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RE-ESTABLISHMENT PLAN FOR THE WILD REINDEER POPULATION IN NORDFJELLA ZONE 1

The wild reindeer population of Nordfjella zone 1 shall be re-established after the eradication of the entire population due to chronic wasting disease.

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1 Summary

It has been decided that the wild reindeer population in Nordfjella zone 1 shall be eradicated. The area must then be left fallow for several years before healthy animals are brought in and a wild reindeer population is re-established in the area. The Norwegian Food Safety Authority and the Norwegian Environment Agency have prepared a plan for how the re-establishment can occur. In this we discuss different source populations, methods for transferring animals and establishing the health of source populations. The management of different populations is also discussed. Finally we give an estimate of costs.

2 Introduction

The objective is to attempt to eradicate chronic wasting disease (CWD) in Norway. On the basis of scientific recommendations, the infected wild reindeer population in Nordfjella zone 1 will therefore be eradicated. The culling was determined by the Norwegian Food Safety Authority on 15 September 2017 in the regulations on culling wild reindeer in and from Nordfjella zone 1, Buskerud, Hordaland and Sogn og Fjordane and will be performed in line with the plan for removal of the wild reindeer population in Nordfjella zone 1, dated 15 June 2017.

We shall re-establish a healthy reindeer population in Nordfjella zone 1 after the area has been fallow for a minimum of five years. In its [letter of 23 June 2017](#), the Ministry of Agriculture and Food asked the Norwegian Food Safety Authority and the Norwegian Environment Agency to create a plan for this re-establishment.

The report of a dedicated re-establishment group has been used as a basis for the plan. A meeting was also held in September 2017 with expert and resource persons, including local reindeer management and landowner interests, which also provided input.

This re-establishment plan discusses a number of topics that must be further evaluated in the coming years. The plan will be adapted to take new knowledge into account. Great emphasis has been placed on ensuring that this is a concrete plan, but not all details are discussed here.

3 Evaluation and uncertainties

Ongoing research and information gathering projects are providing us with new information about the infectious material and its incidence in animals and the environment in Norway. Such new information may affect the implementation of the re-establishment plan.

If we find the classic CWD strain in wild reindeer populations other than that of Nordfjella zone 1, the Norwegian Food Safety Authority and the Norwegian Environment Agency will consider what significance this has for the re-establishment.

A successful fallow period is a prerequisite for successful re-establishment. This plan therefore briefly discusses some important elements that must be followed up in connection with following.

4 Relevant source populations and methods of transfer

It is natural to consider collecting animals from the three main genetic groups of reindeer that we currently have in Norway: the populations in the Langfjella region (area 14-20) and the Rondane/Dovre region (area 2, 3, 5, 6) and semi-domesticated reindeer.

Langfjella was at one time an unbroken area that was used by wild reindeer. Today the area is more fragmented due to human activity and the wild reindeer populations are largely isolated in different conservation areas (see Figure 4.1). Even so, the long-term goal is to protect large and unbroken areas of living space for wild reindeer, including breaking down the barrier effects that limit use of the areas today.

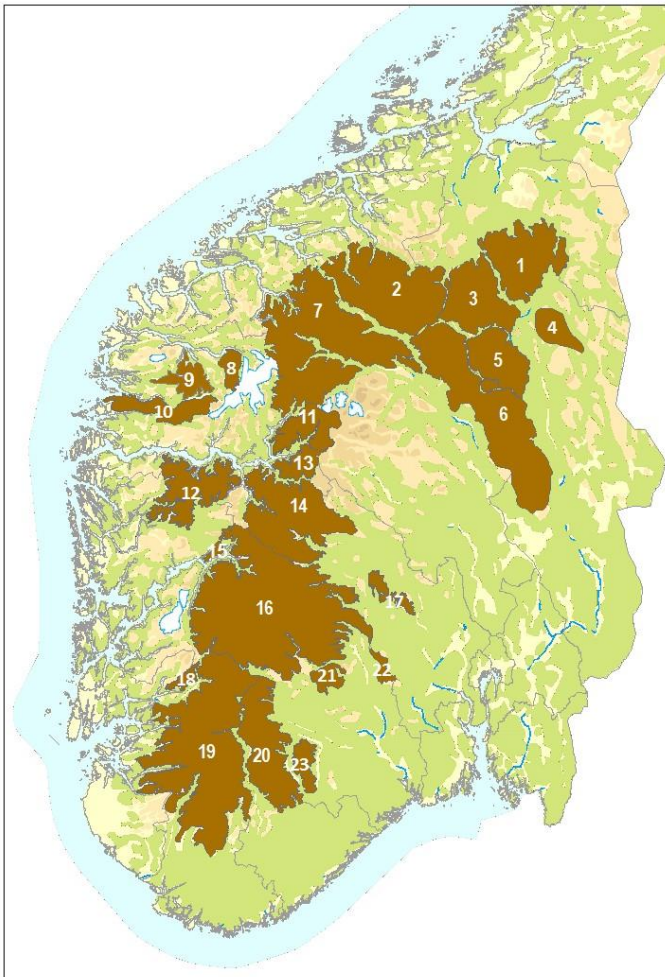


Figure 4.1. The map shows the 23 different management areas for wild reindeer in Norway. Nordfjella is area 14 and zone 1 is the northern part of this area. Hardangervidda is area 16.

4.1 Method of transfer

4.1.1 Herding wild reindeer

Wild reindeer can be herded so that they walk into Nordfjella zone 1 themselves. Using this method it is not possible to hand pick the animals to be transferred, it is a case of mainly taking the animals that move with the herd. If the herding is done during the period of the year when herds of males are separate from the breeding herds of females, calves and young animals, the necessary gender and age composition can be maintained.

The challenge is that animals that walk into the zone themselves may find it easier to attempt to go back to where they came from. This risk is considered to be relatively great. The positive aspect of herding the animals across is that many animals can be taken at a time, while at the same time we can help to re-establish the old migration routes between the fragmented areas of Langfjella. This latter would be consistent with the strategy that is based on the European wild reindeer regions.

Fences are being put up across important migration routes between Nordfjella zones 1 and 2, which will reduce the possibility of reindeer moving south and out of the area. Similarly, fences have been erected on strategic stretches along highway 52 north of zone 1. This fencing is to prevent wild reindeer from moving north and out of the area and to prevent semi-domesticated reindeer from moving into the wild reindeer area.

4.1.2 Immobilisation and transport of wild reindeer using motorised transport

It is possible to immobilise wild reindeer and transport them by helicopter or road vehicle. With such a method we have greater control over which individual animals are transported and we can for example hand pick young animals that are less bound to tradition and place. Neither will the animals know the way back to where they came from. This means that the risk of the animals returning is less, perhaps almost non-existent.

Moving wild reindeer by helicopter or vehicle means that the animals must be sedated in some way. The normal time taken during animal marking operations is up to one hour, which does not seem to have any negative effect on the animals. This would largely cover the time needed for transport by helicopter. If animals are moved by land-based transport, the immobilisation time will be longer. As the immobilisation time increases, so does the risk of respiratory or circulatory failure. With other animal species, long transports of more than 20 hours have been performed, but there is no such experience with wild reindeer or caribou. There is therefore more uncertainty in connection with longer transport times.

One possibility is to collect reindeer in a grazing area for immobilisation and movement by animal transport vehicle. This method requires facilities at both the place of capture and the place of delivery, but the advantage is that the animals do not have to be herded for great distances.

If the animals are moved by helicopter, several animals must be transported and brought round simultaneously so that they can find each other immediately instead of moving out of the area looking for other reindeer.

All individuals that are transported by vehicle or helicopter must be ear marked and several should be fitted with GPS transmitters so as to be able to monitor whether animals are moving out of the area they were transported to.

4.2 Relevant source populations for the re-establishment of zone 1

4.2.1 Hardangervidda

Studies of genetic variation show that the reindeer in Nordfjella are not significantly different from reindeer in Hardangervidda or the other populations in the Langfjella region.

Hardangervidda has a large population of reindeer, which means that it is possible to collect many animals. The winter population is approximately 11,000 wild reindeer. The health of the population must be checked by testing several hundred animals a year during the fallow period.

Hardangervidda wild reindeer area is large and the distance to Nordfjella zone 1 could make transferring animals something of a challenge.

How long it would take to establish a relatively large population in zone 1 with animals from Hardangervidda, therefore depends on which method is used for transportation, cf. section 4.1. If one were to herd animals from Hardangervidda to Nordfjella zone 1, they would need to pass through Nordfjella zone 2 and it would be necessary for Nordfjella zone 2 to be given a clean bill of health before the transfer of animals started. If we could successfully herd many wild reindeer through zone 2, a large population could be established in zone 1 relatively quickly. If the animals must be sedated and transported it would take longer, since this would be a larger and more difficult operation.

There is however a risk that animals would make their way back to Hardangervidda after transfer to zone 1, a risk that is considered to be greater with herding than with moving individuals by road.

4.2.2 Nordfjella zone 2

Nordfjella zone 2 consists of wild reindeer with the same origin as the animals in Nordfjella zone 1. The area has a smaller population of about 400 wild reindeer. When the health of the population is to be checked, a large proportion of the animals must therefore be tested over the course of time. Nordfjella zone 2 is geographically adjacent to Nordfjella zone 1, which makes the distance and the transport of animals easier. There will be a risk that the herd can return from zone 1 to zone 2.

4.2.3 Setesdal-Ryfylke wild reindeer area and Brattefjell-Vindeggen wild reindeer area

4.2.4 The wild reindeer in these areas have the same origin as those in Nordfjella zone 1 which makes them a relevant source population.

4.2.5 The Dovre/Rondane region

Wild reindeer in the Dovre/Rondane region are genetically different from the populations in Langfjella. However the region does have several wild reindeer areas with relatively large populations from which animals could be collected. The distance is greater, which means that every individual animal would need to be sedated and transported by road. Even though access to animals is good, the method of transfer would mean that relatively few animals would form the basis for a new population in zone 1. It would therefore take longer to build up the population.

4.2.6 Lærdal/Årdal

The Lærdal-Årdal wild reindeer area has been judged to be too small to use as a source

for re-establishment.

4.2.7 Semi-domesticated reindeer

Semi-domesticated reindeer are genetically different from wild reindeer. These animals are on the other hand more used to people and transport to Nordfjella zone 1 would be relatively simple to perform and many animals could be transferred at the same time. The advantage with this is that the population in Nordfjella zone 1 could be built up quickly.

4.3 Overall assessment of source population and method of transfer

We wish Nordfjella zone 1 to be re-established with animals that have the same origin as the animals in zone 1 today. It would also be a great advantage if the population from which animals are to be transferred is large enough for the re-establishment of zone 1 not to take too long.

The agencies have placed importance on locality and possible adaptation and genetically it is therefore considered best to re-establish Nordfjella zone 1 with reindeer from the Langfjella region. The most relevant areas in this region are considered to be Nordfjella zone 2 and Hardangervidda. It is felt that the Lærdal-Årdal wild reindeer area has too small a population to be used as a source.

Essentially, it is not desirable to use semi-domesticated reindeer for re-establishment since this would not help to maintain the wild reindeer characteristics in Nordfjella. Since migration routes are established across the wild reindeer areas of south Norway, this could also lead to further undesirable mixing of semi-domesticated reindeer genes into the wild reindeer populations.

Of the methods that have been described, herding the animals across stands out as the simplest and cheapest method. Compared with immobilising and transporting reindeer, herding the animals into zone 1 would also help to build up the population more quickly because more animals could be moved simultaneously. However herding the animals is only practical from populations within a short distance, in other words Nordfjella zone 2 and perhaps Hardangervidda. Herding the animals across from Hardangervidda is considered to carry more risk, because of the risk of animals infected with CWD returning to Norway's largest wild reindeer area and because of the greater distance to zone 1.

Based on the above assessment, re-establishment with reindeer herded across from Nordfjella zone 2 would be the preferred option at present. A combination with re-establishment from more than one area cannot be excluded and must be considered further. If CWD is discovered in Nordfjella zone 2 or Hardangervidda, the re-establishment plan must be adapted.

4.4 Evaluation based on new genetic surveys

There are ongoing studies of genetic susceptibility to chronic wasting disease and future research may provide us with information about possible differences between populations and in resistance or susceptibility to CWD. There would however be a need to test a relatively high number of positive animals in order to be able to draw conclusions about whether any genetic variation in the prion protein in reindeer is associated with CWD. If we are to increase our knowledge in this area, resources would need to be made available for this purpose.

If studies were to show that reindeer with certain genotypes are more susceptible to CWD than others, this could be useful information in re-establishment terms. A new assessment of the re-establishment plan must therefore be made when we receive new information.

5 Clean bill of health for source populations

When transferring reindeer to zone 1, it is a prerequisite that the population or individual to be transferred is free of CWD. It is in any case a prerequisite that zone 2 is given a clean bill of health before re-establishment of zone 1 starts.

5.1 Methods for establishing health

It is necessary for populations that animals will be transferred from to be given a clean bill of health. These means that a considerable number of animals, preferably from hunting or animals found dead, must be tested over the course of several years. Testing is done using approved analysis methods and using samples from the brain and preferably also lymph nodes. How many animals must be tested in the various wild reindeer areas before their populations can be given a clean bill of health is not known at present. A number of research institutions are now working on developing a model that would help to answer this.

A supplement to testing populations is testing every single animal that is introduced into Nordfjella zone 1. The method for testing live animals using rectal biopsy is under development. One case of CWD has been discovered using this method. We cannot document the absence of prions with certainty using this method alone, but in combination with testing of the population it would increase the probability of stocking with healthy animals. Testing of live animals would be costly, since this method requires the animals to be immobilised before testing. After testing the animal must be kept in captivity and under observation until the results are available.

5.2 Testing of wild reindeer populations in Norway

In 2016, 44 wild reindeer from zone 2 were tested and so far in 2017 about 60 wild reindeer from the same area have been tested. However, because of the risk of wild reindeer in zone 2 coming into contact with wild reindeer in zone 1, testing for health in zone 2 cannot begin until it can be assumed that all the wild reindeer have been eradicated from zone 1.

About 1,200 reindeer from Hardangervidda wild reindeer area have been tested during 2016 and 2017. CWD has not been found in any of them. However it is too early to give Hardangervidda a clean bill of health and it is therefore important to keep testing wild reindeer from Hardangervidda until the re-establishment of zone 1 begins.

It is also important to be able to give other possible source populations a clean bill of health. This would give us security in the event that CWD is discovered in both Hardangervidda and Nordfjella zone 2. Over the course of future hunting seasons, the national information gathering programme will therefore prioritise testing of populations in the Langfjella region, i.e. Setesdal-Ryfylke wild reindeer area and Brattefjell- Vindeggen wild reindeer area. If CWD is found in Langfjella, testing wild reindeer in the Snøhetta, Rondane and Knutshø wild reindeer areas must be prioritised.

6 Management of the populations

6.1 Management of source populations

In Nordfjella wild reindeer area, the local wild reindeer administration's target winter population is 2,000 animals in zone 1 and 400 in zone 2. There are currently slightly fewer than 400 wild reindeer in Nordfjella zone 2. The lack of grazing resources and the traffic in the area mean that it cannot support a large population over time. The growth of wild reindeer in zone 2 is relatively poor, but even so a surplus can be removed over the course of a few years. During the fallow period the surplus can be removed by hunting. If the area is able to support a larger number of animals while a sufficient number is also removed for testing, consideration must be given to increasing the population in the period before transfer to zone 1.

It would be necessary for up to 300 females to be transferred from zone 2 to zone 1. The herds of females will include both previous years' calves and yearling males. The transfer can be made by herding about 100 females a year into zone 1 over three years. A 15% proportion of males, or about 15 males per year, would be in addition to this. It is important to transfer the animals as quickly as possible. If the herd grows quickly the inbreeding effect will not be as great.

Calculations show that if 300 wild reindeer are introduced it would probably take about 6-7 years for there to be approximately 1,000 wild reindeer in the area, cf. Figure 5.1. The management aim in the longer term is to maintain large, unbroken wild reindeer areas with migration across the wild reindeer areas in the Langfjella region. If conditions are facilitated for an increased exchange of reindeer between the present management units (wild reindeer areas/zones) within the Langfjella region, the number of animals that are actively stocked will not be as critical for the population's gene pool. This would also allow a more natural re-establishment of the area over time.

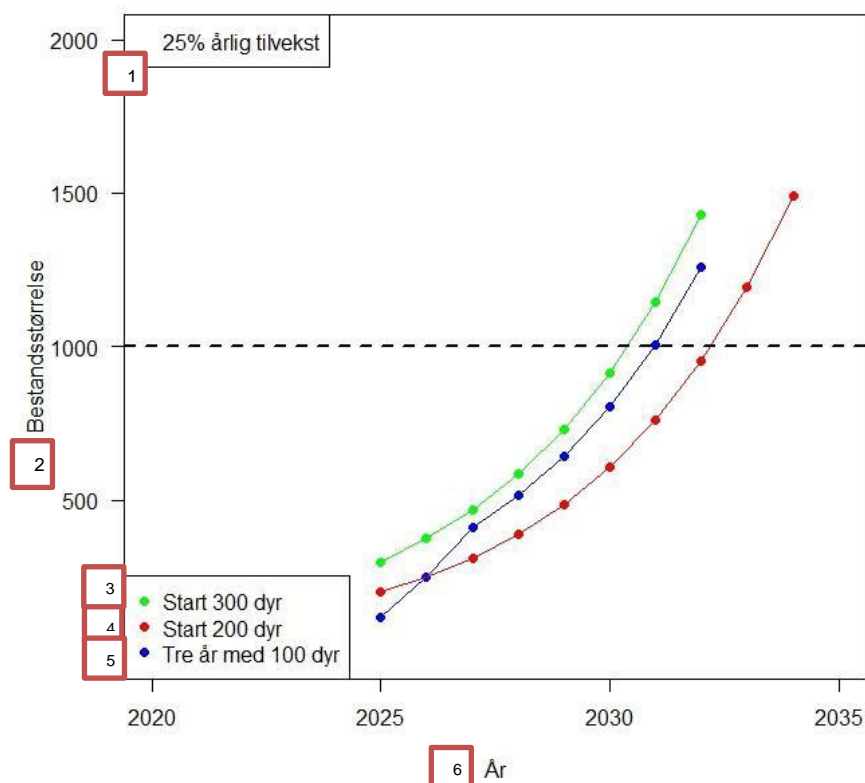


Figure 5.1. The figure shows the estimated population growth given the transfer of 200 wild reindeer (red), 300 wild reindeer (green) and 100 wild reindeer per year for three years (blue). With these alternatives it takes around 6-8 years for the population of zone 1 to reach 1,000 animals. The figure has been prepared by Atle Mysterud, UiO.

Figure text translated:

1. 25% annual growth
2. Population size
3. Start 300 animals
4. Start 200 animals
5. Three years of 100 animals each
6. Year

In Hardangervidda the number of wild reindeer is high and there is no need to increase the population even if many animals were taken from here to Nordfjella zone 1. Hardangervidda has a relatively low killing percentage from hunting. Too large a population in Hardangervidda could lead to increasing competition for grazing and animals moving out of the area.

6.2 Management and hunting

In order to have population in zone 2 that is suitable for collecting animals while being kept up to a certain level, the pattern of hunting must allow for population growth. In this way we can test more reindeer in connection with hunting without this having a negative effect on calf growth and density. The same model that helps to provide the answer to how many reindeer must be tested before Nordfjella zone 2 can be given a clean bill of health will also help to outline such a hunting strategy.

When the fallow period is over, hunting in zone 2 will be restricted or stopped during the years needed to transfer animals to zone 1. This will help to maintain the population in zone 2 while zone 1 is being re-established with the surplus from zone 2. Central and local management authorities must decide in consultation on hunting based on the number of reindeer in each gender and age group that are in zone 2 in the period in question.

In the first years of the build-up phase the animals must have peace to establish themselves in zone 1 and there should be no hunting in zone 1 during this phase. Ongoing testing for the existence of prions in the area must be performed by testing animals that are found dead, as well as by testing faeces if this method has been developed.

Hunting in zone 1 can start after evaluation by the local wild reindeer administration and the Norwegian Environment Agency. All wild reindeer that are then killed must be tested for CWD. All reindeer that are found dead throughout the period must be tested for CWD.

6.3 Involvement of stakeholders

It is important to establish a good dialogue with and between landowners on both sides of county road 50, i.e. in zone 1 and zone 2. In the phase when there is hunting in zone 2, the dialogue should include the best hunting pattern to be able to test as many reindeer as possible without reducing the population. After the fallow period, when the re-establishment phase itself begins, there must be acceptance of suspension of hunting or limited hunting in zone 2 for about three years. In these years the surplus in the wild reindeer population of zone 2 will be transferred to zone 1. It is important to build up local understanding of the re-establishment of the reindeer population in zone 1. This must also include a dialogue between central and local stakeholders and experts to decide when hunting is to start in the area.

6.4 Reindeer that are transferred to zone 1

It may be easier for younger animals to remain in a new area, since they are less bound by tradition and it is less probable that they will go back to where they came from. Ideally, the animals transferred into zone 1 would be 1-2 years old.

There should be an overwhelming proportion of females in the stock introduced so as to encourage rapid population growth through production of calves. If the animals are transferred in winter there will be less risk involved for calves that become separated from their mothers, since the calves will be big enough to fend for themselves.

There should be about 15% males in the animals introduced. This will be sufficient to cover the females and also consistent with the target for the proportion of adult males in Nordfjella. It is desirable to attempt not to transfer large adult males. The reason is that such males can soon become dominant and perform most of the mating. With a male segment of a more equal and younger age, more will participate in mating and thus increase genetic variation in the population.

Transferring wild reindeer will require resources for field work, including dismantling and re-erecting the fence that separates Nordfjella's zones 1 and 2.

6.5 Follow up of transferred animals

After transfer of reindeer to zone 1, the animals must be monitored. This is both to ensure that they remain in the area and to be able to test any sick or dead animals. Throughout the build up phase, all wild reindeer that are found dead in zone 1 must be tested for CWD, based on samples from both brain and lymph nodes.

A number of animals will be fitted with GPSA transmitters when they are transferred into zone 1. During re-establishment, 15-30 wild reindeer (10-15 males and 5-15 females) in zone 1 must be fitted with GPS transmitters at all times. The fences beside roads in the area will also need to be inspected. These are to help prevent the reindeer from moving out of zone 1 after transfer.

It will be desirable to further develop methods that can reveal with certainty prions in samples of faeces, among other things. This would make it possible to test wild reindeer without having to kill or sedate them first, which could be important during a build up phase when no animals are being hunted. The use of sensitive methods such as RT-QuIC is relevant in this context. This method is expected to be implemented by the Norwegian Veterinary Institute during the course of 2018. It is however not approved for verification of CWD. It is uncertain whether the method can be used, but it would be realistic to expect an answer to whether it can be used before re-establishment begins. It is important to allocate resources to testing and developing this method.

7 Fallow period in Nordfjella zone 1

Implementing the re-establishment plan will require a successful fallow period. This plan therefore briefly discusses some important elements of fallowing.

7.1 Duration of the fallow period

After all wild reindeer have been eradicated from zone 1, it is the extent and duration of infection in the environment that will determine the length of the fallow period. There is no information available about how

quickly the infectious material in Nordfjella zone 1 will be broken down. Based on present knowledge, the fallow period has been given a duration of five years, which is in line with the recommendations of VKM (The Norwegian Scientific Committee for Food Safety). The transfer of wild reindeer to Nordfjella zone 1 can therefore begin in autumn/winter 2023 at the earliest.

To be able to establish a healthy wild reindeer population in Nordfjella zone 1, its environment must be free of infection. To ensure that re-establishment is successful, funding must therefore be secured for research and development of methods that can reveal the presence of infectious material in the environment. New information from such projects would be of significance for when re-establishment can start.

Preventing the potential spread of infection from known hot spots such as salt licks is also a vital factor for real fallowing and its duration. Funding must therefore be secured for monitoring and inspecting the salt licks so that poor enclosure of these does not lead to an extension of the fallow period.

The fallow period starts when it can be assumed that the last wild reindeer have been eradicated from the area. Naturally, it will be difficult to know this with certainty. If any wild reindeer are encountered in the area after it has been assumed that the last animals have been killed, these reindeer must be killed and tested. If CWD is confirmed in any of these animals, this could extend the fallow period. If CWD is not confirmed in any of these animals, this will have no consequences for the length of the fallow period. This will require having sufficient resources for monitoring the area, including inspection of the fences.

7.2 Land management

It is important to ensure land management in Nordfjella zone 1 during the fallow period that corresponds to what applies when there are wild reindeer there. This is partly to ensure that the area is not subject to other land use or the facilitation of increased traffic inside the wild reindeer area. Land zoning and guidelines as laid down in the Regional plan for Nordfjella and Raudafjell 2014-2025 will continue to apply. Work on developing and implementing mitigating measures that could improve the area's functionality for wild reindeer, such as reduction of migration barriers, will continue. Among other things, this is relevant in connection with the revision of concession conditions for watercourse regulation and in the development and determination of plans for paths and ski trails. There should be facilitation of good, natural migration possibilities between zone 1 and zone 2 after the barrier fence alongside county road 50 is removed. The barrier fence alongside highway 52, to prevent intrusion by semi-domesticated reindeer, should remain permanently however.

8 Finance

The re-establishment of the population in Nordfjella zone 1 is conditional on there being sufficient financial resources for giving populations a clean bill of health, for developing methods for detecting infection and for implementation of re-establishment.

The measures proposed in the plan are of such a nature and extent that detailed budgeting is difficult. We have limited previous figures to work from and effectiveness is partly dependent on circumstances outside our control. We act on the assumption that the estimates must be adjusted. The table below only gives a summary of costs in connection with the re-establishment itself. Costs relating to information gathering about CWD etc. will also accrue during future years. We therefore wish to have close dialogue with the affected ministries in connection with the budget processes in the years to come.

Based on the assumption that the wild reindeer will have been eradicated from the area by 1

May 2018, it is natural to assume the start of the fallow period during the course of 2018 with a subsequent start of re-establishment in 2023.

Throughout the fallow period the area must be monitored, with an increase in inspections and sample taking. Relevant source populations must also be subject to information gathering and monitoring. The cost to the Norwegian Environment Agency of monitoring, information gathering and the necessary R&D has been estimated as approximately NOK 6.5 million per year. The costs to the Norwegian Food Safety Authority are estimated as approximately NOK 4.5 million per year.

The Norwegian Environment Agency has not estimated the cost of re-establishment with an assumed start up in 2023, since this depends on which areas are chosen for the source population and which method is used. The Norwegian Food Safety Authority has estimated that during the re-establishment period itself the transfer of animals will involve a cost of NOK 1 million per year in addition to the approximately NOK 4.5 million per year given for the fallow period (see the section above).

The national screening programme for CWD must also continue for the foreseeable future. The cost of this must be expected to be at today's level.

Table 8.1. The table shows the tentative overall budget for the outline measures up until re-establishment is complete. The assumed start of re-establishment is autumn 2023. The cost of transferring animals from other areas is not included by the Norwegian Environment Agency since this will depend on which areas are involved and what method is used.*

Measure	Mapping	R&D (faeces, genetics, sensitive tests)	Inspection animals, fences and fences	GPS marking	Transfer of animals	Miscellaneous	Total
MT 2018	1,500,000	1,500,000	1,000,000			500,000	
MD 2018	4,000,000	1,500,000	200,000	500,000		650,000	
MT 2019	1,500,000	1,500,000	1,000,000			500,000	
MD 2019	4,100,000	1,500,000	210,000	500,000			
MT 2020	1,500,000	1,500,000	1,000,000			500,000	
MD 2020	4,300,000	1,500,000	230,000	500,000			
MT 2021	1,500,000	1,500,000	1,000,000			500,000	
MD 2021	4,400,000	1,500,000	240,000	500,000			
MT 2022	1,500,000	1,500,000	1,000,000			500,000	
MD 2022	4,500,000	1,500,000	250,000	500,000			
MT 2023	1,500,000	1,500,000	1,000,000		1,000,000	500,000	
MD 2023	4,600,000	1,500,000	500,000	500,000	???		
MT 2024	1,500,000	1,500,000	1,000,000		1,000,000	500,000	
MD 2024	4,700,000	1,500,000	500,000	500,000	???		
MT 2025	1,500,000	1,500,000	1,000,000		1,000,000	500,000	
MD 2025	4,800,000	1,500,000	500,000	500,000	???		
MT 2026	1,500,000	1,500,000	1,000,000		1,000,000	500,000	
MD 2026		1,500,000	300,000	500,000			

MT 2027	1,500,000	1,500,000	1,000,000		1,000,000	500,000
MD 2027		1,500,000	300,000	500,000		
Unknown date						

*The overview assumes start of fallow period on 1 May 2018. If not all the wild reindeer have been eradicated by then, there will be a need for further funding to continue the culling of wild reindeer in zone 1. This will also mean a longer period before re-establishment can start, with consequent costs.