Saving the Endangered Fennoscandian *Alopex lagopus* SEFALO+

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INTERIM REPORT
WITH FINANCIAL SUMMARY
1 June 2003 – 31 October 2005

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Introduction

Background

The arctic fox *Alopex lagopus* is threatened to go extinct in the European Union and adjacent areas. It is a priority species according to the EC Habitat directive. The main threats are the small population size constrained by low food availability and competition from the larger red fox *Vulpes vulpes.*

The arctic fox is a circumpolar, tundra-living canid. In mainland Europe, it breeds above the tree line in the mountain tundra of Fennoscandia (Sweden, Finland, Norway, the Kola Peninsula). The breeding population reached at least 15 000 individuals in peak years in the mid-19th century. However, it suffered a drastic decline due to over-harvest by the fur industry at the beginning of the 20th century. The population has remained at a low density for over 70 years. Population estimates in 2003 totalled 150 adults, of which approximately 50 were found in Sweden, 50 in Norway, and 10-15 in Finland. From Kola, there were indications of a similar situation, suggesting a population of *ca.* 40 adults. Several factors may have contributed to the non-recovery of the arctic fox:

- *Threat 1 Low population size* The population is fragmented as large areas within its previous range are empty. Young foxes may therefore have difficulties finding a non-related partner and there is a risk of inbreeding. Further, the small population size implies that even small changes in demographic parameters or pure "accidents" can affect the risk of extinction dramatically.
- *Threat 2 Low food availability* Arctic fox breeding is strongly dependent on the availability of the main prey, lemmings and voles (*Lemmus sp., Microtus sp., Clethrionomys sp.*). These small rodents generally have a cyclical pattern of abundance with peaks every 3-4 years, followed by population lows (1-2 years.). Arctic foxes can have up to 19 young in peak years, while few or no cubs are born during lows. The rodent peaks failed to appear during the 1980s and 1990s, causing a further decline in the arctic fox population.
- *Threat 3 Competition* The red fox is a dominant competitor and a predator on arctic fox juveniles. Is has increased in numbers above the tree line in the 20th century, taking over dens and excluding the arctic fox from parts of its breeding range.
- *Threat 4 Diseases* A captive breeding programme in Sweden in the early 1990's failed due to an outbreak of fatal encephalitis. If the disease occurs in the wild population, the effects could be detrimental. Other diseases or parasites could also have serious effects on the population.
- *Threat 5 Disturbance* Disturbance at dens from hunting dogs in early autumn may cause an early juvenile emigration with subsequent higher juvenile mortality.
- *Threat 6 Hybridisation* Hybridisation with escaped farmed arctic foxes, which probably are less well adapted to natural habitats, could decrease the fitness of the wild population. Whether or not hybridisation has occurred is unknown, but farmed foxes have been observed in the wild.

Overall objectives

We will use a dynamic management approach to monitor the population and allocate conservation actions in the most efficient way. Since there are few arctic foxes, we will follow and support individuals through den surveys, radio tracking and genetic analyses. Thus, we will have an individual perspective rather than a spatial one with specified target areas.

Actions within the project targets 75% of the population in mainland Europe, totalling 100% of the Community population. The project is mainly aimed at conserving the arctic fox within the EU community. However, these foxes belong to a population where approximately half of the individuals are found in Norway. Therefore, SEFALO+ also intends to monitor the population in Norway.

The actions will increase population viability through increased reproductive output and decreased mortality for the arctic fox.

Specific objectives

- To investigate presence, breeding success and genetic substructure of the arctic fox population in Sweden, Finland and Norway through monitoring (D1, Threat 1). This action is a prerequisite for actions D2-5 and to evaluate the success of the project.
- To evaluate the need for translocation of arctic foxes within or to Fennoscandia (A3, Threat 1).
- To offer supplementary feeding to arctic foxes at inhabited dens in Sweden and Finland (D2, Threat 2) and to control red foxes in surrounding areas (D3, Threat 3).
- To monitor the arctic fox in Sweden and Finland for various diseases and identify the unknown disease causing encephalitis in captive foxes. If needed, to develop a strategy for eradication of diseases in the wild population (D4, Threat 4).
- To decrease disturbance and disseminate information to the public (D5, E1-E7, Threat 5).
- To develop a method to identify escaped farmed foxes in the wild and investigate if hybridisation with wild foxes has occurred (D1, Threat 6).
- To develop a Norwegian action plan for the arctic fox (A2) and local actions plans in Sweden and Finland. To implement the local plans within authorities to safeguard future monitoring and action programme (C1, All threats).

Expected results

- *Threat 1 Low population size* Knowledge on population size, distribution, inbreeding and Allee effects. Experience from SEFALO indicate that if actions D1-3 and D5 are combined, it is realistic to increase the number of reproducing arctic foxes over 5 years (A2, A3, C1, D1).
- *Threat 2 Low food availability* Increased number of arctic fox litters, litter size and juvenile survival (C1, D1, D2)
- *Threat 3 Competition* Reduced competition from breeding red foxes. Increased number of arctic foxes which establish territories and breed; decreased mortality (C1, D1, D3).
- *Threat 4 Diseases* Identify and screen any new virus to investigate the level of threat. If possible, treat the disease and increase survival (C1, D1, D4)
- *Threat 5 Disturbance* Reduced disturbance from hunting dogs. Understanding of threats and actions from the public (C1, D1, D5, E1-E7).
- *Threat 6 Hybridisation* Identify hybrids in the wild and suggest action (C1, D1).

Participating organisations

Stockholm University SU	Swedish Environmental Protection Agency SEPA	County Administration Board (CAB) of Jämtland	County Administration Board of Västerbotten	County Administration Board of Norrbotten	Finnish Forest Research Institute FFRI
Park and Forestry Service PFS	Norwegian Institute for Nature Research NINA	Swedish University of Agricultural Science SLU	Swedish National Veterinary Institute NVI	Lapplandsafari AB Geunja	Fjällhästen AB
Ramundberget Alpina AB	University of Iceland	Fjällräven AB	WWF Sweden	Dogman	EU Life-Nature

Summary

Overall, the project has run smoothly and according to plan. In Sweden-Finland, we see an increase in the total population size of arctic foxes for the first time since the 1980's. However, the increase has been concentrated to a core area in Swedish Jämtland, southern Västerbotten and Norwegian Borgefjell, while there are no signs of a change for the better in Norrbotten and Finland. Actions within SEFALO+ have most likely contributed to the development in the south, as Swedish areas with more extensive actions are located there. Since the start of the first project phase (SEFALO) in 1998, the positive population trend has been most apparent in the Helags area where actions also have been most intense. The combination of actions with extra feeding and red fox control has thus shown to be very successful and we have managed to increase target populations to include also northern Jämtland and southern Västerbotten. Our main task for the rest of the project time will be to implement these actions for other populations. We have completed survey on the genetics and population structure in Scandinavia. The results show that there are four isolated populations within Scandinavia, and therefore actions within one population will not benefit others. We therefore need to implement efficient actions in all populations. Further, inbreeding and loss of genetic variation may lead to a decrease in survival and reproductive success. In Norway, the total number of recorded arctic fox litters has been relatively stable since the start of more intense den site monitoring in the beginning of the 1980's, varying from 0-21 litters between years, with peaks in numbers of litters during lemming population peaks.

Main activities

A. Preparatory actions/ management plan preparation The project have received and continuously updated necessary permits (A1, Table1, 3). The Norwegian action plan is finished (A2, Table 2).

C. Non-recurring management The work with the Local Action Plans in Sweden are well advanced and we expect no delays. The Finnish Action Plan is somewhat uncertain. We need a year with good abundance to be able to evaluate the detailed status of arctic foxes in Finland (see Overall Project Aseesment).

D. Recurring management All actions have been carried out according to the contract (Table 1).
Monitoring (D1) We surveyed 393 of 608 known dens in Sweden and Finland in winter 2005. In summer, we surveyed 493 dens in Sweden-Finland and 223 of 698 dens in Norway. We found 26 arctic fox litters in Sweden and 21 in Norway. There was no reproduction in Finland. In Sweden a total of 95 cubs were ear tagged for later identification. Genetic analyses show that the Scandinavian arctic foxes are divided into four populations and therefore should be treated as separate management units. Dispersal between the populations is low and actions in one of the populations will probably not affect the other populations. The northernmost population must be considered especially important since it constitutes a link between Russia and the rest of Scandinavia (Table 2, 3).
Feeding (D2) We fed arctic foxes at 23 dens in winter and 20 during the summer of 2004 and 20 dens during winter and 21 during summer of 2005, including most dens with arctic fox litters.
Red fox control (D3) This action is necessary since the red fox is a dominant competitor and a predator on arctic fox cubs, and since feeding of arctic foxes (D2) may attract red foxes. In winter 2005 we culled a total of 279 red foxes in important arctic fox areas in especially Finland, Jämtland and southern Västerbotten. This increase in number of culled red foxes is partly due to an increased intensity in the action but also a natural response in red fox numbers to the high abundance of small

rodents. Red fox control has been carried out with different methods in different areas due to differences in logistics and local attitudes. However, we emphasize that red fox control has been done in total agreement with local authorities and varying interest groups like Sami reindeer herders, grouse hunters and conservation people.

Disease (D4) We have found a herpes virus which may be the cause of fatal encephalitis in captive arctic foxes. We have done an autopsy and run tests of the general health of a wild arctic fox female which was found dead. Blood samples have been taken from a few wild cubs for later analyses (Table 1).

Protection of areas around dens with cubs (D5) In 2005, we excluded the area around 20 of 26 breeding dens from ptarmigan hunting. In some cases all juveniles in a den died at an early stage due to starvation before the hunting took place.

E. Public awareness and dissemination of results The website has been updated (E1). Information about the arctic fox and SEFALO+ was included in the summer edition of the Fjällräven AB catalogue for outdoor equipment, distributed in six languages (E2, Table 2). Local information addressed to wildlife tourists in the Nature Reserve of Vindelfjällen has been disseminated by local tourist operators on a person to person basis (E3). Ramundbergets Alpina AB has built an arctic fox playground where children learn about foxes during play and distributed information about the arctic fox to their guests (E4, Table 3). According to the plan we organised the first arctic fox seminar together with a Norwegian information project on arctic foxes (Projekt Fjellreven) in Meråker, Norway, November 2004. The second seminar was held in Helags June 2005, in addition to the contract. We have had continuous press contacts and SEFALO+ has been featured in papers, radio and television programmes (E6).

F. Overall project operation Overall project operation has run smoothly. The Project leading group has had continuous contacts and produced a General Management Plan (F1, Table 2). The Steering Committee met in November 2003, November 2004 and June 2005 (F2). The operating groups in Sweden, Finland and Norway have had meetings and continuous contacts on a person to person level to discuss how to execute actions (F3-F5). A field hand book about arctic fox has been published by the Project leading group (F1) to coordinate field work and ensure data quality.

Table 1. Actions June 1 2003 – September 30 2005. x indicates planned actions which have been executed according to the approved contract (form 22), ***X*** indicates actions executed in addition to the contract (D1-2) or earlier than planned (A1, E5, F2), **N** indicates a planned action which has not been executed (E2).

Action / Period	A			C	D					E							F					
	1	2	3	1	1	2	3	4	5	1	2	3	4	5	6	7	1	2	3	4	5	6
2003 Jun-Sep	x				***X***	***X***		x	x	x		x			x		x		x	x	x	
Oct-Dec								x		x	x	x	x		x		x	x	x	x	x	
2004 Jan-Mar					x	x	x	x		x		x	x		x		x		x	x	x	
Apr-Jun	***X***	x			x	x	x	x		x	**N**	x			x		x		x	x	x	
Jul-Sep					x	x		x	x	x		x			x		x		x	x	x	
Oct-Dec	x				x	x	x	x		x	x			x	x		x	x	x	x	x	
2005 Jan-Mar	x				x	x	x	x		x		x			x		x		x	x	x	
Apr-Jun					x	x	x	x		x	x	x		***X***	x		x	***X***	x	x	x	
Jul-Sep					x	x	x	x	x	x		x			x		x		x	x	x	

Table 2. Deliverable products June 1 2003 – September 30 2005 (approved contract form 23).

Product	Action	Expected date of delivery	Date of Completion
General management plan	F1	December 2003	March 2004 / July 2005
Norwegian action plan	A2	April 2004	September 2003
European information, biannual	E2	November 2003 / May 2004 / November 2004 / May 2005	November 2003 / Not delivered May 2004 / November 2004 / May 2005
A report on genetic identification of farm-bred *Alopex*	D1	July 2005	September 2004 / June 2005
Local action plans	C1	December 2005	Well under way
A report on the genetic structure of Fennoscandian *Alopex*	D1	December 2006	December 2005

Table 3. Project milestones June 1 2003 – September 30 2005 (approved contract form 24).

Milestone	Action	Expected date of delivery	Date of Completion
Obtain permits necessary for actions D1 and D3	A1	September 2003	April 2004
Playground in Ramundberget	E4	December 2003	December 2003
Renew ethical permit for trapping, tagging, radio collaring and blood sampling	A1	December 2004	April 2003
Alopex lagopus seminars	E5	December 2004	November 2004 / June 2005
Renew ethical permit for trapping, tagging, radio collaring and blood sampling	A1	December 2004	April 2004 / October 2004
PhD dissertation on *Alopex lagopus* genetics	A3, D1	December 2005	December 9, 2005
Local action plans	C1	December 2005	Well under way
Alopex lagopus seminars	E5	December 2005	December 8, 2005

Report of Activities

A. Preparatory actions, elaboration of management plans and/or of action plans

A1 Permits Monitoring (D1) involves visiting arctic fox dens, ear tagging of juveniles and radio collaring. Blood samples will be taken to screen the population for diseases (D4). Since the arctic foxs is protected, permits are needed to visit dens, to trap and tag individuals and to take blood samples. Permits are also needed for red fox control (D3), and e.g. in Finland local authorities, Sami reindeer herders, grouse hunters and researchers have together elected the person who can carry a gun in snowmbile. In some cases, the project will also need permits to use snowmobiles and helicopters in otherwise restricted areas.

Actions foreseen in report period Competent authorities and partners who also are competent authorities will issue the permits necessary for the project.

Progress to date The project has received necessary permits. In addition, SU has renewed the ethical permit from the Swedish National Board for Laboratory Animals for trapping, tagging, radiocollaring and blood sampling of arctic foxes in Sweden. These permits are valid to 2007-05-07. The permit to control red foxes is valid to 2008-12-31. Other permits are renewed each season.
Variations/complications/delays None

A2 Norwegian Action Plan About half of the Fennoscandian arctic fox population is located in Norway. Actions in Norway are therefore vital for the survival of the population. The Norwegian Directorate for Nature Management (NDN) will develop a Norwegian action plan for the conservation of the arctic fox in Norway. The objective is to achieve a more favourable conservation status of the arctic fox.
Actions foreseen in report period The plan will be finished in 2004.
Progress to date The plan was finished in September 2003. Norway is a third country partner in SEFALO+. The Norwegian input according to the approved contract is therefore limited to monitoring in summer (D1; den surveys, trapping and ear tagging of arctic foxes). In the action plan, Norway aims to start conservation actions in addition to the Norwegian involvement in SEFALO+ and several research projects. The plan is available on the Internet at http://www.dirnat.no/archive/attachments/01/53/Rappo049.pdf
Variations/complications/delays The Norwegian Directorate for Nature Management (DN) finance a larger project in support of the Norwegian arctic foxes. Several agencies in Norway are involved but all actions are coordinated by NINA.

A3 Translocation Evaluation Report The current small population size can lead to inbreeding depression, Allee effects and fragmentation (Threat 1). Translocation of individual arctic foxes, e.g. reciprocal restocking of individuals between subpopulations or introduction of individuals from Russia, could be necessary to eliminate these problems. Monitoring (D1) will provide information on the substructure of the Fennoscandian arctic fox population. Thus, the objective with this action is for Stockholm University and the assistant project leaders to investigate the need for translocation and produce a Translocation Evaluation Report. If translocation is needed, the report will suggest appropriate methods.
Actions foreseen in report period None. The Translocation Evaluation Report is due in December 2006. However, monitoring which will render data on population substructure has been performed (D1).
Progress to date See above
Variations/complications/delays None

C. Non-recurring management

C1 Implementation Conservation actions will be implemented within CABs in Sweden and PFS in Finland to ensure that they have the organisation and experience needed to continue appropriate actions also after the project ends. This is necessary since the present population size is critically low (Threat 1) and the arctic fox will need more time than this project period to recover. Further, the CABs differ in landscape and infra structure, e.g. distances between arctic fox habitat, built-up areas and roads. Thus, local Action Plans will be developed for each county to attain the goals of SEFALO+. The plans will describe local conditions regarding the distribution of arctic fox habitat and clarify how actions can be executed in each area during and after SEFALO+.

Actions foreseen in report period The CABs will produce Local Action Plans, with assistance from SU by December 2005. FFRI and PFS will produce a similar Action Plan for Finnish Lapland, also by December 2005.
Progress to date The work with the Local Action Plans are well advanced and will probably be ready by December 2005. They will be included in next Progress Report.
Variations/complications/delays None

D. Recurring management

D1 Monitoring Monitoring through den surveys will provide information on arctic fox presence and breeding success, food availability for arctic foxes and red fox density. This is necessary to decide when and where actions D2-D3 and D5 will be performed (Threats 2-3, 5). In addition, radio collaring and radio tracking of arctic foxes, ear tagging of juveniles and genetic analyses of faeces will resolve population size, population substructure, survival, migration rates and routes, and identify potential hybrids with farmed foxes. Radio tracking of individual arctic foxes may also be a tool to follow individual arctic foxes and support them with feeding etc. through their lifetime. During trapping and tagging of arctic foxes, it is also possible to take blood samples to screen the wild population for diseases (D4, Threat 4). In Finland and Sweden, monitoring will cover both summer and winter, while only summer surveys will be conducted in Norway. Over time, information from monitoring will be used to determine status and viability of the Fennoscandian arctic fox population and to produce the Translocation Evaluation Plan (Threat 1, A3). Genetic analyses will enable us to identify hybrids in the wild and produce a Report on the genetic structure of Fennoscandian arctic foxes (Threat 1) and a Report on genetic identification of farmed arctic foxes (Threat 6). Finally, monitoring is necessary to evaluate the project.
Actions foreseen in report period The CAB's, PFS and Finnish Forest Research Institute (FFRI) are responsible for summer and winter den surveys, tagging and radio tracking in their areas of their jurisdiction in Sweden and Finland. SU will assist in Sweden when needed. In Norway, NINA is responsible for summer surveys under SEFALO+. Stockholm University will do genetic analyses of collected material and develop a method to identify farmed foxes, as the Report on genetic identification of farmed arctic foxes is due in July 2005.
Progress to date
Field work Winter 2004-2005 We surveyed 393 of 608 dens in Sweden and Finland. In total, 47 dens were inhabited by arctic foxes and 53 dens by red foxes (Table 7). We estimated that there were 48-67 arctic foxes. This is an increase since the start of the first phase of the project, winter 1998-1999 (see SEFALO B4-3200/98/515), when we estimated that there were 36-59 arctic foxes compared to 90-110 the winter 2004-2005. This increase is due to efficient actions and due to an increase in rodent abundance.
Field work Summer 2005 (Sweden and Finland) We found an additional 22 dens during summer. Thus, we surveyed 493 of 622 known dens. In Sweden, lemming availability had increased in some areas and showed high abundance in Jämtland and southern Västerbotten (Borgafjäll), intermediate in northern Västerbotten (Vindelfjällen) and parts of Norrbotten, and low abundance in Finland (Table 13). We found 26 arctic fox litters and 13 red fox litters. The arctic fox litters were located in Helags (7), Sösjö-Offerdalsfjällen (1), Borgafjäll Z (5), Borgafjäll AC (9), Vindelfjällen (2), Arjeplog (1) and in Nationalparksblocket (1) (Fig. 1, Table 9). We trapped and tagged 95 cubs and 2 adult foxes. In Finland, lemming availability remained low. There were occasional observations of adult arctic foxes but no arctic fox litters (Fig. 1). However, there were 2 red fox litters (Table 9).

When lemming availability is increasing or high, most adult arctic foxes try to reproduce and are found established at dens in summer. In 2001, lemming and vole availability was high in all of

Sweden. This was followed by a decrease and low abundance of rodents in 2002-2003. There was then a strong increase of rodent abundance in 2004 with a peak during early 2005 in Jämtland and Västerbotten.

Field work Summer 2005 (Norway) Under the national arctic fox monitoring program, and SEFALO+, 223 of the known arctic fox dens were surveyed during spring and summer 2005 (actions completed on assignment from the Norwegian Directorate for Nature Management, DN). Priorities were given to den sites that have been used within the last 15 years. We recorded 21 arctic fox litters and 5 red fox litters. The arctic fox litters were located in Finnmark (2), Reisa, Nord-Troms (2), Troms-Dividalen (1), Nordland-Saltfjell (4), Børgefjell (11) and at Finse, Hordaland (1) (Fig 1, Table 10). There was a minimum of 39 cubs recorded in total. Of these, 10 cubs were captured and ear-tagged. A total of 34 new den sites were found during summer, 23 arctic fox dens, 7 red fox dens and 4 dens of uncertain origin, and the national fox database now include 698 described fox den sites (of which 540 are arctic fox den sites). In September an arctic fox cub ear-tagged in Sweden in the Helags area was observed in Norway, in Tydalen west of Sylane. This fox cub was accidentally killed by a car shortly after.

Variations/complications/delays We have no winter inventories for one important area in Norrbotten (Nationalparksblocket) due to logistic problems. Radio tagging was not performed at all this year. We hade problems to catch the foxes in September, i.e. when they were large enough to be fitted with a radio collar.

Genetics and Subpopulation structure Although the expected date of delivery of the report on the genetic structure of Fennoscandian *Alopex* (Table 2, 3) is not due until December 2006, we found the results very important and we thus include the findings in this Interim Report. We have used DNA analysis to identify faeces from red and arctic foxes, a method which has been used continuously as a supplement during summer and winter surveys. This has allowed us to determine the current distribution of the arctic fox in Scandinavia (Fig. 6). Furthermore, it has allowed us to establish that competition from the red fox (Threat 3) is higher in summer than in winter, suggesting that the main goal of the red fox control (D3) should be to exclude red foxes from arctic fox summer habitats (Appendix: Media and Publications). Analyses of all genetic samples collected in Norway are reported in the attachments to The Norwegian Arctic fox Monitoring report 2005 (Appendix: Media and Publications).

Deliverable: a report on genetic identification of farm-bred arctic foxes (see Appendix: Media and Publications). In collaboration between Stockholm University and NINA we have also developed a method to distinguish wild Fennoscandian arctic foxes from escaped farm-bred arctic foxes using DNA found in e.g. faeces (Threat 6). This method also allows for identification of hybrids between farm-bred and wild arctic foxes. The report on genetic identification of farm-bred foxes is included in Appendix. This method will be used in the monitoring of the arctic foxes in Sweden, Norway and Finland in order to identify any escaped farm-bred foxes or hybrids.

Deliverable: a report on the genetic structure of Fennoscandian arctic foxes (see Appendix: Media and Publications). We have completed three genetic studies on the genetic variation, population substructure and effects of inbreeding in Scandinavia (Threat 1). These studies are a part of the PhD-thesis by Love Dalén (milestone deadline 2005; *see* Appendix: Media and Publications). The first study showed that genetic variation was lost over the demographic bottleneck 100 years ago, but that the rate of loss seems to have been reduced by a continuous immigration from Russia. The second study showed that the arctic fox population in Scandinavia is fragmented into four isolated populations where each has a very small population size (Fig. 6). Furthermore, the arctic foxes on the Kola Peninsula are not part of the Scandinavian populations, but rather belong to the Russian population. In the third study, we found that the level of genetic variation in an individual (caused by

inbreeding) affects the arctic foxes' survival and reproductive success. Taken together, these results suggest the following:

The four populations in Scandinavia should be considered as separate management units. The current conservation actions in Scandinavia are mainly focused on supplementary feeding (D2) and red fox control (D3). Dispersal between the populations seems to be very low and it is thus unlikely that actions in one of the populations will have any demographic spin-off effects in any of the other populations. Since the persistence of all populations is important to preserve the connectivity within Scandinavia, actions need to be taken in all populations to be effective. The northernmost population (Fig. 6) must be considered especially important since it constitutes a link between Russia and the rest of Scandinavia.

The observed inbreeding depression and loss of genetic variation through genetic drift are potentially large threats to the persistence of the arctic fox in Scandinavia. One possible action to increase viability is genetic restoration through translocation, both through augmentation of existing populations or reintroduction to regions where the arctic fox currently is extinct. A more comprehensive evaluation of the need for translocations, and guidelines on how to accomplish this will be supplied in the translocation evaluation report (A3) in December 2006.

D2 Feeding Feeding of arctic foxes at inhabited dens is necessary since low food availability causes reproduction to fail (Threat 2). The action will increase the number of breeding attempts, litter sizes and juvenile survival. It might also improve adult survival. It is important to combine feeding with red fox control (D3) since feeding may otherwise attract red foxes with consequent negative effects on the arctic fox. The project leading group will produce an Evaluation Report on this action by June 2006.

Actions foreseen in report period We will feed arctic foxes at inhabited dens during summer and winter in Sweden and Finland. CABs, FFRI and PFS are responsible for the action. SU will analyse monitoring information so that allocation of resources can gain maximum effect (D1).

Progress to date During winter 2004-2005, 20 of the 47 dens with arctic fox activity were fed (Table 7). The aim was to have feeding at all dens inhabited by arctic foxes if it was logistically possible. However, since we have found that feeding attracts red foxes, the feeding action in winter should be combined with red fox control. In areas where this is not possible, no feeding should take place. During summer 2005, we had feeding stations at 21 dens, including some dens where adult foxes used the feeding stations although they failed to reproduce (Table 9).

Variations/complications/delays Some dens with arctic fox litters were not fed during summer. The reasons were logistical and that the litter was discovered too late in the season. Several of the reproductions in Sweden and Norway 2005 failed in July or August. Rodent populations went through a crash during this period and many litters suffered from starvation. We managed to handle this in some areas by intensive feeding. However, in other areas the extra feeding started too late. The decline of rodent populations is difficult to foresee and it is therefore very difficult logistically to handle the feeding action. The extra feeding during winter and summer did not take place in Vindelfjällen and in some areas in Norrbotten. This is partly due to that the red fox control did not work satisfactorily in these areas. In Finland, there was some feeding in winter but no feeding in summer as the arctic foxes never established at den sites (Table 6-7).

D3 Red fox control Red foxes will be controlled by culling in areas close to recent or previous arctic fox territories in Sweden and Finland. Culling is necessary as the red fox is a dominant competitor and a predator on arctic fox juveniles. Arctic foxes avoid areas with red foxes and do not establish there (Threat 3). Further, feeding (D2) involves a risk that red foxes are attracted to an area and take over arctic fox dens. All hunting will take the utmost caution, as not to cause any disturbance to other wildlife and only a limited number of carefully selected persons are included. The red fox is a

common species in Fennoscandian forests and hunting in some selected mountain tundra habitats will not have any detrimental effects on the population as a whole. We expect culling to leave more dens and territories suitable for establishment of arctic foxes, which implies more litters born and higher juvenile survival due to decreased predation from red foxes. The project leading group will produce an Evaluation Report on this action by June 2006.
Actions foreseen in report period CABs, FFRI and PFS are responsible for performing culling. SU will analyse monitoring information so that allocation of resources gains maximum effect (D1). Rangers in the CAB's and selected experienced local hunters will perform culling.
Progress to date In winter 2004-2005, a total of 279 red foxes were culled (Table 7) with 120 in Finland, 92 in Jämtland and 26 in southern Västerbotten (Borgafjäll). Red fox control has been carried out with different methods due to differences in logistics and local attitudes as reported earlier. In Finland, Jämtland and southern Västerbotten (Borgafjäll) the action works efficiently. In addition to this there has also been some hunting by local hunters in southern Västerbotten. However, in the rest of Västerbotten hunting has not been efficient with only 6 red foxes shot in Vindelfjällen. In Norrbotten, it is mainly in the most northerly area, Råstojaure, where hunting has taken place (12 foxes) with an addition of 5 foxes in Sitas.
Variations/complications/delays Regarding the different methods used, hunting with the use of snow mobiles has been efficient. The alternative methods have, however, not reached such levels that any positive effect on arctic foxes could be detected.

D4 Disease The main scope and responsibility of SLU has been to identify a causative agent of a fatal necrotizing encephalitis of arctic foxes within a captive programme and monitor its possible spread in nature. The latter includes wild arctic foxes and other animals. The causative agent has for many years been elusive. Several possible agents have before the start of SEFALO+ been tested negative. The role of the NVI has been to characterize the pathological changes of the fatal necrotizing encephalitis that affected the arctic foxes in the captive program in order to be able to postulate an etiology and to differentiate the disease from other, previously recognized conditions, to summarize a list of the pathological agents known to have caused disease in arctic foxes in Sweden, for both, arctic foxes in captivity and arctic foxes in the wild, to rule out the already known pathogens as cause of the novel necrotizing encephalitis and to conduct a pathological examination and laboratory testing on all arctic foxes that die in Sweden, and/or on biological samples from arctic foxes, to provide knowledge on health-disease status and presence and significance of various pathogens, such as lung parasites. A Disease Evaluation Report will be produced by December 2007.
Actions foreseen in report period SLU and NVI will work on the identification of the pathogen causing encephalitis. During monitoring (D1) we will check for symptoms in juveniles and collect arctic foxes found dead. A complete pathological description will also be made.
Progress to date In order to identify the causative agent behind the fatal encephalitis we have used several strategies. One was to try to grow the infectious agent on a panel of different cells. The other one was to by molecular means identify unique nucleic acid, belonging to the infectious agent, by a selective hybridization and PCR amplification method. We have also retested some potential agents such as *Encephalitozoon cuniculi* with PCR and immunohistochemistry with negative results.

At the start of a project like this it is extremely valuable to make a careful pathological examination that may point toward a possible type of pathogen (virus, parasite or bacteria). During the initial years we (SLU and NVI) have collected data from pathological findings during the years. This has been completed. A scientific publication on the descriptive pathology of the encephalitis is currently prepared. The paper, based on the neuropathology of 8 selected cases, will be submitted to an international scientific journal. The findings point toward a viral infection. A recompilation of the pathological examinations, clinical histories and laboratory testing conducted on artic foxes at NVI was prepared. This work resulted on a number of summarizing tables: list of 37 arctic foxes, since 1986, diagnosis, origin of the foxes, clinical history, gross and histopathology findings, serological testing for virus and protozoa, bacteriology, haematology and clinical chemistry, tests to identify

virus and protozoa in tissues, parasitological investigations, other tests (electron microscopy). As a whole, the information provides a good overview of the health-disease status of the wild and captive arctic foxes received at NVI throughout the years.

It was concluded that the necrotizing encephalitis was indeed a novel disease, to the best of our knowledge not previously described in arctic foxes, not caused by any of the recognized pathological agents of arctic foxes and of a likely viral etiology. Furthermore, the type of lesions in the brain is consistent with herpesviral encephalitis found in other species.

A complete post mortem examination of the adult female arctic fox from Borgafjäll, was conducted at NVI on 25 October 2004. The cause of death was trauma (biting wounds). Encephalitis was ruled out by histopathology in this fox.

In the next year, we will apply our findings to attempt to determine the significance of the pathogens known to be present in the arctic foxes as determinants of disease. We will focus primarily on the encephalitis, but also on the effect of some parasites. We will continue monitoring the disease status of the arctic foxes in the wild. We will conduct post mortem examination and laboratory testing on a limited number of culled red foxes from the arctic-fox area, to establish their potential role in the transmission of pathogens to artic foxes.

We have tried to grow the agent/agents on a standard selection of cells that are commonly used in our laboratory for this type of work. However, the attempts were unsuccessful. This work will be continued using another panel of cells that were not covered in the initial screen from different animal species. A contact has been established with Dr Riebe in Germany that has a large collection of animal cells of different species and types.

We have used different molecular strategies to identify a possible infectious agent. A so called "pan PCR" covering all known viruses within a family has been used. Another is to use a more general technique of subtractive hybridization. This is a powerful technique that enables researchers to compare two populations of nucleic acids. Usually one is looking for mRNA differences, but DNA and RNA can also be compared. The end-result is by obtaining a large collection of clones that are expressed/present in one population and not in another. These clones are sequenced and compared with each other and to a database. The subtractive hybridization gave two major tracks one being "Herpesvirus". In the meantime we also used a "pan-herpesvirus PCR" that was developed for other purposes in the laboratory. The latter gave a clear PCR product at the correct molecular weight. A second region of the herpesvirus genome was also investigated. Both gave positive PCR products. These small PCR products were sequenced and proved to be herpesvirus DNA. We then set out to see if the herpesvirus could we identified in tissue of infected animals. For this we constructed probes that could be used for *in situ* hybridization and used paraffin embedded material from diseased animals. These results clearly show that diseased animals harbour large quantities of herpesviruses within areas in inflammation. This indicates that the herpesvirus that we have identified is a strong candidate of being the causative agent behind the necrotizing encephalitis. However, this is not formal proof of this. Another explanation may be that another agent, still unidentified, reactivates a latent herpesvirus. For a stronger case we have during the last year expanded the study by testing a larger number of diseased animals. The data from this extended study is unfortunately not hundred per cent conclusive due to poor PCR data. In other words, multiple PCR bands appear when using brain material. This is the material most currently available. However, cerebrospinal fluid showed nicely one band.

We have characterized the herpesvirus in more detail by sequencing larger parts of the genome. A long, ca 800 base pair stretch of the genome was amplified and sequenced for phylogenetic analyses. The results show a close relationship with bovine herpes virus type 1 (BHV-1). With this data at hand we will construct a real-time PCR method for better PCR data of brain material. This work is currently ongoing.

Taken together, we have characterized the identified herpesvirus in more detail. The following year we will develop a real-time PCR method that will give us the tools for analyses of the spread of this virus in other animals and arctic foxes in wild as well as the dead captive ones. We have a collection of material that will be tested, including red foxes from the mountain area.

Variations/complications/delays None

D5 Protection of areas around dens with cubs Areas around Swedish dens with arctic fox cubs will be excluded from ptarmigan hunting. Ptarmigans are hunted in basically all mountain tundra areas from August 25 until February or March. Excluding areas from hunting is necessary since hunters use unleashed dogs and especially juvenile foxes may be disturbed and leave the area (Threat 5). We expect a resulting increase in juvenile survival.
Actions foreseen in report period The CABs in Sweden will exclude areas around breeding dens from ptarmigan hunting.
Progress to date In 2005, the CABs excluded the areas around 20 of the 26 breeding dens from ptarmigan hunting.
Variations/complications/delays Some arctic fox litters died of starvation before hunting started and protection was therefore not necessary. In Norrbotten and in one small area in Borgafjäll Jämtland, the areas around breeding dens were only excluded from hunting with dogs, since the dogs, not hunting in itself, constitutes the main threat to arctic foxes. The aim with this distinction was to achieve a greater local acceptance for the action.

E. Public awareness and dissemination of results

It is vital that the general public understands why arctic fox conservation is important. Increased awareness of the status and ecology of arctic foxes is necessary to gain local understanding and acceptance for actions such as red fox control (Threat 3, D3) and exclusion of areas from ptarmigan hunting (Threat 5, D5). Each action in this section has defined target groups.

E1 Website – Global information The SEFALO website at http://go.to/sefalo contains information about the SEFALO project, arctic fox ecology and conservation issues. The target groups are school children, students and scientists within and outside Europe.
Actions foreseen in report period SU is responsible for keeping the website updated.
Progress to date Our website has been updated. There is also a home page about the arctic fox in Norway organised by our colleagues, Prosjekt Fjellreven, with information about SEFALO+ and our partner NINA. http://www.fjellrev.no/
Variations/complications/delays Due to a major change of personnel that has worked with this action, the home page was not updated during 2005. However, this has now been organised so it will be updated continuously.

E2 European information Information about the project will be presented on two pages in a catalogue for outdoor equipment. This catalogue is distributed twice a year in Swedish, English, German, Finnish, Norwegian and Danish. For the winter edition of 2005 it will also be published in Russian. The edition in 2003 was 100 000 copies, but it is planned to increase to 400 000. The target group is people engaged in outdoor activities.
Actions foreseen in report period SU will provide material to Fjällräven AB which will produce and distribute the catalogue in fall-winter 2004-2005 and spring-summer 2005.
Progress to date Beside an edition that we missed 2004, as reported in last progress report, we have included information about the project in fall-winter 2004 and the spring-summer 2005 editions of the catalogue, printed in Swedish, English, German, Norwegian, Danish, Finnish and Dutch (see Appendix: Media and Publications). The 2005 summer edition was the first time also printed in French.
Variations/complications/delays None

E3 Local information addressed to wildlife tourists In the Nature Reserve of Vindelfjällen, Saami tourist operators certificated as eco-tourist companies, Lapplandsafari AB-Saami Ecolodge and Fjällhästen, will reach individual tourists that travel in arctic fox habitat with appropriate information.
Actions foreseen in report period SU is responsible for providing information to these local tourist operators. Lapplandsafari AB-Saami Ecolodge and Fjällhästen are responsible for disseminating information to their guests.
Progress to date Lapplandsafari AB-Saami Ecolodge and Fjällhästen have informed their guests about the project as planned (see attached pictures). They have communicated arctic fox biology and SEFALO actions during informal contacts with their guests, i.e. about 15 tourist groups each. The project leader has visited both partners and updated them on the current status of the project. The exhibition in Ammarnäs has been completed (see attached picture), however, we will report more detailed about this in next report.
Variations/complications/delays None

E4 Local information addressed to children Ramundberget is a holiday resort with skiing and hiking activities in a mountain area in Jämtland, Sweden. Ramundbergets Alpina AB will build a playground with an arctic fox theme (a fox den, fox statues, etc.) in 2003. Personnel will show children how the arctic foxes live and explain what problems they face. Booklets and toys with information on arctic fox conservation issues will be sold on a non-profit basis.
Actions foreseen in report period Ramundberget will build a playground and distribute information to their guests. SU will provide updated information to Ramundbergets Alpina AB.
Progress to date A playground which resembles an arctic fox den was built during 2004. The playground is used during the winter season and during play, children learn how arctic foxes live in their dens. Personnel at Ramundberget have spread information about arctic foxes during public lectures and informal contacts with tourists (see attached pictures). During skiing contests for children, arctic fox puppets are distributed along with information about arctic foxes. The project leader has visited this partner and updated the personnel on the current status of the project. Since this action concerns winter activities it was not feasible to include pictures about this yet so we will make a full detailed report about it in the next progress report.
Variations/complications/delays The playground was completed 2004, and documentation for SEFALO+ will be included in next report including, but see also pictures enclosed in this report. The financial report from this partner is included in this Interim Report.

E5 Seminars - Conferences It is important to disseminate results and discuss planned actions within the international scientific community and with NGO's involved in conservation. Thus, we aim for a continuous process of project evaluation. We will arrange a total of 4 seminars with scientists, NGO's and other people with interest in arctic fox conservation. Prof. Pall Hersteinsson from Iceland University, who is officer in the IUCN Arctic Fox Specialist Group, will attend as external consultant. SU will also attend four international scientific conferences to disseminate project results regarding conservation biology.
Actions foreseen in report period Planning of the seminar which will take place December 8 2005 in Stockholm.
Progress to date The first seminar was arranged by Projekt Fjellreven, a Norwegian information project on arctic foxes, and The Norwegian Directorate for Nature Management (DN), in collaboration with SEFALO+. The seminar was held in Meråker, Norway, on November 15-16, 2004. The Commission agreed to us holding the seminar outside EU. Results from the seminar can be found on the home page: http://www.fjellrev.no/. The second seminar was held in Helags June 2005 (see attached pictures), with talks by the Project Leading Group (Anders Angerbjörn, Heikki

Henttonen, Bodil Elmhagen), the external consultant (Pall Hersteinsson) and representatives from the Swedish Operating Group (Love Dalén, Peter Hellström). Invited to this seminar were rangers from all CABs, volunteering field workers, and partners in SEFALO+ such as SLU, FFRI, SEPA, NINA.
Variations/complications/delays A second seminar was organised in addition to the contract during this report period in June 2005.

E6 Press contacts We aim to keep continuous contacts with the press and disseminate project results to newspapers, magazines, radio and television.
Actions foreseen in report period All partners are responsible for keeping contacts with the press and disseminate results.
Progress to date The project has been featured in papers, television programmes, radio etc (see Appendix p. 29)
Variations/complications/delays None

E7 Layman's report SU will produce a layman's report at the end of the project period 2008. The report will be available in paper and electronic format, in Swedish and English.
Actions foreseen in report period None

F. Overall project operation

F1 Project leading The leading group will have frequent meetings and discuss co-ordination and how different actions (D1-D6) are implemented within the different countries (F3-F5). The Project leader is responsible for reports and communications with LIFE, for the overall project operation and basic financial administration. The Assistant Project leader is responsible for all actions in Finland while the Operating group leader for Norway is responsible for monitoring in Norway (D1). The Project leading group will present a General Management Plan and detailed plans for the action programme to the Steering Committee by December 2003. Based on the yearly Progress Reports, the Project leading group will present an updated Project Action Plan to the Steering Committee in November each year 2004-2007. The Project leading group will present a Final Report to the Commission by June 2008.
Actions foreseen in report period The Project leading group will produce a updated General Management Plan by December 2004, have meetings, produce reports and communicate with LIFE.
Progress to date The General Management Plan was updated in June 2005 and discussed with the Steering Committee in June 2005. The Plan will be updated continuously when needed. The leading group has also had ongoing discussions about progress, actions and arctic fox biology during the report period. The Project leader organised a meeting in Helags, Västerbotten, June 16 - 21, 2005, with three important components: (1) The Steering Committee had its yearly meeting (see F2); (2) a seminar on field methods (see E6); (3) a workshop on ethical considerations in research on mammals and birds, including field methods and excursions to an occupied arctic fox den (see F3).
Variations/complications/delays The Project leading group has produced and published a Field Hand Book (see Appendix: Media and Publications) in order to make the field work more efficient and more precise (July 2005). The cost for this was accepted by the Commission to be included in the SEFALO+ project. The Hand Book has been very appreciated by rangers and field workers in both Sweden, Norway and Finland.

F2 The Steering Committee The Steering Committee shall supervise the project, meet on a yearly basis and approve an updated project action plan, submitted by the Project leading group each year.
Actions foreseen in report period The Steering Committee will meet in November 2004 to confirm the planned actions and elaborate detailed evaluation routines for the project.

Progress to date The meeting for 2004 was held in Meråker, Norway, on November 15-16. The situation for arctic foxes in each country was reviewed. Prioritised areas for actions were determined. The red fox issue was especially discussed. It was decided that the Steering Committee meeting should be held in different places each year and that the next meeting should be held in Helags, Jämtland, in relation to arctic fox field work in June 2005. The meeting for 2005 was held at Helags on June 18 - 21. Field methods during actions and a draft of the "Field hand book for arctic foxes" were discussed. Field methods were especially discussed at this meeting and some methods were demonstrated at an arctic fox den occupied with both adult and juvenile arctic foxes.
Variations/complications/delays Instead of having a yearly meeting in November, the Steering Committee decided to spread them over the year and to have them at different places. Therefore, there have been two Steering Committee meetings during this report period.

F3 The Operating Group in Sweden The Operating group leader in Sweden is responsible for field actions and practical co-ordination.
Actions foreseen in report period The Operating group leader will have continuous contact with all Partners and coordinate the project. There will be meetings with field personnel to discuss the practical aspects of the actions.
Progress to date Project coordination had worked smoothly. We had a large meeting in Meråker in connection with the Nordic arctic fox meeting (Nov 2004). Many rangers from all CABs were present and we discussed all parts of the field work. We organised a workshop with rangers from all CABs in Helags, Västerbotten, on June 16 - 21, 2005. At this workshop, other field workers also took part. Field methods, protocols and reporting were discussed and tested in the field. All field works got information about the regulation of ethical considerations when studying wild mammals in Sweden. They are now certified to conduct field work within SEFALO+. In addition to this Interim Report, we have written less formal reports in Swedish which have been distributed to field workers and others.
Variations/complications/delays The personnel in the Operating group has gone through several changes during the report period. Magnus Tannerfeldt left the project during 2004 and Bodil Elmhagen took his place. Boldil Elmhagen has now also left the project, June 2005, and meanwhile Love Dalén has been working as Operating Group leader in Sweden. He has now finished his Ph D and will leave the project January 2006 and will be replaced by Karin Norén. This has delayed an update of the home page but the project leader has taken more part in the work of the Operating Group in Sweden.

F4 The Operating Group in Finland The Operating group leader in Finland is responsible for field actions and practical co-ordination.
Actions foreseen in report period The Operative group leader will have continuous contact with people engaged in the project in Finland and co-ordinate the project. There will be meetings to discuss the practical aspects of the actions.
Progress to date Project co-ordination had worked smoothly with three internal meetings.
Variations/complications/delays None

F5 The Operating Group in Norway The Operating group leader in Norway is responsible for field actions and practical co-ordination.
Actions foreseen in report period The Operating group leader in Norway will have continuous contact with the group operating the national arctic fox monitoring program on behalf of the Norwegian Directorate for Nature Management (DN): the Norwegian Nature Inspectorate (SNO) doing the practical work in the field, and the Norwegian Institute for Nature Research (NINA) which gives priorities, coordinates the reported results and runs the national fox database. The actions in

SEFALO+ is actions in addition to the national arctic fox monitoring program which started in 2003 in Norway, and SEFALO+ actions will supplement national monitoring actions by extra monitoring effort in there boarder areas between Norway, Sweden and Finland, to cover areas that are not part of the national monitoring program. To ease actions as trapping and earmarking (D1), the Operating group leader in Norway will have running contact with the coordination field unit in SNO.
Progress to date Project co-ordination have worked smoothly and information between the different agencies involved in arctic fox monitoring is distributed effectively, in great help to trapping and ear-tagging in special. There are priority meetings prior to every breeding season, and there are running contacts between coordinators in the field during the whole summer. Changes and improvements are discussed at the end of every season.
Variations/complications/delays None

F6 Auditor's report The independent auditor at Stockholm University will make a revision in the last year of the project (2008) in accordance with Article 27 of the Standard Administrative Provisions.
Actions foreseen in report period None

Complementary actions in Norway

National monitoring program In summer 2003, Norwegian environmental authorities decided to start a national arctic fox monitoring program which covers larger areas than SEFALO+. The Norwegian Directorate for Nature Management (DN) has given the assignment to the Norwegian Nature Inspectorate (SNO) coordinating the practical work in the field and to the Norwegian Institute for Nature Research (NINA) which gives priorities and quality check all the incoming field data. NINA is responsible for operating the national fox database and the annual report of the program. The monitoring actions in SEFALO+ (D1) supplements the national monitoring actions by putting extra monitoring effort in the boarder areas between Norway, Sweden and Finland.
Genetic analyses Faeces samples are collected at den sites during the monitoring. Genetic analyses are performed to distinguish between faeces originating from arctic fox, red fox, farmed foxes or wolverine. Mitochondrial haplotyping and microsatellite analyses are performed on the arctic fox samples both to get information on genetic substructures and to be able to detect foxes either with farm origin or potential hybrids between wild and farmed foxes. The microsatellite analyses are performed to get a more substantial basis for genetic sub structuring of the Fennoscandian arctic fox population. The genetic studies are done in cooperation with Stockholm University. As for Norway this action is not included in SEFALO+. All data analysed in 2003, 2004 and 2005 are reported in the annual report 2005 for the national monitoring program on arctic fox in Norway.
Captive breeding The Norwegian Institute of Nature Research (NINA), are running a captive breeding program for arctic foxes on assignment from the Norwegian Directorate for Nature Management (DN), not included in SEFALO+. The project received official approval in spring 2000. In summer 2001 a total of 6 pups were caught, followed by 3 more in 2002, 4 in 2004 and 5 in 2005. These captive foxes represent 6 of the extant arctic areas (Hardangervidda, Blåfjell/Lierne, Børgefjell, Saltfjellet, Indre Troms and Finnmark). All animals were housed in a conventional farm situation at Dal forsøksgård (Dal experimental animal station) belonging to the Norwegian Veterinary University until early 2004. In spring 2004 there was the first breeding success, 5 cubs were born after moving an arctic fox couple into a natural enclosure setting at Landedrag zoo. "The captive breeding station for arctic fox" was build summer 2005 in Oppdal commune. The station is situated at 1280 m.a.s.l. in a natural alpine habitat. It consists of 8 fenced enclosures, each enclosures being 50x50m. In the enclosures there are build boulders of stones as natural hides and they each have two artificial den sites. There are now totally 18 arctic foxes in the breeding program, where 10

of these are set in 5 couples of a female and a male. The other 8 foxes are at the moment not part of the breeding set up plan, due to possible mixing with tame foxes that have escaped from farmed conditions.

Red fox control In spring 2004, the Norwegian Directorate for Nature Management (DN) initiated the designing of a "red fox control research project" in Norway at the request from the Norwegian Ministry of Environment. This is not included in SEFALO+. The University of Tromsø, Prof. Rolf A. Ims and his research group, implemented a "red fox control program" spring 2005 as part of a large scale ecosystem research project "Ecosystem Finnmarksvidda" in the northern county on Norway, Finnmark. Red fox control has been completed on the north-eastern half-island Varangerhalvøya, while three other areas were set up as control areas. The Norwegian Nature Inspectorate (SNO) and Fjelltjenesten Finnmark being responsible for the red fox culling in the field. Winter 2005 totally 76 red foxes was killed in the project. Under this action part of the goal to test if the control of red fox leads to an increase in the arctic fox population. The group leading this research program is in close contact with SEFALO+ regarding the same control actions undertaken in SEFALO+, and evaluation of this control program will be coordinated between the different research groups.

Public information Norges Naturvernforbund (NNV), Norges Jeger og Fisker Forbund (NJFF), Verdens villmarks fond Norge (WWF) and Den norske turistforening (DNT), 4 non governmental organizations in Norway are together running "Prosjekt Fjellrev" a public information project (www.fjellrev.no). This information project was funded by the Norwegian Directorate for Nature Management (DN). Together with SEFALO+ and DN they arranged the Nordic arctic fox seminar in Meråker, Norway 15-16th November 2004. This seminar was partly financed by Nordisk Ministerråd. "Prosjekt fjellrev" also represent a joint political pressure highlighting the importance conserving the arctic fox on the Fennoscandian peninsula.

Overall Project Assessment

Overall, the project has run smoothly. In Sweden-Finland, we see an increase in the total population size of arctic foxes for the first time since the 1980's. However, the increase has been concentrated to a core area in Swedish Jämtland, southern Västerbotten and adjacent areas in Norway, while there is no change for the better in Norrbotten and Finland (Fig. 2-4). In Norway, the total number of recorded arctic fox litters has been relatively stable since the start of more intense den site monitoring in the beginning of the 1980's, varying from 0-21 litters between years, with peaks in numbers of litters following lemming population peaks (Fig. 5). However, during this period the most isolated arctic fox populations as Dovrefjell/Snøhetta has gone extinct and there has been significant decrease in Central Hardangervidda and Indre Troms.

Estimated number of arctic foxes: The population size of arctic foxes is best estimated in summers of high lemming availability. Arctic foxes use large, conspicuous dens and it is therefore possible to perform surveys of known dens. However, in winter it is easy to overestimate population size since arctic foxes can move long distances. Tracks from one individual can therefore be counted more than once. But in summers of high lemming availability, most adults are established at dens and it is possible to get a reliable estimate of population size.

During the first phase of the project (1998-2002), we saw a continued overall decline in the adult reproducing population in Sweden (Fig. 3). In 2001, there was a lemming peak which covered all Swedish mountain tundra habitat. Despite this, only 9 litters were born in Sweden and we estimated that there were 26-34 adults at dens. The next lemming peak came 2004 and 2005 with 14 and 26 litters respectively in Sweden. Most notably, there seemed to be a positive trend in Jämtland and southern Västerbotten from the winter 2000-2001 and onwards, where we have had both extensive

feeding and efficient red fox hunting in the area. Thus, there has been a substantial increase in the arctic fox population of Jämtland and southern Västerbotten from 2 litters in 2001 (Fig. 2) compared to 22 litters in 2005 (Fig. 1). In the summer of 2005, we estimated a total of 70-86 adult arctic foxes at dens in Sweden-Finland, the highest numbers since the start of SEFALO in 1998. With intensive actions during the low phase, i.e. 2002 and 2003, we have thus managed to keep the foxes from 2001 alive so they could take advantage of the next lemming peak 2004 and reproduce successfully. With the help of combined feeding and red fox culling these animals also produced litters in 2003. However, despite good rodent availability in northern Västerbotten and Norrbotten 2004 and 2005, arctic foxes did not respond in the same positive way with only 2 litters in each area 2005.

The population estimates for Norrbotten and Finland are less certain. However, there are no signs of an increase in the population. Generally, it is difficult to execute actions in northern Norrbotten. The reasons are mainly logistical. Areas with arctic foxes are situated longer distances from built-up areas and roads than in Västerbotten and Jämtland. We will continue discussions on how to increase the extent of actions in Norrbotten and northern Västerbotten. In Finland, red fox hunting is highly efficient. However, there are only a small number of arctic foxes (Fig. 1, 4a, Table 4-7) and they have not established at dens which makes feeding difficult. Arctic foxes mainly seem to pass through Finland. There are a number of possible explanations. Firstly, there have not been any lemming peaks in the area. Secondly, it may be difficult for the small number of arctic foxes in the area to find a partner. Thirdly, it could be that arctic foxes, despite efficient hunting of red foxes, often are disturbed by red foxes as the large number of culled red foxes could indicate that there are more red foxes around in Finland than in e.g. Helags (Table 4, 6, 7, Fig. 4b). We aim to keep actions going in Finland, to increase the quality of the habitat and encourage arctic foxes to re-establish in the area.

We have completed survey on the genetics and population structure in Scandinavia. The results show that there are four isolated populations within Scandinavia, and therefore actions within one population will not benefit others. We therefore need to implement efficient actions in all populations. Further, inbreeding and loss of genetic variation may lead to a decrease in survival and reproductive success. The northern population is especially important as being a link to Russia and the largest of the four.

In Norway, the minimum of 21 litters born this summer is the highest number recorded since the monitoring started in Norway (Fig. 5). From the numbers of documented reproductions we estimate that there are no more than 50 adult arctic foxes in Norway. As in 2001 and 2004, the relatively high reproduction in 2004 follows peaks in the lemming population. It appears that the arctic foxes are still present throughout most of their former distribution, although gaps are starting to appear and the population is hence slowly decreasing. The Dovrefjell population appears to have gone extinct in the mid 1990's, leaving a gap of 300-400 km between the animals that occur around Finse, and those in the Swedish Helags population. Despite this wide distribution, the actual numbers of arctic foxes still present are very small. The Børgefjell population at the border of Nord-Trøndelag and Nordland counties stands out as the only population with more than 40 documented reproductions in the 11 year period 1994-2005.The survival of the arctic fox pups born this summer was extremely low in Norway, and there is reason to believe that non of the pups born in the 16 litters south of Troms county survived. This very high mortality rate is most likely connected to lack of food, caused by an early crash in the lemming population.

Problems during the report period

We have not encountered any great problems during the report period. We have applied very efficient set of actions in Jämtland, southern Västerbotten and Finland. However, we need to get more efficient actions in northern Västerbotten and Norrbotten. This is especially important since our genetic analyses show a subdivision in isolated populations.

Appendix: Tables and Figures

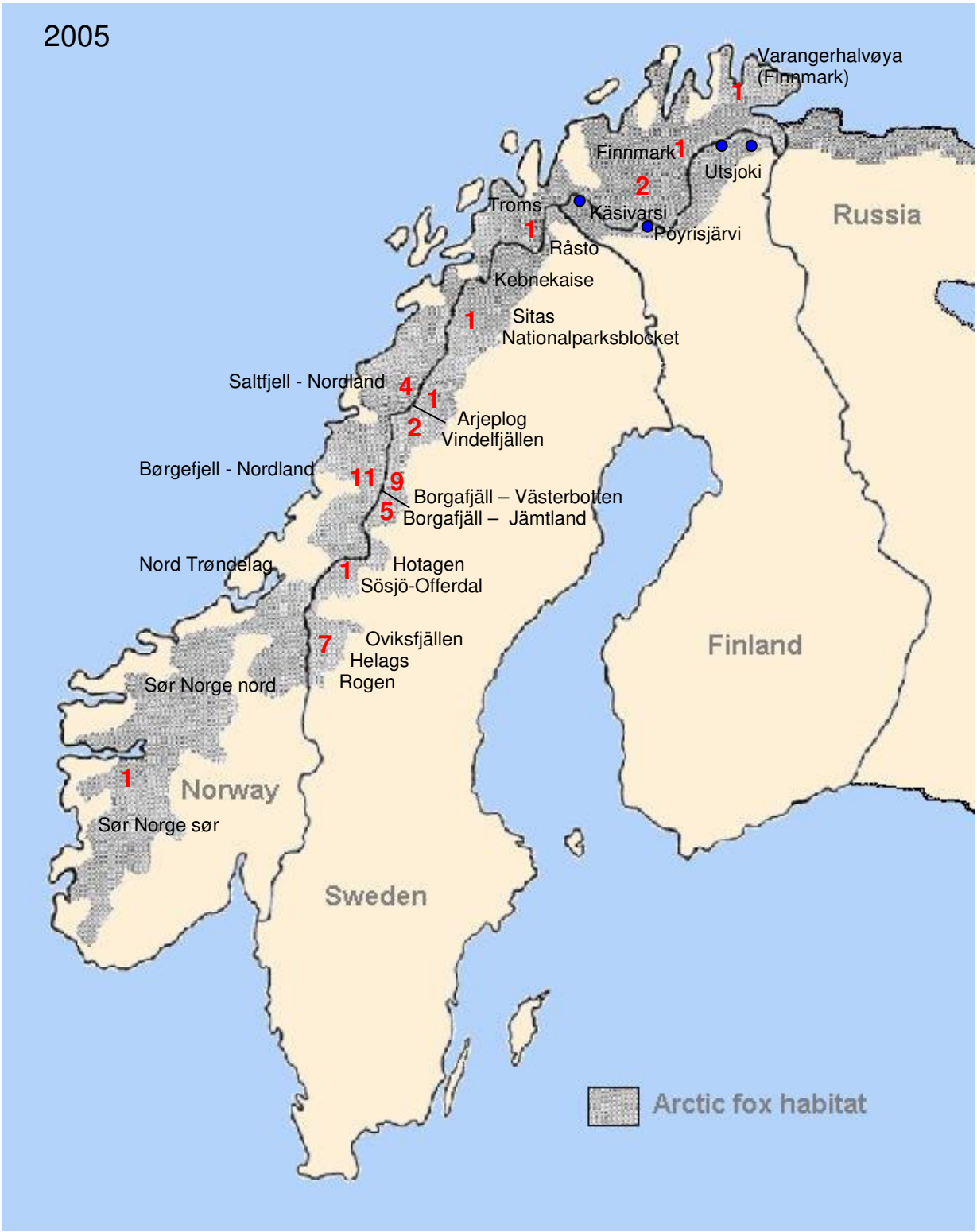

Figure 1. The project area includes area above treeline in Finland, Sweden and Norway. Red numbers show the number of litters 2005 in different areas in Sweden and Norway. There were no arctic fox litters in Finland, but arctic foxes were observed in areas marked with blue dots.
Projektområdet inkluderar områden ovanför trädgränsen i Finland, Sverige och Norge. Röda siffror visar antalet fjällrävskullar i olika svenska och norska fjällområden 2005. I Finland hittades inga fjällrävskullar, men synobservationer av vuxen fjällräv gjordes i områdena markerade med blå punkter.

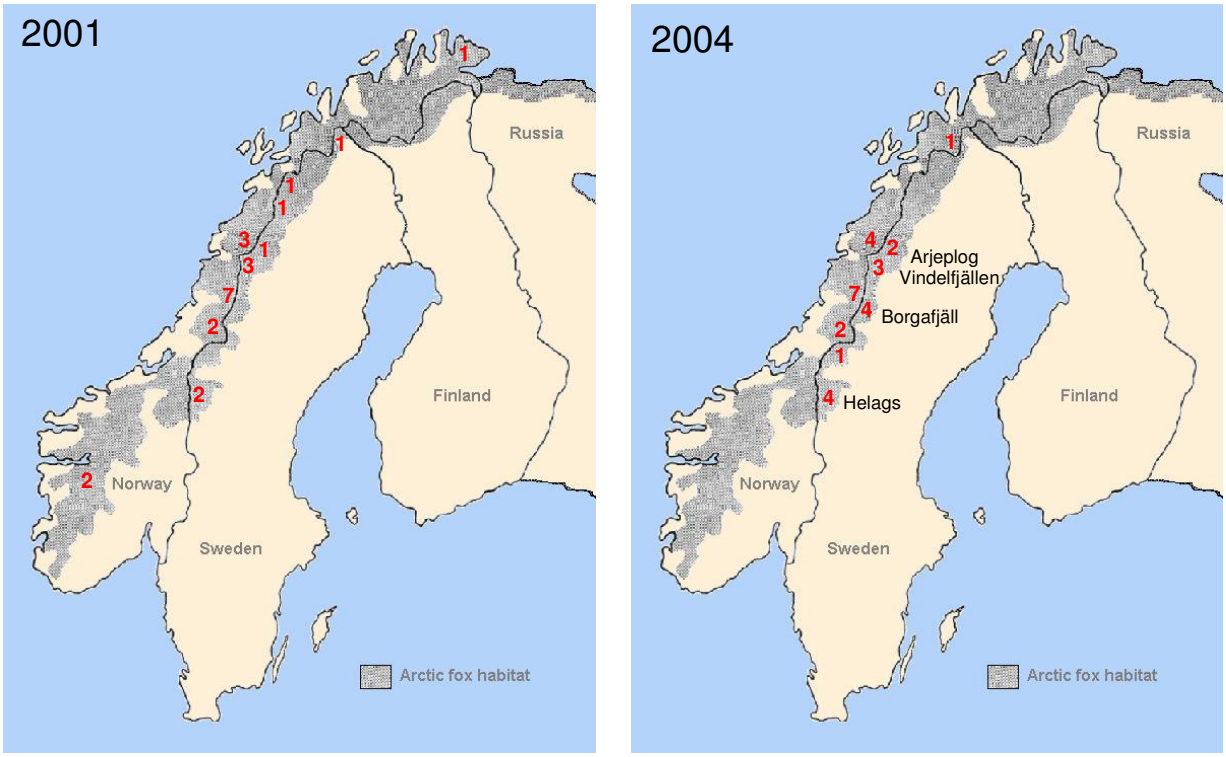

Figure 2. Arctic fox litters in Sweden and Norway in 2001 and 2004. Lemming availability was high in most of Sweden and Norway in 2001, but not in Finland. The number of adult arctic foxes is best estimated during such conditions as most adults try to breed and are found established at dens in summer. In 2004, lemming availability was intermediate to high in Vindelfjällen and Borgafjäll respectively, while there were less lemmings further south and north. Thus, overall conditions from Helags to Arjeplog were not as good as in 2001, but still relatively comparable. There were 6 litters in these areas in Sweden in 2001 while there were 14 in 2004, indicating an increase in the arctic fox breeding population.

Fjällrävskullar i Sverige och Norge 2001 resp. 2004. Tillgången på lämmel var mycket god i nästan hela Sverige och Norge 2001, medan Finland inte omfattades av lämmeltoppen. Antalet vuxna fjällrävar uppskattas bäst under sådana förhållanden eftersom de flesta försöker reproducera sig och därmed hittas etablerade vid lyor under sommaren. Sommaren 2004 var tillgången på lämmel intermediär till god i Vindelfjällen resp. Borgafjäll. Förhållandena från Helags i söder till Arjeplog i norr var därmed inte lika goda som 2001, men ändå relativt jämförbara. Sommaren 2001 hittades 6 kullar i dessa områden i Sverige, medan där fanns 14 sommaren 2004. Det tyder på en ökning av antalet vuxna fjällrävar.

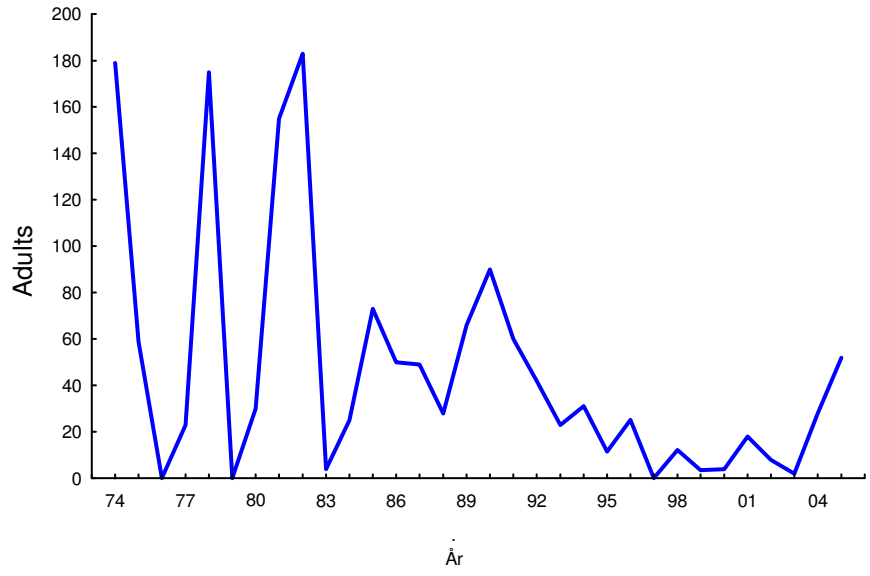

Figure 3. The number of arctic foxes that have reproduced in Sweden in 1974-2005. *Antal fjällrävar som reproducerat sig i Sverige 1974-2005.*

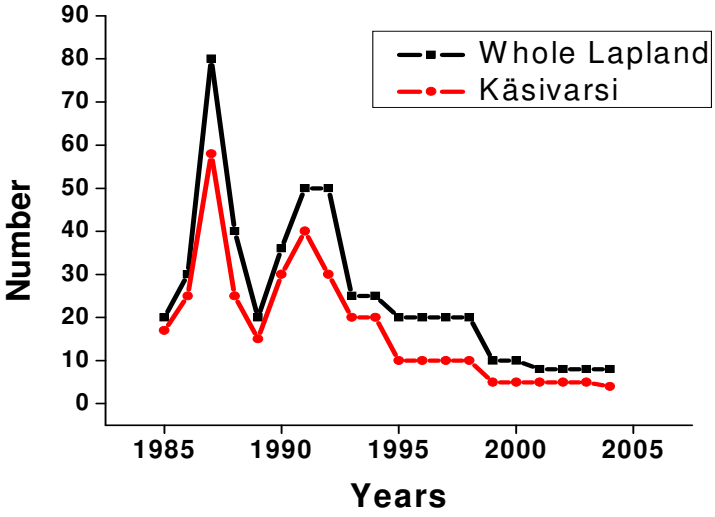

Figure 4a. Estimated numbers of arctic foxes in Käsivarsi and the whole of Finnish Lapland 1985-2004. *Uppskattat antal fjällrävar i Käsivarsi resp. hela finska Lapland 1985-2004.*

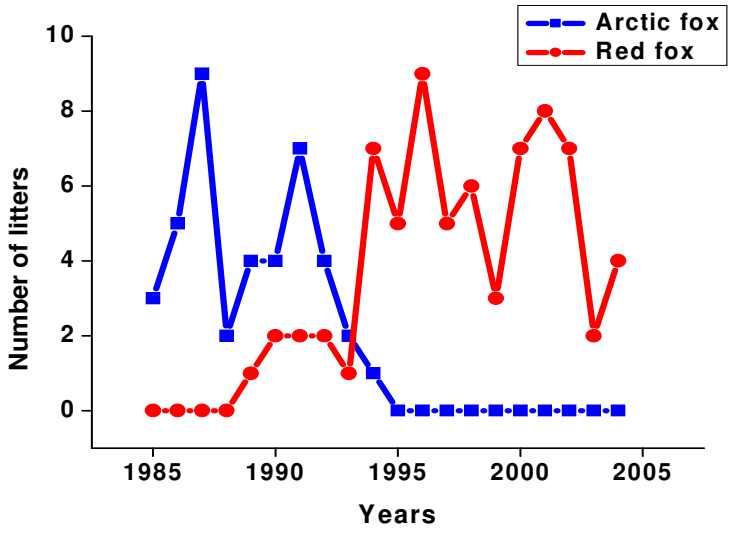

Figure 4b. The number of arctic and red fox litters in Käsivarsi, Finland 1985-2004. *Antal fjäll- och rödrävskullar i Käsivarsi, Finland 1985-2004.*

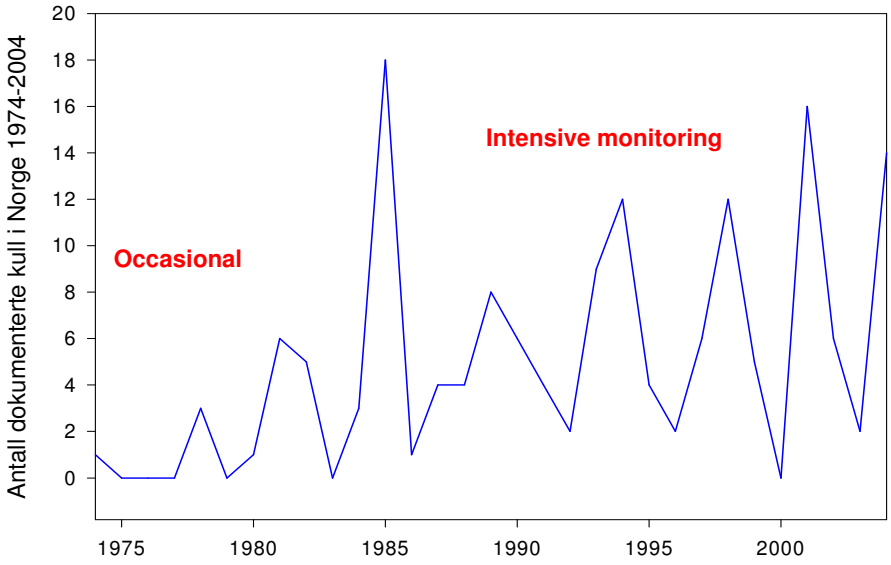

Figure 5. The number of arctic fox litters in Norway in 1974-2004. *Antal fjällrävskullar i Norge 1974-2004.*

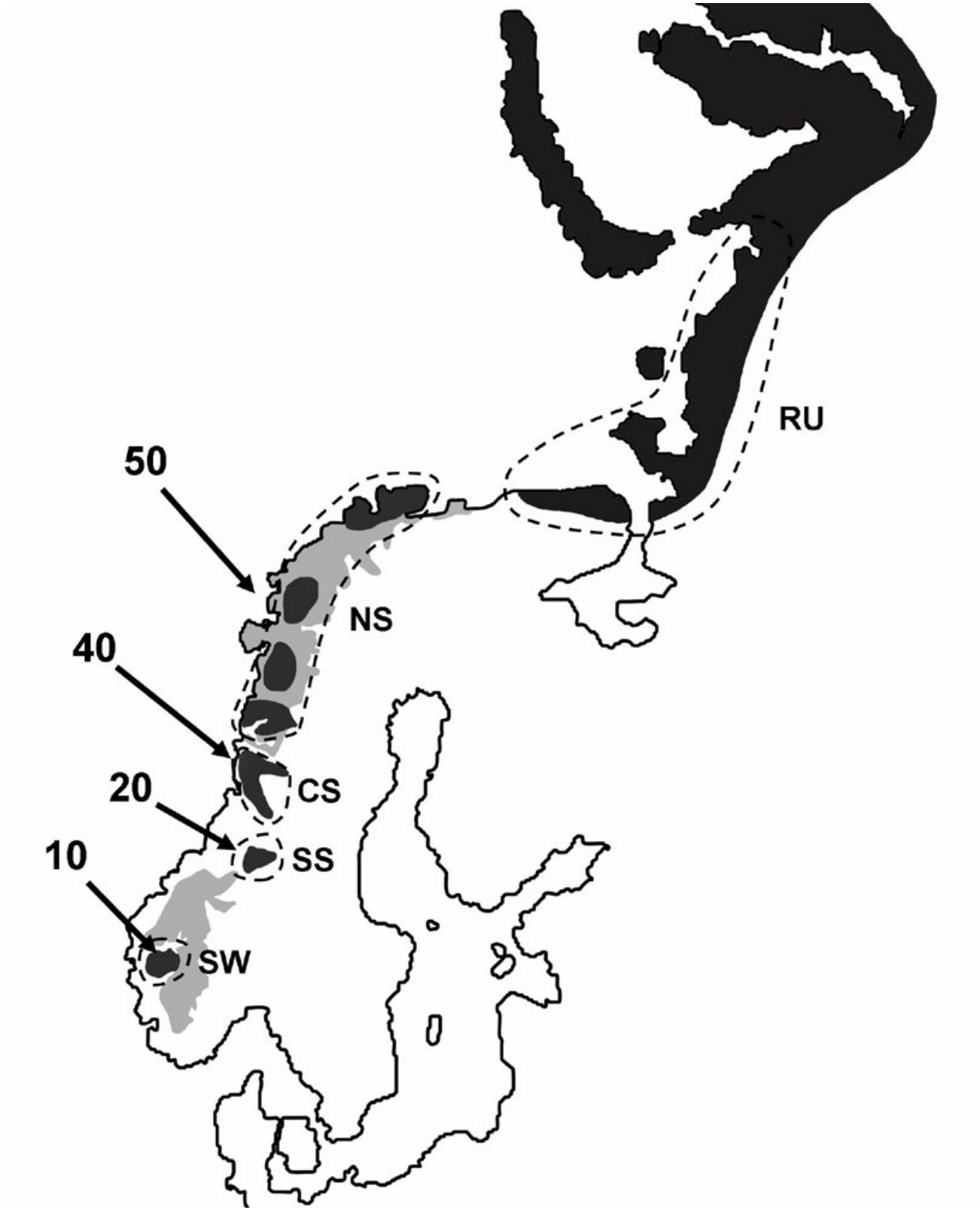

Figure 6. The substructure of arctic foxes in Scandinavia with estimated numbers in each population. RU= Russia, NS= northern Scandinavia, CS= central Scandinavia, SS= southern Scandinavia, SW= southwest Scandinavia. Grey is the area of former arctic fox distribution.