GUIDELINES FOR PROPER INTEGRATED NATURE CONSERVATION PLANNING

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Centralparks

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Introduction

This guideline is based on the experience exchange and innovative methods introduced and developed under the WPT2 of the Centralparks Interreg CE1359 project, led by the Danube-Ipoly National Park Directorate. It referes to the Hungarian situation especially in the case of Danube-Ipoly National Park Directorate. The aim of the document is to showcase effective and innovative management tools and methodologies invented and tested within the framework of this project to serve as a guideline for other Carpathian Protected Area managers.

The Centralparks project

The Carpathians are one of the most important European ecoregions. They are one of the European wilderness refuges, where the natural values are threatened by biodiversity loss and increasing human pressure. Traditional nature conservation is lacking to succeed in the protection of these natural values. Such issues cannot be solved by individual countries, therefore transnational cooperation is needed. The Centralparks project aims to build management capacities of Carpathian protected areas for the integration and harmonization of biodiversity protection and local socio-economic development.

One of the specific objectives set up for the project is *"improving integrated environmental management capacities of protected area administrations and other public sector entities dealing with the protection and sustainable use of natural resources"*. Within the project, the Danube-Ipoly National Park Directorate aims to build capacities of Carpathian protected area managers.

Work of WPT2 – Building management capacities for protected area managers

Currently, nature conservation is lacking in human resources and expert capacities, which makes long-term planning of nature conservation difficult. Mostly old-fashioned habitat mapping methods are in the everyday use of protected area managers, which need special expertise and use a large proportion of resources. Nature conservation management planning is lacking effective, integrated, science-based information, therefore the preparation of innovative tools and methods are needed.

To face the main challenge, international cooperation and experience exchange will be built to address and share best practices in biodiversity and site management. As a base of the new approach, innovative site evaluation methodologies were developed and tested within the project. The methodologies and the field implementation experiences will be introduced within this output.

Chapter 1: The base of the nature conservation management planning

In Hungary, the rules for creating nature conservation management plans are contained in the following legislation:

1. Act LIII of 1996 on the Nature conservation (Nature Conservation Act -NCA) on the rules for the preparation and content of a nature conservation management plan. (II. 5.) Environmental- and Water Management Ministry's decree.
2. 16/2012. (VII. 6.) instruction of the Rural Development Ministry

In the case of protected natural areas of national importance, the national park directorates performing nature conservation management tasks are responsible for the preparation of management plans. Conservation management comprises a set of activities involving the monitoring of compliance with the legislation on protected natural areas, the preservation of protected species, and active interventions in the area under the self-management of the national park directorate.

The website of the Deputy State Secretariat for Nature Conservation of the Ministry of Agriculture guides the content requirements of the management plans, the following overview is quoted on this basis:

"According to the NCA nature conservation management plan shall be prepared for each protected natural area in accordance with the provisions of this Regulation, which shall be reviewed at least every 10 years. The nature conservation management plan must also be prepared for the areas subject to the protection procedure because of the PNA. According to the regulation, the nature conservation management plan is a mandatory content element of the legislation declaring it protected.

The rules regarding the preparation and content of nature conservation management plans are laid down in Decree 3/2008 (II. 5.) of the Ministry of Environment and Water. The nature conservation management plan shall be prepared for the protected natural area and the area that was subject to the procedure for declaring it protected based on the above. The nature conservation management plan may also cover a sub-area of a protected natural area. These are summarized below as design areas.

The nature protection management plan, as defined by law, is a document that contains the nature conservation management methods for the protection, maintenance, restoration, and presentation of the protected natural area and its natural values, as well as the restrictions, prohibitions, and other obligations specified for these purposes. The nature conservation management plan is set out in PNA. It shall be published as a law (ministerial decree) in accordance with the provisions of the Act. The provisions of the nature conservation management plan shall be binding in the given protected natural area.

Considering the legal requirements, the Danube-Ipoly National Park Directorate commissioned Ferenc Szmorad, a certified forest engineer, to prepare the management plan.

The overview of the content of the nature conservation management plan:

A) DOCUMENTATION ESTABLISHING THE CONSERVATION MANAGEMENT PLAN

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1.2. The nature conservation purpose of the planning area

1.3. Real estate registration data

1.4. Other requirements in force in the design area

1.4.1. Spatial and settlement planning plans

1.4.2. Tourism development plans

1.4.3. Forest plans

1.4.4. Game management plans

1.4.5. Environmental plans

1.4.6. River basin management plans

1.4.7. Water damage control plans

1.4.8. Other water management plans

1.4.9. Water rights establishment / operation / termination permits

1.4.10. Wiring licenses

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2.1.2. Geomorphological features

2.1.3. Hydrological conditions

2.1.4. Soil properties

2.1.5. Climatic conditions

2.2. Inanimate natural values

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2.2.2. Geomorphological values

2.2.3. Hydrological values

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2.3.2. Vegetation, vegetation cover

2.3.3. Mushrooms (fungia)

2.3.4. Flora

2.3.5. Fauna

2.4. Landscape and cultural history features

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2.4.2. Landscape values of the design area

2.4.3. Cultural-historical values of the design area

2.5. Education, research

2.5.1. Educational, environmental education activities

2.5.2. Research activities

2.6. Management characteristics

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2.6.2. Forestry

2.6.3. Game management

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2.6.5. Tourism, ecotourism

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4.1.7. Land and land use

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4.1.9. Nature conservation infrastructure

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4.2. Detailed handling instructions

4.2.1. Agriculture

4.2.2. Forestry

4.2.3. Game management

4.2.4. Management requirements for water management

4.2.5. Transport handling regulations

4.2.6. Management regulations for construction activities

4.2.7. Management standards for tourism (tourism, holidays, ecotourism, demonstration, education, recreation)

4.2.8. Management standards for industrial and mining activities and line facilities

4.2.9. Municipal management regulations

4.2.10. Management regulations related to landscape and cultural-historical values

4.2.11. Exemptions from restrictions and prohibitions

4.2.12. Table of management regulations for forest-planned areas

4.2.13. Table of management regulations for non-forested areas

C) ANNEXES TO THE DESIGN DOCUMENTATION

5. Map attachments

5.1. Topographic base map of the design area

5.2. Delimitation of sites of European Community importance overlapping the planning area

5.3. Map of forest planning areas in the planning area

5.4. Map of the cultivation branch of the planning area

5.5. Map showing the ownership of the design area

5.6. Habitat map of the planning area

5.7. Maps showing the values of the design area requiring special protection

5.8. Other maps

6. Tables

7. Bibliography

The following is a summary of the elements:

A) DOCUMENTATION ESTABLISHING THE CONSERVATION MANAGEMENT PLAN

1. General information

1.1. Design area identification

The identifier of the Börzsönyi sub-area of the Danube-Ipoly National Park, the time of its promulgation, the legal place, the name, the total area, and the distribution of the areas based on the protection levels, the nature conservation manager, the name of the competent nature conservation authority.

1.2. The nature conservation purpose of the planning area

List of key conservation objectives. Its main value is a large forest block free of internal settlements, which forms the interior of a volcanic mountain range. Within this, forests with a particularly good structure and grasslands with a special composition should be given priority. Among the protected species, the Carpathian mountain elements can be highlighted (e.g. Green shield-moss *(Buxbaumia viridis(*, Rosalia longicorn *(Rosalia alpine)*, Wrinkled bark beetle *(Rhysodes sulcatus)*, White-backed Woodpecker *(Dendrocopos leucotos)*, Red-breasted flycatcher *(Ficedula parva)*, Black stork *(Ciconia nigra)*, Eastern imperial eagle *(Aquila heliaca)*, Eurasian lynx *(Lynx lynx)*).

1.3. Real estate registration data

The Land Registry registers real estate in Hungary with maps with topographical numbers and associated land registers. The entries related to the plots of land, including the protection, are clearly and publicly included. An itemized review of these will filter out any inaccuracies made during the designation of protection, which is why it is a very important element.

1.4. Other requirements in force in the design area

1.4.1. Spatial and settlement planning plans

The developments and land use in the individual settlements are regulated by the local development plans, their review, the discovery of contradictions with the protection goals, their later adjustment is an important official tool for achieving our goals.

1.4.2. Tourism development plans

Tourism is an increasingly important economic sector, but careless developments are among the biggest threats in Hungary, so it is essential to review them and classify them properly.

1.4.3. Forest plans

In Hungary, forest-related activities are regulated by the State Forest Agency in the forest plans prepared by it with the involvement of the managers. These cover a period of 10 years and are being prepared for forest planning areas of approximately 10,000 ha. There are 3 forest planning districts in Börzsöny, the forest plans of which define the river management and contain the nature protection regulations, which, however, are not in a concise, conceptual way, but for the individual forest parts (3-6 ha forest areas with a similar image and requiring management).

1.4.4. Game management plans

The achievement of the nature conservation goals of the Hungarian forest areas is most significantly endangered by irresponsible big game management; too many cloven-footed large games will destroy and damage the seedlings, with wild boars and alien mouflons destroying more sensitive grasslands with their trampling. The examination of plans governing game management is therefore important.

1.4.5. Environmental plans

Environmental protection deals with the protection of the human environment, pollution, prevention, and remediation. The study of the plans gives an idea of the vulnerability of the landscape in this respect.

1.4.6. River basin management, water damage prevention, and other water management plans

Plans containing water regulations are important for the protection of wetlands and streams. There are serious conflicts of interest between flood protection, water management, and nature conservation, but the fauna of small watercourses, although small, is particularly sensitive to infrastructural interventions.

1.4.10. Wiring licenses

Utility and power line network plans.

1.4.11. Building permits

Examination of building permits issued and to be issued in design areas is also an important element.

1.4.12. Mining permits

An overview of possible or potential mining activities in the area, also from a historical perspective. Its significance cannot be overstated either.

2. Description of the condition of the design area

In this chapter, the environmental condition of the design area is described, as an inventory, providing a factual starting point for planning.

2.1. Environmental elements

2.1.1. Geological features

Summary of the geological characteristics of Börzsöny

- surface development of Börzsöny (textual description and attachment of a map appendix showing the events of volcanism)
- description of the current geological structure of Börzsöny (short textual description)
- presentation and a brief description of the main rock types (andesite, andesite tuff, dacite, agglomerates, limestone, gravel, etc.)
- attaching an overview map showing the geological conditions of the area (polygon shape or A4 format, editable in portrait orientation, jpg with appropriate resolution)

2.1.2. Geomorphological features

Summary of the geomorphological characteristics of Börzsöny

- general geomorphological characterization of Börzsöny
- overview map showing the geomorphological conditions of the area (polygon shape or A4 format, editable in portrait orientation, jpg with appropriate resolution)

2.1.3. Hydrological conditions

- general hydrological characterization of the design area
- springs and watercourses of the area (artificial, secondary), water levels
- compilation of an overview map showing the hydrological conditions of the area

2.1.4. Soil properties

- general soil characteristics of the design area
- characterization of the main soil type groups and the most important soil types
- framework soils, rocky soils, brown forest soils, swamp, and floodplain forests
- overview map showing the soil conditions of the area

2.1.5. Climatic conditions

- the general climatic characteristics of the planning area
- overview map reflecting the climatic conditions of the area (reflecting the pattern of climate-zonal forests)

2.2. Inanimate natural values

2.2.1. Geological values

Presentation and summary of the special geological and petrological values of Börzsöny:

- only the discussion of the characteristic/special formations or the geological base sections (if any) (there are no Börzsöny items in the available register of the protected geological base sections, but this has yet to be checked)!
- short textual description, evaluation
- itemized list (developed in a separate table: publicity_of_funds.xls)
- digital map representation of occurrences (point shp, with OBJECT_ID and NAME in the attribute table)

2.2.2. Geomorphological values

Presentation and summary of the special (surface) geomorphological formations of Börzsöny:

- only mention objects of special significance that require special protection!
- short textual description, evaluation
- itemized list (developed in a separate table: public_geomorphology.xls)
- digital map representation of occurrences (point shp, with OBJECT_ID and NAME in the attribute table)

Presentation and summary of the natural cavities (caves) of Börzsöny:

- a full description of the caves that occur
- short textual description, evaluation
- itemized list (developed in a separate table: public_caves.xls)
- digital map representation of occurrences (point shp, with OBJECT_ID and NAME in the attribute table)

2.2.3. Hydrological values

Presentation of the major sources, watercourses, and water levels of Börzsöny:

- short textual description, evaluation
- itemized list (sources - for completeness, in separate xls)
- itemized list (streams - only major watercourses, in separate xls)
- itemized list (small forest water levels - for completeness, in separate xls)
- itemized list (artificial lakes - for completeness, in separate xls)
- digital map representation of occurrences (point, line, or polygon shp, with OBJECT_ID and name in the attribute table)

2.3. Biological characteristics

2.3.1. General biogeographical characterization

- a summary of the main phytosanitary and zootechnical characteristics of the planning area

2.3.2. Vegetation, vegetation cover

- an overview of the vegetation of the planning area, which together with the habitat map gives an idea of the vegetation conditions of the mountains.
- List of major species associated with them.
- Detection of occurring habitat categories and Natura2000 marker habitats with area data.
- Characteristic description of each habitat, compilation of risk factors, and description of nature conservation treatments.

2.3.3. Mushrooms (fungia)

The mushroom world of Börzsöny is presented by a short, concise description of the taxonomic groups of protected species, by compiling a list of protected species supplemented with nature conservation indicators, and by highlighting and evaluating species of national or regional nature conservation significance (there is no presence of strictly protected, Community importance large mushroom and moss species).

2.3.4. Flora

Like the fungal world, the flora of Börzsöny is characterized by a short, concise description of the taxonomic groups of protected and/or species of Community importance, the compilation of a list of protected and/or species of Community importance supplemented with nature conservation indicators, and species of national or regional nature conservation importance must be highlighted and evaluated.

2.3.5. Fauna

The fauna of Börzsöny, like that of fungi and flora, is characterized by a short, concise description of the taxonomic groups of protected and/or species of Community importance, the compilation of a list of protected and/or species of Community importance supplemented by national and regional conservation indicators. The most important species must be characterized and evaluated.

2.4. Landscape and cultural history

2.4.1. Landscape history of the design area

The chapter presents the landscape historical features of Börzsöny. The development of the current landscape cannot be independent of the thousands of years of human presence. The Bronze Age earthworks in the interior of the mountains are a good example of this.

2.4.2. Landscape values of the design area

Inventory of landscape values.

2.4.3. Cultural-historical values of the design area

Cultural and historical monuments in settlements and forests (e.g. churches, settlements, huts, crosses).

2.5. Education and research

2.5.1. Educational, environmental education activities

List of organizations and locations in the planning area, mainly environmental education, the buildings of the National Park Directorate (Lynx House, Királyrét), presentation of the most relevant environmental educational programs there.

2.5.2. Research activities

Presentation of research activities in the field of design.

2.6. Management characteristics

The management characteristics of the planning area are largely determined by the high forest cover and the proportion of forest cultivated areas well above 90%. In addition to the predominant forestry at the regional level, agricultural activity plays only a very subordinate role, arable land, meadows, pastures, vineyards, gardens, and orchards together do not reach 5%, and their utilization is possible. No management activity is taking place. The significance of the small number and small size of water bodies (streams, artificial lakes) regarding fishing is negligible, but much more significant fishing waters are available on a regional scale (Danube, Ipoly, Lake Diósjenő). In contrast, the utilization of large game stocks has a much higher economic/farming weight, and wildlife hunting (despite all its projected problems) is one of the most important sectors related to the closed forest block. At the

regional level, tourism is also more important, with its service facilities. In addition to the "bases" of the mountain settlements, service facilities are also located in many places on the mountains (e.g. Nagyirtáspuszta, Nagy-Hideg-hegy, Királyháza). There is no industrial activity within the design area, and today mining activity takes place only on one site, on an ad-hoc basis. The infrastructure of the region is largely provided by the public utility network connected to the settlements on the outskirts of the mountains and the inner recreation areas. The number of facilities serving specifically tourism purposes is not significant. From the point of view of the preservation of the natural values of the planning area, the weight and significance of the individual sectors are different, taking into account the magnitude of the negative effects and problems. The order of forestry, tourism, game management, and agriculture can be determined here. Among the non-classical economic/management activities, the maintenance of infrastructure and the various water management activities can also be added to this order.

More detailed descriptions shall be provided for the following sectors:
2.6.1. Agriculture
2.6.2. Forestry
2.6.3. Game management
2.6.4. Fishing, angling
2.6.5. Tourism, ecotourism
2.6.6. Industry, mining
2.6.7. Infrastructure, line facilities
2.6.8. Other activities relevant to conservation management

3. Defining Conservation Management Objectives

3.1. Natural values, areas, landscapes

- Objective group (1): to maintain the level of protection of natural values, natural areas, and landscapes
- Objective group (2): preservation and/or improvement and restoration of the favorable natural condition

3.2. Activities related to the design area

- conservation management objectives related to long-term use and recovery in line with nature conservation interests
- topics to be covered: farming, other land use, demonstration, education, research, etc.

B) DETAILED CONSERVATION MANAGEMENT PLAN

4. Conservation strategies and detailed management regulations

4.1. Conservation strategies

the wording in line with the objectives

grouping and structuring of strategies: non-intervention, minor intervention, active treatment, recovery, resettlement, resettlement, temporal and spatial constraints, regulations, etc.

All of these are broken down into the following components:

4.1.1. Protection of geological and topographical natural values and caves
4.1.2. Habitat management, maintenance
4.1.3. Protection of species
4.1.4. Visit
4.1.5. Education and presentation
4.1.6. Research, investigations
4.1.7. Land and land use
4.1.8. Landscape and cultural-historical values
4.1.9. Nature conservation infrastructure
4.1.10. Property relations, property policy

4.2. Detailed handling instructions
List of management standards for each sector required to achieve conservation objectives.
4.2.1. Agriculture
4.2.2. Forestry
4.2.3. Game management
4.2.4. Management requirements for water management
4.2.5. Transport handling regulations
4.2.6. Management regulations for construction activities
4.2.7. Management standards for tourism (tourism, holidays, ecotourism, demonstration, education, recreation)
4.2.8. Management standards for industrial and mining activities and line facilities
4.2.9. Municipal management regulations
4.2.10. Management regulations related to landscape and cultural-historical values
4.2.11. Exemptions from restrictions and prohibitions
4.2.12. Table of management regulations for forest-planned areas
4.2.13. Table of management regulations for non-forested areas

Literature:
Ferenc Szmorad - The Börzsöny Mountains of the Danube – Ipoly National Park 16/2012. (VII. 6.) Nature conservation management plan prepared in accordance with the instructions of the Ministry of Environment
https://termeszetvedelem.hu/termeszetvedelmi-kezelesi-tervek-cel-es-rendeltetes/

Chapter 2: The utilization of the LiDAR laser scanning method

2.1. The methodology of the LiDAR laser scanning

The LiDAR survey is included in the 3D scanning procedures, sensory remote sensing technologies. In our case, the survey is a distance measurement through laser rays from a plane, to the direction of the Earth-Centerpoint and surface modeling from the generated point cloud. With the current instruments (e.g. Leica) we are collecting the part-reflection of the discharged pulse, so we have the information from the absolute route of the given bunch. The different part-reflections from the given bunch can be aggregated separately: the first (canopy level), the lowest (ground level), and the reflections in between. The method's specialty is that the reflection from the different heights can be aggregated, filtered. That is why we can prepare a surface model (from the closest points – DSM) and a digital relief model (from filtering the furthest reflections – DEM) from just one measurement. Between the two extremities, the reflections, coming from the different heights, could give a picture, e.g. in the case of a forest, from the diversity within the stand (e.g. presence /absence of the middle layer or its patchiness, mapping the closed clearings).

The Danube-Ipoly National Park Directorate (DINPD) ordered remote sensing data (LiDAR, orthophotography, and hyperspectral imagery) at the end of 2020.

Our strategic, long term goals can be summarized as follows:

1. Determination of the following abiotic patterns and processes:

a) getting a detailed digital terrain model (DTM), searching for:

- special habitat types (e.g. rock towers)
- archaeological artifacts (e.g. tells and bronze age fortifications, mining holes)
- getting information about historical land use (e.g. timber transportation on water and tracks)
- getting information about the impacts of recent forestry infrastructure (most importantly: erosion, fragmentation caused by forestry activity)

b) flood modeling on the Ipoly valley test site

2. Biological information gathering

a) signs of and information about historical disturbances from the distribution of eroded pit and mound complexes

b) tree height map derived from the DTM (DTM - last returning signal) and the digital surface model (DSM – first returning signal)

c) vertical structure of stands

d) canopy closure, gap mapping

e) laying deadwood mapping

f) ecological analysis of biotic information (point data of animals and plants) and LiDAR data, try to build prediction models

g) aiming to map patches with high structural diversity

h) aiming to map invasive species based on the hyperspectral imagery

3. Networking

a) sharing data and information with fellow research and managing organizations

Many components of this data hardly lost their information value (primarily: DTM), many components are changing on the midterm (5-10 years, e.g. DSM, orthographic imagery), and there are components which are changing quickly (hyperspectral imagery – the invasive species spread rapidly).

Literature:

C.; Stadler, J.; Müller, J.; Förster, B.; A. Göttlein, A és Brandl, R. (2010) – LiDAR as a rapid tool to predict forest habitat types in Natura 2000 networks. Biodivers. Conserv.

Belényesi M.; Burai P.; Czimber K.; Király G.;Kristóf D. (szerk.) és Tanács E. (2013a) – Távérzékelési adatok és módszerek erdőtérképezési célú felhasználása megvalósíthatósági tanulmány. An Augur Kft., Bp.

Belényesi M.; Burai P.; Czimber K.; Király G.;Kristóf D. (szerk.) és Tanács E. (2013b) – Távérzékelési adatok és módszerek erdőtérképezési célú felhasználása –Esettanulmányok és ajánlások An Augur Kft., Bp.

Müller, J. és Brandl, R. (2009) – Assessing biodiversity by remote sensing in mountainous terrain: The potential of lidar to predict forest beetle assemblages. J. Appl. Ecol.

Simonson, W. D.; Allen, H. D. és Coomes, D. A. (2014) – Application of airborne lidar for the assessment of animal species diversity. Methods in Ecology and Evolution

Tews, J.; Brose, U.; Grimm, V.; Tielborger, K.; Wichmann, M.C.; Schwager, M.; és Jeltsch, F. (2004) – Animal species diversity driven by habitat heterogeneity/diversity: the importance of keystone structures. Journal of Biogeography

Van Leeuwen M., és Nieuwenhuis M. (2010) – Retrieval of forest structural parameters using LiDAR remote sensing. Eur J For Res.

Further readings: https://www.interreg-central.eu/Content.Node/Centralparks/D.T2.1.1-Report-of-the-workshop-about-LiDAR-and-forest-state.pdf

2.2. The results of the pilot action LiDAR

2.2.1 Abiotic patterns and processes

Special habitat types (e.g. rock towers)

Rock towers and sudden fractures in the terrain create special habitats for mosses, ferns, and provide nesting and hiding places for birds (ravens, peregrine falcon), and mammals (Eurasian lynx, European wildcat). Therefore, the detailed knowledge of this habitat type can promote the effective protection of these taxa. The below map is an example of the High Börzsöny, where is a characteristic habitat type.

Further use of the data could be in nest mapping, evaluating the mapped towers.

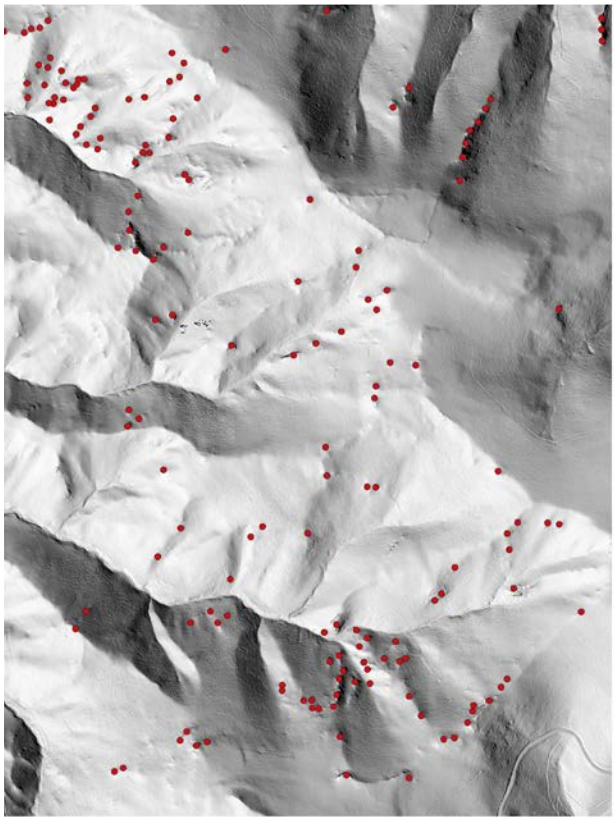


Figure 1: Rock towers in the High Börzsöny

Archaeological artifacts, e.g. tell and bronze age fortifications, mining holes

Elements of cultural heritage found in the countryside are protected value in Hungary, therefore the national park directorates are responsible for their intact state (along with the National Museum, and local museums). Mapping and understanding these are important tasks, and the DTM provided by the LiDAR survey provides an excellent base for that.

The current maps of fortifications made by the national park's ranger service are corrected in many sites. It can be also used for networking with museums and research centers.

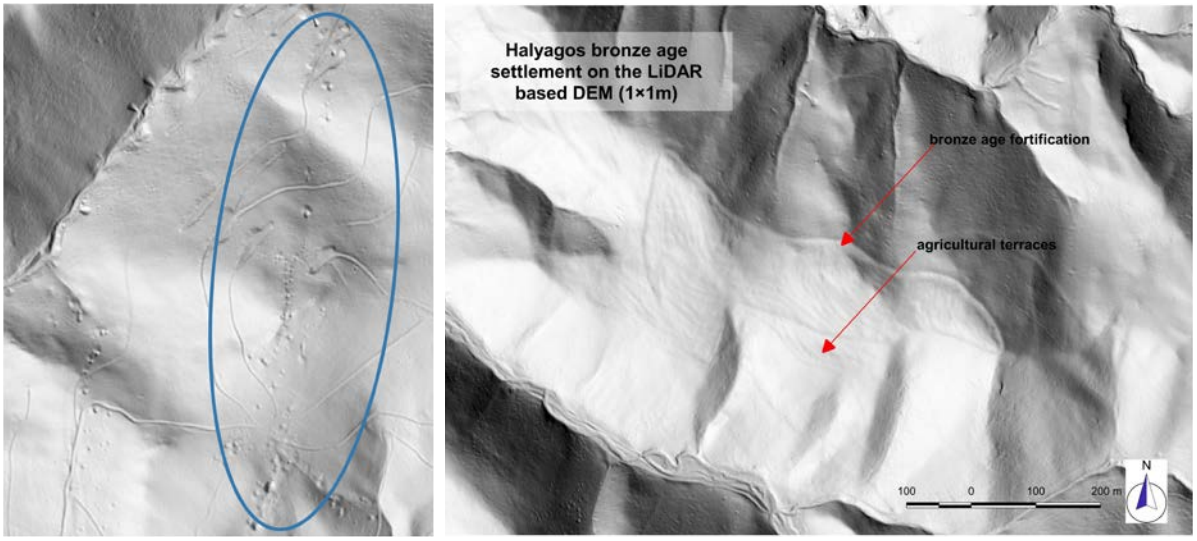


Figure 2: R: Ancient mining holes in the Nagybörzsöny area. L: Bronze age settlement and fortification of Halyagos

Historical land use (timber transportation on water and tracks)

In Europe, the history of land use usually dates back to the Neolithic. The most significant changes are made however in the last few centuries when forest and timber were used for producing wood ash (for glass making), charcoal, fuelwood and later industrial timber, clear-cutting large areas. The skinning of the wood and the products were conducted earlier on chariots, later on, railways. We have historical maps of railway systems from the 19th century and the LiDAR data can help to specify the traces.

Usually, the substructure can be found, but many times it is reused as forest roads, therefore it is covered, and more detailed DTMs are required, which can be done from the LiDAR point clouds. As a result, more detailed DTM is required, and the base maps should be georeferenced.

The impacts of recent forestry infrastructure (most importantly: erosion, fragmentation caused by forestry activity)

Erosion and fragmentation are the two most detectable signs of forestry activities on LiDAR-based DTMs. The forestry road network in the Börzsöny Mountains is relatively sparse, although there are some cases, where further actions have to be carried out. The erosion caused by the local skidding can be very substantial. The evidence provided by the DTM is crucial to estimate the extent of this damage. The only problem is to isolate the fresh and decades-old signs of the erosion marks, which can be evaluated on-site.

Further analysis can be carried out by continuous mapping and evaluation, comparison of the DTM and the field experiences.

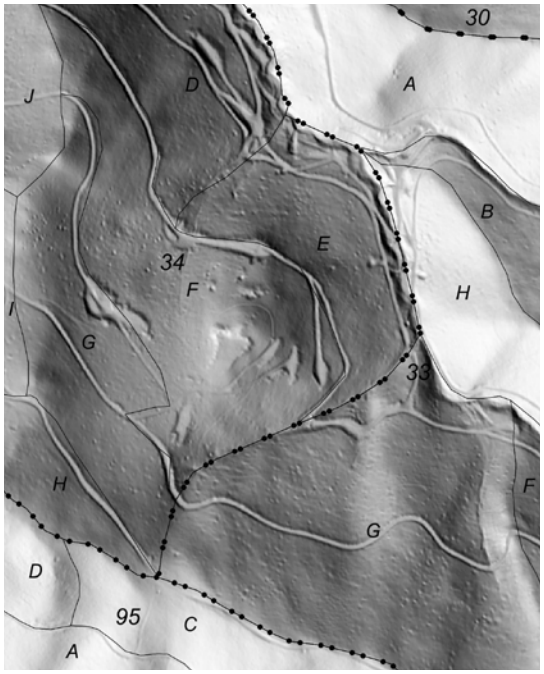


Figure 3: Erosion caused by skidding in the Királyháza area

Flood modeling on the Ipoly valley test site

Large areas of the Ipoly Valley are managed by the DINPD. The Ipoly is a medium-small river carving a unique valley, surrounded by hills and mountains. This valley is mostly narrow, but in a few areas it widens, and floodplains are created. These carry a large variety of wetland flora and fauna. The key factor to protect this system is flooding. River regulations carried out in the past centuries cut out most of the wetlands, and the revitalization (planned flooding through canals) needs careful planning. Flood modeling requires fine detailed DTM data.

Further activities with the results could be networking with the state water agency, further lowland areas will be mapped with LiDAR.

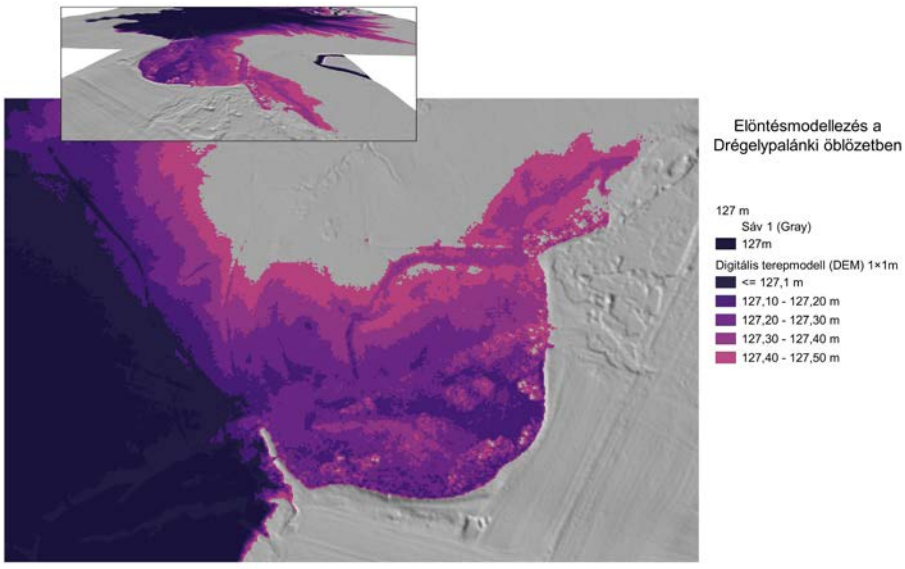


Figure 4: Flood modeling on a small „side-basin". The vertical resolution is 10cm. The deeper and higher ground can be easily identified, therefore the ideal direction of the flooding is readable

2.2.2. Biological information gathering

Signs of and information about historical disturbances from the distribution of eroded pit and mound complexes

The Börzsöny Mountains were struck in the last 30 years by large-scale abiotic disturbances (1996, 1999, 2001, 2014), and it is a recurring question if it has any historical antecedents. The fine resolution DTM can be used to map historical pit and mound complexes. This micro topography, caused by uprooting can be found even after 100 years. For this purpose, finer resolution DTMs have to be built, to reliably identify the eroded pit and mound complexes.

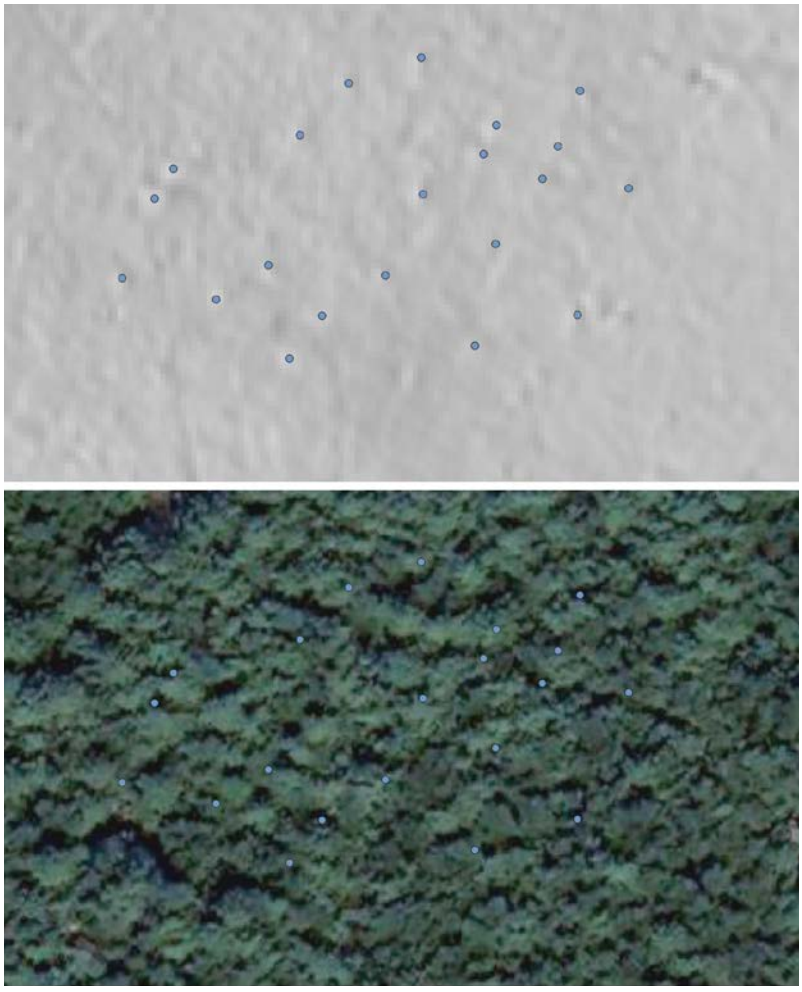


Figure 5: Pit and mound complexes identified on the DTM, on a known historical disturbance site

Tree height map derived from the DTM (last returning signal) and the digital surface model (DSM – first returning signal)

Tree height gives primary information about the quality of the stand, e.g. lower-height oak stands, with deteriorating health, are very important for many protected Buprestidae species. The height (evaluated together with the stand age) carries information about the timber value, and we can point out areas more unsuitable for forestry activities. Models have to be built to automate the mapping process.

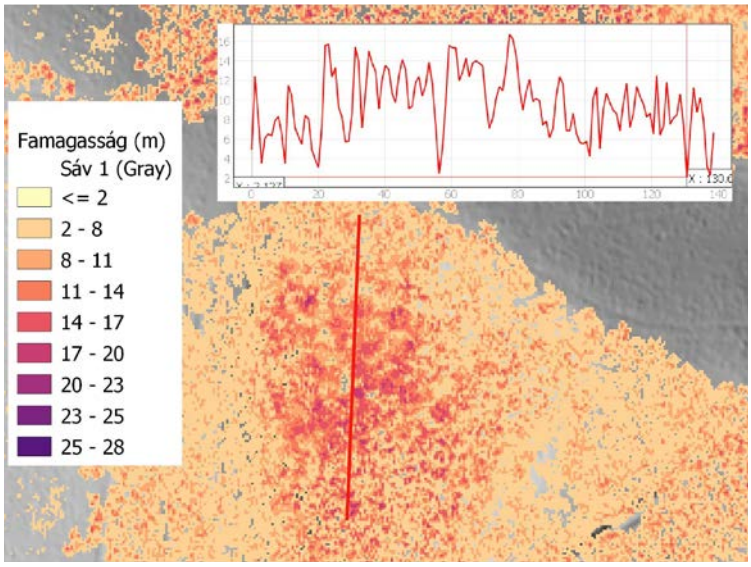


Figure 6: Tree height model and profile on a southern slope

Vertical structure of stands

Current LiDAR data can be used to evaluate the in-stand structural richness, based on the number of the in-stand reflections. However, it is a very current, upcoming topic with many difficult questions to answer. We get a reflection-density (numbers of reflections between the first and the last reflection) map, but the resolution is too fine to evaluate stand-scale patterns.

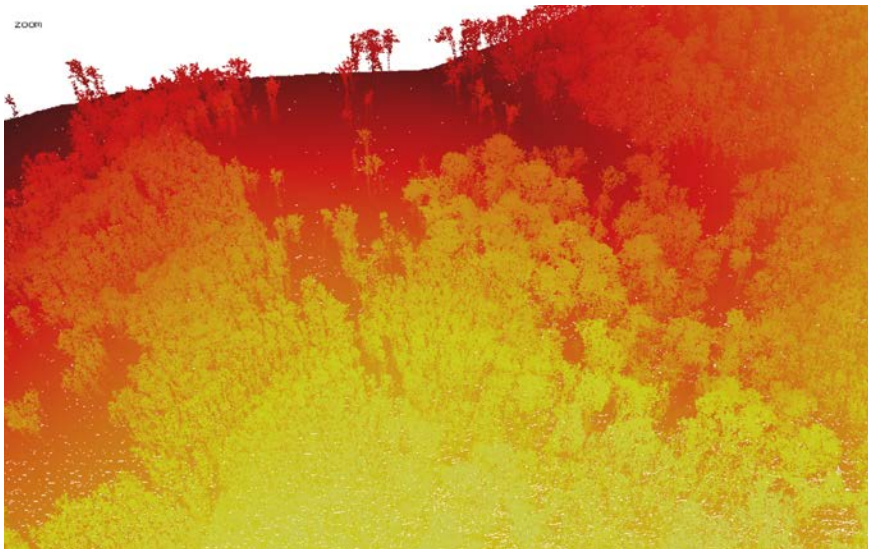


Figure 7: LiDAR point cloud

Canopy closure, gap mapping

Canopy closure can be easily estimated to certain areas from LiDAR data. A minimal height needs to be selected, and the remaining reflection cloud gives the canopy cover percentage.

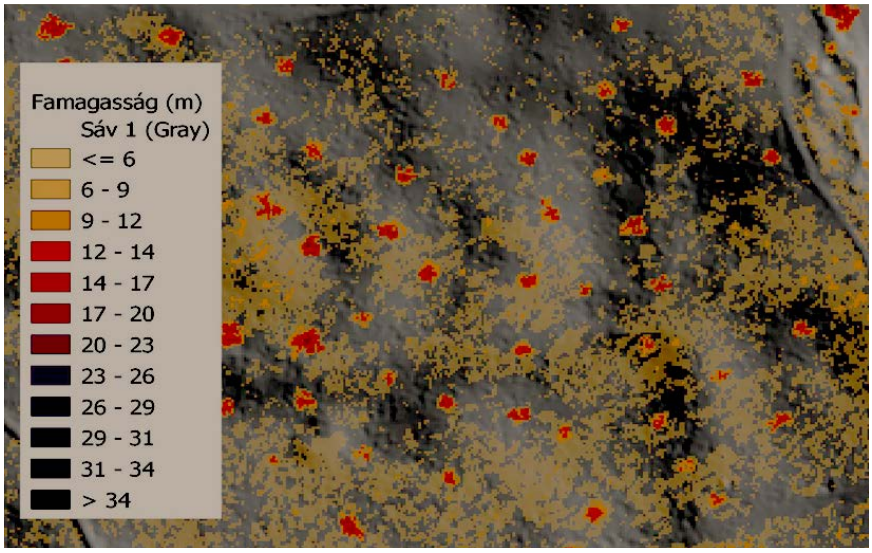


Figure 8: Tree height and canopy closure on a clear cut area, with the remaining trees

Networking

LiDAR data covering large areas is not unique, but neither widespread in Hungary, but the basic understanding and its utilization is spreading. If someone is in possession of good quality LiDAR data covering relatively large areas, the interests of professionals from further additional areas are growing. We are already connected with museums, the archaeological research group of the Pécsi University of Sciences and the forest ecological group of the Eötvös Loránd University.

Data sharing and joint research can be very useful and productive.

Further readings: https://www.interreg-central.eu/Content.Node/Centralparks/D.T2.2.1-Pilot-Action-LiDAR.pdf

Chapter 3: Habitat mapping

3.1. The methodology of habitat mapping

The methodology for habitat mapping within the Hungarian vegetation botanical and nature conservation practice evolved in the 1990s, based on vegetation mapping. The overgrown numbers of vegetation categories did not enable the practical use for nature conservation purposes, and they were not able to serve as a base for proper treatment planning. The first General Hungarian Habitat Categorization System (Általános Nemzeti Élőhelyosztályozási Rendszer – Á-NÉR) was published in 1997. There have been several updates so far. The actual category system was prepared in 2011 and includes every single habitat type occurring in Hungary. The Danube-Ipoly National Park Directorate has prepared 90 habitat maps since its establishment in 1997 in its administration area.

Further important supplementary information was surveyed during the implementation period (15th of April and 30th of September):

- the presence of protected and rare plant species;
- the potential habitat type;
- the threats and risks;
- any treatment/management proposal.

The potential vegetation could determine the end goal of nature conservation management.

The collected data allows the National Park Directorates to fulfill their obligations to display Natura 2000 marker habitats during the forest management planning. These data also simplify the nature conservation management planning itself: the surveyor will see how many areas are available from the exact habitat types, the distribution of the high nature conservation value habitats, and pictures of the general threat of the area.

Further readings: https://www.interreg-central.eu/Content.Node/Centralparks/D.T2.1.5-Habitat-Mapping-Guidelines.pdf

3.2. The results of the habitat mapping for Börzsöny Mountains

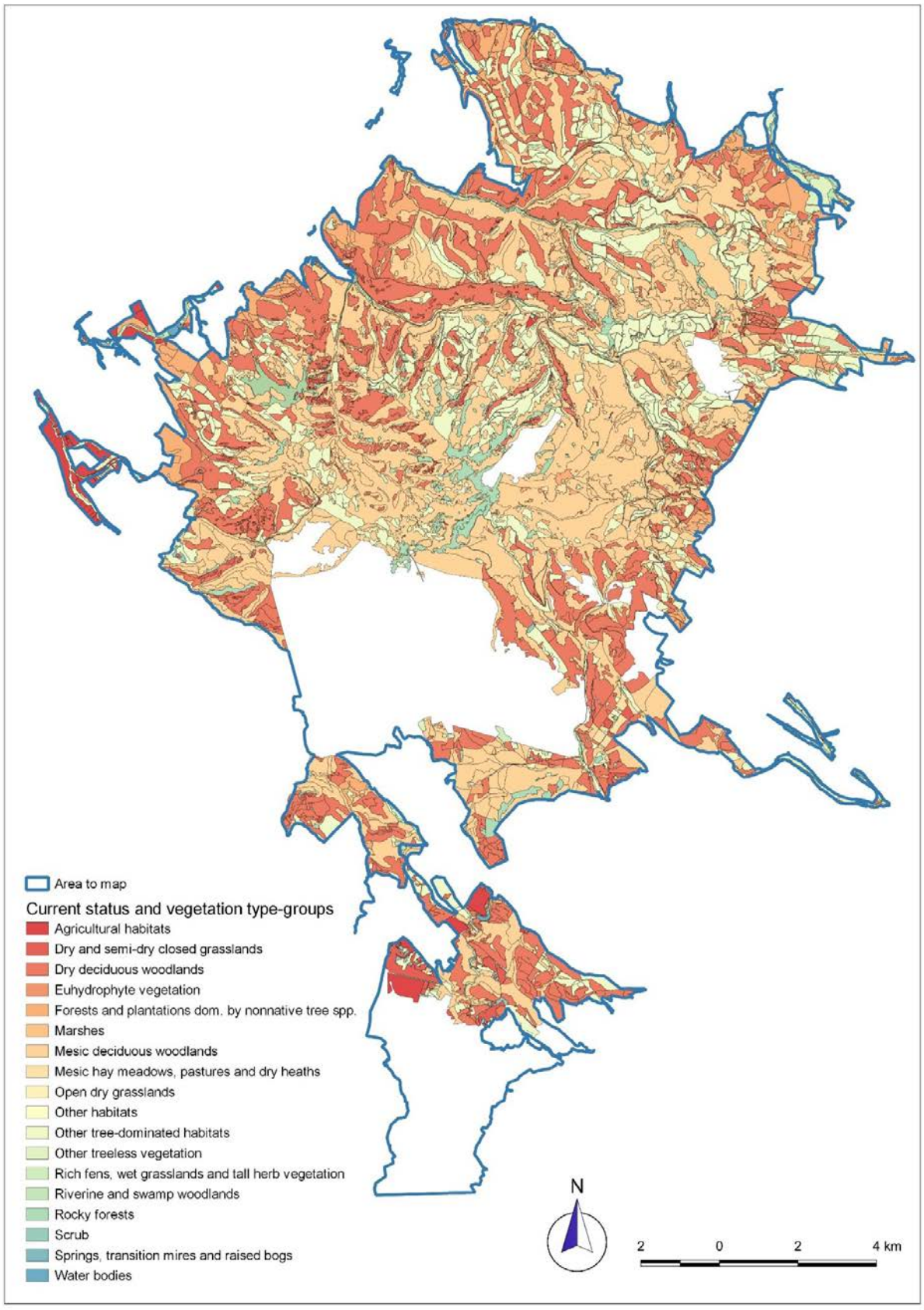
The Danube-Ipoly National Park Directorate carried out the habitat mapping for 30.000 ha within the framework of the Interreg CE1359 Centralparks project. For an area of 24.880,4 ha, an external expert was contracted.

Table 1: Distribution of the habitat categories

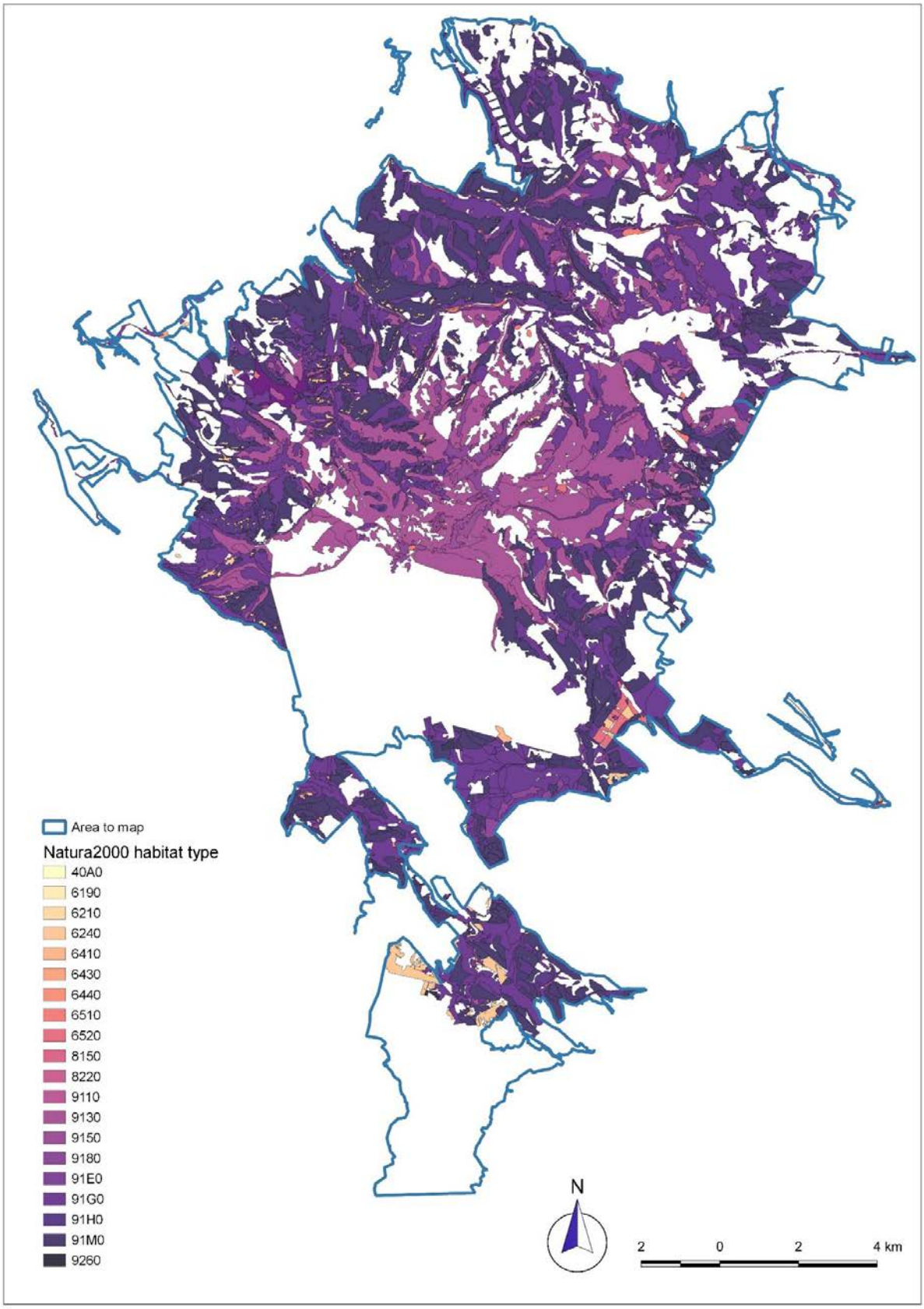
Group	Area (ha)	Rate (%)	Unit
Springs, transition mires and raised bogs	0,1	0,00	1
Marshes	5,2	0,03	2
Euhydrophyte vegetation	0,2	0,00	3
Rich fens, wet grasslands and tall herb vegetation	14,9	0,07	4
Mesic hay meadows, pastures and dry heaths	115,6	0,57	5
Dry and semi-dry closed grasslands	236,2	1,17	6
Open dry grasslands	4,4	0,02	7
Scrub	52,0	0,26	7
Other tree-dominated habitats	3391,1	16,85	8
Riverine and swamp woodlands	217,1	1,08	9
Mesic deciduous woodlands	8708,9	43,28	10
Dry deciduous woodlands	4986,2	24,78	11
Rocky forests	524,8	2,61	12
Other habitats	165,8	0,82	13
Other treeless vegetation	277,9	1,38	14
Forests and plantations dominated by non-native tree species	1126,7	5,60	15
Agricultural habitats	278,8	1,39	16
Water bodies	15,1	0,07	17

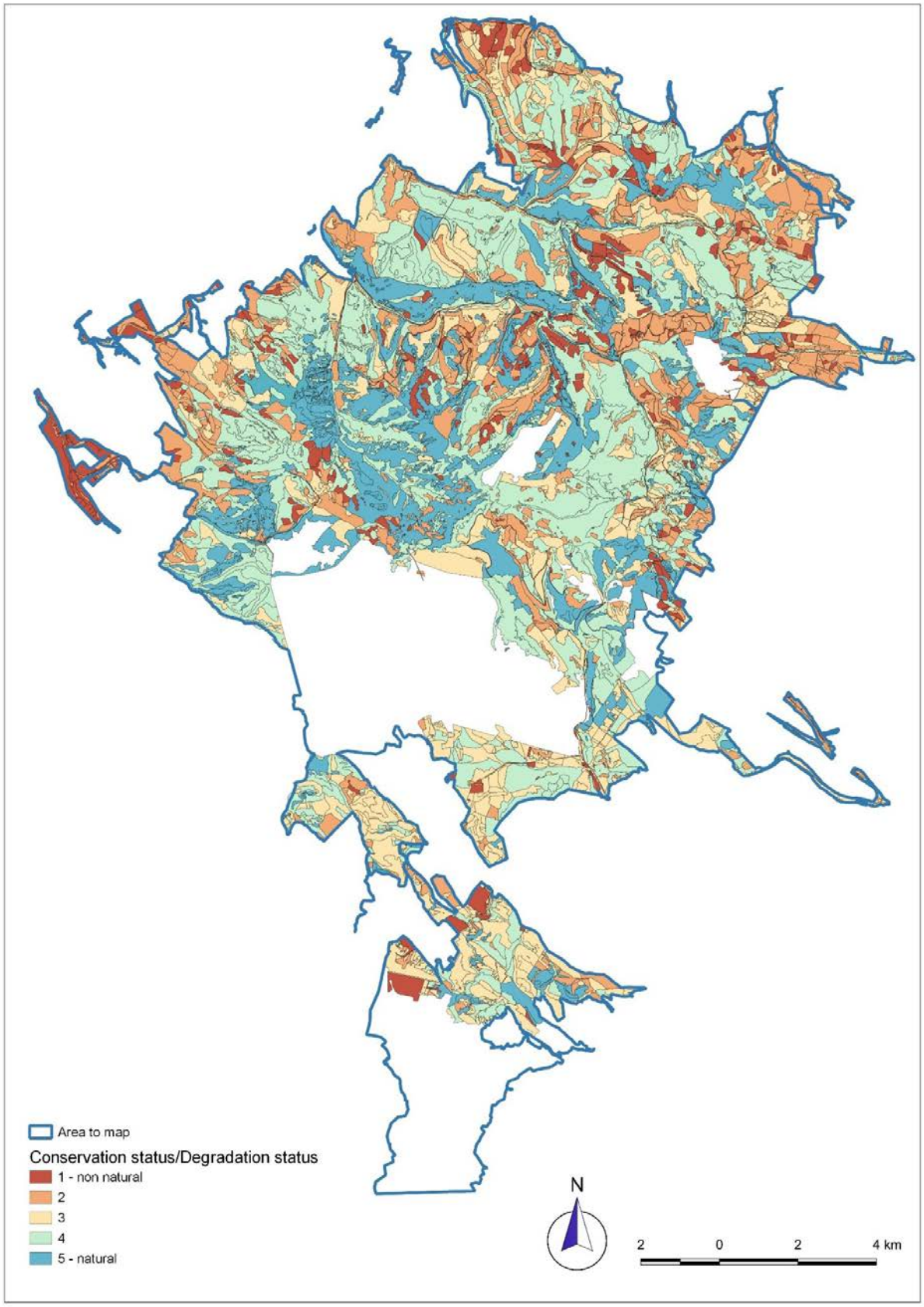
Table 2: Distribution of the naturalness state scale (1: very bad; 5: in a very good naturalness state)

Naturalness value	Area (ha)	Rate (%)
1	1384,141	6,88
2	3798,953	18,88
3	4126,415	20,51
4	7121,14	35,39
5	3696,007	18,37



Map 1-2-3: habitat types, Natura 2000 habitat types, and nature conservation status of the Börzsöny Mountains


Area to map
Natura2000 habitat type
40A0
6190
6210
6240
6410
6430
6440
6510
6520
8150
8220
9110
9130
9150
9180
91E0
91G0
91H0
91M0
9260
N
2
0
2
4 km



Further readings:

https://www.interreg-central.eu/Content.Node/Centralparks/D.T2.2.2-Habitat-Mapping-of-Boerzsoeny-Mountains.pdf

Chapter 4: Forest state evaluation

4.1. The forest state evaluation protocol

The new methodology followed the structure of the systematic forest state assessment methodology, developed within the SH4/13 project (http://karpatierdeink.hu/eng/1-feladatcsomag)

The general objectives included several projection tasks:

i. The monitoring of the process to convert envisaged forest management into continuous forest-covered management.
ii. The examination of the effects of cutting on forests, how the forest state characteristics depend on management.
iii. The examination of the effects on the framework of nature conservation purposed forest management activities and treatments and how they affect the forest biome, as well as the monitoring of how the forest state characteristics depend on these treatments.

Within the SH-4/13 project, only the initial phase could be implemented, due to the limited time frame.

The steps of the database's establishment:

1. The data of the selected package's (forest block) plot from the previous project database are retrieved: identification and nomination of the pictures, averaged positioning of the plot, the start of the plot recording, altitude of the plot.
2. For every picture taken to the plot (except the upward-facing picture 5-5 picture/plot), separate records are generated and are optimized to the recognition in the SMASH application. The picture is moved towards the compass direction, for example, the pictures taken from the North are moved in a northern direction.
3. The preparation of the pictures and stamp pictures is controlled, the pictures are individually identified to assure there is no duplication of the information.
4. An empty Geopaparazzi/SMASH project database got its field package name with the use of the recorded information mentioned above, the pictures, stamp-pictures, image notes, and the recognition information (position, altitude, date and time, name of the plot, direction of the picture taken) uploaded to the database.
5. The generation of project databases is happening through python scripts and SQL retrievals and commands.
6. The prepared project database could be used after copying and associating it to the smartphones (SMASH/ project folder). Copying is manual so far, but the Geopaparazzi Server could allow the import of the project to the the application.

For these reasons, the monitoring methodology has the following essential features:

- It is not based on the time series of the exact points
- the base unit of the changes in the forest unit
- the point-based evaluation clarifies and supplements the forest unit scaled comparisons in the case of precise localization.

The selection of concrete sampling areas happens following the criteria:

- tree utilization types (TI- purification, TKGY – selection thinning, NFGY – increment thinning, FVB – regeneration cutting's preparatory cut, FVV regeneration cutting's final cut- the years in the period from the first intervention, TRV, - clear-cutting, SZV -selection cutting, KGH – stock-care utilization, HGY-production thinning, EÜ – sanctuary cutting, ET – other production)
- natural disturbance interventions (abiotic, biotic)
- forestry interventions (shrub elimination, soil preparation, tree replacement, and care)
- nature conservation treatment
- in case of a renewal, the presence or absence of game control fences (no/evidence)
- effect of forestry manager (KRT, NM, DJ, KE, private)
- the years in the period from the first intervention
- control
- tree stand type (B- beech, GYT-hornbeam-oak forest, CS -Turkey oak)
- age (young, middle-aged, old)
- size of the forestry unit

The number of variables mentioned above in square brackets leads to the conclusion that the examination of all of the realistic combinations of the variables could have required a large number of sampling areas within the forest unit.

The exact number of sampling plots also depends on the planned frequency of samplings within the forest unit. The SH-4/13 project's protocol allows with 1, 2, or 4 points in one ha. The planned 3.000 points redesign took part between 3.000 and 750 ha.

Suggestions to the selection of sampling forestry units (or well-defined unit parts):

1. The sampling should focus on the prior tree utilization (TI - purification, KGY – selection thinning, NFGY – increment thinning, KGH- stock-care utilization) and selection cutting. The classic cutting utilization of the final harvest should be underrepresented.
2. The sampling should take the forestry manager's layer.
3. The sampling should include not-treated control areas, including ice breaking and not ice-breaking parts, with the main age groups.
4. The sampling should be limited to the main 3 tree stand types (B- beech, GYT-hornbeam-oak forest, CS -Turkey oak).
5. The sampling should not focus generally on forestry interventions. If there is information on the intervention, then a 1-1 targeted examination should plan later.
6. The sampling should not focus on the presence/absence of the fences.
7. The number of years in the period from the first intervention shall not be taken into account from 2021, shall focus on the intervention implemented in 2019. That is how we can limit the chance of the review of a forestry plan.

Further reading: https://www.interreg-central.eu/Content.Node/Centralparks/D.T2.1.2-Forest-state-evaluation-protocol.pdf

4.2. The field implementation of forest state evaluation

Data from 118 forest plots and 4.070 sampling plots surveyed in 2021 allow for a versatile analysis. This report addresses the following issues:

- the proportion and spatial pattern of the planned wood use;
- how the composition of the tree species changes, the fate of the mixed tree species;
- how the variability of the diameter distribution develops;
- whether dead wood associated with wood uses has been removed;
- how intense the traces of wood use work are on the site and the remaining trees.

4.2.1. Intensity and spatiality of wood use implementation

When using the monitoring protocol, surveyors should record whether there is a trace of fresh wood use in the plot / immediate area. Out of a total of 4070 plots, 3554 fell into forest areas, in 2019-2020 wood was used. Of these, we found clear traces of wood used in 2227 cases (62.6%). Given the intensive sampling (4 plots/ha, 20% coverage), this means that in many cases wood uses only affected certain sub-areas of forest areas. This is understandable and even expected in the case of fiber cutting, so we would traditionally expect a uniform spatial coverage in the case of pre-uses of the cutting mode (TI, TKGY, NFGY). There are several reasons for this deviation. It may be convenient (extraction, simplicity of approximation), but it may also be the case that the farmer is trying to create a more spatially varied tree stand within the framework of the cutting mode. We first examine the spatial distribution of uses of different intensities. It is important to explain that the results reported below do not refer to the proportion of wood harvested in terms of intensity, but to the proportion/frequency of plots affected by wood use.

As table 3 shows, there are perceptible differences between each type of wood use and each farmer. It is quite understandable that in the case of TI or NFGY, a larger proportion of the plots are affected by wood use than, due to their nature, a more massive SZV. Only a comparison of the number of TKGY is a good example of the difference between individual farmers. Kemence Forestry performed much better in space than Királyréti Forestry.
But like so many times, behind the averages, there can be a wide variety of behaviors in this case as well. There is no significant difference in the average of the forests (72% -79%).
The results reported in the following subsections are using data from the plots affected by the intervention.

Table 3: Distribution of the intensity of the interventions (in the percentage of the actual areas used) between farmers and types of use. (Abbreviations: TI- purification, TKGY – selection thinning, NFGY – increment thinning, SZV -selection cutting, SZAL_KGH – stock-care)

Forest manager	TI	TKGY	NFGY	SZV	SZAL_KGH	controll	SUM
Diósjenő Forestry	X	65,5	72,8	58,1	X	0	46,8
Kemence Forestry	76,9	85,7	78,9	X	X	0	59,9
Királyrét Forestry	X	57,1	74	41,1	44,2	X	48,7
Nagymaros Forestry	67,3	69,4	72,3	51,8	X	X	65,3
SUM	72,9	71,1	74,7	49,1	44,2	0	55,7

4.2.2. Tree species composition and mixture

One of the important goals of treatment impact monitoring is to monitor what happens to the tree species composition during use and how the fate of the mixed tree species changes (number, mixture ratio). After all, it is during the pre-uses that the representation of older species of these species will / will be decided.

The number of tree species did not change significantly in the forest parts affected: the smallest decrease (-0.05) was measured in the forest parts of Nagymaros, while the largest decrease (-0.3) was measured in the forest parts examined in Kemence Forestry. If we look only at the data of the forest parts affected by TI, it can be stated that we experienced the largest decrease in the average number of tree species here (Nagymaros Forest -0.99; Kemence Forestry -0.72). In the case of TKGY, there was no significant change in the average number of tree species. In the case of both NFGY and SZV interventions, we measured the largest (NFGY -0.3; SZV 0.52) decrease in the average number of tree species in the examined forest parts of Nagymaros Forestry.

If we focus our analyzes on the species treated as mixed tree species (the number of native tree species except for KTT, CS, B, GY), then in addition to their number of species, it is also worth examining the evolution of their mixture ratio. Our interest was mainly focused on the direction and extent of the use of TI, TKGY, and NFGY. According to the combined data of all examined use types, the average number of mixture species decreased minimally (-0.16), and their mixture proportion (calculated based on coverage in these surveys) decreased minimally, on average by 1.8%. There is a large variance in the proportions of the forest behind the minimum average change in the forest fragment scale. The range of the average change in the proportion of mixed tree species per forest section was between 24.77% and + 22.1%. Positive values - i.e. the increase in the proportion of mixed tree species as a result of the intervention - occurred mainly in all forestry and almost all types of wood use. To interpret these, it is worth looking at the itemized description of each forest detail. After all, this result can be caused by the targeted extraction of the target tree species (B, GY, KTT, CS), but it is also simply that the spatial resolution is higher than the original survey (4 plots/ha in 2021, while only 1 plot in 2014-2016). / ha), the patches of the forest part richer in mixed tree species were also included in the sample.

Concerning changes in tree species composition, it is worth briefly addressing the issue of non-native species, especially aggressively spreading non-native species. The area studied is generally, fortunately, still very poor in these species. Nevertheless, we examined forest fragments where the proportion of aggressively spreading alien tree species (mainly acacia and/or idol) increased. The most worrying manifestation of this is the parts of the forest affected by the felling, where the dense idol tree has grown young in the open-planned open-air stand without great care.

4.2.3. Tree structure

The average closure of the forest stands affected by the areas, decreased only slightly. Different variances were observed behind the similar small mean change for each bout. The largest variance (13.9) was observed in Királyréti Forestry, while the smallest (7.8) was observed in the affected forest parts of Diósjenő and Kemence Forestry.

The relative cover values of the 5 thickness classes used to describe the stand (0-8 cm; 9-20 cm; 21-35 cm; 36-50 cm; 50p cm) depend on the thickness distribution of the starting stand and in this context on the type of intervention.

Accordingly, e.g. as a result of TI, the relative coverage of the 0-8 cm thickness class decreased (by 11.5% on average), while that of the 9-20 cm class increased (by 17.6% on average). Similarly, general effects of other types of use can be observed.

Among the variables used to describe the tree structure, the average values of diameter class diversity and pseudo-species number (number of non-empty cells in the species x thickness class matrix) are only our minimum, increased minimally, but also significantly varied between forest parts. The more significant increase in the number of pseudo-species is recorded in several cases (e.g. NM 38 / A), where the pre-intervention sampling was much less intensive.

4.2.4. Deadwood conditions

During the monitoring, we paid special attention to the change in the supply of deadwood. The question was how the number of standing dead trees would change. In other words, would the conscious removal of dead trees be achieved during the interventions? In addition to the registration of the standing dead tree according to the protocol (only in the case of NFGY, SZV, SZAL-KGH), we also asked if the surveyor noticed any traces of the dead tree felling in the forest area. The surveyors gave a positive answer to the latter question in the case of 22 forest districts, i.e. in almost one-fifth of the examined forest districts affected by the intervention, we detected traces of deliberate removal of standing deadwood. Before presenting the obtained results, it is worth emphasizing that the forests of Börzsöny are poor in deadwood. According to the data of the baseline survey between 2014 and 2016, the average number of dead trees thicker than 8 cm per plot (500 m^2) is only 1.17 (i.e. 23 per hectare). On the average of the forest stands affected by the intervention, the number of all standing dead trees per plot decreased by 0.52, i.e. by almost 45%, the largest (0.78) in Nagymaros Forestry and the smallest (0.39) in Királyréti Forestry. Most of the standing dead trees were thin, only 23% of the plots contained standing dead trees thicker than 20 cm (Királyrét 19.9%; Diósjenő 20.8%; Nagymaros 24.1%; Furnace 35.2%), this decreased down to an average of 15% (Diósjenő 7.8%; Királyrét 12.8%; Nagymaros 18%; Kemence 27.2%). The largest decrease (17.8%) was measured in Diósjenő and the smallest (9.6%) in Kemence Forestry. The frequency of plots with deadwood thicker than 20 cm before and after the procedure is shown in maps 7-8.

Similar to standing deadwood, the supply of lying deadwood was relatively low even before the interventions. The average amount of lying deadwood per forest was 5.1-7.5 m^3. The smallest dead trees were in Nagymaros and the most in Kemence Forestry. The proportion of plots with deadwood thicker than 8 cm was between 0.84 and 0.87, while the proportion of plots with thicker than 35 cm was only 0.028 in Nagymaros Forestry, and between 0.07 and 0.092 for the other three forests. As a result of the interventions, the amount of lying deadwood showed a small decrease (on average 0.59 m^3/ha). The largest average decrease (-1.07 m^3) was detected in the area of Nagymaros Forestry, which already contains the least dead wood, -0.57 m^3 in the Diósjenő Forestry, -0.39 m^3 in the Királyréti Forestry, and -0.3 m^3 in the Kemence Forestry. A decrease of 24 m^3 was measured. Maps 11-12 show the amount of lying deadwood before and after the procedure. The proportion of plots with a thickness of more than 8 cm increased minimally, while the proportion of plots with a thickness of more than 35 cm increased minimally in two cases (Diósjenő 0.024; Nagymaros 0.028), decreased in two cases (Királyrét -0.02; Furnace 0.04).

4.2.5. Tracks of the tree utilization

It is difficult to conclude this issue directly from the data of the protocol recording. This is why we designed a questionnaire that the surveyors filled in after taking the plots belonging to the 1-1 forest plot, i.e. after visiting the whole forest plot. The level of soil damage associated with wood use was not considered dangerous by the surveyors in the majority of the forest areas affected by the treatment (41 barely and 46 poor ratings), giving a strong rating in 11 cases and an extreme rating in only 4 cases. From this point of view, the most favorable situation was registered in the area of Nagymaros Forestry, wherein half of the affected forest parts (34) the soil damage was weak, and in only 4 cases the soil damage was weak. The other extreme was found in the examined forest details of Királyréti Forestry, where 11 strong and 3 extreme were observed in addition to 11 barely, 13 weak ratings. Kemence Forestry is similar to that in Nagymaros, while weak soil damage was predominant in Diósjenő Forestry (12 out of 18 cases).

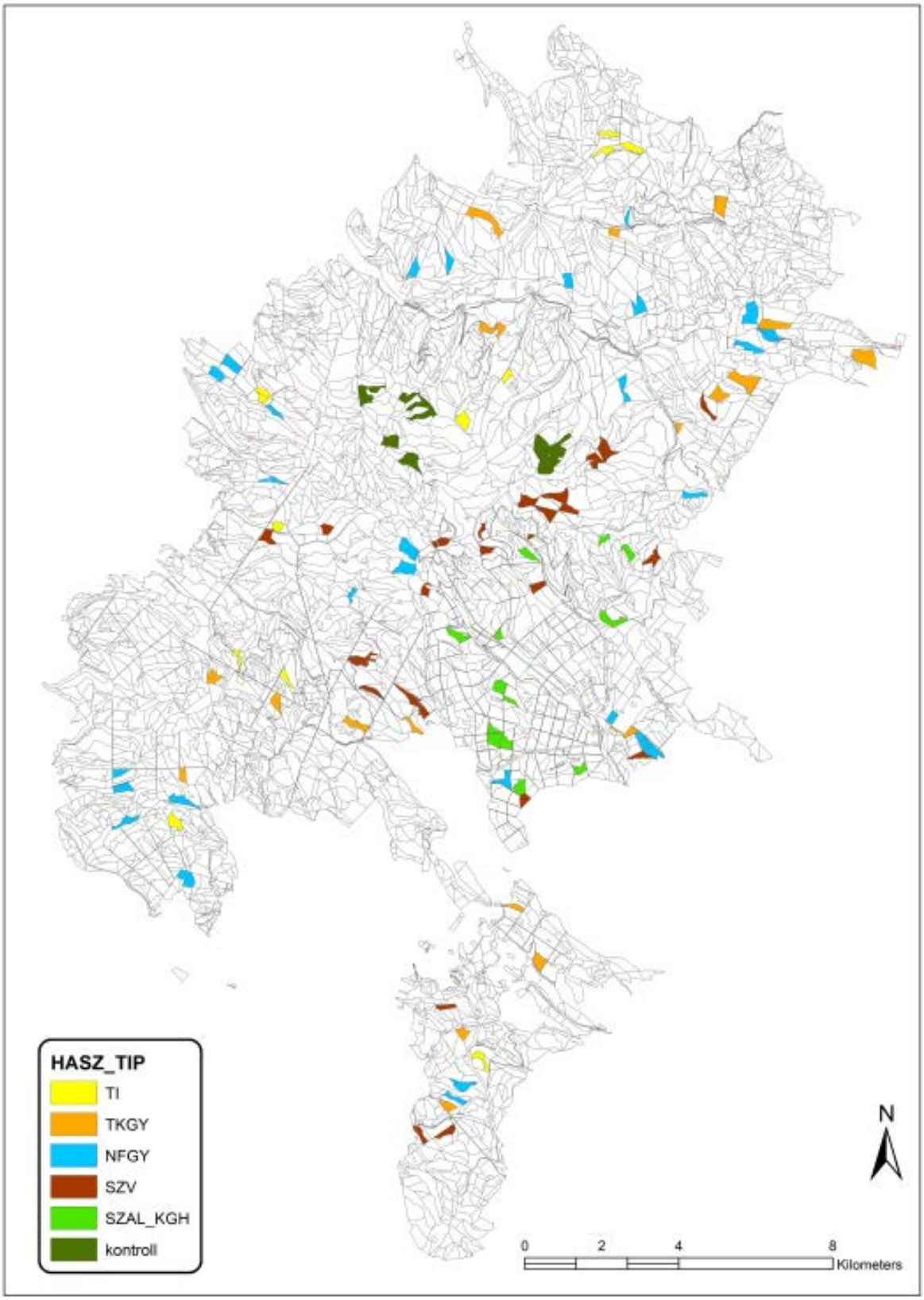
The question on cortical damage was absent in 60 cases, scattered in 39 cases, and in 3 cases the surveyors gave many answers. The differences between the individual forests are similar to those described for soil damage. The no-scatter ratio in Nagymaros is 26-7, Furnace 12-8, Diósjenő 9-8, while in Királyrét 13-16.

Literature:

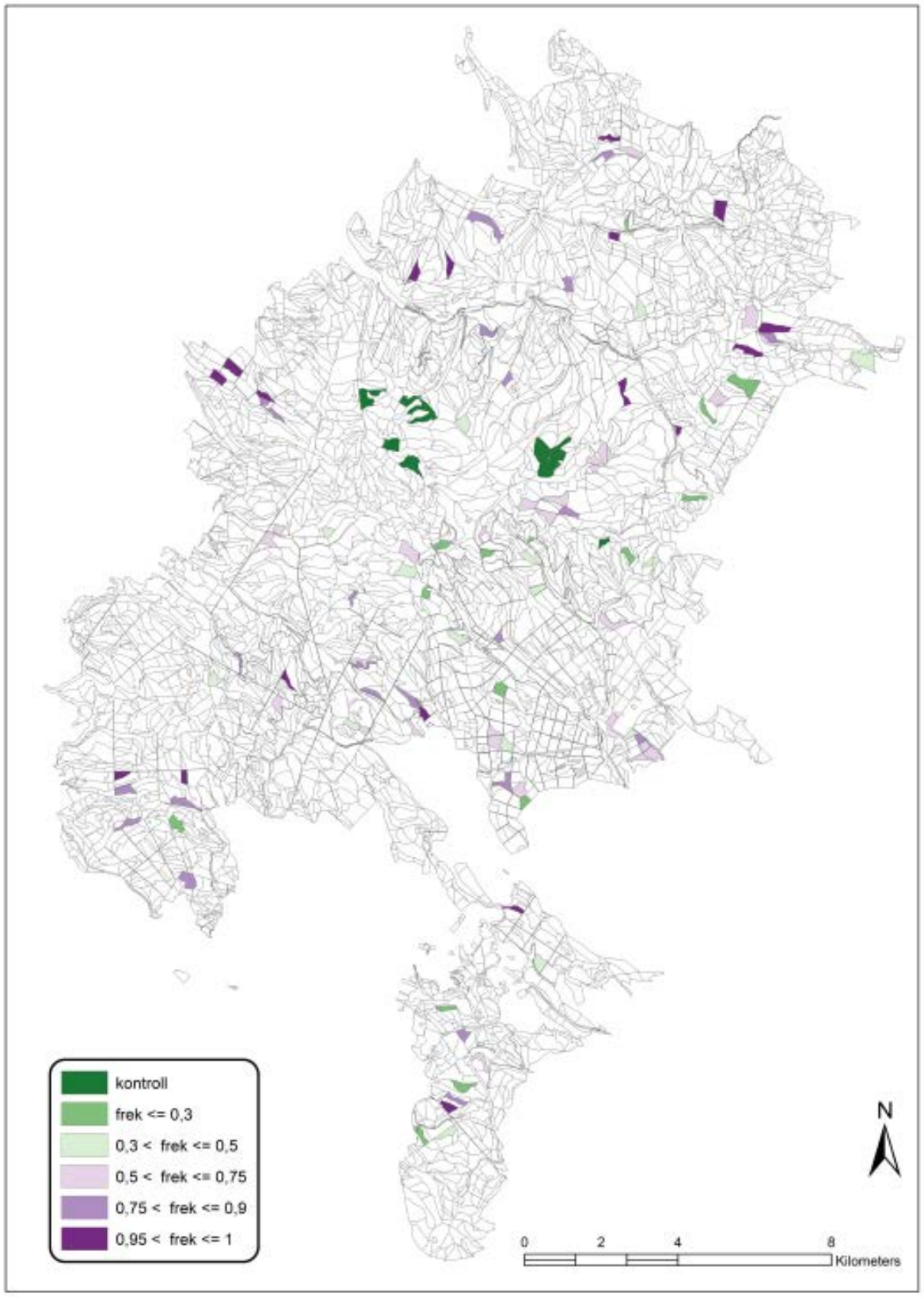
EcoLingua Bt. 2020. Revision of the forest condition description methodology to establish the forest management impact monitoring to be carried out in Börzsöny within the framework of the CENTRALPARKS tender. Research report

Standovár, T., Bán, M. & Kézdy, P. (szerk.) 2017. Erdőállapot-értékelés középhegységi erdeinkben. – ROSALIA A Duna-Ipoly Nemzeti Park Igazgatóság tanulmánykötetei 9. Duna-Ipoly Nemzeti Park Igazgatóság, Budapest, 612 pp.

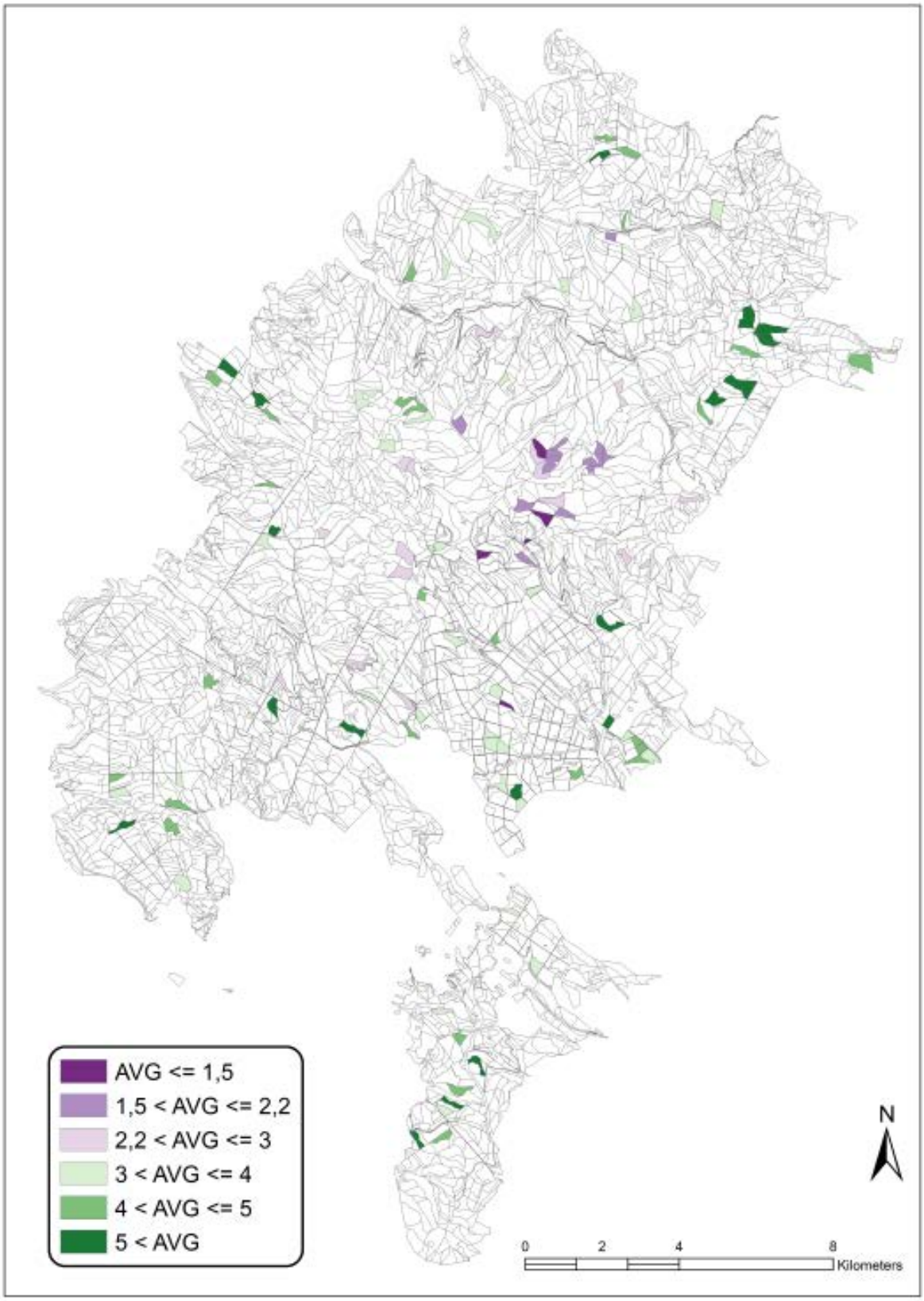
Further readings: https://www.interreg-central.eu/Content.Node/Centralparks/D.T2.2.3-Forest-state-evaluation.pdf



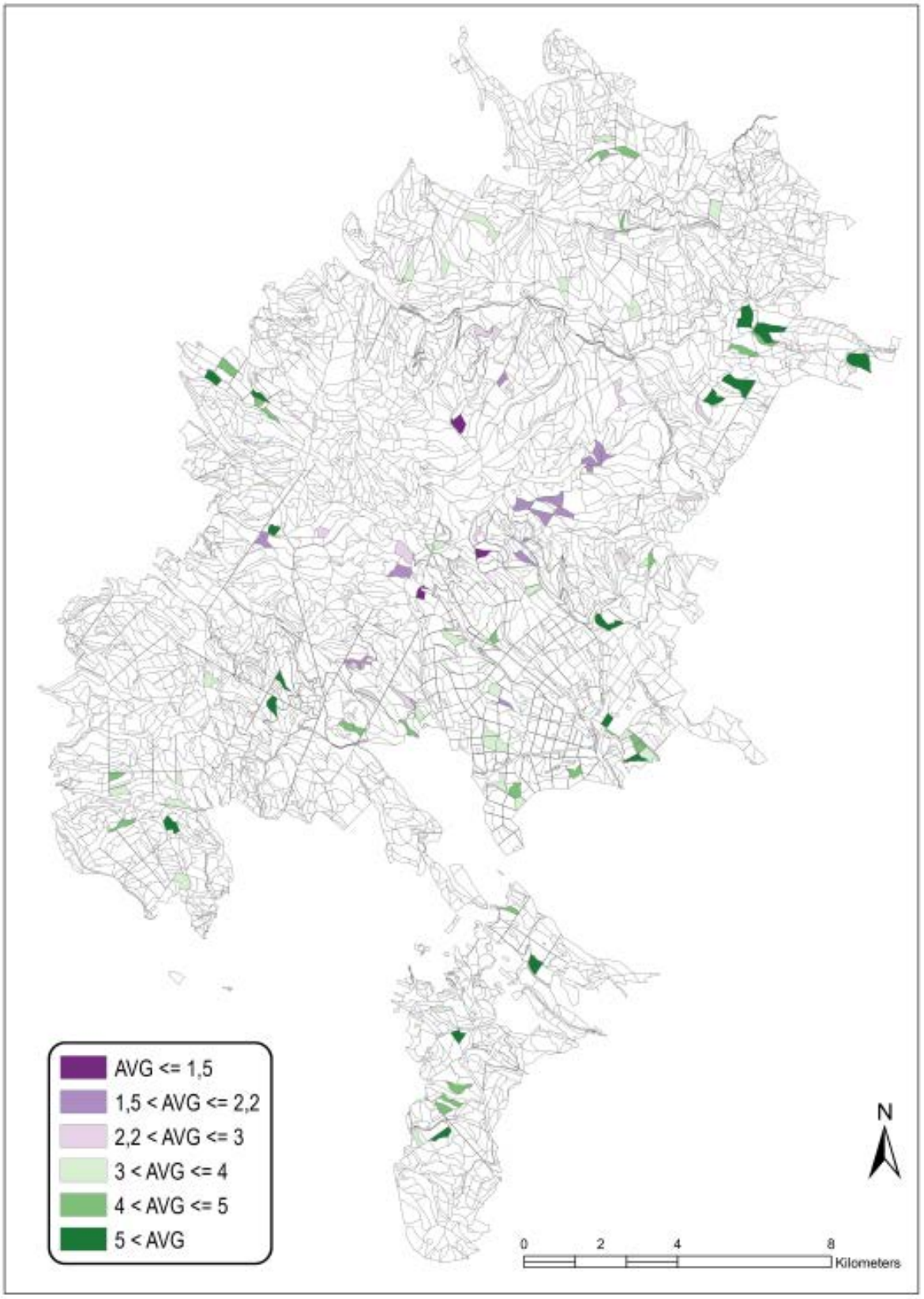
Map 4: In the area of Börzsöny in 2021, the forest parts were affected by sampling



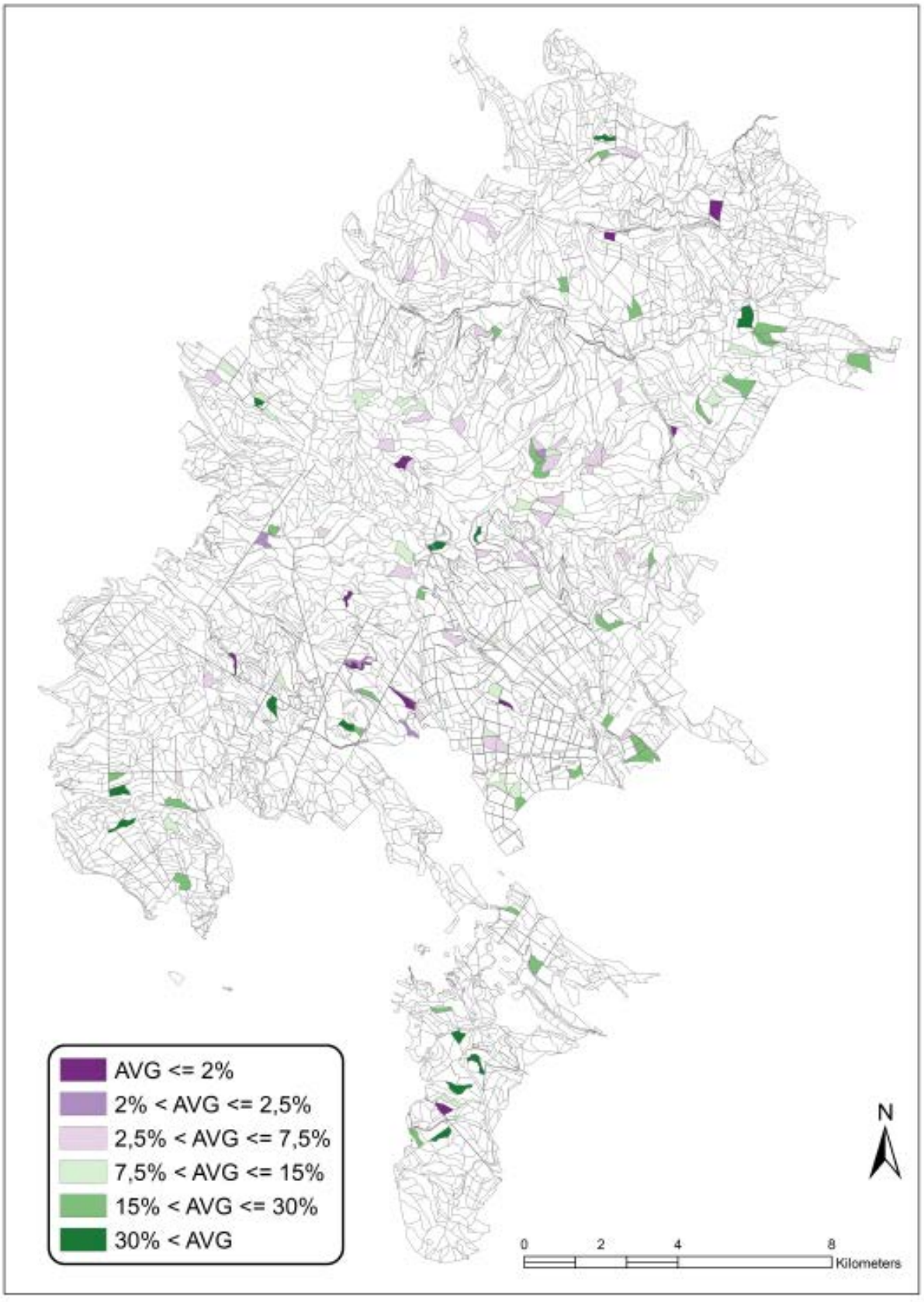
Map 5: Frequency of wood use by forest parcel (use in a proportion of the plots in the forest parcel)



Map 6: The average number of tree species per forest plot before the use of wood in 2019-2020



Map 7: The average number of tree species per forest plot after 2019-2020 tree uses



Map 8: The average proportion of mixed tree species per forest plot before timber use in 2019-2020

Chapter 5: Grassland state evaluation

5.1. The grassland state evaluation protocol

The methodology is based on the idea introduced within O.T2.1 „Assuring quality in grassland management with a goal-oriented database" (https://www.interreg-central.eu/Content.Node/Centralparks/Centralparks-CE1359-O.T2.1-Joint-strategic-document-on-ra-5.pdf) together with the base of the forest state evaluation protocol (SH4/13 project - http://karpatierdeink.hu/eng/1-feladatcsomag). During the preparation, the Natura 2000 monitoring protocol for dry grasslands was used as background documentation as well.

There are numerous, very diverse (even within one habitat) grasslands within the administration area of the Danube-Ipoly National Park Directorate. This means a dozen of more than 100 ha areas of grassland in the total administration area of the national park.

These grasslands are mostly affected by turning into shrubs to a greater or lesser extend or are the areas of previous shrub removal.

I. Level: Determination of the current state (field visit)

Normally a systematic site visit series (might be complemented with the prediction of the population's dimension of the protected and Nature 2000 species). This level could be implemented based on the "experienced opinion", does not require a detailed analysis and data collection.

This solution is not (1.) or very limitedly (2.) standardizable, but it is not time-consuming and it is cost-effective. Its main advantage is that the method is adaptable to the exact area and situation and it gives immediate and concrete feedback for the area manager. (In this case, the focus is not on the scientific perfection of the monitoring, but on the practice-oriented character, where the expert level meets the everyday challenges of the grassland management level.)

(1.) Non-standardization has some disadvantages. It is Non-objective and needs the same surveyor in a long term.
(2.) Standardization possibilities:

- sampling point checking once or more time annually, monitoring for years
- taking notes on the subjective impression of the surveyor
- determined track lines
- consultation on land use management
- photo documentation
- list of queries on each habitat type (optional)

II. Level: Preparation

Consultation with the landowner about land use and any other relevant information is a must. Communication with park rangers is crucial. In general park rangers have deep knowledge about the sites. To set out sampling points park rangers' involvement is very important. If there are some records or reports on the treatment, that is very useful.

III. Level: Sampling points

The area of sampling points has the same size. Every point is circle-shaped, the radius is 11,25 m and the total area is 400 m2. Midpoint has to be marked and recorded with GPS coordinates. Several survey points are optional. It depends on the goal and resources. The first survey preferred to be done by an expert but, after all, university students also could make it.

Tasks:

- Sampling point description, important variables are vegetation, land use, weather, natural or human-made disturbance, or any other important detail.
- Photo documentation from the midpoint, photos have to represent the vegetation and its surroundings.
- Estimation of dominant species (%) if possible all detected species have to be recorded.
- All protected and Natura 2000 species have to be recorded (number of blossoming individuals) as well as game damage.
- If the point is reforested by bush species, the bush cover has to be recorded. If saplings are represented the height of all individuals (under 3 m), they have to be recorded each year. If the number of individuals is more than 10, height measurement has to be done on 10 randomly selected specimens.
- Preparation of mini vegetation maps.
- If any kind of disturbance covers more than 10 m2, it has to be marked on the minimap.

Time of survey

- For dry or semi-dry grasslands: May or June. If samplings will be repeated in the following years, the period has to be the same.

IV. Level: Measurement of Variables in vegetation

This phase has to be done by experts or park rangers.
In the pilot site, 6 circle-shaped sampling points have to be set up. The diameter of each circle is 80 cm (alternative hoops can be used.)

The 6 sampling units have to be perpetuated in the following way:
The circles have to be localized within the 22.5 m diameter circle in 1 marked caliber on the division of the circle, and the other 5 circles have to be pointed 4 m far from each other's center point.
Within the 80 cm diameter circles the following vegetation variables have to be recorded:

- A number of all species and their scientific names (this could be limited to the 1-2 or 3-4 dominant species, preparation of species groups, etc.)
- Total vegetation cover (%) (could be more than 100%)

- Each species cover (%): if there is a shrub layer then the B-level cover has to be determined separately
- Number and cover of flowering individuals
- Bare ground cover (%)
- Stone cover (%)
- Any kind of dung cover
- Leaf litter cover: on a five grade scale (not presented, presented in a very small amount, small amount, large amount, very large amount)
- Height of vegetation: across the division of the 80 cm diameter circle, in 5 repetitions, measured in cm. In the case of multi-layered grassland, it has to be determined in every layer (for short and long grass kinds)
- If the vegetation is covered in tussock then individual tussocks have to be determined, noted, and described. If the vegetation is partly covered by tussocks, the % of the tussock's cover has to be determined
- Photo documentation of the circles (as much coverage of the photo as possible, photos should be taken from above, in parallel with the surface)

Facultative task – more precise prediction of the leaf litter cover

Requires more time and effort. In some cases, it must be implemented, because in some treatments and changes the leaf litter cover is indicated by its cover. It is important to implement monitoring on the effects of grazing plus mowing/stalking and the changes in those grasslands.

The leaf litter has to be determined in the neighbor area by a minimum of 3 pieces (optimally 6) with 80 cm diameter circles. 3 m from the circle samplings (to not change the sampling plots) – the 22.5 m diameter sites, perpendicular to the sampling plots, within the circles the total amount of leaf litter has to be separated and measured on the field. The measuring sites could be changed.

Possibility of an even more precise prediction

Before collecting the leaf litter, the vegetation cover has to be cut, with 3 cm stubble high, and collected. After that, the leaf litter has to be collected. Both samples have to be dried out and measured under laboratory conditions.

Time of survey

- For dry or semi-dry grasslands: May or June. If samplings will be repeated in the following years the period has to be the same.

V. Level: Facultative task: an examination of the grass structure

Perpetuation of:

1. Three pieces 2x2 m coenological (plant community) quadrat;

2. Transect along with the 2 parallel sides of minimum 1 (ideally all three) quadrat, which is 4 m long, consisting of 5x5 cm micro-quadrats. During the survey of the micro-quadrats, the start and end of the clones should be fixed (it has high importance during the monitoring of the grassland-structure treatments). Based on the expert's opinion,

on a selected diameter of 22.5 m representative sampling area patch and a representative part of the examined grassland (if somehow not possible: on the direct physical neighbor area with the same treatment)

The recording of the grass structure is similar to the Natura 2000 intensive grassland monitoring datasheet's description.

The designation of sampling areas and the indoctrination require special expertise, after this phase the expertise of the surveyor is irrelevant. The analysis and evaluation have to be done by a professional. Based on this evaluation method any moderate degradation can be determined since the methodology is sensitive to the interactions between the species and the structural changes of the grass vegetation.

Time of survey:

- For dry grasslands: May or June. If samplings will be repeated in the following years the period has to be the same. (There shall be less than a week shift between the sampling of the 2 phases.)

Further readings: https://www.interreg-central.eu/Content.Node/Centralparks/D.T2.1.3-Grassland-state-evaluation-protocol.pdf

5.2. Field implementation of the grassland state evaluation

5.2.1. Non-peat-forming reed beds, sedges, and ponds (B1a)

Natura 2000 habitat type: not comparable

Coenotaxon(s): Phragmitetum communis (Soó1927 em. Schmale 1939, Typhetum latifoliae G. Lang 1973)

Occurrence: The habitat type occurs very sporadically in the mountains, forming small stands in waterlogged areas. Broad-leaved sedge occurs in the Inner Lake of Bernecebarát, Lake Bajdázói, Lake Büdös, Broad Field, while reed occurs in the Kóspallagi reservoir. Reedbeds are also found wedged between the gullies of the King's Ridge.

General characterization: The associative Typha latifolia and Phragmites australis form dense, species-poor stands about 2-2.5 m high in shallow, fluctuating water levels in small eutrophic water bodies of natural or artificial origin and their riparian zone. Peat formation does not occur beneath such reed beds and reed beds. The stands embedded in oak woodland or wet valley bottom habitats are often only a few tens or sometimes a few hundred square meters in size. In addition to the constituent species, other typical species are Alisma plantago-aquatica, Calystegia sepium, Galium palustre, Iris pseudacorus, Lycopus europaeus, Lysimachia vulgaris, Lythrum salicaria, Polygonum hydropiper, Scutellaria galericulata, Solanum dulcamara.

Natural condition: the known small fragmentary stands are species-poor, featureless, and of medium natural status (TDO=3).

Vulnerability: The main threat is feral pigs grazing. The zonation complex of Lake Büdös and the associated broad-leaved sedge of Lake Büdös in Kotholya have been trampled by wild boars (the sedge of the Inner Lake has been fenced in the recent past for similar reasons). The habitat type is not currently threatened by the spread of invasive plant species.

5.2.2. Non-clogging high grassland (B5)

Natura 2000 habitat type: not comparable

Coenotaxon(s): Caricetum gracilis Almquist 1929, Caricetum acutiformis EGGLER 1933, Caricetum buekii Kopeczky et Hejny 1964, Caricetum melanostachyae BALÁZS 1943, Galio palustris-Caricetum ripariae Balátová-Tulackova et al. 1993

Occurrence: In the valleys of the southern part of the mountain range, especially in the Mill Valley, large valley bottoms are covered by Caricetum buekii. Caricetum gracilis occurs in the low-lying, humid, central part of the King's Ridge. Small stands of the alkali sedge association (Caricetum melanostachyae) are found at Pénzásás, in the Great Iron Valley, in the saddle between the Salt Mountain and the Great Eagle Mountain, in waterlogged depressions. Coastal saltmarsh (Galio palustris-Caricetum ripariae) is a component of the zonation complex of Lake Büdös and a small stand is known at Kapitány-Rét. Small stands of Caricetum acutiformis are scattered in the wide valleys of the mountain range (Kemence Valley, Great Valley).

General characterisation: Intermittently waterlogged, species-poor grassland communities on well-nourished sites. No peat formation under the vegetation. In general, they are uniform grasslands with a grass height of 0,5-1 m. However, the moorland in the southern part of the Bernese Mountains is characterised by the development of heavy (50-80 cm high) heaths due to long periods of no mowing. The most common species are Carex acuta (syn.: C. gracilis), C. acutiformis, C. melanostachya, C. riparia, C. buekii, and other typical species are Calystegia sepium, Humulus lupulus, Galium palustre, Lycopus europaeus, Lythrum salicaria, Lysimachia vulgaris, Symphytum officinale, Urtica dioica.

Natural condition: The large areas of the Mill Valley with its large areas of shrubby, boggy bogs are of good natural condition. The sharp edge of the King's Ridge is in a good natural condition, as is the dry marsh sedge of the embedded blue-perennial marsh. The shoreline sedge of the Büdös Lake zonation complex is in moderately degraded condition due to damage by feral hogs, while the Captain's Ridge stand is in moderately degraded condition due to drainage/dewatering. The natural condition of the small marsh sedges in the valley bottom, which have developed in the disturbed production areas, is also moderate, similar to that of the small areas of the bog sedges.

Threats: Burning during the dormant season can damage the beautifully shrubby stands of the bog swamps. In the Mill Valley, trampling along the hiking trail does not cause significant damage. The wetland tall fesue is threatened by desiccation and by wild boars. Occasionally, for example in the Pénasca valley or the Great Basin valley, the grassland is also used as a loading area. Invasive species are currently not found in the core habitats.

5.2.3. Meadows with Purple Moor Grass (D2)

Natura 2000 habitat type: Purple Moor Grass swamps on calcareous, peaty, or clayey soils (Molinion caeruleae) (6410)ih

Cenotaxon(s): Succiso-Molinietum hungaricae (Komlóri 1958) Soó 1969 corr. Borhidi 2001

Occurrence: A rare, unique habitat type in the mountains. Its largest stands (in more than one case several hectares) occur in the area of the King's Ridge in Kotholya, while a smaller, more species-poor patch is known from the sloping part of the Great Valley of Bernecebarát above the Betyár well.

General characterisation: A type of turf that has developed secondarily in valley bottoms or undrained depressions, following the formation of loose areas, on soils with a bound, impermeable layer. Stands of tall grass (1-1,5 m), dense, the shrubby structure may have shallow surface water cover in spring, drying out by mid-summer. Molinia

arundinacea is the dominant (almost monodominant) species of the grassland type, while the other type (partly rare) species are: Deschampsia caespitosa, Filipendula ulmaria, Galium boreale, Gentiana pneumonanthe, Gladiolus imbricatus, Gymnadenia conopsea, Iris sibirica, Juncus atratus, Juncus conglomeratus, Juncus effusus, Lysimachia vulgaris, Lythrum salicaria, Pseudolysimachion longifolium, Sanguisorba officinalis, Scutellaria hastifolia, Selinum carvifolia, Succisa pratensis, Thalictrum lucidum, Viola canina.

Natural condition: Most of the stands are of favorable natural condition, free of alien elements (TDO=4), and the south-eastern, deepest part of the King's Ridge is also very species-rich and close to natural condition (TDO=5).

Vulnerability: Although the abandonment of meadow cultivation in recent decades has allowed some expansion of the stands, the maintenance of good natural conditions (prevention of further homogenisation) is strongly influenced by the lack of mowing. In the absence of regular or at least periodic mowing, the expansion of reed (Phragmites australis) from lower-lying areas and the encroachment of shrubs and woody vegetation from the edges are problems. In the area of the King's Ridge, the former drainage ditch, although it is now largely blocked, is an obstacle to a better water supply for the area.

5.2.4. Wetland meadows (D34)

Natura 2000 habitat type: Cnidion dubii river valley marshes (6440)

Cenotaxon(s): Agrostio-Deschampsietum caespitosae Ujvári 1941, Carici vulpinae-Alopecuretum pratensis (Máthé et Kovács 1967) Soó 1971 corr. Borhidi 1996

Occurrence: A rare habitat type throughout the mountain range, typically occupying areas of less than 0.5-1 ha within a closed forest block. Larger stands of a few hectares are found in the Broad Meadow. It occurs in broad stream valleys (e.g. Kemence Valley, Great Valley) in valley bottom situations, on low-lying sloughs along with intermittent watercourses (Béla Ridge, Bull Ridge), on gentle slopes with seepage, on flat troughs (Széles Meadow), on forest sloughs with spring water confluences (e.g. Faragottkúti Grassland, Tányér Ridge).

General characterisation: For most of the growing season, the meadows are lush and moist (often waterlogged in spring, but drying up in summer), with tall grasses. Their soils are not peaty meadows or slope alluvium. In addition to the predominant grassland grasses, there are also a large number of colourful flowering dicots. Protected plant species are rarely found. The species composition of their dryland stands becomes similar to that of the mown grassland (E1). Stand-forming species: Alopecurus pratensis, Deschampsia caespitosa. Other characteristic species: Ranunculus acris, R. repens, Lysimachia vulgaris, L. nummularia, Lychnis flos-cuculi, Inula britannica, Carex vulpina, C. acutiformis, C. panicea, Cardamine pratensis, Allium angulosum, Symphytum officinale, Stachys palustris, Poa trivialis, Lythrum salicaria, Cirsium canum.

Natural condition: stands regularly mown each year are typical of favorable natural conditions (TDO=4). Wetland meadows that have not been mown for a long time, are tallgrass, grassy, fragmented, with a moderate or strong transition to herbaceous grassland (OB), are characterized by a moderately degraded condition (TDO=3) (e.g. the section of the Kemence Valley above the King's Well, Great Valley).

Threats: The main threat is the lack of regular mowing, which leads to the onset of high mosses, weeds, scrub, and character loss in the marshes. The resumption of livestock farming in the Broad Meadows may lead to overgrazing on the grassland. The habitat type is not currently threatened by the spread of invasive species, but there is a potential threat from Solidago species. Occasional problems may be caused by the weed control effect of spreaders in the vicinity of the marsh meadows and the resulting wild trampling.

5.2.5. Meadows with False oat-grass (E1)

Natura 2000 habitat type: Lowland and hilly reaper meadows (Alopecurus pratensis, Sanguisorba officinalis) (6510)

Cenotaxon(s): Alopecuro-Arrhenatheretum (Máthé and Kovács 1960) Soó 1971, Pastinaco-Arrhenatheretum (Knapp 1957) Passarge 1964

Occurrence: A scattered habitat type throughout the mountain range, typically occurring in small stands (less than 0.5-1 ha) within closed forest blocks (e.g. Bajdázói, Taxi, Szállásoki). Larger patches of several hectares are very rare in the interior of the mountain range (e.g. Kemence valley above the junction with Csarna valley, Nyíri-ret), but more common on the mountain rim (e.g. around Törökmező, Malom valley, Széles meadow).

General characterization: Secondary, mainly oak belt, often on unflooded surfaces of stream valleys, developed on slash-and-burn, fresh, nutrient-rich soils, a tall grass (1-1.2 m), species-rich meadows, predominantly grassland (sometimes with 8-10 species of grass), with scattered tall, bushy-stemmed bivalves and a large number of bivalves as understory grasses. The most abundant species are Arrhenatherum elatius and Dactylis glomerata, but there are also patches dominated by Alopecurus pratensis, Briza media, Festuca pratensis, and Trisetum flavescens. Other typical species are Anthoxanthum odoratum, Campanula patula, Centaurea pannonica, Colchicum autumnale, Cruciata laevipes, Dianthus deltoides, Galium mollugo agg., Galium verum, Helictotrichon pubescens, Holcus lanatus, Leucanthemum vulgare, Lychnis flos-cuculi, Orchis morio, Pastinaca sativa, Poa pratensis, Potentilla reptans, Ranunculus acris, Rumex acetosa, Rumex thyrsiflorus, Stellaria graminea, Trifolium pratense, Trifolium repens, Veronica chamaedrys.

Natural condition: the unmowed, regularly mown stands are typical of favourable natural condition (TDO=4), and the low-lying, alder-dominated, golden oat-dominated mowing layer of the Broad field is of outstanding natural condition (TDO=5). In contrast, the mowed areas of long-unmanaged, siskan-dominated, weedy grasslands, which show a more moderate or stronger transition to lush grassland (OB), are in many cases in a moderately degraded state (TDO=3).

Threats: The main threat to the maintenance and natural state of the stands is the lack of regular mowing, which leads to weed infestation, invasion by siskana (Calamagrostis epigeios), high mold, and blackberry blight. Long periods of no treatment lead to intensive scrub encroachment and afforestation, while the use of grassland as a loading area or approximate trail leads to weed encroachment and the appearance of adventive species (e.g. Ambrosia artemisiifolia, Erigeron annus). The over-seeding of grassland leading to glaciation was previously carried out for wild fodder in the Kemence Valley. Another problem is the weed control effect of the scattering of grass on the slash-and-burn pastures, and the resulting trampling and trampling by wild boars.

5.2.6. Open siliceous mudflats (G3)

Natura 2000 habitat type: Pannonian rocky grassland (Stipo-Festucetalia pallentis) (6190)

Coenotaxon(s): Asplenio septentrionali-Melicetum ciliatae (Soó 1940) Máthé et M. Kovács 1964, Minuartio-Festucetum pseudodalmaticae (Mikysa 1933) Klika 1938, Poëtum scabrae Zólyomi 1936

Occurrence: Throughout the entire mountain range, but especially in South-Börzsöny on the slopes of Szent-Mihály-Hill above the Danube, in Southwest-Börzsöny (Bánya-Hill, Gömbölyű-Kő) and on the rocky copas of Central-Börzsöny (Jancsi-Hill, Wild-Top, Drínó, Nagy-Mána, Rustok-Hill, Zálog-Bérc) and on the rocky walls above the Kemence Valley in the North-Börzsöny (Barát-kő, Cicőke, Kő-szirt), on Kámor and Kőember, which occur on steep slopes, rocky peaks and ridges.

General characterization: It occurs at altitudes of 150-700 m above sea level on siliceous bedrock, on extremely dry, rocky-rocky subsoil, predominantly south, south-west, and less frequently east-facing, with a slope angle of 20-40-(80)°. Grassland cover ranges from 10-20-(40)%. Occurs in small stands, often only a few hundred square metres, rarely several hectares. The majority of stands are of natural origin. There are also extensive siliceous grasslands as a secondary result of grazing. The habitat is not threatened by invasive species. Conservation species: Festuca pseudodalmatica, Poa pannonica, Melica ciliata. Other characteristic species: Asplenium septentrionale, Erysimum crepidifolium, Gagea bohemica, Inula oculus-christi, Jovibarba hirta, Linaria genistifolia, Sedum acre, Sedum sexangulare, Sedum album (South Woodland), Sempervivum matricum, Seseli osseum, Teucrium chamaedrys, Thymus glabrescens. Three "subtypes" occur in the area. Minuartio-Festucetum pseudodalmaticae - Festuca pseudodalmatica is the dominant perennial, clump-rooted grass of the Hungarian open siliceous silt-loam grassland community. It is most abundant and has a characteristic species assemblage on the Jancsi Hill and Wild Roof in Perőcsény. Poëtum scabrae - Hungarian periwinkle and open siliceous silt-grassland, partly formed as a degradation stage, partly as a pioneer community (e.g. Rustok Hill, Nagy-Mána, Kőember, Kopasz Hill). Asplenio septentrionali-Melicetum ciliatae - This is a mountain-wide community of siliceous rocky outcrop grassland, typical of sunny, steep rock faces and rocky slopes, usually complexed with open siliceous rocky outcrops. It occurs on the rocks of the Barát rock, Cicőke, Drínó, Kámor, St. Michael's Hill, Wild-top. Typical species are Melica ciliata, rock-forming ferns, possums, crow's-foot, and cirrus roses. The latter form pioneer communities on rock outcrops with mossy-uzmose synusia. The subtypes often form complexes with each other and with the stony-soil slope steppe (H3a).

Natural condition: The majority of stands are in favorable natural status, free of alien species (TDO=4). There are many moderately degraded, wild-roaming stands (TDO=3) with degradation-tolerant grasses (Botriochloa ischaemum, Cleistogenes serotina) and annual weeds (Scleranthus annuus, Polygonum aviculare, Tragus racemosus).

Vulnerability: overgrazing, grazing, ploughing, and fertilisation by overstocked big game (mainly mouflon and wild boar), leading to degradation, weed encroachment, changes in dominance (Festuca pseudodalmatica may be conspicuous by its decline), and the formation of completely barren patches. In beautiful viewpoints (Ant Hill, Raven Rock), degradation is caused by trampling by tourists.

5.2.7. Sloping steppes with stony soils (H3a)

Natura 2000 habitat type: Subpannonian steppe (6240*)

Cenotaxon(s): Potentillo-Festucetum pseudodalmaticae Májovsky 1955, Inulo oculi christi-Festucetum pseudodalmaticae Májovsky et Jurko 1956, Stipetum tirsae Meusel

Occurrence: A habitat type occurring throughout the whole mountain range, but especially in the south-western part of the Börzsöny, on the slopes of the Szent-Mihály-Hill and Ördög-Hill above the Danube in the southern part of the Börzsöny, and on the rocky copas of the Central Börzsöny, which occurs within the closed forest block, on steep slopes with shallow, stony soils, near rocky peaks and ridges, which are already unfavourable for forestry.

General characterization: It occurs at altitudes of 150-850 m above sea level on siliceous bedrock, on erubic soils, predominantly with a south-south-west exposure, with a slope angle of 10-30-(40)°. They are closed, medium to low, species-rich, dry grassland communities dominated by mesophytic grasses. Grassland cover between 60 % and 95 %. Typically small in area (less than 0.5-1 ha), often forming patches of only a few hundred square metres. Most of the stands can be considered natural, but there are also secondary or extensive stands of uncharacteristic stands. Range-forming species: Festuca pseudodalmatica (widespread), Festuca pallens (Salt Hill, Great Koppány), Stipa dasyphylla (Salt Hill, Bánya Hill, Dríno, Rustok Hill), Stipa pulcherrima (mainly in the south, Devil's Hill, Stipa tirsa (in

the south and south-west of the mountain range, Nagy-Galla, Kis-Koppány, Hegyes-Hegy - these are not secondary stands on the site of abandoned vineyards!), Bothriochloa ischaemum (widespread), Cleistogenes serotina (widespread). In smaller patches Bromus pannonicus var. reptans, Chrysopogon gryllus, Elymus hispidus, Festuca valesiaca (more on the mountain slopes), Poa pannonica, Stipa pennata may also become dominant. Other typical species are Achillea crithmifolia, Allium sphaerocephalon, Asperula cynanchica, Dianthus pontederae, Eryngium campestre, Galium glaucum, Hypericum perforatum, Potentilla arenaria, Stachys recta, Teucrium chamaedrys, Thymus glabrescens.

Natural condition: stands dominated by the clump-rooted hemicryptophytic grasses (Stipa pulcherrima, S. dasyphylla, S. tirsa, Festuca pseudodalmatica, F. pallens) are typically of favourable natural condition (TDO=4). Parts of the species-rich, diverse sloping grassland of the Great Salt Hill (dominated by Stipa dasyphylla and Festuca pallens) and the Great Coppice (dominated by Festuca pallens and Festuca pseudodalmatica) can be considered as even better (TDO=5). In stands trampled by wildlife or tourists, the dominance pattern changes, with the dominance of disturbance-tolerant, trampling grasses such as Cleistogenes serotina, Elymus hispidus, and Bothriochloa ischaemum, and the proliferation of species tolerant of trampling and grazing (Euphorbia cyparissias, Eryngium campestre, Caucalis platycarpos). Such stands can be considered as moderately degraded (TDO=3), even if only the small areas of sloping grassland dominated by Poa pannonica are of the most pioneer character.

Threats: The main threat is overstocking of big games, mainly wild boar and mouflon. Their trampling, grazing, grazing, and fertilization lead to degradation, fragmentation, weeding, and changes in the dominance of the sloping grassland. It can be characterized by blackberry blight and the formation of 0,5-1 m high bush patches. Due to trampling by tourists, Festuca pseudovina may proliferate in viewpoints (Ant Hill). Invasive species are not yet a threat to the habitat type.

5.2.8. Forest-steppe, semi-dry slash and burn, dry grassland (H4)

Natura 2000 habitat type: Important orchid habitats (6210*) of calcareous semi-natural dry grassland and its shrubby variants (Festuco-Brometalia)

Coenotaxon(s): Polygalo majoris-Brachypodietum pinnati H. Wagner 1941, Campanulo-Stipetum tirsae Meusel em. Soó 1971

Occurrence: Scattered, predominantly in the southern part of the mountains, mainly in mountain peripheral situations, with small stands (less than 1 ha). Stands of several hectares are rare (e.g. Turkish Field). It occurs, for example, on the Gomb Hill in Kemence and on the Fehér Hill in Nagymaros (the species-rich Campanulo-Stipetum tirsae forest stands on the southern slopes of the Danube, on the site of abandoned vineyards (Eszperanto Hill in Nagymaros, Kapu Hill, Ruzsás Hill in Szczecin) are located outside the boundaries of protected areas).

General characterization: A type of grassland, mainly in the mid-mountain landscape, mainly in a tannic-oak belt. Typically occurs in forested environments, with southern to western exposure, on gentle to steep slopes. Semi-dry grasslands, slash meadows, dominated mainly by broad-leaved grasses, rich in species, including bivalves, and containing forest species. In addition to broad-leaved grasses, large-leaved dicots are common. In the Börzsöny area, it is mainly found on limestone bedrock, brown Rendzina soils and brown forest soils eroded on siliceous bedrock, and the sites of abandoned vineyards. Species: Brachypodium pinnatum, Bromus erectus agg., Danthonia alpina, Stipa tirsa. Other characteristic species: Adonis vernalis, Aster amellus, Aster lynosiris, Avenula pubescens, Centaurea sadleriana, Cirsium pannonicum, Dianthus pontederae, Dorycnium herbaceum, Festuca valesiaca, Geranium sanguineum, Inula ensifolia, Inula hirta, Inula salicina, Jurinea mollis, Linum flavum, Linum tenuifolium,

Peucedanum cervaria, Polygala major, Pulsatilla grandis, Rosa gallica, Teucrium chamaedrys, Thymus pannonicus.

Natural condition: most of the stands are in a favourable natural condition, stabilised and free of alien species (TDO=4), but there are occasional stands of poorer natural condition (TDO=3).

Threats: The main threats to the maintenance of good natural conditions are scrub encroachment by bearded buckthorn, celandine, frost, and monocotyledonous hawthorn. Vegetation encroachment, such as the proliferation of Geranium sanguineum, is also a negative factor, as it leads to species depletion. Some stands are threatened by the expansion of acacia. Sometimes wild boar grazing also occurs in such grasslands.

5.2.9. Slough grassland, grassland with cohesive soils (H5a)

Natura 2000 habitat type: Subpannonian steppe (6240)

Coenotaxon(s): Salvio nemorosae-Festucetum rupicolae Zólyomi ex. Soó 1964, Cynodonti-Poëtum angustifoliae Rapaics ex. Soó 1957

Occurrence: Scattered in the south-western part of the Büsöny area, mainly on the mountain rim of the Ipoly valley and on the north-western edge of the Márianosztrai basin. The stands range from less than 1 ha to several hectares (e.g. Panholc, Bizmet Rét, Galla Tisza, under the Nostrai edges). It is also found in the South-Börzsöny, e.g. in the Mill Valley around the Ant Ditch.

General description: Closed dry grasslands of humus-rich soils formed on loess, loess-sand, clay-marsh, and calcareous-sandy slate of the Upland. In the past, most of them were used for grazing, which led to the proliferation of pine grass. Such grasslands are generally not very species-rich, with disturbance-tolerant dry grassland elements rather than the rarer, more valuable specialist species. Conservation species: Festuca rupicola, Festuca valesiaca, Bothriochloa ischaemum, Brachypodium pinnatum, Elymus hispidus, Poa angustifolia, Arrhenatherum elatius. Other typical species: Adonis vernalis, Agrimonia eupatoria, Aster lynosiris, Centaurea sadleriana, Chamaecytisus austriacus, Dianthus collinus, Filipendula vulgaris, Fragaria viridis, Gentiana cruciata, Inula germanica, Inula oculus-christi, Iris variegata, Knautia arvensis, Lathyrus pannonicus, Linum hirsutum, Linum tenuifolium, Nepeta nuda, Phlomis tuberosa, Rosa gallica, Salvia nemorosa, Salvia pratensis, Stipa tirsa, Teucrium chamaedrys.

Natural condition: the majority of the stands are in a favorable natural condition, dominated by Festuca species and free of alien species (TDO=4). This is the case, for example, for the majority of the Galla's Mistletoe. The stands are moderately degraded (TDO=3), with weedy, species-poor stands, saturated with species that are tolerant to disturbance and heavily shrubby stands.

Vulnerability: Many stands, which are no longer used, are threatened by scrub encroachment, resulting in the conversion of the habitat into thickets of Rosa canina, Prunus spinosa, Crataegus monogyna, Cornus sanguinea, etc. Such grasslands are also frequently threatened by white acacia invasions from nearby upland acacia woodlands. Wild boar encroachment often results in an overgrowth of Calamagrostis epigeios, which inhibits the natural regeneration of the grassland. The species-rich, valuable grassland of the Galla plateau is under threat from increased wild trampling due to the scattering of the grass almost in the middle.

5.2.10. Shade-tolerant open rock vegetation (I4)

Natura 2000 habitat type: not comparable

Coenotaxon(s): Hypno-Polypodietum Jurko et Peciar 1963, Ribeso alpini-Rosetum pendulinae Sádlo 1991 (only with Ribes uva-crispa)

Occurrence: Throughout the whole mountain range, but predominantly in the north-facing rock outcrops, rock faces and rocky valleys of the Central Beech (Barsi beech, Drínó valley, Haramia-lik, Hegyes-hegy-slope, Raven-rock, High-Tax, Nagy-Hideg-Mountain, Great-Mana-peak, Great-Varsa-peak, Dobó peak, Pleska-rock, Rosy-valley, Eagle's Nest-peak, Castle-peak, etc.), always a habitat type with small stands.

General characterization: It occurs in an altitudinal zone of 300-900 m above sea level, on siliceous bedrock, on rocky-rocky subsoil, predominantly exposed to the north, on shaded, hollow rock outcrops with a slope angle of 60-80° (90°), on rock faces, rubble slopes, and gorge valleys. Typically occurs in small patches of a few tens to a few hundred square meters. The habitat is usually embedded in surrounding beech or rocky-soil forests. The moss-grass layer is well developed. The species-poor grassland cover is variable, being more developed in patches and sparse elsewhere. It may also have a shrub layer. They are predominantly natural in origin, but also occur secondarily in abandoned quarries and on unforested rocky outcrops after previous cutting. The dominant species may be Polypodium vulgare, P. interjectum (the frequency of the latter needs to be clarified), Rosa pendulina (Great Varsa Pit), Hypnum cupressiforme, Dicranum scoparium. Other typical species are Asplenium septentrionale, A. trichomanes, Cystopteris fragilis, Dryopteris filix-mas, Sedum maximum, Scrophularia vernalis, Valeriana officinalis ssp. sambucifolia, Cotoneaster niger, Euonymus verrucosus, Hedera helix, Ribes uva-crispa, Rubus idaeus.

Conservation status: Most of the stands (although essentially a species-poor habitat type) have favorable conservation status. Patches more heavily disturbed by the game animals are classified as moderately degraded.

Vulnerability: Generally a habitat type with low vulnerability due to the difficult accessibility of rocky outcrops. Overstocking by a large game (mouflon, deer) (grazing and trampling) mainly disturbs stands including Rosa pendulina. It is occasionally (rarely) threatened by the end-use of encroaching forests, although these are mostly classified as protected forests. Invasive species are not yet a threat.

Other open (grassland) habitat types:

- Stagnant and slow-moving aquatic seaweed vegetation (Ac)
- Ditch and marsh tall fescue, shade-shrub marginal vegetation (D6)
- Riparian and marsh tall fescue (D5)
- Uncharacteristic unlogged wetlands (OA)
- Undistinguished grassland (OB)
- Undistinguished dry to semi-arid grasslands (OC)
- Herbaceous drift species stands (OD)
- Tall ruderal weeds (OF)
- Trampled weeds and ruderal mudflats (OG)
- Non-native shrub or Japanese knotweed dominated stands (P2c)

Literature:
„Assuring quality in grassland management with a goal-oriented database"
https://www.interreg-central.eu/Content.Node/Centralparks/Centralparks-CE1359-O.T2.1-Joint-strategic-document-on-ra-5.pdf
Forest state evaluation SH4/13 project - http://karpatierdeink.hu/eng/1-feladatcsomag
ÉNÁR 2011: https://www.novenyzetiterkep.hu/eiu2011

Further reading:
https://www.interreg-central.eu/Content.Node/Centralparks/D.T2.2.4-Grassland-state-evaluation-1.pdf

Chapter 6: Forest fauna evaluation

6.1. Birds (Aves)

Nearly half of the members of the Hungarian bird fauna (440 species) occur more or less regularly in the Börzsöny Mountains. The number of regularly or occasionally nesting species is around 120. However, species richness is severely limited by the fact, that except for a few smaller stagnant waters, typically of artificial origin or maintenance, there is virtually no wetland in the area.

Börzsöny is a somewhat neglected or rather misunderstood area in Hungarian ornithological research. In the decades before the turn of the millennium, the mountains were recognized solely in terms of birds of prey species (Nagy 1998, Varga et al. 1999). In addition to the small number of informative publications, the research material processing the entire avifauna (manuscript type) was produced only during the preparation of the Danube-Ipoly National Park, but its emphasis also reflects the previous approach (Vojnits 1993). Other bird species previously considered valuable from a conservation point of view, such as Tetrastes bonasia, Cinclus cinclus, or Monticola saxatilis, can only be traced back to the establishment of the Börzsönyi Landscape Protection Area almost half a century ago. Unfortunately, the most recent scientific publication on zoology (Vojnits - Csóka 2014) also provides little support, and the validity of the information contained in it is almost four decades old.

In recent decades, how professional data is published has also changed. Instead of written and classically referenced literature regarding Hungarian field birds, also observation data via a website are published. Accordingly, the source of the faunistic data of the bird species is the interactive Internet ornithological database operated by the Pest District Ornithological Circle (PKMK): http://www.birding.hu (with data between 2000–2020; 6009 data) and the Danube-Ipoly National Park Directorate biotic database (OBM - status as of June 2, 2020; 26,842 data).

The bird species occurring in the design area come from 13 fauna areas. Nearly half of the species (40%) are palearctic fauna, but European and European-Turkestan species are also present to a significant extent (32% in total). Holarctic (9%) and Old World (6%) elements are much smaller, and the species of the remaining fauna areas all account for less than 5%.

According to the latest data sheets of the International Union for Conservation of Nature (IUCN), the bird species in Börzsöny belong to the Least Concern category, except for four species. The red kite (Milvus milvus) and the bald eagle (Circus macrourus), which are very rare in the design area, are classified in the Near Threatened (NT) category. Both the great goda (Limosa limosa) and the formerly regularly nesting saker falcon (Falco cherrug), which has been a rare guest in recent decades, both fall into the Vulnerable category.

According to the system of BÁLDI et al. (1995), the endangerment of the Hungarian bird fauna allows for a much more detailed approach. According to its classification, 19 of the 34 bird species among the 74 most endangered terrestrial vertebrates in Hungary have been confirmed in the planning area so far. Among the species that are slightly better than these but still highly endangered (protected and/or of Community importance) are 32 species. A total of 26 species are considered to be moderate and 62 species are considered to be at low risk.

Table 4: The most important bird species from the Börzsöny Mountains sub-area of the DINPD. Abbreviations: SP: strictly protected, P: protected, BD: Bird Directive.

Name	Scientific name	Level of protection	Nature conservation value (HUF)	BD Annex	Priority
Black Stork	*Ciconia nigra*	SP	500000	I.	2
European Honey Buzzard	*Pernis apivorus*	SP	100000	I.	3
Red Kite	*Milvus milvus*	SP	500000	I.	2
White-Tailed Eagle	*Haliaeetus albicilla*	SP	1000000	I.	2
Short-toed Snake-eagle	*Circaetus gallicus*	SP	1000000	I.	2
Lesser Spotted Eagle	*Clanga pomarina*	SP	1000000	I.	2
Imperial Eagle	*Aquila heliaca*	SP	1000000	I.	2
Golden Eagle	*Aquila chrysaetos*	SP	500000	I.	2
Saker Falcon	*Falco cherrug*	SP	1000000	I.	2
Peregrine Falcon	*Falco peregrinus*	SP	500000	I.	2
Corn Crake	*Crex crex*	SP	500000	I.	2
Stock Dove	*Columba oenas*	P	50000	II.	3
Eurasian Eagle-Owl	*Bubo bubo*	SP	500000	I.	2
Ural Owl	*Strix uralensis*	SP	100000	I.	3
Black Woodpecker	*Dryocopus martius*	P	50000	I.	3
Middle Spotted Woodpecker	*Dendrocopte s medius*	P	50000	I.	3
White-backed Woodpecker	*Dendrocopo s leucotos*	SP	250000	I.	2
Gray Wagtail	*Motacilla cinerea*	P	50000	0	3
White-throated Dipper	*Cinclus cinclus*	SP	500000	0	2
Common Firecrest	*Regulus ignicapilla*	P	25000	0	3
Red-breasted Flycatcher	*Ficedula parva*	SP	100000	I.	2
Collared Flycatcher	*Ficedula albicollis*	P	25000	I.	3
Common Raven	*Corvus corax*	P	50000	0	3
Rock Bunting	*Emberiza cia*	SP	100000	0	3

Bird species of national importance (priority = 2)

- Black Stork (Ciconia nigra): Its domestic population is 350–400 pairs, of which 3–8 pairs nest in the Börzsöny. It prefers closed, large-scale forest stands with stream valleys.
- White-Tailed Eagle (Haliaeetus albicilla): A domestic population of around 300 pairs is on the rise. In recent years, it has appeared as nesting in the mountains: a couple nests near Hont.
- Short-toed Snake-eagle (Circaetus gallicus): 1-2 pairs of the domestic population of barely 50 pairs nest regularly in the mountains.

- Imperial Eagle (Aquila heliaca): its domestic population of around 200 pairs is also significant in Europe. The last domestic nesting pair lives in Börzsöny in a mountainous area.
- Peregrine Falcon (Falco peregrinus): This cosmopolitan species has been breeding in Hungary since 1997. The species was one of the first to settle in Börzsöny, where it has been present in increasing numbers ever since. 10% of the Hungarian population of 50–70 pairs live in the mountains.
- Eurasian Eagle-Owl (Bubo bubo): Only 80 pairs are known in the country, of which 3–5 pairs nest in Börzsöny. It is a bird of rocky habitats, abandoned mines, but in some places, it is also believed to spend time in twig nests.
- White-backed Woodpecker (Dendrocopos leucotos): a significant part of its domestic population of about 250–750 pairs (approx. 100–120 pairs) lives in Börzsöny. At the domestic level as well, it is one of the most important highly protected species in the mountains, the preservation of which is a primary task.
- Red-breasted Flycatcher (Ficedula parva): 40–65 pairs live in Hungary. Börzsöny is the most important area for the species, the population here is 30–50 pairs. It is also a dominant species at the domestic level; the protection of its habitats is of paramount importance.

Bird species of regional importance (priority = 3)

- European Honey Buzzard (Pernis apivorus): 5–7% of the domestic population of 800–1,000 pairs spends in Börzsöny, mainly in oaks.
- Stock Dove (Columba oenas): Its domestic population is around 10,000 pairs. A common species of the beech zone of Börzsöny, a significant part of the Hungarian population lives here.
- Ural owl (Strix uralensis): Its domestic population fluctuates between 100 and 300 pairs, 10% of which can be found in Börzsöny. It is a bird in the beech zone, but its feeding requires grasslands wedged between forests.
- Black Woodpecker (Dryocopus martius): Part of its domestic population of about 10,000 pairs lives in Börzsöny. It is a common species that spend mainly on beeches and beech-mixed stands.
- Middle Spotted Woodpecker (Dendrocoptes medius): has a domestic population of 16,000–22,000 pairs. It is a typical and common species of the oak forests of Börzsöny, indicating the quality of the habitat.
- Gray Wagtail (Motacilla cinerea): 300–600 pairs live in Hungary and the min. 10–20% in Börzsöny. Habitat quality indicators are found in almost all watercourses.
- Common Firecrest (Regulus ignicapilla): over 10% of the domestic population of 400–500 pairs nest in Börzsöny. The population is attached to the planted European spruce forests.
- Collared Flycatcher (Ficedula albicollis): A significant part of the domestic population of 76,000–81,000 pairs lives in the mountains. It is also a common breeding species in beeches and oak-dominated stands.
- Common Raven (Corvus corax): 4,000–6,000 pairs live in Hungary. It is a common nesting species in Börzsöny, but we do not have accurate data on its population. It nests mainly in the beech zone, it typically prefers undisturbed forest stands.
- Rock Bunting (Emberiza cia): 10–20% of the domestic population of 500–750 pairs live in Börzsöny. Nesting of rocky habitats and andesite grasslands.

6.2. Mammals (Mammalia)

Hedgehoges (Erinaceomorpha)

The only local species listed here, the Northern white-breasted hedgehog (Erinaceus roumanicus), which occurs sporadically in the deciduous forests and more open habitats of Börzsöny, is a protected but non-community interest species and has no special nature conservation significance.

Shrew-forms (Soricomorpha)

Species in the area of Börzsöny (based on captures, visual observations, and owl sputum analyzes) have been confirmed. These are mostly species that live hidden and are active at night, moving in the soil and algae level, in dense riparian vegetation, or underground. Our knowledge of their occurrence and frequency in the area is therefore relatively incomplete. Shrews usually avoid closed forests but are more likely to be found in open and mosaic habitats, grasslands, bushes, wooded stands (in the vicinity of mountain ranges, and the vicinity of the internal clearing meadows of Börzsöny). While bicolored shrew (Crocidura leucodon) and Lesser white-toothed shrew (Crocidura suaveolens) occurs in relatively drier habitats, common shrew (Sorex araneus) occur in dwarf terns, marshy meadows, highland meadows, and various wetlands. The Eurasian water shrew (Neomys fodiens) also lives close to water, living in the vicinity of forest lakes, small water bodies, and water-bearing alders (partly also penetrating the surrounding forests). Finally, important to note is the presence of the European mole (Talpa europaea), which is widespread in Hungary, and which can be found everywhere in the grasslands and forests of Börzsöny (except for the rocky parts).

A total of 6 protected species are known to occur in the design area, but none of them are highly protected and of common importance. Based on the evaluation (prioritization) performed based on domestic occurrences and frequency data, only 1 species may have a special nature conservation significance.

Table 5: The most important conservation species of the Börzsöny Mountains subdivision of DINPD.
Abbrevtion: P: protected, HD: Habitat Directive

Name	Scientific name	Level of protection	Nature conservation value (HUF)	HD Annex	HD Annex: level of Priority
Eurasian water shrew	*Neomys fodiens*	P	50,000	0	0

Bats (Chiroptera)

A total of 24 protected and/or Community importance bat species are known to occur in the design area, including 6 highly protected species - Mediterranean Horseshoe Bat (Rhinolophus euryale), Greater Horseshoe Bat (Rhinolophus ferrumequinum), Western barbastelle (Barbastella barbastell), Bechstein's bat (Myotis bechsteinii), Pond bat (Myotis dasycneme), truncated-eared bat (Myotis emarginatus). (All bat species are protected in Hungary!) 9 species of community importance are present, in addition to the already mentioned highly protected species, they also include the Lesser horseshoe bat (Rhinolophus hipposideros), the Lesser Mouse-eared bat (Myotis blythii), and the Greater mouse-eared bat (Myotis myotis). Based on the evaluation (prioritization) based on the Hungarian

occurrences and frequency data, a total of 16 species have a special nature conservation significance.

Table 6. The most important bat species in the Börzsöny Mountains subdivision of DINPD.

Name	Scientific name	Level of protection	Nature conservation value (HUF)	BD Annex	Priority
Mediterranean Horseshoe Bat	Rhinolophus euryale	FV	250,000	II., IV.	2
Greater Horseshoe Bat	Rhinolophus ferrumequinum	FV	100,000	II., IV.	3
Lesser horseshoe bat	Rhinolophus hipposideros	V	50,000	II., IV.	3
Western barbastelle	Barbastella barbastellus	FV	100,000	II., IV.	3
Alcathoe bat	Myotis alcathoe	V	50,000	IV.	3
Bechstein's bat	Myotis bechsteinii	FV	100,000	II., IV.	3
Lesser Mouse-eared bat	Myotis blythii	V	50,000	II., IV.	3
Brandt-denevér	Myotis brandtii	V	50,000	IV.	3
Pond bat	Myotis dasycneme	FV	100,000	II., IV.	3
Geoffroy's bat	Myotis emarginatus	FV	100,000	II., IV.	3
Whiskered bat	Myotis mystacinus	V	50,000	IV.	3
Natterer's bat	Myotis nattereri	V	50,000	IV.	3
Kuhl's pipistrelle bat	Pipistrellus kuhlii	V	50,000	IV.	3
Soprano pipistrelle	Pipistrellus pygmaeus	V	25,000	IV.	3
Brown long-eared bat	Plecotus auritus	V	50,000	IV.	3
Parti-colored bat	Vespertilio murinus	V	50,000	IV.	3

Hares and rabbits (Lagomorpha)

Of the 2 domestic species of rabbits and hares, only the European hare (Lepus europaeus) lives in Börzsöny. Its specimens are mainly found in open or mosaic habitats on the outskirts of the mountains, but they also appear sporadically inside the mountains. Hares and rabbits are considered game species in Hungary.

Rodents (Rodentia)

A total of 6 protected rodent species and/or species of community importance are known to occur in the design

area, including 1 highly protected species, the Forest dormice (Dryomys nitedula). Of the species of Community importance, 1 species is present, namely the Eurasian beaver (Castor fiber). Based on the evaluation (prioritization) based on domestic occurrences and frequency data, only 2 species have a special nature conservation significance.

Table 7: The most important rodent species in the Börzsöny Mountains subdivision of DINPD. Abbrevations: P: protected, SP: strictly protected, BD: Bird Directive.

Name	Scientific name	Level of protection	Nature conservation value (HUF)	BD Annex	Priority
Eurasian beaver	*Castor fiber*	P	50,000	II., IV.	3
Forest dormice	*Dryomys nitedula*	SP	100,000	0	2

Carnivores (Carnivora)

There are up-to-date data on the permanent or intermittent occurrence of a total of 7 protected species and/or species of Community importance in the design area, including 5 highly protected species: gray wolf (Canis lupus), wild cat (Felis silvestris), Eurasian otter (Lutra lutra), Eurasian lynx (Lynx Lynx), brown bear (Ursus arctos) are species of community importance, except the wildcat. Based on the evaluation (prioritization) based on the Hungarian occurrences and frequency data, a total of 4 species have a special nature conservation significance.

Table 8: The most important predatory species in the Börzsöny Mountains subdivision of DINPD. Abbrevations: SP: strictly protected, BD: Bird Directive.

Name	Scientific name	Level of protection	Nature conservation value (HUF)	BD Annex	BP Annex level of Priority
Wild cat	*Felis silvestris*	SP	250,000	IV.	3
Eurasian lynx	*Lynx lynx*	SP	500,000	II., IV.	2
Grey wolf	*Canis lupus*	SP	250,000	II., IV.	2
Brown bear	*Ursus arctos*	SP	250,000	II., IV.	2

Even-toed ungulates (Artiodactyla)

Among the species belonging to the taxonomic unit, no protected and/or species of community importance occur in the area of Börzsöny. The species to be included are the wild boar (Sus scrofa), roe deer (Capreolus capreolus), red deer (Cervus elaphus), mouflon introduced in the 1960s (Ovis aries musimon), and, more recently, the fallow deer (Dama dama) from the surrounding hills. Game species that can be hunted, which cause nature conservation problems mainly due to their habitat use and increased population.

6.3 Saproxylic fauna

Results Species numbers, protected and NAT 2000 marker species During the survey, 1190 data on a total of 107 saproxylic species, of which 38 are protected, including 6 NATURA 2000 marker species, have been recorded. Furthermore, 13 occurrences of 6 protected but not saproxylic beetle species have been recorded.

Table 9: Protected saproxylic beetle species found during the research

Scientific name	Level of protection	Number of specimen
Acmaeodera degener	protected	2
Aegosoma scabricorne	protected	14
Aesalus scarabaeoides	protected	36
Akimerus schaefferi	protected	1
Ampedus quadrisignatus	protected	2
Camptorhinus simplex	protected	1
Cerambyx cerdo	protected, Natura 2000 species	141
Cerambyx scopolii	protected	5
Cerambyx welensii	protected	1
Coraebus fasciatus	protected	10
Cucujus cinnaberinus	protected, Natura 2000 species	29
Dicerca berolinensis	protected	59
Dorcus parallelipipedus	protected	73
Elater ferrugineus	protected	7
Eurythyrea quercus	protected	77
Gasterocercus depressirostris	protected	3
Gnorimus variabilis	protected	19
Kisanthobia ariasi	protected	1
Lacon querceus	protected	14
Lamprodila rutilans	protected	3
Limoniscus violaceus	protected, Natura 2000 species	36
Lucanus cervus	protected, Natura 2000 species	67
Necydalis ulmi	protected	3
Oryctes nasicornis	protected	1
Platycerus caraboides	protected	3
Protaetia aeruginosa	protected	38
Protaetia affinis	protected	4
Protaetia fieberi	protected	4
Protaetia marmorata	protected	10
Purpuricenus kaehleri	protected	2

Rhysodes sulcatus	protected, Natura 2000 species	2
Rosalia alpina	protected, Natura 2000 species	215
Saperda octopunctata	protected	16
Saperda scalaris	protected	23
Schizotus pectinicornis	protected	7
Sinodendron cylindricum	protected	29
Tenebrio opacus	protected	13
Trichoferus pallidus	protected	2

Approximately 50% of the measured data are from selected, data-deficient fauna patches, and some of the data are from one-hectare sample areas generated during or outside fauna patches during access to these areas.

Important species for the fauna evaluation

A significant part of the protected species found (38) are not rare beetles and are relatively easy to find based on their knowledge of their habitat. Based on the data of the Rolsalia longicorn (Rosalia alpina) 215, the Great capricorn (Cerambyx cerdo) 141, or the Great capricorb l 67, we can assume that where there is a suitable habitat for them, their stable population occurs. The violet click beetle (Limoniscus violaceus), previously known from a small number of sites, now has some sites in Börzsöny, and data from 36 transects has been collected during the present research. Several protected species may be trapped en masse in red wine, but the application of this collection method was not the task of current research. Although all species of saproxylophagous species (Gnorimus variabilis, Protaetia aeruginosa, P. affinis, P. fieberi, P. marmorata) were found in Börzsöny (Fig. 9), they can be detected much more reliably and from several areas with wine traps.

Figure 9: Protaetia aeruginosa, P. fieberi, P. marmorata and P. affinis

This is also true for the protected long-horned beetle species Trichoferus pallidus, the Purpuricenus kaehleri (Figure 10), and the protected species, which provide a lot of data without trapping, i.e. the great longhorn beetle (Cerambyx cerdo), the European stag beetle (Lucanus cervus), and the Rosalia longocorn (Rosalia alpine).

Figure 10: long-horned beetle species Trichoferus pallidus and Purpuricenus kaehleri

The above is also proved by the fact that the wine traps of Nagymaros captured almost all valuable saproxylic species that can be collected by this method in 2021. The repeated lack of the Rhysodes sulcatus (Figure 11) from the Natura 2000 marker species, which pursues a hidden lifestyle from the Szokolya: Iron Pot Valley and its new occurrence data from the Diósjenő: Nyír-meadow is a significant faunistic result.

Figure 11: Rhysodes sulcatus in its habitat at Vasfazék valley

Furthermore, the Olexa thorn-necked beetle (Hylis olexai) was also found in the Vasfazék Valley (Figure 12), which has only a few domestic data from Börzsöny. On the last day of the research, the typically early autumn false beetle (Hallomenus binotatus) was found (Figure 12), which occurs only sporadically in Hungary.

Figure 12: Hylis olexai and Hallomenus binotatus

During the research, the European toothed beetle (Prostomis mandibularis) was found in three areas (Perőcsény: Csarna stream valley, Perőcsény: Drinó stream valley, Nagymaros, Szent-Mihály saddle) (Fig. 13), a rarity known in Börzsöny since 2021. Together with its larvae, it occurs in red rotting stumps.

Figure 13: Larvae and imago of Prostomis mandibularis

The protected Four-spotted click beetle (Ampedus quadrisignatus) (Figure 14) is sporadically known from the mountains, but its two recent occurrence data are also valuable results. This also applies to the Necydalis ulmi which develops in oak and beech horns, and its data on two dead specimens are an important faunistic result. The larvae of the Reitterelater dubius (Figure 15) were found in two places (Letkés: Nagy-Galla, Kemence: Nagy-Oros-peak). This species, like the usty click beetle (Elater ferrugineus), develops in large-volume bogs, typically those where many flowering beetle larvae have lived for a long time, and their feces and chewing grinding forms a thick layer at the bottom of the burrow. It has been found several times in Hungary and abroad in a nest where the scarab beetle (Osmoderma barnabita) lives (Németh et al 2016).

Figure 14: Ampedus quadrisignatus and larvae

Figure 15: Reitterelater dubius and larvae

The larvae of the rusty click beetle (Elater ferrugineus) were found in 7 sites, while the larvae of the click beetle (Lacon querceus) were found in 14 sites.

Figure 16: Elater ferrugineus and larvae

Figure 17: Lacon querceus and its larvae

The plain weevils (Camptorhinus simplex) (Fig. 18) have only small occurrence data in the mountains. The rare and protected species, which also flies well in the light, from the dry oak forest near Kemnce has been recorded on June 11th.

Figure 18: Camptorhinus simplex

The Eurythyrea quercus is a nationally rare species but is more and more extensive in faunistic surveys, and it appears that it is found in most of our sunny, dead-tree-rich, older oak forests. The 77 occurrence data collected during the research refer to outflows on barkless oak in all cases except for one dead animal. Much less data is known about the Acmaeodera degener. Although the Cucujus cinnaberinus is not a rare species, it is mainly characteristic of our softwood groves and planted poplar forests. In the course of the research, It has been found relatively rarely in deadwood, yet 29 larval occurrence data were found, mainly from under linden and beech bark. The larva of the Schizotus pectinicornis lives in a similar habitat, the characteristic larvae of which were encountered 7 times.

Figure 19: Larvae of the Pyrochroa coccinea and Schizotus pectinicornis in the same habitat under the beech bark and Cucujus cinnaberinus larvae under the lime bark

From a beetle faunistic point of view, a notable result has been obtained that can be attributed to non-saproxylic beetles. Within the administrative boundary of Kemence, a previously unknown beetle species from the Meloidae family was found on the rocky grasslands near the Asztal-Kő Mountain. The Stenoria analis, which occurs in several European countries, develop in the nest of bee species and is active in late summer. Without this assignment, the fauna of Hungary would not have been enriched with this species, a publication on the beetle is expected at the end of 2021 (under evaluation).

The faunistic data collection, which requires a lot of expertise and time, should be continued, especially in the older forest stands, as this way we can get an increasingly accurate picture of the beetle fauna of the mountains.
By further fine-tuning the sampling protocol used, a methodology that examines this difficult target group can be developed. Without having to rely on extremely difficult-to-determine absent data, the occurrence of individual species can be indicated by more complex habitat definitions. Furthermore, the recorded data, together with the data from the forest condition surveys, can provide a complex picture of each area.

As a result, all the promising habitats were surveyed for the study. Pursuing further faunistic studies should be encouraged. There is a good chance that valuable and interesting species can be found in these areas. The older oak forest wih a sunny and steep hills, with the presence of dead-wood, should be the main focus of the further studies, where the beetle species found in such habitats would almost certainly occur using the wine trap method. Especially, the more closed, older beeches and debris slopes with many different types of deadwood, where valuable species can be found with a detailed search from autumn to early spring.

Literature:

MERKL O. 2016: Az „Erdei életközösségek védelmét megalapozó többcélú állapotértékelés a magyar Kárpátokban" című, a Svájci-Magyar Együttműködési Programban nyertes pályázat (SH/4/13) keretén belül a holtfához kötődő bogárfajok felméréséről a Börzsönyben és a Mátra kiválasztott részein. Kutatási jelentés.
NÉMETH T., LAUŠ B. & TALLÓSI B. 2017: New distributional data on Elateroidea (Elateridae and Eucnemidae) for Albania, Bulgaria, Croatia, Greece, Macedonia, Montenegro and Serbia. – Folia entomologica hungarica 78: 47–56.

Further reading: https://www.interreg-central.eu/Content.Node/Centralparks/D.T2.2.5-Forest-fauna-evaluation.pdf

Chapter 7: Case study on developing new management policies

In the summer of 2021, the DINPD initiated a change of management of a forest compartment (code: Nagybörzsöny 80/B, main species: sessile oak and beech; average age: 80 years, area: 9,27 ha, estimated volume: 360 m3/ha) at the state forest enterprise (managing unit: Forestry of Nagymaros) to introduce ecologically more responsible management methods, than the usual shelterwood system. This compartment has been selected because one of the main problems in the Börzsöny Mountains is that the forests are mainly even-aged, mostly around 100 years old (widespread clear cuts were carried out at the beginning of the 20th century), and the present management method (shelterwood system) is just re-creating this problem for the future. Besides the large, undisturbed, unmanaged patches and remnant groups, continuous cover forestry is equally important to create heterogeneous stands and landscapes.

During several field examinations, involved national park staff, together with foresters explored the forest, made several maps and planned a selection-cutting, which duration is 40 years instead of the usual 10 years used at the shelterwood system.

The forest inventory has been created with the Bitterlich-relaskop. The most plannable way seemed to be using small sub-compartments, on which the cutting is executed in two steps; first an uneven preparatory-cutting (around 40-50%), then a clearcut (after 5 years). The compartment was divided into 37 sub-compartments (average area: 0,25 ha), one of these is planned to be a remnant stand (age at 2100 is 180 years), but the detailed planning was calculated with the abandonment of the stands beside the creek after the first cut, to create an uneven, microhabitat-rich environment.

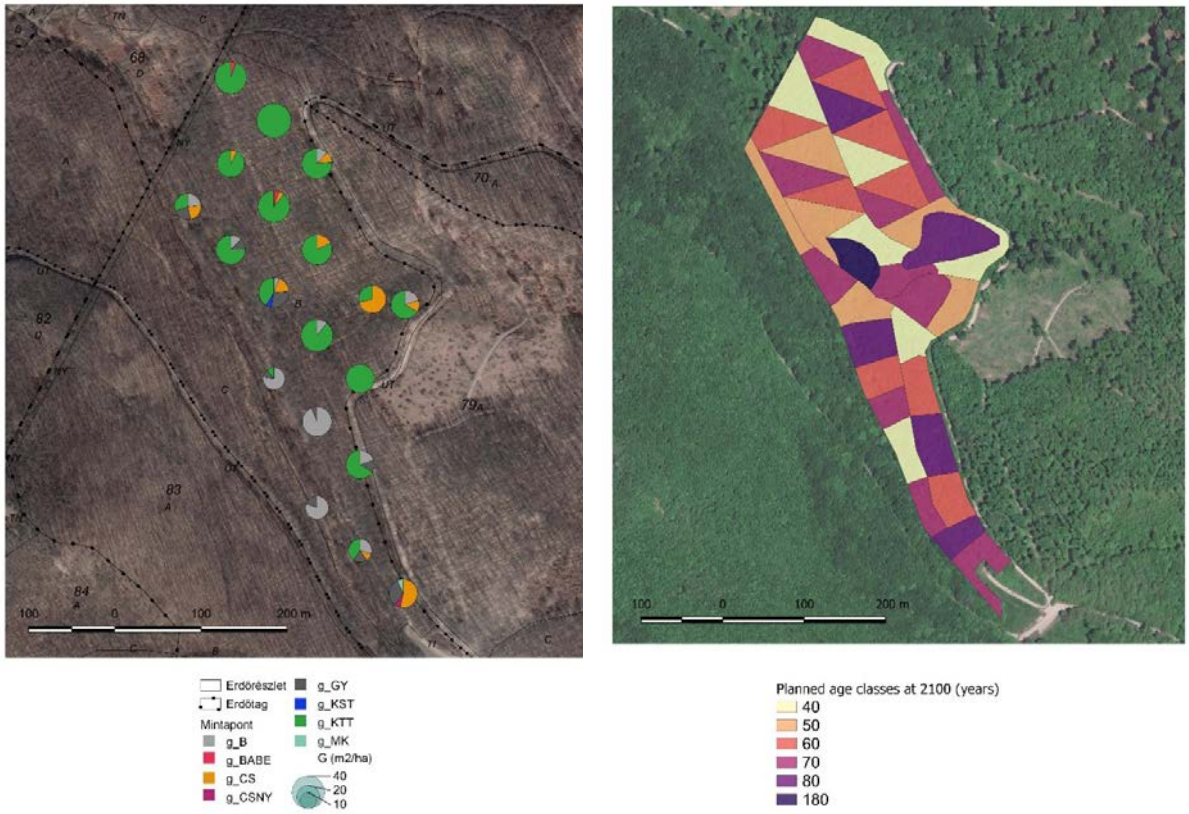


Figure 20: Left: results of the basal-area measurements (G; tree species: B: beech, BABE: wild service, CS: turkey oak, CSNY: wild cherry, GY: hornbeam, KST: pedunculate oak, KTT: sessile oak, MK: ash). Right: sub-compartments and predicated ages at 2100.

The first cuts were made in the autumn of 2021, in 5 sub-compartments, and the results were satisfying for the forestry from the financial perspective. The volume achieved the planned level, and the costs were not very high. The next cutting is planned to be carried out in 2026 when the 5 thinned sub compartments will be cut down, and in new 8 sub compartments will be thinned.

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