



HUMANITA: Human-Nature Interactions and Impacts of Tourist Activities on Protected Areas

Understanding and managing the impacts of tourism on protected areas



About HUMANITA

The **Interreg CE project HUMANITA** aims to address human-nature interactions and tourism impacts in protected areas. Increased demand and interest in outdoor activities are great opportunities but also challenges for each protected area (PA) to meet visitors' expectations and protect natural values.

The **HUMANITA** project brings together **11 partners** from **Austria, Slovenia, Croatia, Hungary, Italy, and Slovakia** to assist PA managers in Central Europe (CE) in the evidence-based and participatory management, prevent negative impacts and human-nature conflicts, and reduce risk using an incremental approach. This project focuses on the joint development of new complementary tools and methods for assessing the impact of tourists. By sharing experiences across countries, it seeks to improve how we evaluate environmental conditions and trends, make clear management decisions, and provide information for both national and EU policymakers, as well as the public.

To ensure its effectiveness, impact, and long-term sustainability, the **HUMANITA** key project activities are meant to:

- (1) Test and produce innovative solutions to assess the impact of tourist activities on nature.
- (2) Assist managers of protected areas to optimise them with nature protection.
- (3) Involve tourists and local communities in participatory monitoring to bring awareness-raising, trust-building, and behavioural change.
- (4) Enhance the protection of natural heritage, ecosystems, and valuable areas.
- (5) Develop a "common heritage" narrative for pilot sites.

We invite you to join us on this journey and dive into the world of research and development with us to create a better world, a healthier and safer environment, and a brighter future.

Impressum

Project title:

HUMANITA – Human-Nature Interactions and Impacts of Tourist Activities on Protected Areas

1. University of Žilina (UNIZA), Slovakia – **Lead Partner**
2. Eurac research (EURAC), Italy
3. University of Parma (UNIPR), Italy
4. Notitia Ltd (NOTITIA), Croatia
5. Carinthia University of Applied Sciences (CUAS), Austria
6. CEEweb for Biodiversity (CEEweb), Hungary
7. EGTC GEOPARK KARAWANKEN/KARAVANKE (EGTC GEOPARK), Austria/Slovenia – **pilot site**
8. Public Institution Kamenjak (PIK), Croatia – **pilot site**
9. Tuscan-Emilian Apennine National Park (PNATE), Italy – **pilot site**
10. Bükk National Park Directorate (BNPD), Hungary – **pilot site**

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Photos:

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Acknowledgement

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The HUMANITA innovative approach

Supporting Protected Area managers in nature conservation

National Park Malá Fatra

Malá Fatra National Park, located in **north-western Slovakia**, represents one of the country's most diverse and ecologically valuable **mountain areas**. The park hosts a rich mosaic of habitats, from montane beech and fir forests to alpine meadows, **supporting high biodiversity and numerous endemic, rare, and protected species**. Malá Fatra is the westernmost national park of the Carpathians with a permanent presence of **large carnivores** (bear, wolf, lynx) and original, relatively well-preserved ecosystems in which fundamental ecological and evolutionary processes are still maintained. For the industrialised countries of Central and Western Europe, the area is of transnational eco-stabilisation importance, as it enables the spread of Western Carpathian species into neighbouring territories.



The Park is a popular destination for both **summer and winter tourism**. The area offers a variety of activities, including **hiking, skiing, and mountain biking**, attracting numerous visitors annually. However, the increasing number of tourists has led to several environmental concerns. The formation of secondary trails due to heavy tourist traffic has resulted in soil erosion and habitat degradation. **Additionally, activities such as mountain biking on hiking trails and bivouacking in unauthorised areas contribute to the disturbance of local ecosystems.**

Digital visitor monitoring helped us assess the frequency of hikers and bikers on official and promoted trails, as well as on unofficial trails, and to better understand which areas of high visitation may lead to negative environmental impacts on various natural assets. We focused particularly on monitoring trampling processes at pilot sites, identifying species threatened by visitor impacts, and evaluating the effects of increased tourist activity on wildlife and erosion development. In addition, water quality was monitored in rivers.

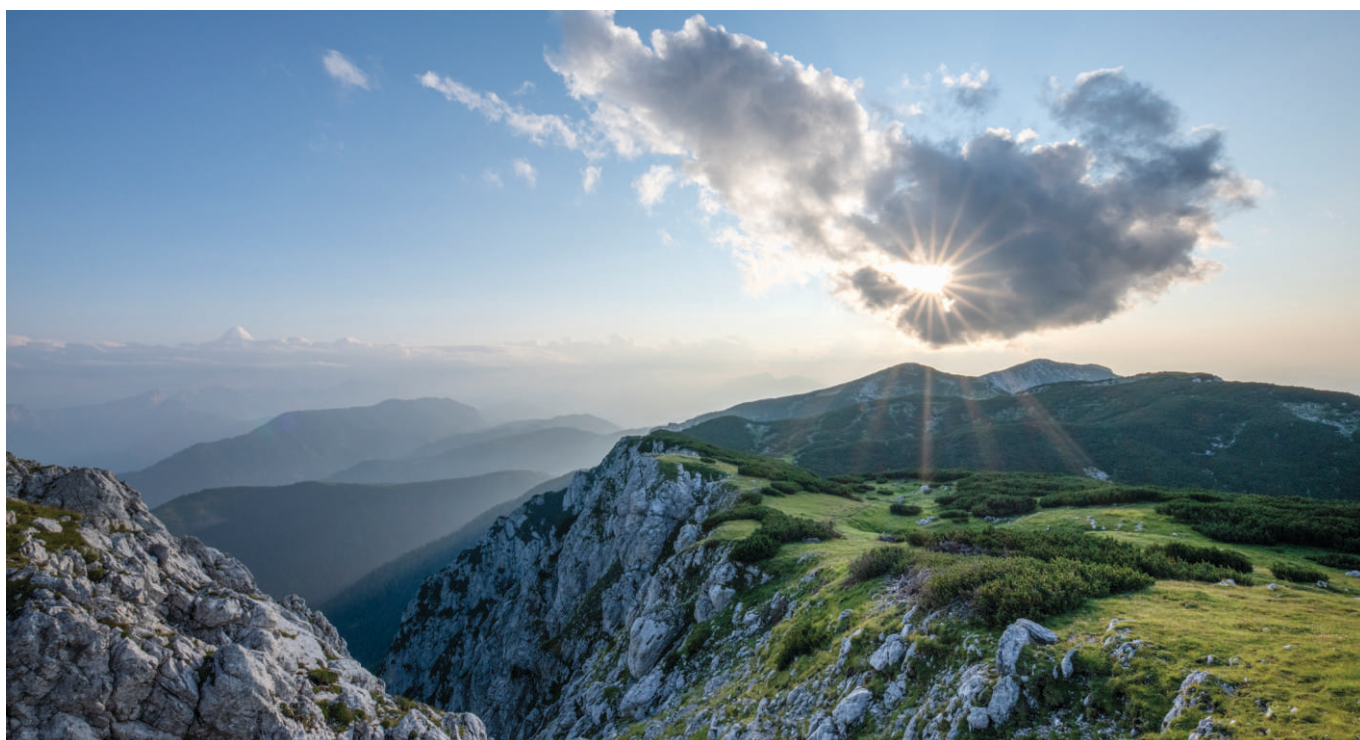
Karawanken–Karavanke UNESCO Global Geopark

The Karawanken–Karavanke **UNESCO** Global Geopark is a **cross-border region** of natural and cultural experiences with an outstanding geological heritage. **Five Slovene and nine Austrian municipalities are bound together in an area of 1,067 km²**. The Geopark features over 1,200 kilometres of hiking trails and more than 1,000 kilometres of forest roads and cart tracks for mountain biking, along with several bike parks, attracting outdoor enthusiasts year-round.

The Geopark has a significant elevational variation of 1,900 meters between the lowlands and high mountains. It is a unique area

characterised by a wide variety of habitats due to its distinct geological features. The region includes **rock walls, scree, mountain meadows, marshes, fens, rivers, lakes, and forests**, all of which support **numerous rare and protected plant and animal species**. It is estimated that more than 1,500 plant species, around 7,500 animal species, and 30,000 insect species can be found in the Karawanken–Karavanke Geopark.

Throughout the summer and winter, the Karawanken–Karavanke Geopark experiences a significant increase in recreational activities, which can cause various



impacts and conflicts among users. These issues arise from unclear regulations, unauthorised usage, and illegal activities in nature that affect protected areas and vulnerable species. In selected pilot areas of the Geopark, we focus on managing visitor flows, understanding the relationship between people and nature, and examining how recreational activities affect the environment, including flora, fauna, and physical and hydrological processes.

As part of the HUMANITA project, we focus on environmental challenges at pilot sites on Mount Petzen/Peca and Hochobir/Ojstrc, monitoring visitor flows and assessing their impact on nature, including the installation of visitor counters in strategic locations. We also focus on erosion monitoring, wildlife observations (pattern of behaviour and influence on wildlife), and participatory monitoring, with particular attention to Invasive Alien Species and, overall, the presence of non-native species. So far, we've identified **over 30,000 locations of more than 80 non-native plant species**.



Tuscan-Emilian Apennine National Park

Appennino Tosco-Emiliano National Park (PNATE) is a protected area located along the **northern Apennine ridge between Emilia-Romagna and Tuscany**. Established in 2001, the Park covers **over 26,000 hectares** across the provinces of Reggio Emilia, Parma, Lucca, and Massa Carrara, and includes 15 Natura 2000 sites as well as the **UNESCO MaB Reserve "Appennino Tosco-Emiliano"**. It is characterised by high landscape diversity, ranging from glacially shaped valleys and high-altitude grasslands to extensive beech forests, karst systems, peat bogs, and glacial lakes.



The Park hosts a wide variety of habitats and species of high conservation value, acting as a biogeographical crossroads between Alpine and Mediterranean regions. Its fauna includes stable wolf populations, large ungulates, raptors such as the golden eagle and peregrine falcon, and several amphibian species protected under EU Directives. Forest ecosystems cover more than half of the area, reflecting long-term natural recolonisation processes following the decline of traditional agro-pastoral activities.

As a partner and pilot site of the HUMANITA project, PNATE is actively involved in field-based monitoring of tourism impacts, the development of innovative environmental monitoring methods, and the testing of best practices for managing human–nature interactions. These activities are carried out in collaboration with the University of Parma and other project partners, with the aim of improving conservation strategies and sustainable tourism management in sensitive mountain environments.



Public institution Kamenjak

The Public Institution of Kamenjak is participating in the HUMANITA project on the pilot site of the significant Landscape of Lower Kamenjak and the Medulin archipelago. Lower Kamenjak and the Medulin archipelago is a protected area in the **Municipality of Medulin** known for its various landscapes, including the shore, cliffs, caves and beaches. **It is a peninsula that stretches out into the Adriatic, about 3400 metres long and from 500 to 1600 metres wide. Lower Kamenjak is a part of the ecological Natura 2000 network**, due to its variety of plant species (591 species, 85 plant families), including some **endangered species of vascular plants**. The protected grasslands also present an important factor in the distinctiveness of the area, and are important for the current

rich biodiversity state of the area. Around **150 bird species** (wintering, nesting and migratory) have been recorded, of which **130 are endangered, more than 50 diurnal butterfly species**, along with numerous species of insects, reptiles, mammals and others. What is also important for the significance of the area are the dinosaur footprints located on Point Grakalovac and the island of Fenoliga. The main challenge of area management is the balancing of nature conservation and visitor management. The number of visitors is roughly **about 700,000 visitors by car and about 230,000 pedestrians and cyclists yearly** (peaking in the summer, when the pressure is highest), which poses a significant pressure on flora and fauna, and impacts the cleanliness of beaches and sea. Due to a high visitor number during the peak season in the summer, the main concern of the institution is to mitigate human influence on nature and restore certain degraded areas due to human influence. The main activities are the monitoring of visitors through implementation of camera car counters on pre-designated parking zones to better manage visitor dynamics, the monitoring of grassland fragmentation and wild trail formation through UAV surveys and pollution monitoring and its impact on flora and fauna. The project objectives are the minimisation of human influence and preservation of degraded areas in the pilot site.

Bükk National Park Directorate

The Bükk National Park Directorate (BNPD) participates in the HUMANITA project on the pilot site encompassing Bükk National Park and Mátra Landscape Protection Area. These areas in **Northern Hungary** feature distinct karst landscapes in Bükk with highly karstified limestone, caves, sinkholes, and 94% forest cover supporting **diverse Carpathian, Mediterranean, and Alpine flora** like **lady's-slipper orchid** (*Cypripedium calceolus*), alongside fauna including **Eurasian lynx** (*Lynx lynx*), **grey wolf** (*Canis lupus*), and **cave bats**. The volcanic Mátra hosts stratovolcanic andesite formations, high-mountain habitats with glacial relicts like **alpine rose** (*Rosa pendulina*), protected amphibians such as **yellow-bellied toad** (*Bombina variegata*), and raptors including eastern **imperial eagle** (*Aquila heliaca*). Both sites form key Natura 2000 network components, serving as biodiversity hotspots with historical caves evidencing Palaeolithic human use.

Visitor hotspots include Szalajka-valley, Lillafüred, Három-völgy, Tar-kő peak, Kékestető peak, and Mátrafüred-Sás-tó, with peaks from April to October, especially July-August. Post-COVID surges intensified pressures, with sites like Suba-lyuk cave showing 15.3% growth (2023-2024 data from counters and mobile phone cellular analysis). High seasonal concentrations cause habitat trampling on rocky grasslands (e.g., Tar-kő), cave vandalism (e.g., Kecse-lyuk), invasive species spread via trails, pathogen transmission like chytrid fungus (*Batrachochytrium dendrobatidis*) to amphibians, and waste clustering near roads (48% within 20m).

The primary challenge lies in balancing nature conservation with **intensifying tourism, including physical habitat degradation, wildlife disturbance** (bats, raptors, carnivores), pathogen vectors from hikers/vehicles, and illegal motorised access. Current measures feature strictly protected areas with no public access, a developed hiking route system. Ranger patrols, over 50 educational trails, visitor centers, and citizen apps like Hulladkradar/iNaturalist, yet gaps persist in biosecurity (no boot stations) and real-time data integration. HUMANITA monitoring via infrared counters, STRAVA/cellular data, acoustic sensors, and surveys addresses these by quantifying flows and impacts for data-driven decisions.

Project efforts focus on minimising human impacts through visitor monitoring (counters, cellular data), vegetation/soil surveys, bat acoustics, amphibian pathogen tests, and invasive tracking, while restoring degraded sites. Goals include evidence-based zoning refinements, seasonal closures, trail optimisations, and awareness campaigns on "invisible" threats like pathogens, preserving favorable conservation status.





Testing and producing innovative monitoring methods and solutions to assess the impact of tourist activities on nature

One of the core objectives of the HUMANITA project is to develop a proposal for a more comprehensive monitoring system for conservation areas, with a particular focus on the environmental impacts of outdoor tourism on natural assets. Project partners tested a mix of traditional and innovative monitoring methods across five pilot sites. Together, they created a modular, adaptable monitoring framework that reflects both biodiversity and tourism impacts. Commonly developed strategy guides sustainable visitor management and sets priorities for future implementation and re-evaluation. The development and testing of diverse monitoring methods at selected sites aim to improve the understanding of relationships between visitor activities and associated ecological processes.

The indicators monitored within the HUMANITA project are grouped into the following thematic areas:

- ▶ **Visitor monitoring**
- ▶ **Vegetation monitoring**
- ▶ **Erosion monitoring**
- ▶ **Wildlife monitoring/observation**
- ▶ **Pollution monitoring**

A combination of traditional and innovative approaches was applied. **Automated visitor counters** were deployed to monitor visitor numbers along popular hiking and mountain biking trails, as well as access roads, enabling a better understanding of visitor flows on both officially promoted routes and informal or unauthorised paths. In addition, outputs from data collected by **various outdoor and fitness applications**, such as Outdooractive and STRAVA, were analysed to complement on-site monitoring.

Vegetation monitoring focused on assessing the richness, distribution, and diversity of protected species, as well as the spread of invasive plant species along trails. Trampling intensity, particularly in connection with touristic infrastructure, proved to be a relevant proxy for biodiversity monitoring. **University of Parma** collected tree-ring core samples along selected trails, ski slopes, and undisturbed areas to identify indicators of anthropogenic disturbance affecting surrounding vegetation.

Erosion monitoring was conducted using multiple approaches. **University of Žilina** focused on tourist-induced erosion along selected hiking trails using a UAV-based LiDAR scanner in Malá Fatra. **University of Parma** carried out erosion monitoring along hiking trails within the **Tuscan-Emilian Apennine National Park**, combining UAV-based photogrammetric surveys with both high- and low-altitude flights to capture different levels of detail. Ground-based photogrammetric surveys were also conducted using a 360-degree panoramic camera.

Visitor impacts on wildlife were specifically examined for bats, amphibians, and soil mites by analysing their responses to human presence. Soil mite abundance and biodiversity were investigated as reliable indicators of soil health and environmental stress caused by tourist traffic. These results were correlated with erosion data to assess the condition of soils along trails and in adjacent areas.

The **Karawanken-Karavanke UNESCO Global Geopark** is conducting wildlife observations near popular hiking and biking trails to understand the behaviour and presence of various species, particularly vulnerable ones. We have focused on 20 carefully selected sites in the Petzen/Peca pilot area, utilising high-tech wildlife cameras. Permissions have been obtained from landowners to respect local interests while gathering vital ecological data, contributing to wildlife conservation, and enhancing our understanding of the region's ecological dynamics.

In three frequently visited caves in **Bükk National Park**, acoustic monitoring devices were installed to analyse interactions between human and wildlife soundscapes.



Additional monitoring focused on amphibian population diseases, particularly **chytridiomycosis** (caused by *Batrachochytrium dendrobatidis*), by comparing data from sites close to touristic areas with those from more remote habitats. Bioacoustic methods were also used to assess species presence and activity near selected roads and to evaluate overall biodiversity levels within **the Tuscan-Emilian Apennine National Park**.

Within the Significant landscape of **Lower Kamenjak**, monitoring of soil composition revealed microplastic pollution of soils in proximity to 10 parking zones. Furthermore, the impact of microplastics on the distribution of earthworms was analysed.

Overall, the project involved a wide range of surveys and measurements carried out by the partners to collect relevant indicators for assessing visitor impacts at the pilot sites. This comprehensive framework resulted in a substantial and diverse dataset requiring coordinated management and analysis to identify cause-and-effect relationships between monitored parameters. To support this process, a shared database was developed as a centralised platform for storing and managing all monitoring data. Integrated graph-based and GIS-based dashboards enable partners to conduct comparative analyses across different monitoring activities, ensuring efficient use and interpretation of the collected data.

HUMANITA provides a flexible, science-based monitoring system that helps conservation managers understand tourism impacts and supports sustainable, evidence-based visitor management across Europe's protected areas.



Participatory monitoring: Involving tourists and local communities in monitoring activities to bring awareness-raising, trust-building and behavioural change

Participatory monitoring

Among the main objectives the HUMANITA project is oriented to actively engage visitors and local communities in participatory monitoring initiatives, thereby fostering heightened awareness, mutual trust, and constructive behavioral transformation. In response to global challenges, the project emphasises the necessity of locally tailored solutions to safeguard endangered species, manage invasive alien species, protect water resources, and address a spectrum of environmental concerns.

Accordingly, the adoption and testing of specialised tools supporting Citizen Science activities is carried out to enable tourists and visitors to contribute meaningfully to data collection on environmental impacts of tourism in protected areas. Citizen science is an inclusive research methodology that empowers volunteers to collect data, widening the existing datasets in support of the scientific knowledge. Through the design and implementation of participatory monitoring toolkits such as GPS based tracking of trail usage and the identification of invasive and non-native plant species, participants assumed an active role in data acquisition. The data collected have been consolidating a shared database, thereby enhancing insights into the relationship between tourism and protected natural environments.



Summer School

As an integral component of the participatory monitoring activities, the HUMANITA project convened a Summer School titled "Monitoring Visitors and Their Impact on the Environment," which took place from July 14 to 17, 2025. Hosted at the **Carinthia University of Applied Sciences** and the **Karawanken-Karavanke UNESCO Global Geopark**, the event welcomed 55 young researchers. They were not only young researchers, but also students from various fields and professionals from practice. The initiative aimed to build participants' competencies in selecting appropriate monitoring methodologies, designing monitoring frameworks, and conducting environmental measurements.

By providing emerging environmental professionals with innovative monitoring tools and promoting transnational knowledge exchange, the Summer School served as a high-quality training event designed to prepare

future technicians to address the current and upcoming challenges of managing visitors in protected areas.

More broadly, the Summer School represents a pivotal achievement in advancing HUMANITA's overarching mission to enhance human–nature interactions throughout Central Europe, integrating academic rigor with practical application and establishing the foundation for a cross-border network of future environmental experts.

Green Academy

The Green Academy is a collection of open access training materials built collaboratively among partners to disseminate digital educational resources pertaining to citizen science initiatives and participatory activities developed under the project. The primary topics addressed by the uploaded documents regard the i-Naturalist app use and ongoing initiatives within the project pilot sites, the HulladekRadar tool for littering mapping and citizen science educational activities. The Green Academy's materials are accessible in the media section of the official project website and referenced and contextualised in multiple articles and posts on the project social media pages with more in-depth information on methodologies, available tools, and best practices.

Human–nature conflict management: Enhancing the protection of natural heritage, ecosystems, and valuable areas through “common heritage” narrative

Understanding human impacts and their attitude

In today's digital age, **storytelling** is often overlooked in communication, yet its emotional power remains crucial, especially when grounded in knowledge. This raises the question of how alternative methods can engage visitors to natural areas, particularly where environmental issues are well-known. The focus is on how communication can educate and transform individuals from contributors to active participants in mitigating environmental damage.

The HUMANITA project emphasises a participatory approach to **raising awareness** about human impacts on the environment, with a goal of mutual learning. The project began by examining tourism's effects on the environment, like soil erosion and pollution, and questioned visitors' awareness of their actions' consequences. It then focused on improving communication to engage visitors in conservation efforts.

Within the project, partners developed a guideline manual for **new communication narratives**, based on heritage interpretation, which builds on informal education theories, particularly experiential learning from activities such as park visits. It aims to make natural and cultural phenomena relatable to everyone, not just experts, through interpretive planning.

The guide outlines a four-phase process for developing compelling narratives, with a people-centric approach. It includes practical tools, templates, and examples in six appendices to help practitioners apply the guidelines effectively. By following these steps, interpreters can create narratives that foster personal connections and inspire stewardship of heritage sites.

Common Heritage Narrative

The HUMANITA project also focused on innovative mechanisms for the development of common heritage narratives aimed at raising awareness on nature protection and stimulate visitors' behavioural change. With this purpose, the Guideline Manual for New Communication Narratives has been developed with Michal Medek, Director of the Czech Institute for Heritage Interpretation and professor of environmental education and heritage interpretation at Masaryk University, Brno, drawing upon the extensive field of heritage interpretation.

The manual is intended as a practical guide to assist park and protected area managers in transforming theoretical content into engaging and context-sensitive narratives that promote conservation awareness. Storytelling and communication are powerful tools that, when applied to scientific and heritage communication, stimulate emotional responses and strengthen public engagement. Then, the purpose of this work consists in making cultural and natural phenomena as personal experiences that resonate with individuals' daily lives, deepening their emotional connection to the place and inspiring sustainable habits. Communicating natural heritage is not just about providing information, it's about fostering connections, encouraging reflection, and promoting stewardship. The manual invites parks managers to experiment with new forms of storytelling that can transform visitors' approach to protected areas into meaningful, lasting experiences.





HUMANITA impact and long-term sustainability: Key outputs and results

The HUMANITA project focuses on enhancing awareness and fostering responsible behaviour towards natural heritage sites by visitors. It aims to address the environmental impacts caused by tourism, such as soil erosion, wildlife disturbance, and pollution. The project's outputs include tools and methodologies for effective communication, with a focus on participatory approaches and heritage interpretation. Key outputs include guidelines for developing compelling narratives, training materials for practitioners, and strategies for improving visitor engagement in conservation efforts. These outputs are designed to help create sustainable tourism practices and raise awareness about human impacts on natural environments. **It is important to emphasise that the model is replicable, and the materials can be used by other parks and protected areas:**



Transnational monitoring strategy

Transnational monitoring strategy sets the framework for the development, testing, and evaluation of a monitoring system that supports visitor management activities of pilot sites within the INTERREG Central Europe project HUMANITA. It is also the framework for pilot actions, based on the report on best practices and gaps to monitor environmental impacts of tourism and report on tourism impacts at pilot sites. Indicators and methods were selected by relevance, validity, practicality, clarity, credibility, and public interest.

Pilot actions testing new innovative monitoring methods and approaches

Following the approach of the jointly developed **Transnational monitoring strategy**, five (5) pilot actions were developed for the purpose of testing new methods and approaches to collect information on chosen indicators that provide a strategic and accessible overview of the impact of different tourist activities on natural values in protected areas.

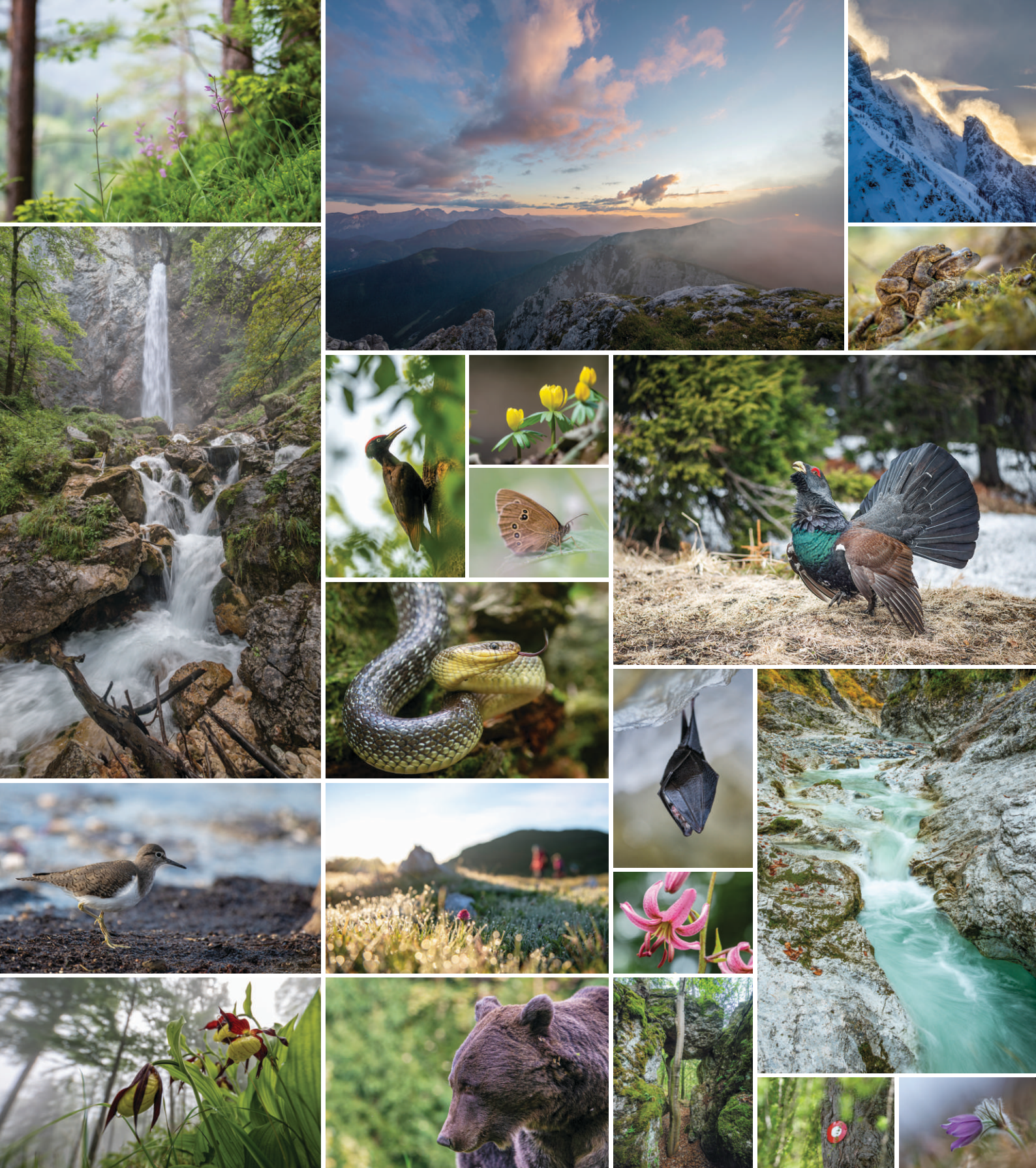


Solutions assessing the impact value of different types of tourist activities on nature

Innovative solutions (technological, methodological) were jointly developed to assess the impact of tourist activities on natural values, to provide complex information on changes and trends in the condition of the environment, for the purpose of meeting the visitor management use requirements in the protected areas.

Local action plans to monitor and resolve human-nature conflicts in pilot sites

Local action plans were developed for pilot sites to provide a framework for the protected areas to monitor human impacts, further engage local people and tourists in monitoring and nature protection, develop proactive programs for managing ecosystems and their use by visitors, and properly manage human-nature conflicts respecting the local context and legal framework.



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