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ReCo

Ecological restoration for habitat development

The ReCo project Practitioners' Guide (D.2.4.1)

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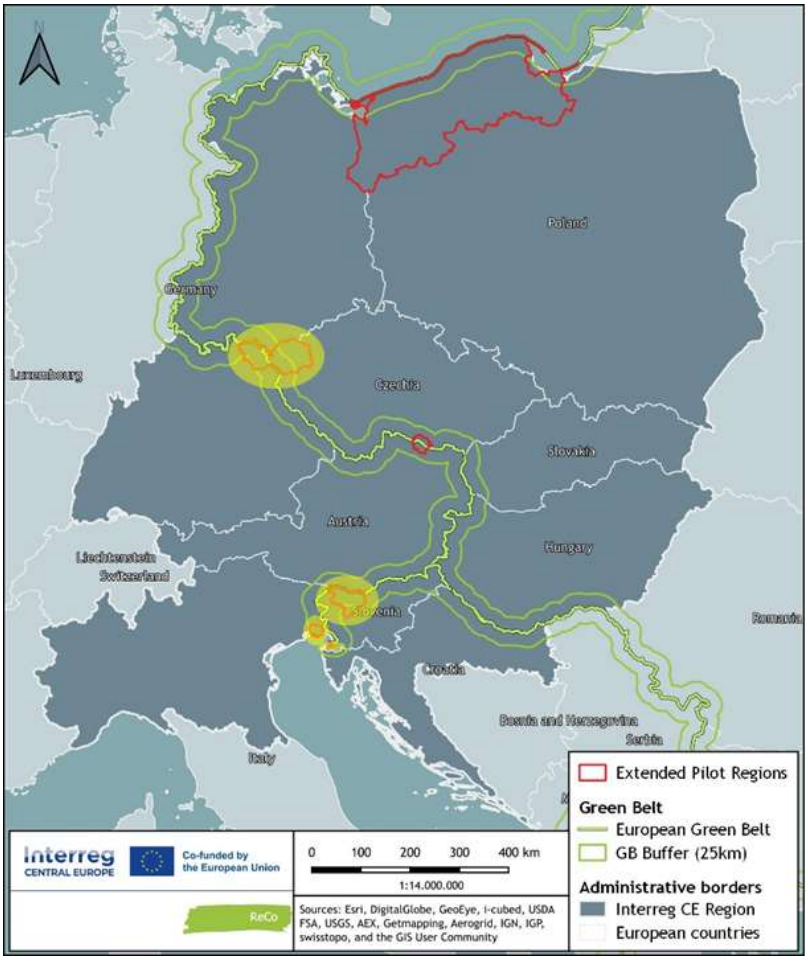
EXECUTIVE SUMMARY

Restoring and reconnecting habitats along the European Green Belt is critical to counteract biodiversity loss from habitat fragmentation and climate change. Under the Interreg ReCo project (*Restoring degraded eco-systems along the Green Belt to improve and enhance biodiversity and ecological connectivity*), four pilot regions implemented joint habitat restoration actions to enhance ecological connectivity and resilience.

These pilots, spanning wetlands, meadows, and dry grasslands in Italy, Germany, Czech Republic, and Slovenia, demonstrate **innovative techniques** (e.g. peatland re-wetting, meadow reseeding, invasive shrub removal) and a **community-based approach** to leverage local support. Some pilot engaged stakeholders across borders and sectors, illustrating how collaborative restoration can improve Natura 2000 habitats and contribute to climate adaptation (e.g. better water retention, carbon storage in peatlands).

This guide synthesizes the objectives, methods, and lessons from the ReCo's Joint Pilot Actions "Habitats" – Fichtelgebirge Mountains/Smrčiny Mountains, Gorenjska region, Karst plateau near Trieste, Škocjanski zatok Nature Reserve, and providing practitioners with practical insights to plan and replicate habitat restoration initiatives that boost biodiversity and climate resilience across regions.



The ReCo project's pilot regions; regions dedicated to habitat protection are marked with yellow (Author: University of Vienna)

OBJECTIVES AND SCOPE

The habitat restoration pilots aimed to enhance biodiversity and connectivity in degraded ecosystems while fostering local stewardship. Joint Pilot Actions were implemented in four pilot regions to test and demonstrate innovative ecological restoration approaches with the main aim of achieving community-based leverage effects – i.e. catalyzing additional local initiatives and funding through stakeholder involvement. Specific objectives included restoring key habitat types (wetlands, wet meadows, alpine grasslands, and karst dry grasslands) and improving conditions for target species (e.g. freshwater pearl mussel, mountain daffodil) as indicators of ecosystem health. An important goal was to integrate climate adaptation into restoration – for example, re-wetted peatlands and wetlands for natural water storage and resilient meadows that can withstand changing climate conditions.

This guide covers four pilot regions representing two broad habitat categories – lowland habitats (coastal wetland in Škocjanski Zatok, Slovenia, and karst dry grasslands in Trieste, Italy) and mountain habitats (alpine meadows in Gorenjska, Slovenia, and montane wetlands/peatlands in Fichtelgebirge–Smrčiny on the German-Czech border). Each profile summarizes the site's restoration goals, actions, stakeholders, and outcomes. We then outline restoration techniques by habitat type (wetland, meadow/ dry grassland), monitoring approaches to track progress, community engagement strategies, lessons learned, and policy or replication potential. The insights are meant to be practically translatable for restoration practitioners, emphasizing transnational cooperation and community involvement as key to sustainable impact.

PILOT REGION PROFILES (HABITAT RESTORATION PILOTS)

1. Montane wetlands and peatland restoration – Fichtelgebirge/Smrčiny (Germany/Czech Republic)

1.1. Goals

Protect and restore small water bodies, fens, and peat bogs in the Fichtelgebirge–Smrčiny Mountains to improve habitat for the **freshwater pearl mussel** (*Margaritifera margaritifera*) and other wetland biota. Strengthen ecological connectivity of streams and wetlands across the German-Czech border, essentially recreating a network of healthy aquatic and semi-aquatic habitats.

1.2. Actions

Cross-border coordination of restoration measures on both sides of the border. Implementation focused on hydrological restoration: **dismantling old drainage systems** and ditches to re-wet peatlands and wet meadows, thereby raising water tables and reviving natural mire vegetation. Removal of non-native conifer plantations in and around wetland areas to reduce water uptake and shading (restoring natural open wetland conditions). Removal of shrub from a wet meadow. Restoration of streams. Creation of ecological corridors along streams – e.g. restoring riparian zones and connecting fragmented wetland patches. Water quality improvements (through re-wetting and reducing sediment runoff) directly benefit the filter-feeding pearl mussels. Joint field teams from Germany and Czech Republic exchanged best practices and ensured methods were compatible across the border.

1.3. Stakeholders

Led by BUND (Friends of the Earth Germany, Bavarian branch) and Ametyst NGO (Czechia), with close involvement of local nature conservation authorities, forestry departments, and water management agencies in both countries. Local municipalities and landowners were consulted since restoration involved altering drainage and forest cover. The **transboundary stakeholder collaboration** was a highlight – German and Czech experts, officials, and community members took part in planning meetings and site visits, building trust and a shared vision for the watershed.

1.4. Outcomes

Implement hydrological restoration measures over several hectares of bog and wet meadow habitats, for example by blocking drainage channels to restore natural water levels and re-saturate peat soils. Initial monitoring indicates increased water retention and the reappearance of typical bog species (e.g., wetland wildflowers) in treated areas. While freshwater pearl mussels are long-lived and slow to respond, the improved stream connectivity and water quality are expected to bolster their remaining populations. This pilot demonstrates how coordinated actions can enhance an entire watershed's ecological function for climate adaptation (natural flood control and carbon sequestration in peat) while protecting an umbrella species.

Wet meadow with *Succisa pratensis* in the Fichtelgebirge region (Author: Nora Sichardt)

1.5. Transferability and replicability potential

This pilot exemplifies a successful cross-border peatland and wetland restoration initiative, offering a replicable model for other transboundary landscapes. Key interventions, like blocking drainage, removing non-native conifers, and creating ecological stream corridors, are standard hydrological techniques adaptable to other peat-forming ecosystems in Central and Eastern Europe.

The project's binational coordination structure, joint fieldwork, and shared monitoring tools demonstrate how governance and technical alignment can be achieved across jurisdictions. The approach is especially relevant for regions within the Alpine-Carpathian corridor and can be replicated through bilateral agreements and stakeholder engagement. Long-term ecosystem services such as carbon sequestration and water retention provide strong justifications for replication through climate or biodiversity funds.

2. Alpine meadow revival – Karavanke Mountains (Gorenjska, Slovenia)

2.1. Goals

Revitalize species-rich **alpine meadows** in the Western Karavanke range, particularly around Mount Golica (famed for its **wild mountain daffodils**), to halt biodiversity decline caused by modern land-use changes. The flagship target is the poet's daffodil (*Narcissus poeticus* ssp.), an endangered symbol of the region, alongside other meadow flora and associated fauna. Another goal is to reinforce traditional landscape management that supports climate resilience and sustainable tourism.

2.2. Actions

Emphasis on **sustainable mowing and land management practices**. Mowing regimes were adjusted – e.g. later mowing in the season to allow plants (like daffodils) to complete their reproductive cycle before cutting. Steep meadows that had become overgrown were cleared by hand or with specialized remote-controlled mowers, minimizing erosion on fragile slopes. No synthetic fertilizers were used; instead, limited **organic fertilization** helped restore soil nutrients without harming native plants. A **reseeding program** was launched in collaboration with Slovenia's Institute for Nature Conservation: seeds of daffodils were collected on private agricultural land and sown using various techniques on testing plots, where the growth of daffodils will be monitored until 2029. Community involvement was strong – volunteers and farmers joined in traditional hay-making events to exchange their knowledge and experience of their work on meadow conservation. Beyond on-ground work, innovative public engagement tools were used: an **augmented reality (AR) experience** was developed to let visitors virtually experience the spring daffodil bloom and learn about meadow ecology year-round. Local workshops and guided "bloom hikes" educated on biodiversity and appropriate behavior in nature.

2.3. Stakeholders

Coordinated by BSC Kranj – Regional development agency of Gorenjska, with support from the development agency RAGOR and municipal authorities, responsible for sustainable tourism and daffodil conservation programme. Traditional land users (farmers) were key stakeholders – many were directly involved through agreements to adopt the wildlife-friendly mowing schedule. The Slovenian Institute for Nature Conservation provided scientific guidance of seeding programme. Tourist information office of Jesenice helped promote the AR tools and aligned tourism practices (like timing of meadow visits) with conservation needs. The general public was engaged through outreach events, ensuring that the cultural value of the daffodil meadows is recognized and locals feel pride and responsibility for their upkeep.

Alpine landscapes of the Gorenjska region (Author: Jošt Gantar)

2.4. Outcomes

Approximately 40 hectares of alpine meadows have been placed under improved management. This practice appears to support the observed increase in native wildflower diversity and the stabilization or growth of the mountain daffodil population, as indicated by flowering counts, although weather conditions also play an important role in influencing

flowering trends. By late 2024, four more landowners voluntarily joined the meadow restoration scheme, extending late mowing practices to new plots. The community's embrace of sustainable land care suggests a lasting stewardship effect – crucial for long-term meadow resilience. Educational outcomes are notable: the AR and on-site interpretation have raised public awareness, leading to local support for continued meadow conservation (including a revived annual "Daffodil Festival" celebrating conservation). This pilot underscores that blending traditional practices with modern technology and community outreach can successfully safeguard endangered habitats and species.

2.5. Transferability and replicability potential

The revival of high-biodiversity alpine meadows through adapted mowing regimes, and native reseeding is widely replicable in mountainous regions affected by land-use abandonment or intensification. This model is ideal for other Natura 2000 alpine habitats.

The project's collaborative work with farmers and local landowners through agreements and shared equipment use provides a template for engaging traditional land users. The use of innovative outreach tools such as AR/VR apps to engage younger audiences can also be transferred to enhance environmental education in other regions. This combination of traditional management, scientific input, and tech-based outreach presents a highly adaptable package for other alpine and subalpine landscapes across Central Europe.

3. Karst dry grassland restoration – Pian del Grisa (Trieste Plateau, Italy)

3.1. Goals

Expand and reconnect **karst dry grassland** habitat by reversing decades of forest encroachment due to land-use abandonment. Preserve the region's dry grassland biodiversity and its role as a corridor for species, while enhancing climate resilience (open dry grassland are less fire-prone than dense brush).

3.2. Actions

A tree-cutting intervention was carried out on two hectares of encroached dry grassland, with the removal of invasive woody vegetation (in particular the fire-prone tree *Pinus nigra* and the invasive shrub *Cotinus coggygria*) to **reopen the landscape**. To avoid leaving bare soil after the eradication of the shrubs and thus pre-vent the spread of invasive alien species such as *Ailanthus altissima* and *Senecio inaequidens*, a program was held in collaboration with a forest nursery of the Friuli-Venezia Giulia Region, first to collect seeds of native species during different seasons, second to grow them in the nursery, third to reintroduce them by transplantation of seedlings paired with the sowing of native seeds

in the grassland. A joint **botanical and faunal monitoring** program (of birds, carabids and butterflies) was carried out continu-ously before, during and after the intervention, to compare open heath and bushy are-as, to assess the evolution of the site and to track habitat recovery and species return.

Public meetings, field activities and citizen science events were organized to ensure the involvement of the community, including schools, in monitoring procedures, planting operations and after-cutting site control aimed at preventing the taking root of alien species. Furthermore, identification cards for the native animal and plant species were printed and two information panels on the Pian del Grisa biodiversity were installed, to support the **educational activities** and **raise awareness** among the local population and hikers on the importance of actively protecting this semi-natural environment.

Representative faunal and botanical species of the Karst dry grassland (*Melitaea cinxia*, *Pulsatilla montana*), educational events and monitoring activities in Pian del Grisa (Author: Eugenio Melotti & Roberto Valenti)

3.3. Stakeholders

Led by WWF Italy, in the role of managing body of the Miramare and Trieste Coast Biosphere Reserve, the project was carried out in close cooperation with the services of the

Friuli-Venezia Giulia Region dealing with biodiversity, forest management and protected areas, which provided technical-scientific guidance and operational support (especially by making the nursery available and by training the company in charge of tree-cutting operations). The University of Trieste was also involved in technical-scientific support for the definition of monitoring methodologies. Key stakeholders of the project were the representatives of the *comunelle* (the local collective management owning a large part of the karst dry grassland areas), and small producers such as shepherds and farmers involved in the active conservation of this habitat. Finally, schools and the general public were involved through information and citizen science events and given dissemination material.

3.4. Outcomes

Approximately two hectares of dry grassland underwent active restoration (removal of the thickets, transplanting and reseeding of the native flora). Monitoring activities in the low-encroachment dry grassland areas highlighted a high botanical and lepidopteran biodiversity. However, the advance of the woodland and the absence of a large area of open grassland reduces the number of avifauna species linked to this habitat. There-fore, an increased area of open dry grassland will secure the presence of already-monitored species in the medium term, while improving the regional connectivity for species and serving as a demonstration for similar Mediterranean habitats.

In addition, thanks to the project, guidelines for the agro-pastoral management of the karst dry grassland were compiled, to ensure its active conservation in the long term through the involvement of local producers and give continuity to the pilot action by finding an equilibrium between the potential productive exploitation of the grassland and biodiversity preservation. These guidelines may also be included in the general management plan of the Karst site of community importance and special protected area (SIC-ZPS).

The results in terms of community involvement and outreach were also noteworthy, given that the public events organized and the information panels set on the site helped increase collective awareness about the need of an active management of the dry grassland to safeguard biodiversity and helped reduce the social conflict usually raised by tree felling operations.

3.5. Transferability and replicability potential

The techniques used in the Trieste Plateau pilot, including tree cutting and shrub removal, control of the regrowth of invasive species through early manual removal, nursery propagation of native dry grassland species and joint replanting and sowing strategies, are broadly replicable across Mediterranean and karst regions facing shrub encroachment due to land abandonment. The low-technology and community-based approach ensures cost-effectiveness and scalability.

Replanting native plants from locally collected seeds also ensures genetic compatibility, a replicable best practice for maintaining ecological integrity. The pilot's success was grounded on a strong partnership with local civic and scientific communities, which can be replicated elsewhere using similar stakeholder engagement structures.

4. Coastal wetland enhancement – Škocjanski zatok Nature Reserve (Koper, Slovenia)

4.1. Goals

Enhance the ecological value and climate resilience of the **Mediterranean brackish wetland** at Škocjanski zatok – a coastal lagoon and marsh threatened by climate change (e.g. altered rainfall patterns, sea level rise) and past degradation. The aim is to improve habitat conditions for waterbirds and other Natura 2000 species, ensuring this restored nature reserve continues to serve as a biodiversity hotspot along the coast.

4.2. Actions

The reserve managers (DOPPS – BirdLife Slovenia) undertook a comprehensive **habitat mapping and assessment** were done to identify how climate change and prior land uses had impacted the wetland's hydrology and vegetation.

Based on findings, physical interventions focused on creating new habitats: specifically, the construction of **two shallow mudflats** within the lagoon using heavy machinery designed for wetland work. These mudflats provide crucial foraging and nesting areas for wading birds and waterfowl (with particular emphasis on the colonial nesting of terns), compensating for habitat loss due to climate-induced changes. Water level management was fine-tuned to maintain these mudflat zones during key migration and breeding seasons. Additionally, the pilot enhanced **monitoring of bird populations** – increasing the frequency of bird counts and improving the equipment for conducting monitoring – to track how species respond to the new mudflats. The project also included preparing the site for **extreme weather events** (like creating higher-ground islets as refuges during flooding, and improving water flow for drought periods).

4.3. Stakeholders

Managed by DOPPS – Bridlife Slovenia in partnership with the Slovenian Water Agency, Municipality of Koper, and Port of Koper. As a nature reserve, Škocjanski Zatok already involves many stakeholders: local fishermen, birdwatchers, and educational groups. These groups were consulted and kept informed; some volunteers assisted with bird monitoring and planting of salt-tolerant vegetation on the new mudflats. Climate experts were also engaged to advise on adaptive management.

The pilot served as a platform for collaboration between conservationists and infrastructure planners (considering the site's proximity to urban areas and a port, future-proofing the wetland against development and climate impacts required dialogue).

Visitors Centre in the Škocjanski zatok Nature Reserve (Author: Tilen Basle)

4.4. Outcomes

The creation of new mudflats has already yielded positive signs – within months, increased numbers of shorebirds (especially terns) have been recorded utilizing the areas for feeding and roosting. The habitat heterogeneity in the reserve has improved, supporting a broader range of species. These interventions act as **nature-based climate adaptation**: the wetland's water retention capacity is higher, and it can better buffer storm surges or droughts, protecting both wildlife and nearby human communities. The pilot also produced detailed habitat maps and a climate impact report that will guide ongoing management. As a result of this action, Škocjanski zatok is positioned as a **model for coastal wetland restoration** in the face of climate change, illustrating practical measures (like engineered mudflats and adaptive water management) that other coastal sites can replicate.

4.5. Transferability and replicability potential

This pilot demonstrates the feasibility of climate-adaptive wetland restoration in coastal and lagoon environments threatened by eutrophication and sea level rise. Techniques such as artificial mudflat creation using locally sourced sediment, micro-topography manipulation, and adaptive water level management are applicable to other Mediterranean and temperate brackish wetland systems.

The technical methods, e.g. sediment relocation using floating excavators, and the integration of community science and public awareness are especially transferable to protected coastal zones. The pilot also provides a strong legal and procedural blueprint for working within protected areas, including securing nature conservation consents and collaborating with port authorities and municipal stakeholders.

Brackish lagoon in the Škocjanski zatok Nature Reserve (Author: Tilen Basle)

RESTORATION TECHNIQUES AND METHODS

1. Overview

The habitat pilots deployed a variety of restoration techniques, often tailored to habitat type (wetland vs. meadow vs. grassland) but underpinned by common principles: restore natural processes (hydrology, succession, disturbance regimes), use native species, and involve innovative tools when helpful.

Below, we categorize and describe the techniques by habitat type, highlighting practical considerations for implementation. By applying these techniques – and adapting them to local conditions – practitioners can restore a wide range of habitats. Critical to success is planning with an ecosystem/holistic approach (e.g. addressing hydrology, vegetation, and human use together) and being open to creative solutions, from high-tech tools to reviving age-old practices.

2. Wetland & peatland restoration

The pilots stressed **hydrological restoration** as the foundation of wetland recovery. In peatlands and wet meadows, this meant **raising the water table** by closing drainage ditches and removing subterranean pipes to restore natural water retention. For example, the Fichtelgebirge/Smrčiny team blocked old forestry drains, allowing bog pools to re-form and peat moss to regenerate. Where wetlands had been overgrown or silted, earth-works were used – such as excavating shallow depressions and **creating ponds or mudflats** to increase habitat diversity. At Škocjanski zatok, using an **amphibious excavator** to sculpt new mudflat areas was critical for providing bird habitat under changing climate conditions. Wetland restoration also entailed removing incompatible vegetation: the elim-ination of planted conifers in bogs helped re-establish the open, sunlit conditions many wetland species need. **Natural materials** (like wooden dams in ditches or heaped peat to plug drains) were favored to ensure longevity and ecological compatibility. These inter-ventions restore the wetland's ability to hold water during storms and release it during droughts, a natural buffer against climate extremes.

3. Meadow and open habitat restoration

Managing ecological succession and promoting native plant regeneration were key. Tech-niques included **mowing regimes** that mimic traditional practices – for instance, cutting alpine hay meadows later in the season and only once or twice per year, rather than

frequent early mowing, so that plants can set seed. In the Karavanke meadows, this later mowing (often in July instead of June) significantly benefited the **mountain daffodil** and associated flora. On gentle terrain, this was done by mechanical mowers; on steep or sensitive sites, the pilots used **remote-controlled mowers** and manual scything with minimal soil disturbance. Another best practice was the use of **native seed banks** – collecting seeds from healthy nearby meadows and dispersing them in restoration sites to reintroduce a diverse mix of local genotypes. This approach, taken in Slovenia, ensured that the restored meadows have the proper species composition and genetic diversity to thrive.

In Italy's dry grassland, removing invasive shrubs (like *Cotinus coggygria*) by the roots prevented rapid regrowth, and follow-up planting of native heath and grass species, as well as the combined sow of native seeds helped out-compete any returning invasives. In all cases, careful timing (e.g. cutting after bird nesting season, transplanting and sowing immediately after shrub removal) and technique (e.g. slash and remove cut biomass to prevent nutrient overload) were crucial implementation details.

4. Habitat connectivity measures

Beyond site-level actions, the pilots took steps to improve **structural connectivity** between habitats. In practice, this involved creating or enlarging habitat corridors: for example, linking a chain of small wetlands along a stream so aquatic species can move between them, or clearing a series of meadow patches in formerly continuous grassland so pollinators and other fauna can disperse. In the Trieste dry grassland, strategic clearing in selected spots effectively **reconnected heath fragments** that had been isolated by woods. In cross-border contexts, connectivity meant ensuring restoration on one side of the border complemented the other (the DE/CZ pilot identified cross-border stream networks and aligned their restoration so water flowed freely and species could migrate unimpeded). Such measures illustrate that **restoration at the landscape scale** – not just isolated patches – is necessary to achieve long-term biodiversity gains.

5. Innovative tools and techniques

The pilots innovated in both equipment and community-facing methods. Use of **specialized machinery** like remote mowers in Slovenia allowed access to steep, otherwise unreachable plots, meaning no area was left unmanaged due to difficult accessibility. The amphibious excavator in Škocjanski zatok is another example – a customized tool to shape wetland terrain that conventional machines couldn't handle. On the social side, the introduction of **augmented reality and virtual education** in the Gorenjska pilot was a novel technique to bolster restoration outcomes: by increasing public awareness and virtual access to the habitat, the project built broader support for meadow conservation. While AR doesn't directly restore habitat, it is a method to ensure the restored habitat's **cultural**

and educational value is recognized, which in turn helps with long-term protection (an informed public is more likely to advocate for conservation). Each pilot thus combined traditional ecological methods with innovative twists suited to their context.

Škocjanski zatok Nature Reserve (Author: Tilen Basle)

MONITORING APPROACHES AND INDICATORS

Robust monitoring was built into each pilot to evaluate ecological outcomes and guide adaptive management. A variety of approaches and indicators were used, reflecting the different habitat types and goals.

1. Flora and vegetation monitoring

In terrestrial habitats (dry grasslands and meadows), teams conducted regular **botanical surveys** to measure plant community changes. For example, in Pian del Grisa, fixed plots were established to track dry grassland regeneration – noting cover of target species vs. return of undesired shrubs. In Karavanke alpine meadows, the abundance of indicator species like the mountain daffodil is counted annually (number of blooming stems per area) to gauge the success of mowing and reseeding. Vegetation structure is also noted (e.g. grass height after mowing, litter accumulation) as an indicator of management effectiveness.

Invasive plant spreading in the Smrčiny Mountains Pilot Region (Author: Ondřej Volf)

Photopoint monitoring (taking repeat photos from set points) has been a simple but effective tool to visually document the reduction in shrub cover and the re-emergence of open meadow habitat.

2. Wildlife and biodiversity surveys

Every pilot tracked certain **faunal indicators** to see how animal life responded to restoration. Slovenian Škocjanski zatok, being a bird reserve, ramped up its **bird counts** – monthly surveys of waterbird and wader populations – to capture changes in species use of the new mudflats. Early results showed increased bird presence, validating the intervention. In the Italian dry grassland pilot, a joint **butterfly, carabids and avifauna monitoring** was carried out since these groups respond quickly to habitat changes. Presence of dry grassland specialist butterflies and ground-nesting birds are positive indicators of heath quality. In the German/Czech wetland/peatland pilot, although pearl mussels are the ultimate target, their long lifecycle means short-term indicators like **aquatic invertebrate diversity** and water beetle presence are monitored as proxies for improved water quality and habitat structure. Where available, **Natura 2000 monitoring protocols** were followed (e.g. habitat 7230 – alkaline fens – has specific structure and species indicators) to ensure results align with EU standards.

3. Hydrological and environmental indicators

In wetlands and peatlands, monitoring the **physical environment** is as important as biology. The Fichtelgebirge/Smrčiny team installed simple water level gauges in re-wetted peat bogs to continuously log groundwater levels and ensure the blocking of drains is achieving the desired hydrological effect. Periodic **water quality tests** (measuring parameters like nitrate, phosphate, and sediment load in streams) were done to check that restoring wetlands is improving downstream water conditions (key for pearl mussels which require clean, well-oxygenated water). Soil moisture and peat depth are also being measured in some plots to track peatland recovery (peat formation is a slow indicator but wet soil is a quick sign of progress). These environmental metrics help quantify the **climate regulation benefits** of restoration – e.g. higher water tables indicate carbon sequestration potential and reduced CO_2 emissions from dried peat.

4. Use of technology in monitoring

Several pilots embraced new technology for more effective monitoring. Drones with aerial cameras were flown over alpine meadows to map vegetation cover and detect any regrowth of shrubs in remote spots – this helped target follow-up removal efforts efficiently.

GIS mapping has been central: all pilot regions compiled baseline and post-restoration maps (using GIS software) to visualize habitat changes and calculate restored area.

In the Italian pilot, all botanical and faunal monitoring data were taken on **georeferenced digital maps** and then uploaded on free apps (i.e. iNaturalist) to enlarge the community of potential users. Also innovative tools such as audiomoths were used in particular for avifauna monitoring.

In one pilot, a **virtual reality and augmented reality tool** (an integrated VR-AR solution with 360-degree images of the natural environment and daffodil blooms) was developed. It provides an impression of the exciting display also outside of the flowering seasons. At each location, the app shows icons to discover background content: local people taking care of the meadows, nature values of rich biodiversity and interesting sights to see. Virtual experience is accessible via web app integrated in the Tourism Jesenice web site and QR codes placed on the spot to view content on visitors' devices.

5. Community-based monitoring

In line with the community approach, some monitoring was done with help from citizen scientists. For instance, local birdwatchers in Koper contributed to bird monitoring in Škocjanski zatok, extending the capacity of park staff. In Italy, WWF involved students and the general public in noting phenological events (dates of first flowering, etc.) and recognizing botanical and faunal species in the dry grassland, which not only provided data but also deepened community connection to the site. This inclusive monitoring builds local capacity to steward the habitat long after the project. It also serves as an **indicator of social sustainability**: the number of volunteers and local groups continuing to monitor is a metric of how well the project has instilled a conservation ethic.

By combining these approaches, the pilots created a robust monitoring framework. Key **indicators** across sites include: vegetation cover by native vs. invasive species, counts of target species (e.g. pearl mussel juveniles, Narcissus flowers, breeding bird pairs), water level stability, and stakeholder participation rates. These indicators feed into evaluation reports and allow practitioners to adaptively manage – for example, if invasive regrowth is detected, additional clearing can be scheduled; or if water levels are not high enough, extra damming might be done. Continuous monitoring thus ensures the restoration efforts stay on track towards the long-term ecological goals.

COMMUNITY ENGAGEMENT AND STAKEHOLDER INVOLVEMENT

A defining feature of these pilots is the **community-based development approach**, which sought to leverage local knowledge, enthusiasm, and resources for greater impact. Restoration investments were accompanied by extensive stakeholder outreach, ensuring local buy-in and paving the way for sustained action beyond the project's end.

Overall, **community engagement proved essential** for the pilots' success. The restoration of nature was paired with a "restoration" of human connections to that nature – rekindling traditional practices, fostering new environmental stewardship, and ensuring that the local community sees itself as a beneficiary and guardian of the project. These pilots clearly illustrate that when residents and stakeholders are meaningfully involved, they can contribute resources (time, knowledge, funding) that greatly amplify the project's outcomes. Moreover, community involvement lays the groundwork for continuity: stakeholders who have been part of the journey are likely to maintain the restored sites and possibly advocate for scaling up these efforts regionally.

1. Local stakeholder workshops

Each pilot region held workshops and meetings with local stakeholders early and throughout the process. These forums included landowners, farmers, local officials, conservation NGOs, and interested citizens. For example, in the Solvenian alpine meadow pilot, workshops specifically targeted **landowners and farmers**, providing information on mowing practice changes and offering support (seed or equipment) for those who join the restoration effort. By involving locals in planning, the pilots built trust and aligned restoration actions with local socio-economic interests (e.g. assuring farmers that later mowing could be compatible with their needs). These workshops maximized **community-based leverage effects**: local stakeholders began proposing their own complementary initiatives, effectively multiplying the project's impact.

2. Volunteer involvement and citizen science

Hands-on participation was a cornerstone. In Italy, on-field volunteer days were organized for seed collection, transplanting of seedlings, search and eradication of alien species at the juvenile stage, attracting local nature enthusiasts to contribute labor and learn restoration techniques firsthand. Similarly, the Slovenian alpine meadow pilot revived communal hay-cutting events where volunteers joined farmers in mowing and raking hay, turning what was once seen as hard work into a social conservation activity. These efforts

not only got essential work done cost-effectively but also gave volunteers a sense of ownership. Several pilots integrated **citizen science**: in Italian Pian del Grisa, volunteers helped monitor butterflies and birds, reporting observations that became part of the scientific dataset. This approach both raised public awareness and provided additional monitoring capacity. By engaging citizens in data collection, the projects helped demystify science and empowered the community as partners in conservation.

3. Public awareness campaigns and education

Outreach to the broader public was achieved through interpretive signage at sites, media coverage, and educational programs. Each pilot installed informational panels explaining the restoration to visitors (for instance, signs at Škocjanski zatok describe the new mudflats and why they benefit birds under climate change) or depicting local biodiversity (for instance, signs at Pian del Grisa illustrate the dry grassland flora and fauna).

Press releases and social media were used to share milestones – stories on the Interreg website featured pilot updates, which were widely shared. In Gorenjska, the VR-AR experience about the mountain daffodil effectively turned education into an attraction, reaching younger audiences and tourists who might not attend a traditional lecture. School group visits were organized in some regions (e.g. local schools came to planting events or to observe scientists at work). Public excursions help raise awareness and foster acceptance of nature conservation, including some less conventional measures. The pilots found that highlighting charismatic species and visible changes (e.g. re-filled ponds, blooming meadows) in their communications helped capture public imagination. As a result, there is a growing local pride in these natural assets, and communities are more likely to support policies or volunteer efforts that continue the restoration.

4. Alliances and partnerships

The pilots leveraged partnerships beyond the immediate project team. They tapped into networks like hunting associations, tourism operators to find common ground. By involving such diverse partners the pilots reduced potential conflicts and gained new supporters for their cause. The cross-border nature of two pilots inherently required alliance-building between countries; joint pilot teams were formed, meeting regularly to steer the actions in a coordinated way. This not only improved technical outcomes but also built a sense of a transnational community working to restore the Green Belt.

A tangible outcome of stakeholder involvement is the formation of local action groups or informal coalitions that will carry on aspects of the work (for example, landowner groups in Slovenia who will continue to exchange best practices for meadow management, or the Czech-German task force that will monitor the Fichtelgebirge/Smrčiny wetlands in the future).

LESSONS LEARNED AND BEST PRACTICES

The habitat pilots taught that **ecological restoration is as much a social process as a technical one**. The best practices revolve around inclusive planning, evidence-based actions, and forward-thinking design. These lessons learned will inform future projects – indeed, they are already being compiled into the ReCo project's strategy and practitioner guidelines – ensuring that the knowledge gained is transferred to other practitioners aiming to restore degraded ecosystems in Central Europe and beyond.

1. Integrate science with traditional knowledge

Successful restoration blended scientific methods with local traditional knowledge. In Karavanke, scientific input determined optimal mowing times and seed mix, while farmers' knowledge of the land guided practical mowing techniques on steep slopes. Moreover, in Pian del Grisa several interviews with breeders, farmers and representatives of the collective management of the dry grassland areas were carried out to integrate the traditional management methodologies with current technical and scientific knowledge for long-term maintenance. This combination ensured interventions were both ecologically sound and pragmatically feasible. Best practice include conduct participatory planning sessions where scientists and local land users design restoration protocols together.

2. Prioritize hydrology in wetland restoration

A consistent lesson is that **"water is life"** in wet habitats – restoring natural hydrology is the first step before biological measures. The peatland pilot showed that blocking drains and re-wetting peat not only revived plant life but also provided climate mitigation co-benefits (carbon storage). Projects should allocate sufficient time and resources to understand site hydrology and address it (through ditch plugging, pond creation, etc.) as a foundational activity.

3. Phased and adaptive approach

Rather than one-off actions, pilots used a phased approach with feedback loops. For example, after initial shrub clearing, the dry grassland team monitored regrowth and adapted their strategy by doing a second clearing or adding plantings where needed. This adaptive management, guided by monitoring data, proved vital. Lesson learned: build

flexibility into project plans – be ready to tweak methods (mowing frequency, water levels, etc.) based on early results and feedback from stakeholders or indicators.

4. Community-based leverage effects are real

Engaging the community not only helped implementation but also **unlocked new resources**. In Slovenia alpine region, more landowners volunteered their meadows for restoration in 2025 after seeing the project's success, effectively scaling up the effort at no extra cost. This example of **leverage effects** initial project investments spurring additional actions. Thus, a best practice is to plan for and encourage spin-off projects or local initiatives (e.g. through small grants or technical support for community ideas).

5. Transboundary cooperation increases impact

Where ecosystems cross political boundaries, joint action is far more effective than isolated efforts. The peatland pilot demonstrated that coordinating across borders leads to more coherent ecosystem restoration, as water flow does not heed borders. A best practice is establishing formal **joint management team** for cross-border sites, as was done in ReCo, including regular communication and mutual training. This builds trust and ensures continuity even if funding cycles differ by country.

6. Monitoring and technology enhance restoration outcomes

Innovative use of technology (drones, GPS) provided new insights and precision in these pilots. For instance, drone imagery quickly identified where invasive regrowth was happening, enabling rapid response. Telemetry (though part of species pilots) underscores how technology can fill knowledge gaps about animal-habitat interactions – analogous approaches (like installing loggers for water or animal movement) could be applied in habitat projects to understand usage patterns. The lesson is that even conservation projects on a budget can incorporate selected tech tools to greatly enhance understanding and visibility (e.g. inexpensive camera traps or drones can yield data that guides management and also produces compelling visuals for outreach).

7. Address climate adaptation explicitly

Restoration is most powerful when it not only looks to the past (historical ecosystem state) but also to the future. The pilots that explicitly factored in climate trends – e.g. designing wetlands to handle floods/droughts, maintaining habitat heterogeneity – are likely to yield

more durable outcomes. Practitioners should frame restoration as part of a **climate adaptation strategy** for the landscape. This perspective can also help garner policy support and funding, as many regions seek nature-based solutions to climate impacts.

8. Flagship species can drive conservation

Focusing on a charismatic or culturally significant species (daffodil, pearl mussel) proved to be a double-edged tool: it rallied public interest and political will, while also delivering ecosystem benefits since these species required broad habitat improvements. The lesson is to always tie species-focused efforts back to habitat health to ensure holistic restoration. A best practice is to use flagship species in communications and engagement, but measure success with both species and habitat indicators.

Freshwater pearl mussel on the left and Breeding Station in Fichtelgebirge on the right (Author: BUND-Hof)

9. Secure policy and institutional support early

The pilots showed that having local authorities and policymakers on board from the beginning smooths implementation (e.g. getting permits for earthworks, aligning agri-environment schemes for meadow mowing). As shown by the Italian pilot, the alignment between planning and regulatory institutions together with the land managers serves to open up possibilities for making prohibitions and uses of the territory more effective. Moreover, it paves the way for upscaling. In these pilots, early involvement of ministries and regional authorities meant that pilot results were quickly considered for integration into local policy (such as updating management plans for the parks or reserves). A takeaway is to involve governing bodies in advisory roles during the project, so they feel ownership of results and more readily adopt successful measures into policy or funding streams.

POLICY AND REPLICATION POTENTIAL

The experiences from Joint Pilot Actions dedicated to habitats have significant implications for **policy integration and replication** across the European Green Belt and other regions. In essence, the habitat pilots have created a **proof of concept** for community-engaged ecological restoration that policymakers can scale up. By bridging local action and policy vision, the ReCo project ensures that these pilot actions are not isolated incidents but the first steps in a broader movement to restore connectivity and biodiversity along Europe's Green Belt and beyond. The continued collaboration between project partners, communities, and policymakers will be key to realizing this vision at regional/landscape scales.

1. Informing regional and national policy

The pilots' outcomes are feeding into a **Joint Transnational Restoration & Connectivity Strategy** for the Central European Green Belt, which outlined how and where to prioritize restoration for maximum biodiversity gain. This strategy, based on pilot evidence, helps national authorities recognize the Green Belt as a priority region to achieve EU Biodiversity Strategy 2030 targets. For example, the success with peatland re-wetting and its climate benefits might inform national climate action plans or biodiversity action plans (e.g. incorporating peatland restoration targets). The alpine meadow pilot's approach could influence agri-environmental schemes in Slovenia to support late mowing and traditional practices in mountain areas. There is also ongoing dialogue with policymakers to reduce legal barriers – one output of the Italian pilot is to have highlighted and helped reduce the issue related to the existing conflict between regional regulations dealing with forest protection and grassland conservation. Furthermore, WWF guidelines for long-term agro-pastoral conduction were made available for their inclusion in the dry grassland management plan.

2. Upscaling through local and EU funding

With pilots demonstrating positive results, partners are looking to replicate or scale them using new funding. The formation of **Joint Local/Regional Restoration Plans** (one for each pilot region) is an immediate outcome, detailing next steps to expand the restoration locally. These plans will be used to apply for funding (e.g. through EU Rural Development programs, LIFE projects, or national funds). For instance, the cross-border wetland team (DE/CZ) is exploring a dedicated Interreg cross-border project to extend wetland restoration to adjacent catchments, building directly on their pilot blueprint.

Similarly, the Karavanke meadow work may be expanded through a rural development grant that incentivizes more farmers to join. The pilot investments acted as seed money,

proving concepts that can now attract larger financing – a classic case of a pilot-to-policy upscale. As for the Pian del Grisa pilot, the collective management body, who received the agro-pastoral management guidelines for the grassland, could more easily get funds from the regional rural development plan (PSR).

The project partners are also actively sharing results with the **Central European Green Belt initiative** and the EU Platform on Restoration to ensure knowledge is transferred to other regions.

3. Transnational peer learning

Replication is being fostered via peer exchange. The ReCo project facilitated **peer-review visits** among pilot teams. These visits, and the resulting reports, act as a manual for replication by highlighting what worked and what challenges arose. Outside of the project, the documented methodologies (e.g. a manual on how to restore alpine meadows, a guide on community engagement in wetland areas) will be made available to practitioners in other countries. The pilots have already drawn interest from other Green Belt regions. This knowledge transfer is a direct replication outcome.

4. Long-term sustainability

A critical aspect of replication is ensuringthe the long-term persistence of the restored sites themselves. To that end, partners have secured commitments for **post-project stewardship**. These commitments mean the pilots won't be abandoned after the project, which is itself a policy success (embedding new practices into institutional routines). It also reassures funders that scaling up is building on a solid, maintained foundation.

5. Replicability of techniques

Technically, the methods used are **highly replicable** with local adaptations. The guide and fact sheets from each pilot serve as templates – e.g. a step-by-step process on how to restore a small wetland (site assessment, stakeholder engagement, obtaining permits, physical works, monitoring) can be applied to any similar degraded wetland. The cost/benefit information from pilots (captured in project reports) can help others plan budgets and justify expenditures by showing ecosystem service returns (like flood mitigation or ecotourism gains). We anticipate that the **demonstration effect** of these pilots will inspire at least a dozen similar projects in the next few years. Indeed, this guide is itself a tool for replication: practitioners reading it can identify strategies suitable for their context, and adjust based on the lessons shared.

VISUAL AIDS

To effectively communicate and plan restoration projects, **visual aids** are indispensable. Maps, infographics, and photographs can illustrate complex ecological information in an accessible way for practitioners and stakeholders alike. In the context of the ReCo pilots, maps were used to show pilot locations and the spatial layout of restoration measures (e.g. habitat mapping). Infographics could be helpful to summarize project concepts – for instance, a flowchart of the restoration process from planning to monitoring, or a before-and-after diagram of a drained vs. re-wetted peatland. Visual documentation of on-ground actions, like collecting native wildflower seeds in an alpine meadow (Slovenia) to restore the iconic mountain daffodil habitat, serves as both a record of progress and a powerful outreach tool to engage communities in restoration efforts. In publications and workshops, **photographs** provided compelling evidence of change – pictures of dried-out wetlands next to images of the same area re-flooded with thriving vegetation can convince decision-makers of restoration's value.

Other visual aids that proved useful include:

- **GIS maps and spatial plans** showing ecological networks, such as locations of ponds built or areas mowed, overlaid on land use maps; these helped stakeholders visualize where interventions occur,
- **monitoring graphs**, like simple graphs of water level changes over time in the peatland, or bar charts of species counts pre- and post-restoration; these translate data into a visual story of improvement that is easier to grasp than raw numbers,
- **educational infographics** for the public illustrating, for instance, the meadow ecosystem, threats, and how restoration (mowing, seeding) helps – complete with icons for cows, flowers, and scythes; it can be displayed at visitor centers and on social media, raising awareness in a visually engaging way.

Finally, it's worth noting that visual tools were not just after-the-fact illustrations; they were part of the process. The **augmented reality** application is a prime example of a visual aid doubling as an educational tool, allowing people to "see" the restored meadow in full bloom virtually. Similarly, visualizations of planned mudflats at Škocjanski zatok were created to discuss designs with stakeholders before construction, ensuring everyone had a clear picture of the outcome, and **identification cards** for botanical and faunal species were realised for Pian del Grisa, to be given to participants in citizen science events and to spread the knowledge and raise awareness about local biodiversity.

Practitioners should harness visual aids at all stages – planning, implementation, monitoring, and dissemination. Good visuals can bridge language gaps in transnational work, clarify goals for contractors and volunteers, and inspire broader support by highlighting the beauty and impact of restoration. As the saying goes, "seeing is believing" – and in ecological restoration, helping people see what's possible is a critical step toward achieving it.

APPENDIX 1 – SUMMARY OF HABITAT RESTORATION PILOT ACTIONS UNDER THE ReCo PROJECT

Pilot region	Habitat type	Key restoration actions	Techniques used	Lead partner & partners	Expected outcomes
Fichtelgebirge/Smrčiny Mountains (DE/CZ)	Mountain streams, peat bogs & wetlands	Cross-border restoration targeting headwater streams and wetlands for freshwater pearl mussel conservation. Includes creating small waterbody corridors, rewetting peat bogs, and removing non-native conifer plantations. Stream channels were widened and cleaned. Meadows mown to restore foodplant for marsh fritillary butterfly.	Dismantling drainage systems; removal of invasive trees; gravel/sediment excavation; semi-natural side channel construction; periodic meadow mowing.	BUND (Germany) & Ametyst (Czech Republic)	Rejuvenated aquatic and peatland habitats with natural water dynamics restored. Revitalized mussel breeding grounds. Higher biodiversity and habitat connectivity.
Gorenjska Region (Slovenia)	Alpine meadows	Restoration and conservation of alpine meadows in the Karavanke Mountains with focus on the endemic *Narcissus* sp. Measures include adapted farming practices and pilot testing of remote movers for steep slopes. Seeds of mountain daffodil were collected and sown in test plots. Public awareness through VR-AR, hiking events and workshops.	Delayed mowing and exclusion of spring grazing; selective shrub/forest-edge cutting; organic fertilization of grasslands; artificial seed propagation; continuous ecological monitoring.	BSC Kranj (Regional Development Agency)	Flourishing mountain meadows with improved plant diversity and a stable mountain daffodil population. Greater stakeholder involvement securing long-term conservation.

Trieste Karst Plateau (Italy)	Karst dry grassland	Expanding karst dry grassland by countering forest encroachment and reconnecting remnant open areas. Activities include clearing invading trees/shrubs (e.g. cutting *Pinus nigra* and removing *Cotinus coggygria*), collecting native dry grassland seeds, nursery propagation, and replanting in restoration sites. Community engagement and education support long-term site stewardship.	Tree cutting and shrub removal; invasive species eradication; seed collection and nursery cultivation of native plants; field transplanting of seedlings associated with sowing of native seeds..	WWF Italy – AMP Miramare (Miramare and Coast of Trieste Biosphere Reserve Authority)	Re-established and enlarged karst dry grassland habitat, with restored connectivity between dry grassland patches and preserved biodiversity of the plateau. Enhanced resilience of the habitat through community-led maintenance efforts.
Škocjanski zatok (Slovenia)	Brackish wetland lagoon	Climate adaptation measures to safeguard coastal wetland habitats: mapping of habitats and bird populations, and creation of new mudflat areas (total ~420 m^2) by elevating sediment islets. These measures provide additional high-ground nesting sites for water birds, habitat for halophytic plants and improve water flow in the lagoon.	Dredging and earthworks to create/raise mudflats; water level management; ongoing habitat and wildlife monitoring.	DOPPS – BirdLife Slovenia (Nature Reserve Manager)	Secured and enhanced Natura 2000 saltmarsh and mudflat habitats, supporting increased breeding of key bird species and improving lagoon water circulation.

APPENDIX 2 – CONTACTS TO EXPERTS RESPONSIBLE FOR JOINT PILOT REGIONS

Joint Pilot Region	Fichtelgebirge (Germany)	Smrčiny (Czech Republic)	Karavanke Mountains (Gorenjska, Slovenia)	Pian del Grisa (Trieste Plateau, Italy)	Škocjanski zatok Nature Reserve (Koper, Slovenia)
Name of organisation	Bavarian Branch of Friends of the Earth Germany	Ametyst NGO	BSC, Business Support Centre, ltd Kranj	Marine Protected Area of Miramare	DOPPS-BirdLife Slovenia
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The ReCo project's (www.interreg-central.eu/projects/reco) consortium consist of:

- Bavarian Branch of Friends of the Earth Germany (Lead Partner, Germany),
- DOPPS – BirdLife Slovenia (Slovenia),
- Ametyst, NGO (Czech Republic),
- Federacja Zielonych "GAJA", NGO (Poland),
- WWF Italy (Italy),
- Thayatal National Park (Austria),
- University of Vienna (Austria),
- Landscape Research Insitute (Czech Republic),
- BSC – Business support organisation ltd., Kranj (Slovenia),
- Podyji National Park Administration (Czech Republic),
- Ministry of the Environment of the Czech Republic (Czech Republic).