



LIFE
Lynx



EURASIAN LYNX

biology, threats and
translocations from
Carpathians to Dinarides

Brochure about lynx produced within LIFE Lynx project

Preventing the Extinction of the Dinaric-SE Alpine Lynx Population Through Reinforcement and Long-term Conservation

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ABOUT THE PROJECT



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About lynx biology

Two species of lynx live in Europe - Eurasian (*Lynx lynx*) and Iberian lynx (*Lynx pardinus*). As the name of the latter implies, it can be only found on the Iberian Peninsula, while the Eurasian lynx is widespread from Scandinavia, Baltic region, Central and Eastern Europe, the Dinarides and Balkans to Anatolia, Iran, Iraq, North and Central Asia. With the wide geographical range, Eurasian lynx also covers different habitats; steppe habitats, semi deserts, temperate forests, taiga and in the Himalayas even areas above the treeline.

Lynx is the largest wild cat in Europe, an adult animal measuring 80 to 150 cm in length and 65 cm in height. Females are on average 2.5 kg lighter than males and weigh between 15 and 21 kg. In captivity, a lynx can reach 25 years of age, specimens of 18 years of age have been recorded in the wild. On average, wild lynx live much less - about eight years.

This species is solitary and territorial. The size of the home range depends on the prey availability and varies in the Alps and Dinarides between 50-250 km² for female and 70-450 km² for male lynx. Territories of males overlap those of females, but animals of the same sex avoid each other.

It socializes only with the opposite sex during mating. This period runs from February to mid-April. The female usually gives birth in late May and can have one to four kittens. They stay with her until the next mating season, up to about ten months of age, and then search for their own territory.



Photo: Miran Krapež

Although its sense of smell is good, it's not as sharp as that of a wolf. Its primary senses are sight – during the day and night, and also hearing. Lynx is a pure carnivore and in Europe its main prey are ungulates, with eastern populations (Turkey) feeding primarily with hares. The choice of prey depends on the density of available prey species in the area. In most of Europe the main lynx prey is roe deer, in Alps also chamois can present a big share of it. Red deer occurs as a prey species only when its densities are higher. If ungulate species are absent in its territory, it preys on smaller mammal species and larger birds. Among livestock, sheep, goats and fallow deer in enclosures are the most frequent prey, but in Dinaric area attacks on livestock are very rare. A large proportion of the lynx diet in this area is represented by the edible dormouse, populations of which grow quickly after the fruitful years of fruit-bearing tree species, especially beech. In Scandinavia lynx often prey on Siberian musk deer or caribou. The choice of prey therefore also depends on the density of available prey species in the area - with ungulates having a big influence on lynx presence. Smaller prey is mostly caught by young adults after they have separated from their mothers.



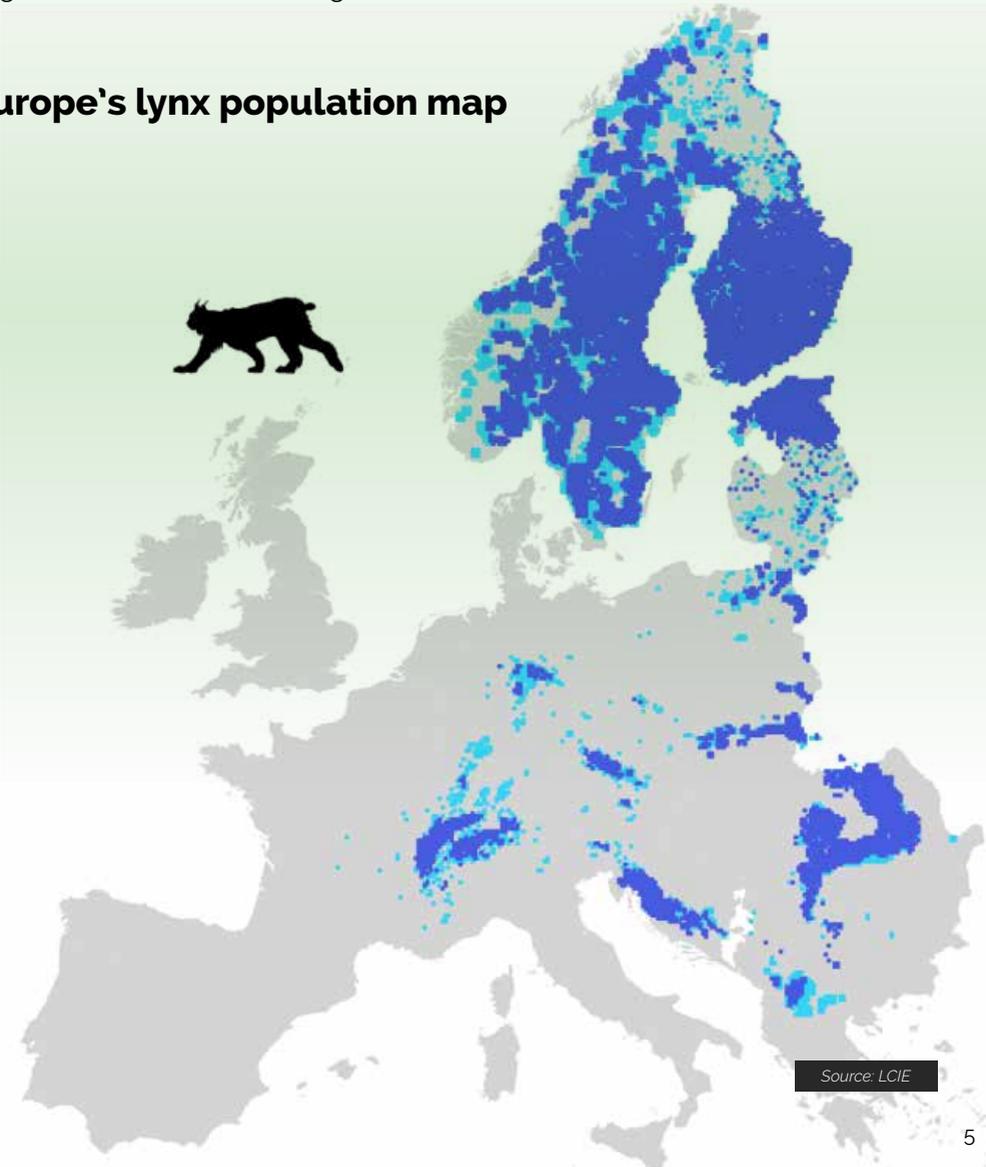
Illustration: Paul Veenvliet

Lynx body mass is between 15-25 kg, males being heavier than females.

On average lynx weighs 4 to 5 times more than a domestic cat.

Lynx hunts from an ambush, which means that it quietly moves closer to its prey, jumps onto it and then bites it in the neck, crushing the windpipe and suffocating it. The claws are hidden most of the time, allowing it to stalk quietly. That's also the reason claws are not visible in its traces. Lynx hunts on the ground and only climbs on a tree occasionally in order to escape the danger. It primarily feeds on muscle, leaving the digestive tract. It buries its prey after feeding and can return to feed on it for several days. Lynx doesn't remove prey's head - but this can be done by the fox, who occasionally feeds on the remains of the lynx's prey. Although lynx stays in the woods during the day, it mostly hunts at night, where ungulates often gather. Its movement and regional distribution are strongly influenced by larger roads with heavy traffic, proximity to settlements, as well as larger rivers and mountain ridges.

Europe's lynx population map



Source: LCIE

Ungulates – lynx – hunting: a collision of interests?

The main prey species of lynx is roe deer and not as often also red deer and chamois. There are concerns that lynx might over-reduce abundance or change behaviour of these species and through this also affect the hunter's own hunting success. In fact, opinions on the impact of the lynx on prey species vary, but various studies show that, in the long term, lynx can even have a positive impact on the health and behaviour of their prey species.

Predators can have an indirect (non – lethal) influence on their prey. For instance, prey species change their behaviour and space use in areas where predators get exterminated or the other way around - they get more watchful if a predator is present in the area. They are trying to avoid predators by minimizing habitat overlap with them, both spatially and temporally. Most of the lynx kills happen in the dense vegetation area, from an ambush, while hunters usually harvest roe deer in open areas. This means roe deer need to use different strategies to avoid predation by both, lynx and humans.



The effects of predation on roe deer by lynx depend on several different factors, main being the energy requirements of the lynx. For example, lynx females with kittens will have higher kill rates than solitary females because parenting requires higher food demand. Males will also predate more deer than single females because they have larger territories and consequently higher movement rates and energy demands.



When catching red deer, lynx usually select younger animals. When catching roe deer though, lynx have no age or sex preferences. Studies have shown that lynx-killed roe deer were in poorer health (i.e. had a higher proportion of animals with depleted fat reserves and more starving animals compared with human harvest). In general, lynx is a better natural selector than humans, as more animals killed by lynx were not in good health condition. However, this doesn't mean lynx don't predate on healthy animals as well. Higher roe deer density enables lynx a more selective hunting behaviour while in contrast to that, low prey density would force lynx into greater effort at each hunting attempt. Regardless of the variations in kill rates, lynx as an apex predator maintains the ecological balance and promotes biodiversity. The most obvious direct benefit of lynx depredation for other forest species is the carcass, available for scavenger species.



Ungulate abundance, especially at a larger scale, is not estimated precisely, since such monitoring would be too expensive. Approximate ungulate densities can be estimated through counting of pellets, harvest statistics and direct counting where it is possible. Culling statistics are usually given as a number of animals culled per 100 hectares per year and differ between regions and hunting systems. In a good quality habitat for ungulates (most parts of the Alps and Dinarides), hunters cull from 2 to 4 or more roe deer per 100 ha per year. In Slovenia in Notranjska and Kočevska hunting management units (where lynx is also present) 1.04 roe deer are culled per 100 ha per year on average (data from years 2006 – 2011), which is significantly higher than lynx kill rates in a saturated lynx population, where annual lynx predation is from 0.33-0.38 roe deer killed per 100 ha. Anthropogenic mortality of roe deer is therefore considerably higher than mortality caused by lynx. Moreover, a concentration of ungulate mortality to a certain period of the year, like the rutting season, resulting in a large part of males being culled can have negative side effects to the population, like disruption of breeding groups, decreased fertility and lower population viability. Most of the hunting management in Europe is based on hunting quotas which are sex and aged structured. With structured quotas, the cull is balanced and is trying to mimic natural predation.

Environmental changes and new management systems have resulted in higher ungulate densities compared to the 1970s. Together with the abandonment of many rural and mountain areas, lynx now find perfect conditions in Dinarides and SE-Alps.



Photo: Lan Hočevar

In Slovenia, collaboration between managers and hunters has been exemplary. Beside many actions within the LIFE Lynx project which hunters are part of, they are also involved in the field work, such as helping with searching and surveying lynx kill sites. This gives all new insights into the predator-prey relationship.

To conclude, both lynx and humans affect prey population dynamics. Considering the knowledge we have about these effects and the interaction between ungulates, lynx and hunting does not necessarily represent a collision of interests. It needs to be understood, explained and respected in management and conservation of both, lynx and ungulates. We believe involving these relationships, especially the effects of lynx predation on roe deer, into hunting management plans is crucial and by doing so, prevent misunderstandings and prejudice of lynx, the hunter.

Problems Dinaric lynx population is facing today

Lynx disappeared from the Dinarides and Alps in the beginning of the 20th century, due to high human population growth and consequently excessive lynx habitat loss, its prey depletion and socially promoted, unregulated killing in the 19th century. In 1973 six lynx were reintroduced from Slovakian Carpathian Mountains to Kočevje (Southern Slovenia) to repopulate this area. In the first four years after the reintroduction, the population increased and spatially expanded so fast that in 1978 culling of the first lynx was allowed.

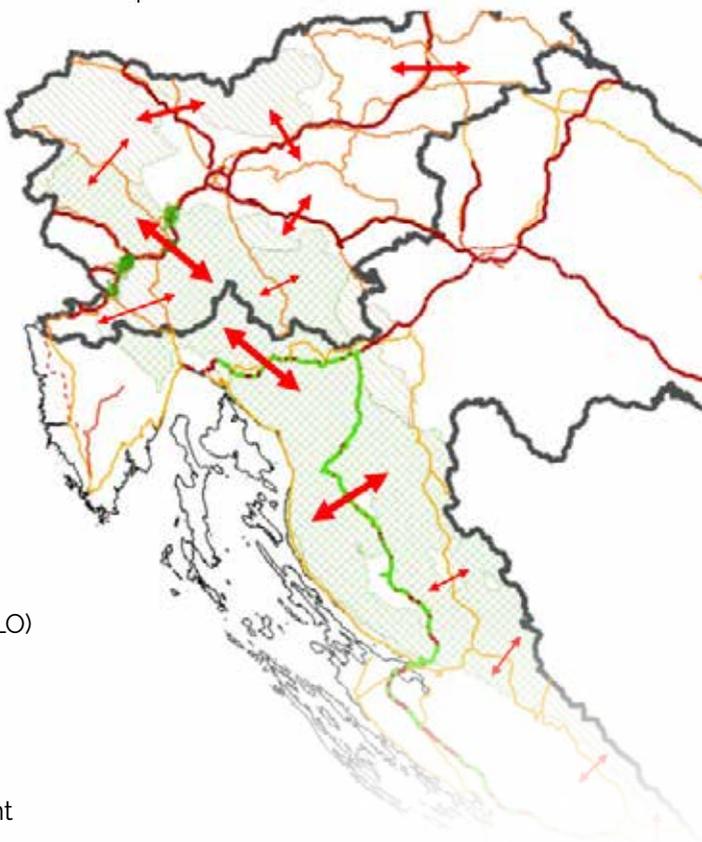
Presumably, high hunting and poaching pressure in the 90's as well as advanced habitat fragmentation have limited species distribution in the north, with highways Ljubljana-Trieste and Ljubljana-Karawanks being major obstacles. But an additional problem emerged that was endangering this population. The reintroduced population faced the so-called founder effect; it was established by a very small number of individuals, which resulted in its small genetic variation. Later were also two pairs of the six translocated lynx reported to be related to each other. Moreover, this population kept being isolated from other lynx populations for more than four decades. All this accelerated the increase of inbreeding to a critical level today's population is facing. The study of the broader public's opinion within Dinarides and SE-Alps shows they wish for the lynx to remain a part of this area.

There are two main actions needed to prevent lynx from extinction: 1) translocations of lynx, not related to lynx in the Dinaric-SE Alpine population, 2) the increase of possibilities for merging this population with other neighbouring populations and ensure the gene flow between them.

Several other factors also play an important role in the lynx comeback. One of the most important ones is dispersal, which can be hindered by low habitat connectivity. In the last 200 years, habitat connectivity has been significantly lowered by different barriers like highways, railways, urban settlements, intensive agricultural land and other human made structures. These structures usually have a strong impact on the state of the species by reducing the ability of the area to satisfy its needs, increasing mortality (road kills), reducing connectivity among different populations and so on.

Based on the data of the collared lynx in Slovenia and Croatia we assume the transport infrastructure has a high impact on local oscillations in population size and may obstruct the population flow. In order to improve the connectivity between now segregated lynx populations in the Alps and the Dinarides, we will introduce a "stepping stone" population, by releasing five lynx from Slovakia and Romania in the SE Alps. Another important factor is prey availability, which can have a significant role for the lynx population dynamics and viability. In presence of even minor changes in survival rate of subadults and adults in a population, we must consider adequate prey species management to be one of the important short-term conservation priorities, too.

Lynx habitat fragmentation



Legend

- Constant presence
- Occasional presence
- Transitions (CRO)
- Smaller transitions (SLO)
- Viaduct (SLO)
- Highway
- Main road
- National border
- Obstructed movement

The main goal of the LIFE Lynx project is to prevent the extinction of the Dinaric lynx population and safeguard the population into the 21st century. Our intention is to implement a reinforcement plan that is socially acceptable, scientifically based and enriched with experiences from successful reintroductions made in other areas. We will reinforce the Dinaric-SE Alpine population with at least 14 lynx from the viable source population in the Carpathians and maintain high public support while fine-tuning the reinforcement with the best available data to reach the ultimate indicator of success.

What is lynx monitoring and why do we need it?

Monitoring is a systematic collection of data about certain wild species. Using scientific methodologies we collect, archive, analyse and evaluate data about:

- species distribution,
- population size,
- mortality,
- genetic diversity,
- health and
- any other parameter that is important for management and protection of the species.

In the scope of the LIFE Lynx project, we monitor Dinaric and SE Alpine lynx populations to track the effectiveness of the reinforcement process. The most important methodologies we use for lynx monitoring in our project are camera trapping, collecting signs of lynx presence, genetic analysis, telemetry, necropsies and questionnaires for public attitude surveys.

In the last two decades, **camera trapping** has been established as one of the most useful methods for lynx monitoring. Cameras set in nature are activated by the movement, so animals can be monitored without human presence in the habitat. Unique lynx coat pattern enables easy distinction of different individuals, when photographed from the same side. Since lynx are territorial, camera trapping can provide the information on occupancy and, if the network of camera traps is dense enough, also about the size of their territories and lynx density.

Lynx is characterized by a thick brown and white fur with black spots, a short tail with a black tip and ear tufts. Each specimen has its own unique pattern that makes them recognizable from each other in the photos.



Collecting **signs of lynx presence** is very useful for monitoring of population status:

- Observing **lynx in nature is quite** rare; but people who met them often report that lynx did not run away. It is important to notice that sometimes lynx can be misidentified with other animals, most usually the wildcat.
- More often, we can **find lynx footprints** in mud or snow. They have a specific cat footprint, the size of a human fist, usually with no claws visible.
- Sometimes we find **lynx's prey**, usually roe deer, in the forest. It is typical for a lynx to cover its prey with leaves and soil after feeding.
- Hair, urine and scats can be found on **lynx's marking spots**, which are usually hard to find. It is a little bit easier in the winter when lynx can be tracked in the snow.
- **Lynx call** during the mating season with distinctive voices, which are similar to roe deer barking.

Non-invasive samples - scats, urine and hair, are the most important source of DNA for genetic analysis. Invasive samples - tissue and blood, are taken from animals captured for telemetry research, translocated lynx and from found carcasses (e.g. car crash, poaching). Genetic analysis provide us with invaluable information about the level of genetic variability and inbreeding in population, sex of individual animals and about family relatedness among individuals.

For monitoring of movements and activity of individual animals we also use **telemetry**. Lynx are captured and equipped with a collar, which collects and sends precise GPS positions of the animal. The first lynx with such a collar in the Dinarides was lynx Bela in Croatia in 2001. Since then 23 lynx were collared in Croatia and 13 in Slovenia.



Illustration: Paul Veenliet

Primerjava odtisov šap psa, risa in domače mačke.
Ris in domača mačka imata vpotegnjene krepmlje, zato jih pri odtisih šap ne vidimo.

In case of **finding a dead lynx**, the necropsy is performed by a specialized veterinarian to determine the cause of death. Necropsies are also an important source of information about individual and population health. Inbreeding causes health problems, like pathologies on heart and susceptibility to infectious diseases due to impaired immunity.

First GPS telemetry data from a transboundary female Dina

Dina was a young female captured and collared in 2006 on Snežnik plateau in Slovenia. She was the first lynx equipped with a GPS/GSM collar globally. But very soon researchers realized she was not only Slovenian lynx, as in the next months Dina was frequently crossing the border between Slovenia and Croatia. This once again demonstrated the need for international collaboration in management and conservation of lynx populations in Europe. With the help of detailed information obtained through GPS-telemetry, researchers were able to collect many valuable data on lynx ecology and behaviour and in June 2007 also confirmed the birth of two kittens, named Puhi and Burja. With the help of genetic analysis, it was detected in 2019, that Burja is still alive today and lives in Gorski Kotar. Not knowing it was the same lynx, she was named Miška in 2011 when she was photographed for the first time by a Croatian hunter. The large carnivore centre in Pivka was also named after Dina. It's purpose is to direct and inform visitors about the coexistence of people and large carnivores.



Photo: Miha Krofel

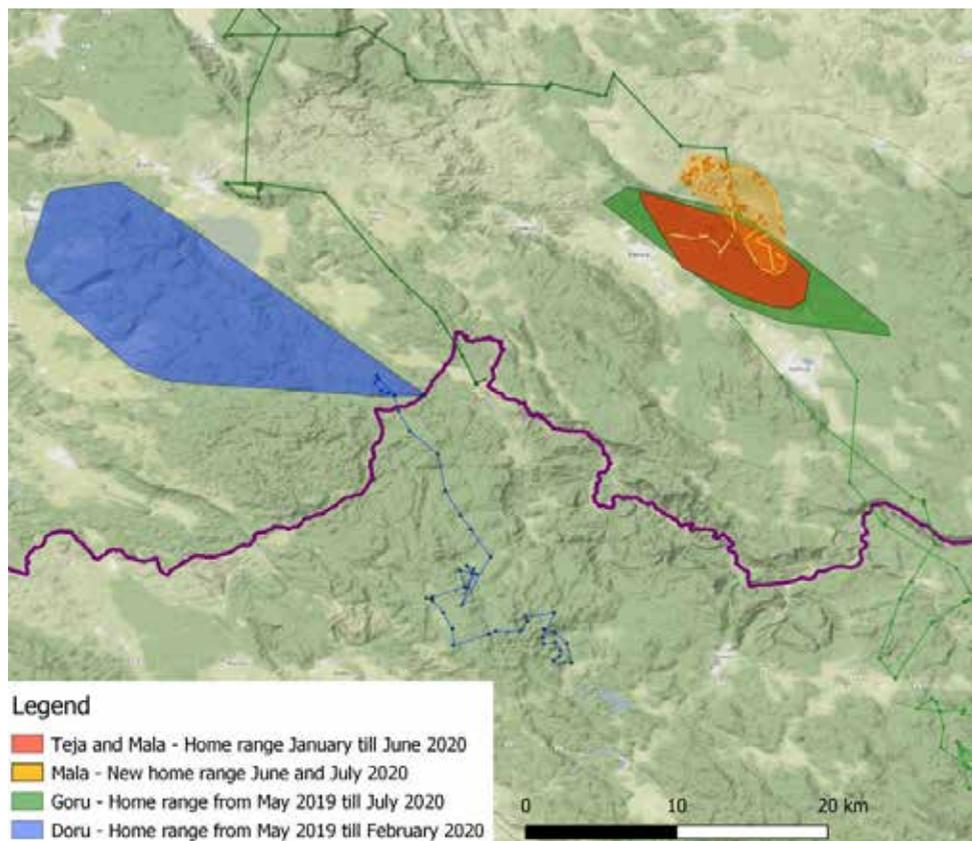
First two in LIFE Lynx project were Goru and Doru

In February 2019 the first two lynx for translocation were captured in Romania. After the quarantine, necessary to ensure animals are healthy and will not transmit any diseases, in May 2019 lynx Goru was released in Slovenia and Doru in Croatia.*

Both lynx were equipped with telemetry collars which provide data about their movements and activity. Goru established his territory in Mala Gora (Slovenia), and Doru in the Javorniki area (Slovenia). In the beginning of 2020 the first reproduction of lynx Goru was genetically confirmed, a female lynx Mala is an offspring of Goru and Teja, a female resident lynx.

* Strategies of the releases differ between the countries; in Slovenia all lynx wait for three weeks in order to adapt to the new environment in quarantine enclosures. This raises the possibility of lynx staying in the area. In Croatia this is not urgent, since the range of the optimal habitat is bigger.

Lynx Goru, Doru, Teja and Mala movement



Source populations of translocated lynx

In Romania

Based on the last national reports, the Romanian part of the Carpathian lynx population is stable, as it counts approx. 2000 individuals, covering a range estimated to 100.000km² in Alpine and Continental bioregions, being considered to have favourable conservation status.

Present information about the lynx population, although scarce, suggests that the main drivers of lynx population size and its distribution are: existing large patches of undisturbed forest, relief variability, and large areas with low human activity.

Another driver of the present lynx population is the legal framework on which the lynx population was managed. The minimum population size of approx. 500 individuals was registered at the beginning of 1950 when the lynx was considered a game species with no protection status. In the last century, the lynx population had been either fully protected or the hunting was strictly regulated. Moreover, hunting of lynx was forbidden in the last eight years, but the other human-caused mortality (poaching, traffic kills) is unknown.

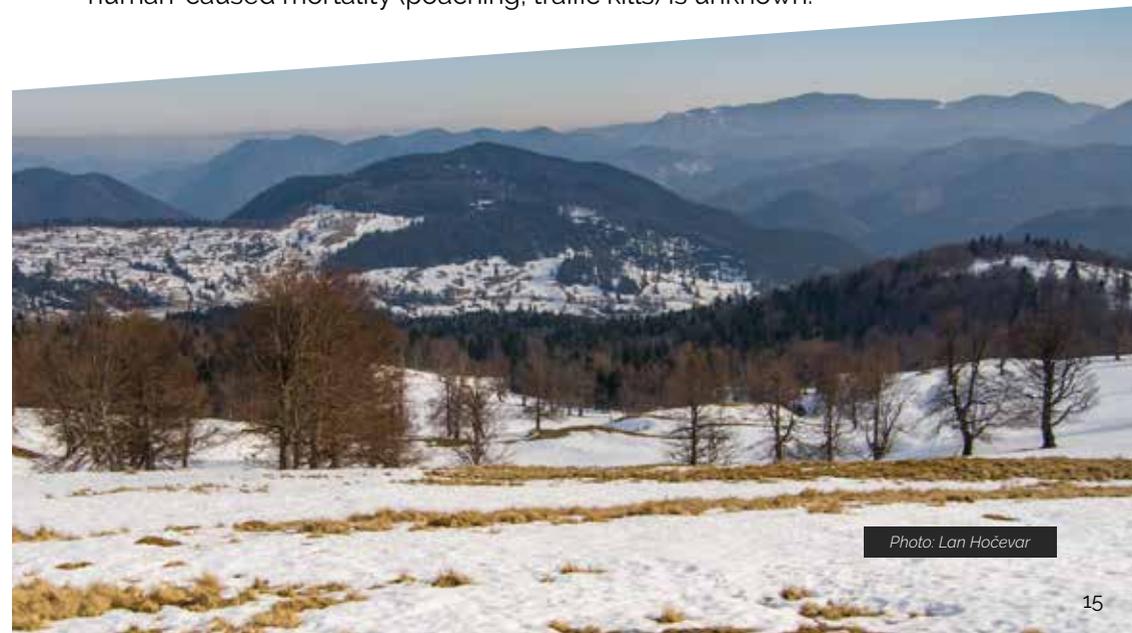


Photo: Lan Hočevar

Also in Romania the main prey species of lynx is the roe deer and old studies showed that other small mammals and birds are part of the lynx diet as well. In the last decades, there were very few cases of lynx predation on livestock, lynx being considered a non-conflictual large carnivore species.

Nevertheless, in the present context, several threats like infrastructure development (causing road mortality and habitat fragmentation), uncontrolled and illegal deforestation (changing lynx and prey species habitats) and a large number of feral domestic animals (cats and dogs, affecting prey availability and disease transmission) are considered of high importance when ensuring the long term preservation of the species. In the last fifty years, all lynx reintroduction or reinforcement projects in Central Europe used wild-caught lynx from the Carpathian population (Slovakian part) and the Romanian population plays a key role in the long-term survival of the species in Europe.

Due to the high genetic diversity and an estimated density of approx. 1.5 - 2 individuals per 100 km², the removal, for conservation purposes of 2-3 individuals per year, presenting less than 10% of the average annual hunting harvest in the last three decades, cannot be considered as a threat to the conservation status of the Romanian part of the population. The planned capture season, from December to mid-April, takes into consideration the biology of the lynx allowing us to avoid any capture of pregnant females or females with small kittens. In order to increase the success of the reinforcement programme, lynx are being captured in different areas to avoid capturing related individuals. All planned activities within the LIFE Lynx project consider firstly the safety of the source lynx population and the wellbeing of each captured individual.



Photo: Lan Hočevár

In Slovakia

Lynx, translocated to Slovenia in 1973, were part of only one of the eighth translocations in Europe carried-out during the 70s and 90s. Altogether, approximately 100 lynx were translocated from Slovakia within the historical reintroduction programmes. The lynx population is autochthonous in the Slovak Carpathians probably since Pleistocene. The lowest estimates of the Slovak lynx population were recorded in the beginning of the 1930's, with an estimation of only 50 lynx. However, within the following decades, Slovak lynx population began to recover and this positive trend allowed the implementation of several lynx reintroduction programmes in the Western and Central Europe.

The capture of lynx took place along with legal hunting. The proportion of captured lynx oscillated between 10% and 18% from all annually hunted individuals, showing that the reintroduction programmes did not have a negative influence upon the lynx demography within the source population.

The official lynx reintroduction programmes and cooperation among the forestry, hunting and conservancy communities within the Slovak Carpathians is regarded internationally as an excellent model for the sustainability of lynx in Europe. As a result, it was used as an example for many subsequent large carnivores' conservation programmes.

A scientifically based monitoring was established in winter 2012/13, ensuring the stability of the Slovakian part of the population. Results enabled us to estimate the average lynx density to be 1 (+/- 0.31) lynx per 100 km² of suitable habitat. Using this data together with the total coverage of the suitable habitat available of 28,090 km², it is possible to estimate the lynx population in Slovakia which results in 280 adult individuals.

The participation of all interested stakeholders groups in recent and actual monitoring actions are an example of excellent cooperation and mutual trust. This is important for resolving predator-human conflicts in the future in order to maintain a sustainable lynx population with the capacity of being a source for future reintroduction programmes.

Ecotourism and other values of lynx presence for society

Ecotourism and especially wildlife tourism are one of the most growing branches of the economy worldwide. Tourism connected to the wildlife species can contribute to the development of the local community and builds higher tolerance to these species. When developing lynx-based tourism, we must take care because poorly planned tourist activities can negatively impact on lynx as well as other species and their habitats. That is why recommended tourism products are only those that follow the principles of ecotourism. These products include interpretation of the lynx and its habitat for small groups of tourists, thus being a quality product for the guests while bringing an economic benefit to the local community with no negative effects on the species, habitat and local community.

By raising awareness, ecotourism helps to preserve lynx in our forests.

Web portal Discover Dinarics, developed within the LIFE DINALPBEAR project, promotes only responsible tourist programmes which support nature conservation, help promote coexistence with wildlife and generate revenue for local communities. All approved tourism providers wear bear-friendly label. The programmes about lynx are not based on lynx observation since lynx in nature tends to avoid human presence. Thus, they include other activities that enable guests to experience and interpret its natural environment, recognize the presence of lynx in the forests, be involved in artistic creation, etc. Tourist packages that were until now designed with the support of the LIFE Lynx project are The Kingdom of the Lynx - art workshop and Painting for the Lynx - Art Holiday. There are several other ecotourism programmes where lynx is not the main topic, but tourists also have the chance to learn more about the species and experience its habitat. Local providers have the opportunity to develop new ecotourism packages that should comply with the guidelines for responsible tourism management and the code of conduct - Visiting Nature in Slovenia.

Until 2022 LIFE Lynx project will support development of two more lynx-based tourism products: The Lynx Trail, the educational trail starting at the Hut Pri Jelenovem studencu near Kočevje, and electronic guide about lynx for the 49 km long Via Dinarica mountain trail between Slovenia and Croatia.

Although lynx has lived in our forests until the beginning of the 20th century and then again since 1973, there are relatively few mentions in cultural and folk tradition about lynx, in comparison to other large carnivores. This is probably due to the fact that lynx is very difficult to see, and the locals were not particularly associated with it. We know rare phrases such as "to gaze like a lynx" or "to be angry like a lynx" and some place names associated with the lynx, like Risnjak - National Park in Croatia and the constellation Lynx visible in the Northern celestial hemisphere. Since 2018, we celebrate International Lynx Day on June 11th.



Photo: Vasja Marinč

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