PROJECT SUMMARY FOR BJESHKËT E NEMUNA / ZALLI I RUPES, KOSOVO

EU4Green: Support the implementation of the Green Agenda for the Western Balkans

WP1-16: Biodiversity: Integrated Management of Floodplains in Protected Areas

Deliverable WP1-16_Del-1 Project summary for each study area of the 6 economies

February 2026

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Project Summary for Bjeshkët e Nemuna / Zalli I Rupes, Kosovo[1]

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CONTENT

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ABBREVIATIONS

CLC	CORINE Land Cover
CLC+B	CLCplus Backbone
EC	European Commission
EU	European Union
GIS	Geographic Information System
IUCN	International Union for Conservation of Nature
KOS[1]	Kosovo[1]
NbS	Nature-based Solutions
NGO	Non-Governmental Organisation
SDF	Standard Data Form for Natura 2000 sites
WB6	Western Balkans (Albania, Bosnia and Herzegovina, Kosovo[1], Montenegro, North Macedonia and Serbia)

[1] This designation is without prejudice to positions on status, and it is in line with UNSCR 1244 and the ICJ Opinion on the Kosovo* declaration of independence.

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PREFACE

The world of nature largely depends on the human factor, especially regarding the conservation of biodiversity. At the same time, human well-being depends on biodiversity. The Western Balkans (WB6) are engaged in efforts to safeguard biodiversity, striving to balance the demand for development with the necessity for environmental conservation.

The project EU4Green: Support the implementation of the Green Agenda for the Western Balkans (short: EU4Green) assists the WB6 – Albania, Bosnia and Herzegovina, Kosovo[1], Montenegro, North Macedonia, and Serbia – in greening their economies and in enhancing monitoring and reporting as well as aligning with the EU standards. It is also tightly linked to the Green Agenda for the Western Balkans (GAWB)[2]. The project includes different pillars, with one of them being biodiversity. Financed by the European Union (EUR 10 million) and the Austrian Development Agency (EUR 1 million), the project was implemented by the Environment Agency Austria in cooperation with public authorities and institutions of the WB6. The project was implemented from 2022 to 2025.

EU4Green Biodiversity activities placed their focus on floodplain ecosystems as they encompass a naturally high but threatened biodiversity and unique spatial and temporal variability, while providing important functions and services to landscapes and humans. Shaped by the rivers and the adjacent wetlands and floodplain forests, they are an important and characteristic natural feature of the WB6, in terms of nature conservation but also for recreation and (eco-)tourism. They are increasingly recognized as key assets for the Green Agenda for the Western Balkans. Providing biodiversity conservation, carbon storage, and climate resilience, they are the backbone of a sustainable landscape and its biological heritage. Their protection and restoration align with EU Directives and strategies, underscoring their role in regional ecological and rural development[3,4]. Yet, they are threatened by river regulation, land-use changes and pollution. Due to their many-faceted character, floodplain ecosystems need conservation measures that maintain their various functions in an integrative way, considering a wide range of different natural assets and their threats. Thus, they act as suitable case studies for training and applying methodologies related to nature conservation.

EU4Green Biodiversity activities provided such trainings and materials to support the WB6 in three thematic fields – species and habitats of Natura 2000 network, Nature-based Solutions, and connectivity. This report outlines the most important background information, used methodologies and achieved results and outputs of the covered topics for the case study of Kosovo[1] (KOS). Furthermore, the methods used for gathering all knowledge presented in this report can be transposed to other ecosystems, habitats and species.

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[2] EUROPEAN COMMISSION, 2020. Green Agenda for the Western Balkans. Brussels: European Commission. Available at: https://neighbourhood-enlargement.ec.europa.eu/system/files/2020-10/green_agenda_for_the_western_balkans_en.pdf
[3] EUROPEAN ENVIRONMENT AGENCY, 2019. Floodplains: a natural system to preserve and restore. EEA Report No 24/2019. Publications Office of the European Union, Luxembourg.
[4] EUROPEAN COMMISSION, 2020. An Economic and Investment Plan for the Western Balkans: Green Agenda for the Western Balkans. COM(2020) 641 final. Brussels: European Commission.

1. EU4GREEN'S PILOT SITE IN KOSOVO

The activities of the EU4Green project were conducted within six pilot sites – one in each economy (Figure 1), selected by the National Focal Points at the beginning of the project.

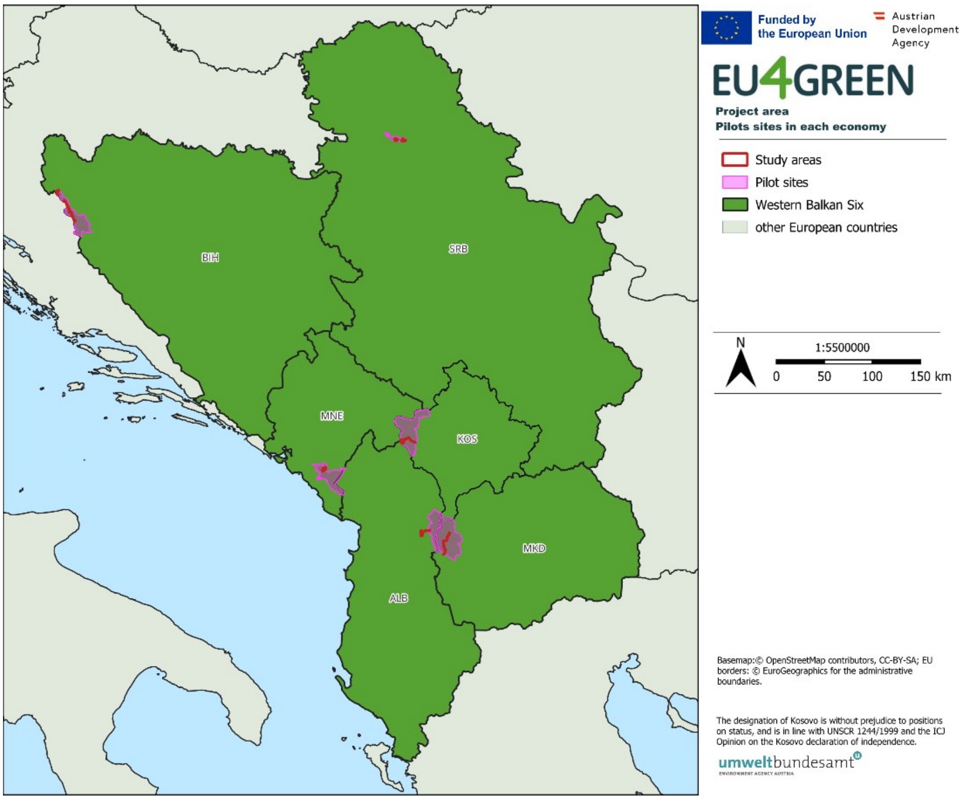

Figure 1 - The six pilot sites in the economies of the Western Balkans.

In Kosovo[1], the Bjeshkët e Nemuna National Park was chosen. It is the largest protected area of Kosovo[1], encompasses 63,000 ha and is also recognised as an Important Bird Area by BirdLife International. It was established in 2012. Located in the west of Kosovo[1], it protects the southernmost part of the Dinaric Alps. This mountain range, known as the Accursed Mountains, is covered by an impressive cross-border network of protected areas, consisting of Kosovo's[1] Bjeshkët e Nemuna National Park, Montenegro's Prokletije National Park and the Albanian Alpet e Shqipërisë National Park. The second highest peak of the Accursed Mountains, Gjeravicë, which has an elevation of 2.656 meters above sea level. It is the highest peak in the Republic of Kosovo* and part of the Bjeshkët e Nemuna National Park near the border of Albania.

The natural assets of the Bjeshkët e Nemuna National Park are shaped by the high amplitude in elevations, a diverse geomorphology and the influence of different climate zones. It is characterized by a high richness in fauna and flora. While deciduous forests cover the lower elevation, which is then replaced by coniferous forests and ultimately by pastures, meadows and alpine vegetation. More than 1,000 plant species were recorded in the national park so far, with at least 33 endemic species (a high fraction of glacial relicts) – numbers which are expected to increase with further research, particularly on non-vascular plants. Iconic animal species such as brown bears, Balkan lynxes and imperial eagles roam freely in areas with little or extensive anthropogenic influence. Species diversity of invertebrates is expected to be very high, too, with 129 species of butterflies recorded so far.

Throughout the national park, several Alpine creeks wind their way through rocky terrain, among them also the Lumbardhi i Deçanit river, which originates close to the Albanian border from the Bogiçevica mountain. After crossing the border of the national park right before flowing through Deçan, it continues its way through the lower lands, partly meandering, and feeds into the White Drin river. Its powers the Kožnjer hydroelectrical power plant. Known challenges in conservation are climate risks, construction of infrastructure and degradation of forests. Additionally, the human settlements suffer from floods, erosion and sedimentation.

Because each thematic field in EU4Green Biodiversity requires its own appropriate spatial scale, the analyses are conducted at different extents around the core study area or pilot site in Kosovo[1]. This ensures that the applied methods remain feasible and that the conclusions drawn from the elaborated outcomes are meaningful. As a result, each topic refers to a specific spatial extent and corresponding buffer zone (Figure 2Error: Reference source not found).

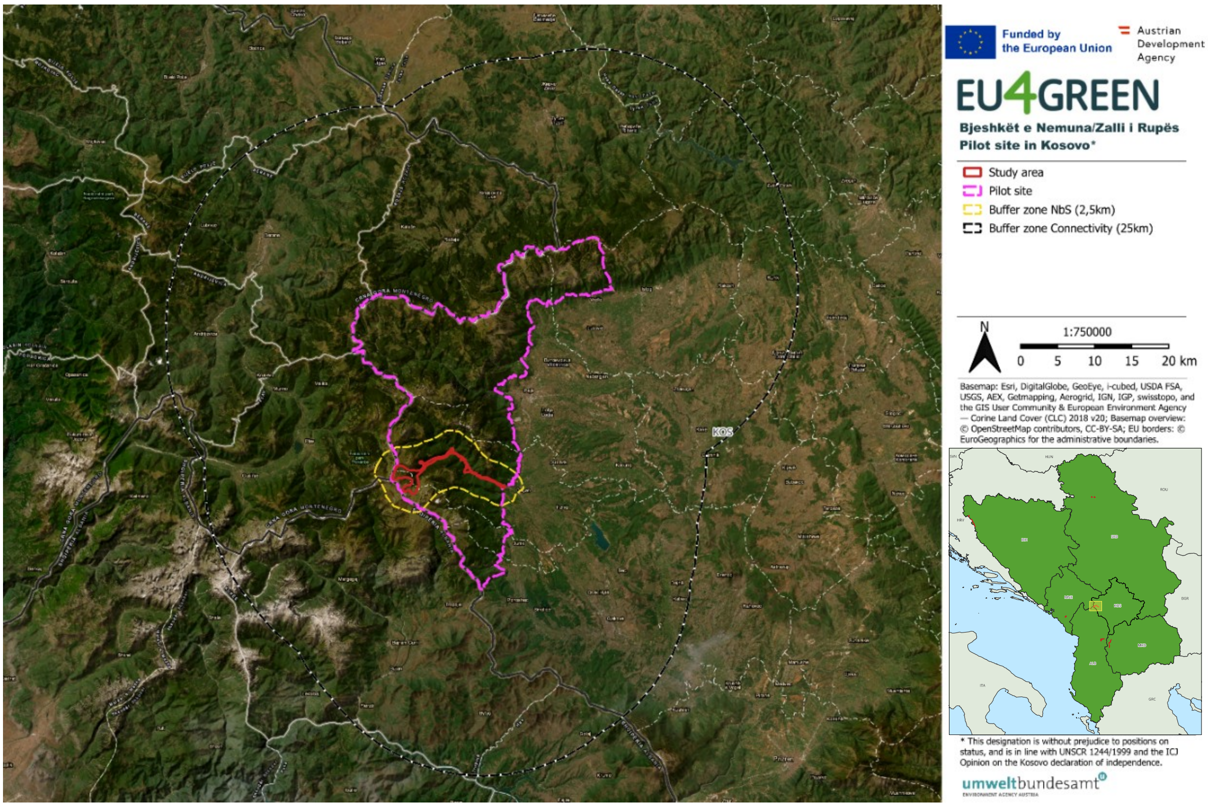

Figure 2**: The different spatial extents of the local activities carried out in and around Bjeshkët e Nemuna National Park (depicted in pink). The core study area for mapping species and habitats of Natura 2000 sites (chapter** Error: Reference source not found**, depicted in red) stretches along the river floodplain. The study area for Nature-based**

Solutions (chapter Error: Reference source not found**, depicted in yellow) was derived by adding a buffer around the core study area. The area assessed for connectivity (chapter** Error: Reference source not found**, depicted in black) was derived by adding a buffer around the national park's borders.**

2. CONNECTIVITY

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With contributions from: Philipp Semenchuk, EAA

2.1. Summary

The ecological connectivity of landscapes shapes species distribution, enables genetic exchange, and ensures long-term biodiversity conservation. In human-modified environments, habitat fragmentation threatens these processes, making the identification and preservation of ecological corridors essential. Protected areas risk isolation without connectivity to other relevant populations, ultimately reducing their effectiveness over time.

To address these challenges, a least-cost path analysis was performed to identify the 'cheapest' corridors based on resistance maps. Using CORINE Land Cover data, resistance values were assigned to land cover classes for two target land cover classes: Broad-leaved forest and Natural grasslands. The Bjeshkët e Nemuna National Park in Kosovo[1] served as the study site, with a 25 km buffer zone analysed for ecological connectivity of the two target land cover classes. **Results** show that Natural grasslands and Broad-leaved forests are well connected across the mountainous landscape, but corridors in flatter areas outside the mountains are under pressure from human development. Conservation priorities include maintaining existing corridors, promoting land-use practices that sustain connectivity and to designate wildlife corridors in areas with rapid industrial development. The study acknowledges limitations such as reliance on expert judgment, data resolution, and temporal validity of the land cover dataset, but highlights the method's simplicity as a practical tool for conservation planning. Ultimately, it underscores the need for strategic spatial conservation planning and cross-border collaboration to secure ecological corridors and enhance biodiversity resilience within and between protected areas. Cross-border cooperation is especially vital, as ecological processes and wildlife corridor often extend beyond political boundaries. By strengthening cooperation between neighboring regions and economies, we can better safeguard ecological connectivity, reduce habitat fragmentation, and enhance the overall resilience of biodiversity in the face of climate change and human pressure.

2.2. Introduction

The movement of organisms is a fundamental ecological process that influences species distribution, population dynamics, and evolutionary trajectories. This movement is shaped by a range of intrinsic and extrinsic factors, including life-history traits, landscape structure and environmental variability[5]. In an increasingly human-modified world, where habitat fragmentation and changes in climate disrupt natural landscapes, understanding and maintaining the functional connectivity of ecosystems is vital for biodiversity conservation.

Landscape connectivity refers to the degree to which the landscape facilitates or impedes movement of organisms among habitat patches[6]. It plays a central role in enabling gene flow across populations, enhancing species' persistence in fragmented habitats, and supporting ecological resilience under changing environmental conditions. Understanding these processes is of particular importance in the light of protected areas, which act as harbours for biodiversity in a more modified landscape. With increased development in the surroundings of protected areas, this effect gets more pronounced over time. For example, without appropriate buffer zones, landscape diversity shows higher decreases closer to national park borders[7]. The resulting isolation of protected areas undermines the effectiveness of long-term conservation of the local populations. However, quantifying connectivity across heterogeneous landscapes is complex and demands robust analytical approaches[8].

To address this challenge, a variety of modelling tools and algorithms have been developed to simulate and map potential movement pathways. Among these, the least-cost path analysis has emerged as a widely applied method in connectivity modelling. This analysis identifies the 'cheapest' and most efficient route between two areas based on a resistance surface, which acts as a connectivity indicator mapping the 'cost', permeability or relative difficulty for an organism to traverse different habitats[8,9,10]. Although conceptually simple, this method provides valuable insights into likely movement patterns by highlighting important corridors and potential barriers and therefore supports the design of effective conservation measures along critical pathways facilitating the gene flow between populations.

The aim of this study is (a) to provide a simple method for the planning of corridors to enhance connectivity between populations which can be easily adapted to other areas or

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[5] NATHAN, R., W. M. GETZ, E. REVILLA, M. HOLYOAK, R. KADMON, D. SALTZ & P.E. SMOUSE, 2008. A movement ecology paradigm for unifying organismal movement research. In: Proceedings of the National Academy of Sciences, 105(49), 19052–19059. https://doi.org/10.1073/pnas.0800375105

[6] RUDNICK, D.A., S.J. RYAN, P. BEIER, S.A. CUSHMAN, F. DIEFFENBACH, C.W. EPPS, L.R. GERBER, J. HARTTER, J.S. JENNESS, J. KINTSCH, A.M. MERENLENDER, R.M. PERKL, D.V. PREZIOSI & S.C. TROMBULAK, 2012. The role of landscape connectivity in planning and implementing conservation and restoration priorities. In: US Forest Service Research and Development. https://research.fs.usda.gov/treesearch/42229

[7] KUBACKA, M., P. ŻYWICA, J.V. SUBIRÓS, S. BRÓDKA & A. MACIAS, 2022. How do the surrounding areas of national parks work in the context of landscape fragmentation? A case study of 159 protected areas selected in 11 EU countries. In: Land Use Policy, 113, 105910. https://doi.org/10.1016/j.landusepol.2021.105910

[8] ZELLER K.A., K. MCGARIGAL, A.R. WHITELEY, 2012. Estimating landscape resistance to movement: A review. In: Landscape Ecology, 27(6), 777–797. https://doi.org/10.1007/s10980-012-9737-0

[9] ADRIAENSEN F., J. CHARDON, G. DE BLUST, E. SWINNEN, S. VILLALBA, H. GULINCK & E. MATTHYSEN, 2003. The application of 'least-cost' modelling as a functional landscape model. In: Landscape and Urban Planning, 64(4), 233–247. https://doi.org/10.1016/s0169-2046(02)00242-6

[10] KUMAR S.U., S.A. CUSHMAN, 2022. Connectivity modelling in conservation science: a comparative evaluation. In: Scientific Reports, 12(1). https://doi.org/10.1038/s41598-022-20370-w

updated data sources and (b) to show outputs of this method to provide a first draft of potential corridors for efficient and effective nature conservation actions at the pilot sites.

2.3. Material and methods

2.3.1. Resistance map

The CORINE Land Cover 2018 dataset with a pixel size (resolution) of 100 m x 100 m was chosen as source for the resistance map. CORINE Land Cover (CLC) is a European-wide open-source land cover dataset developed under the Copernicus Programme, managed by the European Environment Agency[11]. Each CORINE land cover class[12] was assigned a resistance value based on expert judgment, reflecting its relative permeability with respect to the target ecological feature and using a discrete exponential scale (values 1, 2, 4, 8; see Table 1Error: Reference source not found).

Table 1: Resistance values of different CORINE land cover classes in relation to Natural grasslands and Broad-leaved forest, respectively. Resistance values are based on expert opinion and form the basis of the resistance maps.

Level 3 Code	CORINE land cover class	Resistance value of	
		Natural grasslands	Broad-leaved forest
1.1.1	Continuous urban fabric	8	8
1.1.2	Discontinuous urban fabric	8	8
1.2.1	Industrial or commercial units	8	8
1.2.2	Road and rail networks and associated land	4	8
1.2.3	Port areas	8	8
1.2.4	Airports	4	8
1.3.1	Mineral extraction sites	8	8
1.3.2	Dump sites	8	8
1.3.3	Construction sites	8	8
1.4.1	Green urban areas	4	4
1.4.2	Sport and leisure facilities	8	8
2.1.1	Non-irrigated arable land	4	8
2.1.2	Permanently irrigated land	4	8
2.1.3	Rice fields	4	8
2.2.1	Vineyards	4	8
2.2.2	Fruit trees and berry plantations	8	4
2.2.3	Olive groves	4	4
2.3.1	Pastures	2	4

[11] CORINE Land Cover. [Retrieved November 12, 2025] https://land.copernicus.eu/en/products/corine-land-cover
[12] CLC Nomenclature EN. [Retrieved November 12, 2025] https://clc.gios.gov.pl/doc/clc/CLC_Nomenclature_EN.pdf

Level 3 Code	CORINE land cover class	Resistance value of	
2.4.1	Annual crops associated with permanent crops	8	4
2.4.2	Complex cultivation patterns	4	4
2.4.3	Land principally occupied by agriculture, with significant areas of natural vegetation	2	2
2.4.4	Agro-forestry areas	4	2
3.1.1	Broad-leaved forest	8	1
3.1.2	Coniferous forest	8	2
3.1.3	Mixed forest	8	1
3.2.1	Natural grasslands	1	8
3.2.2	Moors and heathland	1	4
3.2.3	Sclerophyllous vegetation	4	2
3.2.4	Transitional woodland-shrub	4	4
3.3.1	Beaches, dunes, sands	4	8
3.3.2	Bare rocks	4	8
3.3.3	Sparsely vegetated areas	2	8
3.3.4	Burnt areas	4	4
3.3.5	Glaciers and perpetual snow	8	8
4.1.1	Inland marshes	4	8
4.1.2	Peat bogs	2	4
4.2.1	Salt marshes	4	8
4.2.2	Salines	8	8
4.2.3	Intertidal flats	8	8
5.1.1	Water courses	8	8
5.1.2	Water bodies	8	8
5.2.1	Coastal lagoons	8	8
5.2.2	Estuaries	8	8
5.2.3	Sea and ocean	8	8

2.3.2. Pilot site, buffer and target land cover classes

Bjeshkët e Nemuna National Park was chosen as the pilot site to test the connectivity model in Kosovo[1] (see also chapter 1). To assess the ecological connectivity, a 25 km buffer was applied around the pilot site's boundary to form the buffer zone.

We analysed the same two CORINE land cover classes in all six study areas: Broad-leaved forest and Natural grasslands. Broad-leaved forest is the most common land cover type in all assessed sites, covering on average 37 % of the sites' area. They provide crucial ecosystem services such as clean drinking water and timber. Natural grasslands in Europe are biodiversity hotspots, often even at a small scale, but are threatened by land-use change[13]. They are a less common land cover class in the assessed sites, covering only 18 % on average. However, they provide vital ecosystem services, such as areas for extensive grazing and play an important role in providing habitat for a wide range of (critically) endangered species.

2.3.3. Connectivity analysis

To test the connectivity of the largest patches of the target land cover, all directly connected pixels of the target land cover were classified as one patch. Subsequently, the connectivity was tested for the ten largest patches through a least-cost path analysis. The least-cost-path analysis was performed in R with the package *grainscape* (the annotated R code can be found in Annex I). The connectivity of each target land cover class was analysed separately.

[13] HABEL, J.C., J. DENGLER, M. JANIŠOVÁ et al. 2013. European grassland ecosystems: threatened hotspots of biodiversity. In: Biodivers Conserv 22, 2131–2138 (2013). https://doi.org/10.1007/s10531-013-0537-x

2.4. Results and discussion

Both target land cover classes – Natural grasslands and Broad-leaved forests – are relatively common, covering 20 % and 30 % respectively in the mountainous pilot site Bjeshkët e Nemuna National Park. Both land cover classes are fairly well connected inside the pilot site and to other mountainous areas but patches in lower areas are often only connected with corridors through farmland and near towns.

2.4.1. Natural grasslands

Within the pilot site, a well-connected chain of patches of high alpine Natural grasslands extend southward, maintaining connectivity through a mosaic of shrubland and grassland to additional Natural grasslands patches beyond the pilot site's boundaries (Figure 3). Two corridors connect the northern patch to the pilot site. The proximity of these corridors to the town of Rožaje, Montenegro, increases their vulnerability to urban expansion and subsequent loss of natural habitats (Figure 3 A).

2.4.2. Broad-leaved forest

A connected band of Broad-leaved forest runs along the eastern slope of the mountains, forming an important north-east to south-west running corridor (Figure 4). As part of the European Green Belt initiative[14], this corridor provides a crucial connection to northern regions beyond the pilot sites boundaries, underscoring the importance of its protection for biodiversity. Modelled corridors to the west traverse high alpine terrain whereas east running corridors cross a human modified landscape. One eastward running corridor crosses the R107 north of Deçan through farmland (Figure 4 A). Designating a corridor through this area would improve the connectivity to forest patches in the lowlands and link valuable habitats. Another corridor connects one south-eastern patch with the pilot site (Figure 4 B). This corridor must cross two major roads (R109 and 9-1) and farmland, impacting its ability to connect important forest habitats.

2.4.3. Limits of the study

The least-cost path analysis offers a simple and recommendable scoping tool for gaining insights into connectivity at the local level. Clear advantages of the approach are its modest data requirements and simple application. However, the approach relies on several assumptions. The underlying cost landscape depends on expert judgement which is rarely tested with empirical data[15]. The spatial extent and of the study area and resolution (pixel size) highly influences the output of the algorithm[16]. The used CORINE land cover data set is from 2018. Land use changes since 2018 have therefore not been accounted for. The next

[14] https://www.europeangreenbelt.org/
[15] STEVENSON-HOLT, C.D., K. WATTS, C.C. BELLAMY, O.T. NEVIN, A.D. Ramsey, 2014. Defining landscape resistance values in least-cost connectivity models for the invasive grey squirrel: a comparison of approaches using expert-opinion and habitat suitability modelling. In: PLoS One. 2014 Nov 7;9(11):e112119. doi: 10.1371/journal.pone.0112119. PMID: 25380289; PMCID: PMC4224439.
[16] MUREKATETE, R.M. & T. SHIRABE, 2021. On the effects of spatial resolution on effective distance measurement in digital landscapes. In: Ecol Process 10, 50. https://doi.org/10.1186/s13717-021-00296-3

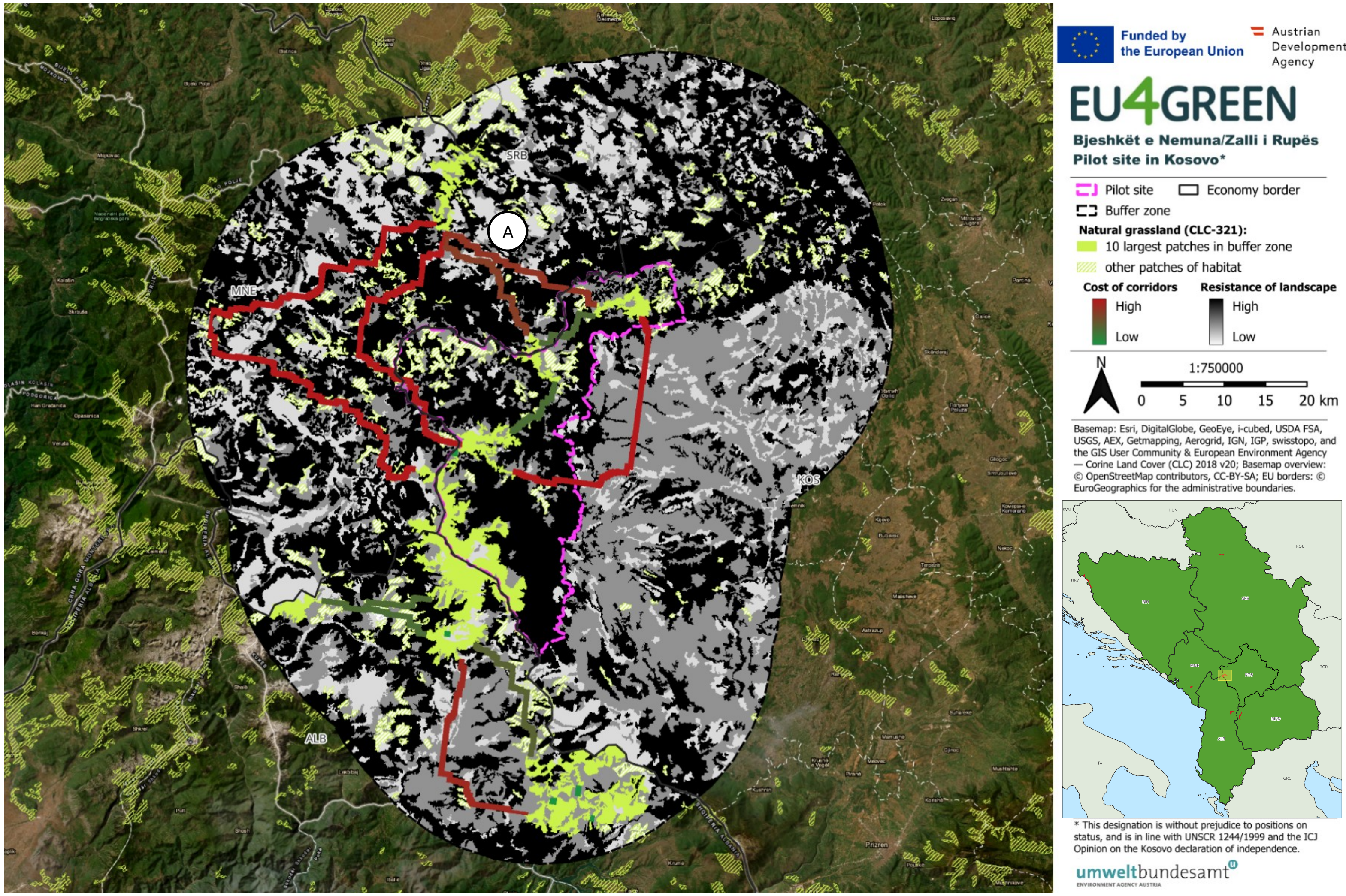

Figure 3: Connectivity of Natural grasslands in the buffer zone around Bjeshkët e Nemuna National Park, Kosovo*. The grayscale background map shows landscape resistance values (from 1 = white = low resistance to 8 = black = high resistance), green areas show the Natural grasslands. The corridors between the ten largest patches of Natural grasslands show the results of the least-cost path analysis. The colors of the corridors correspond to the cost in relation to the permeability of the landscape (from green = 4 to red = 540). The thickness of the corridors has been enhanced for better visibility. The letters highlight corridors or large patches mentioned in the text.

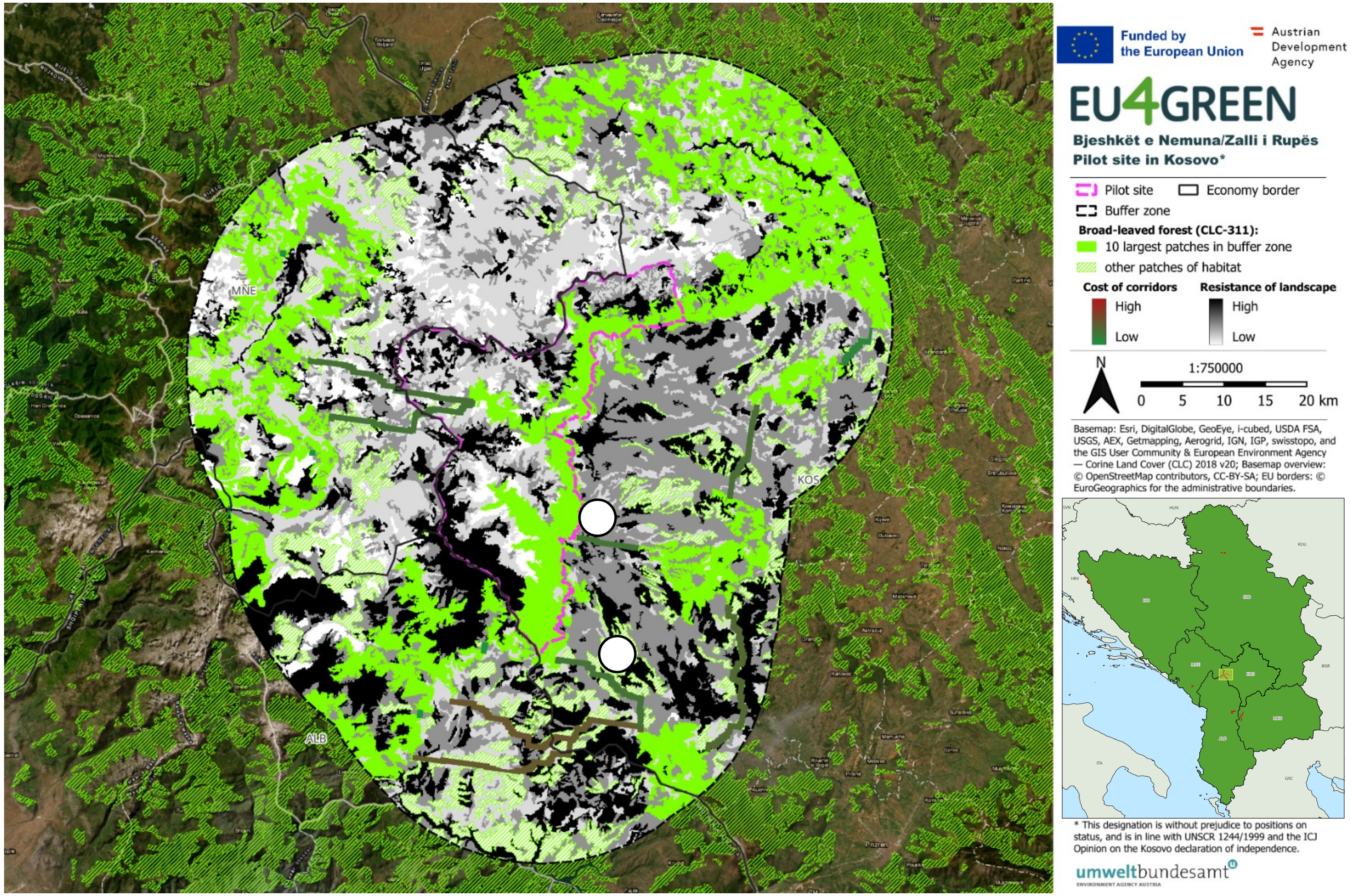

Figure 4: Connectivity of Broad-leaved forest in the buffer zone around Bjeshkët e Nemuna National Park, Kosovo*. The grayscale background map shows landscape resistance values (from 1 = white = low resistance to 8 = black = high resistance), green areas show the Broad-leaved forest. The corridors between the ten largest patches of Broad-leaved forest show the results of the least-cost path analysis. The colors of the corridors correspond the cost in relation to the permeability of the landscape (from green = 2 to red = 2022). The thickness of the corridors has been enhanced for better visibility. The letters highlight corridors or large patches mentioned in the text.

CORINE land cover data set is being released in 2026, and stakeholders are being advised to run the model with the provided code (Annex I) again to receive updated results. Another assumption is that organisms find and use these corridors, although individual preference and variability are not accounted for. The concept of least-cost path informed corridors is rarely tested with in-situ movement data[17]. The analysis could be taken further by verification of results through movement data, in-situ studies or expert knowledge.

2.5. Conclusion

This study shows potential corridors which facilitate the movement of organisms between large patches of the target land cover classes of Natural grasslands and Broad-leaved forest. The objectives for connectivity in the study area of Bjeshkët e Nemuna will be primarily to preserve already existing corridors in mountainous areas and to establish explicit wildlife corridors in the human modified lowland areas before they are under pressure from economic development.

The results highlight the need for well-informed and anticipatory spatial planning in the surroundings of the Bjeshkët e Nemuna National Park, securing the long-term persistence of corridors. Well-functioning corridors avoid genetic impoverishment of the national park itself but also amplify the positive effects of the national park on its surroundings, e.g. by allowing individuals to disperse into adequate habitat patches within the surrounding landscape. To secure these processes and support sustainable development in the surroundings, the designation of less strict spatial protection schemes as buffer zones is a popular tool.

Nature conservation areas in cross-border regions highly profit from transregional collaboration. This is especially true for the topic of connectivity where the natural values of protected areas can be impacted if corridors for connectivity are lost.

[17] LALIBERTÉ J., M.-H. ST-LAURENT, 2020: Validation of functional connectivity modeling: The Achilles' heel of landscape connectivity mapping. In: Landscape and Urban Planning, Volume 202, https://doi.org/10.1016/j.landurbplan.2020.103878.

3. SPECIES AND HABITAT TYPES OF NATURA 2000 SITES: REQUIREMENTS AND METHODS FOR REPORTING ON THEIR ECOLOGICAL INFORMATION

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With contributions from: EU4Green contracted biodiversity experts (Naim Berisha, Linda Grapci-Kotori and Qenan Maxhuni), Thomas Ellmauer, EAA

3.1. Summary

Identification of suitable sites and preparation of all relevant materials are major milestones required for proposing the future Natura 2000 network to the European Commission and therefore are an important endeavour for Accession Candidates. For each potential Natura 2000 site, a wide range of evidence-based and scientific information is required. Accession Candidates are required to set up systematic approaches to gather this information, but there are pitfalls which should be avoided to gather the required data efficiently. The activities summarised in this chapter are based on the approach developed in Austria. EU4Green offered a training for local biodiversity experts from the WB6, who learned and applied – in an exemplary manner – all subsequent steps of mapping and assessing species and habitat types in potential Natura 2000 sites. They were familiarised with the Standard Data Forms (more particularly, the ecological information), which is the format required for providing the information to the European Commission. Furthermore, the biodiversity experts were trained in developing Site-specific Conservation Objective and conservation measures, which are a prerequisite for all Natura 2000 sites confirmed by the European Commission, also following a standardised approach. All methodologies are described in detail. The fieldwork results of the biodiversity experts are presented and discussed. The chapter illustrates how a synergistic and efficient system for fulfilling the provisions of the Nature Directives towards Natura 2000 sites could look like on the local level.

3.2. Introduction

3.2.1. The Natura 2000 network of protected areas

The designation of protected areas is one of the prime tools in biodiversity protection. The Kunming-Montreal Global Biodiversity Framework, signed by 196 countries, foresees the halt and reverse of biodiversity loss. One of its key global targets for 2030 is effectively conserving and managing 30 % of all land, waters and seas[18]. The EU Biodiversity Strategy for 2030 sets out the goal to not only protect at least 30 % of all land and sea, but also bring 10 % of all EU land and sea under strict protection[19]. In this context, the GAWB calls upon the WB6 to align their policies to the EU Biodiversity Strategy for 2030[20].

EU4Green placed a strong focus to support the WB6 with alignment to the EU legislation for nature protection, more precisely on the Birds Directive (2009/147/EC _ $_{ex\ 79/409}$) and the Habitats Directive (92/43/EEC). They define species and habitats of Community interest, and measures for species and site protection. The EU Member States are to implement it through interdependent steps, hence for accession candidates, a similar approach was considered.

The primary objective of the EU Nature Directives is achieving and maintaining a Favourable Conservation Status for all species and habitats of Community interest. An important part is the designation and good management of Natura 2000 sites that form an EU-wide coordinated network of protected areas. The aim of each site is to ensure the long-term conservation of the habitats and species of Community interest that occur within them. Additionally, the Natura 2000 sites simultaneously act as contribution to the Pan-European Emerald Network of the Bern Convention[21]. Accession candidates are required to prepare their future Natura 2000 sites, using the framework of the Emerald Network[22].

3.2.2. Standard Data Forms

For each Natura 2000 site, Member States fill a Standard Data Form (SDF)[23], thereby providing information on area, location, characteristics and management, as well as ecological information on its habitat types and species[24]. As the EC uses the SDFs to review the contribution of Natura 2000 towards the achievement of the Nature Directive's objectives, the EC recommends an update to the SDFs at least every six years.

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[18] CONVENTION ON BIOLOGICAL DIVERSITY, 2022. Decision adopted by the Conference of the Parties to the Convention on Biological Diversity. 15/4. Kunming-Montreal Global Biodiversity Framework. [Last access: 9 December 2024]. Available at: https://www.cbd.int/doc/decisions/cop-15/cop-15-dec-04-en.pdf

[19] EUROPEAN COMMISSION, 2020. EU Biodiversity Strategy for 2030. Bringing nature back into our lives. Brussels: European Union. [Last access: 9 December 2024]. Available at: EU Biodiversity Startegy

[20] EUROPEAN COMMISSION, 2020. Guidelines to the Implementation of the Green Agenda for the Western Balkans. Brussels: European Union. [Last access: 9 December 2024]. Available at: https://neighbourhood-enlargement.ec.europa.eu/system/files/2020-10/green_agenda_for_the_western_balkans_en.pdf, p. 1 – 22.

[21] European Environment Agency, 2023. The Natura 2000 protected areas network. [Last access: 23 September 2025] Available at: https://www.eea.europa.eu/themes/biodiversity/natura-2000/the-natura-2000-protected-areas-network

[22] Secretariat of the Bern Convention, 2017. The Emerald Network. A tool for the protection of European natural habitats. [Last access: 23 September 2025]. Available at: The Emerald Network.

[23] The European Commission updated the format of the Standard Data Form in 2023; its use is required from February 2025 onwards.

[24] C/2023/8623. ABl L, 2023/8623. Available at: Updated Standard Data Form

Filling SDFs requires evidence-based information, with several provisions specified in the explanatory notes of the SDFs[24]. To guarantee transparent and reproducible results, particularly regarding the ecological information on habitat types and species, a standardized methodology is required. Nevertheless, the EC does not provide a methodological standard for the required fieldwork and methodology to produce the results for the SDFs. In the light of EU accession, accession candidates are required to develop and apply a methodology that fits the provisions.

EU4Green offered a training for local experts in the Austrian methodology. Throughout the training, the experts learned all subsequent steps of mapping and assessing species and habitats in an exemplary manner. They first learned about the official requirements and the Austrian methodology. One of the most important tasks was adapting the methodology to the local circumstances and the present species and habitats. Then, the experts applied and tested the developed methodology through fieldwork. Ultimately, the results were summarized, following the standards laid out by the SDFs.

3.2.3. Structure and parameters of the SDFs

The SDF contains six main sections with fields to fill (Table 2). Most sections are filled once for the entire Natura 2000 site, like the site location, description and management. However, the ecological information needs to be filled for every habitat type and species, respectively, occurring in the Natura 2000 site. The SDFs are then delivered to the EC through the Reportnet 3.0 of the EU.

Table 2: Sections of the Standard Data Form for species and habitats. Source: European Commission[24].

Section	Requirement
1. Site identification	Required for each Natura 2000 site
2. Site area and location	
3. Ecological information	
3.1 Habitat types	Required for each Annex I habitat type present within the Natura 2000 site
3.1.a Essential information	
3.1.b Site assessment & Degree of Conservation	
3.2 Species	Required for each bird species relevant for Article 4(1) and 4(2) of the Birds Directive and each Annex II species of the Habitats Directive present within the Natura 2000 site
3.2.a Essential information	
3.2.b Site assessment & Degree of Conservation	
3.3 Other species	Optional
Site description	Required for each Natura 2000 site
Site management	
Geospatial representation	

The trainings focused on how to gather the data required for the ecological information. The ecological information includes two sub-sections for both habitat types and species: the essential information (Infobox 1) and the site assessment (Infobox 2).

Infobox 1 – SDF's Essential information

For habitat types, this section includes covers basic information like the **habitat type code**, information on the **period of data collection**, and the **cover** of the habitat type in hectares. The cover can be gathered by either complete mapping, statistical estimation, extrapolation of a limited amount of data, or, with very limited data, by expert opinion.	For species, this section includes **species group, code and name, population type** (e.g. permanent, reproducing) and **size** (min. and max.), and **species abundance** (e.g. common, rare). Population data can come from complete mapping, statistical estimation, extrapolation, or, with very limited data, by expert opinion. It is possible to indicate that species data is sensitive, thereby avoiding disclosure to the public by the EC.

Under certain circumstances, species and habitats can be categorized as non-present or non-significant, so that only selected fields need filling[25]. Apart from that, the more elaborate site assessment is required.

Infobox 2 – SDF's Site assessment	
For habitat types, this section includes the **representativity** (e.g. excellent, significant) in comparison to the interpretation manual of Annex I habitat types. This parameter equals one of the criteria of Annex III of the Habitats Directive for Natura 2000 site selection and states how typical a habitat type is. Secondly, the **relative surface**, i.e. the share of the habitat types cover *within the Natura 2000 site* in the *total habitat area of the economy*, is classified in one of six pre-defined range categories, from 0 – 2 % up to 75 – 100 %.	For species, this section includes the share of the site's **population** in the population in the entire economy. There are six pre-defined range categories. Explanatory text may be provided.

[25] Non-presence means that either the habitat or species was present at the time of site designation but is no longer present, or was not present at the site of site designation but is intended to be re-established. Non-significance for habitat types means little conservation value (very small, degraded, fragmented, limited fulfilment of ecological functions, structural components, and characteristic species) that does not offer relevant restoration possibilities (already previous to site designation). Non-significant species are very rarely observed on site.

Ultimately, the key parameter of the SDF for both species and habitat types is the Degree of Conservation (Infobox 3).

Infobox 3 – Degree of Conservation
The Degree of Conservation equals the Annex III criteria for Natura 2000 site selection and is also referred to as the **local condition of a habitat type or species**. It addresses the **quality of the habitat type or the habitat of the species** and requires information on the **spatial extent in good or not good / sufficient or non-sufficient quality**.

Depending on the methodology used, the Degree of Conservation offers high potential for synergies with the assessments on biogeographical level, thus providing an efficient and holistic system for mapping and monitoring the species and habitats of Community interest. While the information gathered on site level can be incorporated into Article 17 reporting, the information on biogeographical level provides important input when defining conservation objectives on site level.

3.2.4. Condition indicators and threshold values

When mapping specific species and habitat types in Natura 2000 sites, condition indicators define how to measure and grade the circumstances that affect their local preservation. The application of condition indicators in itself is not a requirement for fulfilling the EU Nature Directives, however, it is an exceptional opportunity for using synergies between the obligations on local (Natura 2000 sites) and biogeographical level[26]. Therefore, it is applied by several EU member states (e.g. Austria, Germany). Furthermore, it provides a comparable, repeatable and reliable framework for assessing the Degree of Conservation of a species or habitat within a given area.

Condition indicators root in the ecological requirements of species and habitat types and are tightly linked to parameters that are required for Article 17 reporting (Infobox 4).

[26] Evans & Arvela (2011): Assessment and reporting under Article 17 of the Habitats Directive. Explanatory Notes & Guidelines for the period 2007-2012, p. 9.

Infobox 4: Condition indicators

For a **habitat type**, condition indicators allow to measure the conservation of its structure and function. To reflect on ecological integrity, condition indicators relate to three assets:

- **Species composition**: presence/absence, number or abundance of indicative species,
- **Structure and functions**: determinative structural, dynamic or ecological factors, and
- **Impacts**: most important driving factors (natural or anthropogenic)

The condition indicators for a **species** relate to three assets:

- **Population**: reproduction or mortality rates, population density
- **Habitat**: necessary habitat size and habitat elements (structures and/or quality required for reproduction, resting, foraging)
- **Impacts**: most important driving factors (natural or anthropogenic)

Population indicators may be difficult to assess and/or fluctuate over time. Therefore, a strong focus is given to the condition of the habitat for the species, like the Degree of conservation does.

Linking these standardized assets to the ecological requirements of the species or habitat type is the basis for formulating condition indicators (Figure 5, Figure 6). Depending upon the complexity of the ecological requirements, up to several indicators per asset can be necessary.

To ensure comparability between different sites, years (repeated monitoring) and experts carrying out fieldwork, condition indicators ought to be measurable. Therefore, for each condition indicator the method of measurement requires definition, specifying how to assess the indicator during fieldwork. In general, quantitative indicators are easier to standardize than qualitative indicators.

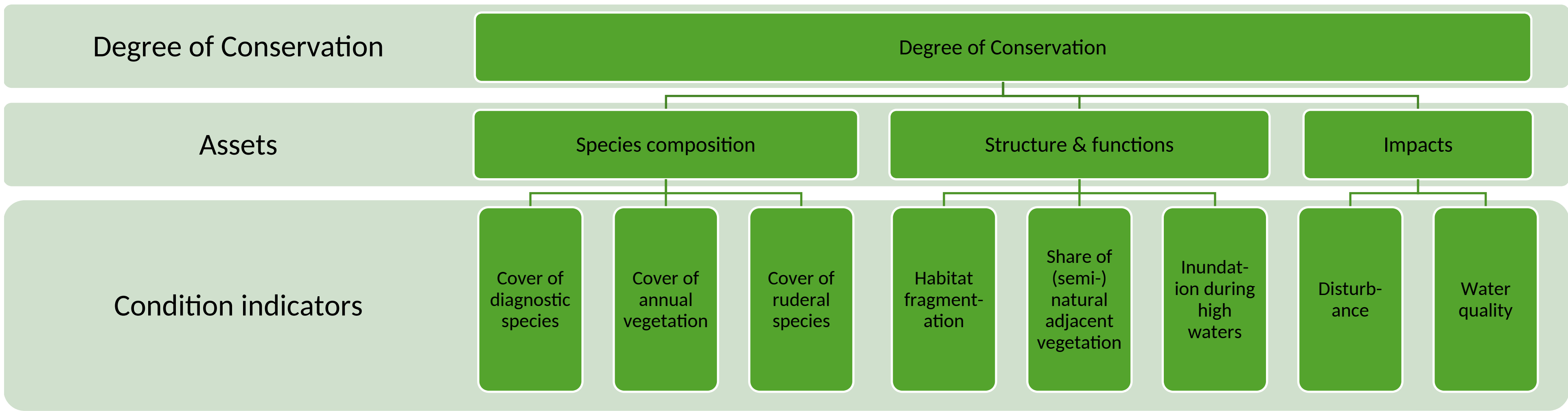

Figure 5: Exemplary illustration of the Degree of Conservation for habitat type '3130 Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoeto-Nanojuncetea*' (wording of indicators was simplified for understandability). The Degree of Conservation is composed of three different assets (species composition, structure and functions, and impacts), each of them with condition indicators. For each condition indicator, a method for measurement and a grading system with threshold values is needed.

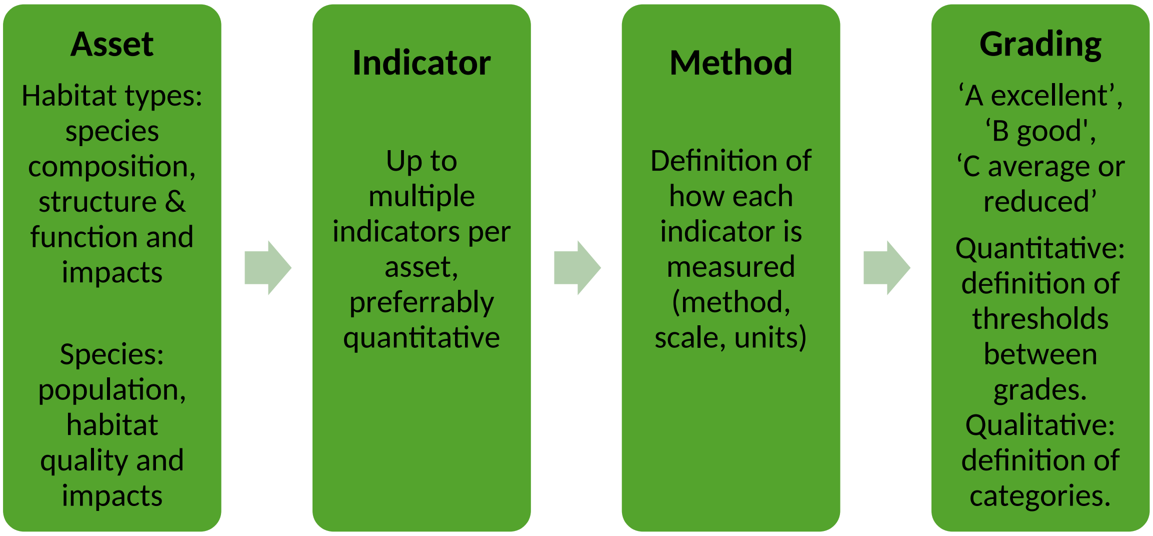

Figure 6: Procedure for defining condition indicators.

Ultimately, a grading system is used to specify if measurements correspond with a good or not-good Degree of Conservation. Based on the provisions for the SDFs, the grading system has three grades: 'A excellent', 'B good' and 'C average or reduced'. For quantitative indicators, thresholds are required to differentiate between excellent, good and average/degraded. For qualitative indicators, the three categories need detailed qualitative description to allow for clear differentiations.

3.2.5. Site-Specific Conservation Objectives based on condition indicators

Condition indicators support the concise development of Site-Specific Conservation Objectives (SSCOs). SSCOs set out the conservation priorities for Natura 2000 sites and make sure that they contribute to achieving a Favourable Conservation Status on biogeographical level. The Habitats Directive foresees that SSCOs are required for each target feature and Natura 2000 site. They must be specific to the target feature and formulated precisely, quantitatively and in a measurable manner to allow for monitoring and reporting. SSCOs should follow a consistent approach and comprehensively define the desired condition of the target feature, including its ecological characteristics[27].

The methods presented in this report aim at establishing a synergistic and efficient system, fulfilling the provisions of the Nature Directives. Through well-defined indicators, the acquired ecological data is comparable, repeatable and reliable, and can be used for other mandatory activities like development of SSCOs and Art. 17 monitoring. During the trainings of EU4Green, 14 biodiversity experts – between one and three per economy – learned how to develop such indicators, define meaningful thresholds, and will be able to share their knowledge in future projects on biodiversity monitoring.

[27] European Commission, 2024. Commission Note on Setting Conservation Objectives for Natura 2000 Sites. [Last access: 15/10/2025] Available at: https://circabc.europa.eu/ui/group/3f466d71-92a7-49eb-9c63-6cb0fadf29dc/library/4f06f774-df20-4269-9e49-1a79a95fa040/details

3.3. Material and methods: the case study

3.3.1. Study area

For training the application of methods, a case study was established (Figure 7). The study area was delineated by the biodiversity experts and measures approx. 10 km^2 in size. It is located along the Lumbardhi i Deçanit river, which originates in the higher elevations in the southwest of the national park and finds its way to the lower elevations around the small town of Deçan, with several tributaries feeding into the Lumbardhi i Deçanit river along the way. It forms a partly steep valley, with a narrow riverbed running over rocky ground, surrounded by deciduous and coniferous forest.

Along the assessed river stretch, one of the major pressures comes evident: several hydropower plants can be found between the mountainous upstream sections and Deçan. Three of them are located along the gravel road following the Lumbardhi i Deçanit river, another small one is installed further upstream, where the road narrows.

By splitting the study into subareas (approx. 1 km^2 each), the parallel assessment of the target features (habitats, birds, fish) in corresponding areas was facilitated.

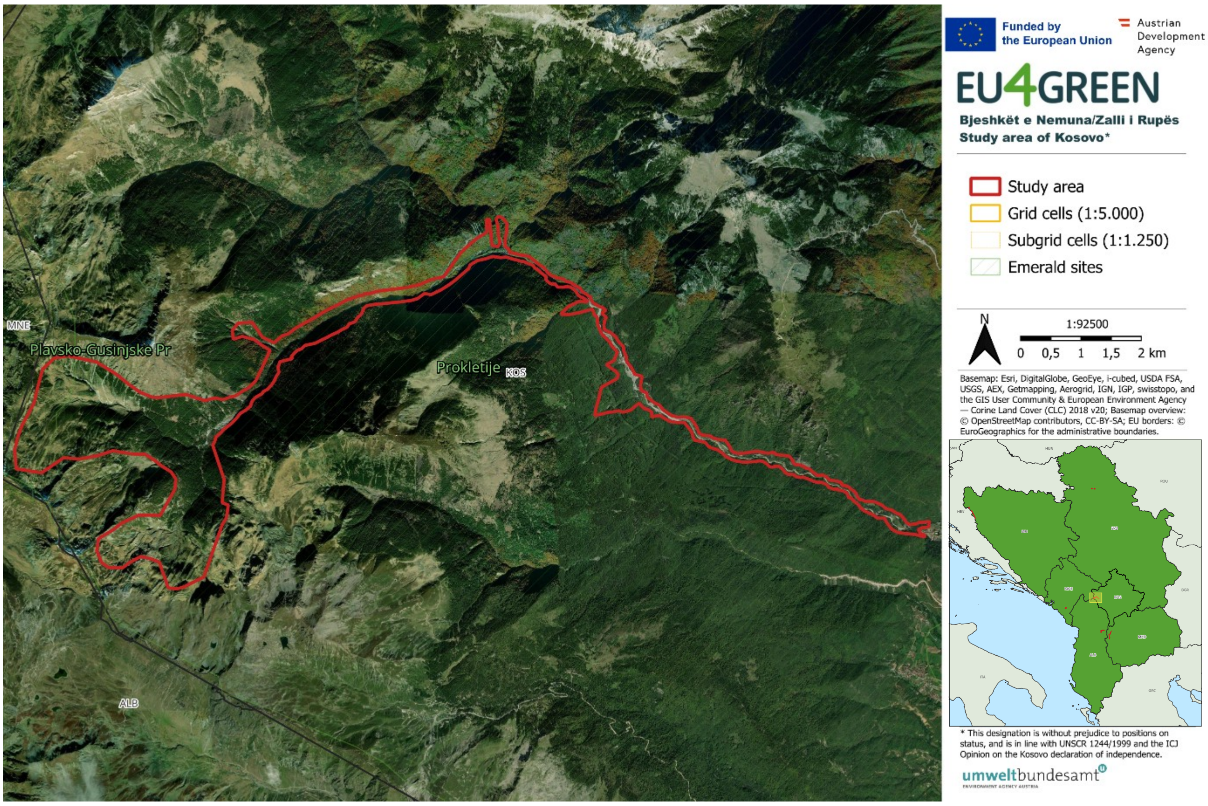

Figure 7: Study area at the Bjeshkët e Nemuna National Park, Kosovo[1].

The study area was placed based on the subsequent criteria:

- Located within or surrounding the pilot site

- Borders corresponding with natural water dynamics and other already occurring features (roads, dams, trees, etc.)
- Covering the locally typical zonation of the vegetation on one or both sides of the river
- Access possible (almost) entirely (regarding permits, barriers, etc.)
- Appropriate for sampling all three groups of selected habitats and species (see 3.3.2 Features of the Birds and Habitats Directive)

The study area was not required to be identical with borders of existing protected areas.

For practical reasons and a more detailed mapping during the fieldwork, the mapping scale was standardized to 1:5.000 and a grid with the cell size of ca. 62.5 ha was created. A subsequent division into four sub-cells ensured a more precise estimation of coverages and thresholds, especially for the indicators of the bird species assessments.

3.3.2. Features of the Birds and Habitats Directive

The activities of EU4Green focused on birds (especially grassland and forest birds), fish and habitats as groups of target features that acted as examples, outlining the process behind the conservation assessments. The features sampled in Kosovo[1] can be found in Table 3.

Table 3: Assessed species and habitats for the study area of Kosovo[1].

Group	Code	Feature
Fish	1107	*Salmo marmoratus**
Birds	A238	*Dendrocopos (Leicopicus) medius*
Birds	A429	*Dendrocopos syriacus*
Birds	A236	*Dryocopus martius*
Birds	A321	*Ficedula albicollis*
Birds	A338	*Lanius collurio*
Birds	A246	*Lullula arborea*
Birds	A234	*Picus canus*
Habitat types	3240	Alpine rivers and their ligneous vegetation with *Salix elaeagnos*
Habitat types	4060	Alpine and Boreal heaths
Habitat types	7230	Alkaline fens
Habitat types	9130	Asperulo-Fagetum beech forests
Habitat types	91E0	Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae)
Habitat types	91K0	Illyrian *Fagus sylvatica* forests (Aremonio-Fagion)

**Since Salmo marmoratus could not be found in the study area, the contracted expert used Salmo trutta as a dummy species instead to practice the methodology.*

3.3.3. Fact files and condition indicators

The experts developed fact files for the species and habitat types that were assessed in the pilot sites, this process was guided and quality checked by EAA experts as well. These fact files summarize the knowledge available for each species and habitat, giving a well-structured overview of the identification and ecological requirements (Table 4, Table 5). During development, the trained experts collaborated and brought together their knowledge to produce harmonized fact files with condition indicators and thresholds that can potentially be applied across the WB6. All fact files are found in Annex II.

Fact files act both as a guidance for field mapping identification (interpretation) and as basis for the assessment of condition indicators. The condition indicators were defined based on the theory specified in chapter 3.2.4 Condition indicators and threshold values. For birds, priority was given to the habitat indicators, as reliable population assessments were not feasible under the time frame of the training activities.

Table 4: Fact file structure for a habitat type.

Section	Content
Fact File	
Code and name	In accordance with Annex I of the Habitats Directive; names in English and in local languages.
Short profile	Summary of most significant features of the habitat type.
Cross-references to classification systems	Cross-references between the interpretation manual of Annex I habitat types and relevant international, national and/or local classification systems (e.g. phytosociology, biotopes). The classification could be identical (=), broader and therefore encompassing the Annex I habitat type (>), narrower than the Annex I habitat type (<), or partly overlapping (#).
Coenosis	Typical plant species (characteristic, dominant, indicative species), typical other species.
Ecology	Ecological requirements regarding soil (soil type, acidity, nutrients), water regime, climatic condition, elevation.
Structure	Horizontal and vertical structure (e.g. zonation, patchiness, life forms, vegetation layers), structural components (e.g. dead wood).
Dynamics	Vegetation phases, ecological cycles.
Dependency on maintenance	If human maintenance is required, specification of required type of utilization, intensity of use, etc.
Threats and pressures	Future threats and present pressures, Red List status, typical impacts.
Typical conservation measures	Regularly applied conservation measures.
Distribution	Description and/or distribution maps.
Assessment of Degree of Conservation	
Species composition indicators	Indicators for assessing species composition by presence or absence, number or abundance of indicative species. Assigned with thresholds for excellent, good or average/reduced condition.
Structure and functions indicators	Indicators for assessing the determinative structural, dynamic or ecological factors. Assigned with thresholds for excellent, good or average/reduced condition.
Impact indicators	Indicators for assessing the most important pressures and impacts (natural and anthropogenic). Assigned with thresholds for excellent, good or average/reduced condition.
Species observations during fieldwork	Overview of observations made during field work.

Aggregation Scheme	Scheme for aggregating population, habitat and impact indicators.

Table 5: Fact file structure for a species.

Section	Content
Code and name	In accordance with Habitats or Birds Directive; names in English and in local languages.
Short profile	Summary of most significant features of the species.
Characteristics for species identification	Characteristics in size, coloration, behaviour, etc., including sex and age differences as well as comparison to other, similar species.
Biology	Details on reproduction, feeding, resting.
Population ecology	Data regarding reproduction rate, mortality and migration, preferably numeric.
Habitat for the species	Description of habitat requirements and typical biomes, if necessary, differentiated into life cycle habitats (reproduction, feeding, resting) and with description of relevant habitat elements (e.g. open water, deadwood).
Threats and pressures	Future threats and present pressures, Red List status, typical impacts.
Species protection measures	Regularly applied conservation measures.
Distribution	Description and/or distribution maps.
Assessment of Degree of Conservation	
Population indicators	Indicators for assessing the reproduction, mortality or population density. Assigned with thresholds for excellent, good or average/reduced condition.
Habitat indicators	Indicators for assessing the habitat quantity and quality. Assigned with thresholds for excellent, good or average/reduced condition.
Impact indicators	Indicators for assessing the most important pressures and impacts (natural and anthropogenic). Assigned with thresholds for excellent, good or average/reduced condition.
Species observations during fieldwork	Overview of observations made during field work.
Aggregation scheme	Scheme for aggregating population, habitat and impact indicators.

3.3.4. Mapping units, field protocols and fieldwork

Mapping units specify the spatial scale on which the condition indicators are measured. During fieldwork, the habitat experts delineated every patch of homogenous habitat on a map, with the aim to cover the entire study area. After assessing the spatial extent of a homogenous patch, the habitat was classified as either a habitat type of the Habitats Directive or no (protected) habitat type. For the habitat types of Community interest, further data was assessed, including the condition indicators.

For the mapping of the fish and bird species, a raster-based approach with pre-defined grid cells (1:5.000) was used. The fish experts sampled the river stretches and water bodies using electrofishing and measured condition indicators for population, habitat and impact in each grid cell. The bird experts subdivided the grid cells into four sub-grid cells each. Within each sub- cell, the general land cover and, particularly for forests and grasslands, several other indicators were assessed. These indicators were general indicators, not (yet) linked to the condition indicators and threshold values of specific species. This was done post hoc by data transformation and statistical analysis.

The field protocols are to be found in Annex IIIa-c. All mappings were carried out between April and September 2024 (Table 6).

Table 6: Mapping period and fieldwork days for each study area and feature group.

Feature group	Mapping period	Fieldwork days
Birds	September 2024	9
Fish	June 2024	9
Habitat types	May, June and July 2024	13
Total	May - September 2024	31

3.3.5. Occupancy

For bird species, priority was given to assessing habitat and impact indicators for several reasons: i) assessing habitat quality and impacts was new to most of the trained experts, while knowledge on population assessments was relatively high; ii) fieldwork protocols for mapping bird populations are available in the WB6 but less so for habitat quality and impacts; iii) possible time frames for fieldwork were better suited for habitat and impact assessment.

Therefore, population indicators were not targeted during fieldwork for birds. In consequence, occupancy of habitats was not assessed in the field. It was assumed that if a species is generally present within the 10 km^2 study area, all suitable habitat for the species is occupied.

3.3.6. Aggregation within mapping units

On completion of fieldwork, the condition indicators were aggregated, first within each asset and then for the entire mapping unit. If an asset had two or more condition indicators, logical aggregation was used (see Annex IV). In case a particular asset had only one condition indicator, the grade was used directly for the asset. The grading system is designed in a way that single condition indicators with low grading have a significant effect on the aggregated grade of the asset and the grade of the entire mapping unit (Figure 8).

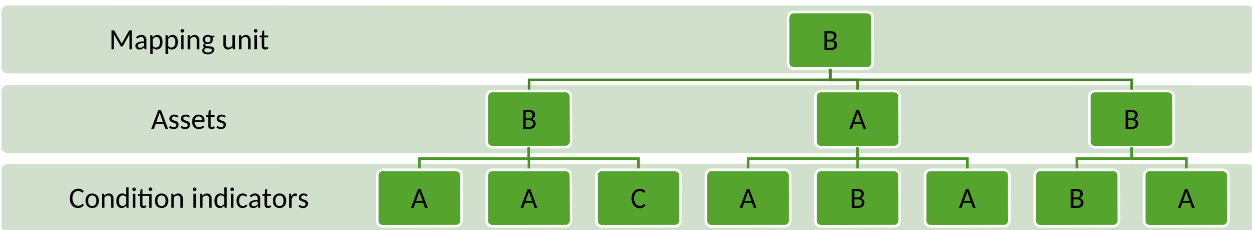

Figure 8: Exemplary illustration of the aggregation from the grades of condition indicators to the grades of the assets within each mapping unit.

For habitats, all three assets were then aggregated to receive the aggregated grade for the entire mapping unit, i.e. the habitat polygon. For species on the other hand, only the habitat asset and impact asset were aggregated within each grid cell, while the population asset (where available) was kept separate. This is because the Degree of Conservation and the Area in Good Condition only relate to the species' habitat, not its actual population.

3.3.7. Aggregation to Degree of Conservation and Area in Good Condition

The final step was aggregating the mapping units within the entire pilot site for each species and habitat. For this, the area of all relevant mapping units with identical aggregated grade (A, B or C) was summed up. For the categorized Degree of Conservation, thresholds were applied:

- If ≥ 70% of the habitat area within the pilot site is graded A, the categorized Degree of Conservation is A.
- If ≥ 50% of the habitat area within the pilot site is graded C, the categorized Degree of Conservation is C.
- For all other cases, the categorized Degree of Conservation is B.

For the Area in Good Condition, the sums of grade A and B were combined. The Area in Not Good Condition is the area of all mapping units with grade C.

3.3.8. Site-Specific Conservation Objectives

The Site-Specific Conservation Objectives (SSCOs) were developed by the biodiversity experts from the WB6, following methodological guidance from the EU4Green project team. For all target features, the concept of Favourable Reference Values[28] was used, although this is not a provision of the Birds Directive. The biodiversity experts deduced the current state in the economy or the biogeographical region, and the Favourable Reference Values for range, area, population, or amount of habitat in good condition based on literature research and GIS (Geoinformation System) analyses. This benchmark acted as first-level conservation objectives, to which the SSCOs contribute. Then, the maximum contribution of the site was identified based on the knowledge gained during fieldwork to identify the SSCOs. Ultimately, the SSCOs were concretised to identify concrete conservation measures. The best showcases are presented.

3.3.9. Software

Geo data compilation and spatial analysis was done in QGIS[29] as well as R version 4.3.1[30].. Statistical analysis was carried out with Microsoft ® Excel ® 2016 and R version 4.3.1.

[28] In preparation: Environment Agency Austria. (2026). The implementation of the EU Nature Directives: a manual for the Western Balkans. (WP-16_Del-2). Huchler, K., Samec, S., Fuchs, S. Ellmauer, T. EU4Green project, Biodiversity.
[29] QGIS Development Team. (2025). QGIS Geographic Information System (Version 3.40). QGIS Association. https://www.qgis.org
[30] R Core Team (2023). R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria. https://www.R-project.org/

3.4. Results and discussion

3.4.1. Habitat types

With a total of six recorded habitat types under the Habitats Directive, the study area at the Bjeshkët e Nemuna National Park is hosting several habitat types protected in the EU. During fieldwork, all habitat types of the Habitats Directive were identified and spatially delineated to gather their distribution (Figure 9). The habitat patches (= occurrences) can be found along the entire river stretch, covering extensive areas of the study area, reaching from the alpine tributaries upstream to the lower sections near the town Deçan.

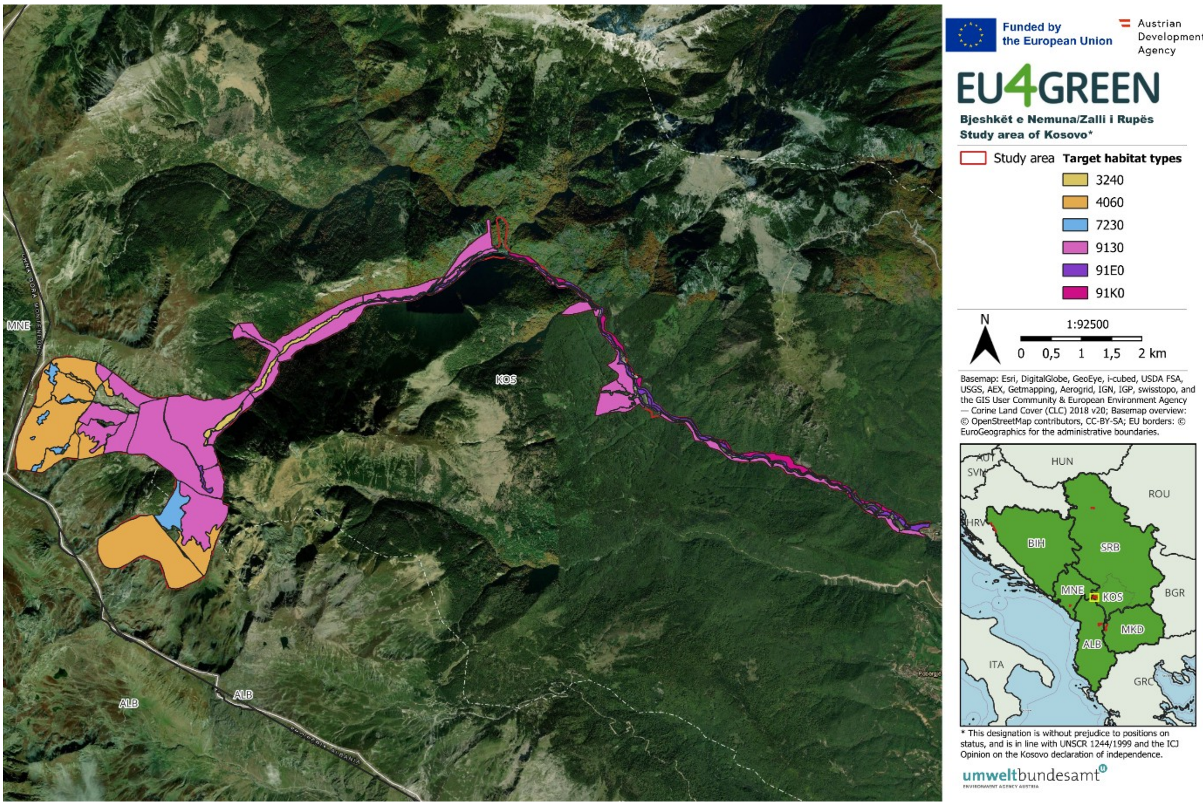

Figure 9: Distribution of the assessed Natura 2000 habitat types in the Bjeshkët e Nemuna National Park study area.

Most of the habitat types are extraordinarily well-preserved, as the overall condition of most habitat types is graded as ‘B good’ or ‘A excellent’ (Error: Reference source not found, Figure 11).

Among the six habitat types identified within the Kosovar study area, improvement potential was identified only for habitat type ‘3240 Alpine rivers and their ligneous vegetation with *Salix elaeagnos*’. A total of 35.3 ha of this habitat was assessed by the contracted habitat expert, with 100% classified as being in a ‘C average or reduced’ condition. The key drivers include suboptimal species composition and structure, notably the lack of diagnostic species (e.g. *Salix elaeagnos*), limited coverage of shrub and herbaceous species, a relatively high presence of invasive alien species, insufficient deadwood and old trees, and reduced flood dynamics. While impacts are currently assessed as good, potential for improvement through the restoration of riverbeds and banks remains. The other five habitat types were assessed as being in good condition.

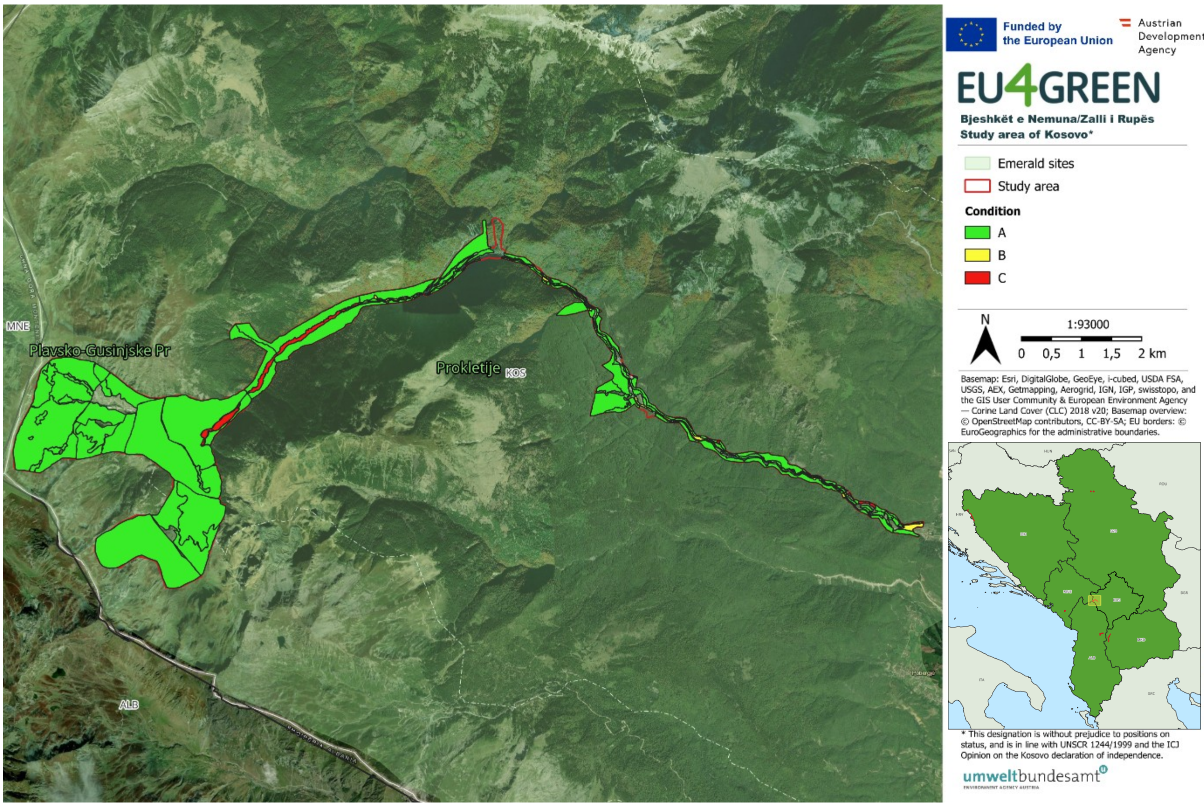

Figure 10: Condition of the assessed Natura 2000 habitat types in the Bjeshkët e Nemuna National Park study area.

Figure 11**: Condition of the assessed habitat types in the Bjeshket e Nemuna National Park study area.**

The information gathered during fieldwork was then added to the ecological information of the Standard Data Forms (Table 7,

Error: Reference source not found,Error: Reference source not foundError: Reference source not found Table 9).

Table 7: Ecological information for '3240 - Alpine rivers and their ligneous vegetation with *Salix elaeagnos*' and '4060 - Alpine and Boreal heaths' at the Bjeshkët e Nemuna study area (10 km^2).

Information	Habitat 1	Habitat 2
3.1a Essential information (habitat type)		
3.1.1 Habitat type code	3240	4060
3.1.2 Priority form	not applicable	not applicable
3.1.3 Non-presence	not applicable	not applicable
3.1.4 Cover	35.3 ha	543.2 ha
3.1.5 Caves	not assessed	
3.1.6 Method used for cover	complete survey or a statistically robust estimate	complete survey or a statistically robust estimate
3.1.7 Period of last data collection	not assessed	
3.1b Site assessment (habitat type)		
3.1.8 Significance	Significant	Significant
3.1.9 Representativity	C: significant	A: excellent
3.1.10 Relative surface	C: 2% ≥ p > 0%	B: 5% ≥ p > 2%
3.1.11 Relative surface explanations (optional)		
3.1.12 Degree of conservation		
3.1.12.1 Degree of conservation – categorised	C: reduced	A: excellent
3.1.12.2 Degree of conservation – area	Good condition: 0 ha Not-good condition: 35.3 ha	Good condition: 543.2 ha Not-good condition: 0 ha
3.1.12.3 Degree of conservation – method used	Based mainly on extrapolation from a limited amount of data (expert judgement)	Based mainly on extrapolation from a limited amount of data (expert judgement)
3.1.13 Conservation objectives		
3.2.14 Conservation objectives – explanations		
3.2.19 Global	C: significant value	A: excellent value
3.2.20 Update date	January 2025	January 2025

Table 8: Ecological information for ‘7230 - Alkaline fens’ and ‘9130 - Asperulo-Fagetum beech forests’ at the Bjeshkët e Nemuna study area (10 km²).

Information	Habitat 3	Habitat 4
3.1a Essential information (habitat type)		
3.1.1 Habitat type code	7230	9130
3.1.2 Priority form	not applicable	not applicable
3.1.3 Non-presence	not applicable	not applicable
3.1.4 Cover	59.3 ha	947.4 ha
3.1.5 Caves	not assessed	
3.1.6 Method used for cover	complete survey or a statistically robust estimate	complete survey or a statistically robust estimate
3.1.7 Period of last data collection	not assessed	
3.1b Site assessment (habitat type)		
3.1.8 Significance	Significant	Significant
3.1.9 Representativity	A: excellent	A: excellent
3.1.10 Relative surface	C: 2% ≥ p > 0%	B: 5% ≥ p > 2%
3.1.11 Relative surface explanations (optional)		
3.1.12 Degree of conservation		
3.1.12.1 Degree of conservation – categorised	A: excellent	A: excellent
3.1.12.2 Degree of conservation – area	Good condition: 59.3 ha Not-good condition: 0 ha	Good condition: 947.4 ha Not-good condition: 0 ha
3.1.12.3 Degree of conservation – method used	Based mainly on extrapolation from a limited amount of data (expert judgement)	Based mainly on extrapolation from a limited amount of data (expert judgement)
3.1.13 Conservation objectives		
3.2.14 Conservation objectives – explanations		
3.2.19 Global	A: excellent value	A: excellent value
3.2.20 Update date	January 2025	January 2025

Table 9: Ecological information for ‘91E0 - Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae)’ and ‘91K0 - Illyrian Fagus sylvatica forests (Aremonio-Fagion)’ at the Bjeshkët e Nemuna study area (10 km²).

Information	Habitat 5	Habitat 6
3.1a Essential information (habitat type)		
3.1.1 Habitat type code	9130	91K0
3.1.2 Priority form	not applicable	not applicable
3.1.3 Non-presence	not applicable	not applicable
3.1.4 Cover	78.7 ha	55.7 ha
3.1.5 Caves	not assessed	
3.1.6 Method used for cover	complete survey or a statistically robust estimate	complete survey or a statistically robust estimate
3.1.7 Period of last data collection	not assessed	
3.1b Site assessment (habitat type)		
3.1.8 Significance	Significant	Significant
3.1.9 Representativity	B: good	C: significant
3.1.10 Relative surface	C: 2% ≥ p > 0%	C: 2% ≥ p > 0%
3.1.11 Relative surface explanations (optional)		
3.1.12 Degree of conservation		
3.1.12.1 Degree of conservation – categorised	B: good	C: reduced
3.1.12.2 Degree of conservation – area	Good condition: 78.7 ha Not-good condition: 0 ha	Good condition: 55.7 ha Not-good condition: 0 ha
3.1.12.3 Degree of conservation – method used	Based mainly on extrapolation from a limited amount of data (expert judgement)	Based mainly on extrapolation from a limited amount of data (expert judgement)
3.1.13 Conservation objectives		
3.2.14 Conservation objectives – explanations		
3.2.19 Global	B: good value	C: significant value
3.2.20 Update date	January 2025	January 2025

3.4.2. Birds

At the Kosovar study area at Bjeshkët e Nemuna National Park, seven bird species were studied. Five of them require forested areas for reproduction (*Dryocopus martius*, *Dendrocopos medius*, *Dendrocopos syriacus*, *Ficedula albicollis* and *Picus canus*) and are hereafter referred to as forest bird species. The remaining two species (*Lullula arborea* and *Lanius collurio*) are considered as grassland birds. In total, 44,72 % of the 10 km^2 study area are forested, equalling a total area of forest habitats of 447.2 ha. The forest patches are mostly deciduous but also coniferous and located in the lower areas of the Lumbardhi i Deçanit river valley. Both habitat condition (Figure 12) and overall condition (Error: Reference source not found) of the forest birds were not as good as for habitat types (Figure 13).

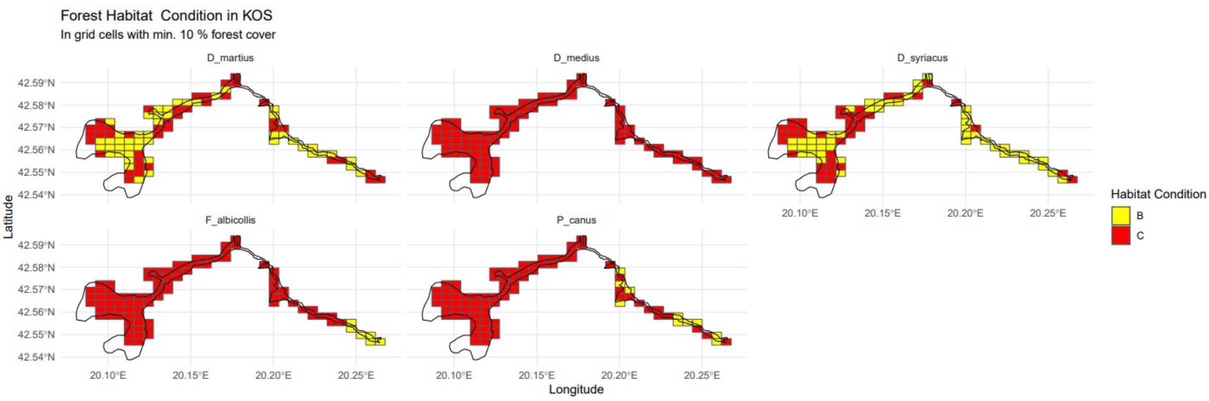

Figure 12: Maps of the sub-grid cells with the assessed conditions in the Bjeshkët e Nemuna National Park study area for the forest bird species *Dryocopus martius*, *Dendrocopos medius*, *Dendrocopos syriacus*, *Ficedula albicollis* and *Picus canus*.

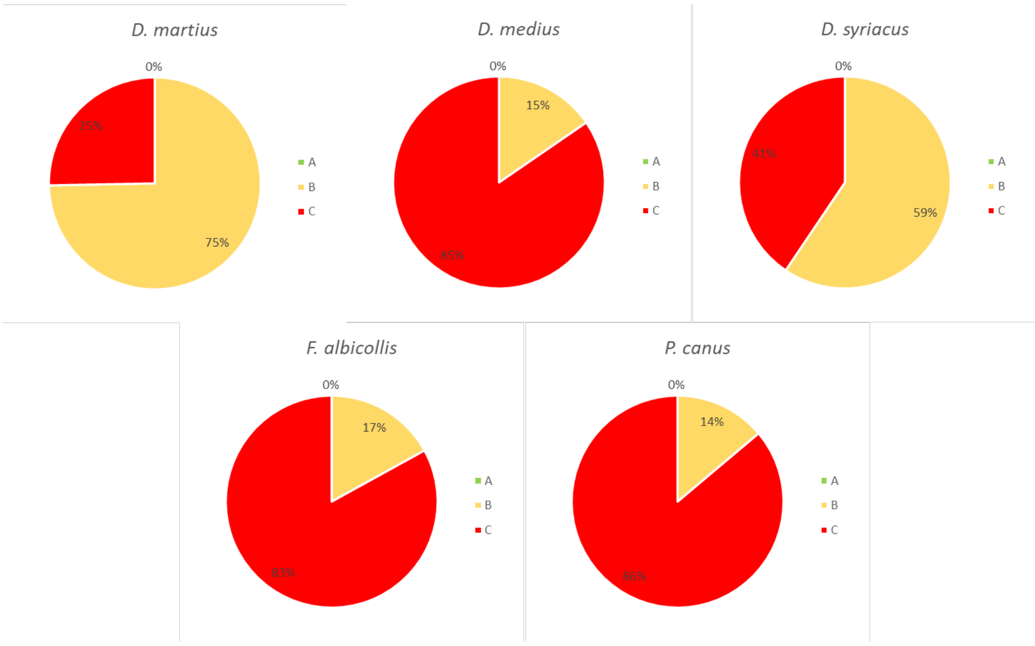

Figure 13: Condition of the assessed forest birds in the Bjeshkët e Nemuna National Park study area.

The best results were found for the Black Woodpecker *Dryocopos martius*, with 75% in condition 'B good' and only 25 % in condition 'C average or reduced'. The Syrian Woodpecker *Dendrocopos syriacus* was in a similar condition, having 59% in condition 'B good' and 41% in condition 'C average r reduced'. Grid cells with a grading of 'C average or reduced' received this grading for *D. martius* primarily because of a lack of sufficiently dense canopy as well as of available standing deadwood. The total condition of *D. syriacus* was depending mainly on the low canopy density and lack of standing deadwood as well, but was also due to a low percentage of deciduous trees.

The other three forest species the fraction of assessments with 'C average or reduced' ranges between 83-86%. The main factors for the woodpecker species (*D. medius* and *P. canus*) coincide with the ones mentioned above. For the Collared flycatcher (*Ficedula albicollis*) factors such as a low percentage of old-growth forest and disturbances in the form of pathways or silvicultural use are more relevant. All of the found species lack sub grid cells in condition 'A excellent'.

Regarding grassland habitats, a total of 352.625 ha (or 35.26 % of the study area) are available. They are located in the western part of the study area (Figure 14). It appears that most open areas do not meet the habitat requirements of *Lullula arborea*, due to the lack of mature, dense bushes and hedgerows as well as very extensive grassland. For *Lanius collurio* on the other hand, in the upper regions of the study area, several habitats with good (37%) and even excellent (26%) conditions could be assessed. Although the biggest factor for improvement is, as well, the coverage of hedges and bushes within that extensive grassland, specifically thorny species.

For the grassland bird species, the habitat condition is shown in Figure 14 and overall condition in Figure 15.

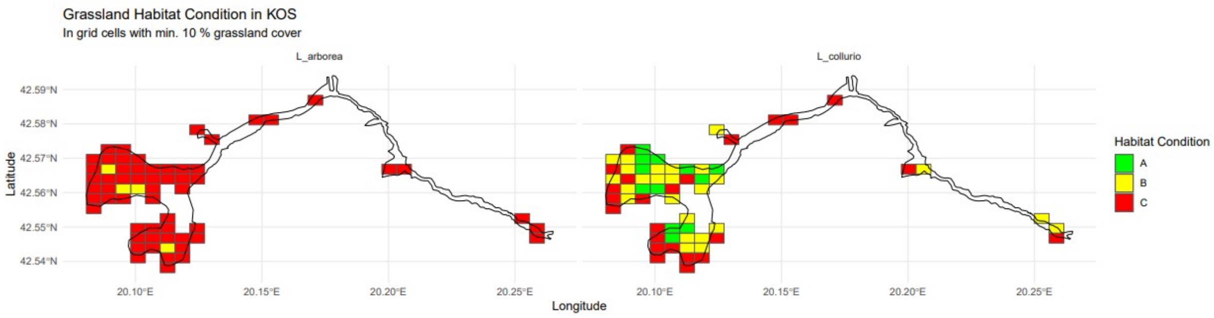

Figure 14: Maps of the sub-grid cells with the assessed conditions in the Bjeshkët e Nemuna National Park study area for the grassland bird species *Lullula arborea* and *Lanius collurio*.

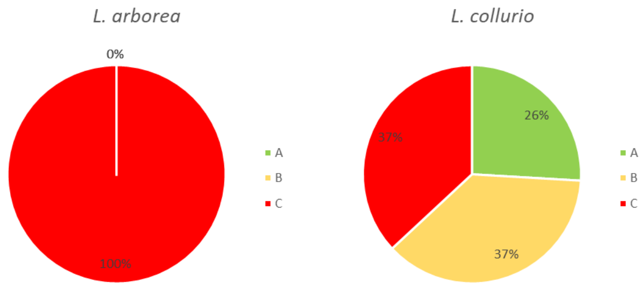

Figure 15: Condition of the assessed grassland birds in the Bjeshkët e Nemuna National Park study area.

Based on the information gathered during fieldwork, the ecological information for the SDF's were compiled (Table 10, Table 11, Table 12).

Table 10: Ecological information for *Lullula arborea*, *Lanius collurio* and *Ficedula albicollis* at the Bjeshkët e Nemuna study area (10 km^2).

Information	Species 1	Species 2	Species 3
3.2a Essential information (species)			
3.2.1 Species group	B = Birds	B = Birds	B = Birds
3.2.1 Species code	A246	A338	A321
3.2.3 Scientific name	*Lullula arborea*	*Lanius collurio*	*Ficedula albicollis*
3.2.4 Sensitivity of species data		not assessed	
3.2.5 Non-presence	not applicable	not applicable	not applicable
3.2.6 Population type	Permanent	Permanent	Permanent
3.2.7 Population size and unit			
3.2.7.1 Population size	0 (30-50)	0 (20-30)	0 (5-10)
3.2.7.2 Population unit	i = individuals	i = individuals	i = individuals
3.2.8 Abundance category	Present	Very rare	Very rare
3.2.9 Method used for population size	Based mainly on expert opinion with very limited data	Based mainly on expert opinion with very limited data	Based mainly on expert opinion with very limited data
3.2.10 Period of last data collection		not assessed	
3.2b Site assessment (species)			
3.2.11 Significance		not assessed	
3.2.12 Species meeting ornithological criteria for SPA classification		not assessed	
3.2.13 Population	B: 15% ≥ p > 2%	C: 2% ≥ p > 0%	C: 2% ≥ p > 0%
3.2.13 Population – explanations (optional)			
3.2.15 Degree of conservation			
3.2.15.1 Degree of conservation – categorised	C: reduced	B: good	B: good
3.2.15.2 Degree of conservation – occupied area	Sufficient quality: 0 ha (0 %) Non-sufficient quality: 352.625 ha (100 %)	Sufficient quality: 222.425 ha (63.08 %) Non-sufficient quality: 130.2 ha (39.92 %)	Sufficient quality: 75.95 ha (16.98 %) Non-sufficient quality: 4371.225 ha (83.02 %)
3.2.15.3 Degree of conservation – occupied percentage classes	Sufficient quality: 0-25 % Non-sufficient quality: 76-100 %	Sufficient quality: 51-75 % Non-sufficient quality: 26-50 %	Sufficient quality: 0-25 % Non-sufficient quality: 76-100 %
3.2.16 Conservation objectives			
3.2.17 Conservation objectives – explanations			
3.2.18 Isolation	unknown	C: population not isolated within extended distribution range	C: population not isolated within extended distribution range
3.2.19 Global	B: good value	B: good value	B: good value
3.2.20 Update date	December 2024	December 2024	December 2024

Table 11: Ecological information for *Picus canus*, *Dryocopos martius* and *Dendrocopos medius* at the Bjeshkët e Nemuna study area (10 km^2).

Information	Species 4	Species 5	Species 6
3.2a Essential information (species)			
3.2.1 Species group	B = Birds	B = Birds	B = Birds
3.2.1 Species code	A338	A339	A246
3.2.3 Scientific name	*Picus canus*	*Dryocopos martius*	*Dendrocopos medius*
3.2.4 Sensitivity of species data		not assessed	
3.2.5 Non-presence	not applicable	not applicable	not applicable
3.2.6 Population type	Permanent	Permanent	Permanent
3.2.7 Population size and unit			
3.2.7.1 Population size	7 (20-40)	2 (10-20)	8 (30-50)
3.2.7.2 Population unit	i = individuals	i = individuals	i = individuals
3.2.8 Abundance category	Rare	Very rare	Rare
3.2.9 Method used for population size	Based mainly on expert opinion with very limited data	Based mainly on expert opinion with very limited data	Based mainly on expert opinion with very limited data
3.2.10 Period of last data collection		not assessed	
3.2b Site assessment (species)			
3.2.11 Significance		not assessed	
3.2.12 Species meeting ornithological criteria for SPA classification		not assessed	
3.2.13 Population	B: 15% ≥ p > 2%	C: 2% ≥ p > 0%	B: 15% ≥ p > 2%
3.2.13 Population – explanations (optional)			
3.2.15 Degree of conservation			
3.2.15.1 Degree of conservation – categorised	C: reduced	B: good	C: reduced
3.2.15.2 Degree of conservation – occupied area	Sufficient quality: 62 ha (13.86 %) Non-sufficient quality: 385.175 ha (86.14 %)	Sufficient quality: 334.025 ha (74.7 %) Non-sufficient quality: 113.15 ha (25.3 %)	Sufficient quality: 68.975 ha (15.42 %) Non-sufficient quality: 378.2 ha (84.58 %)
3.2.15.3 Degree of conservation – occupied percentage classes	Sufficient quality: 0-25 % Non-sufficient quality: 76-100 %	Sufficient quality: 51-75 % Non-sufficient quality: 0-25 %	Sufficient quality: 0-25 % Non-sufficient quality: 76-100 %
3.2.16 Conservation objectives			
3.2.17 Conservation objectives – explanations			
3.2.18 Isolation	C: population not isolated within extended distribution range	C: population not isolated within extended distribution range	C: population not isolated within extended distribution range
3.2.19 Global	B: good value	B: good value	B: good value
3.2.20 Update date	December 2024	December 2024	December 2024

Table 12: Ecological information for *Dendrocopos medius* at the Bjeshkët e Nemuna study area (10 km^2).

Information	Species 7
3.2.1 Species group	B = Birds
3.2.1 Species code	A429
3.2.3 Scientific name	*Dendrocopos syriacus*
3.2.4 Sensitivity of species data	not assessed
3.2.5 Non-presence	not applicable
3.2.6 Population type	Permanent
3.2.7 Population size and unit	
3.2.7.1 Population size	4 (50-80)
3.2.7.2 Population unit	i = individuals
3.2.8 Abundance category	Rare
3.2.9 Method used for population size	Based mainly on expert opinion with very limited data
3.2.10 Period of last data collection	not assessed
3.2b Site assessment (species)	
3.2.11 Significance	not assessed
3.2.12 Species meeting ornithological criteria for SPA classification	not assessed
3.2.13 Population	B: 15% ≥ p > 2%
3.2.13 Population – explanations (optional)	
3.2.15 Degree of conservation	
3.2.15.1 Degree of conservation – categorised	B: good
3.2.15.2 Degree of conservation – occupied area	Sufficient quality: 265.825 ha (59.44 %) Non-sufficient quality: 282.35 ha (40.56 %)
3.2.15.3 Degree of conservation – occupied percentage classes	Sufficient quality: 51-75 % Non-sufficient quality: 26-50 %
3.2.16 Conservation objectives	
3.2.17 Conservation objectives – explanations	
3.2.18 Isolation	C: population not isolated within extended distribution range
3.2.19 Global	B: good value
3.2.20 Update date	December 2024

3.4.3. Fish

At the Bjeshkët e Nemuna National Park study area, one fish species was intended to be studied: the Marble trout *Salmo marmoratus*. Since the highly doubtful occurrence of *S. marmoratus* in the area due to the several barriers along the Lumbardhi i Deçanit river was confirmed during the assessments, the contracted expert used the Brown trout *Salmo trutta* as a surrogate species for the purpose of method practice regarding the assessments of individuals and populations. Besides individual numbers, the evaluation followed the indicators elaborated for the target species *S.* marmoratus.

Suitable habitats were found in the eastern, lower parts of the study area. In total 24 sub grid cells were assessed along the Lumbardhi i Deçanit river. 16 of them (67%), located in the lower sections of the river in the eastern part of the study area, were found in ‘B good’ condition. Further upstream, the results showed that 33% if the sub grid cells being in a ‘C average or reduced’ condition. (Figure 16). The unfavourable condition of the upper areas of the river due to the high pressures through impacts (‘C average or reduced), such as anthropogenic material inputs, but even more the fragmentation of the water body through several hydropower plants, and thus the lack of connectivity within the sub habitats in the lower sections. This also causes the population in the upper sections to deplete (‘C average or reduced), noticeable by low to non-existent fish densities as well as the lack of population structure and connectivity. The lower segments of the river are less affected by human impacts, resulting in higher fish densities and better population structures. However, the population connectivity is also unfavourable.

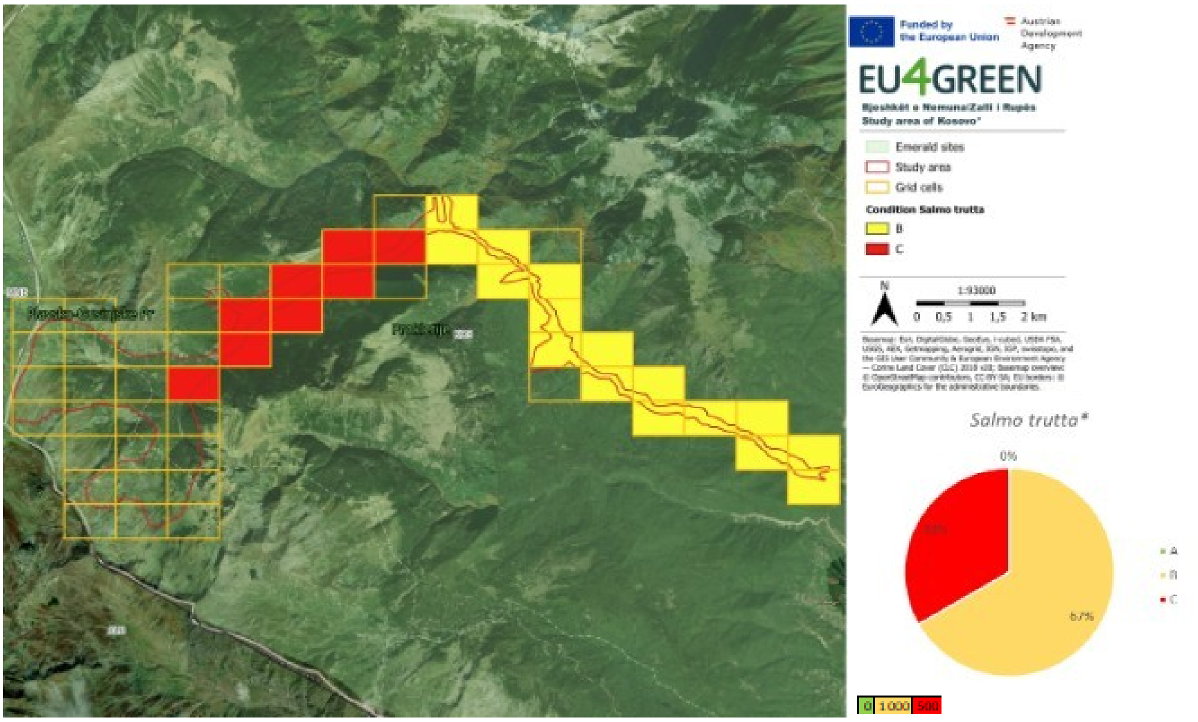

Figure 16: Distribution and condition of *S. trutta in the Bjeshkët e Nemuna study area. (*selected as a practical surrogate for *S. marmoratus*)**

Based on the information gathered during fieldwork, the ecological information for the SDF’s were compiled (Table 13Table 10).

Table 13: Ecological information for *Salmo marmoratus (S. trutta)* at the Bjeshkët e Nemuna study area (10 km^2).

Information	Species 1
3.2.1 Species group	F = Fish
3.2.1 Species code	1107
3.2.3 Scientific name	*Salmo marmoratus (Salmo trutta)*
3.2.4 Sensitivity of species data	not assessed
3.2.5 Non-presence	not applicable
3.2.6 Population type	Permanent
3.2.7 Population size and unit	
3.2.7.1 Population size	495
3.2.7.2 Population unit	i = individuals
3.2.8 Abundance category	Rare
3.2.9 Method used for population size	survey/statistically robust estimate
3.2.10 Period of last data collection	not assessed
3.2b Site assessment (species)	
3.2.11 Significance	Significant
3.2.12 Species meeting ornithological criteria for SPA classification	not assessed
3.2.13 Population	C: 2% ≥ p > 0%
3.2.13 Population – explanations (optional)	
3.2.15 Degree of conservation	
3.2.15.1 Degree of conservation – categorised	B: good
3.2.15.2 Degree of conservation – occupied area	Sufficient quality: 976.64 ha (66.67 %) Non-sufficient quality: 488.32 ha (33.33 %)
3.2.15.3 Degree of conservation – occupied percentage classes	Sufficient quality: 51-75 % Non-sufficient quality: 26-50 %
3.2.16 Conservation objectives	
3.2.17 Conservation objectives – explanations	
3.2.18 Isolation	C: population isolated
3.2.19 Global	A: excellent value
3.2.20 Update date	December 2024

3.5. Conclusions

The fieldwork conducted within Bjeshkët e Nemuna National Park proved its exceptionally high natural value, yielding particularly strong results for the studied forest habitat types as well as fens and alpine heaths. Also, good results were assessed for the Black Woodpecker (*Dryocopus martius*) and the Red-backed Shrike (*Lanius collurio*). At the same time, the investigations brought to light several challenges, both in terms of methodology and conservation practice, which should be addressed in future work to record and, subsequently, improve the valuable natural features in the area and beyond.

The exemplary assessments and evaluations indicated the need for action specifically regarding the fragmentation and naturalness of the water body of the Lumbardhi i Deçanit river. The existing pressures impact all of the assessed target features in one way or the other, causing the lack of population exchange and connectivity, provision of suitable habitats or species and natural river dynamics. Future Site-specific conservation objectives and conservation measures could target those challenges. The applied approach serves as a foundation for developing new objectives to guide the management of the National Park. These findings highlight how the local circumstances, both natural and human-influenced, can be brought together with the overall conservation status through a structured approach, ensuring that each site contributes as much as possible to the conservation of the species or habitat type.

In the eyes of EAA experts on biodiversity, the expert team responsible for the fieldwork demonstrated a high level of professionalism and motivation, successfully tailoring the methodological framework to local circumstances. In doing so, they gained valuable new insights that will prove highly useful for extending and refining mapping activities in the future, thereby strengthening the long-term conservation efforts in Bjeshkët e Nemuna National Park. They also gathered important knowledge to support the development of a general methodology to map potential future Natura 2000 sites in Kosovo[1].

4. NATURE-BASED SOLUTIONS IN FLOODPLAINS: METHODS FOR ASSESSING IMPLEMENTATION POSSIBILITIES ON A REGIONAL LEVEL

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4.1. Summary

EU4Green aimed to highlight the potential of innovative Nature-based Solutions (NbS) at the Bjeshkët e Nemuna National Park in Kosovo[1]. River regulation, intensification of land use and habitat fragmentation threaten biodiversity, ecosystem services and human well-being. NbS are increasingly recognised in policy frameworks such as the Green Agenda for the Western Balkans, the EU Biodiversity Strategy 2030 and the EU Nature Restoration Regulation as effective, multifunctional responses to these challenges. To define realistic objectives for the development of NbS, the methodology combined literature review, expert questionnaires and participatory workshops with an analysis of geospatial data to identify and localise priority areas. The results were developed in close consultation with local experts and the National Park Directorate "Bjeshkët e Nemuna".

Major societal challenges – such as flood risk, water pollution, soil erosion and habitat degradation – were linked to appropriate NbS, associated ecosystem services, indicators and data sources. Ten NbS objectives were defined across five fields of action: sustainable agricultural landscapes, forests and wooded ecosystems, riparian ecosystem restoration, protection of high-value ecosystems and soil desealing. These priority measures include conservation agriculture, grassland restoration, ecological forest management, afforestation of steep slopes, riparian buffer zones, floodplain restoration, river connectivity measures, protection of sensitive Natura 2000 species and habitats and permeable surfaces in built-up areas. The results demonstrate both the high potential of NbS in the Lumbardhi i Deçanit river valley and key challenges, including limited site-specific data, competing land uses, existing riverbank constructions and complex land ownership patterns. Successful implementation will require strong partnerships with National Park authorities as central coordinators supported by municipalities, landowners, farmers and the wider public. Overall, the EU4Green NbS outputs provide a robust and practical basis for advancing restoration, biodiversity conservation and climate resilience on the local level, in line with EU and global objectives.

4.2. Introduction

4.2.1. EU4Green's activities on NbS

EU4Green assessed and highlighted the potential of NbS on pilot site level. Because of anthropogenic activities, such as river regulations, intensification of land use and habitat fragmentation, the pressure on riparian ecosystems like floodplains is increasing. Over time, these pressures threaten the rich nature of those ecosystems and affect human well-being. The disturbed natural systems contribute to a range of societal challenges, e.g. water pollution, flood risk or soil erosion. NbS can serve as a valuable tool that help to tackle those challenges, reducing the exposure of negative effects.[31, 32]

Furthermore, NbS are promoted as valuable tool by the GAWB[2] and explicitly mentioned in many other major EU frameworks and strategies, such as the EU Biodiversity Strategy 2030[19], the EU Nature Restoration Regulation[33], the Common Agricultural Policy[34] and the Water Framework Directive[35]. These alignments emphasise the importance and necessity of the NbS concept.

Within EU4Green, the promotion of the NbS concept was supported through capacity building, such as expert workshops and webinars and establishment of a Community of Practice together with IUCN. Furthermore, EU4Green developed a comprehensive guidance document on riparian buffer zones, a NbS that provides multiple benefits when implemented along rivers. The guidance document highlights how to plan, finance, implement and evaluate such NbS.

Ultimately, the concept was also expanded to the pilot sites, with the aim to narrow down and target the crucial societal challenges and define potential NbS to improve the situation effectively and sustainably. This process was conducted in consultation with local experts and relevant stakeholders such as protected areas administrations, taking into account the relevant data and knowledge already gathered on the pilot site.

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4.2.2. NbS as sustainable tool

Definition of societal challenges, NbS and ecosystem services

Before diving into the topic of Nature-based Solutions, a few definitions are required for a common understanding of terms and, furthermore, intention and aim of the activities.

The term *societal challenges (SC)* refers to complex issues and problems that affect communities, societies, or humanity at large. They often require collective efforts and solutions to address them effectively. General examples would be poverty or inequality.

Nature-based Solutions (NbS) are defined as strategic actions that protect, sustainably manage, and restore natural or modified ecosystems to address societal challenges. In the current case study of floodplains, this would target more specifically climate change, disaster risk, water and food security, and public health. While at the same time biodiversity and human well-being are being enhanced as well. [36, 37, 38]

Unlike conventional engineering solutions (e.g. dams or concrete barriers), NbS rely on natural processes. For instance, restoring wetlands or riparian forests can offer flood protection while supporting biodiversity, sequestering carbon, and providing recreation. Compared to grey infrastructure, such interventions often deliver greater ecosystem services and long-term adaptability [39].

Ecosystem services (ES) are the benefits that humans derive from ecosystems, encompassing a wide range of goods and services that contribute to human well-being[40]. They comprise of biotic/abiotic and biophysical/geophysical services that are classified in 3 main categories:

- Provisioning services (e.g. food, water, raw materials)
- Regulation & maintenance services (e.g. climate regulation, nutrient cycling, pollination)
- Cultural services (e.g recreation, education, spiritual fulfilment)[41]

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[36] Cohen-Shacham, E., Walters, G., Janzen, C. and Maginnis, S. (eds.) (2016). Nature-based Solutions to address global societal challenges. Gland, Switzerland: IUCN. xiii + 97pp.
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Benefits of NbS

NbS offer a multifaceted approach to address environmental challenges, particularly in the context of climate change and ecosystem degradation. By enhancing carbon sequestration in e.g. wetlands, NbS contribute significantly to climate mitigation while also adapting urban areas to extreme heat through increased vegetation cover[42]. Moreover, they support biodiversity conservation by protecting and restoring critical habitats in terrestrial and aquatic ecosystems [43]. NbS also improve water quality and availability by filtering pollutants through vegetated buffers and wetlands, while simultaneously enhancing soil health through erosion control and nutrient cycling [44].

Beyond ecological gains, NbS deliver social benefits as well, which improve human well-being and community resilience. Green infrastructure, such as parks and urban forests, reduces stress, enhances mental health, and promotes physical activity [45]. NbS also buffer the impacts of natural disasters by restoring natural floodplains and stabilizing slopes, reducing the risk of floods and landslides[46]. Importantly, many NbS projects are participatory, involving local communities in planning and maintenance, which fosters social cohesion and a sense of ownership[47].

Economically, NbS provide cost-effective alternatives to traditional technology-based solutions while generating green jobs and supporting sustainable agriculture. They reduce long-term infrastructure costs by minimizing the need for expensive engineered solutions. Restoration and conservation work also drives employment in sectors like forestry, agriculture, and ecotourism. Furthermore, integrating agroecological practices improves soil and water management, leading to higher and more sustainable agricultural productivity [48].

4.2.3. Relevant guidelines and documents

To support the systematic planning, implementation and evaluation of NbS in the WB6, a range of European and international frameworks and guideline documents are available. These frameworks provide conceptual definitions, methodological standards and practical tools to assess the condition of the targeted ecosystems, ecosystem services and the effectiveness of NbS interventions. Together, they ensure coherence with EU and global biodiversity and restoration policies, enable evidence-based decision-making and support the translation of strategic objectives into measurable, site-specific actions.

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[46] Cohen-Shacham, E., Walters, G., Janzen, C., & Maginnis, S. (2016). *Nature-based solutions to address global societal challenges*. IUCN.
[47] Raymond, C. M., et al. (2017). *A framework for assessing and implementing the co-benefits of nature-based solutions in urban areas*. Environmental Science & Policy, 77, 15–24.
[48] Tittonell, P. (2014). *Ecological intensification of agriculture—sustainable by nature*. Current Opinion in Environmental Sustainability, 8, 53–61.

IUCN Global Standard for Nature-based Solutions[49]

The IUCN Global Standard for Nature-based Solutions provides a structured framework to support the effective design, implementation and evaluation of NbS. Developed by IUCN, it defines eight criteria and 28 indicators on key aspects such as biodiversity outcomes, ecosystem integrity, trade-offs, stakeholder involvement and adaptive management. The document ensures that NbS address major societal challenges (e.g. climate change, biodiversity loss and disaster risk) while delivering measurable and sustainable benefits for both people and nature, highlighting the importance of integrating environmental protection with human well-being and long-term resilience. By promoting scientifically robust and socially inclusive approaches, it supports scalable, economically viable and policy-relevant solutions that strengthen ecosystem health, human well-being and long-term resilience.

In addition, it should also be mentioned, that the IUCN provides many more reports, policy briefs and other supporting documents on NbS. Some of the most relevant for the cause of the projects work are the following:

- IUCN Global Standards for Nature-based Solutions[50]
- Nature-based Solutions for climate: A compendium of best practices in the Western Balkans[51]
- Nature-based Solutions in the Post-2020 Global Biodiversity Framework Targets[52]

Alignment with the Post-2020 Global Biodiversity Framework[53]

The Kunming–Montreal Global Biodiversity Framework defines 23 global targets for 2030, including the protection and restoration of 30 % of land and seas and the sustainable use of natural resources. NbS provide a practical path to implement these targets, particularly those related to ecosystem restoration, climate resilience, sustainable land use and nature's contributions to people. By translating global goals into locally adapted, multifunctional measures, NbS help bridge biodiversity, climate and development agendas and increase the feasibility, acceptance and impact of GBF implementation in the Western Balkans.

EU4Green: Guidance document on NbS: riparian buffer zones

[49] International Union for the Conservation of Nature (IUCN). (2020a). IUCN Global Standard for Nature-based Solutions: A user-friendly framework for the verification, design and scaling up of Nature-based Solutions (1st ed.). IUCN. https://doi.org/10.2305/IUCN.CH.2020.08.en

[50] International Union for the Conservation of Nature (IUCN). (2020a). IUCN Global Standard for Nature-based Solutions: A user-friendly framework for the verification, design and scaling up of Nature-based Solutions (1st ed.). IUCN. https://doi.org/10.2305/IUCN.CH.2020.08.en

[51] IUCN (2021). *Nature-based Solutions for Climate: A Compendium of Best Practices in the Western Balkans*. Gland, Switzerland: International Union for Conservation of Nature (IUCN). https://iucn.org/sites/default/files/2023-12/nbs-compendium-western-balkans_finalo.pdf

[52] IUCN (2020). *Nature-based Solutions in the Post-2020 Global Biodiversity Framework Targets*. Gland, Switzerland: International Union for Conservation of Nature (IUCN). https://iucn.org/sites/default/files/2022-11/nbs-in-gbf-targets-brief-november-2022.pdf

[53] Convention on Biological Diversity (CBD). (2022). Kunming-Montreal Global Biodiversity Framework. CBD COP15, Montreal.

The guidance document provides an overview of relevant principles and approaches for the planning, implementation, and monitoring of riparian buffer zones as a key NbS along rivers and floodplains in the WB6. While the main concepts and methodological foundations are described in the respective chapter of this summary report, the detailed guidance and concrete steps are addressed in depth and in the dedicated EU4Green deliverable.

Catalogue of NbS for Water Management in the Eastern Partnership Countries[54]

This catalogue provides a comprehensive overview of 34 NbS relevant to water management at the river basin scale, with applicability also to the WB6. Each factsheet combines documented case studies, technical references and indicative cost information, supporting informed decision-making by practitioners, authorities and planners. Within EU4Green Biodiversity activities, a targeted selection of these NbS forms the analytical basis for defining NbS objectives and measures in the three pilot study areas.

Voluntary Guidelines for the design and effective implementation of ecosystem-based approaches to climate change adaptation and disaster risk reduction and supplementary information[55]

The CBD voluntary guidelines provide support to governments, organisations, and communities for designing and implementing ecosystem-based approaches to climate change adaptation and ecosystem-based disaster risk reduction. It emphasizes the use of biodiversity and ecosystem services as sustainable, cost-effective, and inclusive strategies to reduce vulnerability to climate hazards while enhancing human and ecological resilience. The guidelines outline principles and practical steps for embedding NbS into policies and projects, highlighting co-benefits such as improved livelihoods, food security, and cultural values. Supplementary case studies and tools illustrate how ecosystem restoration, conservation, and sustainable management can function as NbS that simultaneously address climate risks, safeguard biodiversity, and support long-term development goals.

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[54] EU4Environment – Water Resources and Environmental Data. (2024). Catalogue of Nature-based Solutions for the water sector in the Eastern Partnership countries (Sept. 2024, Version Final). EU4Environment. Water Resources and Environmental data

[55] Secretariat of the Convention on Biological Diversity (2019). Voluntary guidelines for the design and effective implementation of ecosystem-based approaches to climate change adaptation and disaster risk reduction and supplementary information. Technical Series No. 93. Montreal, 156 pages.

4.3. Material and methods

4.3.1. Literature research

As basis for all further activities, the first step consisted of screening existing literature. In combination with expert's knowledge, the aim was to get an overview of the most relevant NbS for societal challenges typically related to floodplains and other riparian ecosystems. As main references for this preliminary work, the CICES nomenclature[56] on ecosystem services was used together with the systematic review on ecosystem services of Grima et al. [57]. Within EU4Green, we created a first selection by linking the relevant societal challenges with the corresponding NbS and suggested indicators..

4.3.2. Workshops with local experts

Together with the biodiversity experts of each pilot region, who were already involved in a close cooperation for the assessment of the Natura 2000 features, a participative workshop on NbS was held. The workshop started with a theoretical part, giving input on definitions and examples of SC & NbS. In the following participative working sessions, the plenum of experts was consulted on their estimations of the regional and local circumstances of each study area. With their active involvement, questionnaires on currently pressing SC and potential NbS for the areas were filled out to complement the preselected list of key challenges and potential measures. Each assessment was followed by a prioritization of the elaborated SC and NbS lists for each pilot area.

The ranked collection was evaluated and constituted the final selection of SC & NbS for the subsequent outputs, such as the NbS matrix and the guidance document on NbS.

4.3.3. NbS matrix

The NbS matrix was compiled as key output subsequently to the expert workshop, combining the outputs of the participative session with further findings from literature. The resulting list was then extended by linking ecosystem services and suitable indicators according to Grima et al.[56].

As additional information, the ranked priority for societal challenges and NbS in each economy was integrated as well. Since data availability is a significant issue for the WB6, valuable information on existing data sources was added.

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[56] Haines-Young, R. (2023): Common International Classification of Ecosystem Services (CICES) V5.2 and Guidance on the Application of the Revised Structure.
[57] Grima, N., Jutras-Perreault, M. C., Gobakken, T., Ørka, H. O., & Vacik, H. (2023). Systematic review for a set of indicators supporting the Common International Classification of Ecosystem Services. *Ecological Indicators*, *147*, 109978.

4.3.4. NbS objectives

Study area

The selection of the case study sites was primarily guided by the explicit interest of the beneficiary in the development of NbS objectives for EU4Green's pilot site, Bjeshkët e Nemuna National Park, which highlighted a demand to explore NbS as a tool to address local challenges and support alignment with EU standards. The choice also reflected each economy's progress in implementing the GAWB and built on earlier work of EU4Green on Natura 2000 preparation.

For the analyses, the study area mapped for Natura 2000 features was extended by a 2.5 km buffer. This scope was chosen to capture the most relevant surrounding landscape and integrate additional data beyond the core Natura 2000 assessments.

Data basis

To identify suitable NbS measures for the pilot region, core datasets from the EU4Green project were combined with selected external sources to provide a robust data basis for regional decision-making. The analysis relied largely on harmonised remote-sensing data available for the entire WB6, including data from CLC+ Backbone[58,59] and Copernicus DEM[60], meaning that the resulting maps indicate priority areas for action and may include generalisations or artefacts inherent to the spatial resolution and thematic limits of the datasets.

Key inputs for the further analysis included Natura 2000 habitat assessments from EU4Green (chapter Error: Reference source not found), which document Annex I habitat types and other relevant land cover classes within the core study areas, complemented by additional data for the surrounding landscape. Land cover information was derived from the CLC+ Backbone raster (2023, 10 m resolution) and vector dataset (2018, MMU 0.5 ha), providing detailed and up-to-date insights into land cover patterns and dynamics. Topographic information was taken from the Copernicus DEM GLO-30 and processed into contour lines to support the identification of flood- and water-related NbS action areas. OpenStreetMap data[61] were used to supplement small and linear watercourses not fully captured in CLC+ datasets, due to their relatively rough resolution.

The selection of measures was further informed by the Catalogue of Nature-based Solutions for the water sector[62]. Table 14 shows the measures for the NbS objectives within the case study area, according to the NbS catalogue. As another output developed during the

[58] European Environment Agency & Copernicus Land Monitoring Service. (2018). CLC+ Backbone 2018 – Vector dataset. European Union. DOI: https://doi.org/10.2909/d45d5114-fb86-4265-9c5a-a7225a511f7c
[59] European Environment Agency; Copernicus Land Monitoring Service. (2025). CLCplus Backbone 2023 (Raster, 10 m). European Union. DOI: https://doi.org/10.2909/b0bd43c6-1fa1-4d88-9c45-98b13a95d0b2
[60] European Space Agency & European Commission (2022). Copernicus Digital Elevation Model (DEM) for Europea with a resolution of 30 m, derived from Copernicus Global 30 m data set. http://data.europa.eu/88u/dataset/f576cda8-d598-478c-b8fe-ad2634c927e8
[61] OpenStreetMap contributors. (2024). OpenStreetMap data on streams and rivers. OpenStreetMap Foundation. https://www.openstreetmap.org

EU4Green project, the NbS matrix (Annex V) synthesises expert input from workshops and literature, linking societal challenges to suitable NbS, ecosystem services and potential indicators. It provides additional options beyond those mapped in this document.

Table 14: Selection of NbS for water management, according to the Catalogue of NbS by EU4Environment (2024), listed by main land cover categories found in the study areas.

Main Category	NbS Measures
Rivers, streams, and floodplains	Restoration of buffer strips, riparian forest and gallery forest Floodplain restoration and management Natural bank stabilisation Stream and river restoration Reconnection of oxbow lakes Removal of lateral barriers Removal of transversal barriers
Agriculture and grasslands	Agroforestry, buffer strips and hedges Conservation agriculture Conversion to meadows and pastures Restoration of existing pastures, steppes and natural grasslands Sustainable pasture management
Forests and woodlands	Adapted forestry in floodplains and wet forests Afforestation Close-to-nature forestry Coarse woody debris in rivers and streams
Settlements and built-up areas	Permeable surfaces
Cross-cutting measures	Conservation of existing high environmental value ecosystems

Definition of NbS objectives and measures

The identification of action zones in the study areas followed a systematic, data-driven approach combining ecological information, spatial analyses and remote-sensing data. Natura 2000 habitat assessments and CLC+ Backbone land-cover data formed the baseline for defining the ecological context, while Copernicus DEM data were used to capture terrain characteristics such as slope, hydrological pathways and flood-prone areas. Additional spatial parameters, including buffer zones and distance analyses, helped prioritise areas with high pressure, degradation risk or potential for improved ecological connectivity.

Based on these spatial characteristics, suitable NbS were assigned to each area, ensuring that proposed measures directly address site-specific ecological and socio-environmental challenges. This process resulted in 10 recommended NbS objectives, structured across five

[62] EU4Environment – Water Resources and Environmental Data. (2024). Catalogue of Nature-based Solutions for the water sector in the Eastern Partnership countries (Sept. 2024, Version Final). EU4Environment. Catalogue of Nature Based solutions

fields of action and linked to spatial layers and 18 concrete NbS measures. The framework enables clear visualisation of priority areas and provides a solid basis for future implementation planning (see Table 15Table 15).

The five fields of action cover the following land-use and ecosystem categories: sustainable agricultural landscapes, forests and wooded ecosystems, riparian ecosystem restoration, protection of high-value ecosystems and soil desealing.

Table 15: Fields of action linked to the respective NbS Objectives, specific measures for realisation and land cover type with the used criteria.

Field of action	NbS Objective	NbS measure (according to EU4Environment, 2024)	Land cover type & criteria
Sustainable agricultural landscapes	1) Enhancement and restructuring of homogenised, agricultural landscapes	Agroforestry, buffer strips and hedges	Large coherent farmland and grassland with > 100m distance from the next landscape element (e.g. forest) below an altitude of 1500m
	2) Conservation agriculture	Conservation agriculture	All agricultural areas
	3) Grassland conversion, restoration & sustainable use	Conversion to meadows and pastures	All grassland
		Restoration of existing pastures, steppes and natural grasslands	
		Sustainable pasture management	
Forests and wooded ecosystem	4) Ecological forest management	Adapted forestry in floodplains and wet forests	All forests of the catchment area in proximity to the river
		Close-to-nature forestry	
	5) Expanding forest cover	Afforestation	Open land with moderate to steep slopes below an altitude of 1500m
Riparian ecosystem restoration	6) Restoring aquatic habitat structures	Coarse woody debris in rivers and streams	Forests within 50m proximity to the river, below an altitude of 1500m
	7) Revitalising floodplains and riparian buffer zones	Floodplain restoration and management	Forests and open land on gentle slopes within 100m proximity to the river
		Restoration of buffer strips, riparian forest and gallery forest	
	8) Restoring river dynamics and connectivity	Natural bank stabilization	Water courses buffered with 25m
		Reconnection of oxbow lakes	
		Removal of lateral barriers	
		Removal of transversal barriers	
		Stream and river restoration	
Protection of high-value ecosystems	9) Protection of high-value ecosystems	Conservation of existing high environmental value ecosystems	Assessed annex I habitat types
Soil desealing	10) Sustainable built-up areas	Permeable surfaces	Sealed or built-up surfaces > 500m^2

Stakeholder involvement

To ensure the practicality and local relevance of the proposed NbS objectives and measures, regional stakeholders were consulted during the development process. Their input was crucial for validating the results on-site conditions and assessing the feasibility and compatibility of the proposed measures with existing land-use and conservation frameworks. For the Bjeshkët e Nemuna National Park study area in Kosovo[1], the professional and technical services of the Bjeshkët e Nemuna National Park Directorate provided site-specific expertise on environmental conditions, land ownership as well as management constraints and opportunities according to the zonation of the protected area, with feedback coordinated through email exchanges.

The involvement of the colleagues in the Bjeshkët e Nemuna National Park allowed feedback and clarifications regarding the given document on NbS objectives and site-specific conditions.

4.3.5. Software

Geo data compilation and spatial analysis was done in QGIS[63].

[63] QGIS Development Team. (2025). QGIS Geographic Information System (Version 3.40). QGIS Association. https://www.qgis.org

4.4. Results and discussion

4.4.1. NbS matrix

The NbS matrix represents the condensed output of the literature review, expert workshops and questionnaires as well as data acquisition process carried out within the project. It provides a structured overview linking societal challenges (SC) identified in the study areas with potential NbS, their associated ecosystem services (ES), suitable indicators, and exemplary data sources. The matrix thus serves as an integrative tool to connect pressures, responses and measurable outcomes in a transparent and comparable manner.

For Kosovo[1], societal challenges were identified and ranked based on expert input, reflecting their relative importance at the regional level. Corresponding NbS measures were then assigned to each challenge and flagged as NbS or non-NbS based on expert judgement and alignment with established NbS definitions. Where applicable, an NbS ranking was included to reflect the perceived relevance or effectiveness of the measure in addressing the specific challenge.

The matrix further links each NbS to relevant ecosystem services, such as biodiversity conservation or enhancement, and proposes potential indicators (e.g. number of species, α-/β-diversity) to support monitoring and evaluation as well as ensuring systematic tracking of ecological outcomes. Exemplary data sources, including zoological and botanical surveys, are referenced to indicate how these indicators could be operationalised in practice.

The full NbS matrix, including detailed rankings and data references, is provided in Annex V.

4.4.2. Guidance document on NbS

The elaborated Guidance document on NbS: riparian buffer zones focused on an impactful and highly relevant NbS for floodplains within the Western Balkan pilot sites. Riparian buffer zones represent a powerful NbS to address pressing environmental and societal challenges associated with floodplains. As linear habitat structures along rivers and floodplains, they provide multiple benefits: reducing flood risk, improving water quality, conserving biodiversity, and enhancing ecosystem services for local communities.

The key elements covered in the guidance document encompass:

- An overview of the concept and benefits of NbS, aligned with international standards, relevant policy frameworks and stakeholder engagement.
- Practical guidance on the design, management, and integration of NbS – illustrated by the practical example of riparian buffer zones – into broader conservation and land-use strategies.
- A focus on indicators and monitoring approaches that enable administrations to track effectiveness, adapt management, and demonstrate outcomes.

- A designated chapter by Green Finance experts that outlines potential finance und funding opportunities available for NbS projects in the WB6.

While the proposed NbS offer significant opportunities, implementation in the region still faces barriers such as limited data availability, financial constraints, fragmented governance, and competing land-use interests. Addressing these challenges requires cross-sectoral cooperation, long-term commitment, and investment in knowledge and capacity building.

For protected area administrations, this guidance provides a practical tool to strengthen floodplain resilience, enhance biodiversity conservation, and contribute to EU environmental objectives. By adopting evidence-based and participatory approaches, administrations can ensure that riparian buffer zones deliver sustainable, multifunctional benefits for both people and nature.

4.4.3. NbS objectives

The NbS objectives and recommended measures for floodplain landscapes are based on the Catalogue of NbS for Water Management in the Eastern Partnership Countries [64]. Together, they address key pressures on floodplain ecosystems while delivering multiple co-benefits for biodiversity, water management and climate resilience. Across all objectives, early and continuous involvement of relevant stakeholders is essential for successful implementation.

In the following, the five broader **fields of action** and their ten *objectives* are elaborated, each comprising specific **NbS measures**.

Sustainable agricultural landscapes

Objective 1 – Enhancement of homogenised agricultural landscapes

This objective addresses structurally poor agricultural landscapes lacking natural elements and habitats. Measures such as **agroforestry systems, hedges and buffer strips** introduce woody and linear landscape features into farmland and adjacent infrastructure. These measures reduce surface runoff and wind erosion, improve soil water infiltration and retention, and provide habitats for a wide range of species, including pollinators and natural pest controllers, but also serve as vital migration corridors through the most intensive parts of the agricultural landscapes.

Objective 2 – Conservation agriculture

Conservation agriculture aims to improve soil health, biodiversity and ecosystem services through reduced soil disturbance, permanent soil cover and diversified crop rotations. Practices such as no- or low-till cultivation, strip cropping, early sowing and crop

[64] EU4Environment – Water Resources and Environmental Data. (2024). Catalogue of Nature-based Solutions for the water sector in the Eastern Partnership countries (Sept. 2024, Version Final). EU4Environment. Water Resources and Environmental data

diversification enhance biological processes above and below ground, increase water and nutrient efficiency and support stable long-term production. While implemented at farm scale, the impacts must be assessed at watershed scale to effectively mitigate environmental pressures.

Objective 3 – Grassland conversion, restoration and sustainable use

This objective targets the loss and degradation of grasslands caused by abandonment or intensification. Measures include **converting arable land back to meadows or pastures**, **restoring degraded grasslands** through seed transfer from species-rich sites, and applying sustainable grazing or mowing regimes. These practices enhance biodiversity, carbon sequestration and ecosystem resilience while maintaining forage production.

Forests and wooded ecosystems

Objective 4 – Ecological forest management

Adapted forest management in floodplains and wet forests aims to maintain riparian forest integrity and ecosystem services. Measures include rewetting, filling drainage ditches, limiting grazing and restricting wood extraction. As another effective NbS, **close-to-nature forestry** under the umbrella of Sustainable Forest Management can be mentioned. It promotes natural structures, diverse tree species and age classes, and key habitat features such as deadwood and veteran trees.

Objective 5 – Expanding forest cover

Afforestation and reforestation restore forest cover on degraded or deforested land using native species. Implementation can follow natural succession or active planting and includes approaches such as agroforestry. These measures enhance connectivity, carbon storage and climate resilience.

Riparian ecosystem restoration

Objective 6 – Restoring aquatic habitat structures

The reintroduction of **coarse woody debris** into rivers and streams moderates flow velocity, increases local water levels and creates diverse aquatic habitats. When carefully designed, these measures contribute to the mitigation of floods and erosion and the enhancement of biodiversity without compromising river stability or species migration.

Objective 7 – Revitalising floodplains and riparian buffer zones

Floodplain restoration and the **establishment of riparian buffer zones** restore natural river dynamics and create space for flooding and sediment processes. These measures improve water retention, reduce flood and drought risks, filter pollutants and excess nutrients from agricultural runoff, and enhance habitat diversity. Buffer width varies depending on site-specific conditions.

Objective 8 – Restoring river dynamics and connectivity

This objective focuses on **stream and river restoration**, implementing NbS like reconnecting rivers with their floodplains and side channels by removing or modifying lateral and transversal barriers. Measures include **reconnecting oxbow lakes**, **removing dams or weirs**, **dismantling bank reinforcements** and applying **natural bank stabilisation** techniques to restore sediment transport, flow diversity and habitat connectivity.

<u>Protection of high-value ecosystems</u>

Objective 9 – Protection of high-value ecosystems

This objective supports the **conservation and improvement of existing Annex I habitat types** and other high-value ecosystems identified in Natura 2000 assessments within the study area during the project's course. Site-specific, long-term management is essential to maintain favourable conservation status and safeguard ecosystem functions such as water purification, biodiversity support and climate regulation.

<u>Soil desealing and built-up areas</u>

Objective 10 – Sustainable built-up areas

Permeable and porous surfaces replace sealed areas in urban and rural settings, allowing rainwater infiltration, groundwater recharge and controlled runoff. These measures are applicable to roads, farmyards and urban spaces and require regular maintenance to ensure long-term functionality.

4.4.4. Maps of the NbS objectives and measures

Based on the spatial analysis of the study area and the feedback obtained through stakeholder involvement, concrete areas of action could be delineated for each of the 10 NbS objectives. The institutional and professional input provided by the Bjeshkët e Nemuna National Park Directorate was systematically integrated into the results, ensuring that site-specific ecological conditions, management priorities and constraints were adequately reflected in the interpretation of the findings.

The following figures present a series of maps illustrating the spatial distribution of the identified areas of action and their corresponding NbS objectives. These maps represent a synthesis of geospatial analyses and expert validation and are intended to support orientation and future planning rather than prescribe fixed interventions.

The comments and data input from the Bjeshkët e Nemuna National Park Directorate were used to adjust and refine the proposed action zones by considering existing and planned management measures, land ownership patterns, recreational pressure, and other ecological or administrative constraints. This ensures that the mapped NbS objectives are consistent with the management plan of the national park and provide a realistic, implementation-oriented basis for further prioritization and discussion.

Management zones of the Bjeshkët e Nemuna National Park

The Bjeshkët e Nemuna National Park is divided into three management zones, each governed by distinct conservation objectives and land-use regulations (Figure 17).

Zone I – Strict protection (orange): comprises areas of exceptional natural value with high biodiversity and largely undisturbed ecosystems. These zones serve as key habitats and migration corridors for protected and endemic species. Human intervention is prohibited, except for scientific and educational purposes, and all areas are designated as strictly protected nature reserves.

Zone II – Active management (purple): covers the largest share of the park and includes forests and pastures of high ecological and landscape value. While conservation remains the primary objective, regulated human activities such as sustainable agriculture, grazing, limited forestry, collection of non-timber forest products, and low-impact recreation are permitted under the National Park management plan.

Zone III – Permanent residence and sustainable development (green): encompasses areas of lower ecological sensitivity that allow settlements and economic activities. In addition to activities permitted in Zone II, this zone enables construction for housing, social infrastructure, and tourism, with a focus on sustainable and rural development in accordance with spatial planning requirements.

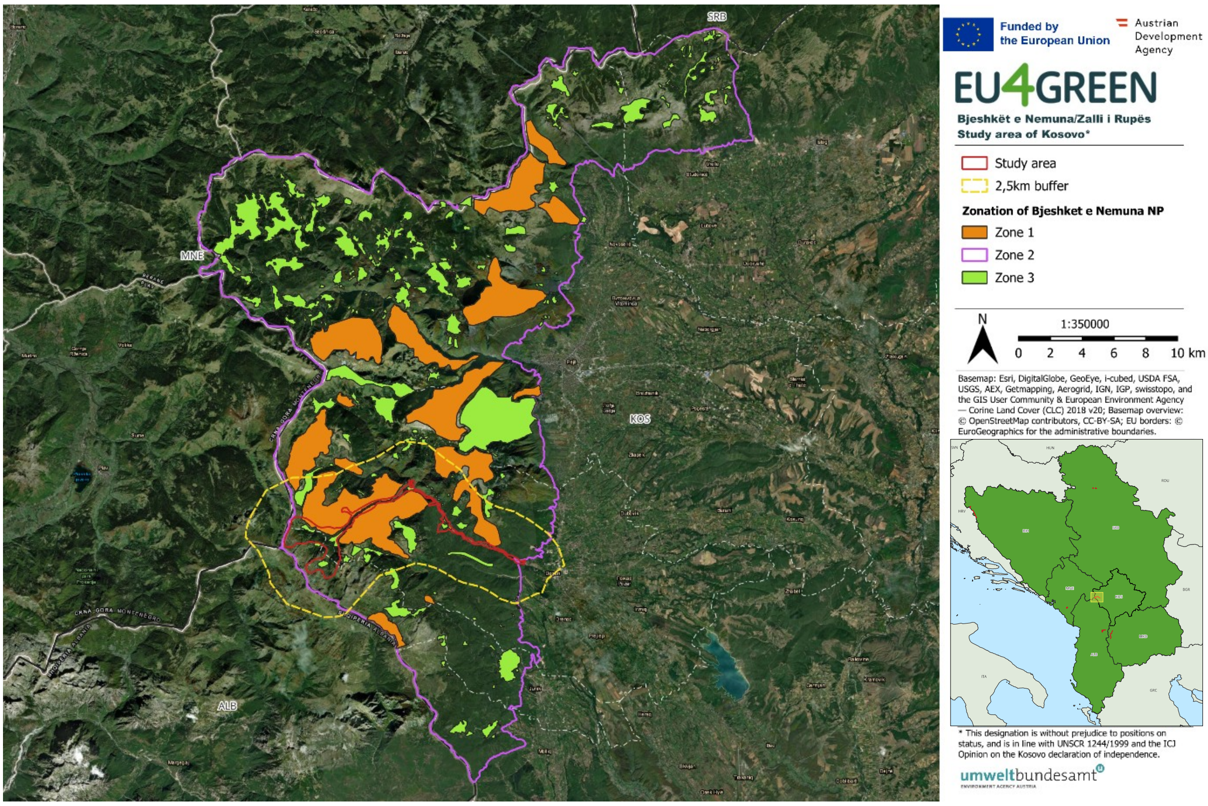

Figure 17: The management zones of the Bjeshkët e Nemuna National Park, defining Zone I (Strict Protection), Zone 2 (Active management) and Zone 3 (Permanent Residence and Sustainable Development). (geodata of zonation provided by the Directorate of the Bjeshkët e Nemuna National Park).

Given these differentiated management regimes, tailored implementation approaches are required within the project area. Strict conservation zones (Zone I) present opportunities for early implementation of NbS, as their exclusive conservation mandate allows ecological restoration measures with minimal social or economic conflict. In contrast, a significant portion of the project area overlaps with Zone III, where private land ownership and residential use prevail. Here, NbS implementation may be more complex and will require a bottom-up, community-based approach to engage landowners, build awareness, and secure long-term acceptance and support for proposed land-use and management changes.

Land cover types

As shown in Figure 18, the studied area is predominantly covered by broad-leaved forests (light-green) in lower altitudes (eastern part) as well as coniferous forests (dark green) in the higher altitudes (central part). Above the tree line, alpine heats and meadows predominantly occur in the study area. Within the mostly forest areas, some larger and smaller patches of open land can also be found, mostly consisting of different grassland types (olive-green) and agriculturally used areas (yellow). In the lowlands of the case study area in very east, the town Deçan is located. Besides the main stream of the Lumbardh i Deçanit River, a number of smaller tributaries can be found.

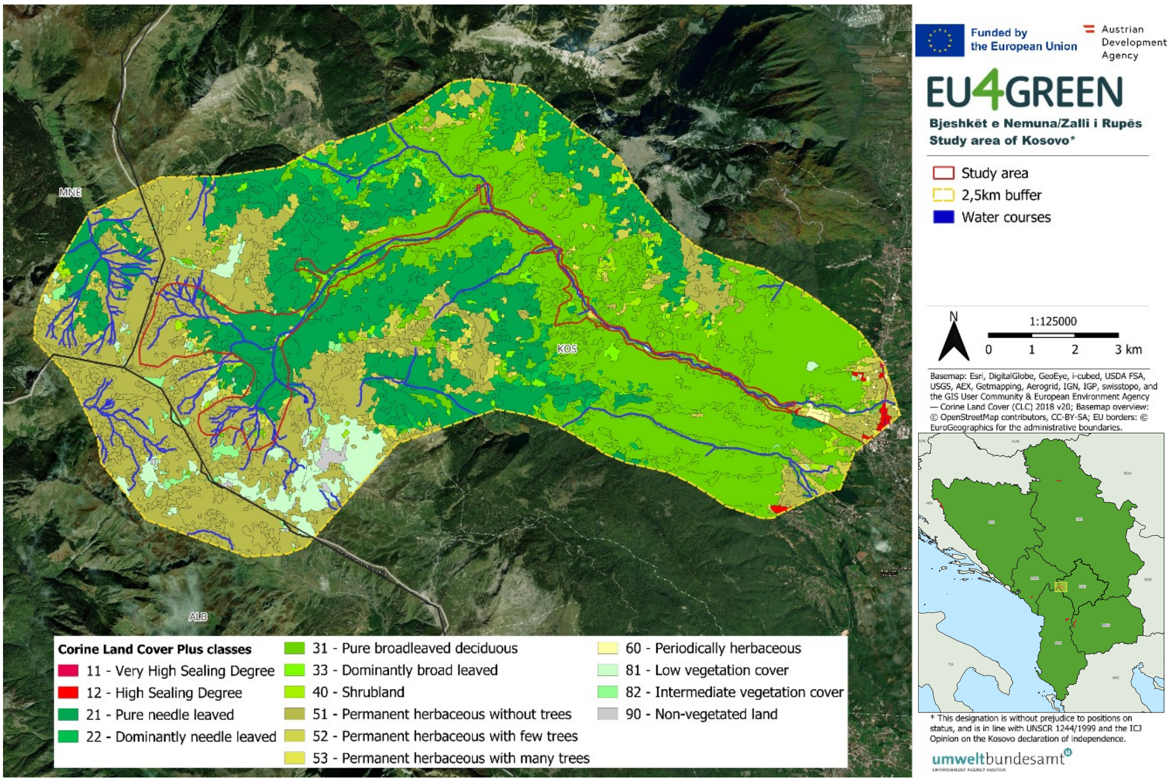

Figure 18: Land cover types according to the CLC+ Backbone raster (2023, 10 m resolution) and vector dataset (2018, MMU 0.5 ha) datasets in the Bjeshkët e Nemuna National Park study area, Kosovo[1].

Sustainable agricultural landscape

Within the Kosovo[1] study area (Figure 19) opportunities to promote more sustainable farmland management are largely limited to the lower altitudes. The areas surrounding the village of Deçan are dominated by grassland, with some arable land. While conservation agriculture approaches are applicable to the latter, most agricultural parcels are already well structured due to their generally small size. Nevertheless, a few structurally simplified patches were identified where the introduction of landscape elements such as hedges or shrub belts is recommended.

Most areas with potential for NbS measures are located outside the national park boundaries or outside Zone II (purple line). Consequently, the cooperation and engagement of the local population are particularly important for successful implementation.

Grasslands above 1500 m were excluded from the assessment of homogenised agricultural land, as they are naturally treeless and extensively managed. However, sustainable management practices could be promoted in some lower alpine grasslands. In the lowland areas, measures aimed at grassland restoration and sustainable use are recommended. It is also shown that relevant grassland areas occur across Zones I, II, and III, underscoring the need for zone-specific approaches that account for differing management regimes and stakeholder contexts.

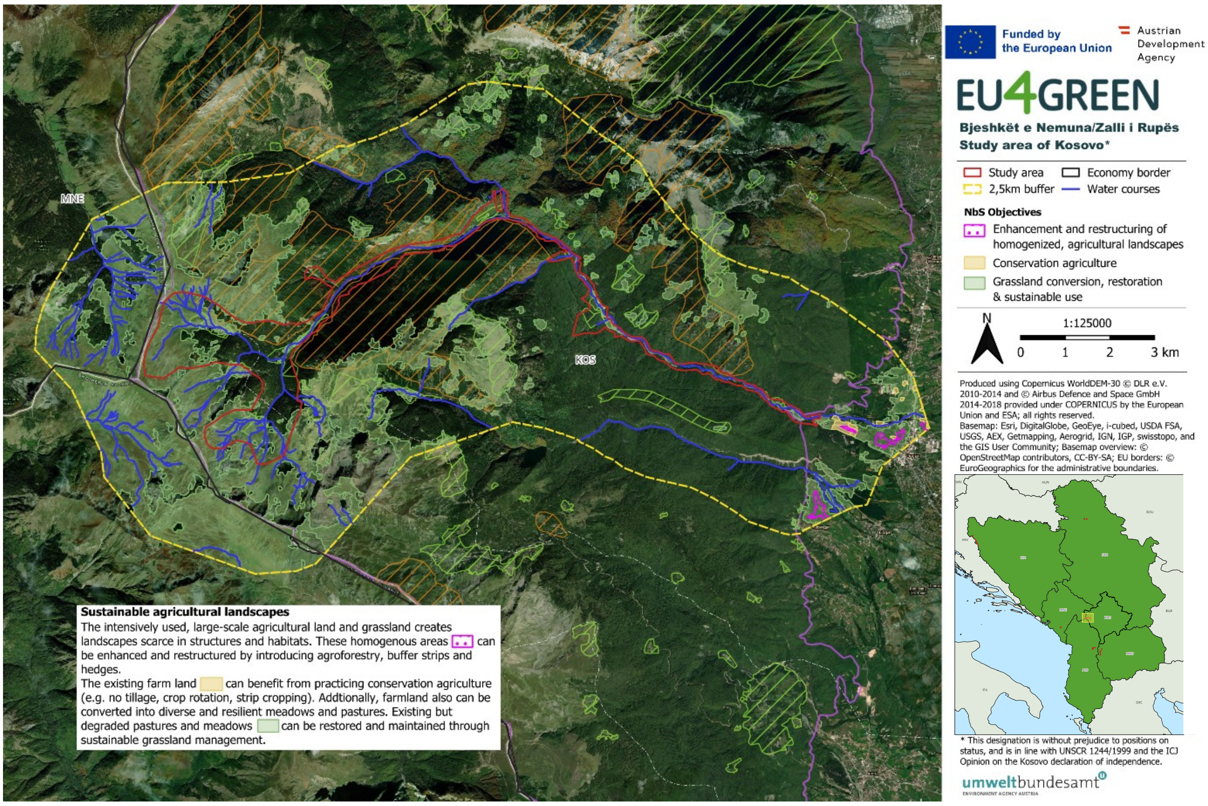

Figure 19: The NbS objectives for the field of action “Sustainable agricultural landscapes” in the Bjeshkët e Nemuna National Park study area, Kosovo[1].

Forests and wooded ecosystems

With regard to potential afforestation measures, the steep valley of the Bjeshkët e Nemuna National Park study area (Figure 20) offers only limited opportunities, as most slopes are already forested. For the remaining potential sites, additional data, such as biotope mapping or in-situ surveys, are required to determine the need for further interventions or whether naturally open habitats (e.g. dry or wet grasslands, floodplains) are present already. Where appropriate, forestry measures should be adapted to floodplain and wet forest conditions and, where feasible, close-to-nature forestry, particularly along rivers, should be followed.

Strictly protected Zone I and actively managed Zone II largely encompass the forested valley slopes, extending from river corridors to higher elevations. In these zones, close-to-nature forestry approaches may be applied where necessary, for example to support the transition from former plantations to more natural forest structures, improve species and structural diversity, or enhance riverbank stability and flood protection.

Although Zone III covers a smaller area within the study region, it remains highly relevant for implementation. Measures in this zone require close coordination with landowners and local communities, presenting both challenges and opportunities for sustainable NbS. While higher elevations are dominated by extensive mountain grasslands, Zone III in lower areas mainly consists of smaller, fragmented forest patches.

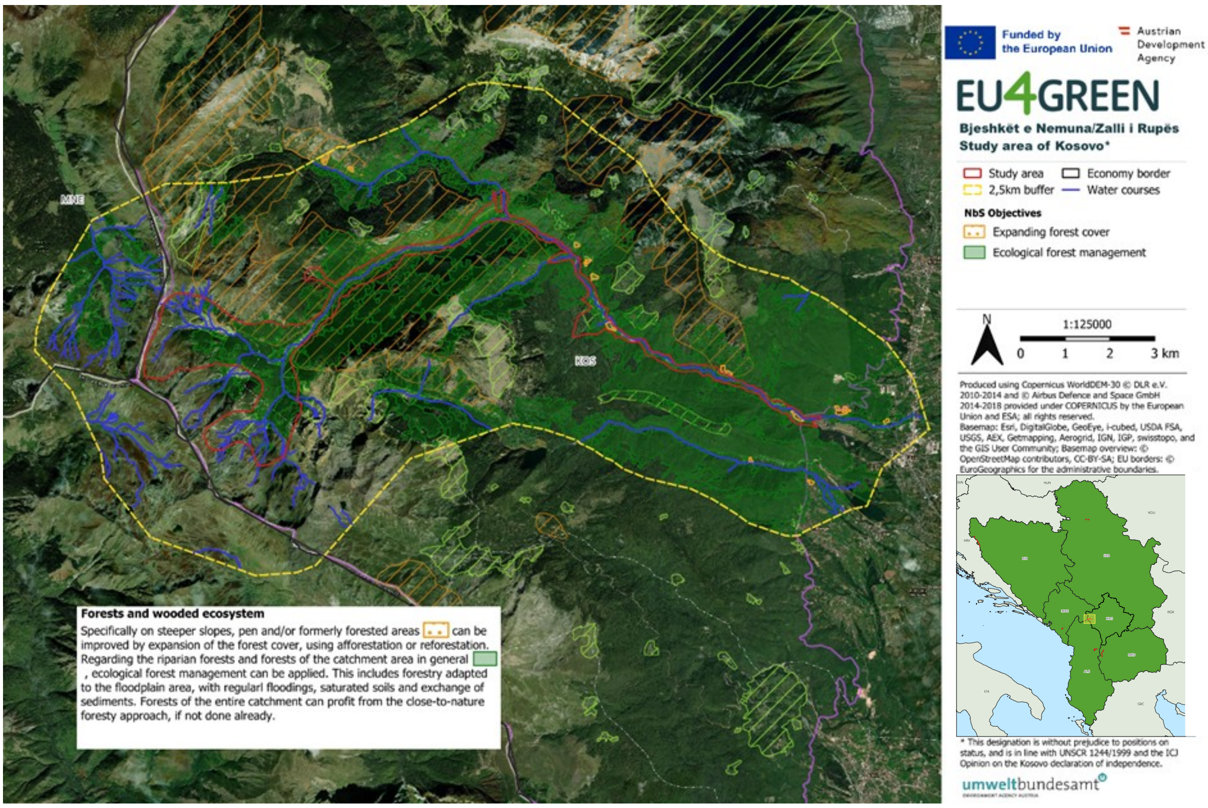

Figure 20: The NbS objectives for the field of action "Forests and wooded ecosystems" in the Bjeshkët e Nemuna National Park study area, Kosovo[1].

Riparian ecosystems restoration

As illustrated in Figure 21, objectives related to the restoration of aquatic habitat structures are primarily recommended for river stretches at lower elevations, where reducing flow velocity and enhancing flood protection are most effective. Measures to revitalise floodplains and riparian buffer zones are likewise mainly suited to lower-lying areas, as the steep and narrow valley morphology limits implementation options upstream; more extensive interventions are feasible around Deçan (Figure 5). A further priority is the mitigation of river fragmentation caused by barriers such as hydropower plants, for example through fish ladders or comparable measures to restore ecological connectivity and continuity.

In the case of Deçan, most target areas lie outside the national park boundaries, making early stakeholder engagement and participation essential for successful implementation.

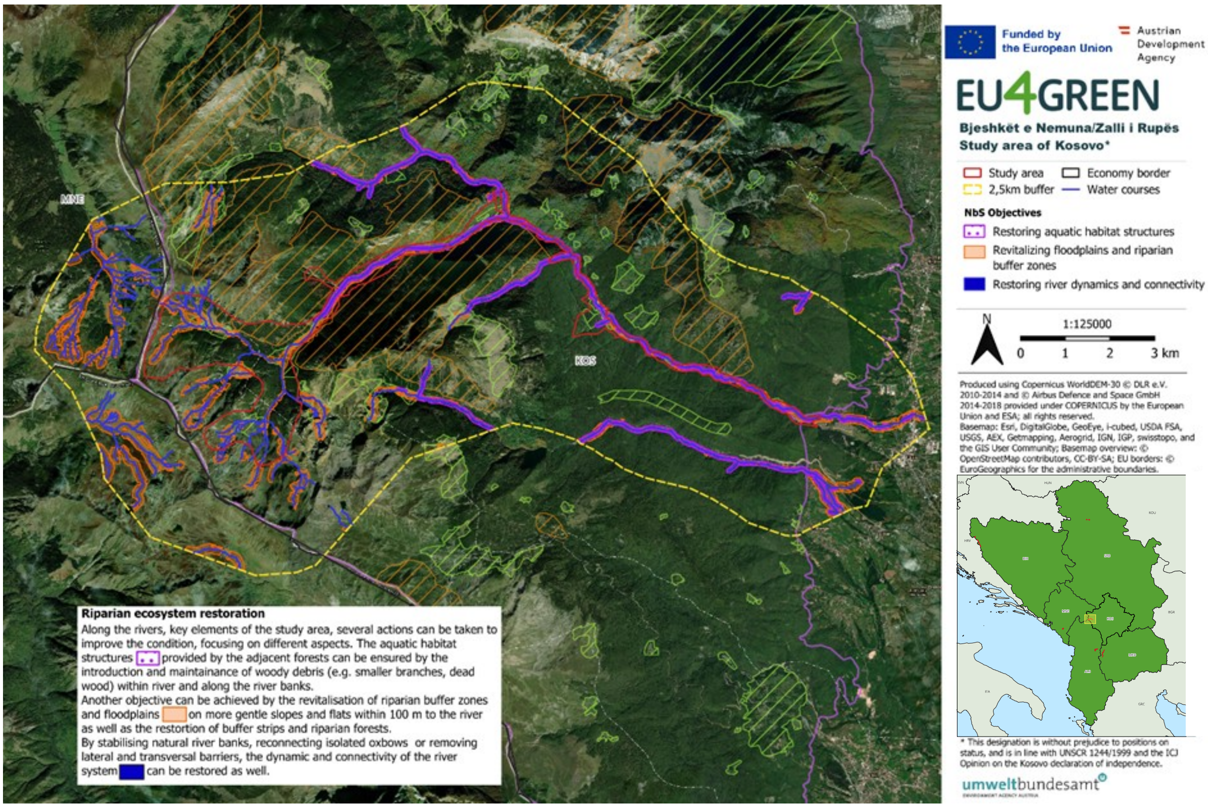

Figure 21: The NbS objectives for the field of action “Riparian ecosystems restoration” in the Bjeshkët e Nemuna National Park study area, Kosovo[1].

Protection of high-value ecosystems

The slopes within the national park study area host a range of Annex I habitat types, including habitat ‘3240 Alpine rivers and their ligneous vegetation with *Salix elaeagnos*’, as well as ‘4060 Alpine and Boreal heaths’ at higher elevations. Below the tree line, habitats such as ‘9130 *Asperulo-Fagetum* beech forests’ and ‘91E0 alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior*’ are present (Figure 22).

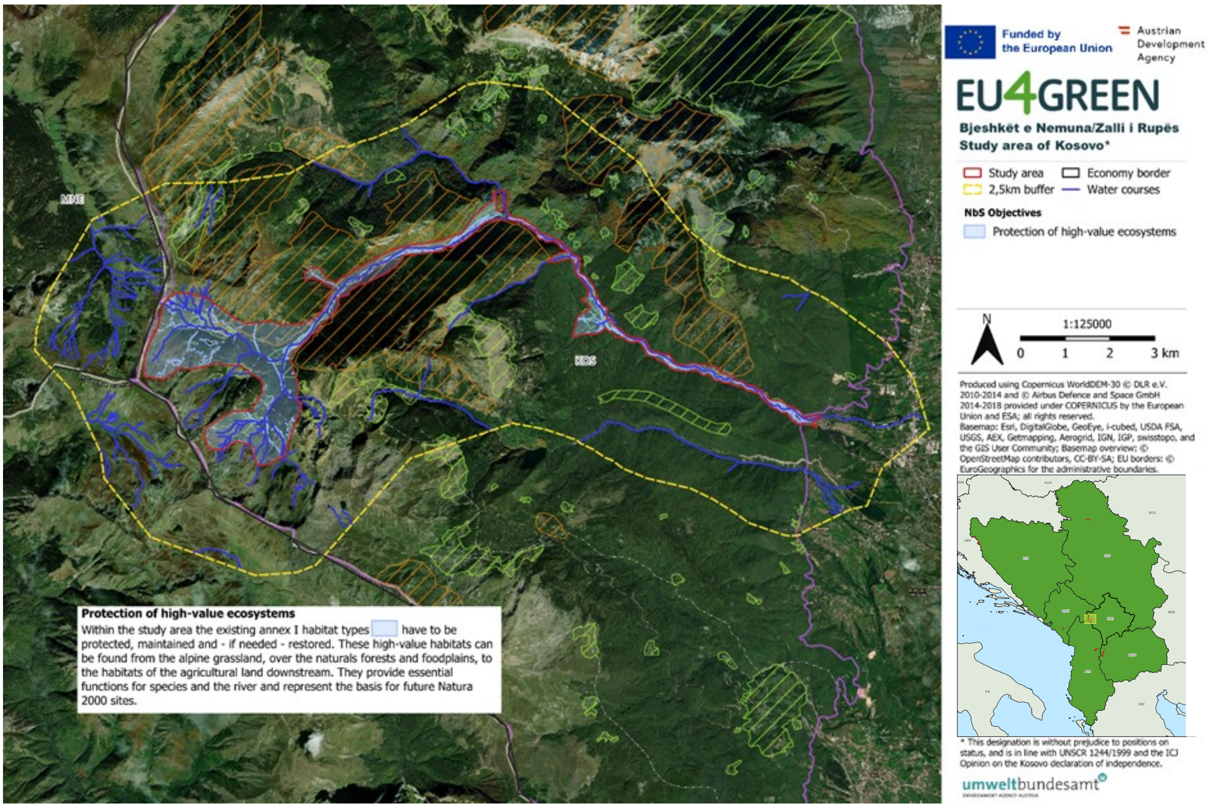

Figure 22: The NbS objectives for the field of action “Protection of high-value ecosystems” in the Bjeshkët e Nemuna National Park study area, Kosovo[1].

Soil desealing

As shown in Figure 23, sealed surfaces are largely concentrated in the built-up areas of the settlement in the eastern part of the study area. In addition, the unpaved road leading into the valley should be maintained in its current state or, where erosion control is required, upgraded using permeable surface materials.

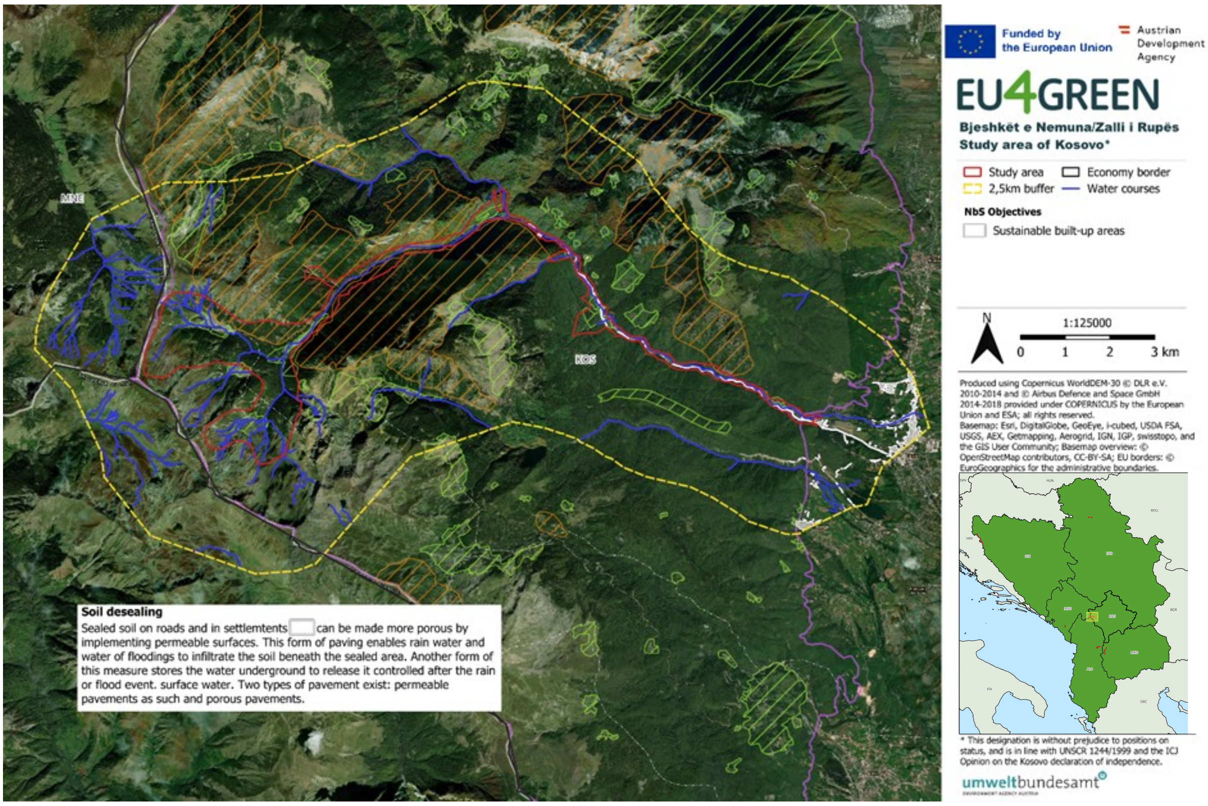

Figure 23: The NbS objectives for the field of action "Soil desealing" in the Bjeshkët e Nemuna National Park study area, Kosovo[1].

4.5. Conclusions

The development of NbS objectives and the guidance document on riparian buffer zones highlighted both the opportunities for various fields of action and also constraints of applying NbS in the study area of Kosovo[1]. While the availability of harmonised geospatial datasets enabled a consistent analysis across ecosystems, limitations in site-specific data – particularly on land ownership, agricultural practices and detailed management regimes, but also a higher thematical resolution of the habitat types beyond the core study area of the project – remain a key challenge for implementation-oriented planning. These gaps underline the need for complementary field assessments and locally maintained databases to refine priorities and measures.

The main challenges for NbS implementation relate to competing land uses, especially intensive agriculture, existing river barriers and infrastructure, and the complexity of administrative and property arrangements. Accordingly, future efforts should prioritise grassland management and restoration, the mitigation of agricultural pressures through riparian buffer zones, the gradual reconnection of the fragmented river sections across the hydropower plants with nature-based approaches, and ecologically adapted forestry in floodplain and riparian forests. These measures offer high potential to enhance biodiversity, water quality and flood resilience while delivering additional ecosystem services.

Effective implementation will depend on strong partnerships and participatory governance. Bjeshkët e Nemuna National Park authorities play a central role as coordinators and facilitators, but successful NbS deployment also requires early involvement of municipalities, landowners, farmers and the wider public. On a higher political level, decision-makers need to be brought on board, and awareness needs to be raised. This is crucial for the mobilisation of financial resources and securing fundings on the short and long term. Strengthening cross-sectoral cooperation, clarifying land-use and ownership conditions, and embedding NbS into management plans and local development strategies will be essential next steps to translate the developed objectives and guidance into sustainable and effective practice and actions.

The project outputs, with their strong practical and implementation-oriented focus for the WB6 context, together with the wide range of international guidelines and standards on NbS, provide a well-founded basis for the future implementation of NbS measures in the Lumbardhi i Deçanit river valley. These outputs also contribute to strengthening institutional capacities and technical knowledge required for the effective design, deployment and long-term management of nature-based solutions. Furthermore, the integration of international best practices with local environmental, social and governance conditions ensures that the proposed measures are both context-sensitive and adaptable to the specific ecological characteristics of the river basin.