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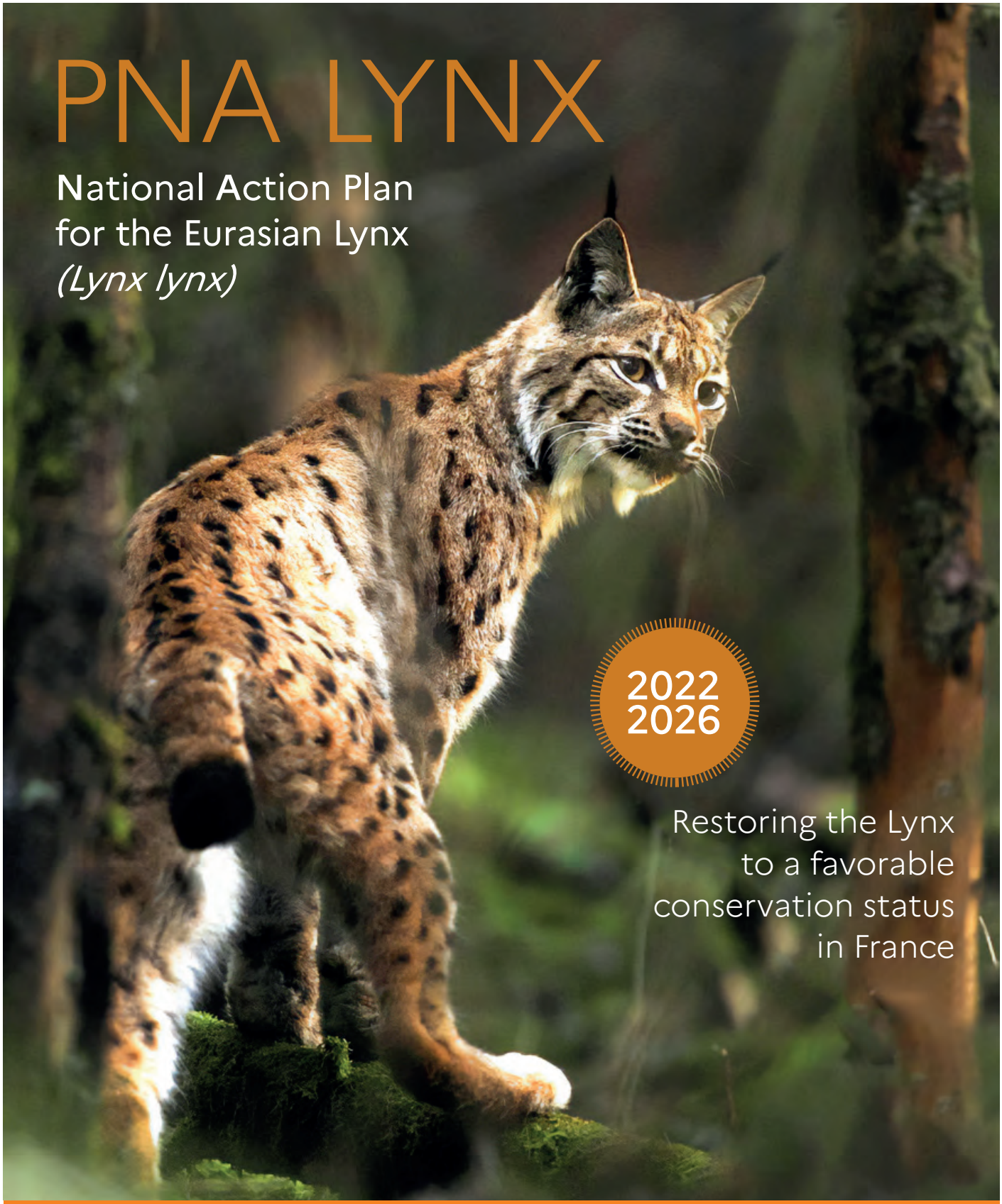
PNA LYNX

National Action Plan for the Eurasian Lynx *(Lynx lynx)*



2022
2026

Restoring the Lynx to a favorable conservation status in France

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Editorial

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It gives us great pleasure to launch this first National Action Plan for the Eurasian Lynx (*Lynx lynx*).

The Eurasian lynx is the largest wild cat in Europe, and one of the three large carnivores present in metropolitan France alongside the brown bear (*Ursus arctos*) and the gray wolf (*Canis lupus*). Like them, the Eurasian lynx now benefits from an action plan to foster the coexistence of this iconic species with human activities.

The Eurasian lynx is back from the brink of extinction. Already absent from France by the early 20th century, it made its way back in the 1970s following reintroductions in Switzerland then in the Vosges Mountains. It is currently found in the Vosges, Jura and the Alps. The situation of lynx populations remains of concern and varies from one mountain range to another.

It is the population's vulnerability that in 2018 led the French government to mandate the Prefect of the Bourgogne-Franche-Comté region to develop this first national action plan.

The threats that still weigh on this feline have led us to make firm commitments to facilitate exchanges between lynx populations in different mountain ranges and reduce in particular mortality due to road accidents, to combat illegal killing, to improve scientific knowledge (notably through international cooperation), to take into account damage that lynx populations can cause to domestic herds, and to improve coexistence with hunting activities, etc. These are all priority actions on which our efforts will focus in the years to come.

To achieve these objectives, the in-depth dialog initiated with all the stakeholders in the region must be pursued in the future. It is in this spirit and drawing upon current initiatives that this plan must be drafted, under the joint aegis of the DREAL Bourgogne-Franche-Comté and the French Biodiversity Agency, OFB.

The plan's implementation will also be guided by the scientific expert appraisals carried out in the first year: together, we will thus be able to base future actions on acknowledged and shared scientific grounds.

This 5-year plan is a first step to meet the requirements shared by all stakeholders to improve the lynx population's viability and facilitate its movements. There are still points to be clarified and developed in the PNA's application, but the experience and knowledge we acquire will enable us to progress towards a new version with new objectives for the years to come.

The success of this first national plan for the Eurasian lynx depends on each one of us.

Many of us hope that it will be implemented with determination and in close cooperation with all the stakeholders concerned, in order to restore this feline to its rightful place in French forests and regions.

Barbara Pompili
French Minister of Ecological Transition

National Action Plan for the Eurasian Lynx (*Lynx lynx*)

- Restoring the Lynx to a favorable conservation status in France -

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Document References

This document includes the information on biology and ecology needed to present the species and its conservation issues. For an extensive overview of knowledge on the species, please refer to the document produced by the Research and Observation Center for Carnivores (Centre de Recherche et d'Observation sur les Carnivores, hereinafter CROC) within the framework of the Lynx Program in the Vosges Mountains (Programme Lynx massif des Vosges, hereinafter PLMV). In late 2019, the PLMV became the Vosges Regional Action Plan (PRA) for Lynx (Charbonnel & Germain, 2019), upon which the national action plan (PNA) has greatly drawn. Components from the diagnoses and action sheets also include points from the discussions initiated and the actions suggested for inclusion during the drafting of the action plan for the conservation of the Eurasian lynx by the SFEPM-WWF (Drouilly, 2019) in agreement with the interested parties.

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1.INTRODUCTION

PNA LYNX 2022-2026

1. INTRODUCTION

A. What is a national action plan?

National action plans (PNAs) are strategic tools established by Article L. 411-3 of the French Environment Code. They are designed to ensure the conservation or restoration to a favorable conservation status of species of wild fauna and flora that are either threatened or of particular interest (referred to in articles L. 411-1 and L. 411-2 in addition to pollinating insect species). This tool for protecting biodiversity and wildlife is used to reach a favorable conservation status when other environmental and sectoral public policies, including regulatory nature protection tools, are deemed unable to achieve this objective.

Some species of wild fauna and flora are particularly threatened, mostly due to human activities. These threats can lead to the depletion or even extinction of such species in all or part of the areas where they live. The conservation status of these species is considered poor or unfavorable when the parameters that determine their population dynamics or that assess the quantity and quality of their habitats are deteriorating to such an extent that their long-term maintenance is compromised. In this case, specific actions to restore their populations and habitats are undertaken. A favorable conservation status reflects a situation where the species in question is maintained over the long term in the natural habitats where it lives.

The PNA is a tool for rallying the various stakeholders (institutions, academics, socio-economic players and associations). It defines a medium- or long-term strategy (5 to 10 years) for an endangered species, and is designed to:

- organize the coherent monitoring of the populations of the species concerned;
- implement coordinated actions conducive to the restoration of these species or their habitats;
- keep the players involved and the general public informed;
- facilitate the integration of species protection into human activities and public policies.

When the numbers have become too low or the species has disappeared, PNAs can also be used to undertake operations intended to boost the population or reintroduce the species.

PNAs are not binding and are based on the collective commitment of players who have the means to act in the interest of endangered species.

There are two types of PNA:

- national recovery action plans characterize the measures to be implemented in order to improve the biological status of the species to be saved. They usually cover a 5-year period;
- national conservation action plans are used to capitalize on actions to ensure the long-term conservation of the species concerned. This is especially true for species that have already been the subject of a national recovery action plan. Once their biological status has improved or been stabilized, a national conservation action plan should be implemented. This type of plan covers a 10-year period on average.

B. Why is a PNA needed for lynx?

The Eurasian lynx gradually disappeared in France between the 17th and the early 20th century due to shrinking forests, the scarcity of its preferred prey and direct persecution. It began entering France again in the 1970s thanks to the reintroductions initiated in Switzerland (1972-1975) and in the Vosges Mountains (1983-1993). Naturally returning through Switzerland, the species was able to recolonize the Jura Mountains, from where it was able to reach the northern part of the Alps.

The Eurasian lynx is strictly protected internationally by the Bern Convention, and at European level by the Council Directive on the conservation of natural habitats and of wild fauna and flora. In France, it is listed as a protected and endangered species. The situation of lynx populations in France varies from one mountain range to another: the Vosges population has declined dramatically, the Jura population is stable and the Alps population is struggling to grow. Road accidents, illegal killing and a lack of connectivity between the different populations are still threats to the long-term conservation of the species. Its very conservative mode of dispersal also slows down the expansion of the species in France, as lynx—particularly females—stay close to their natal home range. Finally, the species has not been readily accepted by part of the hunting community; fears also persist regarding its coexistence with livestock activities, which can lead to local conflicts.

During the revision of the PNA framework in 2017, the lynx's population trend was corrected from "increasing" to "decreasing", due in particular to the shrinking of its regular geographic range in the Vosges Mountains. This is why the species is classified as "Endangered" in the Red list on continental mammals in metropolitan France according to the criteria of the International Union for Conservation of Nature (IUCN), and is currently considered a priority for public action.

This situation has led several organizations to initiate actions designed to benefit the species. Faced with the alarming situation in the Vosges Mountains, as early as 2016 the CROC research and observation center initiated the PLMV, a program designed to define a long-term strategy for the conservation of lynx in this area. This program was then transformed into a regional action plan (PRA) that was validated by those involved and the Grand Est Regional Scientific Council for Natural Heritage (CSRPN) in late 2019, supported by the DREAL Grand Est (Charbonnel & Germain, 2019). In 2018, the SFEPM was mandated by the World Wildlife Fund to launch the drafting of an action plan for the conservation of the Eurasian lynx in France. The outcome in 2019 was a document containing proposals for actions to be implemented by the French government within the framework of a PNA (Drouilly, 2019).

It was against this backdrop that, in August 2018, the French Ministry of Ecological and Inclusive Transition (MTES) mandated the prefect of the Bourgogne-Franche-Comté region to coordinate a PNA for lynx. The drafting of this action plan was entrusted to the ONCFS, now OFB, which monitors the species nationwide. Through a shared diagnosis and taking into account the current initiatives in favor of the species, **it appears that restoring a favorable conservation status for lynx in France requires:**

- improving knowledge of the species and strengthening population monitoring,
- reducing direct threats and identified obstacles to the conservation and development of populations (collisions, illegal killing, lack of connectivity between populations, etc.),
- better acceptance of the species by all stakeholders,

- improved coexistence with livestock-rearing activities by promoting prevention and reducing the impact of predation,
- campaigns to inform, raise awareness and disseminate knowledge on the role of the lynx in ecosystems along with the challenges of its conservation and its coexistence with human activities.

To achieve its objectives, the PNA must pursue the process initiated by various players, i.e., a dialogue based on established and shared scientific bases, in order to unite all those involved in lynx conservation—associations, protected area managers, scientists, representatives of socio-professional activities, breeders, hunters, managers of amenities and habitats, foresters, and local populations. The second goal is to coordinate their actions in the mountain ranges concerned (the Vosges, Jura, and Alps) while managing the opening up of conservation actions to neighboring countries (Switzerland, Germany).

Lynx grooming itself in the Jura forest (© A. Rezer)

C. Summary

The Eurasian lynx is protected internationally by the Bern Convention of 1979 on the conservation of European wildlife and natural habitats, and by Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora, which classifies it as a priority species of Community interest.

In France, it benefits from full protection through the ministerial order of April 23, 2007, which lists all the protected terrestrial mammals nationwide along with the measures for their protection.

It is classified as "Endangered" in the national Red List established according to IUCN criteria.

In late 2017, the National Natural History Museum (MNHN) considered the lynx population to be on the decline.

This situation has led to the emergence of several initiatives in the form of a plan for the conservation of the species by organizations such as the CROC research and observation center, which in 2016 initiated the PLMV (which has since become the Regional Action Plan for Lynx in the Vosges Mountains), or the WWF, which entrusted the SFEPM with the drafting of an action plan for the conservation of the Eurasian lynx in 2018.

In order to help meet the requirements of the Act on the restoration of biodiversity, nature and landscapes of August 8, 2016, the French ministry in charge of ecology has at the same time mandated the Prefect of the Bourgogne-Franche-Comté region to develop a national action plan (PNA) drafted by the OFB and coordinated by the DREAL BFC.

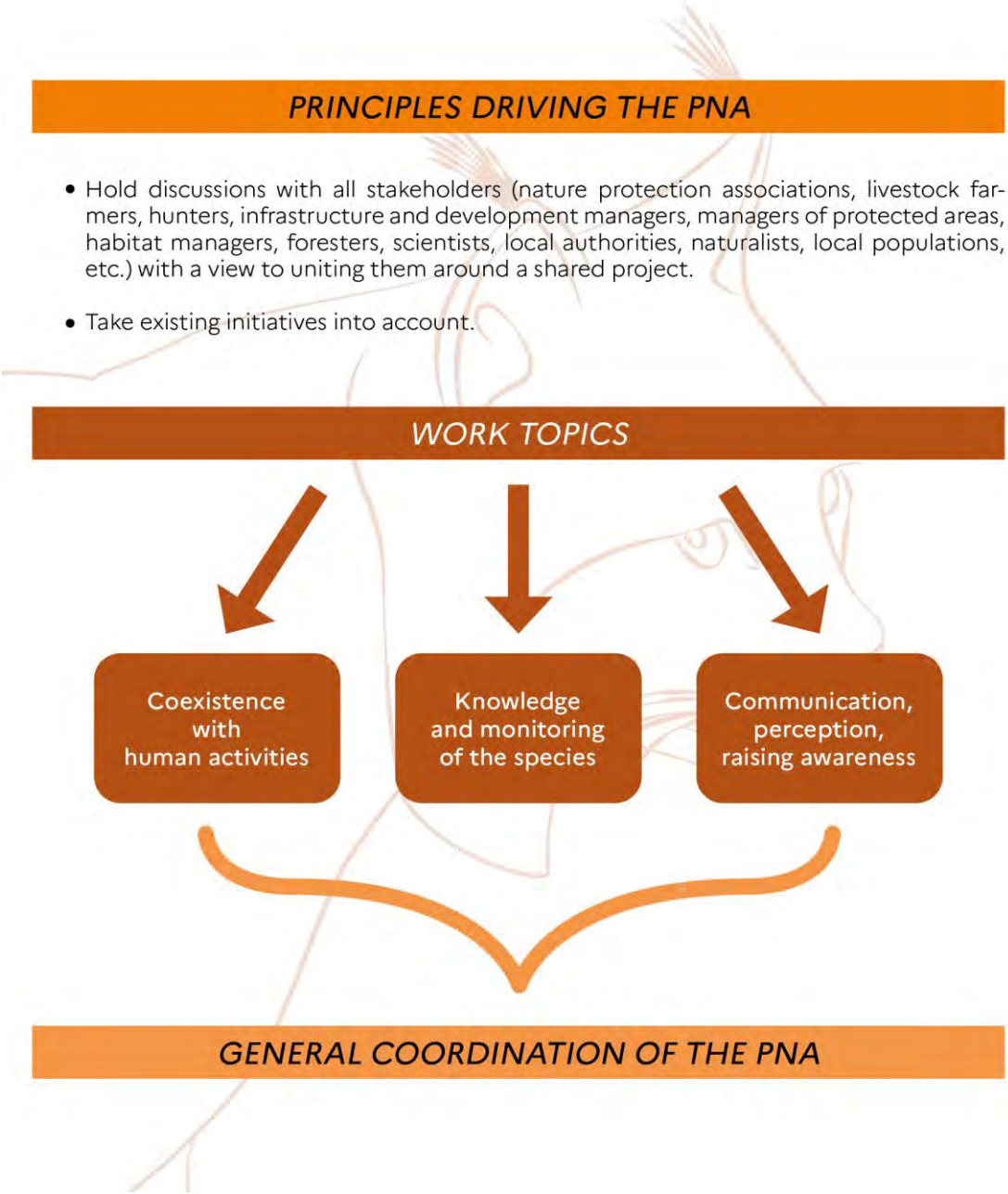
The long-term strategy for the Eurasian lynx in France is designed to restore the species to a healthy conservation status throughout its current range and in new areas of spontaneous colonization. This strategy will be implemented on the basis of progressive objectives, some of which will be differentiated according to the mountain ranges involved. This first PNA aims to restore the species' conservation status over 5 years, without reintroduction or regulation. Its objectives are as follows:

- improve knowledge of the species' dynamics in all the mountain ranges where it is present, especially in the Alps and areas recently recolonized;
- maintain/re-establish positive inter-annual demographic dynamics in the Jura and Alps;
- curb the species' negative demographic trend in the Vosges Mountains by working primarily on improving locals' perception of the species. The Eurasian lynx is in critical danger of extinction here because it is so scarce.

This PNA prioritizes the actions needed over a 5-year timeframe, while identifying actions that will later contribute to the geographic expansion of the lynx's range as part of a strategy to ensure its sustainability in France.

Once concluded, the plan will be assessed by a third-party organization. The DREAL BFC, which is in charge of coordinating the PNA, will monitor its application every year, with a mid-term review of the actions implemented in order to make any necessary adjustments to those identified in this document, in keeping with regional variations (such as the Vosges PRA for lynx). PRA Lynx Massif des Vosges).

To ensure that our considerations were productive, two principles guided the discussions and three work topics were identified to structure them.



This task began in 2019 within **four working groups**, each covering a single topic. An additional group was devoted to the operational procedures needed to coordinate and monitor the PNA. All those involved in the conservation of the species (French administration, local authorities, socio-professional organizations, associations, naturalists, etc.) were invited to take part in the discussions to define the actions.

Because the situation of the species differs from area to area, **three regional technical groups**—one each for the Vosges, Jura, and Alps—were set up to prioritize the actions previously discussed for their respective mountain ranges. For the Vosges Mountains, the technical and scientific committee for the PLMV/PRA also acted as the regional technical group for the PNA for Lynx (see Charbonnel & Germain, 2019 for its members).

Following the recommendations issued by the French nature conservation council (CNPN) on January 12, 2021, the stakeholders were brought together and a questionnaire was sent to them in order to consolidate the formulation of actions, their prioritization and their management.

The **steering committee** met at each stage. Its composition and role were determined by a prefectoral order.

The **scientific council** was represented within this steering committee. Like the latter, its composition was determined by a prefectoral order. It has a chair and two vice-chairs, rules of procedure and an accompanying ethics charter. It is responsible for providing recommendations and opinions on all matters referred to it by the prefect coordinating the PNA. The scientific council may also organize a working group on a specific topic, either on its own initiative or at the request of one or more of its members.

The PNA is submitted to the **CNPN** for its opinion.

A **funding committee** will be created to help project leaders in their search for funding and to provide financial support for the various actions planned. A meeting with the pre-selected members of this committee will be held prior to the PNA's validation.

Three main levers for action that could improve the long-term viability of the Eurasian lynx in France have been identified:

- improve the conditions under which lynx can coexist with human activities,
- remove obstacles to the species' survival and dispersal by addressing human-induced causes of mortality and eliminate impediments to the movement of individuals and to exchanges between population nuclei,
- improve communication about the species and coordination of the PNA (cross-cutting topic).

Fourteen priority objectives accompanied by operational actions have been identified based on the three topics previously mentioned.

Topic	Objective no.	Objective description
Improve the conditions under which lynx can coexist with human activities	1.1	Reduce conflicts with livestock farming activities
	1.2	Inform, raise awareness and discuss matters with livestock farmers and players
	1.3	Improve coexistence with hunting activities and the participation of hunting in lynx conservation
	1.4	Improve connectivity, facilitate exchanges between lynx populations, and reduce mortality due to collisions
	1.5	Improve acceptance of the species with the support of social sciences
	1.6	Study how human activities interfere with and influence the lynx
Reduce threats to the viability of the species and remove obstacles to its expansion	2.1	Strengthen the monitoring of lynx populations to discern trends
	2.2	Improve knowledge on the genetics of lynx populations
	2.3	Organize health monitoring and improve knowledge on the health status of lynx populations
	2.4	Better understand and evaluate the diversity of the species' diet, particularly with regard to predation on wild and domestic animals
	2.5	Combat the illegal killing of lynx
	2.6	Optimize the system for the care and rehabilitation of any lynx in distress or temporary difficulty
Communicate on, raise awareness of and promote the species	3.1	Develop tools for disseminating information, educating people and raising awareness of the species and the challenges of its conservation
Facilitate the PNA	4.1	Facilitate, coordinate, monitor and assess the PNA

2. PRESENTATION OF THE SPECIES

PNA LYNX 2022-2026

2. THE EURASIAN LYNX: PRESENTATION OF THE SPECIES

A. Systematics

The Eurasian lynx (*Lynx lynx*, of the order Carnivores and family Felidae) is the largest wild cat in Europe. It is one of the three large carnivores present in metropolitan France alongside the brown bear (*Ursus arctos*) and the gray wolf (*Canis lupus*).

The *Lynx* genus includes three other species:

- The red lynx (*Lynx rufus*), more commonly known as the "bobcat". Found in Canada, the United States and Mexico;
- The Canadian lynx (*Lynx canadensis*), found in Canada and the United States;
- The Iberian lynx (*Lynx pardinus*), one of the most endangered cat species in the world. Found only in Spain and Portugal, with about 500 individuals in the wild. Its status has nevertheless improved in recent years thanks to the conservation actions carried out under the Life+ IBERLINCE program, which have enabled the species to move from its "Critically Endangered" (CR) classification to "Endangered" (EN) (Rodríguez & Calzada, 2015).

All three species are smaller than the Eurasian lynx and prefer to feed on lagomorphs and rodents, but occasionally on ungulates.

There is currently no consensus on the taxonomic division of the *Lynx lynx* species into subspecies. The very wide historical (and prehistoric) distribution, from Western Europe to Central Asia and as far as the Pacific coast, and the successive isolations during the ice ages have probably led to differences within the species. Data comparisons focusing on morphology, geography, paleontology and genetics have led to the current proposal of nine subspecies (Figure 1). All lynx in France descend from the Carpathian strain, *Lynx lynx carpathicus.* Unless otherwise specified, in the remainder of this document the term "lynx" refers to the Eurasian lynx species and to the Carpathian subspecies for the French populations.

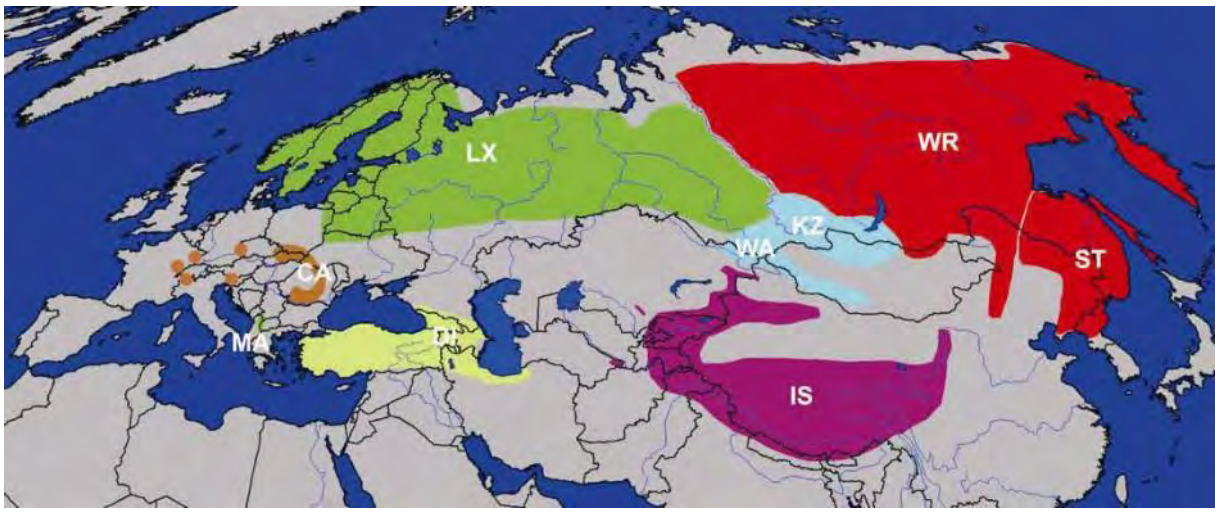


Figure 1. Distribution of the different Eurasian lynx (*Lynx lynx*) subspecies: **LX**: Eurasian lynx (*L. l. lynx*) Scandinavia, Finland, Belarus, Baltic States, Russia from the Urals to Siberia and east to the Yenisei River; **CA:** Carpathian lynx (*L. l. carpathicus*), Carpathian Mountains; **MA:** Balkan lynx (*L. l. balcanicus* or *martinoi*): Balkans (Albania, Macedonia, Montenegro, Kosovo); **DI**: Caucasian lynx (*L. l. dinniki*): from the southern part of the

Caucasus Mountains to Turkey, Iraq, Iran, and Turkmenistan; **IS:** Himalayan lynx (also known as the Tibetan, Central Asian or Turkestan lynx, *L. l. isabellinus*): Central Asia (Turkmenistan, Afghanistan, Pakistan, Uzbekistan, Kazakhstan, Kyrgyzstan, Tajikistan, China, India, Nepal, Bhutan); **WA:** Altai lynx (*L. l. wardi*): Altai Mountains (Russia, Kazakhstan, China, Mongolia); **KY:** Baikal lynx (*L. l. kozlovi*): Central Siberia, from the Yenisei River to Lake Baikal; **WR:** Siberian lynx (*L. l. wrangeli*): in Siberia, east of the Yenisei River; **ST:** Amur lynx (*L. l. stroganovi*): Russian Far East, Ussuri and Amur rivers, North Korea, Manchuria (China); according to von Arx *et al*. (2004). (2004).

B. General description

The characteristic silhouette reveals a relatively short body on long legs with broad paws. It has a rounded head with a short muzzle. The lynx's most striking features, however, are undoubtedly its short tail (the shortest of all Felidae) ending in a black tip, the "sideburns" on its cheeks and the tufts of black hair sprouting from the top of its ears. With a shoulder height of 50 to 60 cm when standing, a body length between 80 and 110 cm and a tail of 16 to 25 cm, it weighs between 17 and 30 kg. Males are 20 to 40% heavier than females.

The lynx's characteristic silhouette: broad paws, a short tail ending in a black tip, a rounded head, a short muzzle and tufts of black hairs on its ears. (left © A. Rezer, right © P. Raydelet)

The short jaw has only 28 teeth (rather than the 30 found in most Felidae) with long, curved canines and large carnassial teeth. This morphology allows the Lynx to develop a strong bite: the canines ensure a solid grip on the prey, which is generally killed by compressing the trachea or breaking the spine. Characteristic neck wounds and hematomas are actually used as criteria when examining prey to determine the lynx's responsibility.

Coat color and patterns vary according to geographic regions but also between individuals of the same population. The coat varies from yellow-gray to reddish brown, while the belly, inside of the legs and chest are much lighter, even white. Coat patterns also vary: spots may be small, large or absent, and rosettes may be defined more or less clearly (Thüler, 2002). These patterns are unique to each individual and differ from one side to the other. This natural "marking" is used to individually identify each lynx and is widely used in the monitoring of the species (see chapter c).

Examples of different coats observed for the Eurasian lynx (© OFB/RLL)

C. Protection and conservation status

a) Protection

International protection

The Eurasian lynx is listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, Washington Convention, 1973. Appendix II lists species that (a) are not necessarily currently threatened with extinction, but could be if trade were not strictly regulated to avoid exploitation incompatible with their survival, and (b) are similar to an endangered species listed in Appendix I and whose trade could be adversely affected should the specimens not be distinguished. There is in fact a strong demand for lynx furs on the international market. The main producers are Canada (*Lynx canadensis*), the United States (*Lynx rufus*) and Russia (*Lynx lynx*). If not strictly controlled, this trade could lead to poor management of Eurasian lynx populations, which are more susceptible to overexploitation, and potentially put additional pressure on the Iberian Lynx, listed in Appendix I (Breitenmoser *et al.*, 2000). This appendix prohibits international trade in the specimens listed therein unless the import is for non-commercial purposes (e.g., loans or donations) and particularly exchanges for scientific purposes: transactions can then only take place if authorized by an import permit and an export permit (or a re-export certificate). Some exemptions are foreseen, especially in breeding situations, but they are very limited and lead to the specimens concerned being placed in Appendix II.

CITES is applicable to the whole of the European Union under Council Regulation (EC) No 338/97 of 9 December 1996 on the protection of species of wild fauna and flora by regulating trade therein, where the lynx is listed in Annex A (which reproduces CITES Appendix I).

European protection

The Eurasian lynx is listed in Appendix III (protected wildlife species) of the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention, 1979). In application of this convention, Member States are obliged to implement legislative or regulatory provisions in order to ensure the conservation of the listed species and their inclusion in national environmental, planning and development policies. For species listed in Appendix III, regulated exploitation is permitted as long as it does not jeopardize the existence of populations, as is the case in Norway for the Eurasian lynx. This convention has been ratified by both the European Union (Council Decision 82/72/EEC of December 3, 1981) and France (Act no. 89-1004 of December 31, 1989 and Decree no. 90-756 of August 22, 1990).

The Eurasian lynx is listed in Annex II of the Habitats-Fauna-Flora Directive, 1992 (EEC 92/43), which aims to ensure the maintenance—or, where appropriate, the re-establishment—in a favorable conservation status, of the natural habitat types and habitats of the species concerned in their natural range. Annex II concerns species of Community interest whose conservation requires the designation of special areas of conservation (SACs). The Estonian, Latvian and Finnish populations of lynx are excluded. However, the species is not included among the priority species, i.e., those whose conservation status is of concern and for which a special effort must be made. On the other hand, the Eurasian lynx is also listed in Annex IV of the species of Community interest requiring strict protection and measures prohibiting the capture, killing, intentional disturbance, deterioration or destruction of breeding sites or resting places, and trade. An exception is made for the Estonian populations, for which the Eurasian lynx is listed in Annex V as a species whose taking in the wild and exploitation may be subject to management measures. Article 16 of the Directive sets out the conditions for derogations on the status of species, in particular to prevent significant damage to livestock, or for research and education purposes, or for repopulating. It was incorporated into French law by Article L. 411-2 of the Environment Code (see below).

National protection

Beyond the obligations arising from the signature of international and European conventions, and in application of EU regulations and directives, the lynx benefits from the status of protected species in France as well as from specific provisions in application of Articles 3 and 4 of Act no. 76-629 of 10 July 1976 on the protection of nature, codified under articles L. 411-1 and L. 411-2 of the Environment Code and by the ministerial order of April 17, 1981, repealed and replaced by the order of 23 April 2007, itself amended on September 15, 2012, specifying the list of terrestrial mammals protected throughout France and the terms of their protection. Finally, the species was listed in the ministerial order of 27 May 2009, amending that of July 9, 1999, determining the list of protected species threatened with extinction in France whose range exceeds the boundaries of a single *département*. Thus, unless a derogation is granted, it is forbidden to kill, mutilate, capture or remove individuals or intentionally disturb or naturalize them. It is also forbidden to destroy, alter or deteriorate lynx breeding sites and resting places[1]. Whether alive or dead, it is also prohibited to transport, traffic, use (commercially or not) or detain lynx, offer one for sale, sell or buy it.

1These prohibitions apply to physical or biological features deemed necessary for the reproduction or resting of the species in question for as long as they are actually used or usable during that species' successive reproduction or resting cycles, and insofar as the destruction, alteration or deterioration jeopardizes the successful completion of those biological cycles.

Any person who violates the conservation status of the species in breach of these prescriptions is liable to up to three years' imprisonment and a fine of €150,000 according to Article L.415-3 of the Environment Code amended on July 24, 2019 (or seven years' imprisonment and a fine of €750,000 if the act is committed by an organized gang - L. 415-6).The fine is doubled when this violation takes place in the heart of a national park or nature reserve.

Conservation status

The Eurasian lynx is classified as of "Least Concern" (LC) in the IUCN's Red List at both worldwide (Breitenmoser *et al.*, 2015) and European levels (Von Arx, 2018). While the overall trend is considered stable, many small isolated populations are classified as "Endangered" (EN) or "Critically Endangered" (CR). In Europe, for example, only a few native populations are classified as LC, while the reintroduced populations and the Balkan population are classified as Endangered (EN or CR). The native Scandinavian population, originally classified as LC, has now been downgraded to "Vulnerable" (VU) due to a decline in numbers over the past decade. The IUCN's French Red List recognizes the vulnerability of the species in France and classifies it in the EN category, i.e., threatened with extinction in mainland France (MNHN *et al.*, 2018).

b) Population distribution and trends

The historical (and prehistoric) distribution of the Eurasian lynx stretched from Western Europe to Central Asia and as far as the Pacific coast. In Europe, the species was present throughout the continent except for the Iberian Peninsula, the Pyrenees being considered a boundary between the Eurasian lynx population and that of the Iberian lynx (Figure 2, Kratochvil *et al.*, 1968). The species has been in decline since the Middle Ages as its forest habitat has regressed and its prey become scarcer. Extensive hunting has contributed to a significant reduction in lynx populations, even in areas of northern and eastern Europe where there was still sufficient forest cover and an abundance of prey. In central and western Europe, the interaction of these three factors of decline—killing, habitat loss and the decrease in wild ungulate populations—has led to the lynx occupying only a few safe havens in forested mountain ranges (for a historical review, see Stahl & Vandel, 1998). The Lynx disappeared from the Vosges Mountains in the early 17th century but survived in the neighboring Palatinate until the 18th century, and in the Jura Mountains until the 19th century (Herrenschmidt & Leger, 1987). The last individuals disappeared from the Alps in the 1930s.

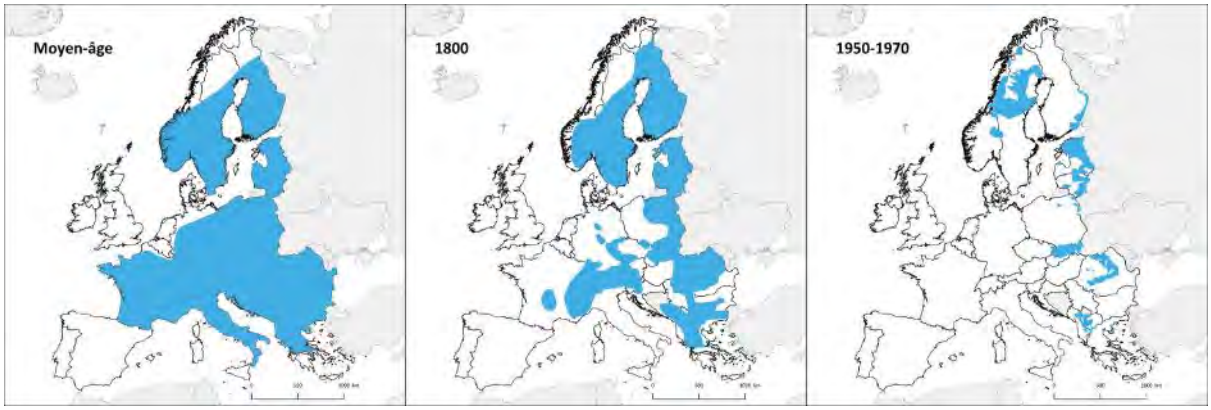


Figure 2. Changes in the presence of the Eurasian lynx in Europe from the Middle Ages to the middle of the 20th century, according to Kratochvil *et al*. (1968). (1968).

European numbers were at their lowest in the 1950s, with the species surviving in only five isolated populations: the Scandinavian (Norway, Sweden), Karelian (Finland), Baltic (Estonia, Latvia, Lithuania and Poland), Carpathian (Bulgaria, Czech Republic, Hungary, Poland, Romania, Serbia and Slovakia), and Balkan populations (Albania, Macedonia, Serbia, Kosovo, Montenegro, Greece Von Arx *et al.*, 2004). Some of these native populations were on the verge of extinction.

Societal changes in the second half of the 20th century led to reforestation of the continent, better management of wild ungulates and the introduction of legislation to protect various species, creating a favorable context for the return of the lynx (Breitenmoser, 1998; Linnell *et al.*, 2009). This situation has allowed the remaining population nuclei to expand and recolonize part of their historical range. Moreover, thanks to the reintroduction programs initiated in the 1970s, new populations have been established in Central and Western Europe: the Dinaric (Croatia, Bosnia-Herzegovina, Slovenia), Bavarian-Bohemian (Austria, Germany, Czech Republic), Alpine (Austria, France, Italy, Slovenia, Switzerland), Jura (France, Switzerland), Vosges-Palatinate (Germany, France), and Harz Mountains (Germany) populations.

Worldwide

The Eurasian lynx is very widely distributed, most of the populations being found in the continuum of boreal forests extending from Scandinavia and Russia (south of Siberia) to the Pacific. In Central Asia, there are populations in Mongolia, China, on the Tibetan plateau, along the Himalayan range to Afghanistan. In the Near and Middle East, the populations extend between the Caucasus Mountains, Turkey and Iran.
The main population nucleus in Russia is estimated at more than 22,000 individuals. The number of individuals is estimated at 10,000 in Mongolia and 27,000 in China but these numbers are not well documented in Asia and should be taken with caution. The world population appears to be stable, but data are incomplete for many countries where trends remain poorly documented (Breitenmoser *et al.*, 2015).

Within Europe

The species' geographic range is currently estimated at more than 800,000 km² with about ten populations spread over 23 European countries, between Scandinavia, along the forested mountain ranges of Central Europe and as far south-east as the Balkans (Figure 3, Chapron *et al.*, 2014; P.

Kaczensky, *personal communication*, Linnell *et al*. 2020, *in press*). The total European population is estimated at 9,000-10,000 individuals, but differences in the methods used and census efforts do not always allow reliable estimates and comparisons between populations (Kaczensky *et al.*, 2013). Native populations, whose population trend became positive again between the middle and end of the 20th century, make up the majority of the European population with each one numbering between 1,200 and 2,500 individuals, with the exception of the Balkan population, which would appear to have only 20 to 40 individuals nowadays. The Karelian and Carpathian populations are relatively stable, while the Baltic population is declining. The Scandinavian population is currently classified as "Vulnerable" partly due to management "measures" that have contributed to a drop in numbers since 2001. Populations originating from reintroductions established in Central and Western Europe are generally small, remain highly fragmented and show varied trends (Von Arx, 2018; LCIE, 2019). Recent trends and estimates are given in Table *1*.

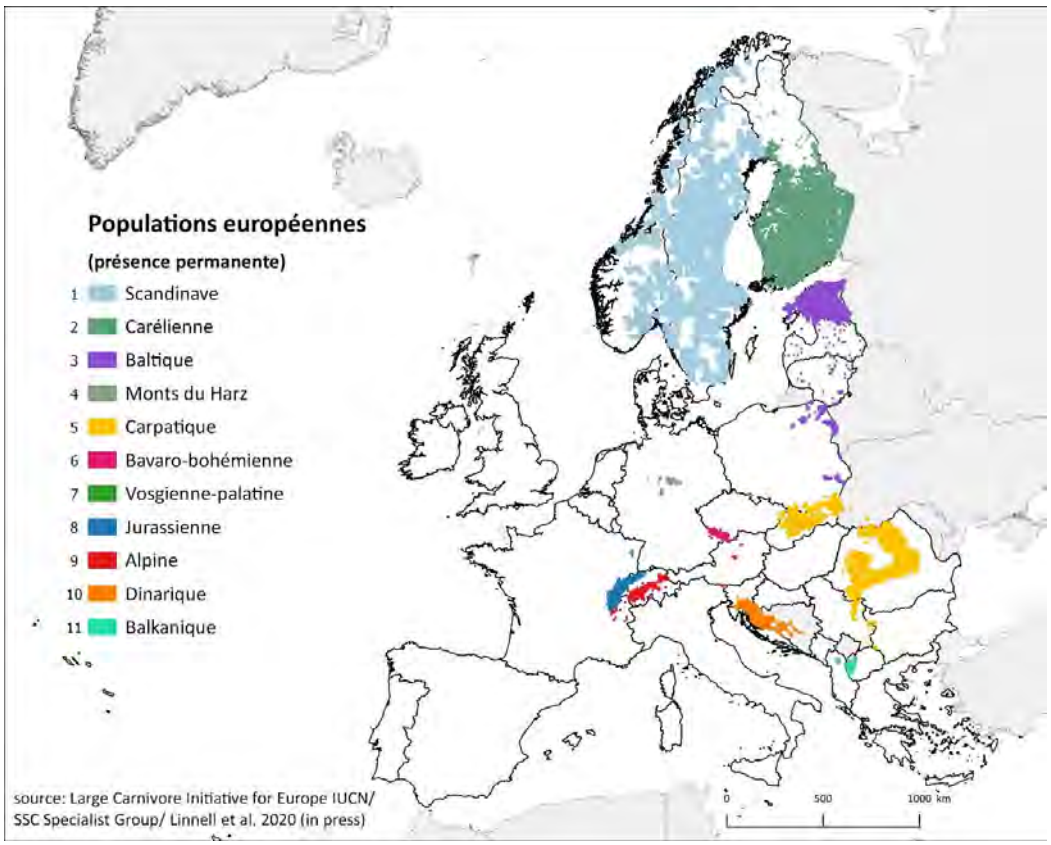


Figure 3 Distribution of Eurasian lynx populations in Europe. Only the grid cells indicating the lynx's permanent presence are shown (see Kaczensky 2018 for the methodology. N.B.: at the time these data were obtained, the distribution of the Vosges-Palatinate population did not reflect the presence of lynx reintroduced into the Palatinate). The numbers refer to the details in Table 1. Source: P. Kaczensky, *personal communication*, Linnell *et al*. 2020 (*in press*).

Table 1: Characteristics of Eurasian lynx populations in Europe. Sources: von Arx 2018; Charbonnel & Germain 2019, LCIE 2019.

	Population	Country (approximate % of the population)	Estimates (2012-2016)	Trend (2012-2016)	UICN category (2018)	Origin
1.	**Scandinavian**	Sweden (81%), Norway (19%)	1,300-1,800	decreasing	VU	native
2.	**Karelian**	Finland (unknown %), (Russia)	2,500 (excluding Russia)	stable	LC	native
3.	**Baltic**	Estonia (49%), Lithuania (37%), Poland (6%), Ukraine (5%), Latvia (3%), (Belarus and Russia)	1,200-1,600 (excluding Belarus and Russia)	decreasing slightly	LC	native
4.	**Bavarian-Bohemian**	Czech Republic (67%), Germany (23%), Austria (10%)	60-80	stable	CR	reintroduced
5.	**Carpathian**	Romania (57%), Ukraine (16%), Slovakia (15%), Poland (9%), Serbia (2%), Czech Republic (0.5%), Bulgaria (0.5%), Hungary (<0.05%)	2,100-2,400	stable	LC	native
6.	**Alpine**	Switzerland (77%), France (10%), Italy (7%), Slovenia (3%), Austria (3%)	163	increasing slightly	EN	reintroduced
7.	**Jura**	France (70%), Switzerland (30%)	140	increasing slightly	EN	reintroduced
8.	**Vosgian-palatinate ***	France (10%), Germany (90%)*	<30 *	decreasing, reintroductions ongoing	CR	reintroduced
9.	**Dinaric**	Bosnia and Herzegovina (53%), Croatia (39%), Slovenia (8%)	130	stable or decreasing	EN	reintroduced
10.	**Harz Mountains**	Germany (100%)	46	increasing slightly	CR	reintroduced
11.	**Balkan**	Rep. of North Macedonia (85%), Albania (15%), Rep. of Kosovo (?), Serbia (?)	20-40	stable	CR	native

* This estimate takes into account the reintroductions into the Palatinate (2016-2020)

Within France

In France, the lynx's return to the Jura Mountains was observed in 1974 following the reintroductions carried out in Switzerland between 1972 and 1975 (Breitenmoser *et al.*, 1998). The population there has grown steadily since then and continues to consolidate its presence by occupying almost the entire mountain range. Between 1983 and 1993, 21 lynx individuals were released in the Vosges Mountains as part of the only reintroduction program conducted in the area. Many of these animals disappeared due to illegal killing (three confirmed cases, three suspected). There was one case of malnutrition, and two individuals had to be recaptured because they were not wild enough. Only 10 individuals eventually contributed to the initial establishment of a small founding population (Vandel *et al.*, 2006). In the Alps, reintroductions in Switzerland (1971-80), Slovenia (1973), and Austria (1977-79) were subsequently consolidated, leading to the reconstitution of several subpopulations. The biggest of these is established in the north-west part of the Swiss Alps (Schnidrig *et al.*, 2016; Molinari-Jobin *et al.*, 2018). Some individuals probably reached the French side by corridors from the Jura via the Vuache, Salève and Epine mountain ranges (Zimmermann, 2004; Zimmermann & Breitenmoser, 2007). The geographic range within which lynx are regularly found in France has been steadily increasing since their return (Figure 4). It is currently estimated at 8,800 km^2 concentrated in the three mountain ranges of eastern France: the Vosges, the Jura and the Alps (Figure 5, ONCFS/RLL, 2019). Nevertheless, this increase corresponds mainly to the consolidation of their presence in the Jura Mountains, and the situations remain mixed depending on the geographic location. This is especially true for the Vosges Mountains, where their distribution has decreased and the situation remains of concern.

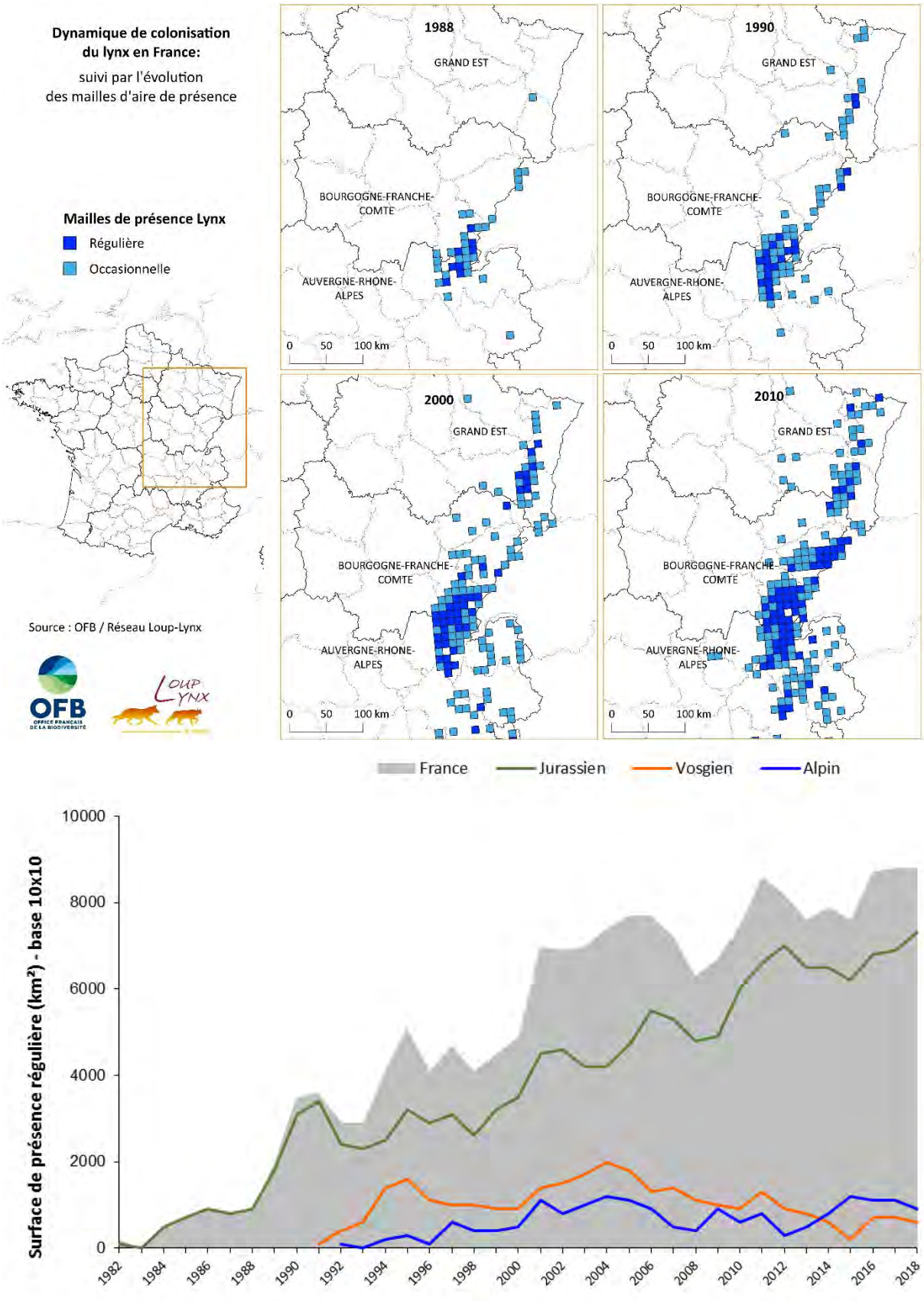


Figure 4. Colonization dynamics and evolution of the geographic range (km²) of the lynx's regular presence in the different French mountains where the species is established (ONCFS/RLL, 2019).

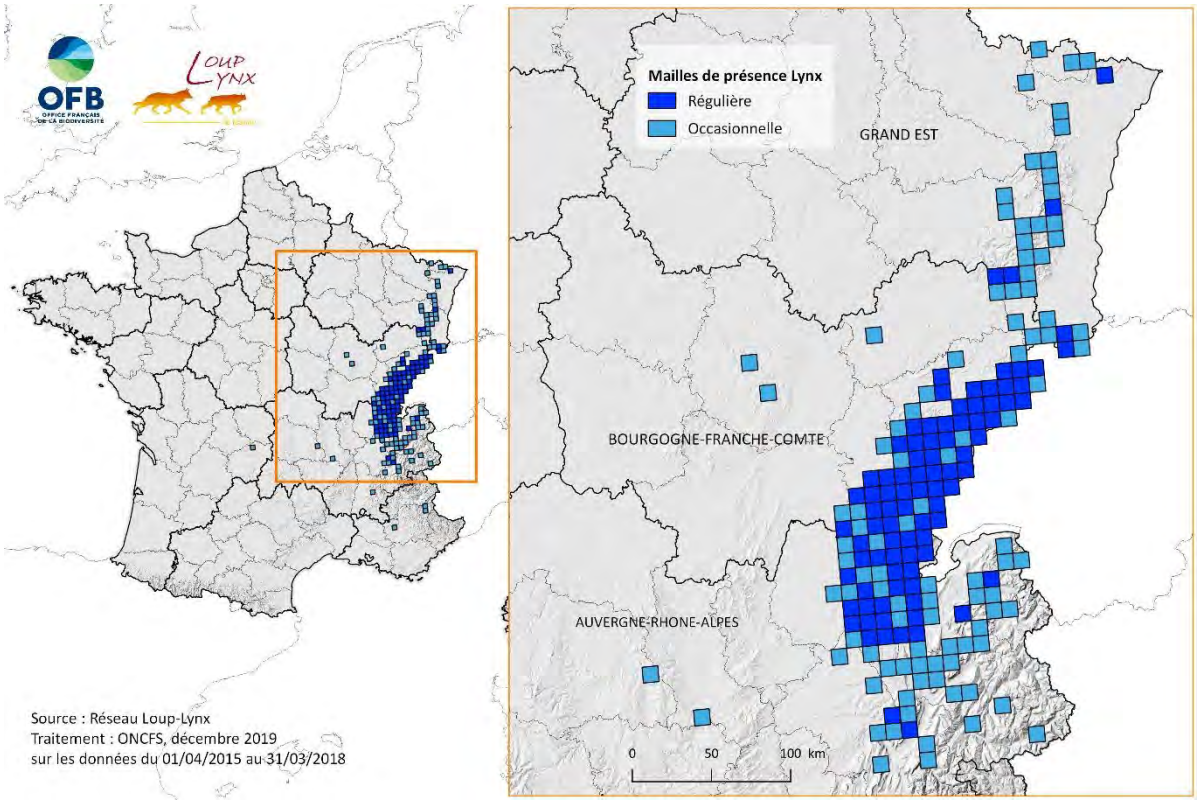


Figure 5. Distribution of the lynx in France in 2018, represented using elementary 10x10 km grid cells (standardized 100 km² grid, European Environment Agency)

The Jura

The Jura Mountains make up the core of the lynx's distribution (80%, from a range of 7,300 km^2 of regular presence in 2018 up to 7,500 km^2 including the Alsatian Jura). The species has recolonized almost all the forest habitats of the first and second plateaus along with the Haut Jura. Its distribution ranges from the Doubs and Haut-Rhin in the north to the Ain, as far south as Bugey. Westward it is bound by the municipality of La Bresse. The spatial dynamics tend to be stable or even slightly increasing, with the lynx's presence consolidated throughout the mountain range (ONCFS/RLL, 2019). The level of occupancy by lynx of the Jura Mountains could today facilitate the natural colonization of other uplands (such as the Bourgogne or Beaujolais). This has in fact been observed in recent years, underlining the challenge of ensuring connectivity between neighboring mountain ranges and sectors capable of hosting the species to the west of the Jura.

The Vosges

In the Vosges Mountains, after having reached a 2,000 km² range in 2005, for a population estimated at about twenty individuals, the species has experienced a drastic decline. This decline was caused among other things by illegal killing, the consequences of which were compounded by the population's small size. It led to fears of the lynx disappearing almost completely from these mountains (Laurent *et al.*, 2012; Germain & Marboutin, 2014; Germain, 2016). There were probably only a few individuals left before the reintroductions in the neighboring Palatinate in 2016 (Stiftung

Natur und Umwelt Rheinland-Pfalz, 2015). The range was limited in 2018 to 600 km^2 between the Vosges du Nord and Hautes-Vosges sectors (400 km² in the Vosges as a geographic entity; the remaining 200 km² concern the Alsatian Jura, which is geographically attached to the Jura Mountains). The future of this population currently depends first on the settlement of animals reintroduced into the Palatinate forest in Germany, second on the (presumably limited) movement of individuals from the Jura Mountains, and third on the maintenance or re-establishment of functional connectivity between the neighboring mountain ranges (the Palatinate, Vosges, Black Forest, and Jura; Charbonnel & Germain, 2019).

The Alps

In the Alps, the species still seems to be in the process of establishing itself with little change in the geographic range (900 km^2 in 2018). Lynx can be found in the mountains of the Northern Pre-Alps, Chablais, Vuache, and Chambotte up to the Chartreuse, which appears to be the current southern limit of the species' range. Progression is slow in the Alps, where the main source of individuals on the French side would appear to be due to dispersal from the Jura. There is little connectivity with the adjacent mountains and within the mountain range itself, particularly because of extensive urbanization in the valleys. Exchanges are theoretically possible with the Swiss Alps via the Chablais in the canton of Valais. However, the few individuals present in the southern part of the Bas-Valais cannot serve as a demographic source for the colonization of other favorable sectors in the southern Alps, and exchanges appear to be complicated because the area has numerous obstacles to dispersal (intense cultivation of the Rhone plain, a dense human population with major infrastructures, and numerous illegal killings (Biollaz *et al.*, 2015; Zimmermann *et al.*, 2019; Arlettaz *et al.*, 2020)). The Chartreuse Mountains are still the best-documented nucleus region of the French Alps, but they appear to be isolated from the rest of the Alps. A greater surveying effort remains to be made to better characterize the status of the French Alpine population. However, the Alps remain the best hope, in terms of size and available habitat, for establishing a significant population in this part of Europe. Beyond protecting current population nuclei and maintaining existing connections, expansion into the Alps on such a scale may require a proactive approach using the movements of individuals to strengthen subpopulations, expand lynx home ranges, form "stepping stones" to ensure connectivity between existing populations, or even expand the genetic pool through individuals from other populations (Schnidrig *et al.*, 2016).

c) Monitoring of lynx populations in France

Ideally, the monitoring of species such as the lynx should involve a combination of indicators that, estimated annually for example, would be used to:

- map the species' distribution and its progression,
- estimate the numbers with a confidence interval that takes into account the difficulty in detecting all individuals,
- measure changes in annual population growth.

However, these indicators—which were well suited to monitoring the lynx population in the early days of its reappearance in France—are not so well suited when there is widespread growth. In this case, it is better to use monitoring methods that take into account the species' geographic densification,

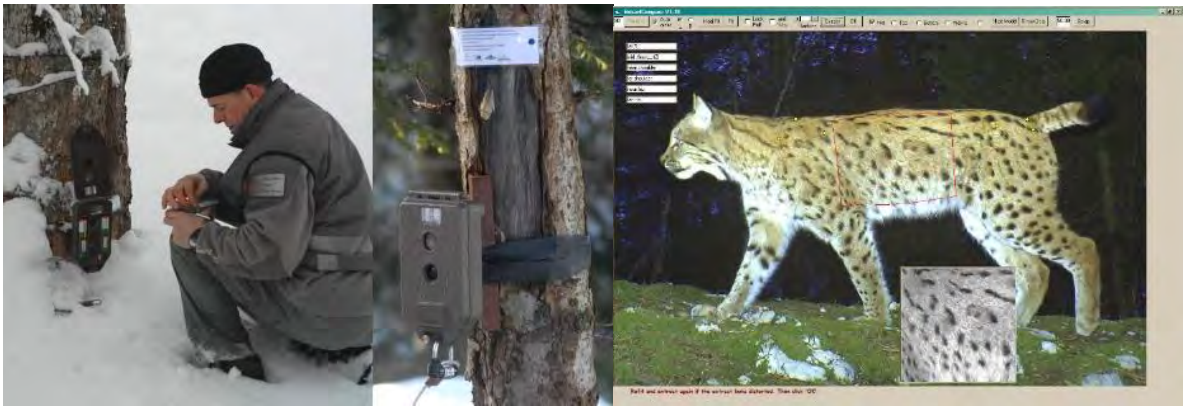
differences in the information provided on signs as to the lynx's presence between various sectors, the colonization front, and sectors that have been poorly or not covered. All of these factors impact the monitoring of the population, and the balance of the human and financial resources needed to monitor this species.

To gauge the conservation status of populations, it is preferable to monitor changes in the areas where lynx are found either regularly or occasionally rather than estimating numbers. Indeed, distribution models are increasingly used for programs monitoring large predators (Duchamp *et al.*, 2019). This method may be used to evaluate the whole species distribution relatively frequently (yearly) and is a good indicator for the spatial colonization process, which is relevant for territorial species. The demographic situation can thus be represented by assessing how the space is, or is not, occupied by the species (for a review see Holt *et al.*, 2002). This method is particularly relevant for the lynx as its long-distance dispersal and colonization potential is more limited than with other species such as the wolf.

The monitoring of the species in France is thus based on the opportunistic collection of evidence indicating the lynx's presence (direct observations, photographs, prey, paw prints) compiled and validated by the OFB's wolf and lynx study network (RLL). The accepted signs of presence are then carried over onto the European Environment Agency's 10x10 km grid so as to characterize the lynx's geographic range. This grid system is used for several international indicators: Natura 2000, the Habitats-Fauna-Flora Directive, and Status & Conservation of the Alpine Lynx Population (SCALP). This geographic grid system has been validated by comparison with baseline telemetry data acquired between 1980 and 1995. It was found to be a relatively reliable estimate of the size of the lynx's home range (Vandel, 2001; Marboutin *et al.*, 2008). In 2013, the method was refined to allow for greater responsiveness to variations in the estimation of the geographic range. The lynx's presence is considered regular if at least two signs are accepted for a grid cell during the two overlapping biennia preceding the year of the estimate, and occasional if fewer than two were accepted (see the detailed method in the Lynx Network Bulletin no. 18, 2013). The differentiation between regular and occasional presence remains nonetheless sensitive to the surveying effort. For example, the occasional presence noted in the other sectors of the Northern Alps would require a reinforced follow-up to obtain a more robust estimate of the distribution over the whole Alpine mountain range. Incursions are sometimes observed in areas a long way from the heart of sectors where there is a regular presence, for example in Haute-Saône and the Rhône (Monts du Lyonnais, Laurent *et al.*, 2012) and signs are occasionally found in particular in the Massif Central mountain range or in the Southern Alps. Only recurrent signs, accompanied by photographs or genetic confirmation, can attest to the lynx's presence in these sectors far from the home ranges where they are regularly present. The regular/occasional presence approach is thus valid if the species is already present over a large enough area and in sufficiently high numbers to be detected. Other methods should be used for small populations, such as estimating population size using the photographic capture-recapture method with camera traps (see below). However, in the same way that abundance and density estimates can be refined using capture-recapture models, the presence approach can also be corrected thanks to modeling, by factoring in the imperfect detection of the species, or errors in its identification (false positives) (Louvrier *et al.*, 2018, 2019). Survey efforts can thus be verified *a posteriori* to correct for non-detection. This kind of work may be used to produce a map of France showing the places where it is sure that the species is present (accepted signs of presence) and those where its presence is probable to a greater or lesser degree, even though it has not been detected there. This method is being investigated for lynx,

particularly in the context of habitat modeling and sustainability studies (OFB/CEFE/CROC/CEREMA, ongoing).

Photo-identification



Camera traps and photo-identification have become the main tools for monitoring lynx (© OFB/S. Gatti)

The unique patterns of the lynx coat make individual photo-based recognition and tracking possible. In 2008, following the example of what KORA was developing in Switzerland, S. Paillard (ONF 25) and S. Regazzoni (ONCFS SD 25) highlighted the usefulness of photo-identification and the constitution of a photographic database for monitoring the species (Network Bulletin no. 14). Since 2010, therefore, the ONCFS/OFB has been working on a photographic database and analysis of the photos sent to the RLL (Chenesseau *et al.*, 2010). Driven by the democratization and generalization of photographic equipment, especially camera traps, this type of evidence has become the main tool for monitoring the species in France. In addition to being an undeniable sign of the species' presence in an area, each photo of a lynx—ideally with both flanks—constitutes an individual's veritable ID. The RLL keeps a database of these photos and identified individuals. Each lynx photo received is reviewed with an identification support program and validated for placement in the catalog of identified animals (Hiby, 2010; Gatti *et al.*, 2011). This database was used for abundance and density estimates during intensive camera trap campaigns conducted in different sectors of the Jura Mountains between 2011 and 2015 (Gatti *et al.*, 2014, 2016). This type of individual monitoring can also be used to characterize lynx dispersal to new areas or between different mountain ranges, to identify individuals responsible for damage, to gain at least an approximate idea of home ranges, and to estimate certain demographic parameters such as reproduction and survival.

Estimating numbers and densities

The first question asked when a rare or endangered species is mentioned is "how many are there in the country?" Population size is often seen as the most meaningful of estimators, and it may sometimes seem counter-intuitive that estimates of numbers, obtained by simple counting, are not used as a measure of the conservation status of populations (Duchamp *et al.*, 2019). Despite developments in modeling, counting the number of individuals is only relevant on a local scale to obtain an idea of population density. Implementing such estimates at ever larger geographic scales quickly reaches its limits for a discrete species with a huge home range and a low population density. The estimates become less and less robust, with large confidence intervals, and call upon significant logistical, financial and human resources for an ultimate result that is not very accurate.

The numbers, presented up until 2011, correspond only to an assumed order of magnitude that is itself derived from an indirect and approximate estimate: 108 to 173 individuals in France, 19 to 30 of which are in the Vosges, 13 to 21 in the Alps and 76 to 121 in the Jura (estimate for 2008-2010, Marboutin *et al.*, 2011). These figures result from the multiplication of the geographic range by an amplitude of reference densities that are derived from studies conducted in Switzerland and France in the Jura Mountains up to 2011 (i.e., 1.1 to 1.6 individuals/100 km^2, Breitenmoser-Würsten *et al.*, 2007; Gatti *et al.*, 2011). Abundance and density can be estimated from the results of intensive camera trap campaigns, analyzed by capture-recapture methods. These protocols can be useful for measuring local abundance in reference areas, and can be repeated at regular intervals to monitor population trends at this scale. These estimates are theoretically valid only for the study area sampled and for the period considered, so they represent only a snapshot of the state of the lynx population in this area. Any extrapolation from these figures must therefore be made with caution and be limited to areas adjacent to the study areas, provided that the habitat is comparable.

Densities estimated by camera trapping can differ greatly from one country to another because of the methods used (mathematical models, estimates of the area sampled) and prevent relevant comparisons between different sites in Europe. For example, with a similar camera trapping protocol and the use of mathematical models, densities calculated in Switzerland are based on a favorable habitat model within fixed reference areas (Laass, 1999; Zimmermann, 2004), whereas in France, densities have been estimated on the basis of the area delimited by the camera trap sites, extended by a buffer zone (according to Karanth & Nichols, 1998), with no habitat limit. The estimates presented in the KORA reports in Switzerland are therefore based on smaller reference areas than those calculated in France and mathematically produce higher densities: 1.6 to 3.6 lynx/100 km² of favorable habitat for the Swiss Jura between 2010 and 2013 (Zimmermann *et al.*, 2012, 2013; Foresti *et al.*, 2014) compared with estimates of 0.9 to 1.6 lynx/100 km² for the French Jura between 2011 and 2014 (Gatti *et al.*, 2014). In the Bavarian Forest National Park, Weingarth *et al.* (2012) found a similar density (0.9 lynx/100 km²) with the same method used in France.

To address the sensitivity of these estimates to the calculation of the sampled area, capture-recapture methods using new "spatially explicit capture-recapture" (SECR) models are now used in many studies on large carnivores. These models incorporate spatial heterogeneity in the detection of different individuals (Efford, 2004; Royle & Young, 2008). SECR models add a particularly attractive spatial dimension to the study of density, revealing the heterogeneity of lynx distribution across the landscape and the variability of densities, which are too often "standardized" by ad hoc reference values (Rovero & Zimmermann, 2016). They have recently been implemented in camera trapping studies of lynx populations, and produce the most robust estimates for comparing different sites (Blanc *et al.*, 2013). Using these models to examine densities in the Jura Mountains, Gimenez *et al*. (2019) found a north-south (Doubs-Jura-Ain) density gradient from 0.24 to 0.91 lynx/100 km². Using similar models, densities were estimated at between 1.38 and 1.47 lynx/100 km² in the northwestern Swiss Alps (Pesenti & Zimmermann, 2013), and in two areas of Slovakia the figures were 0.58 and 0.81 lynx/100 km² (Kubala *et al.*, 2019). These methods can be useful for qualifying the species' conservation status at the smaller scale of a mountain range and thus for comparing local situations (Blanc *et al.*, 2013; Gatti *et al.*, 2014; Gimenez *et al.*, 2019; Duchamp *et al.*, 2020). Multi-site estimates can be obtained through the implementation of camera traps and SECR models, with a rolling plan every 5 years for example (as in Switzerland). Combining these models with data from opportunistic

monitoring could further improve their accuracy and utility for larger-scale estimates (Blanc *et al.*, 2014).

This is why this PNA proposes objective (2.1). "Strengthen the monitoring of lynx populations to discern trends", the first action of which will be to conduct a collective scientific and technical expert appraisal under the joint auspices of the OFB and the MNHN to define the conditions needed to ensure the lynx's long-term maintenance in France.

D. Biological and ecological considerations for conservation

a) Reproduction and population dynamics

Lynx take two years to reach sexual maturity (Axnér *et al.*, 2009), but not all of them start breeding at this age; it is generally considered that females start to mate around the age of two, and males around three (Andrén *et al.*, 2002; Breitenmoser-Würsten *et al.*, 2007; Nilsen *et al.*, 2012). Exceptions can, however, be observed with females mating at one year of age (Engleder *et al.*, 2019) and males reaching maturity before their second year (Kvam, 1991).

Lynx are considered to be strictly seasonal breeders (Henriksen *et al.*, 2005), with only one litter per year. Females normally have only one ovulation cycle per year with an estrus phase lasting only two to three days (Jewgenow *et al.*, 2014). However, a second cycle sometimes occurs, with induced or spontaneous ovulations, a situation that can lead to either late or replacement litters (Breitenmoser-Würsten *et al.*, 2007; Painer *et al.*, 2014; Mattisson *et al.*, 2020).

The mating season is from mid-February to mid-April. During this period, the male and female may stay together for a few days and mate frequently (Stehlik, 1983).

Outside the mating period, lynx interact little, though encounters are more frequent than one would think (F. Zimmermann, personal communication, Sidorovich *et al.*, 2018). Here a male and a female are "greeting" each other by sniffing, rubbing their cheeks and giving each other headbutts. The average litter size is two kittens. (© P. Raydelet)

However, not all females have a litter every year. For the Jura and the Swiss Alps, on average 84% and 88% of the females give birth (Breitenmoser-Würsten *et al.*, 2001, 2007). The main factors of variation in these reproduction rates appear to be the availability of prey and the proportion of females that reproduce from the age of two years (studies on Scandinavian populations; Andrén *et al.*, 2002; Nilsen *et al.*, 2012).

Lynx kittens are born in May-June, after a gestation of about ten weeks (67-72 days). A few cases of late litters have been observed in the wild, in August following the loss of a litter in May (Breitenmoser-Würsten *et al.*, 2007) but also without a first litter being detected (late July and mid-August, Mattisson *et al.*, 2020). The size of litters remains relatively constant, with an average of two, but up to four kittens (Nilsen *et al.*, 2012; Gaillard *et al.*, 2014).
The female usually chooses a site in a rock formation (in scree slopes, under an overhang, in caves or crevices) in which to give birth, but dens have also been observed under tree stumps, roots, low branches, piles of dead branches, and bushes (Boutros, 2002). Kittens weigh between 250 g and 360 g at birth and are very limited in their motor skills, eyesight and ability to regulate their temperature until they are two to three weeks old. The female may then regularly move her litter to other dens, all within 500 m of the original den where she gave birth, Boutros *et al.*, 2007). As the kittens grow, the female spends more time outside the den and makes longer excursions. Her young begin to venture outside the den at four weeks of age, and at about two months they are able to follow their mother over longer distances. When they reach about nine weeks, the female brings them to a prey. By then, their milk teeth are well enough developed for them to be able to eat meat.

Young lynx feeding on the carcass of a chamois killed by the mother lynx (© P. Massit)

Dispersal

The mother and her subadult young usually separate around their tenth month, between March and April. It is usually the mother who initiates this separation. During this first phase of independence, subadults may remain for a few months within their mother's home range, enabling them to acquire their first hunting experience in a familiar and favorable environment (Zimmermann *et al.*, 2005; Samelius *et al.*, 2012). Young lynx may occupy temporary home ranges for a few months before settling in a permanent home range near occupied territories (Zimmermann, 1998). Dispersal distances vary greatly according to studies: 5 to 129 km in Poland (Schmidt, 1998), 3 to 428 km in Scandinavia (Samelius *et al.*, 2012), and in Switzerland 4 to 56 km for the Alps and 2 to 93 km for the Jura (Zimmermann *et al.*, 2005). These dispersal distances are influenced by the local presence of other individuals, the presence of vacant territories, the availability of a suitable habitat, but also the way these habitats are organized within the landscape, and the barriers and obstacles to animal

movement (Schmidt, 1998; Sunde *et al.*, 2000; Zimmermann *et al.*, 2005). In Switzerland, however, it appears that a high density of lynx may not necessarily lead to an expansion in the population (Zimmermann *et al*., 2005, 2007). This is reflected in the average dispersal distance, which ranges between 25.9 km in the Alps (higher density) and 63.1 km in the Jura (lower density), (Zimmermann *et al*. , 2005). Females are consistently more conservative than males in their dispersal behavior.

Dispersal mechanisms determine the ability of the species to colonize new territories or to re-establish itself in its former range when conditions become more favorable. It is important to understand these mechanisms and the factors influencing the geographic expansion of the species in order to act on the factors impeding or facilitating its development. Lynx clearly have the ability to travel long distances. In Switzerland, telemetric tracking has shown that adults, particularly males, are able to cross "barriers" such as road infrastructures, even with chain-link fenced sections (Breitenmoser-Würsten *et al.*, 2001; Ryser *et al.*, 2004). However, subadult lynxes – particularly females – do not venture far from their place of birth and find it difficult to get across obstacles of this type. Although a few cases of spectacular dispersal movement have been observed in males, with distances of up to 300 km, these events remain exceptional. The probability of a female venturing into the same area at the same time is low and these dispersals have yet to result in the establishment of a new population (Zimmermann & Von Arx, undated). Of the males concerned by this long-distance dispersal, some tried unsuccessfully to find mates, before returning to settle in their birth territory. In several cases, unfavorable habitats combined with the presence of "barriers" (linear infrastructures) have led young lynx to return and settle in their birth territory. (Zimmermann, 2004). Modeling based on habitats in anthropized and fragmented landscapes (Switzerland, Germany) show that anthropogenic mortality factors, such as collisions accidents, can limit dispersal to a greater extent than the fragmentation or availability of favorable habitats (Kramer-Schadt *et al.*, 2004; Zimmermann & Breitenmoser, 2007). All these factors, combined with the conservative dispersal behavior of females, play a role in the slow expansion of lynx populations, with new areas being colonized only through a process of dispersal over short distances.

b) Social and spatial organization

The size of the home ranges occupied by individuals varies according to sex, habitat type, season and available prey. In the Jura, the average home range size is between 260 and 280 km² for males, and between 150 and 180 km² for females (Stahl *et al.*, 2002; Breitenmoser-Würsten *et al.*, 2007). In the Swiss Alps, home ranges are smaller, at an average 170 km² for males and 100 km² for females, Breitenmoser-Würsten *et al.*, 2001. This is also the case in the Vosges Mountains, with sizes of 187 km² for males, and between 73 and 102 km² for females, Vandel *et al.*, 2006). In Scandinavia, the home ranges can be as large as between 1,000 and 1,400 km² for males and between 480 and 800 km² for females (Linnell *et al.*, 2001; Herfindal *et al.*, 2005; Aronsson *et al.*, 2016). These regional variations can be explained primarily by differences in environmental productivity. Home ranges are smaller where there is a high prey density. At the same time, the size of the male home range is also influenced by the density of lynx in the surrounding area and the opportunities for access to breeding partners.

The home ranges of individuals of the same sex are generally adjacent with little overlap (less than 10% Breitenmoser *et al.*, 1993). The home range of one male may overlap with that of between one and three females. In Switzerland, one case was observed with six females Breitenmoser-Würsten *et al.*, 2007.

These home ranges remain relatively stable over time, even in areas where the main species of prey undertake seasonal migration (reindeer in Norway, Walton *et al.*, 2017). The area occupied becomes temporarily smaller for males during the mating season, when they are trying to stay close to receptive females, and for females during the period when their movements are restricted owing to the presence of their young (Herfindal *et al.*, 2005; Aronsson *et al.*, 2016). The land tenure of the lynx may span a period of between seven and nine years, with spatial organization changing only when a resident individual disappears. Territories left vacant by females tend to be reoccupied quickly, although observers in Switzerland have noted that it can take between three and five years for a male to be replaced, leading to a local imbalance in the gender ratio during this period (Breitenmoser-Würsten *et al.*, 2007). The frequent disappearance of individuals (owing to the high rate of anthropogenic mortality, for example) can therefore have an impact on the social structure, with longer-term effects on the reproductive success and genetic diversity of the population.

c) Survival and mortality

Lynx can live for up to 15-20 years in the wild and over 20 years in captivity (Stehlik, 2000; Breitenmoser-Würsten *et al.*, 2007). The most critical periods in the survival of young lynx are when they begin to venture out of the den and also when they leave their mother's care (Jedrzejewski *et al.*, 1996; Boutros *et al.*, 2007). Mortality is high in the first year. In Scandinavia, Andrén *et al.* (2002, 2006) reported survival rates of between 39% and 73% for juveniles, depending on the site of study. In the Jura and the Swiss Alps between 50% and 60% of juveniles die before becoming independent (Boutros *et al.*, 2007; Breitenmoser-Würsten *et al.*, 2007). After this period, survival rates improve for subadults (70%-77%) and adults (84%-91%) in Scandinavian populations. In Switzerland, however, survival rates remain low for both subadults (44%-53%) and adults (72%-76%). Breitenmoser-Würsten *et al.* (2007) explain this difference by the anthropogenic mortality rate, which remains high throughout the life of individuals in the Jura Mountains and Swiss Alps. In these regions, the level of illegal killing is comparable to that found in other European studies, but collisions with vehicles appear to be far more common than in other populations.

It is difficult to precisely establish the relative importance of the various causes of mortality, owing in particular to differences in the detectability of the individuals concerned: young or adult, tagged lynx or the chance discovery of animals killed by disease or collision accidents, etc. (Stahl & Vandel, 1999; Schmidt-Posthaus *et al.*, 2002). Nevertheless, studies concur in stating that anthropogenic factors (illegal killing, collision accidents, legal culling) are the main causes of lynx mortality in our regions, accounting for between 54 and 77% of identified deaths Breitenmoser-Würsten *et al.*, 2007. Disease, prey availability or even inter- or intraspecific attacks (predation, territorial defense, etc.) play a smaller role. In Scandinavia, the lynx population is growing at a rate estimated at around 20%/year, based solely on natural factors, but this figure can drop to as low as 7% if we include anthropogenic factors (2%-4% including the legal hunting quota Andrén *et al.*, 2006). This low growth rate means that any additional mortality, particularly in adults, can reverse the trend and increase the likelihood of a population becoming extinct (Heurich *et al.*, 2018).

In 2020, a summary listed 175 lynx mortality events occurring between 1990 and 2019 in France, providing the basis for a recent assessment of the various causes of mortality detected (Lena *et al.*, undated; Lena, 2020). Trauma was the main proximate cause with 72% (126/175) of lynx found dead or sick, with a known diagnosis. Collisions with vehicles accounted for 58% (101/175) of overall

mortality in the French lynx population. In 21 cases of trauma, the cause could not be determined. Two deaths were caused by falls and two by intraspecific attack.

Human activities accounted for 9% of the number found dead or sick (exposure or poisoning with toxic products, shootings, attacks by herd guardian dogs, traps). Infections are rarely the cause of death, accounting for just 7% of the total identified. Starvation is rare in theory, and was visible in just seven lynx carcasses. Other rarer causes of death were identified. For example, one adult male lynx died of cardiorespiratory arrest caused by severe hypertrophic cardiomyopathy. Necrotic hepatitis of unknown etiology was identified in two juvenile female lynx. One lynx died of internal bleeding of undetermined origin.

The main causes of mortality and the associated issues are discussed in chapter 3 as part of the threats and limiting factors justifying targeted actions.

Lynx killed in a road accident, Doubs, 2011 (© OFB/S. Gatti)

d) Habitat

In Europe, the lynx shows a preference for forest, lowland and mountain habitats. It tends to favor areas of continuous woodland with a high degree of cover (Schadt *et al.*, 2002; Zimmermann & Breitenmoser, 2002; Mikusinski & Angelstam, 2004; Niedziałkowska *et al.*, 2006). Lynx prefer forests primarily for reasons relating to the distribution of their main prey. However, forests are also good for stalking prey, and for finding places where they can rest and give birth (Sunde *et al.*, 1998; Podgórski *et al.*, 2008; Müller *et al.*, 2014). To a lesser extent, other environments may become hunting grounds, such as meadows, moors and scrubland on the edge of a forest (Schadt *et al.*, 2002; Zimmermann, 2004; Basille *et al.*, 2009). On Switzerland's Central Plateau, a densely populated region between the Jura and the Alps, with 50% farmland, 24% forest cover and 16% housing and infrastructure, the presence of lynx as well as signs of their reproduction have been reported regularly since 2012 (Zimmermann & Von Arx), (undated).

The knowledge gathered by scientific studies to date shows that the lynx reacts to human interference (e.g., in terms of movement, pace of activity, predatory behavior, resting, birthing), although the extent of this reaction varies with the nature, source and level of interference. It will be necessary to gather more knowledge on this subject and, at the same time, to broaden the field of study to include

all practices likely to significantly affect the species, particularly during the key phases of its biological cycle.

While lynx are able to live in semi-natural, rural areas of continuous human activity, they stay away from the most heavily anthropized areas, which are generally associated with higher risks (road fatalities, killing). This toleration appears to be facilitated by the presence of nearby forest areas and the availability of spots for resting, stalking or birthing in more rugged terrain of greater complexity and with more heterogeneous forest land (Zimmermann & Breitenmoser, 2007; Podgórski *et al.*, 2008). Furthermore, fragmented environments disturbed by human activity, or farming environments are generally associated with a higher abundance of lynx prey, such as roe deer. Lynx thereby adapt their use of their habitat by seeking a compromise between access to prey and exposure to anthropogenic risks (Bunnefeld *et al.*, 2006). In selecting their habitat, lynx will therefore tend to choose forest areas with good but not maximum prey density. At the same time, within their home range, lynx will adapt the pace of their activities and the use of space to minimize interaction with human activities while hunting in areas that are rich in prey and suited to their predatory techniques (Filla *et al.*, 2017; Gehr *et al.*, 2017). In this way, lynx will tend to wait for nightfall, when the level of human activity is lower, to venture out into more open, more highly anthropized environments with more abundant prey. By day, they will prefer habitats with denser cover and more rugged terrain away from infrastructures, and will tend to move faster. In summer, the lynx also selects its habitat for the type of plant cover. In winter, with the downturn in human activity (less farm work, some roads closed), they track their prey at lower altitudes, in more disturbed environments, close to humans. These detailed spatial and temporal adaptations show the potential for lynx to coexist with human activities in highly modified environments, providing that they have access to abundant prey, sufficient forest cover and habitats closely matching their needs. Several studies have highlighted the key role played by habitat characteristics (heterogeneous visibility, complex forest area) and by the micro-habitat (rock formations, tree stumps, windfalls, uprooted trees) in the ability of lynxes to live close to human activities and in modified landscapes, providing them with places suitable for hunting, resting, and birthing (Podgórski *et al.*, 2008; Belotti *et al.*, 2013; Signer *et al.*, 2019).

In the case of the lynx, the issue of habitat cannot be placed on the same scale or level as for many other species that depend on a protected forest environment and that are far more sensitive to interference. For this reason, the lynx cannot really play a role as an indicator or umbrella species[2] for the conservation of biodiversity in forest areas (Linnell *et al.*, 2000). The size of the lynx home range means that the scale of the challenge to be addressed in ensuring the survival of the population extends far beyond the protection of optimal habitats within protected areas the size of those currently existing in France. Maps showing the main protected areas and the zones where lynx are present in each mountain range are included in the appendix of the PNA. Conservation efforts should focus on multi-use landscapes, anthropized but able to support lynx populations (Linnell *et al.*, 2001). Forest areas, even where they are exploited, meet the needs of the lynx. They provide food, a habitat suitable for its activities (hunting, reproduction, resting), and they are also necessary to establish and maintain population nuclei. One sphere, however, in which the lynx can play a role as a flagship species[3], is in maintaining connectivity between these forest habitats. The fragmentation of these woodlands into a matrix of non-forest habitats is a greater problem in this part of Europe for the lynx

2 Sensu Landres *et al*, 1988; Simberloff, 1998; Caro & O'Doherty, 1999
3 Sensu Simberloff, 1998

than the quality of these habitats (Linnell *et al.*, 2000). Long-term viability, on the scale of a mountain range or metapopulation, depends more on the continuity of these habitats and the connectivity between the areas in which the species is present. The problems caused by habitat fragmentation are discussed in chapter 3D.

e) Diet

The lynx is a strict carnivore. In Europe, over thirty species of mammals and birds have been identified as being part of the lynx diet (Breitenmoser & Haller, 1993; Nowicki, 1997; Jędrzejewska & Jędrzejewski, 1998; Sunde *et al.*, 2000; Jobin *et al.*, 2000; Valdmann *et al.*, 2005). In most countries in Europe (west, east and central), where the two species coexist, the roe deer (*Capreolus capreolus*) is the lynx's main prey, followed by other ungulates such as the Alpine chamois (*Rupicapra rupicapra*) and the red deer (*Cervus elaphus*). In this part of its range, the lynx is described as an opportunistic generalist predator specializing in medium-sized ungulates (Odden *et al.*, 2006). Ungulates make up between 70% and 90% of lynx prey, and up to 89% of the ingested biomass. The relative importance of the different ungulate species in the diet of the lynx varies according to their distribution and availability. In Switzerland, the diet consists primarily of roe deer and chamois (60% and 24% respectively, Breitenmoser *et al.*, 2010), although chamois are consumed more frequently than roe deer in some mountain ranges: 60% and 25% of prey respectively in the Central Alps (Molinari-Jobin *et al.*, 2007), and 41% and 36% in the Bernese Oberland (Vogt *et al.*, 2019). Deer are the main secondary prey in Poland (20% vs 65% of roe deer, Schmidt, 2008), in the Dinaric Alps (7% vs 80% of roe deer, Krofel *et al.*, 2011) and in the Bohemian Forest (13% vs 82% of roe deer, Mayer *et al.*, 2012). The deer killed are almost exclusively fawns, juveniles and, more rarely, adult females (Okarma *et al.*, 1997; Belotti *et al.*, 2014). These proportions may also vary over time in the same area of study (see Vogt *et al.*, 2019).

To a lesser extent, the diet of the lynx may also include: red foxes (*Vulpes vulpes*), European and mountain hares (*Lepus europaeus* and *L. timidus*), Alpine marmots (*Marmota marmota*), and other small mammals (voles, dormice, mice). It is extremely rare for the lynx to prey on grouse (capercaillie (*Tetrao urogallus*), black grouse (*T. tetrix*) and rock ptarmigan (*Lagopus sp.*)), wildcats and domestic cats (*Felis silvestris* and *F. catus*), pine martens and weasels (*Martes martes* and *M. foina*), badgers (*Meles meles*) and wild boar (*Sus scrofa*) (Okarma *et al.*, 1997). These alternative, smaller prey species can make up a significant part of the diet, depending on variations in ungulate availability. In Nordic countries, for example, hares and grouse make up between 20% and 45% of prey in Scandinavia (Pedersen *et al.*, 1999; Odden *et al.*, 2006; Mattisson *et al.*, 2011; Gervasi *et al.*, 2014) and up to more than 90% in Finland (Pulliainen *et al.*, 1995). In Switzerland, hares, marmots and foxes can make up between 10% and 25% of prey, or about 8% of the biomass ingested (Molinari-Jobin *et al.*, 2007; Vogt *et al.*, 2018). This quantity may seem low viewed against the overall diet, but these types of prey may nevertheless be an important local resource from time to time for dispersing individuals (Zimmermann, 1998) or for females with young (Okarma *et al.*, 1997; Krofel *et al.*, 2011).

In Europe, with the exception of Nordic countries, the lynx prefers wild prey and avoids domestic prey (Breitenmoser *et al.*, 2010; Gehr *et al.*, 2017). Some depredation of domestic livestock is observed but it remains rare in relation to the overall total (0.01%-0.55% of the total herd population, based on the average for 11 European countries (Kaczensky, 1999)). Depending on farming practices, and in certain ecological and environmental conditions, the predation of domestic livestock may undergo a

temporary local surge in terms of the number of animals killed. This is the case in Scandinavia in particular, in areas where semi-domesticated reindeer and sheep are widely reared without herding, in forest and mountain habitats, and where the density of roe deer and alternative prey is low (Mattisson *et al.*, 2011). In these areas, where they are the only real ungulate resource, reindeer make up around 70% of lynx prey (up to 86% in winter) and sheep up to 36% in summer (Odden *et al.*, 2006; Gervasi *et al.*, 2014).

In the Alps and Jura Mountains, domestic animals are never the main prey (Jobin *et al.*, 2000; Stahl *et al.*, 2001). When it occurs, depredation almost exclusively concerns sheep and goats. The proportion of domestic prey in the lynx diet has been estimated at around 6% in Switzerland. This figure varies significantly, depending on the area and the period: 0.4% in the Jura, between 3.2% and 19% in the Alps (Breitenmoser *et al.*, 2010). These high numbers observed in the northwestern part of the Swiss Alps between 1999 and 2001 can be attributed to a local decline in ungulate numbers over the same period. The latest monitoring figures for this area (2011-2015) give a figure of 1.5% for domestic prey (Gehr *et al.*, 2017). In the French Jura, local variations can be attributed primarily to the development of hot spots, with most depredations concerning farms with a number of higher risk factors (proximity of forests, abundance of roe deer, non-existent or inadequate protection measures; Stahl *et al.*, 2001, 2002). Lynx predation nevertheless remains relatively low at regional level (0.26% of the herd, mainly lambs and subadults (Stahl *et al.*, 2001). Over the past 20 years in France, compensation for lynx depredation has concerned 140 animals/year on average (corresponding to 90 attacks/year), with trends remaining relatively stable (source: RLL database 1984-2018).

f) Predatory technique and behavior

The lynx is a stalker with a highly efficient technique even when the density of prey is low (Nilsen *et al.*, 2009). It usually launches its attack at a distance of under 20 meters, chasing its prey over less than 45 meters on average, with an estimated success rate of 65% (83% for ungulates, Pedersen *et al.*, 1999). Scavenging behavior is sometimes observed but remains rare (Odden *et al.*, 2006; Réseau-Loup-Lynx, 2011; Von Arx *et al.*, 2017). If left undisturbed, the lynx will feed on its prey for between three and seven days in the case of an adult ungulate, and between two and three days for a fawn, consuming between 70% and 80% of the prey (Jobin *et al.*, 2000; Breitenmoser *et al.*, 2010). Daily consumption is between two and three kg, but this figure can increase rapidly in the case of females with several young (up to seven kg per day, Breitenmoser *et al.*, 2010).

Domestic prey are generally consumed to a lesser extent and abandoned more quickly than wild prey, probably because of the risks associated with the presence of humans nearby, and the possibility of disturbance or handling of the carcass (Stahl *et al.*, 2001; Odden *et al.*, 2002; Breitenmoser *et al.*, 2010). Excessive predation ("surplus killing") remains extremely rare.


Lynx consuming a deer (© A. Rezer). Chamois carcass after several days of consumption by a lynx (© P. Raydelet)

Scale of lynx predation

The extent of lynx attacks and predation of ungulates are well documented across several regions of the lynx habitat in Europe: Scandinavia (Odden *et al.*, 2006; Nilsen *et al.*, 2009; Mattisson *et al.*, 2011; Gervasi *et al.*, 2014), Poland (Jędrzejewski *et al.*, 1993; Okarma *et al.*, 1997), Bohemian Forest (Belotti *et al.*, 2015), Dinaric Alps (Krofel *et al.*, 2014), Swiss Alps and Jura (Breitenmoser & Haller, 1993; Jobin *et al.*, 2000; Molinari-Jobin *et al.*, 2002, 2007; Breitenmoser *et al.*, 2010). The age, sex and reproductive status of individual lynx can influence the rate of predation: males have higher predation rates than females and they also attack larger prey (chamois, deer). However, the highest rates are observed in females with young (Nilsen *et al.*, 2009; Breitenmoser *et al.*, 2010; Mattisson *et al.*, 2011; Krofel *et al.*, 2014; Andrén & Liberg, 2015). Differences can also be observed depending on whether the population is settled or in the colonization phase, primarily as the result of prey being more or less vigilant (Breitenmoser & Haller, 1993; Molinari-Jobin *et al.*, 2004). Other factors may include the distribution and availability of primary and secondary prey (Gervasi *et al.*, 2014), or the presence of scavengers and their activity on lynx prey (Mattisson *et al.*, 2011; Krofel *et al.*, 2012). The exploitation of prey may be disturbed or curtailed by the action of scavengers, leading the lynx to increase its predation rate (Okarma *et al.*, 1997). Weather conditions, particularly snow cover, are also a factor, alongside variations in prey availability depending on habitat and seasons, albeit on a smaller scale in this last case (Nilsen *et al.*, 2009; Belotti *et al.*, 2013, 2015). However, the annual rates observed in central and western Europe remain relatively stable, at around 55-70 ungulates/lynx/year (Belotti *et al.*, 2015).

Several studies have looked at the quantitative effects of predation on ungulates. The impact is greater in cases where environmental productivity is low (Melis *et al.*, 2009; Davis *et al.*, 2016), and can be amplified by specific climatic factors (such as harsh winters). In some areas, lynx predation is combined with the pressure of hunting (Melis *et al.*, 2010, 2013). The return of the lynx to areas where prey has not yet adapted to its presence can reduce the annual survival rate of young roe deer (e.g., in Bavaria from 79% to 61%, Heurich *et al.*, 2012) and affect the growth rate of the population in direct proportion to the rate of predation (Andrén & Liberg, 2015). In Switzerland, the lynx accounted for

between 24% and 37% of roe deer mortality in the Jura between 1988 and 1997 (Molinari-Jobin *et al.*, 2002), with hunting accounting for between 45% and 56%. Over the same period, in the Alps, predation accounted for between 12% and 62% of mortality depending on the period (Breitenmoser & Haller, 1987; Breitenmoser *et al.*, 2010, compared to between 53% and 15% for hunting). In comparison, estimates indicate a figure of 39% for Poland (Okarma *et al.* (1997) and 43% for Bavaria (Heurich *et al.* (2012). In Switzerland, the lynx is thought to kill a maximum 9% of the roe deer population in the Jura and the Alps, although a peak of up to 39% was observed between 1997 and 2001 (Breitenmoser *et al.*, 2010). All these studies suggest that the predation of deer by the lynx is additive and that these variations, with their resulting impact, depend to a large extent on the initial situation of the prey populations, particularly their density (Heurich *et al.*, 2012). The lynx is an efficient predator even when prey density is low, and predation is likely to reduce the population in low-density areas. Above a certain level of density, the rate of lynx predation remains constant and it is other factors, such as winter mortality and density dependence) that limit the abundance and growth of roe deer populations (Andrén & Liberg, 2015). A functional response (e.g., a switch to alternative prey) to a decrease in prey availability appears to be limited, but a numerical response in the form of lower lynx density can be observed with a time lag of a few years. There may also be a delayed response by gamekeepers to the decline in game. Along with the other factors mentioned above, this will have the effect of amplifying fluctuations rather than increasing system stability (Breitenmoser *et al.*, 2010).

For chamois, Swiss data for the Alps and Jura show predation by lynx to total 3%-6% and 11% respectively. Based on the potential growth rate and the environmental characteristics of the Jura Mountains, where it seems to be more vulnerable, predation by the lynx is likely to limit the growth of the chamois population (Jobin *et al.*, 2000; Molinari-Jobin *et al.*, 2002). According to the most recent study in the Swiss Alps, in areas where chamois is the main prey (or one of the main prey), lynx appear to show a preference for kids, young of the year or old chamois (Vogt *et al.*, 2019). Breeding and survival rates for kids do not appear to vary between areas of high and low predator pressure by lynx, and are even comparable to the average values observed in areas with no lynx. It would therefore seem that mortality due to predation of chamois is partially compensatory, whereas mortality due to hunting is additive. Predation of the chamois population by lynx is thought to be equivalent to a hunting take of 8%, but in most parts of Switzerland hunting rates are higher and therefore have a greater impact than the presence of the lynx. The impact of hunting, particularly of adults, could therefore be the main factor affecting the dynamics of the chamois population. Additional factors (climate, epizootic diseases) could be sufficient to cause a decline in numbers.

Concerns relating to predation are greatest in contexts where the lynx is recolonizing its historical range after decades or even centuries of absence. These studies underline the complexity of the various factors influencing the dynamics of the ungulate population, and the need for local data on the environment, prey and predator densities, culling rates and the various factors of mortality in order to better understand the variations within the system, to build knowledge, and to improve coexistence with the species. Chapter 3 details the implications of predation for coexistence with human activities and perceptions of the lynx. The importance of this topic justifies a specific objective (2.4) "Better understand and evaluate the diversity of the species' diet, particularly through predation on wild and domestic animals". This includes a study of the diversity of the lynx's diet with a view to finding out more about the relative share of different prey species as well as, for some of them, the effects of predation on the population structure.

g) Genetic diversity

The genetic viability of a population depends on its ability to maintain a level of genetic diversity that is sufficient to guarantee its evolutionary and adaptive potential. The impoverishment of this diversity through excessive inbreeding or genetic drift is a risk that directly concerns small isolated groups of lynx, either reintroductions (Schnidrig *et al.*, 2016) or relict populations that have been greatly reduced in the past (Schmidt *et al.*, 2011; Ratkiewicz *et al.*, 2012, 2014; Frankham *et al.*, 2017). Reestablishing and maintaining demographically and genetically viable lynx populations requires a metapopulation approach, with the key aim of increasing connectivity between mountain ranges. Even if a population is demographically viable (200-250 individuals in the case of the lynx, according to Wilson, 2004), a flow of individuals within a far larger metapopulation is usually necessary to ensure genetic viability. Several large potential populations or metapopulations have been suggested. In France, studies are looking at the "Alpine population" and the "Upper Rhine metapopulation", consisting of the secondary mountain ranges of the Jura, the Vosges-Palatinate forest, the Black Forest and the Swabian Jura.

The reintroduced populations spring from a small number of founding individuals and are therefore developing with a very low level of genetic diversity. The individuals reintroduced in the Alps, Jura and Vosges were all from the Carpathian population (Slovakia). Only six individuals were involved in the foundation of the population in the Dinaric Alps in 1973 (Sindicic *et al.*, 2009). This program was a success, with the population growing and expanding across Slovenia, Croatia and Bosnia-Herzegovina. However, it has been in decline over the past 10-15 years, presumably for reasons relating to the negative impact of inbreeding and a falling birth rate (Sindičić *et al.*, 2013; Schnidrig *et al.*, 2016). In the subpopulations of the northwestern Alps and the Jura, the level of heterozygosity currently stands at 41% and 53% respectively, compared to 63% in the original Carpathian population (Breitenmoser-Würsten *et al.*, in progress). This low level of genetic variability and the significant differences in relation to the Carpathian source population indicate a strong genetic drift (Breitenmoser-Würsten & Obexer-Ruff, 2003). The differences between the Jura and the Alps are thought to be the result of greater initial diversity among the founding individuals in the Jura, stronger initial dynamics, and the immigration of at least two animals from the Alps, whereas the subpopulation in the northwestern Alps has undergone several bottlenecks since the initial reintroductions (Breitenmoser-Würsten *et al.*, in progress). In this context, and in the light of the analyses conducted in Switzerland showing that the frequency of heart murmurs is potentially linked to genetic factors (RyserDegiorgis *et al.*, 2018), it would be useful to improve our knowledge of the genetics of French lynx populations and the possible inbreeding depressions that could result from the initial low genetic diversity of these populations.

In France, a prospective study conducted in 2010 already highlighted the difficulty of finding markers of sufficient variability to conduct genetic analyses with the resolution necessary for providing robust results that could be interpreted for genotyping (Shehzad, 2010). This study also highlighted spatial structuring between the Vosges and Jura in the samples analyzed with traces of potential exchanges between these population nuclei (or of a distant link between the individuals reintroduced from the Carpathians to Switzerland and those in the Vosges Mountains). Samples from the Vosges or the Jura analyzed for other studies also show a low level of diversity (Breitenmoser-Würsten & Obexer-Ruff, 2007; Bull *et al.*, 2016).

The OFB is currently setting up a partnership with KORA to find out more about genetic diversity in the lynx and the gene flow between the Jura population and populations or individuals in neighboring mountain ranges (Palatinate-Vosges, Black Forest, Swabian Jura, Alps). The KORA program began

systematic genetic monitoring of the Alpine and Jura populations in 2001 (Breitenmoser-Würsten & Obexer-Ruff, 2007). It uses the laboratory of the Institute of Genetics within the Veterinary Faculty of the University of Bern, which has modern facilities and state-of-the-art equipment. The studies conducted by this laboratory, which is recognized for its genetic expertise in the lynx, focus in particular on genetic diversity and drift, the gene flow, inbreeding and bottlenecks in relation to population demographics and health (Maudet *et al.*, 2002; Marker *et al.*, 2008). The current protocol is based on a set of 20 markers for population analyses and 25-28 markers for individual analyses (relatedness, inbreeding, individual variability). This method provides a basis for comparison and discussion with other European laboratories (in Germany, the Czech Republic, Krojerová-Prokešová *et al.*, 2019 and Slovenia, Sindičić *et al.*, 2013) involved in lynx monitoring (in this case, based on 15 shared microsatellites). DNA is extracted from invasive samples (tissue, blood). KORA is also working with the Senckenberg Institute for Conservation Genetics in Gelnhausen, Germany for genome-wide sequencing (RADSeq, SNP). The Chrono-Environment laboratory (LCE) is also seeking to develop the use of non-invasive samples (feces collected for dietary analysis) to obtain genetic material. This has specific limitations in that genetic material is present only in small amounts in non-invasive samples. Moreover, rapid degradation of these samples reduces the success and reliability of genotyping compared to invasive samples. Nevertheless, with an active, geographically organized research protocol, this approach could potentially mobilize more samples and look at genetic parameters on varying geographic scales that would not be dependent on opportunities to collect invasive samples (discovery of carcasses, collection through the immobilization of live animals).

Given the small population sizes in the different mountain ranges and their relative isolation, any increase in the mortality of breeding adults contributes to accelerating the impoverishment of this genetic diversity. Inbreeding problems could then amplify the impact of some diseases, jeopardizing population survival over the long term.

For these reasons, this PNA includes a dedicated objective (2.2) "Improve knowledge on the genetics of lynx populations".

h) Health risks

Health monitoring of the lynx has developed over the past twenty years, particularly in Switzerland, with the systematic examination of carcasses, the parasitological analyses of feces from captured lynx, as well as physical examinations and blood tests on captured animals. A wide range of diseases, both infectious and non-transmissible, have been identified in this species. The lynx is a potential carrier of diseases commonly found in other felines, including domestic cats. Moreover, as a predator, it can be infected through its prey. Nevertheless, the solitary habits of the Lynx could reduce the risk of transmission of some pathogens.

Infectious diseases can account for a significant proportion (18%-40%) of the causes of mortality detected (Schmidt-Posthaus *et al.*, 2002). Mange, particularly sarcoptic mange, is the disease most frequently detected as a cause of mortality (up to 22% of the carcasses examined in Sweden; Ryser-Degiorgis *et al.*, 2005). Fatal cases have been reported in many populations (Ryser-Degiorgis *et al.*, 2002; Hameed *et al.*, 2016) and, in Scandinavia, an epidemic of sarcoptic mange is suspected to have caused a significant decline in numbers (Mörner, 1992). Foxes are considered as the main source of contamination for lynx, but transmission is also possible within the family group, or between adults during the breeding season. Cases of notoedric mange have also been reported in a small number of

animals in Switzerland, where domestic cats could be responsible for the contamination (Ryser-Degiorgis *et al.*, 2002). A lynx tracked by telemetry in the northwestern Alps was infected with both cat mange and fox mange (F. Zimmermann, *pers. comm.*).

Carcass of a lynx with scabies, discovered in the Doubs region. (© ONCFS SD25)

Gastrointestinal parasites are found in about 70% of the lynxes examined. The most common endoparasites are nematodes (*Toxocara sp.*, *Trichinella sp.*), and cestodes (*Taenia spp.*). Cases of infection by lungworms (*Capillaria sp*., *Aelurostrongylus sp.*) and protozoa (*Cytauxzzon sp.*) have also been reported. Prevalence rates vary widely across regions and populations. With the exception of a few documented cases, these pathogens do not appear to significantly affect lynx populations and most individuals remain asymptomatic.

Viruses found in other feline species have also been detected sporadically, such as feline panleukopenia and feline infectious peritonitis (Schmidt-Posthaus *et al.*, 2002; Ryser-Degiorgis, 2009). Rabies has occasionally been detected in the past (Stahl & Vandel, 1999), but is no longer a concern given the situation of the disease in Europe and the fact that the role of the lynx as a vector is considered to be insignificant. In Switzerland, distemper was found in a lynx showing clinical symptoms in 2009 (Origgi *et al.*, 2012). In the Swiss Jura in the winter of 2016-2017, three lynx captured for the purpose of reinforcing the population in neighboring countries tested positive for the first time for feline immunodeficiency virus (FIV, Ryser-Degiorgis *et al.*, 2017). Tests conducted on 83 samples taken from lynx previously captured in Switzerland between 2001 and 2016 revealed no antibodies to FIV, suggesting the recent emergence of the disease in Switzerland. In the case of lynx living close to humans, contact with domestic cats could facilitate transmission. A case of feline leukemia virus (FeLV) was also discovered in a male taken from the Neuchâtel Jura to reinforce the population in the Palatinate region (I. Marti and M-P Ryser-Degiorgis, *pers. comm*.). A further case was also apparently identified in the Harz Mountains of Germany (F. Zimmermann, *pers. comm.*).

To date, the diseases described in the lynx do not seem to jeopardize the long-term survival of the populations. The solitary habits of the lynx limit the risk of epidemics. The probability of an infectious

agent becoming established in the population is low since intraspecific interactions are rare. Nevertheless, even minor or discrete diseases can influence demographic parameters (diseases causing infertility, sterility, changes in population structure or changes impacting dispersal and migration patterns; Preece *et al.*, 2017). These effects can be all the more devastating in small, fragmented populations (Murray *et al*. 1999). 1999). In this context, it is essential to ensure early detection of any disease likely to have an impact on a population suspected as having low genetic diversity and that is also subject to other forms of pressure, particularly anthropogenic mortality. Particular emphasis must be placed on feline leukemia and external and internal parasitosis in the lynx.

At present, the OFB is responsible for the early detection of diseases or harm to the species, whether as part of the technical framework of the SAGIR (national wildlife health monitoring system) and RLL networks or as part of the legal framework and prerogatives of the environmental inspectors. The OFB's Wildlife Health Unit (USF) runs monitoring, study and research programs in epidemiology and ecotoxicology, in association with external scientific and technical partners (specialized laboratories, departmental veterinary analysis labs). The USF also provides the technical interface, working with environmental inspectors as part of a legal framework. The USF coordinates the SAGIR network, encompassing all diseases with environmental, economic, societal and public health implications. The SAGIR network exhaustively collects any carcasses found, regardless of their condition. It then systematically implements a complete, harmonized necropsy examination, looking for the causes of mortality and the associated factors. In addition to the necropsy examinations carried out as part of the technical procedure, SAGIR also conducts forensic necropsies as part of legal procedures. Samples are banked (organ bank, serum bank and histological bank) for possible retrospective studies, where the state of preservation and integrity of the carcass allows this.

A summary of the analyses carried out between 1990 and 2019, on 175 lynx mortality events, sheds further light on these health issues for the lynx in France (Lena *et al.*, undated; Lena, 2020). Lethal infections account for 7% of events, but they are still a major concern. Lethal parvovirus infections were diagnosed in two juvenile lynx in 2018 and 2019. In 2001, a suspected case of feline infectious peritonitis was reported in a young female lynx following a positive PCR test for coronavirus. Seven lynx had bacterial septicemia, sometimes caused by superinfection of severe sarcoptic and auricular mange. One lynx was found to have suppurative bronchopneumonia with non-specific germs. Individuals may be asymptomatic carriers of infectious agents. Six of the 23 lynx for which virological analyses were carried out were found to be carriers of parvovirus, defined by a low viral load, or previous contact with the germ revealed by serology. One out of 14 lynx tested was shown to have been in contact with a paramyxovirus, which causes distemper. One lynx was found to be carrying feline coronavirus following testing of a lung sample (the only sample tested).

The authors of this summary underline the prevalence of parasitism in the lynx in France: endoparasites were found in 39% (67/170) of lynx studied, and external parasites in 32% (54/170) of the number. Animals carrying high levels of parasites may be considerably weakened and therefore more vulnerable to secondary disease processes. In the case of external parasites, tracking methods using camera-traps could be used to identify some sublethal pathological processes as part of a non-invasive approach. This is already the case for the detection of sarcoptic mange in wolves in the Iberian Peninsula (Oleaga *et al.*, 2011).

A working group on health issues could be set up to adjust and strengthen monitoring strategies. The authors put forward a number of possible actions: harmonizing protocols, supplementing serum and organ banks, and making some examinations and samples systematic, even in the absence of clinical symptoms. Serological surveys would make it possible to better characterize the spatio-temporal circulation of infectious agents and assess the risk to the population. Systematic testing should be carried out for some pathogens (such as FeLV). It is also important to link wider surveillance to the health monitoring of lynx populations. Other sympatric species (domestic or wild) could act as sentinels and contribute to the early detection of diseases of concern to lynx populations (e.g., foxes and distemper).

For these reasons, the PNA includes several targeted actions relating to objective (2.3) "Organize health monitoring and improve knowledge on the health status of lynx populations".

i) Role of the lynx in the ecosystem

As a large predator, the lynx can play a role at several levels in trophic cascades and in the functioning of certain ecosystems. We can see one clear example in its interaction with its main prey of ungulates, particularly roe deer and chamois, as well as in its interaction with other predators and the indirect impact of this interaction on the environment and animal communities.

Predator-ungulate interaction and forest ecosystems

In addition to the numerical effects on the abundance of prey, discussed in the previous section, the risk or pressures of predation by lynx create a "landscape of fear" for prey (Laundré *et al.*, 2001), which can influence the spatial and temporal distribution of ungulates, as well as their behavior. A number of studies have shown that prey respond in different ways to signs of lynx presence (urine, feces), leading them to visit these spots less frequently, to shorten or change the time of their visits, or to increase their vigilance (Utsi, 2015; Wikenros *et al.*, 2015; Eccard *et al.*, 2017; Vogt *et al.*, 2019). Hunting also contributes to the "landscape of fear", requiring prey-game to adapt to a wide range of constraints when faced with multiple predators. Bonnot *et al.* (2020) showed that roe deer come out mainly at dusk and that they adjust their daily routines to take account of the presence of hunters or lynx. However, these changes are not systematic. Samelius *et al*. (2013), for example, found that roe deer in Sweden did not change their habitat despite high lynx predation rates. In Switzerland, Vogt *et al.* (2019) showed that chamois were more vigilant following an encounter with a lynx but that they returned to normal after about two days. Adjustments could depend on each specific context, landscape heterogeneity, the presence of predators and multiple risks, including hunting, with complex trade-off mechanisms between nutritional needs and predation risks (Wirsing *et al.*, 2010; Lone *et al.*, 2014; Schmidt & Kuijper, 2015; Norum *et al.*, 2015).

Predation pressure can influence the behavior of lynx prey, as well as its vigilance and spatial and temporal distribution. However, the extent and effects of predation depend on many factors and also the local context (© A. Rezer).

These effects on herbivore density and their use of space can have a positive impact on the forest environment by reducing browsing pressure, with potential cascade effects on forest regeneration, and on the structure and diversity of vegetation (Ripple *et al.*, 2014; Angelstam *et al.*, 2017). A first study in Switzerland showed a significant reduction in browsing intensity following the return of the lynx (Schnyder *et al.*, 2016).

Effects on the health of ungulate populations

A few studies suggest that lynx tend to select prey in poorer physical condition (Okarma, 1984; Pedersen *et al.*, 1999; Krofel *et al.*, 2014), contributing to a better overall health status in the prey population in question. However, these results are not necessarily observed in all regions (e.g., in Switzerland, Liberek, 1992, or Norway, Andersen *et al.*, 2007). Lynx show no particular preference for a given age group or sex in roe deer or chamois. Rather, their diet reflects seasonal variations. They feed mainly on fawns in summer, male chamois during the rutting season, and adult female roe deer in winter (Molinari-Jobin *et al.*, 2002, 2004). Locally, in parts of the Swiss Alps where chamois is one of the main types of prey, the lynx may show a preference for kids, young of the year and old chamois (Vogt *et al.*, 2019). The relatively low selectivity of the lynx can be explained by its predation mode. As it stalks its prey, it does not necessarily select a specific category. Krofel *et al.* (2014) suggest that the lynx may have a positive effect by reducing the selection by hunters of a particular sex or age group and by spreading predation pressure over the year as a whole.

Interaction with other predators

Large predators also have an impact on ecosystems through their potential role in limiting the population of smaller carnivores and the cascade effects on prey communities. According to the theory of mesopredator release (Soulé *et al.*, 1988), a decline in superpredators and a reduction in the pressure (competition, predation, "landscape of fear") they bring to bear on medium-sized carnivores leads to a significant increase in the abundance of this last category with negative effects on their prey (Prugh *et al.*, 2009). The fox is the most abundant mesopredator in areas where the lynx is present. Although foxes make up only a small proportion of the lynx diet, they are regularly killed without

necessarily being eaten (Sunde *et al.*, 1999; Jobin *et al.*, 2000; Molinari-Jobin *et al.*, 2002). The fox is also a predator of ungulate fawns, and in particular roe deer, making it a potential competitor for the lynx (Linnell *et al.*, 1995; Panzacchi *et al.*, 2009). Foxes can also exploit the carcasses of deer killed by lynx, giving them access to a more stable food resource especially in winter, as has been seen in Sweden. However, the positive impact on fox survival does not seem to compensate for the reduction in numbers caused by the lynx (Helldin & Danielsson, 2007). The regulating role of the lynx in relation to the fox depends on the density of the lynx population as well as on environmental productivity (Helldin *et al.*, 2006; Elmhagen *et al.*, 2010; Pasanen-Mortensen *et al.*, 2013; Pasanen-Mortensen & Elmhagen, 2015), but it is considered to be a key factor in variations of fox numbers, with cascade effects on some species (e.g., grouse and hares, Lindström *et al.*, 1994; Sæther, 1999; Elmhagen & Rushton, 2007).

The return of the wolf to eastern France and the slow recolonization of the lynx in the Alps raises questions concerning the coexistence of these two large predators. In Sweden, recolonization by the wolf appears to have little influence on the spatial distribution of lynx and the way they use their habitat within their home range (Wikenros *et al.*, 2010). In this region, where the wolf's main prey is the elk *(Alces alces*) and the density of the deer population is high, competition with the lynx appears to be low. Although home ranges overlap, no cases of wolf predation on lynx or their young have been reported. A study by Schmidt *et al.* (2009) in the Bialowieza Forest of Poland showed similar results based on the telemetric tracking of seven lynx and three wolves over a three-year period. In cases where home ranges overlap, wolves prefer larger prey (deer). At the same time, a high density of ungulates suggests little competition. The different hunting methods may also contribute to an even clearer separation of each animal's niche. However, these studies do not allow monitoring in sufficient detail to establish whether this cohabitation is also made easier by fine spatial and temporal modulations in habitat use (as suggested by May *et al.*, 2008), in particular, by exploiting the heterogeneity of the forest habitat and the microhabitats used by the lynx for hunting and resting. It would be particularly useful to conduct a simultaneous study of both predators with short geolocation intervals in contexts where prey density is lower and the availability of larger ungulates more limited. Finally, the study carried out in the Naliboki forest in Belarus provides evidence to suggest that it is the lynx, on the contrary that may have more impact on the wolf, rather than the other way round, with fatal attacks on wolf litters, pregnant females and weaker individuals, avoidance of the sites frequented by the lynx, and also strong interference by wolves on the carcasses of prey killed by lynx (Sidorovich *et al.*, 2018).

Scavengers and kleptoparasitism

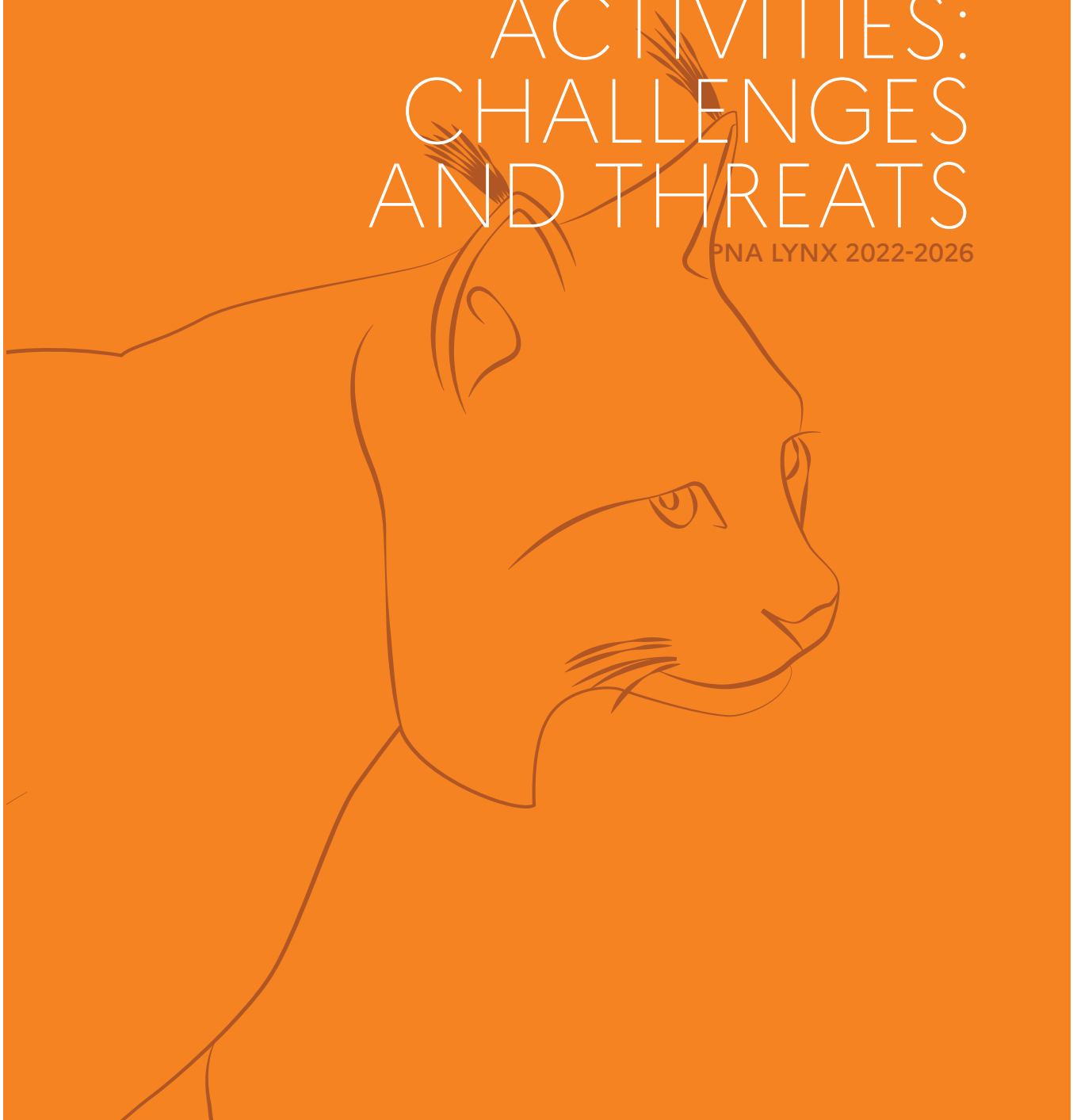
The time it takes for the lynx to completely consume its prey makes it vulnerable to kleptoparasitism, the exploitation of its prey by other predators or scavengers. Although the lynx may sometimes hide carcasses, around a dozen species have been listed in Europe as exploiting lynx prey, primarily foxes, wild boar and ravens (*Corvus corax*, Hucht-Ciorga, 1988; Jędrzejewska & Jędrzejewski, 1998; Jobin *et al.*, 2000; Červený & Okarma, 2002). In areas where the species live in sympatry, wolves and especially brown bears are likely to take lynx prey. In Slovenia, for example, 15% of the biomass of prey killed by lynx is lost to bears, resulting in a 23% increase in lynx predation, with the associated consequences in terms of energy expended (Krofel *et al.*, 2012). Similar consequences have been reported in cases where prey is removed by humans (Krofel *et al.*, 2008). This increase in the predation rate, if it becomes significant, could aggravate the conflict between the predator and human activities. No

study has quantified this aspect of lynx ecology in France or in border populations. Interference is probably more frequent in the case of domestic prey, or when carcasses are removed for health or aesthetic reasons, but wild boar taking lynx prey (Jędrzejewski *et al.*, 1993; Molinari-Jobin *et al.*, 2002) could also lead to more frequent hunting.

Many studies have highlighted the benefits of restoring a function such as predation within ecosystems and the negative effects of the decline or absence of large predators (Ritchie & Johnson, 2009; Johnson, 2010; Estes *et al.*, 2011; Ritchie *et al.*, 2012; Ripple *et al.*, 2014). Nevertheless, in the absence of studies conducted in relevant local contexts, based on robust methods and with sufficient numbers, the authors recommend caution in order to avoid over-interpreting or generalizing the supposed impact of large predators (Allen *et al.*, 2017). These effects are highly context-dependent and, in highly anthropized landscapes, they may be modulated and mitigated by human activities (farming practices, environmental productivity; Haswell *et al.*, 2017). The densities reached by lynx in these anthropized environments may not be sufficient to have a significant impact on the ecosystem compared with the human impact. Only the effects caused by changes in the behavior of prey and mesopredators could be more pronounced or widespread, even with low predator density (Kuijper *et al.*, 2016).

3. COEXISTENCE WITH HUMAN ACTIVITIES: CHALLENGES AND THREATS

PNA LYNX 2022-2026



3 COEXISTENCE WITH HUMAN ACTIVITIES: CHALLENGES AND THREATS

The lynx is making a return to a highly anthropized environment, in some cases after an absence of over a century. Despite its requirements in terms of space or habitat, studies show that a return of the species and an expansion in numbers is still possible in modified landscapes with multiple uses, with the species coexisting with human activities (Linnell *et al.*, 1996; Chapron *et al.*, 2014). This recent proximity follows a long absence and has necessarily led to conflicts with a number of human activities. In the case of the lynx, the main conflict is with the hunting community, which is fearful of the impact the lynx may have on prey-game (roe deer, chamois). In the livestock sector, the main problem lies in adapting practices to this new context. While damage is relatively low across the predator's range, repeated and persistent attacks on some farms can have a strong economic and psychological impact locally, seriously undermining tolerance of the predator's presence. Differing levels of acceptance also reflect the different relationships of stakeholders to nature and the landscape, and these conflicts are sometimes more the result of human, social and political dynamics than of direct interaction with the species in question (Breitenmoser, 1998; Benhammou & Dangléant, 2009).

The relative importance of the limiting factors and threats to the lynx population varies from region to region depending on population characteristics (e.g., size, isolation) and the local ecological and sociological contexts. The findings of expert groups and studies nevertheless concur on the main threats and obstacles to the development of the species in Europe (Kaczensky *et al.*, 2013; Boitani *et al.*, 2015): a low level of acceptance owing to conflicts with the hunting community and farmers, attacks (illegal shooting, poisoning, etc.) which are probably directly linked to this lack of acceptance, habitat loss owing primarily to infrastructure development, and accidental mortality (e.g., collisions with vehicles). On the other hand, while the availability of wild prey may have been a limiting factor in the past, it is no longer a problem today, as the ungulate population has grown considerably in France since the return of the lynx (Saint-Andrieux & Barboiron, 2019).

These anthropogenic factors account for most cases of lynx mortality (adults and subadults) in Europe. In France, the RLL database lists 236 dead lynx over the period 1974-2018, with collision accidents accounting for 58% of cases and illegal killing for 6%. Of the 175 mortality events analyzed by the SAGIR network for the period 1990-2019 (Lena *et al.*, undated; Lena, 2020), the proportion of deaths caused by collision accidents is the same (58%), while 9% of cases were directly linked to other anthropogenic factors, for example poisoning (n=3), shooting (n=6 over the period 1992-2019), attacks by herd guardian dogs (n=2), and traps (n=2). The number of carcasses found represents only a small proportion of the total mortality, and the non-random discovery of carcasses may skew these proportions (Stahl & Vandel, 1999). This means that lynx killed in collision accidents are more likely to be identified and reported, whereas other causes of mortality, such as illegal killing or disease, will tend to be underestimated. For example, a comparison between lynx tracked by telemetry and those found dead by chance reveals a significant difference in the respective proportions of the causes of death (Schmidt-Posthaus *et al.*, 2002). In estimates conducted in Switzerland on lynx tracked by telemetry, anthropogenic factors were again seen to account for up to 70% of deaths, but the figures for collision accidents and illegal killing were virtually the same (29% and 32% respectively, Breitenmoser-Würsten *et al.*, 2007).

These European studies also identify another important factor: management problems at the institutional level, including a lack of dialog between stakeholders, inadequate resources for supervisory structures or failure to uphold the law (Kaczensky *et al.*, 2013; Boitani *et al.*, 2015). A lack of knowledge of the species is also mentioned, not only in terms of basic knowledge and the status of

the population, but also in terms of awareness-raising and education of the various audiences concerning the species. Alongside these threats are factors intrinsic to the species such as high juvenile mortality, limited dispersal capacity and potential inbreeding problems owing to the isolation of populations and the small number of founding individuals.

A. Acceptance of the species

In our culture and in the collective imagination, the lynx does not occupy the same position as the wolf or the bear. It remains relatively unknown, receiving little media coverage, but it is also less controversial than the other two large carnivores, with many being unaware of its current presence in Europe among the local fauna (Kleiven *et al.*, 2004; Van Heel *et al.*, 2017). The level of acceptance and the general perception of carnivores varies considerably depending on the type of person, the geographic areas and the level of knowledge of the species. The category of occupational or recreational activity is a particularly important factor, especially when these activities interact directly with wildlife. Being familiar with the species and having some level of knowledge may play a role in forming attitudes but is not necessarily sufficient to change negative perceptions (Ericsson & Heberlein, 2003; Bath *et al.*, 2008; Lescureux *et al.*, 2011). The lynx has a broadly positive image with the general public and is often seen to enjoy almost unanimous approval (over 70%) in surveys concerning its presence or possible reintroduction (Génot, 2006; Scheid, 2013; Fräger & Schraml, 2016; Smith *et al.*, 2016). However, this favorable opinion is expressed primarily by urban dwellers or players who are not directly concerned by the presence of the lynx, except as users of nature, with ecological or ethical values. Their opinion in no way guarantees local acceptance of the species (Vourc'h, 1990).

The lynx is a discreet animal with a generally positive public image, but local perceptions vary considerably among the various stakeholders directly concerned by its presence (© P. Raydelet) (© P. Raydelet)

Problems relating to coexistence or acceptance of the lynx by some local stakeholders may not only lead to acts of destruction, but also create an environment that would be unfavorable to any proactive conservation initiatives such as reinforcement or reintroduction programs. For these reasons, the PNA

includes a dedicated objective (1.5) "Improve acceptance of the species with the support of social sciences".

B. Illegal killing

Illegal killing is difficult to assess by definition. Nevertheless, it is seen as a real threat to lynx populations in Europe, since it may be sufficient to limit an increase in numbers or even lead to a local decline in isolated, small populations (Von Arx *et al.*, 2004; Kaczensky *et al.*, 2013). In Scandinavia, where the lynx is huntable, illegal killing continues to account for 46% of adult mortality, significantly reducing the population growth rate (Andrén *et al.*, 2006). In the region of Bohemia (Germany, Czech Republic and Austria), illegal killing accounts for a significant proportion (59%) of the mortality detected. Modeling studies suggest that 25% of adult lynx are killed each year. At the same time, trends in the population of reintroduced lynx can only be explained by an additional undetected mortality rate of between 15% and 20% (Červený *et al.*, 2002, 2019; Heurich *et al.*, 2018). Killing on this level is sufficient to halt the expansion of the species. Any increase in this additional mortality, even by a small percentage, could result in local extinction of the species. In the Jura Mountains of Switzerland, an estimate based on telemetrically monitored lynx suggested that illegal killing accounts for 32% of mortality. In the Alps, the results of recent local surveys and intensive monitoring using camera traps suggest extremely strong local pressure on the lynx population in a corridor between the Valais and the Prealps (Biollaz *et al.*, 2015; Arlettaz *et al.*, 2017, 2020).

In France, some twenty confirmed cases have been reported since the return of the lynx. Killing was the main cause of mortality identified during the reintroduction in the Vosges Mountains, with three confirmed cases and three suspected cases (Vandel *et al.*, 2006). Some associations believe that there could be as many as a dozen cases. The pressure on the Vosges population in particular does not seem to have lifted, and illegal killing is suspected to be the direct cause of its recent decline. Hunting from a tree stand is common in this region and could encourage the act of killing (Benhammou, 2007). In their analysis of mortality events over the 1992-2019 period, in addition to six shootings, Lena *et al.* (in progress) reported two lynx shot after being caught in traps. Shootings are often fatal. However, sometimes gunshot injuries are discovered during the necropsy of animals that died as the result of another causal agent. For example, pellets were discovered by chance during the necropsy of three lynx.

Examination of a lynx killed in November 2019, © OFB SD25

For these reasons, the PNA includes an action to prevent illegal killing. The purpose of objective (1.3) is to "Improve coexistence with hunting activities and the participation of hunting in lynx conservation".

When lynx are killed illegally, the local public prosecutor's office systematically opens an investigation, which is conducted by the OFB's environmental inspectors, sometimes in conjunction with the national police. As part of this, to help identify the perpetrators, the investigators may draw upon the resources of the scientific and technical police, such as the IRCGN (Institut de recherche criminelle de la gendarmerie nationale/National Gendarmerie criminal research institute), or the OCLAESP (Office central de lutte contre les atteintes à l'environnement et à la santé publique/Central Office for Preventing Environmental and Public Health Offences). Given that these offences take place in the natural environment, with carcasses sometimes discovered a long time after the event and with little or no physical evidence, solving these cases tends to be a long and complex process, and the perpetrators are rarely identified.

The OFB is in regular contact with the public prosecutor's office. It is seeking to raise awareness of the gravity of any offences towards the lynx and to make penalties more dissuasive, given the national status of this species and its vulnerability in terms of the impact of any additional mortality. The OFB's environmental inspectors attend legal hearings. They can answer any questions raised by the court, underlining conservation issues and providing details on the investigation. The decision ultimately rests with the judges. The number of convictions remains low and does not seem to be sufficiently dissuasive in relation to the penalties that are theoretically applicable. In the two most recent examples, both concerning organized hunts, the perpetrators received, in the first case, a two-month suspended prison sentence, a €1,500 fine, and a two-year cancellation of their hunting license (Les Molunes, Jura, 2009) and, in the second case, a €600 fine with an order to pay €2,000 in compensation but with no cancellation of their hunting license (Labergement-du-Navois, Doubs, 2014). In contrast, the cost of reintroducing a lynx as carried out in the Palatinate region is estimated at around €10,000. These killings and other reported incidents, concerning hunting dogs in particular, raise questions about the impact of organized hunts with regard to the species.

Over the course of 2020, three lynx were shot in the Vosges and Jura Mountains, showing that France still has a problem in this respect, and that conflicts involving the presence of the lynx and some stakeholders continue to result in the regular killing of animals. The Ministry of Ecology and the local prefects will continue to file a complaint for each illegal killing. All aspects relating to the conditions required for replacing animals illegally killed will be addressed by the Scientific Council (acceptability, impact on the population nuclei from which any replacements would be removed, responsibility for their survival, safety, and so on).

C. Collision accidents

Lynx populations are required to develop in increasingly anthropized landscapes, with expanding land transport infrastructure networks and steadily increasing road traffic. These infrastructure networks hinder the movement and dispersal of lynx, and are also the cause of many fatal accidents. Since the return of the lynx to France, 142 collision accidents have been reported, almost all of them fatal, accounting for nearly 58% of the cases of mortality detected (1974-2018 figures compiled in the RLL database). Over the past decade, an average of seven lynx have been killed every year, mostly on roads, but also on railways (less than 10% of accidents, Savouré-Soubelet *et al.*, 2012). As mentioned

earlier, the share of accidents in mortality is probably overestimated, as they are more easily detected and reported. Nevertheless, collision accidents are one of the main, if not the main, cause of death in countries with a high infrastructure density, such as France, and figures are likely to remain high in view of traffic trends across Europe (Blanc *et al.*, 2015). For example, following the recent reintroductions to the Palatinate in Germany, two of the 16 lynx released have already been killed in collision accidents: Labka, who arrived in December 2017, was found on a railway line on February 27, 2018 , while Lucky, who was released in July 2016, was hit by a car while chasing a roe deer on May 13, 2019 (see the reports on the website of the Stiftung Natur und Umwelt Rheinland-Pfalz).

Lynx, especially dispersing subadults, are regularly killed on the road, but also sometimes on railways (© ONCFS SD25, ONF39)

An analysis of the mortality data collected by the RLL and the in-depth studies carried out for the first ITTECOP project (Infrastructures de Transports Terrestres, Ecosystèmes et Paysages/Land Transport Infrastructure, Ecosystems and Landscapes (Gaillard *et al.*, 2012) and also as part of a brief from the DGALN/DEB/MTES commission (Morand, 2016) (Direction Générale de l'Aménagement, du Logement et de la Nature/General Directorate for Planning, the Environment and Housing, Direction de l'Eau et de la Biodiversité/Directorate for Water and Biodiversity, Ministère de la Transition Ecologique et Solidaire/Ministry of Ecological and Inclusive Transition) show that the probability of occurrence of these accidents is linked to many factors: the location of infrastructure in the landscape in relation to the favorable habitats, home ranges or movement corridors of the lynx, the detailed characteristics of this infrastructure, such as the presence of crossing structures (e.g., wildlife crossings), fences, traffic density, breeding or dispersal periods. Lynx of any age or sex are at risk of accidents, but animals in the learning phase (juveniles) or dispersal phase (subadults) pay the highest price. The number of accidents detected increases significantly in autumn and winter, also reflecting increased movement by females, from one prey to the next with the young of the year, and by males during the rutting season. Apart from the additional mortality caused in adults, collision accidents are a potential problem when adding to the population, as well as an obstacle to the dispersal of individuals, and thus to the colonization of new areas.

Morand (2016) discusses corrective measures that could reduce the risk of accidents and/or improve ecological transparency: lynx use wildlife crossings that are also useful for many ungulate species (Kusak *et al.*, 2009), chain-link fencing can prevent access to a road and direct the animals towards a crossing structure. However, the report also highlights the main reasons for the malfunctioning of

these crossing structures (underpasses, overpasses) and small-scale constructions (fences: length, height, mesh size, etc.) and the need for further monitoring and studies concerning the structures in terms of location, design and attractiveness, as well as other measures (signs, speed limits) in order to significantly improve their effectiveness. For example, chain-link fencing that directs animals towards a crossing structure can also turn into a barrier that traps the animal on the traffic lanes even though a wildlife crossing is available further away, as was the case in the Doubs in 2011 (Regazzoni, 2011).

Example of a wildlife crossing over a divided highway (© OFB/S. Gatti). These wildlife crossings can be used by lynx. Suitable fencing must be provided to direct them towards these structures so that they can get across any obstacles safely, here in the Doubs (© FDC25).

Alongside the need to develop knowledge, awareness and communication, these studies also highlighted the need for practical measures to manage and develop land transport infrastructure at clearly identified “black spots”. Three busy roads crossing the Jura region account for 30% of collisions: the N57, the N5 and the D470. Other roads, particularly former national roads that have been downgraded to departmental roads, are also particularly dangerous: the D437 and D683 in the Doubs, the D471, D1083, D436, D69 and D52 in the Jura, and the D1504, D1084 and D1206 in the Ain. Measures to prevent collision accidents could begin by targeting these identified routes (e.g., with fencing) and more broadly, and above all, by organizing and structuring a common dynamic involving all stakeholders and experts in the species, together with the managers and specialists in charge of the engineering and maintenance of road and rail infrastructures, as well as transport planning (Morand, 2016).

For these reasons, the PNA includes several dedicated actions in objective (1.4) "Improve connectivity, facilitate exchanges between lynx populations, and reduce mortality due to collisions".

D. Habitat fragmentation

Forests are the preferred habitat of the lynx in Europe. The situation regarding both the forest habitat and ungulate populations has improved considerably since the species disappeared in the 19th century. The forests of the Alps, the Jura and the Vosges provide good habitats for the lynx. However, these habitats tend to be small and highly fragmented. This limits population growth and the dispersal of individuals, as well as hampering the recolonization of new territories (Schadt *et al.*, 2002; Kramer-Schadt *et al.*, 2004; Zimmermann *et al.*, 2005). Adults are able to cross sub-optimal habitats or

obstacles such as roads within their home range or in the surrounding area, but the obstacle-crossing abilities of dispersing subadults appear to be more limited (Zimmermann & Breitenmoser, 2007; Zimmermann *et al.*, 2007). Young females tend to settle close to their natal home range, while males find it difficult to cross these discontinuous lines and to reach favorable but more distant habitats, although some dispersals have been reported between the Jura and the Black Forest - Swabian Jura (F. Zimmermann, *pers. comm.*). In addition, as mentioned above, the risk of collision accidents is higher in habitats fragmented by transport infrastructure.

Habitat fragmentation also reduces the functional connectivity between different population nuclei (inside and between mountain ranges) that is essential for maintaining the genetic mixing necessary for long-term viability. Within Western Europe, we can already observe strong genetic differentiation between population nuclei (Schmidt *et al.*, 2011; Ratkiewicz *et al.*, 2012, 2014). Further isolation of the population of a given mountain range could have significant consequences for what is already considered to be low genetic diversity.

The questions of ecological continuity and collision accidents are intrinsically linked: as part of the measures taken for lynx conservation and habitat management, we need to maintain forest areas of sufficient size, and above all, to maintain or restore connectivity between these favorable habitats by reducing the risk of fatal collision accidents. In France, as part of the national guidelines for the preservation and restoration of ecological continuity (green and blue grid in the national environmental plan), a number of tools have been put in place, such as the SRCE (schémas régionaux de cohérence écologique or regional plans for ecological coherence), which are part of the SRADDET (schémas régionaux d'aménagement, de développement durable et d'égalité des territoires or regional plans for development, sustainable development and territorial equality) in order to inform project leaders of the challenges of ecological continuity. Decree No. 2019-1400 of December 17, 2019 adapting these national guidelines for the preservation and restoration of ecological continuity encourages the SRADDET to take account of the need to preserve the species for which they are recognized as having national responsibility and to protect these animals in their movement. The lynx is listed in Annex 1 of this decree as a species sensitive to fragmentation, and whose preservation is one of the objectives set for the national coherence of the green and blue grid in the regions of Auvergne-Rhône-Alps (*départements* of Ain, Ardèche, Drôme, Isère, Loire, Rhône, Savoie and Haute-Savoie), Bourgogne-Franche-Comté (Doubs, Jura, Haute-Saône and Territoire de Belfort), Grand Est (Bas-Rhin, Haut-Rhin, Meurthe-et-Moselle, Meuse, Moselle and Vosges), and Provence-Alpes-Côte d'Azur (no *départements* specified).

Taking account of the needs of the lynx is also part of the ERC (*Eviter Réduire Compenser* or Avoid, Reduce, Compensate) principle, which seeks to integrate environmental issues into the definition of planning projects. The ERC principle is based on measures to avoid environmental damage, to reduce the extent of any damage that could not be completely avoided and, where possible, to compensate for any significant effects that could not be avoided or sufficiently reduced. It therefore applies to the drafting, revision and modification of plans, programs or documents for urban planning, as well as to projects. It may draw upon the SRCE and the SRADDET. As part of this aim, the ITTECOP ERC-Lynx project was set up in 2018, with the objective of "Avoiding, reducing and compensating the risk of lynx mortality in accidents with transport vehicles". This project is led by the CEFE in partnership with the CEREMA, the CROC and the OFB. It is seeking to develop an operational predictive tool for decision-makers and land transport infrastructure managers, among others. This tool will integrate the risk of

collision accidents, the viability of lynx populations and the planning and management objectives in the regions concerned (transport infrastructures, landscape).

E. Risks associated with exposure to toxic agents

Predators are highly vulnerable to the accumulation of contaminants. This is particularly true of the carnivores at the top of the food chain. A cocktail of these toxic agents or high levels of concentration can affect the health of individual animals and their reproduction, as well as placing additional pressure on population dynamics. The diet of the lynx consists primarily of medium-sized wild ungulates, although smaller secondary prey such as lagomorphs and rodents are also consumed in quantities that are difficult to assess. This type of prey can represent a possible route of exposure for toxic agents. Stahl & Vandel, 1999, for example, report two cases of secondary poisoning by an anticoagulant (bromadiolone) used to control water voles. Deliberate poisoning is also mentioned as one of the suspected causes of harm to the species. Of all the lynx analyzed between 1990 and 2019 (Lena *et al.*, undated; Lena, 2020), three died as a result of poisoning by toxic residues. The residues identified were rat poison compounds with an anticoagulant action (VKA vitamin K antagonists, such as bromadiolone, chlorophacinone, difenacoum, difethialone), chloralose-based rat poison, insecticides (cholinesterase inhibitors, ChEIs, carbofuran, lindane), or lead. In the case of the anticoagulants, secondary poisoning by consuming contaminated prey (rodents, foxes, etc.) is the most likely scenario in most cases. One lynx was accidentally poisoned with pentobarbital by eating a euthanized sheep.

In some cases, non-lethal exposure to toxic substances can weaken animals or make them less alert, possibly leading to secondary events such as an increased risk of collision accidents. For this reason, injured animals are systematically tested for targeted toxic residues. In this sample group of lynx, 148 toxicological analyses were carried out for all compounds (VKA, ChEIs, chloralose, strychnine, lead). Some animals were found to be contaminated with toxic agents, mainly anticoagulants (14/19), and more precisely bromadiolone, which was detected in eight lynx. Anticoagulants are responsible for lethal hemorrhagic disorders, as well as sub-lethal disorders. To date, little is known about their role in collision accidents or about the ecological mechanism of exposure. Chloralose and cholinesterase inhibitors are currently the compounds most widely used for killing wildlife. This potential threat remains to be explored to clarify the risk to the species.

For these reasons, the PNA makes provision for action as part of objective (2.3) "Organize health monitoring and improve knowledge on the health status of lynx populations".

Lynx carrying a vole. (© ONCFS/FRC FC/ONF/FDC 01, 25 & 39/RNNHCJ)

F. Coexistence with livestock

In most European countries, predation by the lynx concerns no more than a few dozen to a few hundred animals per year, mainly sheep (see Kaczensky *et al.*, 2013 for recent estimates). The situation is different in Scandinavian countries. Their herding system is based on the extensive rearing of semi-domesticated reindeer and sheep with no surveillance, and losses are high (several tens of thousands of animals per year, Swenson & Andrén, 2009; Mattisson *et al.*, 2011). In contrast, in Eastern Europe, only a few animals per year are predated (under twenty in all cases) in countries that have often maintained traditional methods of prevention against predation (surveillance, guardian dogs, night pens, Mertens & Promberger, 2001; Keçi *et al.*, 2008; Rigg *et al.*, 2011; Yilmaz *et al.*, 2015). France and Switzerland are the main countries concerned by lynx attacks on domestic animals in Western Europe, with the number of attacks over the past ten years varying between 46 and 102/year in France (corresponding to between 59 and 176 compensated animals/year) and between 20 and 40/year in Switzerland (between 23 and 86 compensated animals/year, sources: RLL and KORA/depredations databases).

The PNA identifies two specific objectives (1.1) "Reduce conflicts with livestock activities" and (1.2) "Inform, raise awareness and discuss matters with livestock farmers and players" with seven dedicated actions.

Predation by the lynx of domestic animals in France almost exclusively concerns sheep. (© OFB/S. Gatti)

a) Situation concerning depredation in France

When the reintroduction program began in the Vosges Mountains, increasing signs of lynx presence were being observed in the Jura mountains, with the first attacks on livestock taking place in 1984 in the Ain and 1987 in the Jura (Herrenschmidt & Vandel, 1992). The number of attacks then rose sharply, reaching a total of 187 attacks attributed to lynx and 404 animals compensated in 1989. This led to strong protests from mountain farmers, supported by hunters, in opposition to nature protection associations and the authorities (Grosjean, 1992). In August 1988, a lynx was shot and left in front of a police station in the Ain *département*. A protest march against the presence of the lynx brought together more than a thousand people in Bourg-en-Bresse in July 1989. After consulting the local authorities and the ONC (*Office National de la Chasse* or national hunting office), the Ministry of the Environment put in place response and protection measures, authorizing the culling of lynx in areas of high predation (Campion-Vincent, 1996). In the period up to 1991, eleven lynx were officially culled but, at the same time, at least two animals were illegally killed. The number of attacks then fell sharply and the situation calmed, following the payment of compensation, even though some farmers were still affected by attacks. A second peak of around 160 annual attacks was observed in 1999-2000. The number then fell continuously until 2007, a historically low year with 28 attacks (Figure *6*). The number of attacks began rising again in 2011, but has remained relatively stable in recent years with fewer than a hundred cases reported annually.

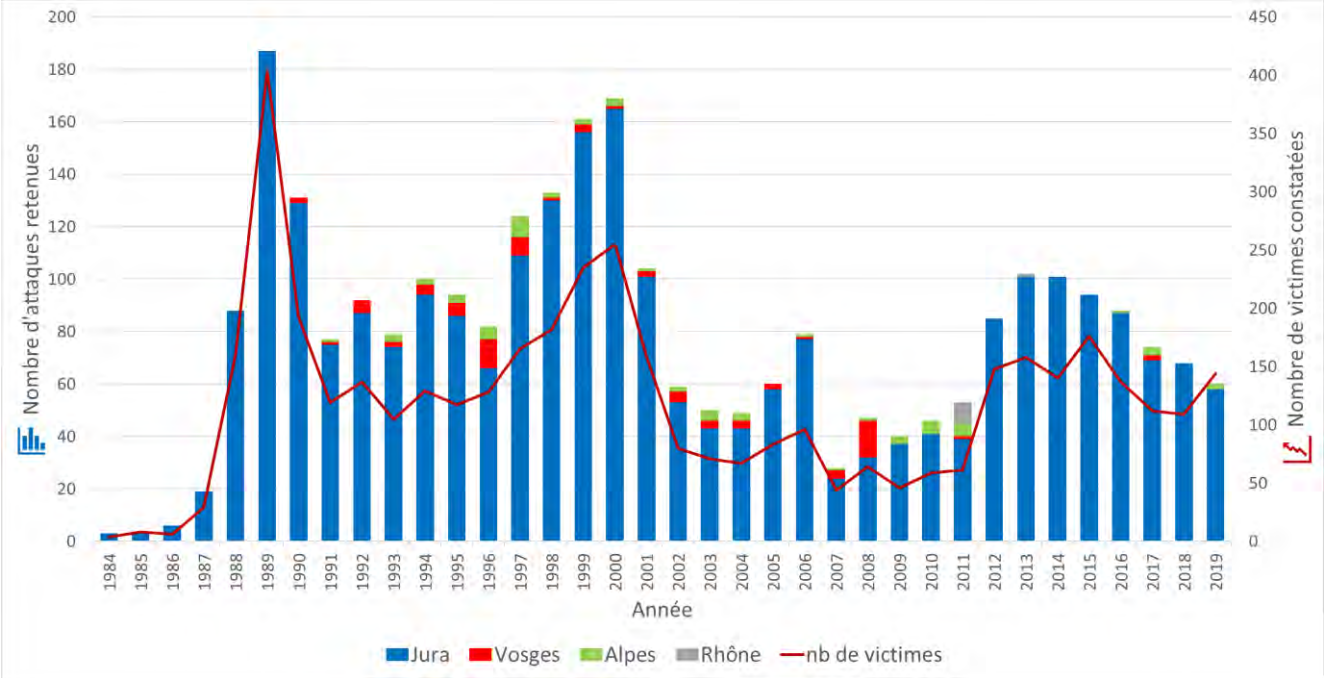


Figure 6 Number of attacks and predated animals reported for the lynx in France between 1984 and 2019 (source RLL database)

The number of attacks has returned to a level close to that of the early 1990s, while the area in which the lynx is present has practically doubled over the past twenty years. Most of the attacks (95%) concern the Jura Mountains. The characteristics of mountain farming in the Jura and Vosges differ from those in the Alps, for example. Flocks/herds are rarer and smaller (fewer than 100 head generally, 50 on average), often split into a number of small groups, which remain in the same place throughout the season.

Depending on the year, between 10% and 23% of the flocks/herds listed in farming statistics suffered attacks, although only one or two in most cases. The number of animals killed during an attack varies between one and three in the vast majority of cases (more than five animals killed in just over 1% of cases) while the annual number of predated animals corresponds to between 0.1% and 0.6% of the regional flock/herd (Stahl *et al.*, 2001). The pattern of attacks is heterogeneous. Each year, between 30% and 70% of attacks occur in between two and six "hot spots", defined as areas with more than ten attacks per year within a 5 km radius. These hot spots make up less than 5% of the total area in which attacks have been observed, and just 12.5% of the farms attacked. The farms suffering repeated attacks therefore have a significant impact on the number of animals killed each year. In 2007, for example, no hot spots were observed, resulting in a year that was historically low year in terms of the number of animals killed.

By way of comparison, Switzerland has also observed fluctuations in attacks on domestic flocks/herds, but it has an alternative explanation. Shortly after the reintroductions began, the first attacks on domestic livestock were reported in 1973 (Capt *et al.*, 1993). They continued to increase up to 1988, before falling in subsequent years. These fluctuations have been attributed to the numerical and behavioral responses of the wild prey population, the recolonization by the lynx and the subsequent partial shift of predation to domestic prey, before the predator-wild prey system stabilized once again (Breitenmoser & Haller, 1993). In the mid-1990s, a similar imbalance in the system was observed in

the northwestern Alps, with a significant increase in depredations and a sharp drop in the hunting take resulting from the combined effects of predation, several harsh winters in succession, an outbreak of keratoconjunctivitis in chamois, and a late adjustment of hunting quotas (Molinari-jobin *et al.*, 2001; Breitenmoser *et al.*, 2010, see details of this event in § f). At the end of the 1990s, this situation led to a wave of protests and a series of illegal killings of lynx, which led the federal government to request the development of the Swiss Lynx Plan. This enabled the culling of predatory lynx, for example, and the reduction of "excess" numbers through translocation or culling (Blankenhorn, 2003). Nevertheless, even when depredation rates were at their highest, the losses caused by lynx never exceeded 0.2-0.4% of the local flock/herd (Angst & Breitenmoser, 2003). The Swiss Lynx Plan authorizes the regulation of the lynx population (Art. 12 para. 4, Federal Act on the Hunting and Protection of Wild Mammals and Birds, and Art. 9 of the Bern Convention), only if a number of conditions are satisfied, such as the large-scale expansion of the lynx at sub-compartmental level (inter-cantonal large predator management units), documentation of species reproduction, population monitoring and the implementation of reasonable protection measures (OFEV (office fédéral de l'environnement or federal office for the environment), 2016).

b) Risk factors and attack hot spots

During the recolonization of the French Jura Mountains, similar events to those described in Switzerland were observed during the initial phase. After this period, however, the spatial and temporal distribution of lynx attacks in the Jura did not reflect changes in the lynx population as a whole, or a decrease in the abundance of ungulate population. On the contrary, the sectors concerned were also those in which the strongest increase in roe deer numbers was observed. Year-to-year variations in the number of attacks on flocks/herds at regional level have been driven primarily by the appearance or disappearance of a few major hot spots (Stahl *et al.*, 2001). Excluding these points, the number of attacks remains relatively stable.

Hot spots are a local phenomenon involving small areas and small numbers of individuals. They have also been described in Switzerland and seem to share the same characteristics (Angst & Breitenmoser, 2003). The spots most at risk are generally adjacent to wooded areas, or even enclosed forest land, close to habitats with abundant deer, far from inhabited areas, and lacking specific protection (the relatively low electric fences serve only to contain the flock/ herd, not to protect them from attacks by carnivores). These characteristics are likely to favor the development of hot spots and can sometimes pave the way for the emergence of "specialist" behavior in some individuals (Stahl *et al.*, 2001, 2002). Even for these individuals, however, domestic prey makes up only a tiny proportion of their diet (Stahl *et al.*, 2001). These behaviors are not systematic, and not all lynx faced with the same environmental conditions will necessarily develop these behaviors. The characteristics of the areas of attack seem to be a more important factor than individual behavior in the development of hot spots, which have been seen to regularly reappear in the same areas with different lynx, or shortly after the lynx responsible for the attacks is culled (Stahl *et al.*, 2001; Angst & Breitenmoser, 2003). Setting aside this predominant "site effect", there do not seem to be any clear factors explaining why individuals develop this type of behavior (health status, sex, reproductive status), and no evidence suggesting that these behaviors are transmitted to young animals taking part with their mothers in these attacks (Stahl *et al.*, 2002). In Switzerland, attacks on domestic animals seem to be mainly carried out by the males, who are more opportunistic than the females (F. Zimmermann, *pers. comm*., see also in Scandinavia, Bunnefeld *et al.*, 2006; Odden *et al.*, 2013). Of the 14 shooting permits issued in

Switzerland between 1997 and 2004 for predatory lynx, one male suffered from mange and a second, very old male had old bullet wounds (Breitenmoser & Breitenmoser-Würsten, 2008).


The factors that lead lynx to become regular predators of sheep are probably multiple and remain difficult to predict. Anecdotally, dental problems have been noted on lynx responsible for multiple attacks, here on a lynx culled in 2006 (Boyer, 2007), and on a lynx of at least 13 years of age, which died on capture in 2017, although it had never caused any damage during the first ten years of monitoring. (© ONCFS SD39, © ONCFS S. Gatti).

c) Measures to manage conflicts with livestock farming

The first expert committees were set up in 1986 to determine the responsibility of the lynx in livestock attacks. They initially involved gamekeepers from the ONC together with a veterinarian and a member of a nature protection association. A scale of compensation was established in 1989 in consultation with farmers in the Ain *département*, based on a veterinarian's estimate of the price of each animal in each category (lamb, ewe, ram, etc.). These procedures are considered slow and complex by farmers. Given the increase in the number of reported attacks, it was important to implement a simplified process, involving only ONC gamekeepers. It was also agreed that this compensation should take account of indirect loss: the stress caused to the flock/herd. Compensation was initially paid by the WWF, in the absence of public compensation available for attacks by protected species. From 1990 onwards, this compensation was channeled through the Chambers of Agriculture. In 1991, the Ministry of the Environment set up a new procedure with the FFNE (Fonds Français pour la Nature et l'Environnement or French Fund for Nature and the Environment) for faster payment of compensation. In 1998, the Ministry of the Environment initiated discussions on the harmonization of procedures and compensation scales for large predators. The financial management of compensation for damage was placed in the hands of the ONC, which became the ONCFS (Office national de la chasse et de la faune sauvage or National hunting and wildlife agency) in 2000. Until 2019, a specific scale was applied for lynx, based on an agreement between the Ministry and the ONCFS. This scale could draw upon the more detailed circular of January 27, 2011 concerning compensation for damage caused by the gray wolf. Since July 2019, the compensation procedure for damage caused by the Eurasian lynx has been governed by two new texts (decree No.2019-722 of July 9, 2019 on compensation for damage caused to domestic herds by the gray wolf, the brown bear and the Eurasian lynx, and the ministerial order of July 9, 2019 applying this decree, which harmonizes the scales and reviews the conditions applicable to compensation for attacks by the three large carnivores. These texts provide compensation for direct costs (dead, euthanized or missing animals), as well as indirect costs (stress, reduced weight gain, abortions or reduced lactation), veterinary costs associated with predation and, where applicable, repairs to damaged equipment (fences, pens). The scale also takes into account the value of each animal based on the quality label (e.g., organic) and the sales channel (e.g., short supply chain). Overall, compensation has been increased by 14% compared to previous

texts. However, if more than five attacks occur in two years, compensation will be paid only if protective measures are implemented.

Excluding the hot spots or pastures considered to be at risk, an approach based on financial compensation for lynx-related losses appears to be the most cost-effective choice, given the diffuse and relatively unpredictable nature of attacks (Stahl *et al.*, 2001). It would be unrealistic to seek to implement preventive measures on all the farms in the area where the lynx is present or to eliminate attacks altogether. Nevertheless, concentrating on the hot spots or high-risk spots (in or around forests, for example), appropriate measures could be sufficient to reduce attacks to a minimal level, compatible with the continuation of activities in conditions acceptable to farmers.

d) Livestock protection measures

Several measures have been suggested to protect livestock from lynx attacks: adapted anti-predator electric fences (four wires or more, sufficient height), herdsmen, night pens, moving livestock to spots away from the forest areas, and using guardian dogs (Linnell *et al.*, 1996; Breitenmoser *et al.*, 2005). These measures, alone or in combination, are likely to significantly reduce attacks over the long term, but not all of them are economically viable or appropriate for the local context and livestock farming practices, particularly in the Jura massif. Employing herdsmen is not economically feasible, night shelters require buildings, as well as more fodder and concentrates to feed the animals, and the possibilities for moving livestock are limited, given the mosaic configuration of habitats in the Jura. A combination of fencing and guardian dogs seems to be the best option.

Several documents set out recommendations for fences to keep lynx out: closed fencing, uninterrupted on all sides of the pen, set back from any trees or installations likely to be crossed by predators, angled at the top for high fences, one or more electric wires set back at the top with less than 25 cm between wires, at least five wires on movable fences, one low wire positioned at under 20 cm, and at least 90 cm in height (AGRIDEA, 2006; Protection Suisse des Animaux, 2017; SNU-RLP, 2017).

Guardian dogs have also proved their usefulness in preventing attacks not only by lynx, but also by wolves and bears (Rigg *et al.*, 2011; Yilmaz *et al.*, 2015). The first trials carried out in 1998 in the Jura by the ARTUS association with two Pyrenean mountain dogs proved their efficiency in reducing the number of attacks. A second trial in 1999 with a dog from the LIFE wolf program also gave good results on a flock that had suffered 11 and then 16 attacks in the previous years. The lynx stayed away from the herd from the second night of the dog's presence and stopped attacking the farm (Vandel *et al.*, 2001). Dogs subsequently became more common in the Jura, although there was no real structure or support. It was only in 2007, with the founding of the association *Pôle Grands Prédateurs Jura* (PGPJ), that a process was put in place to support farmers, placing the emphasis on the prevention of conflict, with the return of large predators. A survey of 22 farmers showed a significant 86% fall in lynx attacks, along with an 87% fall in attacks by stray dogs, which was the main cause of damage reported by the farmers surveyed (Landry & Raydelet, 2010). These studies and trials demonstrate the effectiveness of the system while also revealing its limits. Even among farmers with dogs, the way livestock are managed means that one-quarter of the animals remain unprotected and, beyond a certain number, it is clearly economically and logistically unthinkable for the farmer to keep as many dogs as there are groups of animals. The combination of the "site effect" and the development of recurring depredation by the lynx at the hot spots also means that as soon as a dog is taken away (e.g., following complaints

from the neighbors about noise, or because of its behavior) the attacks resume. Also, when a dog is present, the lynx may shift its attacks to a neighboring, unprotected holding. Experience has also highlighted the importance of training and making the right choices in terms of the bloodline and background of the dogs in order to maximize the efficiency of the system and to limit accidents (biting). However, the positive results in terms of prevention unfortunately run up against a number of problems directly related to the dogs. In addition to day-to-day management, problems relating to the liability of farmers in the event of incidents and neighborhood disputes caused by noise levels (inherent to the dog's "work") are often mentioned as a disincentive to the use of guardian dogs. The IDELE (Institut de l'Elevage or livestock farming institute) is currently seeking to structure the sector and to provide technical support for the introduction and use of guardian dogs. Looking beyond protection from lynx attacks, this work is particularly important in that it could also be applied to the planned long-term return of the wolf to the region, helping to avoid the development of "anti-predator" feeling that would aggravate conflict (Lescureux & Linnell, 2010; Monrolin & Benhammou, 2015).

Guardian dogs have demonstrated their efficiency in protecting livestock in the Jura. Experience has highlighted the importance of training and the need to structure the sector in order to provide dogs with good bloodlines. (© P. Raydelet).

e) Financing for protection measures

The question of sustainable financing for protection measures and technical support on farms is one of the main obstacles to more peaceful cohabitation with the lynx (Monrolin & Benhammou, 2015). The conditions applicable to compensation from the fifth attack, as set out in the new texts, raise the question of financing. These measures represent an additional cost for the farm, since they demand additional labor and time for purchasing, implementation and maintenance. These costs cannot be borne by the farmer alone. The first funds for protection measures against predators came from Local Farming Contracts (2000-2003). Subsequent aids were co-financed by the government and the European Agricultural Fund for Rural Development (EAFRD). This aid provides partial funding for the purchase of a guardian dog, the construction of suitable fences or shelters, or assistance for bringing in the animals at night. However, access to this aid is still only available to farmers in areas recognized as being impacted by wolf or bear predation. In view of the relatively low cost of lynx predation, the Ministry of Agriculture relies on emergency funds to finance protection measures. Emergency funds are state funds allocated on an ad hoc basis by the Ministry. The aim is to provide a rapid response to crisis situations relating to attacks by wolves, bears or lynx on sheep, goats or cattle. The funds can be used in regions not covered by the livestock protection aid plan put in place as part of the CPEDER

(contrat de protection de l'environnement dans les espaces ruraux or contract for the protection of the environment in rural areas); This contract is limited to the predation areas identified annually by prefectoral order as part of environmental protection operations in rural areas relating to the protection of livestock against predation by wolves and bears (OPEDER for "large predators", see the Order of November 28, 2019 applying Article D. 114-11 of the Rural and Maritime Fishing Code and Decree No. 2015-445 of April 16, 2015 on the implementation of rural development programs for the period 2014-2020). As stated in Decree No. 2015-445, "the impact of damage to livestock caused by the lynx is relatively low compared to that of the wolf. Although the damage is more limited in terms of numbers and spatial distribution, it can nevertheless harm the farms concerned. A protection support system is therefore required. These emergency funds are used to deploy emergency protection measures when the first attacks take place (equipment for setting up electric pens, hazing equipment), as well as for training, vulnerability studies and the dissemination of information. As these funds are valid for one year, it is difficult to ensure the sustainability of the funding, particularly as regards the management of guardian dogs or the maintenance of equipment. A more flexible system could suffice to address the specific problem of the lynx. It would be similar to the one applied to wolf predation circles, but based on the vulnerability of given sites and the risk of their becoming hot spots. Specific action is planned as part of objective (1.1) "Reduce conflicts with livestock farming activities".

f) Operations concerning individuals responsible for repeated attacks

In eastern France, the return of the lynx has taken place in an area where sheep farming has developed significantly in the absence of predators, against a backdrop of agricultural decline, with fenced pens on the outskirts of wooded areas and animals that often stay outside at night. Furthermore, the livestock sector is struggling with a difficult socio-economic situation, with fierce competition from imported meat (Benhammou, 2007). The availability of compensation and the possible removal of lynx that cause significant damage have lessened negative reactions to the species. However, compensation does not necessarily make up for the indirect impacts of predation (psychological stress, extra work, impact on the rest of the flock or herd), and some farmers may still feel that this protected predator (Ferreira-Koch, 1998) has complete immunity. The lynx is still perceived as a problem for many farmers, even those who have not experienced an attack, but who are fearful about possible attacks and their consequences for a labor-intensive sector that is already under considerable pressure and in a situation of economic fragility.

For some analysts, conflicts between the farming community and the lynx are more psychological than economic, given the relatively low cost of predation on a regional scale (Breitenmoser, 1998). Nevertheless, the level and persistence of attacks at hot spots have a significant impact locally and escalate the tensions expressed on a broader scale against the predator. This raises the question of how to adjust the organization of farming systems to cope with the return of predators. The farming community points to the difficulties of implementing effective measures, and the incompatibility of livestock farming with the presence of large predators. Some believe that it is the lynx that needs to adapt (Vourc'h, 1990; Ferreira-Koch, 1998; Kvaalen, 1998). This position could be more to do with ideology and a unwillingness to take account of the natural constraints associated with a policy of nature protection (Monrolin & Benhammou, 2015). However, it would not take much to resolve this conflict, to curb a movement that is not as widespread as for the wolf and to facilitate cohabitation with predators.

Selective culling is one of the measures suggested to reduce damage to domestic livestock. It is also a way to manage conflicts in areas experiencing repeated attacks, to give farmers a sense that they are taking back control and lifting the "impunity" of the predator (Linnell *et al.*, 1996; Treves & Naughton-Treves, 2005). This possibility is regularly raised by representatives of the farming community concerning animals responsible for the hot spots (Benhammou, 2007).

At the same time as the compensation procedures were being put in place, a number of shooting and trapping permits were issued "for scientific study" through to 1993, even though the species was still legally protected and without taking account of the potential impact on the population. The Decree of July 22, 1993 modifying the Decree of April 17, 1981 listing the protected mammals in France put an end to this legal contradiction. It made provision for the Ministry in charge of protecting nature to authorize the capture or killing of lynx (as well as of wolves, bears and even the Eurasian hamster), with the approval of the CNPN, in order to "prevent significant damage to crops or livestock, providing that there is no other satisfactory solution and that the exemption does not impact the survival of the population concerned". A technical protocol has been established, setting out the criteria necessary for the removal of a lynx. A committee made up of farmers' unions, nature protection associations, hunting federations, the ONF and the ONCFS meets under the aegis of the local prefecture to analyze the scale and duration of damage and the impact on the farm, and to study the possibility of implementing sustainable prevention measures on a case-by-case basis. The protocol provides for a series of graduated non-exclusive intervention measures (from simple financial compensation, through to measures to reduce the risk of attack, and the conditions for removal of the animal). Destruction is seen as the last resort. Analyses show that when ten attacks occur within a radius of three km, the situation is likely to persist and develop. This is therefore the limit adopted by the prefect to decide to implement removal, based on one adult per year and per *département* (Lynx Network Bulletin No. 8, 2001, Stahl *et al.*, 2001). Some thirty permits have been issued, leading to the removal of around ten animals. The animals were either placed in captivity or euthanized, the last time in 2006. This measure is applied in several European countries to lynx responsible for repeated attacks (Linnell *et al.*, 1999). Given the conservation status of the species concerned, it nevertheless remains highly controversial, not only for ethical reasons, but also and above all for its relative effectiveness (Herfindal *et al.*, 2005; Linnell *et al.*, 2010). In situations where environmental conditions and farming practices remain unchanged, studies of the "site effect" show that attacks resume on these same sites on average 40 days after the removal of the predatory animals, and almost systematically over the following years (Stahl *et al.*, 2001; Angst *et al.*, 2002). The system was nevertheless maintained under Article L. 411-2 of the Environment Code, as authorized by the Bern Convention, and confirmed by Article 3 of the Order of April 23, 2007 setting out the list of terrestrial mammals protected in France and the procedures applicable to their protection, repealing and replacing the Order of 1981.

The relocation of "problem" animals is also one of the techniques under consideration for reducing damage by large predators (Miller *et al.*, 2016). Nevertheless, relocating a lynx responsible for attacks could pose a real problem of acceptance if it continued its predatory behavior in its new sector (Stahl *et al.*, 2001). Switzerland's Lynx Plan makes provision for the translocation of individuals, in particular to reduce a "local overabundance" of lynx, but these operations cannot concern lynx responsible for attacking livestock (Angst & Breitenmoser, 2003; OFEV 2016).

An action associated with objective (1.1) "Reduce conflicts with livestock farming activities" makes provision for implementing a gradual intervention system for swift and sustainable resolution of the

problems raised by identified hot spots, while respecting the strict protection and conservation status of the species.

G. Coexistence with the hunting community

This issue merits a dedicated objective (1.3) "Improve coexistence with hunting activities and the participation of hunting in lynx conservation" with four dedicated actions.

Negative attitudes towards the lynx are widespread in the hunting community and often go hand-in-hand with negative attitudes towards predators in general (Zeiler *et al.*, 1999; Fasel, 2003; Hunziker, 2003; Lescureux *et al.*, 2011; Červený *et al.*, 2019). Although attitudes of this type are not systematic or even held by the majority in some cases, they can nevertheless be expressed more or less forcefully in some contexts, compared with more positive or neutral attitudes (Vourc'h, 1990; Bath *et al.*, 2008; Christen *et al.*, 2016). These attitudes stem primarily from fear of the impact on ungulate populations and the competition between predators and hunters for their preferred prey/game (Linnell *et al.*, 2000; Ericsson & Heberlein, 2003; Røskaft *et al.*, 2007). In this context, the return of the lynx is perceived as disrupting the efforts of the hunting community in terms of management, as well as interfering with their activities (Christen *et al.*, 2016). This perception may also be a way of defending their social identity, setting themselves apart from people who may hold opposing values and views of nature, the role of the lynx in the ecosystem and, more generally, its place in the environment (Lüchtrath & Schraml, 2015; Van Heel *et al.*, 2017). Despite the protected status of the lynx, these unfavorable perceptions can lead to retaliation in the form of illegal killing (see chapter 3B). This remains one of the main causes of mortality and an obstacle to the development of lynx populations in Europe (Schmidt-Posthaus *et al.*, 2002; Andrén *et al.*, 2006; Breitenmoser-Würsten *et al.*, 2007; Liberg *et al.*, 2012; Kowalczyk *et al.*, 2015; Heurich *et al.*, 2018).

a) Perceived or actual impacts on prey populations

Conflicts with the hunting community have been heightened by the return of the species following its reintroduction. The return of the lynx to the regions from which it was absent for many years is taking place in areas where ungulates are once again abundant, with strict management by hunters, but within systems that were not designed to take account of the presence of a predator (Capt, 1998; Breitenmoser *et al.*, 2010). Following the reintroduction of the lynx in the Vosges Mountains, a swirl of rumors and claims spread across the hunting community, exploiting and feeding into a fear of seeing game disappear, with the lynx being described as an "insatiable" predator, a "poor regulator" and a "four-legged poacher" (Ferreira-Koch, 1998). In the Jura Mountains, soon after the reintroduction, hunters began to claim that lynx were responsible for a decline in roe deer numbers, implicitly expressing a need for financial compensation (Benhammou, 2007). In 2000, a group of hunters in the Hohneck region of the Vosges Mountains launched a petition against the lynx, blaming it for a "sharp decline" in the number of roe deer, and also for the disappearance of the capercaillie, chamois, deer, hares and wild boar, referring to the reintroduction as an "ecological disaster" (Lynx Network Bulletin No. 06, 2000). The perceived or actual impact on roe deer or chamois populations is therefore at the heart of the conflict. Some stakeholders in the hunting community point to the potential financial consequences in terms of compensation in the event of a failure to reach the minimum numbers provided for in hunting plans, or concerning the value of hunting grounds in some regions, where rental can represent a significant budget (Vourc'h, 1990; Christen *et al.*, 2016).

The nature and scale of the impact of the return of the lynx, in terms of prey abundance or behavior, remain difficult to predict as they depend on so many covariables. European studies of lynx predation highlight local differences in terms of the prey take, the proportions of the various species in their diet, and the ways in which prey adapt their behavior to take account of the presence of the predator (see § D-f and § D-i). However, none of them seem to identify a threat to the survival of game populations, which are also highly sensitive to other factors such as climate, habitat quality, competition with other ungulate species, diseases, hunting management, and so on.

Long-term monitoring in Switzerland shows that fluctuations in prey and lynx populations are the result of complex dynamics. In the northwestern Swiss Alps, the roe deer population continued to expand through to the early 1990s, following a series of mild winters with low mortality. This led to an increase in the lynx population, with a slight time lag. At the same time, at the request of the foresters, the hunters had also increased their deer take. In around 1995, the roe deer population started to fall, the hunting take decreased and hunters were no longer able to achieve minimum numbers. In a slightly time-lagged numerical response, the lynx population continued to increase and partially shifted its predation to chamois. Predation peaked between 1997 and 2000, contributing to 60% of roe deer mortality and 30% of chamois mortality, while ungulates also suffered from harsher winters (Breitenmoser *et al.*, 2010). The sharp drop in the hunting take sparked fierce controversy and soaring numbers of illegal killings (Ceza *et al.*, 2001). These events led to the implementation of management measures through the Swiss Lynx Plan (Blankenhorn, 2003; OFEV 2016), which has since resulted in the culling of lynx that prey on domestic animals (seven in the northwestern Alps, one in the Jura, for fourteen shooting permits issued between 1997 and 2004, Breitenmoser & Breitenmoser-Würsten, 2008) and the translocations of over 20 individuals since 2001 for reintroduction and reinforcement projects in northeastern Switzerland, Italy (Tarvisiano, Friuli-Venezia Giulia region), Austria (Kalkalpen National Park) and Germany (Palatinate Forest, Ryser *et al.*, 2004; Zimmermann *et al.*, 2011; Fuxjäger & Molinari-Jobin, 2013; Molinari-Jobin & Molinari, 2014; Breitenmoser *et al.*, 2016).

In France, attitudes can differ from one FDC (fédération départementale des chasseurs or departmental hunting federation) to another, as was the case for the reintroductions in the Vosges Mountains. In the Jura Mountains, where the return of the lynx was more gradual, FDCs are more likely to recognize that the pace of this natural process gave technicians time to modify hunting plans as the predator population expanded, paving the way for acceptance by a majority of hunters. Moreover, the three FDCs in the Jura *départements* are actively involved in monitoring the species. However, while recognizing the legitimate place of the lynx in France, hunting bodies regularly come out in favor of relaxing the current protection status in order to regulate the species, applying the same management rules as for any other species, if the population is considered viable. These positions are set out in their communication as well as in policy documents at the local or national level through the SDGC (schémas départementaux de gestion cynégétique or departmental hunting management plans) and the White Paper of the FNC (fédération nationale des chasseurs or national hunting federation) on large predators (Hargues & Arnauduc, 2014).

In the Jura *département*, for example, the increase in signs of lynx presence in the early 2000s coincided with a fall in the hunting take of roe deer. The immediate perception of this was based on a cause-and-effect relationship. However, a closer examination reveals that this fall concerned all hunting entities and was independent of the level of presence of the lynx (permanent, recent, irregular or absence, (Hesler, 2006). Nevertheless, the FDCs continue to escalate reports claiming that roe deer

numbers have been falling over the past ten years in the north of the Jura Mountains, that the chamois recruitment has also fallen in the southern part of the mountains, and that there has been a general decline in the hunting take between 2005 and 2010. What are the respective roles of hunting, lynx predation and other factors in the variability of the hunting take?

Interpretations based on the hunting take alone are not sufficient to draw reliable conclusions on their respective roles. For this reason, it will be necessary to study in detail the dynamics of prey populations and predation mechanisms including, in this case, the impact of hunting. Often, answers will only become available following five to ten years of field studies (Marboutin, 2007, e.g., Andrén & Liberg, 2015; Belotti *et al.*, 2015). It was against this backdrop that the idea of a predator-prey project took form in the Jura Mountains in collaboration with the ONCFS, the FDC and research groups from the CNRS (Centre national de la recherche scientifique or French national center for scientific research) (Marboutin, 2016). This program has been ongoing since 2017, with the exception of the lynx capture component, which was rejected by the CNPN.

b) Social aspects and relations with nature

The role of farmers and hunters in countryside management must now also encompass environmental concerns in a society that is becoming less rural. The introduction of hunting plans in the 1970s contributed to increasing the responsibilities of hunters as managers of populations of large game. The return of the lynx is perceived as a challenge to this legitimacy in that it largely squeezes them out of decisions concerning ungulate populations. For some members of the hunting community, the feeling that they have lost control over their territory and their way of life is exacerbated by the fact that they cannot regulate the numbers of lynx, owing to their protected status (Vourc'h, 1990; Ferreira-Koch, 1998; Christen *et al.*, 2016). The petition from the Hohneck group mentioned earlier refers to a "political-technocratic power that dreams of returning to prehistoric times in the Vosges forests". In the Vosges Mountains, the first reintroductions were carried out before the end of the consultation process between the various stakeholders. This left a permanent mark that is still present in discussions today on the future of the lynx in the mountains (Vourc'h, 1990, workshops and work groups studying the development of the PRA, Charbonnel & Germain, 2019). In conflicts relating to large carnivores, ethical and ecological arguments do not always suffice. Even the community of conservation stakeholders cannot always agree on the measures and actions to be taken, even though the objectives are clearly shared (Lute *et al.*, 2018). Hunters may even be suspicious of some technical or scientific arguments. Estimates of population size are regularly called into question, as was the case in the Czech Republic, where hunters' estimates of the size of the lynx population are three times higher than those based on camera traps and genetic sampling (Červený *et al.*, 2019). This doubt concerning the numbers may reflect the different scales on which reasoning and perceptions are based. Conservationists tend to think in terms of a mountain range, a region or even the distribution area of a species, whereas hunters generally apply their own spatial and temporal scales. In the Vosges Mountains, for example, they refer to their territories and the land that they rent for the duration of a hunting lease (Vourc'h, 1990; Christen *et al.*, 2016). However, according to the same authors, some hunters believe that the lynx can play a positive role in the ecosystem and that it has its place in the diversity of wildlife.

It is essential to take account of these human, social and political aspects in efforts to improve acceptance of lynx by the hunting community and to avoid the psychological reactance that can lead

to a polarization of positions, reinforcing negative views of the species and increasing the risk of acts of destruction (Lüchtrath & Schraml, 2015; Červený *et al.*, 2019).

Although it appears that perceived or actual competition between hunters and the lynx, and negative attitudes towards the presence of the lynx or against restoration are the main obstacles to successful conservation of the species, all the specialists nevertheless agree on the need to better understand and better communicate on the effects of predation, and to integrate predation into ungulate management in order to address this conflict with the hunting community (e.g., Kaczensky *et al.*, 2013; Linnell, 2013; Boitani *et al.*, 2015). As part of a European strategy, they recommend the following for each population: 1) obtain data on predator-prey relationships and population dynamics (numerical and functional responses), 2) assess the combined and mutual effects of predation and hunting on prey populations, 3) examine hunters' attitudes towards the lynx and their perception of the impact of predation, 4) develop recommendations for adapting ungulate management to the presence of the lynx and the effect of predation, 5) inform managers and hunters, communicating the findings of these studies and the resulting recommendations.

Furthermore, this strategy also recommends actions to increase information, awareness and cooperation with the hunting community through involvement in research and monitoring activities for the species, as well as through communication campaigns and science outreach studies, and workshops for the exchange and transfer of information and feedback in order to facilitate a dialog between stakeholders. In this context, biologists and managing bodies should be supported by specialists in the humanities and mediation.

c) Need for dialog and mediation

For conservation actions to be accepted by local stakeholders, it is all the more important to develop trusting relationships in this area between the different players and to obtain assistance from specialists in the humanities and social sciences to develop effective communication concepts. Breitenmoser (1998) pointed out that "conservationists must also accept that for many local stakeholders, and in particular rural players, nature protection is not their most important issue". What is the situation more than 20 years after this observation? Conservation strategies need up-to-date social and humanities studies as appropriate for the context and need their support, especially with regard to coexistence with large predators, where the human dimension is as important (or more important?) than the biological and ecological aspects. Taking these differences in values and perceptions into account is the key to reaching consensus and creating a favorable environment for action around the lynx. Such participatory and inclusive processes have proved useful in neighboring countries. In Switzerland, after two years of discussions, Pro Natura, Swiss Hunting (Chasse Suisse), the Swiss Sheep Breeding Federation and the WWF agreed on a text laying the ground for a number of common principles, objectives and areas of action with regard to large predator policy in 2012 under the arbitration of the Federal Office for the Environment (OFEV). In Germany, after the failure of attempted action plans between 2004 and 2010 (Herrmann *et al*., 2004, 2010) and following a negative opinion expressed by the Rhineland-Palatinate Ministry of the Environment, a dialog was initiated by the Luchs Projekt Pfälzerwald-Vosges du Nord Association with the Ministry of the Environment, the Hunting Federation and the main scientific partners specializing in the lynx. This work culminated in 2015 in the LIFE Luchs Pfälzerwald program for the reintroduction of 20 lynx over a period of six years (Stiftung Natur und Umwelt Rheinland-Pfalz, 2015). Finally, the LIFE Lynx project

in the Dinaric Alps, involving Italy, Slovenia, Croatia, Slovakia and Romania, has succeeded since 2017 in involving partners from the hunting community in a large-scale operation to strengthen the lynx population.

H. Disruption and disturbance of individuals

The issue of the effects or influence of human activities on the lynx requires consideration on various scales in space and time: on the scale of the habitat, the environment, the home range and important sites for the species (prey consumption sites, resting sites, den sites, nursery sites, etc.), but also seasonal variations (logging, hunting season, winter or summer recreational activities) and the time of day.

As detailed, lynx populations in France are likely to develop in habitats and environments that are heavily impacted by human activity. However, the lynx adapts reasonably well to the presence of humans, as long as prey is abundant and it has forest refuges and steep terrain nearby. The lynx also adapts its activities and habitat use to achieve this trade-off between prey abundance and human disturbance. If we look at the particularly sensitive period of birthing and rearing of young, monitoring carried out on the dens of about thirty females in Switzerland over 20 years (Boutros *et al.*, 2007) has revealed a wide diversity of sites for birthing and rearing of young. Females choose sites that are not easily accessible and regularly change the location of their young. There is no evidence to suggest that their ability to find these sites is a limiting factor, or even that variations in site quality have negatively affected the survival of the young. In addition, where prey is sufficiently abundant, the presence of humans does not appear to negatively influence the reproductive success of the females (Scandinavia, López-Bao *et al.*, 2019).

Studies on disturbance by human activities focus on distinguishing between behavioral disturbances (which will result in a change in behavior) and physiological disturbances (which result in energy expenditure and/or which may compromise the survival or reproductive success of the animal, Blanc *et al.*, 2006; Tablado & Jenni, 2017; Le Grand *et al.*, 2019). With regard to disturbances due to human activities in areas where lynx are present, in particular outdoor activities (leisure, nature sports, animal observation, hunting, etc.), the issue also arises during forestry operations. Different types of disturbance that may affect the lynx can be identified:

- disturbance while hunting prey, that could lead a lynx to abandon it (and consequently force the lynx to hunt more, thus increasing its energy expenditure and its impacts on wild and domestic prey, potentially leading to more conflicts);
- disturbance at resting sites, which could increase energy expenditure;
- disturbance of prey, which could increase energy expenditure;
- disturbance of nursery sites or of a female with her litter, which could lead to additional energy expenditure and risks if the mother has to move her litter or, in an extreme case, separation of the mother and her litter;
- disturbance caused by direct pursuit of an animal, which, in addition to stress and energy expenditure, could result in an aggressive defense reaction.

There are currently no studies in France on disturbance of the lynx by these activities and, in the absence of detailed remote monitoring, it remains difficult to quantify beyond the anecdotal cases reported. With regard to prey disturbance, displacement or removal of prey by human intervention does not appear to be common practice as in other European countries (Krofel *et al.*, 2008). However,

this practice has not been quantified. In human and landscape contexts relatively similar to France, the best monitored lynx populations (i.e., by GPS and VHF telemetry) are those in Switzerland. The few anecdotal cases of disturbance noted, particularly during forestry operations, have led individual animals to move away temporarily, or to move litters over short distances (F. Zimmermann, pers. comm.) without the opportunity for any more significant consequences to be measured. In Scandinavia, for example, where the lynx frequents areas with abundant human activity and infrastructure, their behavior, especially that of females accompanied by their young, generally involves avoiding humans (Bunnefeld *et al.*, 2006; Bouyer *et al.*, 2015). Nevertheless, this avoidance is not very marked and no short or long-term effect of a one-off disturbance has been detected, even for females with their kittens and even during intentional experimental disturbances caused to lynx monitored by telemetry (Sunde *et al.*, 1998).

Although awareness-raising actions can already be carried out among users of natural areas and professionals who could disturb the species, the potential impact of disturbance as a conservation issue has yet to be quantified. This is why objective 1.6 of this National Action Plan involves a study of the influence of human activities in terms of disturbance on the species, in order to identify preventive steps during the most sensitive periods (birthing and the period of dependence of the young) and for activities that are most likely to cause negative impacts.

I. Potential benefits of the presence of the lynx

Although the lynx does not occupy the same place in history or popular culture as other iconic animals, including other large predators, the species as a large feline carnivore is often described as charismatic, with significant potential for use as a flagship species (Simberloff, 1998). Its image is used by several conservation organizations for their campaigns and by national parks and zoos, but also for marketing campaigns or commercial products (as examples, see the summaries of Charbonnel & Germain, 2019 and Drouilly, 2019).

There is little research or quantified data on the potential economic benefits of the return or the presence of the lynx. The most detailed discussions were held under a project to reintroduce the lynx in the United Kingdom (White *et al.*, 2015). In this study, the authors attempted to estimate the relationship between the costs resulting from predation (compensation for damage) and from the management of the reintroduced lynx (monitoring and population maintenance) against the various benefits in terms of income from tourism, the positive impact on forestry and reduced crop damage and other potential collateral benefits (reduced collisions with large wild animals, disease transmission).

A report by WWF-UK (Goodwin *et al.*, 2000) sets out the opportunities and challenges of tourism involving carnivores. The tourism services on offer will have to be responsible, in the sense that they will have to be planned and managed sustainably on the basis of appreciation of nature and local culture, providing information about the various species and their conservation issues and minimizing the negative impact of this tourism (disturbances, development of infrastructures and increased number of visitors to the detriment of the lynx habitat and protection from disturbance, increases in road traffic, etc.). The very nature of carnivore behavior may temper this enthusiasm for tourist services based solely on these species: they are difficult to see and the signs of their presence alone (tracks, feces, etc.) may only offer limited attraction. Nevertheless, the authors argue that the image of large carnivores may be strong enough as a symbol of wilderness and natural areas to play a role

that can also encompass other key species in the region and the enhancement of landscapes and protected areas, but also aspects of local culture. For example, in connection with the project to reintroduce the lynx into the Harz Mountains in 1999, a visitor service was developed to make this region a lynx-related tourist destination (observation platforms, themed trails, derived products). In their study on the economic impact of the lynx for this national park, White *et al.*, 2016 showed that for 54% of respondents, the lynx was an important factor in their decision to visit the Harz Mountains, after hiking, scenery and peace and quiet. The authors estimate the economic benefits of the lynx in this national park at between €9 and 15 million. Their estimates of benefits from tourism after a reintroduction to the UK amount to €73m over a 25-year period (White *et al.*, 2015).

If carnivores add value to the local tourism experience (as a "loss leader" offering wider communication and ecosystem education opportunities), benefits could be generated for local communities through commercial opportunities associated with this tourism (accommodation, hotels and restaurants, services, crafts and related products, etc.). Local practices that promote peaceful coexistence between human activities and predators could also be promoted (traditional herding methods, adaptation of practices to the presence of predators, Marsden *et al.*, 2016). Potential conservation benefits include increased public awareness, contributions from tourism activities to research and conservation programs and the development of partnerships between economic players and conservation programs or actions to promote coexistence with human activities. The authors (Goodwin *et al.*, 2000) nevertheless stress that these strategies must be carefully thought out to ensure that these developments benefit local communities, otherwise the problems of acceptance of the species will increase, and to avoid uncontrolled tourism development with practices that would become destructive for the species or the local environment (an example is the tourism around the Iberian lynx in the Doñana Park, Spain). A study by White *et al.* (2015) also attempted to quantify the positive impacts of the presence of the lynx through its control of the deer population or its behavioral effects on deer populations. Deer populations are increasing throughout the UK and result in significant costs due to their effects on forest regeneration, crop damage, vehicle collisions and the amount of money spent to regulate their population. The authors estimate that over a 25-year post-reintroduction period, the savings for forestry would amount to €1.9 million, a reduction in road collisions equivalent to €1 million and a reduction in crop damage amounting to €840,000.

This is why the proposal under objective 1.5 of this National Action Plan is to "Improve acceptance of the species with the support of social sciences, carry out a literature study among the various stakeholders on the ecosystem value of the lynx and draw from international experience (Spain in particular)".

4. ISSUES AND STRATEGY

PNA LYNX 2022-2026

4 ISSUES AND STRATEGY OF THE NATIONAL ACTION PLAN (PNA)

A. Conservation issues

The present and future PNAs for the Eurasian lynx in France will aim in the long term to re-establish and maintain the species in a favorable conservation status throughout its current range and in new areas of spontaneous colonization.

It should be stressed that the debates and opinions produced during the preparation of this first plan raised questions about the status of the populations and the definition of the conservation status of this species.

Also, as was done for the brown bear and gray wolf, a collective expert assessment on both the biological and sociological aspects will be conducted for the Eurasian lynx. The results of such an assessment, entrusted to the National Natural History Museum (MNHN) and the OFB, will if necessary lead to an update of the strategy and actions under the plan (see chapter 5).

B. Strategy

The aim of the long-term strategy for the Eurasian lynx in France is to restore the species to a good conservation status throughout its current range and in new areas of spontaneous colonization. This strategy will be implemented on the basis of progressive objectives, differentiated where appropriate for the various mountain ranges.

This first PNA prioritizes the action needed over a five-year period, while identifying actions that will later contribute to the strategy for the geographic expansion of the lynx's range and the long-term viability of the species in France.

Accordingly, the steps taken under this plan will prioritize the conservation of existing populations and will tackle the obstacles to the survival of individuals and to ensuring functional connectivity between the mountain ranges. This will involve the following in particular:

- improving acceptance of the species by addressing conflicts with livestock farming and hunting activities. Even if all the needs of the lynx were met optimally from an ecological point of view (in particular ensuring the continuity of favorable habitats and functional connectivity between the different population nuclei), improving coexistence with human activities would remain a determining factor in restoring this protected species to a favorable conservation status;
- removing obstacles to the survival and dispersal of the lynx by tackling the causes of anthropogenic mortality (collisions, illegal killing), by eliminating obstacles to the movement of individuals and to exchanges between population nuclei and by enhanced demographic, health and genetic monitoring to improve responsiveness and to accurately predict the viability of the populations.

In order to implement the above strategy, the PNA will be built around the following four main topics:

C. Objective of the Plan

The current five-year plan aims to restore the species to a good conservation status without reintroduction or population regulation and will be based on progressive objectives, some of which will be tailored as appropriate for each mountain range. These objectives are as follows:

- improve knowledge of the dynamics of the lynx in all areas where the species is present, in particular in the Alps, as well as in recent recolonization areas;
- in the Jura Mountains and the Alps, maintain/re-establish positive demographic dynamics from year to year;
- in the Vosges Mountains where the Eurasian lynx is critically endangered because of its very low numbers, curb the negative demographic dynamics by working primarily to improve perception of the species among local stakeholders.

In order to meet the above objectives, natural recolonization will be prioritized during the period of this first plan. However, the Vosges lynx populations are critically endangered, as their numbers are very low and result from reintroductions. The collective expert assessments mentioned above will address this situation. Should these studies highlight the need to strengthen the population for restoration purposes at a time to be specified, i.e., "intentional relocation of a specimen to release it into an existing population of its kind", the PNA should provide information for a possible policy decision by identifying the technical, regulatory and social prerequisites to be met with regard to the appropriateness of such population enhancements. The commitment of the parties is a prerequisite for success and a positive impact will determine the long-term success of such operations.

Previous experience, including past reintroductions (definition taken from the International Union for Conservation of Nature (IUCN) guidelines: "an attempt to establish a species in an area which was once part of its historical range, but from which it has been extirpated or become extinct") in the Vosges Mountains and the recent reintroduction operations in Germany and enhancement operations in the Dinaric Alps show that without consultation, mediation and sufficiently broad consensus, such operations are likely to end in failure and lead to exacerbation of the tensions which already exist in relation to the species. The situation of the lynx in France requires this work to be carried out and proactive approaches to be considered at the same time, but not in such a hurry as to be counter-productive. This is a matter of respect for all those involved in a concerted approach to the coexistence of the species with human activities, but also for responsibility towards the animals that might be used in such programs (responsibility for their survival and safety and the impact on the population nuclei from which they would be taken). This type of operation could only be carried out in the right place and at the right time after assessment of the conservation status of the lynx population and the results of scientific monitoring and studies on the appropriateness and feasibility of these possible operations, as provided for in the PNA.

The issue of replacing individuals that have died from illegal human causes will be addressed by the Scientific Council in all its dimensions (acceptability, impact on the population nuclei from which they are taken, responsibility for their survival and safety, etc.), in order to establish the conditions required in advance and to provide information for a possible decision on the replacement of dead individuals.

Finally, no measures can be planned to regulate the population in view of the protection measures for this species and its conservation status.

5. IMPLEMENTATION OF THE PNA

PNA LYNX 2022-2026

5 IMPLEMENTATION OF THE PNA

A. Duration of the plan, monitoring of its implementation and evaluation

The PNA is set for a period of five years, with progress in its implementation monitored annually by the DREAL BFC, which is in charge of coordinating the plan.

The PNA is not set in stone; it sets out objectives. The actions it contains are changeable by nature and may be readjusted or redefined during implementation of the plan. An action can be modified if it proves ineffective or unworkable.

A mid-term technical and financial assessment of the actions taken will be carried out in order to make any necessary adjustments to the actions identified in this document, in line with regional variations (for example: Vosges PRA for Lynx). If such updates or reorientations are required, they will be examined by the Steering Committee of the PNA, which may decide to add other actions on the proposal of the technical secretariats if they are deemed appropriate or more relevant.

The progress of the actions will be presented to the steering committee, examining the effectiveness of the resources used and whether they are adequate to the objectives. Results and monitoring indicators have been set to evaluate the latter.

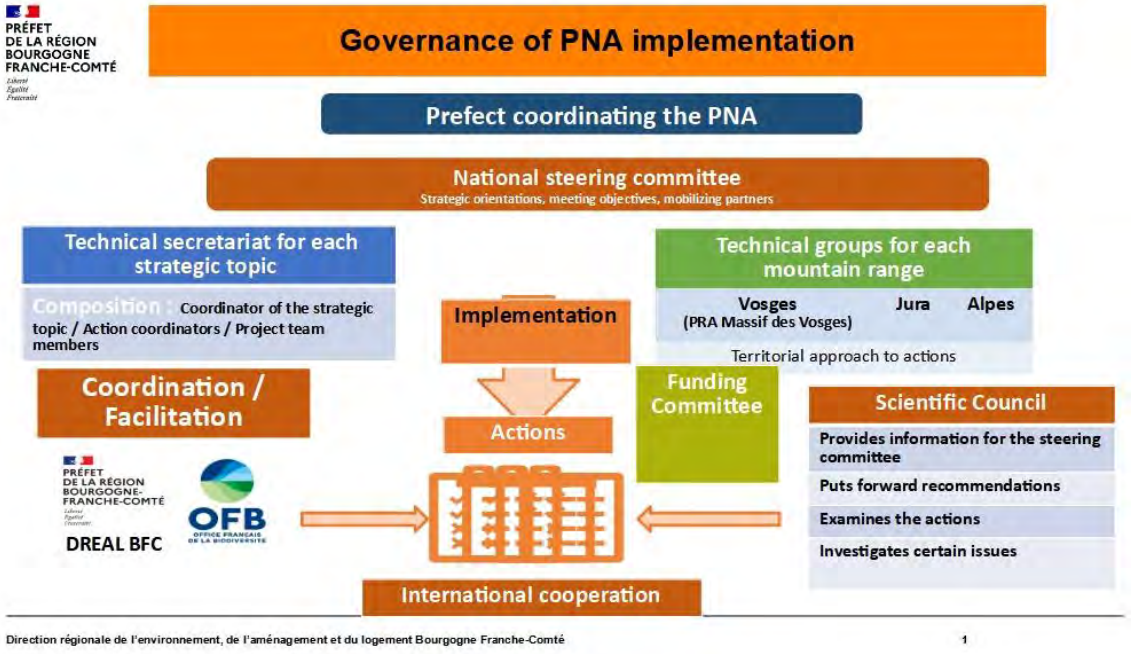
An evaluation by a third-party organization will be carried out at the end of the process. The aim is to measure the effectiveness of the actions in the long term using indicators set according to each action. The evaluation results in a final report with an analysis of the results of the actions. The report should enable the PNA project manager to decide on the effectiveness of the action taken and whether it needs to be renewed or adjusted.

B. Governance for operational implementation

The characteristics of the species and the threats it faces constitute grounds for the State to be responsible for developing this PNA. The prefect of the Bourgogne-Franche-Comté region has been mandated by the Ministry and is the coordinating prefect of the PNA.

The importance of taking action, linked to the range of national issues surrounding the lynx, require collective mobilization for which the PNA is the tool to share diagnoses and ensure coherent initiatives. The governance is therefore shared. Consultations have taken place right from the development and drafting phase. Several bodies have been set up to organize the effective implementation of the plan, specifying the roles of each of them.

The Jura, Vosges-Palatinate and Alpine lynx populations are part of cross-border populations. The planned governance therefore includes an international cooperation component to ensure consistency between the actions carried out by the States or regions within the relevant biogeographic region and to provide information for consideration through feedback from the other countries. This governance involves cooperation with institutions, scientists and associations, for example through exchange networks such as EuroLynx or LIFE Palatinat or cooperation with La Garenne zoo in Switzerland. Governance must be strengthened, particularly in relation to Spain, in order to draw lessons from the work carried out on the Iberian Lynx in terms of acceptability and amenities.



Coordination

The DREAL BFC is coordinating the implementation of the plan with the support of the OFB. As such, it:

- is the delegated coordinator of the plan assigned to it. It carries out this role in conjunction with the steering committee. It is responsible for technical coordination beyond its region, while strategic and policy coordination is the responsibility of the prefect;
- coordinates the steering committee on behalf of the coordinating prefect, prepares the annual action programs to be submitted to the steering committee and organizes annual action monitoring and the drafting of a mid-term review of actions under the plan;
- provides support to the partners, particularly the action coordinators and the regional coordinators;
- coordinates the partner network;
- provides secretarial services and engineers the plan;
- communicates on matters related to the plan and its dissemination;
- makes presentations to the CNPN.

Steering Committee for the PNA

The PNA Steering Committee is chaired by the Prefect of the Bourgogne-Franche-Comté region. Its composition is established by a prefectoral order and is set out in an appendix to this document. It was set up during the development and drafting phases of the PNA with which it was associated.

During implementation of the PNA, the role of the steering committee is to:

- promote dialog between stakeholders;

- propose strategic orientations and priority actions to be implemented and adjust them if necessary;
- make decisions to adjust the identified actions or add new actions if they are deemed relevant;
- confirm the follow-up of the actions decided upon and the assessments at each stage, and evaluate the plan.

The Steering Committee may refer matters to the Scientific Council, of which the Chair is an *ex officio* member.

Scientific Council

The Scientific Council reports to the Steering Committee and its Chair. It is composed of academics who ensure a balanced representation of the different disciplines related to the species and its environment (humanities, biological sciences or law), and who are appointed on an *intuitu personae* basis with a time-limited mandate.

Its composition and functioning are stipulated by a prefectoral order and are set out in an appendix to this document. It has a chair and two vice-chairs, procedural rules and an attached Charter of Ethics.

It is responsible for making recommendations and issuing opinions on the PNA's actions. It does not have to examine the relevance of all the studies on the lynx that are already scientifically framed, such as PhD theses or research programs that are already evaluated by *ad hoc* committees. It may organize a working group on a specific topic, on its own initiative or at the request of one or more of its members. This working group may be assisted by external experts.

The secretariat of the Scientific Council is provided by the DREAL BFC. The Scientific Council is consulted by the chair of the steering committee for its opinions or to clarify the actions under the plan to the steering committee according to the scientific guidelines that are relevant to the conservation of the species. The Scientific Council may, on its own initiative, investigate issues that it considers relevant to the objectives of the PNA.

Funding Committee

The task of this committee, which will be created after validation of the PNA, will be to support the action coordinators in the search for funding by identifying potential financial partners, including local authorities (regions and *départements*) and by ensuring and encouraging complementary public funding for the PNA.

Technical Groups for each mountain range

Three technical groups have been set up respectively for the Vosges, Jura Mountains and the Alps. Each of them involves all the stakeholders in the areas concerned and prioritizes the PNA's actions in their area. The technical and scientific committee for the PRA acts as the technical group for the Vosges Mountains.

Technical Secretariat for the strategic topics

A technical secretariat is established for each of the following strategic topics: 1/ Improve the conditions under which lynx can coexist with human activities; 2/ Reduce threats to the viability of the species and remove obstacles to its expansion; 3/ Communicate on, raise awareness of and promote the species.

The technical secretariat includes the coordinator of the strategic topic/action coordinators/associated members of the project team.

The DREAL coordinates strategic topics 1 and 2 with the support of the OFB. For strategic topic 3, the French Society for the Study and Protection of Mammals (SFPEM) is responsible for coordination and the technical secretariat includes the DREAL BFC, the OFB, the SFEPM and the members of the associated project teams.

This secretariat is responsible for:

- promoting dialog and consultation between stakeholders involved in actions under this strategic topic;
- supplementing and/or simplifying the action sheets and, if applicable, breaking them down into more operational sub-actions, in particular specifying the schedule, provisional costs and quantitative and/or qualitative monitoring and evaluation indicators;
- coordinating and monitoring the work to meet the objectives and carry out the actions under the strategic topic;
- ensuring coherence, liaising and jointly building the various partnerships and projects implemented under the strategic topic;
- identifying and centralizing initiatives and projects by stakeholders that can contribute to the objectives under the strategic topic;
- submitting proposals to the Steering Committee to adjust the identified actions or add new actions if they are deemed relevant;
- contributing to monitoring and evaluating the objectives and actions under the strategic topic;
- reporting to the Steering Committee on the progress with meeting the objectives and with carrying out the actions.

Coordinator for each action

A first call for expressions of interest for coordinating the actions took place at the end of 2020. It was supplemented by a questionnaire sent to stakeholders in May 2021.

The action sheets identify the coordinator.

The action coordinator reports on the progress of the action and is responsible for completing the action indicators. In conjunction with the plan coordinator, the activity coordinator is responsible for mobilizing funds. His/her role is to schedule and coordinate discussions with the members of the project team and to liaise with the plan coordinator.

Project team

The project team is the coordinator's close working team. This team identifies the operators to be involved in each action, specifies the schedule, examines the funding arrangements and ensures that the actions are monitored and are consistent. The composition of these teams mentioned in the following sheets of objectives is given as an indication. Anyone wishing to be involved in a project team in accordance with the principles set out in this PNA can do so. For this purpose, the person should contact the action coordinator and the DREAL coordinator.

C. Relationship between national and regional action plans

For the actions to address the issues in the different mountain ranges, local variations of the PNA can be agreed, for example in the form of a Regional Action Plan (e.g., the Vosges PRA). In accordance with the ministerial instruction of 09 May 2017, a PNA "is subject to regional variations allowing for relevant actions to be taken into account according to the local situation of the species or groups of species considered. Without taking the form of a regional action plan, they involve actions organized and implemented by a regional coordinator when necessary." The form of governance chosen for this plan, particularly through establishing a Mountain Range Technical Group, already favors a territorial approach. In this respect and insofar as the three areas where the lynx is present have different population dynamics, the actions identified on the national level are therefore intended to be applied in a differentiated manner and adapted to local issues. The sheets of "objectives" mention the level of priority of each of the actions in the three mountain ranges.

For the Vosges Mountains, in accordance with the approach initiated in this mountain range since 2016, the PLMV received a favorable opinion from the Grand Est CSRPN on 20 December 2019. As such, it became the first regional version of the PNA for the lynx: the Vosges PRA for Lynx. Since the PNA was drafted, there has been constant dialog between the various bodies, and between the DREAL BFC and the coordinator (DREAL Grand-Est) and the operator (CROC research and observation center) of the Vosges PRA. The PNA was largely drafted on the basis of the plan, from which it used the bibliography (by agreement).

The PRA for Lynx has its own participatory governance with a leader (the DREAL Grand-Est, also a member of the Steering Committee for the PNA for Lynx), a steering committee, a facilitator, coordinators and their associated partners, and a technical and scientific committee composed of five working groups. The technical and scientific committee for the PRA, on which the DREAL BFC, the coordinator of the PNA for Lynx, is formally represented, acts as the Mountain Range Technical Group for the PNA.

D. Actions to be taken

A table summarizing the objectives and actions and the individual sheets of objectives are set out below. Descriptions of the objectives and actions are detailed after the table:

(*) For details of the project teams and related partners, please refer to the sheets below

Objectives	Actions	Coordinator(s)*	Duration	Cost
Strategic topic 1 Improve the conditions under which lynx can coexist with human activities				
1.1 Reduce conflicts with livestock farming activities	Communicate on effective means of protection.	DREAL/Regional Food, Agriculture and Forest Directorate (DRAAF)/Departmental Territorial Divisions (DDTs)	2022	€15 k
	Set up and run a responsive technical support unit for livestock farmers in each *département*.	DREAL/DDTs/OFB/ DRAAF	2022 - 2026	€150 k/year of protection measures €40 k/year of compensation €12 k/year of training days
	Revise the damage compensation arrangements in the July 2019 Decree, prescribing specific measures for the lynx, followed by their implementation.	Ministry of Ecological Transition (MTE)/Ministry of Agriculture and Food (MAA)	2022 - 2026	Human resources of State departments
	Set up and run a progressive intervention system for quick and sustainable resolution of the problems posed by the identified hot spots.	DREAL/DDTs/OFB	2022 - 2026	Human resources of State departments/partner participation
1.2 Inform, raise awareness and discuss matters with livestock farmers and players	Establish and implement a scheme for informing farmers of the potential presence of the lynx and/or of lynx attacks.	CRAs/DDTs/OFB	2022 - 2026	Human resources of State departments
	Make the departmental large predator committees a place for key discussions between partners on the problems of livestock farming in the presence of the lynx.	DDTs/OFB/DREAL/ DRAAF	2022 - 2026	Human resources of State departments/partner participation
	Pursue or set up mediation initiatives for each of the mountain ranges.	DREAL/DDTs/DRAAF	2022 - 2026	€20 k/year
1.3 Improve coexistence with hunting activities and the participation of	Pursue or set up additional communication and mediation initiatives, encourage contact with hunters	DREAL/DDTs	2022 - 2026	€20 k/year
	Involve hunting stakeholders in the field alongside other voluntary stakeholders in research and monitoring actions.	National Hunting Federation (FNC)	2022 - 2026	*Currently being estimated*

Objectives	Actions	Coordinator(s)*	Duration	Cost
hunting in lynx conservation	Structure a communication and prevention action to counteract illegal killing.	DREAL/OFB/FNC	2022 - 2023	€5 k/year
	Invite hunting stakeholders to include recommendations favorable to lynx conservation in SDGCs and other hunt management plans. Ensure that the SDGCs are consistent with the strict protection requirements for the species.	Prefects/DDTs	2022 - 2026	Human resources of State departments
	Improve the knowledge of hunters and future hunters about the biology, ecology, legal status and conservation status of the lynx.	FNC	2022 - 2026	€20 k/year
1.4 **Improve connectivity, facilitate exchanges between lynx populations, and reduce mortality due to collisions**	Take action on road collision mortality	CEREMA	2022 - 2026	€13 M
	Provide data for the ITTECOP tool, developing it and making it available	CEREMA	2022 - 2026	€30 k/year
	Communicate with planners and users	CEREMA	2022 - 2026	€30 k/year
1.5 **Improve acceptance of the species with the support of social sciences**	Study perceptions and monitor changes in the perception of the lynx among the various types of rural stakeholders, particularly those involved in livestock farming and hunting	DREAL	2022 - 2026	€300 k or post-doctoral research thesis
	Carry out a literature study among the various stakeholders on the ecosystem value of the lynx and draw from international experience (Spain in particular)	DREAL	2022 - 2023	€10 k/year
	Conduct a multi-species analysis on the methodologies to be applied to assess the level of acceptance of the species in the relevant areas Measure the impact of the information and awareness campaigns and actions carried out with stakeholders on changes in the perception of the lynx.	DREAL	2023 - 2024	€150 k
1.6 **Study how human activities interfere with and influence the lynx**	Draw up a literature summary of studies on disturbance by human activities and deduce appropriate courses of action and lines of research	DREAL	2022	€7.5 k

Objectives	Actions	Coordinator(s)	Duration	Cost
Strategic topic 2 Reduce threats to the viability of the species and remove obstacles to its expansion				
2.1 Strengthen the monitoring of lynx populations to discern trends	Conduct a collective scientific and technical assessment under the joint aegis of the OFB and the MNHN to ascertain the conditions for long-term viability of the lynx in the region.	OFB/MNHN	2022 - 2023	Annual agreements between the MTE and institutions
	As soon as the PNA is adopted, conduct a study of the technical, regulatory and social preconditions for success prior to a decision to resort to a population enhancement operation.	OFB/MNHN	2022 - 2024	Annual agreements between the MTE and institutions
	Enhance the monitoring network and its structure, particularly in high-risk areas.	OFB	2022 - 2026	€115 k/year (equipment + coordinator time spent for each mountain range or study area, i.e., 0.5 full-time equivalents (FTE)/mountain range + 1 FTE on the national level)
	Promote the exchange of monitoring data (feedback to stakeholders who contribute to the use of these data).	OFB	2022 - 2026	€40 k/year (or 0.5 FTE)
	Obtain a centralized monitoring data tool compatible with the databases in neighboring countries.	OFB	2023 - 2026	Thesis or post-doctoral research (€75 k/year)
2.2 Improve knowledge on the genetics of lynx populations	Referral to the MNHN and OFB following the results of the collective expert assessment/set up a working group	MNHN/OFB	2024 - 2026	*Currently being estimated*
	Collect samples (invasively and non-invasively), analyze them according to protocols that allow for metapopulation-wide assessments, bank the results and assess the possibilities for pooling them.	OFB	2022 - 2026	€24 k/year
2.3 Organize health monitoring and improve knowledge on the health status of lynx populations	Carry out integrated epidemiological monitoring of lynx populations to be linked to research.	OFB	2022 - 2026	€12 k/year

Objectives	Actions	Coordinator(s)	Duration	Cost
2.4 **Better understand and evaluate the diversity of the species' diet, particularly with regard to predation on wild and domestic animals**	Study the diversity of the lynx diet to improve knowledge of the relative share of different prey species and, for certain prey species, the effects of predation on the population structure.	DREAL	2023 - 2026	*Currently being estimated*
2.5 **Combat the illegal killing of lynx**	Improve the organization of the investigation services (in particular the establishment of a specialized forensic unit) and the quality of the investigations carried out in cases of suspected and proven illegal killing of lynx.	OFB	2022 - 2026	€5 k/year
	Raise awareness among stakeholders (reminder: see communication and mediation targeting livestock and hunting stakeholders and communication charter).			
2.6 **Optimize the system for the care and rehabilitation of any lynx in distress or temporary difficulty**	Strengthen the monitoring and intervention system throughout the lynx's range.	DREAL/OFB	2022 - 2026	€50 k/year
	Establish procedures for dealing with lynx individuals in distress (intervention in the field, diagnosis, prevention, care, biosecurity, etc.).	DREAL/OFB	2022 - 2023	Human resources of State departments/partner participation Rehabilitation of lynx individuals in distress €20 k/year
	Involve and inform the public and local stakeholders when animals are released into the wild (with due regard to the protection of the released animals)	DREAL/OFB/DDTs	2022 - 2026	€2 k/year
	Conduct studies (including retrospective studies) on the results of these re-introductions, and study the origin and fate of the animals taken into care.	OFB	2022 - 2026	€10 k/year
	Conduct discussions in the working group on releases into the wild (selection of locations that limit the risks for the animal, potential interaction with human activities and expected benefits for the viability of the species).	DREAL/OFB/DDTs	2022 - 2024	Human resources of State departments/partner participation

Objectives	Actions	Coordinator(s)	Duration	Cost
Strategic topic 3 Communicate on, raise awareness of and promote the species				
3.1 Develop tools for disseminating information, educating people and raising awareness of the species and the challenges of its conservation	Establish a common communication charter	SFEPM	2022 - 2023	€15 k
	Establish an ethical charter for certifying initiatives carried out to benefit the lynx	SFEPM	2022 - 2023	€15 k
	Target communication to different audiences.	SFEPM	2022 - 2026	€50 k/year
	Organize international events.	SFEPM	2022 and 2026	€10 k/event
	Create a reference Internet platform on the lynx	DREAL	2022 - 2026	€4.5 k for creation, then €0.5 k/year

Objectives	Actions	Coordinator(s)	Duration	Cost
Strategic topic 4 Facilitate the PNA				
4.1 Facilitate, coordinate, monitor and assess the PNA	Coordinate the Steering Committee	DREAL	2022 - 2026	€5 k/year and 1 DREAL FTE and OFB support €50k for the final evaluation in 2026 (external service provider)
	Coordinate the Funding Committee	DREAL	2022 - 2026	
	Provide a secretariat and coordinate the Scientific Council	DREAL	2022 - 2026	
	Provide a technical secretariat for the strategic topics	DREAL	2022 - 2026	
	Ensure good coordination and consistency between the national and regional action plans	DREAL	2022 - 2026	
	Annual review of the PNA	DREAL	2022 - 2026	
	Mid-term evaluation of the PNA	DREAL	2022 - 2026	
	Final evaluation of the PNA	DREAL	2026	
	Include international partners in the working groups	DREAL	2022 - 2026	

Total over 5 years	€16.310 m	Total per year (excluding collision black spot budget)	2022 €867K	2023 €951K	2024 €861K	2025 €786K	2026 €826K

Objective 1.1	Reduce conflicts with livestock farming activities
Description	Reduce conflicts with livestock farming activities by implementing lynx protection measures and procedures and by providing technical and financial support to minimize the impact on livestock farmers.
Background	With less than a hundred reports per year, the number of lynx attacks on domestic livestock in France remains relatively low compared to the damage caused by other predators. This average is stable, while the range of the lynx has almost doubled in the last 20 years. These attacks are limited to sheep or goats and involve less than three animals killed in 95% of cases. However, in some cases, repeated attacks may occur on one and the same farm. These situations exacerbate tensions and are still a major obstacle to the acceptance of the species locally. Expectations have been expressed that more consideration should be given to the financial and psychological impact on farmers whose livestock suffer attacks, especially in cases of repeated attacks. The conditions for compensation for damage caused by the lynx, in the same way as damage caused by the wolf or the bear, are specified in Decree No. 2019-722 of July 9, 2019. In particular, this stipulates that payment of compensation is conditional on the introduction of protective measures, which are funded: – either on the basis of the Order of November 28, 2019 on environmental protection operations in rural areas relating to the protection of herds against predation (OPEDER order), enabling the use of aid from the State and the European Agricultural Fund for Rural Development (EAFRD) by zones established in relation to the presence of the wolf and the bear; – or from the emergency credits of the Ministry of Agriculture, which can be used without any zoning conditions as soon as the first lynx attack occurs. Damage caused by the lynx must be dealt with fairly and quickly. While the principle of making compensation conditional on the means of protection cannot be called into question, work must be undertaken by the ministries of agriculture and ecology, in conjunction with farmers' representatives, to refine the way in which this principle applies to the lynx. There are effective means of protection applicable to the lynx. Guardian dogs have already proved their worth, even though they can create new difficulties for the farmer (conflicts with neighbors or other users of the countryside, associated costs and extra work). Other means can be developed, tested, and adapted to the various livestock farming contexts throughout the range of the lynx (terrain, habitat, livestock herding). Lynx hot spots only affect a minority of farms and are mainly due to the characteristics of the areas at risk. Studies carried out in the Jura Mountains in 2001 on the vulnerability of farms, on recurrent attacks and on the lynx that cause them should be supplemented with the data acquired in recent years, in order to achieve better herd protection and to improve the coexistence of livestock farming activities with the presence of the lynx.
Monitoring and evaluation indicators	**Monitoring indicators:** see data sheets **Evaluation indicators:** • Change in the number of farms effectively and efficiently protected • Change in the time taken to process compensation claims and to pay financial assistance for herd protection • Number of farms diagnosed with regard to their vulnerability and the feasibility of introducing means of protection • Number of livestock farmers/farms receiving support to introduce protective measures • Number of farms receiving long-term financial support for preventive measures • Trends in the number of hot spots, the number of victims attributed to the lynx and the

	economic damage per year and per *département*
Potential partners	Regional Agricultural and Rural Development Association (ARDAR), Nature Farmers (Paysans de Nature), Panthera, Farmers' Confederation (Confédération paysanne), Haut-Jura Regional Nature Park (PNRHJ), Haute Chaîne du Jura National Nature Reserve (RNNHCJ), MAA, IDELE, Pôle Grands Prédateurs (Large Predators Unit), IPRA, Chambers of Agriculture, Agricultural Unions, OFB, DRAAF, Payment Services Agency (ASP), MSA, Regional Authorities (for management of the EAFRD), IGMA-Biodiversité.

Action sheets

Action 1			
Wording and description	**Communicate on effective means of protection**		
Coordinator	**DREAL/DRAAF/DDTs**		
Project team	**DDT 39/Association of Alternative Protections for the Cohabitation of Livestock and Wildlife (APACEF)/National Federation of Farmers' Unions (FNSEA)/National Sheep Federation (FNO)/ARDAR/IDELE/Regional Chamber of Agriculture (CRA)/Farmers' Confederation (Confédération paysanne)**		
Geographic areas	**The Alps**	**Jura Mountains**	**Vosges Mountains**
Monitoring indicators	• Production and dissemination of a report/study on the state of play of livestock herding and effective protection/prevention measures against lynx predation		
Schedule and cost	**2022**: €15 k **2023**: **2024**: **2025**: **2026**:		

Action 2			
Wording and description	**Structure a responsive technical support unit for livestock farmers in each *département*, responsible for:** **- promoting the guardian dog sector** **- diagnosing vulnerability** **- specifying appropriate protection measures** **- supporting and monitoring the implementation of the measures** **- providing support for compensation**		
Coordinator(s)	**DREAL/DDTs/DRAAF**		
Project team	**DDT 39/APACEF/FNSEA/FNO/ARDAR/IDELE/IPRA/CRA/MSA/Confédération paysanne**		
Geographic areas	**The Alps**	**Jura Mountains**	**Vosges Mountains**
	Priority	**Priority**	**Priority**
Monitoring indicators	• Existence of the sector and the technical network • Number of interventions by the technical support unit • Number of vulnerability diagnoses		

	• Number of people made more aware • Number of livestock farmers/farms receiving support to introduce protective measures • Annual monitoring of the budget for emergency credits or aid for adaptation in areas where lynx are present • Number of guardian dogs
Schedule and cost	

2022	2023	2024	2025	2026
€150 k/year for protection measures €40 k/year for compensation €12 k/year for training days				

Action 3	
Wording and description	**Revise the damage compensation arrangements in the July 2019 Decree, prescribing specific measures for the lynx, followed by their implementation.**
Coordinator	**Ministries of ecology and agriculture**
Project team	**/**
Monitoring indicators	• Publication of a revised decree
Schedule and cost	

2022	2023	2024	2025	2026
Human resources of State departments				

Action 4	
Wording and description	**In compliance with the strict protection status and conservation status of the species, set up and run a progressive intervention system for quick and sustainable resolution of the problems posed by the identified hot spots.**
Coordinator(s)	**DREAL/DDTs/OFB**
Project team	**APACEF/FNSEA/FNO/LPO/CRA/Confédération paysanne**
Monitoring indicators	• Number of interventions by the action unit
Schedule and cost	

2022	2023	2024	2025	2026
Human resources of State departments				

Action to be taken in the longer term	
Wording and description	**Study the behavior of lynx predators of domestic herds, in particular the issue of hot spots and the dynamics between the site, the terrain, livestock farming practices, the resources set up, the landscape, etc., in order to highlight the causes on a case-by-case basis.**

Objective 1.2	Inform, raise awareness and discuss matters with livestock farmers and players
Description	Improve coexistence with the livestock farming sector by ensuring regular dialog between this sector and the various stakeholders operating in relation to the lynx; provide information and raise awareness among the livestock farming sector about the lynx and the means of protection.
Background	The return of the lynx to France took place at a time when livestock farming had been developing without wild predators for decades. Livestock farmers did not feel involved in the reintroductions in the Vosges Mountains and the increase in attacks on sheep in the 1990s in the Jura Mountains exacerbated tensions in the profession with regard to the species. Although the number of attacks has remained relatively stable while the lynx population has increased, perceptions and attitudes remain mixed: while some farmers recognize that the damage is minor in relation to the livestock present, compared to the damage caused by other predators, the lynx can be perceived as an additional source of pressure. The impacts (damage, additional work, stress) are felt in a difficult socio-economic background in a sector that considers itself under-valued. The protected status of the species exacerbates this feeling of powerlessness in the face of potential damage. Negative perceptions are also fueled by a lack of communication and knowledge about the species, its biology, its behavior, its presence in the areas and effective means of protection. Initiatives such as those of the Jura Pôle Grands Prédateurs and the "Lynx Parliament" (Vosges du Nord Regional Nature Park/LIFE Luchs Pfälzerwald Project) have shown their effectiveness in terms of improving coexistence with livestock, information and awareness raising. The PNA must encourage such actions and continue efforts to improve the involvement of the agricultural community in disseminating information, communication and actions undertaken to benefit the species. Synergies with wolf-related actions under the PNA will be sought and encouraged, particularly on issues related to the impact of predation on agriculture and the need to provide information for professionals.
Monitoring and evaluation indicators	• Number of farmers participating in meetings and number of farmers reached by communication, information or awareness-raising campaigns • Number of training and awareness-raising programs set up and implemented; number of participants • Results of surveys on acceptance of the lynx by farmers in the year following approval of the PNA and after the various mediation, information and awareness-raising campaigns • Number of monitoring units organized and number of participants • Number of departmental large predator committees organized and number of participants
Potential partners	DDT, IDELE, Pôle Grands Prédateurs, Vosges du Nord and Ballons des Vosges Regional Nature Parks, PNRHJ, IPRA, Chambers of Agriculture, Agricultural Unions, DREAL, DRAAF, Confédération paysanne, ASTER, DDT25, APACEF

Action sheets

Action 1			
Wording and description	**Establish a scheme for informing farmers of the potential presence of the lynx and/or in the event of attacks (including on the colonization fronts) and implement it in compliance with species protection requirements**		
Coordinator	**CRAs/DDTs/OFB/DRAAF**		
Project team	**APACEF/FNSEA/FNO/ARDAR/Confédération paysanne**		
Geographic areas	**The Alps**	**Jura Mountains**	**Vosges Mountains**
	Priority	**Priority**	**Priority**
Monitoring indicators	• Existence of the scheme		
Schedule and cost	**2022**	**2023**	**2024**	**2025**	**2026**
	Human resources of State departments				

Action 2			
Wording and description	**Make the departmental large predator committees a place for key discussions between partners on the problems of livestock farming in the presence of the lynx** **Widen the circle of participants and improve the coordination technique**		
Coordinator(s)	**DDTs/OFB/DREAL/DRAAF**		
Project team	**/**		
Geographic areas	**The Alps**	**Jura Mountains**	**Vosges Mountains**
	Priority	**Priority**	**Priority**
Monitoring indicators	• Number of committee meetings		
Schedule and cost	**2022**	**2023**	**2024**	**2025**	**2026**
	Human resources of State departments				

<table>
<tr><td>Action 3</td><td colspan="3"></td></tr>
<tr><td>Wording and description</td><td colspan="3">Pursue or set up mediation initiatives for each of the mountain ranges to facilitate coexistence with the lynx, taking into account the level of acceptability and the expectations and interests of all stakeholders.</td></tr>
<tr><td>Coordinator(s)</td><td colspan="3">DREAL/DDTs (including DDT 39 for the Jura Mountains)/DRAAF</td></tr>
<tr><td>Project team</td><td colspan="3">Jura Shepherds' Association (Association des bergers du Jura)/Paysans de nature/Confédération paysanne</td></tr>
<tr><td rowspan="2">Geographic areas</td><td>The Alps</td><td>Jura Mountains</td><td>Vosges Mountains</td></tr>
<tr><td></td><td>Priority</td><td>Priority</td></tr>
<tr><td>Monitoring indicators</td><td colspan="3">• Number of meetings and participants in exchange and mediation groups</td></tr>
<tr><td>Schedule and cost</td><td colspan="3"><table><tr><th>2022</th><th>2023</th><th>2024</th><th>2025</th><th>2026</th></tr><tr><td colspan="5">20 k/year</td></tr></table></td></tr>
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<table>
<tr><th colspan="2">Action to be taken in the longer term</th></tr>
<tr><td>Wording and description</td><td>Facilitate experience sharing (local, national and with neighboring countries).
Promote livestock farmer adaptation work in the lynx's range in information and public awareness-raising campaigns.</td></tr>
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Objective 1.3	Improve coexistence with hunting activities and the participation of hunting in lynx conservation.
Description	Work with the hunting community to promote the coexistence of the lynx with hunting activities by taking the lynx into account in such activities, improving acceptance of the species and participating in its conservation. This participation includes the close involvement of hunters in monitoring and research on the species.
Background	As with other predators, the lynx is a source of conflict with some hunters. These stakeholders highlight their concerns about the local impact on game species numbers (mainly roe deer and chamois) or on their behavior (spatial reorganization, vigilance). The lynx can then be perceived as disrupting hunting activities, casting doubts on the management of the game. A lack of factual and scientific information can also result in increased weight of anecdotal evidence or prejudices about the species. These positions and negative attitudes towards the lynx lead to a mistrust of conservationists and undermine the involvement of the hunting community in the actions undertaken. For their part, hunting stakeholders deplore the lack of consultation in actions relating to the species or the lack of recognition of their activities in improving the level of knowledge. The lynx is a protected species and in view of its current conservation status in the area, it is not possible to make any exemptions from this status to accommodate the wishes of hunters. However, the questions and concerns of the hunting community regarding the species should be addressed. Mediation initiatives and the involvement of the hunting community have shown positive results in Europe, for example in the context of reintroductions in Germany. Similar initiatives are being pursued on the French side, in the Vosges du Nord for example, in order to work towards improved acceptance of the species. This mediation work should be carried out on the basis of diagnostics shared by each of the stakeholders and based on scientific studies involving all of them. The presence of the lynx in hunting activities should be taken into account both through studies on predation, which will answer questions from the hunting community and support the work of the hunting federations in their management of game species, and through the study of the effects of hunting on lynx, in particular the possible risks for the species during hunting activities.
Monitoring and evaluation indicators	• Number of hunters and/or federations involved (individually or through agreements), agent/technician time, budget allocated to monitoring and research activities • Number of communications issued and audience reached in the hunting community (presentations at meetings, articles in hunting magazines) • Results of surveys and studies on representations and perceptions of the lynx and their development • Existence of a lynx component in training courses
Potential partners	DREAL FC, OFB, mediators (see the example of the Lynx Parliament, Vosges du Nord Regional Nature Park), national and departmental hunting federations and hunters' associations, protected areas, Nature protection associations, RNNHCJ, Panthera, SOS Peregrine Falcon, SFEPM, DDTs, etc.
Action sheets	

Action 1			
Wording and description	**Pursue or set up communication and mediation initiatives and encourage contact with hunters**		
Coordinator	**DDT 39/FNC**		
Project team	**APACEF/National Union of Mountain Guides**		
Geographic areas	**The Alps**	**Jura Mountains**	**Vosges Mountains**
	Priority	**Priority**	**Priority**
Monitoring indicators	• Number of meetings and number of participants in working or mediation groups involving representatives of the hunting community		
Schedule and cost			

2022	2023	2024	2025	2026
€20 k/year				

Action 2	
Wording and description	**Involve hunting stakeholders in the field alongside other voluntary stakeholders in research and monitoring actions.**
Coordinator(s)	**FNC**
Project team	**DREAL/OFB/DDTs with support from the Scientific Council of the PNA for Lynx**
Monitoring indicators	• Number of communications to hunters on research and monitoring • Number of coordination actions and hunters involved in monitoring and research actions.
Schedule and cost	

2022	2023	2024	2025	2026
Under evaluation				

Action 3			
Wording and description	**Structure a communication and prevention action to counteract illegal killing, summarizing the strictly protected legal status of the species, the risks incurred in the event of killing, the conservation status of the species, its heritage status and its role in the ecosystem balance**		
Coordinator(s)	**DREAL/OFB/FNC**		
Project team	**DDTs for *départements* 39 and 25**		
Geographic areas	**The Alps**	**Jura Mountains**	**Vosges Mountains**
	Priority	**Priority**	**Priority**
Monitoring indicators	• Number of communications • Significant decrease in the annual number of lynx deaths due to illegal hunting by humans		
Schedule and cost			

2022	2023	2024	2025	2026
€10 k/year				

Action 4	
Wording and description	**Invite hunting stakeholders to include recommendations favorable to lynx conservation in SDGCs and other hunt management plans.** **Ensure that the SDGCs are consistent with the strict protection requirements for the species.**
Coordinator(s)	**Prefects/DDTs**
Project team	**FNC/SOS Peregrine Falcon/OFB**
Monitoring indicators	• Number of SDGCs that include a paragraph on lynx conservation issues and actions • Increased number of SDGCs in line with the imperatives for strict protection of the species
Schedule and cost	2022 | 2023 | 2024 | 2025 | 2026 Human resources of State departments and the project team

Action 5	
Wording and description	**Improve the knowledge of hunters and future hunters about the biology, ecology, legal status and conservation status of the lynx throughout the range of the species and its colonization fronts.**
Coordinator(s)	**FNC**
Project team	**Haut-Jura Regional Nature Park (PNRHJ), National Union of Mountain Guides**
Monitoring indicators	• Number of information and awareness-raising actions • Number of persons holding a hunting license who have attended at least one training course/number of licenses issued/for each mountain range
Schedule and cost	2022 | 2023 | 2024 | 2025 | 2026 €20 k/year

Action to be taken in the longer term	
Wording and description	**Create a network for discussion and feedback with other hunters on the presence of the lynx (including border countries).** **Initiate discussions on game management or any other aspect of hunting practice (e.g., lease locations) on the basis of the results of game population monitoring and predation studies.**

Objective 1.4	Improve connectivity, facilitate exchanges between lynx populations, and reduce mortality due to collisions
Description	The objective is twofold: 1° Improve knowledge about the connectivity between lynx populations and promote discussions while taking these issues into account in spatial development projects, including those concerning transport infrastructures. 2° Reduce the risk of lynx mortality due to collisions with vehicles by first analyzing mortality data on existing infrastructures, developing tools to assist decision making and to raise awareness of the problem, taking remedial steps to reduce access to hazardous areas and make it easier for lynx individuals to cross infrastructures and, finally, raising awareness among road users in sensitive areas.
Context	Forests are the preferred habitat of the lynx in Europe. With large home ranges and relatively poor capacity for dispersal, the lynx needs large contiguous forest areas to maintain its communities and to colonize new areas. The species is highly sensitive to fragmentation of its habitat and any breaks in the continuity of this habitat constitute obstacles to the movement of individuals, limiting the expansion of their populations and exchanges between population nuclei. In the case of transport infrastructure, these obstacles also constitute collision risks, with direct impacts on the survival of individuals and collateral impacts on the survival of dependent young. Since the return of the lynx to France, more than 150 cases of fatal collisions have been recorded between 1974 and 2018, accounting for nearly 60% of detected fatalities. Over the last decade, an average of about ten lynx individuals have been killed per year, mainly on roads, not counting the indirect impact on dependent juveniles. There have also been a few rare cases of railway collisions (less than 10% of collisions). Ensuring functional connectivity between the different population nuclei is also essential for maintaining genetic mixing through the formation of a metapopulation, necessary for the long-term viability of the species in this part of Europe. The habitat and connectivity issues for the lynx are on different scales and obviously extend to neighboring countries. The Vosges Mountains remain relatively isolated despite the arrival of a few individuals from the reintroductions that took place from 2016 to 2020 in the Palatinate forest in Germany, or which may have come up from the Jura Mountains. Functional corridors with the Black Forest or the Swiss Jura remain to be identified. The Jura Mountains supply population nuclei in the Alps, but movements within the Alps and exchanges with Swiss populations remain poorly documented and are considered to be very uncommon. Here again, urbanization, dense infrastructures and breaks in forest continuity could strongly limit lynx movements and slow down the development of the Vosges-Palatine and Alpine populations. Areas where lynx are illegally killed are also a hindrance in some parts of the mountain range in Switzerland. More needs to be known about the movements of these animals. Identifying barriers to movement and steps to improve connectivity within and between mountain ranges will also contribute to the objectives of maintaining lynx populations. Two research projects (Land Transport Infrastructures, Landscapes and Ecosystems - ITTECOP) have addressed these issues by developing spatial models of lynx collision risks and long-term population viability, also in relation to changes in the landscape and hence in the lynx habitat. In these projects, areas with a high potential risk of collision were identified in the Jura Mountains. Then a predictive tool was developed for France entitled Avoid, Reduce and Compensate (ERC) Lynx (effect of spatial development on the viability of lynx populations), intended primarily for infrastructure management bodies and developers. Field observations should continue to provide information for these studies. Nevertheless, specific actions should be implemented now in order to reduce the observed collision deaths, such as informing public decision makers, management bodies and users about proven accident black spots, but also sharing shortcomings in the development of particular infrastructures (e.g., lack of chain-link fencing or appropriate wildlife crossing points). It must be possible to take these steps quickly. Accordingly, the intention of the PNA is to facilitate quick one-off actions on different levels with the help of land stakeholders through developments of varying scope (maintaining and placing fences and

	wildlife crossing points) and longer-term discussions with land management bodies and developers.
Monitoring and evaluation indicators	**Monitoring indicators:** see action sheets **Evaluation indicators** • Identified collision black spots and priority areas for improvement • Number of remedial steps (crossing points, protection, chain-link fencing) created, repaired or adapted • Length of such facilities in kilometers or hundreds of meters • Evaluation of the effectiveness of the remedial steps • Changes in the number of collisions in the range and the mortality rate
Potential partners	Developers and managing bodies: APRR, AREA, SANEF, VNF, SNCF network, DREAL/DIR (national roads), National Forestry Office (ONF), European Community of Alsace (roads transferred to the community), departmental councils (departmental roads) Local and regional authorities: Regions, European Collectivity of Alsace, *Départements* Monitoring: OFB, managers of protected areas, naturalist networks, hunting federations and associations, Associations of Alternative Protections for the Cohabitation of Livestock and Wildlife (APACEFS), Haute Chaîne du Jura National Nature Reserve (RNNHCJ), French Society for the Study and Protection of Mammals (SFEPM), other managing bodies Continuity of the ITTECOP project and the ERC Lynx tool: ITTECOP project team: OFB/CEFE CNRS/CEREMA Awareness raising: Nature protection association (APN) (France Nature Environment - FNE), Panthera, Ferus, Haut-Jura Regional Nature Park (PNRHJ), Centre Athénas, managing bodies Habitat research: National Research Institute for Agriculture, Food and Environment (INRAE) or University/cross-border partners from Switzerland and Germany (Swiss Carnivore Ecology and Wildlife Management Foundation (KORA)/ SNU FVA Wildtierinstitut/etc.) in the process of setting up a LIFE project.

Action sheets

Action 1			
Wording and description	**Take action on road collision mortality:** - **Identify, map and prioritize collision black spots on transport infrastructures** - **Implement measures as appropriate for the species and the areas concerned (quickly resolving the black spots already identified) and evaluate the effectiveness of the measures in improving connectivity and reducing mortality. Experiment with an inclusive territorial approach (in a regional nature park) for introducing a dedicated plan**		
Coordinator(s)	**CEREMA**		
Project team	**DREAL/OFB/PNRHJ/transport infrastructure managing bodies/FNC/FNE/Bird Protection League (LPO)/Wild Carnivore Observatory (OCS)/Centre Athénas**		
Geographic areas	**The Alps**	**Jura Mountains**	**Vosges Mountains**

<table>
<tr><td></td><td colspan="6">Studies to be carried out in the 3 mountain ranges</td></tr>
<tr><td>Monitoring indicators</td><td colspan="6">• Number of diagnoses and cartographic atlases of sites with issues and black spots in the 3 mountain ranges
• Number of meetings with infrastructure managing bodies and other stakeholders
• Number of black spots dealt with and assessed (per year)
• Number of lynx involved in road collisions per département/year</td></tr>
<tr><td>Schedule and cost</td><td colspan="6"><table>
<tr><th></th><th colspan="2">2022</th><th>2023</th><th>2024</th><th>2025</th><th>2026</th></tr>
<tr><td>Identification of black spots</td><td colspan="3">Production and dissemination
€30 k</td><td></td><td></td><td>Renewal of the study
€30 k</td></tr>
<tr><td>PNRHJ experimentation</td><td colspan="3">€40 k</td><td></td><td></td><td></td></tr>
<tr><td>Taking remedial steps</td><td colspan="6">Cost to be specified according to the information
from the collective expert assessment mentioned above: 1st estimate €12m</td></tr>
</table></td></tr>
</table>

<table>
<tr><td>Action 2</td><td colspan="6"></td></tr>
<tr><td>Wording and description</td><td colspan="6">Provide data for the ITTECOP tool, developing it and making it available</td></tr>
<tr><td>Coordinator(s)</td><td colspan="6">CEREMA</td></tr>
<tr><td>Project team</td><td colspan="6">CEFE-CNRS/OFB/FNC/LPO/PNRHJ/transport infrastructure managing bodies</td></tr>
<tr><td rowspan="2">Geographic areas</td><td colspan="2">The Alps</td><td colspan="2">Jura Mountains</td><td colspan="2">Vosges Mountains</td></tr>
<tr><td colspan="6">Priority</td></tr>
<tr><td>Monitoring indicators</td><td colspan="6">• Updating and improving the model
• Number of development scenarios elaborated
• Number of new stakeholders who have used the ITTECOP ERC Lynx tool</td></tr>
<tr><td>Schedule and cost</td><td colspan="6"><table>
<tr><th>2022</th><th>2023</th><th>2024</th><th>2025</th><th>2026</th></tr>
<tr><td colspan="5">€30 k/year</td></tr>
</table></td></tr>
</table>

<table>
<tr><td>Action 3</td><td colspan="3"></td></tr>
<tr><td>Wording and description</td><td colspan="3">Communicate with planners and users
Communication with users will be divided into two parts:
- National and local awareness campaign (in high-risk areas)
- Placing road signs as appropriate for the lynx and seasonal road signs (during high-risk periods) to keep motorists vigilant</td></tr>
<tr><td>Coordinator</td><td colspan="3">CEREMA</td></tr>
<tr><td>Project team</td><td colspan="3">FNC/FNE/LPO/PNRHJ/transport infrastructure managers/Centre Athénas</td></tr>
<tr><td rowspan="2">Geographic areas</td><td>The Alps</td><td>Jura Mountains</td><td>Vosges Mountains</td></tr>
<tr><td colspan="3">Priority</td></tr>
<tr><td>Monitoring indicators</td><td colspan="3">• Number of municipal bodies and developers made more aware/year
• Number of information/awareness-raising materials produced
• Number of people made aware and audience reached among motorists in high-risk areas
• Number of road signs placed along transport infrastructures</td></tr>
<tr><td>Schedule and cost</td><td colspan="3"><table><tr><th>2022</th><th>2023</th><th>2024</th><th>2025</th><th>2026</th></tr><tr><td colspan="5">€30 k/year</td></tr></table></td></tr>
</table>

Action to be taken in the longer term	
Wording and description	**Carry out or supplement diagnoses of lynx migration flows and movements in relation to their habitat** **Develop and implement a habitat management strategy in line with connectivity issues for the species** **Facilitate the reporting and handling of one-off reports and of risks or problems in certain areas or on certain road developments** **Monitor existing crossing points, whether or not they are for wildlife, checking for possible upgrades or redevelopment** **Evaluate the effectiveness of the proposed signs or collision prevention devices**

Objective 1.5	Improve acceptance of the species with the support of social sciences
Description	Study the representations and perceptions of the species and its interaction with humans in order to identify the best action strategies to improve its acceptance and measure the impact of the action taken to meet this objective.
Context	In order to improve the conservation status of the lynx, various factors that hinder the expansion and development of its populations need to be studied. In addition to biological factors (dispersal capacity) and ecological factors (habitat and connectivity), representations and perception of the species can contribute positively or negatively to its dynamics and/or to acceptance of various conservation or management measures (developments, habitats and conflicts with human activities). Understanding the factors that influence the tolerance of local stakeholders (hunters, livestock farmers, foresters, associations, local authorities, etc.) of the presence of the lynx is essential with regard to acceptance of the species and to steps to be taken to conserve its populations and habitats that are favorable to the long-term viability of the species.
Monitoring and evaluation indicators	**Monitoring indicators**: see action sheet **Evaluation indicator** • Studies, reports and publications produced on the subject of acceptance • Recommendations and participation of social science stakeholders in actions under the PNA • Evaluation of changes in representations and perceptions of the lynx (surveys)
Potential partners	Nature protection associations (National Association for the Protection of Large Predators - FERUS, Panthera, Association of Alternative Protections for the Cohabitation of Livestock and Wildlife - APACEF, Haute-Savoie Conservancy for Natural Areas - ASTER), managers of natural areas (PNRHJ, Haute Chaîne du Jura National Nature Reserve - RNNHCJ), local authorities, social and professional organizations, universities, FNC, Departmental Hunting Federation (FDC), National Sheep Federation (FNO), National Federation of Farmers' Unions (FNSEA)

Action sheets

Action 1			
Wording and description	**For each mountain range, study perceptions and monitor changes in the perception of the lynx among the various types of rural stakeholders, particularly those involved in livestock farming and hunting:** • **including a review of existing studies on perception of the lynx** • **drawing conclusions from the above for the planned actions**		
Coordinator	**DREAL**		
Project team	**DDT39/FNC/LPO**		
Geographic areas	**The Alps**	**Jura Mountains**	**Vosges Mountains**
	Priority	**Priority**	**Priority**
Monitoring indicators	• Number of studies on representations • Number of social science studies in the entire range • Number of perception surveys conducted		

Schedule and cost	

2022	2023	2024	2025	2026
€300 k or post-doctoral research/thesis				

Action 2	
Wording and description	Carry out a literature study among the various stakeholders on the ecosystem value of the lynx and draw from international experience (Spain in particular)
Coordinator	**DREAL**
Project team	**DDT39/FNC/LPO**
Monitoring indicators	• Study carried out
Schedule and cost	

2022	2023	2024	2025	2026
€10 k/year				

Action 3	
Wording and description	Conduct a multi-species analysis on the methodologies to be applied to assess the level of acceptance of the species in the relevant areas, drawing in particular on what has been done in Spain for the Iberian lynx Measure the impact of the information and awareness campaigns and actions carried out with stakeholders on changes in the perception of the lynx
Coordinator	**DREAL**
Project team	**FNC**
Monitoring indicators	• Study carried out • Number of information and awareness campaigns • Number of actions carried out
Schedule and cost	

2022	2023	2024	2025	2026
	€150 k			

Objective 1.6	Study how human activities interfere with and influence the lynx
Description	This study should determine the disturbance factors that could influence the conservation of the lynx, particularly with regard to the different periods in the life cycle of this species. On the basis of the information that will emerge from this study, the ability of the relevant areas to provide for the biological requirements of the species, to leave the animals undisturbed and to conserve their habitats will be evaluated.
Context	Over the last ten years, there has been a significant increase in scientific research and publications on the issue of disturbance. There are numerous potential sources of interference that cover a wide range of issues. Outdoor sports activities and, more generally, the growing use of natural areas are raising the issue of their impact on individuals of the species. The effects or influence of anthropogenic activities on the lynx require consideration on different scales in space and time: habitat, environment, home range, sites of importance for the species (prey consumption sites, resting sites, den sites and nursery sites, etc.), but also seasonal variations (logging, hunting season and winter or summer recreational activities) and the time of day. Studies on disturbance by human activities focus on distinguishing between behavioral disturbances (which will lead to a change in behavior) and physiological disturbances (which lead to energy expenditure and/or which may compromise the survival or reproductive success of the animal, Blanc *et al.*, 2006; Tablado & Jenni, 2017; Le Grand *et al.*, 2019). Although awareness-raising actions can already be carried out among visitors to natural areas and professionals who may disturb the species, the potential impact of disturbance as a conservation issue has yet to be quantified.
Monitoring and evaluation indicators	• Literature review carried out
Potential partners	Nature protection associations, managers of natural areas, local authorities, social and professional organizations, universities, FNC and FDC, FNE, CEREMA, DDTs

Action sheet

Action 1	
Wording and description	**- Draw up a literature summary of studies on disturbance by human activities and deduce appropriate courses of action and lines of research** **- Referral to the Scientific Council** **- Present the Scientific Council's conclusions on the relevance of conducting a study**
Coordinator	**DREAL**
Project team	**Support from the Scientific Council**
Monitoring indicators	• Production and dissemination of the summary
Schedule and cost	

2022	2023	2024	2025	2026
€7.5 k				

Objective 2.1	Strengthen the monitoring of lynx populations to discern trends
Description	Continue the monitoring of lynx populations, combine the efforts of stakeholders, standardize, coordinate and adapt efforts to obtain precise, reliable and regular estimates of the status of the populations, particularly in areas with issues (scanty data, colonization fronts, areas with connectivity issues).
Context	The lynx species in France is concentrated in three cross-border populations: the Vosges-Palatinate population (Vosges Mountains on the French side), the Jura population and the Alpine population. Information on the conservation status of the lynx is obtained through changes in its range in the area. This indicator is based on collection of presence indicators by correspondents of the RLL coordinated by the OFB. Established in 1988, the Network centralizes these clues (observations, wild and domestic prey, tracks, hairs, feces, etc.). Newsletters published since 1998 provide news and reports on the monitoring of the species in France. Developments in digital photography and the increasing use of camera traps have also made it possible to estimate local abundances and to track individuals photographically, identifying them by the patterns on their fur. However, the growth of the species in the area requires the deployment of additional dedicated human and financial resources. Moreover, depending on the context and scale, methods need to be adapted to ensure that the indicators and estimates remain reliable and responsive. Observation pressure and methods are therefore not necessarily homogeneous across the area and data are still scanty in some zones due to a lack of suitable surveys or insufficient information feedback. Neighboring countries (Switzerland, Germany) also have their own monitoring and indicator systems. Efforts are being made to develop cross-border cooperation. Data exchange and working groups are being set up on the European level: Upper Rhine Conference (ORK), Status and Conservation of the Alpine Lynx Population (SCALP), EuroLynx. Expert groups have recently decided to extend the methodology and data exchange under the SCALP project to the entire Jura and Vosges Mountains, the Upper Rhine area (Vosges-Palatinate Forest, Black Forest and adjacent regions) and the Dinaric Alps.
Monitoring and evaluation indicators	**Monitoring indicators**: see sheets below **Evaluation indicators:** • Annual production of population indicators on the mountain range scale (population status and conservation, development, geographic range, etc.) • Number of intensive monitoring campaigns • Number of partnerships, agreements signed • Area surveyed each year • Human resources dedicated to monitoring the species • Financial resources dedicated to monitoring the species
Potential partners	Managers of natural areas (Natural Area Conservatories (CEN), Regional Nature Parks (PNR), Nature Parks (PN), National Nature Reserves (RNN), etc.), ONF, nature protection associations, hunting federations and associations, international partners (KORA, SNU: Stiftung Natur und Umwelt Rheinland-Pfalz, SCALP), the Network's observer correspondents, naturalist associations, naturalists and volunteers, agricultural professions, etc. Universities, CNRS: for research and development of data analysis methods.

Action sheets

Action 1			
Wording and description	Conduct a collective scientific and technical assessment under the joint aegis of the OFB and the MNHN to ascertain the conditions for long-term viability of the lynx in the region (population dynamics, genetic viability, reception capacity and availability of habitats, etc.).		
Coordinator	OFB/MNHN		
Project team	Ministry of Ecology/DREAL/support from the Scientific Council		
Geographic areas	The Alps	Jura Mountains	Vosges Mountains
	Priority	Priority	Priority
Monitoring indicators	• Production of the study		
Schedule and cost	2022 / 2023 / 2024 / 2025 / 2026 Annual agreements between the State and institutions		

Action 2			
Wording and description	As soon as the PNA is adopted, conduct a study of the technical, regulatory and social preconditions for success prior to a decision to resort to a population enhancement operation.		
Coordinator	MNHN/OFB		
Project team	Ministry of Ecology/DREAL/support from the Scientific Council		
Geographic areas	The Alps	Jura Mountains	Vosges Mountains
	Depending on the results of Action 1	Depending on the results of Action 1	Priority
Monitoring indicators	• Production of the study		
Schedule and cost	2022 / 2023 / 2024 / 2025 / 2026 Annual agreements between the State and institutions		

Action 3			
Wording and description	**Enhance the monitoring network and its structure, particularly in high-risk areas, i.e., on the fringes of the range and in areas with scanty data and connectivity issues**		
Coordinator	**OFB**		
Project team	**DDT39/Panthera/APACEFS/FNC/FDC/FNE/ONF/DDT25/RNNHCJ/LPO/OCS/SFEPM/PNRHJ/ Centre Athénas**		
Geographic areas	**The Alps**	**Jura Mountains**	**Vosges Mountains**
	Priority	**Lower priority**	**Priority**
Monitoring indicators	• Changes in the number of data items collected • Changes in the number of active participants in data dissemination • Development of data exchange with neighboring countries		
Schedule and cost	**2022**	**2023**	**2024**	**2025**	**2026**
	€115 k/year (equipment + time spent in each mountain range or study area, i.e., 0.5 FTE/mountain range + 1 national FTE)				

Action 4			
Wording and description	**Promote feedback of monitoring data by all available means: participatory science, data agreements, communication concerning tools** **Encourage feedback to stakeholders who contribute to the use of these data**		
Coordinator	**OFB**		
Project team	**APACEFS/FNC/FDC/FNSEA/FNO/DDT25/CEREMA/LPO/OCS/SFEPM/Centre Athénas**		
Geographic areas	**The Alps**	**Jura Mountains**	**Vosges Mountains**
	Priority	**Priority**	**Priority**
Monitoring indicators	• Number of meetings to coordinate and report on the network data (including neighboring countries)		
Schedule and cost	**2022**	**2023**	**2024**	**2025**	**2026**
	€40k/year (or 0.5 FTE)				

<table>
<tr><td>Action 5</td><td></td></tr>
<tr><td>Wording and description</td><td>Obtain a centralized monitoring data tool compatible with the databases in neighboring countries.</td></tr>
<tr><td>Coordinator</td><td>OFB</td></tr>
<tr><td>Project team</td><td>Jura Shepherds (Bergers Jura), Nature Farmer (Paysan de Nature)/Panthera/APACEFS/FNC/FDC/DDT25/Haute Chaîne du Jura Nature Reserve (RNFHJ)/CEREMA/OCS/
SFEPM</td></tr>
<tr><td>Monitoring indicators</td><td>• Existence of the platform
• Regular updating interval
• Number of users, platform audience
• Contribution to European data
• International working groups</td></tr>
<tr><td>Schedule and cost</td><td>
<table>
<tr><th>2022</th><th>2023</th><th>2024</th><th>2025</th><th>2026</th></tr>
<tr><td></td><td colspan="4">Thesis or post-doctoral research (€75 k/year)</td></tr>
</table>
</td></tr>
</table>

Objective 2.2	Improve knowledge on the genetics of lynx populations
Description	In the framework of the collective expert assessment under 2.1, conduct and mobilize research actions to better describe the genetic diversity of lynx populations in the different mountain ranges in relation to the demography and connectivity of the species, in order to guide the considerations and priorities for improving viability on the metapopulation scale.
Context	A small number of founder individuals, relatively low numbers, reduced connectivity between the different mountain ranges and the dispersal patterns of individuals are all factors likely to affect genetic diversity. The consequences of a low level of genetic diversity on lynx populations are still poorly understood, but inbreeding problems can affect the long-term survival of the populations. The first analyses carried out on the Jura and Alpine lynx already show less genetic diversity than in the Carpathian stock population and a spatial structuring between the Vosges population and the rest of the range. The frequency of heart murmurs potentially linked to genetic factors appears to have increased in the Swiss Alpine and Jura populations and may be a sign of inbreeding depression. The objective of this topic of the PNA is to jointly establish an organization with interested and competent stakeholders and to initiate research actions on the genetic characteristics of the lynx populations in the different mountain ranges. These studies should describe the diversity and genetic structure of the lynx populations and the gene flow on different geographic scales: 1) to provide information on the genetic structure of the lynx and the gene flow on a metapopulation level; 2) to monitor inbreeding in relation to the health of the lynx population (link to the health data sheet) These actions should be carried out in collaboration with the neighboring countries of Switzerland and Germany in order to ensure consistent protocols and data interoperability on the metapopulation level. They should be part of a joint process of population monitoring (genetic, demographic and health status) and make use of knowledge on the movements of individuals (dispersal), but also an understanding of the habitat, corridors and barriers to lynx movements. The results should be used to guide the discussions and priorities for improving ecological connectivity between subpopulations and mountain ranges with the ultimate aim of making up a genetically viable metapopulation.
Monitoring and evaluation indicators	**Monitoring indicators:** see action sheets **Evaluation indicators:** • Existence of a shared work space between stakeholders of the metapopulation • Number of Working Group meetings and cross-border exchanges • Improved knowledge of genetic diversity and distribution by mountain range?
Potential partners	KORA (and partners of the "Lynx conservation in Switzerland: genetics, health and demography" project, FIWI Zentrum für Fisch und Wildtiermedizin, University of Bern), Departmental Veterinary Laboratories, members of the SAGIR network, SFEPM (non-invasive sample collection network), Chrono-Environmental Laboratory of Bourgogne-Franche-Comté University (for non-invasive sampling), Centre Athénas

Action sheets

Action 1	
Wording and description	**Improve knowledge of genetic issues:** • **following the assessment under 2.1, referral to the MNHN and OFB regarding the importance of genetics in terms of lynx conservation with a view to possible actions under the next PNA** • **set up a working group on the genetic issues identified and their implications for the conservation of lynx populations**
Coordinator	**MNHN/OFB**
Project team	**/**
Monitoring indicators	• Number of working group meetings
Schedule and cost	

2022	2023	2024	2025	2026
		Cost to be ascertained according to the information from the collective expert assessment mentioned under 2.1		

Action 2			
Wording and description	**Collect and pool samples (invasively and non-invasively), analyze them according to protocols that allow for metapopulation-wide assessments, bank the results and assess the possibilities for pooling them**		
Coordinator	**OFB**		
Project team	**APACEFS/ONF/OCS/SFEPM/PNRHJ/Centre Athénas**		
Geographic areas	**The Alps**	**Jura Mountains**	**Vosges Mountains**
	Priority	**Priority**	**Priority**
Monitoring indicators	• Number of samples collected and analyzed		
Schedule and cost			

2022	2023	2024	2025	2026
€24 k/year				

Action to be taken in the longer term	
Wording and description	**Diagnosis at the metapopulation level in order to:** **1) provide information on the genetic structuring of the lynx and the gene flows on the metapopulation level** **2) monitor inbreeding in relation to lynx health (link to health data sheet)**

Objective 2.3	Organize health monitoring and improve knowledge on the health status of lynx populations
Description	Early detection of diseases of concern to lynx populations, keeping samples for retrospective studies, improve knowledge by making these samples available, and effectively link monitoring and research on emerging and priority issues for the species, as part of a common health strategy.
Context	Early detection of infectious pathogens in lynx populations is essential for the conservation of the species. By detecting their effects (morbidity and lethality) we can understand how these agents affect the population dynamics and could weaken the conservation status of this species. The literature review shows that the impact of diseases on the population dynamics of European lynx appears to be limited to date. Although a wide range of infectious agents has been reported in lynx, mange is so far the only disease suspected to have had a measurable impact on a lynx population in Scandinavia. Nevertheless, viruses responsible for epizootic diseases in other feline species are in circulation among lynx populations, such as feline panleukopenia (several cases confirmed among lynx in France), feline infectious peritonitis, distemper virus in Switzerland in 2009 and, for the first time in 2017 in the Swiss Jura, feline immunodeficiency and leukosis viruses. Parasites are highly prevalent and cases of sarcoptic mange are detected sporadically in France on corpses or suspected after expert examination of photographs. Notoedric mange is also possible. Recently, cardiac dysfunctions, probably of genetic origin, have been identified among the lynx population of the Swiss Jura. From a toxicological point of view, cases of environmental contamination by anticoagulants (used in the control of ground voles or as biocides) have been reported by the SAGIR network. Exposure to anticoagulants could be a comorbidity factor (impaired alertness) increasing the risk of collisions. In a context where any additional mortality (or decline in fertility) is likely to affect populations, it appears necessary to detect any emerging pathological process at an early stage and then to describe and quantify it and understand its pathophysiological and epidemiological mechanisms. This action under the PNA has five objectives: 1) ensure early detection of diseases of concern to lynx populations by means of integrated epidemiological monitoring (post mortems, clinical examinations on live lynx, sentinel species); 2) ensure sample preservation for establishing or further investigating a diagnosis retrospectively and applying molecular epidemiology; 3) improve knowledge by making these samples available; 4) effectively link monitoring and research for emerging and priority health issues for the species; 5) organize disease prevention and take early action on health crisis management. This action under the PNA should make use of all the capacities of the various partners. Issues should be prioritized in conjunction with neighboring countries for cross-border populations, and protocols should be standardized with these teams as far as possible.
Monitoring and evaluation indicators	**Monitoring indicators:** see action sheets **Evaluation indicators:** • Number of samples centralized, number of individuals autopsied, number of clinical diagnoses, number of health alerts • Studies carried out, articles, scientific reports • Working group and status of cross-border exchanges • Established and shared protocols, methodological developments • Organizations involved and trained in sample collection protocols • Number of partnerships and agreements established • Human and material resources dedicated to health monitoring

Potential partners	FIWI Zentrum für Fisch- und Wildtiermedizin, University of Bern) KORA, Wildlife Veterinary and Agricultural Expertise Unit (Pôle EVAAS VetAgro Sup), National Veterinary School of Toulouse (ENVT), French Association of Directors and Executives of Public Veterinary Analysis Laboratories (ADILVA), Faunapath, French Association for the Study and Protection of Mammals (SFEPM), Centre Athénas

Action sheet

Action 1	
Wording and description	**Organize integrated epidemiological monitoring of lynx populations:** • **share a protocol for handling each lynx individual (alive or dead) for sampling or data collection** • **link monitoring and research on emerging health issues or priority conservation issues** • **continue to set up and manage an organ/serum/history bank** • **organizing health crisis management**
Coordinator	**OFB**
Project team	**DREAL BFC/Centre Athénas/ENVT/LDAH05/ADILVA/Pôle EVAAS/FIWI (Switzerland)/CHRONO-ENVIRONMENTAL LABORATORY (Bourgogne-Franche-Comté University)**
Monitoring indicators	• Number of samples collected and processed • Number of individual autopsies • % of corpses processed under optimum conditions (processing time, most possible analyses carried out)
Schedule and cost	<table><tr><th>2022</th><th>2023</th><th>2024</th><th>2025</th><th>2026</th></tr><tr><td colspan="5">€12 k/year for analyses and biobank</td></tr></table>

Objective 2.4	**Better understand and evaluate the diversity of the species' diet, particularly with regard to predation on wild and domestic animals**
Description	Answer questions on: the diet of the lynx; the importance of predation on hunted species and domestic livestock in local contexts in relation to issues of social acceptance; coexistence with the species; and knowledge for conservation purposes.
Context	The presence or return of a predator to an area brings the species into confrontation with the sociological and economic aspects of its coexistence with human activities. Conflicts linked to predation (whether actually experienced or just anticipated) are a major obstacle to acceptance of the species (or at least to peaceful coexistence). For the hunting community, the presence of the lynx raises the question of its impact on populations of hunted (game) species. Various studies conducted elsewhere in Europe show local differences in the rates at which prey animals are killed and the proportions of their species in the diet, but none of them suggest any risk to the survival of the populations of hunted species. However, hunting stakeholders are still asking for local studies that take the specific context of their areas into account. In the absence of answers to these questions, there is still concern about the role of the lynx on the trends in prey/game populations (mainly roe deer and chamois). More pragmatically, they also stress the implications for local management of these species by taking ungulate consumption by lynx into account in hunting plans. For livestock farming, repeated attacks on one and the same farm exacerbate tensions in relation to the species. Such hot spots may account for the majority of depredations each year and maintain the perception that the return of the lynx to a livestock farming area will lead to the lynx specializing in domestic livestock herds. French studies on damage to livestock date back more than 15 years and could benefit from an update to try to answer these questions in the current context of the presence of the lynx and livestock farming practices. The working groups also revealed requests from some stakeholders to clarify the importance of so-called secondary prey in the lynx diet. More precise identification could put the importance of the different species in the diet into perspective, depending on the context and the period of the animal's life, and may help to identify possible routes of exposure to contaminants or pathogens. Based on the existing literature, detailed and systemic studies are needed to provide information on the interaction between predation by the lynx and other factors affecting prey populations (hunting and other anthropogenic causes of mortality, climate, epizootic diseases, density dependence, behavioral responses of prey animals and effects on trophic cascades). These studies are an essential support for communication and mediation programs among the various stakeholders, in particular to achieve objectives 1.2 and 1.3. Finally, in the broader context of application of this research, the development and introduction of functional ecology studies on the species also contributes to improved understanding of the role of the lynx in the ecosystem through predation (additive or compensatory effects on prey animals, prey selection or changes in the behavior of the prey, effects on trophic cascades and interaction with other predators). The issue of the lynx is then not only addressed in terms of social acceptance and conflict reduction, but in terms of the benefits of the predator's presence to the ecosystem.
Monitoring and evaluation indicators	• Number of studies initiated • Scientific and popular science articles and reports published on the effects of predation and hunting on wild and domestic fauna and identification of the lynx diet in each mountain range • Approved and implemented protocols • Number of samples used and/or number of animals monitored

Potential partners	Ungulate monitoring: FDC, OFB, Universities Research on prey: OFB, RLL, FDC, CROC research and observation center (Vosges Mountains); Depredations: OFB, DDT, farmers, agricultural unions (FNO, FNSEA, Permanent Assembly of Chambers of Agriculture (APCA), Young Farmers (JA)) Non-invasive diet studies: SFEPM, Universities (including Chrono-Environment Lab)

Action sheet

Action 1	
Wording and description	**Study the diversity of the lynx diet to improve knowledge of the relative share of different prey species and, for certain prey species, the effects of predation on the population structure in the context of predation-related conflicts:** - **Referral to the Scientific Council on methods to identify diet diversity** - **Referral to the Scientific Council on the terms of reference of the study to be conducted** - **Launch the study** **Create conditions for success by facilitating discussions and developing research actions with all stakeholders and the Scientific Council on functional ecology that address the needs for knowledge and the issues of acceptance and conservation of the lynx, in the context of conflicts related to predation.**
Coordinator(s)	**DREAL**
Project team	**OCS/SFEPM/WWF/Panthera/APACEFS/FNC/FDC/FNE/RNFHJ/LPO/SOS Peregrine Falcon-Lynx/PNRHJ/Centre Athénas**
Monitoring indicator	• See objective sheet above
Schedule and cost	<table><tr><th>2022</th><th>2023</th><th>2024</th><th>2025</th><th>2026</th></tr><tr><td colspan="5">Currently being estimated</td></tr></table>

Objective 2.5	Combat the illegal killing of lynx
Description	Reduce illegal lynx killing by strengthening the means of investigation, dissuasive measures, raising stakeholder awareness and better quantifying and describing the harm caused to the species.
Context	By definition, the share of illegal killing among the causes of death is difficult to estimate. Overviews of lynx populations in Europe identify illegal killing as one of the main causes of mortality and therefore a major hindrance to improving the conservation status of lynx populations. Estimates from individuals tracked by telemetry show that illegal killing may account for up to 46% of adult mortality in Scandinavian countries and 32% of mortality in Switzerland, i.e., equivalent to road deaths. Additional high adult mortality may be sufficient to limit population growth, slow the colonization of new areas or even lead to local decline in small, isolated populations. With about fifteen confirmed cases recorded since the return of the lynx to France (1974), illegal killing accounts for 10% of the individuals found dead. However, in the absence of monitored individuals, this figure is a minimum indication of such destruction. Illegal killing is directly linked to difficulties in restoring the population and the recent decline of the Vosges mountain population, with three confirmed and three suspected cases among lynx reintroduced between 1983 and 1993, while associations refer to a dozen suspected cases. In early 2020, the national control strategy set out the monitoring priorities of services of the State and its public water, nature and marine environment policing authorities. Among its priorities, this strategy identifies the fight against illegal killing of protected species, including the lynx, which is explicitly mentioned (action 3.6). This action is therefore a priority for the OFB. However, in order to initiate a court investigation, there has to be a corpse or a witness. In the absence of tangible evidence, it is often impossible to submit pleadings based on these suspicions and only a small number of proceedings initiated after known cases of illegal killing have led to identification and conviction of the perpetrators. In addition to direct action, it would be advisable to better quantify and describe these killings in order to understand such acts. Beyond strengthening the human and material resources required to conduct these investigations, combating illegal acts must not be based solely on repressive aspects. These acts are mostly due to refusal to accept the species or to poor conflict management. A prevention component is also necessary, including awareness raising and involving stakeholders in conserving and monitoring the species.
Monitoring and evaluation indicators	**Monitoring indicators:** see sheet **Evaluation indicator:** • Trends in mortality attributed to illegal killing and/or destruction pressure indicators (signs of non-lethal shooting) • Resolution rate of investigations • Changes in the budget for combating species damage • Changes in the resources put to use for the investigations • Protocols developed and implemented • Number of working group meetings and proposals put forward • Summary of sentences and convictions • Number of organizations involved in legal action against willful harm to the species
Potential partners	Managers of natural areas (CEN, PNR, national parks, nature reserves, etc.), nature protection associations, Centre Athénas, hunters' federations and associations, SOS Peregrine Falcon-Lynx (C. Kurtz), DDT, DREAL, Police, Wildlife Health Unit (USF), international partners (authorities in charge of law enforcement and combating illegal killing, research teams)

Action sheets

<table>
<tr><td>Action 1</td><td colspan="3"></td></tr>
<tr><td>Wording and description</td><td colspan="3">Applying the principle of continuous improvement:
• improve the organization of the investigation services (in particular the establishment of a specialized forensic unit) and the quality of the investigations carried out in cases of suspected and proven illegal killing of lynx:
• continue to raise awareness among public prosecutors of the seriousness of any offence relating to this species
• communicate more widely on the findings of investigations and on proceedings that lead to convictions</td></tr>
<tr><td>Coordinator</td><td colspan="3">OFB</td></tr>
<tr><td>Project team</td><td colspan="3">IGMA-BIODIVERSITE/APACEFS/DDT 25/SOS Peregrine Falcon</td></tr>
<tr><td rowspan="2">Geographic areas</td><td>The Alps</td><td>Jura Mountains</td><td>Vosges Mountains</td></tr>
<tr><td>Priority</td><td>Priority</td><td>Priority</td></tr>
<tr><td>Monitoring indicators</td><td colspan="3">• Number of staff trained in operating procedures and bodies made more aware
• Prefectoral press releases on illegal killings, with reminders of the law (100% of cases)
• Number of prefectoral press releases on the conclusions of the investigations
• Number/audience of awareness-raising campaigns among target audiences
• Number of prosecutors made more aware, information meetings with relevant legal authorities</td></tr>
<tr><td>Schedule and cost</td><td colspan="3"><table><tr><th>2022</th><th>2023</th><th>2024</th><th>2025</th><th>2026</th></tr><tr><td colspan="5">€5 k/year</td></tr></table></td></tr>
</table>

Action 2	
	Raise the awareness of stakeholders reminder: see communication and mediation actions targeting livestock and hunting stakeholders and the communication charter (actions under objectives 1.2 and 1.3 and the communication charter, action 1 under objective 3.1)

Objective 2.6	Optimize the system for the care and rehabilitation of any lynx in distress or temporary difficulty
Description	Apply the resources required for the rescue, care and reintegration of lynx individuals in distress into the wild.
Context	Anthropogenic factors (vehicle collisions, illegal killing, hunting) account for most of the lynx mortality in Europe. These factors can account for up to 70% of known causes of mortality (estimates made in Switzerland on lynx tracked by telemetry) and hamper the development of lynx populations. Accidents and illegal shooting or trapping are not always fatal, but for injured lynx individuals or dependent young whose mothers disappear, survival may depend on prompt and adequate care. Depending on their condition and the success of the care provided, these animals may be released back into their natural environment. Authorization to capture and hold animals and the methods for intervening on the species are governed by a ministerial order which also specifies the technical framework (decision to capture and approval of the decision) and the geographic framework of capture and release actions. To date, only one wildlife rescue center has this accreditation: the Centre Athénas in the Jura Mountains. The PNA should therefore ensure that there is an intervention and care network throughout the habitat of the species that is authorized and trained to capture, diagnose, treat and rehabilitate rescued lynx individuals so that they can be released with the best possible chance of survival. The PNA must also encourage feedback, cross-border exchanges and discussions with teams working on the management of other species in distress and the development of shared protocols for improving interventions, diagnosis, preventive action, care, release into the wild and post-release monitoring to ensure the effectiveness of these actions and their contribution to the conservation objectives for the population. This will include considering how released individuals can play a role in actions to improve the connectivity and long-term viability of the populations. These approaches must also be integrated and coordinated with the demographic, epidemiological and genetic monitoring actions carried out for the species. The capture of a lynx is an opportunity to acquire valuable data during its examination (state of health, diseases, genetics, etc.) and subsequently, in the event of release back into the wild, to monitor the behavior and fate of the individuals by fitting them with GPS collars and transponders.
Monitoring and evaluation indicators	**Monitoring indicators**: see action sheet **Evaluation indicators:** • Number of stakeholders and bodies informed and made aware of issues relating to reporting lynx individuals in difficulty and of the intervention protocols • Number of local stakeholders and trained/authorized bodies • Number of lynx individuals cared for, rehabilitated and released into the wild • Clinical diagnoses carried out • Protocols, monitoring sheets, reports from the bodies in charge • Studies carried out, articles published, scientific reports disseminated • Working group meetings • Survival and reproduction of rehabilitated lynx, post mortem examinations in the event of mortality • Number of stakeholders and bodies informed and made aware of issues relating to reporting lynx individuals in difficulty and of the intervention protocols
Potential partners	DDTs, Panthera, FNSEA, FNO, FNE, RNFHJ, CEREMA, SOS Peregrine Falcon-Lynx, PNRHJ, ADILVA, Pôle EVAAS, KORA
Action sheets	

<table>
<tr><td>Action 1</td><td colspan="3"></td></tr>
<tr><td>Wording and description</td><td colspan="3">Strengthen the monitoring and intervention system throughout the lynx's range by training local units and stakeholders (OFB, fire brigade, police, veterinarians, volunteers, etc.).</td></tr>
<tr><td>Coordinator</td><td colspan="3">DREAL/OFB</td></tr>
<tr><td>Project team</td><td colspan="3">APACEFS/DDTs/National Union of Mountain Guides/CEREMA/Centre Athénas</td></tr>
<tr><td rowspan="2">Geographic areas</td><td>The Alps</td><td>Jura Mountains</td><td>Vosges Mountains</td></tr>
<tr><td>Priority</td><td>Priority</td><td>Priority</td></tr>
<tr><td>Monitoring indicators</td><td colspan="3">• Working group meetings
• Number of stakeholders and bodies informed and made aware of issues relating to reporting of lynx individuals in difficulty and of the intervention protocols
• Number of local stakeholders and bodies trained/authorized</td></tr>
<tr><td>Schedule and cost</td><td colspan="3"><table><tr><th>2022</th><th>2023</th><th>2024</th><th>2025</th><th>2026</th></tr><tr><td colspan="5">€50 k/year</td></tr></table></td></tr>
</table>

<table>
<tr><td>Action 2</td><td></td></tr>
<tr><td>Wording and description</td><td>Conduct discussions on how to deal with lynx individuals in distress (criteria, protocol for diagnosis, care, preventive action: support from a "multidisciplinary diagnostic unit")

Organize a procedure for raising alerts and managing specimens in the event of a suspected highly contagious disease or proven circulation of an infectious agent of concern to the lynx population.</td></tr>
<tr><td>Coordinator</td><td>DREAL/OFB</td></tr>
<tr><td>Project team</td><td>APACEFS/FNC/Centre Athénas/FNE/EVAAS/FIWI/KORA</td></tr>
<tr><td>Monitoring indicators</td><td>• Monitoring sheets, reports from the bodies in charge</td></tr>
<tr><td>Schedule and cost</td><td><table><tr><th>2022</th><th>2023</th><th>2024</th><th>2025</th><th>2026</th></tr><tr><td colspan="5">€20 k/year</td></tr></table></td></tr>
</table>

Action 3	
Wording and description	**Involve and inform the public and local stakeholders when animals are released into the wild (with due regard to the protection of the released animals).**
Coordinator	**DREAL/OFB/DDT/s**
Project team	**FNC/FNSEA/FNO/Centre Athénas/SFEPM**
Monitoring indicators	• Number of press releases
Schedule and cost	

2022	2023	2024	2025	2026
€2 k/year				

Action 4	
Wording and description	**Conduct studies (including retrospective studies) on the results of these reintroductions and study the origin, behavior and fate of animals taken into care (management of mortality/morbidity after their release)**
Coordinator	**OFB**
Project team	**Panthera/APACEFS/FNSEA/FNO/National Organization of Mountain Guides/Centre Athénas**
Monitoring indicators	• Studies carried out, articles published and scientific reports disseminated on the origin and fate of individuals released into the wild and the results of these re-introductions into the natural environment.
Schedule and cost	

2022	2023	2024	2025	2026
€10 k/year				

Action 5	
Wording and description	**Conduct discussions in the working group on procedures for release into the wild (protocols, monitoring after release, selection of locations that limit the risks for the animal, potential interaction with human activities and expected benefits for the viability of the species)**
Coordinator	**DREAL/OFB/DDTs**
Project team	**APACEFS/FNC/FDC/FNSEA/FNO/National Organization of Mountain Guides/ADILVA, EVAAS Unit, FIWI/KORA/Centre Athénas**
Monitoring indicators	• Potential release areas
Schedule and cost	

2022	2023	2024	2025	2026
Human resources State departments/partner participation				

Objective 3.1	Develop tools for disseminating information, educating people and raising awareness of the species and the challenges of its conservation
Description	Inform and raise awareness about the lynx and issues related to its conservation, and contribute to improved understanding and coexistence by influencing the perception of the species and suitable communication for each audience and for the local contexts.
Context	The lynx is still relatively unknown and has received little publicity, but it is also less controversial than the wolf or the bear among the French population. The level of acceptance and perception of carnivores can vary greatly between different categories of people, geographic areas and levels of knowledge of the species. Knowledge and familiarity with the species may play a part in attitudes, but are not necessarily sufficient to change negative perceptions which are often related to the type of professional or recreational activity interacting directly with the predator. Lack of acceptance of the lynx among livestock and hunting stakeholders is considered to be one of the major obstacles to the conservation and development of the species. Negative perceptions and attitudes towards the species persist until answers are provided, factual knowledge is shared and a dialogue is established between the different stakeholders. The general public in theory has a favorable attitude towards the species, but is still poorly informed about its biology, its needs, its place in the ecosystem and the conservation issues raised by its return to areas shared by many users and environments marked by the human footprint.
Monitoring and evaluation indicators	• Communication Charter, application rate • Identification of elements of a common language • Number of documents and awareness-raising tools produced and disseminated • Number of events organized (at least one international event) • Number of information/awareness-raising campaigns carried out • Audience reached (number of classes, livestock farmers, hunters, users of natural areas, general public, etc.)
Potential partners	Environmental education bodies (associations, Permanent Environmental Initiative Centers (CPIE), etc.), CROC, Nature protection associations, protected areas, etc. Perception study: CNRS, University, representatives of livestock farmers, hunting federations and associations, local authorities, chambers of commerce and agriculture, etc.

Action sheets

Action 1	
Wording and description	**Establish a common communication charter**
Coordinator	**SFEPM**
Project team	**LPO/FNC/FDC/FERUS/Centre Athénas/PNRHJ**
Monitoring indicators	• Dissemination of a charter

Schedule and cost	2022	2023	2024	2025	2026
	€15 k				

Action 2	
Wording and description	Establish an ethical charter for certifying initiatives carried out to benefit the lynx.
Coordinator	**SFEPM**
Project team	**LPO/FNC/FERUS/Centre Athénas/PNRHJ**
Monitoring indicators	• Dissemination of a charter • Number of "certified" initiatives implemented in favor of the lynx

Schedule and cost	2022	2023	2024	2025	2026
	€15 k/year				

Action 3			
Wording and description	Communication targeting the following: • schoolchildren (environmental education) • socio-economic players (reminder of communication actions included in the other topics: livestock farming, hunting, motorists) with a contact group to be planned to ensure consistency • general public		
Coordinator	**SFEPM**		
Project team	**LPO/FNC/FERUS/Centre Athénas/PNRHJ/National Union of Mountain Guides**		
Geographic areas	The Alps	Jura Mountains	Vosges Mountains
	Priority	Priority	Priority
Monitoring indicators	• Number of schoolchildren made more aware/per year/mountain range • Number of people made more aware/per year/mountain range • Number of social and economic players made more aware • Number of training/awareness-raising events • Number of events organized		

Schedule and cost	2022	2023	2024	2025	2026
	€50 k/year				

Action 4	
Wording and description	Organize international events
Coordinator	**SFEPM**
Project team	**LPO/FNC/FERUS/Centre Athénas**
Monitoring indicators	• At least one event held at the beginning and one at the end
Schedule and cost	

2022	2023	2024	2025	2026
€10 k				€10 k

Action 5	
Wording and description	Create a reference Internet platform on the lynx.
Coordinator	**DREAL**
Project team	**/**
Monitoring indicators	• Number of visitors to the platform
Schedule and cost	

2022	2023	2024	2025	2026
€4.5 k	€1 k	€1 k	€1 k	€1 k

Objective A4.1	Coordinate, implement and evaluate the PNA
Description	Coordinate, implement and monitor the progress of the PNA, facilitating cooperation between stakeholders, ensuring consistency between actions and evaluating their effectiveness.
Monitoring and evaluation indicators	• Annual reports on actions undertaken under the PNA • Evaluation and monitoring of actions • Meetings of working groups and the Scientific Committee • Number of agreements signed • Funding status of actions • Evaluation of the PNA at 3 and 6 years, updating or establishing new actions if applicable
Potential partners	All PNA partners

Action sheets

Coordinator(s)	**DREAL BFC**
Action 1	**Coordinate the Steering Committee**
Monitoring indicators	• Number of meetings/year • % of minutes/total number of meetings
Action 2	**Coordinate the Funding Committee**
Monitoring indicators	• Number of meetings/year • % of minutes/total number of meetings
Action 3	**Provide a secretariat and coordinate the Scientific Council**
Monitoring indicators	• Number of meetings/year • % of minutes/total number of meetings
Action 4	**Provide a technical secretariat for the strategic topics**
Monitoring indicators	• Number of meetings/year • % of minutes/total number of meetings
Action 5	**Ensure good coordination and consistency between the national and regional action plans**
Monitoring indicators	• Inclusion of a section on the relationship between the national and regional action plans in the annual monitoring
Action 6	**Annual review of the PNA**
Monitoring indicators	• Number of annual reviews/duration of the plan
Action 7	**Mid-term evaluation of the PNA**
Monitoring indicators	• Production of the evaluation
Action 8	**Final evaluation of the PNA**
Monitoring indicators	• Presentation of the evaluation in the Steering Committee meeting
Action 9	**Include international partners in the working groups**

<table>
<tr><td>Monitoring indicators</td><td>• Number of international partners involved/year</td></tr>
<tr><td>Schedule and cost</td><td>
<table>
<tr><th></th><th>2022</th><th>2023</th><th>2024</th><th>2025</th><th>2026</th></tr>
<tr><td>Coordination</td><td colspan="5">1 DREAL FTE and OFB support + €5 k/year</td></tr>
<tr><td>Final evaluation (external service)</td><td></td><td></td><td></td><td></td><td>€50 k</td></tr>
</table>
</td></tr>
</table>

ACKNOWLEDGEMENTS

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CROC research and observation center; French Society for the Study and Protection of Mammals (SFEPM); WWF France;

Federation of Regional Nature Parks of France; Regional Nature Parks of the Vosges du Nord, Haut-Jura and Chartreuse;

National Nature Reserves of the Haute Chaîne du Jura and the Hauts de Chartreuse;

Center for Studies and Expertise on Risks, Environment, Mobility and Development (CEREMA); Swiss Carnivore Ecology and Wildlife Management Foundation (KORA); Chrono-Environment Laboratory of the University of Franche-Comté; "Societies, Actors and Government in Europe" Laboratory of the University of Strasbourg;

Association for Wildlife Protection (ASPAS); Association of Alternative Protections for the Cohabitation of Livestock and Wildlife (APACEF), Centre Athénas animal rescue center; FERUS; FNE; LPO; OCS; Pôle Grands Prédateurs Jura; SOS Peregrine Falcon-Lynx; Panthera;

Naturalists; correspondents of the RLL;

Regional Chambers of Agriculture;

Regional Environment, Development and Housing Directorates (DREAL) of the Grand-Est, Bourgogne-Franche-Comté and Auvergne-Rhône-Alpes; Regional Food, Agriculture and Forest Directorates (DRAAF) of the Grand-Est, Bourgogne-Franche-Comté and Auvergne-Rhône-Alpes; DDTs for *départements* 39 and 57;

Département of Isère;

ONF; National and Regional Forestry Property Centers; National Federation of Forest Municipalities (FNCOFOR);

Jura Mountain Police Commissioner;

Farmers' Confederation (Confédération paysanne); Rural Coordination Office (Coordination Rurale); National Sheep Federation (Fédération Nationale Ovine); National and Departmental Federations of Farmers' Organizations (Fédérations Nationales et Départementales des Syndicats d'Exploitants Agricoles); Young Farmers (Jeunes Agriculteurs);

Livestock Farming Institute (IDELE);

National Federation of Hunters of France; Departmental Federations of Hunters for *départements* 01, 25, 39, 67, 68, 90;

SNCF Network;

Besançon Museum/Citadel;

Ministry of Ecological Transition;

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ABBREVIATIONS

APN: Nature Protection Association

CEN: Natural Area Conservatory

CEREMA: Center for Studies and Expertise on Risks, Environment, Mobility and Urban Planning

CNPF: National Forestry Property Center

CNRS: National Center for Scientific Research

CROC: Research and Observation Center for Carnivores

CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora

CNPN: Nature Conservation Council

COPIL: Steering Committee

CPIE: Permanent Environmental Initiative Center

DDT: Departmental Territorial Division

DEB: Directorate for Water and Biodiversity

DGALN: General Directorate for Planning, Housing and Nature

DIR: Interdepartmental Roads Directorate

DRAAF: Regional Food, Agriculture and Forestry Directorate

DREAL: Regional Directorate for the Environment, Planning and Housing

ERC: Avoid, Reduce, Compensate (principle or sequence aimed at ensuring that developments do not have a negative impact on their environment)

FDC: Departmental Hunting Federation

EAFRD: European Agricultural Fund for Rural Development

FNC: National Hunting Federation

FRC: Regional Hunting Federation

ITT: Land Transport Infrastructure

ITTECOP: Land Transport Infrastructures, Ecosystems and Landscapes

IRCGN: National Gendarmerie Criminal Research Institute

KORA: Swiss Carnivore Ecology and Wildlife Management Foundation

LChP: Federal Law on Hunting and Protection of Wild Mammals and Birds (Switzerland)

LCIE: Large Carnivore Initiative for Europe

LDV: Departmental Veterinary Laboratory

LIFE: Financial Instrument for the Environment (of the European Union)

MAA: Ministry of Agriculture and Food

MTES: Ministry of Ecological and Inclusive Transition

OCLAESP: Central Office for Preventing Environmental and Public Health Offences

OFB: French Biodiversity Agency

OFEV: Federal Office for the Environment, Switzerland

ONC: National Hunting Office (became ONCFS in July 2000)

ONCFS: National Hunting and Wildlife Agency (became OFB in January 2020)

ONF: National Forestry Office

ONG: Non-Governmental Organization

PLMV: Lynx Program in the Vosges Mountains

PNA: National Action Plan

PN: National Park

PNR: Regional Nature Park

PRA: Regional Action Plan

RNN: National Nature Reserve

RNNHCJ: Haute Chaîne du Jura National Nature Reserve

SAGIR: National Wildlife Health Monitoring System for AGIR (Epidemiological Surveillance Network for Wild Birds and Mammals)

SCALP: Status and Conservation of the Alpine Lynx Population

SDGC: Departmental Hunting Management Plan

SFEPM: French Society for the Study and Protection of Mammals

SRADDET: Regional Plan for Development, Sustainable Development and Territorial Equality

SRCE: Regional Plan for Ecological Coherence

TVB: Green and Blue Framework

IUCN: International Union for Conservation of Nature

UMS PatriNat: Joint Natural Heritage Service Unit

UPADE: Predator-Pest and Exotic Animals Unit, research and expertise unit of the OFB

WWF France: World Wide Fund for Nature (formerly World Wildlife Fund) France

6. BIBLIOGRAPHIE

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AGRIDEA 2006. Clôtures de protection en agriculture contre la faune sauvage. www.agridea.ch. pdf.

Allen B.L., Allen L.R., Andrén H., Ballard G., Boitani L., Engeman R.M., Fleming P.J.S., Ford A.T., Haswell P.M., Kowalczyk R., Linnell J.D.C., David Mech L. & Parker D.M. 2017. Can we save large carnivores without losing large carnivore science? *Food Webs* 12: 64–75. https://doi.org/10.1016/j.fooweb.2017.02.008.

Andersen R., Karlsen J., Austmo L.B., Odden J., Linnell J.D.C. & Gaillard J.M. 2007. Selectivity of Eurasian lynx *Lynx lynx* and recreational hunters for age, sex and body condition in roe deer Capreolus capreolus. *Wildlife Biology* 13: 467–474. https://doi.org/10.2981/0909-6396(2007)13[467:soelll]2.0.co;2.

Andrén H. & Liberg O. 2015. Large impact of Eurasian lynx predation on roe deer population dynamics. *PLoS ONE* 10 (3): 1–16. https://doi.org/10.1371/journal.pone.0120570.

Andrén H., Linnell J.D.C., Liberg O., Andersen R., Danell A., Karlsson J., Odden J., Moa P.F., Ahlqvist P., Kvam T., Franzén R. & Segerström P. 2006. Survival rates and causes of mortality in Eurasian lynx (*Lynx lynx*) in multi-use landscapes. *Biological Conservation* 131 (1): 23–32. https://doi.org/10.1016/j.biocon.2006.01.025.

Andrén H., Linnell J.D.C., Liberg O., Ahlqvist P., Andersen R., Danell A., Franzén R., Kvam T., Odden J. & Segerström P. 2002. Estimating total lynx *Lynx lynx* population size from censuses of family groups. *Wildlife Biology* 8 (1): 299–306. https://doi.org/10.2981/wlb.2002.027.

Angelstam P., Manton M., Pedersen S. & Elbakidze M. 2017. Disrupted trophic interactions affect recruitment of boreal deciduous and coniferous trees in northern Europe. *Ecological Applications* 27 (4): 1108–1123. https://doi.org/10.1002/eap.1506.

Angst C., Hagen S. & Breitenmoser U. 2002. Übergriffe von Luchsen auf Kleinvieh und Gehegetiere in der Schweiz. Teil II: Massnahmen zum Schutz von Nutztieren. *KORA Bericht 10*: 65p. pdf.

Angst C. & Breitenmoser U. 2003. Eurasian lynx depredation on livestock in Switzerland - a lasting controversy 30 years after the reintroduction. *Procedings of the 2nd Conference on Status and Conservation of the Alpine Lynx population*: 34–35. pdf.

Arlettaz R., Biollaz F., Mettaz S., Roder S., Klaus E., Zimmermann F. & Braunisch V. 2017. Abnormally low lynx density in the SW Swiss Alps points to poaching, what targeted inquiries confirm..., *in Proceedings of the 33rd IUGB Congress & 14th Perdix Symposium.* Bro E. & Guillemain M. (eds.)ONCFS, Paris. p. 51. pdf.

Arlettaz R., Chapron G., Kéry M., Klaus E., Mettaz S., Roder S., Vignali S., Zimmermann F. & Braunisch V. 2020. Illegal hunting threatens the establishment of a lynx population and highlights the need of a centralized judiciary approach. *bioRxiv*. https://doi.org/10.1101/2020.08.16.252890.

Aronsson M., Low M., López-Bao J. V., Persson J., Odden J., Linnell J.D.C. & Andrén H. 2016. Intensity of space use reveals conditional sex-specific effects of prey and conspecific density on home range size. *Ecology and Evolution* 6 (9): 2957–2967. https://doi.org/10.1002/ece3.2032.

Axnér E., Uhlhorn H., Ågren E. & Mörner T. 2009. Reproductive Maturation in the Male Eurasian Lynx (*Lynx lynx*) : A Study on 55 Reproductive Organs Collected from Carcasses During 2002-2005.

Reproduction in Domestic Animals 44 (3): 467–473. https://doi.org/10.1111/j.1439-0531.2008.01130.x.

Basille M., Herfindal I., Santin-Janin H., Linnell J.D.C., Odden J., Andersen R., Arild Høgda K. & Gaillard J.-M. 2009. What shapes Eurasian lynx distribution in human dominated landscapes: selecting prey or avoiding people? *Ecography* 32 (4): 683–691. https://doi.org/10.1111/j.1600-0587.2009.05712.x.

Bath A., Olszanska A. & Okarma H. 2008. From a human dimensions perspective, the unknown large carnivore: Public attitudes toward Eurasian lynx in Poland. *Human Dimensions of Wildlife* 13 (1): 31–46. https://doi.org/10.1080/10871200701812928.

Belotti E., Kreisinger J., Romportl D., Heurich M. & Bufka L. 2014. Eurasian lynx hunting red deer: is there an influence of a winter enclosure system? *European Journal of Wildlife Research* 60 (3): 441–457. https://doi.org/10.1007/s10344-014-0801-8.

Belotti E., Červený J., Šustr P., Kreisinger J., Gaibani G. & Bufka L. 2013. Foraging sites of Eurasian lynx *Lynx lynx* : relative importance of microhabitat and prey occurrence. *Wildlife Biology* 19 (2): 188–201. https://doi.org/10.2981/12-077.

Belotti E., Weder N., Bufka L., Kaldhusdal A., Küchenhoff H., Seibold H., Woelfing B. & Heurich M. 2015. Patterns of lynx predation at the interface between protected areas and multi-use landscapes in Central Europe. *PLoS ONE* 10 (9): 1–23. https://doi.org/10.1371/journal.pone.0138139.

Benhammou F. 2007. Crier au loup pour avoir la peau de l'ours. Une géopolitique locale de l'environnement à travers la gestion et la conservation des grands prédateurs en France. Thèse. *Institut des Sciences et Industries du Vivant et de l'Environnement, AgroParisTech*. 665 p. pdf.

Benhammou F. & Dangléant C. 2009. *Ours, lynx, loup : une protection contre nature ?* Toulouse, Milan. 117 p. www.editionsmilan.com.

Biollaz F., Mettaz S., Zimmermann F., Braunisch V. & Arlettaz R. 2015. Statut du lynx en Valais quatre décennies après son retour : suivi au moyen de pièges photographiques. *Bulletin de la Murithienne*: 29–44. https://doi.org/10.7892/boris.93720.

Blanc L., Kramer-Schadt S., Bernard C., Zimmermann F., Marboutin E. & Gimenez O. 2015. Restoring a viable population of lynx in the French Vosges Mountains: Insights from a spatially explicit individual-based model, in *Dynamique des populations d'espèces rares et élusives : Le Lynx Boréal en Europe. Thèse en Biologie des populations et Ecologie, Université de Montpellier 2, UMR CNRS 5175 (Laboratoire d'Ecologie Fonctionnelle et Evolutive)*. p. 140–168.

Blanc L., Marboutin E., Gatti S. & Gimenez O. 2013. Abundance of rare and elusive species: Empirical investigation of closed versus spatially explicit capture-recapture models with lynx as a case study. *The Journal of Wildlife Management* 77 (2): 372–378. https://doi.org/10.1002/jwmg.453.

Blanc L., Marboutin E., Gatti S., Zimmermann F. & Gimenez O. 2014. Improving abundance estimation by combining capture-recapture and occupancy data: Example with a large carnivore. *Journal of Applied Ecology* 51 (6): 1733–1739. https://doi.org/10.1111/1365-2664.12319.

Blanc R., Guillemain M., Mouronval J.B., Desmonts D. & Fritz H. 2006. Effects of non-consumptive leisure disturbance to wildlife. *Revue d'Ecologie (La Terre et la Vie)* 61 (2): 117–133. http://hdl.handle.net/2042/55674.

Blankenhorn H. 2003. The Swiss Lynx Management Plan. *Environmental encounters* 58: 69–71. pdf.

Boitani L., Alvarez F., Anders O., Andren H., Avanzinelli E., Balys V., Blanco J.C., Breitenmoser U., Chapron G., Ciucci P., Dutsov A., Groff C., Huber D., Ionescu O., Knauer F., Kojola I., Kubala J., Kutal M., Linnell J., Majic A., Mannil P., Manz R., Marucco F., Melovski D., Molinari A., Norberg H., Nowak S., Ozolins J., Palazon S., Potocnik H., Quenette P.-Y., Reinhardt I., Rigg R., Selva N., Sergiel A., Shkvyria M., Swenson J., Trajce A., Von Arx M., Wolfl M., Wotschikowsky U. & Zlatanova D. 2015. Key actions for Large Carnivore populations in Europe 120 p. pdf.

Bonnot N.C., Couriot O., Berger A., Cagnacci F., Ciuti S., De Groeve J.E., Gehr B., Heurich M., Kjellander P., Kröschel M., Morellet N., Sönnichsen L. & Hewison A.J.M. 2020. Fear of the dark? Contrasting impacts of humans versus lynx on diel activity of roe deer across Europe. *Journal of Animal Ecology* 89 (1): 132–145. https://doi.org/10.1111/1365-2656.13161.

Boutros D. 2002. Characterisation and Assessment of Suitability of Eurasian Lynx (*Lynx lynx*) Den Sites. *KORA Bericht* 12: 1–31. pdf.

Boutros D., Breitenmoser-Würsten C., Zimmermann F., Ryser A., Molinari-Jobin A., Capt S., Güntert M. & Breitenmoser U. 2007. Characterisation of Eurasian lynx *Lynx lynx* den sites and kitten survival. *Wildlife Biology* 13 (4): 417–429. https://doi.org/https://doi.org/10.2981/0909-6396(2007)13[417:COELLL]2.0.CO;2.

Bouyer Y., Gervasi V., Poncin P., Beudels-Jamar R.C., Odden J. & Linnell J.D.C. 2015. Tolerance to anthropogenic disturbance by a large carnivore: the case of Eurasian lynx in south-eastern Norway. *Animal Conservation* 18 (3): 271–278. https://doi.org/10.1111/acv.12168.

Boyer J. 2007. Prélèvement légal d'un lynx dans le jura en 2006. *Bulletin lynx du Réseau* 13: 14.

Breitenmoser-Würsten C. & Obexer-Ruff G. 2003. Population and conservation genetics of the two re-introduced lynx (*Lynx lynx*) populations in Switzerland - a molecular evaluation 30 years after translocation. *Procedings of the 2nd Conference on Status and Conservation of the Alpine Lynx population. Environmental encounters 58*: 28–31. pdf.

Breitenmoser-Würsten C. & Obexer-Ruff G. 2007. Reintroduction of Lynx in Switzerland - A Molecular Evaluation 30 Years after Translocation. *Abstract in: Felid Biology and Conservation. 41. The Wildlife Conservation Research Unit, Oxford University.* p. 530. pdf.

Breitenmoser-Würsten C., Vandel J.-M., Zimmermann F. & Breitenmoser Breitenmoser-Würsten U. 2007. Demography of lynx *Lynx lynx* in the Jura Mountains. *Wildlife Biology* 13 (13): 381–392. https://doi.org/10.2981/0909-6396(2007)13[381:DOLLLI]2.0.CO;2.

Breitenmoser-Würsten C., Zimmermann F., Molinari-Jobin A., Molinari P., Capt S., Vandel J.-M., Stahl P. & Breitenmoser U. 2007. Spatial and Social stability of a Eurasian lynx *Lynx lynx* population: an assessment of 10 years of observation in the Jura Mountains. *Wildlife Biology* 13 (4): 365–380. https://doi.org/10.2981/0909-6396(2007)13[365:sassoa]2.0.co;2.

Breitenmoser-Würsten C., Zimmermann F., Ryser A., Capt S., Laass J., Siegenthaler A. & Breitenmoser U. 2001. Untersuchungen zur Luchspopulation in den Nordwestalpen der Schweiz 1997–2000. *KORA Bericht* 9: 88p. pdf.

Breitenmoser U., Bürki R., Lanz T., Pittet M., Von Arx M. & Breitenmoser-Würsten C. 2016. The recovery of wolf *Canis lupus* and lynx *Lynx lynx* in the Alps: Biological and ecological parameters and wildlife management systems. *KORA Bericht* 70: 276p. pdf.

Breitenmoser U. & Breitenmoser-Würsten C. 2008. *Der Luchs: ein Grossraubtier in der Kulturlandschaft*. Wohlen/Bern, Switzerland, Salm-Verlag. 584 p.

Breitenmoser U., Breitenmoser-Würsten C., Lanz T., Von Arx M., Antonevich A., Bao W. & Avgan B. 2015. *Lynx lynx* (errata version published in 2017). *The IUCN Red List of Threatened Species 2015*: e.T12519A121707666.

Breitenmoser U. 1998. Large predators in the Alps: The fall and rise of man's competitors. *Biological Conservation* 83 (3): 279–289. https://doi.org/10.1016/S0006-3207(97)00084-0.

Breitenmoser U., Angst C., Landry J.-M., Breitenmoser-Würsten C., Linnell J.D.C. & Weber J.-M. 2005. Non-lethal techniques for reducing depredation. *in* Woodroffe R., Thirgood S. & Rabinowitz A. (eds.), *People and Wildlife, Conflict or Co-existence?* Cambridge, Cambridge University Press. p. 49–71. https://doi.org/10.1017/CBO9780511614774.005.

Breitenmoser U., Breitenmoser-Würsten C. & Capt S. 1998. Re-introduction and present status of the lynx (*Lynx lynx*) in Switzerland. *Hystrix - Italian Journal of Mammalogy* 10 (1): 17–30. https://doi.org/10.4404/hystrix-10.1-4118.

Breitenmoser U., Breitenmoser-Würsten C., Okarma H., Kaphegyi T., Kaphygyi-Wallmann U. & Müller U.M. 2000. Action Plan for the conservation of the Eurasian Lynx (*Lynx lynx*) in Europe. *Nature and environment* 112: 68p. pdf.

Breitenmoser U. & Haller H. 1993. Patterns of Predation by Reintroduced European Lynx in the Swiss Alps. *The Journal of Wildlife Management* 57 (1): 135–144. https://doi.org/10.2307/3809010.

Breitenmoser U. & Haller H. 1987. La réintroduction du lynx *Lynx lynx*: Une appréciation après 15 ans d'experience en Suisse. *Ciconia* 11 (2): 119–130. pdf.

Breitenmoser U., Kavczensky P., Dötterer M., Breitenmoser-Würsten C., Capt S., Bernhart F. & Liberek M. 1993. Spatial organization and recruitment of lynx (*Lynx lynx*) in a re-introduced population in the Swiss Jura Mountains. *Journal of Zoology* 231 (3): 449–464. https://doi.org/10.1111/j.1469-7998.1993.tb01931.x.

Breitenmoser U., Ryser A., Molinari-Jobin A., Zimmermann F., Haller H., Molinari P. & Breitenmoser-Würsten C. 2010. The changing impact of predation as a source of conflict between hunters and reintroduced lynx in Switzerland, *Biology and Conservation of Wild Felids*.OUP Oxford. p. 493–506. pdf.

Bull J.K., Heurich M., Saveljev A.P., Schmidt K., Fickel J. & Förster D.W. 2016. The effect of reintroductions on the genetic variability in Eurasian lynx populations: the cases of Bohemian–Bavarian and Vosges–Palatinian populations. *Conservation Genetics* 17 (5): 1229–1234. https://doi.org/10.1007/s10592-016-0839-0.

Bunnefeld N., Linnell J.D.C., Odden J., Van Duijn M.A.J. & Andersen R. 2006. Risk taking by Eurasian lynx (*Lynx lynx*) in a human-dominated landscape: effects of sex and reproductive status. *Journal of Zoology* 270 (1): 060606025751009-??? https://doi.org/10.1111/j.1469-7998.2006.00107.x.

Campion-Vincent V. 1996. Le retour du Lynx. Anthropozoologica 23: 3–12. pdf.

Capt S. 1998. Conflicts with the lynx: depredation and competition with hunters, *in* Breitenmoser-Würsten C., Rohner C. & Breitenmoser U. (eds.), *The re-introduction of the lynx into the Alps*. Strasbourg, Council of Europe Publishing. p. 55–58. pdf.

Capt S., Bernhart F., Breitenmoser U., Breitenmoser-Würsten C., Haller H., Liberek M., Vandel J.-M.J.-M., Herrenschmidt V., Breitenmoser-Wuersten C., Haller H., Liberek M., Vandel J.-M.J.-M. & Herrenschmidt V. 1993. Prédation du lynx (*Lynx lynx*) sur les ongulés sauvages et domestiques. *Actes du colloque prédation et gestion des prédateurs*: 85–92. pdf.

Caro T.M. & O'Doherty G. 1999. On the use of surrogate species in conservation biology. *Conservation Biology* 13 (4): 805–814. https://doi.org/10.1046/j.1523-1739.1999.98338.x.

Červený J., Krojerová-Prokešová J., Kušta T. & Koubek P. 2019. The change in the attitudes of Czech hunters towards Eurasian lynx: Is poaching restricting lynx population growth? *Journal for Nature Conservation* 47 (July 2018): 28–37. https://doi.org/10.1016/j.jnc.2018.11.002.

Červený J., Koubek P. & Bufka L. 2002. Eurasian Lynx (*Lynx Lynx*) and its chance for survival in Central Europe: The case of the Czech Republic. *Acta Zoologica Lituanica* 12 (4): 428–432. https://doi.org/10.1080/13921657.2002.10512534.

Červený J. & Okarma H. 2002. Caching prey in trees by Eurasian lynx. *Acta Theriologica* 47 (4): 505–508. https://doi.org/10.1007/BF03192475.

Ceza B., Rochat N., Tester U., Kessler R. & Marti K. 2001. Zoom sur les liquidateurs de lynx - eliminations illégales de lynx en Suisse: faits et indices. *Pro Natura* 26: 1–33. pdf.

Chapron G., Kaczensky P., Linnell J.D.C., Von Arx M., Huber D., Andrén H., López-Bao J.V., Adamec M., Álvares F., Anders O., Balčiauskas L., Balys V., Bedő P., Bego F., Blanco J.C., Breitenmoser U., Brøseth H., Bufka L., Bunikyte R., Ciucci P., Dutsov A., Engleder T., Fuxjäger C., Groff C., Holmala K., Hoxha B., Iliopoulos Y., Ionescu O., Jeremić J., Jerina K., Kluth G., Knauer F., Kojola I., Kos I., Krofel M., Kubala J., Kunovac S., Kusak J., Kutal M., Liberg O., Majić A., Männil P., Manz R., Marboutin E., Marucco F., Melovski D., Mersini K., Mertzanis Y., Mysłajek R.W., Nowak S., Odden J., Ozolins J., Palomero G., Paunović M., Persson J., Potočnik H., Quenette P.-Y., Rauer G., Reinhardt I., Rigg R., Ryser A., Salvatori V., Skrbinšek T., Stojanov A., Swenson J.E., Szemethy L., Trajçe A., Tsingarska-Sedefcheva E., Váňa M., Veeroja R., Wabakken P., Wölfl M., Wölfl S., Zimmermann F., Zlatanova D. & Boitani L. 2014. Recovery of large carnivores in Europe's modern human-dominated landscapes. *Science* 346 (6216): 1517–1519. https://doi.org/10.1126/science.1257553.

Charbonnel A. & Germain E. (Coordination) 2019. Plan Régional d'Actions en faveur du Lynx boréal (*Lynx lynx*) dans le Massifmassif des Vosges : rétablir le Lynx dans un état de conservation favorable dans le cadre d'une démarche participative, concertée et partagée avec les acteurs du territoire. Lucy (57), France, *Centre de Recherche et d'Observation sur les Carnivores (CROC)*. 254 p. pdf.

Chenesseau D., Chandosne C., Paillard S. & Gatti S. 2010. Identification individuelle des lynx en Franche-Comté. *Bulletin lynx du Réseau* 16: 6–7. pdf.

Christen G., Mechin C. & Wintz M. 2016. Le lynx : perturbateur ou partenaire de l'équilibre sylvo-cynégétique? Regard sur les jeux d'acteurs qui s'approprient le retour du lynx dans la réserve de biosphère transfrontalière Vosges du Nord – Pfälzerwald. *Ann. Sci. Rés. Bios. Trans. Vosges du Nord-Pfälzerwald* 18: 60–88. pdf.

Davis M.L., Stephens P.A. & Kjellander P. 2016. Beyond climate envelope projections: Roe deer survival and environmental change. *Journal of Wildlife Management* 80 (3): 452–464. https://doi.org/10.1002/jwmg.1029.

Drouilly M. 2019. Plan d'actions pour la conservation du Lynx boréal (*Lynx Lynx*) en France – Propositions à mettre en œuvre par l'État dans le cadre d'un PNA Paris, Bourges, *Société française pour l'étude et la protection des mammifères (SFEPM) / WWF France*. 177 p. https://doi.org/10.13140/RG.2.2.21735.19369.

Duchamp C., Gimenez O., Deharte A., Chenesseau D., Bollet Y. & Fanjul J.-B. 2020. Estimation de densités des lynx sur les sites pilotes de l'Ain et du Jura par méthodes de capture-recapture photographiques spatialisées 12 p. pdf.

Duchamp C., Gimenez O., Oksana G., Drouet-Hoguet N. & Guinot-Ghestem M. 2019. Evaluation d'une métrique de suivi de l'état de conservation de la population de loups en France. Note Technique2019-20. pdf.

Eccard J.A., Meißner J.K. & Heurich M. 2017. European roe deer increase vigilance when faced with immediate predation risk by Eurasian lynx. *Ethology* 123 (1): 30–40. https://doi.org/10.1111/eth.12420.

Efford M. 2004. Density estimation in live-trapping studies. *Oikos* 106 (3): 598–610. https://doi.org/10.1111/j.0030-1299.2004.13043.x.

Elmhagen B., Ludwig G., Rushton S.P., Helle P. & Lindén H. 2010. Top predators, mesopredators and their prey: interference ecosystems along bioclimatic productivity gradients. *Journal of Animal Ecology* 79 (4): 785–794. https://doi.org/10.1111/j.1365-2656.2010.01678.x.

Elmhagen B. & Rushton S.P. 2007. Trophic control of mesopredators in terrestrial ecosystems: top-down or bottom-up? *Ecology Letters* 10 (3): 197–206. https://doi.org/10.1111/j.1461-0248.2006.01010.x.

Engleder T., Mináriková T., Volfová J., Watzl J., Watzl B., Gerngross P. & Belotti E. 2019. First breeding record of a 1-year-old female Eurasian lynx. *European Journal of Wildlife Research* 65 (1): 17. https://doi.org/10.1007/s10344-019-1256-8.

Ericsson G. & Heberlein T.A. 2003. Attitudes of hunters, locals, and the general public in Sweden now that the wolves are back. *Biological Conservation* 111 (2): 149–159. https://doi.org/10.1016/S0006-3207(02)00258-6.

Estes J.A., Terborgh J., Brashares J.S., Power M.E., Berger J., Bond W.J., Carpenter S.R., Essington T.E., Holt R.D., Jackson J.B.C., Marquis R.J., Oksanen L., Oksanen T., Paine R.T., Pikitch E.K., Ripple W.J., Sandin S.A., Scheffer M., Schoener T.W., Shurin J.B., Sinclair A.R.E., Soulé M.E., Virtanen R. & Wardle D.A. 2011. Trophic downgrading of planet Earth. *Science* 333 (6040): 301–306. https://doi.org/10.1126/science.1205106.

Fasel M. 2003. Lynx and hunter – competitors forever? *Environmental encounters* 58: 79–82. pdf.

Ferreira-Koch D. 1998. Les éleveurs et les chasseurs des Vosges du Nord et leurs relations au Lynx (*Lynx lynx*). Image et place de l'animal dans notre société. *Ann. Sci. Rés. Bios. Vosges du Nord* 6 (1997/1998): 77–94. pdf.

Filla M., Premier J., Magg N., Dupke C., Khorozyan I., Waltert M., Bufka L. & Heurich M. 2017. Habitat selection by Eurasian lynx (*Lynx lynx*) is primarily driven by avoidance of human activity during day and prey availability during night. *Ecology and Evolution* 7 (16): 6367–6381. https://doi.org/10.1002/ece3.3204.

Foresti D., Lenarth M., Breitenmoser-Würsten C., Breitenmoser U. & Zimmerman F. 2014. Abondance et densité du lynx dans le Centre du Jura suisse : estimation par capture-recapture photographique dans le compartiment I, durant l'hiver 2013/14. *KORA Bericht* 62: 15p.

Fräger C. & Schraml U. 2016. Die Akzeptanz des Luchses im Pfälzerwald - eine vergleichende Studie. (Public acceptance of the lynx in the Palatinate Forest - a comparative study. *Schriftenreihe der Vereinigung der Wildbiologen und Jagdwissenschaftler Deutschlands* 2: 331–334.

Frankham R., Ballou J.D., Ralls K., Eldridge M., Dudash M.R., Fenster C.B., Lacy R.C. & Sunnucks P. 2017. *Genetic Management of Fragmented Animal and Plant Populations*Vol. 1.Oxford University Press. 528 p. https://doi.org/10.1093/oso/9780198783398.001.0001.

Fuxjäger C. & Molinari-Jobin A. 2013. Release of the third lynx in the Kalkalpen (Austria). *SCALP News* (14): 1p.

Gaillard J.M., Hermery A., Bonenfant C., Basille M., Marboutin E., Mauz I. & Doré A. 2012. Mise au point d'un modèle de diagnostic des interactions entre structures paysagères, infrastructures de transports terrestres et espèces emblématiques - Le cas du Lynx dans le massifmassif jurassien. *Rapport final programme ITTECOP. MEDDTL*: 123p. pdf.

Gaillard J.-M., Nilsen E.B., Odden J., Andrén H. & Linnell J.D.C. 2014. One size fits all: Eurasian lynx females share a common optimal litter size. *Journal of Animal Ecology* 83 (1): 107–115. https://doi.org/10.1111/1365-2656.12110.

Gatti S., Blanc L., Gimenez O. & Marboutin E. 2014. Estimation des densités de lynx dans le massifmassif du Jura entre 2011 et 2014. *Faune Sauvage* (304): 4–8. pdf.

Gatti S., Blanc L., Gimenez O. & Marboutin E. 2011. Première session intensive de piégeage photographique en Franche-Comté. *Bulletin lynx du Réseau* 17: 20–23. pdf.

Gatti S., Cadier G. & Rosset J. 2016. Suivi par piégeage photographique du Lynx boréal sur la Réserve Naturelle Nationale de la Haute Chaîne du Jura : session intensive 2015. *Bulletin lynx du Réseau* 20: 15–18. pdf.

Gehr B., Hofer E.J., Muff S., Ryser A., Vimercati E., Vogt K. & Keller L.F. 2017. A landscape of coexistence for a large predator in a human dominated landscape. *Oikos* 126 (10): 1389–1399. https://doi.org/10.1111/oik.04182

Génot J.-C. 2006. *Vivre avec le lynx.* Saint-Claude-de-Diray, Hesse Editions. 141p.

Germain E. 2016. Suivi par piégeage photographique du lynx dans le Massifmassif des Vosges / Session intensive 2015 dans les Vosges du Nord. *Bulletin lynx du Réseau* 20: 19–22. pdf.

Germain E. & Marboutin É. 2014. Suivi par piégeage photographique du Lynx sur le massifmassif Vosgien: session intensive 2014. *Bulletin lynx du Réseau* 19: 22–25. pdf.

Gervasi V., Nilsen E.B., Odden J., Bouyer Y. & Linnell J.D.C. 2014. The spatio-temporal distribution of wild and domestic ungulates modulates lynx kill rates in a multi-use landscape. *Journal of Zoology* 292 (3): 175–183. https://doi.org/10.1111/jzo.12088.

Gimenez O., Gatti S., Duchamp C., Germain E., Laurent A., Zimmermann F. & Marboutin E. 2019. Spatial density estimates of Eurasian lynx (*Lynx lynx*) in the French Jura and Vosges Mountains. *Ecology and Evolution* 9 (20): 11707–11715. https://doi.org/10.1002/ece3.5668.

Goodwin H., Johnston G. & Warburton C. 2000. Tourism & Carnivores - The challenge ahead. 26 p. pdf.

Grosjean D. 1992. Impact of Lynx on farming.*In:* Council of Europe. p. 66–70.

Hameed K., Angelone-Alasaad S., Din J.U., Nawaz M.A. & Rossi L. 2016. The threatening but unpredictable Sarcoptes scabiei: First deadly outbreak in the Himalayan lynx, *Lynx lynx* isabellinus, from Pakistan. *Parasites and Vectors* 9 (1): 1–3. https://doi.org/10.1186/s13071-016-1685-0.

Hargues R. & Arnauduc J.P. 2014. Les chasseurs français et les grands prédateurs. Le livre blanc de la FNC sur les grands prédateurs: 48p.

Haswell P.M., Kusak J. & Hayward M.W. 2017. Large carnivore impacts are context-dependent. *Food Webs* 12 (October 2017): 3–13. https://doi.org/10.1016/j.fooweb.2016.02.005.

Helldin J.-O. & Danielsson A. V. 2007. Changes in red fox *Vulpes vulpes* diet due to colonisation by lynx *Lynx lynx*. *Wildlife Biology* 13 (4): 475–480. https://doi.org/10.2981/0909-6396(2007)13[475:cirfvv]2.0.co;2.

Helldin J.O., Liberg O. & Glöersen G. 2006. Lynx (*Lynx lynx*) killing red foxes (Vulpes vulpes) in boreal Sweden - Frequency and population effects. *Journal of Zoology* 270 (4): 657–663. https://doi.org/10.1111/j.1469-7998.2006.00172.x

Henriksen H.B., Andersen R., Hewison A.J.M., Gaillard J.-M., Bronndal M., Jonsson S., Linnell J.D.C. & Odden J. 2005. Reproductive biology of captive female Eurasian lynx, *Lynx lynx*. *European Journal of Wildlife Research* 51 (3): 151–156. https://doi.org/10.1007/s10344-005-0104-1

Herfindal I., Linnell J.D.C., Moa P.F., Odden J., Austmo L.B. & Andersen R. 2005. Does recreational hunting of lynx reduce depredation losses of domestic sheep? *Journal of Wildlife Management* 69 (3): 1034–1042. https://doi.org/https://doi.org/10.2193/0022-541X(2005)069[1034:DRHOLR]2.0.CO;2

Herfindal I., Linnell J.D.C., Odden J., Nilsen E.B. & Andersen R. 2005. Prey density, environmental productivity and home-range size in the Eurasian lynx (*Lynx lynx*). *Journal of Zoology* 265 (1): 63–71. https://doi.org/10.1017/S0952836904006053

Herrenschmidt V. & Leger F. 1987. Le Lynx *Lynx lynx* dans le nord-est de la France. La colonisation du massifmassif jurassien francais et la reintroduction de l'espece dans le massifmassif vosgien. *Ciconia*

Herrenschmidt V. & Vandel J.-M. 1992. The Reappearance of the Lynx in France - Biological and Sociological Aspects. *In: The situation, conservation needs and reintroduction of lynx in Europe*. https://doi.org/10.1017/CBO9781107415324.004.

Hesler 2006. Etude des populations d'ongulés sauvages et relation avec la présence du lynx en Franche-Comté

Heurich M., Schultze-Naumburg J., Piacenza N., Magg N., Červený J., Engleder T., Herdtfelder M., Sladova M. & Kramer-Schadt S. 2018. Illegal hunting as a major driver of the source-sink dynamics of a reintroduced lynx population in Central Europe. *Biological Conservation* 224: 355–365. https://doi.org/10.1016/j.biocon.2018.05.011.

Heurich M., Möst L., Schauberger G., Reulen H., Sustr P. & Hothorn T. 2012. Survival and causes of death of European Roe Deer before and after Eurasian Lynx reintroduction in the Bavarian Forest National Park. *European Journal of Wildlife Research* 58 (3): 567–578. https://doi.org/10.1007/s10344-011-0606-y.

Hiby L. 2010. ExtractCompare. A computer-assisted photograph-matching system of natural marks. Conservation Research Ltd. www.conservationresearch.co.uk.

Holt A.R., Gaston K.J. & He F. 2002. Occupancy-abundance relationships and spatial distribution: A review. *Basic and Applied Ecology* 3 (1): 1–13. https://doi.org/10.1078/1439-1791-00083

Hucht-Ciorga I. 1988. Studien zur Biologie des Luchses: Jagdverhalten, Beuteausnutzung, innerartliche Kommunikation und an den Spuren fassbare Körpermerkmale (Hunting and intraspecific communication in the lynx). Stuttgart, Ferdinand Enke Verlag. 177 p. pdf.

Hunziker M. 2003. The human dimension: Reasons for acceptance and resistance of lynxes and other predators in Switzerland. *Environmental Encounters*: 22–24. pdf.

Jędrzejewska B. & Jędrzejewski W. 1998. Diets and Hunting Habits of Predators, *Predation in Vertebrate Communities. Ecological Studies:The Białowieża Primeval Forest as a Case Study (Analysis and Synthesis)*.Springer, Berlin, Heidelberg. p. 180–323. https://doi.org/10.1007/978-3-662-35364-6_5.

Jędrzejewska B. & Jędrzejewski W. 1998. *Predation in Vertebrate Communities.* Vol. 135. Berlin, Heidelberg, Springer Berlin Heidelberg. (Ecological Studies). https://doi.org/10.1007/978-3-662-35364-6.

Jędrzejewski W., Schmidt K., Miłkowski L., Jędrzejewska B. & Okarma H. 1993. Foraging by lynx and its role in ungulate mortality: the local (Białowieża Forest) and the Palaearctic viewpoints. *Acta Theriologica* 38: 385–403. https://doi.org/10.4098/AT.arch.93-30.

Jedrzejewski W.W., Jedrzejewska B., Okarma H., Schmidt K., Bunevich A.N.A.N., Milkowski L., Jedrzejewski B., Okarma H., Schmidt K., Bunevich A.N.A.N. & Milkowski L. 1996. Population dynamics (1869-1994), demography, and home ranges of the lynx in Bialowieza Primeval Forest (Poland and Belarus). *Ecography* 19 (2): 122–138. https://doi.org/10.1111/j.1600-0587.1996.tb00163.x.

Jewgenow K., Painer J., Amelkina O., Dehnhard M. & Goeritz F. 2014. Lynx reproduction – Long-lasting life cycle of corpora lutea in a feline species. *Reproductive Biology* 14 (2): 83–88. https://doi.org/10.1016/j.repbio.2014.03.002.

Jobin A., Molinari P. & Breitenmoser U. 2000. Prey spectrum, prey preference and consumption rates of Eurasian lynx in the Swiss Jura Mountains. *Acta Theriologica* 45: 243–252. https://doi.org/10.4098/AT.arch.00-26

Johnson C.N. 2010. Red in tooth and claw: how top predators shape terrestrial ecosystems. *Journal of Animal Ecology* 79 (4): 723–725. https://doi.org/10.1111/j.1365-2656.2010.01706.x

Kaczensky P. 1999. Large Carnivore depredation on livestock in Europe. Ursus 11: 59–71. https://www.jstor.org/stable/3872986. pdf.

Kaczensky P., Chapron G., Von Arx M., Huber D., Andrén H. & Linnell J. 2013. Status, management and distribution of large carnivores – bear, lynx, wolf & wolverine – in Europe. *A Large Carnivore Initiative for Europe Report* (December): 272. pdf.

Karanth K.U. & Nichols J.D. 1998. Estimation of tiger densities in India using photographic captures and recaptures. *Ecology* 79 (8): 2852–2862. https://doi.org/https://doi.org/10.1890/0012-9658(1998)079[2852:EOTDII]2.0.CO;2

Keçi E., Trajçe A., Mersini K., Bego F., Ivanov G., Melovski D., Stojanov A., Breitenmoser U., Von Arx M., Schwaderer G., Spangenberg A. & Linnell J.D.C. 2008. Conflicts between lynx, other large carnivores, and humans in Macedonia and Albania. *Proceedings of the 3rd Congress of Ecologists of the Republic of Macedonia, 06-09.10.2007, Struga*: 257–264. pdf.

Kleiven J., Bjerke T. & Kaltenborn B.P. 2004. Factors influencing the social acceptability of large carnivore behaviours. *Biodiversity and Conservation* 13 (9): 1647–1658. https://doi.org/10.1023/B:BIOC.0000029328.81255.38.

Kowalczyk R., Górny M. & Schmidt K. 2015. Edge effect and influence of economic growth on Eurasian lynx mortality in the Białowieża Primeval Forest, Poland. *Mammal Research* 60 (1): 3–8. https://doi.org/10.1007/s13364-014-0203-z.

Kramer-Schadt S., Revilla E., Wiegand T. & Breitenmoser U. 2004. Fragmented landscapes, road mortality and patch connectivity: modelling influences on the dispersal of Eurasian lynx. *Journal of Applied Ecology* 41 (4): 711–723. https://doi.org/10.1111/j.0021-8901.2004.00933.x.

Kratochvil J., Verescagin N.K., Saint Girons M.-C., Toschi A., Atanasov N., Vala F. & Kirikov S.V. 1968. History of the distribution of the lynx in Europe. *Acta Scientiarum Naturalium Academiae Scientiarum Bohemicae BRNO* 2 (4): 1–50. pdf.

Krofel M., Huber D. & Kos I. 2011. Diet of Eurasian lynx *Lynx lynx* in the northern Dinaric Mountains (Slovenia and Croatia). *Acta Theriologica* 56 (4): 315–322. https://doi.org/10.1007/s13364-011-0032-2.

Krofel M., Jerina K., Kljun F., Kos I., Potočnik H., Ražen N., Zor P. & Žagar A. 2014. Comparing patterns of human harvest and predation by Eurasian lynx *Lynx lynx* on European roe deer *Capreolus capreolus* in a temperate forest. *European Journal of Wildlife Research* 60 (1): 11–21. https://doi.org/10.1007/s10344-013-0745-4.

Krofel M., Kos I., Linnell J., Odden J. & Teurlings I. 2008. Human kleptoparasitism on Eurasian lynx (*Lynx lynx* L.) in Slovenia and Norway. *Varstvo Narave* 21 (August 2015): 93–103. pdf.

Krofel M., Kos I. & Jerina K. 2012. The noble cats and the big bad scavengers: Effects of dominant scavengers on solitary predators. *Behavioral Ecology and Sociobiology* 66 (9): 1297–1304. https://doi.org/10.1007/s00265-012-1384-6.

Krojerová-Prokešová J., Turbaková B., Jelenčič M., Bojda M., Kutal M., Skrbinšek T., Koubek P. & Bryja J. 2019. Genetic constraints of population expansion of the Carpathian lynx at the western edge of its native distribution range in Central Europe. *Heredity* 122 (6): 785–799. https://doi.org/10.1038/s41437-018-0167-x.

Kubala J., Smolko P., Zimmermann F., Rigg R., Tám B., Ilko T., Foresti D., Breitenmoser-Würsten C., Kropil R. & Breitenmoser U. 2019. Robust monitoring of the Eurasian lynx *Lynx lynx* in the Slovak Carpathians reveals lower numbers than officially reported. *Oryx* 53 (3): 548–556. https://doi.org/10.1017/S003060531700076X.

Kuijper D.P.J., Sahlén E., Elmhagen B., Chamaillé-Jammes S., Sand H., Lone K. & Cromsigt J.P.G.M. 2016. Paws without claws? Ecological effects of large carnivores in anthropogenic landscapes. *Proceedings of the Royal Society B: Biological Sciences* 283 (1841): 20161625. https://doi.org/10.1098/rspb.2016.1625.

Kusak J., Huber D., Gomerčić T., Schwaderer G. & Gužvica G. 2009. The permeability of highway in Gorski kotar (Croatia) for large mammals. *European Journal of Wildlife Research* 55 (1): 7–21. https://doi.org/10.1007/s10344-008-0208-5.

Kvaalen I. 1998. Acceptance of lynx by sheep farmers - a sociological comparison, *in* Breitenmoser-Würsten C., Rohner C. & Breitenmoser U. (eds.)Council of Europe Publishing. p. 59–64.

Kvam T. 1991. Reproduction in the European lynx, *Lynx lynx*. *Zeitschrift für Säugetierkunde* 56 (3): 146–158

Laass J. 1999. Evaluation von Photofallen für ein quantitatives Monitoring einer Luchspopulation in den Schweizer Alpen. pdf.

Landres P.B., Verner J. & Thomas J.W. 1988. Ecological Uses of Vertebrate Indicator Species: A Critique. *Conservation Biology* 2 (4): 316–328. https://doi.org/10.1111/j.1523-1739.1988.tb00195.x

Landry J. & Raydelet P. 2010. Efficacité des chiens de protection contre la prédation du lynx dans le Massifmassif jurassien: 1–37. pdf.

Laundré J.W., Hernández L. & Altendorf K.B. 2001. Wolves, elk, and bison: reestablishing the 'landscape of fear' in Yellowstone National Park, U.S.A. *Canadian Journal of Zoology* 79 (8): 1401–1409. https://doi.org/10.1139/z01-094.

Laurent A., Léger F., Briaudet P.-E., Léonard Y., Bataille A. & Goujon G. 2012. Évolution récente (2008-2010) de la population de lynx en France. *Faune Sauvage* (294): 38–39. pdf.

LCIE 2019. Status of large carnivore populations in Europe 2012-2016. Available from https://ec.europa.eu/environment/nature/conservation/species/carnivores/conservation_status.htm.

Le Grand L., Thorsen N.H., Fuchs B., Evans A.L., Laske T.G., Arnemo J.M., Sæbø S. & Støen O.-G. 2019. Behavioral and Physiological Responses of Scandinavian Brown Bears (Ursus arctos) to Dog Hunts and Human Encounters. *Frontiers in Ecology and Evolution* 7. https://doi.org/10.3389/fevo.2019.00134.

Lena A. 2020. Epidémiologie descriptive des processus morbides des espèces loup et lynx en France, entre 1990 et 2019, et optimisation des stratégies de surveillance*Ecole Nationale Vétérinaire et Université Paul-Sabatier, Toulouse*. 185 p. pdf.

Lena A., Paul M., Duchamp C., Jean N., Hivert L., Delpont M. & Decors A. (*in press*). La mortalité des loups et lynx en France : analyse des causes et adaptation de la surveillance sanitaire. *Faune Sauvage.*

Lescureux N. & Linnell J.D.C. 2010. Knowledge and perceptions of Macedonian hunters and herders: The influence of species specific ecology of bears, wolves, and lynx. *Human Ecology* 38 (3): 389–399. https://doi.org/10.1007/s10745-010-9326-2.

Lescureux N., Linnell J.D.C., Mustafa S., Melovski D., Stojanov A., Ivanov G., Avukatov V., Von Arx M. & Breitenmoser U. 2011. Fear of the unknown: Local knowledge and perceptions of the eurasian lynx *Lynx lynx* in western Macedonia. *Oryx* 45 (4): 600–607. https://doi.org/10.1017/S0030605310001547.

Liberek M. 1992. Analyse du prélevèment du lynx (*Lynx lynx*) dans le Jura vaudois (Suisse): Premier approche de l'influence de ce predateur sur les populations d'ongulés.*Université de Neuchâtel, Neuchâtel, Suisse*. 111 p. pdf.

Liberg O., Chapron G., Wabakken P., Pedersen H.C., Hobbs N.T. & Sand H. 2012. Shoot, shovel and shut up: cryptic poaching slows restoration of a large carnivore in Europe. *Proceedings of the Royal Society B: Biological Sciences* 279 (1730): 910–915. https://doi.org/10.1098/rspb.2011.1275.

Lindström E.R., Andrén H., Angelstam P., Cederlund G., Hörnfeldt B., Jäderberg L., Lemnell P.-A., Martinsson B., Sköld K. & Swenson J.E. 1994. Disease Reveals the Predator: Sarcoptic Mange, Red Fox Predation, and Prey Populations. *Ecology* 75 (4): 1042–1049. https://doi.org/10.2307/1939428.

Linnell J.D.C. 2013. From conflict to coexistence? Insights from multi- disciplinary research into the relationships between people, large carnivores and institutions. *Lcie* (February 2013): 1–56. pdf.

Linnell J.D.C., Aanes R. & Andersen R. 1995. Who killed Bambi? The role of predation in the neonatal mortality of temperate ungulates. *Wildlife Biology* 1 (1): 209–223. https://doi.org/10.2981/wlb.1995.0026.

Linnell J.D.C., Odden J., Smith M.E., Aanes R. & Swenson J.E. 1999. Large Carnivores That Kill Livestock: Do 'Problem Individuals' Really Exist? *Wildlife Society Bulletin* 27 (3): 698–705. https://www.jstor.org/stable/3784091. pdf.

Linnell J.D.C., Breitenmoser U., Breitenmoser-Würsten C., Odden J. & Von Arx M. 2009. Recovery of Eurasian Lynx in Europe: What Part has Reintroduction Played? in Hayward M.W. & Somers M.J. (eds.), *Reintroduction of Top-Order Predators.* Blackwell Publishing Ltd. p. 72–91. https://doi.org/10.1002/9781444312034.ch4.

Linnell J.D.C., Broseth H., Odden J. & Nilsen E.B. 2010. Sustainably harvesting a large carnivore? Development of eurasian lynx populations in Norway during 160 years of shifting policy. *Environmental Management* 45 (5): 1142–1154. https://doi.org/10.1007/s00267-010-9455-9.

Linnell J.D.C., Swenson J.E. & Andersen R. 2000. Conservation of biodiversity in Scandinavian boreal forests: Large carnivores as flagships, umbrellas, indicators, or keystones? *Biodiversity and Conservation* 9 (7): 857–868. https://doi.org/10.1023/A:1008969104618.

Linnell J.D.C., Andersen R., Kvam T., Andrén H., Liberg O., Odden J. & Moa P.F. 2001. Home range size and choice of management strategy for lynx in Scandinavia. *Environmental Management* 27 (6): 869–879. https://doi.org/10.1007/s002670010195.

Linnell J.D.C., Smith M.E., Odden J., Swenson J.E. & Kaczensky P. 1996. Strategies for the reduction of carnivore–livestock conflicts: a review. *Norw. Inst. Nature Res. Oppdragsmelding* 443: 1–116. pdf.

Lone K., Loe L.E., Gobakken T., Linnell J.D.C., Odden J., Remmen J. & Mysterud A. 2014. Living and dying in a multi-predator landscape of fear: roe deer are squeezed by contrasting pattern of predation risk imposed by lynx and humans. *Oikos* 123 (6): 641–651. https://doi.org/10.1111/j.1600-0706.2013.00938.x.

López-Bao J.V., Aronsson M., Linnell J.D.C., Odden J., Persson J. & Andrén H. 2019. Eurasian lynx fitness shows little variation across Scandinavian human-dominated landscapes. *Scientific Reports* 9 (1): 8903. https://doi.org/10.1038/s41598-019-45569-2.

Louvrier J., Duchamp C., Lauret V., Marboutin E., Cubaynes S., Choquet R., Miquel C. & Gimenez O. 2018. Mapping and explaining wolf recolonization in France using dynamic occupancy models and opportunistic data. *Ecography* 41 (4): 647–660. https://doi.org/10.1111/ecog.02874.

Louvrier J., Molinari-Jobin A., Kéry M., Chambert T., Miller D., Zimmermann F., Marboutin E., Molinari P., Müeller O., Černe R. & Gimenez O. 2019. Use of ambiguous detections to improve estimates from species distribution models. *Conservation Biology* 33 (1): 185–195. https://doi.org/10.1111/cobi.13191.

Lüchtrath A. & Schraml U. 2015. The missing lynx — understanding hunters' opposition to large carnivores. *Wildlife Biology* 21 (2): 110–119. https://doi.org/10.2981/wlb.00068.

Lute M.L., Carter N.H., López-Bao J. V. & Linnell J.D.C. 2018. Conservation professionals agree on challenges to coexisting with large carnivores but not on solutions. *Biological Conservation* 218 (September 2017): 223–232. https://doi.org/10.1016/j.biocon.2017.12.035.

Marboutin É. 2016. Un projet à l'étude : l'analyse des relations prédateurs – proies entre lynx, chamois, chevreuils… et chasseurs. *Bulletin lynx du Réseau* 20: 11–12. pdf.

Marboutin É. 2007. Lynx et populations de chevreuils en Franche-Comté : une première approche descriptive. *Bulletin lynx du Réseau* 13: 31–32. pdf.

Marboutin E., Duchamp C., Boyer J., Léger F., Léonard Y., Catusse M. & Migot P. 2008. Suivi et statut de conservation des populations de Loup et de Lynx. *Revue scientifique Bourgogne-Nature* 8 (8): 73–82. pdf.

Marboutin É., Duchamp C., Moris P., Briaudet P.-E., Léger F., Laurent A., Léonard Y. & Catusse M. 2011. Le suivi du statut de conservation de la population de lynx en France : bilan pour la période triennale 2008-2010. *Bulletin lynx du Réseau* 17: 24–29. pdf.

Marker L.L., Wilkerson A.J.P., Sarno R.J., Martenson J., Breitenmoser-Würsten C., O'Brien S.J. & Johnson W.E. 2008. Molecular Genetic Insights on Cheetah (*Acinonyx jubatus*) Ecology and Conservation in Namibia. *Journal of Heredity* 99 (1): 2–13. https://doi.org/10.1093/jhered/esm081.

Marsden K., Hovardas T., Psaroudas S., Mertzanis Y. & Baatz U. 2016. EU Platform on Large Carnivores: Supporting good practice for coexistence – presentation of examples and analysis of support through the EAFRD 32 p. pdf.

Mattisson J., Odden J., Linnell J.D.C., Painer J., Persson J. & Andrén H. 2020. Parturition dates in wild Eurasian lynx: evidence of a second oestrus? *Mammalian Biology* 100 (5): 549–552. https://doi.org/10.1007/s42991-020-00037-7.

Mattisson J., Odden J., Nilsen E.B., Linnell J.D.C., Persson J. & Andrén H. 2011. Factors affecting Eurasian lynx kill rates on semi-domestic reindeer in northern Scandinavia: Can ecological research contribute to the development of a fair compensation system? *Biological Conservation* 144 (12): 3009–3017. https://doi.org/10.1016/j.biocon.2011.09.004.

Mattisson J., Persson J., Andrén H. & Segerström P. 2011. Temporal and spatial interactions between an obligate predator, the Eurasian lynx (*Lynx lynx*), and a facultative scavenger, the wolverine (*Gulo gulo*). *Canadian Journal of Zoology* 89 (2): 79–89. https://doi.org/10.1139/Z10-097.

Maudet C., Miller C., Bassano B., Breitenmoser-Wursten C., Gauthier D., Obexer-Ruff G., Michallet J., Taberlet P. & Luikart G. 2002. Microsatellite DNA and recent statistical methods in wildlife conservation management: applications in Alpine ibex [*Capra ibex* (*ibex*)]. *Molecular Ecology* 11 (3): 421–436. https://doi.org/10.1046/j.0962-1083.2001.01451.x.

May R., Van Dijk J., Wabakken P., Swenson J.E., Linnell J.D.C., Zimmermann B., Odden J., Pedersen H.C., Andersen R. & Landa A. 2008. Habitat differentiation within the large-carnivore community of Norway's multiple-use landscapes. *Journal of Applied Ecology* 45 (5): 1382–1391. https://doi.org/10.1111/j.1365-2664.2008.01527.x.

Mayer K., Belotti E., Bufka L. & Heurich M. 2012. Dietary patterns of the Eurasian lynx (*Lynx lynx*) in the Bohemian Forest. *Saeugetierkundliche Informationen* 8 (45): 447–453. pdf.

Melis C., Basille M., Herfindal I., Linnell J.D.C., Odden J., Gaillard J.-M., Høgda K.-A. & Andersen R. 2010. Roe deer population growth and lynx predation along a gradient of environmental productivity and climate in Norway. *Écoscience* 17 (2): 166–174. https://doi.org/10.2980/17-2-3314.

Melis C., Jędrzejewska B., Apollonio M., Bartoń K.A., Jędrzejewski W., Linnell J.D.C., Kojola I., Kusak J., Adamic M., Ciuti S., Delehan I., Dykyy I., Krapinec K., Mattioli L., Sagaydak A., Samchuk N., Schmidt K., Shkvyrya M., Sidorovich V.E., Zawadzka B. & Zhyla S. 2009. Predation has a greater impact in less productive environments: variation in roe deer, *Capreolus capreolus*, population density across Europe. *Global Ecology and Biogeography* 18 (6): 724–734. https://doi.org/10.1111/j.1466-8238.2009.00480.x.

Melis C., Nilsen E.B., Panzacchi M., Linnell J.D.C. & Odden J. 2013. Roe deer face competing risks between predators along a gradient in abundance. *Ecosphere* 4 (9): art111. https://doi.org/10.1890/ES13-00099.1.

Mertens A. & Promberger C. 2001. Economic aspects of large carnivore-livestock conflicts in Romania. *Ursus* 12: 173–180. https://www.jstor.org/stable/3873246.

Mikusinski G. & Angelstam P. 2004. Occurrence of mammals and birds with different ecological characteristics in relation to forest cover in Europe – do macroecological data make sense? *Ecological Bulletins* 51 (January 2004): 265–275. https://doi.org/10.2307/20113315.

Miller J.R.B., Stoner K.J., Cejtin M.R., Meyer T.K., Middleton A.D. & Schmitz O.J. 2016. Effectiveness of contemporary techniques for reducing livestock depredations by large carnivores. *Wildlife Society Bulletin* 40 (4): 806–815. https://doi.org/10.1002/wsb.720.

MNHN, UICN France, SFEPM & ONCFS 2018. La Liste rouge des espèces menacées en France - Chapitre Mammifères de France métropolitaine 244 p. pdf.

Molinari-Jobin A., Kéry M., Marboutin E., Marucco F., Zimmermann F., Molinari P., Frick H., Fuxjäger C., Wölfl S., Bled F., Breitenmoser-Würsten C., Kos I., Wölfl M., Černe R., Müller O. & Breitenmoser U. 2018. Mapping range dynamics from opportunistic data: spatiotemporal modelling of the lynx distribution in the Alps over 21 years. *Animal Conservation* 21 (2): 168–180. https://doi.org/10.1111/acv.12369.

Molinari-Jobin A., Molinari P., Loison A., Gaillard J.-M. & Breitenmoser U. 2004. Life cycle period and activity of prey influence their susceptibility to predators. *Ecography* 27 (3): 323–329. https://doi.org/10.1111/j.0906-7590.2004.03862.x.

Molinari-Jobin A., Molinari P., Breitenmoser-Würsten C. & Breitenmoser U. 2002. Significance of lynx *Lynx lynx* predation for roe deer *Capreolus capreolus* and chamois *Rupicapra rupicapra* mortality in the Swiss Jura Mountains. *Wildlife Biology* 8 (1): 109–115. https://doi.org/10.2981/wlb.2002.015.

Molinari-jobin A., Wurs B.R.E.-, O S.I.C. & Breitenmoser U.R.S. 2001. Present status and distribution of the Lynx in the Swiss Alps. *Hystrix, the Italian Journal of Mammalogy* 12 (2): 17–27. https://doi.org/10.4404/hystrix-12.2-4174.

Molinari-Jobin A., Zimmermann F., Ryser A., Breitenmoser-Würsten C., Capt S., Breitenmoser U., Molinari P., Haller H. & Eyholzer R. 2007. Variation in diet, prey selectivity and home-range size of Eurasian lynx *Lynx lynx* in Switzerland. *Wildlife Biology* 13 (4): 393–405. https://doi.org/10.2981/0909-6396(2007)13[393:VIDPSA]2.0.CO;2.

Molinari-Jobin A. & Molinari P. 2014. Reinforcement of the south-eastern Alpine/Dinaric lynx population. *SCALP News* (15): 1p. pdf.

Monrolin M. & Benhammou F. 2015. Améliorer la gestion du Lynx et de l'expansion du Loup en France : une géoprospective des grands prédateurs en Franche-Comté. *Revue scientifique Bourgogne-Nature* (21/22): 327–334. pdf.

Morand A. 2016. Le Lynx : risques routiers et mesures correctrices – état des lieux et recommandations 90p. www.cerema.fr.

Mörner T. 1992. Sarcoptic mange in Swedish wildlife. *Revue scientifique et technique (International Office of Epizootics)* 11 (4): 1115–1121. https://doi.org/10.20506/rst.11.4.658.

Müller J., Wölfl M., Wölfl S., Müller D.W.H., Hothorn T. & Heurich M. 2014. Protected areas shape the spatial distribution of a European lynx population more than 20 years after reintroduction. *Biological Conservation* 177: 210–217. https://doi.org/10.1016/j.biocon.2014.07.007.

Niedziałkowska M., Jedrzejewski W., Mysłajek R.W., Nowak S., Jedrzejewska B. & Schmidt K. 2006. Environmental correlates of Eurasian lynx occurrence in Poland - Large scale census and GIS mapping. *Biological Conservation* 133 (1): 63–69. https://doi.org/10.1016/j.biocon.2006.05.022.

Nilsen E.B., Linnell J.D.C., Odden J. & Andersen R. 2009. Climate, season, and social status modulate the functional response of an efficient stalking predator: the Eurasian lynx. *Journal of Animal Ecology* 78 (4): 741–751. https://doi.org/10.1111/j.1365-2656.2009.01547.x.

Nilsen E.B., Linnell J.D.C., Odden J., Samelius G. & Andrén H. 2012. Patterns of variation in reproductive parameters in Eurasian lynx (*Lynx lynx*). *Acta Theriologica* 57 (3): 217–223. https://doi.org/10.1007/s13364-011-0066-5.

Norum J.K., Lone K., Linnell J.D.C., Odden J., Loe L.E. & Mysterud A. 2015. Landscape of risk to roe deer imposed by lynx and different human hunting tactics. *European Journal of Wildlife Research* 61 (6): 831–840. https://doi.org/10.1007/s10344-015-0959-8.

Nowicki P. 1997. Food habit and diet of the lynx (*Lynx lynx*) in Europe. *J. Wildl. Res.*

Odden J., Linnell J.D.C. & Andersen R. 2006. Diet of Eurasian lynx, *Lynx lynx*, in the boreal forest of southeastern Norway: the relative importance of livestock and hares at low roe deer density. *European Journal of Wildlife Research* 52 (4): 237–244. https://doi.org/10.1007/s10344-006-0052-4.

Odden J., Linnell J.D.C., Moa P.F.P.F., Herfindal I., Kvam T. & Andersen R. 2002. Lynx Depredation on Domestic Sheep in Norway. *The Journal of Wildlife Management* 66 (1): 98–105. https://doi.org/10.2307/3802876.

Odden J., Nilsen E.B. & Linnell J.D.C. 2013. Density of Wild Prey Modulates Lynx Kill Rates on Free-Ranging Domestic Sheep. *PLoS ONE* 8 (11): e79261. https://doi.org/10.1371/journal.pone.0079261.

OFEV (Office Fédéral de l'Environnement) 2016. Plan Lynx. Aide à l'exécution de l'OFEV relative à la gestion du lynx en Suisse. 23 p. pdf.

Okarma H. 1984. The Physical Condition of Red Deer Falling a Prey to the Wolf and Lynx and Harvested in the Carpathian Mountains. *Acta Theriologica* 29 (23): 283–290. pdf.

Okarma H., Jędrzejewski W., Schmidt K., Kowalczyk R. & Jędrzejewska B. 1997. Predation of Eurasian lynx on roe deer and red deer in Bialowieza Primeral Forest, Poland. *Acta Theriologica* 42: 203–224. https://doi.org/10.4098/AT.arch.97-22.

Oleaga Á., Casais R., Balseiro A., Espí A., Llaneza L., Hartasánchez A. & Gortázar C. 2011. New techniques for an old disease: Sarcoptic mange in the Iberian wolf. *Veterinary Parasitology* 181 (2–4): 255–266. https://doi.org/10.1016/j.vetpar.2011.04.036.

ONCFS / Réseau Loup-Lynx. 2019. Mise à jour de l'aire de présence détectée du Lynx boréal (*Lynx lynx*) en France -2018. Lynx Flash info n°10 Novembre 2019. pdf.

Origgi F.C., Plattet P., Sattler U., Robert N., Casaubon J., Mavrot F., Pewsner M., Wu N., Giovannini S., Oevermann A., Stoffel M.H., Gaschen V., Segner H. & Ryser-Degiorgis M.-P. 2012. Emergence of Canine Distemper Virus Strains With Modified Molecular Signature and Enhanced Neuronal Tropism Leading to High Mortality in Wild Carnivores. *Veterinary Pathology* 49 (6): 913–929. https://doi.org/10.1177/0300985812436743.

Painer J., Jewgenow K., Dehnhard M., Arnemo J.M., Linnell J.D.C., Odden J., Hildebrandt T.B. & Goeritz F. 2014. Physiologically Persistent Corpora lutea in Eurasian Lynx (*Lynx lynx*) – Longitudinal Ultrasound and Endocrine Examinations Intra-Vitam. *PLoS ONE* 9 (3): e90469. https://doi.org/10.1371/journal.pone.0090469.

Panzacchi M., Linnell J.D.C., Odden M., Odden J. & Andersen R. 2009. Habitat and roe deer fawn vulnerability to red fox predation. *Journal of Animal Ecology* 78 (6): 1124–1133. https://doi.org/10.1111/j.1365-2656.2009.01584.x.

Pasanen-Mortensen M. & Elmhagen B. 2015. Land cover effects on mesopredator abundance in the presence and absence of apex predators. *Acta Oecologica*. https://doi.org/10.1016/j.actao.2015.04.002.

Pasanen-Mortensen M., Pyykönen M. & Elmhagen B. 2013. Where lynx prevail, foxes will fail - limitation of a mesopredator in Eurasia. *Global Ecology and Biogeography* 22 (7): 868–877. https://doi.org/10.1111/geb.12051.

Pedersen V.A., Linnell J.D.C., Andersen R., Andrén H., Lindén M. & Segerström P. 1999. Winter lynx *Lynx lynx* predation on semi-domestic reindeer *Rangifer tarandus* in northern Sweden. *Wildlife Biology* 5 (1): 203. https://doi.org/10.2981/wlb.1999.025.

Pesenti E. & Zimmermann F. 2013. Density estimations of the Eurasian lynx (*Lynx lynx*) in the Swiss Alps. *Journal of Mammalogy* 94 (1): 73–81. https://doi.org/10.1644/11-MAMM-A-322.1.

Podgórski T., Schmidt K., Kowalczyk R. & Gulczyńska A. 2008. Microhabitat selection by Eurasian lynx and its implications for species conservation. *Acta Theriologica* 53 (2): 97–110. https://doi.org/10.1007/BF03194243.

Preece N.D., Abell S.E., Grogan L., Wayne A., Skerratt L.F., Van Oosterzee P., Shima A.L., Daszak P., Field H., Reiss A., Berger L., Rymer T.L., Fisher D.O., Lawes M.J., Laurance S.G., McCallum H., Esson C. &

Epstein J.H. 2017. A guide for ecologists: Detecting the role of disease in faunal declines and managing population recovery. *Biological Conservation* 214: 136–146. https://doi.org/10.1016/j.biocon.2017.08.014.

Protection Suisse des Animaux 2017. Des clôtures sûres pour les animaux domestiques et sauvages 10 p. pdf.

Prugh L.R., Stoner C.J., Epps C.W., Bean W.T., Ripple W.J., Laliberte A.S. & Brashares J.S. 2009. The Rise of the Mesopredator. *BioScience* 59 (9): 779–791. https://doi.org/10.1525/bio.2009.59.9.9.

Pulliainen E., Lindgren E. & Tunkkari P.S. 1995. Influence of food availability and reproductive status on the diet and body condition of the European lynx in Finland. *Acta Theriologica* 40 (2): 181–196. https://doi.org/10.4098/AT.arch.95-19.

Ratkiewicz M., Matosiuk M., Kowalczyk R., Konopiński M.K., Okarma H., Ozolins J., Männil P., Ornicans A. & Schmidt K. 2012. High levels of population differentiation in Eurasian lynx at the edge of the species' western range in Europe revealed by mitochondrial DNA analyses. *Animal Conservation* 15 (6): 603–612. https://doi.org/10.1111/j.1469-1795.2012.00556.x.

Ratkiewicz M., Matosiuk M., Saveljev A.P., Sidorovich V., Ozolins J., Männil P., Balciauskas L., Kojola I., Okarma H., Kowalczyk R. & Schmidt K. 2014. Long-range gene flow and the effects of climatic and ecological factors on genetic structuring in a large, solitary carnivore: The Eurasian lynx. *PLoS ONE* 9 (12): 1–29. https://doi.org/10.1371/journal.pone.0115160.

Regazzoni S. 2011. Une collision routière à proximité d'un passage à faune. *Bulletin lynx du Réseau* 17: 6–7. pdf.

Réseau-Loup-Lynx 2013. Vers une nouvelle définition et mise à jour de l'aire de présence régulière. *Bulletin Lynx du Réseau* 18: 22–23. pdf.

Réseau-Loup-Lynx 2011. Un lynx charognard. Bulletin lynx du Réseau 17: 13–14. pdf.

Rigg R., Finďo S., Wechselberger M., Gorman M.L., Sillero-Zubiri C. & Macdonald D.W. 2011. Mitigating carnivore–livestock conflict in Europe: lessons from Slovakia. *Oryx* 45 (2): 272–280. https://doi.org/10.1017/S0030605310000074.

Ripple W.J., Estes J.A., Beschta R.L., Wilmers C.C., Ritchie E.G., Hebblewhite M., Berger J., Elmhagen B., Letnic M., Nelson M.P., Schmitz O.J., Smith D.W., Wallach A.D. & Wirsing A.J. 2014. Status and Ecological Effects of the World's Largest Carnivores. *Science* 343 (6167): 1241484–1241484. https://doi.org/10.1126/science.1241484.

Ritchie E.G., Elmhagen B., Glen A.S., Letnic M., Ludwig G. & McDonald R.A. 2012. Ecosystem restoration with teeth: What role for predators? *Trends in Ecology and Evolution* 27 (5): 265–271. https://doi.org/10.1016/j.tree.2012.01.001.

Ritchie E.G. & Johnson C.N. 2009. Predator interactions, mesopredator release and biodiversity conservation. *Ecology Letters* 12 (9): 982–998. https://doi.org/10.1111/j.1461-0248.2009.01347.x.

Rodríguez A. & Calzada J. 2015. *Lynx pardinus* (errata version published in 2020). *The IUCN Red List of Threatened Species 2015*: e.T12520A50655794. https://doi.org/http://dx.doi.org/10.2305/IUCN.UK.2015-2.RLTS.T12520A50655794.en

Røskaft E., Händel B., Bjerke T. & Kaltenborn B.P. 2007. Human attitudes towards large carnivores in Norway. *Wildlife Biology* 13 (2): 172–185. https://doi.org/https://doi.org/10.2981/0909-6396(2007)13[172:HATLCI]2.0.CO;2.

Rovero F. & Zimmermann F. 2016. *Camera trapping for Wildlife Research*.Pelagic Publishing. 320 p.

Royle J.A. & Young K. V 2008. A hierarchical model for spatial capture-recapture data. *Ecology* 89 (8): 2281–2289. https://doi.org/10.1890/10-1440.1. pdf.

Ryser-Degiorgis M.-P., Bröjer C., Hård af Segerstad C., Bornstein S., Bignert A., Lutz H., Uggla A., Gavier-Widén D., Tryland M. & Mörner T. 2005. Assessment of the health status of the free-ranging Eurasian lynx population in Sweden. *In: Proceedings of the 1st workshop on lynx veterinary aspects, 4-6 November 2005.* Ministry of the Environment. pdf.

Ryser-Degiorgis M.-P.. 2009. Causes of mortality and diseases of Eurasian lynx (Lynx lynx). In : VARGAS A., BREITENMOSER-WURSTEN C, BREINTENMOSER U. (eds) (2009) Iberian Lynx Ex Situ Conservation: An Interdisciplinary Approach, Fundación Biodiversidad in collaboration with: IUCN Cat Specialist Group, Madrid: 275–289. pdf.

Ryser-Degiorgis M.-P., Breitenmoser-Würsten C., Marti I., Pisano S.R.R., Pewsner M., Breitenmoser U. & Kovacevic A. 2018. High prevalence of heart anomalies of suspected genetic origin in a reintroduced Eurasian lynx (*Lynx lynx*) population, Switzerland *In:* p. 3–4. pdf.

Ryser-Degiorgis M.-P., Marti I., Pisano S., Wehrle M., Hofmann-Lehmann R., Breitenmoser U., Origgi F., Kübber-Heiss A., Knauer F. & Meli M. 2017. Suspected Feline Immunodeficiency Virus Infection In Eurasian Lynx During A Translocation Program - A Veterinary Challenge At The Interface Among Health Risks, Species Conservation, Animal Welfare And Politics. *In: 66th WDA Annual International Conference.* p. 27. pdf.

Ryser-Degiorgis M.-P., Ryser A., Bacciarini L.N., Angst C., Gottstein B., Janovsky M. & Breitenmoser U. 2002. Notoedric and Sarcoptic Mange in Free-ranging Lynx from Switzerland. *Journal of Wildlife Diseases* 38 (1): 228–232. https://doi.org/10.7589/0090-3558-38.1.228.

Ryser A., Wattenwyl K. von, Ryser-Degiorgis M.-P., Willisch C., Zimmermann F. & Breitenmoser U. 2004. Luchsumsiedlung Nordostschweiz. *KORA Bericht* 22: 60p. https://doi.org/10.1017/CBO9781107415324.004. pdf.

Sæther B.-E. 1999. Conservation biology Top dogs maintain diversity. *Nature* 400 (6744): 510–511. https://doi.org/10.1038/22889.

Saint-Andrieux C. & Barboiron A. 2019. Prélèvements ongulés sauvages saison 2018-2019. *Faune Sauvage* (324): I–VIII. pdf.

Samelius G., Andrén H., Liberg O., Linnell J.D.C., Odden J., Ahlqvist P., Segerström P. & Sköld K. 2012. Spatial and temporal variation in natal dispersal by Eurasian lynx in Scandinavia. *Journal of Zoology* 286 (2): 120–130. https://doi.org/10.1111/j.1469-7998.2011.00857.x.

Samelius G., Andrén H., Kjellander P. & Liberg O. 2013. Habitat Selection and Risk of Predation: Re-colonization by Lynx had Limited Impact on Habitat Selection by Roe Deer. *PLoS ONE* 8 (9): e75469. https://doi.org/10.1371/journal.pone.0075469.

Savouré-Soubelet A., Sordello R., Géraldine R. & Haffner P. 2012. Réflexion préliminaire concernant les impacts du réseau ferroviaire sur le Lynx boréal (*Lynx lynx*): 16. pdf.

Schadt S., Revilla E., Wiegand T., Knauer F., Kaczensky P., Breitenmoser U., Bufka L.L., Červený J., Koubek P., Huber T., Staniša C., Trepl L., Cerveny J., Koubek P., Huber T., Stanisa C. & Trepl L. 2002. Assessing the suitability of central European landscapes for the reintroduction of Eurasian lynx. *Journal of Applied Ecology* 39 (2): 189–203. https://doi.org/10.1046/j.1365-2664.2002.00700.x

Scheid C. 2013. Le Lynx a-t-il encore sa place dans les Vosges ? www.ecofaune.fr. 42p. pdf.

Schmidt-Posthaus H., Breitenmoser-Wörsten C., Posthaus H., Bacciarini L. & Breitenmoser U. 2002. Causes of mortality in reintroduced Eurasian lynx in Switzerland. *Journal of Wildlife Diseases* 38 (1): 84–92. https://doi.org/10.7589/0090-3558-38.1.84.

Schmidt K. 2008. Behavioural and spatial adaptation of the Eurasian lynx to a decline in prey availability. *Acta Theriologica* 53 (1): 1–16. https://doi.org/10.1007/BF03194274.

Schmidt K. 1998. Maternal behaviour and juvenile dispersal in the Eurasian lynx. *Acta Theriologica* 43 (4): 391–408. https://doi.org/10.4098/AT.arch.98-50.

Schmidt K., Jędrzejewski W., Okarma H. & Kowalczyk R. 2009. Spatial interactions between grey wolves and Eurasian lynx in Białowieża Primeval Forest, Poland. *Ecological Research* 24 (1): 207–214. https://doi.org/10.1007/s11284-008-0496-y.

Schmidt K. & Kuijper D.P.J. 2015. A “death trap” in the landscape of fear. *Mammal Research* 60 (4): 275–284. https://doi.org/10.1007/s13364-015-0229-x.

Schmidt K., Ratkiewicz M. & Konopiński M.K. 2011. The importance of genetic variability and population differentiation in the Eurasian lynx *Lynx lynx* for conservation, in the context of habitat and climate change. *Mammal Review* 41 (2): 112–124. https://doi.org/10.1111/j.1365-2907.2010.00180.x.

Schnidrig R., Nienhuis C., Imhof R., Bürki R. & Breitenmoser U. 2016. Lynx in the Alps: Recommendations for an internationally coordinated management. *KORA Bericht* 71: 70. pdf.

Schnyder J., Ehrbar R., Reimoser F. & Robin K. 2016. Ungulate populations and browsing intensities following the reintroduction of lynx in the canton of St. Gallen [Huftierbestände und Verbissintensitäten nach der Luchswiederansiedlung im Kanton St. Gallen]. *Schweizerische Zeitschrift fur Forstwesen* 167 (1): 13–20. https://doi.org/10.3188/szf.2016.0013.

Shehzad W. 2010. Contribution to the development of a non-invasive genetic system for identifying Eurasian lynx (*Lynx lynx*) individuals in France.*Université Joseph Fourier, Grenoble*. 25 p. pdf.

Sidorovich V., Gouwy J. & Rotenko I. 2018. Unknown Eurasian lynx *Lynx lynx* : New findings on the species ecology and behaviour. Minsk, Chatyry Chverci. 276 p. pdf.

Signer J., Filla M., Schoneberg S., Kneib T., Bufka L., Belotti E. & Heurich M. 2019. Rocks rock: the importance of rock formations as resting sites of the Eurasian lynx *Lynx lynx*. *Wildlife Biology* 2019 (1). https://doi.org/10.2981/wlb.00489.

Simberloff D. 1998. Flagships, umbrellas, and keystones: Is single-species management passé in the landscape era? *Biological Conservation* 83 (3): 247–257. https://doi.org/10.1016/S0006-3207(97)00081-5.

Sindičić M., Gomerčić T., Polanc P., Krofel M., Slijepčević V., Gembarovski N., Eurčević M. & Huber E. 2013. Kinship analysis of dinaric lynx (*Lynx lynx*) population | Analiza rodoslovlja dinarske populacije risa (*Lynx lynx*). *Sumarski List* 137 (1–2): 43–49. https://hrcak.srce.hr/98730. pdf.

Sindicic M., Sinanovic N., Majic S.A., Huber, Kunovac S. & Kos I. 2009. Legal status and management of the Dinaric lynx population. *Veterinaria* 58 (3–4): 229–238. pdf.

Sindičić M., Polanc P., Gomerčić T., Jelenčič M., Huber Đ., Trontelj P. & Skrbinšek T. 2013. Genetic data confirm critical status of the reintroduced Dinaric population of Eurasian lynx. *Conservation Genetics* 14 (5): 1009–1018. https://doi.org/10.1007/s10592-013-0491-x.

Smith D.J., O'Donoghue P., Convery I., Eagle A. & Piper S. 2016. Reintroduction of the Eurasian Lynx to the United Kingdom: Results of a Public Survey 30 p. https://insight.cumbria.ac.uk/id/eprint/3188. pdf.

SNU-RLP 2017. LIFE LYNX UE - Plaquette Information pour les éleveurs. Stiftung Natur und Umwelt Rheinland-Pfalz. 2p. pdf.

SNU-RLP 2015. Wiederansiedlung von Luchses (*Lynx lynx carpathicus*) im Biosphärenreservat Pfälzerwald. Stiftung Natur und Umwelt Rheinland-Pfalz. 4p. pdf.

Soulé M.E., Bolger D.T., Alberts A.C., Wrights J., Sorice M. & Hill S. 1988. Reconstructed Dynamics of Rapid Extinctions of Chaparral-Requiring Birds in Urban Habitat Islands. *Conservation Biology* 2 (1): 75–92. https://doi.org/10.1111/j.1523-1739.1988.tb00337.x.

Stahl P. & Vandel J.-M. 1999. Mortalité et captures de lynx (*Lynx lynx*) en France (1974-1998). *Mammalia* 63 (1). https://doi.org/10.1515/mamm.1999.63.1.49.

Stahl P., Vandel J.M., Herrenschmidt V. & Migot P. 2001. The effect of removing lynx in reducing attacks on sheep in the French Jura Mountains. *Biological Conservation* 101 (1): 15–22. https://doi.org/10.1016/S0006-3207(01)00054-4.

Stahl P. & Vandel J.M. 1998. Le lynx boréal : *Lynx lynx* (Linné, 1758). *Encyclopédie des carnivores de France* 19. Société française pour l'Étude et la Protection des Mammifères, Bourges. 65p.

Stahl P., Vandel J.M.M., Herrenschmidt V. & Migot P. 2001. Predation on livestock by an expanding reintroduced lynx population: long-term trend and spatial variability. *Journal of Applied Ecology* 38 (3): 674–687. https://doi.org/10.1046/j.1365-2664.2001.00625.x.

Stahl P., Vandel J.M., Ruette S., Coat L., Coat Y. & Balestra L. 2002. Factors affecting lynx predation on sheep in the French Jura. *Journal of Applied Ecology* 39 (2): 204–216. https://doi.org/10.1046/j.1365-2664.2002.00709.x.

Stahl P. & Vandel J.M. 1999. Mortality and captures of live lynx (*Lynx lynx*) in France (1974- 1998). *Mammalia*

Stahl P. & Vandel J.-M. 1999. Mortalité et captures de lynx (Lynx lynx) en France (1974-1998). Mammalia 63 (1). https://doi.org/10.1515/mamm.1999.63.1.49.

Stehlik J. 2000. Reproductive biology of the European lynx, *Lynx lynx* (Linnaeus, 1758) at Ostrava Zoo. *Zool.Garten* (70): 351–360

Stehlik J. 1983. Le comportement sexuel du lynx boréal (*Lynx lynx*). *Mammalia* 47 (4). https://doi.org/10.1515/mamm.1983.47.4.483.

Sunde P., Kvam T., Bolstad J.P. & Bronndal M. 2000. Foraging of lynxes in a managed boreal-alpine environment. *Ecography* 23 (3): 291–298. https://doi.org/10.1111/j.1600-0587.2000.tb00284.x.

Sunde P., Kvam T., Moa P., Negård A. & Overskaug K. 2000. Space use by Eurasian lynxes *Lynx lynx* in central Norway. *Acta Theriologica* 45: 507–524. https://doi.org/10.4098/AT.arch.00-50.

Sunde P., Overskaug K. & Kvam T. 1999. Intraguild predation of lynxes on foxes: Evidence of interference competition? *Ecography* 22 (5): 521–523. https://doi.org/10.1111/j.1600-0587.1999.tb01281.x.

Sunde P., Stener S.Ø. & Kvam T. 1998. Tolerance to humans of resting lynxes *Lynx lynx* in a hunted population. *Wildlife Biology* 4 (1): 177–183. https://doi.org/10.2981/wlb.1998.020.

Swenson J.E. & Andrén H. 2009. A tale of two countries: large carnivore depredation and compensation schemes in Sweden and Norway, *in* Woodroffe R., Thirgood S. & Rabinowitz A. (eds.), *People and Wildlife*. Cambridge, Cambridge University Press. p. 323–339. https://doi.org/10.1017/CBO9780511614774.021.

Tablado Z. & Jenni L. 2017. Determinants of uncertainty in wildlife responses to human disturbance. *Biological Reviews* 92 (1): 216–233. https://doi.org/10.1111/brv.12224.

Thüler K. 2002. Spatial and Temporal Distribution of Coat Patterns of Eurasian Lynx (*Lynx lynx*) in two reintroduced Populations in Switzerland. *KORA Bericht* 13: 35. pdf.

Treves A. & Naughton-Treves L. 2005. Evaluating lethal control in the management of human–wildlife conflict, *in* Woodroffe R., Thirgood S. & Rabinowitz A. (eds.), *People and Wildlife, Conflict or Co-existence?* Cambridge, Cambridge University Press. p. 86–106. https://doi.org/10.1017/CBO9780511614774.007.

Utsi A.I. 2015. Seasonal and Diurnal Variation in Habitat Overlap of Roe Deer and Eurasian Lynx in a Human-Dominated Landscape. Master thesis. *Norwegian University of Science and Technology*. 35p. http://hdl.handle.net/11250/2358876. pdf.

Valdmann H., Andersone-Lilley Z., Koppa O., Ozolins J. & Bagrade G. 2005. Winter diets of wolf Canis lupus and lynx *Lynx lynx* in Estonia and Latvia. *Acta Theriologica* 50 (4): 521–527. https://doi.org/10.1007/BF03192645.

Van Heel B.F., Boerboom A.M., Fliervoet J.M., Lenders H.J.R. & Van den Born R.J.G. 2017. Analysing stakeholders' perceptions of wolf, lynx and fox in a Dutch riverine area. *Biodiversity and Conservation* 26 (7): 1723–1743. https://doi.org/10.1007/s10531-017-1329-5.

Vandel J.-M., Stahl P., Durand C., Balestra L. & Raymond J. 2001. Des chiens de protection contre le lynx. *Faune Sauvage* (254): 22–27. pdf.

Vandel J.-M. 2001. Répartition du Lynx (*Lynx lynx*) en France (Massifmassif alpin, jurassien et vosgien). Méthodologie d'étude et statut actuel.*Ecole Pratique des Hautes Etudes, Montpellier*. 112 p.

Vandel J.-M., Stahl P., Herrenschmidt V. & Marboutin E. 2006. Reintroduction of the lynx into the Vosges mountain massifmassif: From animal survival and movements to population development. *Biological Conservation* 131 (3): 370–385. https://doi.org/10.1016/j.biocon.2006.02.012.

Vogt K., Signer S., Ryser A., Schaufelberger L., Nagl D. & Willisch C. 2019. Einfluss von Luchsprädation und Jagd auf die Gämse – Teil 1 und 2 Bericht in Zusammenarbeit mit dem Jagdinspektorat des Kantons Bern. *KORA Bericht* 84: 161. pdf.

Vogt K., Vimercati E., Ryser A., Hofer E., Signer S., Signer C. & Breitenmoser U. 2018. Suitability of GPS telemetry for studying the predation of Eurasian lynx on small- and medium-sized prey animals in the Northwestern Swiss Alps. *European Journal of Wildlife Research* 64 (6): 73. https://doi.org/10.1007/s10344-018-1225-7.

Von Arx M. 2018. *Lynx lynx* (errata version published in 2019). *The IUCN Red List of Threatened Species 2018*: e.T12519A145266191. URL.

Von Arx M. 2020. *Lynx lynx* (amended version of 2018 assessment). *The IUCN Red List of Threatened Species* 2020: e.T12519A177350310. https://doi.org/10.2305/IUCN.UK.2020-3.RLTS.T12519A177350310.en.

Von Arx M., Breitenmoser-Würsten C., Zimmermann F. & Breitenmoser U. 2004. Status and conservation of the Eurasian lynx in Europe in 2001. *KORA Bericht* 19. pdf part. 1. 2a. 2b. 3.

Von Arx M., Breitenmoser-Würsten C., Zimmermann F., Kunz F., Vogt K., Ryser A., Struch M. & Breitenmoser U. 2017. Der Luchs im Jura - unter besonderer Berücksichtigung des Solothurner Juras. *Naturforschende Gesellschaft des Kantons Solothurn* 43 (1): 177–234. pdf.

Vourc'h A. 1990. Représentation de l'animal et perceptions sociales de sa réintroduction. Le cas du lynx des Vosges. *Revue d'Ecologie* Suppl. 5: 175–187. http://hdl.handle.net/2042/54614. pdf.

Walton Z., Mattisson J., Linnell J.D.C., Stien A. & Odden J. 2017. The cost of migratory prey: seasonal changes in semi-domestic reindeer distribution influences breeding success of Eurasian lynx in northern Norway. *Oikos* 126 (5): 642–650. https://doi.org/10.1111/oik.03374.

Weingarth K., Heibl C., Knauer F., Zimmermann F., Bufka L. & Heurich M. 2012. First estimation of Eurasian lynx (*Lynx lynx*) abundance and density using digital cameras and capture-recapture techniques in a German national park. *Animal Biodiversity and Conservation* 35 (2): 197–207. https://doi.org/259204.

White C., Convery I., Eagle A., O'Donoghue P., Piper S., Rowcroft P., Smith D. & Van Maanen E. 2015. Cost-benefit analysis for the reintroduction of lynx to the UK: Main report. Application for the reintroduction of Lynx to the UK government 48 p. http://insight.cumbria.ac.uk/id/eprint/2127/. pdf.

White C., Almond M., Dalton A., Eves C., Fessey M., Heaver M., Hyatt E., Rowcroft P. & Waters J. 2016. The Economic Impact of Lynx in the Harz Mountains. *Prepared for the Lynx UK Trust by AECOM.* pdf.

Wikenros C., Kuijper D.P.J., Behnke R. & Schmidt K. 2015. Behavioural responses of ungulates to indirect cues of an ambush predator. *Behaviour* 152 (7–8): 1019–1040. https://doi.org/10.1163/1568539X-00003266.

Wikenros C., Liberg O., Sand H. & Andrén H. 2010. Competition between recolonizing wolves and resident lynx in Sweden. *Canadian Journal of Zoology* 88 (3): 271–279. https://doi.org/10.1139/Z09-143.

Wilson C.J. 2004. Could we live with reintroduced large carnivores in the UK? *Mammal Review* 34 (3): 211–232. https://doi.org/10.1111/j.1365-2907.2004.00038.x.

Wirsing A.J., Cameron K.E. & Heithaus M.R. 2010. Spatial responses to predators vary with prey escape mode. *Animal Behaviour* 79 (3): 531–537. https://doi.org/10.1016/j.anbehav.2009.12.014.

Yilmaz O., Coskun F. & Ertugrul M. 2015. Livestock damage by carnivores and use of livestock guardian dogs for its prevention in Europe - A review. *Journal of Livestock Science* 6: 23–35.

Zeiler H., Zedrosser A. & Bath A. 1999. Attitudes of Austrian hunters and Vienna residents toward bear and lynx in Austria. *Ursus* 11: 193–200. https://doi.org/10.2307/3873001.

Zimmermann F., Küttel J., Breitenmoser-Würsten C., Breitenmoser U. & Kunz F. 2019. Monitoring déterministe du lynx avec les pièges-photos dans le Sud du Bas-Valais IVd durant l'hiver 2018/19. *KORA Bericht* 89: 19. pdf.

Zimmermann F., Molinari-Jobin A., Ryser A., Breitenmoser-Würsten C. & Breitenmoser U. 2011. Status and distribution of the lynx in the Swiss Alps 2005-2009. *Acta biologica slovenica* 54 (2): 73–80. pdf.

Zimmermann F., Pesenti E., Lanz T., Breitenmoser-Würsten C. & Breitenmoser U. 2012. Abondance et densité du lynx dans le Sud du Jura suisse: estimation par capture-recapture photographique dans le compartiment I, durant l'hiver 2011/12. *KORA Bericht* 58: 14. pdf.

Zimmermann F. 2004. Conservation of the Eurasian lynx (*Lynx lynx*) in a fragmented landscape - habitat models, dispersal and potential distribution. PhD thesis. *Département d'Ecologie et Evolution, Faculté de biologie et de médecine, Université de Lausanne*. 193 p. pdf.

Zimmermann F. 1998. Dispersion et survie des Lynx (*Lynx lynx*) subadultes d'une population réintroduite dans la chaîne du Jura. *KORA Bericht* 4: 50. pdf.

Zimmermann F., Breitenmoser-Würsten C. & Breitenmoser U. 2007. Importance of dispersal for the expansion of a Eurasian lynx *Lynx lynx* population in a fragmented landscape. *Oryx* 41 (3): 358–368. https://doi.org/10.1017/S0030605307000712.

Zimmermann F., Breitenmoser-Würsten C. & Breitenmoser U. 2005. Natal dispersal of Eurasian lynx (*Lynx lynx*) in Switzerland. *Journal of Zoology* 267 (4): 381–395. https://doi.org/10.1017/S0952836905007545.

Zimmermann F. & Breitenmoser U. 2007. Potential distribution and population size of the Eurasian lynx *Lynx lynx* in the Jura Mountains and possible corridors to adjacent ranges. *Wildlife Biology* 13 (4): 406–416. https://doi.org/10.2981/0909-6396(2007)13[406:pdapso]2.0.co;2.

Zimmermann F. & Breitenmoser U. 2002. A distribution model for the Eurasian lynx (*Lynx lynx*) in the Jura Mountains, Switzerland, *in* Scott J.M., Heglund P.J., Samson F., Haufler J., Morrison M., Raphael M. & Wal B. (eds.), *Predicting Species Occurrences: Issues of Accuracy and Scale*.Island Press, Covelo, CA. p. 653–660. pdf.

Zimmermann F., Foresti D., Schlageter A., Breitenmoser-Würsten C. & Breitenmoser U. 2013. Abondance et densité du lynx dans le Nord du Jura suisse: estimation par capture-recapture photographique dans le compartiment I, durant l'hiver 2012/13. *KORA Bericht* 59: 15. pdf.

Zimmermann F. & Von Arx M. (2021 in press). Eurasischer Luchs. *Säugetieratlas der Schweiz und Liechtensteins.* (in press).

Zimmermann F. & Von Arx M. 2021. Eurasischer Luchs, in Graf R. F. & Fischer C. (Hrsg.), Säugetieratlas der Schweiz und Liechtensteins. Schweizerische Gesellschaft für Wildtierbiologie SGW, Haupt Verlag, Bern. 478 p. www.haupt.ch.

7.ANNEXES

PNA LYNX 2022-2026

7 ANNEXES

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

MINISTÈRE DE LA TRANSITION ÉCOLOGIQUE ET SOLIDAIRE

Paris, le 27 AOUT 2018

Le ministre d'Etat

à

Monsieur le Préfet de la région Bourgogne-Franche-Comté

Objet : Plan national d'actions en faveur du lynx boréal en France

Le lynx boréal (*Lynx lynx*) est une espèce strictement protégée, à la fois au niveau international, par la Convention de Berne, et au niveau européen, par la Directive 92/43/CEE dite « Habitats-Faune-Flore », où il est classé « prioritaire d'intérêt communautaire » et inscrit en annexes II et IV.

Cette espèce est par ailleurs classée en danger dans la liste rouge nationale établie selon les critères de l'Union internationale pour la conservation de la nature (UICN). Le lynx boréal fait aujourd'hui partie des espèces identifiées comme prioritaires pour l'action publique. Dans la liste actualisée fin 2017 par l'Unité Mixte de Service « PatriNat », le lynx a en effet vu sa tendance de population corrigée, de « augmentation » à « diminution ». La question de la mise en œuvre d'un plan national d'actions pour cette espèce se pose à nouveau.

La population française de lynx est aujourd'hui estimée entre cent et cent-cinquante individus, répartis sur le territoire du Jura, des Alpes et des Vosges. Elle présente des tendances d'évolution contrastées : le noyau du Jura reste stable et celui des Alpes est en cours d'installation. La situation dans les Vosges interpelle tout particulièrement : 21 individus y ont été relâchés entre 1983 et 1993 mais un seul animal y a été identifié lors de la dernière campagne de relevés photographiques. Cette région est pourtant stratégique, car elle se situe au cœur des échanges entre la population suisse de lynx et la population du Palatinat, en cours de reconstruction.

Les principales menaces pour le lynx en France sont une faible acceptation par les chasseurs, la fragmentation des habitats et la mortalité accidentelle (collisions routières et ferroviaires). La pression de prédation étant relativement faible (122 constats d'attaque en 2017, dont 80 dans l'Ain et 30 dans le Jura), l'acceptation par les éleveurs est à ce jour correcte.

.../...

L'évolution inquiétante du noyau vosgien et la constatation des impacts des collisions routières sur la mortalité des lynx ont poussé plusieurs organisations à proposer des actions de sauvegarde de l'espèce :

- Programme Lynx Massif des Vosges (PLMV) ;
- Programme LIFE Lynx ;
- Projet ERC du CEREMA (éviter, réduire et compenser le risque de mortalité du lynx boréal par collision avec les véhicules de transport) ;
- Centre Athénas (accueil des jeunes lynx et un programme de recherche génétique) ;
- Programme Prédateur Proies Lynx proposé par l'ONCFS.

Compte tenu de la spécificité de l'espèce et des menaces qui pèsent sur elle, je souhaite que vous engagiez la coordination d'un plan national d'actions en faveur du lynx, selon la procédure prévue par la note du 9 mai 2017 relative à la mise en œuvre des plans nationaux d'actions prévus à l'article L. 411-3 du code de l'environnement. Ce rôle de coordinateur du PNA se justifie du fait que la majeure partie de la population de Lynx est dans votre zone de compétence, que vous déployez des outils pour la conservation, la connaissance, la prévention de la prédation et la communication du lynx et des liens étroits avec la plupart des partenaires évoqués (convention avec le centre Athénas, le Muséum d'histoire naturelle de Besançon, le Centre de recherche et d'observation sur les carnivores, appui à des travaux de recherche, etc.).

Vous pourrez vous appuyer pour la rédaction du PNA sur l'ONCFS, qui assure le suivi de l'espèce, en tenant compte des diverses initiatives déjà existantes, notamment celles du WWF et de la SFEPM.

Vous associerez à ces travaux les DREAL dont le territoire est concerné par l'espèce.

Vous vous attacherez à fédérer l'ensemble des acteurs concernés par la conservation du lynx et notamment les représentants des activités socioprofessionnelles tels que les éleveurs et les chasseurs. Il conviendrait également d'associer à la démarche les scientifiques qui conduisent des études sur le lynx en Europe.

Vous organiserez à la rentrée (septembre ou octobre) une première réunion du comité de pilotage réunissant l'ensemble des acteurs concernés, en présence de la direction de l'eau et de la biodiversité.

Nicolas HULOT

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RÉPUBLIQUE FRANÇAISE

PRÉFET DE LA RÉGION BOURGOGNE-FRANCE-COMTE

Direction Régionale de l'Environnement,
de l'Aménagement et du Logement
de Bourgogne-Franche-Comté
Service Biodiversité Eau Patrimoine
BFC-2020-07-20-005

Arrêté portant constitution du Comité de Pilotage du Plan National d'Actions en faveur du Lynx

ARRÊTÉ PRÉFECTORAL N° 20-129 BAG

Le Préfet de la Région Bourgogne-France-Comté
Préfet de la Côte d'Or
Officier de la Légion d'Honneur
Officier de l'Ordre National du Mérite

Vu la note du ministère en charge de l'Écologie en date du 9 mai 2017 relative à la mise en œuvre des plans nationaux d'actions prévus à l'article L.411-3 du code de l'Environnement,

Vu la lettre de mission du 27 août 2018 par laquelle le Ministre en charge de l'écologie mandate le Préfet de la région Bourgogne-Franche-Comté pour élaborer un Plan National d'Actions en faveur du Lynx,

Vu la consultation engagée en 2018 par la DREAL,

Considérant la nécessité de s'appuyer sur Comité de pilotage, instance d'information, d'échanges et de consultation pour l'élaboration du Plan National d'Actions et sur les questions stratégiques liées à la conservation des populations de Lynx,

Considérant que ce Comité de pilotage doit être représentatif en rassemblant outre les services de l'État, les collectivités territoriales et de leurs groupements concernées, des établissements publics nationaux œuvrant dans le champ de la biodiversité, des organismes socio-professionnels concernés, des propriétaires fonciers, des usagers de la nature, des associations, organismes ou fondations œuvrant pour la préservation de la biodiversité et des gestionnaires d'espaces naturels,

Considérant qu'il convient d'acter la mise en place du dit Comité de pilotage relatif à l'élaboration et au suivi du Plan National d'Actions en faveur du Lynx, et d'en arrêter les principes de composition et de fonctionnement,

Sur proposition du directeur régional de l'environnement, de l'aménagement et du logement de Bourgogne-Franche-Comté,

ARRETE

Article 1er

Le plan national d'actions (PNA) « Lynx » est doté d'un Comité de pilotage présidé par Monsieur le Préfet de région.

Article 2

Une représentativité au niveau national est un pré requis pour l es organisations socio-professionnelles et les associations de protection de la nature souhaitant siéger au COPIL.
La demande pour siéger doit être formulée auprès de M. préfet de la région Bourgogne Franche-Comté.
Toute nouvelle demande sera soumise à l'avis des membres du COPIL.

Article 4

outre la DREAL Bourgogne-Franche-Comté coordinatrice du plan, l'OFB, rédacteur du plan, les DREAL(s) sur le territoire desquelles le plan est déployé, les représentants du MTES, le comité est composé des services et structures suivantes :

- la Direction Régionale de l'Alimentation, de l'Agriculture et de la Forêt Bourgogne-Franche-Comté
- l'Office National des Forêts,
- les Commissariats à l'aménagement de Massif des Alpes, du Jura et des Vosges,
- les régions sur le territoire desquelles le plan est déployé (Auvergne-Rhône-Alpes, Bourgogne Franche- Comté, Grand Est, Provence Alpes Coté d'Azur)
- les aires protégées (Fédération des parcs naturels de France et Réserves naturelles de France),
- l'Assemblée Permanente des Chambres d'Agriculture (APCA)
- le Centre National de la Propriété Forestière (CNPF)
- la Fédération Nationale des COmmunes FOrestières (FNCOFOR)
- la Fédération Nationale Ovine (FNO)
- la Fédération Nationale des Syndicats d'Exploitants Agricoles (FNSEA)
- les Jeunes Agriculteurs (JA)
- la Fédération Nationale des Chasseurs de France (FNC)
- France Nature Environnement (FNE)
- la Confédération Paysanne
- la Coordination Rurale
- la Société Française pour l'Étude et la Protection des Mammifères (SFEPM)
- World Wildlife Fund France (WWF France)
- Férus
- la Ligue de Protection des Oiseaux (LPO)

Article 5

Le secrétariat du Comité de pilotage est assuré par la Direction régionale de l'Environnement, de l'Aménagement et du Logement de Bourgogne-Franche-Comté (service Biodiversité, Eau, Patrimoine)

Article 6

Le COPIL est réuni à l'initiative du Préfet de la région Bourgogne-France-Comté sur proposition de la DREAL Bourgogne-Franche-Comté. Il est réuni au moins 1 fois par an. Le Préfet peut faire intervenir toute personne qu'il juge utile à la conduite des débats du COPIL sans voix délibérative.

Article 7

Le Comité de pilotage est doté d'un conseil scientifique dont la composition et les principes de fonctionnement sont précisés par un arrêté préfectoral.

Article 8

Le préfet de la région Bourgogne-Franche-Comté et le directeur de la Direction régionale de l'Environnement, de l'Aménagement et du Logement de Bourgogne-Franche-Comté sont chargés de l'exécution de la présente décision qui sera publiée au Recueil des Actes Administratifs.

Bernard SCHMELTZ

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PRÉFET DE LA RÉGION BOURGOGNE-FRANCE-COMTE

Direction Régionale de l'Environnement,
de l'Aménagement et du Logement
de Bourgogne-Franche-Comté
Service Biodiversité Eau Patrimoine

BFC-2021-06-21-00001

ARRÊTÉ PRÉFECTORAL N° 21-696 BAG
portant modification de l'arrêté n° 20-129 BAG du 20 juillet 2020 de constitution du Comité de Pilotage du Plan National d'Actions en faveur du Lynx

Le Préfet de la Région Bourgogne-France-Comté
Préfet de la Côte d'Or
Officier de la Légion d'Honneur
Officier de l'Ordre National du Mérite

Vu la note du ministère en charge de l'Écologie en date du 9 mai 2017 relative à la mise en œuvre des plans nationaux d'actions prévus à l'article L.411-3 du code de l'Environnement,

Vu la lettre de mission du 27 août 2018 par laquelle le Ministre en charge de l'écologie mandate le Préfet de la région Bourgogne-Franche-Comté pour élaborer un Plan National d'Actions en faveur du Lynx,

Vu la consultation engagée en 2018 par la DREAL,

Vu l'arrêté n°20-129 BAG du 20 juillet 2020 portant constitution du Comité de pilotage du PNA Lynx,

Vu l'arrêté BFC-2020-07-20-004 du 20 juillet 2020 portant constitution du Conseil scientifique du PNA Lynx,

Vu le règlement intérieur du Conseil scientifique du PNA Lynx,

Considérant la demande formulée par les membres du COPIL que le Conseil Scientifique soit formellement représenté au Comité de pilotage,

Considérant que les travaux du Conseil scientifique du PNA Lynx doivent notamment éclairer les membres du Comité de pilotage sur les actions identifiées au plan,

Considérant la nécessité de préciser le rôle du Comité de pilotage,

Sur proposition du directeur régional de l'environnement, de l'aménagement et du logement de Bourgogne-Franche-Comté,

ARRETE

Article 1er

L'article 1 est rédigé comme suit :

Le plan national d'actions (PNA) « Lynx » est doté d'un Comité de pilotage présidé par Monsieur le Préfet de région.
Il a pour missions de favoriser la concertation entre les parties prenantes, de proposer les orientations stratégiques et les actions prioritaires à mettre en œuvre, leur ajustement le cas échéant, de décider, de valider le suivi des actions décidées et les bilans à chaque étape, ainsi que l'évaluation du plan.
Il peut saisir le Conseil scientifique.

Article 2

Un article 8 rédigé comme suit est inséré :

Le président du Conseil scientifique, ou l'un des membres qu'il aura préalablement désigné, siège au sein du Comité de pilotage.

Article 3

Le préfet de la région Bourgogne-Franche-Comté et le directeur de la Direction régionale de l'Environnement, de l'Aménagement et du Logement de Bourgogne-Franche-Comté sont chargés de l'exécution du présent arrêté qui sera publié au Recueil des Actes Administratifs.

Fabien SUDRY

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PRÉFET DE LA RÉGION BOURGOGNE-FRANCE-COMTE

Direction Régionale de l'Environnement,
de l'Aménagement et du Logement
de Bourgogne-Franche-Comté
Service Biodiversité Eau Patrimoine

BFC-2020-07-20-004

Arrêté préfectoral portant constitution du Conseil scientifique du Plan National d'Actions en faveur du Lynx

Le Préfet de la Région Bourgogne-France-Comté
Préfet de la Côte d'Or
Officier de la Légion d'Honneur
Officier de l'Ordre National du Mérite

Vu le code de l'environnement, notamment son article L.411-3 ;

Vu la lettre de mission du 27 août 2018 par laquelle le Ministre en charge de l'écologie mandate le Préfet de la région Bourgogne-Franche-Comté pour élaborer un Plan National d'Actions en faveur du Lynx,

Vu la réunion du Comité de pilotage du PNA lynx en date du 21 juin 2019,

Vu l'arrêté de création du Comité de pilotage du PNA Lynx

Vu la consultation organisée par la DREAL Bourgogne Franche-Comté en mai 2020

Sur proposition du directeur régional de l'environnement, de l'aménagement et du logement de Bourgogne-Franche-Comté,

DECIDE

Article 1er

Le plan national d'actions (PNA) « Lynx » est doté d'un Conseil scientifique chargé de formuler des recommandations sur les études, les expérimentations scientifiques, les orientations stratégiques du PNA et toutes les actions autres s'inscrivant dans les objectifs du PNA.

Article 2

Le Conseil Scientifique est saisi par le président du comité de pilotage.

Il peut également se saisir d'office pour apporter une expertise scientifique et technique sur des thématiques qui lui semblent pertinentes dans le cadre des objectifs du PNA.

Il peut contribuer aux travaux des comités techniques de massifs et des groupes de travail.

Article 3

Le Conseil scientifique du PNA Lynx est composé de personnes reconnues pour leurs compétences en matière de sciences naturelles, de sciences humaines, de gestion.

Article 4

Sont nommés membres du conseil scientifique du plan national d'actions en faveur du Lynx, pour une durée de 3 ans renouvelable :

Monsieur Farid BENHAMMOU
Monsieur Philippe BILLET
Monsieur Guillaume CHAPRON
Monsieur Guillaume CHRISTEN
Monsieur Hervé FRITZ
Monsieur Olivier GIMENEZ
Monsieur Patrick GIRAUDOUX
Monsieur Alexis LÉCU
Monsieur François MOUTOU
Madame Audrey SAVOURE-SOUBELET
Madame Nolwenn DROUTET-HOGUET
Monsieur Pierre TABERLET
Madame Aline TREILLARD
Monsieur Fridolin ZIMMERMAN

Article 5

Article 6

Le secrétariat du conseil scientifique est assuré par la Direction régionale de l'Environnement, de l'Aménagement et du Logement de Bourgogne-Franche-Comté (service Biodiversité, Eau, Patrimoine) Le service recherche du CGDD du Ministère apporte un appui scientifique pour la préparation et le suivi des travaux du conseil scientifique.

Article 7

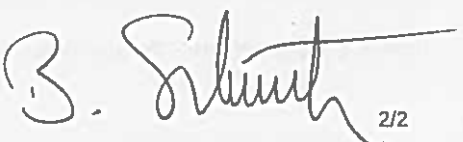
Le Conseil scientifique se dotera d'un règlement intérieur et élit en son sein un/une président (e).

Article 8

Les membres du conseil scientifique exercent leurs fonctions à titre gratuit. Il peut toutefois leur être alloué des indemnités correspondant aux frais de déplacement et de séjour effectivement supportés à l'occasion des réunions, dans les conditions fixées par le décret n° 2006-781 du 3 juillet 2006 fixant les conditions et les modalités de règlement des frais occasionnés par les déplacements temporaires des personnels civils de l'Etat.

Article 9

Le préfet de la région Bourgogne-Franche-Comté et le directeur de la Direction régionale de l'Environnement, de l'Aménagement et du Logement de Bourgogne-Franche-Comté sont chargés , de l'exécution de la présente décision qui sera publiée au Recueil des Actes Administratifs.



Bernard SCHMELTZ

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RÉPUBLIQUE FRANÇAISE

PRÉFET DE LA RÉGION BOURGOGNE-FRANCE-COMTE

Direction Régionale de l'Environnement,
de l'Aménagement et du Logement
de Bourgogne-Franche-Comté
Service Biodiversité Eau Patrimoine

BFC-2021-06-21-00002

ARRÊTÉ PRÉFECTORAL N° 21.697 BAG
portant modification de l'arrêté n°BFC-2020-07-20-004 du 20 juillet 2020 de constitution du Conseil scientifique du Plan National d'Actions en faveur du Lynx

Le Préfet de la Région Bourgogne-France-Comté
Préfet de la Côte d'Or
Officier de la Légion d'Honneur
Officier de l'Ordre National du Mérite

Vu la note du ministère en charge de l'Écologie en date du 9 mai 2017 relative à la mise en œuvre des plans nationaux d'actions prévus à l'article L.411-3 du code de l'Environnement,

Vu la lettre de mission du 27 août 2018 par laquelle le Ministre en charge de l'écologie mandate le Préfet de la région Bourgogne-Franche-Comté pour élaborer un Plan National d'Actions en faveur du Lynx,

Vu l'arrêté n°20-129 BAG du 20 juillet 2020 portant constitution du Comité de pilotage du PNA Lynx,

Vu l'arrêté BFC-2020-07-20-004 du 20 juillet 2020 portant constitution du Conseil scientifiques du PNA Lynx,

Vu les demandes de rectification orthographique de nom formulées par deux membres du Conseil scientifique,

Considérant la nécessite de procéder à la correction de ces erreurs matérielles,

Considérant la demande formulée par les membres du Comité de pilotage pour que le Conseil Scientifique soit formellement représenté au Comité de pilotage,

Considérant que les travaux du Conseil scientifique du PNA Lynx doivent notamment éclairer les membres du Comité de pilotagesur les actions identifiées au plan,

Sur proposition du directeur régional de l'environnement, de l'aménagement et du logement de Bourgogne-Franche-Comté,

ARRETE

Article 1er

L'article 4 de l'arrêté BFC-2020-07-20-004 est rédigé comme suit :

Sont nommés membres du Conseil scientifique du plan national en faveur du Lynx, pour une durée de 3 ans renouvelable :

Monsieur Farid BENHAMMOU
Monsieur Philippe BILLET
Monsieur Guillaume CHAPRON
Monsieur Guillaume CHRISTEN
Monsieur Hervé FRITZ
Monsieur Olivier GIMENEZ
Monsieur Patrick GIRAUDOUX
Monsieur Alexis LÉCU
Monsieur François MOUTOU
Madame Audrey SAVOURE-SOUBELET
Madame Nolwenn DROUET-HOGUET
Monsieur Pierre TABERLET
Madame Aline TREILLARD
Monsieur Fridolin ZIMMERMANN

Article 2

L'article 5 de l'arrêté BFC-2020-07-20-004 est rédigé comme suit :

Le président du Conseil scientifique, ou l'un des représentants qu'il aura préalablement désigné, siège au sein du Comité de pilotage du PNA Lynx

Article 3

L'article 7 est rédigé comme suit :

Le Conseil scientifique se dote d'un règlement intérieur et élit en son sein un président selon les règles arrêtées par le règlement intérieur. Le président est assisté par un ou plusieurs vice-présidents élus selon les mêmes règles édictées dans le règlement intérieur.

Article 4

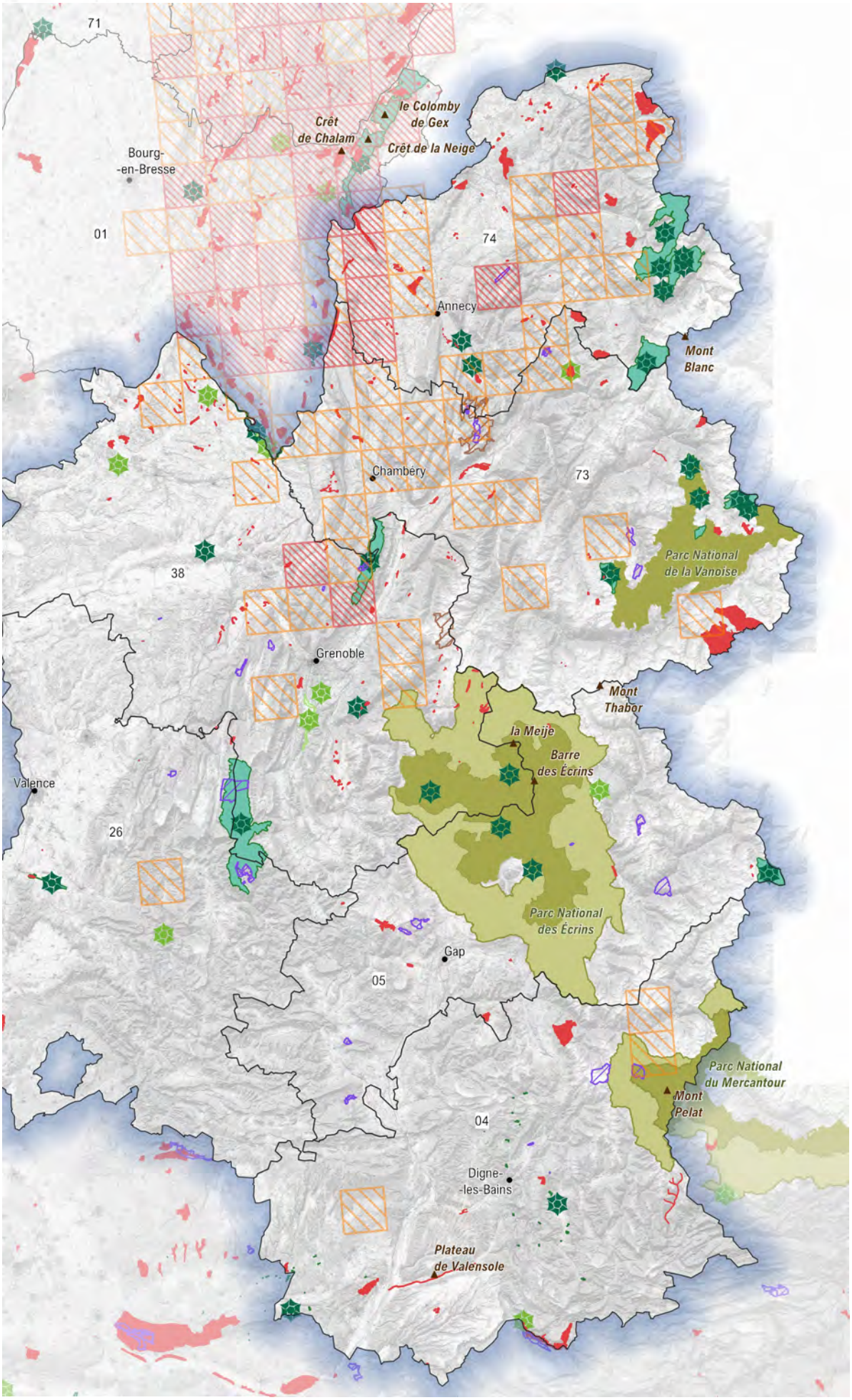
Le préfet de la région Bourgogne-Franche-Comté et le directeur de la Direction régionale de l'Environnement, de l'Aménagement et du Logement de Bourgogne-Franche-Comté sont chargés de l'exécution de la présente décision qui sera publiée au Recueil des Actes Administratifs.

Fabien SUDRY

PRÉFET DE LA RÉGION BOURGOGNE-FRANCHE-COMTÉ

Direction régionale de l'environnement, de l'aménagement et du logement

Zones de présence du Lynx et aires protégées
Massif des Alpes



N

Légende

Zone de présence du Lynx :

- Occasionnelle
- Régulière

Aires Protégées :

Parc national :

- Aire Optimale d'Adhésion (AOA)
- Zone d'Etude de Coeur (ZEC)
- Réserve naturelle nationale
- Réserve naturelle régionale
- Arrêté de protection du biotope
- Réserve biologique
- Réserve nationale de chasse et faune sauvage

- Préfecture
- Grand sommet
- Limites départementales

Sources :
IGN - OSM - INPN - ONF - OFB
GeoGrandEst - DatARA - DataSud - DREAL BFC

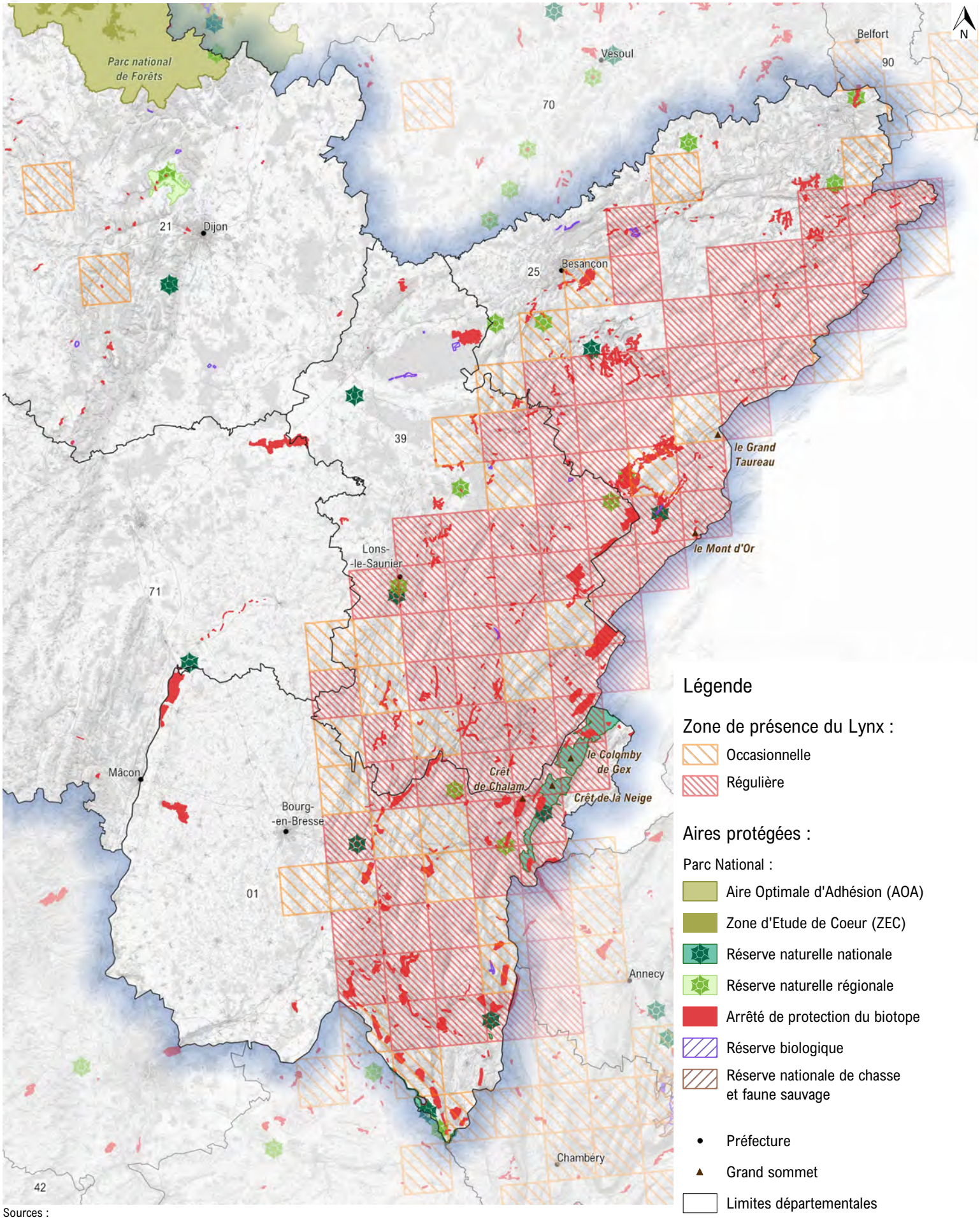
Conception :
DREAL BFC / SDDA/DC/PG 30-04-2021

0 10 20 30 40 km

PRÉFET
DE LA RÉGION
BOURGOGNE-
FRANCHE-COMTÉ

Direction régionale
de l'environnement,
de l'aménagement et du logement

Zones de présence du Lynx et aires protégées
Massif du Jura



Légende

Zone de présence du Lynx :

- Occasionnelle
- Régulière

Aires protégées :

Parc National :

- Aire Optimale d'Adhésion (AOA)
- Zone d'Etude de Coeur (ZEC)
- Réserve naturelle nationale
- Réserve naturelle régionale
- Arrêté de protection du biotope
- Réserve biologique
- Réserve nationale de chasse et faune sauvage

- Préfecture
- Grand sommet
- Limites départementales

0 10 20 30 40 km

Sources :
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Conception :
DREAL BFC / SDDA/DC/PG 30-04-2021

PRÉFET
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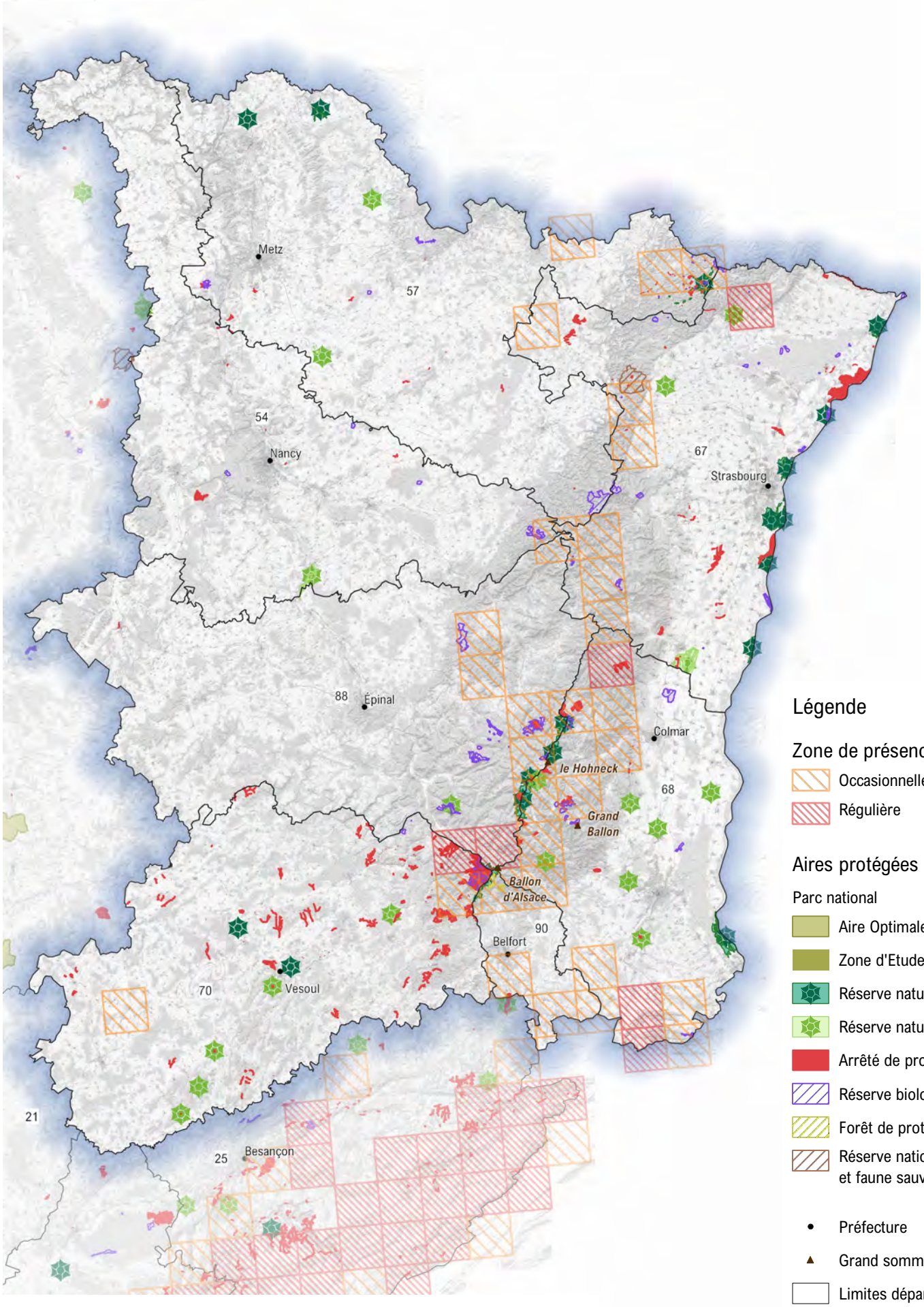
BOURGOGNE-
FRANCHE-COMTÉ

Direction régionale
de l'environnement,
de l'aménagement et du logement

Zones de présence du Lynx et aires protégées
Massif des Vosges



Légende

Zone de présence du Lynx :

- Occasionnelle
- Régulière

Aires protégées :

Parc national

- Aire Optimale d'Adhésion (AOA)
- Zone d'Etude de Coeur (ZEC)
- Réserve naturelle nationale
- Réserve naturelle régionale
- Arrêté de protection du biotope
- Réserve biologique
- Forêt de protection
- Réserve nationale de chasse et faune sauvage

- Préfecture
- Grand sommet
- Limites départementales

Sources :
IGN - OSM - INPN - ONF - OFB
GeoGrandEst - DatARA - DataSud - DREAL BFC

Conception :
DREAL BFC / SDDA/DC/PG 30-04-2021

0 10 20 30 40 km

Feuille de route de l'objectif 1.4 « Améliorer la connectivité et les échanges entre les populations de Lynx et réduire la mortalité liée aux collisions »

1/ Rappels

A/ Description

L'objectif poursuit deux axes :

1° Améliorer les connaissances sur la connectivité entre les populations de Lynx et favoriser les échanges en prenant en compte ces enjeux dans les projets d'aménagement du territoire, dont ceux notamment sur les infrastructures de transport.

2° Réduire les risques de mortalité du Lynx par collision avec les véhicules en analysant d'abord les données de mortalité sur les infrastructures existantes et en développant des outils d'aide à la décision et de sensibilisation à la problématique, ainsi que par la mise en œuvre de mesures correctrices, permettant ainsi de réduire l'accès aux zones dangereuses et de faciliter le franchissement des infrastructures ainsi qu'en sensibilisant les usagers de la route dans les zones sensibles.

B/ Contexte

En Europe, la forêt constitue l'habitat préférentiel du Lynx. Avec des domaines vitaux importants et des capacités de dispersion relativement faibles, les Lynx ont besoin de grandes surfaces forestières continues pour se maintenir et coloniser de nouveaux territoires. L'espèce se montre très sensible à la fragmentation de son habitat et les ruptures dans la continuité de cet habitat constituent des obstacles aux déplacements des individus, limitant l'expansion des populations, les échanges entre les noyaux de populations. Dans le cas des infrastructures de transport, ces obstacles constituent aussi des risques de collision, avec des impacts directs sur la survie des individus, et collatéraux sur la survie des jeunes dépendants. Depuis le retour du Lynx sur le territoire français, plus de 150 cas de collisions mortelles ont été constatés entre 1974 et 2018, représentant près de 60% des cas de mortalités détectés. Une synthèse réalisée en 2020 sur 175 évènements de mortalité de Lynx répertoriés de France entre 1990 et 2019 confirme que 58% (101/175) relève de collisions mortelles. Au cours de la dernière décennie, ce sont en moyenne une petite dizaine de Lynx par an qui sont tués sans compter les incidences indirectes sur les juvéniles dépendants), majoritairement sur les routes, accompagnés de quelques rares cas de collisions ferroviaires (moins de 10% des collisions).

Assurer une connectivité fonctionnelle entre les différents noyaux de population est aussi essentiel pour maintenir un brassage génétique par la formation d'une métapopulation, nécessaire à la viabilité à long terme de l'espèce dans cette partie de l'Europe.

Les enjeux d'habitat et de connectivité pour le Lynx se situent à différentes échelles et s'étendent évidemment aux pays limitrophes. Ainsi le massif des Vosges reste relativement isolé malgré l'arrivée de quelques individus issus des réintroductions qui ont eu lieu de 2016 à 2020 dans la forêt du Palatinat en Allemagne, ou qui ont pu remonter depuis le massif du Jura. Des corridors fonctionnels avec la Forêt Noire ou le Jura suisse restent à mettre en évidence. Le massif du Jura alimente des noyaux de population dans les Alpes mais les mouvements au sein du massif alpin et les échanges avec les populations suisses restent peu documentés et sont suspectés très faibles. Là encore, l'urbanisation, la densité des infrastructures et les ruptures dans la continuité forestière pourraient fortement limiter la circulation des Lynx et freiner le développement des populations vosgienne-palatine et alpine. Des zones où les destructions illégales sont fortes sont aussi un frein mis en évidence dans certaines régions du massif en Suisse.

Des connaissances restent à acquérir sur les mouvements des animaux. L'identification des obstacles aux déplacements, et les mesures prises pour améliorer la connectivité à l'intérieur d'un massif et entre massifs participeront aussi aux objectifs de maintien des populations de Lynx.

Deux projets de recherches (ITTECOP), respectivement en 2012 **(Gaillard *et al.,* 2012)** et 2018-2020 **(Equipe projet ERC Lynx, 2021)** se sont penchés sur ces thématiques en développant des modèles spatiaux de risques de collisions des Lynx et de viabilité de la population sur le long terme en lien également avec des changements du paysage, et donc de l'habitat du Lynx. Ces projets ont permis d'identifier les zones à fort risque potentiel de collision dans le massif du Jura, puis de développer, à l'échelle de la France, un outil prédictif intitulé ERC Lynx (effet d'aménagements du territoire sur la viabilité des populations de Lynx), destiné particulièrement aux gestionnaires d'infrastructures et aux aménageurs. Les observations effectuées sur le terrain doivent continuer à alimenter ces études.

Néanmoins, des actions concrètes doivent être mises en œuvre dès à présent afin de réduire les mortalités par collisions observées comme l'information des décideurs publics, gestionnaires et usagers sur les sites accidentogènes avérés mais également le partage des lacunes dans les aménagements sur certaines infrastructures (défaut d'engrillagement ou de passages à faune adaptés par ex.). L'ensemble de ces actions doit pouvoir être réalisées rapidement.

Le PNA entend ainsi faciliter les actions à différentes échelles, sur des actions ponctuelles et rapides grâce aux acteurs de terrains, par des aménagements d'ampleur variable (entretien et pose de clôture, passage à faune) et des réflexions à plus long terme avec les gestionnaires et aménageurs.

2/ Présentation des actions à conduire

Action n°1 :

A/ Identifier les points noirs de collisions sur les infrastructures de transport.

Actuellement en France, les collisions routières constituent la principale menace pesant sur les populations de Lynx boréal : les collisions représentent près de 60% des cas de mortalité détectés, 90% de ces collisions étant de nature routière et 10% de nature ferroviaire.

Le Lynx figure à l'annexe II de la directive « Habitats » (Directive 92/43/CEE du Conseil du 21 mai 1992 concernant la conservation des habitats naturels ainsi que la faune et la flore sauvages) et est protégé à ce titre, notamment par les dispositions de l'article 12 paragraphe 4 qui impose de mettre en place un système de contrôle des mises à morts accidentelles de ces espèces afin d'acquérir des données fiables sur le nombre de ces destructions accidentelles et leur incidence sur l'état de conservation de l'espèce. Le document d'orientation de la Commission européenne relatif à l'interprétation de cette directive, publié en octobre 2021, indique que le cas des collisions entre la faune figurant à l'annexe de la directive et les véhicules entre dans le champ d'application de cet article. Il cite explicitement l'impact des collisions routières sur les populations de Lynx ibérique.

Des **connaissances doivent donc être acquises sur les déplacements** de l'espèce, les obstacles à ces déplacements ainsi que leur impact sur l'état de conservation du Lynx. Un **diagnostic des sites à enjeux** sera établi en croisant les données liées à la biodiversité (cartographies des continuités écologiques régionales, bases de données nationales et locales…), les informations sur les infrastructures existantes (type d'infrastructures, trafic, …), ainsi que les informations sur les collisions concernant le Lynx sur les réseaux routiers (ou ferroviaires) à partir des données bibliographiques disponibles ou des prospections de terrain réalisées.

Dans ce cadre, **un bilan sera effectué auprès des gestionnaires d'infrastructures** en ce qui concerne la remontée des données de mortalité dont ils disposent sur les collisions avec le Lynx de même que les informations sur leurs projets d'aménagements susceptibles d'impacter l'espèce. Dans tous les cas, il s'agira d'instaurer une dynamique de communication en ce sens. Ils seront également encouragés à échanger leurs retours d'expériences sur les difficultés et solutions envisagées pour réduire la mortalité par collision du Lynx.

Cette analyse permettra **d'identifier et de cartographier les « points noirs »** pour l'espèce sur l'ensemble de son aire de répartition. Une **méthode de hiérarchisation** devra être mise en place afin d'identifier les secteurs nécessitant d'intervenir prioritairement sur un pas de temps à définir en fonction des moyens et mesures correctrices à mettre en œuvre. Cette étape fluide d'acquisition de connaissances sur les sites problématiques pour l'espèce est indispensable pour la mise en œuvre des actions suivantes. Ces travaux devront être valorisés et diffusés largement. Les livrables et moyens de communication retenus seront adaptés aux publics ciblés.

B/ Agir à court, moyen et plus long terme par la mise en œuvre de mesures correctrices adaptées et hiérarchisées.

Suite aux travaux (Gaillard *et al*., 2012 ; Morand, 2016 ; Equipe projet ERC Lynx, 2018-2020) et aux réunions collectives qui ont déjà eu lieu dernièrement avec les partenaires, notamment scientifiques et techniques, des actions concrètes doivent être mises en œuvre dès à présent sur les points noirs déjà bien identifiés (voir ci-dessous). L'objectif est bien, après les avoir hiérarchisés, de résoudre rapidement ces points noirs et de réduire les mortalités par collisions observées.

Des contacts ont été déjà pris, notamment lors des travaux du projet ITTECOP « ERC Lynx », et des réunions de concertation autour de la création de l'outil ERC Lynx. Ils seront approfondis et élargis auprès d'autres gestionnaires d'infrastructures de transport (conseils régionaux, départementaux, concessionnaires autoroutiers

ou ferroviaires, directions interdépartementales des routes) afin de les associer à ces études ou de les sensibiliser aux résultats. Ils pourront prendre la forme de journées d'échanges présentant les enjeux et secteurs prioritaires.

Trois points noirs représentent à eux seuls 30% des collisions dans le massif du Jura :

- Route nationale 57, section Pontarlier à Jougnes (Doubs)
- Route nationale 5, section Morbier (Jura)
- Route départementale 470 section Villards-d'Héria (Jura)

Ces tronçons routiers capitalisent jusqu'à plus de 8 collisions par an certaines années (2004, 2008, 2011 par exemple).. L'année 2021 est quant à elle particulièrement meurtrière, notamment sur la RN57, pour des raisons encore à approfondir. Au-delà de ces trois principaux tronçons, d'autres routes (anciennement nationales devenues départementales) sont particulièrement sujettes aux collisions sur les départements du massif du Jura : Département du Jura : D471, D1083, D436, D69, D52 ; Département de l'Ain : D1504, D1084 et D1206 ; Département du Doubs : D437 et D683.

Au-delà de l'importance de la résolution de ces points noirs bien identifiés, il existe d'autres remontées d'informations de cas isolés et/ou peu nombreux de collisions mais pour lesquels les solutions sont relativement faciles et peu couteuses à mettre en œuvre. C'est le cas notamment des exemples suivants, pour les routes/autoroutes : l'écopont d'Orchamps Venne (D461) qui présente une étanchéité de clôture insuffisante proche de l'écopont non conforme aux mesures préconisées ; l'échangeur de Nantua (A40/A404) avec la présence d'une clôture grillagée à maille large (inefficace pour les jeunes Lynx), et l'absence de clôture sur plus d'une cinquantaine de mètres avec accès facile pour un Lynx à la chaussée. Pour les voies ferroviaires, une collision récente, proche d'Artemare est également liée à l'existence d'une clôture perméable à la faune. De telles situations contribuent à augmenter, de manière non négligeable, le taux de mortalité annuel. Il faut donc agir rapidement pour réduire ce risque.

De manière générale, les solutions permettant de faciliter le franchissement des individus doivent être adaptées au point noir concerné (type de réseau, enjeux environnementaux, contexte local, configuration de la zone, topographie, etc.). Les solutions de franchissement peuvent aller de la simple clôture adaptée au Lynx à des techniques innovantes (détecteur de mouvement, …), et à celles plus conséquentes de passages dédiés à la grande faune équipés selon les indications qui devront être formalisées par l'équipe projet.

L'efficacité de ces ouvrages de franchissement nécessitera également la plupart du temps la réalisation d'aménagements rendant attractives ces zones de traversée comme l'installation ou la réfection des clôtures le long des infrastructures, avec un maillage et une hauteur adaptés à l'espèce, la présence de masques végétaux, etc. Il s'agira d'exppiter les nombreux exemples et préconisations issus duguide relatif aux passages faune à paraître par le CEREMA en 2021 et du document d'orientation relatif à la directive « Habitats » publié par la Commission européenne en octobre 2021, et dans lequel ces aménagements sont cités comme ayant fait leurs preuves pour le Lynx ibérique (voir les programmes européens LIFE Iberlince, LIFE SAFECROSSING et LIFE LYNXCONNECT). Afin de faciliter la réalisation d'une nouvelle évaluation du besoin et enrichir la connaissance, les retours d'expérience des différents maîtres d'ouvrages et l'expertise scientifique et technique des institutions spécialisées et des milieux associatifs devront être recueillis en parallèle.

Un suivi adapté devra être mis en place afin de mesurer l'efficacité des mesures mises en œuvre.

Il s'agit aussi d'améliorer le partage de l'information auprès des décideurs publics, gestionnaires et usagers sur de tels sites accidentogènes avérés mais également de partager les lacunes dans les aménagements sur ces infrastructures (défaut d'engrillagement ou de passages à faune adaptés par ex.). L'ensemble de ces actions doit pouvoir être réalisé rapidement, l'équipe projet doit préciser les aménagements adaptés aux différents sites identifiés.

Expérimenter sur un territoire la mise en place d'une démarche intégratrice

Lors des Groupes de travail et des COPIL, le PNR du Haut-Jura a proposé d'être territoire d'expérimentation pour travailler sur les mortalités du Lynx par collision. En effet, ce territoire porte une forte responsabilité nationale pour la conservation du Lynx et est concerné par des collisions routières avec le Lynx.

Ce projet est conforme avec la Charte du Parc en particulier la mesure 2.1 « Développer une gestion du territoire respectueuse des patrimoines naturels » et avec la Stratégie opérationnelle 2015-2020, plus précisément les objectifs opérationnels de priorité 1 suivants :

Affiner et partager un diagnostic sur lequel viendra s'appuyer la Trame Verte et Bleue du Parc. En arrêter les composantes et les orientations (acquisition de connaissance, gestion, suivi, diffusion de la connaissance et des expériences) en lien avec les partenaires et le conseil scientifique.

Assurer ou accompagner la protection et la gestion des continuités écologiques

Poursuivre et développer des opérations de gestion ciblées et/ou expérimentales visant en particulier le maintien des potentialités biologiques des milieux forestiers et ouverts remarquables.

Poursuivre la dynamique de gestion/préservation de certaines espèces emblématiques du Haut-Jura.

Cette expérimentation démarrera des 2022

Ainsi, le territoire fera l'objet d'un diagnostic précis des collisions sur la base des données récentes et actualisées de mortalité. Le recensement des routes et tronçons « meurtriers », de même que celui des secteurs à enjeu au sein du périmètre du PNR sera effectué et cartographié. Les facteurs explicatifs seront recherchés : densité du trafic, vitesse des usagers, trame paysagère (forêt, manque de visibilité…), aménagements (grillage non efficient, etc.). Un tel diagnostic sera suivi de l'analyse du/des moyens les plus adaptés à déployer sur le territoire du Haut-Jura en évaluant leur coût/efficacité (faisabilité…) pour une mise en œuvre en 2023.

Ce projet permettra un travail collaboratif avec les structures techniques ayant compétence sur les enjeux biodiversité/infrastructures routières (CEREMA/OFB/DREAL-DIR/Départements/ SNCF réseau) ainsi que les membres du COPIL du PNA Lynx.

Les résultats attendus sont les suivants :

A court terme, diminuer le nombre de collisions selon un diagnostic des axes les plus accidentogènes ou à risque.

Concernant les axes routiers, expérimenter un outil de sensibilisation des automobiles aux risques de collisions.

Nourrir les réflexions sur les solutions à apporter aux structures gestionnaires des axes de circulation pour diminuer les risques de collisions.

Promouvoir le patrimoine du territoire via l'image du Lynx. L'information autour du risque de collision est l'occasion de communiquer positivement sur la présence de cette espèce, de son rôle dans le paysage jurassien et de susciter l'adhésion de la population (locale ou visiteurs) à sa préservation.

Action n°2 : Alimenter l'outil ITTECOP « ERC-Lynx », le développer et le mettre à disposition

Les projets d'aménagement, qu'ils soient routiers ou bâtis, sont susceptibles d'impacter la viabilité des populations de Lynx à plus ou moins long terme. D'ailleurs, les porteurs de projets d'aménagement entrepris dans des zones où le Lynx est potentiellement présent doivent réaliser une évaluation environnementale et mettre en œuvre la séquence Éviter-Réduire-Compenser (ERC). L'outil ERC Lynx a pour rôle de favoriser et de renforcer la mise en œuvre de politiques publiques d'aménagement du territoire telle la Trame Verte et Bleue et ses déclinaisons régionales (Schéma Régional Cohérence Écologique / Schéma Régional d'Aménagement, de Développement durable et d'Égalité du Territoire). C'est dans ce contexte qu'il a été développé, suite à un appel à projet 2017-2020 du programme ITTECOP[1].

C'est un outil innovant et robuste (issu d'une approche prédictive par modélisation et de données réelles de terrain) d'aide à la décision pour enrichir les réflexions autour des projets d'aménagement et guider les acteurs du territoire dans le choix le moins impactant. Pour cela, il renseigne sur les effets des projets d'aménagement sur la viabilité des populations de Lynx à l'horizon de 50 ans. Il repose sur la mise en commun, l'ajout et l'exploitation des résultats de précédents travaux majeurs (modélisation, diagnostics écologique et technique) en lien avec la viabilité des populations de Lynx, les risques de collision lors du franchissement d'ITT et les mesures correctrices.

Dans le cadre du PNA, les opérateurs techniques pourront s'appuyer sur une première version d'un outil à portée opérationnelle dans leur processus de prise de décision relatif à l'aménagement du territoire. Les perspectives dans le cadre du PNA sont d'améliorer l'outil par la prise en compte des routes (effet « barrière ») dans le processus de dispersion et l'intégration de nouvelles données, notamment celles liées aux dispositifs d'écoponts et de passages inférieurs en s'appuyant, notamment sur les résultats du programme européen H2020 « BISON ».

Action n°3 : Communiquer auprès des aménageurs et des usagers

Effectuer une campagne de sensibilisation auprès des automobilistes dans les zones à risques

Cette campagne de sensibilisation auprès des automobilistes doit s'appuyer sur les partenaires locaux, institutionnels et associatifs. De fréquence annuelle ou bi-annuelle, elle pourra précéder les périodes de risques pour l'espèce (automne, hiver). Elle pourra être d'envergure nationale (réalisation de vidéos diffusées sur les plateformes de streaming, sur les sites des institutions, etc.) mais être également déclinée selon des modalités renforcées dans les zones à risques (panneaux d'information, plaquettes de présentation de l'espèce, sessions d'information en présentiel, …). A cet égard, il conviendra de se pencher sur la nécessité de prévoir une communication spécifique sur le Lynx car un comportement spécifique de l'automobiliste est attendu, ou bien, au travers d'une communication générale sur la grande faune, de sensibiliser les conducteurs sur les réactions et réflexes de conduite associés.

Cette campagne de valorisation du Lynx permettra de renforcer son identité et donc l'attention qui lui est portée par les automobilistes dans leurs comportements de conduite. Elle pourra présenter les grandes caractéristiques de l'espèce, sa biologie et son comportement, l'évolution des populations ainsi que son aire de répartition.

Elle doit s'attacher à présenter les risques des collisions entre le Lynx et les véhicules pour la sécurité routière mais aussi et surtout pour la survie des noyaux de populations et le maintien de la biodiversité.

1 Ce programme incitatif de recherche est conduit par le ministère de la Transition écologique, en coordination avec l'Agence de l'environnement et de la maîtrise de l'énergie (Ademe). Son objectif principal est de confronter les enjeux techniques des infrastructures de transport et leurs emprises (routières, ferrées, et fluviales ou énergétiques) et leurs interfaces avec les territoires (gares, ports, aéroports, etc.) en incluant les dimensions paysagères et de biodiversité (www.ittecop.fr).

Mise en place d'une signalétique routière adaptée au Lynx

Cette action s'adresse aux aménageurs et aux gestionnaires. La mise en place d'une signalétique routière relevant d'un cadre normalisé, il conviendra d'analyser en amont le besoin et les solutions offertes à ce jour par les panneaux normalisés existant (notamment panneau de signalisation A15b indiquant la proximité de passage d'animaux sauvages, panneaux de signalisation d'intérêt culturel et touristique en France H1 à 4).

Comme l'ont démontré les travaux des programmes LIFE Iberlince en Espagne, aujourd'hui prolongés par ceux du programme LIFE SAFE CROSSING, l'une des causes des collisions est liée à l'absence de sensibilisation ou de modification de la conduite des automobilistes malgré la présence de panneaux routiers informant des risques de traversées d'animaux. L'installation d'une signalétique routière représentant le Lynx est de nature à insister sur l'identité de l'espèce menacée par le risque de collisions et de modifier le comportement des automobilistes. Il s'agira d'étudier au sein du groupe partenarial les modalités d'une telle campagne, son probable caractère temporaire à la période de sensibilité maximale de l'espèce au risque de collision, en relation au maintien du niveau de vigilance des conducteurs. Ces panneaux pourront également être renforcés par l'usage de systèmes visuels (couleurs, panneaux clignotants, etc.) permettant d'en accentuer la particularité.

Sur les sites à enjeux, d'autres actions peuvent être également conduites en l'absence de passage dédié à la faune comme la réduction de vitesse temporaire, la pose de radars sur les périodes à enjeu ou encore des aménagements de voirie.

La mise en œuvre de cette action devra se faire en lien avec l'action 1 du présent objectif. Une expérimentation de cette action sera notamment conduite dans le cadre d'un partenariat avec le PNR du Haut-Jura sur son territoire dès 2022..

Pour mémoire, actions à mener sur du plus long terme :

- Réaliser ou compléter des diagnostics sur les flux migratoires et les déplacements des lynx en relation avec l'habitat
- Développer et implémenter une stratégie de gestion de l'habitat en lien avec les enjeux de connectivité pour l'espèce
- Faciliter la remontée et le traitement de signalements ponctuels, de risques ou de problèmes dans certaines zones ou sur certains aménagements routiers
- Assurer un suivi des ouvrages de franchissement existants, dédiés ou non à la faune, pour d'éventuels requalifications ou réaménagements
- Évaluer l'efficacité de la signalétique ou des dispositifs anticollisions envisagés (notamment en s'appuyant sur le réseau d'observation des FDC)

Quelques références utiles et disponibles

Cerema/Morand A. (2016). Le lynx : risques routiers et mesures correctrices – état des lieux et recommandations. 90p. DGALN/DEB/PEM2 (www.cerema.fr).

Cerema (sous la direction de Nowicki F.) (2021). Préservation et restauration des continuités écologiques pour un projet d'infrastructure de transport - guide techniques des passages à faune" (www.cerema.fr téléchargeable gratuit).

Équipe projet ERC-Lynx (2021). Éviter, réduire et compenser le risque de mortalité du Lynx par collision avec les véhicules de transport. Développement d'un outil prédictif opérationnel à destination des gestionnaires des infrastructures de transport terrestre couplant risque de collision, viabilité des populations de lynx et enjeux des territoires. Projet ITTECOP 2018-2020, CEFE/Cerema/CROC/OFB. Version finale de septembre 2021. 300p. pdf.

Gaillard J.M., Hermery A., Bonenfant C., Basille M., Marboutin E., Mauz I. & Doré A. (2012). Mise au point d'un modèle de diagnostic des interactions entre structures paysagères, infrastructures de transports terrestres et espèces emblématiques – Le cas du Lynx dans le massif Jurassien. Rapport final du programme ITTECOP. MEDDTL : 123p. pdf.

LIFE SAFE CROSSING (2021). Workshop « *Preventing Animal-Vehicle collisions* »: Innovative techniques to mitigate transportation infrastructure impact on large carnivores. LIFE11BIO/IT/072-LIFE17NAT/IT/464 Visioconférence le 12 janvier 2021.

Morand A. (2021). Les actions liées aux infrastructures de transport et l'outil ERC-Lynx In: *Les actes de la journée de restitution du projet ERC-Lynx : Eviter, réduire et compenser la mortalité du Lynx boréal par collision avec les véhicules de transport*. Webinaire du 4 juin 2021, Projet ITTECOP 2018-2020, CEFE/Cerema/CROC/OFB. p 21-26.

Souillot D. (2019). Réduire et éviter le risque de mortalité du Lynx boréal (*Lynx lynx*) par collision avec les véhicules de transports terrestres dans le Massif du Jura « Typologie des tronçons accidentogènes et profils biologiques des lynx morts ». Stage de Master 2 / Université de Perpignan Via Domitia / Master Biodiversité, Ecologie, Evolution / Parcours "Biodiversité et Développement Durable". Encadrée par Alain Morand (Cerema Est) avec l'appui de l'équipe projet ERC Lynx. pdf.

PNA LYNX

LES ASSOCIATIONS DE PROTECTION DE LA NATURE

SFEPM, WWW France, CROC, FERUS, FNE, LPO, ASPAS, APACEFS, KORA, Centre de soin Athenas, OCS, Pôle Grands Prédateurs, SOS Faucon Pèlerin-Lynx, Panthera

LES AIRES PROTÉGÉES

Parcs naturels régionaux des Ballons des Vosges, des Vosges du Nord, du Haut-Jura et de la Chartreuse, Réserve naturelle nationale de la Haute Chaîne du Jura, Parc naturel régional du Doubs Horloger

LES COLLECTIVITÉS LOCALES

Conseils régionaux, Conseils départementaux

2022
2026

LES SERVICES DE L'ÉTAT ET LES ÉTABLISSEMENTS PUBLICS

DREAL, DDT, OFB, CEREMA, ONF, VNF

LES SOCIOS-PROFESSIONNELS

FNO, FNSEA, Confédération Paysanne, Coordination rurale, Jeunes agriculteurs, FNC, FDCs, les Chambres régionales d'Agriculture, ARDAR, CNPF, CRPF, FNCOFOR

ET AUSSI

La Citadelle de Besançon, Le Laboratoire Chrono-Environnement, SNCF Réseau, IPRA, IDELE

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