

# The Arctic fox

– a threatened species in the Fennoscandia mountains



## The Arctic fox – a characteristic species for the Fennoscandia mountains

The Arctic fox, *Vulpes lagopus*, lives in the far north and is extremely well-adapted to life in the high mountains and an Arctic climate. Although there are many Arctic foxes globally, there are very few in Norway, Sweden and Finland. The number of Arctic foxes in Scandinavia began to decline dramatically in the mid-1800s; despite long efforts to protect the species this decline has continued to the present day. The primary reasons why the Arctic fox is endangered are changes to rodent life patterns, growing red fox populations and the fact that the Arctic fox population has had a long period of decline.

The Arctic fox population is now so small that the species is entirely dependent on support for its long-term survival. However, understanding why the numbers of Arctic fox have declined allows us to take the necessary action to begin rebuilding the population. These interventions are partly conducted within research projects, which makes it possible to evaluate their effects and subsequently improve the methods that are used.

Felles Fjellrev – the project that first published this brochure

– is now two InterReg/EU-funded projects that cover all cross-border subpopulations of Arctic foxes in Norway, Sweden and Finland. Both projects are working to conserve the Arctic fox. The objective is to strengthen existing populations and to increase opportunities for Arctic foxes to become established in areas between large subpopulations, creating a more cohesive and viable Arctic fox population in Scandinavia.

We have collected information about the Arctic fox, management across national borders and the latest results from research into the Arctic fox.

- » About the Arctic fox
- » Where do Arctic fox live?
- » Adaptations to life in the Arctic
- » Reproduction and survival
- » The Arctic fox in the ecosystem
- » Management and re-establishment of Arctic fox populations
- » Hopes for the future
- » What can you do to help the Arctic fox?
- » Read more about the Arctic fox

## The Arctic fox – two colours, same species

The Arctic fox is a popular mountain animal. It is a cat-sized canine and has two different colour variations.

The Arctic fox is a small carnivore, around half the size of a red fox. Its body is small and compact, and covered with thick fur. It has short legs and little, rounded ears. It rarely weighs more than three or four kilos, but its weight depends on the individual and the season. The Arctic fox is a member of the Canidae family, just like the red fox, and they both belong to the Vulpes genus.

The Arctic fox has two colour variants, a white and a blue. The white fox is entirely white in the winter, but in the summer it is a brown colour with yellow areas on the body's underside. The blue fox is entirely brown in the summer and turns a steely blue colour in the winter. The colour is inherited and the blue is

dominant. Two blue parents, or one blue and one white parent, may have both white and blue pups in the same litter. However, two white parents will only have white pups. There are more white than blue foxes in our mountains. However, the blue colour dominates in coastal areas, probably because it provides better camouflage and protection from other predators. The Arctic fox may sometimes have a sand-coloured variant.

The Arctic fox has a distinctive running gait, as it almost bounces over the ground. Its tracks are similar to those of the red fox and it can be difficult to distinguish between them using just their pawprints, even though the Arctic fox's pawprints are smaller.



## Where do Arctic fox live?

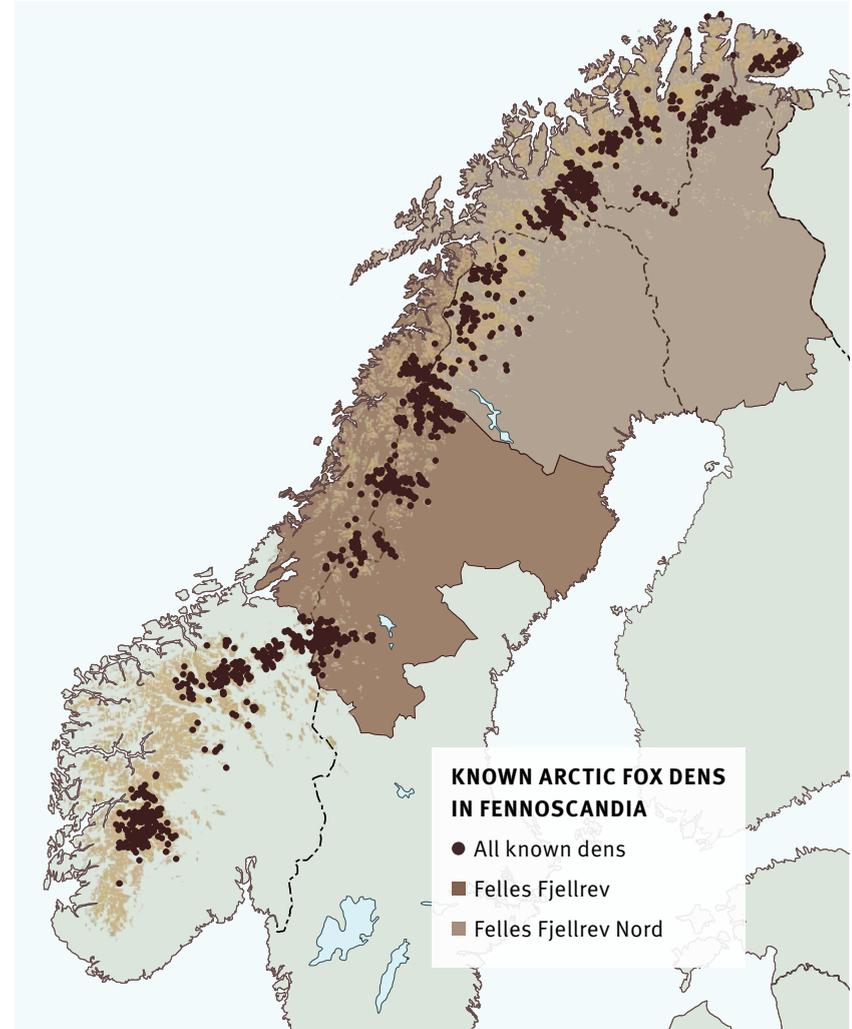
The Arctic fox lives in the far north, in the high mountains and in Arctic coastal areas. The global population is large, but only a few remain in this region.



The Arctic fox lives on the tundra in the Arctic areas of the northern hemisphere and has a circumpolar range. There are several hundred thousand Arctic foxes in the world, and it is a common species in parts of Siberia and North America, and on Greenland, Svalbard and Iceland.

In our mountain areas, Arctic foxes are found in the high mountains, above the treeline, but there are only a few left. Sweden, Norway and Finland have a combined Arctic fox population that is sparsely distributed from the tundra in the north and southwards along the mountains. To the south, the Arctic fox is limited by competition from the red fox. The red fox is unable to cope with the Arctic climate as well as the Arctic fox does, which dominates where the climate is cold and harsh.

The Scandinavian Arctic fox population has just over 300 adult individuals (2018) that are divided into several subpopulations. There are four core populations in Mid-Scandinavia, from Trøndelag – Jämtland/Härjedalen to Nordland – Västerbotten, with several smaller subpopulations between them. Further north, in Troms – Finnmark – Norrbotten and northern Finland, there are only small subpopulations that are also far apart.



## **Life in a freezer – adaptations to life in the Arctic**

The Arctic fox is extremely well-adapted to life in the Arctic. Its body shape, insulating fur and an efficient metabolism keep down its energy consumption. The Arctic fox can also survive for long periods without food, which gives it an advantage over other species.

It is clear from its body shape that the Arctic fox is adapted to an Arctic climate and cold conditions. In an Arctic climate, it is good to have short legs and round body, as this means the body's surface area is as small as possible in relation to its weight and volume. This allows the Arctic fox to stay warm more easily.

Its winter coat has the best insulating capacity recorded among mammals. The undersides of its paws are also covered with fur in the winter. Its fur means that the Arctic fox can cope with temperatures around  $-40^{\circ}\text{C}$  without needing to use more energy to stay warm. Arctic foxes that live in extreme Arctic environments may sometimes have to cope with temperatures as low as  $-70^{\circ}\text{C}$ .

The Arctic fox also saves energy by having the veins in its legs very close together. The hot blood that flows out into its legs warms up the cooler blood that is flowing back into its body. This means the legs have a lower temperature than the rest of the body and that heat loss is reduced. This is called countercurrent exchange – a common adaptation among animals that live in cold areas.

The Arctic fox also finds it easy to store body fat. In the summer

and autumn, the Arctic fox eats everything it can find, building up an insulating layer of fat reserves that it uses up during the winter. It may also store food and bury what it catches when there is plenty to eat. Still, when the winter storms are at their worst, life is tough for the Arctic fox. Then it lies down in a sheltered place and lets itself be covered by snow, or it digs itself into a snowdrift. A healthy Arctic fox can survive without food for several weeks.





## Life as an Arctic fox

Arctic foxes that live in coastal areas and those in mountain and tundra areas are the same species, but they have different survival strategies and are adapted to the environments in which they live. Both the males and females help to defend their territory and raise their pups.

### Lemming fox and coastal fox

The Arctic fox has two ecotypes, depending on where it lives. The lemming fox is the most common and lives in the high mountains of Scandinavia and on the tundra in Russia, North America, Canada and eastern and north-eastern Greenland. Rodents are an important part of the ecosystem in these areas and are extremely valuable to the Arctic fox's diet.

The coastal fox lives in the rich coastal areas of Iceland, Svalbard and western Greenland, where there are plenty of seabirds, seal carcasses and fish to feed a stable Arctic fox population. In coastal areas, Arctic fox have six to eight pups each year, all of which have a good chance of survival because the food supply is stable and predictable.

The lemming fox has an entirely different survival strategy,

which is linked to the availability of prey. Its favourite foods are lemmings and other small rodents, but the numbers of these vary greatly from year to year. You may have heard the expressions lemming year or rodent year? They usually occur every three to four years and this cyclic pattern is reflected in the Arctic fox's reproduction. When there are plenty of lemmings and other small rodents, Arctic foxes have lots of young. In years with fewer small rodents, the Arctic foxes have no – or just a few – pups. Even if the Arctic fox prefers to eat lemmings, it is a generalist that eats what it finds. The size of an Arctic fox's territory also varies with the amount of available food. In coastal areas, where food supplies are stable, an Arctic fox will defend a small territory that may often overlap the ones around it. In the high mountains, Arctic foxes have a much larger range and their territories do not overlap to the same extent.

## Reproduction and survival

Arctic foxes live in pairs. The male and female help to defend a shared territory and to raise the pups. It was thought that these pairs were life-long partners, but genetic analyses have shown that a male Arctic fox can raise another male's pups and that pups from the same litter can have different fathers. This type of infidelity is relatively common among animals. Arctic foxes probably live in pairs because raising a litter of pups requires a great deal of energy, and it improves the chances of survival. The behaviour is thus inherited. Nor is it unusual for females from the previous year's litter to remain with their parents. When there is plenty of food, the Arctic foxes can thus form social groups that help each other with caring for and feeding the pups.

Arctic foxes feed their pups in a den, so a good den is vital to the pups' survival. It is preferably dug into a sand or gravel bank in a lower area of the mountains and may have many entrances, at least 10 to 20 of them. The biggest dens can have up to 100 entrances and have been used for hundreds of years. Food scraps and scat act as fertiliser for grass and herbaceous plants,

which is why the dens are so verdant and green compared to the rest of the vegetation in the high mountains' harsh environment.

The female is sexually mature in her first year, but whether she breeds or not depends on the availability of food. Arctic foxes mate in March–April and the pups are born after 55 days, in May–June. The size of the litter is also dependent on food availability. Litters of 10–16 pups are relatively common in years with plenty of rodents, but the average is around six pups per litter. Newly born pups are blind and have thin fur. They stay in the den until they are three to four weeks' old, then they take their first shaky steps into an unknown world. The pups are mischievous and, like most mammals, they learn about life through play and physical activity. Watching Arctic fox pups playing boisterously outside the den is a special experience. At 10–12 weeks of age they are already brave enough to venture further from the den and to start to explore the world alone. The pups usually leave the den as autumn approaches, when they move off to find their own territory, a partner and a den.

Mortality varies among Arctic fox pups and some years it can be extremely high. Sometimes all the pups in a litter die, particularly if the lemmings disappear early in the summer. A

growing lemming population is a vast source of food, resulting in large litters and good survival rates. Conversely, few or no pups are born in years with few lemmings.



## **The Arctic fox in the ecosystem**

Small rodents are keystone species in the mountains and the density of many carnivore populations is linked to rodent cycles. In lemming years there is enough food for everyone, but when the lemming population collapses and they disappear many animals face a tough battle for survival.

### **The importance of small rodents**

Lemmings and other small rodents are keystone species in the mountains. The Arctic fox, snowy owl, long-tailed skua, rough-legged buzzard, least weasel, stoat, red fox and a number of other carnivores and birds of prey eat lemmings and voles. There is great competition for food, but during lemming years there is plenty for everyone. A female lemming can have three to five litters in the spring and early summer, with as many as ten young in each litter. The young reach sexual maturity after three weeks and the lemming population can multiply rapidly. If conditions are right, a female can raise litters below the snow cover, becoming a grandmother and great-grandmother before the snow has melted. Then the mountains teem with life. This is a great contrast to when the lemming population collapses and there is no longer enough food for everyone.

Even if the Arctic fox prefers lemmings, it is a generalist that eats what it finds. Hares, frogs, rock ptarmigan, small birds and birds' eggs are all part of its diet – as well as food waste from humans. In the winter, reindeer carcasses can also be an important source of food.

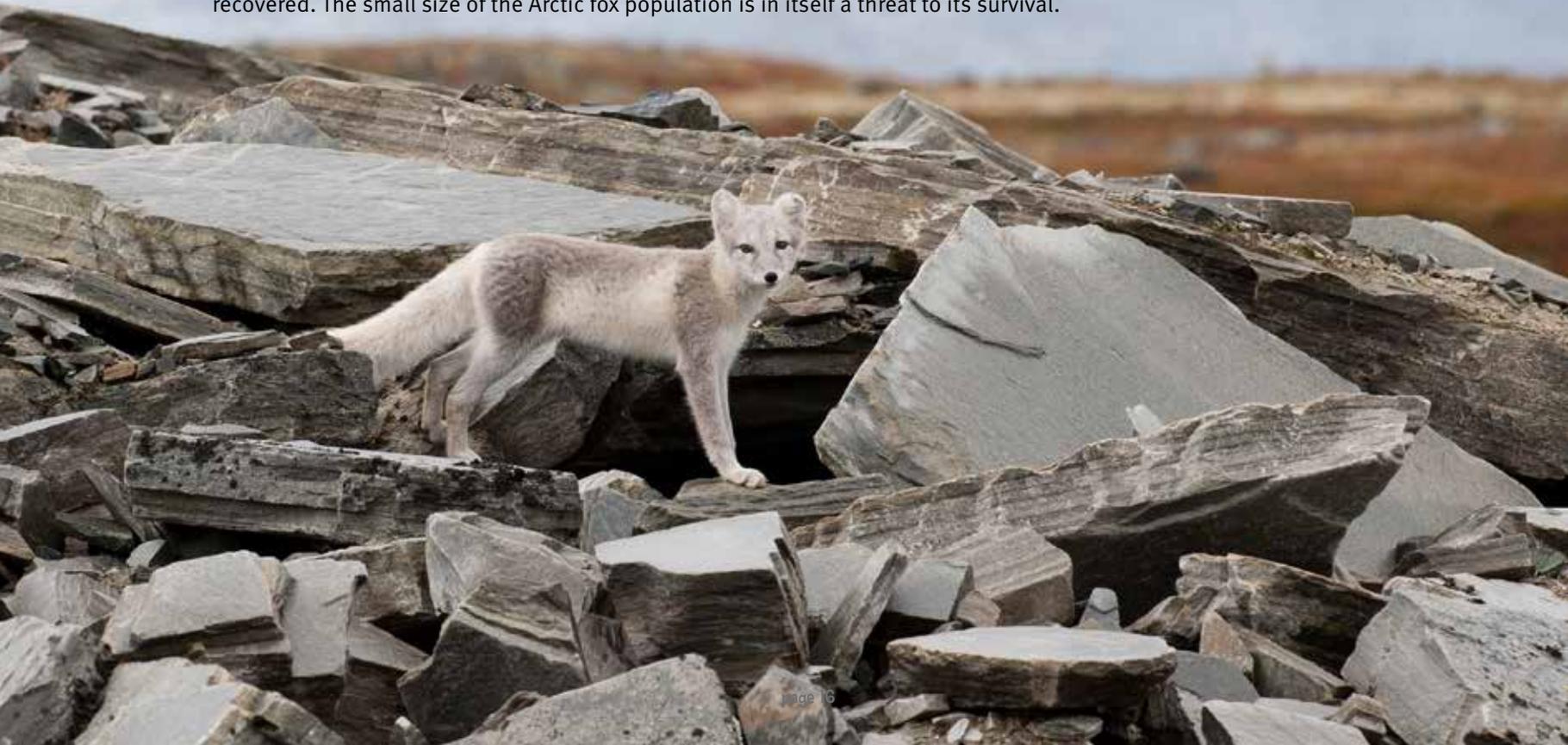
### **Enemies and competitors**

The Arctic fox is a carnivore, but it is also potential prey for larger carnivores. Both golden eagles and wolverines can kill Arctic foxes. However, its toughest competitor is the red fox, which is almost twice its size and physically superior. The Arctic fox and red fox don't only compete for food, but a red fox will happily take over an Arctic fox's den for itself. Even if it doesn't kill the Arctic fox, it will ensure that it is chased away. Arctic foxes try to avoid areas with lots of red foxes.



## **Critically endangered – about declining populations and the Red List**

Extensive hunting in the late 19<sup>th</sup> and early 20<sup>th</sup> century meant that the Arctic fox population went into serious decline. Changes to the life patterns of small rodents and an expanding red fox population are believed to be the major factors in why the Arctic fox population has not recovered. The small size of the Arctic fox population is in itself a threat to its survival.



## **Population size 2018**

The 2018 inventory showed that there were more than 300 adult Arctic foxes in Scandinavia, distributed fairly evenly between Norway and Sweden. In Finland, no Arctic foxes are known to have bred since 1992, but in the winter of 2017/2018 Arctic foxes were observed in some dens and at feeding stations.

## **When is a species put on the Red List and what does it mean?**

The Scandinavian Arctic fox is located at the edge of the species' range and is therefore more sensitive to climate and environmental changes than the Arctic foxes that live in the middle of the range, on the tundra and in the Arctic. The Arctic fox is a common species globally, but in Norway and Finland it is assessed as being "critically endangered" and in Sweden it is noted as "endangered" on the Red List. There is a risk that the Arctic fox will disappear completely from our nature.

All three countries share the objective of stopping biodiversity loss, so the Arctic fox soon had its own action programme in both Sweden and Norway. In 2017, the Swedish Environmental

Protection Agency and Norwegian Environment Agency agreed on a joint action programme for the Arctic fox, including proposals for continuing interventions that may increase the chance of the Arctic fox surviving (see page 24).

## **Betrayed by its own fur**

Two hundred years ago, there were probably more than 10,000 Arctic foxes in our mountains. As with the other large carnivores (bear, wolf, lynx and wolverine), the Arctic fox was hunted in great numbers in the 19th century and early 20th century. Its unique fur made it particularly desirable. The pelt of an Arctic fox could be worth a year's wages for an ordinary labourer. People who knew where the dens were could earn good money, quickly. At that time, it was common to dig the Arctic fox pups out of the dens, raise them until they were fully grown and then flay them and sell the pelt. Other Arctic foxes were taken to fur farms. This led to a dramatic reduction in the Arctic fox population and it was protected throughout Scandinavia – first in Sweden in 1928, then in Norway in 1930 and finally in Finland in 1938.



## Why is the Arctic fox still endangered?

Unlike the other carnivores, the number of Arctic foxes has not increased after it was protected. There are multiple reasons for this, but one problem is that the Arctic fox population is small and scattered. A number of factors and significant changes to the environment play a role. Research has shown that the two most important reasons for the continuing decline in Arctic fox numbers are changes to rodent life cycles and the spread of the red fox in mountain areas. Climate change and increased human influence on mountain landscapes and ecosystems should be added to this.

### A small population makes the situation worse

One serious threat to the Arctic fox is that there are too few of them. The Arctic fox population is currently scattered into small, isolated populations. As these small populations die out, the distance between the remaining populations increases. Small populations are vulnerable to temporary impacts and environmental changes. Single events, such as an adult female being killed by a car, may mean that a subpopulation disappears. In a small population, it is also hard to find a partner that is not a relative, so there is a significant risk of inbreeding. Before interventions began, the Scandinavian Arctic fox had already lost 25 per cent of its genetic variation. This situation is now slowly improving.

Arctic foxes can walk a long way to find a partner and a territory. They probably orientate themselves with the help of their amazing sense of smell and so manage, impressively, to find other Arctic foxes. As the various populations of Arctic foxes get bigger, we are able to see increased migration and an increasing exchange of individuals between different areas.

Small populations are also more vulnerable to factors that are only small threats to the survival of larger populations, such as parasites and diseases, farmed foxes or other disturbances.



## The rodents that disappeared

The lemming is very important to the mountain ecosystem and is the basis of the several species' survival, including the Arctic fox. A rich supply of lemmings results in many large litters. However, in years with few lemmings, few or no pups are born. An Arctic fox rarely lives for more than five years in the wild, so is very sensitive to changes in the lemming population. In order to understand what happens to the Arctic fox, it is important to understand the secret of the lemming's life cycle. The three or four-year population cycle is no longer as predictable as it once was and this has become particularly apparent in the past 30 years. In some mountain areas it has completely stopped and rodent years have vanished. However, these fluctuations have returned to some degree since the start of the 21st century, but it is primarily in the central and inner areas of Scandinavia that cycles are more regular over longer periods of time. In Finnmark the rodent cycle is still fairly noticeable; it has a five-year cycle with mice as the dominant species.

New research indicates that these changes are largely due to a warmer winter climate. Lemmings give birth to their young

under the snow throughout the winter, so fewer lemmings are born in shorter and wetter winters. The mild climate also means that the air space under the snow can disappear, so the lemmings lose their winter homes. When lemmings disappear, this can lead to the Arctic fox and other characteristic species in the high mountains finding it more difficult to survive.

### **The advance of the red fox**

There is a lot to indicate that the Arctic fox is under increasing pressure from expanding red fox populations. The Scandinavian mountains are greatly affected by the forest ecosystems surrounding them, so the habitats of the Arctic fox and the red fox partly overlap. Because the red fox is larger and not as well adapted to life in extreme winter environments as the Arctic fox, it finds it more difficult to find food and stay warm in the high mountains and on the tundra. However, a warmer climate and increased human activity in the high mountains has provided the red fox with more stable access to food. Growing red fox populations also appear to coincide with growing populations of deer and reindeer, and fewer natural enemies in the form of

large carnivores. This may have made it easier for the red fox to survive in the mountains, where the erratic availability of food previously gave the Arctic fox an advantage. The Arctic fox has been pushed up into more marginal mountain areas, while the red fox has taken over the productive, lower areas.



## Management and recovery of the Arctic fox population

The Arctic fox in Scandinavia is entirely dependent on support to return to a viable level.



## **Why do we need to protect the Arctic fox?**

The Arctic fox is a characteristic species that belongs in our mountains. Along with wild reindeer and the lemming, the Arctic fox was one of the first species to migrate into Scandinavia after the last ice age. The Arctic fox thus has a natural place in our high mountain areas where, over several thousand years, it has adapted to life alongside other species and is therefore an important part of species diversity in the mountains. Mountain fauna would be much poorer without the Arctic fox.

Following the climate summit in Copenhagen in 2009, the Arctic fox was named an international symbol species to highlight the effects of climate change. Sweden, Norway and Finland have signed the Convention on Biological Diversity and have therefore promised to protect and preserve endangered species.

Most core areas for the Arctic fox are in the mountains along the border between Norway and Sweden, and furthest north along the border with Finland. Therefore, to succeed in boosting the Arctic fox's chances of survival, it is important to cooperate across national boundaries and for administrative authorities

to work well together. Knowledge about what caused the decline in the Arctic fox population allows us to take action to help it.

## **Shared plan to help Arctic foxes thrive (2017-2021)**

In 2017, Norway and Sweden launched a shared programme of action aimed at achieving a thriving Arctic fox population in Scandinavia. The long-term vision is to create a viable and stable Arctic fox population that does not require support.

The joint action programme has a positive effect on the Arctic fox population by re-establishing and strengthening small and medium-sized subpopulations. This allows increased inward and outward migration which, in turn, reduces inbreeding and helps the Arctic fox to thrive.

Based on the Arctic fox's distribution, biology, experience of intervention and a threat analysis the Swedish Environmental Protection Agency and the Norwegian Environment Agency propose continuing with the proven interventions of supplementary feeding, releasing young Arctic fox from the breeding station and control of the red fox population.

The action programme also proposes intervention in the causes of the increase in the red fox population in our mountain areas, which can be tied to the greater availability of food for the red fox – as well as more types of prey, large deer cadavers and waste from human activity. The aim is to reduce the amount of such easily available food resources, which would lead to fewer red foxes and less competition for the Arctic fox. There is also a proposal to introduce a health monitoring programme to increase preparedness for diseases of an epidemic character.



#### **SHORT-TERM OBJECTIVES (2021):**

- » All Arctic fox subpopulations for which there are interventions will have a positive trend.
- » Linking the Scandinavian subpopulations through the spontaneous inward and outward migration of Arctic foxes.
- » An increase in the northern subpopulations due to new interventions that are expected to result in increased migration and increased reproduction.

#### **LONG-TERM OBJECTIVES (2035):**

- » The Scandinavian Arctic fox population has increased to at least 1,000 adult individuals and at least 250 litters are born in years with a good supply of lemmings.
- » The geographic distribution of the Arctic fox has increased, so Sweden and Norway have an interlinked Arctic fox population with ecological, demographic and genetic exchange, in which today's core areas have been linked and there is a stable occurrence of Arctic foxes in the intervening mountain areas.
- » All subpopulations are in good health due to continual monitoring, mapping and treatment of diseases and parasites.

## **Cross-border cooperation through Felles Fjellrev**

Sweden, Norway and Finland have strengthened their regional cooperation through several Interreg/EU projects, right across the Arctic fox's range.

### **FELLES FJELLREV I AND II, 2010–2014 AND 2016–2019**

Both these projects have received funding from Interreg/Nordens gröna bälte and Felles Fjellrev II was also funded in partnership with counties in Interreg/Botnia-Atlantica.

Felles Fjellrev II includes Jämtland/Härjedalen and Västerbotten in Sweden, and Trøndelag and Nordland in Norway. Project owners are the County Administrative Board of Jämtland and the Norwegian Environment Agency.

The county administrative boards of Västerbotten and Jämtland, the Norwegian Environment Agency through Statens naturoppsyn (SNO), Norwegian Institute for Nature Research (NINA) and the Department of Zoology at Stockholm University are participating in the project's activities in the field.

The WWF in Sweden and Norway is participating in the project's communication with information via websites and social media.

## **THE PROJECT HAS TWO PRIMARY OBJECTIVES:**

1. to promote the exchange of Arctic foxes between core areas in the project – Junkeren/Vindelfjällen, Børgefjell/Borgafjäll, Sylane/Helags and Dovrefjell – by conducting interventions in intervening and smaller mountain areas. These intervening mountain areas can thus function as distribution corridors to link together the four core Arctic fox areas. The interventions were shown to have a positive effect during Felles Fjellrev (see pages 30–33).
2. to create interest in Arctic foxes and to teach people about them and the vulnerable mountain nature that is their home.

### **FELLES FJELLREV NORTH (2017–2019)**

The project is part-funded by Interreg/Nord. It started in 2017 and includes Troms and Finnmark in Norway, the county of Norrbotten in Sweden, and northern Finland. Project partners are the County Administrative Board of Norrbotten (which is the coordinating project manager), Metsähallitus in Finland, Stockholm University and the Norwegian Institute for Nature Research (NINA). The University of Tromsø is also a member of the project's management group.

The project's objectives are to strengthen the Arctic fox population in Nordkalotten and expand cross-border cooperation, and to contribute to increased knowledge about the Arctic fox in the project area.

### **Strengthening existing Arctic fox populations – supplementary feeding and red fox culls**

In areas where there are already Arctic foxes, measures are taken to improve the chances of their survival. There are two primary interventions that give good results – supplementary feeding and culling red foxes.



### **SUPPLEMENTARY FEEDING OF THE ARCTIC FOX**

Research has shown that feeding during the summer increases the survival of both adult animals and pups, while winter feeding leads to more mating and larger litters. Specially designed automatic feeders have been located in many mountain areas in Norway and Sweden. These have been designed so that, almost without exception, they allow Arctic foxes to access food. The analysis of images from game cameras with motion sensors shows that very few red foxes visit the automatic feeders, compared to the number of Arctic foxes. In total, there are now almost 250 automatic feeders for Arctic foxes in Scandinavia and each year they are filled with almost 30 tons of dry feed. It is important that the automatic feeders are filled with food throughout the year, but especially during the winter.

### **CULLING RED FOXES**

In Sweden, the county administrative boards have long combined red fox culls with supplementary feeding, particularly around Helags and in Borgafjäll. Some red foxes have also been culled in mountains close to the border in Trøndelag, Norway. This has had a positive effect on these Arctic fox subpopulations.

Significant efforts have been made to reduce the number of red foxes on the Varanger Peninsula in Norway, but without combining this with supplementary feeding. The Arctic fox population here has not yet recovered; They are isolated from other Arctic fox populations. The number of Arctic foxes was probably already too low for the intervention to have a positive effect. So far, the interventions carried out in Finland have not had any effect. No arctic foxes have bred there since 1992.

### **Re-establishing extinct and small subpopulations – releasing Arctic foxes into the wild**

When the size of a subpopulation falls below a critical minimum size, the low number of individuals may mean that Arctic foxes are unable to find partners and that no new pups are born. This happened on the Varanger Peninsula in Finnmark, where the Arctic fox population has continued to decline despite intensive red fox culls.

Since 2006, Arctic foxes from the Norwegian breeding station have been released in areas with few Arctic foxes, or where they have entirely disappeared. Every year, 35–60 Arctic foxes



are released. In total, from 2006 to 2018, more than 400 Arctic foxes have been released in seven different mountain areas in Norway, from the Varanger Peninsula to Hardangervidda. As yet, no Arctic foxes have been released in Sweden or Finland, but Felles Fjellrev Nord is investigating opportunities to release Arctic foxes here too.

The Arctic foxes are released in February, when they are almost fully grown and have eaten enough to have a good layer of fat.

Before being released, the foxes are marked with microchips and ear markers so they can be identified. They are released into areas with known dens, where an artificial den has been placed in advance, as well as an automatic feeder that they recognise from the breeding station. The foxes are monitored using automatic chip scanners in the feeders, DNA from scat, etc., game cameras and visual observations.

Around half of the Arctic foxes that are released survive their



first year. This is a much higher than expected survival rate, and is higher than for the pups born in the wild. Releasing Arctic foxes has led to the re-establishment of several subpopulations that were assessed as being extinct. Some animals migrate to other mountain areas, where they become established and have their own pups. Releases have thus also contributed to strengthening a number of subpopulations in Sweden. Arctic foxes originally from the breeding station in Norway have also been observed in Finland. Released Arctic foxes, and their offspring, form a significant number of the reproductive individuals in Scandinavia.

### **When should intervention occur?**

The effects of all these measures increase when they coincide with good conditions for lemmings and other small rodents. The years when rodents increase in number are when Arctic fox pups have a particularly high survival rate. We must take account of how Arctic foxes, which are dependent on lemmings, best respond to intervention with the same pattern as the rodent population cycles, i.e. every three to five-years. This also entails a quadrupling of the time that future management measures

must take, compared to non-cyclic species where improvements may be expected every year. This also highlights the need for patient and persistent efforts in all work that aims to help the Arctic fox.

### **Arctic fox breeding station**

Sæterfjellet breeding station was founded in 2005 and is located in natural high mountain terrain in Oppdal. Over the years, 33 Arctic foxes born in the wild have been brought to the breeding station, which has space for eight pairs of Arctic foxes. There is plenty of room in the enclosures, each of which is as big as half a football pitch. Every enclosure has two artificial dens and rocky areas that provide protection and the opportunity to climb. The foxes also dig their own holes and dens in the enclosures. They are fed with fresh food for fur-bearing animals and dry dog food, as well as moose and deer that have died in the wild.

The breeding animals reflect the genetic variation among the Arctic foxes in Scandinavia, so the adapted release of young foxes will contribute to the increased exchange of individuals and improved genetic variation. The breeding programme also works as a buffer against the loss of genetic variation.

Arctic fox pups are born in May–June and can then grow up in a secure environment. In the wild, the pups usually leave their parents and migrate in August–September. However, the pups at the breeding station can grow bigger, and are first released into the wild in the following February.

You can watch the Arctic foxes live via three cameras at the breeding station. Go to [www.fellesfjellrev.se](http://www.fellesfjellrev.se)

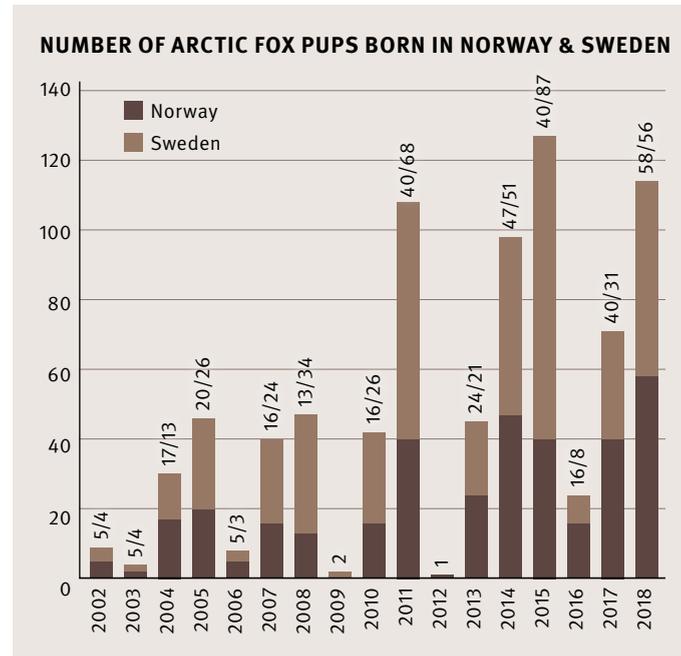


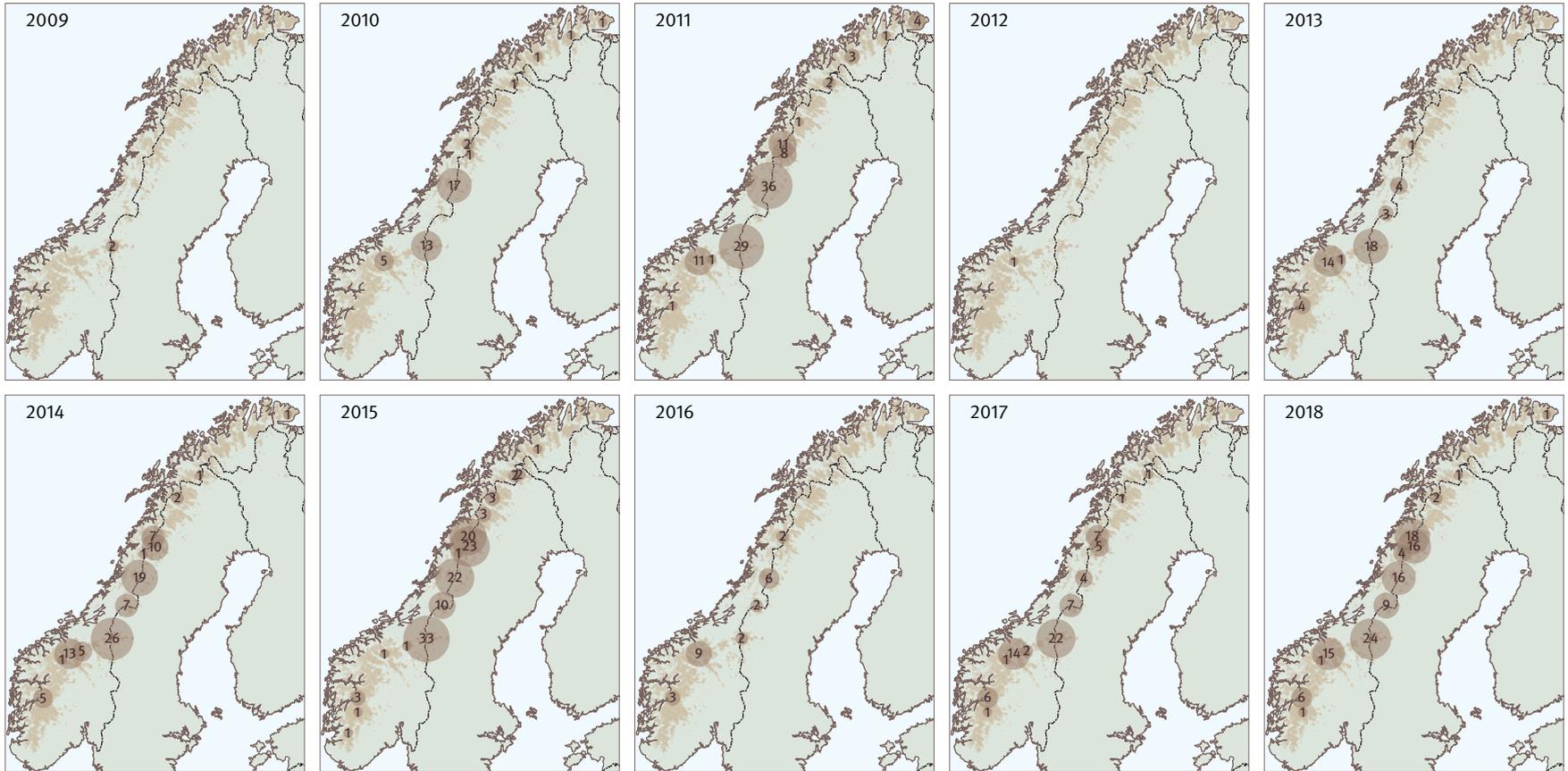
## Inventories keep the Arctic fox under observation

Inventorying the Arctic fox allows us to see how the population changes over time. We learn about the mountain areas in which the Arctic fox thrives – and why. Sweden, Norway and Finland have coordinated how the inventorying and monitoring of Arctic foxes is conducted, so that work is done in the same way and using the same methods.

A selection of known Arctic fox dens are checked every winter and summer to look for activity and any new litters. The number of pups is counted. Scat, hair and other biological material are gathered for DNA analyses. These DNA analyses provide information about the sex and individual, as well as the relationships between individuals. When known individuals appear, we know that they have survived for another year. Recurring DNA finds are also used to document the migration of Arctic foxes between different areas of the mountains – so far, the Scandinavian record is over 700 km. Using DNA and capture/recapture we are also able to estimate how many Arctic foxes live in the various mountain areas.

Inventories and monitoring are also important instruments for evaluating the effects of the interventions.





*Distribution of Arctic fox litters in Fennoscandia over the last ten years.*

## Linking Arctic fox populations

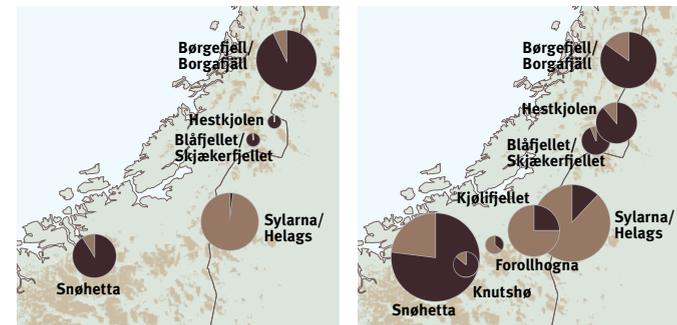
In 2010, when Felles Fjellrev began, the three core areas for Arctic foxes in Snøhetta/Dovrefjell, Sylarne/Helags and Børgefjell/Borgafjäll were a long way apart. Using funding from Interreg/EU, interventions were carried out in small mountain areas, known as stepping stone areas or dispersal areas, between the three core areas. After a short period, there were multiple documented cases of Arctic foxes migrating between the three core areas. Pairs of Arctic foxes became established and, over the following years, new litters were documented in several of these stepping stone areas.

### Growth in all subpopulations and increased genetic variation

A number of subpopulations have been re-established and all subpopulations in the project area are now growing. A greater proportion of individuals in the various subpopulations are having pups, which is important in maintaining genetic variation. We can also see a significant increase in genetic variation; this is a result of increased inward and outward

migration. The growing exchange of individuals between the various subpopulations is vital if the species is to thrive.

The Arctic fox has become increasingly viable in the project area. Interventions in the stepping stone areas between the core areas have been very important in linking up the various areas that have Arctic fox populations.



*The above figure shows the genetic signatures of the various subpopulations and how they change between 2008 and 2015. The number of subpopulations also increases over this period.*

## Migrating Norwegian Arctic foxes helped the Swedish Arctic fox population

The Arctic foxes in the Helags area of Sweden are an example of how inbreeding can affect a population. In the early 2000s, the foxes in this population were descended from just five individuals. With no contact with Arctic foxes in other populations, the degree of inbreeding rapidly increased – and nine years later the foxes were all related to each other, the equivalent of mating between half-siblings. The lack of genetic variation led to inbreeding depression, with the foxes having lower survival rates and fewer pups.

In 2010, a blue Arctic fox, a male, suddenly appeared in Helags. Because the Helags population then only had white foxes, this blue fox was an immigrant. Shortly afterwards, another two male foxes arrived in Helags, one white and one blue. The three new arrivals had been released on Snøhetta in Dovrefjell in 2009, and the two blue foxes were brothers. All three had walked around 250 kilometres to Helags. They established themselves in Helags, found partners and had pups. The Helags population has now almost doubled in size and the degree of inbreeding

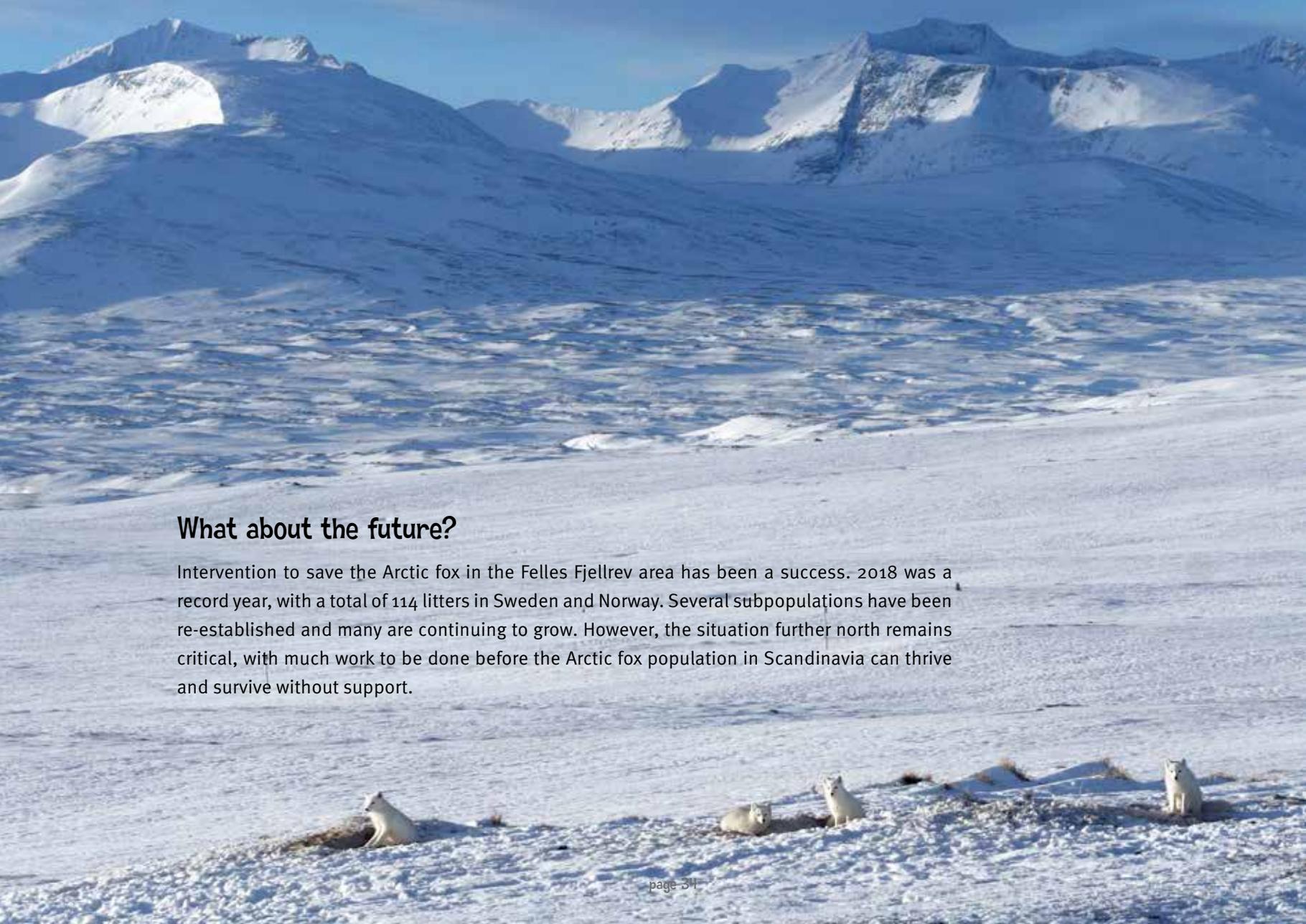
in the population has almost halved. One study, funded by the Swedish Research Council Formas and Felles Fjellrev, showed that 90% of the Arctic fox litters had genetic traces of the immigrants. The pups in these litters have a survival rate that is almost twice as high as that of other litters.

### READ MORE ABOUT CURRENT ARCTIC FOX RESEARCH

- » [www.nina.no/fjellrev](http://www.nina.no/fjellrev)
- » [www.su.se/zoologi/forskning/fjällrävsprojektet](http://www.su.se/zoologi/forskning/fjallraevsprojektet)
- » [www.coat.no/Fjellrev](http://www.coat.no/Fjellrev)



*One of the "Blues Brothers" who migrated from Norway and saved the Swedish Arctic fox population.*

A wide, snowy landscape under a clear blue sky. In the background, there are large, snow-covered mountains. The foreground is a vast, flat expanse of snow. In the lower part of the image, several Arctic foxes are visible, some sitting and some standing, on a small patch of ground where the snow is slightly disturbed.

## What about the future?

Intervention to save the Arctic fox in the Felles Fjellrev area has been a success. 2018 was a record year, with a total of 114 litters in Sweden and Norway. Several subpopulations have been re-established and many are continuing to grow. However, the situation further north remains critical, with much work to be done before the Arctic fox population in Scandinavia can thrive and survive without support.

### **Three hundred adult Arctic foxes (2018)**

Since 2000, we have come closer to achieving a viable Arctic fox population in Scandinavia. Inventories have shown that there were more than 300 adult Arctic foxes in Sweden, Norway and Finland in 2018. This is almost four times as many as when interventions began. However, there is a long way to go before we have a viable Arctic fox population that can grow naturally.

The vision of the Norwegian-Swedish action programme is “that the Arctic fox population will be stable and viable, with no need for further intervention; that the Norwegian-Swedish-Finnish population has at least 2,000 sexually mature individuals, and that in good rodent years at least 500 litters are born. The Arctic fox population must have a contiguous geographic range, covering the Scandinavian mountains, so they can find unrelated partners for long-term survival”.

There is much to indicate that we are on the way to achieving this. Several subpopulations have been re-established and many are growing. This positive trend is partly self-sustaining, because there is increased inward and outward migration of individuals, which is decisive for long-term survival.

### **Critically few Arctic foxes in the north**

However, from Saltfjellet/Arjeplog and northwards, the situation is critical. Arctic fox populations here have long been critically small, with great distances between the subpopulations. Interventions are now taking place here too, which we hope will bring positive results. For their long-term survival, it is also important that the Arctic fox populations in Scandinavia are linked with the populations to the east – on the Kola Peninsula in Russia.

### **Moving the Felles Fjellrev model forward**

Felles Fjellrev II has also expanded and developed interventions in Nordland and Västerbotten, in addition to the previous ones in Trøndelag and Jämtland/Härjedalen. The equivalent actions, with interventions in large and small subpopulations, started in 2017 through Felles Fjellrev Nord. Interventions are now being conducted in the cross-border populations in Troms and Finnmark in Norway, Norrbotten in Sweden, and northern Finland (see map on page 7).

## What can you do to help save the Arctic fox?

### Report your Arctic fox observations

Please tell us if you are lucky enough to see an Arctic fox as your observation may be important for finding unknown locations for Arctic foxes. We are particularly interested in observations that are outside the Arctic fox's core areas (see map on page 7). We have seen that Arctic foxes are able to find their way back to

old dens that they dig out and re-use. We would also like you to contact us if you find a dead Arctic fox. Leave the fox where it is, but please take pictures. When you report your observations, it is important that you describe the location well, preferably with a UTM position.

Please report your observations to one of the regional authorities for the Arctic fox:

#### SWEDEN:

- » **Norrbottnens län** – Tom Wiklund  
tom.wiklund@lansstyrelsen.se  
+46 70 353 34 72
- » **Västerbottnens län** – Sonja Almroth  
sonja.almroth@lansstyrelsen.se  
+46 10 225 44 13
- » **Jämtlands län** – Lars Liljemark  
lars.liljemark@lansstyrelsen.se  
+46 70 387 70 47

#### NORWAY:

- » **Finnmark** – Magne Aasheim  
magne.aasheim@miljodir.no  
+47 922 64 407
- » **Troms** – Thomas Johansen  
thomas.johansen@miljodir.no  
+47 994 37 644
- » **Nordland** – Geir Heggmo  
geir.heggmo@miljodir.no  
+47 480 32 350
- » **Trøndelag nord** – Tore Solstad  
tore.solstad@miljodir.no  
+47 994 37 770
- » **Sør-Norge nord** – Tord Bretten  
tord.bretten@miljodir.no  
+47 959 11 774
- » **Sør-Norge midt** – Petter Brathen  
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+47 924 07 771

- » **Sør-Norge Sør** – Knut Nylend  
knut.nylend@miljodir.no  
+47 995 29 387

#### FINLAND:

- » **Metsähallitus** – Tuomo Ollila  
tuomo.ollila@metsa.fi  
+35 8400 241 448

### **Do not feed Arctic foxes!**

Take all your rubbish and waste with you when you are in the mountains. You might think you were doing the Arctic fox a favour if you leave your lunch or dinner leftovers, but it has the opposite effect. Rubbish and food waste at cabins and campsites may mean that you instead help the red fox, which is a competitor to the Arctic fox.

### **Do not disturb Arctic foxes!**

Arctic foxes are often unafraid and sometimes even inquisitive, but may still be stressed and worried if we get too close. A lot of human activity close to a den can make the Arctic foxes move to another den, perhaps one that is of poorer quality. Arctic foxes use their dens throughout the year, but are particularly sensitive to being disturbed during two specific periods: prior to mating in March-April and when the pups are young, in May-June-July

A well-made, dry den with many entrances protects the pups from both cold and rain – as well as from other predators such as wolverines and golden eagles. A den with many entrances is an advantage when a golden eagle glides in, hunting in the



area. The pups can then escape into the den, where they are well-protected in the many underground tunnels. If the parents are disturbed in the den, they have to spend time and energy guarding the pups, which leaves less time for finding food for the pups who need to grow.

### **How to avoid disturbing Arctic foxes**

- » Do not get close to Arctic fox dens, particularly from the mid-May to mid-July, when the pups are particularly vulnerable.
- » Stay at least 300 metres from Arctic fox dens, preferably further in open terrain. Groups of people should stay even further away.
- » Dogs, particularly if they are not on a lead, can be a serious disturbance. Dogs can transfer diseases or parasites to Arctic foxes. Dogs sometimes kill Arctic foxes
- » In Sweden, you must always keep your dog on a lead in all areas where the Sami people can herd reindeer – the entire mountain chain that is home to the Arctic fox.

- » An Arctic fox may appear to be quite unafraid, but in most cases it is shy, just like other animals. When a fox at its den shrieks, this is its way of saying: you are too close, I'm scared, so stay away!
- » Their final option is to run away – but they may have been disturbed long before they do this.
- » If you accidentally get close to a den with foxes, you should move away the same way you came, calmly and quietly. If you are in a group, you should all move away at the same time.

*From the Norwegian Environment Agency's fact sheet on Arctic foxes and disturbance.*

### **LEGISLATION TO PROTECT THE ARCTIC FOX**

In Swede, the Arctic fox and Arctic fox dens have general protection from damage or disruption under the Species Protection Ordinance. In Norway, there is equivalent protective legislation under the Fjellrevforskriften.

## **New knowledge about the Arctic fox and disturbance**

Felles Fjellrev funds research into how the Arctic fox is affected by disturbance due to people in the mountains. Although Arctic fox behaviour may be affected by our presence, there also appear to be positive effects – if the guidelines for avoiding disturbing Arctic foxes are followed. In the presence of humans, we have seen that Arctic foxes first hide when they are about 300 metres away, but many foxes become wary and change their behaviour when humans are at least 500 metres away. Arctic foxes with dens that are rarely disturbed become worried and hide when humans are further away compared to those with dens that are closer to trails and mountain cabins/stations. Perhaps the Arctic fox can develop some form of tolerance for humans?

In Helags, guided tours are available to an Arctic fox den. These offer participants both a fantastic experience and increased knowledge, as well as providing money for the supplementary feeding of the Arctic fox in the area.

Human presence due to the guided Arctic fox tours, on trails and around mountain cabins/stations, also seems to provide

some protection against predation by other carnivores. In years with greater predation of Arctic fox, higher survival rates have been observed among pups in dens that are exposed to some disturbance, compared to dens with fewer disturbances.





## The Arctic fox in brief

**LATIN** *Alopex lagopus* | **NORWEGIAN** fjellrev, polarrev, blårev | **SWEDISH** fjällräv, polarräv, blåräv | **FINNISH** naali | **SAMI** svaale, svälla, njälla  
**DANISH** fjeldræv, blåræv | **ICELANDIC** tófa | **ENGLISH** arctic fox, polar fox | **FRENCH** isatis, renard polaire | **GERMAN** Polarfuchs | **SPANISH** zorro ártico

### Diet and population fluctuations

The Arctic fox is an omnivore, but in the summer its diet is dominated by small rodents, mainly lemmings. It eats almost everything it finds to survive, but the Arctic foxes in our mountain areas usually require prey of a special quality and quantity for them to succeed in breeding. The Arctic fox population therefore follows the fluctuations in the rodent population. A good rodent year results in a huge increase in food supply for Arctic foxes, leading to increased reproduction and larger litters.

### Social structure

Arctic foxes live in pairs. Both parents take an active role in raising the pups and in the defence of a joint territory. The pups usually leave the den in the autumn. Initially, they make short trips away from the den; later they are brave enough to go further and

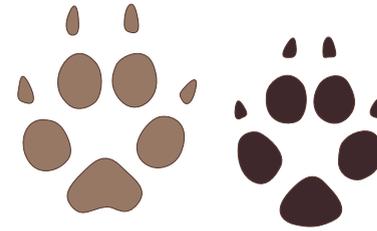
eventually they establish their own territories. If there is plenty of food available, females from the previous year's litter may remain in the parents' territory.

### Territory

The Arctic fox pair defend a joint territory throughout the year. Its size varies with the availability of food. In rich coastal areas the territory can be 5–15 sq. km., while in more desolate tundra and high mountain environments it may be up to 60 sq. km. Arctic foxes can travel long distances; migrations of up to 2,000 km have been documented.

### Size

**WEIGHT** Usually 3–4 kg, the male is slightly larger than the female.  
**LENGTH** 50–65 cm, excluding the tail, which measures 28–33 cm



**PALE BROWN:** Front foot, 5–5.5 cm  
**DARK BROWN:** Hind foot, 5.5–6 cm  
*Illustration above is 50% of actual size.*

- |                      |                |
|----------------------|----------------|
| 1. Walk              | 5. Side trot   |
| 2. Walk in deep snow | 6. Slow gallop |
| 3. Slow trot         | 7. Fast gallop |
| 4. Fast trot         | 8. Mousing     |

## Reproduction

**MATING PERIOD** March–April

**BIRTH** May–June

**LITTER SIZE** 2 to 16 pups (average 6.3)

## Gaits

The Arctic fox and the red fox have the same gait patterns, as illustrated. The Arctic fox moves forward using a short gallop (6) around 70% of the time. The left rear foot (LR) is almost alongside the right front foot (RF). At a fast gallop (7), the distance between the left rear foot (LR) and right front foot (RF) increases, giving a

longer stride length. A lone Arctic fox almost always moves at a fast gallop. When hunting, playing or when with other foxes, other gaits may be used, but never for long periods of time.

However, the red fox moves at a relaxed trot (3) about 90% of the time, placing the rear foot on top of the front foot print. In deep snow, both species may walk (1). Sometimes, in deep, loose snow or when hunting, that also pounce (8), known as “mousing”. Mousing tracks may sometimes be mistaken for hare tracks, but if you follow these you will soon be able to see the hare’s large hind feet. Tracks should be followed for at least 200–300 metres to determine the gait.

## Find out more about the Arctic fox

Felles Fjellrev has, in addition to this brochure, also produced books and films about the Arctic fox and the mountain ecosystem. These are available on our website – [www.fellesfjellrev.no](http://www.fellesfjellrev.no)

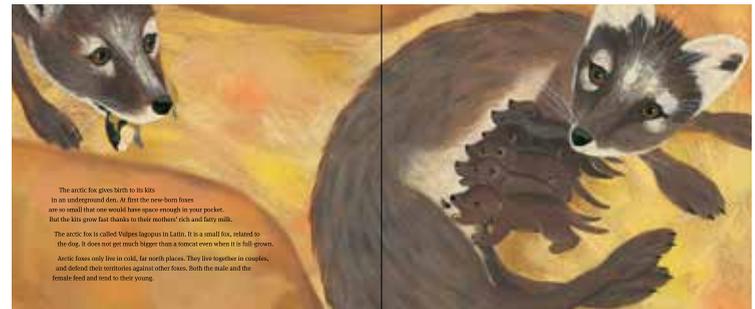


**A FILM ABOUT STORM & TINDE** was made during the first project period. It is primarily for children aged around 10–13, but is also suitable for younger children and adults. We have released the next film, *Storm & Tinde II – a battle for survival*, as part of *Felles Fjellrev II*. The films are in Swedish, Norwegian and English.

**THE BOOK, MEET THE ARTIC FOX**, is a book for children aged five to nine. It is available in six languages: Norwegian, Swedish, South Sami, North Sami, English and German. The book has been donated to schools and preschools in Felles Fjellrev's project area and to various public organisations. The next book,

about lemmings, will be available in the autumn of 2019.

You can also follow our daily work with the Arctic fox via both Facebook and Instagram.



The arctic fox gives birth to its kits in an underground den. At first the new born foxes are so small that one would have space enough in your pocket. But the kits grow fast thanks to their mother's rich and fatty milk. The arctic fox is called *Vulpes lagopus* in Latin. It is a small fox, related to the dog. It does not get much bigger than a racoon even when it is full grown. Arctic foxes only live in cold, far north places. They live together in couples, and defend their territories against other foxes, both the male and the female. Feed and tend to their young.



## Fjellrev i sekken

### Web-based teaching material about the Arctic fox

“Fjällräv i ryggen” is web-based, interdisciplinary teaching material available in Norwegian and Swedish. It is designed so that children in primary schools can learn more about mountain ecology and endangered species via the Arctic fox.

The objective is to provide pupils with real experiences that they can use when thinking about how our actions affect the natural world. “Fjällräv i ryggen” wants pupils to come to see themselves as part of nature and society. This teaching material shows how the critical situation of the Arctic fox has been

greatly influenced by our actions over the last 100 years, so the Arctic fox is a symbol for how everyday actions and choices can have a direct impact on nature. The history of the Arctic fox also shows how the sustainable use of natural resources can contribute to a balanced environment in the mountains

### THE TEACHING MATERIAL IS DIVIDED INTO THREE SECTIONS:

1. Get to know the Arctic fox – introduction with preparatory work for the main section
2. The Arctic fox in the ecosystem – the main section, focusing on the ecosystem and endangered species
3. The climate and climate adaptation – summary with follow-up work and presentations

The Norwegian original, “Fjellrev i sekken” was funded by the Norwegian Environment Agency via “Den naturlige skolesekken”.

The Swedish version, “Fjällräv i ryggen” has been translated, adapted to the Swedish curriculum and funded by Felles Fjellrev II.

You can find the material on [www.fellesfjellrev.se](http://www.fellesfjellrev.se)



IN PARTNERSHIP WITH:



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