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Abstract: We review the Eurasian lynx (*Lynx lynx*) reintroductions in Central and West Europe and the present status of the populations. The requirements defined by the IUCN Reintroduction Guidelines are used to evaluate the reintroduction projects and to identify important factors for successful lynx reintroductions. Reintroduction of Eurasian lynx started as early as 1970 and continues to present. In all attempts, only a small number of animals, ranging from two to 31 animals, were released. Fifty-seven percent of the animals were wild-caught in the Carpathian Mountains of Slovakia; 40% were captive-born lynx and some were of unknown origin. The assessment of the Eurasian lynx reintroduction programmes suffers from lack of information and insufficient (longterm) follow-up monitoring for most projects. Even some of the recent projects failed to apply adequate scientific methods to monitor the fate of the released animals and the success of the Programme. The comparison of the different projects however still allows for some general conclusions regarding the reversal of historic threats, number and origin of the animals, the choice of release sites, information and public involvement, and monitoring and follow-up programmes which might provide some lessons for the recovery of the Iberian lynx.

Notes: Incl. Spanish abstract

# Lessons from the reintroduction of the Eurasian lynx in Central and West Europe

## Lecciones aprendidas a partir de la reintroducción del lince boreal en Europa Central y Occidental

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### RESUMEN

En este capítulo revisamos las reintroducciones del lince boreal (*Lynx lynx*) en Europa Central y Occidental, así como el estado actual de las poblaciones. Para ello, hemos utilizado los requisitos establecidos en la “Guía para Reintroducciones” de la Unión Internacional para la Conservación de la Naturaleza (IUCN), con el fin de evaluar los proyectos de reintroducción e identificar los indicadores que potencialmente pueden afectar al éxito o al fracaso de las reintroducciones de lince. Las primeras reintroducciones de lince boreal comenzaron en el año 1970 y continúan hasta la fecha. En cada caso, sólo se liberó a un número pequeño de linces, entre dos y 31 ejemplares por suelta. El 57% de los linces reintroducidos fueron capturados en la naturaleza, en las montañas de los Cárpatos de Eslovaquia; el 40% fueron linces nacidos en cautividad y el resto de los ejemplares fueron de origen desconocido. En la mayoría de los casos, la evaluación de los programas de reintroducción del lince boreal se ve afectada por la escasez de datos y por la falta de un seguimiento adecuado (a largo plazo); incluso, en algunos de los proyectos más recientes no se han utilizado métodos científicos apropiados para hacer un seguimiento de la evolución de los animales liberados o del grado de éxito del programa. No obstante, el estudio comparativo de los distintos proyectos nos permite sacar algunas conclusiones generales sobre los cambios de las amenazas históricas, sobre el número y origen de los animales, sobre la elección de los lugares de suelta, sobre la diseminación de información y participación del público, así como sobre el control y seguimiento de las poblaciones reintroducidas. Estos datos nos pueden proporcionar lecciones que nos sirvan para la recuperación del lince ibérico.

### PALABRAS CLAVE

reintroducción, lince boreal, *Lynx lynx*, Europa, evaluación, directrices

## **ABSTRACT**

We review the Eurasian lynx (*Lynx lynx*) reintroductions in Central and West Europe and the present status of the populations. The requirements defined by the IUCN Reintroduction Guidelines are used to evaluate the reintroduction projects and to identify important factors for successful lynx reintroductions. Reintroduction of Eurasian lynx started as early as 1970 and continues to present. In all attempts, only a small number of animals, ranging from two to 31 animals, were released. Fifty-seven percent of the animals were wild-caught in the Carpathian Mountains of Slovakia; 40% were captive-born lynx and some were of unknown origin. The assessment of the Eurasian lynx reintroduction programmes suffers from lack of information and insufficient (long-term) follow-up monitoring for most projects. Even some of the recent projects failed to apply adequate scientific methods to monitor the fate of the released animals and the success of the Programme. The comparison of the different projects however still allows for some general conclusions regarding the reversal of historic threats, number and origin of the animals, the choice of release sites, information and public involvement, and monitoring and follow-up programmes which might provide some lessons for the recovery of the Iberian lynx.

## **KEYWORDS**

reintroduction, Eurasian lynx, *Lynx lynx*, Europe, evaluation, guidelines

# Lessons from the reintroduction of the Eurasian lynx in Central and West Europe

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## INTRODUCTION

**T**he Eurasian lynx (*Lynx lynx*), once widespread across Europe, has reached the minimum of its historic distribution during the first decades of the 20<sup>th</sup> century. Due to human persecution in addition to habitat destruction and loss of prey, the species only survived in Russia, the Carpathian Mountains, Western Balkans and in small numbers in Scandinavia and Finland. Around 1950, the general downward trend came to a halt and the autochthonous populations started to recover. Not only the ecological conditions had improved, but also the general attitude of people towards large carnivores had changed and they were granted legal protection or at least some form of controlled hunting (Breitenmoser, 1998). A natural re-colonisation of former habitats in central, southern and western Europe from remnant populations was, however, no longer possible (the lowlands between the forested mountain ranges were too heavily encroached by man).

Therefore, several lynx reintroduction attempts into suitable areas were initiated from the 1970s to present (Figure 1; Table 1). Forty years ago, nobody was aware of the various and long-lasting problems to be faced when reintroducing carnivores. First, the return of large predators provoked massive opposition from people regarding them as competitors. Then, large carnivores need extended living spaces, and no protected area in Europe is large enough to host a viable population. Finally, implementing a reintroduction programme is a difficult, expensive and long-lasting task due to the slow turnover and elusiveness of the animals, and needs long-term commitments of all partners (Breitenmoser et al., 2001). These constraints have to be taken into account when planning such a project. For a successful reintroduction many additional factors, listed in the Guidelines of the IUCN Re-introduction Specialist Group, are important, such as number, age, sex ratio and origin of the animals to be released, the choice of release sites and the duration of the project (IUCN, 1998). Finally, a sound knowledge on the species' biology (life history, ecology, behaviour, genetics) and a robust scientific surveillance of the Programme helps define and adjust the optimal strategy.

## OVERVIEW AND EVALUATION ON EURASIAN LYNX REINTRODUCTIONS

From 1970 to present 14 lynx reintroduction projects in Germany, Switzerland, Slovenia, Italy, Austria, Czech Republic, France and Poland have taken place (Table 1). A total of 172-177 lynx were released. For the time being, we consider four of the projects as successful, six as a failure and four cannot be assessed yet. Many of these reintroductions were poorly prepared and documented. However, a comparison of the requirements for reintroductions, as defined in the IUCN Reintroduction Guidelines (IUCN, 1998), considering the information available, still provides important insights into the reasons for success or failure of reintroduction projects.

## REVERSAL OF THREATS LEADING TO EXTINCTION

The Guidelines list as first requirement the removal of (historic) threats that lead to the extinction of the species. This condition was fulfilled in all reintroduction projects for the Eurasian lynx in regard to the ecological settings: Habitat (forests) and prey populations (roe deer) have recovered across Central and West Europe throughout the 20<sup>th</sup> century (Breitenmoser, 1998; Breitenmoser and Breitenmoser-Würsten, 2008). However, human density and traffic network are nowadays extremely high in some of these regions, both of which are considered an obstacle for the reintroduction of lynx. Increased fragmentation of the landscape, together with a biologically low dispersal potential of the species, hinders the expansion into new areas and the establishment of larger meta-populations.

One threat was only partly reversed: the negative attitude of people. Although the general public welcomes the return of the lynx, the rural population—with a less romantic view of nature—is more sceptical about predators, and important target groups such as hunters and sheep breeders strongly oppose (Hunziker et al., 2001). The last survey on the Eurasian lynx in Europe (von Arx et al., 2004) revealed illegal killing to be believed the main threat for the species. This is especially true for the reintroduced populations. Between 1996 and 2001, the yearly number of illegally killed lynx in the Bohemian-Bavarian population—where the topic has been thoroughly studied (Cervený et al., 2002)—was seven individuals. In other reintroduced populations, cases discovered per year ranged from one to five (von Arx et al., 2004). Considering that the majority of illegal acts never become public, we can assume that this is only the tip of the iceberg. The problem goes far beyond financial and rational reasons and, to mitigate the conflict, not only public education, but also involvement of interest groups are key (see also “Information and public involvement” below).

## NUMBER AND ORIGIN OF ANIMALS

Although an assessment of carnivore reintroductions in general demonstrates that success is a function of the number of animals released and that wild-caught animals have a higher survival rate than captive-born candidates (Breitenmoser et al., 2001), this pattern is not entirely true for the Eurasian lynx. Normally, fewer than 20 lynx, often much less, have been released at a few sites (Table 1). One of the most successful programmes the reintroduction in Slovenia, which formed the basis of the Dinaric population, originated from only six released lynx. We do, however, not know yet whether the limited genetic variability may have a negative impact in the long-run in terms of an enhanced vulnerability to diseases or environmental changes.

Where wild-caught animals were used, they were taken from the Slovakian Carpathian Mountains, the geographically nearest autochthonous lynx population. Although carnivore projects using wild-caught animals have a higher ratio of success (Breitenmoser et al., 2001) and captive-born animals show a higher post-release mortality (Jule et al., 2008), captive-born lynx seem to adapt quite well to living in nature and catching wild prey. Two reintroduction projects, in the Kampinos National Park in Poland and in the Harz Mountains in Germany (Table 1), have used captive-born lynx. The monitoring of the population development was however so insufficient that a proper assessment is difficult (von Arx and Breitenmoser, 2004; von Arx et al., 2004). The Guidelines provide further requirements for using captive stock and state clearly that whenever wild individuals are available they should be preferred over captive ones and “if captive animals are to be used, it must be from a population which has been soundly managed, both demographically and genetically, according to the principles of contemporary conservation biology” (IUCN, 1998). Lynx used for the Kampinos and the Harz reintroductions were taken from European zoos without genetic management. They were partly inbred, partly hybrids of several subspecies.

## CHOICE OF RELEASE SITE

The selection of the release site is crucial. Beyond the obviously important local conditions in regard to adequate ecological resources, the geo-strategic situation of the release site is important. The reintroduction area should, on one hand, be “closed” so that animals dispersing from the release site do not risk losing contact with conspecifics. Yet, on the other hand, the connection to neighbouring existing or potential nuclei must be considered in regard to the long-term development of the (meta-) population. While, for example, lynx released in Austria spread into different directions and were soon too far from each other to set up a socio-spatial system, natural and anthropogenic barriers helped to establish a core population in Switzerland (Breitenmoser and Breitenmoser-Würsten, 2008).

## INFORMATION AND PUBLIC INVOLVEMENT

All reintroduction programmes of Eurasian lynx were controversial, but there is no correlation between short-term success and public information or involvement of stakeholders. Paradoxically, the three most successful projects, those in the North-western Alps, the Jura and in southern Slovenia, were among those with the poorest public information. Nevertheless, public relation seems to be important for the long-term acceptance of the returning predator. The recovery of lynx in Switzerland, for instance, still suffers from the fact that all releases in the 1970s were done in a very clandestine way (Breitenmoser and Breitenmoser-Würsten, 2008).

## MONITORING AND FOLLOW-UP PROGRAMME

Monitoring is an ultimate requirement for the control and the adaptive management of the Programme. Regardless of how careful a reintroduction project is planned and carried out, it will remain a stochastic endeavour with many uncontrollable parameters. The general set-up of a project is never enough to explain successes and failures; knowledge of individual fates is indispensable for a thorough assessment. A successful reintroduction programme must be an adaptive process, where a serious monitoring of all parameters allows the correction of parts of the project as it goes on.

Insufficient post-release monitoring was a deficiency in all early (and also some newer) Eurasian lynx reintroduction projects. Apart from the Vosges reintroduction and the newest project in eastern Switzerland, the fate of the released animals was not consequently surveyed. In Switzerland, a scientific follow-up of the reintroduced lynx was only established in 1980. In spite of all these shortcomings, in approximately half of the reintroduction attempts, released animals established well, reproduced and expanded their distribution range. The remaining projects, however, failed (Table 1).

## STATUS OF THE ESTABLISHED POPULATIONS

At present, we distinguish between the Bohemian-Bavarian, Dinaric, Alpine, Jura, and Vosges-Palatinian populations founded through reintroductions (Table 1; Fig. 1). The last Pan-European inquiry (von Arx et al., 2004) revealed that, approximately 30 years after the reintroductions, all populations are still considered to be “Endangered” to “Critically Endangered” at a local scale, according to the IUCN/SSC Red List Criteria (IUCN, 2003). Population sizes range from 20-37 (Vosges-Palatinian) to 130 (Dinaric). To be upgraded to “Vulnerable”, an effective population size of at least 250 mature individuals would be necessary. Although a surprising number of the small-scale reintroduction projects were “successful” in founding a local population, it will still require a considerable amount of time –and possibly additional efforts– to establish viable populations. However, in many cases, this will never be possible because of the limited potential expansion of some of these populations.



Photo: C. Angst

**FIGURE 1. RELEASE OF A EURASIAN LYNX IN SWITZERLAND.**

**FIGURA 1. SUELTA DE UN LINCE EUROASIÁTICO EN SUIZA.**

Population/ Occurrence	Location of the re-introduction	Years	Number of animals (m/f)*	Origin of animals	Fate **
Bohemian-Bavarian	Bavarian Forest (DE)	1970-74	5-10	3 wild, 2 captive	failed
	Sumava Mts. (CZ)	1982-89	18 (11/7)	wild	(success)
Dinaric	Kocevje (SI)	1973	6 (3/3)	wild	(success)
Alpine	Western Swiss Alps	1971-76	12 (7/5)	wild	(success)
	Engadin (CH)	1972/80	4 (2/2)	wild	failed
	Gran Paradiso NP (IT)	1975	2 (2/0)	wild	failed
	Austrian Alps	1977-79	9 (6/3)	wild	failed
	Eastern Swiss Alps	2001-08	12 (6/6)	wild	uncertain
Alpine/Jura	Swiss Plateau	1989	3	unknown	failed
Jura	Swiss Jura Mts.	1972-75	10 (5/5)	wild	(success)
Vosges-Palatinian	Vosges Mts. (FR)	1983-89	21 (12/9)	19 wild, 2 captive	uncertain
Podyji	Podyji NP (CZ)	1993-94	6 (2/2)	captive	failed
Kampinos occ.	Kampinos NP (PL)	1992-99	31 (14/17)	captive	uncertain
Harz occ.	Harz Mts. (DE)	since 2000	28 (9/15)	captive	uncertain

\* M/F= MALES/FEMALES. SOMETIMES THE INFORMATION IS NOT OR ONLY PARTLY AVAILABLE.

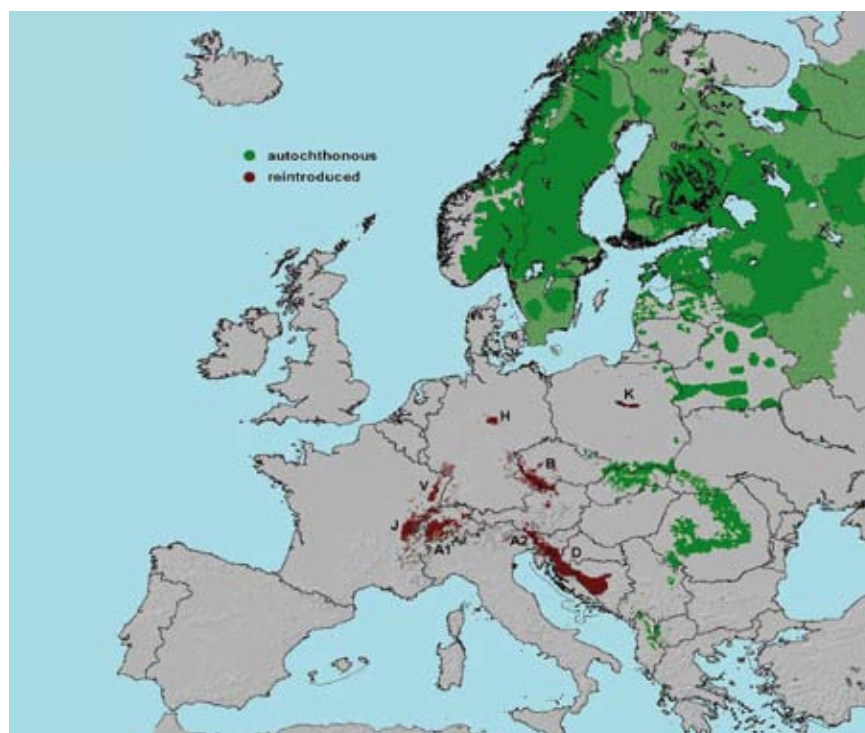
\*\* FATE: "SUCCESS" IN BRACKETS AS THESE POPULATIONS HAVE UP TO NOW BEEN SURVIVING FOR 20-30 YEARS WITH REASONABLE NUMBERS OF ANIMALS, HOWEVER THEIR LONG-TERM SURVIVAL IS NOT YET SECURED.

\* M/F= MACHOS/HEMBRAS. EN OCASIONES LA INFORMACIÓN NO ESTÁ DISPONIBLE O SÓLO SE DISPONE DE DATOS PARCIALES.

\*\* EVOLUCIÓN: "ÉXITO", ENTRE COMILLAS, PORQUE ESTAS POBLACIONES LLEVAN SOBREVIVIENDO YA ENTRE 20 Y 30 AÑOS, CON UN NÚMERO RAZONABLE DE ANIMALES; NO OBSTANTE, SU SUPERVIVENCIA A LARGO PLAZO NO ESTÁ ASEGURADA TODAVÍA.

**TABLE 1. LYNX (*LYNX LYNX*) REINTRODUCTIONS IN CENTRAL AND WEST EUROPE. DATA COMPILED FROM BREITENMOSER ET AL., 2001; VON ARX ET AL., 2004; BREITENMOSER AND BREITENMOSER-WÜRSTEN; 2008, LINNELL ET AL., 2009.**

**TABLA 1. REINTRODUCCIONES DEL LINCE (*LYNX LYNX*) EN EUROPA CENTRAL Y OCCIDENTAL. DATOS RECOPIADOS DE BREITENMOSER ET AL., 2001; VON ARX ET AL., 2004; BREITENMOSER Y BREITENMOSER-WÜRSTEN; 2008, LINNELL ET AL., 2009.**



**FIGURE 2. DISTRIBUTION OF THE EURASIAN LYNX IN EUROPE (VON ARX ET AL., 2004). CONSTANTLY OCCUPIED AREA AND SINGLE OBSERVATIONS (BRIGHTER SHADE). REINTRODUCED POPULATIONS: B=BOHEMIAN-BAVARIAN; D=DINARIC; A=ALPINE [WITH A WESTERN 1) AND EASTERN 2) SUBPOPULATION]; J=JURA; V=VOSGES-PALATINIAN; K=KAMPINOS OCCURRENCE; H=HARZ OCCURRENCE.**

**FIGURA 2. DISTRIBUCIÓN DEL LINCE BOREAL EN EUROPA (VON ARX ET AL., 2004). ÁREA DE OCUPACIÓN CONSTANTE Y OBSERVACIONES INDIVIDUALES (COLOR MÁS CLARO). POBLACIONES REINTRODUCIDAS: B=BOHEMIA-BAVARIA; D=DINARIC; A=ALPES [CON SUBPOBLACIONES OCCIDENTAL 1) Y ORIENTAL 2)]; J=JURA; V=VOSGES-PALATINA; K=PRESENCIA EN KAMPINOS; H=PRESENCIA EN HARZ.**



In order to improve their conservation status, the populations in West and Central Europe should be considered under a metapopulation concept, which would involve improving the connectivity and consequently exchange of individuals between populations. As all potential or extant metapopulations are transboundary, cross-border collaboration has to be improved and coherent strategies should be developed and applied according to the European guidelines for population level management of large carnivores (Linnell et al., 2008).

## CONCLUSIONS

Given the unprofessional approach in most of the Eurasian lynx reintroduction projects carried out in the 1970s and 1980s, the establishment of free-living populations was rather astonishing (Figure 2). However, the assessment of the reintroductions depends on the definition of success and the time frame applied. All populations are still small in size and extension, which makes them not only vulnerable to human-induced mortality, but also to genetic and stochastic processes. Obviously, 20 to 30 years are not enough to ensure the long-term persistence of lynx in Central and Western Europe, and further active support is needed. Even if the early attempts could not be considered brilliant and successful, they have at least allowed us to learn about the reintroduction of controversial animals such as the lynx, and to develop better schemes.

Reintroducing carnivores is a serious business that requires a long-term commitment of all partners involved, also –and especially– from government organisations (see Jiménez, this book). All these projects are controversial, and diverging interests can only be mitigated through a clear and long-term concept regarding reintroduction goals, together with a sound management strategy that grants the long-term survival of the reintroduced lynx populations.

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