

AFTER LIFE CONSERVATION PLAN

Lan Hočevar

Preventing the extinction of the Dinaric-SE Alpine lynx population through reinforcement and long-term conservation

Project LIFE16 NAT/SI/000634 - LIFE Lynx

Prepared by: Tilen Hvala, Rok Černe, Magda Sindičić, Anja Jobin Molinari, Nives Pagon, Urša Fležar, Maja Sever, Ira Topličanec, Manca Velkavrh, Irena Kavčič, Hubert Potočnik, Elena Pazhenkova, Teodora Sin, Jakub Kubala

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PROJECT DETAILS

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

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Coordinating beneficiary:

Slovenia Forest Service (Ljubljana, Slovenia)

Associated beneficiary:

University of Ljubljana (Ljubljana, Slovenia)

Veterinarski fakultet, Sveučilište u Zagrebu (Zagreb, Croatia)

Hunters Association of Slovenia (Ljubljana, Slovenia)

Progetto Lince Italia (Tarvisio, Italy)

Association for the Biological Diversity Conservation (Focșani, Romania)

Association BIOM (Zagreb, Croatia)

Arma dei carabinieri - Comando Unità Tutela Forestale, Ambientale e Agroalimentare (Rome, Italy)

Technical university in Zvolen (Zvolen, Slovakia)

Karlovac University of Applied Sciences (Karlovac, Croatia)

Institute of the Republic of Slovenia for Nature Conservation (Ljubljana, Slovenia)

Project budget:

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Project webpage:

https://www.lifelynx.eu/

@life lynx (FB pages: LIFE Lynx, LIFE Lynx - hrvatski terenski blog)

The LIFE programme is the EU's funding instrument for the environment. The general objective of LIFE is to contribute to the implementation, updating and development of EU environmental policy and legislation by co-financing pilot or demonstration projects with European added value.

Website: http://ec.europa.eu/life

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Abbreviations

SFS - Slovenia Forest Service MNVP - Slovenian Ministry of Natural Resources and Spatial Planning VEF - Faculty of Veterinary medicine Zagreb **BIOM - Association BIOM** HAS - Hunters Association of Slovenia DARS - Highways Company of the Republic of Slovenia EIA - Environmental Impact Assessment ULyCA2 - Urgent Lynx Conservation Action 2 PLI - Progetto Lince Italia WISO - Wild Ungulates and Society Working Group LCIE - Large Carnivore Initiative for Europe SCALP - Status and Conservation of the Alpine Lynx Population MINGOR - Croatian Ministry of economy and sustainable development UL - University of Ljubljana ZRSVN - Institute of the Republic of Slovenia for Nature Conservation **DRSI - Slovenian Infrastructure Agency** MKGP - Slovenian Ministry for Agriculture, Forestry and Food **ARIS - Slovenian Research and Innovation Agency** WWF - World Wide Fund for Nature MNZ - Ministry of the Interior of the Republic of Slovenia MAES - the Mapping and Assessing Ecosystems and their Services LCG – Local Consultative Group

ABOUT THE LIFE LYNX PROJECT

The main goal of the LIFE Lynx project was to save the Dinaric - Southeastern (SE) Alpine lynx population from extinction and to preserve it in the long term. Lynx within that area went extinct at the beginning of the 20th century due to systematic eradication, habitat loss, and lack of prey species. The species was successfully reintroduced in 1973 by translocating animals from the Carpathian Mountains to Slovenia. The animals then spread towards the south-east to Croatia and Bosnia and Herzegovina, as well as to Italy in the west and Austria in the north. Finally, the population got established in Slovenia, Croatia and Bosnia and Herzegovina but did not connect with neighbouring populations and remained isolated. Unfortunately, after a few decades (around the year 2000) due to a small number of founder animals and isolation led to genetic deterioration (inbreeding and genetic drift) resulting in population decline. In order to save the population, transboundary coordinated conservation measures had to be undertaken by translocating individuals from a vital population while maintaining high public support and key stakeholder involvement. The LIFE LYNX project actions were designed to tackle the foreseen threats to the population. The most important conservation and communication actions, which also represent the basis of the After LIFE Conservation Plan, are following the project's main objectives:

- 1. To save the Dinaric-SE Alpine lynx population from extinction by improving the genetic and demographic outlook of this population by directly increasing population viability through reinforcement, and to safeguard the population well into the 21st century.
- 2. To **establish a population stepping stone in the SE Alps** and increase the population connectivity with other populations in the Alps.
- 3. To manage and conserve the population at the transboundary level by developing tight partnerships and collaboration with developed partnerships.
- 4. To foster broad public acceptance through **stakeholder-supported processes**.
- 5. To develop science-based management tools for strategic planning and decision support.
- 6. To improve population connectivity for lynx.

The expected long-term effects of the project are presented in this "After LIFE Conservation Plan" which will further tackle the obstacles in the path towards a genetically viable Dinaric-Alpine lynx metapopulation.

SIGNIFICANCE AND IMPACT OF THE LIFE LYNX PROJECT

Over the course of seven years, the LIFE Lynx project successfully translocated 18 lynxes from the Carpathians to the Dinarics and SE Alps, effectively addressing the issue of inbreeding depression and yielding positive outcomes. We were able to detect 24 litters of translocated lynx with camera traps between 2019 and 2024, among which for 10 we confirmed their origin genetically. In total, we assume that translocated animals produced 53 offspring. This groundbreaking endeavour stands out as the pioneering initiative of its kind, not only reinforcing the remnant lynx population in the Dinarics but also establishing a stepping-stone population in the SE Alps to facilitate the creation of a genetically diverse Dinaric-Alpine lynx metapopulation. The project fostered international cooperation involving five countries: Slovakia and Romania, hosting the source lynx population, and Slovenia, Croatia, and Italy, which share the endangered Dinaric-SE Alpine population. Through this collaborative effort, "Common guidelines for Dinaric-SE Alpine population-level lynx management" were formulated and implemented, ensuring standardised methodologies for future lynx population management within and across neighbouring countries. By collaborating with countries from the source population we not only translocated animals but transferred expert knowledge and implemented systematic monitoring for the duration of the project in the Carpathians. Furthermore, for the first time, a holistic approach was adopted in the field of wildlife crime; the project aimed to raise awareness and knowledge on the importance of sanctioning and prosecuting potential illegal killing of lynxes (and consequently other wildlife) among police and state prosecutors as well as trained field personnel on proper procedures upon finding an illegally killed lynx. In Slovenian national hunting management plans, we considered the impact of lynx predation on wild ungulates to foster a more positive attitude among hunters towards the presence of lynx. In addition, important movement corridors for lynx (and other wildlife) were identified and for the first time protected at national level in Slovenia. Finally, our efforts and aims also inspired and motivated proactive lynx conservation in Italy, where additional 5 lynxes were released within the ULyCA2 project.

THREATS

1. Inbreeding depression

The Dinaric-SE Alpine population traces its roots back to six individuals reintroduced in an lynx-free environment back in 1973. In small populations, close-relative breeding becomes unavoidable, resulting in a rise in homozygosity and the expression of detrimental recessive alleles. Without intervention, this inbreeding leads to a decline, ultimately jeopardising the population with the risk of extinction. Genetic research has substantiated significant levels of inbreeding within the Dinaric-SE Alpine population when compared to their Carpathian source counterparts. The lynx population in the Carpathian Mountains is considered to be one of the best preserved and largest in Europe. There, capture sites were selected using experience and data gathered from camera trapping, telemetry and snow tracking, as well as capacity building through visits of the experienced project partners from the Dinaric and Alpine area. These data helped identify the best micro-locations for lynx captures (actions A1 and A2). Simultaneously, we obtained information about the current genetic status, abundance, and sex-specific territorial distribution of lynx in potential release areas before conducting translocations (action A3) and prepared reinforcement plans (action A4). For the purpose of lynx translocations to the Dinaric - SE Alpine population, which urgently needed intervention, lynxes were caught in the Carpathians and translocated to Slovenia and Croatia (actions C1 and C2). By doing so, we enriched the remnant lynx population and shifted the inbreeding depression trend, which was evident through active and directed surveillance of the lynx viability at population and individual level (actions D2 and D3). At the same time, we surveyed the effects of lynx removal in the source population (action D1). We established a population stepping stone in the SE Alps through lynx reintroductions. This will facilitate long-term connectivity between the Dinaric population and other populations in the Alps, while also enhancing the overall genetic viability of the population. Overall we translocated 18 animals from the source Carpathian population and out of those, 14 were successfully included into the population: 9 animals in the Dinaric mountains (action C3) and 5 animals in the SE Alps (action C4).

2. Lack of conservation and management response to lynx population decline

Before the start of the project, there was no societally acceptable and scientifically-based response to deliver a long-term and pragmatic vision for lynx recovery in the Dinaric-SE Alpine region. Considering the critical status of lynx, this lack of appropriate response leads towards certain extinction and may hinder the prospects for long-term viability even if the current looming extinction is prevented.

2a. Lack of national and transnational management response

Due to their lower incidence of property damage in comparison to wolves or brown bears, lynxes are frequently neglected by managers and decision-makers, resulting in diminished attention and resources allocated to them in national wildlife management planning. Nevertheless, considering the endangered status of the lynx, specific management strategies and documents are crucial for their conservation. Recognising the need for transnational population-level management of a species with high spatial requirements such as the lynx motivated us to develop 'Common guidelines for Dinaric - SE Alpine population-level lynx management' (action A5). These guidelines provide solutions to (i) minimise threats, (ii) restore and increase landscape connectivity within the population and enabled connectivity to the neighbouring populations to facilitate the creation of a Dinaric - Alpine metapopulation (iii) acquire data and knowledge required for successful and efficient long-term lynx conservation and (iv) promote public acceptance. The specific objectives of the guidelines were recommended to be incorporated into national management documents. Furthermore, all three nations sharing the Dinaric-SE Alpine lynx population produced drafts of national or regional (Italy for the Alps) strategic management plans for long-term lynx conservation and delivered them to the responsible authorities (action A5).

2b. Underdeveloped partnerships with stakeholders to support lynx recovery

A failure to address concerns of hunters, livestock breeders, decision-makers, environmentalists, foresters, police, and local residents in general, may seriously undermine public support for lynx conservation efforts. Understanding tolerance mechanisms and working to balance stakeholder interests through collaborative and participatory engagements are important for fostering social acceptance of a large carnivore species such as the lynx. Emphasizing the necessity of public support for the success of lynx reintroduction or reinforcement projects is crucial. That is why we conducted a comprehensive baseline survey to better understand public attitudes and knowledge (action A7 and action D4) and used the findings to develop and implement an in-depth project communication plan (action A8).

Progressive-minded hunters played a pivotal role in the lynx reintroduction initiatives of the 1970s, acknowledging the lynx as an integral part of their wildlife heritage in the Dinaric-SE Alpine region. Recognizing the importance of hunters' acceptance of lynx, we conducted several communication approaches targeting hunters and gamekeepers to safeguard the long-term lynx survival (action E2). Together with most actively engaged hunters and Hunters Association of Slovenia (HAS), we co-created several communication tools (e.g. one-on-one meetings in the field, educational seminars, conferences, popular articles in hunting magazines etc.) and portrayed the lynx as an important species in the forest ecosystem. While the majority of hunters supported the project, those with increasing negative attitudes towards the lynx potentially could pose a threat for the population's revitalisation. This is why we recognised the need to tackle potential illegal killings of lynxes by educating police officers, state prosecutors and field personnel about the importance of prosecuting wildlife crime (action C8). To mitigate the potential conflict with hunters, we acknowledged the impact of lynx (and wolf) predation on wild ungulate populations and accounted for it in the regional hunting management plans which were adopted by the Slovenian government (action C10).

Livestock breeders are an important stakeholder group as occasional lynx predation on livestock may result in lower tolerance, rise in tension and conflicts. To prevent potential attacks on livestock, electric fences were distributed among livestock breeders which expressed the need for additional protection or to those who had damage caused by a lynx (action C9). Nevertheless, we detected very few cases of lynx predation on livestock in the duration of the project.

Lynx-based tourism has the potential to directly benefit local communities. We organised educational seminars for tourism professionals and protected area managers, aiming to introduce and foster awareness regarding the opportunities that the presence of lynx can create in a certain area. We have developed several lynx-based tourism products, like art workshops, thematic trails with info boards and long-distance hiking/cycling trails. Furthermore, to inform media and international partners, a study tour for foreign journalists and tour operators was organised (Action C11).

All of the above-mentioned stakeholders, together with municipality and nature conservation representatives, and other interested members of the public residing in communities near lynx core habitats and release sites, collectively constitute local opinion-makers. Together with them, we formed 'Local Consultative Groups (LCG's)', which were regularly informed and consulted about all aspects of the project. The groups were used as a channel for regular communication with the local inhabitants via email - facilitating quick and efficient answering to all of their questions. Some of the LCG members gave input on project activities, especially those related to lynx management and communication, and shared project results with the wider community at special local meetings. We also carried out different activities and produced materials together with LCG members - offering them help, knowledge and financial means for these to be set or carried out in their local environment (Action E1).

Finally, we provided targeted information and engaged with the general public. To achieve broad acceptance of lynx population reinforcement we: (i) produced documentary films, short videos and a cartoon (action E3), (ii) connected with local schools, targeting school children and increased their knowledge on lynx-related matters (action E4), (iii) engaged with a broader spectrum of key stakeholders (i.e. networking, exchange of knowledge and experience abroad etc.) (action E5), (iv) increased knowledge and awareness about lynx conservation among stakeholders and general public across participating countries by producing diverse project outputs (project bulletins, postcards, brochures, Layman report, notice boards, etc.) (actions E4, E6 and C.11) and finally (vii) established collaboration with lynx celebrity ambassadors (action E7).

We documented and evaluated potential changes in public attitudes and knowledge about lynx over the course of project implementation, thus providing an additional tool for fine-tuning activities over the course of the project (action D4). A set of specific socio-economic indicators was developed and values of the indicators were updated and assessed once per year to closely monitor the impacts of conservation interventions on the socio-economic environment (action D5). We adopted the Mapping and Assessing Ecosystems and their Services (MAES) guidelines to measure the direct connections between project activities and key ecosystem services (i.e. forest ecosystem services and grassland ecosystem services) (action D6).

2c. No systematic transboundary surveillance of lynx population trends, distribution and health status

Before the LIFE Lynx project, there was no reliable transboundary abundance estimate for the Dinaric-SE Alpine lynx population. Estimates of population size based on expert opinion were available for Croatia, Slovenia and Italy but no deterministic monitoring using state of the art methodology was implemented. In some regions, even the range distribution of lynx was unclear and little was known about the current health of the lynx population. We prepared guidelines for lynx camera trapping and genetic sampling, two main population monitoring methods, and those methods were intensively implemented in Italy, Slovenia and Croatia. In parallel, the amount of opportunistic signs of lynx presence significantly increased, as a consequence of intensive educational campaigns, cooperation with interest groups and presence in the media. Population monitoring was financed from several sources; besides the LIFE Lynx project budget, funding from Interreg 3Lynx project and national large carnivore monitoring scheme from the Ministry of Natural Resources and Spatial Planning was used in Slovenia, and the "Development of system for monitoring the status of species and habitat types. Group 6: Development of monitoring program for large carnivores with capacity building of participants (KK.06.5.1.03.0001)" was used in Croatia. Public institutions for management of protected areas in Croatia also significantly participated in the data collection. For the first time, rigorous health monitoring was implemented on translocated, captured and dead-found individuals which provided first insights into the health status of the inbred lynx population. We found evidence of the negative effects of inbreeding depression on animal health, primarily in the form of congenital heart diseases.

Through the deterministic deployment of camera traps across optimal lynx habitats and close collaboration with local hunting clubs and protected areas rangers, we have successfully computed robust estimates of lynx density and abundance for the Dinaric lynx population. Moreover, by adjusting the area included in the systematic camera trapping to the expansion of the Dinaric - SE Alpine population, we have been able to identify translocated lynx reproduction events and confirm the presence of translocated individuals beyond the functionality of their GPS collars and document the changes in the population abundance over the years. Non-invasive genetic sampling has facilitated ongoing monitoring of the population's genetic structure, allowing for genotyping analyses to ascertain lynx origins. Additionally, our continuous dialogue with hunters has yielded increasing amounts of opportunistic data indicating lynx presence in specific areas, which has importantly informed the implementation of the deterministic surveillance methods (action C5).

All these data types that were collected during the project, are stored in a common database, used as a data-sharing repository, which enables fast data exchange and visualisation of geo-referenced lynx data. In this international database, MBase (https://portal.mbase.org), the data on lynx mortality, livecaptures, genetic samples, systematic camera-trapping, opportunistic signs of presence, GPS telemetry locations and damage on human property are instantly available to all project partners, wildlife managers, experts and stakeholders. Moreover, the MBase portal is also a medium for public data promotion and for sharing information with the public. It ensures a user-friendly experience for the general public, when one wants to search for and visualise lynx data on a population level (action C6).

With intensive ecological studies using state of the art GPS telemetry and transboundary surveillance, we obtained rich information on lynx abundance, movement, survival, predation, reproduction and space use, allowing us to assess the impact of the translocations on the remnant lynx population as well as the effect of establishing a new population nucleus. This enabled us to determine the overall success of the reintroduction and reinforcement activities (action D2).

2d. A poor understanding of the population viability drivers of the Dinaric-SE Alpine lynx population

While the extinction pathway of this lynx population is both predictable from genetic theory and from the field observations, the long-term vision needed to ensure the population viability is not clear. The population urgently needed new outbred animals to avoid extinction, but it was less clear how many lynx are needed for the desired rescue effect, and how much gene flow will be required in the future to ensure its long-term viability.

By combining data from genetic samples obtained in the field and computer modelling, we predicted the inbreeding coefficient trend well past the duration of the project and developed optimal management scenarios for ensuring lynx viability in the Dinaric mountains and Southeastern Alps (action D3). We estimated the minimum number of animals needed to be translocated to the Dinaric population for different year intervals between the translocations (3-20 years) in order to keep the inbreeding below 0.15 threshold. We modelled an effect of gene flow resulting from the established stepping stone and corrected the management scenarios accordingly. It is important to stress out that the actual connectivity of Dinaric and SE Alpine population remains understudied, and the management decisions should be based on the less optimistic scenario to prevent the increase of inbreeding. We have formulated the "Guidelines for ensuring the long-term viability in the Dinaric mountains and SE Alps", aimed to provide management strategies, based on results of genetic monitoring and computational modelling.

3. Loss of population connectivity for lynx

Although forest cover is high in most of the project area, individual forest patches are fragmented at different scales. Long-term lynx survival will depend on habitat connectivity. Open lowlands, rivers and valleys with human settlements, and fenced traffic lines hinder the further spread of the Dinaric-SE Alpine lynx population with the risk of habitat fragmentation being increased. In the past, environmental impact assessments (EIA) were performed, however, they rarely considered lynx or other large carnivores due to a lack of proper guidelines.

The project addressed these issues with studies on ecological connectivity within the Dinaric - SE Alpine population and between its neighbouring populations. Using different methodological approaches, we were able to determine (forest) patches with optimal and suitable habitat for lynx in the project area. Furthermore, with identification of patches of suitable habitat in combination with linear barriers (i.e. fenced highways), we detected bottlenecks that hinder sufficient gene flow and dispersal of juvenile individuals (action A6). With the knowledge obtained, we developed a handbook for spatial planners which integrated lynx connectivity and habitat suitability into spatial planning. We organised an educational seminar aimed at spatial planners, governmental institutions, and researchers, presenting the leading factors contributing to habitat loss, fragmentation, and barriers which potentially obstruct lynx movement. During the seminar, we emphasised the adverse effects of these factors on the lynx population (action C7).

Additionally, a habitat study was conducted for the territory of Slovenia in which we identified the main corridors for lynx (and other large mammals). In total, 97 migration corridors were identified, which were later protected through incorporation into the national forest management plans and adopted by the Slovenian government (action A6). This is the first national official protection of corridors in Slovenia.

SWOT ANALYSIS

We used a structured planning method called SWOT analysis to evaluate the strengths, weaknesses, opportunities and threats at the end of the project. The analysis allows the identification of internal and external factors that are favourable or unfavourable to achieve a certain objective or a goal.

	HELPFUL	HARMFUL		
	STRENGTHS:	WEAKNESSES:		
INTERNAL ORIGIN	 Rescuing the Dinaric-SE Alpine population from extinction Nine animals were included into the population in the Dinarics by breeding with remnant individuals or established home ranges in the area with individuals of opposite sex. Substantial decrease in inbreeding coefficient. Reduced inbreeding depression. Increased litter size by 37 % where at least one lynx parent was a translocated animal. Mean population density in the Dinarics increased by 44 % (from 2019 to 2023). Population abundance in the Dinarics increased from 96 (69-133) in 2019 to 152 (121-192) individuals in 2023. The stepping stone population was successfully established (5 out of 6 released animals established home ranges in the project area, all three females reproduced). In parallel, the ULyCA2 project additionally released 5 animals in the Italian Alps. 	 Rescuing the Dinaric-SE Alpine population from extinction Four translocated animals were not included into the population. Based on population modelling, the Dinaric population, unless functionally connected with other populations, will need new translocations in the future in order to keep the inbreeding coefficient at the threshold level below F = 0.15. The Dinaric - SE Alpine population remains isolated and is not connected with neighbouring populations. Four translocated animals went 'missing' with some evidence suggesting the possibility of illegal killing. The newly established stepping-stone population in the SE Alps remains small and not yet functionally connected with the Dinaric population. 		
	collaboration	collaboration		
	 Project partners are active members of international working groups (LCIE, WISO, Linking Lynx, Eurolynx, IUCN Cat Specialist 	 Systematic lynx monitoring is not implemented in Bosnia and Herzegovina; data on lynx presence there is scarce, and the lynx status remains to be determined. 		

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 Group) which offers the potential for collaboration and knowledge exchange in the future. The signing of the Networking agreement between Slovenia Forest Service, Hunters Association of Slovenia and the Styrian Hunting Association paved the way for future collaboration with Austria. The knowledge gained throughout the duration of the project can be transferred to countries who lack the experience in lynx conservation - Croatian partners have already applied for Interreg funds to transfer their knowledge and increase capacities for lynx research in Bosnia and Herzegovina. Experts from Austria and Bosnia and Herzegovina were consulted when preparing 'Common guidelines for Dinaric - SE Alpine population-level lynx management' ensuring broader international consensus. Drafts of lynx management plans for Croatia, Italy and Slovenia were produced and sent to the responsible Ministries. New national management plan was published by Croatian authorities. Guidelines for management of lynx orphans in Croatia prepared within the project served as the base for establishing international cooperation to rehabilitate one lynx orphan from Croatia in Slovakia and then to release the animal in Italy. 	 Although the Styrian Hunting Association showed support for lynx reintroduction, the Carinthian Hunting Association remains unwilling for collaboration and poaching there appears to be an important hindrance for lynx conservation in the region. The lynx management plans for Slovenia and Italy remain to be adopted by the responsible Ministries. National financing for future systematic lynx monitoring is not confirmed by authorities in Slovenia, Croatia and Italy.
Stakeholder-supported reinforcement process to sustain lynx	
recovery	Stakeholder-supported reinforcement process to sustain lynx recovery
 Key stakeholder groups were included in numerous communication and conservation activities. Throughout the project, all stakeholder groups expressed high support for lynx reintroduction. Hunters as the main stakeholder group were widely included in several activities also with active participation: field trips, population surveillance with camera traps, lynx reinforcement, educational seminars, conferences, etc. The international lynx conservation conference organised by HAS was widely attended by representatives from several 	 While the majority of all key stakeholder groups expressed support for lynx conservation, a small share of them showed negative attitudes towards the lynx reintroduction and reinforcement. Fifty police officers trained for proper procedures upon finding an illegally killed lynx do not cover the whole territory of Slovenia and do not present sufficient quantities of personnel for in-depth detection and prosecution of illegal killing of lynxes. State prosecutors were not involved in prevention of wildlife crime from the beginning of the project.

European hunting organisations, where the hunter involvement in the LIFE Lynx project was presented as a good practice example of hunters in large carnivore (lynx) conservation.

- The 'Handbook for investigation of poaching' will serve as a point of reference for field personnel in cases of illegal wildlife killings in the future.
- Carefully developed thematic lynx trails ensure visitors will gain a deeper understanding of lynx conservation and its importance for biodiversity issues and ecosystem functioning.
- Through development of innovative lynx-based art tourism programs new target groups were engaged (artists). Tourism programs and art works will continue to showcase benefits of lynx presence.
- Through local consultative groups (LCG), knowledge was transferred, and awareness increased within local communities and local communities co-created some project activities.
- Celebrity ambassadors and social media influencers contributed to the project's visibility among the general public.
- With educational seminars for police officers and state prosecutors and the developed Handbook for investigation of poaching, we raised awareness among them about the importance of prosecuting and sanctioning illegal killing of lynxes and other protected wildlife.
- Through seminars for teachers, we increased the capacities of teachers to educate school children about lynx and nature conservation. Materials such as teacher's manual, E-lessons and board games for children will spread positive messages beyond the project duration.
- Children's books ('Max, the bravest lynx' and 'The Mighty Lynx') and the brochure about the lynx are available in public libraries.

- Activities for prevention of lynx illegal killing were not foreseen in project proposal and were not implemented in Croatia and Italy.
- Educational meetings for hunters mainly influenced the ones in favour of lynx being present in their hunting grounds as the ones who are against lynx presence did not attend the meetings.
- Not all teachers who participated at seminars were from the project area.
- It was difficult to reach certain stakeholders (hunters and livestock breeders in Croatia and Italy) to participate in the survey of public attitude.
- Reaching targeted audiences on a global level, developing and promoting lynx-based tourism packages required more funding and expertise than planned.
- Lynx based tourism may not attract a wide range of tourists.

 Electric fences purchased within C9 remain available for future damage prevention. Study tours for journalists increased visibility and raised awareness about the project and its objectives on a larger scale. Documentary films depict the efforts of the project in collaboration with key stakeholders. Both films were screened to a broad audience, also at film festivals. A cartoon about lynx (Huda RISanka) also reached a younger audience. Croatian national TV financed filming of an additional documentary, focused on the activities of the Croatian LIFE Lynx team. 	
Science-based management tools for strategic planning to ensure	Science-based management tools for strategic planning to ensure long-
 Iong-term viability for lynx All lynx data on genetic samples, opportunistic data, cameratrapping, GPS-telemetry, mortality, live-captures, intervention events and damages on human property were stored and shared in the web-based geo-referenced database MBase, thus ensuring standardisation of data among the data-sharing countries. The MBase portal will continue operating also after the project, thus being a further repository for shared data on a population level. The 'Common guidelines for Dinaric-SE Alpine population-level lynx management' serve as a foundation for science-based decision-making processes for lynx population surveillance between countries sharing the Dinaric-SE Alpine lynx population. Transboundary camera trapping enabled us to obtain robust lynx density and abundance estimates of high precision at the largest scale reported in Europe and beyond. Continuous population surveillance with camera traps enabled us to detect changes in lynx population status in the Dinaric Mountains during the reinforcement process, as well as document the expansion of the population in detail. 	 term viability for lynx The online portal MBase was publicised among the general public only in the last stages of the project implementation. We experienced a relatively high rate of GPS collars' malfunctions, which limited the duration until which we could track translocated lynx after the releases.

	 Furthermore, these results are a point of reference for any future results obtained with the same methodology, and they enable a comparison of lynx status with different study areas in Europe and beyond. The participation of hunters was crucial to perform the camera trapping at such a scale, as well as increase its effectiveness and the outcomes achieved. Genetic sampling allowed us to track the changes in the Dinaric population's genetic viability. Lynx telemetry enabled an in-depth view in lynx ecology and the data obtained was used in several scientific publications. Health analysis of translocated, captured and dead-found lynxes provided insight into population fitness. Health monitoring confirmed negative effects of inbreeding depression, such as congenital heart defects. Improving the population connectivity The 97 movement corridors for lynx and other large mammals that were identified in the study on ecological connectivity in Slovenia were incorporated into forest management plans and adopted by the Slovenian government. The corridors will be protected for at least the next 10 years. The highways in Croatia are not a barrier for wildlife (lynx) crossing as there are ecoducts, tunnels and viaducts that offer sufficient permeability. 	 Improving the population connectivity Even though we identified 97 important movement corridors for lynx and other large mammals and protected them, their functionality remains unknown. Linear barriers, like fenced highways without suitable crossing objects (Ljubljana - Koper highway) proved to be the most important source of fragmentation for Dinaric and SE-Alpine part of the lynx population. Some of the identified movement corridors are also used for agricultural purposes which might hinder the movement of lynxes
	OPPORTUNITIES:	THREATS:
GIN	Rescuing the Dinaric-SE Alpine population from extinction	Rescuing the Dinaric-SE Alpine population from extinction
TERNAL ORI	 Animals released in the ULyCA2 project offer the possibility of breeding with animals that were translocated into the SE Alps and their offspring, strengthening the lynx genetic variability in the newly established stepping-stone population. 	As the SE-Alpine population grows, its range will expand to Austria, where the acceptance of lynxes by hunters is very low.
EX	Conserving and managing the lynx population through international collaboration	Conserving and managing the lynx population through international collaboration

 A new platform that focuses on large carnivore conserving in the Balkan peninsula area (Dinaric-Elarge carnivore initiative) which will help safeguar lynx population in the future. By building the project's recognition at the Europe Lynx became a good practice example for oth future reintroduction projects. The lynx management plan was adopted by Ministry in Croatia. 	 Given that the lynx management plan has yet to be adopted by the relevant Ministry in Slovenia, there is a possibility that the timeframe for population monitoring using camera traps may not align between Slovenia and Croatia. Such misalignment could diminish the reliability of results regarding lynx abundance and densities at the cross-border level. the relevant
Stakeholder-supported reinforcement process to s	sustain lynx Stakeholder-supported reinforcement process to sustain lynx recovery
 Regular public surveys are planned within the Slovenian action plan for conservation of lynx national management plan. General public and hunters show high supp conservation and strongly oppose illegal killings of According to the public attitude survey results, h personal communication over media and winformation about lynx. Lynx and art-based tourism programs introduced the market and diversified wildlife tourism offer. Hunters in Slovenia and personnel in protected ar expressed high willingness to continue cam activities past the duration of the project. 	 Hunters in Croatia were not willing to participate in the public attitude survey in the beginning of the project. Approximately 15% of livestock breeders support illegal killings of lynx. Attitude survey results suggest that public support for additional translocations will decrease as the population recovers. Low knowledge about lynx among the general public in Italy. Unsustainable tourism activities may pose a risk to lynx habitat. With increased lynx densities, hunters' tolerance may decrease, possibly resulting in illegal killing.
Science-based management tools for strategic planning	ng to ensure Science-based management tools for strategic planning to ensure long-
long-term viability for lynx	term viability for lynx
 Population surveillance with camera traps allows of between the status of lynx populations in Europe The online database MBase will remain a princip for storing and sharing data on lynx signs of p available for viewing by the general public (intere The knowledge gained during extensive lynx monit transferred to other countries sharing the E parallelier 	 The proposed time frame for organisation of lynx national monitoring schemes may not be carried out as expected due to unsecured funding by responsible Ministries. With increasing lynx range and abundance, the current monitoring system might have to be revised and certain adaptations made. Due to global warming, the conditions for collecting non-invasive genetic samples with snow tracking are getting worse each year, monitoring in a lawarming of collected participant.

 By increasing our knowledge on effective ways of collecting non-invasive genetic samples (collecting samples from paw prints in snow/mud) and their processing, we will be able to obtain more genetic samples. 	
 Improving the population connectivity The proposed construction of the ecoduct on the Ljubljana - Koper highway section in Slovenia will increase gene flow between the Dinaric and the SE-Alpine lynx population. 	 Improving the population connectivity Although the border fences between Slovenia and Croatia are currently being removed, there is a risk that they will be rebuilt due to the ongoing global migration crisis. With rapid and regular national budget changes in recent years, there might be a delay in construction of the ecoduct on the Ljubljana - Koper highway (Slovenia).

AFTER LIFE CONSERVATION PLAN

With the project coming to an end, certain measures and conservation actions have to continue to be carried out in order to ensure and safeguard the long-term conservation of the lynx in the project area and beyond. The After LIFE Conservation Plan and its foreseen activities rely on the developed 'Common guidelines for Dinaric-SE Alpine population-level lynx management' and strategic national management plans for lynx conservation in project countries, sharing the Dinaric - SE Alpine lynx population. Drafts of these strategic documents were prepared and sent to the responsible Ministries in Croatia, Slovenia and Italy. However, until the end of May 2024, the lynx management plan was only adopted in Croatia, whereas in Slovenia and Italy they remain to be adopted.

Rescuing the Dinaric-SE Alpine population from extinction

The long-term vision of the LIFE Lynx project is to establish a metapopulation spanning from the Dinaric mountain range to the Swiss Alps, thus ensuring a viable lynx population with sufficient gene flow and individual dispersal between and within regions. Lynx translocations and reintroductions to the Dinarics and SE Alps were the core of the LIFE Lynx project in an effort to decrease the inbreeding coefficient below F = 0.15, as each new integrated animal increases the chances for survival of the entire population. In the period from 2019 to 2023, we translocated 12 lynx to the Dinaric mountains with the action being extremely successful as some of the translocated lynxes, upon arrival, very quickly established their home ranges within the remnant lynx range and most of them successfully bred already in the first season of translocations. With extensive population surveillance with camera traps, genetic sampling and GPS telemetry, we were able to detect at least 18 litters and 38 kittens of translocated lynx in the Dinaric mountains, showcasing their contribution towards reversing the inbreeding trend.

While remnant lynx still were present in the Dinaric population, the population in the SE Alps was newly established within the LIFE Lynx project by reintroducing 6 lynxes (3 females and 3 males) in the period from 2021 to 2023. All but one male lynx successfully established home ranges in the proximity of the release site, safeguarding the creation of a new lynx population nucleus and the population expansion through reproduction. Since the reintroduction, we were able to detect at least 6 litters with 15 kittens and successfully GPS-collared 5 offspring, enabling us to closely monitor their movement and follow the population expansion towards neighbouring countries.

Using deterministic camera trapping and spatial capture recapture modelling, we could robustly assess the changes in the lynx density and abundance in the Dinaric Mountains during the process of reinforcement. We documented a 44% increase in lynx population density and a 42% increase in its abundance over the course of C.5 action (2019-2023). The improvement in the lynx status was especially evident in Slovenia, where the number of adult lynxes in the Dinaric Mountains almost doubled.

In order to determine whether our translocation efforts were fruitful, we tracked the impact of the project on the long term viability of the Dinaric – SE Alpine lynx population and determined how the population should be managed in the long term. The main tool for the latter is stochastic modelling, backed-up with empirical data of population development, aimed to predict the long-term viability of the lynx population in the Dinaric Mountains and the SE Alps. The models presented a rapid decrease

in inbreeding coefficient below the threshold of F = 0.15 in the first 10 years after the first translocations as well as an increase of the effective population size (Ne), thus preventing immediate population extinction.

The overall goal to sustain the vitality of the Dinaric segment and fortify the newly formed Alpine segment of the population was successfully achieved with 14 animals being successfully included into the (sub)populations. Thanks to the 'Optimal management scenarios for ensuring viability of lynx in the Dinaric mountains and South eastern Alps' report, computer simulations indicated that the total inbreeding level will remain under the threshold of 0.15 in the next years. Based on this, **we conclude that the population is saved from extinction.**

Conserving and managing the lynx population through international collaboration

In the seven-year project period, we have established cooperation and mutual trust between all project countries. Common nature conservation goal has strengthened the interinstitutional collaboration and enabled us to manage and monitor the lynx population on a cross-border level as well as to strengthen the collaboration with source-population countries. Sustaining international collaboration involved the exchange of data organised according to the SCALP methodology through the MBase database. This interactive online portal consolidates information sharing for the Dinaric-SE Alpine lynx population, facilitating accessibility to the data also for external users. Furthermore, it is crucial to persist in international cooperation for genetic monitoring of populations, as collaborative efforts in researchers overseeing reintroduced or reinforced populations, facing comparable challenges to the Dinaric-SE Alpine population, can yield significant synergies.

With membership in several platforms associated with large carnivore conservation (WISO, LCIE, CSG, Linking Lynx, Eurolynx) we amplified the project's visibility and stressed the importance of cross-border lynx management and conservation not only between project countries but also with countries with which we share the population or will potentially share it in the long-term. In addition, there is a need to enhance cooperation with Austria, Switzerland, and Bosnia and Herzegovina to pave the way for establishing a broader metapopulation in the long term. To build lynx monitoring capacities in Bosnia and Herzegovina and establish cooperation between management and research institutions, Faculty of Veterinary Medicine University of Zagreb submitted project proposals for the Interreg Croatia - Bosnia and Herzegovina - Montenegro program.

A significant step-forward towards joint lynx conservation efforts was the signing of a networking agreement on exchange of knowledge and information between Slovenia Forest Service, Hunters Association of Slovenia and the Styrian Hunting Association (Austria). This represents a significant milestone in fostering greater acceptance of lynx in Austria and a pivotal development as we observe lynxes gradually migrating towards the Karawanke Alps, bordering with Austria.

Overall goal to maintain and expand the cooperative effort with all nations sharing the Dinaric - SE Alpine population and to establish open communication, emphasising the exchange of information and experience, was successfully achieved.

Overall goal: to further develop partnerships and international collaboration on a metapopulation level.

Measure	Responsible	Funding	Timeframe
Regular cooperation and	MNVP, SFS, UL,	MNVP, UL, MINGOR, PLI	Regular
strengthening the collaboration of	MINGOR, VEF, PLI,		
experts and competent institutions	Other*		
from Slovenia, Croatia, Italy,			
Austria, Switzerland, Romania,			
Slovakia and Bosnia and			
Herzegovina, independently and in			
the framework of international			
groups (e.g. WISO, the emerging			
idea of the Dinaric-Balkan-Pindos			
Large Carnivore Initiative, LCIE, CSG,			
Linking Lynx, Eurolynx).			
Cooperation with European	MINGOR, VEF	MINGOR	Regular
institutions experienced in lynx			
orphan rehabilitation (Croatia).			

*The selection of the institution participating in the activity will be made through a public procurement process.

Stakeholder-supported reinforcement process to sustain lynx recovery

Implementation of conservation actions cannot happen without strong communication support, especially during and after actions such as lynx translocations or reintroductions. Enhancing cooperation, dialogue, and trust among relevant stakeholder groups is imperative. We have identified key stakeholders at the beginning of the project with whom we have built strong partnerships, which led to the successful implementation of different project activities. With diverse approaches, we involved the public in management processes that contributed to fostering tolerance and mutual trust among stakeholders.

Since the beginning of the project, hunters have played a pivotal role as the primary stakeholder group, actively participating in various project initiatives. We fostered a sense of mutual trust through educational seminars, one-on-one meetings, and field activities, involving project staff, researchers, and hunters alike. By publishing articles in the Slovenian and Croatian national hunting magazines, we engaged with hunters who were not directly involved in the project, but were considered important for awareness-raising about the importance of lynx conservation. Our engagement extended through an international lynx conservation conference, presenting the project's main outputs and active hunter involvement, attended by representatives from diverse European hunting organisations, highlighting the crucial role of hunter involvement in sustaining lynx populations.

Local residents were a crucial stakeholder group in the project, and we engaged with them through "local consultative groups" (LCGs), which were open for anyone to join at any point. Members of LCGs were regularly informed and consulted about all aspects of the project and gave input on project activities, especially those related to lynx management and communication. We ensured the broader community remained well-informed about project developments through various channels, including our project webpage and social media platforms such as Facebook, Instagram, and YouTube. Additionally, we conducted presentations and organised documentary film screenings to engage with residents in person. As the presence of lynx did not raise significant concerns among livestock breeders, we addressed issues relating to lynx and livestock through communication channels intended for the broader public.

School children and young individuals, who will play important roles in future decisions regarding lynx conservation were identified as a significant interest group. To engage with this demographic group, we forged close partnerships with nine schools through the Young Lynx Guardians program. Over three years, we conducted various collaborative activities, with teachers consistently updating their pupils on lynx monitoring activities. Furthermore, we organised numerous workshops and field days involving other schools and organisations, broadening our reach to many pupils by project culmination. Additionally, we facilitated seminars for teachers, introducing them to the lynx teacher's manual and e-lessons generated within the project. These resources promise continued dissemination of lynx-related topics in schools even after project completion.

Overall goal: to actively involve all key stakeholder groups through education and awareness-raising, especially in areas where lynxes are newly present.

Measure	Responsible	Funding	Timeframe
Regularly Informing all stakeholders in a timely and correct manner through all available channels (social	MNVP, SFS MINGOR, VEF	MNVP, MINGOR	Regular
media, online articles and local newsletters) and			

Measure	Responsible	Funding	Timeframe
continuous proactive engagement with the media (Slovenia, Croatia).			
Regular education, information and training of hunters in the framework of the hunter and game warden exams/licenses and regular training courses for hunters. Publications in specialized newsletters, e.g. main Slovenian hunting magazine Lovec (Slovenia).	Other*	MNVP	Regular
Educational events for members of lynx intervention team (Croatia).	MINGOR	MINGOR	Each 2 years
Effective prosecution of each case of lynx illegal killing: Ensuring trained personnel (police, prosecutors), ensuring the flow of information among relevant institutions, carcass examinations (Slovenia).	MNZ, Other*	MNZ	Regular
Improve understanding of the reasons for illegal killing through anonymous surveys for hunters and raise awareness about the scale of illegal killing of wildlife, especially among law enforcement authorities, but also among other people, through publications, presentations and participation in relevant events (Slovenia).	Other*	MNVP	Each 5 years
Continuing the practice of taking into account the permanent presence of lynx and its predation in the preparation of hunting management plans in order to ensure a sufficient prey base for lynx and hunters' acceptance (Slovenia).	SFS	МКСР	Each 2 years
Assessing lynx-caused damages to livestock and paying compensation for lynx damage in a timely manner (Slovenia).	MNVP, SFS	MNVP	Regular
Development and implementation of protocols for prevention of illegal killings (Croatia).	MINGOR	MINGOR	Regular

*The selection of the institution participating in the activity will be made through a public procurement process.

Science-based management tools for strategic planning to ensure long-term viability for lynx

The lack of a coherent management response to the Dinaric lynx population decline was recognized as one of the main threats to the population. As the LIFE Lynx project was aiming to provide solutions for all the main problems the lynx population is facing, it was necessary to provide a new management strategy. This led to the development of 'Common guidelines for Dinaric-SE Alpine population-level lynx management', aiming to establish a foundation for lynx management grounded in scientific data and systematic monitoring. The objective was to garner consensus among government institutions, experts, and all stakeholders involved in ensuring effective and coordinated lynx management.

In 2018, Slovenia, Croatia, and Italy established a systematic and comprehensive lynx population surveillance scheme, designed to adapt to changes in population dynamics. This scheme enabled the assessment of crucial demographic parameters such as spatial distribution, population density, the number of reproductive pairs, and the genetic status of the lynx population. It also allowed monitoring of the success of introducing animals into the population and the impact of such translocations on the genetic structure of lynx in the Dinarics. Over five years of systematic monitoring, high-quality data has been collected, providing the first reliable estimates of the lynx population status.

With the help of GPS-telemetrical methodology, we discovered important information on the ecology and behaviour of the species (e.g. space use, interspecific interactions, reproduction, predation) as well as received information on the health status of individuals. Telemetrical surveys are of particular importance in areas where, as a result of reintroductions, lynx have reappeared in the ecosystem after a prolonged absence, not only to evaluate the impact of the presence of a new apex predator on the ecosystem but also for the purpose of engaging with key stakeholders (hunters), raising public awareness and detecting potential illegal killings.

Overall goal: to continue with synergetic science-based, population-level lynx management for the long-term lynx population viability.

Measure	Responsible	Funding	Timeframe
Implementation of questionnaires on the presence of lynx among hunters (Slovenia).	SFS	MNVP	Regular
Collecting opportunistic data on lynx presence (Slovenia, Croatia, Italy).	SFS, VEF, PLI	MNVP, MINGOR, VEF, PLI	Regular
Estimation of minimum population size (optional abundance and density if enough data is available) through camera-trap monitoring on a predefined spatio-temporal frame. Transboundary coordination and data sharing. Collecting images in a national database, data processing, ecological modelling and reporting (Slovenia, Croatia).	SFS, VEF, Other*	MNVP, MINGOR	Each 2 years
Assembling and maintaining data in MBase from countries, sharing the Dinaric-SE Alpine lynx population (Slovenia, Croatia, Italy).	SFS, VEF, PLI	MNVP, MINGOR, PLI	Regular
Organisation of training sessions before each monitoring season (Slovenia).	SFS, Other*	MNVP	Each 2 years
Involvement and regular feedback to hunters, foresters and volunteers on the data collected and the results of lynx population monitoring (Slovenia, Croatia, Italy).	SFS, VEF, PLI, Other*	MNVP, VEF, PLI	Each 2 years
Collection of non-invasive genetic samples and analysis of the genetic parameters (Slovenia, Croatia).	SFS, VEF, Other*	MNVP, MINGOR	Each 2 years
GPS tracking of lynx in the SE-Alpine population for ecology research, engaging with hunters, raising public awareness and detecting potential illegal killing (Slovenia).	UL	ARIS	Until 2026

Measure	Responsible	Funding	Timeframe
Monitoring and recording mortality, determination of causes of death, and collection of samples for genetics (Slovenia, Croatia).	SFS, VEF	MNVP, MINGOR	Regular
Monitoring and recording human-lynx conflict interactions (Slovenia, Croatia, Italy).	SFS, MINGOR, PLI	MNVP, MINGOR, WWF	Regular
Conduct an opinion poll among the general public and hunters in the Dinaric and Alpine regions approximately every 5 years (Slovenia).	Other*	MNVP	Regular

*The selection of the institution participating in the activity will be made through a public procurement process.

Improving the population connectivity

Preserving an ample amount of suitable habitat and preventing habitat fragmentation is essential for lynx conservation. It is crucial to limit irreversible infrastructure interventions in larger forest complexes while simultaneously ensuring connectivity between them. Maintaining existing wildlife migration corridors and establishing new ones, especially in areas historically interrupted by infrastructure is vital for the lynx population connectivity. Therefore, we applied computer modelling to identify the most important animal (lynx) movement corridors that connect the largest patches of suitable habitat in Slovenia. In total, 97 important movement corridors were identified by using the structural connectivity approach. The identified corridors were implemented in national forest and wildlife management plans that are prepared by SFS and were adopted by the Slovenian government. Deforestation is strictly prohibited in the identified corridors for the next 10 years.

The highway stretching from Ljubljana to Koper traverses the forested ridges of the northern Dinarides, creating a barrier that divides the central habitat of large carnivores in Slovenia. Despite the existence of over 80 structures primarily designed for local human passage across the highway, these crossings are often suboptimal and do not pose a sifficient structure for wildlife crossing. Telemetry data from lynx (and other large carnivores) indicate significant limitations in the highway's permeability across certain sections. Two crucial wildlife corridors are obstructed by the highway, one near Vrhnika and Logatec, and another near Postojna. Among 36 GPS-tracked lynxes, only one has successfully learned to navigate the highway through inadequate crossing structures near Vrhnika and Logatec, while no successful crossings have been recorded in the vicinity of Postojna. Furthermore, photos retrieved from camera traps confirmed the highway crossing of two lynx individuals.

Overall goal: to improve the species population connectivity through corridor protection and green infrastructure.

Measure	Responsible	Funding	Timeframe
Ensure that measures are taken to strictly protect the corridors identified in forest management and hunting management plans from further deforestation. Taking corridors into account in spatial planning procedures (Slovenia).	SFS, ZRSVN	MKGP, MNVP	Regular
Improving spatial connectivity in key areas where dispersal is reduced or prevented. Construction of the planned ecoduct (National Spatial Plan2021); implementation of the measures set out in the	DARS, DRSI, ZRSVN	State budget	Until 2029

Measure	Responsible	Funding	Timeframe
Resolution on the National Programme for the			
Slovenia for the period up to 2030 and the Strategy			
Slovenia up to 2030, as well as in the Transport and			
Transport Infrastructure Investment Plan for 2020-			
Revision of the Guidelines for environmental impact	MINGOR	MINGOR	Until 2030
assessment studies for large carnivores (Croatia).			

