

Strategic Action Plan with Adaptation Actions and Climate Resilience-Enhancing Forest Management Practices for Protected Areas

Improving Ecological Corridors and Habitats for Movement of Large Carnivores in the Carpathian, Dinaric and Balkan Mountains

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Photo by: M. Krofel



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Preface

This booklet was created as part of the Interreg Programme Danube Region project number DRP0200359 ForestConnect: Towards a Climate-smart Forest Connectivity for Large Carnivores in the Balkan-Carpathian-Dinaric Region. This is in support of the preservation and restoration of forest ecosystems and ecological corridors in the face of a changing climate in Eastern and Southeastern Europe. It serves as a practical guide, specifically for protected area managers in the Carpathian, Balkan, and Dinaric Mountains, but with general relevance for land managers in other public and private contexts. The 17 management actions described in the booklet aim to improve habitat connectivity and promote healthy populations of large carnivores and their main prey species, taking into account our changing climate. These actions were designed within the ForestConnect *Strategic Expert Group* and the *Thematic Working Groups*. We would like to express our sincere gratitude to those who contributed their time and critical feedback.

The outlined actions are based on general principles of habitat restoration and connectivity. They are intentionally flexible, allowing managers to adapt them to the specific needs and contexts of their protected areas. By working with stakeholders, managers can customize these measures to address local challenges while supporting broader conservation goals. The actions are intended for a broad target group, including protected area managers, OECM managers, landowners, and others who may apply them in their respective contexts.

The booklet is organized into four key sections:

- Infrastructure and Ecological Connectivity
- Habitat Protection and Management
- Management Aspects for Climate Resilience
- Human-Wildlife Conflict Management

Each section provides practical strategic actions to enhance biodiversity, improve climate resilience, and foster collaboration across borders. The Further Literature section at the end of the booklet provides references that will further inform the implementation of the described actions.

We hope this resource helps protected area managers and stakeholders work together to achieve sustainable conservation outcomes and ensure the long-term health of ecosystems and wildlife in the region.

The authors Elisabeth Wiegeler, Daniel Dalton, and Polona Zakrajšek



Photos by: T. Pflieger

About ForestConnect

“Towards a Climate-smart Forest Connectivity for Large Carnivores in the Balkan-Carpathian-Dinaric Region”, the Interreg Programme Danube Region project ForestConnect runs from January 2024 to June 2026. The project focuses on protecting, preserving, and enhancing ecological corridors for large carnivores across six countries of Eastern and Southeastern Europe. Strategic actions should be implemented in protected areas of the involved countries and transferrable region-wide. The functionality of habitats and ecological corridors of large carnivores is threatened by unsustainable management practices, infrastructure developments in their habitats, and the effects of climate change. All of these factors pose pressures on ecosystems. Given the transboundary nature of wildlife movement, coordinated efforts are essential to guarantee provision of the habitat and ecological needs of large carnivores and their prey.

ForestConnect addresses these needs by developing and integrating innovative tools and technologies for transnational monitoring of large carnivores, including mapping safe corridors under various climate change scenarios. ForestConnect proposes practical, climate-resilient measures, engaging local communities and filling critical knowledge gaps. Through capacity building, cooperation, and awareness raising campaigns, ForestConnect provides resources and actionable strategies intended to be implemented by protected area managers and stakeholders, ensuring the durability, transferability, and uptake of its results. These efforts contribute to the long-term conservation of large carnivores and the health of ecosystems across the Danube region.



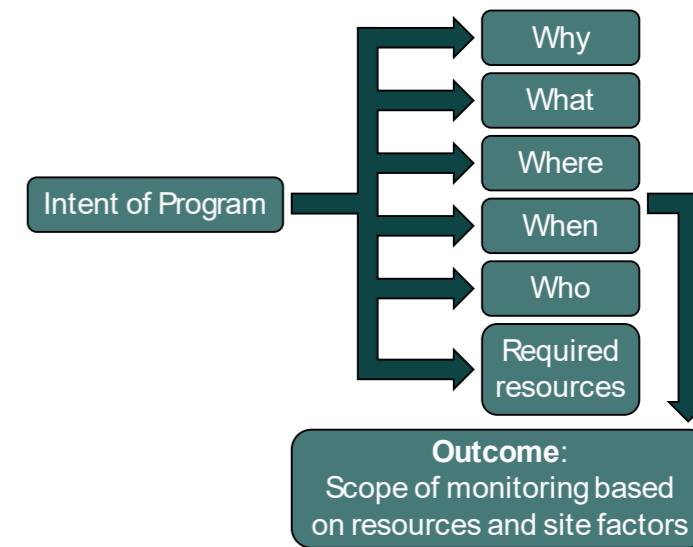
Conceptualization

Protected areas are instruments to preserve important species and habitats. Management activities should be based on the overall requirements and objectives of individual sites. While the needs are different, all work plans require conceptualization to be efficient and effective. Modular elements of a biodiversity monitoring plan should be considered through a series of six guiding questions, resulting in realistic program measures based on goals and capacities. These questions apply to any strategic action, such as those outlined in this book, that will become integrated into pre-existing management plans. The protected area management body may review the guiding questions in a workshop setting to determine potential synergies, trade-offs, or conflicts with existing programs. Consideration of how strategic actions may link with each other will improve the biodiversity monitoring program at a site.

For large carnivore conservation actions, knowledge of population structures is necessary. The genetic structure of populations will help managers determine whether inbreeding is present in the population, indicating isolation and informing management options. This may require collecting baseline population data, if not already available, and performing many cycles of monitoring until population patterns can be confirmed. It should be considered that initial costs may be high, while the benefits of long-term monitoring will only become visible after multiple seasons (Dalton et al., 2024; Marucco et al., 2025).

Before implementing strategic actions, a feasibility assessment or risk analysis should be conducted, particularly for measures where capacity constraints may exist. Key performance indicators and objective measures of success should be considered during implementation. Stakeholder engagement should be defined through clear roles and responsibilities, supporting effective cooperation, monitoring, and reporting.

Human pressure is widely recognized as the dominant driver of habitat use and movement of large carnivores in Europe. Based on the physiological limits of large carnivores, climate is not expected to exert a direct limiting effect on their distributions or movements (Johnson et al., 2023). Nevertheless, climate change is increasingly recognized as an important indirect driver of change through its influence on ecosystem structure. Climatic conditions regulate vegetation composition, forest productivity, and disturbance regimes, including drought stress, windthrow, pest outbreaks, and fire frequency. These processes can alter forest structure and spatial configuration over time, potentially changing the availability of forest cover thereby modifying the permeability of the landscape (Grimm et al., 2013; Cramer et al., 2001). Shifts from closed-canopy forest to more open or disturbed forest types may increase exposure to human activities and infrastructure. Climate-driven changes in vegetation also have cascading effects on prey distributions and abundance. Herbivore populations respond to climatic conditions through changes in forage availability, phenology, and winter severity, which in turn influence the spatial distribution of carnivores. As prey availability shifts across the landscape, large carnivores may adjust their movement patterns and habitat use, potentially altering connectivity pathways (Damien and Tougeron, 2019; Carroll et al., 2024). In addition to ecological processes, climate change can interact with land use dynamics by altering the spatial extent and intensity of human activities. Warming temperatures and changing precipitation regimes may facilitate changing trends in agriculture, forestry operations, or infrastructure development (Zhang and Cai, 2011; Oliver and Morecroft, 2014). As well, the decrease of freshwater might stress large carnivores and their prey and attract them towards artificial water bodies (Mitchell et al., 2018). Conversely, climate-related declines in productivity may lead to land abandonment in other regions.



Source: Graphic adapted from Dalton et al., 2024; Text adapted with permission from Retez, 2026, Output 1.1.2, Interreg Programme Danube Region project number DRP0200359 ForestConnect.

Infrastructure and Ecological Connectivity

Action 1: Ensuring Safe Wildlife Movement in Connected Habitats

Action 2: Maintaining Ecological Connectivity through Wildlife Corridors and Infrastructure Planning and Adaptation

Action 3: Measures to Prevent and Reduce Wildlife Mortality on Roads and Railways

Action 4: Wildlife Monitoring in Ecological Corridors

Relevance to Climate Adaptation and Resilience

Climate change is reshaping species ranges, movement patterns, and habitat use, making ecological connectivity a fundamental element of climate adaptation. Because roads and railways intensify habitat fragmentation, integration of wildlife corridors, crossing structures, and other connectivity measures is essential to help species move safely, maintain gene flow, and preserve key ecosystem functions. Advocating for inclusion and protection of movement corridors may be an effective instrument for spatial planning and policy. At the same time, reducing wildlife mortality is increasingly important, in particular for large mammals who are more affected by landscape fragmentation. Changes in wildlife behavior may raise the likelihood of wildlife-traffic collisions on roads and railways. Targeted measures such as warning systems and habitat management protect both wildlife and people, while avoiding permanent fencing in migration corridors ensures that species can move freely and adapt to shifting habitats. Continuous monitoring of wildlife movement supports these efforts by identifying range shifts and emerging threats, enabling timely adjustments to management strategies, particularly in protected areas and surrounding environments. Together, enhancing ecological connectivity and reducing wildlife mortality provide a comprehensive approach to strengthen ecosystem resilience, safeguard biodiversity, and support the long-term adaptive capacity of both natural systems and human communities.

Ensuring Safe Wildlife Movement in Connected Habitats

Designing, implementing, and integrating ecological connectivity measures play a critical role in mitigating the barrier effects caused by roads, railways and other fenced areas. These measures will help preserve ecological connectivity, minimize wildlife-traffic collisions, and ensure the long-term viability of species that require extensive home ranges, such as bears and wolves. Integrating wildlife protection measures into infrastructure planning and development fosters coexistence between human and nature, while advancing biodiversity conservation efforts. Effects of measures can be modeled under current and predicted climate scenarios.

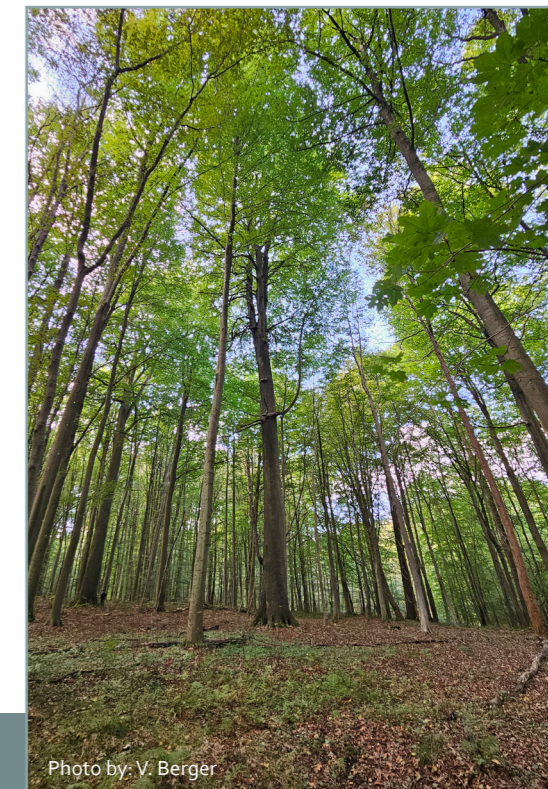
Objectives

- Maintain genetic diversity by facilitating dispersal and gene flow between wildlife populations.
- Ensure safe movement of wildlife across landscapes.
- Reduce wildlife-traffic collisions and improve safety for both wildlife and humans.
- Support transboundary conservation efforts, particularly in regions with shared wildlife populations, such as the Carpathians, Dinarides, and Balkans.
- Align with EU biodiversity goals, such as the Habitats Directive, the Nature Restoration Regulation, and the EU Green Infrastructure Strategy, which emphasize ecological corridors and species conservation.



Key Activities / Implementation Steps

1. **Identification of Priority Areas:** Use habitat modelling, wildlife-traffic collision data, and species movement studies to identify potential conflict points and barriers for wildlife. Prioritize areas with high incidence of collisions and known movement routes for large mammals and other species, considering that when measures are planned based on likely future scenarios, ecological connectivity can be preserved in a changing climate.
2. **Design and Construction of Wildlife-Friendly Measures:** Plan and construct ecological connectivity measures in new development projects. Implement wildlife-friendly features, such as water features, native trees and shrubs, and fencing to guide wildlife to areas where human-wildlife conflicts could be avoided. Ensure that implemented measures are designed to accommodate the target species and local ecological conditions.
3. **Monitoring and Evaluation:** Monitor the use of implemented measures by using camera traps, track surveys, and automated counters. Evaluate the effectiveness of implemented measures for improving connectivity, including wildlife-traffic collision data to assess the mitigation measures.
4. **Community Awareness Raising:** Conduct public awareness raising campaigns to educate both locals and visitors about the importance of implemented measures in areas frequented by wildlife. Promote social connectivity, helping to reduce human-wildlife conflicts.
5. **Public Engagement:** Involve local communities in the planning and implementation of connectivity measures.



Required Resources

Personnel: Engineers, wildlife ecologists, hunters, transportation planners, and local communities for design, construction, and monitoring.

Materials: Construction materials for ecological connectivity; monitoring equipment such as camera traps and automated counters.

Funding: EU Green Infrastructure funds, national transportation budgets, and private sector contributions.

Technical Resources: Technical design guidelines for wildlife crossings, habitat connectivity models and ecological data.

Maintaining Ecological Connectivity through Wildlife Corridors and Infrastructure Planning and Adaptation

To tackle challenges posed by roads and railways, incorporating monitoring of wildlife crossing structures including overpasses, underpasses, and culverts into planning is essential. These adaptations maintain wildlife movement, prevent habitat fragmentation, and reduce wildlife-traffic collisions. Planning and prioritizing wildlife-friendly infrastructure protects biodiversity and supports species adaptation to climate change. Collaboration among protected area managers, transportation authorities, and planners ensures conservation goals are embedded in infrastructure projects.

Objectives

- Safeguard wildlife movement across fragmented landscapes by maintaining ecological connectivity.
- Maintain functional wildlife corridors by assessing quality (bottlenecks, barriers) and restoring degraded sections.
- Secure corridors in spatial planning to prevent new fragmentation and align infrastructure development with conservation goals, e.g., by establishing protected areas.
- Maintain ecological connectivity and functional movement corridors.
- Strengthen cooperation among protected area, forest, transportation, and planning authorities.
- Align infrastructure development with biodiversity conservation goals.



Key Activities / Implementation Steps

1. **Identification of Key Crossing Points:** Identify critical road and railway sections near or in protected areas and important habitats where wildlife crossings are essential. Use ecological data, species movement patterns, habitat modeling, and wildlife-traffic collision hotspots to prioritize areas for intervention.
2. **Design and Implementation of Wildlife Crossings:** Integrate wildlife overpasses, underpasses, and culverts in new infrastructure, and retrofit existing structures with crossing features. Keep underpass surfaces natural with soil or grass, maintain surrounding vegetation to guide wildlife, remove obstacles and waste, and preserve watercourses and riverbank vegetation where present. Avoid artificial lighting, human presence, and noise near crossing points. Plant native vegetation near entrances, and regularly monitor structures to address any degradation and ensure functionality.
3. **Collaboration and Advocacy:** Collaborate with transportation ministries, municipalities, conservation authorities, infrastructure administrators, and NGOs to promote wildlife-friendly infrastructure planning and design. Provide ecological data and technical expertise to ensure that biodiversity conservation is considered in infrastructure development.
4. **Monitoring and Evaluation:** Monitor the effectiveness of wildlife crossings by using camera traps, wildlife-traffic collision data, and stakeholder feedback. Evaluate the use of crossings by wildlife and adapt designs based on monitoring results or examples of good practice from other areas.
5. **Community Engagement and Awareness:** Conduct awareness raising campaigns to highlight the importance of safe driving practices along wildlife corridors.



Required Resources

Personnel: Protected area managers, ecologists, engineers, transportation planners, construction companies, universities, authorities, and local communities for data collection, planning, and monitoring.

Materials: Construction materials for wildlife crossings, fencing, and monitoring equipment (e.g., camera traps, GPS collars).

Funding: EU Green Infrastructure funds, national transportation budgets, and private sector contributions.

Technical Resources: Habitat connectivity models, ecological data, design guidelines for wildlife crossings, and permits.

Measures to Prevent and Reduce Wildlife Mortality on Roads and Railways

Reducing wildlife mortality and improving safety on roads and railways require targeted measures to address wildlife-traffic collisions, which pose risks to both wildlife and humans, causing injuries, fatalities, and material damage. Proposed solutions include reducing wildlife attractants (e.g., carcasses, roadside waste, food spills near roads and railways, etc.), artificial deterrents, warning systems, habitat management, improved visibility to prevent wildlife from accessing roads or railways, and alerting drivers to potential risks. Focusing on critical locations, such as wildlife-traffic collision hotspots, ensures that these measures are both effective and resource-efficient.

Objectives

- Prevent and reduce collisions between wildlife and vehicles on roads and railways.
- Minimize injuries and fatalities among wildlife and humans.
- Decrease material damage caused by wildlife-traffic collisions.
- Increase visibility and awareness for both drivers and wildlife near roads and railways to reduce wildlife-traffic collision risks.
- Enhance ecological connectivity by reducing the barrier effect of linear transport infrastructure.



Photo by: V. Berger

Photo by: B. Immerova

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Photo by: E. Wiegeler

Key Activities / Implementation Steps

- 1. Identification of Critical Areas:** Identify hotspots where wildlife-traffic collisions occur most frequently. Use existing data on wildlife mortality, police and hunting statistics, and insurance records to locate high-risk areas. These critical points are precisely the locations where it is appropriate to apply some of the following mitigation measures.
- 2. Installation of Artificial Deterrents for Wildlife:** Deploy visual, acoustic, or scent-based deterrents, such as blue reflectors, to influence wildlife behavior and prevent animals from entering roads or railways. On railways, implement acoustic warning systems that activate shortly before a train arrives to deter wildlife from the tracks. Test and adapt deterrents based on the type of wildlife and environmental conditions.
- 3. Warning Systems and Signs for Drivers:** Install traffic signs to alert drivers to the increased risk of collisions at wildlife crossings or adjust speed limits, particularly in areas with a high likelihood of wildlife-traffic collisions. Use warning signs with sensors, such as thermal detectors, to detect wildlife movement and activate warnings only when wildlife is present.
- 4. Habitat and Attractant Management and Visibility Improvement:** Manage vegetation along roads and railways within a 3–10 m strip to improve visibility for both wildlife and drivers. Reduce the attractiveness of areas near roads for wildlife by rapid removal of wildlife carcasses and potential food or garbage spills near roads and railways.
- 5. Monitoring and Evaluation:** Monitor the effectiveness of implemented measures by tracking wildlife mortality and wildlife-traffic collision rates before and after installation. Use camera traps and regular field inspections to assess the success of deterrents and warning systems and ensure their continued proper functioning.



Photo by: B. Immerova

Required Resources

Personnel: Road and railway administration staff, ecologists, engineers, and local communities for monitoring and implementation.

Materials: Deterrent devices, warning signs, thermal detectors, and monitoring equipment (e.g., camera traps, GPS).

Funding: National and EU transportation safety funds, insurance company contributions, and private sector partnerships.

Technical Resources: Wildlife movement data, wildlife-traffic collision statistics, monitoring protocols, and permits if needed.

Wildlife Monitoring in Ecological Corridors

Establishing a systematic wildlife monitoring program in ecological corridors is essential for tracking large carnivores and other target species. This action focuses on monitoring species presence, seasonal movements, population trends and structure, and mortality (including wildlife-traffic collisions) while evaluating the effectiveness of mitigation measures like wildlife crossings and fencing. The collected data will inform adaptive management and conservation planning, ensuring the sustained functionality of ecological corridors and enhancing the resilience of wildlife populations to the impacts of climate change.

Objectives

- Monitor wildlife presence, abundance, and seasonal movement patterns in corridor areas.
- Detect and report mortality events, particularly wildlife-traffic collisions, to identify high-risk areas.
- Evaluate the effectiveness of mitigation measures, such as wildlife crossings and fencing.
- Support adaptive management and conservation planning by providing reliable data, including on genetic diversity.
- Strengthen collaboration through shared data and reporting.



Photo by: B. Immerová

Photo by: V. Berger

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Photo by: E. Wiegele

Key Activities / Implementation Steps

1. **Development of Monitoring Protocols:** Create standardized monitoring protocols tailored to the specific conditions of ecological corridors, target species, and selected modeling methods. When possible, use existing protocols that have already been prepared in other projects to strengthen analysis. Include methods for tracking species presence, movement, and mortality, e.g., wildlife-traffic collisions. Keep in mind that data collection and statistical design will affect the results of analysis. Consideration of the analysis in advance of data collection will guide the way data are collected in the field.
2. **Data Collection:** Install wildlife camera traps, passive acoustic monitoring devices, GPS collars and automated counters. Targeted eDNA sampling may be performed according to the monitoring objectives. Use sand strips and field surveys to detect wildlife tracks, scat, and other signs of presence. Regularly maintain devices and perform data backups as part of a data management plan.
3. **Data Analysis:** Regularly analyze data on species distribution, movement patterns, and mortality events. Compile annual reports on species-specific trends and spatial distribution changes.
4. **Evaluation of Mitigation Measures:** Assess the usage and effectiveness of wildlife crossings, underpasses, overpasses, and fencing. Identify wildlife-traffic collision hotspots and recommend targeted interventions to reduce mortality. Documenting the measures makes the impact visible.
5. **Stakeholder Collaboration and Reporting:** Share monitoring results with wildlife and hunting authorities, protected area managers, transportation authorities, forestry agencies, and other stakeholders. Use findings to inform infrastructure planning and adaptive management strategies.
6. **Sharing Data Across Borders:** Uploading monitoring data onto biodiversity platforms such as CCIBIS and GBIF will provide access to key information for other institutions. This activity can improve cross-border collaboration to benefit large carnivore populations.



Photo by: L. Schmalz

Required Resources

Personnel: Trained field staff for monitoring, data collection, analysis, and reporting.

Materials: Wildlife trail cameras, GPS collars, automated counters, and AI-assisted image recognition software.

Funding: National and EU biodiversity funds, protected area budgets, and private sector contributions.

Technical Resources: Data management software, CCIBIS/GBIF, Data Storage, spatial and statistical analysis tools, and monitoring protocols.

Habitat Protection and Management

Action 5: Quiet Zone Conservation Through Reducing Human Disturbance

Action 6: Planting Fruiting Trees and Shrubs to Secure Seasonal Food Sources for a Resilient Ecosystem

Action 7: Restoration and Regeneration of Forests Affected by Disturbances

Action 8: Strategic Fencing in Wildlife Movement Corridors

Relevance to Climate Adaptation and Resilience

Climate change is significantly altering the availability and quality of habitats, making habitat protection and restoration a cornerstone of climate adaptation strategies. Efforts such as establishing quiet zones for wildlife, planting and restoring fruit-bearing tree and shrub habitats to increase food availability and habitat heterogeneity, and regenerating forests damaged by natural and anthropogenic disturbances are essential to maintaining ecosystem health and resilience. While quiet zones primarily address human disturbance, they also help buffer species against additional pressures at a time when climate change is already affecting activity patterns and habitat use. Together, these actions holistically support species adaptations to shifting environmental conditions while ensuring the preservation of critical ecosystem services, such as carbon sequestration, water regulation, and biodiversity conservation. By reducing human disturbances and enhancing habitat connectivity, these measures will promote healthy forest ecosystems capable of withstanding the pressures of climate change. The integration of local communities in habitat management generates a sense of shared responsibility and ensures the sustainability of these efforts. All together, these strategies contribute to the long-term stability and resilience of habitats and species in the face of a changing climate.

Quiet Zone Conservation Through Reducing Human Disturbance

Establishing legally protected "quiet zones" within core wildlife habitats is intended to reduce human disturbances during sensitive periods like spring cub-rearing for bears. These zones should limit activities such as logging, hunting, berry and mushroom picking, off-trail tourism, off-road (motor)biking, and grazing near known dens. Creating quiet zone refuges helps mitigate human-wildlife conflicts, preserve key habitats, and enhance the stability and reproductive success of wildlife populations. Effective implementation relies on collaboration with local authorities, forest managers, rangers, and communities to ensure compliance and long-term success.

Objectives

- Reduce disturbances during critical life stages of target wildlife, such as periods of denning and cub-rearing.
- Minimize human-wildlife encounters and potential conflicts in sensitive areas.
- Maintain stable wildlife populations and support healthy reproductive success rates.
- Protect key habitats from degradation during sensitive periods.



Photo by: L. Schmalz



Photo by: B. Immerová

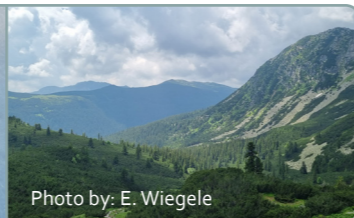


Photo by: E. Wiegele

Key Activities / Implementation Steps

1. **Identification and Mapping:** Identify and map priority quiet zones in core wildlife habitats using GPS data, den surveys, and camera trap monitoring. Use ecological data to determine the most critical areas for protection.
2. **Legal Protection and Regulation:** Establish legal protection status for quiet zones through management plans or other adequate legal frameworks. Implement seasonal restrictions on activities such as logging. Discourage off-trail tourism in protected areas. Close trails if they lead toward dens. Redirect grazing near known dens in other areas through providing incentives for these activities in other areas.
3. **Guidelines and Communication:** Develop and distribute guidelines to local authorities, forest managers, and tourism operators to ensure compliance with restrictions. Informational signage at zone boundaries can inform about the quiet zones.
4. **Community Engagement and Education:** Conduct outreach and education campaigns for local communities, visitors, and landowners to raise awareness about the importance of quiet zones. Train rangers and enforcement staff in monitoring and compliance procedures.
5. **Monitoring and Adaptive Management:** Monitor wildlife activity and disturbance levels using camera traps, ranger patrols, and community feedback to evaluate the effectiveness of quiet zones. Adjust zone boundaries or regulations based on ecological monitoring results and wildlife behavior patterns.

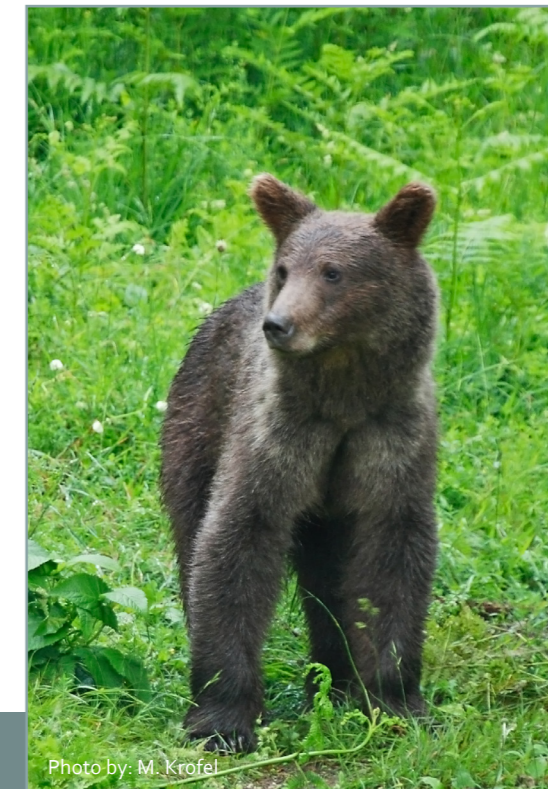


Photo by: M. Krofel

Required Resources

Personnel: Rangers and law enforcement, wildlife ecologists, hunters, GIS specialists, tourism experts, and community outreach officers.

Materials: GPS units, camera traps, signage, and educational materials.

Funding: EU biodiversity and climate adaptation funds and national environmental funds.

Technical Resources: Digital tools for planning zones (GIS tools).

Planting Fruiting Trees and Shrubs to Secure Seasonal Food Sources for a Resilient Ecosystem

Planting native, climate-resilient fruiting tree species enhances feeding habitat quality for wildlife (e.g., bears) or their prey and strengthens ecosystem resilience. As climate change increases the variability and reduces the reliability of natural food sources, these plantings help buffer wildlife against seasonal shortages. Most fruit-bearing forest species are light demanding. They support biodiversity not only by providing food for many species, but also by increasing habitat heterogeneity through the restoration of abandoned orchards and pastures. With careful site selection, such efforts can reduce human-wildlife conflicts and guide carnivore movement within protected areas and connected sites. Paired with water retention measures, these areas offer valuable microhabitats and favorable conditions during dry periods.

Objectives

- Ensure seasonal food availability for large carnivores and their prey.
- Reduce climate-induced human-wildlife conflicts through nature-based solutions.
- Guide wildlife movement across protected areas and connected landscapes.
- Enhance landscape heterogeneity and ecological resilience in forest and non-forest habitats.
- Promote community engagement and awareness through participatory planting efforts.



Photo by: T. Pflieger

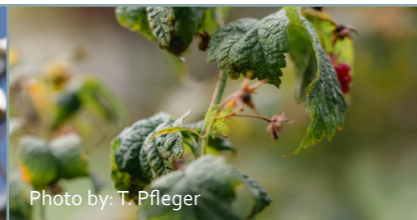


Photo by: T. Pflieger



Photo by: E. Wiegeler

Key Activities / Implementation Steps

1. **Site Selection:** Prioritize abandoned orchards, pastures, forest edges, and corridors to enhance habitat connectivity and reduce pressures. Make sure that the sites are not too close to settlements or other sensitive areas.
2. **Stakeholder Involvement:** Combine ecological expertise with local knowledge to identify suitable areas, assess land ownership, address legal or administrative constraints, and engage local communities. Provide training on seed collection, nursery management, and site care.
3. **Ecological Assessment:** Evaluate wildlife use (e.g., carnivore or wildlife movement corridors), human activity, habitat conditions, and restoration potential to avoid conflicts and maximize ecological value.
4. **Species Selection:** Focus on native, climate-resilient fruit trees (e.g., *Pyrus*, *Malus*, *Prunus*, *Cornus mas*) using local genetic material. Diversify species for extended fruiting seasons and complement with existing hard mast species. Consider potentially using species adapted to future climate projections.
5. **Site Preparation and Planting:** Clear vegetation, improve soil, and install water retention features. Plant saplings and protect them using appropriate techniques such as mulching and placing barriers against browsing.
6. **Demonstration Plots:** Establish pilot sites in representative habitats (e.g., forest edges, degraded land) with optimized layouts for fruit availability and habitat value. Pilot areas will help selection of appropriate climate-adapted varieties in large restoration sites.
7. **Monitoring and Adaptive Management:** Monitor tree survival, fruit production, wildlife use, and human-wildlife interactions. Use results to refine practices and scale up implementation.



Photo by: E. Wiegeler

Required Resources

Personnel: Forest staff, wildlife and vegetation ecologists, educational institutions, and community volunteers.

Materials: Native seedlings, planting tools, tree guards, mulching tools, and monitoring equipment (e.g., camera traps, GPS for relocating trees).

Funding: Potential sources including EU funds, national programs, protected area budgets, and private donors.

Technical Resources: Guidelines for planting and recommendations of which species are native to the area.

Restoration and Regeneration of Forests Affected by Disturbances

Regenerating forests impacted by anthropogenic activity or natural disasters like wildfires, windthrow, landslides and avalanches can be critical for ecosystem structure and functionality. Such disturbances disrupt forest structure, expose soils to erosion, impact nutrient cycles and soil organisms, and can promote the spread of invasive species and pests. This action prioritizes rapid damage assessment, soil stabilization, and the use of natural regeneration or assisted reforestation with native, climate-resilient species. By applying evidence-based restoration techniques, this action seeks to rebuild forest ecosystems, strengthen their resilience to future disturbances, and safeguard essential ecosystem services.

Objectives

- Restore damaged and burned forests while protecting biodiversity and habitats.
- Stabilize soils to prevent erosion and mitigate secondary ecological impacts.
- Promote natural regeneration and, where necessary, assisted reforestation with native species.
- Transition from vulnerable monocultures to mixed, climate-adapted forest stands.
- Increase resilience to future disturbances, including fires, droughts, pests, and diseases.



Key Activities / Implementation Steps

- 1. Rapid Assessment and Mapping:** Conduct systematic assessments and spatial mapping of damaged areas to quantify structural damage and identify priority zones. Use georeferenced data to identify erosion-prone slopes, critical habitats, and areas with high restoration potential.
- 2. Soil Stabilization and Erosion Control:** Apply measures such as mulching, contour barriers, and check dams to stabilize soils and prevent erosion. Avoid soil disturbance through logging and avoid clear cuts.
- 3. Invasive Species Detection and Management:** Ensure prevention, early detection, and containment of invasive species. If present, apply targeted measures to limit spread and impacts via mechanical removal and safe disposal.
- 4. Restoration Planning:** Develop a comprehensive restoration plan that integrates ecological objectives, such as biodiversity conservation and climate adaptation. Include strategies for soil health maintenance, debris removal, and protection of rare species and critical habitats. Leave standing and lying deadwood where possible and feasible to support deadwood-dependent species.
- 5. Regeneration and Reforestation:** Promote natural regeneration as the primary recovery mechanism. Implement enrichment plantings or assisted reforestation with native, climate-resilient species where natural regeneration is insufficient. Use locally sourced seeds and seedlings to preserve genetic diversity and ensure adaptability to local conditions.
- 6. Long-Term Monitoring and Adaptive Management:** Establish permanent plots in combination with remote sensing to monitor forest recovery, including tree growth, species composition, canopy structure, soil condition, rejuvenation monitoring, and biodiversity indicators. Use monitoring data to evaluate the effectiveness of restoration interventions and adapt management practices as needed.



Required Resources

Personnel: Forest management staff, ecologists, and local communities for assessment, restoration, and monitoring.

Materials: Soil stabilization tools, native seedlings, planting equipment, forest monitoring tools (e.g., drones, orthophotos and laser scanner equipment), and other biodiversity monitoring tools (e.g., acoustic sensors).

Funding: EU biodiversity and climate adaptation funds, national forest management budgets, and private donors.

Technical Resources: Restoration guidelines, biodiversity and forest monitoring protocols, and close-to-nature forestry techniques.

Strategic Fencing in Wildlife Movement Corridors

Maintaining the permeability of critical wildlife movement corridors is vital for preserving ecological connectivity. Permanent fencing disrupts wildlife movement, fragments habitats, and increases the risk of population isolation. Fences pose a safety risk to wildlife because animals can get tangled up or injured on them. In cases where fencing is necessary (such as preventing an animal from entering the highway), temporary or non-permanent measures, as well as openings or breaks in large fenced areas, should be used to enable wildlife passage. This strategy supports species adaptation to climate change and helps mitigate human-wildlife conflicts.

Objectives

- Preserve the continuity and functionality of wildlife movement corridors, aided if needed by navigation and protective fencing.
- Reduce habitat fragmentation, supporting the movement of large carnivores and other species.
- Facilitate coexistence between land use activities and wildlife needs.
- Enhance ecological resilience by maintaining population connectivity.



Key Activities / Implementation Steps

- 1. Identification of Movement Corridors:** Map critical wildlife movement corridors, particularly in and around protected areas and other valuable habitats, using ecological data, species movement patterns, and habitat modeling. Identify areas where existing fencing poses a risk to wildlife movement.
- 2. Avoid Permanent Fencing:** Discourage the installation of permanent fences in critical movement corridors. Promote alternative land management practices that do not require fencing.
- 3. Temporary and Non-Permanent Fencing Solutions:** Where fencing is necessary, negotiate with landowners to use temporary or seasonal fencing, such as for grazing purposes. Ensure that temporary fences are removed promptly after their intended use.
- 4. Establish Openings for Wildlife Passage:** In large, permanently fenced areas, create breaks or openings to allow wildlife to pass through safely. Design and implement wildlife-friendly fencing solutions that minimize barriers to movement.
- 5. Monitoring and Threat Mitigation:** Monitor movement corridors to ensure ongoing passability and address new fencing threats (e.g., with non-invasive genetic monitoring).



Required Resources

Personnel: Protected area managers, hunters, government representatives, landowners, farmers, farming communities, wildlife ecologists, and ranger teams for monitoring and implementation.

Materials: Mapping tools, temporary fencing materials, and monitoring equipment (e.g., camera traps, GPS).

Funding: National and EU biodiversity funds, local government budgets, and NGO support.

Technical Resources: Wildlife movement data, fencing design guidelines, and ecological monitoring protocols.

Management Aspects for Climate Resilience

Action 9: Enhancing Forest Structural Diversity for Climate Resilience

Action 10: Adjusting Grazing Intensity to Climate and Vegetation Conditions

Action 11: Integrated Management of Bark Beetle Outbreaks in Coniferous Forest Ecosystems

Action 12: Sharing of Climate-Resilient Forest and Pasture Management Practices

Relevance to Climate Adaptation and Resilience

Adapting forest and pasture management practices to the realities of climate change is vital for enhancing the resilience of ecosystems and the services they provide. Actions such as promoting structural diversity in forests, adjusting grazing intensity to align with climatic and vegetative conditions, and implementing integrated pest management strategies for forest pest and disease outbreaks are critical to mitigating the impacts of extreme weather events, drought, and disease. These measures improve the health and resilience of ecosystems and strengthen their ability to recover from disturbances. Sharing best practices in climate-resilient management across borders and institutions builds a robust knowledge base and improves collaboration among stakeholders. Through proactive measures, beginning with monitoring and followed by targeted interventions, adaptive management techniques ensure that ecosystems remain functional and productive under changing climatic conditions. Such efforts safeguard biodiversity, enhance ecosystem services, and support the livelihoods of communities that depend on these natural resources.

Enhancing Forest Structural Diversity for Climate Resilience

Promoting close-to-nature management of forest stands is key for creating multi-layered, deadwood-abundant, species-diverse, and uneven-aged forests. This enhances resilience to climate change, promotes biodiversity, and boosts carbon storage. Maintaining vertical and horizontal structure supports natural regeneration, reduces vulnerability to pests and diseases, and sustains ecosystem functions. Aligned with close-to-nature forestry, this approach ensures long-term ecological stability, promoting higher resilience, and enabling forests to adapt to changing conditions while maintaining essential ecosystem services.

Objectives

- Strengthen forest resilience and resistance against climate change and disturbances such as pests, diseases, and extreme weather events.
- Support biodiversity by creating varied habitats for wildlife, including vulnerable and endangered species.
- Development of diverse and uneven-aged forest stands, making sure to preserve existing habitat trees.
- Promote natural regeneration and sustainable forest growth to ensure long-term forest health.
- Improve key ecosystem services, such as water regulation, soil stabilization, and carbon storage.



Key Activities / Implementation Steps

1. **Variable Retention Harvesting:** Retain a mix of old and young trees to ensure age diversity. Leave open and shrubby patches, as well as large and old habitat trees, to provide shelter and food for wildlife.
2. **Thinning for Diversity:** Thin dense areas of monoculture stands to promote resilience to storms and allow light penetration and the growth of understory vegetation, supporting biodiversity.
3. **Gap Creation and Multi-Layer Formation:** Create small canopy openings to encourage natural regeneration and the development of an uneven-aged forest structure and natural succession areas.
4. **Deadwood and Snag Retention:** Leave fallen logs and standing dead trees as critical habitat for deadwood-dependent species, as carbon storage, and for microclimatic buffering.
5. **Species Diversification:** Plant or encourage locally adapted species with different ecological functions to increase resilience.
6. **Monitoring and Adaptive Management:** Establish permanent plots to monitor forest structure and biodiversity.



Required Resources

Personnel: Foresters, ecologists, and community volunteers for monitoring and implementation, landowners, and hunters.

Materials: Forest inventory and biodiversity monitoring tools and devices (e.g., laser scanning devices), planting tools, protective equipment, and GIS systems.

Funding: Financial support from EU funds, national biodiversity programs, private donors, and protected area budgets.

Technical Resources: Silvicultural guidelines, forest inventory and biodiversity monitoring protocols.

Adjusting Grazing Intensity to Climate and Vegetation Conditions

Maintaining and restoring open grasslands within large carnivore corridors requires careful alignment of grazing intensity with climate and vegetation conditions. This strategy prevents the negative impacts of overgrazing, such as soil degradation, loss of plant diversity, and reduced carbon sequestration, while also addressing the risks of undergrazing, including the spread of woody plants and invasive species. By applying adaptive grazing management techniques, this action promotes diverse food chains for herbivores, strengthens forest ecosystem resilience, and supports biodiversity conservation.

Objectives

- Maintain or restore open grassland habitats within large carnivore corridors to support ecological stability and biodiversity. This could include reintroducing large free-roaming herbivores to maintain open areas.
- Prevent overgrazing to avoid soil degradation and loss of plant diversity.
- Avoid undergrazing to prevent the encroachment of woody plants and invasive species, which disrupts ecological balance and reduces habitat diversity.
- Support the resilience of food systems by maintaining mosaic habitats for herbivores and other prey species.

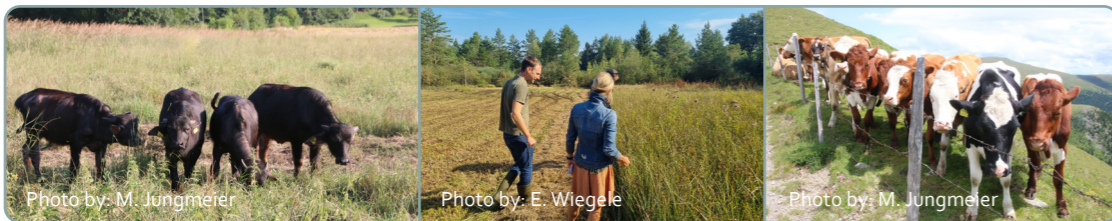


Photo by: M. Jungmeier

Photo by: E. Wiegale

Photo by: M. Jungmeier

Key Activities / Implementation Steps

1. **Mapping and Assessment:** Identify and map diverse open grassland habitats within large carnivore corridors and critical connectivity sectors using habitat suitability and landscape connectivity models. Assess the current state of grasslands, including vegetation types, grazing intensity, and ecological health.
2. **Adaptive Grazing Management:** Adjust grazing intensity by adapting livestock numbers or implementing rotational grazing to prevent overgrazing. Potentially include large free-roaming herbivores. Rest pastures as needed to allow vegetation recovery and maintain soil health.
3. **Restoration of Grassland and Mosaic Habitats:** Restore open grassland habitats within forests, such as meadows and game crop fields, to prevent overgrowth by woody plants and invasive species. Implement measures to enhance soil health and water retention in restored areas.
4. **Stakeholder Engagement and Training:** Collaborate with livestock breeders, land users, and local communities to develop and implement grazing management plans and effective livestock depredation measures (e.g., livestock-guarding dogs). Provide training on sustainable grazing practices and the ecological importance of grassland habitats.
5. **Monitoring and Adaptive Management:** Monitor the impacts of grazing on vegetation, soil health, and biodiversity. Use monitoring data to adapt grazing practices and ensure the long-term sustainability of grassland habitats.



Photo by: D. Dalton

Required Resources

Personnel: Livestock breeders, land users, local communities, forest managers, habitat experts, and ecologists.

Materials: Mapping tools, monitoring equipment (e.g., GPS, drones), and educational materials.

Funding: National and EU biodiversity and climate adaptation funds, as well as private sponsorships and local community contributions.

Technical Resources: Monitoring protocols, habitat health assessments, grazing management and habitat restoration guidelines.

Integrated Management of Bark Beetle Outbreaks in Coniferous Forest Ecosystems

Bark beetle outbreaks in spruce-dominated forests are increasing under warmer and drier climatic conditions. These disturbances can cause extensive tree mortality in affected stands, but they also create structural legacies such as deadwood, root plates, and open-canopy patches that support saproxylic species and early-successional biodiversity. Effective management therefore requires a zoned, risk-based approach that balances the ecological value of natural disturbance with the need to protect high-risk or high-value areas. This action promotes a combination of preventive stand transformation, targeted suppression where necessary, and biodiversity-friendly interventions that retain key disturbance legacies. By aligning bark beetle management with climate adaptation, the aim is to increase forest resilience, maintain ecological functions, and avoid unnecessary ecological impacts while still limiting pest spread where it poses significant risks.

Objectives

- Apply a zoned risk-based approach to bark beetle management.
- Increase long-term forest resilience to climate change and promote healthy close-to-nature forests.
- Protect biodiversity by retaining key disturbance legacies.
- Maintain essential ecological functions of forest ecosystems.
- Strengthen stakeholder understanding and cooperation.

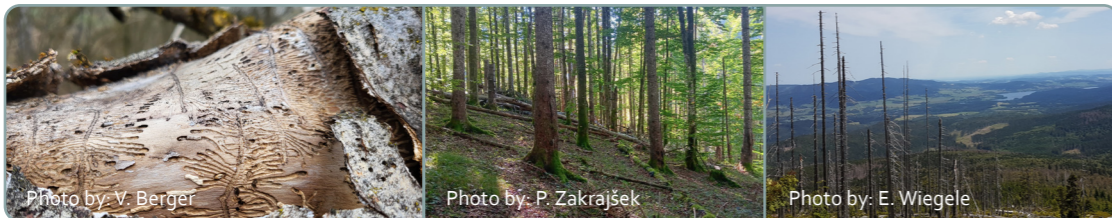


Photo by: V. Berger

Photo by: P. Zakrajšek

Photo by: E. Wiegele

Key Activities / Implementation Steps

- 1. Risk Assessment and Zoning:** Define zones by outbreak risk, conservation value, and proximity to vulnerable assets: tolerance (natural processes), buffer (limited interventions), and suppression (targeted control near infrastructure, plantations, and protected area edges). Promote close-to-nature mixed forests.
- 2. Preventive Measures:** Strengthen resilience through mixed, structurally diverse stands and reduced stress factors. Monitor bark beetle pressure and climate indicators to anticipate risks and adjust actions. Prevent illegal logging and poor practices that create breeding material for pest populations.
- 3. Targeted Suppressive Measures in High-Risk Areas:** Conduct sanitary felling only in suppression zones, removing infested or highly susceptible live and dying trees to protect the remaining assets. Use pheromone traps and trap trees strategically for monitoring. To preserve deadwood and dependent species, avoid large-scale salvage logging where natural disturbance supports conservation.
- 4. Biodiversity-Friendly Retention:** During suppression, retain disturbance legacies (root plates, dead standing and lying trees, sun-exposed branches, regeneration). Use bark scratching instead of tree removals where possible.
- 5. Education and Stakeholder Engagement:** Inform stakeholders about zoning rules, preventive measures, and biodiversity-friendly practices. Provide training on early detection, safe handling of infested material, and climate-related risks.
- 6. Monitoring and Adaptive Management:** Track bark beetle activity, trap performance, climatic stress signals, and the condition of disturbance legacies. Evaluate effectiveness in each zone and adjust strategies accordingly. Document and share lessons learned to strengthen long-term preparedness.



Photo by: E. Wiegele

Required Resources

Personnel: Forest staff, ecologists, and local communities for monitoring, felling, and educational activities.

Materials: Pheromone traps, monitoring tools (e.g., drones, GPS), and educational materials.

Funding: National and regional forest management budgets, EU biodiversity programs, and private donors.

Technical Resources: Pest management guidelines, monitoring protocols.

Sharing of Climate-Resilient Forest and Pasture Management Practices

Promote adaptive management through the collection, documentation, and exchange of forest and pasture management practices for enhancing climate resilience. Protected areas encounter a variety of climate-related challenges, including droughts, wildfires, and human-wildlife conflicts. Sharing field-tested solutions, such as sustainable grazing models, reforestation techniques, and conflict mitigation strategies, encourages collaboration, avoids repeating ineffective approaches, and strengthens institutional knowledge for long-term resilience.

Objectives

- Promote adaptive management based on real-world, field-tested experiences.
- Avoid repeating ineffective or harmful management approaches.
- Build long-term institutional memory and increase knowledge resilience.
- Encourage cross-boundary collaboration and innovation among protected area managers.
- Enhance capacity-building through peer exchange and practical learning.



Key Activities / Implementation Steps

- 1. Inventory of Best Practices:** Identify successful forest and pasture management activities implemented in the past 5–10 years. Focus on practices that address challenges such as erosion, forest regeneration, pasture quality, and human-wildlife conflicts.
- 2. Documentation of Practices:** Develop concise case summaries or practice notes that include the problem addressed, context, approach, observed results, and lessons learned. Include visual aids such as photos, maps, and diagrams to enhance understanding.
- 3. Knowledge Sharing:** Share documented practices during ranger meetings, internal training sessions, and through digital communication platforms (e.g., shared drives, chat groups). Organize peer exchange events, such as round table discussions and study trips, to facilitate learning between protected areas.
- 4. Integration into Management Plans:** Incorporate successful practices into forest and pasture management plans to ensure their application in future projects. Advocate for the inclusion of these practices in national and regional adaptation strategies.
- 5. Monitoring and Evaluation:** Track the adoption and effectiveness of shared practices through management reports and surveys. Use feedback from protected area managers to refine and improve the documentation and sharing process. Document measures to monitor long-term impact.



Required Resources

Personnel: Protected area managers, rangers, farmers, ecologists, and communication specialists.

Materials: IT tools for knowledge sharing (e.g., online platforms), meeting spaces, and documentation tools.

Funding: EU and national adaptation funding schemes, small grants, and bilateral cooperation projects.

Technical Resources: Monitoring tools, case study templates, and digital communication platforms.

Human-Wildlife Coexistence

Action 13: Monitoring and Early Warning of Human-Wildlife Conflicts

Action 14: Protocol for Institutional Response to Problem Wildlife Behavior

Action 15: Fostering Local Partnerships for Sustainable Conservation

Action 16: Empowering Conservation Through Evidence-Based Awareness Raising

Action 17: Responsible Citizen and Media Interactions for Human-Wildlife Coexistence

Relevance to Climate Adaptation and Resilience

Climate change facilitates shifts in wildlife behavior, migration patterns, and habitat use, compounding the occurrence of human-wildlife conflicts that are driven by land use changes. These conflicts pose risks to both human safety and wildlife conservation, making proactive management essential. Monitoring wildlife movements, identifying conflict hotspots, and integrating climate data into conflict prevention strategies are key to addressing these challenges. Collaborative efforts with local communities, such as awareness raising campaigns, participatory planning, and the promotion of non-lethal conflict mitigation measures, promote coexistence and reduce potential conflicts. Responsible media reporting and the use of innovative tools, such as mobile apps for incident reporting and near real-time alerts, enhance the effectiveness of conflict management. By identifying whether changes are caused by land use activities or a combination of factors, root causes can be addressed. Adjustments to land use strategies can then be made to protect wildlife populations while also building community trust and resilience. In the context of climate adaptation, these measures ensure that both human and wildlife populations can thrive in a rapidly changing environment.

Monitoring and Early Warning of Human-Wildlife Conflicts

Addressing climate-related human-wildlife conflicts requires upgrading and integrating local verification committees into a broader digital monitoring network. This action records both damage incidents and non-damage threat encounters involving species like brown bears, wolves, and lynx, while linking these events to climate and seasonal drivers such as food shortages, drought and habitat fragmentation. By forecasting risks and guiding prevention measures, this action aims to enhance coexistence between humans and wildlife to ensure the conservation of large carnivore populations.

Objectives

- Strengthen existing verification committees and establish a reliable, geo-referenced human-wildlife conflict database.
- Map all human-wildlife conflict events, including damage incidents with confirmed and suspected cases.
- Detect climate-related patterns, such as food scarcity and extreme weather displacement, to forecast risks.
- Recognize climate anomalies, plant phenology shifts, human disturbances, and increased human-wildlife conflict events. Provide timely alerts and prevention guidance to high-risk areas.
- Improve public trust, safety, and awareness while conserving large carnivore populations.



Key Activities / Implementation Steps

1. **Protocol Harmonization and Verification Committee Support:** Standardize incident reporting formats for all committees, including damage and threat-only encounters. Connect with damage inspectors, if needed, train and equip ranger and veterinary teams for rapid verification, DNA swabbing, and incident grading. Implement existing monitoring frameworks and protocols for data collection (Dalton et al., 2024; Marucco et al., 2025).
2. **Data and Tools Integration:** Develop a central online database with mobile access for verification committees to upload incident data directly, with offline capabilities for remote areas. Configure mobile apps (e.g., SMART, QField, EarthRanger) and other tools for rangers and community focal points, a web-based dashboard, and a cloud database. Enable features like photo and audio uploading, GPS tagging, and e-signatures for observations and incidents. Incident reporting should occur through the framework of a geofence.
3. **Community Engagement and Awareness:** Involve municipalities and local leaders in prevention and safety awareness campaigns, informing community members that certain species may return after being absent for decades. Promote bear-proof garbage bins, livestock protection (e.g., livestock guarding dogs and electric fences), and safe behavior in areas visited frequently by wildlife.
4. **Sharing the Landscape:** Support the development of effective and lasting solutions to conflict to ensure that people and wildlife can thrive side-by-side in shared landscapes.



Required Resources

Personnel: Verification committees, rangers, veterinarians, and community focal points.

Materials: Smartphones and tablets with mobile app, GPS devices, sampling kits, monitoring tools (e.g., camera traps, audio sensors), digital data assessment platform, and observation protocols.

Funding: National and EU climate adaptation funds.

Technical Resources: Digital twin platforms and predictive models, cloud-based database and visualization dashboard.

Protocol for Institutional Response to Problem Wildlife Behavior

Climate change, anthropogenic impacts, and the reduction of natural food resources are leading to increasingly frequent cases of large carnivores entering human settlements. These situations create a real risk to the life and health of people, as well as to domestic animals and wildlife. Institutional response to problem wildlife is already established in certain areas of the Balkans and could be used as an example for replication or adaptation in other regions.

Objectives

- Support the development of protocols for coordination and response to wildlife habituated to human-related sources of food and lost fear of humans, ensuring effective protection of people and domestic animals across different countries and regions.
- Reduce response times to alerts of problem wildlife, define clear roles and responsibilities of stakeholders and structures, and establish a clear and consistent procedure for responding to received alerts.
- Implement a phased approach – from risk assessment to subsequent actions.
- Minimize the need for extreme measures through prevention and deterrence.



Photo by: S. Nikolić



Photo by: E. Wiegele

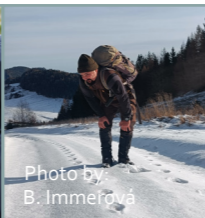


Photo by:
B. Immerová



Photo by: E. Wiegele

Key Activities / Implementation Steps

1. **Risk and Context Analysis:** Identify areas with an increased risk of human-wildlife conflicts (see Action 13).
2. **Establishment of Inter-institutional Structures:** Establish rapid response teams composed of representatives from the relevant responsible institutions as defined by legislation (e.g., laws on protected areas, biodiversity, hunting and wildlife management, use of weapons, and incident response). Teams should be organized on a regional basis according to Step 1, with clearly developed regulations and regular trainings.
3. **Development, Adoption, and Implementation of a Response Procedure/Protocol for Aversive Conditioning of Wildlife Approaching into Settlements.** The protocol should contain: Methods for receiving, registering, and verifying alerts, such as through a dedicated app or secure social media platform; team structure, decision-making procedures for specific actions, and necessary equipment and tools, including the use of deterrents or firearms; indicators for assessing the severity of the situation based on different types of animal behavior and corresponding types of response actions, including urgency (response timeframes); a sequence of steps to be taken by each institution in the different types of actions; communication channels between different team members; methods of documentation and accountability (standardized forms); outreach to communicate with the public and provide safety instructions to local residents.



Photo by: E. Wiegele

Required Resources

Personnel: Trained field teams of experts – biologists, forest officers, veterinarians, hunting and firearms specialists, representatives of the Ministry of Interior and local authorities.

Materials: Vehicles, communication equipment, deterrence and safety equipment, immobilization equipment and medications, protective gear.

Technical Resources: Legal framework enabling response, clear communication channels, financial resources for training and equipment.

Fostering Local Partnerships for Sustainable Conservation

Actively involving landowners and local communities is crucial for improving coexistence with large carnivores and enhancing ecosystem health. Encouraging awareness, dialogue, and collaboration helps to reduce human-wildlife conflicts, promote proactive conflict prevention measures such as implementing buffer zones around settlements, and ensure long-term community engagement in conservation efforts (such as through developing bear-smart communities). Through education, communication campaigns, and participatory approaches, local stakeholders can better understand the ecological importance of large carnivores and adopt sustainable practices.

Objectives

- Increase awareness and acceptance of large carnivores as a key component of the environment.
- Promote practical conflict prevention measures to ensure the safety of livelihoods and wildlife.
- Foster shared responsibility and active participation in the protection and conservation of large carnivores.



Photo by: E. Wiegeler

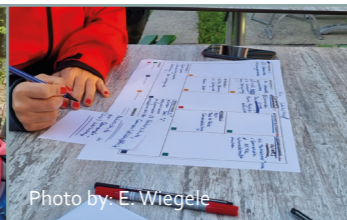


Photo by: E. Wiegeler



Photo by: B. Immerová

Key Activities / Implementation Steps

1. **Awareness Raising and Communication Campaigns:** Launch targeted communication campaigns to educate local communities and landowners about the ecological roles of large carnivores. Publish brochures, fact sheets, and other materials to dispel myths and provide accurate information about large carnivores. Establish an emergency line including a rapid response team for reporting large carnivore presence and incidents.
2. **Community Engagement and Dialogue:** Organize forums and open discussions between local communities, landowners, hunters and protected area administrations to address concerns and share solutions. Include local voices to ensure that solutions are tailored to local conditions and to create a sense of shared ownership in solutions. Conduct classroom lectures and youth engagement activities to raise awareness among younger generations.
3. **Capacity Building and Incentives:** Provide workshops and expert support on practical measures for reducing conflicts, such as livestock protection and beehive safety. Develop incentive programs to support the adoption of conflict reduction practices, such as protective fencing and the use of livestock-guarding dogs.
4. **Participatory Conservation Efforts:** Involve local communities in observation and conservation activities, such as habitat restoration and wildlife tracking. Promote collaboration, mutual learning, and the blending of diverse perspectives, experiences and types of expertise to implement sustainable land management practices that benefit both people and wildlife.
5. **Monitoring and Feedback:** Regularly assess the effectiveness of awareness raising campaigns and conflict prevention measures through surveys and community feedback. Adapt strategies and ensure continuous improvement in community engagement. Collect data on effectiveness of deployed prevention measures and adapt them as needed.



Photo by: E. Wiegeler

Required Resources

Personnel: Community outreach officers, media professionals, educational institutions, conservationists, and local leaders.

Materials: Educational materials, protective equipment (e.g., fencing, guard dogs), and monitoring tools.

Funding: National and EU biodiversity funds, local government budgets, and private sector contributions.

Technical Resources: Conflict prevention guidelines, training materials, and participatory engagement frameworks.

Empowering Conservation Through Evidence-Based Awareness Raising

Bridging the gap between science and society is essential for promoting the work of environmentalists, protected area management bodies, researcher organizations, and NGOs. Evidence-based communication, participatory events, and transparent dialogue play a crucial role in building public trust, countering misinformation, and fostering a deeper connection to nature. Highlighting the scientific foundation and tangible impacts of conservation efforts encourages stakeholders to actively support biodiversity and climate adaptation strategies.

Objectives

- Improve public and stakeholder understanding of the scientific evidence behind conservation actions.
- Build trust and counter misinformation through transparent and participatory communication.
- Increase the visibility and perceived legitimacy of environmentalists among local communities, decision-makers, and visitors.
- Generate emotional connections to nature and biodiversity to encourage support for conservation efforts.



Photo by: E. Wiegele

Photo by: E. Wiegele

Photo by: J. Dulnigg

Key Activities / Implementation Steps

1. **Interactive Events and Public Engagement:** Organize open-door events at visitor centers featuring live demonstrations (e.g., camera traps, wildlife tracking, climate monitoring). Host documentary screenings, study trips, and exchange visits to showcase conservation efforts. Participate in ecological fairs and public events with interactive booths and activities.
2. **Storytelling and Positive Framing:** Use storytelling to highlight the lived experiences of environmentalists and the positive outcomes of their work. Conduct public lectures to present conservation challenges and successes in an accessible and engaging manner.
3. **Educational Materials and Media Outreach:** Emphasize co-creation of knowledge for collaborative development of brochures, fact sheets, and digital content. This way, stakeholders and practitioners can generate, share, and apply knowledge to communicate the evidence and impact of conservation actions. Provide “train-the-trainer” programs for a greater outreach. Collaborate with practitioners and local media to promote accurate and inspiring stories about environmental work.
4. **Strengthening NGO and CSO Participation:** Create channels for non-governmental organizations and civil society organizations to contribute recommendations to management and strategic documents. Encourage their participation in decision-making forums.
5. **Monitoring and Feedback:** Use surveys and media analysis to track changes in public understanding, trust, and support for conservation actions. Improve future communication strategies based on feedback and monitoring results.



Photo by: E. Wiegele

Required Resources

Personnel: Communication specialists, media representatives, environmentalists, educational institutions, practitioners, and local leaders.

Materials: Educational materials, event equipment, and digital communication tools.

Funding: National and EU biodiversity funds, private sector sponsorships, and NGO contributions.

Technical Resources: Media monitoring software, storytelling platforms, and participatory engagement frameworks.

Responsible Citizen and Media Interactions for Human-Wildlife Coexistence

Promoting responsible media coverage of human-wildlife interactions is essential for reducing fear, polarization, and misinformation. Media significantly shapes public perception of wildlife. Collaborating with media outlets, journalists, and stakeholders can encourage informed, solution-oriented reporting that underscores principles of coexistence and highlights the ecological and climate-related factors influencing wildlife behavior.

Objectives

- Reduce fear and polarization in communities surrounding human-wildlife interactions.
- Address misinformation and deepfake videos with scientifically-based evidence.
- Promote awareness of human-wildlife coexistence strategies, including climate adaptation measures.
- Strengthen community resilience to wildlife movements altered by climate change.
- Encourage media professionals to communicate scientifically accurate and locally relevant information on wildlife and ecosystem dynamics.



Photo by: E. Wiegeler

Photo by: I. Svetnik

Photo by: T. Pflieger

Key Activities / Implementation Steps

1. **Media Mapping and Engagement:** Identify and map media outlets, especially local and regional platforms, that frequently cover human-wildlife conflicts. Establish partnerships with NGOs, research institutions, and wildlife departments to provide experts for interviews and fact-checking.
2. **Journalist Training and Workshops:** Conduct workshops and training sessions for journalists on the basics of ecology and climate science relevant to wildlife. Train journalists on responsible reporting practices, avoiding sensationalism, and using neutral, factual terms. Highlight coexistence strategies and community solutions to human-wildlife conflicts.
3. **Media Guidelines and Toolkits:** Develop a media guideline toolkit on climate-sensitive, responsible wildlife reporting. Include recommendations to avoid using sensational language (e.g., "monster"), graphic photos and videos, and misinformation, and instead focus on factual, solution-oriented reporting.
4. **Pilot Campaigns and Outreach:** Launch pilot campaigns in selected high-conflict areas, including social media outreach and community education through local media. Use storytelling and positive framing to highlight successful examples of coexistence and community-led solutions.
5. **Monitoring and Feedback:** Monitor media coverage for shifts in tone, accuracy, and focus on coexistence and climate-linked issues. Collect community feedback on the impact of media coverage and adjust strategies accordingly.



Photo by: S. Lakovic

Required Resources

Personnel: Trainers, communication specialists, wildlife and climate experts, and media representatives.

Materials: Media guideline toolkits, training materials, and monitoring tools for media analysis.

Funding: National and international grants, NGO partnerships, and private sector sponsorships.

Technical Resources: Media monitoring software, training platforms, and communication tools.

Timeline of Implementation

Sustainable management of natural assets starts with clear objectives. The initial step is to gather detailed site information, guided by monitoring indicators that are chosen carefully. Phases should proceed in order: first compile background site information. Next, choose strategic actions whose objectives directly support protected area goals; use the six “Conceptualization” questions (p. 9) to help finalize these actions prior to implementation. After conceptualization, perform test runs on the methods. Once they work as intended, conduct field monitoring and repeat across cycles, feeding results into adaptive management.

The following pages present a general implementation timeline for each action in this booklet. These timelines are not prescriptive and should be modified to reflect on-the-ground realities at implementation sites—namely, start dates, intervals between monitoring cycles, and overall program duration (Dalton et al., 2024).

Section 1: Infrastructure and Ecological connectivity

	Conceptualization and Planning (e.g., Month 1 - Year 1)					Early Implementation (e.g., Year 2-4)			Late Implementation (e.g., Year 5-8)			
Action 1 Ensuring Safe Wildlife Movement in Connected Habitats	Identify priority areas											
	Wildlife-friendly plantings											
	Wildlife-friendly construction											
	Monitoring and evaluation											
	Public engagement											
Action 2 Maintaining Ecological Connectivity through Wildlife Corridors and Infrastructure Planning and Adaptation	Identify crossing points											
	Wildlife-friendly plantings & vegetation management											
	Collaborate with stakeholders											
	Integrate structures in new construction											
	Monitoring and evaluation											
Action 3 Measures to Prevent and Reduce Wildlife Mortality on Roads and Railways	Identify collision hotspots											
	Install deterrents											
	Manage habitat and transportation visibility											
	Install warning systems											
	Monitoring and evaluation											
Action 4 Wildlife Monitoring in Ecological Corridors	Develop monitoring protocols											
	Data collection											
	Data analysis and annual reports											
	Evaluation of measures											
	Stakeholder collaboration											
Data sharing												

Section 2: Habitat Protection and Management

	Conceptualization and Planning (e.g., Month 1 - Year 1)				Early Implementation (e.g., Year 2-4)				Late Implementation (e.g., Year 5-8)			
Action 5 Quiet Zone Conservation Through Reducing Human Disturbance	Identify and map priority quiet zones											
	Establish legal basis											
	Guideline development				Guideline distribution							
	Community engagement and education				Monitoring and adaptive management							
Action 6 Planting Fruiting Trees and Shrubs to Secure Seasonal Food Sources for a Resilient Ecosystem	Identify priority sites and species for planting											
	Stakeholder and community involvement											
	Ecological assessment											
	Establish pilot sites for testing				Add plots for planting and monitoring as needed for adaptive management							
Action 7 Restoration and Regeneration of Forests Affected by Disturbances	Assess and map disturbance											
	Soil stabilization measures											
	Invasive species detection and management											
	Restoration planning											
	Regeneration and reforestation				Monitoring and adaptive management							
Action 8 Strategic Fencing in Wildlife Movement Corridors	Identify movement corridors											
	Promote management not requiring fencing											
	Temporary fencing (depending on conditions)											
	Establish openings in permanent fences				Monitoring and threat mitigation							

Section 3: Management Aspects for Climate Resilience

	Conceptualization and Planning (e.g., Month 1 - Year 1)				Early Implementation (e.g., Year 2-4)				Late Implementation (e.g., Year 5-8)			
Action 9 Enhancing Forest Structural Diversity for Climate Resilience	Thinning and retention for diversity											
	Gap creation											
	Species diversification				Monitoring and adaptive management							
Action 10 Adjusting Grazing Intensity to Climate and Vegetation Conditions	Mapping and assessment											
	Adaptive grazing management				Restoration of grassland and mosaic habitats							
	Stakeholder engagement and training				Monitoring and adaptive management							
	Risk assessment by priority zones											
Action 11 Integrated Management of Bark Beetle Outbreaks in Coniferous Forest Ecosystems	Preventive measures											
	Suppressive measures and retention				Education and stakeholder engagement							
	Monitoring and adaptive management											
	Identify and document best practices											
Action 12 Sharing of Climate-Resilient Forest and Pasture Management Practices	Knowledge sharing											
	Integrate practices into management plan				Monitoring and evaluation							
	Adaptive management											

Section 4: Human-Wildlife Coexistence

	Conceptualization and Planning (e.g., Month 1 - Year 1)	Early Implementation (e.g., Year 2-4)	Late Implementation (e.g., Year 5-8)
Action 13 Monitoring and Early Warning of Human-Wildlife Conflicts	Standardize incident reporting, protocol harmonization, and strengthen verification committee		
	Digital tools and online database		
	Monitoring, early warning and adaptive management		
	Prevention measures, community engagement, and awareness raising		
Action 14 Institutional Response to Problem Wildlife Behavior	Risk and context analysis		
	Set up a rapid response team and protocol		
	Implementation of a response procedure and protocol		
	Conduct regular training for action teams every 3-5 years		
Action 15 Fostering Local Partnerships for Sustainable Conservation	Awareness raising and communication campaign		
	Community engagement		
	Capacity building		
	Participatory conservation activities, monitoring and feedback		
Action 16 Empowering Conservation Through Evidence-Based Awareness Raising	Interactive events, public engagement, and storytelling		
	Educational materials and media outreach		
	Strengthen NGO and civil society participation		
	Monitoring and feedback		
Action 17 Responsible Citizen and Media Interactions for H-W Coexistence	Media mapping and engagement		
	Journalist training and workshops		
	Media guideline and toolkit development		
	Pilot campaigns and outreach, monitoring and feedback		



Photo by: M. Krofel

Potential Funding Sources

A range of funding instruments is available for conservation and restoration initiatives. The following overview highlights common sources and their typical applications (see Underwood et al., 2025). In many cases, small-scale local funding may be the most practical option; national and local organizations can provide guidance on suitable schemes.

EU and National Public Funds:

These include grant programs for conservation, land acquisition, restoration, and management. Relevant instruments span the LIFE Programme, Cohesion Policy funds (such as Interreg, the European Regional Development Fund, and the Cohesion Fund), as well as measures and eco-schemes under the Common Agricultural Policy. Such programs are particularly suited to initiating or expanding restoration and planning efforts, typically require co-funding (around 50–100%), and involve defined administrative procedures.

Private Finance and User-Pays Mechanisms:

This category covers investor-backed approaches and revenue models linked to conservation outcomes. It includes user-pays mechanisms in protected areas (entrance fees, concessions, licenses), payments for ecosystem services, green and resilience bonds, debt-for-nature swaps, blended finance structures that combine public grants with private loans or guarantees, and subsidy frameworks aligned with nature-positive results. These mechanisms are especially relevant for projects with measurable outcomes or predictable cash flows, can provide upfront capital while reducing financial risk, and may help secure long-term operational funding.

For further breakdown of funding options, see:

- LIFE - European Climate, Infrastructure and Environment Executive Agency. https://cinea.ec.europa.eu/programmes/life_en (2026, February 1).
- Inforegio - EU Regional and urban development. https://ec.europa.eu/regional_policy/home_en (2026, February 1).
- Programmes - Interreg EU. <https://interreg.eu/programmes/> (2026, February 1).
- CAP overview - Agriculture and rural development - European Commission. https://agriculture.ec.europa.eu/common-agricultural-policy/cap-overview_en (2026, February 1).

The following overview highlights common sources and their typical applications. For a more detailed description see Underwood et al. (2025).

Existing Strategies and Policies

The ForestConnect Strategic Action Plan is embedded within existing European and international policy frameworks addressing biodiversity conservation, ecological connectivity, climate adaptation, and human-wildlife coexistence. ForestConnect operationalizes and complements these frameworks by translating strategic objectives into concrete, site-level management actions for protected areas and their surrounding landscapes.

The **EU Habitats Directive (92/43/EEC)** further underpins ForestConnect actions by requiring the maintenance or restoration of favourable conservation status for species of Community interest and the ecological coherence of the Natura 2000 network. Measures proposed within the SAP support the Directive's objectives to reduce fragmentation and improve habitat functionality (Council of the European Communities, 1992).

At the European level, the **EU Biodiversity Strategy for 2030** provides a key reference framework by calling for the establishment of a coherent Trans-European Nature Network and the restoration of degraded ecosystems, with particular emphasis on ecological corridors and landscape permeability. These objectives directly align with ForestConnect's focus on improving forest connectivity for large carnivores and maintaining functional movement pathways under changing climatic conditions (European Commission, 2020).

Climate-related actions within the SAP are consistent with the **EU Strategy on Adaptation to Climate Change**, which emphasizes ecosystem-based adaptation and the strengthening of ecosystem resilience as key responses to climate impacts (European Commission, 2021).

The **Nature Restoration Regulation** establishes legally binding targets for the large-scale restoration of degraded ecosystems across the European Union, including forests and connected landscapes that are critical for biodiversity and climate resilience. The Regulation explicitly recognizes the importance of restoring ecological connectivity, improving habitat quality, and enhancing the functionality of ecological corridors as part of achieving favourable conservation outcomes (European Commission, 2025).

The ForestConnect Strategic Action Plan functions as an implementation-oriented interface between existing strategies and on-the-ground management. By aligning with established biodiversity, climate, infrastructure, and coexistence policies, it strengthens policy coherence while supporting protected area managers in applying climate-smart, connectivity-focused measures across the Balkan–Carpathian–Dinaric region and beyond.

Useful Links and Frameworks

Large Carnivore Initiative for Europe (LCIE – IUCN) - <https://www.lcie.org/>

IUCN expert network dedicated to the conservation and management of Europe's large carnivores. Develops guidelines, monitoring standards, and coexistence strategies across Europe.

The EU Platform on Coexistence between people and large carnivores - <https://shorturl.at/XsvyY>

The EU Platform brings together a range of stakeholders to effectively address conflicts related to large carnivore conservation and management.

The Dinaric-Balkan-Pindos Large Carnivore Initiative - <https://dinaric-carnivores.org/en/>

Regional collaboration and exchange on wildlife management.

IENE – Infrastructure & Ecology Network Europe - <https://www.iene.info/>

A global, interdisciplinary network of experts who work on transportation, infrastructure, and ecology. Supports cross-border cooperation in planning, designing, and maintaining transport infrastructure to minimize its impact on biodiversity.

Rewilding Europe - <https://rewildingeurope.com/>

Pan-European program restoring natural processes, wildlife populations, and ecological connectivity. Promotes rewilding approaches and coexistence with large herbivores and carnivores.

Carnivore Damage Prevention News (CDPnews) - <https://cdpnews.net/>

Professional newsletter focused on the complex challenges presented by the coexistence of carnivores and human communities.

NaturaConnect - <https://naturaconnect.eu/>

Horizon Europe project developing the scientific basis and planning tools for a Trans-European Nature Network. Supports the design of connected protected areas across Europe.

Co-creating Coexistence (CoCo) - <https://cocoproject.eu/>

Horizon Europe project focused on finding solutions that harmonize pastoralism and wildlife.

LECA. Supporting the coexistence and conservation of Carpathian Large Carnivores - <https://shorturl.at/657gw>

Interreg Central Europe project strengthening conservation of bear, wolf, and lynx in the Carpathians. Promotes monitoring, stakeholder involvement, and coexistence solutions.

LIFE Lynx - <https://www.lifelynx.eu/>

International project that joined experts, nature conservationists, researchers, and hunters from five countries to prevent genetic erosion and extinction in the Dinaric–SE Alpine lynx population.

LIFE DINALP BEAR - <https://dinalpbear.eu/en/project/project-goals/>

Cross-border project for coordinated conservation and management of brown bears in the Alpine–Dinaric region, focusing on population monitoring, coexistence measures, conflict prevention, connectivity, and education.

LIFEstockProtect - <http://www.lifestockprotect.info/>

LIFE initiative promoting effective livestock protection to reduce conflicts with large carnivores. Focuses on preventative measures, training, and practical tools for farmers.

LIFE WOLFALPS EU - <https://www.lifewolfalps.eu/>

EU LIFE initiative focused on coordinated wolf management in the Alpine region. Enhances monitoring, coexistence measures, and conflict mitigation.

LIFE EuroLargeCarnivores - <https://www.eurolargecarnivores.eu/en>

International project improving coexistence with bears, wolves, and lynx across Europe by connecting stakeholders, sharing knowledge and best practices, and supporting practical conflict prevention and mitigation.

TRANSGREEN - <https://dtp.interreg-danube.eu/approved-projects/transgreen>

Interreg Danube project promoting safer and environmentally-friendly road and rail networks and ecological corridors in mountainous regions of the Danube basin.

ConnectGREEN - <https://dtp.interreg-danube.eu/approved-projects/connectgreen>

Restoring and managing ecological corridors in mountains as green infrastructure in the Danube Basin.

SaveGREEN - <https://dtp.interreg-danube.eu/approved-projects/savegreen>

Safeguarding the functionality of transnationally important ecological corridors in the Danube Basin.

ForestConnect - <https://interreg-danube.eu/projects/forestconnect>

The project generated valuable Outputs and Deliverables, for example D 2.1.1 and O2.1.2. They can be found on the website.

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