely known, but it seems likely that water deficiency during the growing period will limit the distribution in the southern European lowlands (see

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Peters 1997). This may cause reduction of the habitat type especially at lower parts of the Pelister National Park if it is not compensated by increased precipitation and spreading of beech forests to higher altitudes.

Range

This habitat type is found throughout the Pelister National Park and in several other places along North Macedonian mountain slopes and subalpine areas. In addition to the Pelister National Park stands, it occurs naturally along the mountain ranges of Macedonia both inside and outside conservation areas (see Matevski et al. 2017).

Area

Area of this habitat type seems to be quite stable in the Pelister National Park. Beech can colonize oak and *Pinus peuce* forests, but there are no big negative changes going on. The total area of Moesian beech forests in the Pelister National Park is a bit over 500 hectares. It is the most common forest habitat type in the National Park.

Structure and function

Natural regeneration of European beech forests is based on gap-dynamics. In natural conditions primeval beech forests stands are not even-sized, but unevenly structured (Rugani et al. 2013). According to Rugani et al. (2013), this is due to the fact that the disturbance regime is characterized by low intensity, small-scale disturbances. Stand structure, mean tree age, deadwood amount and microclimate are different in primeval and managed stands of beech forests. In a study made in Slovakia it was observed that all development stages of the primeval beech forests were more species-rich in epiphytes and, when investigating larger plot numbers, also in vascular plants than the cultivated forests (Kaufmann et al. 2018). Mixed forests with silver fir (*Abies alba*) are also found in middle and Southeast Europe in natural conditions (Brunet et al. 2010, Nagel & Svoboda 2008) and these stands are also very valuable for biodiversity. In the Pelister National Park beech forests are managed with selective cuttings, so that large individuals or biggest stems of stem groups are removed from the forest stand leading eventually to an even-sized forest structure. Selective cuttings at slopes are good to prevent erosion and the vascular plant composition remains quite stable. However, several structural forest characteristics (including formation of old big trees and coarse woody debris) and species typical for primeval and near-natural beech forests are lost also in selective cuttings. It is probably the selectively harvested stands with many retention trees that approach the overall biodiversity of an old-grown beech forest (Brunet et al. 2010).

Management principles

Forestry at beech forests has a very high socio-economic importance in the Pelister National Park (Avramoski 2006a) by producing firewood and timber for local municipalities and for the economy of the National Park. There are some beech forest stands with old-growth characteristics near Vrteshka, southeast of the St. Ana monastery (Avramoski 2006a). Also at the upper reach of the Brajzino river valley there is a near-natural beech forest with plenty of decaying wood at a strictly protected zone of the Park. Along Stara Buka there also seems to be small beech forest fragments with near-natural conditions. Inventories at beech forests along slopes and ravines at the Pelister National Park should be done as soon as possible. All sites with old-growth characters or occurrences of rare and threatened species should be protected and left completely aside from forestry. The same recommendation was already given in the 2006 management plan (Avramoski 2006a).

In managed even-sized and even-aged stands there are several possibilities to increase biodiversity and the natural function of a beech forest ecosystem (Brunet & Isacsson 2009, Brunet et al. 2010), while cutting wood for economic purposes. These forestry management technics include e.g. retention trees and retention tree groups. Special attention during cuttings should be placed on maintaining existing dead trees and at the same time for the production of dead wood e.g. by girdling and by producing high stumps/snags. In addition to large enough number of retention trees, natural regeneration can be enhanced by cutting gaps. Gap size analysis of primeval beech forests by Rugani et al. (2013) showed that gaps smaller than 500 m^2 are the dominant driving force of stand development at natural beech forests. The amount of coarse dead wood should be over 20 m^3 per hectare to keep saproxylic species viable (Brunet et al. 2010). Inside the conservation areas sanitary cuttings are not needed. Naturally formed dead wood should be saved. These technics increase conservation values and allow timber

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production at the same time for several decades inside the conservation areas. The final goal is to have natural beech forests without forestry and other management plans for the most part of the Pelister National Park.

Conservation status (a draft based on the Twinning project study area)	
Range (of the distribution area)	FV
Area	FV
Structure and function	U1
Future prospects	U1
Overall assessment of Conservation Status	**U1**

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3.7.4. Moesian silver fir forests

Status in Europe		
Habitats directive, Annex I	Habitat type:	**91BA**
G3.1b Temperate mountain Abies woodland		
Threat status in EU28+	Least concern (IUCN)	LC
Threat status in EU28	Near threatened (IUCN)	NT
EU conservation status by biogeographical region		
Alpine	Unfavourable-Inadequate	U1
Atlantic	Not present	-
Black Sea	Not present	-
Boreal	Not present	-
Continental	Unfavourable-Inadequate	U1
Macaronesian	Not present	-
Mediterranean	Not present	-
Pannonian	Not present	-
Steppic	Not present	-

Definition

The Interpretation Manual of European Union Habitats (EU Commission 2013): *"*Forests of *Abies alba* or of *Abies alba* mixed with *Fagus sylvatica, Picea abies, Pinus sylvestris* or *Pinus nigra* of the Rhodopides, the Balkan Range and the Meso-Macedonian mountains within the geographical range of Fagion moesiacum forests. Located mainly on the northern slopes of the mountains on acidic well-drained soils with high moisture, they occur as a relatively thin line between the beech and the coniferous vegetation belts." Subtypes include 42.162 Moeso-Macedonian fir forests (PAL.CLASS).

Description according to EUNIS (Evans & Roekaerts 2015) Moesian *Abies alba* forests Forests of *Abies alba* or of *Abies alba* mixed with *Fagus sylvatica*, *Picea abies*, *Pinus sylvestris* or *Pinus nigra* of the Rhodope Mountains, the Balkan Range, the Moeso-Macedonian mountains and the Pelagonids, within the geographical range of Fagion moesiacum forests. Stands where Fagus sylvatica is co-dominant are treated under 61.6 Fagus woodland.

In Macedonia silver fir trees almost exclusively belong to *Abies borisii-regis* species. Thus into the habitat type 91BA are included forests that are dominated by *Abies borisii-regis* and are often in the Pelister National Park as a result of natural succession of *Pinus peuce* forests. This type is present in the Pelister National Park, mainly at the northern slopes of Mt. Pelister at altitudes from 1200 to 1800 m a.s.l.. There are only a couple of old-growth stands, but instead several successional stages with still a lot of *Pinus peuce* individuals. Sometimes scattered individuals of *Fagus sylvatica* and *Acer* spp. including *Acer heldreichii* are found in these forests. In the upper parts of *Abies borisii-regis* forests it is possible to find fixed stands with *Fagus moesica*. These stands belong to the type 9270 "Hellenic beech forests with *Abies borisii-regis*". However, in the future it will be necessary to define the boundaries of these two habitat types (9270 and 91BA) more precisely. Namely, the question is whether the community with *Abies borisii-regis* should be included in the habitat 9270 "Hellenic beech forests with Abies borisii-regis" or to the habitat 91BA "Moesian silver fir forests".

Vascular plant communities and typical species of 91BA in the Pelister National Park.

In these forests both temperate and boreal species are found, but at lower elevations temperate species are dominant whereas boreal species dominate the upper elevations. Typical species of the 91BA in Pelister National

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Park include *Sanicula europaea*, *Melica uniflora*, *Aremonia agrimonioides*, *Euphorbia amygdaloides*, *Helleborus odorus, Rubus hirtus*, *Sorbus aucuparia*, *Brachypodium sylvaticum*, *Mycelis muralis*, *Prenanthes purpurea*, *Galium rotundifolium*, *Geranium macrorrhizum*, *Cardamine bulbifera*, *Doronicum columnae*, *Oxalis acetosella*, *Hieracium* sp., *Geranium robertianum*, *Milium effusum*, *Calamagrostis arundinacea*, *Vaccinium myrtillus*, *Rhytidiadelphus triquetrus*, *Dicranum polyphyllum*, *Dicranum scoparium* and *Hylocomium splendens.* In the upper parts boreal species such as *Vaccinium myrtillus* are prevailing.

Fig. 63. 91BA Moesian silver fir forests is present especially at the northern slopes of the Pelister National Park (Mt Baba /Pelister) and above Magarevo, Rotino and Capari villages.This habitat type is successional climax phase of coniferous forests at subalpine growing sites with moist microclimate and mesic soils. In near-to-natural stands there is a lot of coarse deadwood. Photos:

Habitat directive species

One Moesian silver fir forest stand close to Pali Snopje hosts a viable population of Green Shield moss (*Buxbaumia viridis*) and *Cucujus cinnabarinus* beetles. This site is also important to woodpeckers such as the Black Woodpecker (*Dryocopus martius*).

Inventory and Monitoring

Standard Field Inventory Form for forests should be used in inventories and monitoring. Inventory information should be collected on polygons inside the studied forest stands. Repeated visits and iteration of inventory at same site is a basic method of monitoring. Suitable monitoring period is between 5-10 years for this habitat type.

Threats and pressures

Inside the Pelister National Park selective cuttings can be a threat if not taken into account in the management plan. There are no natural threats for this habitat type. Sporadic insect outbreaks belong to successional dynamics of coniferous forests and increase the biodiversity at the National Park. Climate warming can increase tree mortality.

Range

This habitat type is found in a few sites in Macedonia. In addition to the Pelister National Park it occurs in Šar Mountain, Rudoka, Bistra, Jakupica, Karadzica, Korab, Galichica, Pelister, Nidze, Dudica, Kozuf, Belasica (Micevski,

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1985). Matevski et al. (2011) consider in their monograph on forest vegetation on Mount Galichica, that the community with the fir trees (*Abies boris-regs*) should be validated in accordance with the previous proposal from Em and give the following combination - *Abieti borisii-regis-Fagetum* (Em 1985) Matevski et al. 2011.

Area

Area of this type is stable or naturally increasing in the Pelister National Park. Estimated area of this habitat type is at Pelister National Park about 700 hectares that includes also some planted (sown) fir forests.

Structure and function

Natural structure consists of old-growth stands with plenty of decaying wood, but also of the continuous regeneration in gaps. Because *Abies borisii-regis* is a shade tolerant species it can replace other tree species and forest habitat types in successional dynamics. Due to the complex land-use history at the Pelister area the present amount of old-growth or near to natural stands of Moesian silver fir forests are low and far from the natural situation. It is already noted in the Plan of Management (Avramoski 2006) that within the old forest stands the fir (*Abies borisii-regis*) is gradually outcompeting the Macedonian Pine (*Pinus peuce*). Also in many middle aged Macedonian Pine stands at the northern slope of Pelister there is usually a more or less dense undergrowth formed by young Moesian silver firs and saplings.

Fig. 64. 91BA Moesian silver fir forests. **a)** Regeneration of *Abies borisii-regis* at gaps (created by windfalls and/or dead standing trees). **b)** Near-to-natural forests are characterized by multi-aged stands with uneven distribution of trees. Photos: Kimmo Syrjänen.

Management principles

Inside the Pelister National Park selective cutting or other forestry practices of Silver fir forests with old-growth characteristics should not be allowed even during insect outbreaks. Without management some *Pinus peuce* forests at Pelister will change in time to *Abies borisii-regis* forests. This is a natural process and should allowed in selected sites. However, it is important to make the selection of which stands are let to develop naturally and which are artificially kept in different habitat type (e.g. *Pinus peuce* forests) by management actions. These decisions are important in management and forestry plans.

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Conservation status (a draft based on the Twinning project study area)	
Range (of the distribution area)	FV
Area	FV
Structure and function	U1
Future prospects	FV
Overall assessment of Conservation Status	**U1**

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3.7.5. High oro-Mediterranean pine forests

Status in Europe		
Habitats directive, Annex I	Habitat type:	**95A0**
G3.6 Mediterranean and Balkan subalpine Pinus heldreichii-Pinus peuce woodland		
Threat status in EU28+	Least concerned (IUCN)	LC
Threat status in EU28	Near threatened (IUCN)	NT
EU conservation status by biogeographical region		
Alpine	Unfavourable-Inadequate	U1
Atlantic	Not present	-
Black Sea	Not present	-
Boreal	Not present	-
Continental	Not present	-
Macaronesian	Not present	-
Mediterranean	Unfavourable-Inadequate	U1
Pannonian	Not present	-
Steppic	Not present	-

Definition

The Interpretation Manual of European Union Habitats (EU Commission 2013): *"1) Balkan endemic forests of Pinus heldreichii or Pinus peuce, restricted to the southern Balkans, Northern Greece and Southern Italy. Accompaning species are Picea abies, Pinus sylvestris, Pinus mugo with understory including Juniperus sibirica, Vaccinium myrtillus, Calamagrostis arundinacea, Brachypodium pinnatum, Luzula luzuloides, Luzula sylvatica, Geranium macrorhizum.*

Subtypes:

42.71 White-barked pine forests

Local treeline formations of Pinus heldreichii restricted to the southern Balkans, northern Greece and southern Italy, usually open and with an undergrowth formed by stripped grasslands on dry, often stony or rocky soils.

42.72 Macedonian pine woods

Pinus peuce formations (Pinion peucis), restricted to the subalpine zone of the high mountains of the Balkan peninsula south to extreme northern Greece (Voras, Varnous, Rhodope)."

The description according to EUNIS (Evans & Roekaerts 2015): "G3.6 Subalpine mediterranean Pinus woodland with the same contents. Plant communities: Pinion peucis, Pinion heldreichii. Species: G3.61: *Pinus heldreichii*, *Pinus leucodermis*, *Brachypodium pinnatum*, *Festuca penzesii*, *Calamagrostis arundinacea*, *Orthilia secunda*. G3.62: *Pinus peuce*, *Vaccinium myrtillus*, *Luzula sylvatica*, *Calamagrostis arundinacea*, *Pinus mugo*."

There is already a fact sheet available of this habitat type for the Republic of Macedonia (Matevski et al. 2017). Presented here is the situation for the Pelister National Park.

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Fig. 65. 95A0 High oro-Mediterranean pine forests are typical for the Pelister National Park. Conservation value of this habitat type with the Macedonian Pine (*Pinus peuce*) is high. Conservation of natural occurrences of 95A0 at the Pelister National Park is globally important. Photo:

Occurrence of the habitat type and its subtypes in the Pelister National Park

95A0 High oro-Mediterranean pine forests are very common and characteristic for the Pelister National Park. The extensive Macedonian Pine (*Pinus peuce*) forests at Pelister National Park are the most important habitats of this type in the Balkans and globally as well (Avramoski 2006). The Macedonian Pine – Molika – has been described by August Grisebach in 1846. Type specimen is based on material collected by him from an area of the present Pelister National Park near Hotel Molika above Magarevo village. At that time trees were young and low. Now at the same place grows probably the oldest Macedonian Pine forests of the Pelister National Park with some large trees over 200 years old. In the Pelister National Park Macedonian Pine forests are most common on the northern slopes on siliceous soils. In addition to the natural regeneration and dynamics, these forests have been increased by forestry actions during the Yugoslavian era and all the forests are not of natural origin. Undergrowth varies from herb-rich sites to rather species poor even-aged stands. In some planted stands undergrowth is almost non-existing because of dense needle litter.

Vascular plant communities and typical species of 95A0 in Pelister National Park

In the National Park Pelister two communities of the Macedonian Pine stand out: the mountain molika forest (Digitali viridiflorae – Pinetum peuces) and the sub-alpine molika forest (Gentiano luteae – Pinetum peuces) (Avramoski 2006). Typical species of mountain forests with temperate distribution at lower altitudes of the Pelister

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National Park can include: *Carex brizoides,Melica uniflora*, *Sanicula europaea*, *Cardamine bulbifera* (Syn.: *Dentaria bulbifera*), *Anemone nemorosa*, *Corylus avellana*, *Symphytum tuberosum*, *Euphorbia amygdaloides*, *Clinopodium grandiflorum* (Syn. *Calamintha grandiflora*), *Helleborus cyclophyllus*, , *Galium odoratum* and *Digidalis viridiflora*. Both in lower and subalpine forests the following species can be found: *Prenanthes purpurea*, *Galium rotundifolium*, *Oxalis acetosella* and *Mycelis muralis*. At some sites *Rubus discolor*, *Rubus hirtus* and *Pteridium aquilinum* are dominant in the undergrowth at lower altitudes, but also *Rubus hirtus* is typical. At upper sub-alpine altitudes undergrowth has a more boreal influence with *Vaccinium myrtillus*, *Calamagrostis arundinacea* and *Juniperus communis* common at the forest bottom. Boreal mosses such as *Rhytidiadelphus triquetrus* can also be found. *Pleurozium schreberi* and *Hylocomium splendens* can occur in these stands.

Habitat directive and other important species

The habitat 95A0 is important for woodpeckers, rare insects, polypores and other fungi living on dead coniferous wood. These forests provide shelter and food for brown bears, wolves and lynxes and for smaller species that serve as their prey. Two occurrences of the Annex II bryophyte *Buxbaumia viridis* has been observed *Pinus peuce* forests in the Pelister National Park. One collection of Habitat Directive Annex beetle *Cucujus cinnabarinus* is from a dead *Pinus peuce*.

Fig. 66. a) *Vaccinium myrtillus* is often dominant at the bottom of subalpine *Pinus peuce* forests. **b)** Dead wood, both standing dead trees and decaying logs, are important for forest biodiversity and an integral part of the natural structure and function of Macedonian Pine forests. Photo: Kimmo Syrjänen.

Inventory and Monitoring

Standard Field Inventory Form for forests should be used in inventories and monitoring. Inventory information should be collected on GPS polygons/monitoring plots inside the studied forest stands. These polygons should be based on a forestry plan of the Pelister National Park. Repeated visits and iteration of inventory at the same site is a basic method of monitoring. Suitable monitoring period is between 5-10 years for this habitat type. Forest stands with different ages, management history, forestry activity and altitudinal position should be taken into account during monitoring.

Threats and pressures

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In several places Moesian silver fir (*Abies borisii-regis*) trees are regenerating under *Pinus peuce* and will slowly replace *Pinus peuce* stands with Moesian silver fir forests. Beech (*Fagus sylvatica)* can also be competitively superior over Macedonian Pine, but although altitudinal ranges of these species are partly overlapping there does not seem to be severe competition. In some stands there are scattered young beech trees, but young sweet chestnut (*Castanea sativa*) trees or saplings can be found in Molika forests. This can be more common in the future due to changing climate. Warming climate can also enhance insect outbreaks in aging old *Pinus peuce* forests or inside self-thinning younger successional stands. According to Avramoski (2006) occasional avalanches destroy large areas of the Macedonian pine forests. Forestry with sanitary cuttings is also a threat to the biodiversity of these forests. In North Macedonia and also in the Pelister National Park an invasive alien insect Western Conifer Seed Bug (*Leptoglossus occidentalis*) that eat the seeds of coniferous trees is very common. This invasive North American insect can be a threat for the regenerative ability of Macedonian pine and fir in the future.

Range

This habitat type is found in several sites at the Pelister National Park (Em & D`ekov, 1969) and in a couple of other places in North Macedonia. In addition to the Pelister National Park it occurs naturally in Planina - Plat, Jablanica and Nižje - Belo Grotlo (Matevski et al. 2017).

Area

Area of this habitat type is stable or slightly increasing in the Pelister National Park. Due to natural succession new areas are colonized, but at the same time some old stands are decreasing. The total area of Macedonian Pine forests in the Pelister National Park is about 1820 hectares. This is the largest complex of *Pinus peuce* forests in North Macedonia. Only relatively small stands are present on Nidze and Shar Planina, and on Jablanica there are registered individual stems (Matevski et al. 2017).

Structure and function

Altitude span of the habitat ranges from 1100 meters (the zone of the mountain beech) to 2200 meters above sea level (subalpine belt) in Macedonia (Matevski et al. 2017). However, *Pinus peuce* is spreading upwards in the Pelister National Park and some stunted individuals are already scattered close to the top of Mt. Pelister. The natural structure and function of the "95A0 High oro-Mediterranean pine forests" in the Pelister National Park is not well known because the present location and structure of forests are the result of historical events (forest cuttings and grazing through the Ottoman Empire era, events during the World War I and cessation of grazing and forestry measures during the Yugoslavian time era). In many forest stands signs of forestry, including tree stumps and even-aged tree structure are noticeable. The Macedonian Pine seems to have a good dispersal ability and it spreads around boulder screes, overgrowing pastures and meadows, areas of degraded forests of other habitat types or abandoned agricultural land, but can also be found outside the boundaries of the Pelister National Park (Avramoski 2006). It is less shade tolerant than *Abies borisii-regis* or *Fagus sylvatica*, but seems to be regenerating at shadier conditions than *Pinus sylvestris*. Natural dynamics of *Pinus peuce* forests may have included disturbance dynamics caused by avalanches, other snow damages, insect outbreaks, storms with windfalls and forest fires. In comparison to near-to-natural circumstances forests are presently quite young and mostly lack old, dead and decaying trees. Present spreading of *Pinus peuce* is a consequence of decreased grazing and other traditional land use.

Management principles

There are several challenges with the present forest structure and dynamics in Macedonian Pine forests. In the National Park there are relatively few very old *Pinus peuce* forests. Surrounding the hotel Molika and in the Magarevo river valley there is a roughly 200 year old *Pinus peuce* stands. The forest suffers badly from polypore fungi *Phaeolus schweinitzii* causing brown rot at basal parts of trunks. Many old large trees are hollow inside that can lead to quick changes in standing tree volume during storms. This stand can also be prone to insect outbreaks. Dead trees and trunks are important for biodiversity and should be left where they are. Dead trees can be cleared from paths but remaining logs should be left in the surroundings. Regeneration at the Molika site will probably follow when suitable gaps are present. Planting young trees is one way to prepare into future changes.

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Some younger stands are even-aged and it is possible to improve the structure and natural regeneration of these stands by cutting. It is also possible to produce gaps through restoration and to create deadwood by girdling trees . If tree die because of forest fires, insect damage or avelanches, they should be left to stay and sanitary cutting should be avoided. Deadwood is important for biodiversity and disturbances are an integral part of the natural forest regeneration dynamics.

Due to the increase of shade tolerant *Abies borisii-regis* at *Pinus peuce* forests in the northern slope of the Pelister below the subalpine areas, some forests may need active management to conserve the structure of Macedonian Pine forest, to ensure regeneration of the species and to maintain a local continuity of old large pine trees and dead wood. These stands should be selected in forest management plan and other stands should be left to develop via natural succession.

Although Macedonian Pine forests are spreading up towards the alpine zone they remain stunted at the upper elevations (Avramoski 2006). This expansion is negative to open alpine heath and grassland habitat types. Removal of colonizing *Pinus peuce* at some parts of the upper subalpine areas and maintaining lower altitude populations is one possible management goal. The future maintenance and location of the Macedonian Pine forests at the Pelister National Park depends on decisions done right now. This is an important theme for biodiversity and recreation and needs to be kept in mind while preparing a management plan and forestry plan for this Natura 2000 area.

Conservation status (a draft based on the Twinning project study area)	
Range (of the distribution area)	FV
Area	FV
Structure and function	U1
Future prospects	U1
Overall assessment of Conservation Status	**U1**

References:

Avramoski, O. (ed.) 2006: The Plan of Management for Pelister National Park. – Pelister National Park &

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4. Noteworthy Species

Makedonian Monitoring Protocols – Species Fact Sheets (mammals, reptiles and amphibians, invertebrates, bryophytes and vascular plants)

by Petri Ahlroth, Dragan Arsovski, Kimmo Syrjänen, Vlado Matevski and Renata Ćušterevska

4.1. Mammals

4.1.1. Eurasian Otter (*Lutra lutra*)

Status in Europe		
Habitats directive, Annex II	Species code:	**4111**
Bern Convention, Annex II		
Protected in many European countries		
Threat status in Europe:	Near threatened (IUCN)	NT
EU conservation status by biogeographical region		
Alpine	Unfavourable-Inadequate	U1
Atlantic	Unfavourable-Bad	U2
Black Sea	Unfavourable-Inadequate	U1
Boreal	Unfavourable-Bad	U2
Continental	Unfavourable-Bad	U2
Mediterranean	Unfavourable-Inadequate	U1
Pannonian	Favourable	FV
Steppic	Favourable	FV

Ecology, threats and pressures

The Eurasian Otter can be found close to a large diversity of waterbodies. Otters occupy both standing and running waters, and they can also be found along very small streams searching for food. Otters have good dispersal ability and move over long distances. Sometimes they might get killed by cars when crossing roads.

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Fig. 67. The Eurasian Otter (*Lutra lutra*). Photo: Petri Ahlroth.

Methods for the inventory and monitoring

Inventory and monitoring of the Otter is based on active searching for footprints, faeces and other sings of presence in their habitat.

Management recommendations for the sites of occurrence

The Otter is not very sensitive to human activities other than hunting and road traffic. The areas occupied by Otters should be left outside hunting activities, and important areas for Otters should be observed and evaluated when planning roads and other infrastructure.

Justifications for the assessment of conservation status

The distribution range covers the whole country. Populations are strong even though the number of suitable lakes, rivers and small waterbodies is limited. In the future, climate change may increase the risks associated with extreme weather conditions such as long periods of drought. The effects of climate change may be particularly severe on smaller waterbodies, and hence reduce the number of stable, suitable habitats. In addition, fish, crayfish and mussel species that are the typical prey for Otters, are slow colonizers making them especially vulnerable to environmental changes caused by climate change.

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Fig. 68. Observations of the Eurasian Otter (*Lutra lutra*). Its potential habitats are standing and running water habitats, including small streams.

Conservation status	
Range (of the distribution area)	FV
Population	FV
Habitat for the species (quality)	XX
Future prospects	XX
Overall assessment of Conservation Status	**XX**

References

EUNIS: https://eunis.eea.europa.eu/species/1435

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4.2. Amphibians

4.2.1. The Yellow-bellied Toad (*Bombina variegata*)

Status in Europe		
Habitats directive, Annex II and IV	Species code:	**1193**
Bern Convention, Annex II		
Protected in many European countries		
List of protected species of North Macedonia		
Threat status in Europe:	Least Concern (IUCN)	LC
EU conservation status by biogeographical region		
Alpine	Unfavourable-Inadequate	U1
Atlantic	Unfavourable-Bad	U2
Continental	Unfavourable-Bad	U2
Mediterranean	Favourable	FV
Pannonian	Unknown	XX

Ecology, threats and pressures

The Yellow-bellied Toad inhabits temporary ponds in several habitat types ranging from forests to forest roadsides, open lowland and highland meadows, and sides of lakes and rivers. It can also be found in slightly urbanized environments, such as artificial ponds, ditches and water-filled road trails in small villages and their surroundings. The ponds that the Yellow-bellied Toad inhabits generally lack vegetation and are free of competing species and predators. Through a quick heating-up of these small waterbodies, a rapid development of spawn and larvae is assured. The reproductive season is late spring and early summer, and active season usually continues until as late as October in North Macedonia.

Although highly adaptable and apparently resistant to extreme flooding events, the populations of The Yellow-bellied Toads can be sensitive to droughts (Cayuela et al. 2016a), which can be due to global climate change, or a consequence of direct human activities (e.g. fires, tillage etc.). These unpredictable environmental conditions may cause high variation in inter-annual fecundity and slightly lower annual survival probabilities of both adults and immatures (Cayuela et al. 2016b, c). Furthermore, typical to all amphibians, Yellow-bellied Toads are likely sensitive to pesticides and other toxic chemicals.

Management recommendations for the sites of occurrence

The species is seemingly much more common across North Macedonia, compared to Western Europe, thus urgent management activities are probably not necessary. Nevertheless, the availability of small temporary ponds is critical to its persistence and population growth, and because of their susceptibility to droughts, those ponds already inhabited by the species should be carefully monitored.

Methods for the inventory and monitoring

The Yellow-bellied Toad can actively be searched for and monitored. Potential waterbodies must be identified and mapped. The species can easily be captured by hand, but pond nets can sometimes be helpful. Monitoring Yellow-bellied Toads can also be done simultaneously while monitoring *Triturus spp*. and *Rana dalmatina*. Adult toads are easy to spot in the field and individual identification is easy due to their unique ventral decorations. Photographic identification allows efficient capture-recapture studies and can give accurate statistical estimations of population size (cf. Cayuela et al. 2016a, b, c).

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Justifications for the assessment of conservation status

The distribution range covers most of the country. The species is not very demanding and small local populations can be found in many localities with temporary ponds. The total population is thus likely large. In the future Yellow-bellied Toads could face the risk of exposure to chytridiomykosis, the wide use of pesticides and other toxic chemicals, and loss of suitable habitats (temporary ponds) caused by human activities or droughts due to climate change.

Fig. 69. a) Dorsal and ventral view of Yellow-bellied toad (*Bombina variegate*). **b)** Under a threat the animal practices the *unkenreflex* - bolting the limbs upward and exposing the belly's yellow warning colour to potential predators. Photos: Petri Ahlroth.

Conservation status	
Range (of the distribution area)	FV
Population	FV
Habitat for the species (quality)	FV
Future prospects	XX
Overall assessment of Conservation Status	**FV**

References

Cayuela, H., Arsovski, D., Bonnaire, E., Duguet, R., Joly, P., & Besnard, A. (2016a). *The impact of severe drought on survival, fecundity, and population persistence in an endangered amphibian*. Ecosphere, 7(2). https://doi.org/10.1002/ecs2.1246

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EEA / EUNIS: https://eunis.eea.europa.eu/species/638

Fig. 70. Observations of the Yellow-bellied toad (*Bombina variegate*). The species probably has small and local populations along the lowlands, in places with small waterbodies.

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4.2.2. The European Pond Terrapin (*Emys orbicularis*)

Status in Europe		
Habitats directive, Annex II	Species code:	**1382**
Bern Convention, Annex II		
Protected in all European countries		
Threat status in Europe:	Near threatened (IUCN)	NT
EU conservation status by biogeographical region		
Alpine	Unfavourable-Inadequate	U1
Atlantic	Unfavourable-Bad	U2
Black Sea	Unfavourable-Inadequate	U1
Boreal	Unfavourable-Bad	U2
Continental	Unfavourable-Bad	U2
Mediterranean	Unfavourable-Inadequate	U1
Pannonian	Favourable	FV
Steppic	Favourable	FV

Distribution of the species

Wide distribution nationally, but limited to water-bodies up to 900 meters above sea level. Primarily, it can be found in the three natural tectonic North Macedonian lakes (Ohrid, Prespa and Dojran Lake) and along the river Vardar valley and its tributaries.

Ecology, threats and pressures

Pond Terrapins inhabit stagnant or slow-flowing and sometimes ephemeral water bodies of variable size and origin (ponds, lakes, rice-fields, drainage canals etc.). They are often seen basking on stones or floating logs.

Reed burning activities that are designed to make room for agricultural land, pose a significant threat. Tourism and construction activities related to it further increase habitat loss. Furthermore, extensive road networks and subsequent roadkills along with illegal trafficking can also threaten populations via the removal of many adult individuals (e.g. more than 1300 confiscated individuals at the border crossing between North Macedonia and Serbia in December, 2012, Nikolić & Golubović 2017). Finally, these long-lived animals can accumulate toxic chemicals in large quantities throughout their lives (e.g. heavy metals and mercury (Hg) [Namroodi et al. 2017; Beau et al. 2019, respectively]). The physiological effects of this bioaccumulation are poorly known, but mercury (Hg) has already been demonstrated to negatively affect the proportion of breeding females in a population (Beau et al. 2019).

Management recommendations for the sites of occurrence

Terrapin habitats have to be taken into account when planning land use and road infrastructure. At least a mosaic structure of their wetland habitats have to be preserved and safe road-crossing infrastructure (i.e. animal tunnels) has to be constructed between water bodies to minimize roadkill numbers. Man-made fires have to be strictly controlled; reed burning in order to make way for agricultural land and/or tourism infrastructure has to stopped.

Methods for the inventory and monitoring

Inventory and monitoring should be based on traps and active searching of individuals. Mark-recapture methods can be used for the estimation of population sizes, but in many cases repeated counting of individuals will suffice

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in order to gain broad insights into population trends. Counting of individuals should be repeated annually in order to enable comparisons between years.

Justifications for the assessment of conservation status

Even though the population at the national level appears rather strong, degradation of habitats has most likely caused a decrease in its total size and in the number of local populations. Confiscations of large quantities of live animals seems to be an ongoing trend (Nikolić &Golubovuć, 2017), and those still living in their native wetlands are likely to bio-accumulate toxins that affect negatively on the proportion of breeding females (Beau et al. 2019).

Fig. 71. a) High levels of pesticides and other toxic chemicals can be poisonous for the European Pond Terrapins (*Emys orbicularis*) and to other organisms. **b)** Traffic and man-made fires threaten Pond Terrapins. Photos: Petri Ahlroth.

Conservation status	
Range (of the distribution area)	FV
Population	FV
Habitat for the species (quality)	U1
Future prospects	U1
Overall assessment of Conservation Status	**U1**

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Fig. 72. Observations of the European Pond Terrapin (*Emys orbicularis*). They can be found alongside the Prespa lake and around Ezerani.

References

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Nikolić, S., & Golubović, A. (2017). *Confiscated Emys orbicularis (L., 1758) Dying Out in a "Temporary" Reception Facility in Serbia: a Case Study Showing the Urgency for a Regional Reptile Rescue Centre*. Acta Zoologica Bulgarica, Suppl. 10: 115–120.

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4.2.3. The Europaean Tree Frog (*Hyla arborea*)

Status in Europe		
Habitats directive, Annex IV	Species code:	**1203**
Bern Convention, Annex II		
Protected in many European countries		
List of protected species of North Macedonia		
Threat status in Europe:	Least concern (IUCN)	LC
EU conservation status by biogeographical region		
Alpine	Unfavourable-Inadequate	U1
Atlantic	Unfavourable-Inadequate	U1
Black Sea	Unfavourable-Inadequate	U1
Boreal	Favourable	FV
Continental	Unfavourable-Inadequate	U1
Mediterranean	Unfavourable-Inadequate	U1
Pannonian	Unfavourable-Inadequate	U1
Steppic	Unfavourable-Inadequate	U1

Distribution of the species

Widely distributed across the country up to 2000 meters above sea level.

Ecology, threats and pressures

The European Tree Frog is most common in wetlands and around water bodies, adults are sometimes inhabiting areas with tall grasses. Additionally, they can be found in anthropogenic habitats, such as parks, gardens, orchards, vineyards and even in small waterbodies such as ditches. Nevertheless, human activities such as man-made fires, intense agricultural activities (along with the use of pesticides) and the construction of small hydropower plants are recognized threats to the European Tree Frog. Furthermore, chytridiomycosis poses a risk to most amphibians in the world (see: https://en.wikipedia.org/wiki/Chytridiomycosis), including the European Tree Frog. It has destroyed many frog populations and even brought some species to extinction. At the moment, the actual risk of this disease to the European tree frog in North Macedonia is not clear.

Management recommendations for the sites of occurrence

Sites where European Tree Frog populations occur should be preserved as they are for the most part, taking care that nearby agricultural or construction activities are contained and cause minimum disturbance to these habitats. In certain sites restoration activities can be used to support the viability of the populations. In addition, small, artificial waterbodies can be made to strengthen small and local populations.

Methods for inventory and monitoring

Inventory and monitoring of this species should be done during the mating season in spring. Male mating calls are easily recognizable and individuals can be distinguished, therefore allowing for population size estimates (under the condition of even [1:1] adult sex ratios). Potential areas should be checked at least a couple of times during the mating season.

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Fig. 73. a) The European Tree Frog (*Hyla arborea*) is a small leaf frog species. **b)** Man-made fires are a risk for many amphibians and reptiles. Prior to the fire this location hosted a thick reed habitat with a dense *H. arborea* population. Photos: Petri Ahlroth.

Justifications for the assessment of conservation status

Conservation status	
Range (of the distribution area)	FV
Population	FV
Habitat for the species (quality)	FV
Future prospects	FV
Overall assessment of Conservation Status	**FV**

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Fig. 74. Observations of the European Tree Frog (*Hyla arborea*). The species is most likely to have scattered populations alongside Prespa lake and aroud Ezerani.

References

EEA/EUNIS: https://eunis.eea.europa.eu/species/710

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4.2.4. The Herman's Tortoise (*Testudo hermanni*)

Status in Europe			
	Habitats directive, Annex II and IV	Species code:	**1217**
	Bern Convention, Annex II		
	Protected in all European countries		
	List of protected species of North Macedonia		
	Threat status in Europe:	Near threatened (IUCN)	NT
EU conservation status by biogeographical region			
	Alpine	Unfavourable-Inadequate	U1
	Black Sea	Unfavourable-Bad	U2
	Continental	Unfavourable-Inadequate	U1
	Mediterranean	Unfavourable-Inadequate	U1
	Steppic	Favourable	FV

Distribution of the species

Widely distributed across the country, up to 1000 meters above sea level.

Ecology, threats and pressures

Herman's tortoise inhabits many types of natural habitats such as meadows, open oak forests and secondary growth forests at sites where the influence of Mediterranean climate is present. They can also be found in urban parks and at the edges of urban environments. The activity period spans from mid-March to early October. Hermann's tortoises are primarily herbivores, but when food is scarce they can also feed on carrion. Mating begins in May and ends in August, with a drop in activity during June.

Tortoises are mainly threatened by habitat loss due to urbanization and agriculture. The limited locomotor capabilities of these armoured animals make them very susceptible to fires as well as vehicles, making roadkill tortoises a common site across roads in North Macedonia. Highways and other prominent roads can therefore fragment populations and reduce genetic diversity. The Hermann's tortoise is listed in CITES, but is nevertheless the target of illegal collection and trafficking. This is mostly due to their popular pet status, as well as their dinner table value in some Asian cuisines. CITES provides some legal shelter for the species, but due to the lack of proper infrastructure and motivation in some countries to implement the convention's legal acts thoroughly, its trafficking continues almost unhindered (Biennial report to the CITES office for 2013–2014;Table 1 in the appendix of Nikolić et al. 2019).

Management recommendations for the sites of occurrence

When planning land use, a mosaic structure of the Herman's tortoise's habitats should be maintained, because habitat destruction is most likely the biggest threat to this species on a national level. In order to further avoid population fragmentation, animal tunnels should be considered when constructing roads through suitable habitats. Man-made fires, particularly those initiated in order to control overgrown agricultural lands should be strictly controlled.

Methods for inventory and monitoring

Funded by the European Union

Adult Hermann's tortoises are conspicuous animals, thus active searching is an efficient method for monitoring. Capturing young individuals can be facilitated with the use of carefully placed artificial refuges, such as fibrocement slabs (Ballouard et al. 2013). Mark-recapture methods can be used for estimating local population sizes, but often repeated counting of all individuals in suitable habitats allow for the comparison of population size or density between years. Nationally, 10 sites counted using mark-recapture methods would already provide the basic data for estimating trends in the national population. For short term assessments (that cover at least one active season) the method of average abundancy index estimation can be used, because it can offer a relatively quick insight into the population status of the species.

Fig. 75. a) Back part of a Herman's Tortoise (*Testudo hermanni*). **b)** Characteristic nail at the tip of a tail. Photos: Petri Ahlroth.

Justifications for the assessment of conservation status

The distribution range of the Hermann's Tortoise covers most of the country and it is not considered rare. The total population appears to be fairly large, but man-made fires, roadkills and habitat fragmentation due to the construction of road infrastructure pose a serious threat to the species. In addition, because it is considered a desirable pet animal, a large number of adult individuals are removed from the wild, further endangering the sustainability of long-lived animal populations (Nikolić et al. 2018).

Conservation status	
Range (of the distribution area)	FV
Population	FV
Habitat for the species (quality)	U1
Future prospects	U1
Overall assessment of Conservation Status	**U1**

Funded by the European Union

Fig. 76. Observations of the Herman's Tortoise (*Testudo hermanni*). The species can be found in large areas around Prespa and Pelister.

References

Ballouard, J.-M., Caron, S., Lafon, T., Servant, L., Devaux, B., & Bonnet, X. (2013). Fibrocement slabs as useful tools to monitor juvenile reptiles: a study in a tortoise species. Amphibia-Reptilia, 34(1): 1–10. https://doi.org/10.1163/15685381-00002859

EEA / EUNIS: https://eunis.eea.europa.eu/species/811

Nikolić, S., Golubović, A., Bonnet, X., Arsovski, D., Ballouard, J.-M., Ajtić, R., … Tomović, L. (2018). *Why and apparently prosperous subspecies needs strict protection? The case of Testudo hermanni boettgeri from the central Balkans*. Herpetological Conservation and Biology, - In press.

Funded by the European Union

4.3. Invertebrates

4.3.1. Dragonflies

4.3.1.1. The Balkan Goldenring (*Cordulegaster heros*)

Status in Europe		
Habitats directive, Annex II and IV	Species code:	**4046**
Bern Convention, Annex I		
Protected in many European countries		
Threat status in Europe:	Least concern (IUCN)	NT
EU conservation status by biogeographical region		
Alpine	Favourable	FV
Continental	Favourable	FV
Mediterranean	Unknown	XX
Pannonian	Unfavourable-Inadequate	U1

Ecology, threats and pressures

The Balkan Goldenring lives in small, swift streams and in the forests surrounding them, located usually in the mountainside. It is sensitive to water quality, making the mountain streams its preferred habitat over lowland rivers and streams that are often too polluted. Unfortunately, plans to increase hydroelectric power output and an increase in tourism-caused waste water pose a serious threat to these fragile aquatic habitats.

Management recommendations for the sites of occurrence

Streams and other waterbodies inhabited by the Balkan Goldenring should be protected against hydroelectric power plants and the dumping of waste water. Strong forestry activities should be banned close to these waterbodies and pesticide-free zones should be implemented next to these vital habitats.

Methods for inventory and monitoring

Main method for the inventory and monitoring of this species is active searching of larvae and exuviae from streams and other likely habitats. Additional information can be collected from observing adult individuals. They can be found from the streams where active breeding occurs or from the surrounding forests where adults feed.

Funded by the European Union


Fig. 77. a) The Balkan Goldenring is a large dragonfly that has yellow rings around its black abdomen. This individual was photographed in Pelister NP, SW from Capari village. **b).** Adult males are often found along forest roads at the slopes of mountains. Photos: Petri Ahlroth.

Justifications for the assessment of conservation status

The current distribution covers almost the entire North Macedonia. At the moment there is no data available that would make estimations of the distribution change possible. Based on the habitat requirements of this species, nothing indicates that the size of the population is decreasing. The species' preferred habitats (clean rivers and streams in mountains slopes) are more stable than other aquatic habitats of the area. Currently no remarkable threats for the species are identified.

Conservation status	
Range (of the distribution area)	FV
Population	FV
Habitat for the species (quality)	FV
Future prospects	U1
Overall assessment of Conservation Status	**U1**

Funded by the European Union

Fig 78. Observations of the Balkan Goldenring (*Cordulegaster heros*) in the study area. Currently observations are concentrated along the areas close to Capari. There is also one observation close to the info-centre of NP. It seems likely that there are more inhabited areas for the species, but during this project no other sites were found.

References

Boudot, J.-P. 2010. *Cordulegaster heros. The IUCN Red List of Threatened Species 2010*: e.T158700A5263990. http://dx.doi.org/10.2305/IUCN.UK.2010-1.RLTS.T158700A5263990.en. Downloaded on 31 August 2018.

EEA / EUNIS: https://eunis.eea.europa.eu/species/196469

Funded by the European Union

4.3.2. Butterflies

4.3.2.1. The Eastern Eggar (*Eriogaster catax*)

Status in Europe		
Habitats directive, Annex II and IV	Species code:	**1074**
Bern Convention, Annex II		
Protected in many European countries		
Threat status in Europe:	Not evaluated (IUCN)	NE
EU conservation status by biogeographical region		
Alpine	Favourable	FV
Atlantic	Unfavourable-Inadequate	U1
Continental	Unfavourable-Inadequate	U1
Mediterranean	Unknown	XX
Pannonian	Unfavourable-Inadequate	U1
Steppic	Unfavourable-Inadequate	U1

Distribution of the species

Eriocaster catax is spread from Western and Southern Europe through Central Europe to Russia and Western Asia. Distribution is rather scattered and species is rather rare through the range. It is considered favourable only at alpine area.

Ecology, threats and pressures

The Eastern Eggar lives in semi-open habitats, at forest edges and roadsides. It is active in late autumn. After mating females lay a few large egg clusters and covers them with the hairs of its abdomen. The larvae weave a silk tent and they live throughout the larval stage close to it. The tents are visible in the landscape; however, there are three *Eriogaster* species in MK (*E. catax, E. riminicola* and *E. lanesris*) and also other species that build "tents" in the trees. The species is nocturnal. The main pressure for the species is the wide use of pesticides close to protected areas.

Management recommendations for the sites of occurrence

Usually there is no need for active managements to maintain the habitats for this species. Use of pesticides should be avoided in areas with colonies.

Methods for inventory and monitoring

The main methods for the monitoring of species are 1) Light trap and 2) active searching of larvae:

Light traps:

The species is night active and adult individuals (mainly males) can be captured using light traps. Adult individuals are active in late autumn. Traps should be installed in semi-open habitats with potential food plants for the species.

Active searching:

Active searching concerns the colonies of larvae. The colonies are visible in spring, before leaves appear. During summer the colonies are difficult to observe behind the leaves.

Funded by the European Union

Fig. 79. a) A colony of young Eastern Eggar (*Eriogaster catax*) larvae. Colonies were found along the roadsides and from pastures in Pelister NP. **b)** One male and two Eastern Eggar females. Photos: Markus Rantala.

Justifications for the assessment of conservation status

The species has wide distribution in the country. Strong fluctuations are typical for the populations, but because the species is not especially demanding with its habitat or food plants, it is able to easily recolonise potential habitats.

Conservation status	
Range (of the distribution area)	FV
Population	FV
Habitat for the species (quality)	FV
Future prospects	FV
Overall assessment of Conservation Status	**FV**

Funded by the European Union

Fig. 80. Observations of Eastern Eggar (*Eriogaster catax*). Several colonies were found from N-W parts of Pelister NP. However, it is likely that the species lives in a much larger area in the Pelister area.

References

EEA / EUNIS: https://eunis.eea.europa.eu/species/130

Funded by the European Union

4.3.2.2. The Marsh Fritillary (*Euphydryas aurinia*)

Status in Europe		
Habitats directive, Annex II	Species code:	**1065**
Bern Convention, Annex II		
Protected in many European countries		
Threat status in Europe:	Least concern (IUCN)	LC
EU conservation status by biogeographical region		
Alpine	Favourable	FV
Atlantic	Unfavourable-Inadequate	U1
Black Sea	Favourable	FV
Boreal	Unfavourable-Bad	U2
Continental	Unfavourable-Inadequate	U1
Mediterranean	Unknown	XX
Pannonian	Unfavourable-Inadequate	U1

Ecology, threats and pressures

This Marsh Fritillary lives in dry or relatively dry meadows. Larvae feed on *Knautia arvense*, *Succisa pratense*, *Scabiosa columbaria* and *Dipsacus* species. It is a declining species in many European countries due to the decline in animal numbers in traditional pastures: lack of pasture animals leads to overgrowing and to the disappearance of Marsh Fritillary's food plants. Subsequently, the overgrowing of pastures is the main threat for this species.

Management recommendations for the sites of occurrence

Marsh Fritillary habitats are very often under the risk of overgrowing. Traditional animal keeping in pastures is the most cost-effective way to maintain these habitats. Occasionally, it may be necessary to remove large vegetation (bushed, trees) from the pasture when restoring a habitat for the conservation purposes of this species. Fortunately for the Marsh Fritillary, many populations live on roadside habitats that are often kept open and subsequently are not at the risk of overgrowing like old pastures and hay meadows are.

Methods for inventory and monitoring

Main method for the inventory and monitoring is active searching of adult individuals or colonies of young larvae.

Funded by the European Union

Fig. 81. Marsh Fritillary (*Euphydryas aurinia*) favours warm places like small meadow patches and roadsides. Photo: Olli Pihlajamaa.

Justifications for the assessment of conservation status

Sufficient amount of data does not exist on this species' distribution changes. The population of *Euphydryas aurinia* is still rather strong, but many suitable habitats are overgrowing due to the changes in animal keeping.

Conservation status	
Range (of the distribution area)	XX
Population	FV
Habitat for the species (quality)	U1-
Future prospects	U1-
Overall assessment of Conservation Status	**U1-**

Funded by the European Union

Fig. 82. Observations of the Marsh Fritillary (*Euphydryas aurinia*). There are suitable habitats and food plants in many parts of the lower areas. Additionally, the lowest parts of the alpine meadows are potential habitats for this species**.**

References

van Swaay, C., Wynhoff, I., Verovnik, R., Wiemers, M., López Munguira, M., Maes, D., Sasic, M., Verstrael, T., Warren, M. & Settele, J. (2010) *Euphydryas aurinia. The IUCN Red List of Threatened Species 2010*: e.T174182A7024283. Downloaded on 31 August 2018.

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4.3.2.3. The Jersey Tiger (*Callimorpha quadripunctaria*)

Syn. *Euplagia quadripunctaria*, *Panaxia quadripunctaria*

Status in Europe		
Habitats directive, Annex II	Species code:	**1078**
Bern Convention, Annex I		
Protected in some European countries		
Threat status in Europe:	Least concern (IUCN)	NE
EU conservation status by biogeographical region		
Alpine	Favourable	FV
Atlantic	Favourable	FV
Black Sea	Favourable	FV
Continental	Favourable	FV
Mediterranean	Unknown	XX
Pannonian	Favourable	FV
Steppic	Favourable	FV

Ecology, threats and pressures

The Jersey Tiger can be found in forests, semi-open areas, parks, gardens and shrub areas. Larvae are polyphagous. They favour nettle (*Urtica dioica*), but may feed on *Plantago*, *Rubus*, *Epilobium*, *Coryllus*, *Ulmus* and many other food plants. The species is not very demanding for its habitat and currently no major threats can be identified.

Management recommendations for the sites of occurrence

Usually there are no urgent needs for management measures to maintain the populations of the species. Use of pesticides should be prevented in the areas of important populations.

Methods for inventory and monitoring

The main methods for inventoring and monitoring *Callimorpha quadripunctaria* are active searching of adult individuals and larvae from suitable habitats. Larvae can be searched from potential food plants.

Funded by the European Union

Fig. 83. Female Jersey Tiger (*Callimorpha* (*Euplagia*) *quadripunctaria*). Photo: Petri Ahlroth.

** During the preparation of the Annex lists of Habitats directive there was some confusion related to the status of some taxons, which were suggested to be included in the annexes at the subspecies level. A decision was made to include part of those taxons at species level. As a result some common species were included in the Annexes. One such species is* the Jersey Tiger (*Callimorpha quadripunctaria).*

Justifications for the assessment of conservation status

The Jersey Tiger has a wide distribution in the country. It is adaptable and can inhabit several habitats, including urban areas, wastelands and other man-made environments.

Conservation status	
Range (of the distribution area)	FV
Population	FV
Habitat for the species (quality)	FV
Future prospects	FV
Overall assessment of Conservation Status	**FV**

Funded by the European Union

Fig. 84. Observations of the Jersey Tiger (*Callimorpha quadripunctaria*). There are plenty of food plants and potential habitats all around the area. Due to its adaptability and ability to disperse, if it is found in one location, it is likely found in the neighbouring areas as well.

References

EEA / EUNIS: https://eunis.eea.europa.eu/species/54

Funded by the European Union

4.3.2.4. The Large Copper (*Lycaena dispar*)

Status in Europe			
	Habitats directive, Annex II and IV	Species code:	1060
	Bern Convention, Annex II		
	Protected in many European countries		
	Threat status in Europe:	Least concern (IUCN)	LC
EU conservation status by biogeographical region			
	Alpine	Favourable	FV
	Atlantic	Unfavourable-Inadequate	U1
	Black Sea	Favourable	FV
	Boreal	Unfavourable-Inadequate	U1
	Continental	Favourable	FV
	Mediterranean	Unknown	XX
	Pannonian	Unfavourable-Inadequate	U1
	Steppic	Unfavourable-Inadequate	U1

Ecology, threats and pressures

The Large Copper (*Lycaena dispar*) can be found in several types of grassland habitats. Its larvae feed on *Rumex* species. It is not especially demanding and it doesn't currently face any major threats.

Management recommendations for the sites of occurrence

Habitat management is rarely needed for this species. If there is a need to strengthen a population, it is enough to keep several small patches open that have the food plants of the larvae. This species is adapted to relatively strong fluctuations in population dynamics. Continuous local extinctions and re-colonisations are typical for this species.

Methods for inventory and monitoring

The Large Copper (*Lycaena dispar*) is a noticeable species and easy to recognize by an experienced person. It is a relatively easy species to monitor by active searching, which is why its monitoring should be carried out in parallel with other species that are active at the same time.

Funded by the European Union

Fig. 85. The Large Copper (*Lycaena dispar*) is active from midsummer to August. It can be found in different types of semi-open habitats. This individual was found on the side of a forest road in Pelister NP. Photo: Petri Ahlroth.

Justifications for the assessment of conservation status

The distribution area of the species has been increasing in many parts of Europe. In pilot areas the species was found in predictable habitats. It is relatively common inhabiting open and semi-open habitats. The species is not especially demanding and habitat destruction is not likely to occur.

Conservation status	
Range (of the distribution area)	FV
Population	FV
Habitat for the species (quality)	FV
Future prospects	FV
Overall assessment of Conservation Status	**FV**

Funded by the European Union

Fig. 86. Observations of the Large Copper (*Lycaena dispar*). There are suitable habitats for the species in the lower parts of Pelister NP.

References

EEA/ EUNIS: https://eunis.eea.europa.eu/species/Lycaena%20dispar

Funded by the European Union

4.3.2.5. The Large Blue (*Maculinea arion*)

Syn. *Phegaris arion*

Status in Europe		
Habitats directive, Annex IV	Species code:	**1058**
Bern Convention, Annex II		
Protected in many European countries		
Threat status in Europe:	Endangered (IUCN)	EN
EU conservation status by biogeographical region		
Alpine	Unfavourable-Inadequate	U1
Atlantic	Unfavourable-Inadequate	U1
Black Sea	Favourable	FV
Boreal	Unfavourable-Bad	U2
Continental	Unfavourable-Bad	U2
Mediterranean	Unknown	XX
Pannonian	Unfavourable-Bad	U2

Distribution of the species

TXT

Ecology, threats and pressures

The Large Blue is a species of open and warm meadows, pastures, eskers and semi-open sandy forest types that have both *Thymus* plants and *Myrmica* ant colonies. Females lay eggs on the flowers of *Thymus*. Larvae first feed on these flowers, but drop down to ground at an early stage. Then the larvae use chemical compounds to mimic *Myrmica* ant larvae therefore making adult ants to pick up the Large Blue larvae and bring it inside their nest. Once there, the young butterfly larvae turn into a predator (or a nest parasite) that feed on the larvae of the host ant.

The main threat for the species is overgrowing of habitats, because *Thymus* species are poor competitors in high vegetation patches.

Management recommendations for the sites of occurrence

Habitats should be protected from overgrowing. Usually the most cost-effective way to maintain the openness of the habitats is the maintenance of traditional animal keeping, i.e. pastures, at these sites. On the other hand, overgrazing should be avoided.

Methods for inventory and monitoring

The only applicable method for the inventory and monitoring of the species is to actively search adult individuals. Individuals can be marked and recaptured, but usually counting the adult individuals from local populations provide sufficient data. However, it is necessary to repeat the counting of individuals several times during the flight period (May to August).

Funded by the European Union

Fig. 87. The Large Blue (*Maculinea arion*) lays eggs on the flowers of *Thymus*, but they also visit them for nectar. This individual was found from the lowest parts of the alpine meadows close to Brajcino village. Photo: Petri Ahlroth.

Justifications for the assessment of conservation status

Sufficient distribution data does not exist for this species in MK. The population has most likely been decreasing as the traditional keeping of animals, i.e. the number of pastures, has been decreasing. In many areas potential habitats suffer from overgrowing.

Conservation status	
Range (of the distribution area)	XX
Population	U1-
Habitat for the species (quality)	U1-
Future prospects	U1-
Overall assessment of Conservation Status	**U1-**

Funded by the European Union

Fig. 88. Observations of the Large Blue (*Maculinea arion*). The species was found at three locations in two different areas. Two locations in the lower parts of alpine meadows are located close to each other.

References

Gimenez Dixon, M. (1996) *Phengaris arion. The IUCN Red List of Threatened Species 1996*: e.T12659A3371159. http://dx.doi.org/10.2305/IUCN.UK.1996.RLTS.T12659A3371159.en. Downloaded on 31 August 2018

Lionel G. Higgins, Norman D. Riley, (1973). suom. Olavi Sotavalta: *Euroopan päiväperhoset*. pp. 271–274. Kustannusosakeyhtiö Tammi, 1973.

EEA / EUNIS: http://eunis.eea.europa.eu/species/235

Funded by the European Union

4.3.2.6. The Clouded Apollo (*Parnassius mnemosyne*)

Status in Europe		
Habitats directive, Annex IV	Species code:	**1056**
Bern Convention, Annex II		
Protected in many European countries		
Threat status in Europe:	Least concern (IUCN)	LC
EU conservation status by biogeographical region		
Alpine	Unfavourable-Inadequate	U1
Black Sea	Favourable	FV
Boreal	Unfavourable-Inadequate	U1
Continental	Unfavourable-Inadequate	U1
Mediterranean	Unknown	XX
Pannonian	Unfavourable-Inadequate	U1
Steppic	Unfavourable-Inadequate	U1

Ecology, threats and pressures

The Clouded Apollo favours small herb rich grasslands and semi-open habitats. Adult individuals can be seen from early to midsummer. Its larvae feed on *Corydalis* species usually favouring *Corydalis solida*. It has suffered from overgrowing of old pastures after the grazing of animals has ended. Traditional agriculture and keeping of grazing animals on the pastures and in forests has previously maintained suitable habitats for this species. In many areas, such habitats are disappearing and populations of Clouded Apollo at those sites are threatened.

Management recommendations for the sites of occurrence

Allowing animals to graze in a traditional manner maintains habitats for this species, but overgrazing should be avoided. Mowing can also function as way to maintain suitable habitats and effectively prevents overgrowing of the vegetation. In areas with Clouded Apollo any use of pesticides must be forbidden and the use of fertilizers should be avoided. Intensive forestry activities should not take place too close to the populations because they may change the microclimate of the sites. Hydrological conditions should be maintained at a natural stage.

Methods for inventory and monitoring

The main method for the inventory and monitoring is an active search of adult individuals. If the population size has to be estimated, the Clouded Apollo is a rather easy to mark and recapture. There are several mathematical methods to estimate the population size according to data from marking and recapturing the individuals (see, https://en.wikipedia.org/wiki/Mark_and_recapture, for example).

Funded by the European Union

Fig. 89. The Clouded Apollo (*Parnassius mnemosyne*) is a relatively large butterfly. Adult individuals can be seen from early to mid-summer flying in meadows and semi-open habitats. Adult butterflies frequently visit flowers. In Pelister NP the Clouded Apollo has small local populations in several locations. This individual was found in a small semi-open patch close to the Capari village. Photo: Petri Ahlroth.

Justifications for the assessment of conservation status

Data is not sufficient for distribution analysis. It seems possible that agricultural changes, especially the use of pesticides, have decreased the quality of habitats and Clouded Apollo populations. It seems likely that a similar trend in agriculture will continue in the future.

Conservation status	
Range (of the distribution area)	XX
Population	U1-
Habitat for the species (quality)	U1-
Future prospects	U1-
Overall assessment of Conservation Status	**U1-**

Funded by the European Union

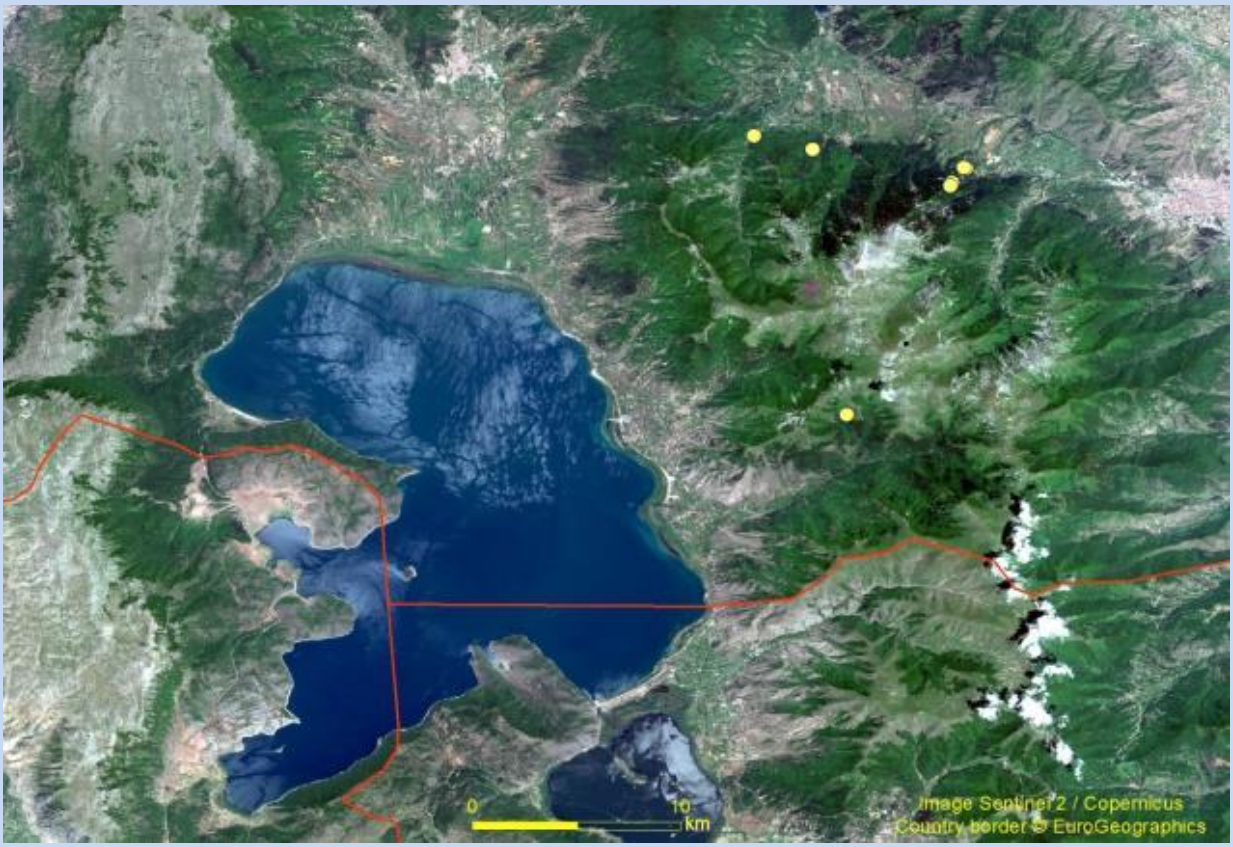

Fig. 90. Observations of the Clouded Apollo (*Parnassius Mnemosyne*). There are several potential areas for the species: they can be found both in the lower parts of the alpine meadows and in other meadows in the lower altitudes.

References

van Swaay, C., Wynhoff, I., Verovnik, R., Wiemers, M., López Munguira, M., Maes, D., Sasic, M., Verstrael, T., Warren, M. & Settele, J. (2010) *Parnassius mnemosyne. The IUCN Red List of Threatened Species 2010*: e.T174210A7029050. Downloaded on 31 August 2018.

EEA/EUNIS:
http://eunis.eea.europa.eu/species/285/conservation_status;jsessionid=21741103B03CB7E899D0F6C983112250?d-49653-s=1&tab=conservation_status&d-49653-o=2&d-49653-p=1&idSpecies=285

EIONET:
https://bd.eionet.europa.eu/article17/reports2012/species/summary/?period=3&subject=Parnassius+mnemosyne

Funded by the European Union

4.3.3. Beetles (Coleoptera)

4.3.3.1. The Cerambyx Longicorn (*Cerambyx cerdo*)

Status in Europe		
Habitats directive, Annex II and IV	Species code:	**1088**
Bern Convention, Annex II		
Protected in many European countries		
Threat status in Europe:	Least concern (IUCN)	NT
EU conservation status by biogeographical region		
Alpine	Unfavourable-Inadequate	U1
Atlantic	Unfavourable-Inadequate	U1
Black Sea	Favourable	FV
Boreal	Unfavourable-Bad	U2
Continental	Unfavourable-Inadequate	U1
Mediterranean	Unknown	XX
Pannonian	Unfavourable-Inadequate	U1
Steppic	Unfavourable-Inadequate	U1

Distribution of the species

TXT

Ecology, threats and pressures

Cerambyx Longicorn is a species of the Cerambycidae family. It favours the warm edges of forests, slopes and roadsides, but it requires habitats that have large dead Oaks (*Quercus*) for breeding. Therein lays its greatest threat: modern forest practices do not leave large or dead oak trees to the forest, and this continuum of dead oaks is vital to Cerambyx Longicorn. Subsequently, the main threat for this species is forestry and the collection of old oak trees for firewood.

Management recommendations for the sites of occurrence

Large oaks should be left out of forestry activities. Dead trees should be saved and left for the beetles. This would benefit also other saprocylic species which use oak as a food source. Active management can be done in the areas with *Cerambyx* population, if the continuum of suitable trees is at risk.

Methods for inventory and monitoring

The main method for the inventories and monitoring is active searching of signs of larvae. Due to the very large size of the species, old signs of larvae are often recognizable from the trees. However, there are several other large-sized species of *Cerambyx* in North Macedonia. Monitoring of this species should be done at the same time with other species that require active searching and share similar habitats.

Funded by the European Union

Fig. 91. a) Old signs of Cerambyx Longicorn (*Cerambyx cerdo*) larvae in a dead oak tree and **b)** the Cerambyx Longicorn is one of the biggest bettle in Europe. Photos: Petri Ahlroth.

Justifications for the assessment of conservation status

Distribution area covers the whole country and signs (including old signs) of the larvae can be seen in suitable trees. It has relatively good dispersal ability and they can colonize suitable trees in the area they live in. Suitable trees, however, are scattered in the landscape and large dead oaks are often used as firewood. Conservation status is estimated as favourable.

Conservation status	
Range (of the distribution area)	FV
Population	XX
Habitat for the species (quality)	FV
Future prospects	FV
Overall assessment of Conservation Status	**FV**

Funded by the European Union

Fig. 92. Observations of the Cerambyx Longicorn (*Cerambyx cerdo*). The species was found at several localities and there is still plenty of good habitat candidates waiting to be surveyed that may have viable populations.

References

World Conservation Monitoring Centre (1996) *Cerambyx cerdo. The IUCN Red List of Threatened Species 1996*: e.T4166A10503380. http://dx.doi.org/10.2305/IUCN.UK.1996.RLTS.T4166A10503380.en. Downloaded on 05 September 2018.

EEA / AUNIS: https://eunis.eea.europa.eu/species/69

Funded by the European Union

4.3.3.2. The *Cucujus cinnaberinus* beetle

Status in Europe		
Habitats directive, Annex II and IV	Species code:	**1086**
Bern Convention, Annex I		
Protected in many European countries		
Threat status in Europe:	Near threatened (IUCN)	NT
EU conservation status by biogeographical region		
Alpine	Unfavourable-Inadequate	U1
Atlantic	Unknown	XX
Black Sea	Unfavourable-Inadequate	U1
Boreal	Unfavourable-Bad	U2
Continental	Unfavourable-Inadequate	U1
Mediterranean	Unfavourable-Bad	U2
Pannonian	Favourable	FV

Ecology, threats and pressures

Cucujus cinnaberinus is a species of the Cucujidae family. It lives under the bark of dead trees and is therefore dependent on the continuum of dead wood. Both larvae and adults can be found under the bark of Aspen (*Populus*), Oak (*Quercus*), Birch (*Betula*) and Pine (*Pinus*) and several forest habitat types can serve as potential habitats. Due to the species' dependency on dead wood, it has disappeared from large areas in Europe as a result of intensive forestry activities. Intensive forestry is also diminishing the living conditions for the species in the only known living area of *Cucujus cinnaberinus* in MK (Pelister NP). Sanitary cuttings in the area do not allow habitats to evolve in a way suitable for the species. This is a common problem for all saproxylic species face in Pelister NP and *Cucujus cinnaberinus* is not the only Annex species suffering from the current management of the areas.

Management recommendations for the sites of occurrence

Number of dead trees should be increased in Pelister NP and valuable forest habitats should be left out of all forestry activities. Restoration activities should be carried out to increase the amount of dead wood in the area. Dense tree cultivation stands should be ecologically restored. The main target in the restoration should be in the conservation of saproxylic species.

Methods for the inventory and monitoring

The main methods for the inventory and monitoring of *Cucujus cinnaberinus* are:

1. Active searching:

   The species can be searched under the bark of dead trees. When searching for it, inventory activities should not cause too much destruction for the (micro-) habitat of the species. Not all bark should be removed from the trees the species live in.

2. Window traps:

   The species can be captured by window traps placed on dead trees. Several tree species can be used for trapping.

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Fig. 93. Adult *Cucujus cinnaberinus*. This specimen was the first individual of this species found in North Macedonia. It was found during the field works of the project in Pelister NP, under the bark of dead Macedonian Pine *Pinus peuce*. Photo: Petri Ahlroth.

Justifications for the assessment of conservation status

There were no previous records of this species before summer 2018. For this reason, the range and potential changes in the range cannot be assessed. Intensive forestry managements have clear negative impacts on the quality of the suitable habitats in Pelister NP. The number of potential trees is inadequate, and population density is low.

Conservation status	
Range (of the distribution area)	XX
Population	XX
Habitat for the species (quality)	U2
Future prospects	XX
Overall assessment of Conservation Status	**U2**

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Fig. 94. Observations of *Cucujus cinnaberinus*. The number of potential habitats for the species is limited, but it is possible that new populations can be found.

References

EEA / EUNIS: https://eunis.eea.europa.eu/species/106

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4.3.3.3. The Stag Beetle (*Lucanus cervus*)

Status in Europe		
Habitats directive, Annex II	Species code:	**1083**
Bern Convention, Annex III		
Protected in all European countries		
Threat status in Europe:	Near threatened (IUCN)	NT
EU conservation status by biogeographical region		
Alpine	Unfavourable-Inadequate	U1
Atlantic	Unfavourable-Inadequate	U1
Black Sea	Favourable	FV
Boreal	Unfavourable-Inadequate	U1
Continental	Unfavourable-Inadequate	U1
Mediterranean	Unknown	XX
Pannonian	Favourable	FV
Steppic	Unfavourable-Inadequate	U1

Ecology, threats and pressures

The Stag Beetle (family Lucaniidae) lives in forest habitats with large oak trees. Larvae of the species require large trees with strong bark that are able to maintain humidity inside. The species has relatively good dispersal ability, but suitable trees are scattered in the landscape. Large dying oaks are often used as firewood, limiting the formation of suitable habitats.

Management recommendations for the sites of occurrence

Old oak forests should be protected. Large dead oaks should not be used as firewood but should be left for the Stag Beetle and a large number of other saproxylic species.

Methods for inventory and monitoring

Stag Beetles are relatively easy to observe during the reproductive season, because both sexes search for dead oaks and males compete over females in conspicuous fights. Females are also partly nocturnal and can be attracted to light. The main methods for the inventories are active searching and the use of light traps in suitable habitats.

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Fig. 95. A male Stag Beetle (*Lucanus cervus*) with its extremely large mandibles. Photo: Petri Ahlroth.

Justifications for the assessment of conservation status

The range of distribution covers the entire country. The population is large, but most likely scattered due to the lack of high quality habitats. Because of e.g. forestry practices, the continuum of habitats with old oaks is at risk.

Conservation status	
Range (of the distribution area)	FV
Population	FV
Habitat for the species (quality)	FV
Future prospects	FV
Overall assessment of Conservation Status	**FV**

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Fig. 96. Observations of the Stag Beetle (*Lucanus cervus*).

References

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EEA / EUNIS: https://eunis.eea.europa.eu/species/221

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4.3.3.4. The *Morimus funereus* beetle

Status in Europe		
Habitats directive, Annex II	Species code:	1089
Bern Convention, Annex I		
Protected in many European countries		
Threat status in Europe:	Not evaluated (IUCN)	NE
EU conservation status by biogeographical region		
Alpine	Favourable	FV
Black Sea	Favourable	FV
Continental	Unfavourable-Inadequate	U1
Mediterranean	Unknown	XX
Pannonian	Favourable	FV
Steppic	Unfavourable-Inadequate	U1

Ecology, threats and pressures

Morimus funereus is a species from the Cerambycidae family. It lives in deciduous forest habitats, on dead deciduous trees such as Oaks (*Quercus*). It favours large trees with thick bark. Besides *M. funereus* (=*M. asper funereus*), also closely related *M. ganglbaueri* was cited for western parts of Macedonia.

Management recommendations for the sites of occurrence

Large deciduous trees (and especially large dead or dying trees) should be left out from forestry activities. In areas lacking suitable trees, the volume of large dead trees should be increased artificially. Restoration activities should be concentrated close to known populations because of the restricted dispersal ability of the species.

Methods for inventory and monitoring

The main method for the inventories and monitoring is active searching. Because finding individuals is more or less accidental, the species should be monitored while searching for other species. The species is nocturnal and in day time adult individuals are resting on the trunks of deciduous trees, trusting on their camouflage. The effort of inventory should be standardized (days/hours) for each study area if comparability of population estimation is important.

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Fig. 97. *Morimus funereus* on an oak trunk. Photo: Petri Ahlroth.

* The taxonomic status of *Morimus funereus* is unclear. Some authorities have suggested that it could be divided into five different species whereas other authors see it as a single species with large morphological and genetic variation. Regardless, Habitats Directive provides legal shelter for the taxon even if the species was split.

Justifications for the assessment of conservation status

Currently there is not enough data to make distribution change estimates of this species. However, the species appears to be widespread in the Balkan countries and it seems the distribution covers the same area as it did in the past. Population density is relatively high in suitable habitat, but the lack of suitable trees in these habitats presents a problem. The species has poor dispersal ability and if local extinctions take place, the probability for recolonization is low.

Conservation status	
Range (of the distribution area)	FV
Population	FV
Habitat for the species (quality)	FV
Future prospects	FV
Overall assessment of Conservation Status	**FV**

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Fig. 98. Observations of *Morimus funereus*.

References

World Conservation Monitoring Centre. (1996) *Morimus funereus. The IUCN Red List of Threatened Species 1996*: e.T13875A4359886. http://dx.doi.org/10.2305/IUCN.UK.1996.RLTS.T13875A4359886.en. Downloaded on 05 September 2018.

EEA / EUNIS: https://eunis.eea.europa.eu/species/258

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4.3.3.5. The Rosalia Longicorn (*Rosalia alpina*)

Status in Europe		
Habitats directive, Annex II and IV	Species code:	**1087**
Bern Convention, Annex II		
Protected in many European countries		
Threat status in Europe:	Least concern (IUCN)	LC
EU conservation status by biogeographical region		
Alpine	Unfavourable-Inadequate	U1
Atlantic	Unknown	XX
Black Sea	Favourable	FV
Continental	Unfavourable-Inadequate	U1
Mediterranean	Unknown	XX
Pannonian	Favourable	FV

Ecology, threats and pressures

Rosalia Longicorn is a species from the Cerambycidae family. It lives in forest habitats favouring mountainous areas where it can be found from slope forests with dead deciduous trees. The species favours large, recently dead Beech (*Fagus*) trunks. The main threat and limiting factor for the population is the lack of suitable dead trees, which are often collected as firewood. In addition, modern intensive forestry practices prevent the creation of suitable habitats.

Fig. 99. a) An adult *Rosalia alpina* on dead beech. The species was found in a mountain slope above Brajcino village. **b)** Habitat for *Rosalia alpina* at a mountain slope in Pelister NP. Photos: Petri Ahlroth.

Management recommendations for the sites of occurrence

Forestry activities should not take place in areas inhabited by *Rosalia alpina*. The species benefits from restoration activities, especially if suitable trees are lacking in the area.

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Methods for inventory and monitoring

Active searching is clearly the most efficient method for inventory and monitoring of this species. Evidence of *Rosalia alpina* can be observed by searching traces of larvae and hatching holes from potential host trees. Additionally, the species can be monitored using window traps, which should be placed in dying or recently died Beech (*Fagus*) trees.

Justifications for the assessment of conservation status

Distribution area of the species covers the whole country. As the species has relatively good dispersal ability, it can easily colonize suitable trees in the living area. The risk is however, that the trees where the females lay their eggs are later collected as firewood, preventing the development of larvae. In areas with forestry activities, the amount of suitable trees is limited. After tree cutting, females may lay their eggs on the log piles that are later sold as firewood.

Conservation status	
Range (of the distribution area)	FV
Population	U1
Habitat for the species (quality)	U1
Future prospects	XX
Overall assessment of Conservation Status	**FV**

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Fig. 100. Observations of *Rosalia alpina*. There are relatively large potential areas for the species. However, the species is not very visible and the proper inventory of populations would require much time and several experts in the field.

References

World Conservation Monitoring Centre. (1996) *Rosalia alpina. The IUCN Red List of Threatened Species 1996*: e.T19743A9009447. http://dx.doi.org/10.2305/IUCN.UK.1996.RLTS.T19743A9009447.en. Downloaded on 05 September 2018.

EEA / EUNIS: https://eunis.eea.europa.eu/species/313

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4.4. Bryophytes and vascular plants

4.4.1. The Green Shield-moss (*Buxbaumia viridis* (Moug. ex Lam. et DC.) Brid. ex Moug. et Nestl.)

Status in Europe		
Habitats directive, Annex II	Species code:	**1386**
Candidate at European Red List (Hodgetts 2015)		
Threat status in Europe:	Not evaluated (IUCN)	NE
EU conservation status by biogeographical region		
Alpine	Unfavourable-Inadequate	U1
Atlantic	Unknown	XX
Boreal	Favourable	FV
Continental	Unfavourable-Inadequate	U1
Mediterranean	Favourable	FV
Pannonian	Unfavourable-Bad	U2

Ecology, threats and pressures

The Green Shield-moss is an inconspicuous moss. The green ripening capsules of about ≤1 cm height are relatively easy to detect, but for the most par the moss lives a hidden life at the surface of decaying wood as a perennial protonema or as small gametophytes. The capsules start to grow in autumn at moist conditions and they grow and ripen during the winter and spring. It is a typical species of old-growth forests with plenty of decaying wood and moist microclimate. The substratum of *Buxbaumia viridis* usually consists of dead conifers (*Abies alba*, *Picea abies*) or more rarely dead deciduous trees (*Populus tremula*, *Fagus sylvatica*) in late decay phases. However, sometimes it grows on humus or peaty soil and can even be found in managed forests or near towns with suitable substrate.

In the Czech Republic altitudinal distribution of the populations spanned 250–1200 meters above sea level, of which most were recorded at the altitudes between 600–900 m a.s.l. (Holá et al.2014). In the Czech Republic most populations are found within a 100 meters from a watercourse (Holá et al.2014). It is observed in Montenegro from 14 known sites at elevations over 1300 m a.s.l. in the northern and north-eastern parts of the country (Dragićević et al. 2012). In Pelister National Park *Buxbaumia viridis* has been found in northern slopes of mountains at elevations of 1400 - 1600 m a.s.l. on decaying logs and stumps of *Abies borisii-regis* and *Pinus peuce*. Accompanying species include other epixylic species such as *Herzogiella seligeri*, *Dicranum tauricum*, *Lophocolea bidentata*, *Brachythecium erythrorrhizon* and *Hypnum cupressiforme*.

The main threat for *Buxbaumia viridis* is forestry and ditching, especially clear cuttings that destroy habitats and change the microclimate in a very drastic way. Selective cutting can also pose a problem, if decaying logs and stumps are smashed as a by-product. Commercial or managed forests are not ideal habitats for this species because there is too little suitable decaying wood and the microclimate is too dry.

Management recommendations for the sites of occurrence

Suitable forest habitats with plenty of decaying wood should be surveyed in Macedonia. All populations should be taken into consideration while planning land use (construction of roads, forestry etc.). All sites with viable populations and forests that are able to maintain populations for a long time should be included in the Natura 2000 network. Management is rarely needed apart from protecting intact forests.

Selective cuttings can still be a threat for *Buxbaumia viridis* even inside national parks and other conservation areas. Sites of occurrences should be left intact even if forests are damaged by insects. Amount of suitable forest habitat

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with old and decaying trees should be increased to favour this and other threatened species that require near-to-natural or old-growth forests. Forest management inside protected areas should not be allowed. The increase of decaying wood should be a priority in all forests of Pelister National Park.

Methods for inventory and monitoring

Inventories should be done both inside and outside of conservation areas in Macedonia to map all populations. For example, it seems likely that there are more populations in the Pelister National Park than are known at the moment. Locating all populations is vital for future management plans.

Main method for the inventory and monitoring of the species is active searching of sporophytes (capsules) in autumn or late spring. Inventories should be concentrated to suitable forest habitats. Data on each patch and locality should be collected using the Field Inventory Form. Monitoring should be based on repeated inventories of known sites. Monitoring should be repeated in 5-6 year cycles.

Fig. 101. The Green Shield-moss is an epixylic moss that lives on soft decaying wood. In Macedonia, only a few records of old and present populations exist. In the Pelister National Park, a large and viable population exists located in a Moesian silver fir forest at Pali Snopje that has plenty of decaying wood. Photos: Kimmo Syrjänen.

Justifications for the assessment of conservation status

Size of distribution area

Distribution of *Buxbaumia viridis* is circumpolar and it is mainly boreal-montane and boreal-temperate. It is not present in the middle and northern part of the boreal zone, but is somewhat common in the boreo-nemoral zone. The largest Green Shield-moss population of EU exists in Sweden, but it can be found in most of the European countries. It is found from all Southeast European countries except for the European part of Turkey (Sabovljevic et al. 2008). In South Europe the species is considered mainly boreo-montane (see ecology). In Macedonia there are observations from Pelister, Mavrovo and Šara Mountains (Cekova, 2005, Papp & Erzberger 2012, Papp et al. 2016). During the Twinning project *Buxbaumia viridis* was found from three localities at the Pelister National Park in 2018.

Size of population

Size of the entire Macedonian population is unknown. There are old records from Pelister and Šara Mountains (Cekova, 2005) and the species has recently been found from the Mavrovo National Park (Papp et al. 2016) and

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from Pelister (Papp & Erzberger 2012). One of the three occurrences that were found during the Twinning project inventories from the Pelister National Park in 2018 is large and viable with several tens of colonized patches of decaying wood and with more than 100 sporophytes. It seems likely that there are viable populations present in the Pelister and Mavrovo National Parks as well.

Quality of habitat for the species

One subpopulation in Pelister has a high amount of decaying wood and this site is important for the maintenance of the population for a long time period. In other places at Pelister, known populations are small and there is a variably amount of decaying wood. The species is usually absent in tree stumps in selectively cut forests.

Future prospect

Selective cuttings inside national parks can be a threat to *Buxbaumia viridis* making future predictions difficult. Without careful management and the increase of suitable habitats the future prospects cannot be favourable. Climate warming is likely to have a negative effect on the species if aridity increases.

Conservation status	
Range (of the distribution area)	FV
Population	U1
Habitat for the species (quality)	U1
Future prospects	U1
Overall assessment of Conservation Status	**U1**

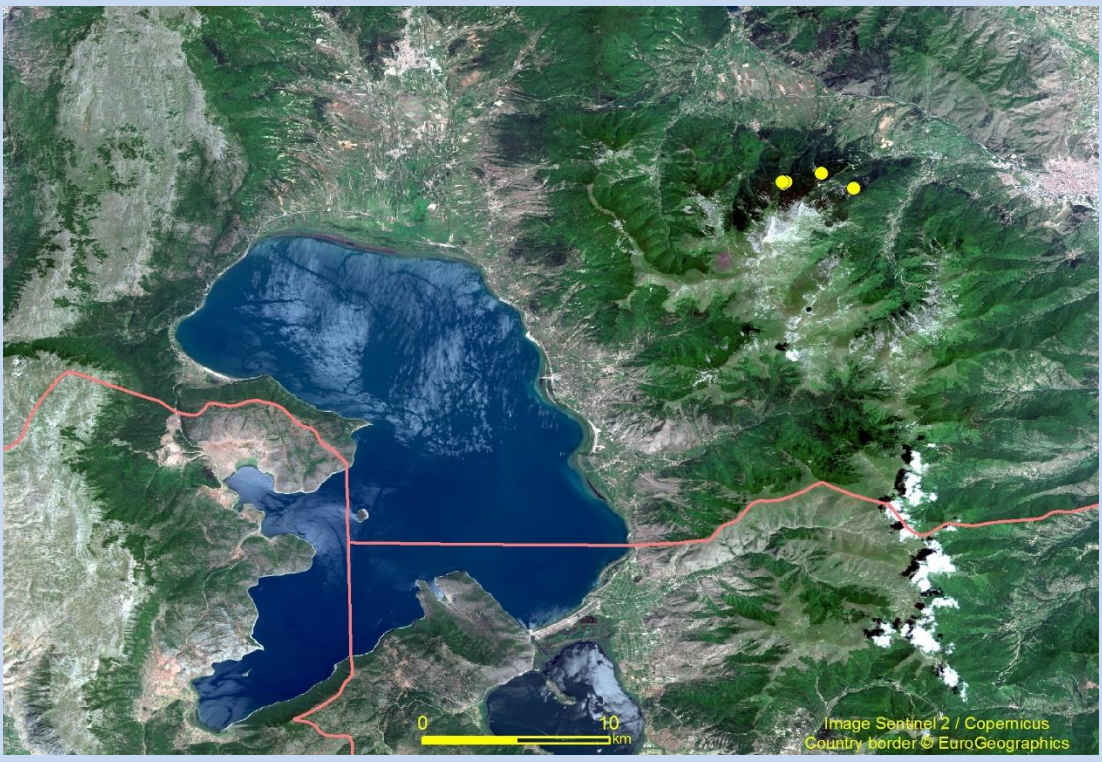

Fig. 102. Observations of *Buxbaumia viridis*.

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References

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4.4.2. *Fritillaria gussichiae* (Degen & Dörfl.) Rix

Syn. *Fritillaria graeca* var. *gussichiae* Degen & Dörfl.

Status in Europe		
Habitats directive, Annex IV	Species code:	**1845**
Bern Convention, Annex I		
IUCN global red list	Data Deficient (IUCN)	DD
Threat status in Europe	Data Deficient (IUCN)	DD
Threat status in EU	Near threatened (IUCN)	NT
EU conservation status by biogeographical region		
Alpine	Favourable	FV
Continental	Favourable	FV
Mediterranean	Unknown	XX

Ecology, threats and pressures

Fritillaria gussichiae is a perennial bulbous herb of the lily family (Liliaceae). Flowering takes place rather early in the spring from April to May. It is between 15-30 cm tall and it has 1-2 nodding flowers per stalk. Flowers are yellowish-green with reddish-brown shading. Dry stalks with ripe upright capsules are visible until autumn.

In Bulgaria the species grows in various types of thermophilous habitats like xerophilous pastures and rocky grounds as well as forests and scrubs at altitudes from 300 m to 1320 m, highest populations found 1800 m a.s.l. (EUNIS 2015, Petrova et al. 2011). In South Serbia, it grows in thermophilous oak forests, scrub communities and pseudo-steppe formations on all kind of bedrocks, 450-800 m a.s.l. (Petrova et al. 2011, Tomović et al. 2007). Petrova et al. (2011) mentions populations to exist between 40 and 1800 m a.s.l. In Pelister National Park this plant is found scattered in several locations at sun exposed grassland slopes both in forest zones and in lower parts of the alpine area, ranging from 1121 to 1615 m a.s.l.

In Pelister National Park the main threat to this species is overgrowth due to cessation of grazing and mowing. There has been a slow overgrowth going on in habitats of the species for the past half of century in Pelister National Park. Overgrowth is based on competition by taller herbs and scrubs and spreading of forests. Succession at present growing sites will begin by tall *Asphodelus albus* herb and *Pteridium aquilinum* grasslands to *Juniperus* and *Prunus* shrubs and further to coniferous, mixed or oak forest. It is not known whether wild boars eat its bulbs, but it is a possible threat. Without management the number of populations will decrease. Atmospheric pollutants (especially nitrogen) can enhance the overgrowth of habitats. Small populations can be also prone to stochastic events. Outside of conservation areas forestry, construction and heavy grazing can pose a threat. Climate change can enhance overgrowth at some places but increased aridity may be beneficial in other sites.

Management recommendations for the sites of occurrence

Management should begin by assessing the occurrences of *Fritillaria gussichiae* at Pelister National Park. Management is probably needed in most populations, but should be prioritized to large habitats with several individuals. Management can include clearing, mowing and raking of the sites after flowering period in late June – July, these actions and their results should be monitored and repeated in 2-year cycles. Occasional grazing of overgrown sites is recommended, but overgrazing should be avoided. Cutting of shadowing trees around habitats to increase sunlight may be good for this species and its habitats.

Methods for inventory and monitoring

Monitoring methodology and protocols for 20 habitats, 20 species and 20 birds

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Main method for the inventory and monitoring of the species is active searching of flowering individuals during flowering season at April-May. Inventories should be done at sun-exposed grassland and meadow patches of valley slopes both in forest and lower alpine zones. Based on information from neighbouring countries, populations are likely to be present at lower elevations than oberved so far in Pelister National Park. Field Inventory Form should be filled for each locality and monitoring should be based on repeated inventories of known sites. Monitoring is needed to be repeated at managed sites in 1-2 year period and in unmanaged sites in 5-6 year period.

Fig. 103. *Fritillaria gussichiae* is a perennial bulbous herb that grows on sun exposed grasslands and meadows at forest zone and at lower parts of alpine zone in Pelister National Park. **a)** Left. A flowering individual at late April. This species can be recognized only during the flowering period at spring. **b**) Right. Overgrowing subalpine grassland above Brajchino village host a few individuals of the species. Photos: Kimmo Syrjänen.

Justifications for the assessment of conservation status

Size of distribution area

Fritillaria gussichiae is endemic to the Balkan Peninsula. It occurs in Serbia, Bulgaria, Greece, Albania and Macedonia (Petrova et al. 2011, EUNIS 2015). All records cited in the old literature of *Fritillaria graeca* in Bulgaria, Serbia and the majority in Macedonia refer to *F. gussichiae* (Petrova et al. 2001). According to Petrova et al. (2011) in Macedonia it is distributed in almost all parts of the country and recorded in Mt Ostri, Mt Kitka, the River Matka gorge, Mt Babuna, Mt Radobilj, Mt Pelister, the River Crni Dim gorge in the vicinity of village Lukovo, surrounding of Doiran Lake, etc. At Pelister National Park the flowering individuals of *Fritillaria gussichiae* were found from two sites in May 2018 during the Twinning project. In addition, capsules bearing *Fritillaria sp.* individuals were present at six other sites. These plants probably belong to *Fritillaria gussichiae*.

The following information on occurrences from Macedonia is available (See Matevski et al. 2019):

Skopje: Zelenikovo (Degen & Dörfler, 1897) (sub *Fritillaria graeca* subsp. *gussichiae*)

Skopje; Shishevo-Man. Sv Nikola, Ostri, Kitka, Shishevo, Babuna Mt., Drenovo, Pelister-Radobil, Dedeli, Vardar, Sveti Nikola (Bornmüller, 1928) (sub *Fritillaria graeca* subsp. *gussichiae*)

Skopje:Treska, Zelenikovo, Drenovo (Soska, 1938, 1939) (sub *Fritillaria graeca* subsp. *gussichiae*)

Dvorce, Radusha (Matvejeva, 1965) (sub *Fritillaria graeca* subsp. *gussichiae*)

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Skopje: Vodno (Drenkovski, 1969) (sub *Fritillaria graeca* subsp. *gussichiae*)

Srumica: Adzilivert, Carevi Kuli, Sveti Ilija, Dedeli (Rudski, 1943; Soska, 1953) (sub *Fritillaria graeca* subsp. *gussichiae*)

Ohrid: Sv. Naum (Černjavski, 1943) (sub *Fritillaria gussichiae*)

Prespa: Oteshevo (Micevski, 1952, herb. mat. MKNH) (sub *Fritillaria gussichiae*)

Garska Reka (Leute, 1978) (sub *Fritillaria graeca* subsp. *gussichiae*)

Dobra Voda (Matevski, 1995) (sub Fritillaria graeca var. gussichiae)

Suva Gora (Teofilovski, 2011) (sub *Fritillaria gussichiae*)

Babuna-kanjon; Dudica, Osogovo, Treska (Jovanovska et al., 2009) (sub *Fritillaria gussichiae*)

Size of population

The actual size of the Macedonian population is unknown. According to Petrova et al. (2011) there is no information available on the status of the populations in Macedonia. However, according to Matevski et al. (2019) this species has a wide distribution in Macedonia and there are a lot of old and new observations of this species. Because Macedonia is considered to be a stronghold for this species, world classification of this species is suggested to be Least Concern (Petrova et al. 2011). Number of individuals per site In Pelister National Park range from one to less than ten and the total number of individuals in the national park is 20-30. Populations are small, but probably only a small fraction of whole Pelisters population was found during the Twinning project field inventories in 2018. Populations were found above Magarevo, Rotino, Capari, Kazan and Brajchino villages.

Quality of habitat for the species

Habitats of *Fritillaria gussichiae* seem to decrease and the species has probably already disappeared from some badly overgrown grasslands. Slow decrease of habitats will continue and this can partly be enhanced by climate warming.

Future prospect

In the near future the decrease of habitats and populations will continue in Pelister National Park. Management actions are needed to improve the conservation status of *Fritillaria gusscihiae* in Pelister National Park.

Conservation status	
Range (of the distribution area)	FV
Population	U1
Habitat for the species (quality)	U1
Future prospects	U1
Overall assessment of Conservation Status	**U1**

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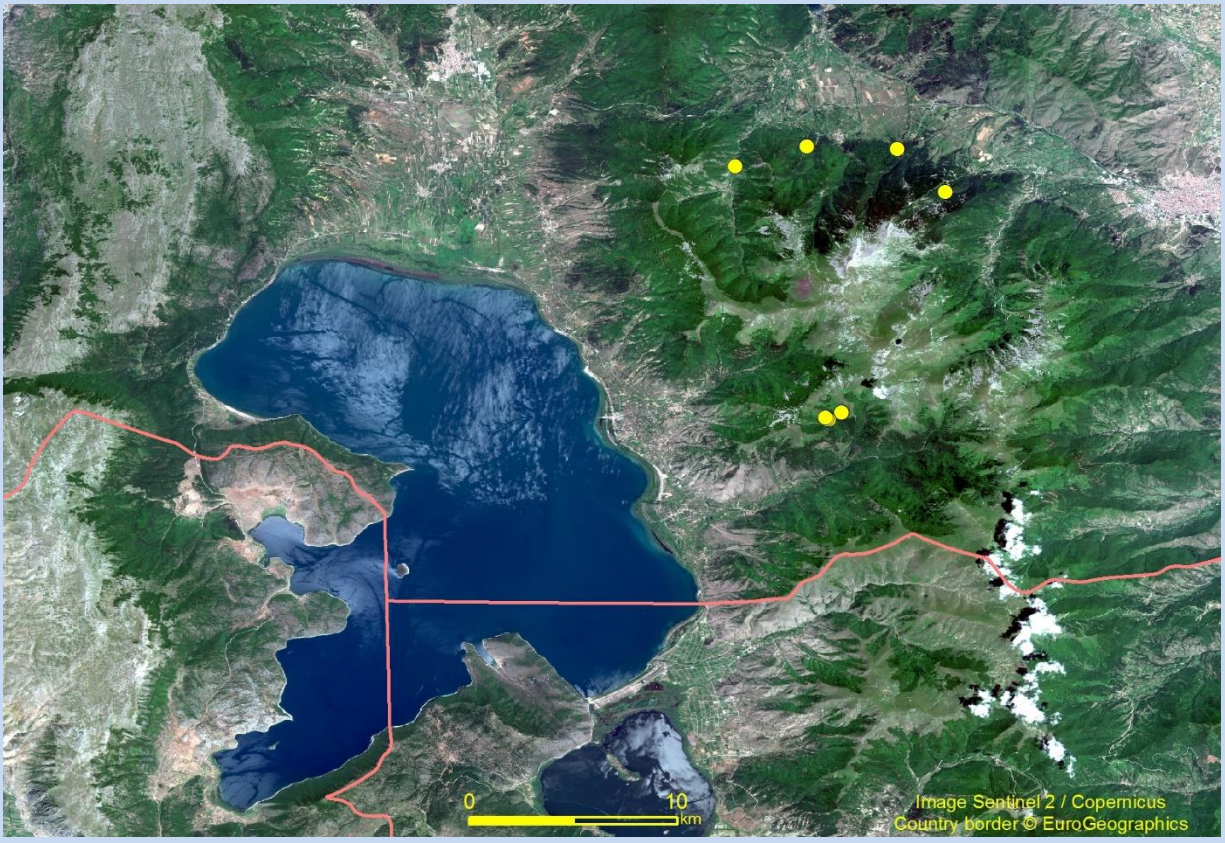

Fig. 104. Observations of *Fritillaria gussichiae*.

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4.4.3. The Goat-Like Himantoglossum (*Himantoglossum caprinum (M. Bieb.) Spreng.*)

Status in Europe			
	Habitats directive, Annex II and IV	Species code:	**2327**
	Bern Convention, Annex I		
	CITES Annex II		
	IUCN global red list	Not Evaluated	NE
	Threat status in Europe	Near threatened (IUCN)	NT
	Threat status in EU	Near threatened (IUCN)	NT
EU conservation status by biogeographical region			
	Alpine	Unfavourable-Inadequate	U1
	Black Sea	Unfavourable-Inadequate	U1
	Continental	Unfavourable-Inadequate	U1
	Pannonian	Unfavourable-Inadequate	U1
	Steppic	Unfavourable-Inadequate	U1

Ecology, threats and pressures

The Goat-Like Himatoglossum is a tall orchid (about 30-70 cm) that is usually a solitary plant in grasslands and open woodlands in rather dry and calcareous soils. It prefers short grassland, woodland edges, forest-steppes, and open woodlands such as oak groves (Rankou 2011). This species grows on relatively thermophilic sites in full sunlight to mid-shade and flowers rather late from June to August (see Rankou 2011 and references therein). It is related and sometimes included into *Himantoglossum hircinum*, but is rather easy to separate while flowering. In Macedonia it is known from rocky dry grasslands on carbonate bedrock. During the Twinning project in 2018 it was observed on the slope of *Quercus trojana* grove and at a roadside of calcareous Juniper heath – dry grassland. Accompanying species were *Asphodeline lutea, Chrysopogon gryllus*, *Nigella arvensis*, *Teucrium capitatum*, *Eryngium campestre*, *Sanguisorba min*or, *Melica ciliata*, *Sedum urvillei*, *Anacamptis pyramidalis*, *Juniperus oxycedrus*, *Quercus trojana* etc.

A wide variety of threats and pressures are reported in several EU member states, changes in hydrology and climate change being highly important threats that are the most frequently reported (EUNIS 2015). Activities associated with agriculture, forestry, transport and urbanisation are also frequently reported but rarely as highly important (EUNIS 2018). In Macedonia one locality is in the National Park Galicica close to Prepa Lake, but land use activities pose a threat. Another site is located in an unprotected area of marble quarries and threats include overgrowth, road construction, mining and burning.

Management recommendations for the sites of occurrence

Inventory of suitable calcareous habitats for the species is needed in the entire Macedonia. All populations should be taken into consideration while planning land use such as construction of roads and forestry actions. Enough sites should be included in the Natura 2000 network. Management actions such as clearing of junipers may be needed at some sites.

Methods for inventory and monitoring

The main method for inventorying and monitoring of the species is active searching of flowering individuals during flowering time. Inventories should be done at calcareous dry grasslands, shrub and open woods throughout the

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entire country. Field Inventory Form should be filled for each locality and monitoring should be based on repeated inventories of known sites. Monitoring has to be repeated in 5-10 year period.

Fig. 105. The Goat-Like Himantoglossum is a rare orchid of dry calcareous grasslands. In North Macedonia it was found from two sites during the Twinning project field inventories in 2018. **a)** A flowering shoot. **b)** A habitat of species in dry calcareous grassland bordered by *Quercus trojana* trees in Oteshevo. Photos: Kimmo Syrjänen.

Justifications for the assessment of conservation status

Size of distribution area

This orchid is rare with widely scattered populations in Southeast Europe, mainly in Balkan where it occurs in Serbia, Albania, Bosnia and Herzegovina and Macedonia. (Rankou 2011), but it is also found in Bulgaria, Hungary, Slovakia, Romania, Croatia, Greece and Slovenia. It also known from Ukraine and its range extends into Asiatic Turkey and the Caucasus (Rankou 2011). In Galichica there are several locations. Other inhabited sites in North Macedonia are listed below and in Matevski et al. (2019):

Zedenska Klisura – Radusa (Matvejeva, 1965) (sub *Himantoglossum hircinum*)

Suva Gora: Shkoza, borova kultura, 550 m a.s.l.; v. Stenche, 800 m a.s.l.; v Chegrane - 850 m a.s.l. (Teofilovski, 2011) (sub *Himantoglossum hircinum*).

Galichica: v. Peshtani (V. Matevski, per.data)

Size of population

Himantoglossum caprinum is localized and rare with a fragmented distribution. The species grows often as solitary individuals or in very small groups and the population size is decreasing (Rankou 2011). During the Twinning project inventories in 2018 it was found from two sites where only single individuals were present, but five earlier observations of this species exist. It seems likely that more populations and individuals exist in the calcareous habitats of Macedonia. Knowledge of existing populations and individuals is equally scarce in the neighbouring countries.

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Quality of habitat for the species

Habitats of the species are suffering from overgrowth and economic activities (e.g. lime-stone mining).

Future prospect

Overgrowth threatens North Macedonian habitats to a certain level. In Trojaci, road construction and marble mining are potential threats. In several other countries climate change is expected to be a threat for this species. The entire population and its subpopulations are extremely small in size, increasing the likelihood of demographic and stochastic threats.

Conservation status	
Range (of the distribution area)	FV
Population	U1
Habitat for the species (quality)	U1
Future prospects	U1
Overall assessment of Conservation Status	**U1**

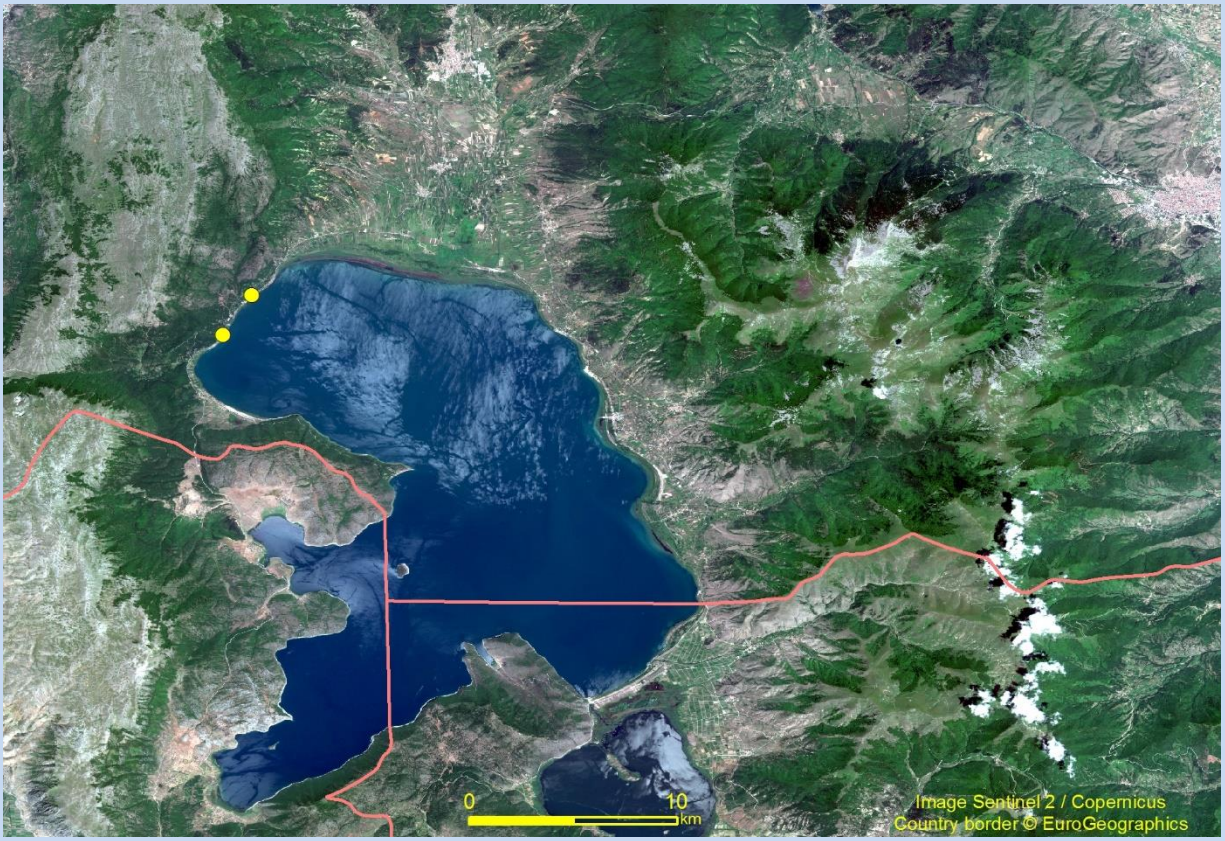

Fig. 106. Observations of *Himantoglossum caprinum*.

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4.4.4. Carpathian Tozzia (*Tozzia carpanthica* Woł.)

Syn.: *Tozzia alpina* subsp. *carpathica* (Woł.) Hayek

Status in Europe		
Habitats directive, Annex IV	Species code:	**6244**
Bern Convention, Annex I		
Protected in many European countries		
List of protected species of North Macedonia		
IUCN global red list	Data deficient (IUCN)	DD
Threat status in Europe		
Threat status in EU		
EU conservation status by biogeographical region		
Alpine	Favourable	FV
Atlantic	Not present	-
Black Sea	Not present	-
Boreal	Not present	-
Continental	Not present	-
Mediterranean	Not present	-
Pannonian	Not present	-
Steppic	Not present	-

Ecology, threats and pressures

Tozzia carpathica is an annual hemiparasite from family *Scrophulariaceae*. It is 15-40 cm high and easiest to observe while during blooming in May-June. The species grows at shorelines of subalpine brooks and streams. In Pelister National Park it is known to occur mainly in the forest zone in Oro-Mediterranean coniferous forests. Soil and microclimate at growing sites are moist and these streams stay flowing throughout the year. Growing sites in Pelister National Park at Rorino river system are semi-shady and accompanying host-species consist mainly of tall herbs that include *Angelica pancicii*, *Geum coccineum*, *Caltha palustris*, *Alchemilla indusiata*, *Chrysosplenium alternifolium*, *Athyrium filix-femina*, *Rumex alpinus*, *Cirsium appendiculatum*, *Veratrum album*, *Geranium sylvaticum* and *Brachythecium rivulare*.

Main threats to this species are forestry and ditching. There is no information on whether the species has strong and abundant populations anywhere in its distribution area, and it is listed threatened in several national Red Lists (Biltz 2011). In Pelister National Park sides of mountain streams are mostly left intact during forestry actions and therefore there are currently no acute human induced threats at the area. Certain populations are below dams at river Sapundžica and its tributaries, increasing the likelihood that these sites dry up at late summer. Climate change can increase aridity threatening Pelister population(s) on a long run.

Management recommendations for the sites of occurrence

Assessment of populations at Pelister National Park should be a priority. All populations should be taken into consideration while planning forestry actions, which should not be allowed in the vicinity of viable populations. Effects of water uptake should be monitored. Management actions those will support populations should also be studied.

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Methods for inventory and monitoring

Main method for the inventory and monitoring of the species is active searching of flowering individuals during growing season. Careful inventories should be done along all rivers and streams at Pelister National Park. Field Inventory Form for vascular plants should be filled for each locality and monitoring should be based on repeated inventories of known sites. Monitoring is needed to be repeated in 5-10 year period.

Fig. 107. The Carpathian Tozzia (*Tozzia carpathica*) is an annual hemiparasite that grows at shorelines of subalpine streams in forest zone. In North Macedonia it has four known localities at Pelister National Park. **a)** flowering individual **b)** Growing site of a small population above Rotino, close to Kopanki-Pali Snopje hiking trail. Photos: Kimmo Syrjänen.

Justifications for the assessment of conservation status

Size of distribution area

Distribution of the species is mainly eastern Carpathian and it grows in Slovakia, Poland, Ukraine and Romania (Dité 2008). It is also known from Balkan mountain range from Bulgaria (Old Plateau, Vitosha, Rila), Serbia, northern Greece (Varnous and Pindos) and North Macedonia (Baba/Pelister). The first record about the presence of the species *Tozzia carpathica* (sub Tozzia alpina) on the territory of North Macedonia (Pelister: Rotino, 1400 m) was cited by Bornmüller (1928). *Tozzia carpathica* is known to grow in North Macedonia only at Pelister National Park (Matevski et al. 2019). There is according to present knowledge altogether five populations, but the real amount is probably somewhat higher. In Pelister National Park it was observed in two localities at Pali Snopje (Borojca and Rotino rivers by twinning project in 2018). It is met also from Caparska river (Čarni & Matevski 2010) and there is earlier information from Nižepole, where it has been observed along Sapundžica and Ezerska rivers (Matevski, 2002-2003). In 2019 there was observed a big population along Stara Buka river. During the phytosocyological investigation on Pelister mountain this species is registered within the association *Doronico austriaci-Cirsetum apendiculatae*, which develops in the belt of the tall herb vegetation along streams from the montane to subalpine zone of Pelister Mt – Capari, from 1270 to1790 m (Čarni & Matevski 2010). The most important plant species that represent part of the association, alliance Cirsion apendiculati, order Adenostyletalia and classis Mulgedio-Aconietea are the following: *Cirsium appendiculatum, Doronicum austriacum, Angelica pancicii, Geranium sylvaticum, Rumex alpinus, Geum coccineum, Athyrium filix femina, Myosotis scorpioides, Cardamine raphanipholia subsp. acris, Mentha spicata* subsp. *spicata*, and others. Until now, this species is not known for other parts of the territory of Republic of North Macedonia.

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Size of population

Actual size of North Macedonian population is not known. Amount of individuals of this annual species probably varies from year to year. Data on present populations show them to be rather small, some tens or at highest about a couple of hundred individuals in each. Estimation of size of the whole Pelister NP population varies from some hundreds to a couple of thousands. Along Stara Buka river the population seems to be viable and at least host several hundreds of individuals in a couple of tens patches.

Quality of habitat for the species

Habitat of the species seems to be rather stable at the moment. Climate warming is probably the biggest thread at long run. Uptake of water and construction of hydroelectric power plants may have had negative effects on habitats of species. However, present populations are mainly at higher levels than these power stations, despite river Sapundžica and its tributaries.

Future prospect

In near future there are no big negative changed to be expected inside Pelister National Park area. At longer time period climate warming will probably affect negatively to occurrences. Climate warming can also enhance negative effects of water uptake. The whole population and subpopulations are small in size that can cause decrease because of demographic and stochastic threats.

Conservation status	
Range (of the distribution area)	FV
Population	U1
Habitat for the species (quality)	FV
Future prospects	U1
Overall assessment of Conservation Status	**U1**

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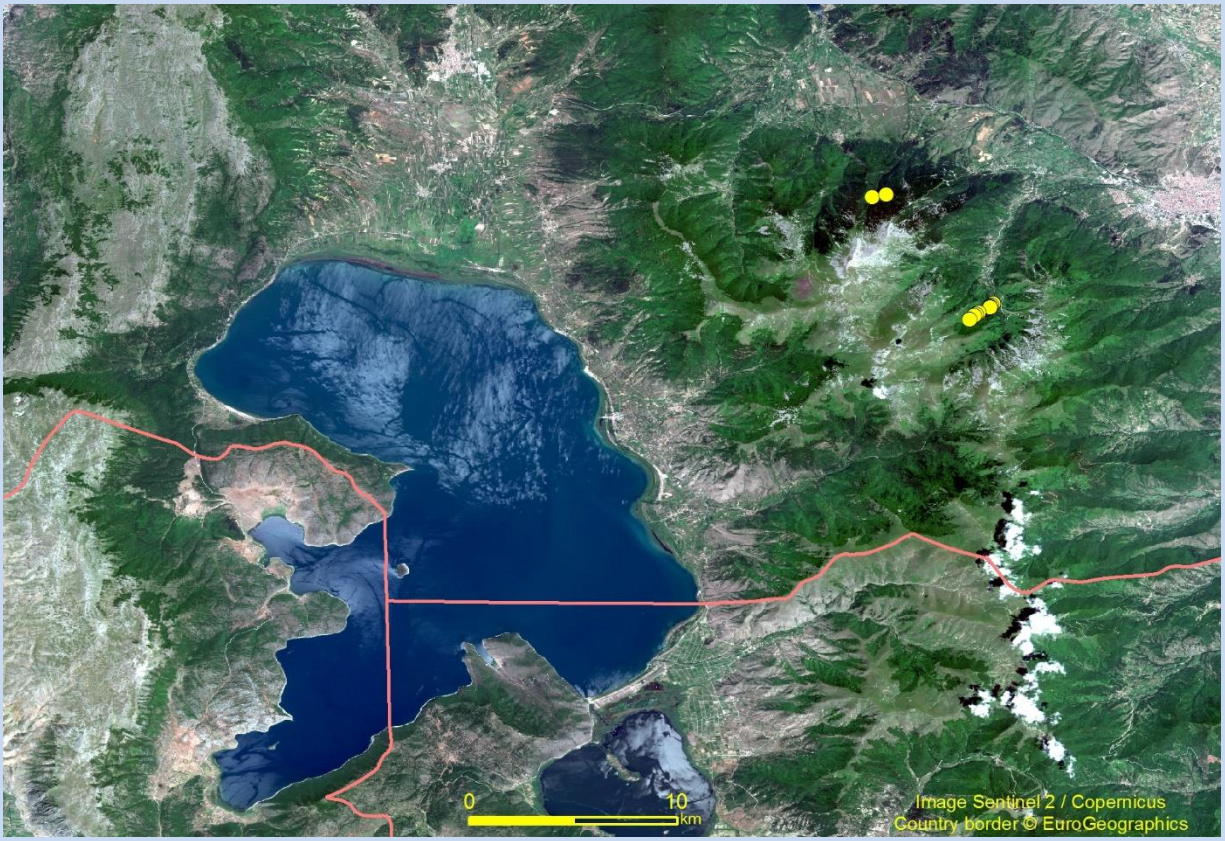

Fig. 108. Observations of *Tozzia carpathica*.

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