# PROJECT SUMMARY FOR SKADAR LAKE NATIONAL PARK, MONTENEGRO

## 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**



Funded by the European Union

With funding from Austrian Development Cooperation

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**Responsible EU Member State project lead:**
Laura Hohoff

**Authors:**
Katharina Huchler
Stefan Fuchs
Martin Suanjak

**With contributions from:**
Bojan Zeković, Hasan Hadžiablahović, Thomas Ellmauer, Philipp Semenchuk, Peter Tramberend as well as the Public Enterprise for National Parks of Montenegro.

**How to cite this report:**

*Environment Agency Austria (2025). Project Summary for Skadar Lake National Park, Montenegro (Deliverable WP1-16_Del-1). Huchler, K., Fuchs, S., Suanjak, M., with contributions from Zeković, B., Hadžiablahović, H., Ellmauer, T., Semenchuk, P., Tramberend, P. as well as the Public Enterprise for National Parks of Montenegro. EU4Green project, Biodiversity. Available on [https://eu4green.eu/library/](https://eu4green.eu/library/) in the "Deliverables" section.*



**Imprint:**
Owner and Editor:
Umweltbundesamt GmbH
Spittelauer Lände 5, 1090 Vienna, Austria

February 2026



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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 |
| **MNE** | Montenegro |
| **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 Montenegro. 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 PITE IN MONTENEGRO

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

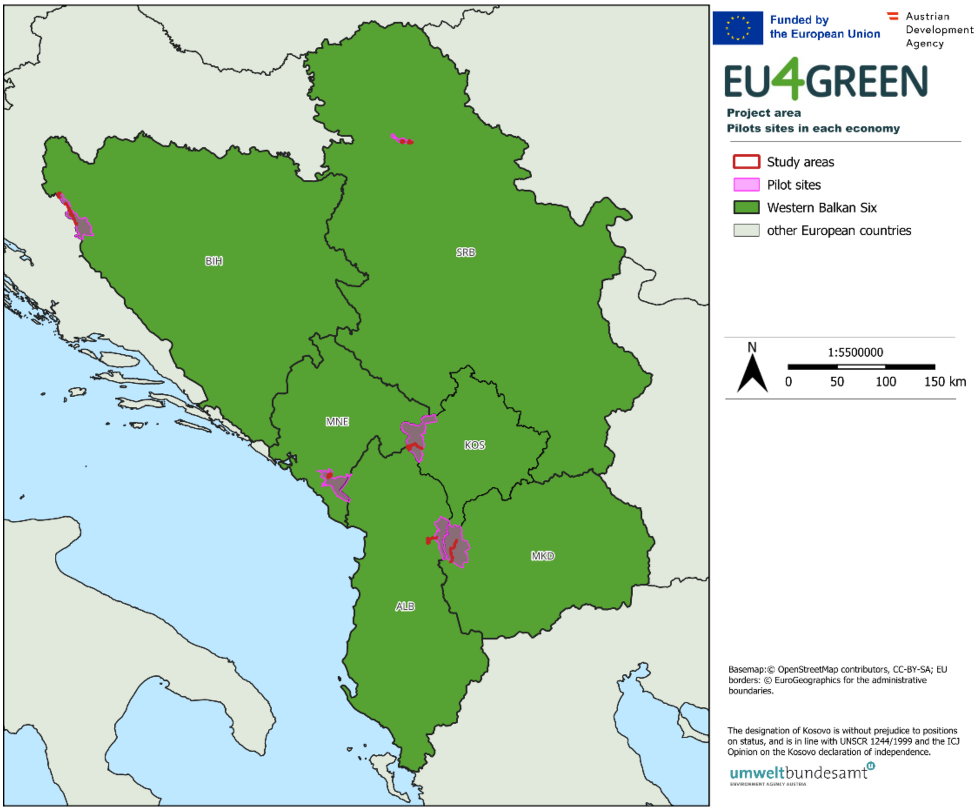


**Figure 1 - The six pilot sites in the economies of the Western Balkans.**

In Montenegro, the Skadar Lake National Park was chosen. Established in 1983, it covers an area of approximately 40,000 hectares, which makes it Montenegro's largest national park.

The most prominent feature of the national park is the Skadar Lake, the largest lake of the Balkan peninsula, shared and protected by both Montenegro and Albania. It is primarily fed by the Morača river, which previously passes through Podgorica and then enters the Skadar Lake at its northwestern end. On the southeastern end, the Skadar Lake feeds into the Bojana river, which unites with the Drin river. The Bojana then forms the meandering border between Montenegro and Albania, before it feeds into the Adriatic Sea after just 44 km.

The lake, the reeds and marshes along the northern shore and the partially flooded areas are all critical wetland habitats, considered an Important Bird Area from BirdLife International and listed as Ramsar sites. They give home to approximately 270 bird species and is an important staging and breeding site for migratory birds. Freshwater biodiversity is high as well, with seven endemic fish species.

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 Montenegro. 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 2).

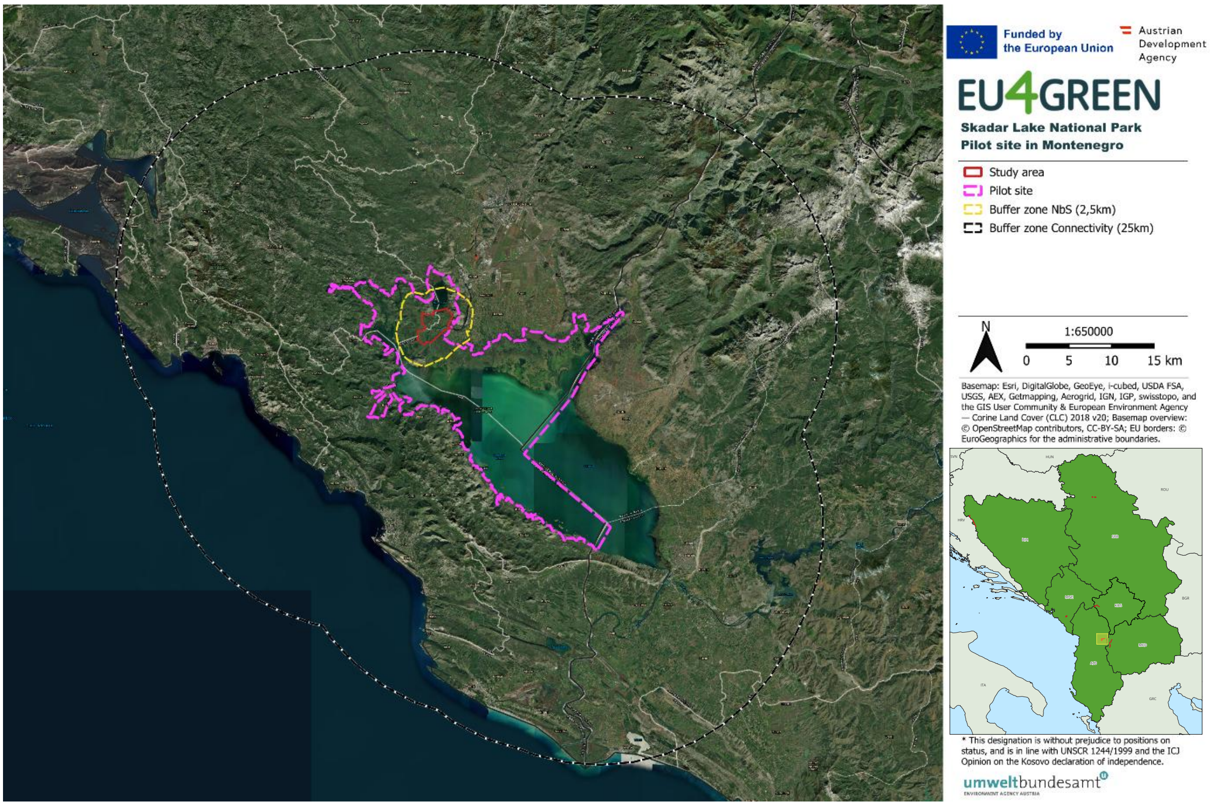


**Figure 2: The different spatial extents of the local activities carried out in and around Skadar Lake National Park (depicted in pink). The core study area for mapping species and habitats of Natura 2000 sites (chapter 3, depicted in red) stretches along the river floodplain. The study area for Nature-based Solutions (chapter 4, depicted in yellow) was derived by adding a buffer around the core study area. The area assessed for connectivity (chapter 2, depicted in black) was derived by adding a buffer around the National Park's borders.**

# 2. CONNECTIVITY

Authors: Martin Suanjak and Katharina Huchler, EAA
With contributions from: Philipp Semenchuk, EAA

## 2.1. Summary

The ecological connectivity of landscapes shapes species distributions, 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 Skadar Lake National Park in Montenegro 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 Broad-leaved forests are well connected across the mountainous landscape, while Natural grasslands patches are small and poorly connected. Conservation priorities include maintaining existing forest corridors and promoting land-use practices that sustain connectivity of Natural Grasslands along the lake edge. 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.

## 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 greater 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 1).

**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 |
| 2.4.1 | Annual crops associated with permanent crops | 8 | 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 | |
|---|---|---|---|
| | | Natural grasslands | Broad-leaved forest |
| 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

Skadar Lake National Park was chosen as the pilot site to test the connectivity model in Montenegro (see also chapter 1EU4Green's pilot pite in Montenegro). To assess the ecological connectivity of the pilot site with the surrounding area, 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 (further information on ecosystem services in chapter 4.2).

### 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

As the pilot site Skadar Lake National Park is mainly a wetland area, Natural grasslands and Broad-leaved forests are naturally rare, covering only 1 % and 3 % of the area respectively.

### 2.4.1. Natural grasslands

In the study area, most of the patches of Natural grasslands lie in the mountainous north-east (Figure 3). The three southern patches are moderately well connected to each other but lack a good corridor to the larger patches in the north. The area north of the town Shkodra is highly fragmented, and it will be necessary to define clear corridors for Natural grasslands before it becomes even more developed. The model identifies a northward corridor crossing the SH1 near Grilë, passing through areas that are already quite built up (Figure 3, A).
Only one small patch of Natural grasslands actually lies in the pilot site (Figure 3, B) and is poorly connected to larger patches in the north-east and the south-east. To enhance the connectivity of Natural grasslands in the Skadar National Park farmers could be incentivized to have more grassland areas at the edge of the lake.

### 2.4.2. Broad-leaved forest

A large patch of Broad-leaved forest reaches over the western boundary of the pilot site (Figure 4). This patch continues in an arch with various corridors over to the northern part of the study area. Generally, these patches are well connected, only one northern corridor crosses the E762/M18 near Novo Selo through farmland (Figure 4, A). In this area a designated forest corridor could enhance the connectivity.

### 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[14]. The spatial extent of the study area and resolution (pixel size) highly influences the output of the algorithm[15]. The used CORINE land cover data set is from 2018. Land use changes since 2018 have therefore not been accounted for. The next 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

[14] 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.
[15] 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

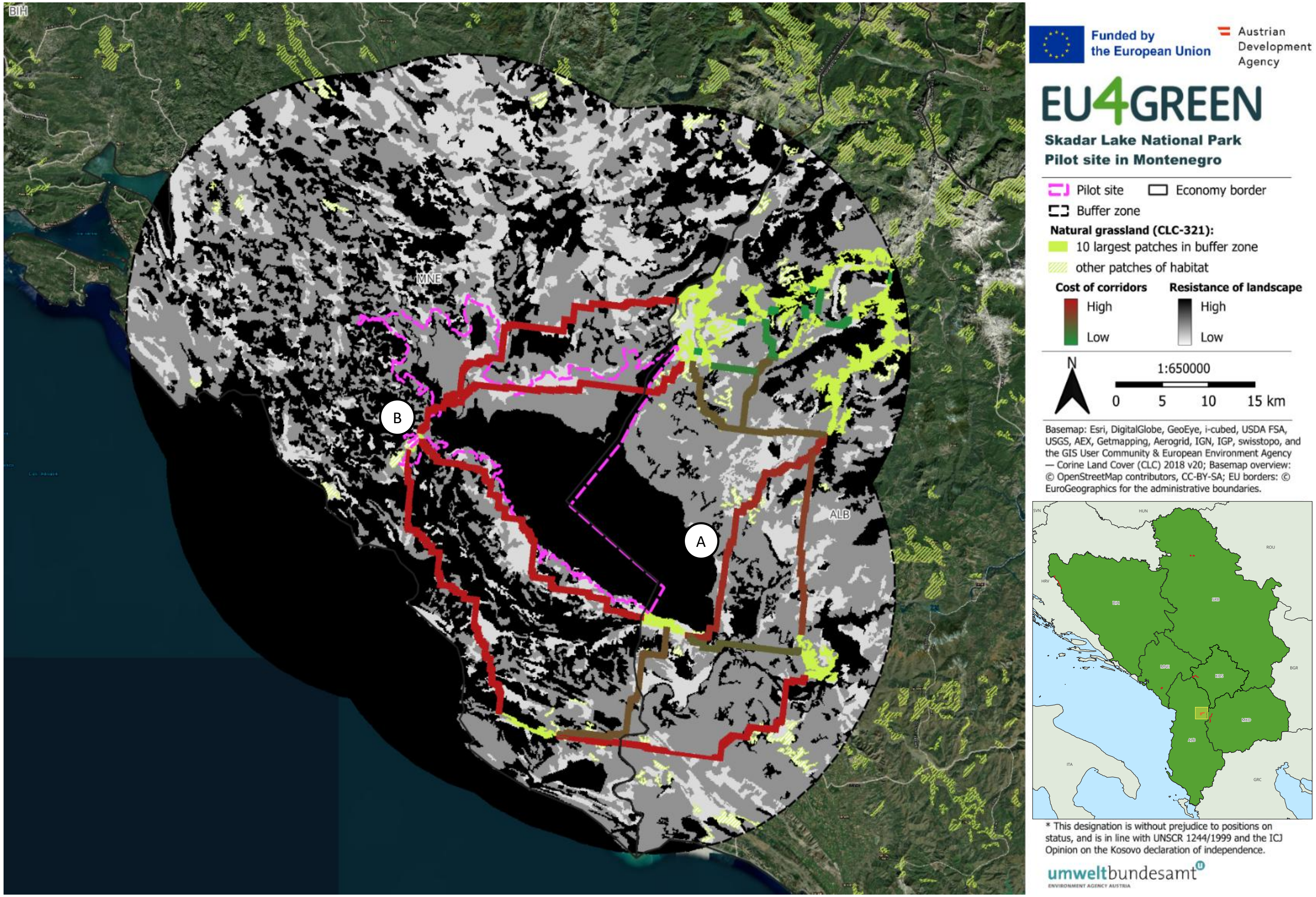


**Figure 3: Connectivity of Natural grasslands in the buffer zone around Skadar Lake National Park, Montenegro. The grayscale background map shows landscape resistance values (from 1 = white = low resistance to 8 = black = high resistance), green areas the Natural grasslands. The corridors between the 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 = 6 to red = 1398). The thickness of the corridors has been enhanced for better visibility. The letters highlight corridors or large patches mentioned in the text.**

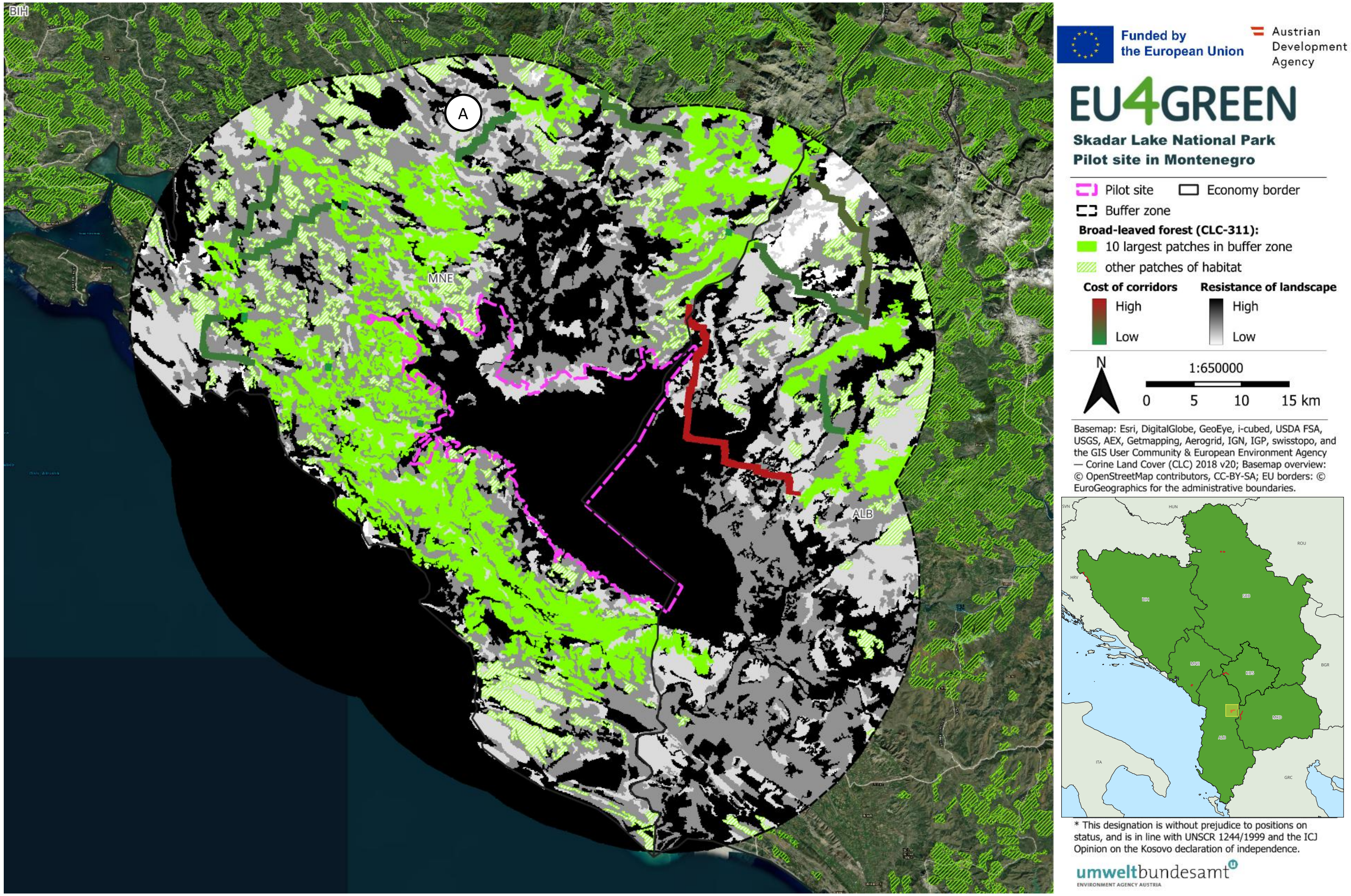


**Figure 4: Connectivity of Broad-leaved forests in the buffer zone around Skadar Lake National Park, Montenegro. The grayscale background map shows landscape resistance values (from 1 = white = low resistance to 8 = black = high resistance), green areas the Broad-leaved forests. The corridors between the ten largest patches of Broad-leaved forests 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 = 1157). The thickness of the corridors has been enhanced for better visibility. The letters highlight corridors or large patches mentioned in the text.**

rarely tested with in-situ movement data[16]. The analysis could be taken further by verification of results through movement data, in-situ studies or expert knowledge.

### 2.4.4. 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 forests. Conservation action to enhance connectivity by the establishment of corridors in the study area of Skadar Lake National Park should focus on the small and poorly connected Natural grasslands patches. The results highlight the need for well-informed and anticipatory spatial planning in the surroundings of the Skadar Lake 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 transnational 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.

[16] 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

Authors: Katharina Huchler and Stefan Fuchs, EAA

With contributions from: EU4Green contracted biodiversity experts Bojan Zeković and Hasan Hadžiablahović, 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[17]. 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[18]. In this context, the GAWB calls upon the WB6 to align their policies to the EU Biodiversity Strategy for 2030[19].

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[20]. Accession candidates are required to prepare their future Natura 2000 sites, using the framework of the Emerald Network[21].

### 3.2.2. Standard Data Forms

For each Natura 2000 site, Member States fill a Standard Data Form (SDF)[22], thereby providing information on area, location, characteristics and management, as well as ecological information on its habitat types and species[23]. As the EC uses the SDFs to review

[17] 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

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[19] 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.

[20] 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

[21] 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: https://rm.coe.int/the-emerald-network-a-tool-for-the-protection-of-european-natural-habi/1680728438#:~:text=EUROPEAN%20STATES%20NOT%20MEMBERS%20OF%20THE%20EUROPEAN%20UNION&text=observer%20states%20in%20the%20neighbouring%20areas%20of%20the%20EU.&text=accession%20to%20the%20EU%20in,therefore%20for%20joining%20the%20EU.&text=actively%20working%20on%20the%20Emerald,the%20Russian%20Federation%20and%20Ukraine.

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

[23] C/2023/8623. ABl L, 2023/8623. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L_202302806

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.

Filling SDFs requires evidence-based information, with several provisions specified in the explanatory notes of the SDFs[23]. 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[23].

| 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[24]. 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. |

[24] 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[25]. 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).

[25] 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.

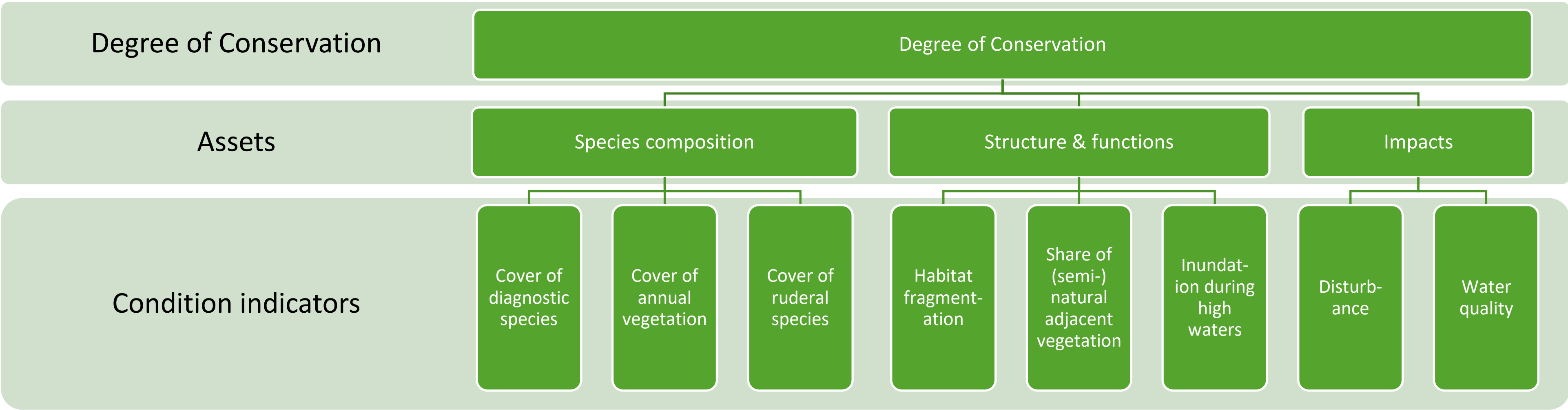


**Figure 5: Exemplary illustration of the Degree of Conservation for habitat type '3130 Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoeto-Nanojuncetea*'** (wording of indicators was simplified for understandability). The Degree of Conservation 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.

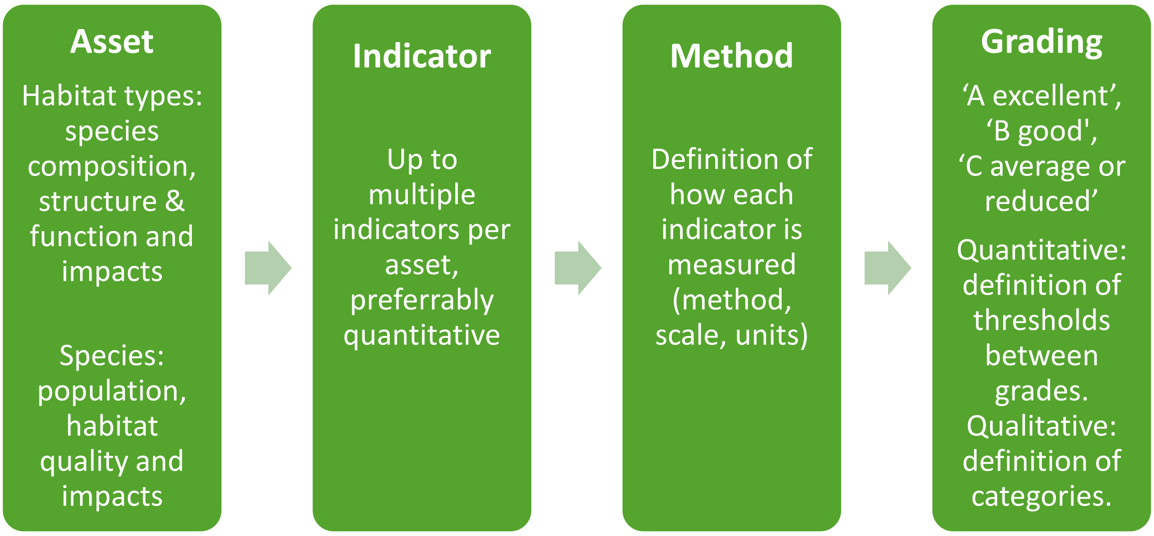


**Figure 6: Procedure for defining condition indicators.**

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[26].

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 and define meaningful thresholds, and will be able to share their knowledge in future projects on biodiversity monitoring.

[26] 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 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. Skadar Lake National Park, established in 1983, covers approximately 40,000 hectares in southern Montenegro along the border with Albania. The study area is located in the southern part of the national park, south of Malo Blato Lake near the village of Bistrice. The area forms part of the extensive Skadar Lake wetland system, which is characterised by shallow water bodies, seasonally flooded meadows, reed beds and agricultural landscapes. Situated along the southern margins of Malo Blato, the study area connects the wetland habitats of the lake with the surrounding low hills and agricultural fields. The landscape is shaped by alluvial sediments and periodic flooding, creating fertile soils that support a mosaic of natural wetland habitats and cultivated land. While settlements in the area are sparse, traditional agriculture and grazing remain important land uses in the surrounding plains and gently rolling hills.

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

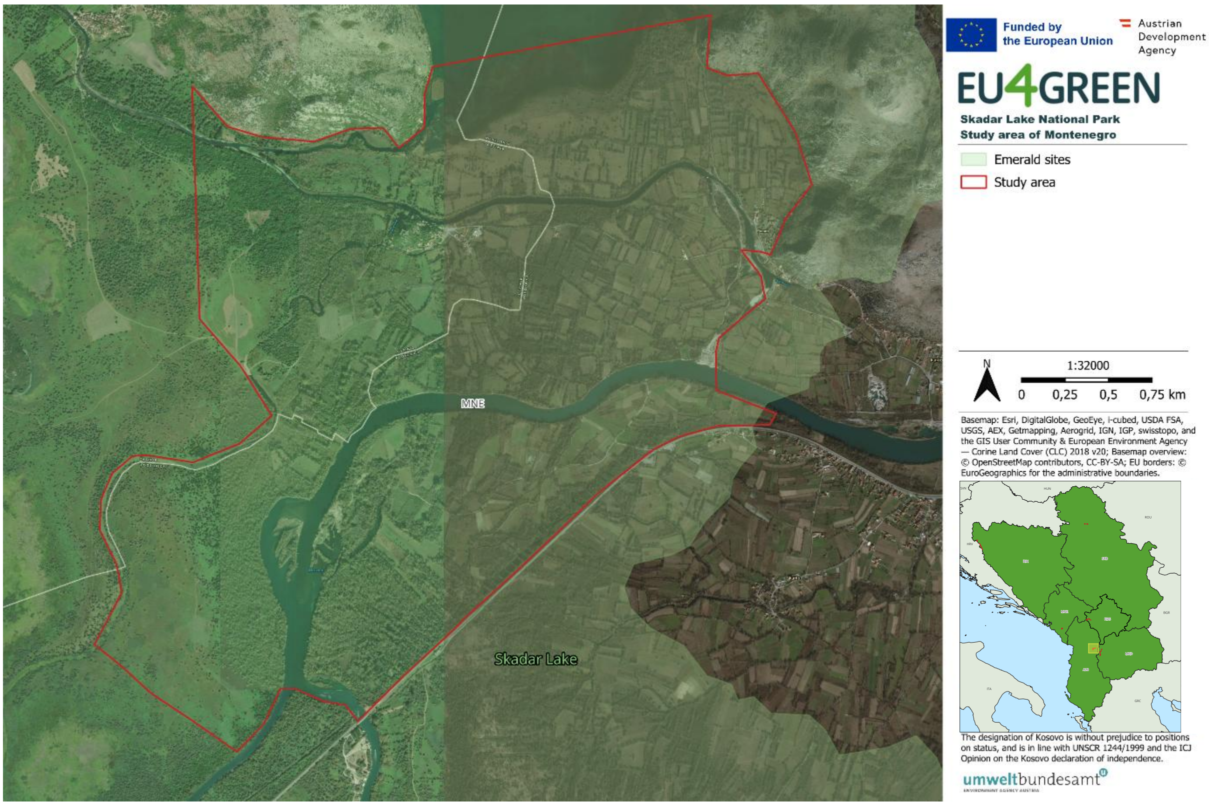


**Figure 7: Study area at the Skadar Lake National Park, Montenegro.**

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 both 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) and habitats as groups of target features that acted as examples, outlining the process behind the conservation assessments. The features sampled in Montenegro can be found in Table 3.

**Table 3: Assessed species and habitats for the study area of Montenegro.**

| Group | Code | Feature |
|---|---|---|
| **Birds** | A402 | *Accipiter brevipes* |
| **Birds** | A238 | *Dendrocopos (Leicopicus) medius* |
| **Birds** | A429 | *Dendrocopos syriacus* |
| **Birds** | A338 | *Lanius collurio* |
| **Birds** | A339 | *Lanius minor* |
| **Habitat types** | 3150 | Natural eutrophic lakes with Magnopotamion or Hydrocharition -type vegetation |
| **Habitat types** | 3280 | Constantly flowing Mediterranean rivers with Paspalo-Agrostidion species and hanging curtains of *Salix* and *Populus alba* |
| **Habitat types** | 6420 | Mediterranean tall humid herb grasslands of the Molinio-Holoschoenion |
| **Habitat types** | 6540 | Sub-Mediterranean grasslands of the Molinio-Hordeion secalini |
| **Habitat types** | 92A0 | *Salix alba* and *Populus alba* galleries |
| **Habitat types** | 92D0 | Southern riparian galleries and thickets (Nerio-Tamaricetea and Securinegion tinctoriae) |

### 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. 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 bird species, a raster-based approach with pre-defined grid cells (1:5.000) was used. 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-b. 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** | May and June 2024 | 10 |
| **Habitat types** | August 2024 | 10 |
| **Total** | May to August 2024 | 20 |

### 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).

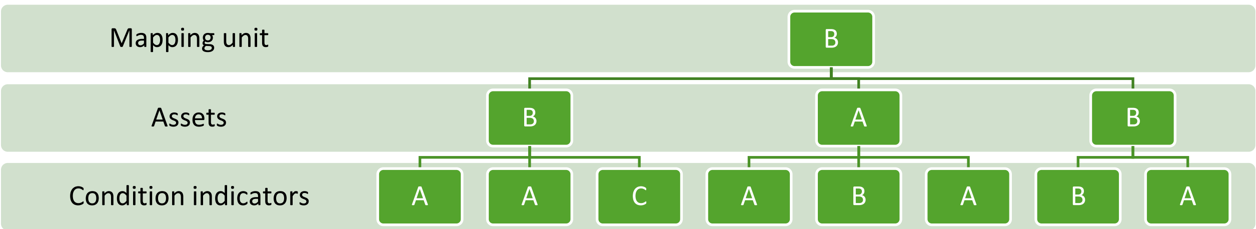


**Figure 8: Exemplary illustration of the aggregation from the grades of condition indicators to the grades of the assets within each mapping unit.**

For habitats, all three assets were then aggregated to receive the overall grade for each habitat polygon. For species, the habitat and impact assets were aggregated in each grid cell, while the population asset (where available) was kept separate. This is because Degree of Conservation and Area in Good Condition relate to the species' habitat, not population.

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

As last step, the mapping units within the entire pilot site were aggregating for each species and habitat type. The area of all relevant mapping units with identical aggregated grade (A, B or C) was calculated. 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[27] was used, although this is not a provision of the Birds Directive. The biodiversity experts deduced the current state in the country 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 showcase is presented.

### 3.3.9. Software

Geo data compilation and spatial analysis was done in QGIS[28] as well as R version 4.3.1[29].. Statistical analysis was carried out with Microsoft ® Excel ® 2016 and R version 4.3.1.

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[27] 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.

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

[29] 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

In total, six habitat types under the Habitats Directive were recorded within the study area. During fieldwork, all habitat types of the Habitats Directive were identified and spatially delineated to gather their distribution (Figure 9). The total area of the mapped habitat types is 645.1 ha. While the standing freshwater habitat type 3150 and their associated vegetation can be found in the north of the study area, mainly within the boundaries of the Gornje Malo Blato lake, the typical sites and vegetation of habitat type 3280 is found along the smaller stretches and the connected floodplains. Within the small-patched mosaic of rivers, floodplains, agriculturally used grasslands and woodlands, the study area hosts two types of mediterranean grassland (6420 and 6540). Large stands of forested habitat types of 92A0 are dominating the study area, but also small sites of 92D0 can be found along the Morača river.

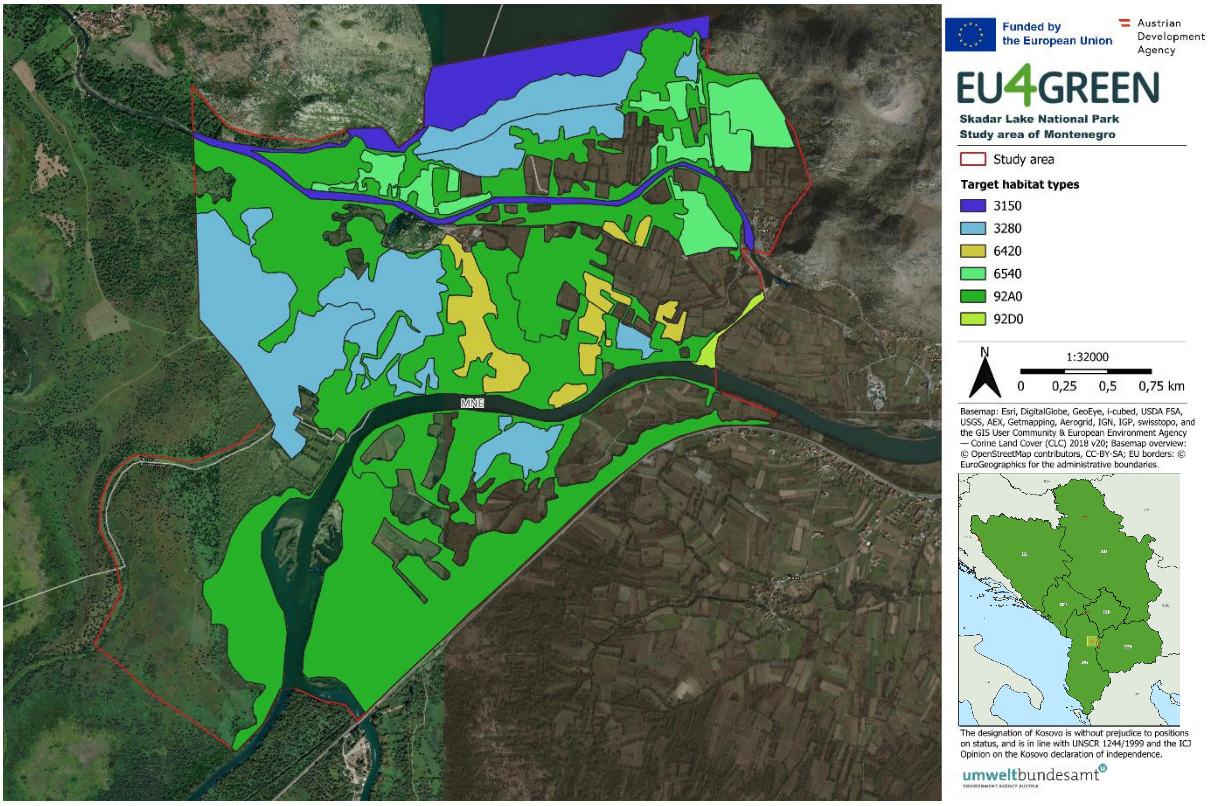


**Figure 9: Distribution of the assessed Natura 2000 habitat types in the study area at the Skadar Lake National Park, Montenegro.**

The condition of each occurrence (Figure 10) was assessed based on the information in the fact files (Annex II), and summed up for each habitat type (Figure 11).

In general, the map shows that habitat types with a more reduced condition are rarely assessed within the study area. Most of the freshwater as well as many sites of the forest and grassland habitats are in an excellent condition. The rest was assessed to be in at least in a good condition, still holding some potential for improvement. Only one site of habitat type 6420 is in a reduced condition.

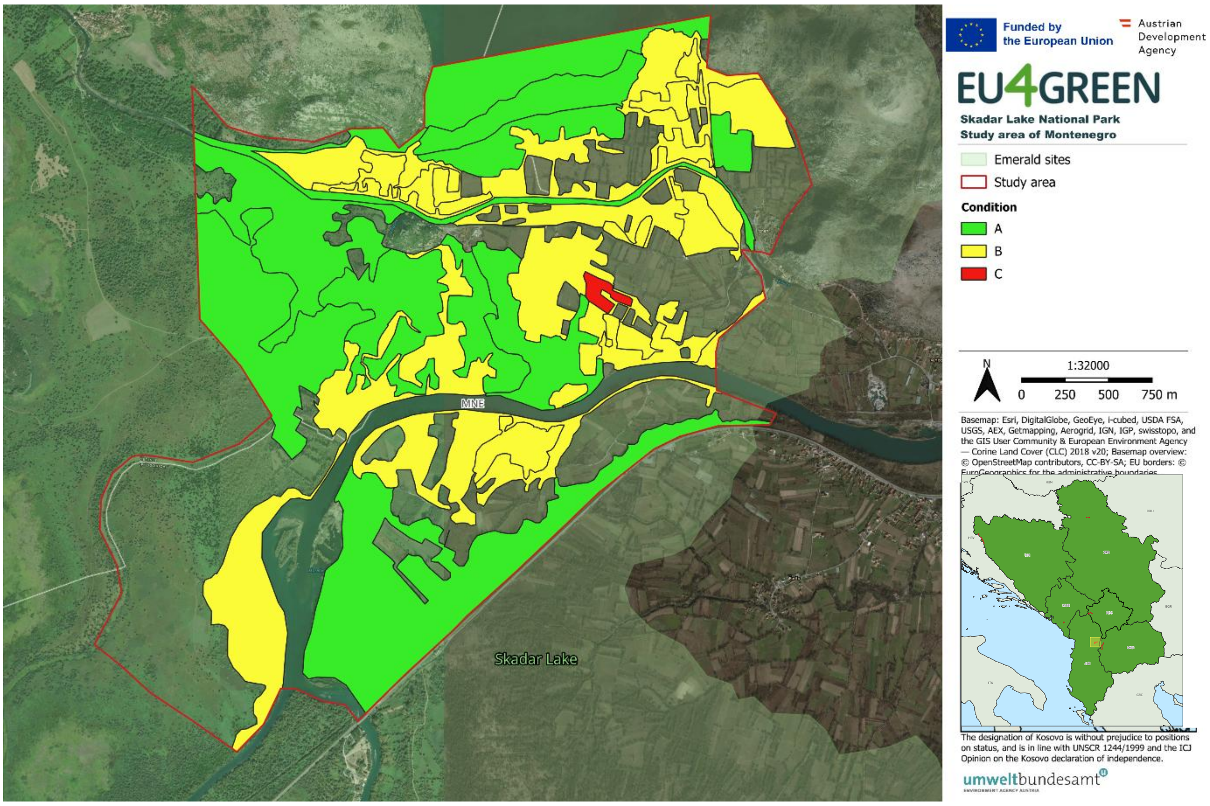


**Figure 10: Condition of the assessed habitat types in the study area at the Skadar Lake National Park, Montenegro.**

The overall condition of '3150 – Natural eutrophic lakes with *Magnopotamion* and *Hydrocharition* type vegetation' was 'A excellent' for all of the assessed area (50.1 ha). '3280 – Constantly flowing Mediterranean rivers with *Paspalo-Agrostidion* species and hanging curtains of *Salix* and *Populus alba*' was in a mostly good condition, with 53% in 'A excellent' and 39% 'B good', while 8% of the area was assessed to be 'C average or reduced'. This unfavourable condition can be traced back to the lack of diagnostic species on the on hand and the presence of invasive alien species on the other hand. Improvement of the structural and functional aspect could be reached by the renaturation of the anthropogenic shorelines as well as the decrease in species of succession caused by this lack of riparian dynamics.

For habitat type '6420 – Mediterranean tall humid herb grasslands of the *Molinio-Holoschoenion*' 90% of the area was in a 'B good' overall condition and 10% in 'C average or reduced condition. Room for improvement can be gained primarily by removing invasive alien species and introducing a more regular, extensive grazing to reduce shrub species. For habitat type '6540 – Sub-Mediteranean grasslands of the *Molinio-Hordeion secalini*', 86% of the assessed area was in an 'B good' overall condition and 14% even in an 'A excellent' condition. The overall recorded condition for the exemplary sites does not indicate an urgent need for action, besides monitoring invasive alien species to avoid any deterioration through their expansion.

With an overall condition of 26% as 'A excellent' and 74% as 'B good' the forests of '92A0 – *Salix alba* and *Populus alba* galleries' are well preserved. The same is the case for habitat type '92D0 – Southern riparian galleries and thickets (*Nerio-Tamaricetea* and *Securinegion tinctoriae*)' with 100% of the assessed area in a 'B good' condition. In order to maintain the good condition, invasive alien species should be monitored as well as fragmentation and the associated edge effects on the forests should not be taking over in the future.

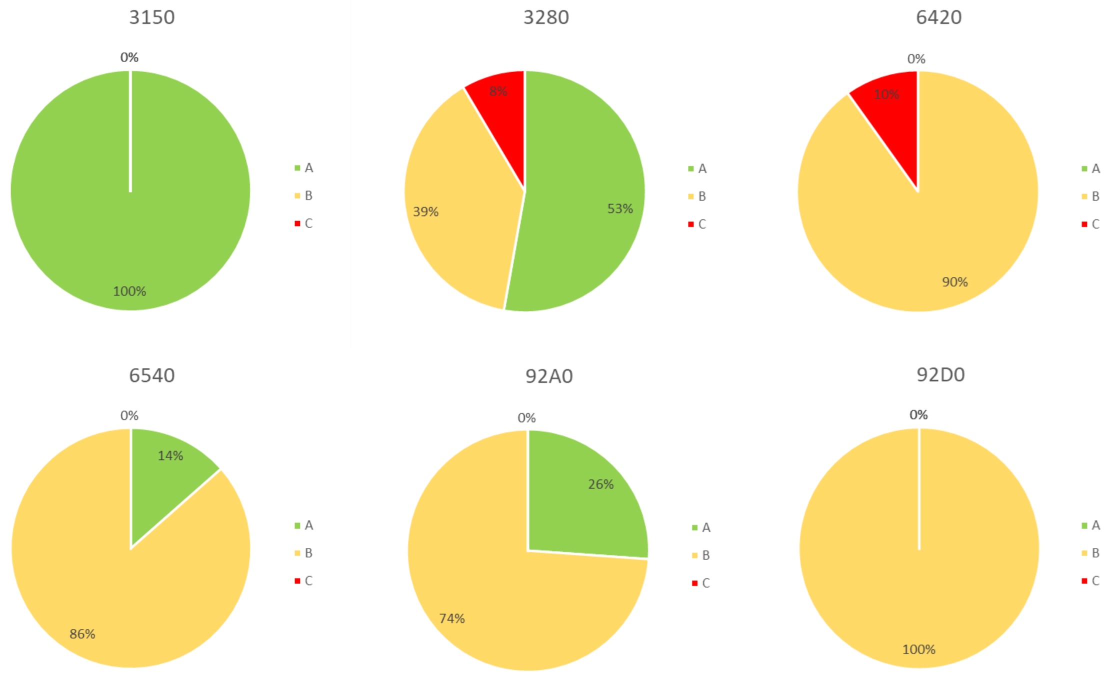


**Figure 11: Condition of the assessed habitat types in the Skadar Lake National Park study area.**

Based on the fieldwork results, the Ecological information of the Standard Data Forms was filled for each habitat type (Table 7, Table 8, Table 9).

The improvements for '92A0 - *Salix alba* and *Populus alba* galleries' were elaborated in greater details through SSCOs by Hasan Hadžiablahović. At the national level, the data from the study area and other known occurrences of the habitat type was extrapolated based on experts' knowledge. This dataset provides an estimate of known occurrences but does not include an assessment of conservation status (e.g. favourable vs. unfavourable condition) for the individual sites. Based on the consolidation of all available sources – including existing occurrences, degraded and destroyed sites, and areas outside formal protection – the total area of habitat type 92A0 in Montenegro was estimated at approximately 11,818 ha. This figure represents all known occurrences at national level, including currently unprotected sites, and serves as the basis for further conservation assessment and target setting. The national assessment is found in Table 10 and formed the basis for developing SSCOs for habitat type 92A0 for Skadar Lake National Park.

Skadar Lake National Park offers no significant opportunities for restoration of destroyed areas, but currently features 373.5 ha of habitat area in good condition, with 97.6 ha in condition A and 275.9 ha in condition B. Therefore, the following SSCOs are recommended:

- Maintenance of 373.5 ha of habitat type 92A0.
- Maintenance of 97.6 ha of habitat type 92A0 in condition A.

- Improvement of condition of 275.9 ha from condition B to condition A.
- Reduction of negative effects through fragmentation within the pilot site.

The following conservation measures can be applied to reach the SSCOs:

- Strong protection regime that prohibits destroying existing occurrences, reinforced by rangers in the field.
- Reduction of negative impacts of fragmentation and edge effects caused by new barriers (e.g. paved or unpaved roads), new agriculturally used area or deforestation) through critical evaluation and control of planned projects and activities.
- Removal and monitoring of invasive alien species within the pilot site.

**Table 7: Ecological information for '3150 - Natural eutrophic lakes with *Magnopotamion* and *Hydrocharition* type vegetation' and '3280 - Constantly flowing Mediterranean rivers with *Paspalo-Agrostidion* species and hanging curtains of *Salix* and *Populus alba*' at the Skadar Lake National Park study area (10 km²).**

| Information | Habitat 1 | Habitat 2 |
|---|---|---|
| **3.1a Essential information (habitat type)** | | |
| **3.1.1 Habitat type code** | 3150 | 3280 |
| **3.1.2 Priority form** | not applicable | not applicable |
| **3.1.3 Non-presence** | not applicable | not applicable |
| **3.1.4 Cover** | 50.1 ha | 143.8 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** | B: 15% ≥ p > 2% | B: 15% ≥ 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: 50.1 ha<br>Not-good condition: 0 ha | Good condition: 132.3 ha<br>Not-good condition: 11.50 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 | B: good value |
| **3.2.20 Update date** | December 2024 | December 2024 |

**Table 8: Ecological information for '6420 - Mediterranean tall humid herb grasslands of the *Molinio-Holoschoenion*' and '6540 - Sub-Mediterranean grasslands of the *Molinio-Hordeion secalini*' at the Skadar Lake National Park study area (10 km$^2$).**

| Information | Habitat 3 | Habitat 4 |
|---|---|---|
| **3.1a Essential information (habitat type)** | | |
| **3.1.1 Habitat type code** | 6420 | 6540 |
| **3.1.2 Priority form** | not applicable | not applicable |
| **3.1.3 Non-presence** | not applicable | not applicable |
| **3.1.4 Cover** | 29.8 ha | 45.5 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** | Non-significant | Non-significant |
| **3.1.9 Representativity** | B: good | B: good |
| **3.1.10 Relative surface** | C: 2% ≥ p > 0% | B: 15% ≥ p > 2% |
| **3.1.11 Relative surface explanations (optional)** | | |
| **3.1.12 Degree of conservation** | | |
| **3.1.12.1 Degree of conservation – categorised** | B: good | A: excellent |
| **3.1.12.2 Degree of conservation – area** | Good condition: 26.9 ha<br>Not-good condition: 2.9 ha | Good condition: 45.5 ha<br>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 | B: good value |
| **3.2.20 Update date** | January 2025 | January 2025 |

**Table 9: Ecological information for '92A0 - *Salix alba* and *Populus alba* galleries' and '92D0 - Southern riparian galleries and thickets (*Nerio-Tamaricetea* and *Securinegion tinctoriae*)' at the Skadar Lake National Park study area (10 km²).**

| Information | Habitat 3 | Habitat 4 |
|---|---|---|
| **3.1a Essential information (habitat type)** | | |
| **3.1.1 Habitat type code** | 92A0 | 92D0 |
| **3.1.2 Priority form** | not applicable | not applicable |
| **3.1.3 Non-presence** | not applicable | not applicable |
| **3.1.4 Cover** | 373.5 ha | 2.4 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 | Non-significant |
| **3.1.9 Representativity** | B: good | B: good |
| **3.1.10 Relative surface** | B: 15% ≥ p > 2% | 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 | B: good |
| **3.1.12.2 Degree of conservation – area** | Good condition: 373.5 ha<br>Not-good condition: 0 ha | Good condition: 2.4 ha<br>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 | B: good value |
| **3.2.20 Update date** | January 2025 | January 2025 |

**Table 10: Restoration and conservation objectives for '92A0 - *Salix alba* and *Populus alba* galleries' on national level, compiled for deduction of SSCOs for Skadar Lake National Park. For the parameter area, the target Favourable Reference Area (FRA) is derived from the data assessed in the study site and of previous projects as well as their extrapolation based on experts' knowledge. by Hasan Hadžiablahović, carried out for the EU4Green project. For the parameter Structure and functions, the target of restoring 90 % of all occurrences to a good condition is derived from the Nature Restoration Regulation.**

| | Area | | Area (source) | Structure and functions (absolute area) | | Structure and functions (relative area) | | Structure and functions (source) |
|---|---|---|---|---|---|---|---|---|
| **Status** | 11,818 | ha | Estimate based on data of study site and previous project on 92A0 in MNE | 7,141.62 | ha in good condition | 60.43 % | in good condition | deduced from area of habitat 91E0 Alluvial forests with Alnus |
| | | | | 4,676.38 | ha in not-good condition | 39.57 % | in not-good condition | |
| **Target** | 12,999.8 | ha | Estimate based on FRA calculation | | | | | |
| **FRVs** | 10-25 % < FR | | Current value is 10 % below the FRA | 11,669.82 | ha in good condition | 90 % | in good condition | application of 90 % goal of the Nature Restoration Regulation |
| | | | | 1,288.98 | ha in not-good condition | 10 % | in not-good condition | |
| **Difference to FRVs** | **1,181.8** | **ha²** | Increase of 1,181.8 ha needed | **4,528.21** | **ha more in good condition** | Increase towards good condition for 4,528.21 ha needed. | | |

## 3.4.2. Birds

At the Skadar Lake National Park study area, five bird species were studied. Two of them require forested areas for reproduction (*Dendrocopos medius* and *Dendrocopos syriacus*) and are hereafter referred to as forest bird species. The three species, *Accipiter brevipes, Lanius collurio* and *Lanius minor*, were studied as grassland bird species.

In total, about 38.9 % of the 10 km$^2$ study area are forested, equalling a total area of forest habitats of 389.0 ha. Both habitat condition (Figure 12) and overall condition (Figure 13) of forest birds were similar to those of habitat types, indicating their close connection.

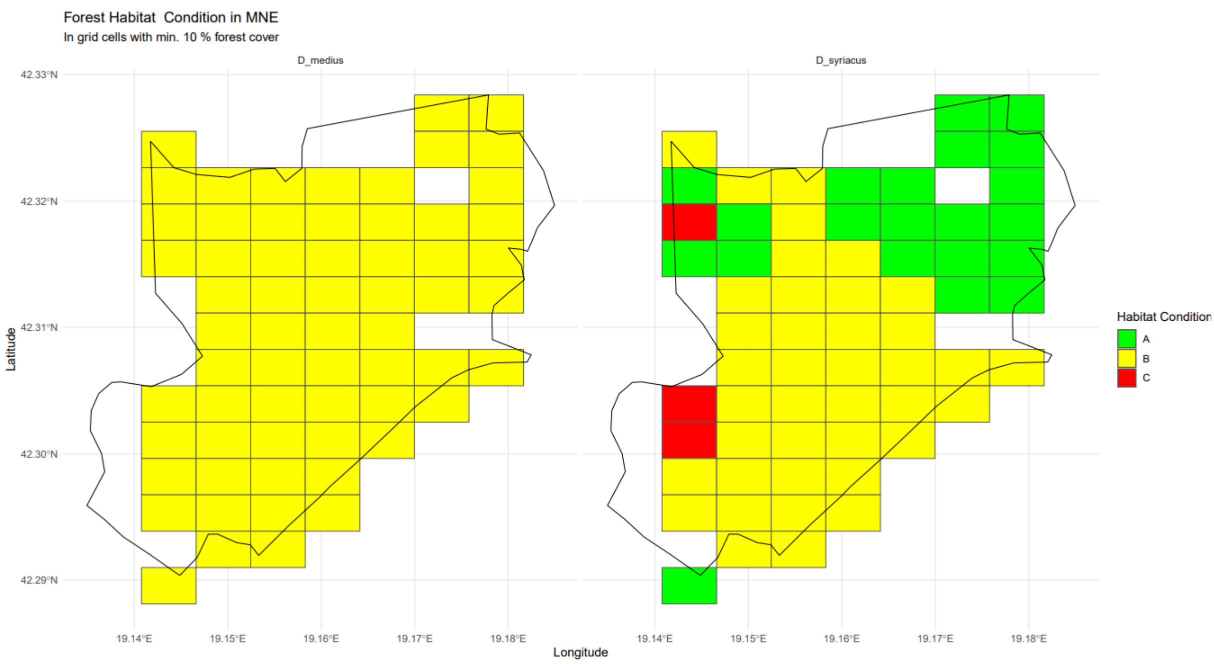


**Figure 12: Maps of the sub-grid cells with the assessed conditions in the Skadar Lake National Park study area for the forest bird species *Dendrocopos medius* and *Dendrocopos syriacus.***

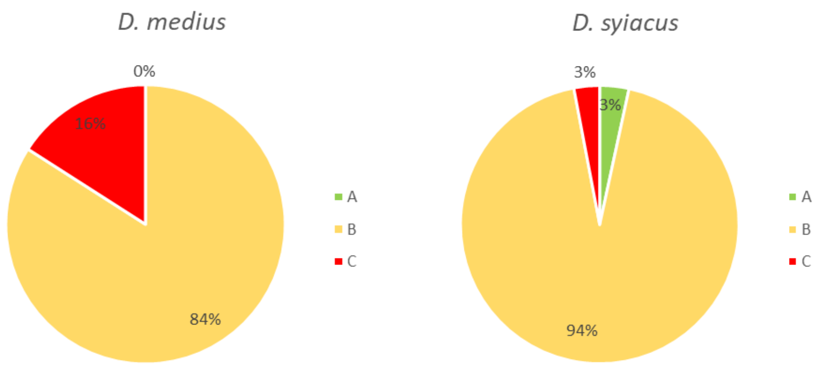


**Figure 13: Condition of the assessed forest birds in the Skadar Lake National Park study area.**

The results for the were found for the Middle Spotted Woodpecker *Dendrocopos medius*, with 84 % in an overall condition ‘B good and 16 % in an overall condition ‘C average or reduced. The sites with a grading of ‘C average or reduced’ received this assessment primarily because of the low percentage of old forests stands but also the lack of standing deadwood contributed to the total condition. The overall condition of the Syrian Woodpecker *Dendrocopos syriacus*, on the other, shows a better result. With 3 % of the total area in condition ‘A excellent’ and 94 % in condition ‘B good’, the species is mostly in a favourable condition in the study area. The small percentage of 3 % assessed in ‘C average or reduced condition’ can be explained by the several parameters regarding the habitat structures, while the impact through human actions appears to be low. Main drivers for the few sites in reduced condition are the lack of deciduous tree species, standing deadwood and canopy density.

Regarding grassland habitats, a total of 361.9 ha (or 36.2 % of the grassland covered study area) are available but both, the condition of the habitat and the overall condition, are rather low (Figure 14, Figure 15). It appears that a considerable percentage of open areas do not meet the habitat requirements of these species. For the Levant Sparrowhawk *Accipiter brevipes*, riparian zones and forests are important breeding grounds, but it requires extensive grassland with shrubs and hedges alike. Within the study area, the requirements are met in 81 % of the grassland habitats, resulting in an overall condition ‘B good’. For the 19 % in ‘C average or reduced’ condition, this is not the case. Since crucial structures like mature, dense bushes and hedgerows are not sufficiently present, the situation can be improved by fostering those elements in the agricultural landscape.
The status of the Red-backed Shrike *Lanius collurio* is much less favourable. With a preference for open terrain with trees and throned bushes, it requires a well-structured agricultural landscape to thrive. Within the studied area, the coverage of bushes and hedgerows with sufficient size, especially thorny species, are assessed to be lacking. Thus, the overall condition of *L. collurio* is ‘C average or reduced’ for 100% of the surveyed sites, highlighting the urgent need of action to improve the situation of this grassland species.

The conservation status of the Lesser Grey Shrike (*Lanius minor*) appears less critical compared to *L. collurio*. Its overall condition was assessed as 'A excellent' for 16 % and 'B good' for 54 % of the studied area. While 30 % remain to be in 'C average or reduced' condition, opportunities for improvement can be found mainly in increasing the presence of wooden structures in the landscape, such as solitary trees, as well as decreasing the intensity of the grassland management regime.

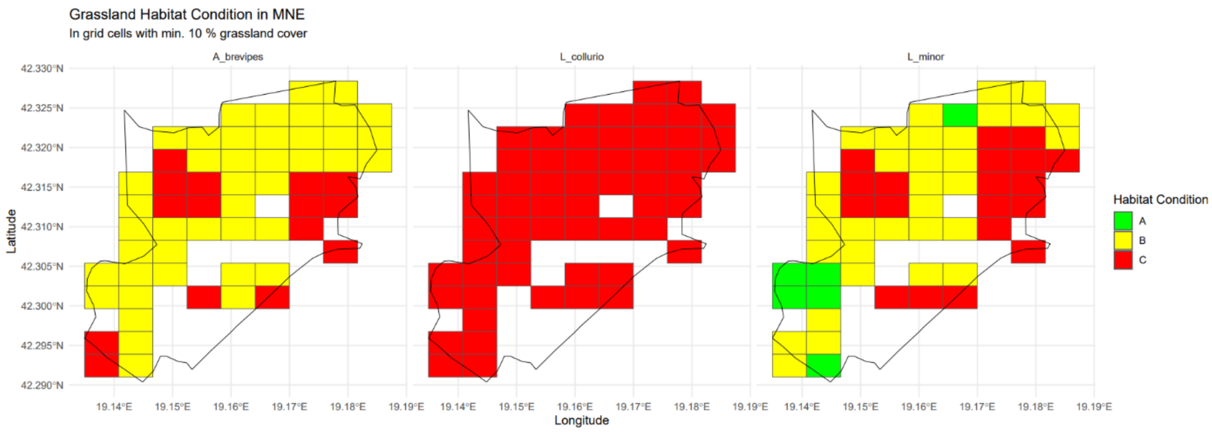


**Figure 14: Maps of the sub-grid cells with grassland habitat and the assessed habitat condition in the Skadar Lake National Park study area for *Accipiter brevipes, Lanius collurio* and *Lanius minor*.**

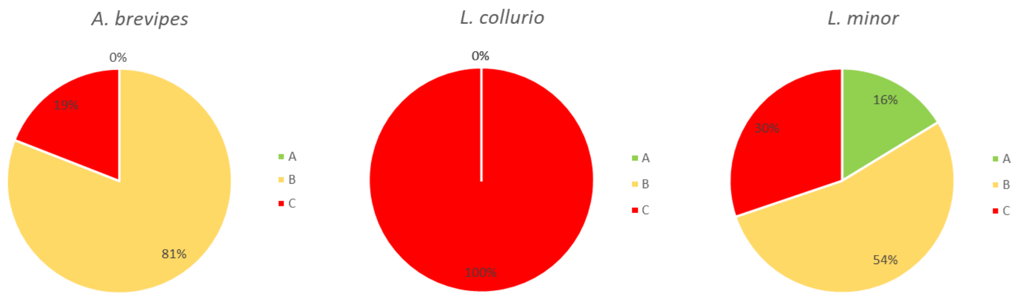


**Figure 15: Condition of the assessed grassland birds in the Skadar Lake National Park study area.**

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

**Table 11: Ecological information for *Accipiter brevipes, Lanius minor and Lanius collurio* at the Skadar Lake National Park 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** | A402 | A339 | A338 |
| **3.2.3 Scientific name** | *Accipiter brevipes* | *Lanius minor* | *Lanius collurio* |
| **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** | Reproducing | Reproducing | Reproducing |
| **3.2.7 Population size and unit** | | | |
| **3.2.7.1 Population size** | 2-3 (15-20) | 2-3 (20-25) | 20-50 |
| **3.2.7.2 Population unit** | p = pairs | p = pairs | p = pairs |
| **3.2.8 Abundance category** | Rare | 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** | Significant | Significant | Non-significant |
| **3.2.12 Species meeting ornithological criteria for SPA classification** | | not assessed | |
| **3.2.13 Population** | C: 2% ≥ p > 0% | 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** | B: good | B: good | C: degraded |
| **3.2.15.2 Degree of conservation – occupied area** | Sufficient quality: 292 ha (81 %)<br>Non-sufficient quality: 69 ha (19 %) | Sufficient quality: 253 ha (70 %)<br>Non-sufficient quality: 109 ha (30 %) | Sufficient quality: 0 ha (0 %)<br>Non-sufficient quality: 362 ha (100 %) |
| **3.2.15.3 Degree of conservation – occupied percentage classes** | Sufficient quality: 76-100 %<br>Non-sufficient quality: 0-25 % | Sufficient quality: 51-75 %<br>Non-sufficient quality: 26-50 % | Sufficient quality: 0-25 %<br>Non-sufficient quality: 76-100 % |
| **3.2.18 Isolation** | B: population on margin but not isolated | C: population within distribution range | C: population within distribution range |
| **3.2.19 Global** | A: excellent value | B: good value | C: significant value |
| **3.2.20 Update date** | December 2024 | December 2024 | December 2024 |

**Table 12: Ecological information for *Ficedula albicollis* and *Lanius collurio* at the Skadar Lake National Park study area (10 km$^2$).**

| Information | Species 4 | Species 5 |
|---|---|---|
| **3.2a Essential information (species)** | | |
| **3.2.1 Species group** | B = Birds | B = Birds |
| **3.2.1 Species code** | A429 | A238 |
| **3.2.3 Scientific name** | *Dendrocopos syriacus* | *Dendrocopos medius* |
| **3.2.4 Sensitivity of species data** | not assessed | |
| **3.2.5 Non-presence** | not applicable | not applicable |
| **3.2.6 Population type** | Permanent | Permanent |
| **3.2.7 Population size and unit** | | |
| **3.2.7.1 Population size** | 5-10 (50-100) | 10-20 |
| **3.2.7.2 Population unit** | p = pairs | p = pairs |
| **3.2.8 Abundance category** | 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 |
| **3.2.10 Period of last data collection** | not assessed | |
| **3.2b Site assessment (species)** | | |
| **3.2.11 Significance** | Significant | Non-significant |
| **3.2.12 Species meeting ornithological criteria for SPA classification** | not assessed | |
| **3.2.13 Population** | 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** | B: good | B: good |
| **3.2.15.2 Degree of conservation – occupied area** | Sufficient quality: 377 ha (97 %)<br>Non-sufficient quality: 12 ha (3 %) | Sufficient quality: 327 ha (84 %)<br>Non-sufficient quality: 62 (16 %) |
| **3.2.15.3 Degree of conservation – occupied percentage classes** | Sufficient quality: 76-100 %<br>Non-sufficient quality: 0-25 % | Sufficient quality: 76-100 %<br>Non-sufficient quality: 0-25 % |
| **3.2.18 Isolation** | B: population not isolated, but on margins of area of distribution | C: population within distribution range |
| **3.2.19 Global** | B: good value | B: good value |
| **3.2.20 Update date** | December 2024 | December 2024 |

## 3.5. Conclusions

The fieldwork conducted within Skadar Lake National Nature Park confirmed its high natural value, yielding particularly strong results for the studied forest habitat type 92A0, the grassland habitat type 6540 as well as the freshwater habitats 3150 and 3280.well as key species of the forests with the Middle Spotted Woodpecker (*Dendrocopos medius*) and the Syrian Woodpecker (*D. syriacus*). As typical species for grassland habitats, the Lesser Grey Shrike (*Lanius minor*) and Levant Sparrowhawk (*Accipiter brevipes*) are in a good condition, both with chances for improving the condition within the study area. Red-backed Shrike (*L. collurio*) on the other hand, requires large habitat improvements regarding the wooden structures in the landscape. In general, for all target features in the study area potential for improvement could be highlighted by the investigations. The study also brought to light several challenges, both in terms of methodology and conservation practice, which should be addressed in future work.

The exemplary site-specific conservation objectives and conservation measures developed during the study not only illustrate the applied approach but also provide a foundation for proposing 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 Skadar Lake National Park. They also gathered important knowledge to support the development of a general methodology to map potential future Natura 2000 sites in Montenegro.

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

Authors: Stefan Fuchs, EAA

with contributions from: Peter Tramberend, Katharina Huchler, EAA and the experts of Public Enterprise for National Parks of Montenegro

## 4.1. Summary

EU4Green aimed to highlight the potential of innovative Nature-based Solutions (NbS) at the Skadar Lake National Park in Montenegro. 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 expertise of the Public Enterprise for National Parks of Montenegro.

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. 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 habitats and permeable surfaces in built-up areas. The results demonstrate both the high potential of NbS in the floodplains between Skadar Lake and Gornje Malo Blato Lake 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 Nature 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.[30, 31]

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[18], the EU Nature Restoration Regulation[32], the Common Agricultural Policy[33] and the Water Framework Directive[34]. 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 expert organisation, taking into account the relevant data and knowledge already gathered on the pilot site.

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[30] INTERNATIONAL UNION FOR CONSERVATION ONF NATURE (IUCN), 2016. WCC-2016-Res-069-EN: Defining Nature-based Solutions. Resolution adopted at the IUCN World Conservation Congress, Honolulu, Hawaii, USA. Available at: https://portals.iucn.org/library/node/46456

[31] Seddon N, Chausson A,Berry P, Girardin CAJ, Smith A, Turner B, 2020. Understanding the value and limits of nature-based solutions to climate change and other global challenges. Phil. Trans. R. Soc. B375: 20190120. Available at: http://dx.doi.org/10.1098/rstb.2019.0120

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[34] Directive 2000/60/EC. Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy. Water Framework Directive. L 327, 1-73. Available at: https://eur-lex.europa.eu/eli/dir/2000/60/oj/eng

## 4.2.2. NbS as sustainable tool

**Definition of societal challenges, NbS & 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. [35, 36, 37]

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 [38].

*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[39]. 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)[40]

[35] 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.
[36] Sowińska-Świerkosz, B., & García, J. (2022). What are Nature-based solutions (NBS)? Setting core ideas for concept clarification. Nature-Based Solutions, 2, 100009.
[37] Dumitru, A., & Wendling, L. (2021). Evaluating the impact of nature-based solutions: A handbook for practitioners. European Commission EC.
[38] Turkelboom, F., Demeyer, R., Vranken, L. et al. How does a nature-based solution for flood control compare to a technical solution? Case study evidence from Belgium. Ambio 50, 1431–1445 (2021). https://doi.org/10.1007/s13280-021-01548-4
[39] 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.
[40] Haines-Young, R. (2023): Common International Classification of Ecosystem Services (CICES) V5.2 and Guidance on the Application of the Revised Structure.

**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[41]. Moreover, they support biodiversity conservation by protecting and restoring critical habitats in terrestrial and aquatic ecosystems [42]. 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 [43].

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 [44]. NbS also buffer the impacts of natural disasters by restoring natural floodplains and stabilizing slopes, reducing the risk of floods and landslides[45]. Importantly, many NbS projects are participatory, involving local communities in planning and maintenance, which fosters social cohesion and a sense of ownership[46].

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 [47].

### 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.

[41] Griscom, B. W., et al. (2017). Natural climate solutions. Proceedings of the National Academy of Sciences, 114(44), 11645–11650.

[42] Seddon, N., et al. (2020). *Understanding the value and limits of nature-based solutions to climate change and other global challenges*. Philosophical Transactions of the Royal Society B, 375(1794), 20190120.

[43] Brauman, K. A., Daily, G. C., Duarte, T. K., & Mooney, H. A. (2007). *The nature and value of ecosystem services: an overview highlighting hydrologic services*. Annual Review of Environment and Resources, 32, 67–98.

[44] Hartig, T., Mitchell, R., de Vries, S., & Frumkin, H. (2014). Nature and health. Annual Review of Public Health, 35, 207–228.

[45] Cohen-Shacham, E., Walters, G., Janzen, C., & Maginnis, S. (2016). *Nature-based solutions to address global societal challenges*. IUCN.

[46] 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.

[47] 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[48]**

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. 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[49]
- Nature-based Solutions for climate: A compendium of best practices in the Western Balkans[50]
- Nature-based Solutions in the Post-2020 Global Biodiversity Framework Targets[51]

**Alignment with the Post-2020 Global Biodiversity Framework[52]**

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**

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

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[48] 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

[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] 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

[51] 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

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

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[53]**

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 five 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[54]**

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.

[53] 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. https://eu4waterdata.eu/images/pdf/library/EU4ENVWaterData_NbSCatalogue-water-EaP_%20Sept24_VF.pdf

[54] 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 the 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[55] on ecosystem services was used together with the systematic review on ecosystem services of Grima et al. [56]. 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 of existing data sources was added.

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[55] Haines-Young, R. (2023): Common International Classification of Ecosystem Services (CICES) V5.2 and Guidance on the Application of the Revised Structure.
[56] 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, Skadar Lake 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[57,58] and Copernicus DEM[59], 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 3.4), 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[60] were used to supplement small and linear watercourses not fully captured in CLC+ datasets, due to their relatively rough resolution.

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[57] 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

[58] 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

[59] 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

[60] OpenStreetMap contributors. (2024). OpenStreetMap data on streams and rivers. OpenStreetMap Foundation. https://www.openstreetmap.org

The selection of measures was further informed by the Catalogue of Nature-based Solutions for the water sector[61]. Table 13 shows the measures for the NbS objectives within the case study area, according to the NbS catalogue. As another output developed during the 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 13: 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<br>Floodplain restoration and management<br>Natural bank stabilisation<br>Stream and river restoration<br>Reconnection of oxbow lakes<br>Removal of lateral barriers<br>Removal of transversal barriers |
| *Agriculture and grasslands* | Agroforestry, buffer strips and hedges<br>Conservation agriculture<br>Conversion to meadows and pastures<br>Restoration of existing pastures, steppes and natural grasslands<br>Sustainable pasture management |
| *Forests and woodlands* | Adapted forestry in floodplains and wet forests<br>Afforestation<br>Close-to-nature forestry<br>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.

[61] 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. https://eu4waterdata.eu/images/pdf/library/EU4ENVWaterData_NbSCatalogue-water-EaP_%20Sept24_VF.pdf

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 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 14).

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 14: 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 > 500m² |

**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 Skadar Lake National Park study area in Montenegro, the experts of the Public Enterprise for National Parks of Montenegro provided their site-specific expertise on environmental conditions, land ownership as well as management constraints and opportunities, through email exchanges.

The involvement of the colleagues of the Public Enterprise for National Parks of Montenegro 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[62].

[62] 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 Montenegro, 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. 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.
- Practical guidance on the design, management, and integration 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 [63]. 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 diversification enhance biological processes above and below ground, increase water and nutrient efficiency and support stable long-term production. While implemented at farm

[63] 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. https://eu4waterdata.eu/images/pdf/library/EU4ENVWaterData_NbSCatalogue-water-EaP_%20Sept24_VF.pdf

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.

**Protection of high-value ecosystems**

*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.

**Soil desealing and built-up areas**

*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 professional input provided by the Public Enterprise for National Parks of Montenegro 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 input from the experts of the Public Enterprise for National Parks of Montenegro were used to adjust and refine the proposed action zones by considering existing challenges, anthropogenic pressures and priority areas as well as other ecological or administrative constraints. This ensures that the mapped NbS objectives are consistent with the current situation of the Public Enterprise for National Parks of Montenegro and provide a realistic, implementation-oriented basis for further prioritization and discussion.

**Land cover types**

As shown in Figure 16, the studied area is characterised by a diverse mosaic of land cover types shaped by hydrological dynamics and traditional land use. As part of the broader Skadar Lake wetland system, the dominant land cover consists of wetland habitats, including shallow water bodies, reed beds, and seasonally flooded meadows. These areas are strongly influenced by fluctuating water levels and periodic inundation, which drive habitat heterogeneity and ecological productivity. Along the margins of Malo Blato and adjacent low-lying areas, alluvial plains support fertile soils that sustain both natural and semi-natural vegetation. These include wet grasslands and transitional habitats that function as important ecological interfaces between aquatic and terrestrial systems.

Beyond the core wetland zones, the landscape transitions into agricultural land, where traditional practices such as low-intensity farming and grazing predominate. These cultivated areas are interspersed with patches of semi-natural vegetation, forming a heterogeneous agricultural matrix that contributes to overall landscape diversity.

The surrounding area is characterised by low hills with mixed land cover, including grasslands, shrub vegetation, and small agricultural plots. Settlement areas are limited and scattered, aggregated in the eastern part of the study area, resulting in relatively low levels of artificial surface cover and maintaining the predominantly natural and semi-natural character of the landscape.

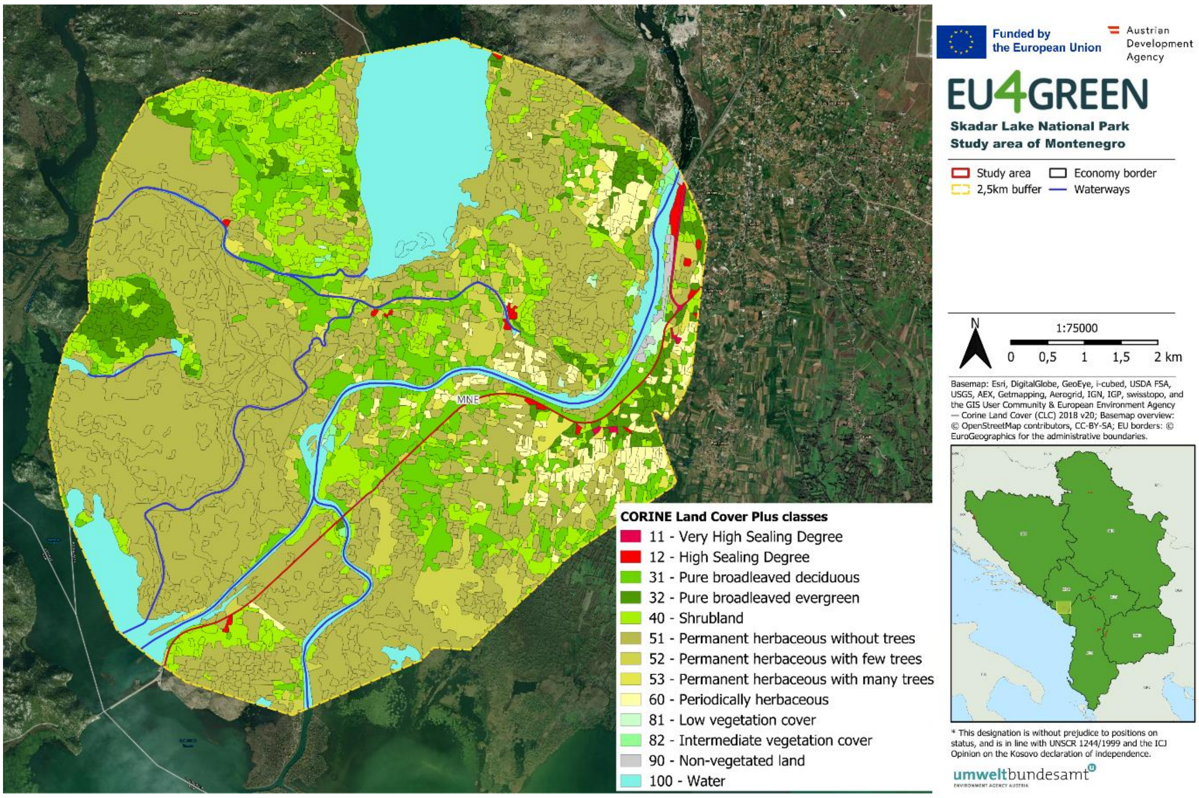


**Figure 16: Land cover types according to the CLC+ Backbone raster (2023, 10 m resolution) and vector dataset (2018, MMU 0.5 ha) datasets in the Skadar Lake National Park study area, Montenegro.**

## Sustainable agricultural landscape

In the study area, particularly around the villages of Bistrice, Bijelo Polje, and Vukovci, more extensive farmland offers opportunities to promote sustainable agricultural practices, including conservation agriculture (Figure 17). The central part of the area is characterised by a mosaic of grasslands, small parcels, and a dense network of hedges, shrubs, and woodland patches, supporting the objectives grassland restoration, conversion, and sustainable use. A targeted assessment of natural values and current management practices would help to refine priority areas. Grassland within the pristine wetland and marshes from the west to the south of the study area was not considered for the homogenised agricultural land, since it naturally treeless and already of high value.

While much of the agricultural land is already well-structured, some areas remain relatively uniform and lack landscape features. In these patches, the introduction of hedges or shrubs is recommended to enhance habitat diversity and support natural pest control by attracting birds and other predator species. However, these ecological benefits are not always well understood locally. The use of nets – often fishing nets – to exclude birds can lead to unintended mortality of non-target species such as songbirds and owls, while more adaptable pests may still bypass these measures. Such practices should be regulated or discouraged, accompanied by targeted awareness-raising and education.

Overall, the successful implementation of these measures depends on the active engagement and support of local communities, ensuring both ecological effectiveness and long-term sustainability.

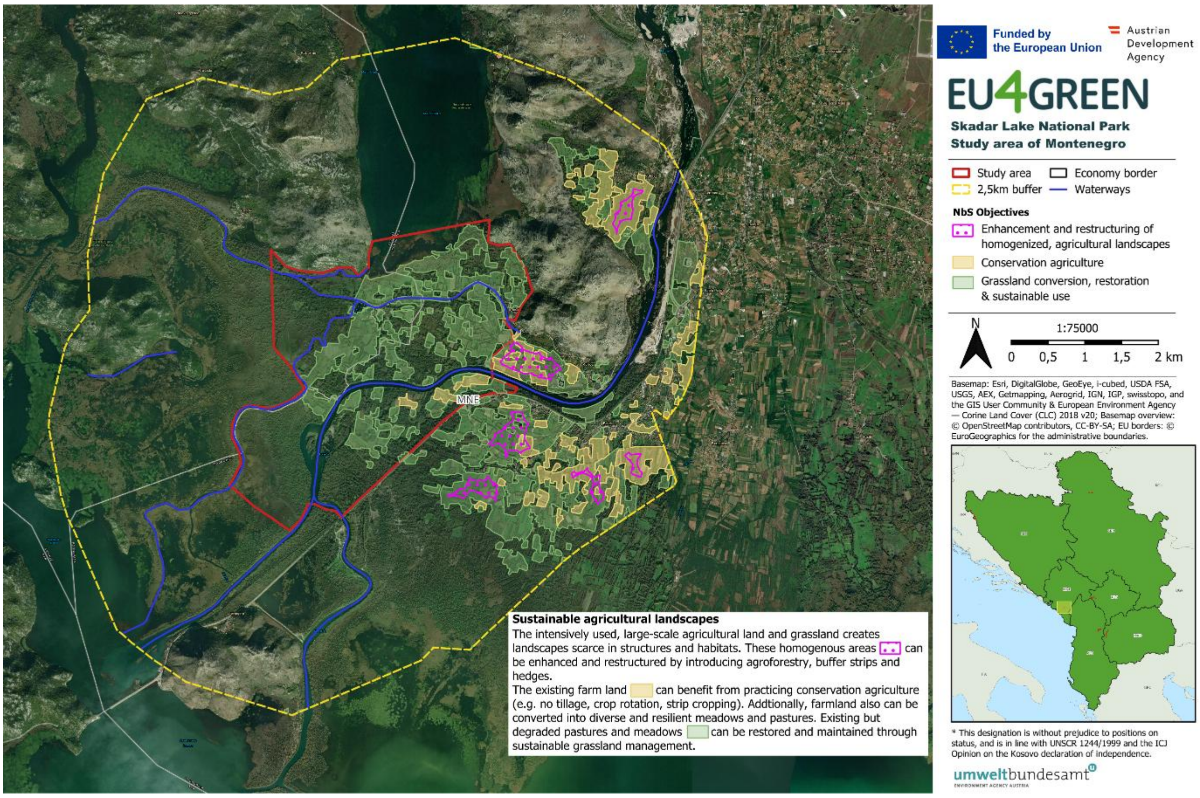


**Figure 17: The NbS objectives for the field of action "Sustainable agricultural landscapes" in the Skadar Lake National Park study area, Montenegro.**

## Forests and wooded ecosystems

In the Skadar Lake National Park study area (Figure 18), opportunities for afforestation are limited due to the predominantly hilly terrain, with only a few suitable sites for stabilising soil and improving water retention. These areas require further verification (e.g. biotope mapping or field surveys) to ensure they are not naturally open habitats such as dry grasslands or rocky areas. While higher elevations are dominated by grasslands, lower areas consist of smaller forest patches.

Forest management should be adapted to floodplain and wet forest conditions. Near rivers, close-to-nature forestry approaches are recommended, including the restoration of plantations to more natural forest compositions, while enhancing bank stability. The control of invasive alien species (e.g. *Gleditsia sp.*) is also necessary.

Implementation of these measures must be coordinated with landowners and local communities, who often face financial constraints. Limited access to machinery and equipment – such as for invasive species management or composting – can hinder action. Therefore, alongside awareness-raising, targeted financial and technical support is essential to enable effective implementation and encourage complementary measures such as tree planting.

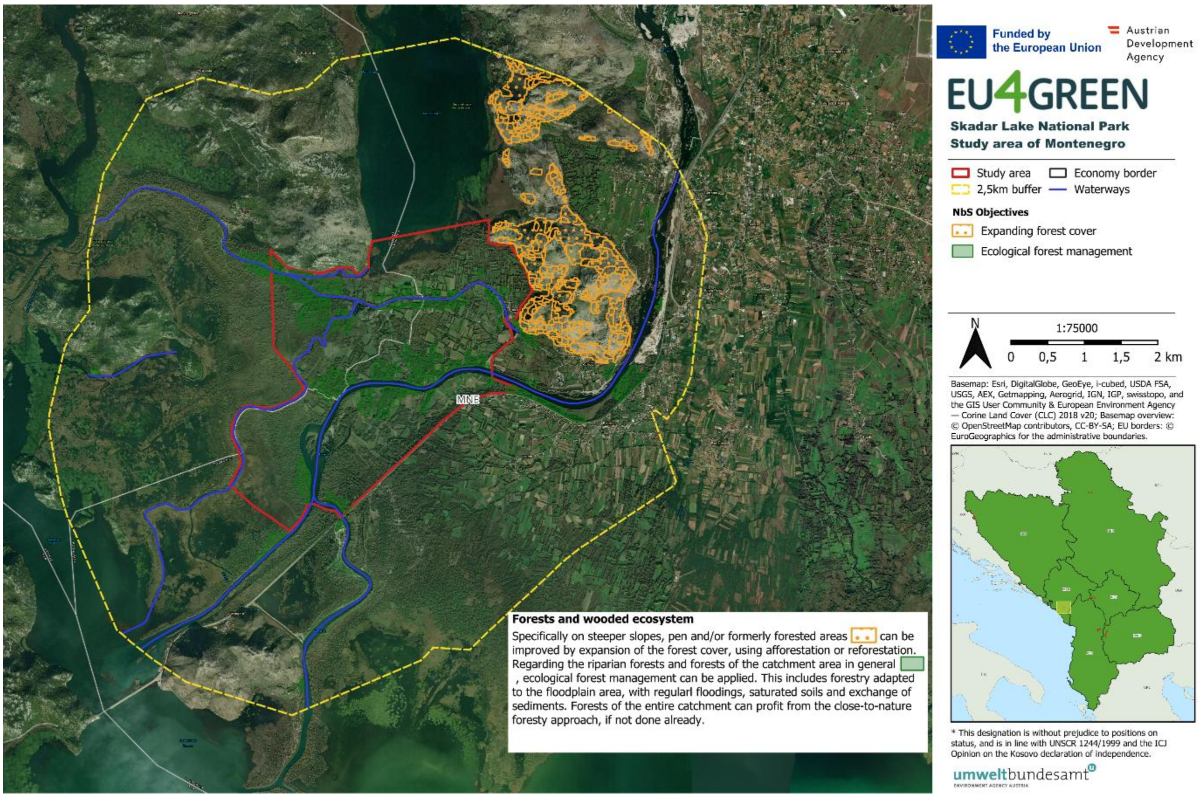


**Figure 18: The NbS objectives for the field of action "Forests and wooded ecosystems" in the Skadar Lake National Park study area, Montenegro.**

## Riparian ecosystems restoration

As shown in Figure 19, restoration of aquatic habitat structures is recommended for river stretches within agricultural areas. These measures aim to reduce flow velocity, enhance flood protection, and improve habitats for aquatic species. In parallel, the restoration of floodplains and riparian buffer zones can help reduce runoff from farmland and intensively managed grasslands.

Addressing river fragmentation caused by barriers such as hydropower plants is also essential. Measures such as fish ladders should be considered to restore ecological connectivity.

Since many target areas, including those near villages like Bistrice, lie outside National Park boundaries, early stakeholder engagement is crucial for successful implementation.

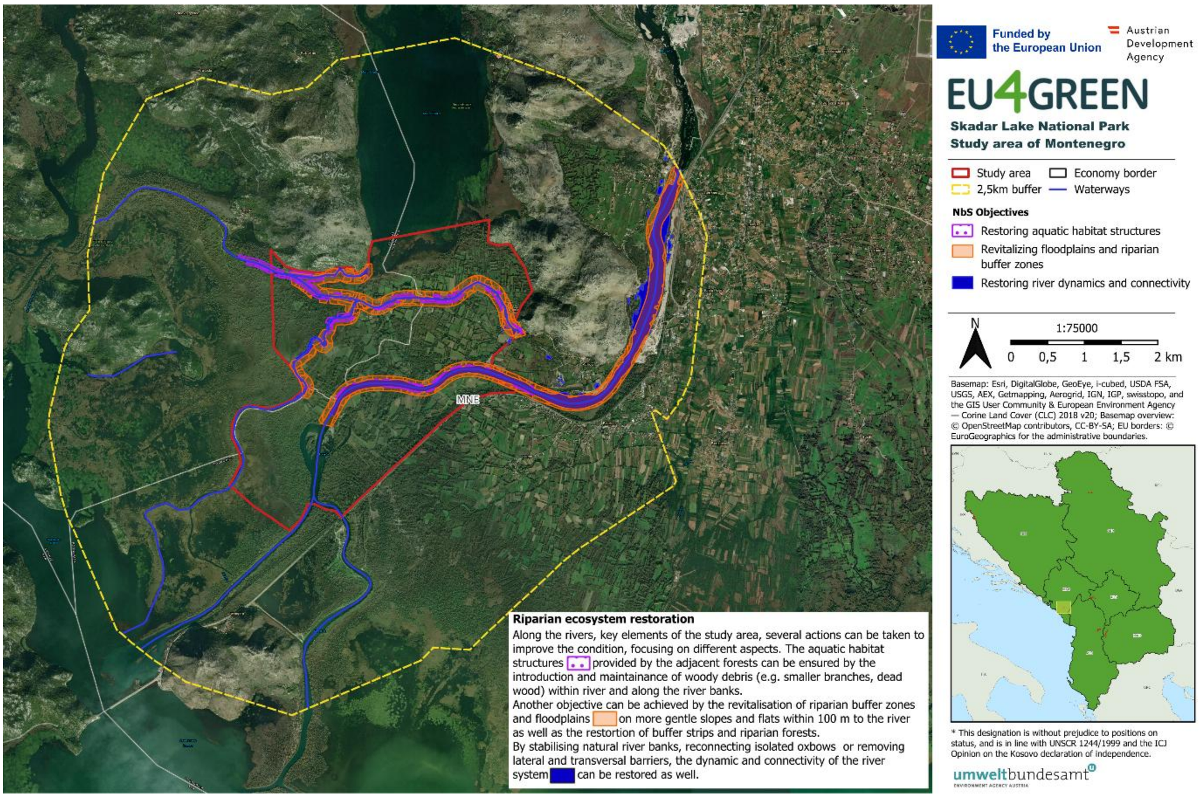


**Figure 19: The NbS objectives for the field of action “Riparian ecosystems restoration” in the Skadar Lake National Park study area, Montenegro.**

## Protection of high-value ecosystems

The slopes of the study area in the National Park host various habitat types of annex I, including valuable aquatic habitat types, e.g. ‘3150 Natural eutrophic lakes with Magnopotamion or Hydrocharition -type vegetation’ and ‘3280 Constantly flowing Mediterranean rivers with Paspalo-Agrostidion species and hanging curtains of *Salix* and *Populus alba’* , rich grassland habitats like ‘6420 Mediterranean tall humid herb grasslands of the Molinio-Holoschoenion’ and ‘6540 Sub-Mediterranean grasslands of the Molinio-Hordeion secalini’ as well as riparian forests of ‘92A0 *Salix alba* and *Populus alba* galleries’ and ‘92D0 Southern riparian galleries and thickets (Nerio-Tamaricetea and Securinegion tinctoriae)’ (Figure 20). Each of these habitat types required targeted measures to fulfil the site-specific conservation objectives and ensure the improvement and maintenance of a favourable condition.

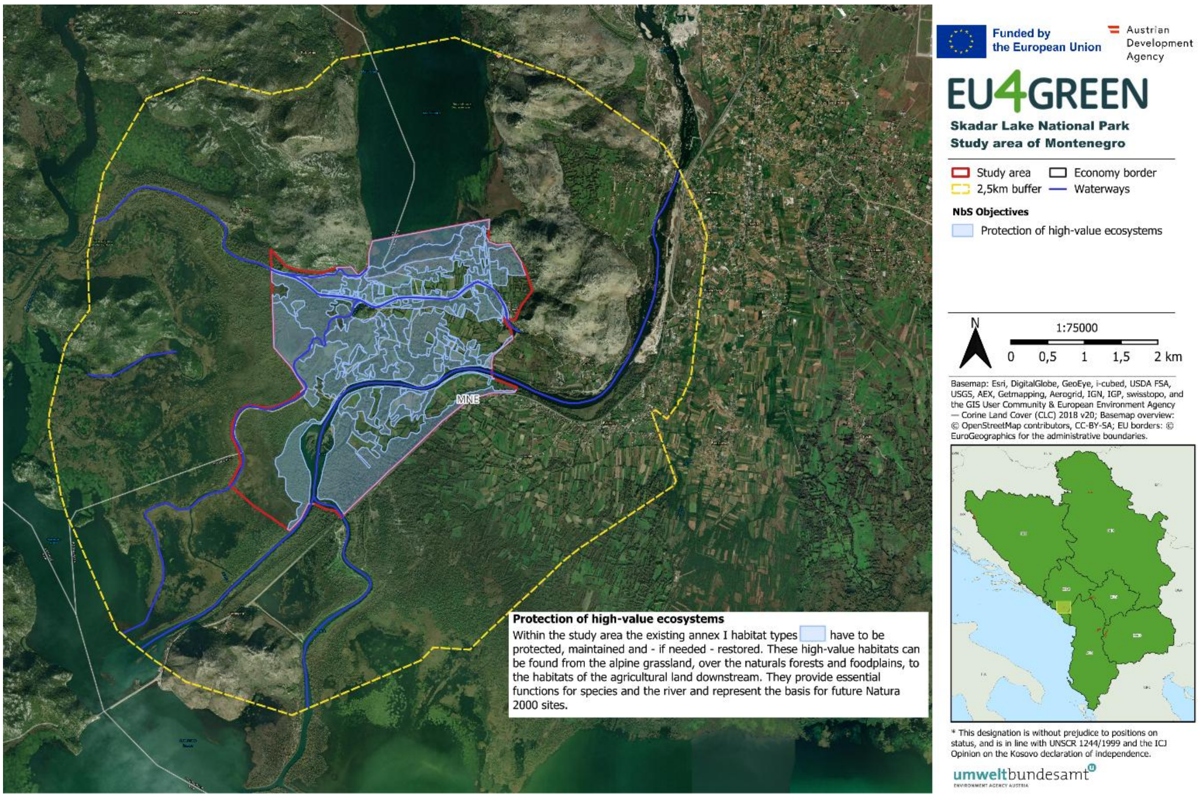


**Figure 20: The NbS objectives for the field of action “Protection of high-value ecosystems” in the Skadar Lake National Park study area, Montenegro.**

## Soil desealing

As visualized in Figure 21, most of the sealed surfaces are located in the built-up areas of the settlements in the eastern part of the studied area. Additionally, the paved road leading from the northeast to the southwest across the entire area, poses a major fragmenting structure and potential high runoff, specifically in the settled area of Bistrice and upstream. Here, permeable surfaces are recommended to reduce erosion and soil sealing.

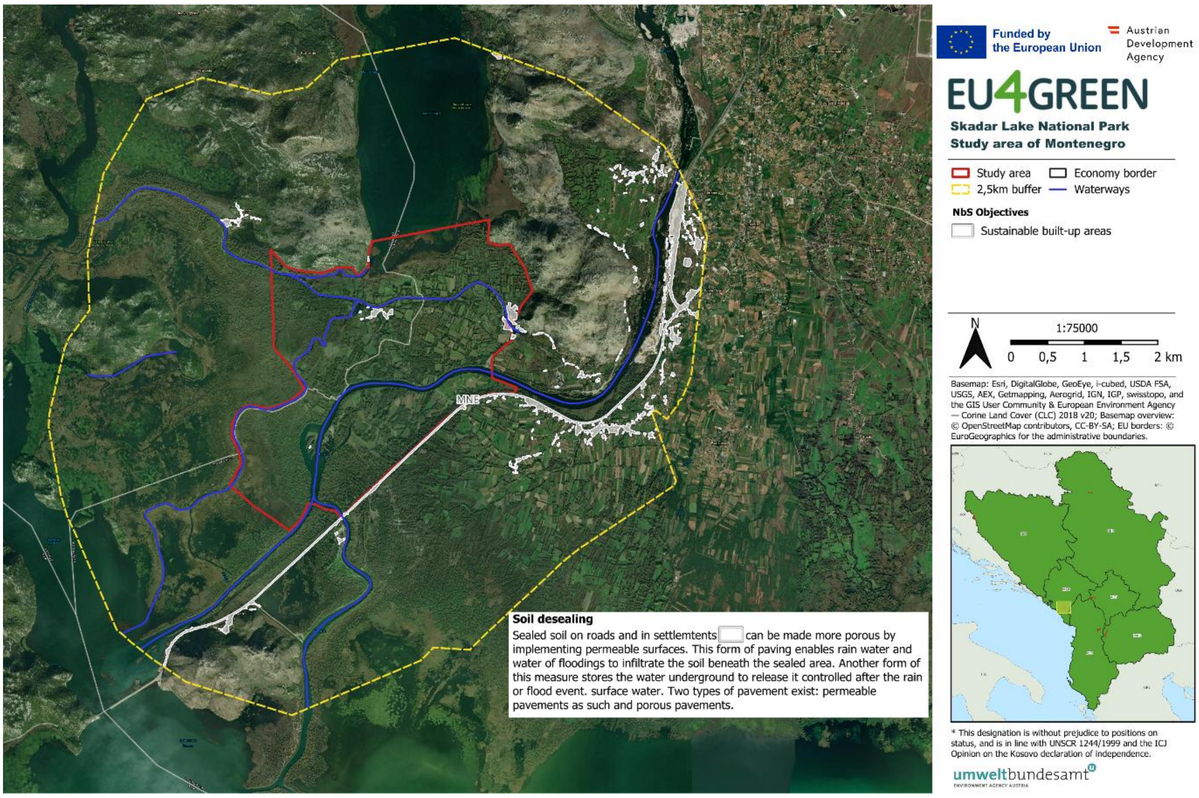


**Figure 21: The NbS objectives for the field of action "Soil desealing" in the Skadar Lake National Park study area, Montenegro.**

## 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 Montenegro. While the availability of harmonised geospatial datasets enabled a consistent analysis across ecosystems, limitations in site-specific data – particularly on land ownership, silvicultural 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 water abstraction, river dysregulation and mismanagement of forests as well as fragmentation through infrastructure. Accordingly, future efforts should prioritise forest management and restoration as well as the restoration of river continuity and connectivity, the enrichment of aquatic structures and the prevention of erosion with nature-based approaches, and ecologically adapted forestry in floodplain, riparian forests and the rivers' catchments. 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. Skadar Lake 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 Skadar Lake watersides and floodplain areas.