WildForestReindeerLIFE; LIFE15 NAT/FI/000881

Strategy on replicability and transferability:

'Reintroducing Forest Dwelling Wild Reindeer in Europe'

Project Action D4 Replicability and transferability of WFR reintroduction elsewhere in EU

PUBLICATION SUMMARY: In Europe, ongoing efforts focus on reintroducing species lost over time to restore ecological processes. While reintroductions, such as wild reindeer, are significant, they are limited to specific regions due to past climate changes. The wild forest reindeer (Rangifer tarandus fennicus) became extinct in Finland due to overhunting a century ago. Since then, it has been successfully reintroduced for three separate times to various parts of its historical range. In the more distant past, wild forest reindeer as well as other subspecies of wild reindeer were present in Europe more extensively.

This review assesses the feasibility of reintroducing wild forest reindeer elsewhere in Europe, outside Finland, emphasizing adaptability and conservation benefits. It targets public and private entities involved in conservation, offering insights rather than specific implementation guidance. The examples provide focus on wild forest reindeer. As a background and a starting point for contemplating the potential of further reintroductions, the text outlines the historical and current status of both in situ and ex situ wild forest reindeer populations, highlighting population decline and subsequent conservation efforts.

The rationales for reintroducing wild forest reindeer are thoroughly examined, emphasizing certain decisive facts and features that justify reintroduction and its place in conservation. The planning and implementation of wild forest reindeer reintroduction require careful consideration. A three-phase workflow is described, involving systematic decision-making and readiness to trigger an exit strategy. Communication and local stakeholders' acceptance and even devotion are crucial aspects, requiring early determination of responsible parties and communication activities. Preparation for crisis communication is essential, considering the involvement of live animals.

[This publication is a non-proofread & non-layout version. The EAZA EEP Long Term Management Plan for wild forest reindeer (Rangifer tarandus fennicus) is scheduled for completion in 2024. The guidance of the completed plan will be taken into account in the finalization of this current publication. The final version will be disseminated to relevant bodies within the Member States according to the plan outlined in Project Action E2 deliverable 'Dissemination of the strategy on replicability and transferability.]

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Reintroducing Forest Dwelling Wild Reindeer in Europe

Rationale, planning and preparations of reintroduction

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WildForestReindeerLIFE
LIFE15 NAT/FI/000881

Cover photo: A one-month-old wild forest reindeer calf inside the Lauhanvuori enclosure of the WildForestReindeerLIFE in June 2022. The 31-hectare captive breeding facility / acclimatization enclosure is situated within a natural habitat. Individuals were released directly from the enclosure to a region that boasts within a radius of tens of kilometres a considerable amount of high-quality wild forest reindeer habitat suitable for both summer and winter. (photo: Milla Niemi/Metsähallitus Parks & Wildlife Finland)

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[This publication is a **non-proofread & non-layout version**. The EAZA EEP Long Term Management Plan for wild forest reindeer (*Rangifer tarandus fennicus*) is scheduled for completion in 2024. The guidance of the completed plan will be taken into account in the finalization of this current publication. The final version will be disseminated to relevant bodies within the Member States according to the plan outlined in Project Action E2 deliverable 'Dissemination of the strategy on replicability and transferability.]

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SUMMARY

In Europe, ongoing efforts focus on reintroducing species lost over time to restore ecological processes. While reintroductions, such as wild reindeer, are significant, they are limited to specific regions due to past climate changes. The wild forest reindeer (*Rangifer tarandus fennicus*) became extinct in Finland due to overhunting a century ago. Since then, it has been successfully reintroduced for three separate times to various parts of its historical range. In the more distant past, wild forest reindeer as well as other subspecies of wild reindeer were present in Europe more extensively.

This review assesses the feasibility of reintroducing wild forest reindeer elsewhere in Europe, outside Finland, emphasizing adaptability and conservation benefits. It targets public and private entities involved in conservation, offering insights rather than specific implementation guidance. The examples provide focus on wild forest reindeer. As a background and a starting point for contemplating the potential of further reintroductions, the text outlines the historical and current status of both in situ and ex situ wild forest reindeer populations, highlighting population decline and subsequent conservation efforts.

The rationales for reintroducing wild forest reindeer are thoroughly examined, emphasizing certain decisive facts and features that justify reintroduction and its place in conservation. The planning and implementation of wild forest reindeer reintroduction require careful consideration. A three-phase workflow is described, involving systematic decision-making and readiness to trigger an exit strategy. Communication and local stakeholders' acceptance and even devotion are crucial aspects, requiring early determination of responsible parties and communication activities. Preparation for crisis communication is essential, considering the involvement of live animals.

1 INTRODUCTION

In several ongoing rewilding projects across Europe, the aim is to reintroduce species that have long been lost. The idea is to restore those lost or weakened ecological processes in which the species to be reintroduced were once involved. Often, the focus seems to be on previously extinct or severely diminished megafauna, which, when reintroduced as part of the ecosystem, could help reshape habitats and communities into more diverse and resilient forms.[1] Through small steps, well-planned actions, and the use of suitable species in selected locations, such efforts can be entirely justified.

During the last Ice Age, wild reindeer of the *Rangifer* genus inhabited practically the entire Europe wherever land was free from ice. As reindeer are primarily a species of cool and cold regions, they disappeared from southern latitudes as the climate changed, gradually shifting the distribution towards the north. The consequences of this species loss due to the climate change have been apparent for quite some time, and the environmental conditions in those areas have completely transformed since.

Efforts to reintroduce wild reindeer are also underway, but since their disappearance due to climate change occurred in vast areas far in the past, reintroduction efforts for wild reindeer are limited to very specific regions. It is not feasible to develop a comprehensive strategy for reintroducing the species across the entire EU or Europe; instead, each country should assess whether the idea of reintroducing wild reindeer applies to them or not. For much of Europe, this is not applicable.

Contemplating the reintroduction of wild *Rangifer* reindeer in Europe is relevant only in the Arctic and boreal zones, and perhaps to a limited extent in the hemi-boreal zone, and in certain specific mountainous regions. It is also necessary to emphasize that *Rangifer* reintroductions do not so much represent the somewhat critically received *'Pleistocene rewilding'* ideology.[2] Primarily, the focus of reintroduction – including those already carried out – is on regions where the species has disappeared mainly within the last few centuries, largely due to excessive hunting pressure for population yield.

For regions where the reintroduction of wild reindeer is even remotely relevant, we outline at the end of this publication a planning and operational workflow to assess the justification and feasibility of such reintroduction. This workflow consists of three phases and aim to reintroduce wild reindeer as part of the region's native fauna. However, the workflow phase sequence is designed to be interruptible at any point, and yet the efforts and resources invested thus far benefit not only the conservation of reindeer themselves but also the overall conservation of biodiversity and the mitigation of habitat loss.

In this publication, the focus is on the wild forest reindeer (*Rangifer tarandus fennicus*), but the design of reintroduction efforts would largely overlap with that of the wild tundra reindeer (*Rangifer tarandus tarandus*) as well. And, undoubtedly, this paper is essential reading for anyone involved in planning a conservation translocation, regardless of the species in question.

This overview is primarily aimed at public and private entities responsible for the conservation of native species in their respective countries. These entities include national conservation and environmental agencies, national administrations responsible for sustainable resource management, zoos and zoo associations, as well as non-governmental organizations involved in nature and species conservation.

[1] Hart, Emma E., Amy Haigh, and Simone Ciuti. 2023. A scoping review of the scientific evidence base for rewilding in Europe. – *Biological Conservation* 285: 110243.
[2] Zimov, Sergey A. 2005. Pleistocene park: return of the mammoth's ecosystem. – *Science* 308: 796-798.

The aim of this strategic review is not to provide a step-by-step guide to the techniques and implementation of wild reindeer reintroduction, but rather to help understand the numerous planning tasks and decisions that must be addressed long before approaching any unsuspecting representative of the *Rangifer* family with a tranquilizer gun (albeit with good intentions, of course). The examples provided in specific sections below describe the considerations and justifications that have been pertinent to Finnish wild forest reindeer reintroductions.

Our text also does not aim to determine which areas in Europe should be targeted for the restoration of wild reindeer populations. Expertise and decision-making capacity in potential areas are better suited for that consideration.

2 HISTORY OF WILD REINDEER IN EUROPE

The consideration of the principles and justification for species reintroduction always starts with historical context.

The forest reindeer and the tundra reindeer both have diphyletic background, as their genomes show signs of ancestors living in both the Western European refugia and the Beringian refugia.[3] During the Ice Age, reindeer were widespread throughout Europe, including the area of Britain, which at that time was connected to mainland Europe by a broad land bridge. The species' distribution in Europe has varied over the last 25,000 years according to fluctuations in climate warming and cooling.[4]

After the Last Glacial Maximum (LGM; 27,000–21,000 years BP), the wild reindeer disappeared from Southeast and Central Europe. However, the 'Allerød warming' did not lead to the complete disappearance of reindeer in Central Europe, as they were present at least during the Younger Dryas period in southwestern Europe. Reindeer likely completely disappeared from mainland Europe around 11,000 years ago, and from southern Scandinavia slightly later. The most recent radiocarbon-dated reindeer subfossils from the British Isles are approximately 10,000 years old. However, there is an interesting written record from around the 12th century suggesting the possible presence of reindeer much later, as the earls of the Orkney Islands mentioned hunting reindeer and red deer in Scotland.[5]

The spread of subspecies to their current ranges in Fennoscandia likely occurred from two directions; mountain reindeer from along the Norwegian coast, as it emerged from the ice, and wild forest reindeer from the southeast and east.[6]

2.1 The history and current status of the wild forest reindeer population

During the Stone Age, through the Iron Age, and into the post-Medieval era, the forest reindeer was one of the most significant prey animals and a cornerstone of settlement in the prehistoric forested

[3] Røed, Knut H. 2005. Refugial origin and postglacial colonization of holarctic reindeer and caribou. – *Rangifer* 25(1): 19-30.
[4] Sommer, Robert S., et al. 2014. Range dynamics of the reindeer in Europe during the last 25,000 years. – *Journal of biogeography* 41: 298-306.
[5] https://www.linkedin.com/pulse/short-history-scotlands-lost-species-4-reindeer-david-hetherington/
[6] Rankama, Tuija, and Pirkko Ukkonen. 2001. On the early history of the wild reindeer (*Rangifer tarandus L.*) in Finland. – *Boreas* 30: 131-147.

regions of Fennoscandia. The forest reindeer was hunted extensively for centuries, and signs of declining populations reportedly began to emerge in the 1500s and 1600s.[7]

Even in the 1600s, wild forest reindeer roamed in herds of thousands in Finland, but the decline in population had already begun. The wild forest reindeer was likely the most significant game animal for Finnish woodlanders and relatively easy to hunt. By the 1800s, the population had dwindled significantly, and the decline continued throughout the century. Finnish wild reindeer (applied to both *R. t. fennicus* and *R. t. tarandus*) were completely protected in 1913, but it was too late. The letter of the law did not quickly gain a foothold in the remote corners of the country where the last wild reindeer lived. By the early 1920s at the latest, the last remaining specimens in Finland were hunted, and thus, the species had become extinct in Finland. In Sweden, the wild forest reindeer had been hunted to extinction a little earlier, in the 1870s.

Despite facing extinction, the wild forest reindeer remained legally protected in Finland. This protection likely played a significant role in the species' re-establishment from the Soviet Union in the 1940s and 1950s. Large carnivores were scarce, and conditions for the growth of the wild forest reindeer population were favourable in the following decades. As the first conservation measure targeting the wild forest reindeer's habitat, an area of 30 km^2 in Elimyssalo was designated protected from all forestry activities for 20 years in 1972. Elimyssalo still remains a protected area, now covering an area of 83 km^2. Overall, approximately 1080 km^2 of habitat is currently protected for the *fennicus* subspecies. By the late 1970s, the wild forest reindeer population in Finland was limited to Kainuu, comprising 500–600 individuals. The recovery of the population was facilitated by the first reintroduction in the early 1980s, introducing individuals from the Kainuu subpopulation to the Suomenselkä area.

Currently, the *fennicus* subspecies is found only in Finland and in Russian Karelia and the westernmost part of the Arkhangelsk oblast. The global population is approximately 5000 individuals, with around 3000 individuals living in Finland. The wild forest reindeer population in Russia is likely declining. Although the species is protected there, poaching is relatively common, and the situation appears to be worsening.[8]

2.2 History of the ex-situ population

The Finnish Forest Administration organized a large meeting in Kuhmo in August 1972 to discuss the conservation of forest reindeer. It was during this meeting that the idea of transferring reindeer to "safekeeping" was first raised, with Korkeasaari Zoo as the initial destination. The plan began to be implemented the following winter. Six forest reindeer were captured alive in Kuhmo, but the transportation proved to be problematic, as only one female survived the journey to Helsinki. This failure resulted in significant criticism. After that, wild forest reindeer were not brought into the zoo population until in 1976 (two males) and 1979 (two females).

The first calf was born in the zoo in 1980. The *ex-situ* population abroad began to grow in 1988 and 1989, when the first transfers were made from Finland to zoos in Sweden. As of the turn of 2023–2024, the zoo population of forest reindeer comprised a total of 159 individuals in 27 European zoos. The genetic foundation of the population traces back to a total of 13 individuals captured from the wild.

[7] e.g. Montonen, M. 1974. *Suomen peura*. WSOY. Porvoo; Tegengren, H. 1952. *En utdöd Lappkutur i Kemi Lappmark*. Åbo Akademi. Turku.

[8] https://scientificrussia.ru/articles/ucenye-karnc-uznat-i-sberec-simvol-severa

Five of them have been recently introduced to the zoo population only recently (2019–2022) as part of the WildForestReindeerLIFE project. Throughout the history of the *ex-situ* population, a total of 50 individuals have been reintroduced to the wild (see following sections).

Wild forest reindeer is one of over 400 species that have an EAZA (*European Association of Zoos and Aquaria*) Ex situ Programme (EEP).[9] The programme coordinator for wild forest reindeer is based at Helsinki Zoo, Finland. The goals for each of the EAZA EEP are set out in the Long-Term Management Plan (LTMP). Such plan for wild forest reindeer is being drafted right at the moment and it will be ratified during 2024. In addition to EAZA's procedures and documentation, the IUCN SSC *Guidelines on the Use of Ex situ Management for Species Conservation*[10] provides practical guidance on evaluating the suitability and requirements of an *ex-situ* component for achieving species conservation objectives.

3 REINTRODUCTIONS IN WILD FOREST REINDEER CONSERVATION

Until the beginning of this decade, the wild forest reindeer population in Finland, and thus in the entire European Union, was divided into two subpopulations: one in Kainuu and the other in Suomenselkä. The Kainuu subpopulation is part of the original population and is occasionally connected to the population in Russian Karelia. The Suomenselkä subpopulation, on the other hand, is the result of the aforementioned first (I) reintroduction in the 1980s.

Reintroduction efforts have also continued in Finland. A small-scale second (II) reintroduction was successfully carried out directly from the *ex-situ* population to the wild in the early 1980s and 1990s. In the WildForestReindeerLIFE project, on the other hand, reintroduction efforts (III) were conducted from 2017 to 2022 in two national parks, where there are now approximately one hundred wild forest reindeer. It is expected that these reintroduction efforts will lead to the establishment of new growing subpopulations.

The following pages will provide an overview of these three reintroduction efforts of wild forest reindeer in Finland in more detail, from their backgrounds to the current situation.

Despite significant conservation efforts and the positive development of the *fennicus* population in Finland, the subspecies is not secure. The current wild forest reindeer population in Finland, and consequently in the entire European Union, can be considered a remnant metapopulation of the previous extensive and cohesive population. The risk of extinction in each subpopulation undoubtedly varies, but in our view, it is a factor that must be taken into account on all occurrence areas, even in the short term. Threats include changes in landscape structure, predation by large carnivores, and mortality due to traffic accidents. The forest reindeer's low reproductive potential and relatively strict habitat requirements do not provide the best possible defence against such threats.

Reintroduction efforts have thus far been used quite successfully in wild forest reindeer conservation; the reintroduction carried out in Suomenselkä four decades ago is likely one of the most successful, if not the best, conservation efforts for the wild *Rangifer* worldwide.

Since the majority of the world's wild forest reindeer population resides in Finland, the responsibility for subspecies conservation lies with Finland and thus with the EU as well. Reintroduction is practically

[9] https://www.eaza.net/conservation/programmes/eep-pages/forest-reindeer-eep/
[10] https://portals.iucn.org/library/node/44952

the only means to expand the range of wild forest reindeer into suitable habitats in other EU member states or outside the Union elsewhere in Europe. It is therefore clear that reintroduction efforts will remain justified to be part of the wild forest reindeer conservation toolkit in the future as well.

3.1 The first reintroduction of wild forest reindeer in Finland

The reintroduction of wild forest reindeer to Suomenselkä between 1978 and 1984 by the State Forest Administration Metsähallitus, Finnish Hunter's Central Organization and WWF Finland stands as a remarkable achievement in wild reindeer conservation efforts.[11] It has resulted in a subpopulation that quite certainly is the largest *R. t. fennicus* occurrence in the world.

Preceding steps

- As the Kainuu subpopulation had gradually grown since the 1950s, the idea of reintroducing wild forest reindeer to other parts of Finland began to emerge for the first time in a meeting discussing the status and conservation of the species in 1972.
- It was known that the last wild forest reindeer had been hunted in the Suomenselkä area only in the late 1800s, and that the population hadn't declined due to habitat loss.
- In 1976, field surveys were conducted to find a suitable area for the reintroduction.
- At the same time, a location for the acclimatization enclosure was also selected, from which the animals would be released.
- A six-hectare enclosure was built in summer 1978 into a wilderness area that is nowadays the Salamajärvi National Park.

Initial capture and transport of founders (1979–1980)

- In 1979 and 1980 eight females and two males were captured with a fixed trapping fence in the Kainuu subpopulation and transported successfully to the enclosure.
- Success with those ten individuals was clearly a learning process, because in total sixteen were caught but six animals lost their lives to complications caused by capture or transport.
- The enclosure in Salamajärvi was expanded to fifteen hectares in summer 1980.

Breeding success

- Six of the eight females were pregnant when they arrived, and four of the calves survived.
- Those four calves were apparently sired by 1-4 unknown wild males (a slight chance is that either or both of the captured males were among them). Thus, the number of original founders in the reintroduction is 10-14.
- Breeding started in captivity, and a total of 26 calves were born by 1984. 21 of them survived.

Releases and escapes

- The population grew within the enclosure, and deliberate releases began in 1979.
- Between 1979 and 1984, a total of 21 individuals were intentionally released.
- Additionally, two wild-caught adult females had escaped from the enclosure in 1981. They were seen in the area with the other released in 1983.
- Another two wild-caught females were taken to a zoo as founders of the *ex-situ* population. (One of them was eventually released again in 1991 in the second reintroduction; see next section.)

[11] Kojola, I. 1993. Peura- ja poroistutusten ekologiaa. – *Suomen Riista* 39:74–84.

Population growth

- The breeding in the wild had started after the first releases, and by the time of enclosure closure, there were around 40 wild forest reindeer in the area.
- The breeding stock remained in the area, and this marked the beginning of the Suomenselkä subpopulation.
- The absence of large carnivores in the area during the 1980s and 1990s likely contributed to the relatively fast population growth.
- Genes of further founders have been introduced since the end of the reintroduction in 1984.
- According to the latest census (2024), the Suomenselkä subpopulation has grown substantially, numbering approximately 2000 wild forest reindeer. The subpopulation appears to healthy and without any apparent signs of inbreeding.
- In hindsight, it's quite clear that this first reintroduction was set up for success. The chosen reintroduction area boasted plenty of first-class habitat. It was the very region in the Southern half of Finland where the wild forest reindeer had disappeared last. Still, at the time of this initial reintroduction the region had held its remote wilderness character. However, there were hardly any large predators around, and the primary cause of extinction had long been addressed as all hunting of wild forest reindeer was prohibited. The goal of the first reintroduction was to establish a new population in the former wild forest reindeer habitats of Suomenselkä, and the result was fantastic; the population grew tenfold in just 13 years since the end of the captive breeding.

3.2 The second reintroduction of wild forest reindeer in Finland

The second reintroduction of the wild forest reindeer took place between 1988 and 1993. Ähtäri Zoo executed the reintroduction without acclimatization enclosure, transporting and releasing the animals directly into suitable summer habitats only some 20 kilometres away from the town of Ähtäri. Although sparsely documented, this reintroduction is known to have been successful, as it resulted in the establishment of a separate small subpopulation, situated 50-70 kilometres south from the Suomenselkä subpopulation, which originated from the first reintroduction and consisted of approximately 100-150 individuals at the time of this second reintroduction. Confirmed evidence of the integration of this newly formed subpopulation with the main population of Suomenselkä was only obtained after 2016, when the occurrence area of the Suomenselkä population had significantly expanded following its population growth to over one thousand individuals.

Releases between 1988–1993:

- Ähtäri Zoo released in spring before calving, a total of 13 females and four males to two locations.
- One of the males was too tame for the wild and sought the company of local people, eventually being returned to the zoo.
- One of the females was among the two individuals of wild origin introduced into the ex-situ population during the first reintroduction. She managed to return to the wild in her later years.

Founders of the reintroduction:

- Although a total of 16 individuals were released, the ex-situ population's studbook pedigree indicates that the entire group's heritage traces back to only one wild male and two wild females.
- Genes of further founders have been introduced since the end of the reintroduction in 1984.

Subsequent stages of the subpopulation:

- The small subpopulation initiated from the second reintroduction appeared to establish itself in the relatively remote area between Ähtäri, Soini, and Karstula municipalities.
- Winter monitoring in the area was infrequent, but when conducted, 20–40 ind. were found.
- The subpopulation did not decline but showed little growth. Based on population monitoring, the number of calves in the area remained consistently low.
- The bear population in the area developed during the 1990s, potentially explaining the poor calf production. Other large carnivores were scarce.
- In the latter half of the 2010s, local people speculated that the wild forest reindeer population in their area was already connected to the main Suomenselkä population, which presumption was soon confirmed by wildlife research monitoring.
- Currently, population monitoring is regularly conducted in the area, and the results are integrated into the main population count of Suomenselkä.

3.3 The third reintroduction of wild forest reindeer in Finland

The third reintroduction of wild forest reindeer in Finland was carried out as two separate actions within the WildForestReindeerLIFE project between 2017 and 2022. Reintroductions were simultaneously conducted southwest of the Suomenselkä subpopulation's distribution area in Lauhanvuori and Seitseminen National Parks, where animals were released directly from acclimatization enclosures. The national parks are approximately 75 kilometres apart and 90-100 kilometres away from the nearest established habitat areas of the Suomenselkä subpopulation.

Background and preparatory actions

- The subpopulation in Kainuu had plummeted by 40 percent between 2001 and 2005, along with the rapid increase in the large carnivore populations exerting predation pressure. [12,13] (The decline continued at a slower pace until 2015.)
- The decline of the population concerned the wildlife management authority, and since especially the first reintroduction of the wild forest reindeer in Suomenselkä had been successful, discussions about a new reintroduction began in 2009.
- To select the target area, a modelling of the summer and winter habitats of the wild forest reindeer was carried out outside the domestic reindeer herding area in 2014. (Migration of wild forest reindeer to the reindeer herding area is prevented because of crossbreeding risk).
- Habitat modelling brought forth three potential target regions for the reintroduction. A social impact assessment was carried out to examine the outlook of the local communities and stakeholders towards the reintroduction plan.[14]
- In 2014, an EU LIFE proposal was prepared for the third reintroduction, with the target area in Western Finland determined after habitat occurrence modelling.

[12] Kojola, Ilpo, et al. 2004. Predation on European wild forest reindeer (*Rangifer tarandus*) by wolves (*Canis lupus*) in Finland. – *Journal of zoology* 263:229-235.
[13] Kojola, Ilpo, et al. 2009. European wild forest reindeer and wolves: endangered prey and predators. – *Annales Zoologici Fennici*. Vol. 46.
[14] Hiedanpää, Juha, and Jani Pellikka. 2022. Homecoming without nostalgia: Local communities and the reintroduction of the wild forest reindeer (*Rangifer tarandus fennicus*) in Finland. – *Environmental Values* 31:153-175.

Construction of acclimatization enclosures and collection of founder individuals

- WildForestReindeerLIFE was initiated in October 2016. The acclimatization enclosures in Lauhanvuori and Seitseminen National Parks (31 ha and 13 ha) were completed a year later.
- Unlike the first reintroduction, the enclosures had to be built predator-proof this time.
- Ten founder individuals were captured from the wild; Altogether six breeding bulls were caught two at a time in the years 2017, 2019, and 2021, and one was taken to each enclosure. Additionally, two adult wild females and two calves were captured. Both females were pregnant upon capture.
- A total of 35 animals were brought from the ex-situ population, the majority of which were reproductive-age females. The EAZA EEP species coordinator determined which individuals were suitable for reintroduction into the wild.[15]

Breeding herds in acclimatization enclosures

- Each breeding herd in both enclosures consisted of one adult wild-caught bull and, depending on the year, 8–15 females. In addition to those, there were often a varying number of juveniles in the enclosures as well.
- The first calves were born in the enclosures in May 2018, and the last ones in June 2022.
- A total of 58 calves were born in the enclosures, out of which 51 were released into the wild (seven died or were stillborn).
- Among the adult individuals in the enclosures, only one female brought from the wild as a calf died in captivity at the age of 2,5 years; she had been sickly throughout.

Releases (2019–2022) and reproduction in the wild

- The first releases were made in October and December 2019, and supplementary feeding was provided near the release site throughout the winter. However, autumn releases and feeding were discontinued the following year because the released animals remained too tame.
- All subsequent releases were conducted during the summer when natural food was abundant. Since then, the animals have had to survive the winters without supplementary feeding.
- The first calves were born to the released animals as early as 2020, with sightings of new calves reported annually thereafter.
- The enclosures were emptied with the final releases in July 2022, and a total of 82 individuals had been released into the wild by that time. The enclosures were left awaiting a possible continuation of the project.
- Wild breeding bulls captured from the wild were not released; instead, they were always transferred to the zoo population in turn to improve the genetic diversity there.
- All adult females, except one zoo-born, were released into the wild. That one exception was deemed too tame to be released into the wild and was returned to the zoo.

Current status

- Of the released individuals, over fifty were marked with colored ear tags upon release. Six were equipped with GPS collars, and approximately twenty-five with small GPS ear tags. However, these GPS tags encountered technical issues, and only one of them functions properly now.

[15] https://www.eaza.net/conservation/programmes/eep-pages/forest-reindeer-eep/

- Citizen sightings of the released individuals are frequent. Additionally, during the summer and fall, calf checks and surveys of breeding herds are conducted based on GPS data from tagged females.
- Nine confirmed deaths of released individuals have been recorded, but the actual number is likely higher.
- Over the years, several sightings of released individuals have been reported over 40 kilometres away from the release sites, but the majority of released animals and their offspring are found within 10 kilometres of the enclosures.
- A post-action assessment on the outlook and opinions of the local communities and stakeholders towards the reintroduction was made in the final stage of the WildForestReindeerLIFE.

4 POPULATION DEVELOPMENT IN FINLAND

According to the latest population estimates, the population of wild forest reindeer in Finland is approximately 3,000. The 2023 census in Kainuu estimated about 900 forest reindeer, while the Suomenselkä subpopulation originating from the first reintroduction effort was estimated to be around 2,000 individuals in the 2024 census. The newly established subpopulations resulting from the reintroduction efforts of the WildForestReindeerLIFE project comprise an estimated total of one hundred individuals. (Fig. 1)

The Kainuu subpopulation reached its peak of 1,700 individuals in 2001. However, it declined rapidly primarily due to predation by large carnivores, decreasing to around 1,000 individuals by 2005 and further to 800 individuals by 2009. The population reached its lowest point, dropping below seven hundred individuals, in 2015. In recent years, calf production in Kainuu has begun to recover. The growth of the Kainuu subpopulation is mainly restricted by large carnivores, traffic, and the degradation of the best winter lichen pastures.

The Suomenselkä subpopulation has been growing throughout its existence. The most rapid growth occurred between 2018 and 2021. In the last three years, the subpopulation has remained stable. In comparison to Kainuu, traffic mortality is relatively higher, which may be attributed to the density of road networks and overall traffic volume, as well as the fact that the orientation of migration routes intersects with the primary directions of main roads, thereby increasing the likelihood of collisions.

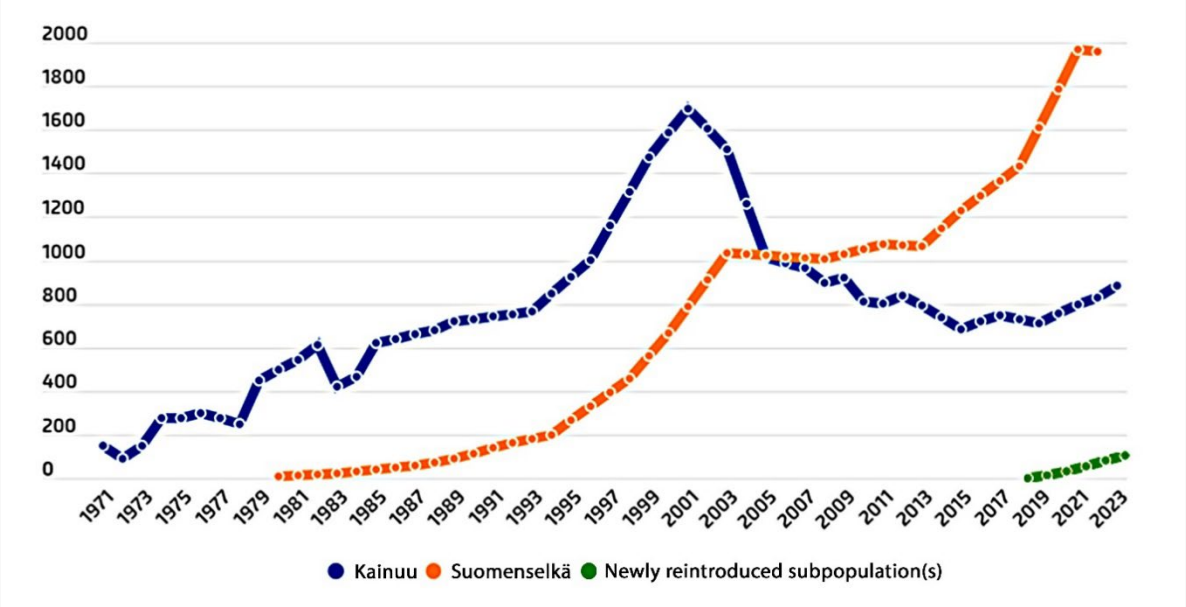


Figure 1. *The development of the wild forest reindeer population in Finland from 1970 to 2023. The Kainuu subpopulation (blue) spontaneously returned to Finland in the 1940s and 1950s and has gradually increased since then. The text describes in more detail the population collapse in Kainuu in the early 2000s. The Suomenselkä subpopulation (orange) originated from the first reintroduction efforts from 1979 to 1984. The population census of the Ähtäri-Soini-Karstula small subpopulation, resulting from a second reintroduction effort by Ähtäri Zoo, is always included in the Suomenselkä population census. Result of the third reintroduction effort is shown in green. (Image source: Natural Resources Institute Finland and WildForestReindeerLIFE)*

5 THE CORE JUSTIFICATION FOR FOREST REINDEER REINTRODUCTION

In the subsequent sections, we introduce the rationales, principles, benefits, and risks of forest reindeer reintroduction, providing evidence that reintroduction indeed has a place in the conservation of the species. However, even before exploring those aspects, we want to emphasize as a solid foundation that certain species-specific characteristics of the forest reindeer as well as certain historical facts related to the reindeer population explain its particular suitability for reintroduction. Three most decisive facts and features are discussed below.

- **The decline and disappearance of the wild forest reindeer followed from a relatively modest yet excessive hunting pressure.**
    - Since the previous decline and disappearance were caused by excessive subsistence hunting, removing the cause of extinction in our conditions is straightforward. This reason for decline was known, and action was taken before the species eventually disappeared from Finland. The same attitude against excessive hunting and for sustainable utilization has since prevailed. The wild forest reindeer still belongs to huntable species and requires a specific license, but hunting pressure is nowadays very low (0.5% of the population). Population development is closely monitored, and decisions on licenses are made on a case-by-case basis. In reintroduction areas – and if necessary, anywhere within the species' range – hunting can be entirely prohibited by the Wildlife Administration at will.

- **The habitat degradation had no role in the decline of the wild forest reindeer that occurred in the last centuries.**
    - When the wild forest reindeer disappeared from Finland, the habitats of the species were mostly still in a nearly pristine state. The wild forest reindeer prefers and even needs certain habitats, but it is not excessively stringent in terms of habitat quality. Its optimal habitats occurred and continue to occur patchily in the landscape. However, the overall quality of habitats and the number of optimal habitats have decreased during the absence of the species and even after its return. Nevertheless, the condition and quantity of habitats have still been sufficient to sustain the returned population on an increasing trajectory. Therefore, it has been and continues to be appropriate to primarily target reintroductions in areas where good or excellent habitat quality is most prevalent.
- **Even if the wild forest reindeer is capable of long-distance migration, it is rather conservative in its migration pattern and does not, therefore, exhibit significant dispersal abilities.**
    - Individuals have been observed occasionally making long-distance migrations/visits to entirely new areas, but the reasons for this behaviour are not very well understood. Overall, the wild forest reindeer does not readily spread to new areas, or at least not rapidly. Reintroductions have facilitated the species' dispersal precisely to areas where good habitat still exists in significant proportions.

6 IUCN AND REINTRODUCTIONS

When it comes to the deliberate movement of individual organisms for species conservation purposes, the Conservation Translocation Specialist Group (CTSG), operating under the International Union for Conservation of Nature (IUCN) Species Survival Commission, is practically the highest authority regarding the planning of such translocations. The expert group has published *Guidelines for Reintroductions and Other Conservation Translocations* for the planning of translocations, as well as a set of taxon-specific guidelines for several species and species groups.[16] Another noteworthy set of guidelines worth exploring is *The Scottish Code for Conservation Translocations*.[17]

In these general guidelines for translocations and other movements conducted for species conservation purposes, the key different types of translocation measures and the corresponding concepts are defined. (In the definitions below, when referring to 'species,' it also applies, as appropriate, to subspecies or other equivalent lower taxonomic levels.)

- **Reintroduction** is the intentional transfer and release of individuals of a species to a previously inhabited range from which the species has disappeared.
- In **functional reintroduction**, the aim is to recreate an ecological function or process that is lost due to the extinction of a native species, by intentionally transferring and

[16] https://iucn-ctsg.org/
[17] https://digital.nls.uk/pubs/e-monographs/2020/216528031.23.pdf

releasing individuals of a closely related species or otherwise ecologically similar species to the former habitat of the extinct species, but outside its original range.

- **Reinforcement** is the intentional transfer and release of individuals of a species into an existing population of the same species for the purpose of increasing its numbers.
- **Assisted colonization** involves the intentional transfer and release of individuals of a species outside its original range to prevent extinction.

In *reintroduction* efforts, the primary focus is on safeguarding biological species, whereas in *functional reintroduction*, the emphasis is on preserving natural processes. Such processes may include, for example, succession, ecosystem services, interspecies interactions, or the species' impact on the ecosystem, community, or physical characteristics of its habitat.

Regarding the reintroduction of wild forest reindeer, this analysis primarily focuses on *reintroduction* efforts. However, it is also justified to consider the possibility of implementing *functional reintroduction* using any suitable reindeer subspecies in an area where the native subspecies has become extinct, but where the presence of any representative of the *Rangifer* genus could positively impact conservation efforts. Methodologically, reintroduction and functional reintroduction do not differ from each other in any way.

6.1 IUCN guidelines on alternative conservation vs. Reintroduction rationale

Reintroduction and translocation, as conservation measures supporting species viability and distribution, must be cautiously utilized. Therefore, the IUCN CTSG has presented a set of alternatives.

Drawing from the experience gained from the Finnish wild forest reindeer reintroductions, we will explore the **alternative conservation solutions** listed by the IUCN for reintroductions and other conservation translocations (highlighted below). It's important to note that while the IUCN's perspective on alternatives is well-founded, for wild forest reindeer in Finland these are not necessarily alternative actions, but rather existing measures already outlined in Finland's wild forest reindeer management plan and currently in practice. In conjunction with these measures, reintroductions complement and expedite the conservation efforts for the subspecies.

ALTERNATIVE: **'Regional Solutions' –** habitat management and restoration, as well as ensuring landscape connectivity, to maximize the viability and natural spread of the target species.

JUSTIFICATION FOR REINTRODUCTION: For the wild forest reindeer, those regional solutions have been and continue to be implemented in the current occurrence range, as well as in the intermediate areas between existing subpopulations. In addition, it may be important to advance the species' spread to existing habitats that are suitable or adequate. In this effort, well-planned reintroduction can play a crucial role.

ALTERNATIVE: '**Species-level Solutions' –** targeted actions related to controlling pathogens, predators, and other between-species interactions that can be detrimental to the conserved species. Also, supplementary feeding, artificial or protected reproduction, and creation of various protective structures.

JUSTIFICATION FOR REINTRODUCTION: Where applicable, species-level solutions are covered fairly comprehensively in the Finland's wild forest reindeer management plan.

Some of the actions in this category are being implemented, and for the rest, there is either legislative readiness or an implementation plan. However, these measures alone cannot ensure the secure future for the population, as the preservation of habitats and the conditions for range expansion must also be ensured.

ALTERNATIVE: **'Social/Indirect Solutions' –** establishment of protected areas, development of legislation, environmental education, conservation actions by local communities, economic incentives to promote conservation or reduce threats to the population.

JUSTIFICATION FOR REINTRODUCTION: In the occurrence of wild forest reindeer, protected areas comprising high-quality habitats are paramount, but they alone are not sufficient. As the species inevitably also relies significantly on managed forests, adequate living conditions must be ensured there as well, wherever suitable habitats exist. The protective legislation directly concerning the wild forest reindeer is in place. Environmental education initiatives have been implemented and will continue. The attitude and approach of local communities towards the wild forest reindeer are crucial for the species' acceptance, and this has been assessed both before and after the third reintroduction. The Game Animal Damages Act is applied in cases of agricultural damage caused by wild forest reindeer.

ALTERNATIVE: According to the IUCN, the **decision to do nothing** can also be a viable option if it is highly likely that the protected species will adapt to changing conditions or move to a new suitable habitat even without human intervention.

JUSTIFICATION FOR REINTRODUCTION: In the case of the wild forest reindeer, the probability of this is too slim to ensure the viability of the population. 60% of the global population of this subspecies resides in Finland, necessitating active and strategic conservation efforts from both Finland and the EU.

6.2 Benefits and risks in reintroductions

The benefit potential of species reintroductions is not particularly hard to imagine. The risks, however, appear to be far more numerous. When it comes to benefits, the species reintroductions can help restore endangered or extinct species to their natural habitats, thus promoting the preservation of native ecosystems. Additionally, reintroductions can enhance the genetic diversity of populations and increase the resilience of communities to disturbances. They also provide opportunities for research and contribute to environmental awareness and public engagement in species conservation.

As said, species reintroductions also carry risks. The adaptability of reintroduced individuals to new environments may vary, leading to the failure of reintroduction efforts. Moreover, reintroductions can have adverse effects on local ecosystems by e.g. competing with other native species for resources. There is also the possibility that reintroductions may transmit diseases and parasites to new areas.

Regardless of the general benefits and risks, reintroductions of species or conservation translocations are generally justified in situations where alternative lower-key conservation measures are ineffective or where their benefits can be significantly complemented. Typically, translocations are part of a broader range of measures within a comprehensive conservation plan. However, it is important to remember that for reintroductions and translocations to be justified, they must yield clear and measurable conservation benefits.

6.2.1 *Potential benefits of wild forest reindeer reintroductions*

In the case of the wild forest reindeer, the benefits of reintroduction are primarily related to the species itself and only indirectly and to a limited extent to other species or habitats. (The social, economic, and habitat quality benefits, as well as those related to other species, have been investigated in the WildForestReindeerLIFE. Documentation regarding these benefits can be obtained upon request from Metsähallitus Wildlife Service Finland.)

Besides the evident general benefits outlined above, there are further advantages below that perhaps deserve to be addressed. Reintroduction presents opportunities for targeted conservation actions, which can be regarded as benefits.

- **Opportunity to contribute to the metapopulation size and structure** – Reintroductions have targeted areas with suitable habitat but lacking the subspecies, where it likely would not have naturally dispersed as rapidly as it did upon reintroduction. Consequently, the reintroductions have increased the population size and established new subpopulations. This is expected to enhance the resilience of the Finnish wild forest reindeer population to disturbances.

- **Opportunity for 'precision work' in securing the genetic integrity** – In wild forest reindeer reintroductions (including a recent reinforcement), the history and genetic structure of the existing population have been carefully considered. The aim has been to enhance genetic diversity within subpopulations by selectively releasing animals based on their genetic backgrounds.

- **Opportunity to manage predation mortality** – Since it is known that predation by large carnivores has reduced the population of wild forest reindeer in their original range, the selection of reintroduction areas has taken into account the avoidance of predation as one of the characteristics of suitable target areas. However, this advantage has lost its significance in recent years with the increase in populations of large carnivores in the same areas.

- **Opportunity to promote the amalgamation of subpopulations** – In potential future reintroductions, efforts will be made to facilitate the amalgamation of subpopulations and the movement of individuals between them to ensure gene flow.

6.2.2 *Potential risks of Wild Forest Reindeer Reintroductions*

The IUCN's *Guidelines for reintroductions and other conservation translocations* (2013)[18] highlight various aspects and principles related to reintroductions and translocations that may lead to the realization of different risks. The guidelines do not provide detailed risk assessments but rather outline general principles, and the examination of risk assessment is based on questions. Below, these questions formulated by IUCN in their guidance are addressed, particularly from the perspective of the third reintroduction carried out in the WildForestReindeerLIFE project.

Q: RISK OF TRANSLOCATING AN ALIEN SPECIES – Is the translocated species native to the target area or not? In the latter case, careful consideration of the reasons for the translocation is necessary before implementation.

[18] https://iucn-ctsg.org/

A: *In the case of wild forest reindeer in western Finland, we are specifically discussing reintroduction. The fennicus subspecies is native to the target area. In other words, the target area historically belongs to the natural occurrence range of this subspecies.*

Q: RISK OF RECURRING EXTINCTION – Is the reintroduction preceded by extinction in the target area? In other words, has the cause of extinction been addressed before the upcoming reintroduction?

A: *In the case of the wild forest reindeer reintroduction, extinction in the target area and nationwide was due to overharvesting. The cause of extinction has been addressed.*

Q: RISK OF CRITICAL INTERSPECIFIC INTERACTIONS FOR THE TRANSLOCATED SPECIES – Is the translocated species critically dependent on other species in the target area?

A: *The wild forest reindeer does not rely entirely on any other species or specific forest habitat type as suggested by the question. However, the availability of Cladonia lichens for foraging during the non-growing season is crucial for the species. Also, they tend to home in on tranquil open and wooded peatland mosaic during summer. In our case the adequacy of food and habitat for the species has been inferred from previous modelling of summer and winter habitat quality.*

The long-term survival of the wild forest reindeer population may be influenced by predation from large carnivores. While our reintroduction target areas were initially chosen to mitigate this risk, the recent expansion of large carnivore populations has increased the likelihood of predation on reintroduced individuals. Strict protection regulations for large carnivores pose challenges for their population management and control.

Q: RISK OF SIMULTANEOUS TRANSLOCATION OF MULTIPLE SPECIES - Are there one or multiple species being reintroduced? The risks increase as the number of translocated species rises.

A: *Only one subspecies is being reintroduced.*

Q: RISK OF INAPPROPRIATE GENETIC HERITAGE - Are the individuals being reintroduced to the target area of foreign origin?

A: *There is no reason to assume that the reintroduced individuals are genetically significantly different from the previously existing population in our target area in western Finland. In any case, the founder individuals are all descendants in direct descent from the existing original wild forest reindeer population in Kainuu. Special attention, however, needs to be paid on the potential risk of crossbreeds (wild x semi-domestic). They are very rare but not completely unknown of.*

Q: RISK OF SOCIAL CONFLICTS OR ECONOMIC DAMAGES - What is the likelihood of socio-economic harmful effects resulting from the conservation-focused translocation?

A: *The damages caused by wild forest reindeer include agricultural damages and road collision damages, with costs generally covered by Game Animal Damages Act or insurance policies. The species does not cause damages to forestry. In comparison to*

the average level of damages caused by ungulates in Finland, the risk of economic damages resulting from reintroduction is low due to the low density of the wild forest reindeer population compared to other ungulates. (Considering the population densities of all cervid species, it can be estimated that, on average, about one in every fifteenth cervid in Suomenselkä is a wild forest reindeer. In the area influenced by the third reintroduction as part of the WildForestReindeerLIFE project, the corresponding ratio at the moment is approximately 1/20.)

Q: RISK OF ADVERSE EFFECTS OF THE TRANSLOCATED SPECIES ON THE TARGET AREA'S NATURAL ENVIRONMENT – Could the translocation cause harmful ecological impacts?

A: *The likelihood of adverse ecological effects from the translocated wild forest reindeer is quite low. We are talking about a native species, and at achievable population densities, it is unlikely to alter the characteristics of its habitats through direct or indirect causal chains.*

Q: RISK TO THE SOURCE POPULATION - Could the translocation pose a risk to the source population?

A: *The Finnish Wildlife Agency issued the WildForestReindeerLIFE project special derogations to collect 40 wild forest reindeer individuals from the natural populations as founders for reintroduction and augmentation efforts. A total of nine derogations were utilized for collecting individuals directly from the wild, while the tenth individual came from the Korkeasaari Wildlife Hospital through a separate process. The derogation decision does not specify the allocation of permits to different subpopulations. Based on the overall population size, it could be inferred that 12 derogations out of 40 were designated for the smaller Kainuu subpopulation. In total, seven derogations were used in the Kainuu population and only two in Suomenselkä. The Finnish Wildlife Agency ensured that harvesting was sustainable when making administrative decisions. Therefore, it can be demonstrated that the collection of individuals for reintroduction in the project did not pose a threat to the source populations.*

Q: RISK OF LACK OF EXPERTISE - Is the competence of the translocation implementers sufficient?

A: The designers and implementers of the live capture, translocation, and husbandry of wild forest reindeer are Finland's leading experts in this field. Therefore, it can be assumed that their competence is indeed sufficient.

Q: RISK OF DISEASES AND PARASITES - Can diseases or parasites be transferred with the animals?

A: *Translocated animals typically carry a parasite load, but it is unlikely that the reintroduced wild forest reindeer carry parasite species not already present in the target area's cervid populations. Some of the wild individuals were treated for parasites, although not all, as the use of tranquilizers prevented deworming with ivermectin in some cases. While there cannot be complete certainty regarding disease transmission, the animals were monitored in captivity for the duration of acclimatization (4-48 months) before release into the wild.*

Q: RISK OF INADVERTENTLY INTRODUCED ALIEN SPECIES - Could other species be unintentionally transferred along with the reintroduced individuals?

A: *Due to the nature of the translocation, the risk of unintentional invasions by other species, especially alien ones, is extremely low.*

Q: RISK OF HYBRIDIZATION OF THE TRANSLOCATED SPECIES - Could the reintroduction lead to unwanted hybridization between closely related species or subspecies?

A: *The first reintroduction of wild forest reindeer in Finland, 35 years after its completion, has led to a risk of hybridization with domestic reindeer as the reintroduced population has grown. It is possible that subsequent or future reintroductions may exacerbate this risk. While there is long-standing experience in managing hybridization risk in Kainuu, the problem is not currently under control without additional measures. These measures are currently being planned and implemented.*

The guidelines of the IUCN recommend that after conducting a risk analysis, consideration should be given to whether there is a 'high degree of uncertainty' regarding the basis or severity of the risks associated with the translocation. In such cases, translocation should be avoided. In the case of the wild forest reindeer in Finland, there is no such uncertainty.

7 PLANNING AND IMPLEMENTATION OF THE REINTRODUCTION

Undertaking reintroduction as a conservation measure requires careful consideration. Above, the history of wild forest reindeer reintroduction in Finland has been presented to support this consideration, along with real-life examples of the reasoning that has been related to the respective decision making. If, after reviewing and reflecting on these, it still seems that reintroducing wild reindeer to the intended target area is a sensible and feasible conservation action, then it would be time to begin planning the practical groundwork and technical aspects of the reintroduction implementation.

7.1 Three phases of the workflow

Below we present a three-phase planning and operational workflow that aims to reintroduce wild reindeer as part of the region's native fauna (see Fig. 2 for the flowchart scheme, and Fig. 3–5 for the workflow phases). Certainly, when starting the work, there's a certain commitment right from the start to completing the task and carrying out the reintroduction, but as already mentioned in the Introduction, this three-part sequence is designed to be interruptible at any point, and yet the efforts and resources invested thus far can be considered to benefit not only the conservation of wild reindeer themselves but also overall conservation of biodiversity and the mitigation of habitat loss.

Although Phases 1-3 appear equally depicted below, it's important to recognize that Phases 1 and 2 involve much less work and are relatively quick to implement compared to Phase 3. A rough estimate would be that 1 and 2 are measured more in months, whereas 3 takes years. The speed of implementation in 1 and 2 obviously depends on the expertise of the individuals involved and the expert support they receive. Additionally, Phases 1 and 2 are not tied to the annual cycle in nature. The real hard work and progression according to nature's terms begin in Phase 3.

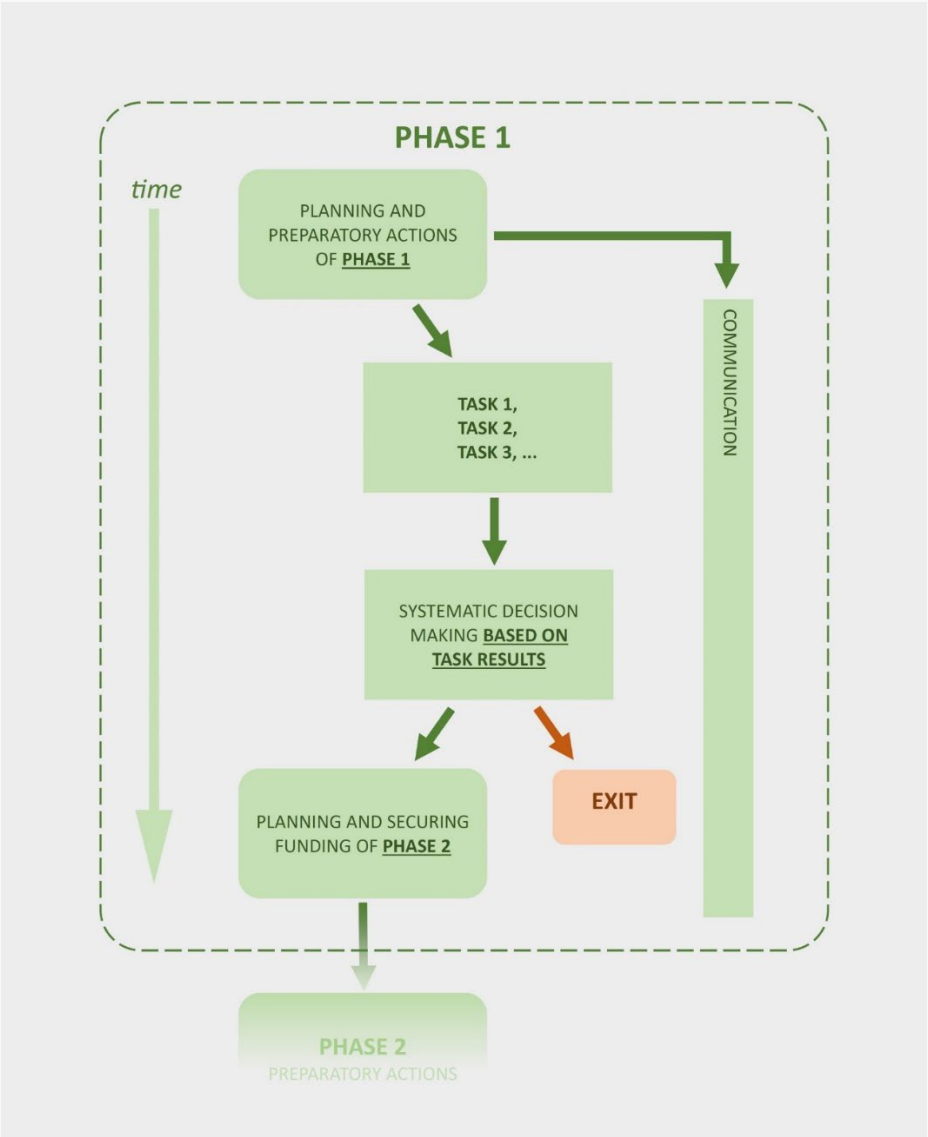
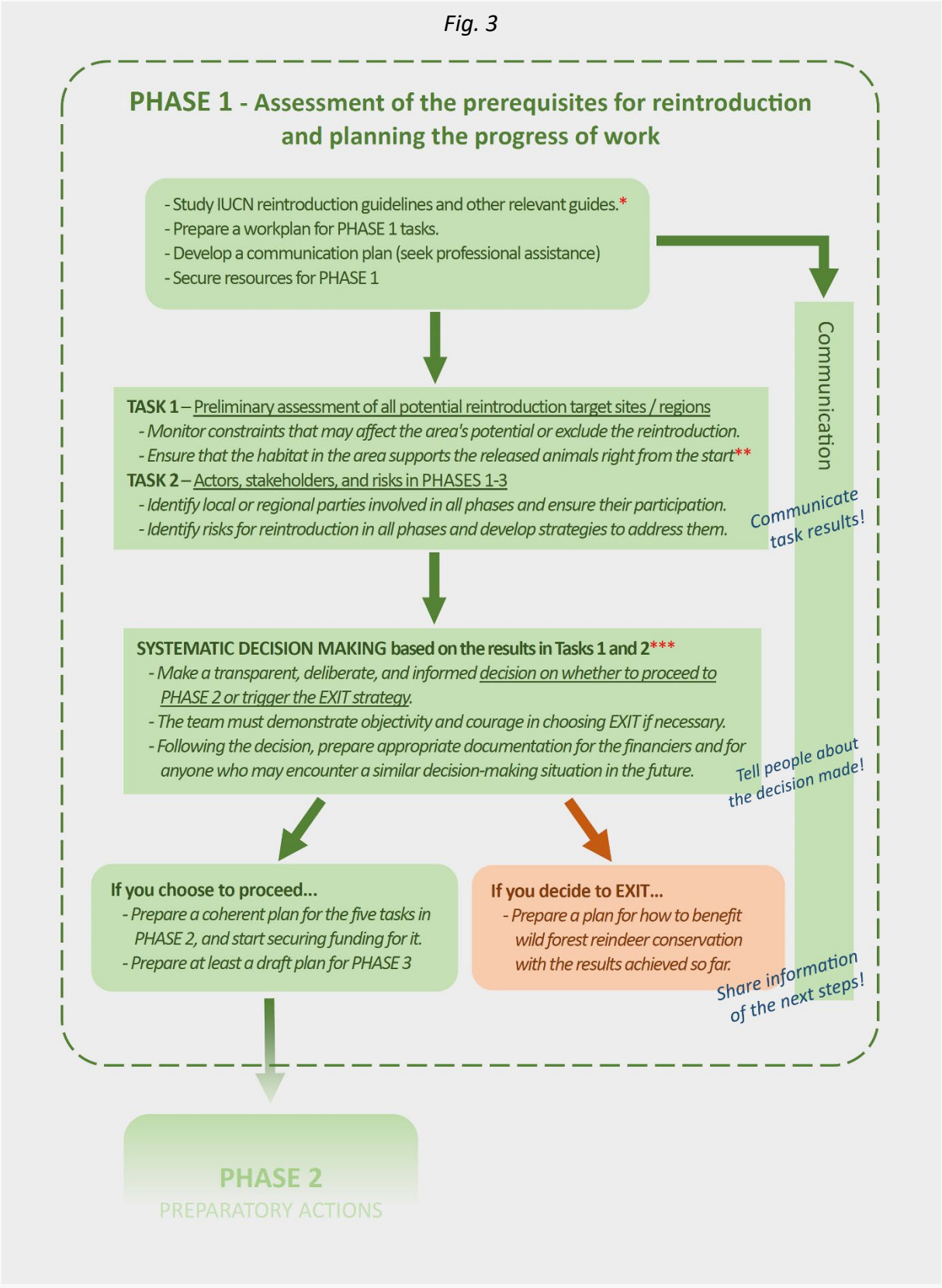


***Figure 2**. Each of the three phases of the planning and operational workflow for wild forest reindeer reintroduction broadly follow the schematic progression and structure depicted in this image. Time progresses downwards. The coming tasks and communication are preceded by careful planning. In Phases 1 and 2, a **systematic decision-making process** is conducted as soon as the task results are revealed. This leads to a deliberate and informed **decision either to proceed to the next stage or to trigger an exit strategy**, which outlines how the results achieved so far can best benefit wild forest reindeer conservation. The exit strategy for Phase 3 differs from that of Phases 1 and 2 because Phase 3 involves the keeping and care of live animals, requiring readiness to trigger the exit at any time as circumstances dictate. The need for communication and public interest in large mammal reintroduction must not be underestimated. The parties responsible for communication, as well as the extent of communication activities for each phase, should be determined early on. Preparation for crisis communication is also essential, as when dealing with live animals, even the delivery of negative news must be managed without fear.*

Fig. 3



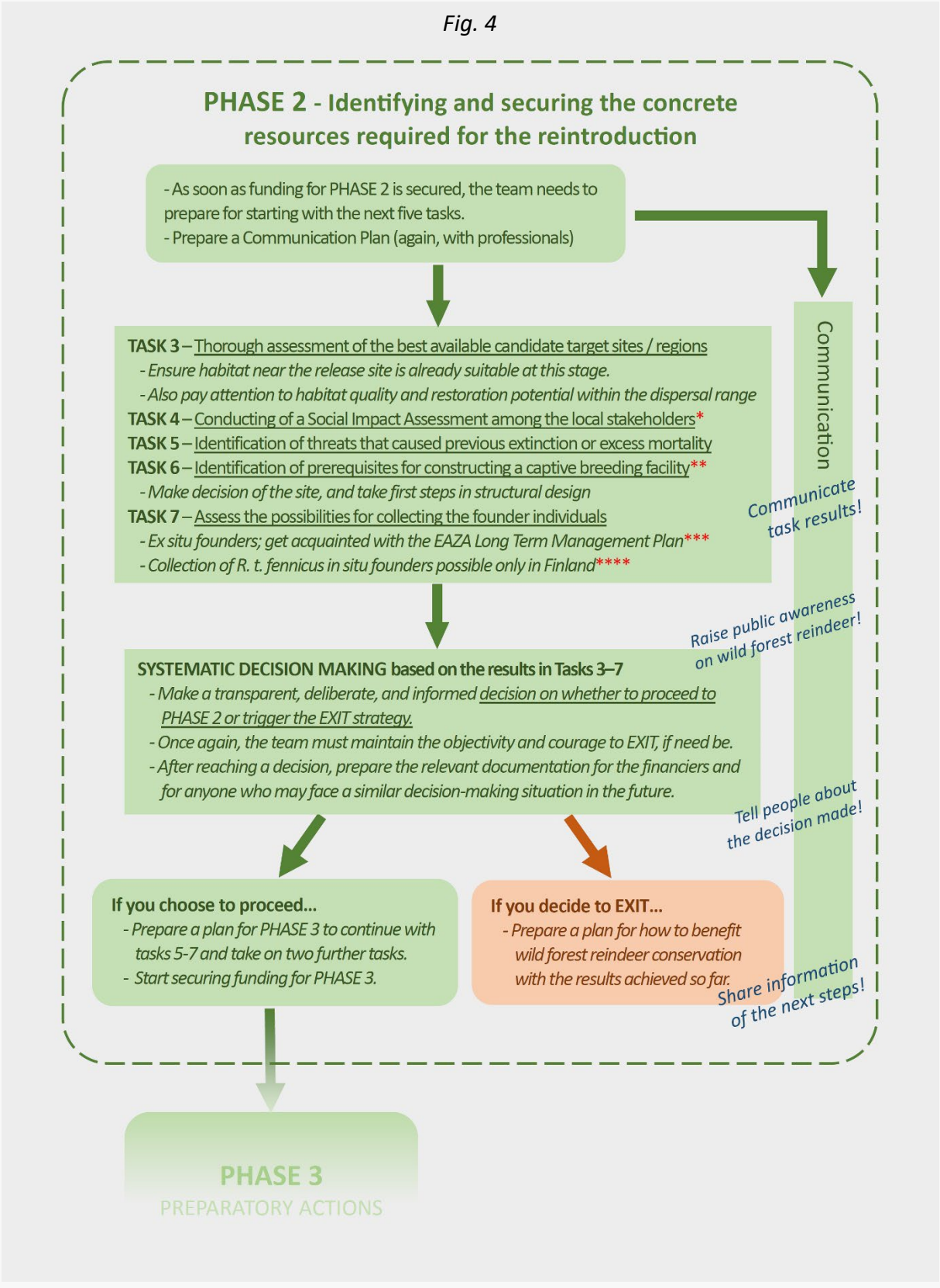
PHASE 1

* https://iucn-ctsg.org/policy-guidelines/conservation-translocation-guidelines/

** See Appendix, image 1.

*** https://doi.org/10.1287/deca.2023.0472

Fig. 4



PHASE 2

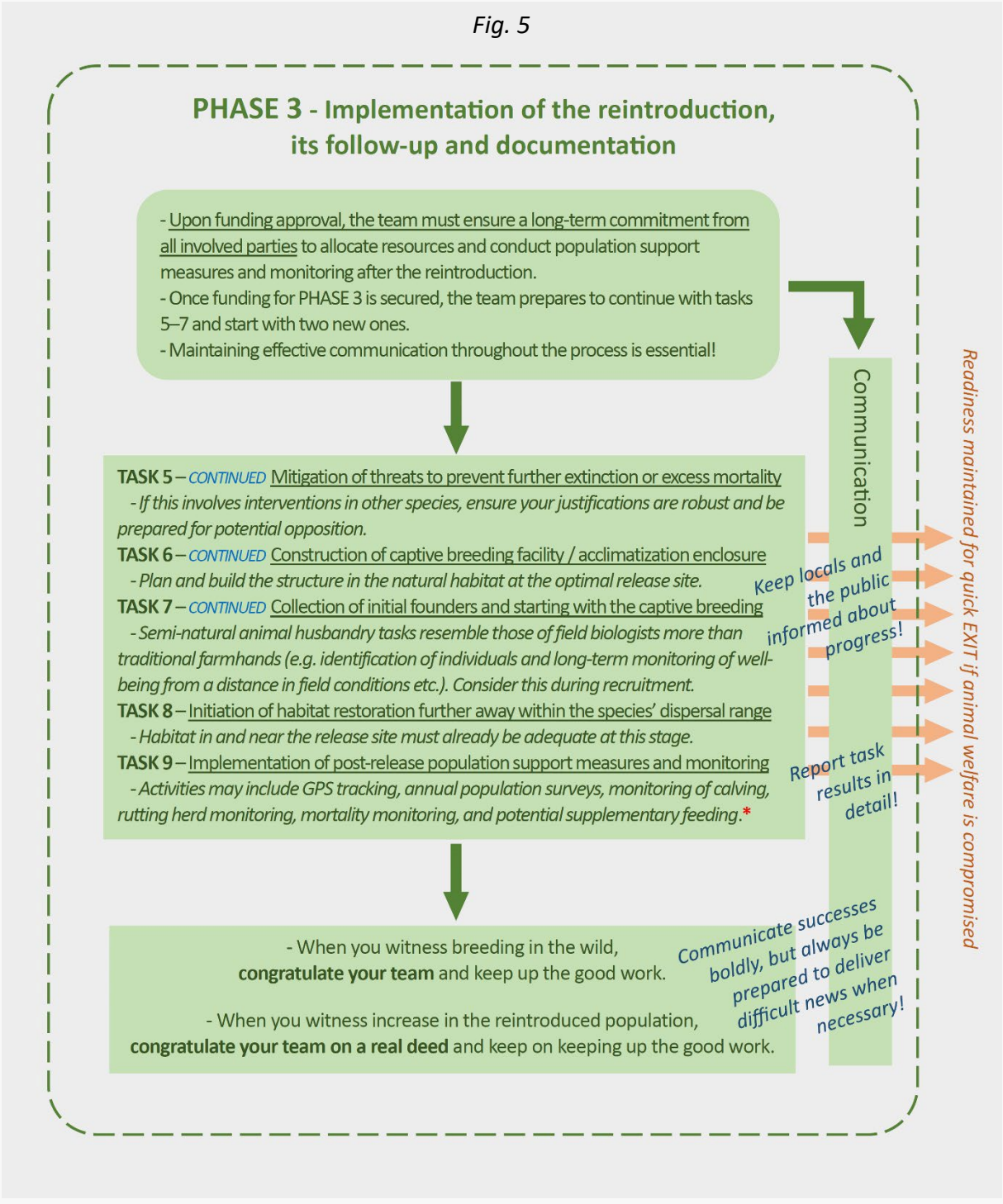
* SIA on wild forest reindeer: https://doi.org/10.3197/096327121X16081160834722

** See Appendix, images 2–4.

*** LTMP of wild reindeer will be published in 2024 (https://www.eaza.net/conservation/programmes/)

**** Potential to collect wild *R. t. fennicus* gametes for artificial insemination is developing in Finland.

Fig. 5



* See Appendix, images 5–6.

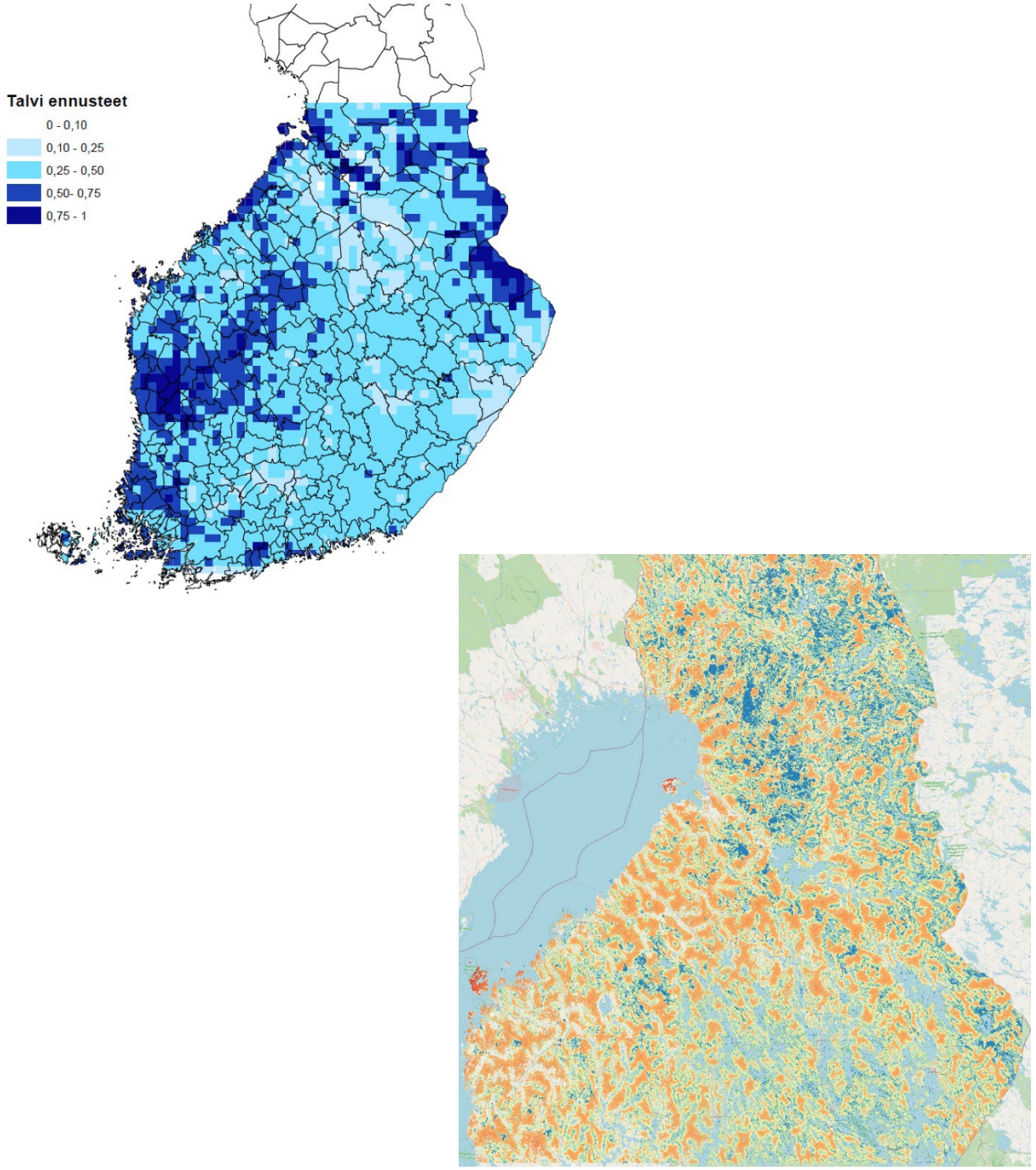


Image 1. *Two examples of modelling the quality of wild forest reindeer habitat in a way that could be used, for instance, for targeting reintroductions on a large or small scale. The upper panel depicts a low-resolution (10 km x 10 km) predictive model of the relative proportion and distribution of winter grazing areas south of the domestic reindeer herding area in Finland. The lower panel illustrates the amount and distribution of habitat preferred by a female caring for a small calf in the weeks following calving, examined at a very fine resolution (16 m x 16 m). GPS collar data has been utilized as background data in the models. (**Image source**: Natural Resources Institute Finland, and WildForestReindeerLIFE)*

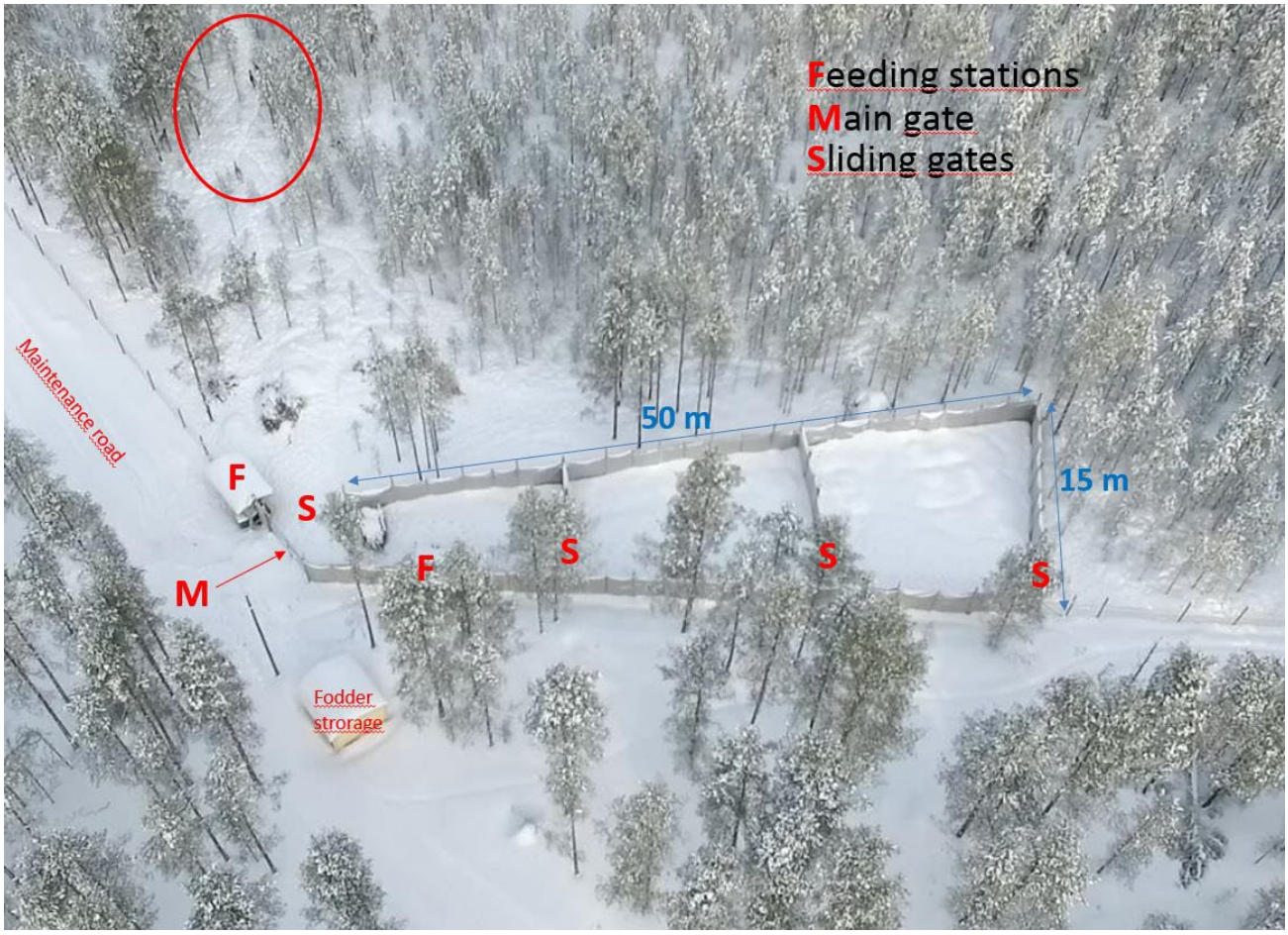


Image 2. *A captive breeding facility / acclimatization enclosure built in a suitable habitat doesn't necessarily need to be a very complex structure to function. In WildForestReindeerLIFE, the enclosures covered areas of 13 and 31 hectares, respectively, comprising the enclosed space surrounded by a predator-proof perimeter fence. In one corner, the entire arrangement contained all the necessary functions for feeding, handling, and releasing. Overall, the facility is quite low-tech. (**photo**: Sakari Mykrä-Pohja/Metsähallitus Parks & Wildlife Finland)*

Image 3. *Sliding gates and partitioning of the corral are used for the capture and separation of animals for sedation, handling, and releases. Animals are attracted to the corral with feed. The capture enclosure is lined with heavy duty fabric to prevent collision injuries. The perimeter fence of the entire enclosure, on the other hand, is made of high-tensile steel wire mesh. (**photo**: Annika Sorjonen)*

Image 4. *The animals are released directly from the corral into the wild. In the image, a young male, among the first to be released, exits the enclosure in the fall of 2019. Wild forest reindeer are quite social, and the released individuals frequently visited the enclosure as long as there were still conspecifics inside.* (*photo: Milla Niemi/Metsähallitus Parks & Wildlife Finland*)

Images 5 and 6. *It is essential to tag a significant proportion of the released animals with GPS; one third wouldn't be a bad choice. For monitoring the mortality alone, cheaper and lighter tracking devices, with tracking intervals of, for example, a week, are sufficient. However, for locating and sneaking up on live animals - during calving checks, for example - devices with VHF tracking options are necessary. The population dynamics of this kind of herd animals can be relatively reliably monitored year after year if a sufficient number of the released animals carry a tracking device. (**photos**: Sakari Mykrä-Pohja/Metsähallitus Parks & Wildlife Finland, and Tero Lähteenmäki)*