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

LIFE16 NAT/SI/000634

Lessons Learned from Past Reintroduction and Translocation Efforts with an Emphasis on Carnivores

Action A.4: Elaboration of plans for reinforcement of the Dinaric – SE Alpine population and for creation of new "stepping stone" population – Guidelines for Lynx Reinforcement

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EXECUTIVE SUMMARY

Successful carnivore reintroduction and translocations efforts must consider both biological and social factors that are context-specific to the species, habitats, and landscapes where carnivore recovery efforts take place. A well-planned and thoughtful reintroduction approach should place considerable attention into developing a robust and sophisticated partnership where team members can integrate both biological and social science to guide planning and implementation. Moreover, building local support for a carnivore reintroduction or translocation is vital for long-term success. However, successful carnivore reintroduction must have "scaled-levels of support", built upon well-designed management plans, forums for stakeholder engagement, effective communication strategies, and institutionally-backed political and financial support at national and international levels. Ideally, a successful carnivore reintroduction effort rests upon the support of *communities of place and communities of interest—where local and broad public support converge*. This is even more critical in Central Europe where the scale of large carnivore life histories transcend national borders, cultures, and management jurisdictions. To address this requires a strong understanding of biological and social conditions at multiple scales.

This report is an attempt to synthesize important lessons from biological findings and social factors from peer-reviewed literature to specific case-studies that involved Eurasian lynx reintroductions and other large carnivores. Ideally, the findings and lessons illustrated in this report will help the LIFE Lynx Project team members continue to follow the IUCN Guidelines for Reintroductions and other Conservation Translocations with additional knowledge that will enhance context-specific planning, effective project implementation, and a comprehensive management approach that coordinates lynx recovery and conservation efforts in Slovenia, Croatia, and Italy.

Biological Lessons:

Release Areas--Core habitat is Important. When animals were released in core habitat/historic range versus periphery habitat, success rates increased.

Habitat—**High Quality Habitat is Important.** Higher quality habitat helps improve the outlook for translocation efforts.

Number of Individuals—More is Better. In general, releasing more animals increased success rates.

Animal Species—Herbivore Translocations Were More Successful than Sensitive Species. Game species (herbivores) translocations were generally more successful than those involving sensitive species.

Taxonomic Status---Mammal Species Do Better than Avian. In general, efforts to translocate mammals were more successful than those that involved birds.

Use Wild-Source Populations of Animals—Reintroductions tended to be more successful when the source population was wild.

Remove Original Cause(s) of Decline - Successful reintroductions occurred more frequently when the original cause of the decline was removed.

Soft-versus-Hard Releases – Both types of releases have been used successfully in Europe. In a North American case, with Canada lynx (*Lynx canadensis*), only soft-releases were recommended.

Historic Eurasian Lynx Reintroduction Lessons (Linnell et al., 2009):

Planning Matters--Future lynx reintroductions must be well planned, use the 1998 IUCN Guidelines for Reintroductions, and invest in robust monitoring.

Scale Matters--Lynx reintroductions should be planned at appropriate scales that facilitate metapopulation level connectivity and better coordination should be carried out by those involved in reintroductions. Efforts will need to consider the challenge of having to work meticulously at the local release site scale and to attend to larger scales where collaboration is needed as lynx expansion occurs.

Communicate--Communication strategies are vital and public consultation are critical for successful reintroductions.

Involve Stakeholders--Efforts should be made to achieve effective stakeholder involvement, participation, and attention must be made to involving local people to build acceptance.

Minimize Lynx Mortality--Clear management plans with long-term goals should be developed with special emphasis on reducing human-caused mortality (i.e., poaching) of lynx.

Social and Management Context Lessons:

Local Stakeholder Support--Diverse and inclusive engagement of local stakeholders to generate support for reintroductions is vital.

Collaborative Process--There should be a collaborative process or mechanism for meaningful participation and information sharing among all vested stakeholders.

Political Support--Political support that is appropriately scaled to the reintroduction effort and has multi-tiered support is important for success. This is the concept that a reintroduction effort must account for values and political support among *communities of place and communities of interest*. Additionally, political support also requires a financial commitment to support a reintroduction effort.

Existing Management Capacity--While seemingly obvious, it is nonetheless important to assess whether an effort has the wildlife management capacity to take on a reintroduction effort.

Comprehensive Management--Successful reintroduction programs rely on a comprehensive approach to planning, monitoring, responding, and adapting to dynamic biological and social factors during effort.

Communication--Public outreach and communication before and during reintroductions occur are critical for maintaining transparency, informing the public, managing public expectations, and maintaining overall public and political support for a reintroduction.

Leadership--Who proposes and carries out the reintroduction is critical in terms of evaluating local and regional perceptions of how power is yielded and may influence local participation.

INTRODUCTION

As a new generation of scientists, conservation biologists, foresters, hunters, and conservation professionals prepare to reinforce the dwindling Eurasian lynx (*Lynx lynx*) population in the Dinaric Mountains and SE Alps of Slovenia, Croatia and Italy, it is worth asking the question, what lessons can we learn from past efforts to reintroduce and translocate large carnivores? Carnivore reintroductions can be extremely costly, risky, and fraught with political and social challenges that can have serious consequences for the species in question. In other words, biological, technical, and social factors all become relevant for whether animals live or die.

Consider that for threatened, endangered, or sensitive species, less than half (46%) of the reintroduction efforts were successful from 1973-1986 where approximately 700 translocations were conducted per year in North America, Australia, and New Zealand (Griffith et al. 1989). Nevertheless, reintroductions and translocations are frequently used as an important conservation tool and there is much reason for optimism. Many reintroduction success stories have enjoyed public and political support and translocations are an important tool for conservation action (Miller et al. 1999).

It is the ethical duty of those who propose and carryout a translocation to use the most relevant information available, including today's best science and lessons from history. The chance to take part in a major carnivore reintroduction may happen just a few times in a human generation. Knowing and learning from the success and mistakes from the past is a responsibility and honor.

The goal of this report is to review relevant literature with a focus on past carnivore reintroduction and translocation efforts and to offer lessons learned, insights, and considerations for the members of the LIFE Lynx Project team as they embark on a new chapter of Eurasian lynx conservation in Central Europe. Ideally, this emerging effort will succeed and provide a model for future lynx reintroductions and conservation.

TERMS

In this report, the term *translocation* is understood to be an overarching term to describe the deliberate release of an organism in the wild. In this report, the term *reintroduction* is used interchangeably with *translocation* to generally describe efforts where animals were deliberately released as a conservation measure to establish or augment a population of conspecifics.

In this report and as relevant to the LIFE Lynx Project, translocation is defined as the intentional release of captive-propagated and/or wild-caught animals into the wild for the purpose of establishing a new population, reestablishing and extirpated population, or augmenting a critically small population (Griffith et al. 1989; Wolf et al. 1996). The more precise term relevant to this project according to the IUCN terminology is *reinforcement*---a type or sub-category of a conservation translocation and is defined as the "intentional

movement and release of an organism into an existing population of conspecifics (IUCN/SSC 2013:2).

METHODS

This report relied extensively on a literature review covering the period 1980-2018. More specifically, special attention was paid to peer-reviewed journal articles that had relevance to the project. The review was focused on the reintroduction and translocation literature, specifically on mammalian translocations involving carnivores. Unfortunately, many reintroductions efforts are never reported on or are difficult to access since some are written up as ministry or agency reports and are not publicly available. And, unsuccessful relocations are generally not reported or underreported based on a literature review of 180 case studies over a 20-year period during 1980-2000 (Fischer and Lindenmeyer, 2000). However, several key review articles that conducted extensive surveys and reviews on reintroduction efforts offer important findings regarding the factors that affect success rates of efforts (Griffith et al., 1989; Wolf et al., 1996, Fischer and Lindenmayer, 2000, Miller et al., 1999) and offer some general and important biological findings that are relevant to the LIFE Lynx Project.

Both biological and socials factors were examined to help better understand the success and challenges that carnivore translocations faced. Additionally, wildlife management reports were examined and the IUCN Guidelines for Reintroductions and other Conservation Translocations were carefully reviewed (IUCN/SSC, 2013). All reports by the IUCN/SSC Re-introduction Specialist Group titled, Global Re-Introduction Perspectives: Re-Introduction Case-Studies from Around the Globe were reviewed for 2008-2016.

In certain cases, experts who were directly involved in carnivore translocations were interviewed to glean additional insights regarding specific case studies that were analyzed. Case studies were examined and briefly summarized to elucidate additional lessons that may be relevant to the current effort to reinforce the Eurasian lynx (*Lynx lynx*) population in Croatia and Slovenia. Case studies are not meant to be exhaustive, rather the intent is to summarize relevant biological and social factors that have direct relevance to the LIFE Lynx Project. The case studies (lynx reintroductions only) were selectively chosen to highlight important lessons from the Linnell et al., (2009) review that covered 15 lynx reintroductions in Central Europe. And a successful Canada lynx (*Lynx canadensis*) reintroduction effort was reviewed to better understand release protocols and lynx survivorship that took place in the State of Colorado, U.S.A.

Insights and lessons regarding social factors that influence reintroduction efforts used four case studies that involved brown bears (*Ursus arctos*). Two of these cases involved failed efforts and two were successful. While there are certainly different biological and social dimensions among brown bears and lynx, there are broad lessons that can be applied to the LIFE Lynx Project, particularly when it comes to public outreach and working closely with local people and communities who live among carnivores.

This author was able to visit the Sumava area (Germany, Czech, Aust.), Palatinate area (Germany), and Trento area (Italy) and learn from those directly involved in the efforts—in

these three case studies, certain lessons elucidated in this report are the observations of this author.

GENERAL BIOLOGICAL FINDINGS FROM REVIEW ARTICLES

One of the first and more comprehensive review articles on translocation efforts was done by Griffith et al. (1989) and relied on a survey of translocation efforts during 1973-1986. The translocations included native birds and mammals in Australia, Canada, Hawaii, New Zealand, and the United States. The authors estimate that during this time period nearly 700 translocations were conducted on an annual average basis. The focus of their analysis was to determine what helped constitute successful translocations, where success was defined as an effort that resulted in a self-sustaining population. The authors were focused on biological factors that enhanced the success of translocation efforts.

The authors found that native game species (herbivore) translocations were 86% successful while just 46% were deemed a success for threatened, endangered, or sensitive species. Translocations where high quality habitat was present increased success rates and translocations into the core of species historical ranges were more successful than efforts on the periphery of species' ranges. The researches also found that translocations of herbivores were more likely to succeed than carnivores. Additional findings were that exclusively wild-caught animals versus captive-reared increased success rates and that greater numbers of released animals improved success rates. The authors stress the importance of habitat quality as a key factor improving translocation success rates.

In 1993, a follow up study to Griffith et al. was conducted by Wolf et al. (1996) and generally confirmed key results from the original 1989 analysis by Griffith et al. This analysis re-surveyed the original translocation programs and surveyed 421 avian and mammal translocation efforts. Of all the 421 translocation efforts surveyed, 67% were defined as successful in 1993, where success was defined as efforts that resulted in a self-sustaining population (Griffith, 1989).

The key summary findings from Griffith et al. (1989) and Wolf et al. (1993) were the following:

1. Release Areas--Core habitat is Important. Both studies suggest that when animals were released in core habitat versus periphery habitat, success rates increased. Wolf et al. (1993) also stressed that releasing animals into their core historic range or habitat was important for success.

2. Habitat—High Quality Habitat is Important. Both studies suggest that higher quality habitat helps improve the outlook for translocation efforts. Wolf et al. (1993) suggest that "good-to-excellent-high quality" habitat improves success rates of translocations.

3. Number of Individuals—More is Better. In general, both studies found that releasing more animals generally increased success. While this may not always be possible for

sensitive or threatened species, the authors found that this factor helped improved the success rates of translocation efforts.

4. Animal status—Herbivore Translocations Were More Successful than Sensitive Species. Game species (herbivores) translocations were generally more successful that those involving sensitive species.

5. Taxonomic Status---Mammal Species Do Better than Avian. In general, Wolf et al. (1993) found that efforts to translocate mammals were more successful than those that involved birds.

Interestingly, Wolf et al. (1993) found that species' reproductive potential (number of offspring and first age of reproduction), number and duration of releases, and source of the translocated animals (wild-caught versus captive-reared) were not significantly correlated with successful translocations. However, these findings should be taken with caution because the study did not report specific correlates by different taxa.

The researchers also reported that survey respondents representing the 421 programs indicated that human-related factors such as positive public relations and attitudes, control of hunting and poaching and protection from human disturbance were perceived by respondents as important in the success or failure among translocation efforts. Wolf et al. (1993) also point out that illegal hunting (poaching) can result in population declines and that local community support is important for enhancing the success of translocation efforts.

Another important review article was conducted by Fischer and Lindenmayer in 2000 and reviewed 180 case studies and theoretical papers published in 12 major international scientific peer-reviewed journals during a 20-year time-frame (1980-2000). The study focused on reintroductions, supplementations, and translocations and did not consider introductions. The authors found that of all the efforts surveyed, that relocations for conservation purposes were the most common. Additional reasons for conducting reintroductions were to solve human-animal conflicts and to restock game populations.

Major lessons from Fischer and Lindenmayer's (2000) review were the following:

1. Use Wild-Source Populations of Animals - Reintroductions appeared to be more successful when the source population was wild.

2. Use More Animals When Possible - When a large number of animals were released (n>100), success rates increased.

3. Remove Original Cause(s) of Decline - Successful reintroductions occurred more frequently when the original cause of the decline was removed (Note: the authors used the same criterion as Griffith et al. (1989) to define success as one where an effort resulted in a self-sustaining population).

The authors also discussed the importance of improving future reintroduction efforts mainly by having: 1) more rigorous testing for the appropriateness of using reintroductions in a given context, 2) the establishment of accepted criteria for judging the success or failure of

relocations, 3) better monitoring after relocations, 4) more financial accountability and reporting, and 5) better efforts to publish successful and unsuccessful relocation efforts.

Apparently most unsuccessful relocations were generally not reported or underreported according to Fischer and Lindenmayer's (2000) analysis. The authors also point out that reintroduction efforts also should pay close attention to public relations, general education of the public, effective team management, social and value considerations of affected stakeholders, legal considerations and potential litigation costs, and long-term commitment of relevant stakeholders to the reintroduction project.

Miller et al. (1999) provide an even more specific review focused on carnivore translocations with an emphasis on biological factors. The important general biological considerations that they identified from the literature include the following:

1. Taxonomy: Animals chosen for a given reintroduction should be as similar as possible to those that originally inhabited the release site(s).

2. Molecular Genetic Data: Maximizing genetic diversity among release animals is generally an optimal strategy for most species. Consider that Beck, et al., (1993) found that genetic screening was performed in only 37% of the reintroduction projects using captive raised animals.

3. Wild vs. Captive Animals:

- Wild-born animals are preferable to captive-born animals for translocations.
- Captive carnivores should be released when there are no other alternatives.*
- Issues associated with using captive-born carnivore translocations include:
    - Ability to search for food
    - Effective predation
    - Predator avoidance
    - Recognition of home sites
    - Movement patterns (e.g., seasonal migrations)
    - Methods of raising young
    - Ability of young to follow mothers to kill sites
    - Negative response to human presence
    - Less shy of humans

***Note:** Captive-raised pumas (*Puma concolor*) in Florida had less fear of humans and were more likely to engage in puma–human and puma–livestock encounters than wild-caught animals (Beldon & McCown, 1996) yet captive-reared Eurasian lynx released in the Harz Mountains of Germany resulted in a successful effort (Jule et al., 2008).

Logan et al. (1996) found that successful translocations of wild-caught pumas in New Mexico were affected by age, sex, and social status. The best results came with translocated pumas between 12 and 27 months of age. This age class of pumas moved the shortest distance from the release sites and rapidly established areas of use. Additionally, Logan et al. (1996) suggest that pumas from this age group may settle an area more quickly. This is likely due to age since at dispersal age, pumas may be more likely to accept an unfamiliar area compared

to an adult who has spent considerable time in a given place. These same researchers also found that females of this age group moved less and had higher survival rates than males. For example, adult pumas (28–96 months of age) that were trapped from established territories traveled the farthest from their release sites and often displayed a homing tendency (Logan et al., 1996). The researchers also documented two pumas from the same age class that returned to their original home territories more than 400 km away. And pumas that were over 96 months in age showed a higher risk of mortality (Logan et al., 1996).

4. Age-Sex Categories: Miller et al. (1999) generally advise that animals should be released in sex ratios similar to what would be found in wild populations of the same species. This should help facilitate reproductive encounter rates and improve chances for mating and reproduction.

5. Demography: Miller et al. (1999) also advise that it is important to understand all key population parameters from the wild population of the carnivore species that is being translocated so that effective monitoring of the reintroduced population can be carried out. For example:

- Fecundity
- Mortality
- Population growth rate
- Age structure
- Sex ratio
- Life expectancy

6. Behavior: Linnell et al., (1997) caution about homing and site fidelity as important behaviors to monitoring in terms of evaluating carnivore reintroductions. They suggest that a period of quarantine and allowing the animals to become habituated to a release site helps reduce the chances of dispersal / homing.

7. Health and Disease: The health and physical condition of animals selected for release should be carefully assessed. Despite the fact that Griffith et al. (1989) found no correlation between success and physical condition of animals at time of release, Miller et al. (1999) suggest that only animals in good physical condition should be used in translocations.

8. Habitat: This is one of the most important considerations to account for when contemplating a carnivore translocation according to Miller et al. (1999). Specifically, the amount and type of habitat, spatial considerations for larger landscape scale connectivity, and current and future management of habitat must be carefully evaluated. Some obvious examples of assessing the quality of habitat include: an adequate prey base, cover, denning sites, water sources, competitors, predators, and the presence of exotics. Other general considerations include:

- Habitat fragmentation
- Mortality sinks (highways, railways, transportation corridors, human development)
- Habitat connectivity potential within a given landscape, especially for female carnivores

The authors also offered general non-biological considerations largely as a set of questions that should be considered when contemplating a carnivore translocation (See Appendix A).

GENERAL LESSONS FROM (18) CARNIVORE REINTRODUCTIONS

David W. Macdonald's (2009) review titled, "Lessons Learnt and Plans Laid: Seven Awkward Questions for the Future of Reintroductions," offers an insightful summary and review of 18 global carnivore reintroduction efforts with emphasis on leopards, lions, wolves, wild dogs, and bears.

Many of the key problems that he identified were highlighted in the previous sections by Griffith et al. (1989), Wolf et al., (1993) and Fischer and Lindenmayer (2000). Furthermore, perhaps the most important and striking lesson in Macdonald's review is that problems that arose largely resulted from not following the IUCN 1998 guidelines.

Lesson:

1. Follow the 1998 IUCN Guidelines – Across all 18 case studies involving carnivore reintroduction, Macdonald suggests that many problems and issues that caused challenges for the efforts could have been avoided if the 1998 IUCN Guidelines had been carefully followed.

Additionally, the authors of the case studies self-reported a reoccurring list of problems that each case study faced. In nearly all cases according the Macdonald (2009), the problems were foreseen by the 1998 IUCN guidelines. Key problems across 18 carnivore reintroductions efforts as identified by Macdonald (1999:420-421):

- Lack of national-level coordination
- Failure to coordinate reintroductions to produce a larger metapopulation
- Lack of attention paid to genetic origins of animals that are released
- Genetic isolation
- Insufficient number of individuals released (eventual loss of genetic diversity/pop. decline)
- Lack of shyness to humans by released animals
- Inability to hunt natural prey leading to livestock losses or starvation
- Inability to avoid predation by sympatric carnivores
- Lack of social behavior resulting in poor pack, pride formation, territory
- Potential animal welfare impacts from capture/handling/quarantine procedures
- Lack of a pre-release feasibility study
- Lack of ecological knowledge of species/life history requirements
- Failure to anticipate effects of reintroduced species on other species
- Reintroduction of species into areas with insufficient carrying capacity
- Failure to reduce existing threats
- Lack of coordination of reintroduction effort
- Lack of data on dispersal distances
- Lack of post-release monitoring
- Illegal or unofficial releases
- Poor public acceptance and understanding

The problems listed above are paired with the 1998 IUCN guidelines and provide a useful check-list that the LIFE Lynx Project team members can rapidly review (Table 1).

Table 1. Problems identified with carnivore reintroductions and potential solutions as identified in the 1998 IUCN guidelines. Table modified from Macdonald (2009:420-421).

Problem(s) Identified	**IUCN Guideline – Solution(s)**
• Lack of national-level coordination • Failure to coordinate reintroductions to produce a larger metapopulation • General lack of coordination	Effort should be multi-disciplinary and coordinated
• Lack of attention paid to genetic origins of animals that are released • Genetic isolation	Molecular genetic studies should be undertaken; a study of genetic variation within and between populations of this and related taxa can be helpful.
• Insufficient number of individuals released (eventual loss of genetic diversity)	The build-up of the released population should be modelled under various sets of conditions in order to specify the optimal number and composition of individuals to be released per year and the number of years necessary to promote establishment of a viable population.
• Lack of shyness to humans by released animals	Individuals should be given the opportunity to acquire the necessary information to enable survival in the wild, through training in their captive environment. Care should be taken to ensure that potentially dangerous captive-bred animals are not so confident in the presence of humans that they might be a danger to local inhabitants and/or their livestock.
• Inability to hunt natural prey leading to livestock losses or starvation • Inability to avoid predation by sympatric carnivores • Lack of social behavior resulting in poor pack, pride formation	A captive-bred individual's probability of survival should approximate that of a wild counterpart.
• Potential animal welfare impacts from capture/handling/quarantine procedures • Lack of pre-release feasibility study	Welfare considerations are of paramount importance through all stages of reintroductions. Feasibility study conducted

• Lack of ecological knowledge	Detailed studies should be made of the status and biology of wild populations to determine critical needs.
• Failure to anticipate effects of reintroduced species on other species	Understanding the effect(s) of the reintroduced species will have on the ecosystem is important.
• Reintroduction of species into areas with insufficient carrying capacity	The area should have sufficient carrying capacity to sustain growth of the reintroduced population and to support a viable (self-sustaining) population in the long-run.
• Lack of data on dispersal distances	Reintroductions should only take place where the habitat and landscape requirements of the species are satisfied.
• Lack of post-release monitoring	Design of pre-and-post release monitoring program; design of post-release monitoring is required of all (or sample of) individuals, including demographic, ecological and behavioral studies of released stock and of mortalities; Interventions (e.g., supplemental feeding, veterinary, aid, horticultural) when necessary; Decisions for revision, rescheduling or discontinuation of program when necessary.
• Illegal or unofficial releases	Full permission and involvement of all relevant government agencies of recipients or host country/countries.
• Poor public acceptance and understanding	The program should be fully understood, accepted, and supported by local communities; Continuing public relations activities, including education and mass media coverage should be undertaken; Socio-economic studies should be made to assess the impacts, costs, and benefits of the reintroduction program to local human populations.

The authors of the 18 carnivore reintroduction efforts also listed in their opinion, what the most important considerations for reintroductions of carnivores should be (See Appendix B) and Macdonald provides seven questions that provide some additional and conceptual considerations for carnivore reintroductions (see Appendix B).

CAPTIVE-BORN VERSUS WILD-CAUGHT CARNIVORES IN REINTRODUCTIONS - OVERVIEW

Jule et al. (2008) provided a specific review to investigate the survivorship of captive-born versus wild-caught carnivores in reintroductions. The researchers reviewed published results from peer-reviewed literature and found evidence to support that reintroduction projects that used wild-caught animals were more likely to succeed that projects using captive-born animals.

These findings are consistent with Fischer and Lindenmayer's (2000), Griffith et al.'s (1989), and Wolf et. al. (1996). Specifically, they found that using data from the Fischer and Lindenmayer review, that projects that used wild-sourced animals were 31% successful and those that used captive-sourced animals were 13% successful. Additionally, they found that wild-caught-carnivores survived more (53%) than captive-born carnivores (32%) (Jule et al. 2008). In all cases, humans were the direct cause of death for 50% both wild-caught and captive-sourced animals and they found that reintroduced captive-born carnivores were susceptible to starvation, unsuccessful predator/competitor avoidance and disease (Jule et al. 2008).

However, it was interesting to note that Eurasian lynx reintroduction efforts in the Harz Mountains of Germany using captive-sourced animals had a relatively high percentage of founders survive (68%) compared to other efforts in Poland and France (Table 1).

Table 2. Carnivore reintroductions and translocations showing only Eurasian lynx reintroduction efforts based on captive-sourced animals (post-1990) (Table adapted with Eurasian lynx information excerpted from Jule et al. 2008).

Eurasian lynx (source of information)	No. Animals released (captive)	No. animals released (wild)	Percentage of founders surviving (captive)	Percentage of founders surviving (wild)	Cause of death
Anders 2004 (Germany)	19	0	.68	NA	Disease, various
Boer et al. 1995 (Poland)	7	0	.42	NA	Human
Blomqvist et al. 2000 (Poland)	25	0	.30	NA	Recaptures, human, unknown
Vandel et al. 2006 (France)	21	0	.30	NA	Human, recaptures, starvation

Important lessons from the review and analysis by Jule et al. (2008) are the following:

Lessons:

1) Carnivore translocation programs were more successful (31%) when wild-caught animals were used compared to efforts that used captive-born animals (13%).

2) Survivorship of released wild-caught animals was higher (53%) than captive-born individuals (32%).

LYNX REINTRODUCTIONS – GENERAL OVERVIEW

Linnell et al. (2009) provide an excellent overview of Eurasian lynx recovery in Europe and offer lessons learned. The authors reviewed 15 lynx reintroduction efforts that relied on the release of some 170–175 lynx across eights countries during the period 1970-2007. The authors point out that very little information exists about these past efforts nor have these cases been well studied—nonetheless, Linnell et al. (2009) have pieced together useful information that has relevance to the LIFE Lynx Project.

The authors suggest that both natural recovery and reintroduction efforts have played an important role in an overall improved outlook for lynx in Central Europe. They contend that conservation reintroductions have been vital for population recovery. However, they suggest that historic efforts were often "ad-hoc" and needed a more comprehensive planning and monitoring process. There are three general characteristics of past Eurasian lynx reintroduction efforts that Linnell at al. (2009) identified as needing improvement. These were: 1) past efforts were poorly planned, 2) certain biological factors were not well attended to at that time, and 3) that public outreach during the pre-release phase was limited and that regional/national coordination across projects was limited. These three characteristics of past efforts identified by Linnell et al., (1999) are summarized below:

1) Procedural Considerations: Linnell et al. (2009) suggest that in general, past lynx reintroductions efforts were poorly planned and relied on few standards as compared to today's well-developed guidelines (IUCN/SSC, 2013). The fact that many reintroductions were done in secret (e.g., Switzerland) had serious repercussions for lynx by local people. In some cases, like Switzerland, poaching of lynx was justified in the minds of local livestock breeders and hunters, since lynx had been released illegally. Even 40 years after some of the clandestine lynx releases in the Swiss Alps, poaching is still an issue and some livestock breeders and hunters still perceive lynx presence in Switzerland as illegitimate due to the clandestine nature of the early releases (Molinari, 2018). Additionally, Linnell at al. (2009) found that poor, post-release monitoring efforts (e.g., no telemetry monitoring of released animals) hampered the ability to be adaptive and likely led to many failed efforts.

2) Biological Considerations: A second area where past lynx reintroduction efforts were problematic involved several biological considerations. First, many efforts used both wild-caught and captive-sourced lynx with mixed results and this generated controversy among both conservation and animal welfare groups (Jule et al. 2008). Nonetheless, several examples where captive-sourced lynx were used were successful (e.g., Harz Mountains-Germany) and in other cases, captive-sourced individuals died of starvation or showed a lack of shyness toward humans (e.g., Vosges Massif – France).

Another concern that Linnell et al. (2009) raised is that there has been little attention paid to the genetic origins of the lynx being released considering that most wild-source populations have come from the Carpathian Mountains and may have a different genetic profile compared to former alpine and existing Balkan populations. In a different example concerning genetics, in the case of the 1973 lynx reintroduction in Slovenia, genetically similar individuals were unintentionally released—the population rapidly increased and the effort was considered a

success at the time, but by the 2000s, population declines attributed to genetic inbreeding and unsustainable hunter harvest have resulted in a small and highly vulnerable population today (Kos et al. 2012).

The third biological factor or concern that was identified by Linnell et al. (2009) was that many lynx reintroduction efforts relied on a small number of release animals or founders. Consider that efforts in the German-Bavarian Forest, 1977-1979, released 5-10 animals, in Austria's Turrach, Styria, 1977-1979, 9 lynxes were released, and in Italy's Gran Paradiso NP in 1975, 2 male lynxes were released—all of these above efforts failed.

3) Social Considerations: Linnell et al. (2009) suggest that past lynx reintroduction efforts paid little attention to important factors like informing local people and affected publics about lynx reintroduction efforts before actual releases were done. Additionally, they found that historically there has been little attention paid to coordination of lynx reintroduction efforts across regions and countries with an explicit goal of developing connected metapopulations. Furthermore, they were critical of efforts where the likelihood of connecting lynx populations is low—in other words, areas that are isolated or have highly fragmented habitat surrounding populations may have less long-term conservation value than efforts involving connections to other populations (Kramer-Schadt et al., 2005). In summary, Linnell et al., (2009) offer the following key lessons from past Eurasian lynx reintroduction efforts.

Lessons:

1. **Future lynx reintroductions must be well planned, use IUCN guidelines, and invest in robust monitoring.**

2. **Lynx reintroductions should be planned at appropriate scales that facilitate metapopulation level connectivity and better coordination should be carried out by those involved in reintroductions.**

3. **Communication and public consultation are critical for successful reintroductions.**

4. **Efforts should be made to achieve effective stakeholder involvement.**

5. **Clear management plans with long-term goals should be developed with special emphasis on reducing human-caused mortality (i.e., poaching) of lynx.**

6. **Efforts will need to consider the challenge of needing to work diligently at the local scale (release site levels) and to attend to larger scales of human communities and national borders as lynx expansion occurs.**

LYNX REINTRODUCTIONS – SELECT CASE STUDIES

Switzerland – Alps (1971-1976) and Jura Mountains (1972-1975) Case Study Summary

Switzerland was the first country to officially reintroduce the lynx into the Alps in the early 1970s. During the initial releases (1971-1976), some were kept secret while others were officially sanctioned (Breitenmoser et al., 1998). Initially, 12 wild-caught lynx from the Carpathian Mountains of Slovakia served as the original founders of the effort. After trapping and holding periods, lynx were hard-released. Apparently, additional clandestine releases occurred in the south-eastern Alps, so it is hard to estimate the total number of lynx that were released in the Swiss Alps during the early 1970s (Linnell et al., 2009). During 2001-2008 translocations of lynx from the north-western Alps to the eastern Alps improved populations and increased distribution of lynx in this area. Overall efforts have been a success and estimates of the lynx population suggest minimally, 60-90 lynx occupying more than 12,000 km^2 in the Swiss Alps (Breitenmoser and Breitenmoser-Wursten, 1998, Molinari-Jobin et al., 2006). More recently estimates suggest more than 100 lynxes in the western Alps (Linnell at al., 2009).

In the Jura Mountains of Switzerland during 1972-1975, 10 lynxes were reintroduced both through clandestine and official efforts. Like the Alp reintroductions, lynx were wild-caught from Slovakia and hard-released—populations responded well, filling approximately 7,000 km^2 of habitat on both the Swiss and French portions of the Jura Mountains and resulting in more than 70 lynx by the early 2000s (Breitenmoser and Breitenmoser-Wursten, 2004; Breitenmoser-Wursten and Breitenmoser, 2007).

It is worth emphasizing that secret releases during the 1970s in both the Alps and Jura Mountains caused rumors and local opposition to lynx recovery that continues to be of concern. In some cases, lynx presence was documented only when livestock breeders began observing sheep losses to lynx. Some of the clandestine releases were done without any official permission (Breitenmoser et al., 1998). Long-time lynx expert Urs Breitenmoser et al., (1998:26) suggests that those individuals who were part of the clandestine releases felt that it was a good strategy at the time but that, “It may have amplified and maintained the controversy. As no authentic information was available, there was much room for rumors and confirmation of archaic prejudices, which are now very hard to overcome.”

Illegal killing of lynx continues to be of concern in Switzerland and are assumed to be a leading cause of morality, but the majority of known lynx mortality is from traffic accidents (Breitenmoser and Breitenmoser-Wursten, 2004). Breitenmoser et al., (1998) suggest that while illegal killing of lynx goes often undetected, estimates from radio-collared individuals suggest that only one in four illegal killings are detected. While efforts have been focused to improve acceptance of lynx and to minimize illegal killing at the canton-level and with local stakeholders, it is unclear whether a more local approach will help reduce illegal killing of lynx.

Lessons:

1. Secret Releases – The fact that many of the early lynx releases were not made public and were not officially sanctioned has had long-term repercussions for local acceptance of lynx in Switzerland. Local opposition to lynx has likely resulted in illegal poaching and is a leading cause of lynx mortality today. Moreover, human-caused mortality may be perceived as acceptable by local people who claim that since the early reintroductions were done secretly and hence illegally, that the killing of a lynx is a justifiable act (Molinari, 2018).

2. Mortality Factors – While lynx reintroductions in Switzerland have been successful, mortality is still a concern. For example, researchers found that approximately 72% (52/72) of known lynx mortality during 1997-1999 was from noninfectious diseases or causes such as vehicular collision and poaching (Schmidt-Posthaus et al., 2002).

France – Vosges Massif (1983-1993) – Case Study Summary

This is one of the better documented Eurasian lynx reintroduction efforts and is largely considered a failure since the population was slow to grow and did not result in a self-sustaining population (Vandel et al. 2006; Scheid, 2018). Lynx were eliminated from the Vosges Mountains Massif area by the 17th and 18th centuries. Reintroduction efforts during 1983-1993 used 21 captive-sourced lynx from zoos. Lynx were both soft-and-hard-released onto four separate areas in the Vosges Massiff over a period of 9 years and were monitored using telemetry. It was unclear how many lynx were soft-versus-hard-released. However, Vandel et al. (2006) report that from 1983-1987, soft-releases were conducted with quarantine periods of 4-45 days in pre-release cages at forest sites. After 1987, all captive-source lynx were brought to a nearby zoo (Zoorama in Chize, France) and held from between 6-156 days (due to administrative barriers) and then immediately hard-released. Despite releasing a relatively large number of animals (21), only 4 females and 6 males are thought to have survived and reproduced during the early phases of the project. The fate of the other 11 lynxes did not end well—five were lost to unknown causes immediately following releases, two were recaptured due to habituation, one died of starvation, and two were illegally shot (Vandel et al. 2006). Additional illegal mortality was documented as the effort progressed with at least (4) additional known lynx poachings and two unknown losses. By 2006 the population had grown to 30 individuals but apparently began to decline and today has 3 known individuals (one male recently dispersed from the Palatinate Forest from Germany) and is not considered a self-sustaining population (Scheid, 2018). Currently there are no plans to reintroduce lynx into the Vosges Massif but dispersal from Germany may provide some future opportunity.

Lessons:

1. Mortality factors – human-caused mortality most likely a result of poaching was suspected to have been a factor inhibiting growth of the population. There was strong opposition of the reintroduction effort by Alsatian hunters who may have been involved in poaching. Their opposition lasted well into the 1990s (Vandel et al. 2006).

2. Captive individuals – there was concern that several of the unknown mortalities of the captive-sourced lynx had lower survivorship and at least two lynxes were habituated (Vandel et al. 2006).

3. Demographic isolation – there was no documented immigration from the Jura Mountains (Vandel et al. 2006).

4. Time frame of releases – releases were spread out over time and this likely slowed reproduction rates considering that the releases occurred over approximately 9 years and during this time, mortality from both known and unknown causes was occurring and likely inhibited reproduction (Vandel et al. 2006).

5. Social context – Vandel et al. (2006) stressed that poaching likely at the hands of hunters was a key limiting factor. They note that it would have been important to have had a much better understanding of hunter perceptions of lynx, hunting periods, and hunter behaviors. They suggested that hunters felt that lynx were a competitor to their roe deer and chamois and therefore were "fiercely" opposed to the reintroductions. Long hunting periods and special local practices of stalking likely contributed to more hunter opportunity to poach lynx.

Germany and Czech Rep. -- Bohemian Forest / Šumava Mountains (1982-1989)

Absent since the late 19th century, lynx were reintroduced to the border region between Germany and the Czech Republic beginning in the 1970s and later in the 80s. Approximately 5-10 (exact numbers are not known) wild-caught lynx were released in the Bavarian Forest National Park during the late 1970s but post-release monitoring was limited. By the early 1980s, 17 wild-caught lynx were released on the Czech side within present day Šumava National Park.

Regular reproduction was observed in the 1990s, telemetry monitoring was used regularly, camera trap monitoring is also used, and current estimates of the population range from roughly 50 individuals Kaczensky et al., (2013) to 70 individuals and occupy approximately 18,000 km^2 (Linnell et al., 2009). In a recent study done only on the Bavarian side of the area, Müller et al., (2014) found that average lynx dispersal distances were comparatively shorter than found in other populations, that the population is likely to remain isolated, and that poaching remains a key threat to the population and limits recovery in other nearby areas (e.g., Austria). Nonetheless, cooperation among lynx biologists and wildlife managers in Germany, Czech Republic, and Austria is strong and efforts to share data, information, and develop a common database for this shared border population of lynx is promising (3LynxProject, 2018).

Lessons:

1. Mortality – Human-caused morality likely from poaching outside the Bavarian Forest and Šumava National Park continue to hamper dispersal and long-term sustainability of this isolated lynx population.

2. Collaboration Across Borders – Improved collaboration and information among lynx managers, biologists, and wildlife managers is a positive development for this effort. Currently there are efforts to develop a common database among all three countries. This should help improve population monitoring, estimating habitat occupancy, and obtaining better estimates for lynx mortality (3LynxProject, 2018).

Germany – Palatinate National Forest (2015-present)

As a result of the failed lynx reintroduction in the Vosges Massif that is due south of the German border, wildlife managers, conservation groups, and personnel from the Palatinate National Forest began early discussions (late 1990s-early 2000s) about possible lynx reintroduction to the German side of the border area in the Federally owned and managed, Palatinate National Forest. As the idea gained traction, extensive public outreach and initial scoping was initiated to assess public acceptance to idea of lynx reintroduction. By 2012, (9) districts and cities, local hunting and livestock breeder associations provided letters of support for lynx recovery in the Palatinate Forest. A hunter supported referendum was agreed upon in 2012 and a Lynx Parliament was established to involve and engage local and regional stakeholders in the effort and provide scientific information about the planned and on-going lynx reintroduction (Idelberger, 2018). Additionally, a lynx management plan was developed before any releases occurred (Stiftung Natur und Umwelt (SNU) Rheinland-Pfalz, 2018).

In 2016 three orphaned lynx were first released, in 2017 another (6) wild-caught lynx were released, two died within the year and in 2018, another four lynx were released. Wild-caught lynx were quarantined for at least 3 weeks in Slovakia and in Switzerland as short as possible and then all hard released, all in the same area of the Palatine National Forest. Telemetry monitoring of all lynx has been conducted and reproduction has been documented. Of the original 13 lynx that were released, there have been (2) known mortalities (injury/train) and (1) male disperser to the Vosges Massif due south of the Palatinate Forest and one was struck by a train (Idelberger, 2018). Current estimates suggest a minimum of 15 known lynx (Rheinland-Pfalz, 2018). Preliminary outlooks for this effort are promising given a well-organized management approach, strong local support by both hunters and livestock breeders, effective responses to livestock damages, an engaged and supportive public, and political support. Given that it is the current stated policy of France not to reintroduce lynx in the Vosges area in the short term, it remains an open question about whether dispersing lynx will be able to recolonize the area successfully and if local people on the French side will accept lynx and not engage in illegal killing. Nonetheless, more than 50 stakeholder meetings have occurred on the French side in an effort to enhance local support for lynx in the general region (Scheid, 2018). Currently the German personnel involved in the effort are providing regular information to their French colleagues.

Lessons:

1. Outreach Before Lynx Releases Cultivated Local Support – Public outreach conducted in the pre-release phase (during 2000s) clearly helped cultivate local support for the effort by hunters and livestock breeders (key stakeholders in this context). A management plan was also developed prior to releases and was made publicly available to local communities (Idelberger, 2018).

2. Local Engagement Through a Lynx Parliament – A Lynx Parliament enables information exchange and engagement of local communities and stakeholders through a roundtable approach that offers civil discussion forum for the project. Stakeholders who are part of the Lynx Parliament have written official engagements that outline their specific commitments to the lynx reintroduction effort (Idelberger, 2018; Rheinland-Pfalz, 2018).

3. Rapid Response to Lynx Damage to Livestock – While there has been only one confirmed incident of livestock damages to sheep, there was a rapid response to install preventive electric fencing, compensation was paid, and follow up communication was done with the sheep breeder. According to German personnel involved, the sheep breeder has maintained strong support for the project and has engaged at a peer-to-peer level among other sheep breeders to support the effort. While this positive situation may be just a result of simply a progressive individual, the rapid response by the authorities may have also been an important precedent setting action.

4. Hard Releases in the Same Area – German personnel involved in the project expressed their support for hard releases indicating that they believed it resulted in less stress for lynx and less chances for injury. They also explained that hard releases in the same area may help lynx more rapidly set up territories and reduce homing tendencies (Idelberger, 2018).

5. Short Time-frame of Initial Releases – Compared to the Vosges reintroduction effort it is interesting to note that within a three-year period (2016-2018), 13 lynx were released. This had likely helped increase reproductive encounters and subsequent reproduction that has been documented (Idelberger, 2018).

Colorado, USA – San Juan Mountains (1999-2006)

This case study is likely one of the most detailed and well documented lynx reintroduction efforts to date. In an effort to restore Canada lynx (*Lynx canadensis*) to the State of Colorado where they had been extirpated in the 19th century, wild-caught Canada lynx from Alaska, British Columbia, Manitoba, Quebec, and Yukon were reintroduced to Colorado, USA during 1999-2006 and released into the San Juan Mountains.

A total of 218 lynxes (115 females, 103 males) were released in southwestern Colorado during the project time-frame. The large number of lynx that were used in the reintroduction provided the opportunity to adjust release protocols in order to optimize lynx survivorship within the first 12 months post-release (Devineau et al. 2011). As the releases proceeded, Devineau et al. (2011) adjusted the release protocols in order to improve lynx survivorship. The summary of findings below reference Devineau et al. (2011).

During 1999, the first (41) wild-caught lynx were released under 3 different release protocols. A total of 19 males and 22 females were released in 1999.

In **Release Protocol – 1 (RP-1)**, 4 females were hard-released on the 2-3 February, immediately after passing a veterinary inspection (males were to be released after females had established territories). Within six weeks of release, 3 lynx had died (2 adults, 1 juvenile). The fourth animal was recaptured since it was emaciated and returned to the holding facility to be fed and eventually re-leased. This early failure caused the researchers to adjust their release protocol.

The second **Release Protocol – 2 (RP-2)** was carried out later in February of 1999 was a soft-release where 9 lynxes were held for at least 3 weeks and fed primarily domestic rabbits to encourage weight gain prior to release. A juvenile female died of starvation within 7 weeks of the release, causing the team to again adjust their release protocol.

Under **Release Protocol – 3** (RP-3), (28) lynx were held at the facility for more than 3 weeks and fed and then released in the spring 1999 (1 April – 31 of May). Of the 28 lynx, 8 females were known to be pregnant at the time of release. The change to the spring release time was done to lessen the chances of post-release starvation. Within 6 months, 2 pregnant females had died of starvation, again resulting in a fourth release protocol.

Beginning in 2000 and continuing until 2006, only **Release Protocol – 4** (RP-4) was used. This was identical to RP-3 except that no pregnant females or juveniles were released. This was accomplished by capturing lynx before the breeding season and aging animals at initial capture sites, and rejecting juveniles for translocation.

By changing release protocols, the researchers were able to improve survivorship of lynx within the first 12 months of release. Specifically, they found that when lynx spent up to 7 days in captivity, average monthly mortality was 0.205 (95% CI =0.069, 0.475). When lynx spent >45 days in captivity, average monthly mortality was reduced to 0.028 (95% CI =0.012, 0.064).

The researchers suggested that longer quarantine times allowed lynx to increase body weight and adjust to the local conditions of their new environment. This may have facilitated social interactions between individuals and further helped lynx establish territories and breeding pairs upon release. Although the sample sizes were too small to accurately detect possible effects of age and pregnancy on release survivorship or season of release and influence on survivorship, the researchers recommend that adult, non-pregnant lynx be released in spring to improve survivorship rates within the first 12 month of release and reduce starvation risk.

Additional findings that are relevant to the LIFE Lynx Project are that 60% of all mortality occurred outside the study area (20,684 km^2 of southwest Colorado's San Juan Mountains) and 40% occurred inside. Outside of the study area, lynx were 1.6 times more likely to die within the first 12 months. Causes of mortality for lynx (inside and outside study area) were the following: poaching (14%), starvation (14%), vehicle collisions (11%), and plague (10%) made up nearly half of known lynx deaths. A full third of lynx deaths were of unknown causes. Other types of trauma (8%), probable predation (4%), predation (4%), and illness (2%) made up the remaining causes of lynx mortality.

Based on breeding surveys, monitoring results, and implantation of the program's original goals, Colorado Parks and Wildlife declared the lynx reintroduction a success in 2010. Currently, it is estimated that there are 150-250 Canada lynx in Colorado.

Lessons:

1. Use Soft-Releases – The researchers in this effort recommend that Canada lynx should be soft-released and not hard-released.

2. Longer Quarantine Periods (≥45 days) Reduced Mortality – Soft releases with a quarantine period of 5-6 weeks where lynx were fed a high-quality diet significantly reduced mortality risks for within the first 12 months of release. Rates of mortality dropped from 0.205 (when lynx were in captivity for 7 days) down to 0.028 when lynx spent >45 days in captivity before being released. Mortality rates were measured as the average monthly mortality during the first year of release. The researchers suggest that there did not appear to be any added advantage nor harm in holding lynx in the quarantine up to at least 50 days.

3. Adult Males and Adult Non-Pregnant Females Do Better When Released in Spring – While the sample sizes were too small to detect whether age, pregnancy, or season of release had an effect on release success, the researchers adapting their release protocol during 2000-2006 and only released adults (males/females) and non-pregnant females.

4. Additional Numbers of Animals May be Beneficial – Although the reintroduction project released a large number (n =218) of lynx, the researchers recommended that even additional animals could be considered due to permanent emigration and mortality associated with lynx movement off of the reintroduction area.

5. Use Intensive Monitoring – Based on their experiences and ability to detect mortality and adjust release protocols, the authors recommend that intensive post-release monitoring should be used to improve reintroduction efforts.

SOCIAL FACTORS - CARNIVORE REINTRODUCTIONS

When humans and large carnivores share the same landscapes, conflicts inevitably arise. Conflicts come in both material forms and those that are issue-based resulting from differing human values associated with carnivores, underlying social issues, and political and symbolic conflicts associated with carnivores (Madden and McQuinn, 2014).

These types of conflicts and concerns can be magnified and intensified when carnivores are proposed to be reintroduced or translocated to areas where they have been extirpated or when populations have become extremely small. While much of the existing literature regarding carnivore reintroductions and translocations has focused on biological and technical aspects of efforts, the complex social dynamics that play out in reintroduction efforts can not be undervalued. Additionally, nearly all historic reintroduction efforts that involve large carnivores like lynx or brown bears, raise important concerns about limiting human-caused mortality from illegal killing (poaching) (Miller et al., 1999).

Treves et al. (2009) have encouraged a systematic and participatory approach to working productively with communities to develop solutions for living with carnivores. The meaningful involvement of people and communities who live with carnivores on a day-to-day basis is essential for a long-term and effective approach to human-carnivore coexistence (Wilson, 2016; Wilson et al., 2017). When possible, working closely with communities to participate, plan, implement, and to sustain efforts to recover carnivores is a proactive and pragmatic strategy. Moreover, building local support for a carnivore reintroduction or translocation is vital for long-term success. However, successful carnivore reintroduction must have "scaled-levels of support", built upon well-designed management plans, effective communication strategies, and institutionally-backed political and financial support at national and international levels. Ideally, a successful carnivore reintroduction effort rests upon the support of *communities of place and communities of interest*—where local and broad public support converge (Wilson, 2016).

A useful way to understand some of these important social factors is to examine historic brown bear reintroduction efforts. While there are certainly different sets of biological, technical, and social issues to consider regarding lynx and brown bears, the broad lessons from historic brown bear reintroduction efforts all have highly relevant applications to the LIFE Lynx Project. The following case study summaries focus on these social factors and draw out relevant lessons. The following case studies are brown bear reintroduction efforts in Austria, France, Italy, and Idaho-USA.

SOCIAL FACTORS - CARNIVORE REINTRODUCTIONS: SELECT CASE STUDIES

Austria – Brown Bear Reintroduction to Upper Austria (1989-1994)

This failed brown bear reintroduction effort offers one of the most important lessons for those involved in large carnivore conservation—that without the support of local people, a reintroduction effort can fail largely as a result of suspected illegal, human-caused mortality of bears.

By the early 1980s, there were discussions about brown bear reintroductions in Austria largely after the result of a lone male bear that had dispersed from Slovenia in 1972 and ended up living in Upper Austria. By 1982, the Lower Austria Hunters Association and Lower Austrian Govt. officials agreed to reintroduce bears but by 1986, the Lower Austria Hunters Association, and groups representing livestock producers, and beekeepers all officially left the partnership and publicly opposed any future reintroduction due to disagreements about the system for compensation for bear damages (Rauer, 2018).

Nonetheless in 1989, World Wildlife Fund – Austria (WWF-Austria) continued to advocate for the reintroduction and assumed a leadership position and became the public face of the project. Reintroduction of 2 females and 1 male occurred. However, at that time, there was little in the way of a management plan or damage response protocol to respond to human-bear conflicts (Rauer, 2018). However, reproduction after the initial release was documented during 1991-2006. By the mid-1990s, high levels of damages occurred from a female with cubs and public support rapidly decreased—subsequently no new bears were reintroduced (Rauer, 1999). The population reached a high in 1999 of 12 documented bears but by 2002, the population began to decline likely as a result of human-caused mortality (Kaczensky et al. 2011). Currently there are no bears in Central Austria in the original release areas (Upper Aust.) and there are only sporadic/annual observations of bears (males) along the Austrian, Italian and Slovenian border. The reintroduction was a failed effort and today, there is no self-sustaining bear population in Austria.

Lessons:

1. Key Stakeholders at the Local Level Did Not Support Reintroduction - Local involvement of hunters, livestock breeders, and beekeepers was not well developed and despite vocal opposition to the project by these stakeholders, WWF-Austria proceeded with the effort. Additionally, there was never a formal decision-making process established to provide a forum for local stakeholders to participate in the effort. Subsequently, illegal poaching by these interest groups was suspected to be a leading cause of the population decline and ultimately resulted in the failure of the reintroduction effort (Rauer and Walzer, 2009).

2. A Reintroduction Effort Should Reflect a Broad Partnership to Reflect Public Interest – Despite the good intentions of WWF-Austria to restore bears to Austria, their willingness to take a high-profile and public leadership position likely made them an easy target to blame for high levels of bear damages that occurred during the mid-1990s. If a broad

coalition of hunters, livestock breeders, and beekeepers had been core partners in the project, it is likely that there would have been a more concerted effort by these interest groups to participate in preventative practices to reduce damages and be more tolerant of bears (Rauer and Walzer, 2009).

3. Mortality Factors Could Not be Lessened – The suspected, illegal killing of bears, coupled with a small population, and genetic concerns all contributed to the eventual loss of the bear population in Austria (Kaczensky et al. 2011).

4. Lack of Political Support for the Project – Ultimately, brown bear reintroduction in Austria never had strong political support at regional or national levels and WWF-Austria was largely the only entity that lead the reintroduction effort (Rauer and Walzer, 2009).

5. Lack of Planning and Monitoring – Throughout the effort it was evident that there was little in the way of a comprehensive management plan to guide the effort in the early stages nor was there a comprehensive monitoring plan to deal with damages, bear behavior, and public attitudes (Rauer and Walzer, 2009).

6. Small Number of Founders – The small number of bears originally released into Austria and the small population made bears inherently vulnerable to stochastic events and human-caused mortality (Rauer and Walzer, 2009).

France – Brown Bear Reintroduction to the Pyrenees (1996-present)

This successful brown bear reintroduction effort perhaps can be broadly characterized as one where the national interest clashed consistently with local interests. This national, government led effort may have produced biological benefits in terms of a small, slowly expanding bear population, but fierce local opposition to the effort may hamper long-term viability of the bear population and opportunities for future reintroductions of bears if needed.

By the 1990s, brown bears were largely absent from the Pyrenees Mountains and concerns had been raised in the 1980s about the loss of bears (Quenette et al. 1999). Only a handful of bears (approximately 5) still remained in the western population. During this same time, the national government, specifically the French Ministry of Environment (lead by the Office National de la Chasse et de la Faune Sauvage), took a lead role in developing the plans and management of the reintroduction effort. In 1993, a public-private committee representing stakeholders was formed along with the Spanish Ministries of Environment and Association pour le Development Economique et Touristique and Artus association, Office National de la Chasse, Associations of Hunters, and Office National des Forest (Quenette et al. 2001). That same year the committee agreed to attempt translocation of brown bears into the Central Pyrenees. During 1996-1997, (3) bears were released to the Central Pyrenees despite strong vocal opposition by local sheep producers (Quenette et al. 2001, Bland, 2012). Limited reproduction was documented but the population remained small and vulnerable during the early 2000s. By 2004 bears were again, largely absent in the Pyrenees and in 2006 another (5) bears (Slovenian) (4) females and (1) male were released and the population increased to approximately (22) in 2011. And despite sustained local opposition (Camarra et al., 2011) an additional male was released in 2016 and 2 additional females were released in 2018.

Currently there are approximately 45 known bears (minimum) in Central Pyrenees and 2 male bears in the Western (Atlantic) Pyrenees.

Key Lessons

1. Political Commitment at the National Ministry Level Helped Make Effort Possible- There was state (ministry-level) support from French, Spanish, Andoran, and Slovenian (source of the bears) governments and financial support of the EU (LIFE projects) that were essential to success. Without this national-level backing, it is unlikely that the reintroduction effort would have occurred. National level support enabled development of management plans, compensation programs, and monitoring (Palazón, 2017).

2. A Long-Term Consultation Process – Developed in the late 1980s, a consultation process did help incorporate local stakeholder interests as not all local inhabitants opposed the reintroduction. However, this process was mainly an information dissemination function rather than actually including local people into decision-making process. Nonetheless, the consultation process provided information, transparency, and helped establish support for the effort (Quenette, 2018)

3. A More Developed Decision-Making Process Was Needed – Quenette (2018) suggested that a more robust and inclusive decision-making process would have been helpful from the beginning of the reintroduction effort to encourage a more participatory form of engagement with all local stakeholders that may have helped develop better acceptance for bears.

4. Sustained Local Opposition and the Long-term Outlook- Currently, there are concerns about poaching, hunting accidents, and strong opposition to future releases of bears. Local opposition to new reintroductions of additional bears may hamper long-term viability of population, extensive sheep production in the French Pyrenees presents coexistence challenges, and small population that may have genetic issues all begs the question whether this reintroduction is sustainable over the long-term (Palazón, 2017).

Italy – Brown Bear Reintroduction – Autonomous Province of Trento (ATP) (1999-2001)

The brown bear reintroduction effort in the Autonomous Province of Trento (ATP) is considered one of Europe's great wildlife success stories. The effort, characterized by long-term political commitments, comprehensive science-based planning and management, well-developed communication strategies and outreach, and broad public support for the initial reintroduction all helped make the reintroduction a success. Bear numbers rebounded and eventually a self-sustaining brown bear population of between 52-63 bears inhabit the ATP area today (Tosi et al. 2015). However, the success of this effort has become more complex and contentious as the bear population has expanded rapidly, damages have occurred, and recent, high-profile human-bear encounters that resulted in serious human injury have eroded public support for bears in ATP (Tosi et al. 2015).

Brown bears were protected in Italy beginning in 1939 where the only two remaining populations occurred in the Appenine Mountains of the Abruzzo region and the Alpine area of northeast Italy's Trentino region. It is important to note that as early as 1976, bear management and conservation was led by the Autonomous Province of Trento (ATP). By the late 1990s, bear numbers had dwindled to some 3-4 brown bears. At this same time, a feasibility study undertaken by the Italian Ministry for the Environment-Land and Sea and the National Wildlife Institute (NWI) found that 40-60 bears could populate the area based on existing habitat (Dalpiaz et al. 2008). The same feasibility study emphasized developing social acceptance of bears, sharing information about a possible reintroduction, and called for prevention and compensation programs to help minimize economic impacts of a future bear population to local people (Dalpiaz et al. 2008).

A broad array of partners and local stakeholders began collaborating to discuss reintroduction and how best to coordinate efforts during the pre-release phase. By the late 1990s, agreement to proceed with the reintroduction was found among both local, regional, and national stakeholders (Jonozovic and Mustoni, 2003). Among those agreeing included, the Adamello Brenta Nature Park, Autonomous Province of Trento (ATP) (lead)-Wildlife Office of the Forest and Wildlife Department, Italian Ministry of he Environment (National Wildlife Institute), Federal Directive of Swiss Forests, WWF-Italy, the Hunters Association of Trento, the Trento Association of Beekeepers and Livestock Breeders along with national, regional, and provincial governments. The neighboring provinces of Sondrio, Verona, Brescia, Bolzano and regions of Lombardia and Veneto agreed to inform local people if bears were present through media releases (Groff et al. 2011, Groff et al. 2013).

In 1997 the ATP conducted a survey of local inhabitants and found that 70% were in favor of the plan to reintroduce bears. Roundtable groups were developed to provide a forum for information exchange and engagement of local stakeholders. And during 1999-2001 10 bears were released (3) males and (7) females. By 2007, reproduction was recorded and bear numbers had increased to 24 (13) females (10) males and (1) unknown (Tosi et al. 2015).

As the bear population increased, damages also increased and by 2011, public support had dramatically shifted—60% opposed the presence of bears, 30% supported the presence of bears and 10% were neutral (Tosi et al. 2015). Then in 2014, 2015, and 2017 a series of serious human injuries resulted from close-encounters situations with bears. Extensive, dramatic, and highly negative media coverage of these events have inflamed the situation (Groff, 2018).

The robust increase in bear numbers over the past twenty years is undoubtedly a biological success as high reproductive rates have led to a self-sustaining population. Moreover, the ATP population provides a source population for improved metapopulation connectivity in the eastern Alps. However, the loss of public support of bears is troubling for the long-term outlook (Tosi et al. 2015). Current management will have to adjust to how best to manage "problem bears" and manage public expectations when bears may need to be removed from the population (Groff, 2018).

Lessons:

1. Existing Management Capacity – The historic role that the ATP had played in bear management beginning in the 1970s was instrumental in bringing technical, organizational, and management expertise to the planning and execution of the reintroduction effort (Dalpiaz et al., 2008).

2. Political Commitment by the Autonomous Province of Trento (ATP) – The political commitment of the province was instrumental for cultivating local support versus the reintroduction effort being pushed by the national government (Rome) (Groff, 2018).

3. Extensive Public Outreach during the Pre-Release Phase – Considerable effort was put informing local people about the effort before any releases of bears occurred. Extensive public meetings were conducted and local roundtables were developed so regular information could flow into communities as the reintroduction occurred and as the bear population expanded (Groff et al., 2018).

4. Maintaining Local Support – The ATP case demonstrates that local support for a reintroduction can shift quickly and dramatically as the bear population increased, damages resulted, and humans were injured. Currently, bear management in ATP is confronting the reality of having to lethally control of bears to protect human safety and balancing animal rights concerns, and those of the local and general public (Groff, 2018).

Idaho – USA Proposed Brown Bear Reintroduction (1990-1995)

This proposed reintroduction effort never took place after strong political opposition at local and state-levels challenged a plan despite the plan being officially adopted by the U.S. Fish and Wildlife Service, a federal agency housed under the U.S. Department of Interior. This case is instructive because despite well-intentioned efforts made by a public-private partnership to provide a substantial role for citizen involvement and management of the reintroduction, political opposition ultimately stopped the proposed reintroduction.

This case study is located in central Idaho, one of 17 Western U.S. States. The last known brown bear (grizzly) was killed there in 1932. With protection of bears in the United States (1975) and the development of recovery plans, this portion of Idaho was officially designated a recovery area under the 1993 grizzly bear management plan (Servheen, 1993).

By 1995 a coalition led by the U.S. Fish and Wildlife Service, National Wildlife Federation (NGO), and Defenders of Wildlife (NGO), Timber Industry representatives, Unions, and the Nez Perce Tribe proposed a new approach to the reintroduction that would develop a citizen appointed committee to manage the reintroduction effort called the Citizen Management Committee (CMC) (Roy et al. 2001). The foundation of the proposed plan called for local management of bears by a 15-member committee to be appointed by the governors of Idaho and Montana (Roy et al. 2001). However, the committee did not have the support or a member from the Idaho Cattlemen's Association or from someone to represent Idaho hunters. Additionally, there appeared to be somewhat weak support from the Idaho Dept. of Fish and Wildlife (Smith, 2003).

The plan called for 25 bears to be released (5 bears/year) with a goal based on habitat analysis that suggested the area could support 280 bears within 50-110 years (Roy et al. 2001).

In 2000, The U.S. Fish and Wildlife Service officially selected the plan to reintroduce bears under the Citizen Management Committee proposed alternative. During this time there was general public support for the reintroduction. Public surveys found that 60% of those who were from the local area (ID/MT) favor and the general U.S. public was 76% in favor of the reintroduction plan (Smith, 2003). However, despite the promising outlook to move forward with the reintroduction, strong and vocal opposition from the State of Idaho emerged. At the local level in Idaho, both county and state-level governments officially opposed the plan as did all the Idaho delegates to the U.S. House of Representative and U.S. Senate. Eventually the U.S. Fish and Wildlife Service was unable to implement the plan because the lack of political will nor adequate funding (Smith, 2003).

Lessons:

1. Not all stakeholders were Included – Despite having the appearance of being a broadly representative forum for stakeholders in Idaho, a likely fatal flaw in the makeup of the Citizen Management Committee was that key associations that included livestock producers/breeders and hunters did not support the effort. Moreover, weak support by the state of Idaho did not help efforts to develop the citizen management committee (Smith, 2003).

2. Does Prominent Leadership by Environmental NGOs Help or Hinder Reintroductions? – In the context of Idaho, prominent leadership by the National Wildlife Federation and Defenders of Wildlife likely fueled political opposition to the effort. And similar to the Austrian case, the public role that an NGO had in promoting the reintroduction effort likely caused negative public perceptions that the reintroduction was a special interest endeavor (Rauer and Walzer, 2009)

3. Strong Local and Regional Opposition – Ultimately, this effort was a failure because of political opposition by the State of Idaho—the exact area where bears were proposed to be released. In hindsight, this seems to be a glaring red flag (Smith, 2003).

If one looks for broad lessons from across the (4) case studies it is clear that social factors are critical to the success or failures of reintroduction efforts (Table 3).

LESSONS FROM (4) CASE STUDIES

1. Local Stakeholder Support - Diverse and inclusive engagement of local stakeholders to generate support for reintroductions is vital.

2. Collaborative Process - There should be a collaborative process or mechanism for meaningful participation and information sharing among all vested stakeholders.

3. Political Support – Political support that is appropriately scaled to the reintroduction effort and has multi-tiered political support is important for success. This is the concept that a reintroduction effort must account for values and political support among *communities of place and communities of interest*. Additionally, long-term political support also requires a financial commitment to support a reintroduction effort by the relevant ministries and or agency.

4. Existing Management Capacity – While seemingly obvious, it is nonetheless important to assess whether an effort has the wildlife management capacity to take on a reintroduction effort.

5. Comprehensive Management – Successful reintroduction programs (e.g., Italy) relied on a comprehensive approach to planning, monitoring, responding, and adapting to dynamic biological and social factors throughout the effort.

6. Communication - Public outreach and communication before and during reintroductions occur are critical for maintaining transparency, informing the public, managing public expectation, and maintaining overall public and political support for a reintroduction.

7. Leadership - Who proposes and carries out the reintroduction is critical in terms of evaluating local and regional perceptions of how power is yielded and may influence local participation and perceptions of the effort. A broad coalition of local, regional, and national interests sharing leadership for a reintroduction effort may be a sound strategy to demonstrate that the effort has public support.

- Perceptions of outside power forcing decisions on local people can result in local opposition.
- Italy and French cases had strong governmental roles.
- Austrian and Idaho cases had strong NGO roles.

Table 3. Comparison of social factors that characterized (4) reintroduction efforts (Austria, France, Italy, USA) and rated by how well these attributes/characteristics were developed: improvement needed = grey, moderately developed = yellow, and well-developed = green.

Characteristic	**Aust.**	**France**	**Italy**	**USA**
Diverse and inclusive engagement of local stakeholders to generate support for reintroduction is evident?				
Collaborative process or mechanism for meaningful participation and information sharing is evident?				
Political support is appropriately scaled or multi-tiered?				
Local scale?				
Regional scale?				
National scale?				
Political support is geographically relevant to proposed release area?				
Existing management capacity is evident and competent to support reintroduction effort?				
Long-term political commitment and financial support for reintroduction by relevant ministry or agency				
A comprehensive management plan / program is in place?				
Public outreach and communication is conducted before and during reintroduction?				
Leadership of reintroduction effort is perceived as serving the public not special interests?				

CONCLUSIONS

Carnivore reintroductions and translocations are risky, expensive, and must attend to both biological and social factors. An effective reintroduction effort requires integration of multiple skill sets to understand these factors by teams of people working together. This is even more critical in Central Europe where the scale of large carnivore life histories transcend national borders, cultures, and management jurisdictions. To address this requires a strong understanding of biological and social conditions at multiple scales.

This report is an attempt to synthesize those key biological findings and social factors from peer-reviewed literature to specific case-studies that involved Eurasian lynx reintroductions and other large carnivores. Ideally, the findings and lessons illustrated in this report will help the LIFE Lynx Project continue to follow the IUNC 1998 Guidelines for Reintroductions with context-specific planning, effective project implementation, and a comprehensive management approach that coordinates efforts in Slovenia, Croatia, and Italy.

Biological Findings: From a biological standpoint, the peer-reviewed literature stresses that habitat quality is a critical factor for determining whether a reintroduction effort results in a self-sustaining population. As habitat quality increases, so do the odds of success. Additionally, efforts that released animals in core, not peripheral habitat (of a species range) also increased the chances that the effort was a success. Another important finding from the literature was that as the numbers of released animals increased, so did success rates. And reintroduction and translocation efforts that removed the original cause of the population decline also increased the chances that the effort would be a success. Another key finding from a review by Macdonald was that carnivore reintroductions that have historically failed do so because the projects failed to closely follow the IUCN Reintroduction Guidelines.

Another biological factor that has attracted attention is whether animals that are released come from wild-caught populations or are from captive-sources. In an extensive analysis by Jule et al., (2008) that focused only on carnivore reintroductions, found that translocation programs were more successful (31%) when wild-caught animals were used compared to efforts that used captive-born animals (13%) and that survivorship of released wild-caught animals was higher (53%) than captive-born individuals (32%).

Historic Eurasian Lynx Reintroductions: In an excellent review of Eurasian lynx reintroduction efforts, Linnell el al. (2009) found that most historic Eurasian lynx reintroductions were poorly planned, certain biological factors were not well attended to (e.g., numbers of released animals, post-release monitoring), and 3) that public outreach during the pre-release phase was limited. Important lessons from that review are the following:

1. Future lynx reintroductions must be well planned, use the 1998 IUCN Guidelines for Reintroductions, and invest in robust monitoring.
2. Lynx reintroductions should be planned at appropriate scales that facilitate metapopulation level connectivity and better coordination should be carried out by those involved in reintroductions.
3. Communication and public consultation are critical for successful reintroductions.

4. Efforts should be made to achieve effective stakeholder involvement.
5. Clear management plans with long-term goals should be developed with special emphasis on reducing human-caused mortality (i.e., poaching) of lynx.
6. Efforts will need to consider the challenge of having to work meticulously at the local scale (release site level) and to attend to larger scales where collaboration is needed as lynx expansion occurs.

Selected Lynx Reintroduction Case-Studies: In additional analysis of lynx reintroductions (4) that were European and from North America (1), is was evident that mortality factors continue to be a major concern across all lynx recovery efforts.

Despite successful lynx reintroductions efforts in both the Jura Mountains and Alps of Switzerland that originated in the 1970s, many historic lynx reintroductions were kept secret and have caused local opposition to lynx that continues to result in illegal poaching. In the case of the French Vosges Massif reintroductions, the use of captive-sourced individuals for releases, a long time-frame during releases, demographic isolation, and suspected poaching by local hunters all contributed to a failed effort.

The 1980 lynx reintroductions in the border region of Germany, Czech Republic, and Austria show positive signs of a small, self-sustaining lynx population and strong international collaborations, yet illegal poaching outside core lynx habitat continues to be a threat. An emerging effort in the German Palatinate National Forest may be a promising model of a successful lynx reintroduction effort that is well organized, has strong local support, robust mechanisms for stakeholder decision-making and governance, and well-designed communication and public outreach strategies. The North American example illustrated that soft-releases using a quarantine time of ≥45 days increased survivorship during the first 12 months when lynx were released. Mortality rates dropped from 0.205 (when lynx were in captivity for 7 days) down to 0.028 when lynx spent >45 days in captivity before being released.

Social Factors: At both a pragmatic level and in terms of maintaining long-term populations of large carnivores, it is vital to work with local communities to participate, plan, implement, and to sustain efforts to recover carnivores. Moreover, building local support for a carnivore reintroduction or translocation is vital for long-term success. However, successful carnivore reintroduction must have "scaled-levels of support", built upon well-designed management plans, forums for stakeholder engagement, effective communication strategies, and institutionally-backed political and financial support at national and international levels. Ideally, a successful carnivore reintroduction effort rests upon the support of *communities of place and communities of interest*—where local and broad public support converge (Wilson, 2016).

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APPENDIX A

The review article by Miller et al. (1999) was focused on key biological factors that influence carnivore translocations. However, the authors also listed several technical recommendations. These were phrased as questions and are the following:

Non-Biological / Technical Considerations for Carnivore Translocations:

1. What legal framework exists regarding the translocation effort?
2. Does the carnivore translocation effort comply with all laws?
3. Are there sufficient funds and intellectual (skills) resources to maintain the program?
4. Will the effort be adequately monitored post-releases?
5. Are clear goals articulated in the project?
6. What types of logistic challenges will occur? Can they be overcome?
7. Is there sufficient capacity, leadership, and organizational capacity for making decisions?

APPENDIX B

The authors highlighted in Macdonald's review were asked to list in order of importance, their perception of what the most important factors are in carnivore reintroductions. These are:

1. Agents of initial decline removed
2. Suitable and abundant prey resource available
3. Monitoring
4. Community/political support
5. Soft releases
6. Suitable size of reintroduction site(s)
7. Founder characteristics – adapted to site, genetically diverse, not all captive bred, not stock killers, wary of humans
8. Appropriate reason to reintroduce predators
9. Financial support/economic impetus
10. Habitat quality of release site
11. Appropriate security (fencing, guarding, etc.)
12. Continued augmentation
13. Inbreeding
14. Competitors at low density
15. Outbreeding depression
16. Re-evaluation of reintroduction protocols

Macdonald concluded his review with 7 considerations and questions that provide general guidance when contemplating a carnivore reintroduction. There are paraphrased below:

1. Is a reintroduction necessary?
2. Reintroductions should aim to create a new future, not a nostalgic look to restore an old past
3. What is the appropriate scale to carry out the reintroduction?
4. Human acceptance and political commitments can change over time, must have an adaptive approach when there is uncertainty in the future.
5. What science is missing? Can the reintroduction effort be done in experimental phases if there is critical missing information?
6. Animal welfare concerns must be carefully considered (management aspect, survivorship, etc..)
7. Each reintroduction effort should be considered at a context specific level, both ecologically and socially but also consider larger lessons (e.g., 1998 IUCN guidelines).