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ReCo

Transnational and regional proposals for targeted restoration actions along EGB CE

(D.1.2.2)

Title: Transnational and regional proposals for targeted restoration actions along EGB CE

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Contents

1. Introduction

Central European landscapes have undergone significant transformations over the centuries, driven by agricultural intensification and expansion, urbanization and industrial activities, but also abandonment of traditional forms of agricultural management. These changes have resulted in habitat fragmentation, loss of biodiversity, and degradation of ecosystem services. Recognizing the urgency of these challenges and the need to take actions in crucial areas to reconnect and revitalize natural habitats and thus strengthen the ecological network, this Working Paper was developed to address these challenges by using modern technologies and methods.

By the integration of the results of Deliverable *D.1.2.1 Transnational and regional GIS surveys* – recent habitat data, historic land cover information, and connectivity analysis - will be combined to highlight the best-suitable areas for future restoration measures to restore ecological integrity, enhance biodiversity, and promote sustainable land use practices.

In each of the ReCo Pilot Regions, the Working Paper will identify those areas with high priority for the targeted habitats and/or species during the project implementation. In close cooperation and exchange with the responsible project partners the regional restoration goals of the project will be considered as well as during the selection of suitable areas.

Following the main objective of the ReCo project to provide solutions for improving protection and connectivity of habitats along the Central European Green Belt (CE EGB), the following chapters will depict the methodology as well as the most relevant areas for the Pilot Regions. It should serve as a basis for future planning and stakeholder alignment for restoration along the CE EGB.

2. Methodology

2.1. Considered data sets

The methodological approach of the Working Paper is based on the main outputs of the previous activities of *A 1.2 - GIS-based survey: Identification & ReCommendation of EGB areas with a particular need of restoration*. The goal of the previous tasks was to carry out GIS based surveys of the CE EGB, based on satellite data, historical maps & other data sets. Alongside with the Broader Habitat Types, also maps of ecosystem services were elaborated. The whole catalogue of maps can be found in *1.2.3 - Transnational atlas on national level along the CE EGB and for six ReCo pilot regions*, which is complementary to the Working Paper.

Since they are described in more detail in the respective report, each result of the preliminary analyses is only described shortly. The focus is laid on their use and implementations for future restoration planning.

2.1.1. Broader Habitat Types

The classification of Broader Habitat Types (BHT) serves several critical purposes in ecological research, conservation planning and environmental management. By grouping the habitats of the diverse landscapes of Central Europe the complex mosaic of ecosystems can be simplified into manageable categories. This enables a clearer understanding of the landscape and to efficiently implement strategies for biodiversity conservation, ecosystem resilience and restoration on a local, regional, national and global scale. Also, the analysis and comparison as well as communication among scientists, policymakers, and stakeholders becomes facilitated.

Based on those BHTs, clear targets for habitat restoration can be drafted aiding to restore ecological corridors and networks, ensuring connectivity across the landscape to support wildlife movement and gene flow. Furthermore, the capacity of ecosystem service provision can also be linked to the BHT classification allowing to recognize and maintain the diverse ecosystem services provided by different habitats, such as carbon sequestration by forests or water purification by wetlands.

In ReCo the task to create comprehensive maps of BHTs for each Pilot Region as detailed as possible was achieved by including different data sets (CLC+ Backbone, Copernicus HRL, existing national and/or regional habitat mappings, classification of Sentinel-2 satellite imagery) as described in the report of *D 1.2.1*. **Figure 1** shows an exemplary map of the core area of PR1 and **Figure 2** the accompanying legend.

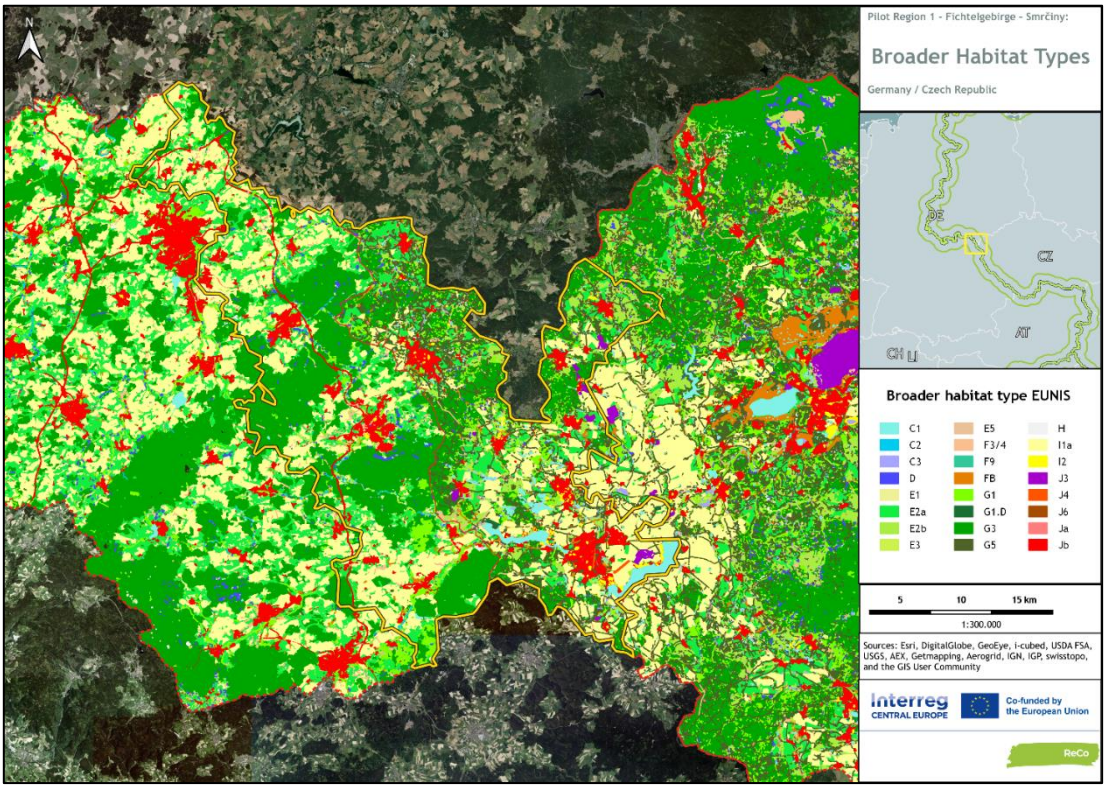

Figure 1 Maps of the broader habitat types of the core area and its surroundings of PR1 – Fichtelgebirge / Smrčiny Mountains.

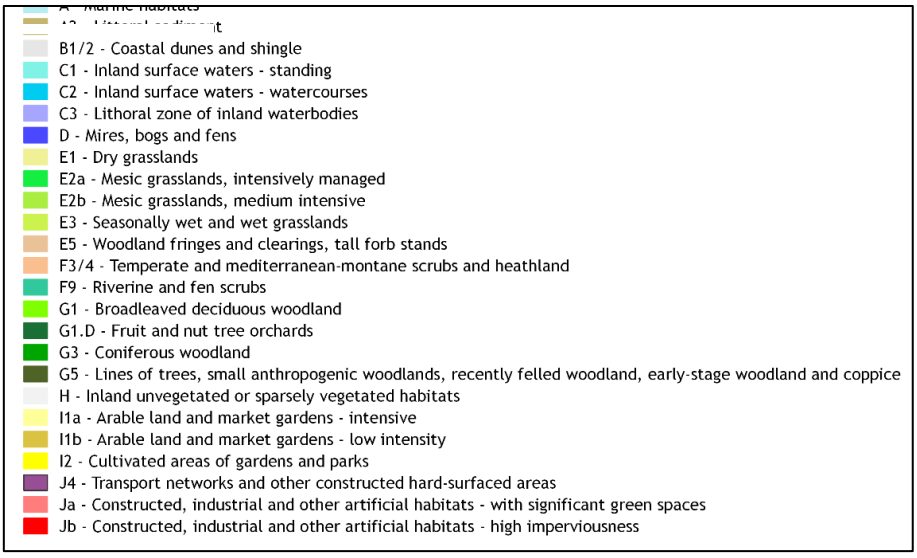

Figure 2 Legend of the broader habitat types in PR1– Fichtelgebirge / Smrčiny Mountains.

2.1.2. Connectivity

2.1.2.1. Morphological Spatial Pattern Analysis

The connectivity analysis is a powerful tool for assessing the ecological coherence of landscapes. By evaluating the physical and functional connectivity between patches of the target habitat(s), this analysis identifies critical corridors and barriers to species movement. Ensuring connectivity is essential for maintaining genetic diversity, facilitating species migration, and enhancing the resilience of ecosystems to environmental changes.

In this work, the Morphological Spatial Pattern Analysis (MSPA) was used for the spatial analysis of the target BHTs. This method is implemented in the GUIDOS Toolbox (Graphical User Interface for the Description of Spatial patterns), developed by the Joint Research Centre of the European Commission (Soille & Vogt, 2009 & 2022). MSPA is used for the analysis and characterization of the spatial structure of binary patterns in a raster format, typically focusing on landscape ecology and habitat connectivity. These binary patterns or raster maps distinguish between foreground (= representing habitat or landcover type of interest) and background (= non-targeted landcover categories). The analysis uses mathematical morphology to process spatial patterns depending on their spatial configuration and relationship to other elements.

As a result, the MSPA classifies each pixel of the target habitat in one of seven morphological classes. The main classes include:

- Core: Interior pixels of a larger habitat patch that are not influenced by the edge.
- Edge: Pixels on the boundary of the habitat patch.
- Islet: Small, isolated patches of habitat.
- Perforation: Interior edges created by holes within a habitat patch.
- Branch: Thin, linear features connected only at one end to a core or bridge.
- Loop: Circular connections within the habitat.
- Bridge: Narrow connections between cores

This analysis gives value to the landscape elements, according to their spatial functionality and thus can be used as a parameter for the identification of crucial nodes and gaps in the ecological network. As depicted in **Figure 3** and **Figure 4Figure 4 The result of the connectivity analysis of PR1 - Fichtelgebirge / Smrčiny Mountains..**, the core areas (green) are connected to each other by the bridges (red), other structures such as branches, loops or islets are nonetheless actually or potentially highly relevant for connectivity.

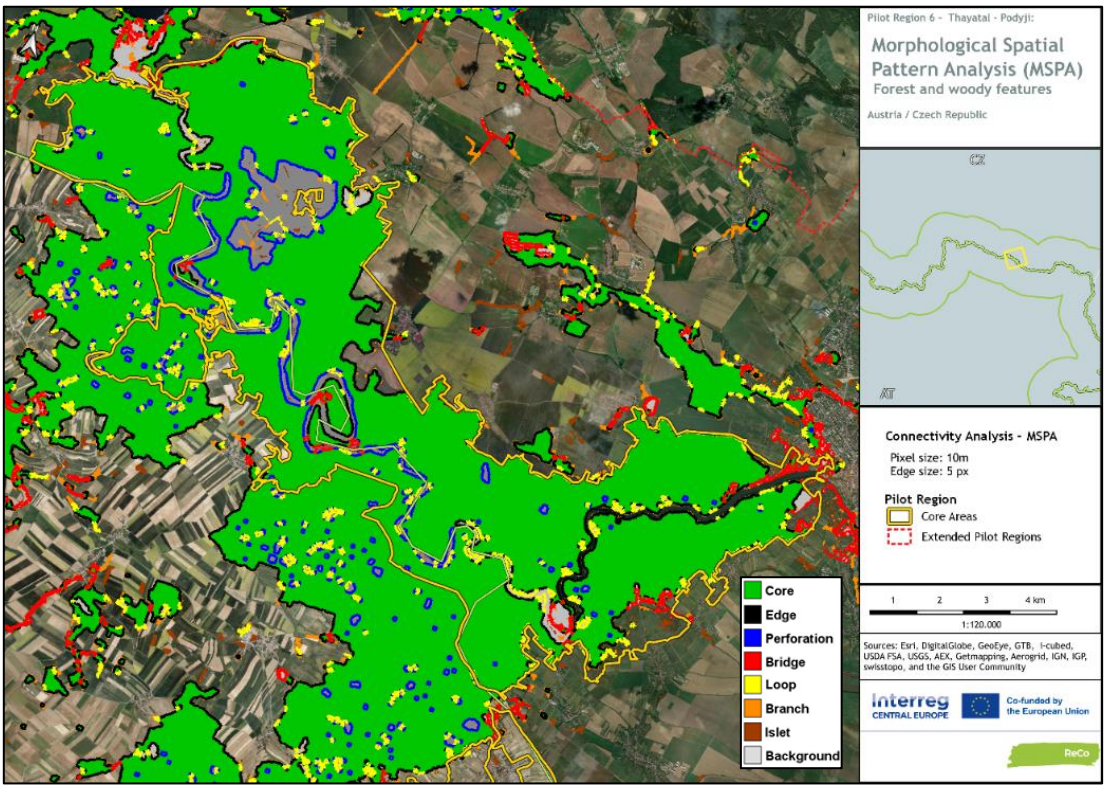

Figure 3 The result of the connectivity analysis of the National Parks Thayatal & Podyjí in PR6.

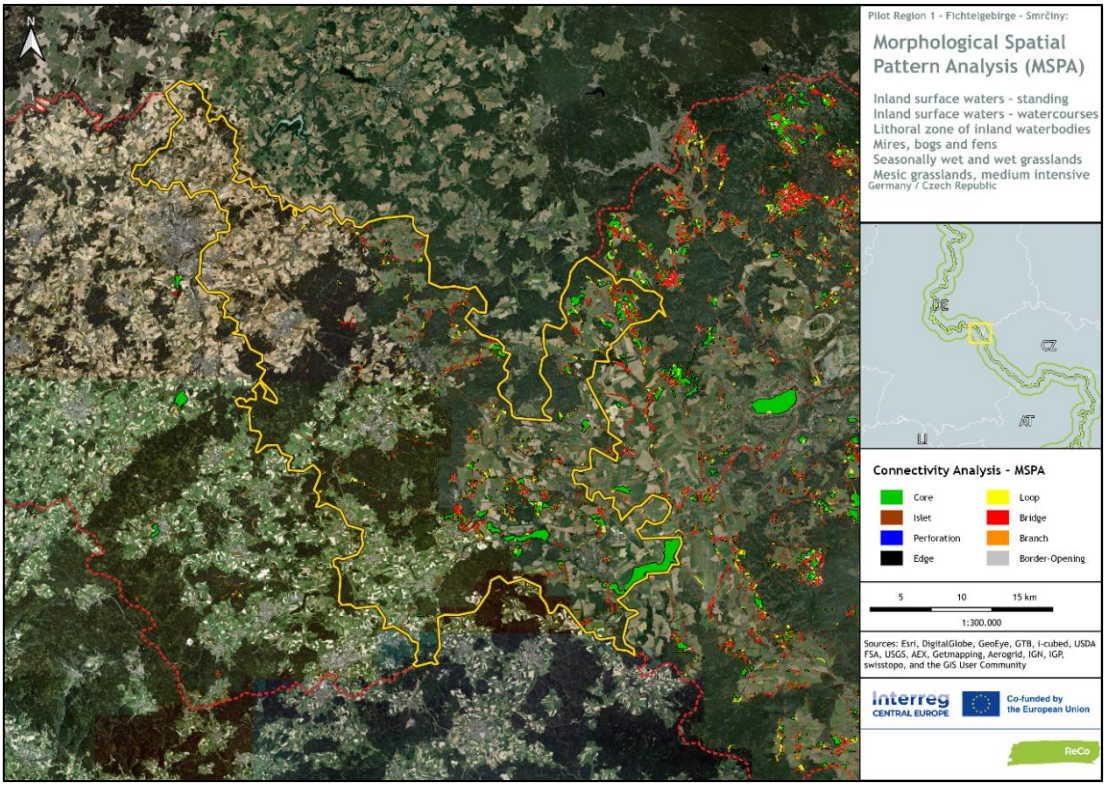

Figure 4 The result of the connectivity analysis of PR1 – Fichtelgebirge / Smrčiny Mountains..

2.1.2.2. Euclidean Distance

As a second analysis by GUIDOS Toolbox, the Euclidean distance (ED), was also conducted. The ED is a measure used to calculate the straight-line distance from each pixel in a raster image to the nearest edge of a habitat patch or other specific landscape element. This metric is essential for various spatial analyses, including connectivity assessments, fragmentation studies as well as ecological planning. It is computed for each pixel in the raster grid. The output is a distance map where each pixel value represents the Euclidean distance to the nearest feature.

This distance map is useful for the visualization of spatial patterns and distances within the landscape and helps to analyse even narrow linear elements (corridors) and small point-features. This proves to be useful especially for the larger Pilot Regions.

Its application on the landscape analysis comprises of estimating edge effects, identification of core areas and assessing the proximity of isolated patches or stepping stones to larger habitat areas and highlighting small-scale networks of green infrastructure.

In the case of ReCo the Euclidean distance helps to identify the most promising gaps to be closed by selecting target habitats with proximity to each other, for realistic restoration actions. An example of this is given in Figure 5.

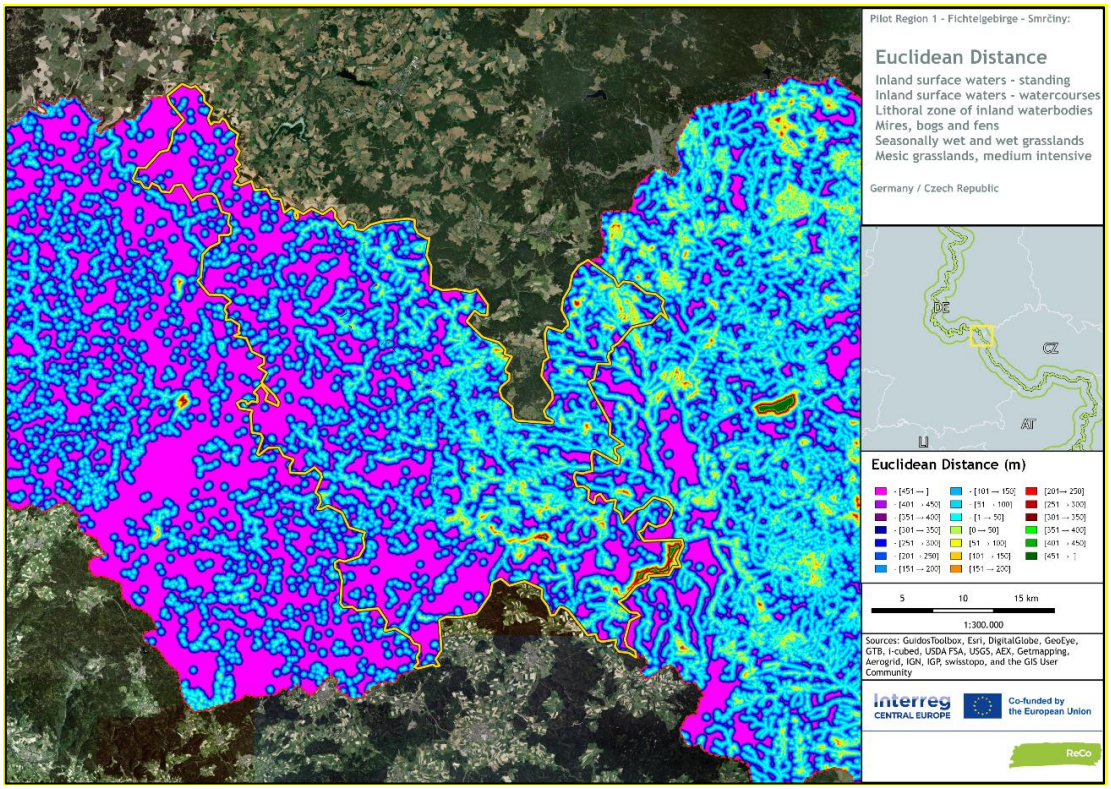

Figure 5 The Euclidean Distance map of PR1. Warm colors indicate the distance from the boundary of the target habitat(s) into the habitat, cold colors indicate the outside of the target habitat(s).) – inland surface waters (both standing and watercourses), lithoral zones of inland waterbodies, mires, bogs, fens, seasonally or permanently wet grasslands and medium intensive mesic grasslands. Thus, the pink areas are showing a lack of

habitats, while the yellow, red & green areas mark existing habitat patches and networks.

2.1.3. Historical land cover

Historic land cover data offers a window into the past, revealing the extent and nature of ecosystems and agricultural land before the intensification of land use and significant human alteration. By examining historical records and maps, we can identify patterns of land use change and the original composition of the landscape. This historical perspective is invaluable for setting realistic restoration targets and understanding the long-term impacts of human activities on the landscape.

For the historical aspect, maps from the second half of the 19th at the scale of 1:25 000 century were used. Due to technical and resource restrictions, historical land-cover classes were captured in a raster of 250m pixel size for most of the core areas of the pilot regions: PR1 - Fichtelgebirge (DE), PR3 - Škocjanski zatok Nature Reserve (SI), PR4 - Gorenjska Region (SI) and PR5 - Ińsko Lakeland (PL). Thank to the data of former projects (Skokanová et al. 2012), a comprehensive vector data set of the historical land cover for PR1 - Smrčiny Mountains (CZ) and PR6 - National Park Thayatal & Podyjí (AT/CZ) could be easily adjusted to more detailed land-cover classes and integrated in the analyses. One of the historical land cover maps can be seen in **Figure 6** for PR4.

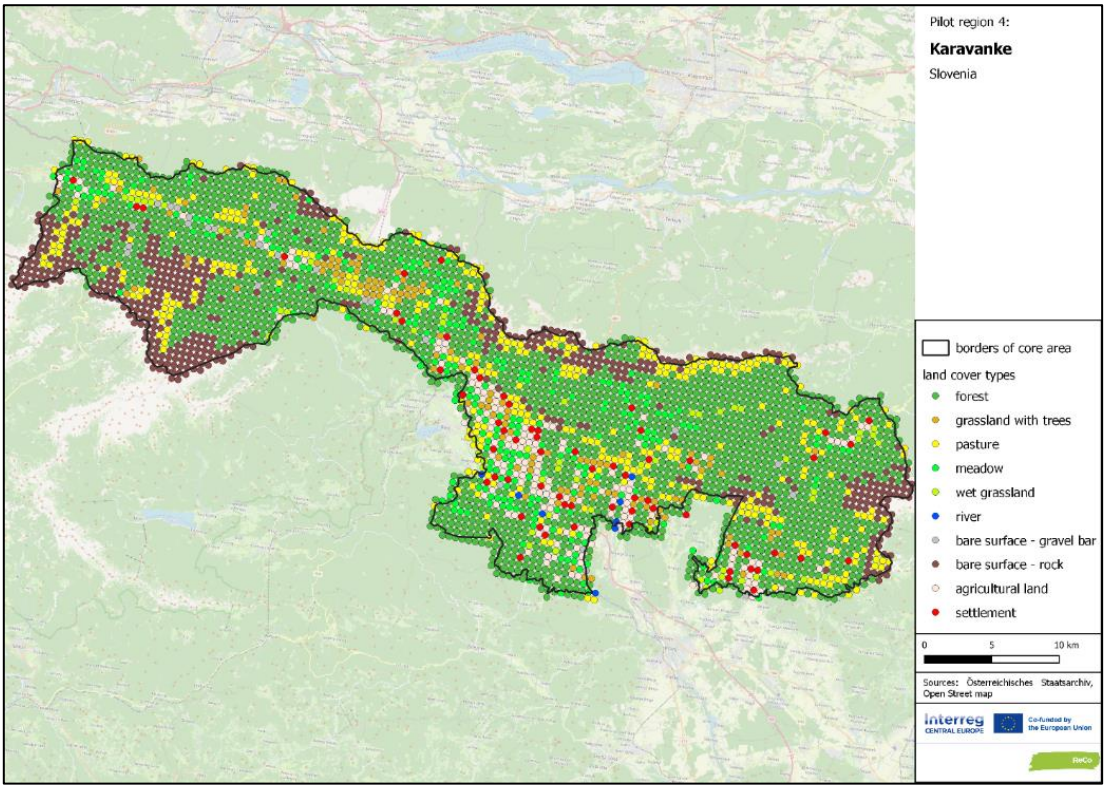

Figure 6 Raster of 250x250m for the historical land cover types of PR4.

In order make the by nature thematically coarse classes of the various historical sources comparable to the recent habitat maps, the historical land cover classes were assigned to broader habitat types (see **Table 1**).

Table 1 Crosswalk between historical land cover classes and broader habitat types

Land cover class	Broader habitat type
Forest	Broadleaved deciduous woodland Coniferous woodland Mixed deciduous and coniferous woodland Line of trees, small anthropogenic woodlands, recently felled woodland, early-stage woodland and coppice
Wet forest	Broadleaved deciduous woodland Coniferous woodland Mixed deciduous and coniferous woodland
Meadow	Dry grasslands Mesic grasslands, intensively managed Mesic grasslands, medium intensive Alpine and subalpine grasslands Woodland fringes and clearings, tall forb stands
Pasture	Dry grasslands Mesic grasslands, intensively managed Mesic grasslands, medium intensive Alpine and subalpine grasslands Inland salt steppes Tundra
Grassland with trees	Sparsely wooded grasslands Arctic, alpine and subalpine scrub Temperate and Mediterranean-montane scrubs and heathland Maquis, arborescent matorral and thermo-Mediterranean brushed Spiny Mediterranean heaths (prygana, hedgehog-heaths and related coastal cliff vegetation) Riverine and fen scrubs Hedgerows
Wet grassland	Seasonally wet and wet grasslands
Wetland	Littoral zone of inland waterbodies
Peatbog	Mires, bogs and fens

Salt marsh	Saline coastal lagoons
River	Inland surface waters - watercourses
Water body	Inland surface waters - waterbodies Highly artificial man-made waters and associated structures
Sea	Marine habitats Estuaries
Bare surface - rock	Littoral rock Rock cliffs, ledges and shores Inland unvegetated or sparsely vegetated habitats
Bare surface - gravel bar	Inland unvegetated or sparsely vegetated habitats
Bare surface - beach	Littoral sediment Coastal dunes and shingle
Arable land	Arable land and market gardens - intensive Arable land and market gardens - low intensity Cultivated areas of gardens and parks
Orchard	Fruit and nut tree orchards
Vineyard	Shrub plantations
Settlement	Extractive industrial sites Transport networks and other constructed hard-surface areas Waste deposits Constructed, industrial and other artificial habitats - with significant green spaces Constructed, industrial and other artificial habitats - high imperviousness

2.2. Aggregation of data

The map of best-suitable sites for restoration efforts is derived from the 3 outputs of the previous task – Broader Habitat Types, connectivity/MSPA and historical land cover. Depending on the pilot region's respective target habitats the potential restoration areas were narrowed down by using the three parameters: habitat quality (BHTs), the functional value as connecting landscape element (MSPA) and the historical aspect to indicate promising areas with related land cover types in the past.

The procedure therefore was to use the general BHT results to have a baseline value for the entire pilot region. While giving the BHT(s) of interest a higher value, barriers such as roads or urban area were rated accordingly low. An example of this step can be seen in the example below (**Figure 7**).

However, depending on the characteristics of the PR and the targeted ecosystems, the aim for the analysis can also be the identification of future stepping stones in the network instead of direct connection. Considering the likeliness of the BHT being changed, the suitability of certain BHTs is very low. For example, it is unlikely that forests will be changed to meadows.

As it can be seen in the example of PR4, potential habitats which are managed more intensively are identified in order to be transformed into extensive grassland.

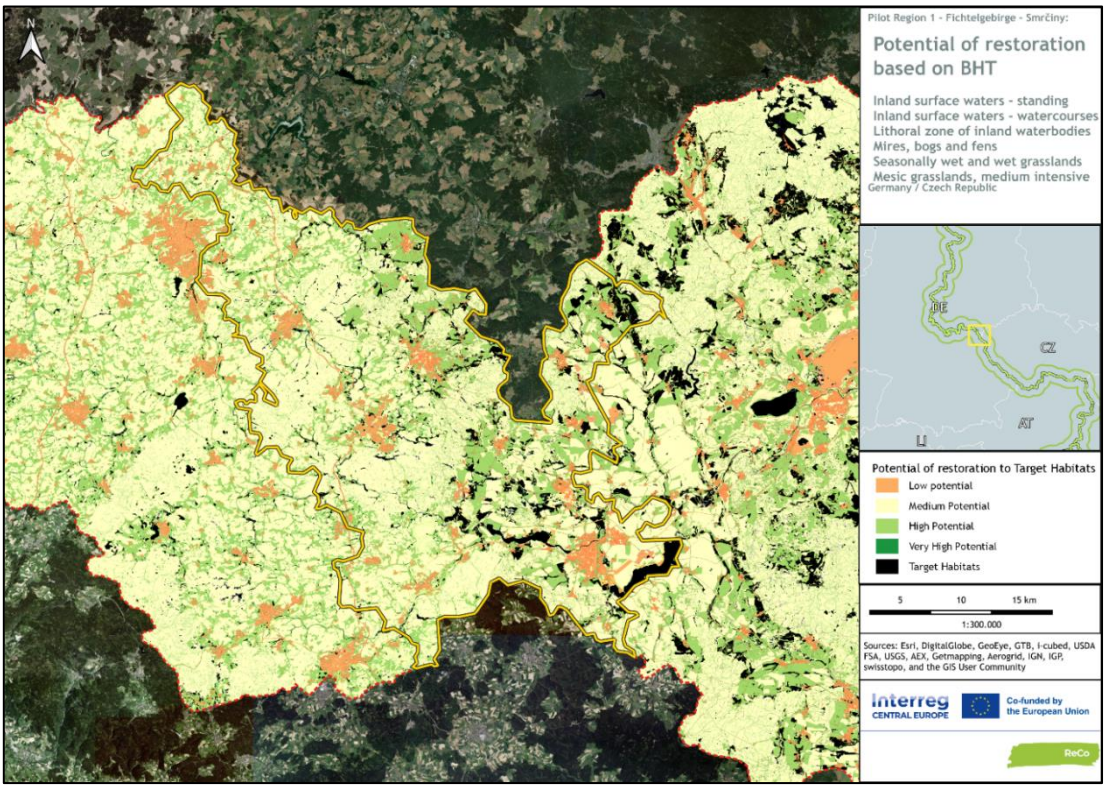

Figure 7 Map of BHTs with a potential for restoration measures of PR1 – Fichtelgebirge / Smrčiny Mountains, ranging from a Low potential (orange) to a Very high potential (green) and the actual target habitats (dark green).

Subsequently, the calculated classes of the MSPA were ranked according to their relevance as (potential) connective element (e.g. bridge = 3, Islet = 2, background = 0, etc.), narrowing down the target habitats in the PR by their functional role in the habitat network (**Figure 8**).

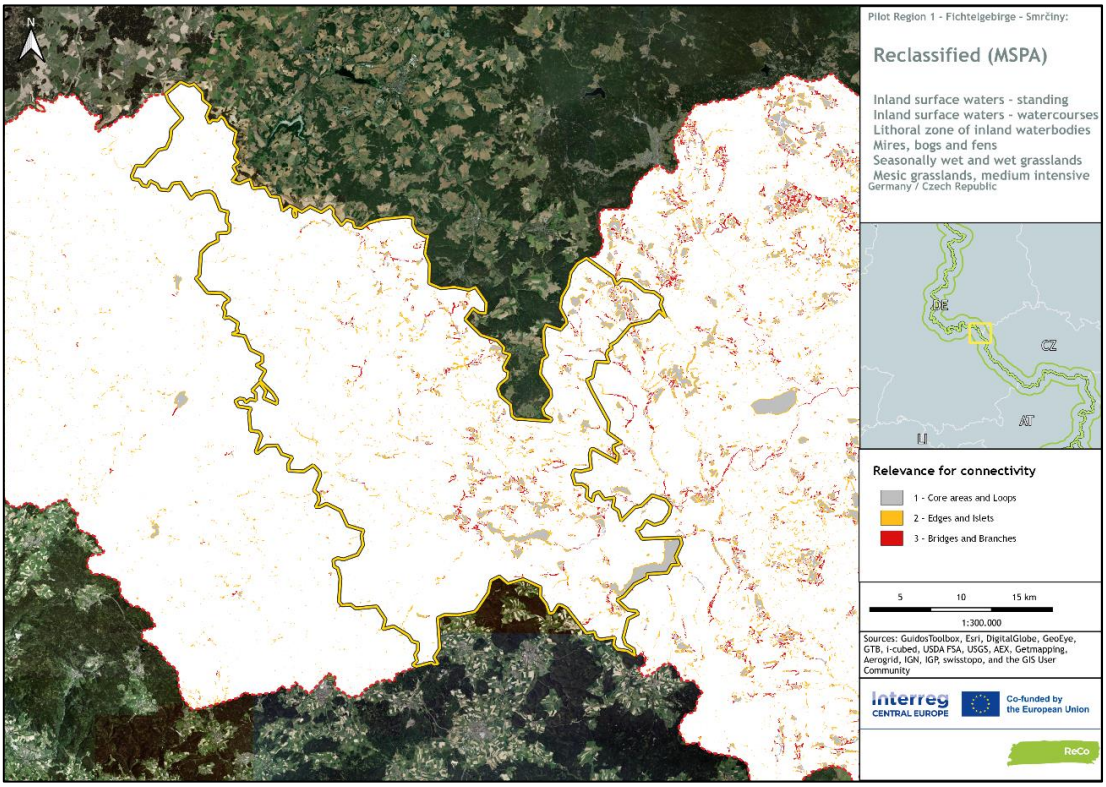

Figure 8 Map of reclassified MSPA, focusing on key elements of connectivity for the target BHT, ranging from 0 for background to 3 for branches and bridges.

Finally, the comparison with the historical configuration of the landscape hints to areas that have been identified as target habitat in former times, before the industrial revolution intensified the land use type or even changed the land cover type as a whole (**Figure 9**).

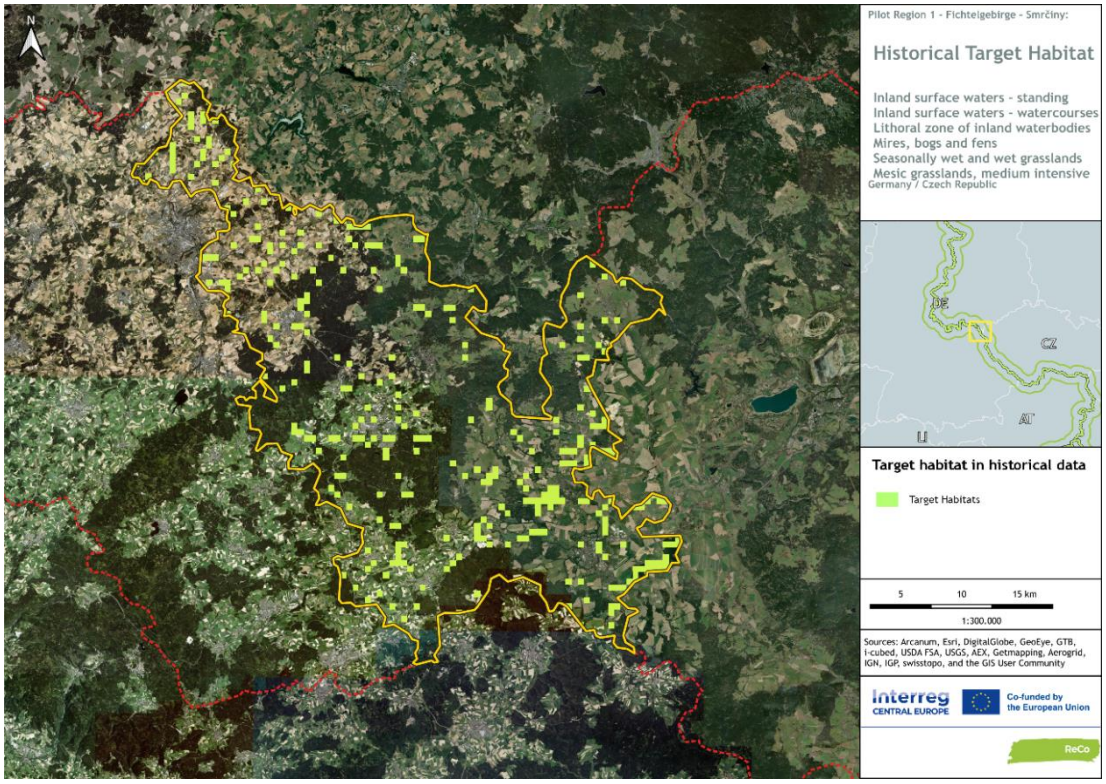

Figure 9 Evaluation of the targeted historic habitat of PR1 – Fichtelgebirge / Smrčiny Mountains.

As a result, a map of the suitability for restoration (**Figure 10Figure 9**) is obtained by the aggregation of the 3 previously mentioned criteria. The map targets areas that have a current BHT suitable for intervention, excluding built environments for example. At the same time, it considers differences in suitability based on the historical data of the region, while focusing on the key elements of connectivity derived from the MSPA.

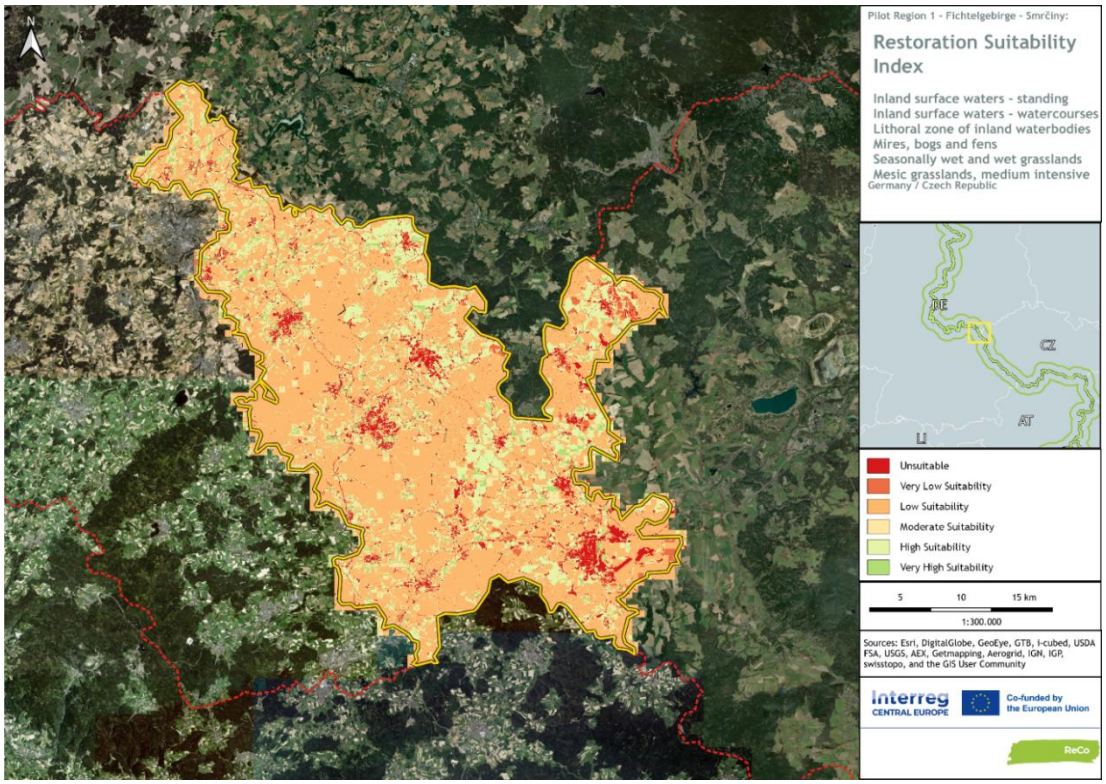

Figure 10 Suitability for Restoration based on current BHT, historical landscape and connectivity analysis.

3. Identification of best-suitable restoration areas

Each pilot region is introduced by the general restoration goals within the ReCo project. In line with that description, the maps of the best-suitable areas provide a selection of the sites with a feasible land use history, crucial elements for the ecological network and target habitats to point out the gaps and focal points in the landscape.

3.1. Fichtelgebirge / Smrčiny Mountains, DE/CZ (PR1)

3.1.1. Target habitats

The main value of the Smrčiny Mountains is the preserved watercourses and their catchment areas with a rich biodiversity. It is one of the most threatened ecosystems in Central Europe. Therefore, the target habitats for the ReCo project are:

- Inland surface waters – watercourses
- Dry grasslands
- Seasonally wet and wet grasslands

The oligotrophic catchment of smaller streams has been preserved here in a very representative form, including the occurrence of the rarest species. In the riverbed there are stands of aquatic macrophytes such as the alpine pondweed *Potamogeton alpinus*. These provide a feeding habitat for the most important species of this habitat, the Freshwater Pearl Mussel *Margaritifera margaritifera*. This is one of the few areas where this species occurs in Central Europe. However, the quality of the habitat is evidenced by the presence of many other species: the Brook Lamprey *Lampetra planeri*, the Bullhead *Cottus gobio*, the Common Minnow *Phoxinus phoxinus,* the kingfisher *Alcedo atthis* and the otter *Lutra lutra*. There are many small tributaries, wetlands and springs in the river basin, where rare plant species such as the broad-leaved marsh orchid *Dactylorhiza majalis*, the bogbean *Menyanthes trifoliata* and the Creeping Willow *Salix repens* grow. In some places, smaller peat bogs have formed with typical species such as the small cranberry *Vaccinium oxycoccos* or the common sundew *Drosera rotundifolia*, and the tiny orchid lesser twayblade *Listera cordata* has been recorded very rarely. In the drier parts we can find wolf's bane *Arnica montana* or common lousewort *Pedicularis sylvatica*. In small pools and generally moist environments, amphibians such as the alpine newt *Ichthyosaura alpestris* or the common newt *Lissotriton vulgaris* thrive.

The second most important species of this region - the butterfly Marsh Fritillary *Euphydryas aurinia* - occurs on the mosaic of scrub, dry and wet meadows and especially the stands of the devil's-bit scabious *Succisa pratensis*.

The black stork *Ciconia nigra* hunts in the water environment and meadows, and the pygmy owl *Glaucidium passerinus has been found in the forest. In the wet meadows,* the corncrake *Crex crex,* common snipe *Galinago galinago* or the whinchat *Saxicola rubetra* nest in the wet meadows.

3.1.2. Current situation

Despite their persisting high value and rich biodiversity, the target habitats are not in an optimal state, and they are endangered by negative influences. During the Iron Curtain times, many former meadows overgrew with high vegetation, bushes and trees or they were forested, and this trend continues until now. Due to the demographic and socio-economic development, with a declining population in the region and an increasing proportion of older people at the expense of the young, there are ongoing changes in land use: agricultural land and farming is being taken over by large landowners and companies with no relationship

to the land. The consequence is intensive farming on large areas, with all the problems that this entails on the one hand, and the absence of farming associated with succession and overgrowth in less attractive areas on the other. The consequence is not only the degradation of the meadows, but also changes in the morphological, chemical and physical characteristics of watercourses with a negative impact on endangered species.

A major challenge for nature conservation in the region is climate change associated with changes in the distribution of rainfall. In recent years, it has become more common for smaller streams to dry up due to drought. This is followed by horrendous mortality of the endangered species in the streams.

In spatial planning outside specially protected areas, meadow ecosystems are often neglected, and priority is given to the protection and connectivity of forest ecosystems, even if they are less valuable from the point of view of biodiversity.

3.1.3. Restoration goals

The main aim of nature conservation must be to maintain and support populations of endangered species in their habitats. In PR1, these are especially two so-called umbrella species whose effective protection can ensure the protection of many other species and their habitat. The Freshwater pearl mussel has two key localities on the Czech side - the Lužní potok stream and the Bystřina stream. Both of these sites are included in the approved conservation programme. Specific management and artificial support of the populations is foreseen here. The Marsh Fritillary is a so-called metapopulation species. It is necessary to provide sufficient sites with suitable habitat where the number of individuals changes dynamically. Ideally, however, the status of the species as a whole is satisfactory. Thus, in PR1 it is necessary to provide more suitable areas with food plants Succia pratensis and other characteristics that meet the requirements of the species.

Restoration and maintenance of both wet and dry valuable meadows as centres of biodiversity is another goal for the region. This should be done not only in the protected areas but also in the open landscape as stepping stones and corridors to ensure ecological connectivity of these ecosystems.

3.1.4. Restoration suitability

Figure 11 shows the result of the aggregation of the considered parameters. The most relevant areas for restoration (yellow to green) as well as the unsuitable areas (orange to red). Due to the intensive agricultural use, the urbanized areas and extensive forests, the space for the targeted BHTs is quite limited. The extensive grasslands and waterbodies with the adjected BHTs on the other hand are highlighted in light green and have in general a higher potential of being restored and integrated in the network of the target habitats. If the historic aspect is comprised of a feasible land cover type, the area is categorized with a very high suitability (green). Those area constitute a great importance in the already scarce distribution of potential target areas in the present landscape.

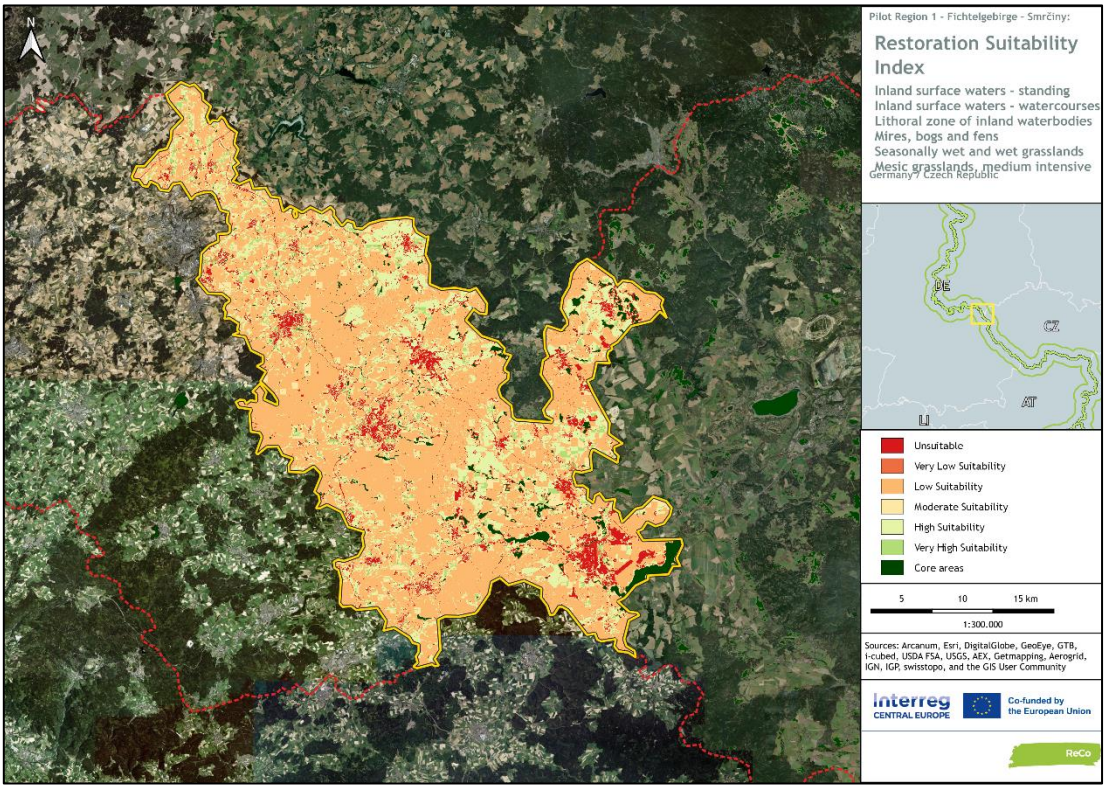

Figure 11 Map of restoration suitability of the target BHTs in PR1 – Fichtelgebirge / Smrčiny Mountains.

As it can be seen more closely on the example of the surrounding area of Aš in **Figure 12**, the grasslands around the rivers Bílý Halštrov and especially Ašský potok to East and North of Aš respectively, show a high potential as restoration sites. In the South-East at the Hazlovský potok river and its direct catchment area, also a high to very high suitability could be detected.

On the German side of the border, the pond system connected by the Roßbach river as well as the river Selb running from North to South have to mentioned as suitable sites, too.

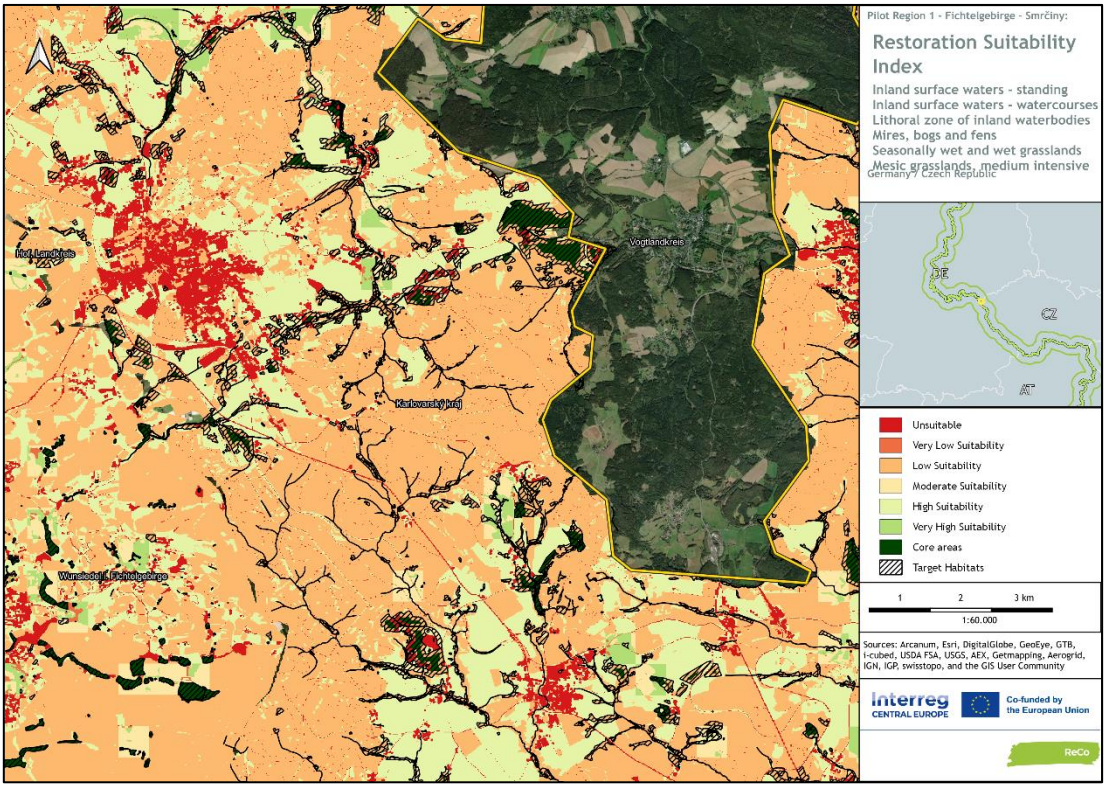

Figure 12 Magnified in section on the Czech part pf PR1, showing the surroundings of Aš – the focused area of the local action plan.

3.2. Miramar, IT (PR2)

Due to the withdrawal of the former Italian project partner over the last two periods, there are no results for pilot region 2 yet. The assessment and evaluation of data situation in accordance with the goals and needs of the pilot region will be postponed since the new institution will be joining the project consortium by the end of period 3. The new pilot region 2 Miramar MPA is located in the Karst region in close proximity to Trieste.

However, the new project partner already elaborated plans for the ReCo project. The work will focus on re-establishing plants in the coast habitat of Karst as well as the invention and testing of new sowing techniques in cooperation with botanical gardens. In close cooperation with PP3 they will also implement the gained knowledge on this topic in Škocjanski zatok Nature Reserve, Koper.

3.2.1. Target habitats

This content will be added in the upcoming project period after the responsible project partner Miramare MPA has joined the project consortium officially.

3.2.2. Current situation

This content will be added in the upcoming project period after the responsible project partner Miramare MPA has joined the project consortium officially.

3.2.3. Restoration goals

This content will be added in the upcoming project period after the responsible project partner Miramare MPA has joined the project consortium officially.

3.2.4. Restoration suitability

This content will be added in the upcoming project period after the responsible project partner Miramare MPA has joined the project consortium officially

3.3. Škocjanski zatok Nature Reserve, SI (PR3)

3.3.1. Target habitats

The Škocjanski zatok Nature Reserve stands as a distinctive ecosystem in Slovenia, distinguished by its proximity to the sea, Mediterranean climate, sub-Mediterranean vegetation, and anthropogenic origin. Boasting a diverse array of habitats, including freshwater wetlands, ponds, reedbeds, shallows, salt marshes, mudflats, islets, and deepwater areas. The primary objective of the Joint Pilot Action in the Škocjanski zatok Nature Reserve is to effectively tackle the challenges arising from climate change, specifically in wetland ecosystems, with a targeted emphasis on coastal wetlands. The initiative aims to devise and implement measures that mitigate the adverse effects of climate change on the safeguarded Natura 2000 habitats and bird species inhabiting the brackish lagoon of the Škocjanski zatok Nature Reserve.

3.3.2. Current situation

The reserve serves as a haven for a rich variety of fauna and flora, some of which are rare and endangered. Notably, 41% of all Slovenian amphibian species, 41% of reptile species, over 66% of bird species observed in Slovenia, and 36% of Slovenia's mammals find refuge in this area.

A noteworthy accomplishment in meeting conservation objectives is the establishment of a freshwater marsh, coupled with extensive efforts to restore and regenerate the habitat in the brackish lagoon, conducted between 2006 and 2007. This success exemplifies best practices in natural habitat creation, marked by collaboration between botanical, ecological, and hydrological experts alongside technical specialists. The restoration and creation of various habitats, rare and endangered at both Slovenian and European levels, have fostered conditions conducive to the proliferation of bird species, especially those of national and international importance. The introduction of mudflats and marginal habitats in the brackish water lagoon has provided new nesting sites for significant Natura 2000 species, including the *Sterna hirundo* (common tern), *Sternula albifrons* (little tern), *Himantopus himantopus* (black-winged stilt), *Tringa totanus* (common redshank), and *Charadrius alexandrinus* (kentish plover).

The Škocjanski zatok Nature Reserve has witnessed the addition of 17 new breeding bird species since 2007, including the *Charadrius dubius* (little ringed plover), *Sterna hirundo* (common tern), and *Himantopus himantopus* (black-winged stilt) since 2007, *Spatula querquedula* (garganey) and *Cygnus olor* (mute swan) since 2008, *Tringa totanus* (common redshank) since 2011, *Sternula albifrons* (little tern) since 2012, *Larus michahellis* (yellow-legged gull) since 2013, *Podiceps cristatus* (great crested grebe), *Aythya farina* (common pochard), and *Ardea purpurea* (purple heron) since 2017, *Anser anser* (greylag goose) since 2018, *Recurvirostra avosetta* (avocet), *Columba palumbus* (woodpigeon), *Oriolus oriolus* (oriole), and *Hirundo rustica* (barn swallow) since 2019. Its ecological significance is underscored by the identification, observation, and recording of more than 1,600 different plant and animal species in the protected area by 2023.

3.3.3. Restoration goals

The pilot action seeks to create new mudflats, enhancing nesting sites for Natura 2000 species. Predicted sea-level rise and climate change threaten coastal wetlands globally, emphasizing the urgency of conservation efforts. The approach involves habitat mapping, bird monitoring, and the creation of two new mudflats using specialized equipment. Risks such as pollution and water quality concerns are addressed through collaboration with stakeholders and effective protocols. Community engagement, educational

outreach, and partnerships with local entities, including the Municipality of Koper and the Port of Koper, are integral to project success. The initiative aligns with the Škocjanski zatok Nature Reserve's 10-year management plan, ensuring long-term sustainability. Regular reporting and workshops ensure transparent communication with stakeholders, supporting adaptive management decisions. With a planned timeline from March 2022 to June 2025, this pilot action represents a comprehensive and sustainable approach to climate resilience in Škocjanski zatok Nature Reserve.

3.3.4. Restoration suitability

In the very specific case of PR3 - Škocjanski zatok Nature Reserve we can see the highly valued nature reserve within the industrial area of Koper enclosing it almost completely. As depicted in **Figure 13**, the core area of the PR is adjected by the sealed surfaces of the city and harbor. Since the latter was covered by marine habitats as well and has been built up only during the last two decades, it appears in a lighter tone of red than the actual city of Koper which has been habituated by humans for a long time.

The South and South-East of the PR consists mostly of elevated agriculturally used land, covered by vineyards and urban area. The few natural BHTs such as meadows and the water bodies flowing into and out of the protected area are highlighted clearly in the PR. The freshwater part of the NR is the Rižana river, flowing in from the East. The two canals connecting to the Northwest and South have a very high potential for renaturation. For the extended PR but also beyond the core areas serves a crucial steppingstone and habitat for countless bird species of the brackish lagoons and other marine and coastal habitats that can be found in the NR.

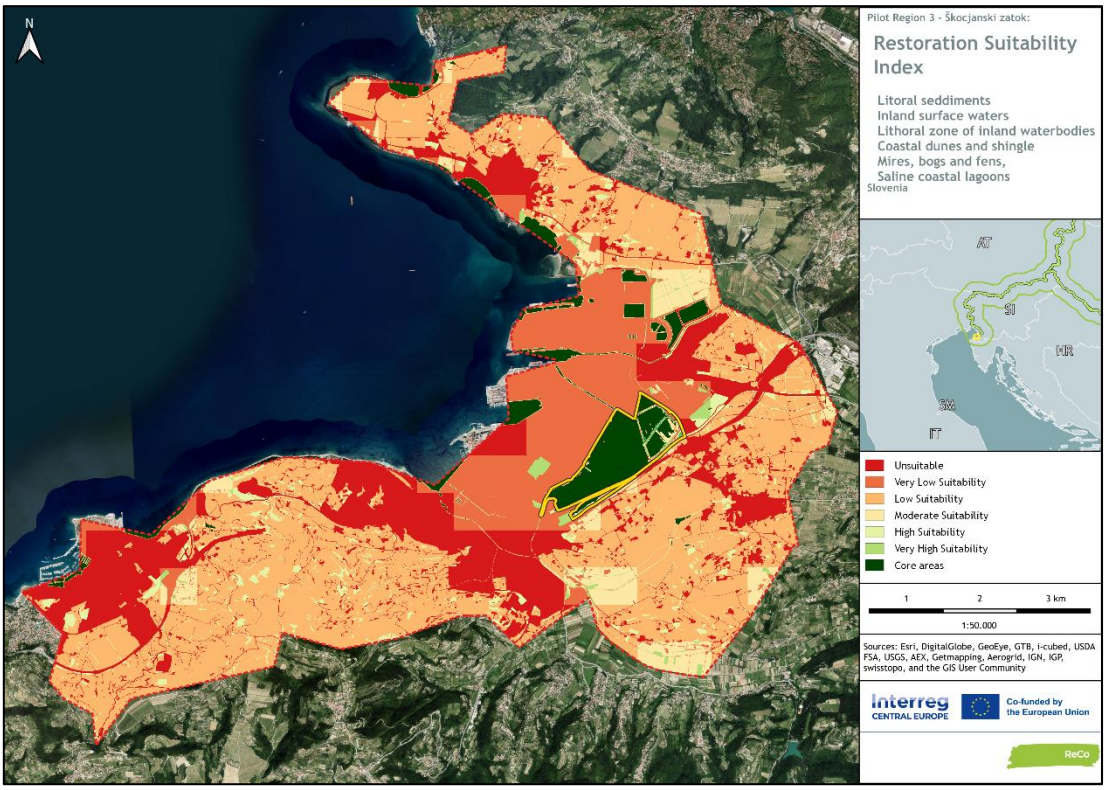

Figure 13 Map of restoration suitability of the target BHTs in PR3 - Škocjanski zatok Nature Reserve.

3.4. Gorenjska Region, SI (PR4)

3.4.1. Target habitats

The Joint Pilot Action in Gorenjska, Slovenia, focuses on revitalizing Alpine meadowlands in the Karavanke Mountains, with a primary goal of implementing, monitoring, and evaluating adapted agricultural management's effects on biodiversity. Emphasizing the mountain daffodil as a flagship species, the project aims to integrate seed collection, test field establishment, and awareness campaigns for landowners, residents, and visitors. The target area encompasses the Western Karavanke Mountains, with meadows in Jesenice hosting the protected daffodil.

The target geographical area of the Joint Pilot Action is situated in the Western Karavanke Mountains, specifically encompassing the Karavanke region within the municipal boundaries of Jesenice. In Jesenice, the mountain daffodil is found in the Karavanke segment of the municipality, initially appearing in the lower part of the Karavanke foothills at an altitude of approximately 700 m.a.s.l. The daffodil habitats include meadows and pastures in the broader vicinity of Plavški Rovt, Planina pod Golico, Prihodi, and Javorniški Rovt. They also extend to overgrown hay meadows above Hrušica, reaching up to the summit ridges of the Karavanke Mountains, notably on Golica (1,835 m.a.s.l.). In the eastern part, the daffodil's distribution is confined to the Javorniški Rovt area, encompassing Jezerec and Mavra. In the western part, its range extends into the municipality of Kranjska Gora, covering the areas of Raven and Dovška Rožca.

3.4.2. Current situation

The municipality of Jesenice, nestled in the Karavanke region, is home to expansive and widely recognized daffodil habitats, notably on the slopes of the Golica Mountains and the meticulously cultivated meadows encircling the villages of Plavški Rovt, Planina pod Golico, Prihodi, and Javorniški Rovt. Local narratives from older generations vividly describe the Golica Mountains' slopes adorned in white with daffodil flowers, making it the largest and most frequented daffodil site in Slovenia. Despite the recognition of daffodil habitats in other regions of the country, Golica and its surrounding villages remain unparalleled in both size and popularity among tourists.

In nurturing these natural environments for daffodils, proper agricultural management of the meadows is indispensable. However, the evolving landscape in these hill regions, adapting to modern agricultural trends and techniques, exerts pressures on daffodil sites. Challenges include:

- overgrowth of farmland,
- shift in agricultural use towards extensive farming, negatively impacting daffodil growth (such as the abandonment of mowing meadows solely for grazing),
- transition to intensive farming with adverse effects (including early spring grazing, premature mowing, ensiling, and baling instead of traditional drying on the ground).

The abundance of daffodil flowers within a specific area is predominantly influenced by cultivation practices and ecological conditions, particularly soil type and moisture, light availability, and the organic content of the soil. Among these factors, cultivation methods are deemed the most influential, emphasizing the pivotal role of proper management for achieving widespread daffodil representation. In instances of inadequate management, neglect, or intensified land use, only specific sections of the area—typically deeper soils with moderate fertilization – can sustain thriving daffodil populations. In areas prone to overgrowth, daffodils may endure for several years or even a decade, persisting individually on the periphery of more densely

vegetated woodlands. The longevity and scattered presence of daffodils in such overgrown areas highlight their resilience even in less favourable conditions.

Relying on daffodil abundance counts and their correlations with climatic data, it becomes evident that the annual daffodil abundance is significantly impacted by weather conditions. Considering the escalating impact of climate change, marked by extreme weather events, it is anticipated that daffodil stands will experience further consequences. In particular, droughts during the dry season are anticipated to emerge as particularly unfavourable situations, posing challenges to the thriving of daffodil populations.

3.4.3. Restoration goals

The primary goal of the Joint Pilot Action is to implement, monitor, and evaluate the effects of adapted agricultural management on mountain meadows in the Karavanke Mountains, with the objective of revitalizing and conserving their biodiversity over the long term. Within this scope, the pilot action will particularly focus on the mountain daffodil *Narcissus poeticus ssp. radiiflorus*. An additional aim is to introduce seed collection for this protected species and establish test sites to monitor the success of the seed collection process. Prioritizing awareness, the project seeks to inform landowners, residents of the Karavanke Mountains, and visitors about the significance of natural values and biodiversity conservation. Over the long term, the project aspires to contribute to the establishment and enhanced management of smaller nature-protected areas. Furthermore, the project endeavours to integrate and coordinate the efforts of sectoral expert services and local authorities for a unified approach to the management of high mountain meadows in the targeted area.

3.4.4. Restoration suitability

The Golica Mountains in the PR4 are hosting numerous patches of alpine meadows containing a unique number of daffodil populations (**Figure 14**). The core area of the PR is scattered with the target BHT that often not connected. Since the region is mainly covered by forests, the habitats of the daffodils are very patch. Additionally, valleys and urban areas pose major barriers as well. Taking the historical land cover into account, several areas with a potential to be restored can be identified.

However, it is unlikely, that the management of existing forests will change completely and be replaced by grassland ecosystems or meadows. Instead, the focus should mainly be laid on more extensive meadows that could be part of the target BHT network and foremost on the preservation and protection of the existing meadows of interest. Thus, without being directly connected, the still serve as stepping stones for a number of species depending on the habitat as well.

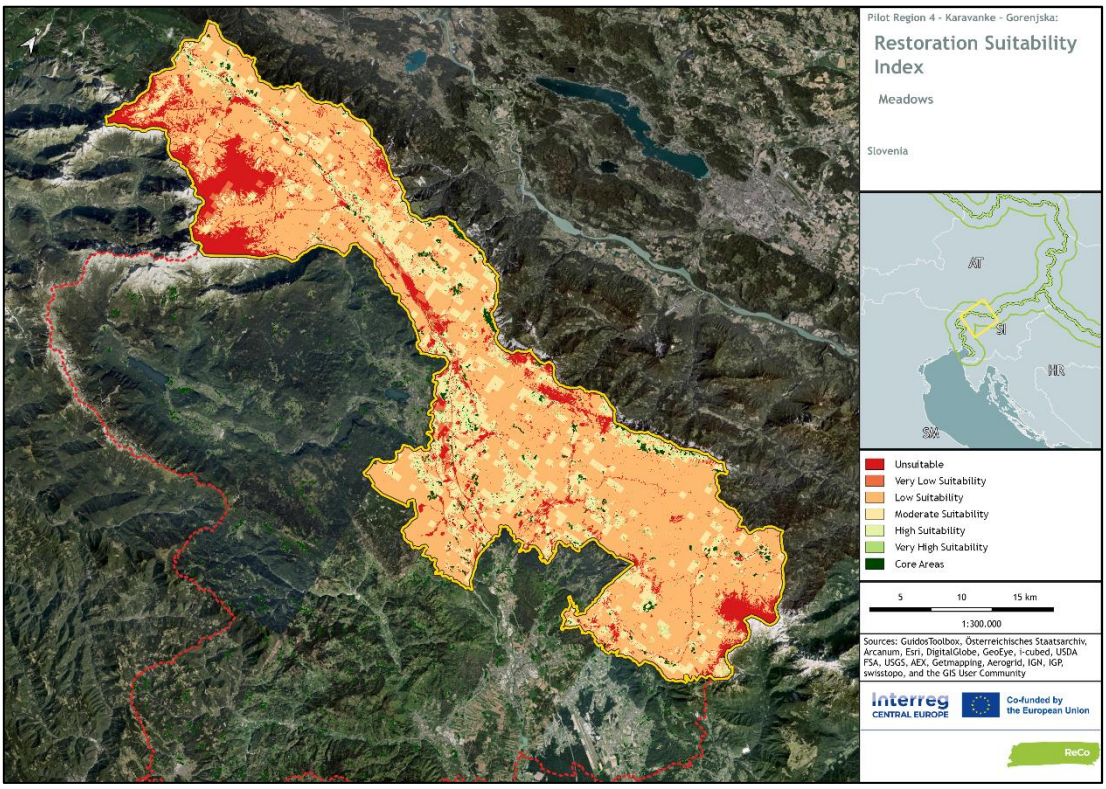

Figure 14 Map of restoration suitability of the target BHT in PR4 - Gorenjska Region.

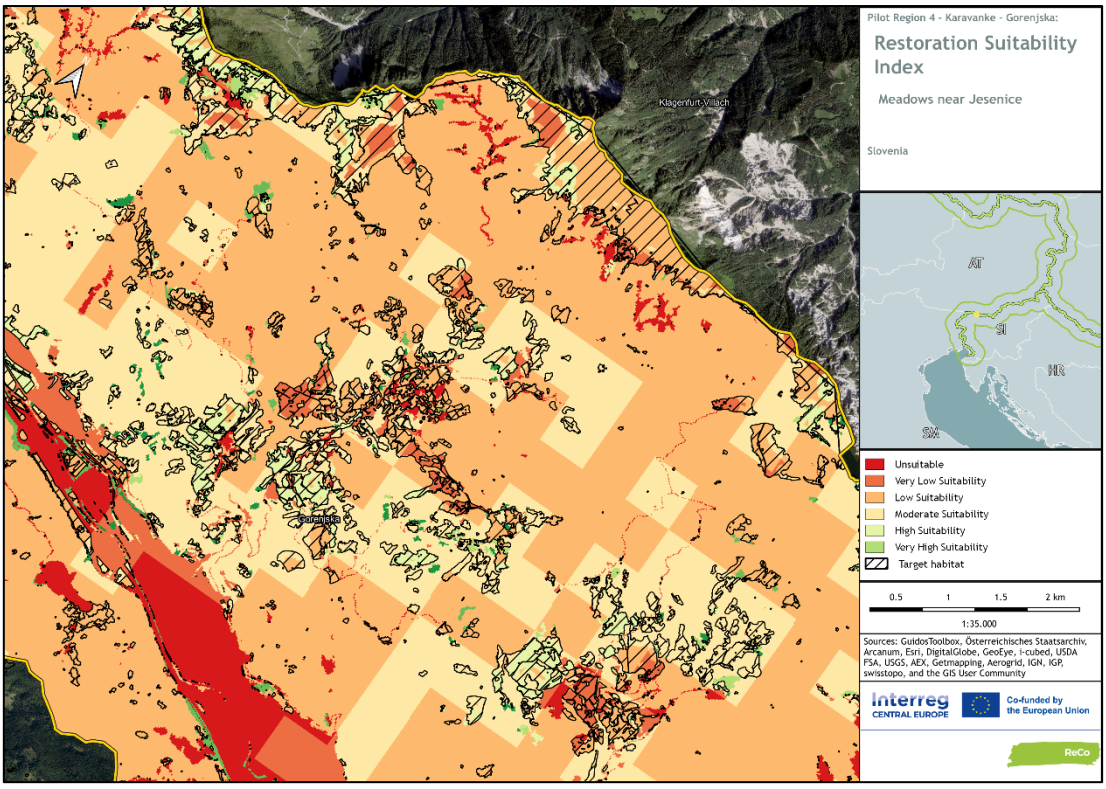

Figure 15 Magnified in section of the area of recorded daffodil populations in PR4 - Gorenjska Region.

3.5. Ińsko Lakeland, PL (PR5)

3.5.1. Target habitats / species

The pilot region focuses on the species of European bison *Bison bonasus*. Suitable habitats for this species are represented by mixture of open land and forests. Therefore, for the regional analyses, following broader habitat types were considered:

- Broadleaved deciduous woodland
- Coniferous woodland
- Mixed deciduous and coniferous woodland
- Line of trees, small anthropogenic woodlands, recently felled woodland, early-stage woodland and coppice
- Dry grasslands
- Mesic grasslands, intensively managed
- Mesic grasslands, medium intensive
- Woodland fringes and clearings, tall forb stands

3.5.2. Current situation

The European bison *Bison bonasus*, the heaviest wild land animal in Europe, faced extinction in the wild at the beginning of the 20th century, but its population has been successfully rebuilt from just 7 individuals. The worldwide population now exceeds 10,000 individuals, surpassing the minimum safe population size. In Poland, there are approximately 2,223 individuals, with 350 bisons distributed among 11 herds in the region, including 77 residing in Ińsko Lakeland.

In the context of European bison conservation, addressing migration barriers is crucial to preventing the isolation of individual herds. The resulting limited gene flow contributes to low genetic diversity, which fosters inbreeding and increases vulnerability to diseases and environmental changes. Additionally, the risk of low social acceptance is significant, as large herds can cause damage to crops, threatening the coexistence of wildlife and agriculture. This challenge can hinder support for conservation initiatives. Furthermore, the persistent threat of poaching hampers population growth, despite the birth of approximately 40 calves per year. Alarmingly, the population has stagnated over the past two years, with 24 bison illegally killed in 2021 alone. This situation underscores the urgent need for collaborative efforts to implement effective anti-poaching strategies and ensure the sustained growth of the European bison population.

The Joint Pilot Action is essential for addressing migration barriers, mitigating human-wildlife conflicts, and combating illegal activities such as poaching. By adopting a collective approach, we can work towards ensuring the long-term viability of European bison populations and safeguarding biodiversity. Our efforts are focused on supporting the reintroduction program established by the West Pomeranian Nature Society, a partner of the ReCo project, since 2005. This comprehensive initiative includes strategies such as captive breeding, reintroduction, translocations, interventions, winter feeding, and veterinary services. Through these concerted actions, we aim to not only increase the overall European bison population but also facilitate the natural diversification of herds.

We are pleased to report a steady rise in bison numbers, with ongoing efforts successfully initiating natural diversification within the herds. Notably, the Ińsko Lakeland has been selected as the site for a newly established herd of reintroduced European bison under the West Pomeranian Nature Society's reintroduction initiative. This location has become a thriving habitat where the reintroduced bison population is now flourishing, underscoring our commitment to the preservation and recovery of the European bison in the region.

3.5.3. Restoration goals

The goal of this Joint Pilot Action is to increase both the size and range of the European bison population that has been reintroduced in Northwest Poland. To achieve this overarching goal, two key objectives have been identified. Firstly, efforts will be directed towards enhancing migration routes for European bison herds, ensuring a conducive environment for their movement. Secondly, there is a focus on minimizing conflicts between humans and European bison, promoting coexistence and harmonious interactions in the region. Through these concerted efforts, the aim is to foster a sustainable and thriving European bison population in Northwest Poland.

Restoration approaches include the enhancement of the management of European bison herds reintroduced in NW Poland. This involves identifying migration barriers and formulating recommendations for transport infrastructure investments. Additionally, efforts are directed towards optimizing the population's spatial structure by maintaining low densities (<3 individuals/1,000 ha) through the increase in the number of herds. The implementation of constant population monitoring is crucial, ensuring a swift response to potential human-bison conflicts. Outlined below are the planned techniques and methods:

1. **GPS-Collar Deployment**: equipping an additional 20 animals with state-of-the-art GPS collars enhances monitoring and analysis of their movements and behaviours, providing valuable data for conservation efforts.
2. **Migration Barriers Identification**: a comprehensive assessment identifies and understands migration barriers that may impede the natural movement of wildlife. This entails studying geographical features, human-made structures, and other factors contributing to obstacles in the animals' migratory routes.
3. **Poaching Identification and Tracking**: implementing advanced tracking technologies actively identifies and monitors instances of poaching. The integration of real-time tracking systems allows for prompt responses to potential threats, contributing to the protection of endangered species and the preservation of biodiversity.
4. **Formulation of Recommendations for Transport Infrastructure Investments**: as part of the pilot investment, a thorough analysis of the existing transport infrastructure in the region is conducted. Based on the findings, detailed recommendations for strategic investments in transportation networks are formulated, aiming to balance human development needs with wildlife conservation and promote sustainable coexistence.

This comprehensive approach involves not only the deployment of technology for data collection but also addresses broader issues such as migration barriers and poaching, contributing to a more holistic and effective conservation strategy.

3.5.4. Restoration suitability

For PR5 Ińsko Lakeland the situation with the bisons is challenging. On the one hand, the need for fostering the populations is given, on the other hand, those large bovids have the potential for conflict since they can cause damage to crops in the cultural landscape. In term of their migration behaviour, they have been seen to use forest but also open land. The tracking data created withing ReCo should shed some light on the preferred BHT for the populations' movements. Using this valuable evidence, more precise and effective measure shall be developed to ensure the thrive of the species as well as reduced conflicted in the critical areas of the cultural landscape.

Since the findings regarding the bison's preferences according to the GPS data still need to be analyzed and the for clarity's sake, the analyses for this deliverable have been conducted separately for BHTs of grasslands (**Figure 16**) and forests (**Figure 17**).

The map for the suitable restoration areas of grassland below shows the distribution of the core patches of the grassland habitats in the core area of PR5. It shows quite dense spot of culminations of meadows especially from the center to the South as well as large areas in East and partly in the North. The potential historic raster cells are evenly scattered across the core area, which derives from the historical maps indicating a lower abundance of forests in the 19. Century.

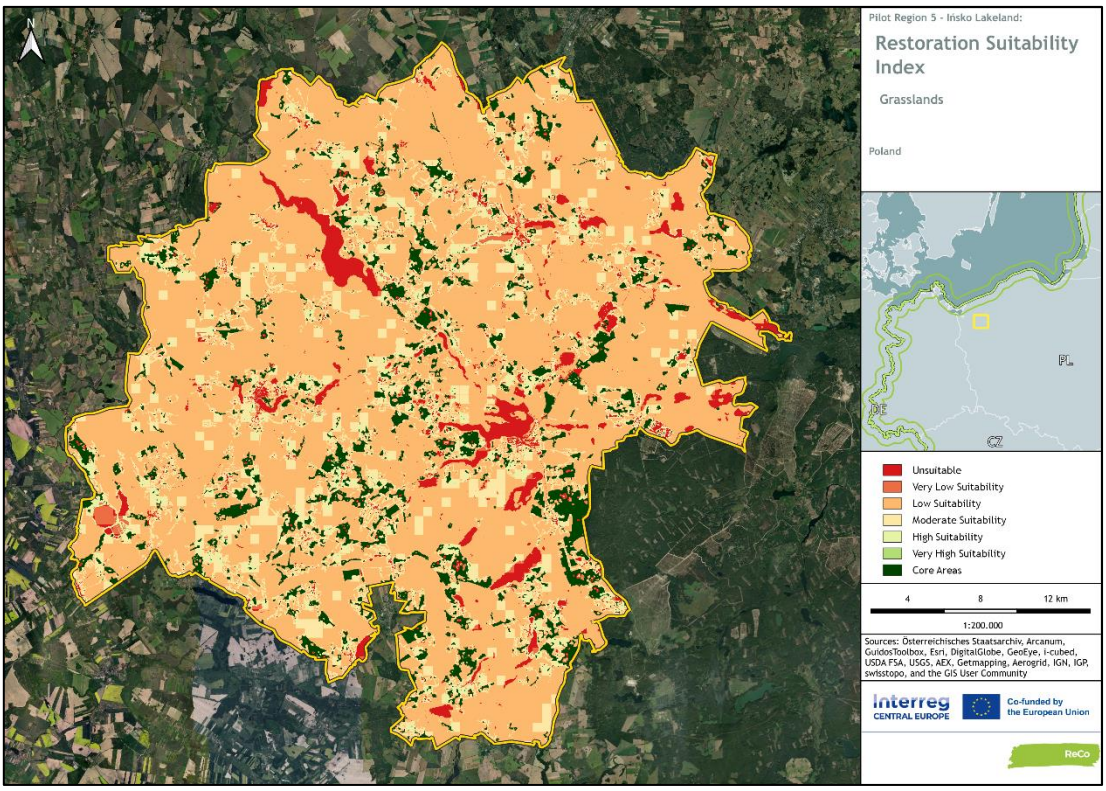

Figure 16 Map of restoration suitability of grassland BHTs in PR5 - Ińsko Lakeland.

In contrast to the historic landscape, the forests are more extensively in today's Ińsko Lakeland. The BHTs of broadleaved deciduous and coniferous forests can found especially in the South of the core area of PR5 as well as large comprehensive woodlands. In each region a number of potential restoration areas within and between forests are indicated in light green and green.

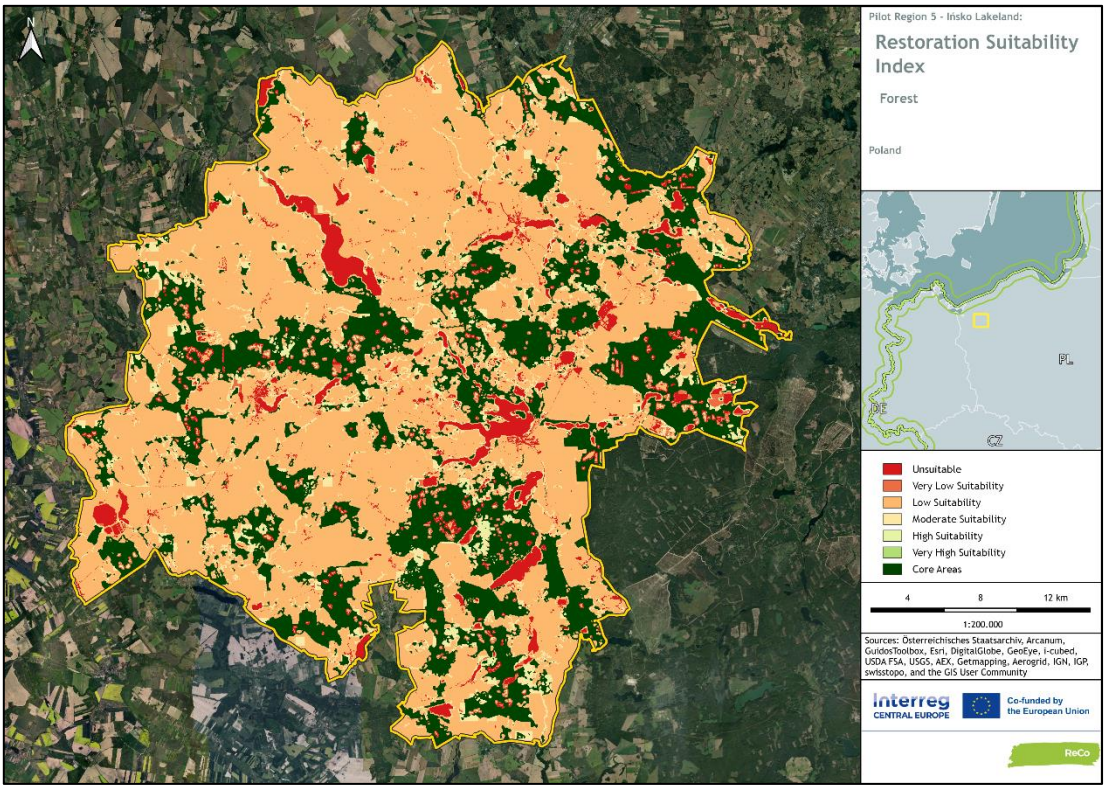

Figure 17 Map of restoration suitability of forest BHTs in PR5 - Ińsko Lakeland.

The barriers for both maps are identical: urban areas and road and train infrastructure as well as large water bodies are depicted as unattractive for migration. The matrix of the region – agricultural landscape – is visualized in orange.

3.6. National Park Thayatal & Podyjí, AT/CZ (PR6)

3.6.1. Target habitats / species

The European wildcat, once extinct in Austria, experienced a remarkable rediscovery in Thayatal National Park in 2007, subsequently becoming a flagship species for the park. Its presence serves as an indicator of a healthy ecosystem with functional trophic levels. The sensitivity of Felis silvestris to disturbance further highlights its role in signifying undisturbed ecosystems.

Characterized by its high mobility, the European wildcat occupies territories ranging from 500 to 1,000 hectares. Landscape connectivity is pivotal in habitat selection and sustaining the species.

The primary focus of the joint pilot activities is to boost the interconnectivity of crucial habitats and acquire knowledge on supporting the population of the flagship species European wildcat Felis silvestris. This collaborative effort seeks to create a thriving ecosystem that not only enhances biodiversity but also contributes to the conservation of the European wildcat.

The Joint Pilot Action on the Czech side aims to establish a system comprising three small ponds and an adjacent wetland, creating a rare and endangered habitat. This initiative is designed to enhance biodiversity and improve connectivity with other isolated water bodies in the generally dry and heavily cultivated surrounding landscape.

The Joint Pilot Action site is situated in Czechia, 7 km southwest of the Znojmo district town, at the southwestern edge of the Hercynian Massif, adjacent to the Pannonian region. The specific location is in a shallow valley near a small intermittent stream. Historically, the area was a regularly mowed wet meadow, but after abandonment, it became overgrown with reed, other tall herbs, and bushes.

3.6.2. Current situation

While Thayatal National Park is primarily covered by undissected forests, the common landscape area encompassing Lower Austria's Eastern Quarter, Waldviertel, Weinviertel, and the counties of South Bohemia, Vysocina, and South Moravia faces increasing fragmentation due to construction, roads, and intensive use. This fragmentation disrupts wildlife migration corridors, isolating crucial protected areas and near-natural landscapes like those in the Waldviertel, South Bohemia, Thayatal, and Podyjí National Parks.

The resulting lack of exchange of animals and plants poses a threat to biodiversity, impacting not only the European wildcat but also other mobile, specialized, and rare species. These ecological stressors highlight the importance of addressing landscape connectivity to ensure the conservation of nature, particularly for species like the European wildcat.

3.6.3. Restoration goals

The Joint Pilot Action in Thayatal and Podyjí National Parks will include several activities. On the Czech side, it will establish three ponds and a wetland, enhancing biodiversity and connectivity in a historically wet meadow near Znojmo, Czechia. Focused on supporting the European wildcat, a biodiversity indicator, the initiative on the Austrian side involves releasing two wildcats, managing meadows, removing invasive species, planting trees, and restoring a wetland. Thayatal, a biodiversity hotspot bordering Lower Austria and the Czech Republic, plays a crucial role in maintaining species connectivity. Monitoring involves GPS data, planting records, and surveys for amphibians, orthopterans, and odonata. The timeline spans March 2024 to February 2026, addressing risks like habitat isolation and climate change. Stakeholders include park

administrations, nature conservation departments, local communities, and the scientific community. Community engagement ensures public awareness, coordination with stakeholders, and municipality presentations. The budget, resources, and equipment details provide transparency. The plan emphasizes sustainability with long-term area management practices. Collected data will aid decision-making, adaptive management, and understanding landscape connectivity for biodiversity conservation in both national parks.

3.6.4. Restoration suitability

Pilot region 6 focuses of the forests and woody features with the national parks functioning not only as an extensive core area of the target BHTs but also as hotspot of biodiversity for the entire region in the border of Austria and Czechia along the European Green Belt. Also, outside the protected areas woodland and other woody structures can be seen as depicted in **Figure 18**, connecting the NP to the Southeast and Northwest. However, due to the intensively used agricultural land and the road network the surroundings of the fragmented corridors of target BHTs hold the potential for restoration. The gaps between BHT patches of close proximity are depicted in general with higher potentials. But also the residual forests in the matrix of the fields are highlighted by yellow colors, indicating historically at least slightly larger or even more connected patches. This could have been achieved by a much more structured landscape, consisting of hedges and other woody features which are far less abundant in the present landscape. Nonetheless, there are still such structure in the PR, which can be seen clearly in green, for example in the Western part or in the North of the Podyjí National Park.

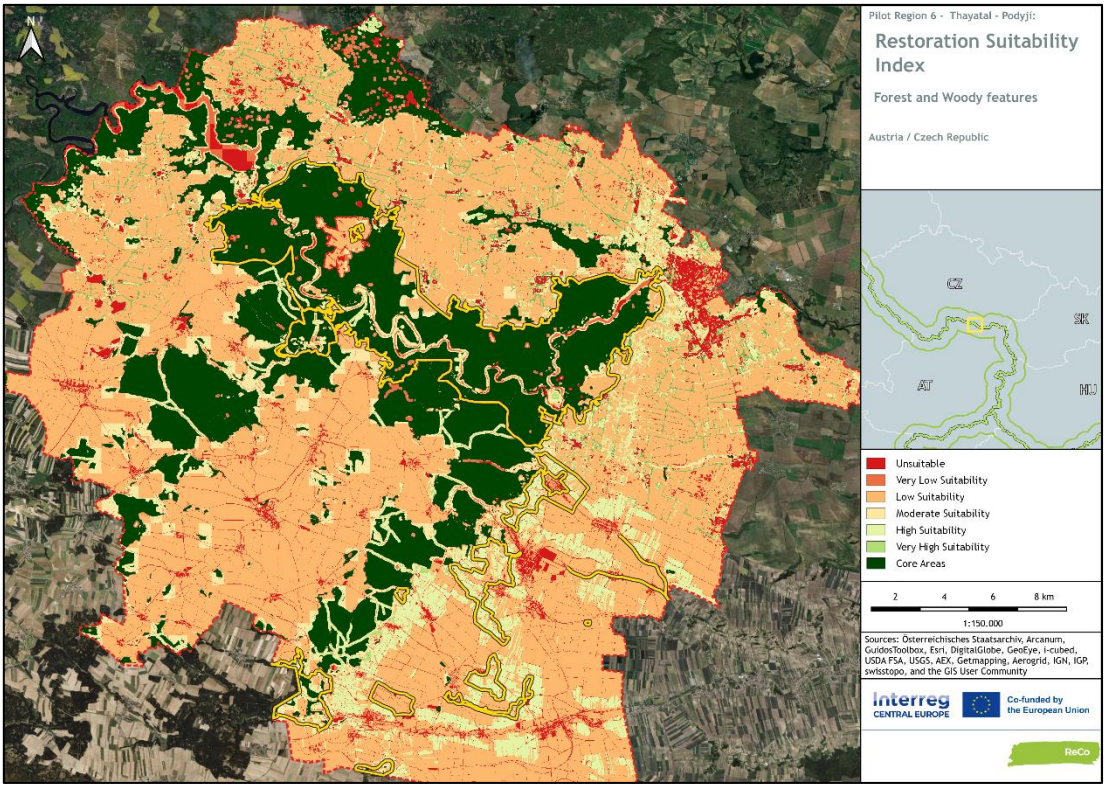

Figure 18 Map of restoration suitability of the target BHTs in PR6 - National Park Thayatal & Podyjí.

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