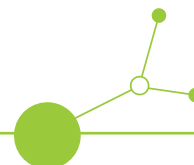


## D.2.2.3 PILOT ACTION IN PILOT AREA 3 THE SLOVAK KARST & NORTH HUNGARIAN MTS. (SK, HU) EURASIAN LYNX

O.2.3 Pilot Action implemented in the Slovak-Karst & North Hungarian Mountains on the monitoring, poaching prevention and conflict prevention of wolves

Activity 2.2 Implementation of Pilot Actions in 4 pilot areas in the Carpathians



Version: March 2026





# PILOT ACTIONS IN PILOT AREA 3 THE SLOVAK-KARST & NORTH HUNGARIAN MOUNTAINS (SK, HU) EURASIAN LYNX

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# Contents

<b>1. Introduction</b> .....	<b>3</b>
<b>2. Introduction to the pilot area</b> .....	<b>4</b>
<b>3. Pilot activities: monitoring harmonisation</b> .....	<b>6</b>
3.1 Camera trapping.....	6
3.2 Non-invasive genetic sampling .....	13
3.3 Synthesis of the main results .....	14
<b>4. Pilot activities: conflict prevention</b> .....	<b>22</b>
4.1 Monitoring/identification of livestock damages & attractants .....	22
4.2 Installation and testing of additional preventive measures .....	23
<b>5. Pilot activities: poaching prevention</b> .....	<b>37</b>
5.1 Seminars for police investigators .....	37
5.2 Survey to assess current practices .....	39
5.3 Survey to assess current practices at an international webinar .....	40
<b>6. Conclusions</b> .....	<b>41</b>
<b>7. References</b> .....	<b>43</b>





## 1. Introduction

The Slovak Karst and North Hungarian Mountains transboundary pilot area is located in the southern part of the Inner Western Carpathians along the Hungarian-Slovak border. It includes parts of the North Hungarian Mountains, the Slovak Karst and the Aggtelek Karst. The area is of key importance for large carnivore conservation especially for the Eurasian lynx (*Lynx lynx*) as the Western Carpathians are widely assumed to support a large and significant Eurasian lynx population (Breitenmoser et al. 2000; von Arx et al. 2004; Hell et al. 2004). Historically, the Slovak Karst and its adjacent regions served as a stronghold for the species and provided source populations for multiple lynx reintroductions to Western Europe (Slovenia, Italy, Austria, France, Switzerland and the Czech Republic) in the 20th century (Zatroch 2014).

The recent situation in Ukraine, which has led to new border fences and further fragmentation of the Carpathian lynx population, has increased the conservation significance of maintaining a healthy lynx population in the Western Carpathians. Furthermore, this region is currently the only area in Hungary where large carnivores occur permanently. In addition to lynx, the presence of wolves (*Canis lupus*) and brown bears (*Ursus arctos*) has been documented for decades, although bears appear only sporadically on the Hungarian side and no reproduction has been recorded so far.

Under the LECA project, the pilot actions focused on three interconnected pillars: monitoring of lynx and other large carnivores, poaching prevention, and conflict prevention and mitigation. Together, these activities helped building trust and strengthening cooperation among stakeholder groups while improving standards of predation prevention. They also provided practical tools to reduce human-large carnivore conflicts in the transboundary region.

Monitoring activities applied a combination of methods, including field mapping, recording life traces, non-invasive genetic sampling and camera trapping across a 10 × 10 km grid. These approaches enabled the identification of species occurrences and the creation of standardized SCALP and occurrence maps. These maps provide harmonised information on the status and distribution of lynx and other large carnivores, forming the basis for lynx population estimate in the pilot area.

Conflict prevention efforts addressed the most common source of conflicts between the large carnivores and the local communities: livestock depredation - especially by wolves - and, particularly in Hungary, the need to raise awareness after decades of large carnivore absence. Detailed depredation data were collected from national and regional authorities at the district level. In addition, several preventive tools were tested and demonstrated in cooperation with local farmers to improve prevention standards in the area. These included multi-wire predator-proof electric fencing, providing livestock guarding dogs, and predator deterrent devices.

Poaching prevention was addressed through participatory monitoring efforts and facilitating cross-border dialogue between stakeholders. Dedicated cross-border seminars was held for police investigators, customs officers and other law enforcement authorities highlighted the scale of wildlife crime in the Western Carpathians, shared best practices in forensic investigation, and fostered cooperation through various institutions, organisations, and environmental police. Genetic analyses were presented as a key tool for forensic evidence, enabling species and individual identification and supporting the prosecution of illegal activities.



## 2. Introduction to the pilot area

The transboundary pilot area is located in the southern part of the Inner Western Carpathians along the Hungarian-Slovak border. It encompasses the middle and eastern ranges of the North Hungarian Mountains, the Aggtelek Karst, and the Slovak Karst. The pilot area includes three national parks: Bükk National Park and Aggtelek National Park on the Hungarian side, and Slovak Karst National Park on the Slovak side, as well as several protected landscape areas (Fig. 1.).

Elevation ranges approximately from 300 to 1,000 meters. The average annual temperature is between 8 and 10°C, while annual precipitation varies from 600 to 800 mm. In recent decades, the number of snowy days has significantly decreased on the Hungarian side, averaging only about 11 snowy days per year today.

The landscape is dominated by deciduous forests interspersed with hay meadows, pastures, croplands, vineyards, and settlements. At lower elevations, Turkey oak (*Quercus cerris*) woodlands prevail, while higher elevations and plateaus support sessile oak-hornbeam (*Quercus petraea* and *Carpinus betulus*) and beech (*Fagus sylvatica*) forests. The karst depressions on the Slovak side are primarily covered by spruce (*Picea abies*). Much of Hungary's remaining old-growth beech forest is found within this pilot area, although overall forest naturalness remains moderate.

Human activities shape much of the landscape. In addition to forestry and game management, viticulture, grazing, and various agricultural practices are widespread. The region also holds significant biodiversity value and is an important destination for ecotourism. The eastern part of the pilot area, in particular, is well known for its caves and distinctive karst formations. Most of the human population is concentrated in valleys and along the edges of the karst regions, mainly in small towns and villages. However, population numbers in the pilot area show a general declining trend<sup>1</sup>.

Lynx, bear, and wolf populations all occur locally within the pilot area. Large carnivore populations on the Slovak side typically function as source populations for neighbouring Hungarian regions. Historical records also indicate that lynx from the Slovak Karst were used in reintroduction programmes in Western Europe (Von Arx et al., 2009, Zatroch 2014). On the Hungarian side, data confirm the permanent presence of wolves and lynx for several years, while bear occurrences have also increased recently, though reproduction has not yet been documented.

Wolves are generally considered the most conflict-prone species in the region, primarily due to their real or perceived impacts on livestock and game species. While the knowledge about the local lynx population is limited.

<sup>1</sup> [https://www.ksh.hu/stadat\\_files/nep/hu/nep0034.html](https://www.ksh.hu/stadat_files/nep/hu/nep0034.html)

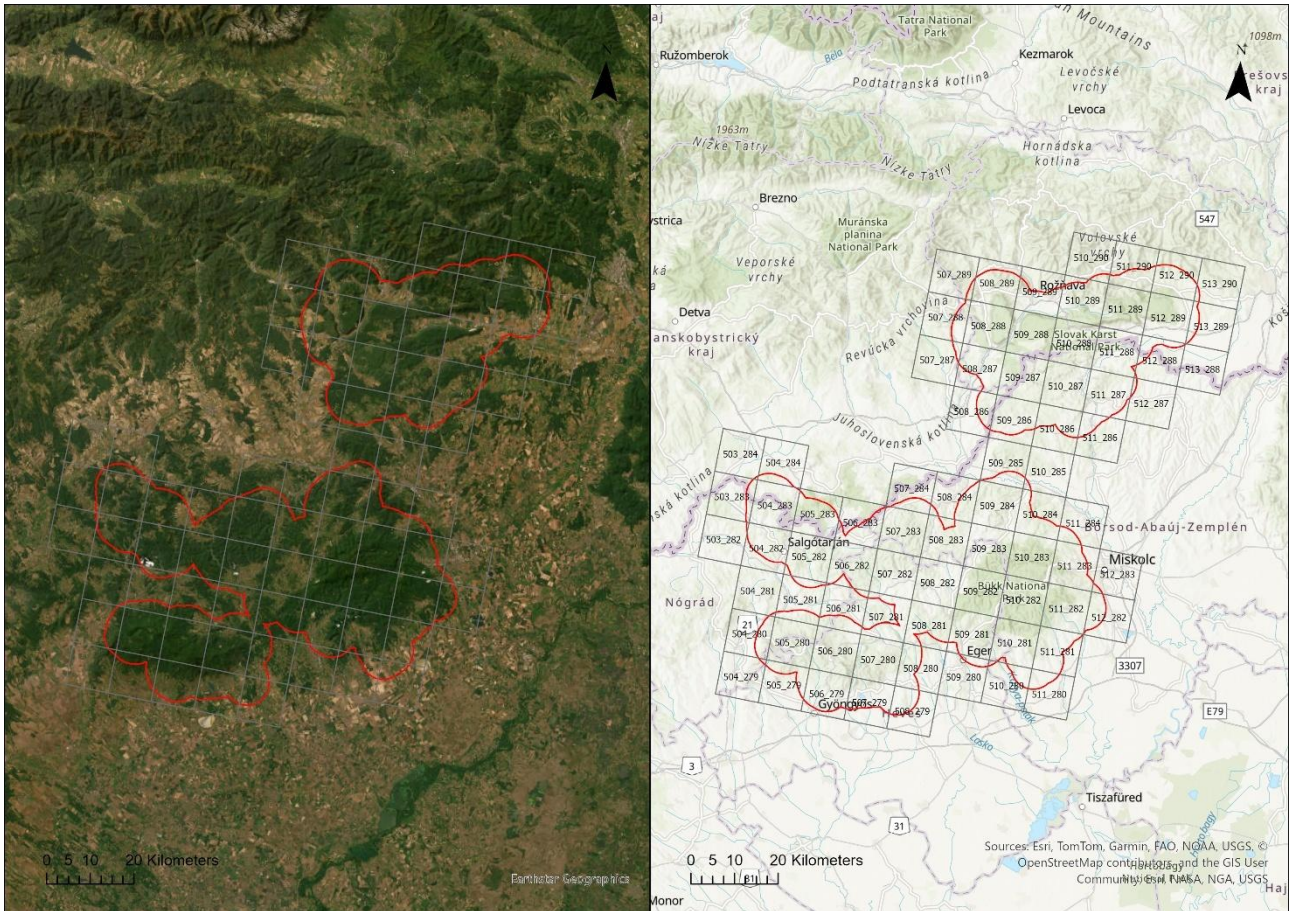


Figure 1.: The cross-border study area Slovak Karst and North-Hungarian Mts. situated in the southern part of the Inner Western Carpathians along the Hungarian-Slovak border region with pre-defined pilot border (red) and 78 mapping grids (EEA 10x10 km).



## 3. Pilot activities: Monitoring harmonisation

### 3.1 Camera trapping

#### 3.1.1. Monitoring approach, data collection and analyses

The monitoring was coordinated by WWF Hungary (WWF HU; PP4) and carried out by WWF Hungary (PP4) with the involvement of several external partners, including the Istenmezeje Hunting Association, the EGERERDŐ Forestry Company, the associated project partner the Aggtelek National Park Directorate (ASP5), WWF Slovakia (WWF SK; PP3), the Bükk National Park Directorate (BNP; PP6), and the State Nature Conservancy of the Slovak Republic (SNC SK; PP8). The monitoring covered the approximately 4,448 km<sup>2</sup> pilot area and included a total of 78 predefined European Environmental Agency (EEA) 10 × 10 km grid cells.

The monitoring and data collection was conducted during periods 1-4, in accordance with the detailed action plan (D.2.1.1), to the extent permitted by the availability of technical equipment, partner training, and local collaborators. From March 2023 onward, field monitoring began with mapping and documenting large carnivore signs (e.g., tracks, scats etc.) (Fig. 2.) and collecting samples for genetic analysis (see details in chapter 3.2). These data were used for the occurrence maps and the identification of the most suitable locations for deploying camera traps.



Figure 2.: Lynx tracks in the snow in the Slovak part of the pilot area (photo © A. Ambruš)

Camera trap monitoring was gradually initiated from 2023 September. In total, more than 170 camera traps were deployed within the pilot area, in addition to the cameras operated by collaborating hunters, foresters, and conservationists such as Bükk Mammalogical Society (HU). Monitoring efforts were conducted in a participatory manner: in Hungary, 30 cameras (out of the 100) were managed by the Istenmezeje Hunting Association and the EGERERDŐ Forestry Company, directly contributing to the data collection and monitoring.



Camera trapping is a particularly effective method for monitoring spotted felids such as the Eurasian lynx (Karanth & Nichols, 1998; Rovero & Zimmermann, 2016). Individuals can be identified non-invasively by their unique coat patterns (Fig. 3), with the benefit of avoiding the need for physical marking (Duľa et al., 2021; Kubala et al., 2019). Recording these patterns provides reliable information for individual identification. To increase the probability of photographing and identifying lynx during capture-recapture surveys, deterministic (intensive) and opportunistic (extensive) camera trapping monitoring was carried out in the pilot area.



Figure 3.: Identification of the same lynx individual at two different locations, based on its unique coat pattern (photo © B. Tám).

Due to the initial limited knowledge about lynx distribution in the pilot area monitoring began with the opportunistic approach. Although this method often does not allow proper capture-recapture analyses and therefore has limited statistical reliability, it enables estimation of the minimum number of lynx present, providing information on locations with identified individuals and enables the identification of new individuals, occasionally documents reproduction success, dispersal distances, and patterns of spatial use and generally allowing larger spatial coverage with only one camera per location. Furthermore, pre-identification of individuals significantly improves the accuracy and robustness of subsequent deterministic surveys. Opportunistic monitoring also serves as a tool for capacity building and scientific communication, supporting the integration of the monitoring framework into local communities. Cameras were deployed based on a preliminary field assessment that identified potential lynx locations using mapped field signs. Opportunistic monitoring was gradually initiated from September 2023, depending on equipment availability, and was primarily conducted from the end of spring in 2024 across the entire pilot area. During the opportunistic phase the cameras were systematically moved around the suitable monitoring grids in the pilot area deploying at the locations with the highest probability of detecting the Eurasian lynx.



Figure 4.: Monitoring location with a camera trap (photo © B. Tám)

The opportunistic phase was followed by the deterministic survey. For this, the study area was systematically subdivided into  $2.5 \times 2.5$  km grid cells following established methodological standards (e.g., ZIMMERMANN et al., 2013). Camera stations were installed in every second grid cell containing suitable habitat, with each station consisting of two cameras positioned in opposite directions to maximise detection probability and ideally capture both flanks of each individual. Individual lynx were subsequently identified by visual inspection of their individual pelage patterns.

The deterministic survey was carried out over an 80-day period, from 24 November 2024 to 17 February 2025. Winter and early spring coinciding with the pre-mating and mating season of the lynx are considered optimal for systematic monitoring due to biological factors (increased lynx activity), reduced human disturbance, and favourable environmental conditions. However, the deterministic monitoring was only initiated in the northern part of the pilot area, specifically in the Slovak Karst and Aggtelek regions, while the rest of the pilot area carried on with the opportunistic approach. This limitation resulted from the findings of the opportunistic monitoring phase, which detected lynx presence exclusively on the Slovak side of the pilot area, the Slovak Karst, and even there only at five locations, while no signs of the species were detected in Hungary. During the deterministic monitoring, a total of 46 camera stations were deployed within the 1,116.5 km<sup>2</sup> monitored area in the northern section of the pilot area.

For the population size estimation, the Spatial Capture-Recapture (SCR) approach was used, following established methodologies (Duľa et al., 2021; Kubala et al., 2019). For the estimation only individuals older than one year (i.e., independent lynx) were included in the analysis. Lynx cubs were excluded because they are considered non-resident as after separating from their mother, they are typically forced to disperse by



resident individuals. The population density (abundance of independent individuals per 100 km<sup>2</sup> of suitable habitat) was estimated based on the SCR method. For this, a 10 km buffer was added to the monitored area of 1,116.5 km<sup>2</sup>, corresponding to the average home range radius of Eurasian lynx in the region (Kubala et al., 2024). In the next step the proportion of suitable and unsuitable habitat was examined, for this data was derived from Landsat and LUCAS data (Pflugmacher et al., 2018). Suitable habitat included all forest types (deciduous, coniferous, and mixed) as well as shrublands and pasture habitats, whereas human settlements and agriculture were classified as unsuitable habitat. After excluding the unsuitable habitats within this expanded area, a total of 2,934.8 km<sup>2</sup> of suitable habitat remained and was used for the lynx density estimation (Fig. 5.).

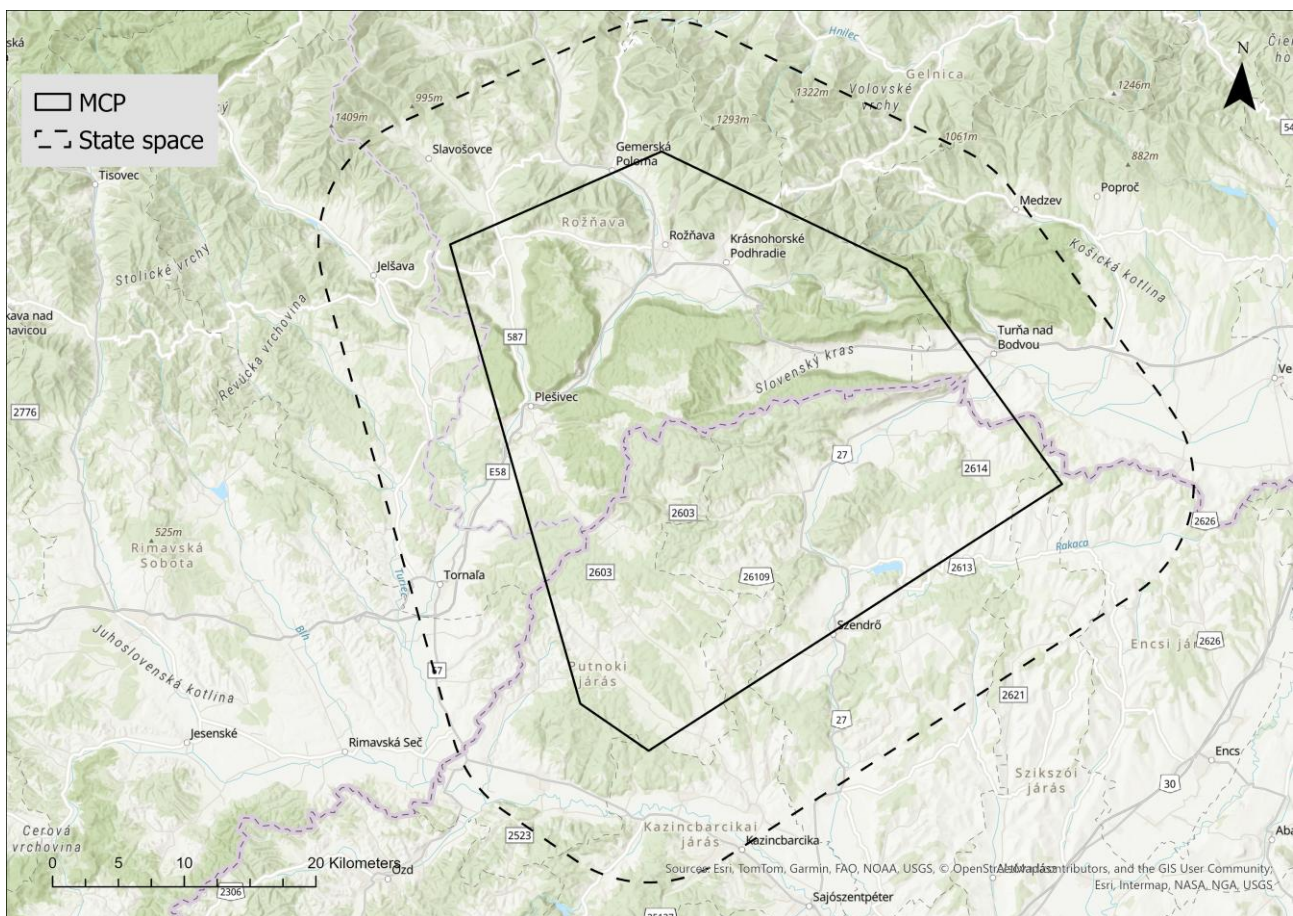


Figure 5.: Schematic representation of the Slovak Karst and North Hungarian Mountains pilot area, encompassing the Slovak Karst (SK) and Aggtelek National Park (HU). The monitored area is indicated by the continuous black line (MCP), while a 10 km buffer is added indicated by the dashed line (State space), which is corresponding to the average home-range radius of Eurasian lynx in the region.

### 3.1.2. Results, population size and density

The cumulative survey effort of the deterministic monitoring amounted to 3,680 effective trap nights (number of monitoring days × number of active stations). During the survey, two camera stations were stolen. Throughout the deterministic monitoring the lynx was detected only at 6 of the 46 monitored stations (13.04%), and two distinct adult (1yr.<) individuals and a cub were identified (Fig. 6.). Unfortunately, as in the opportunistic phase, lynx records were confined exclusively to the Slovak side of the study area during the deterministic monitoring as well.



The statistically estimated Eurasian lynx population within the Slovak Karst (SK) and Aggtelek (HU) National Parks was  $3.03 \pm 1.05$  adult individuals, corresponding to a density of  $0.1 \pm 0.03$  lynx per 100 km<sup>2</sup>. These results may indicate a critical state of the red lynx population in this area and call for conservational actions, as the estimated density represents only a fraction of that observed in other parts of the Slovak Carpathians ( $\sim 1$  ind./100km<sup>2</sup>, see: Kubala et al. 2021), although this area was historically a stronghold of the species. The population size of the Eurasian lynx in the Slovak Carpathians is, based on results obtained through systematic robust monitoring estimated at an average population density of  $1.15 (\pm 0.29)$  lynx per 100 km<sup>2</sup> (Duľa et al. 2021; Kubala et al. 2017; 2023).



Figure 6.: Lynx female with a kitten captured during deterministic monitoring in Slovak Karst NP (photo © WWF SK).

Although the target species of the monitoring was the Eurasian lynx in our pilot area, the monitoring was also able to provide valuable data recording multiple photos and videos about other large carnivores and protected species as well such as wolves, brown bears, wild cats (*Felis silvestris*) and one occasion a Eurasian otter (*Lutra lutra*). On the Slovak side of the pilot area, we managed to capture a huge number of stray dogs (*Canis lupus familiaris*), several golden jackals (*Canis aureus*), and even alien invasive species such as raccoon (*Procyon lotor*) on our camera traps.



Figure 7.: Photo collage of stray dogs recorded on the Slovak side of the pilot area (Slovak Karst National Park) during monitoring in 2023-2025



Figure 8.: Photo collage of jackal and raccoon recorded on the Slovak side of the pilot area (Slovak Karst National Park) during monitoring in 2023-2025



Figure 9.: Brown bear in the Bükk Mts. (photo © WWF HU & EGERERDŐ Forestry Company)



Figure 10.: Wolves in the Mátra Mts. (photo © WWF HU & EGERERDŐ Forestry Company)



## 3.2 Non-invasive genetic sampling

### 3.2.3. Monitoring approach, data collection and analyses

As part of the implementation of project activities under the approved detailed action plan D.2.1.1, genetic sample collection of all large carnivore species was carried out on the Hungarian side of the pilot area. The Bükk National Park Directorate (PP6) was responsible for coordinating the sampling effort. Genetic samples - primarily scats - were collected even before the originally planned P2 period, with sampling taking place between P1 and P4. The fieldwork was most intensive during the colder months between October and April.

Samples were gathered opportunistically by staff from both the Bükk (PP6) and Aggtelek (ASP5) National Park Directorates across the entire pilot area, with occasional contributions from various stakeholder groups. Sampling focused on forest roads, marking sites, animal trails, and routes used during snow tracking. Additional samples were obtained at conflict locations, including suspected livestock depredation sites and wildlife-vehicle collision scenes where carcasses were available. Samples were typically collected using swabs and preserved in ethanol tubes; during colder periods, portions of scats were collected and stored frozen until analysis. Whenever possible, urine was also collected from snow during winter fieldwork.

Over the course of the project, a total of 100 genetic samples were collected and analysed, including one potential lynx sample outside of the pilot area, from Börzsöny as a reference.

The primary objectives of the genetic sampling were to further confirm the presence of the different large carnivore species and to enable parental or kinship analyses. The Hungarian University of Agriculture and Life Sciences in Gödöllő served as the responsible institute for laboratory analyses. Species identification was performed using mitochondrial 16S rRNA gene sequences and the D-loop control region, while individual identification relied on species-specific microsatellite markers. The results were compared with previously obtained genetic datasets for these protected species.

### 3.2.4. Results

Of the 100 collected samples, 83 were identified as canid, 12 as felid, and 5 as ursid in origin.

Among the canid samples, 66 were successfully identified to at least the species level. Of these, one sample belonged to red fox and five to domestic dog, while all remaining successfully identified samples were confirmed as wolf. Complete genotypes were obtained for 31 wolf samples (13 males and 18 females). Two individuals were detected through genetic recapture. Comparison with previously analysed Hungarian wolf samples revealed two distinct related groups (packs) within the dataset.

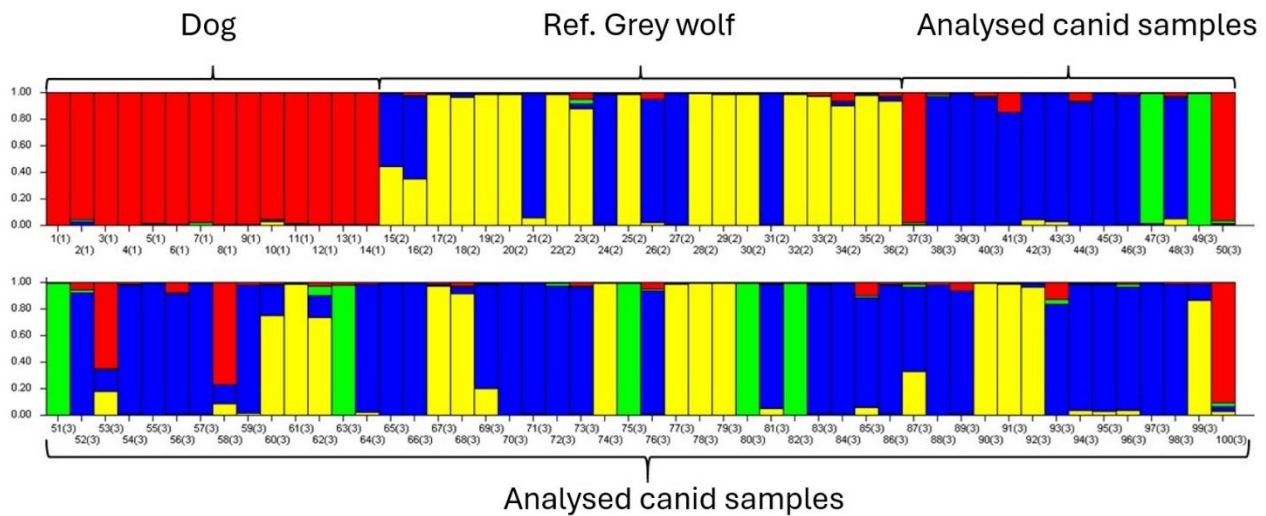


Figure 11.: Result of the Structure analysis of microsatellite (STR) data for dog (red) and grey wolf reference samples (yellow, blue) at K= 4.

Of the 12 presumed felid samples, one could not be assigned to species. Nine samples were identified as either wildcat or domestic cat. One sample's 16S rRNA sequence matched the mitochondrial region of red fox, while another matched the mitochondrial region of Eurasian lynx (reference sample from the Börzsöny).

For the ursid samples, individual identification using microsatellite markers was successful for four presumed brown bear samples, each representing a unique individual (presumably recorded by our cameras, see Fig. 11.). This individual was compared with the previously identified brown bears in Hungary, but no genetic matches were detected.

### 3.3 Synthesis of the main results

Our mapping approach followed the methodology developed by the Large Carnivore Initiative for Europe (Chapron et al., 2014; Kaczensky et al., 2013, 2024) and the Status and Conservation of the Alpine Lynx Population (Molinari-Jobin et al., 2003; Molinari-Jobin et al., 2012). It was based on the data collected during the monitoring period - comprising indirect field signs, genetic samples, and non-invasive camera trap records gathered, processed and analysed between March 2023 and March 2025. Although the dataset is primarily based on data collected through our systematic monitoring, complemented by national and regional monitoring activities. It also incorporated findings from ongoing research and conservation projects.

The large carnivore (LC) data were mapped at a 10 × 10 km ETRS89-LAEA Europe grid scale. This grid system, widely used for Flora-Fauna-Habitat (FFH) reporting by the European Union, was downloaded from the European Environment Agency on June 9, 2023 (<http://www.eea.europa.eu/data-and-maps/data/eea-reference-grids-2>). Data for each monitored grid cell (grid) were classified according to carnivore presence and frequency as follows:

- Confirmed presence
- Unconfirmed presence

When a grid covered more than one country and the countries presented different results, the higher presence value was assigned. To assess the quality, robustness, and reliability of the available data, we applied the SCALP criteria developed for the standardized monitoring of lynx in the Alps (Molinari-Jobin et al., 2003; Molinari-Jobin et al., 2012):



- Category 1 (C1): “Hard facts” – verified and undisputed LC presence records (e.g. dead, injured, orphaned, captured or collared animals; verified camera-trap images; or genetic samples such as scat, urine, hair, or saliva confirmed through laboratory analyses).
- Category 2 (C2): Verified expert observations – LC presence signs (e.g. depredated livestock or wild prey, tracks, other field signs, scat, or documented LC calls) that have been checked and confirmed by an LC expert (e.g. a trained member of the monitoring network) and are supported by documentation.
- Category 3 (C3): Unconfirmed records – unconfirmed C2 LC presence signs, as well as all other presence signs such as sightings or calls that are undocumented and cannot be independently verified.

The collected data were shared among project partners and validated in accordance with the SCALP methodology. Following validation, the dataset was used to produce SCALP-based distribution and occurrence maps for the Eurasian lynx, brown bear, and grey wolf. For lynx and wolf, distribution maps were generated using species-specific monitoring years (WY), defined as the period from 1 May to 30 April of the following year, specifically for the 2023-2024 and 2024-2025 monitoring years. In contrast, brown bear distribution was mapped using calendar years, with separate datasets compiled for 2023 and 2024.

However, it must be noted that monitoring effort was not equal in all of the grids and for all species, therefore no confirmed presence does not strictly mean that the species is not present in certain grids.

### 3.3.1. Status & distribution/occurrence maps: Eurasian lynx

#### 3.3.1.1. SCALP map

Lynx C1 presence was verified in 3 mapping grids (3.8% in total) during the 2023/24 monitoring year, based on mostly camera-trap records (Fig. 12.). In 2024/25, the number of grids with confirmed C1 evidence rose to 7, representing 8.9% of all grids.

In 2023/24, evidence of C2 lynx presence was documented in 2 mapping grids (2.5%). In the following monitoring year (2024/25), the number of sites with C2 evidence confirmed by C1 occurrence. The number of sites with C3 evidence was only in 1 mapping grid (1.2%).

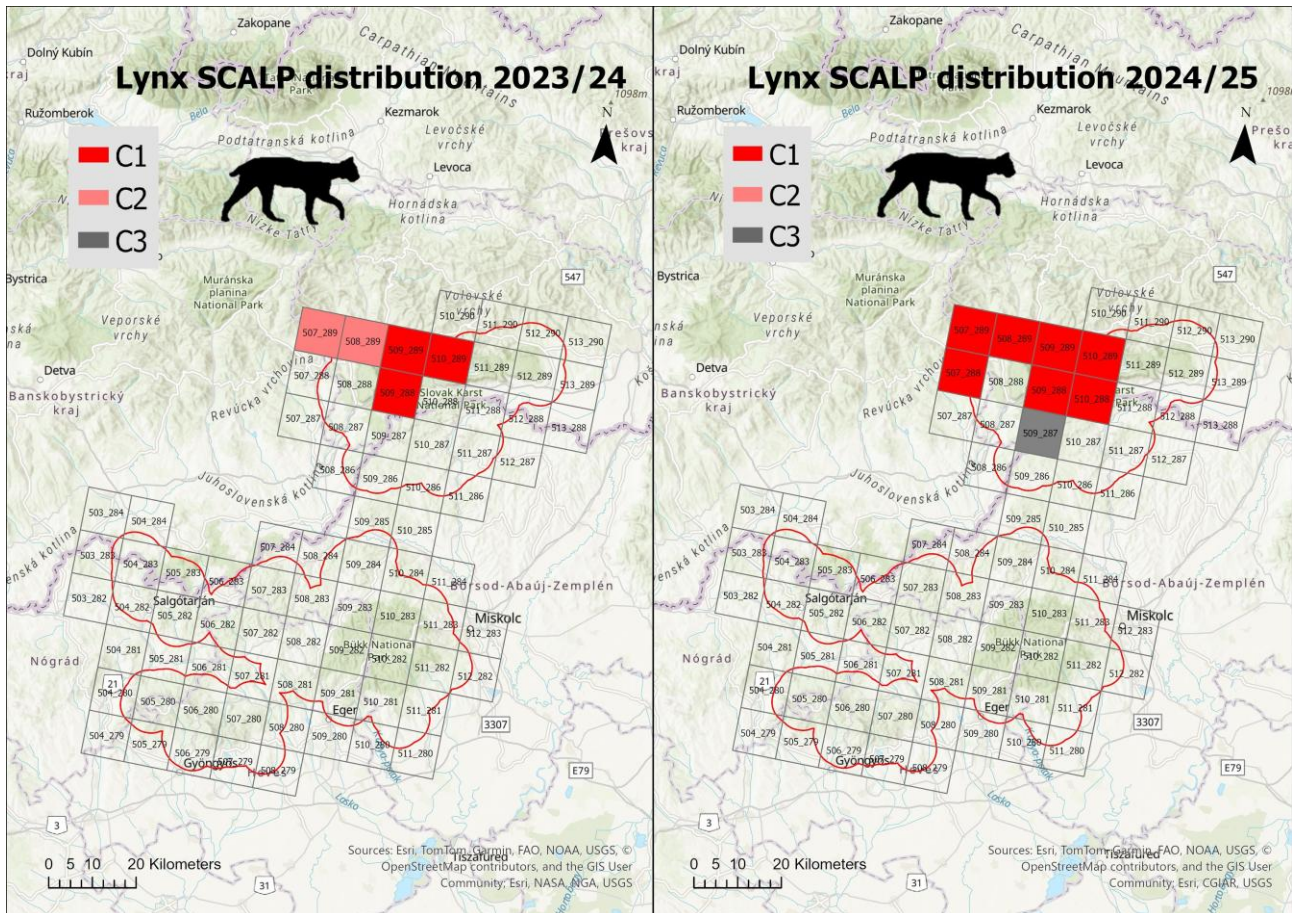


Figure 12.: Distribution of the Eurasian lynx in the Slovak Karst and North Hungarian Mountains pilot area, based on C1-C3 records validated according to the SCALP methodology, mapped at the EEA 10 × 10 km grid level for two consecutive lynx years (2023/24 left; 2024/25 right).

In 2024/2025, reproduction was also confirmed, where a female with one kitten were recorded on camera traps in the Slovak part of the Slovak Karst.

### 3.3.1.2 Occurrence map

A harmonized approach was used both for the calibration process and for presenting large carnivore data at a broader scale. Lynx presence was confirmed only on the Slovak side of the pilot area, in 5 grids (6.4%) during the 2023/24 monitoring year and increased to 7 grids (8.9%) in 2024/25 (Fig. 13.). The confirmed occurrence in these grids was based solely on C1 and C2 evidence, namely camera-trap records and verified indirect field signs such as scats or tracks, following the methodology outlined by Kaczensky et al. (2024).

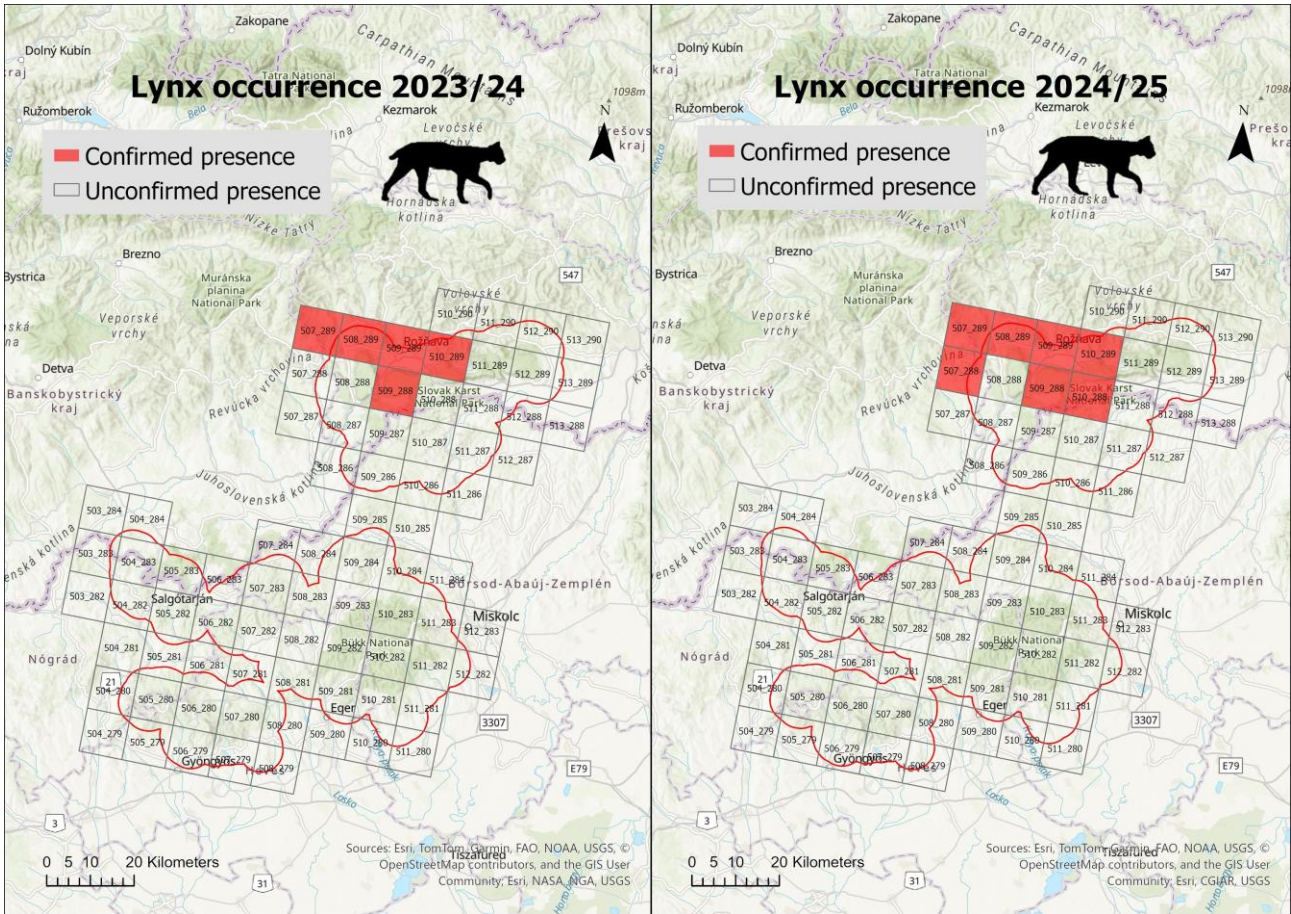


Figure 13.: Confirmed lynx presence based on SCALP-validated data (C1 and C2) at the EEA 10×10 km grid level for 2023/24 and 2024/25, with pre-defined pilot border (red line). The presence of the Eurasian lynx in the pilot area of the Slovak Karst and the Northern Hungarian Mountains was confirmed only on the Slovak side.



Figure 14.: Photo collage of a resident male (Sultan) recorded on the Slovak side of the pilot area (Slovak Karst National Park) during monitoring in 2023-2025



### 3.3.2. Status & distribution/occurrence maps: Wolf

#### 3.3.2.1. SCALP map

Wolf presence, confirmed by validated C1 records (camera-trap photographs and genetic samples), was documented in 19 grids (24.3%) in 2023 and increased to 36 grids (46.15%) in 2024 (Fig. 15.).

During the 2023/24 monitoring year, C2 evidence of wolf occurrence was verified in 11 grids (14.10%). In the subsequent monitoring year (2024/25), the number of grids with C2 evidence declined to 3 grids (3.8%).

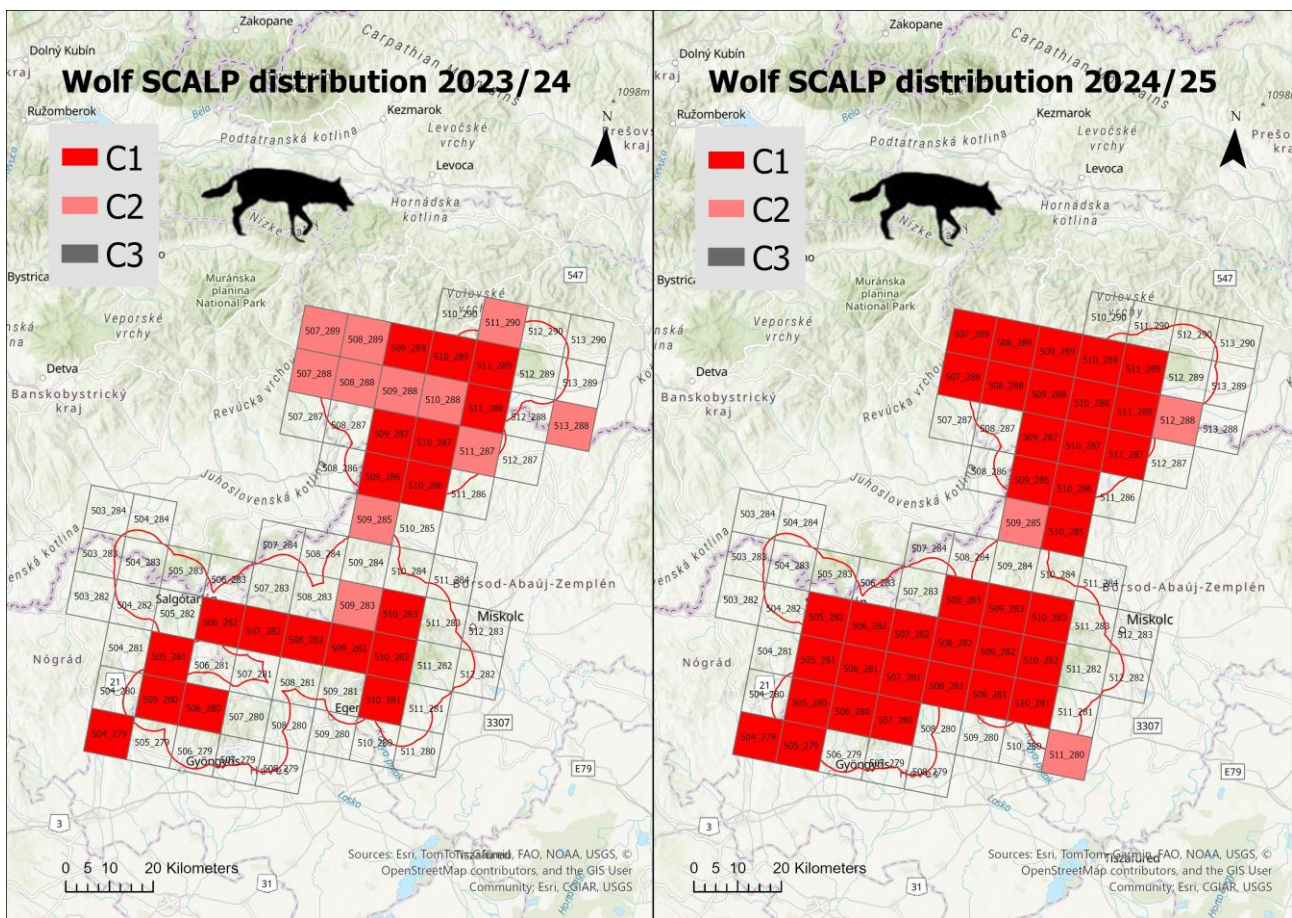


Figure 15.: Wolf distribution based on data (C1-C3) validated according to the SCALP methodology at the EEA 10×10 km grid level in the two consecutive wolf years (2023/24, 2024/25).

#### 3.3.2.2. Occurrence map

Wolf occurrence was confirmed in 30 (38.4% of all grids) mapping grids in the wolf year 2023/24 and in 39 mapping grids (50%) in the wolf year 2024/25. Confirmed presence in these grids was based only on C1 and C2 data (i. e., camera trap records, genetics, scats, etc.) following the methodology reported in Kaczensky et al. (2024) (Fig. 16.).

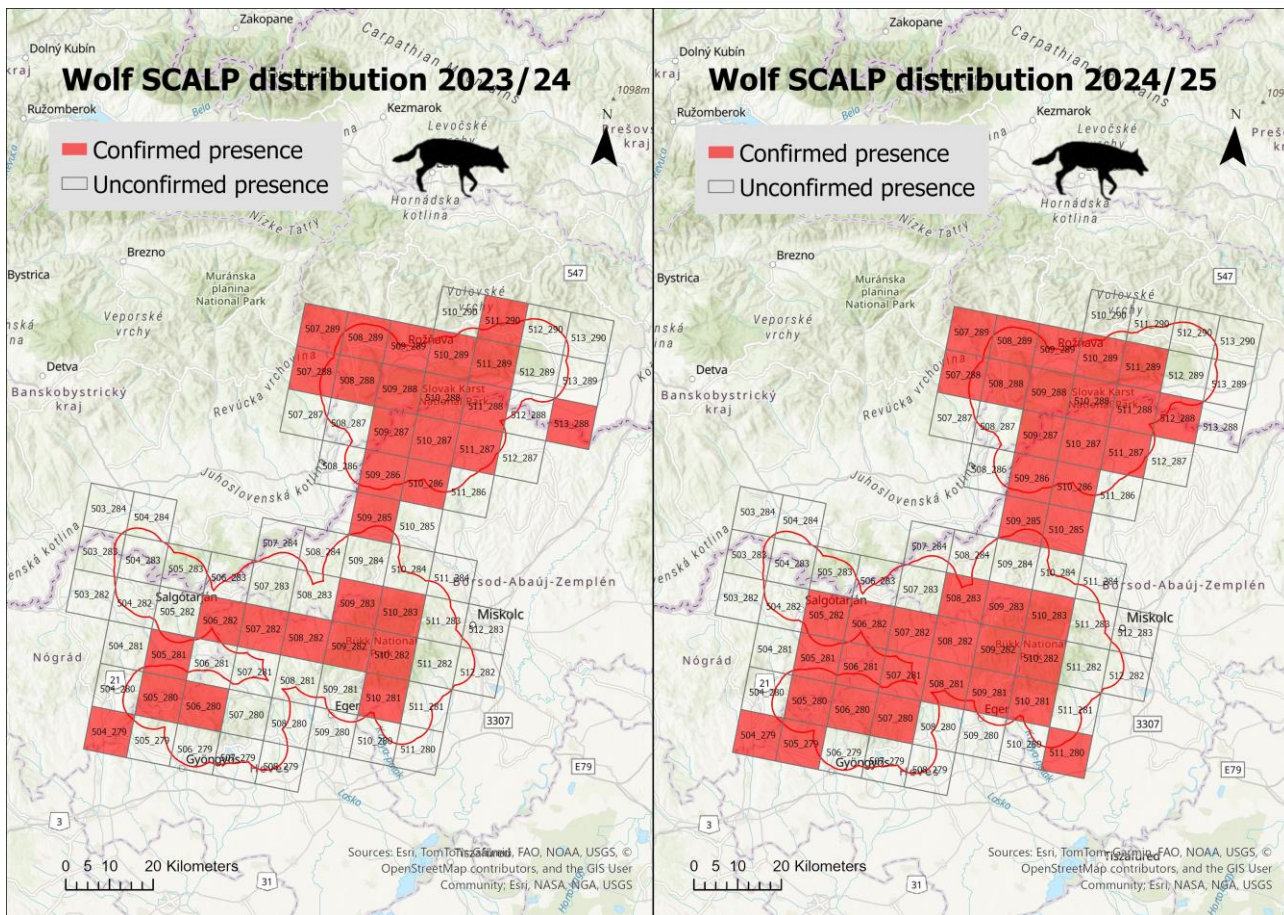


Figure 16.: Confirmed wolf presence based on SCALP data (C1 & C2) at the EEA 10x10 km grid level in the wolf years 2023/24 and 2024/25.



Figure 17.: Photo collage of wolves recorded on the Slovak side of the pilot area (Slovak Karst National Park) during monitoring between 2023-2025.



### 3.3.3. Status & distribution/occurrence maps: Brown bear

#### 3.3.3.1. SCALP map

Bear presence by validated C1 records (camera-trap records and genetic samples) was confirmed in 10 mapping grids (12.8% of all grids) in the year 2023 and in 5 grids (6.4% of all grids) in the year 2024 (Fig. 18.).

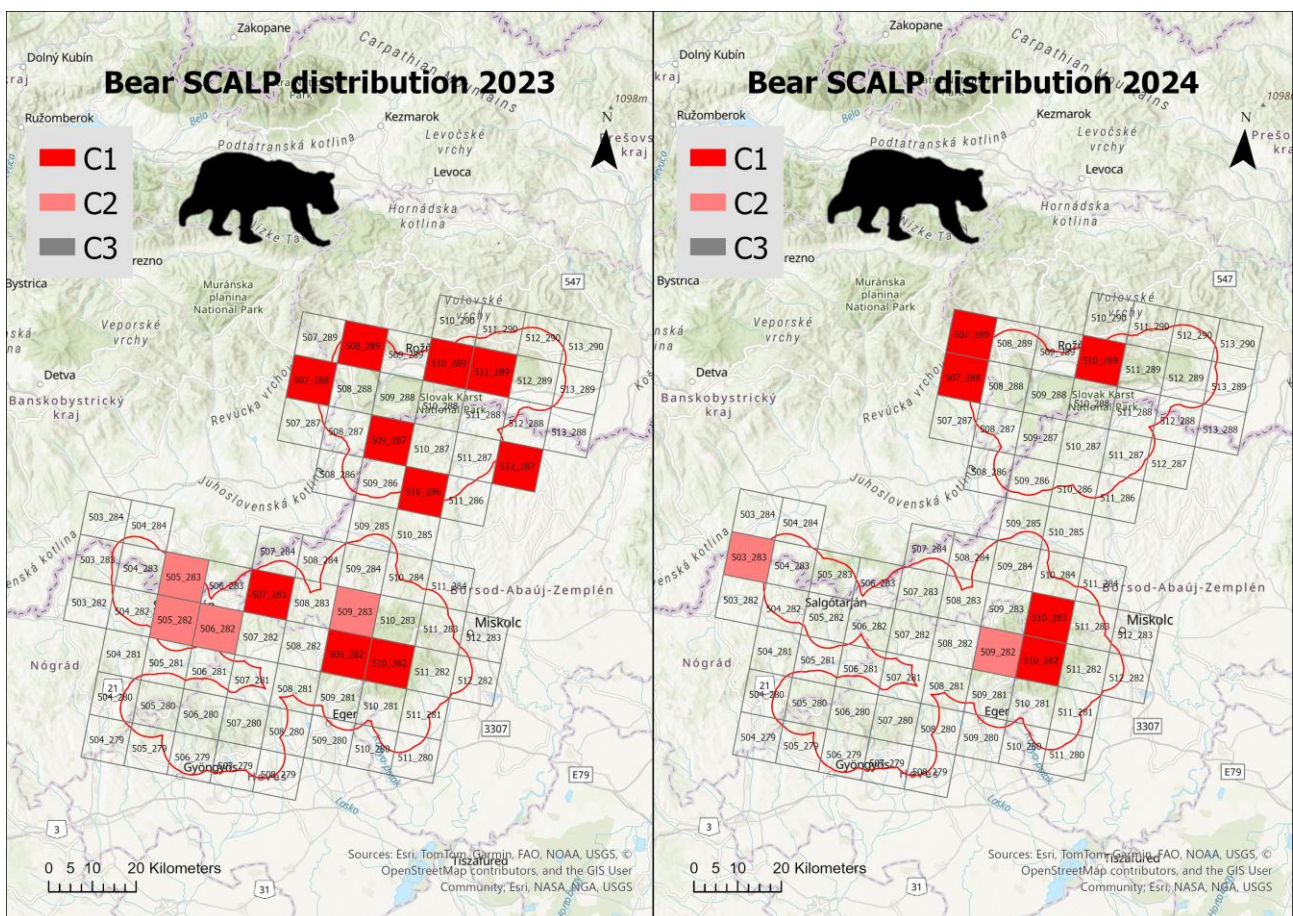


Figure 18.: Bear distribution based on data (C1-C3) validated according to the SCALP methodology at the EEA 10×10 km grid level in years 2023 and 2024.

#### 3.3.3.2. Occurrence map

Bear presence was confirmed in 14 mapping grids (17.9% of all grids) in the year 2023 and in 7 mapping grids (8.9%) in the year 2024 (Fig. 19.). Confirmed presence was based only on C1 and C2 signs of presence (i. e., camera trap records, tracks, scats etc.) following the methodology by Kaczensky et al. (2024) (Fig. 19.).

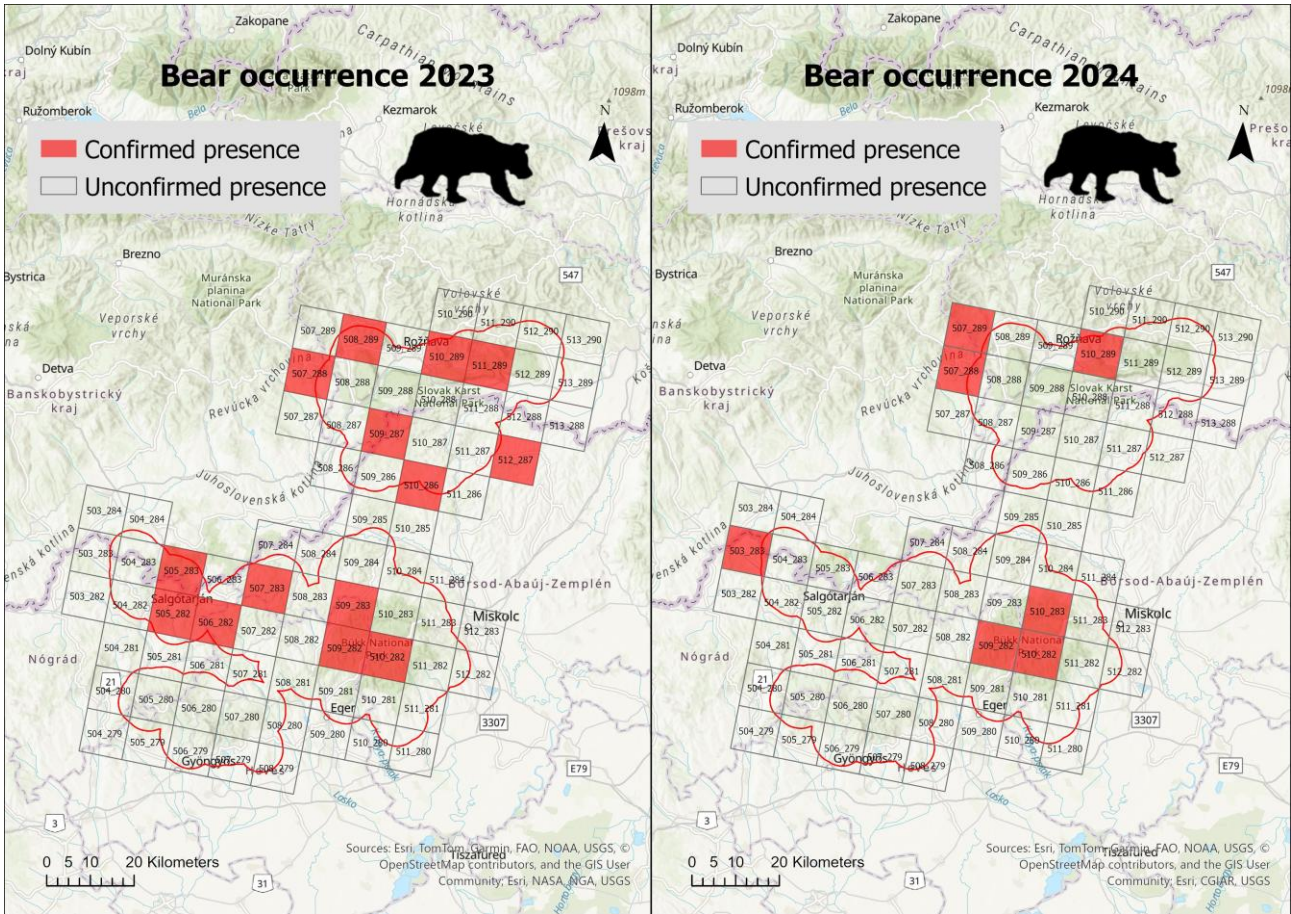


Figure 19.: Confirmed bear presence (C1 and C2 data) in the pilot area of the Slovak Karst and the Northern Hungarian Mountains pilot area in two consecutive years (2023, 2024).



Figure 20.: Photo collage of bears recorded on the Slovak side of the pilot area (Slovak Karst National Park) during the monitoring between 2023-2025.



## 4. Pilot activities: Conflict prevention

### 4.1 Monitoring/identification of livestock damages & attractants

#### 4.1.1. Methods, data collection and analyses

Human-wildlife conflict is one of the major conservation challenges of the 21st century. These conflicts are diverse and complex, typically arising from real or perceived damage or threats posed by wildlife to people and their livelihoods. Human-large carnivore conflicts in Europe follow the same trend. Predation is one of the most visible and contentious forms of conflict, generating economic losses, animal welfare concerns, and social tension in rural communities (Bautista et al., 2019; Bernardi et al., 2025; Chapron et al., 2014; Linnell, 2013; Linnell & Cretois, 2018; Madden, 2008; Zimmermann et al., 2020).

Reliable monitoring and accurate identification of livestock damages are essential for fair and effective conflict mitigation measures. Precise assessments ensure that farmers receive appropriate compensation, help reduce false claims and misconceptions about carnivores, and support informed decision-making regarding their management. Robust monitoring systems benefit all stakeholders: farmers gain clarity and support in managing risks, policymakers can rely on transparent and evidence-based programs, and conservationists strengthen coexistence efforts by building trust. As Europe strives to balance biodiversity conservation with agricultural sustainability, improving methods for documenting livestock damages is crucial to reducing conflict.

Effective mitigation of conflicts between large carnivores—particularly wolves—and livestock farming requires detailed and reliable data on livestock losses. To this end, data on large carnivore attacks on livestock and the number of depredated animals were evaluated for two consecutive wolf years (2023/24 and 2024/25). The assessment was based on available records from the Hungarian National Park Directorates and the State Nature Conservancy of the Slovak Republic (PP8). Only livestock damage cases confirmed by experts and/or supported by genetic evidence were included in the analysis.

#### 4.1.2. Results

In total, only five wolf attacks were documented during the two consecutive wolf years examined (2023/24 and 2024/25) in the Slovak Karst and North Hungarian Mountains pilot area (Fig. 21.). However, it should be noted that Hungary currently lacks systematic prevention and compensation schemes; consequently, livestock keepers have little incentive to report such incidents, and the actual number could differ.

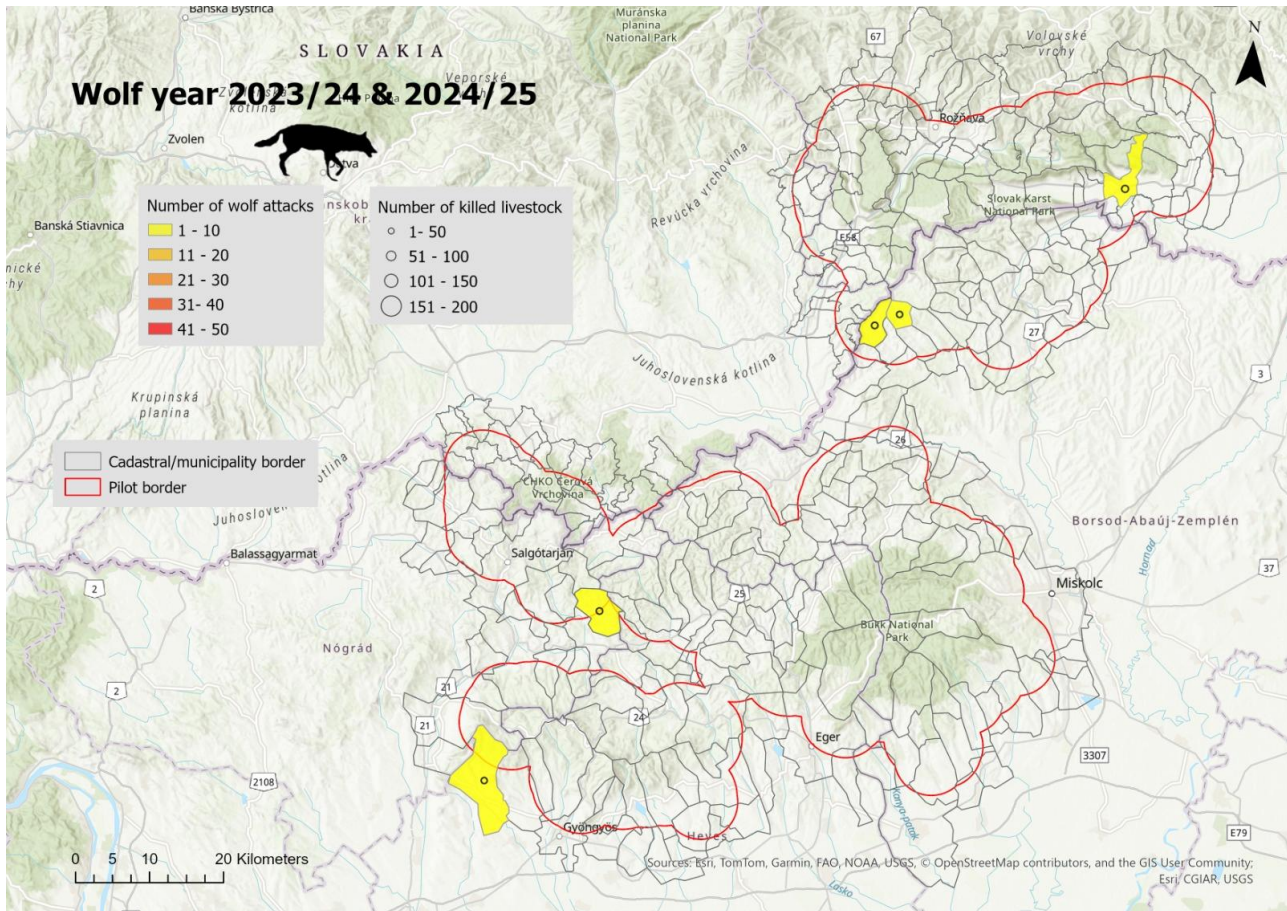


Figure 21.: Number and spatial distribution of confirmed wolf attacks in the Slovak Karst and North Hungarian Mountains pilot area during the 2023/24 and 2024/25 wolf years, mapped at the cadastral unit (SK) and municipality (HU) level.

## 4.2 Installation and testing of additional preventive measures

### 4.2.1. Methods, data collection and analyses

Although human-wildlife conflicts are often far more complex than livestock losses alone, practical tools remain essential for both mitigating conflicts and preventing escalation. Therefore, special attention was given not only to providing preventive tools for testing and demonstration, but also to building active collaboration with the farmers and livestock keepers involved. Their engagement throughout the project was a priority, as effective human-wildlife conflict management requires sustained, collaborative, and process-oriented interventions.

WWF Hungary (PP4) established active collaboration with six farmers starting from Period 2 and maintained this cooperation throughout the project. In Hungary, farmers typically have limited direct experience with and knowledge of effective prevention measures against large carnivore damage, resulting in the use of inadequate techniques (Fig. 22.). This situation is partly due to the fact that no operational systematic national prevention or compensation scheme currently exists in Hungary. Therefore, farmer communities generally refuse otherwise proven prevention tools, such as predator proof electric fence systems due to untrust and lack of funding.



Figure 22.: One of the most challenging tasks in Slovak Karst-North HU Mts. is reducing wolf-human conflict by improving preventive measures and ensuring their effectiveness. Many pastures remain with insufficient protection against large carnivores attacks in Hungary. (Photo Bükk NPD)

Consequently, the primary objective in Hungary was to demonstrate best practices, strengthen existing—but often insufficient—preventive systems, build awareness and trust among farmers, and transfer practical knowledge on how to install, configure, and maintain the provided tools while collecting valuable user feedback. With the exception of one collaborating farmer, none had prior experience with livestock depredation; however, all generally perceived large carnivores - particularly wolves - as a significant threat to their daily operations.

Throughout the project period, regular farm visits were conducted to review experiences, discuss challenges, and assess the practical effectiveness of the preventive tools. WWF Hungary (PP4) purchased and provided five electric fence systems, eight predator-deterrent devices (Foxlights), and two livestock guardian dogs (kuvasz breed). Continuous technical support was also offered for both the electric fencing systems and the guardian dogs.

Preventive systems were designed jointly with farmers based on their operational needs, while the configuration of all provided multi-wire electric fences was standardised to incorporate proven international best practices. Each system had to reach a minimum height of 120 cm, with the lowest wire placed no higher than 20 cm above the ground. The standard wire arrangement followed a 20-40-60-120 cm pattern, ensuring denser spacing in the lower sections where predators typically attempt to breach fences. The operating voltage was required to remain between 3,000 and 5,000 V at all points of the system, supported by the installation of at least three grounding rods placed one metre apart to ensure consistent performance. Besides electric fences, as complementary measures visual deterrents, Foxlights and livestock guardian dogs were provided.



In parallel, similar efforts were undertaken in Slovakia. The preventive systems were based on the conditions mentioned in the 543/2002 (Decree 171/2021 Coll. § 45) law, the §97 and the §102 decree, so even hunting grounds. The prescribed measures have become much more specific: for the protection of livestock the electric fence must be at least 140 cm high, composed of 4 wires, with an electrical voltage source of 12V and power with 4000-6000 W, with a minimum pulse force of 7J. Fenced enclosures with a height of at least 120 cm, have to have at least one electric wire placed 25 cm above the ground on the outside of the fence. While fenced enclosures with a height lower than 120 cm must be secured with 2 electric wires, with the higher wire cannot be lower than 120 cm. If the enclosures do not meet these conditions livestock guardian dogs may be used to protect the animals. For 50 - 300 animals at least 2, more than 300 animals at least 3, more than 500 animals at least 4, more than 700 animals at least 5 dogs must be used. Free grazing herds outside the enclosure also must be protected. The animals must be under the supervision of shepherds and livestock guardian dogs which are at least 18 months old. For up to 500 animals at least 2 livestock guardian dogs have to be present, while for more than 500 animals at least 3 dogs have to protect the livestock. WWF Slovakia (PP3), in cooperation with the Administration of the Slovak Karst National Park, initiated collaboration with local livestock breeders to enhance protection against large carnivores. As part of this initiative, five agricultural entities received electric fencing systems on a loan basis. The main aim of this measure was to strengthen preventive protection for livestock herds against attacks from wolves, bears, and lynxes.



Figure 23.: A flock of sheep protected by sheepdogs and an electric fence on the Silická Plain (photo © B. Tám)



Figure 24.: Meeting between representatives of WWF SK, Slovak Karst National Park, and representatives of the Silická Planina Agricultural Cooperative (photo © WWF SK).

The installation and testing of these additional preventive measures took place at the farms of the cooperating partners in the following places:

The Agricultural Cooperative Vyšná Slaná focuses on sheep breeding and applies a complex protection system combining electric fencing with continuous on-site supervision by a shepherd. The cooperative also employs livestock guardian dogs of both large and medium-sized breeds, ensuring effective round-the-clock protection of the flock.

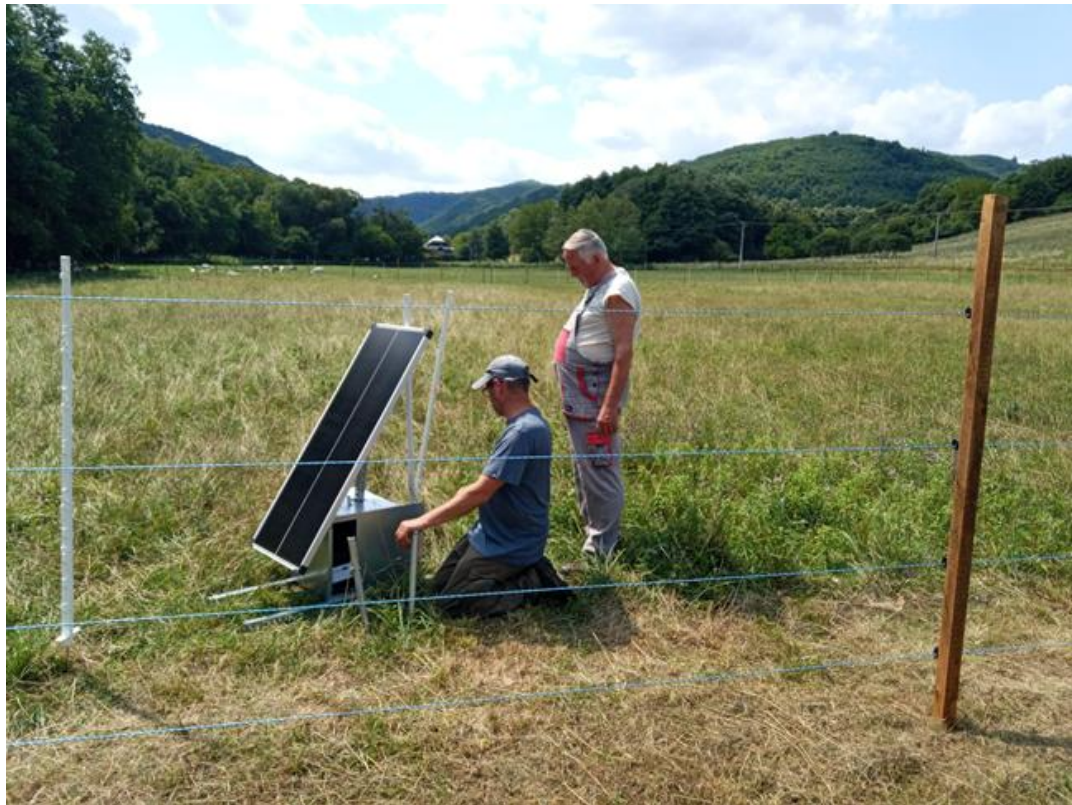


Figure 25.: Predator-proof electric fence installed in self-employed farmer at Slovak Karst, SK (photo © Slovak Karst National Park).

The Agricultural Cooperative Silická Planina, also engaged in sheep farming, uses a similar approach. Their herds are protected with electric fencing and Kangal shepherd dogs, a breed renowned for its strength, bravery, and reliability in defending livestock against predators.

The self-employed farmer Ing. Tamáš specializes in horse breeding. His animals are kept within an electrically fenced enclosure located near the village. Due to the frequent human presence during daytime hours, no additional protective measures are required, as the combination of electric fencing and constant human activity provides adequate security for the horses.

The company Agrospol Honce s.r.o. focuses on cattle breeding and has implemented an integrated system of preventive measures, including electric fencing, regular supervision by a herder, and the use of shepherd dogs. This combined approach ensures safe and reliable livestock management on open pastures, effectively reducing the risk of predator attacks.



Figure 26.: At two locations, the effectiveness of preventive measures is also being monitored using camera traps. (photo © Slovak Karst National Park).



Szentdomonkos lies northwest of the Bükk Mountains, in the valley of the Borsod-Heves Hills. The farmer owns a highly valuable breeding flock of racka sheep, a traditional Hungarian breed, and had no previous experience with large carnivore damage. The newly installed system builds on an earlier structure consisting only of game netting, which the owner felt was insufficient for preventing incursions by large carnivores. In Period 2, WWF Hungary (PP4) provided the tools and equipment to establish a 5-ha electric fence system. The game netting remained in place and was complemented with a 120 cm high, five-wire electric fence equipped with a sixth visibility band, installed on the outside. A Foxlights unit—a night-time predator deterrent simulating human movement with a flashlight—was also provided (Fig. 27.).



Figure 27.: Protection measures deployed in Szentdomonkos, HU (photo © WWF HU).



Nekézseny is located in the northern Bükk Mountains. The small family-owned farm keeps 400 Ile-de-France sheep using an extensive grazing system: the livestock is herded daily from the farm to the pastures and back to the enclosures and barns at night. The flock is under constant supervision by the owners and accompanied by several livestock guardian dogs. Although the farm had an electric fence, it provided only limited protection. While the owners had no direct experience with depredation, wolves regularly and bears occasionally visit the area. Within the project, WWF Hungary (PP4) provided professional guidance on improving the existing system, as well as tools and equipment for a 5-ha electric fence consisting of a 120 cm high, five-wire design supplemented with a visibility band. A Foxlights device was also supplied in Period 2. (Fig. 28.)



Figure 28.: Predator-proof electric fence installed in Nekézseny, HU (photo © WWF HU).



Egerszólát is situated between the Mátra and Bükk Mountains. The owner is familiar with large carnivore conflicts as she is a breeder of kuvasz, a traditional Hungarian livestock guardian dog breed, though she had no direct depredation experience. She keeps Hungarian grey cattle, an extensive breed capable of self-defence as adults, but calves remain vulnerable to predation. WWF Hungary (PP4) provided tools and equipment for the installation of a 5-ha predator-proof electric fence and a Foxlights device for testing in Period 2. (Fig. 29.)



Figure 29.: Predator-proof electric fence installed in Egerszólát, HU (photos © WWF HU).



Szuhogy is located in the Putnok Hills. The family-run farm owns 120 sheep and had no previous experience with large carnivore depredation but had already cooperated with the Kuvasz-Guard Foundation, receiving two livestock guardian dogs. As they recently began expanding their operations and given the lack of a national prevention scheme in Hungary, the farmer contacted WWF Hungary (PP4) for support. In Period 5, WWF Hungary provided tools and equipment for the establishment of a 5-ha predator-proof electric fence and a Foxlights device. (Fig. 30.)



Figure 30.: Predator-proof electric fence in Szuhogy, HU (photos © WWF HU).

Alsószuha lies in the same valley as Dövény in the Putnok Hills. At the end of the summer in 2025 August two farms suffered livestock damages by wolves at the settlement. On of these, a family farm operates on the northern edge of the village, keeping 240 Merino sheep in an area surrounded by forests. At their property the wolf depredation event resulting in the loss of four sheep. Subsequently they installed a four-line multi-wire electric fence provided by the Aggtelek NPD (ASP5) in collaboration with the Bükk NPD (PP6), still they sought additional measures to prevent further incidents. In cooperation with the Kuvasz-Guard Foundation, two kuvasz puppies were also provided to the owners by WWF Hungary (PP4) (Fig. 31.) The other farm, where damages occur situated in south end of the settlement also received electric fences by the Aggtelek NPD (ASP5) in collaboration with the Bükk NPD (PP6) in Period 5 (Fig. 32.).



Figure 31.: Electric fence and livestock guardian dog (kuvasz) puppies provided for the farmer in Alsószuha, HU (photos © WWF HU).



Figure 32.: Electric fence provided for farmer in Alsószuha, HU (photos © Aggtelek NPD).



Dövény lies in a valley of the Putnok Hills, southwest of Aggtelek. The pasture is located on the village outskirts within a Natura 2000 site. Surrounded by forested hills and situated only a few hundred metres from the Szuha stream, the area is an ideal habitat for large carnivores. The farmer keeps around 100 merino sheep in a rotational grazing system over 10 ha, with livestock remaining permanently on the fenced pasture during the grazing season. Although he had no direct experience with depredation, reports by locals frequently mentioned wolves visiting the area. Prior to the collaboration with WWF Hungary (PP4) in the Interreg LECA project, he had already initiated a cooperation with the Kuvasz-Guard Foundation, which provided two kuvasz livestock guardian dogs to protect his flock. Although his earlier three-line multi-wire electric fence was inadequate for effective protection. WWF Hungary (PP4) supported the installation of a 10-ha, 120 cm high, five-wire predator-proof electric fence system in Period 2 and provided a Foxlights unit. WWF Hungary (PP4) with a group of volunteers was also actively involved in the installation of the electric fences. No damages have occurred so far, though the farmer reported two occasions when the dogs showed unmistakable behaviour indicating recent wolf presence. One of these incidents was later indirectly confirmed when the next day a wolf attack occurred only about 4.5 kilometres away in Alsószuha, in which wolves depredating multiple sheep (Fig. 33.).



Figure 33.: The installation of the predator-proof electric fence in Dövény, HU by volunteers (photos © WWF HU).

Besides providing preventive tools directly, WWF Hungary (PP4) also provided direct and indirect technical assistance to the farmers in installing effective electric fences to protect their livestock. Part of the project a tutorial video has been made about how to properly install and maintain such multi-wire electric fence systems (Fig. 34.).





#### 4.2.2. Results

Together, these coordinated activities in Hungary and Slovakia contributed to improving the implementation and acceptance of preventive tools and strengthened cooperation with livestock keepers across the pilot areas. They also provided important insights into the practical challenges and opportunities associated with reducing large carnivore-livestock conflicts. Throughout the project period, no depredation events occurred at these sites despite the continuous presence of large carnivores. The involved farmers generally reported their increased sense of security, reduced fear and stress linked to livestock protection measures and overall satisfaction with the combined protection systems. These cases highlighted that the integration of well-installed electric fencing and adequately trained LGDs can significantly enhance livestock safety even in high-risk areas. Harmonious coexistence between humans and large carnivores is possible only if local communities accept their presence, which becomes far more likely when conflicts are reduced. Such conflicts can be mitigated, particularly through the use of effective preventive measures and continuous communication with the stakeholders.



## 5. Pilot activities: Poaching prevention

Poaching represents a major challenge for biodiversity conservation because illegal wildlife exploitation is typically concealed and difficult to quantify. It creates a significant threat to endangered species (Chapron & Treves, 2016; Estes et al., 2011; Rizzolo et al., 2017) and contributes substantially to global species decline (Challender & MacMillan, 2014; Ghoddousi et al., 2017; Morton et al., 2021), disrupting ecological interactions and ecosystem functioning (Estes et al., 2011). The growing complexity and transnational nature of wildlife crime further complicate conservation efforts (Carter et al., 2017). Understanding the drivers of poaching is therefore essential for developing effective conservation policies and strategies (Montgomery, 2020; Neagu & Rozyłowicz, 2025).

A range of interconnected social, economic, and cultural factors contribute to poaching (Carter et al., 2017; Nellemann et al., 2014). These include poverty and limited livelihood opportunities (Duffy et al., 2016; Hübschle, 2017; Lunstrum & Givá, 2020), lack of trust in authorities (de Juan et al., 2022), and low societal acceptance of large carnivores, often associated with human-wildlife conflicts (Browne-Nuñez et al., 2015; Carter et al., 2017; Eliason, 1999, 2020). In response, some governments have adopted more flexible wildlife management approaches, such as liberalising the culling of large carnivores. However, studies focusing on wolf (*Canis lupus*) management in various countries suggest that these policies may inadvertently increase poaching by reducing the perceived value of protected species (Chapron & Treves, 2016).

The Carpathian Mountains constitute one of Europe's key strongholds for large carnivores, including brown bears (*Ursus arctos*), grey wolves (*Canis lupus*), and Eurasian lynx (*Lynx lynx*). Despite their ecological significance, these species continue to face threats from illegal hunting, habitat alteration, and escalating human-wildlife conflicts.

Project activities on poaching prevention have led by WWF Slovakia (PP3). Part of these efforts WWF SK (PP3) have co-organized transboundary seminars (SK/CZ, PL/SK) with other project partners and participated in the preparation and distribution of surveys among relevant stakeholders from the five countries in the project.

Effective investigation of illegal killing of large carnivores requires well-trained professionals who are able to recognise signs of wildlife crime, collect and secure evidence properly, and cooperate with relevant institutions and experts. In many countries, however, wildlife crime represents a relatively specialised field and is not always sufficiently covered in the standard training of law enforcement officers.

Capacity-building activities such as lectures, seminars and practical training sessions can therefore play an important role in strengthening the knowledge and skills necessary for effective investigation and prosecution of poaching cases. Among other things, they enable the sharing of experiences and networking.

Surveys, questionnaires, and interviews are valuable tools for identifying the needs and knowledge gaps of a target group. This information allows educational activities to be tailored to address the most relevant topics and improve overall effectiveness.

### 5.1 Seminars for police investigators

#### 5.1.1. Poaching prevention seminar in the Beskydy-Kysuce pilot area (CZ-SK)

The cross-border seminar on tackling poaching was held on 3-4 September 2024 at the Beskydy Hotel Portáš in the Beskydy-Kysuce pilot area for representatives of the Police of the Czech Republic and the Slovak Republic, the Customs Administration of the Czech Republic, and the Police Presidium of the Czech Republic.



Over the course of two days, participants attended nine lectures covering topics such as species biology, genetic research, methods of wildlife crime investigation, the legal frameworks in both countries, and examples of successfully resolved cases.

The 35 participants emphasized that expert support is crucial when investigating wildlife crime and highlighted the importance of ensuring that scientific findings are applicable in criminal proceedings. They agreed that combining scientific and forensic approaches is essential for effective casework.

The seminar also provided an important opportunity for networking and establishing new contacts to strengthen future cooperation, with the shared goal of improving investigations into the illegal killing of large carnivores in this pilot area.



Figure 35.: Photo from poaching prevention seminar in the Beskydy-Kysuce pilot area (CZ-SK) (photo © B. Tám)

### 5.1.2. Poaching prevention seminar in the Tatra Mountain pilot area (PL-SK)

On 16-17 January 2025, a cross-border seminar for law enforcement authorities was held at the REWITA Center in Kościelisko. The event brought together 34 participants, including representatives from law enforcement agencies, nature conservation institutions, NGOs, and experts from Poland, Slovakia, and the Czech Republic.

Over the two-day program, attendees heard eight expert presentations addressing the challenges of protecting endangered species, with a particular emphasis on poaching. The agenda featured national overviews of illegal activities targeting protected species, analyses of large carnivore population dynamics in the Carpathian region, and practical approaches to prosecuting environmental crimes. Speakers from Slovakia, Poland, and the Czech Republic shared real case studies involving offenses against protected species and introduced tools used in crime detection and prevention, such as genetic and telemetry monitoring of large carnivores.



The seminar concluded with a strong call to improve cross-border information exchange, develop joint training initiatives, and strengthen support mechanisms for law enforcement agencies. Discussions underscored that effective protection of large carnivores depends not only on robust international cooperation but also on the active engagement of local communities.



Figure 34.: Photo from Poaching prevention seminar in the Tatra Mountain pilot area (PL-SK) (photo © B. Tám)

## 5.2 Survey to assess current practices

A questionnaire was developed based on the experience gained from the LIFE SWiPE project. Before distribution, it was reviewed by the Environmental Police of Slovakia to ensure clarity and quality. The questionnaire was anonymous and targeted at police investigators, aiming to gather information about their experience with poaching—especially incidents involving large carnivores (bear, wolf, lynx)—and to better understand the scale and characteristics of wildlife crime in Slovakia, the Czech Republic, Poland, Hungary, Ukraine, and their border regions.

Between 12 August and 16 September 2025, a total of 48 respondents completed the questionnaire. Of these, 40 responses came from the Slovakia/Czech Republic area, 5 from Hungary, 2 from Poland, and 1 from Ukraine.



### 5.2.3. Results from Slovakia/ Czechia

In the Slovakia/Czechia pilot area, the questionnaire reached a 31.3% response rate, with most respondents being police investigators (67.5%) and relatively early in their careers (57.5% with 0-5 years of experience). Overall, 42.5% consider poaching a problem in Slovakia and 30% view it as serious; regarding large carnivores, views are more divided, with 30% seeing poaching as negligible or marginal and 20% as very serious. Most respondents encounter poaching of game species (82.5%), while 30% have experience with poaching of large carnivores. Motives for killing large carnivores included trophy hunting, fun, adrenaline, adventure, and damage prevention. The groups most frequently identified as poachers are local residents (72.5%), hunters (62.5%), and financially well-off individuals (50%), although hunters are also the group most likely to report poaching (67.5%). The most common illegal activities are hunting without a permit (90%) and use of prohibited methods (65%), especially unauthorised weapons (55%) and trapping (45%). The main investigative challenge is lack of evidence (77.5%), and officers often cooperate with external experts (80%); 45% encounter illegal arms, and 62.5% regard current penalties as insufficient. Measures viewed as effective include enforcing damage claims (75%) and applying deterrent penalties with stronger media coverage (57.5%). Many respondents support improvements such as collecting comparative biological material, marking trophies, and creating a public trophy register (52.5-67.5%). Finally, 87.5% expressed interest in additional training, particularly in crime scene investigation, forensic techniques, legislation, species identification, and cyber tools.

## 5.3 Survey to assess current practices at an international webinar

### A International Online Seminar

Joint online international seminar titled “Large carnivore poaching Investigation in the Carpathian countries” aimed at replicating best practices from the regional to the international level was organised at the 4 November 2025. The event was co-organised by the State Nature Conservancy of Slovakia (PP8), WWF Slovakia (PP3), Mendel University (LP) and the Environmental Police of Slovakia.

Participants were invited from all five countries involved in the project with pilot areas (Slovakia, Czech Republic, Poland, Hungary, and Ukraine).

An international online seminar was organised as part of a high-level knowledge exchange initiative, focusing on the investigation of poaching of large carnivores in the Carpathian region. The event brought together representatives from the project’s pilot countries, creating a platform for sharing experience and strengthening cross-border cooperation.

A central component of the seminar was the presentation of successful investigation cases, with particular attention given to factors that contributed to effective outcomes. This case-based approach supports the transfer of best practices between countries and fosters the development of long-term professional networks among investigators, prosecutors, and subject-matter experts.

The discussions identified several priority areas for further training, including wildlife crime scene investigation, the collection and preservation of forensic evidence, species identification and biological sampling, and the application of ballistics, toxicology, and legal instruments in environmental crime cases. Participants also highlighted the growing importance of addressing emerging challenges, such as cybercrime linked to illegal wildlife trade.

There was strong interest among participants in exchanging practical experience and learning from colleagues who have managed complex cases, emphasizing the value of hands-on, practice-oriented training over purely theoretical approaches.



Overall, the seminar confirmed that capacity building should be continuous, multidisciplinary, and practice-focused. Effective investigation of wildlife crime requires a combination of ecological expertise, forensic skills, legal knowledge, and strong inter-agency collaboration. Establishing platforms for dialogue and knowledge exchange plays a crucial role in enhancing investigative capacities.

## 6. Conclusions

The Slovak Karst and North Hungarian Mountains pilot action generated valuable insights into large carnivore monitoring, conflict mitigation, and poaching prevention in a transboundary region of the Inner Western Carpathians. By integrating complementary monitoring approaches, practical field-based measures, and cross-border cooperation, the pilot demonstrated that conservation challenges and coexistence in a highly fragmented, human-dominated landscape can be effectively addressed through coordinated action.

Monitoring efforts focused primarily on the Eurasian lynx, the flagship species of the pilot area. A harmonised monitoring framework combining camera trapping and genetic sampling substantially improved knowledge of large carnivore occurrence and distribution. Although the Carpathian lynx population is generally considered stable (Kaczensky et al., 2013, 2024), this assessment is not underpinned by sufficiently robust data, and population trends therefore remain uncertain (Kubala et al., 2021), which was reaffirmed in the Slovak Karst and North Hungarian pilot area. Lynx presence was confirmed in only 8.9% of the mapping grids, and exclusively on the Slovak side of the transboundary pilot area. As a consequence, deterministic camera trapping aimed at population size estimation could be implemented only in the northern part of the pilot area. This effort estimated  $3.03 \pm 1.05$  adult lynx within 2,934.8 km<sup>2</sup> of suitable habitat, corresponding to a population density of  $0.1 \pm 0.03$  individuals per 100 km<sup>2</sup>— a number which is only a fraction of the observed average (~1 ind./100km<sup>2</sup>) in the broader region (Duľa et al. 2021; Kubala et al. 2017; 2023). While wolf presence was confirmed in 50% of the mapping grids and brown bear presence was recorded in 17.9%.

Results for the lynx monitoring indicating an alarmingly low population in the transboundary region. These findings also suggest the existence of additional negative underlying issues and trends that are not yet fully understood and therefore require further investigation. Importantly, the results highlight the strong interconnectedness of large carnivore populations, which do not know boundaries. Management decisions and unresolved pressures in one area can have significant consequences for neighbouring and wider populations even across borders, requiring better collaboration between the countries and authorities. These monitoring activities established in the pilot area provided a robust foundation for future transnational monitoring and coordinated management of large carnivore populations across the Carpathian range (Kubala et al., 2021).

Large carnivore-related conflicts in the transboundary area are predominantly associated with wolves. Although recorded data indicate that livestock depredation events are generally infrequent, five damage incidents were documented during two consecutive wolf years (2023/24 and 2024/25), resulting in the loss of 20 livestock animals (sheep and goats). However, in Hungary, limited incentives for damage reporting likely led to underreporting, suggesting that the actual level of conflict may be higher than indicated by official records. At the same time, perceived risk among local communities remains high and can easily translate into increasingly negative attitudes towards large carnivores.

In areas where wolves have recolonised only in recent decades, farmers are often unfamiliar with effective livestock protection measures and may be hesitant to invest in them due to limited trust and financial constraints. To address this, predator-proof electric fencing systems were demonstrated at multiple sites in cooperation with local farmers. Feedback indicated an increased sense of security, reduced stress related to livestock protection, greater acceptance of preventive tools, and strengthened cooperation between conservation actors and livestock keepers across the pilot area. Conflicts with other stakeholder groups,



including hunters and game managers, were addressed through participatory monitoring approaches and regular, intensive exchange of knowledge and data.

Poaching prevention was tackled through dedicated international seminars both in-person and online involving law enforcement agencies, customs authorities, and conservation experts from Slovakia, Poland, the Czech Republic, Ukraine and Hungary. These events enhanced cross-border cooperation, improved understanding of wildlife crime patterns in the Carpathians, and promoted the use of forensic genetics and telemetry data as key tools in wildlife crime detection and prosecution. The seminars also highlighted the importance of coordinated reporting systems and institutional data sharing at both national and international levels.

Overall, active engagement with farmers, hunters, game managers, foresters, and enforcement authorities proved crucial for building trust and implementing effective, on-the-ground solutions. The Slovak Karst and North Hungarian Mountains pilot action delivered essential baseline data, strengthened technical and institutional capacities, and established a replicable model for transboundary monitoring of elusive large carnivore species. The knowledge base, partnerships, and harmonised monitoring framework developed through this initiative provide a solid foundation for long-term conservation and management. Nevertheless, sustained international cooperation, transparent data exchange, and proactive mitigation of emerging barriers - particularly those affecting cross-border movements - remain indispensable for securing the future of lynx and other large carnivore populations within this unique transboundary ecosystem, across the Carpathian region, and throughout Europe. But scaling up these activities and ensuring long-term institutional support will be essential for maintaining coexistence between humans and large carnivores in the future.



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