Chapter 1 – Nature

in strategic environmental assessment report

(SEA 2007 report – US)

Sent to public hearing
from December 10, 2007
until January 15, 2008

Prepared
in connection with the aluminum project
by the Greenland Home Rule
SEA working group

Version: December 9, 2007

Greenland Home Rule
Nuuk, December 10, 2007

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Chapter 1 The natural environment

1.0 Summary

1.1 Introduction

This chapter is based on a draft status report that is currently being prepared by the Danish National Environmental Research Institute (NERI) and the Greenland Nature Institute (GN). The report is scheduled for completion by April 2008. This means that the final NERI/GN status report may differ from the draft version that forms the basis of this chapter.

The primary objective of the NERI/GN status report is to collate and assess existing data and knowledge about the natural environment and the use of natural resources within the area covered by the SEA. In addition, two specific studies (of harlequin ducks and geese) were conducted in the summer of 2007 in connection with the preparation of the report.

The status report describes the SEA region's plant and animal life as well at the use of natural resources through hunting, fishing and tourism. The report focuses on the following species:

- Species that are important to hunting and fishing
- Species that are endangered
- Species that are of international importance/interest

Maps showing the most important areas of distribution/resource utilisation have been made. It should be noted that the data available are often spread over time and space, for which reason other areas may also be important or, conversely, previously important areas may no longer be important.

For each species, the SEA region's importance in terms of the prevalence of the species in Greenland and the risk of the species being affected by the project are assessed. In addition, areas in which there is a shortage of data are identified and a number of recommendations for additional studies are given.

Some species are not described in detail, for example species that are common to the region such as Arctic fox and mountain hare and species that are unlikely to be affected by the project in terms of population levels. However, it cannot be excluded that there are unknown local or rare plants or animals that might be affected. This should be investigated as part of the project.

DMU og GN's statusrapport vil blive tilgængelig, når den foreligger.

1.2 Methodology

Based on the progress report, a number of factors are specified and assessed in relation to each species treated in this chapter. These assessments are summarised in two matrices: one for impacts in the construction phase, and one for impacts in the operation phase.

The following factors have been considered for each species:

- Data quality
- Impact and the types of impact that are considered to be relevant
- Causes of impact (such as the construction of a smelter or of hydropower stations)
- The seriousness of the individual impacts in terms of their effect on the species considered
- Red List categories
- Remedial measures
- Periods in which disturbance should be avoided
- Further studies and surveys

1.3 Conclusion

In all three municipalities, the location of a smelter in the area will have major impacts. However, most of these impacts can be reduced by means of remedial measures. Some of these measures will require prior studies or surveys, in particular in areas where activity should be avoided at certain times of the year, for example caribou calving areas and white-fronted geese moulting areas. Both recommended studies and surveys and possible remedial measures are listed in Annex 1 and Annex 2. The following sections set out the points that are considered to be most important in terms of protecting the natural environment in connection with the location of the smelter. The points are marked in grey in the table.

Sisimiut

Greenland white-fronted goose and Canada goose. West Greenland is the only place where the white-fronted goose breeds, and Greenland therefore has a special responsibility in relation to this species. The area to the north of Kangerlussuaq is generally important both for the Greenland white-fronted goose and the Canada goose. Consequently the area's specific significance for these two species and their use of the area should be mapped, so that activities can be avoided in staging and moulting areas in relevant periods.

Caribou. The area between Itilleq and Sisimiut is an important area for caribou. The installation of a transmission line to Sisimiut through this area could affect migration between this area and inland areas. If roads are constructed in the area, it will cause increased disturbance and result in an increased hunting pressure because of easier access to the area.

Rare plants. The installation of transmission lines through an area at the bottom of Akugdleq, where the transmission line from Sisimiut to Tasersiaq (7e) is planned to be located, may cause irreversible damage of the habitats of a number of plant species in relation to which the SEA region is important in terms of their occurrence in Greenland. However, it would be relatively easy to remedy this effect by mapping the occurrence of rare plants in the area, so that the transmission line can be installed where it will not affect the plant habitats.

Maniitsoq

Thick-billed murre and black-legged kittiwake. If the transmission lines are drawn to Maniitsoq along the coast, they will pass breeding colonies of both thick-billed murre and black-legged kittiwake. Both these species are in decline in Greenland. It will in particular be in connection with the installation of the transmission lines that there will be a risk of disturbing the colonies. Disturbing activities such as passing helicopters and the use of heavy vessels close to colonies should therefore be avoided in the breeding season.

Nuuk

Caribou. The Nordland area (Akia) and Narssarssuaq north of Godthaab Fjord are core areas for caribou. The establishment of a transmission line to Nuuk will affect these important feeding areas by and large all along the transmission lines. Furthermore, the establishment of a smelter in the Nordland area will imply a location that is relatively close to a town, which will cause increased disturbance because of activities related to the smelter and increased hunting pressure resulting from increased recreational activities in the area.

There are no data indicating whether caribou in Greenland follow specific migration routes throughout the year. If a smelter is located at Nuuk or Sisimiut, it should be investigated whether such routes exist. Furthermore no systematic, direct studies of caribou reaction to structures such as transmission lines going through an area are available. If transmission lines are to be established through a core area for caribou, such studies should be made. The impact on migration routes may be reduced by avoiding blockage of narrow passages and

by scheduling activities for periods in which only a few caribou are expected to be in the activity areas.

1.4 Additional studies and surveys

As the data available concerning the species considered are far from exhaustive, NERI and GN have listed a number of additional studies and surveys that should be made. Some of these studies would apply to all the areas potentially affected by the project, while others would only be relevant if certain structures are established. These structures are indicated in Table 5.

Table 5 Proposals for additional studies and surveys, depending on the structures to be established. ABC indicates smelter locations, T indicates transmission lines, and 7e1, 7e3, 7e4, 7d and 6g indicates hydropower potentials (see Figure 1)

		Sisimiut			Maniitsoq				Nuuk				Hydropower				
		A	B	T	A	B	C	T	A	B	C	T	7e1 and 7e4	7e 3	7 d	6 g	T
Vegetation	Mapping sensitive/rare/important types of vegetation	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Vegetation	Determining the occurrence of rare plants	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Caribou	Analysing herd sizes	x	x	x				x	x	x		x	x	x	x	x	x
Caribou	Mapping calving areas								x	x		x			x	x	x
Caribou	Investigating whether caribou follow specific migration routes	x	x	x					x	x		x			x	x	x
Caribou	Studying caribou reaction to transmission lines														x	x	x
Common seal	Studying haul-out areas												x	x			
Birds	Studying the occurrence of birds in freshwater areas												x	x	x	x	
Geese*	Mapping spring resting places	x	x	x								x	x	x	x	x	x
Geese*	Mapping moulting areas	x	x	x					x	x		x	x	x	x	x	x
Char	Determining the occurrence of Arctic charr														x	x	
Char	Determining the significance of the population												x	x	x	x	

* Greenland white-fronted goose and Canada goose

2.0 Material

Status report from the Danish National Environmental Research Institute and the Greenland Nature Institute

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The primary objective of the NERI/GN status report is to collate and assess existing data and knowledge about the natural environment and the use of natural resources within the area covered by the SEA. In addition, two specific studies (of harlequin ducks and geese) were conducted in the summer of 2007 in connection with the preparation of the report.

The status report describes the SEA region's plant and animal life as well at the use of natural resources through hunting, fishing and tourism. The report focuses on the following species:

- Species that are important to hunting and fishing
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Maps showing the most important areas of distribution/resource utilisation have been made. It should be noted that the data available are often spread over time and space, for which reason other areas may also be important or, conversely, previously important areas may no longer be important.

For each species, the SEA region's importance in terms of the prevalence of the species in Greenland and the risk of the species being affected by the project are assessed. In addition, areas in which there is a shortage of data are identified and a number of recommendations for additional studies are given.

Some species are not described in detail, for example species that are common to the region such as Arctic fox and mountain hare and species that are unlikely to be affected by the project in terms of population levels. However, it cannot be ruled out that there are unidentified local or rare plants or animals that might be affected. This should be investigated.

DMU og GN's statusrapport vil blive tilgængelig, når den foreligger.

3.0 Methodology

For each species treated in this chapter, a number of factors are stated and assessed. These assessments are summarised in two matrices: one for impact in the construction phase and one for impact in the operation phase. The structure and general contents of the matrices are outlined in the following sections. Annexes 1 and 2.

Columns

Data quality

The status report is based on existing data about the various species. Since there are great differences in the quality and comparability of the data available, the quality of the data is assessed for each species, using a scale from 0 to 3. The scale and the criteria applied are set out in Table 1.

Impact

Based on the status report, the types of impact considered to be most relevant are stated for each species.

Cause of impact

For each of the possible locations of the facilities it has been assessed whether the construction and/or operation of the facility will have the effect described on the species in question. It has also been assessed whether the effects are reversible or irreversible. The symbols and criteria are stated in Table 2.

The possible locations of the facilities are shown in Figure 1 and described below.

Hydropower station: Three hydropower stations are to be built to provide the power needed to operate the aluminium smelter. It has already been determined what hydropower potentials to use for the project, namely potentials 7e, 7d and 6g (Figure 1). There are several possible locations of the hydropower station for potential 7e. The differences between the individual locations are reviewed in the cumulative study. In this chapter there are only a few references to differences between discharge into Evighedsfjord (7e3) and discharge into Kangerlussuaq (7e1 and 7e4).

Transmission lines (T): The draft layout of transmission line positions is taken from a map that was updated in October 2007. No matter where the smelter is

located, it will be necessary to connect the three hydropower stations with transmission lines. The lines are shown as black lines in Figure 1.

In addition, a number of transmission lines for the smelter itself must be established. Their location will depend on the location of the smelter. In Figure 1, these transmission lines are blue (location in Sisimiut), red (location in Maniitsoq) and green (location in Nuuk).

Smelter: Figure 1 shows three possible sites for the smelter both in Nuuk (ABC) and in Maniitsoq (ABC), while there are only two possible sites in the Sisimiut area (AB).

Seriousness of impact
The seriousness of an impact depends on the population concerned, the period involved, the type of impact to which a species is exposed, the sensitivity of the species, and the national and global importance of the population. The matrix indicates an assessment of the seriousness of various impacts for the species in question. The scale and criteria are set out in Table 3.

Red List category: For each species there is an indication of its categorisation (Table 4). In addition *remedial measures* and the *period* in which disturbance should be avoided are stated. Finally, there are recommendations of *additional studies* that should be conducted in connection with the project.

Figure 1 (ProjectedStructures_new)
Planned location of hydropower stations and possible smelter sites and transmission line locations.

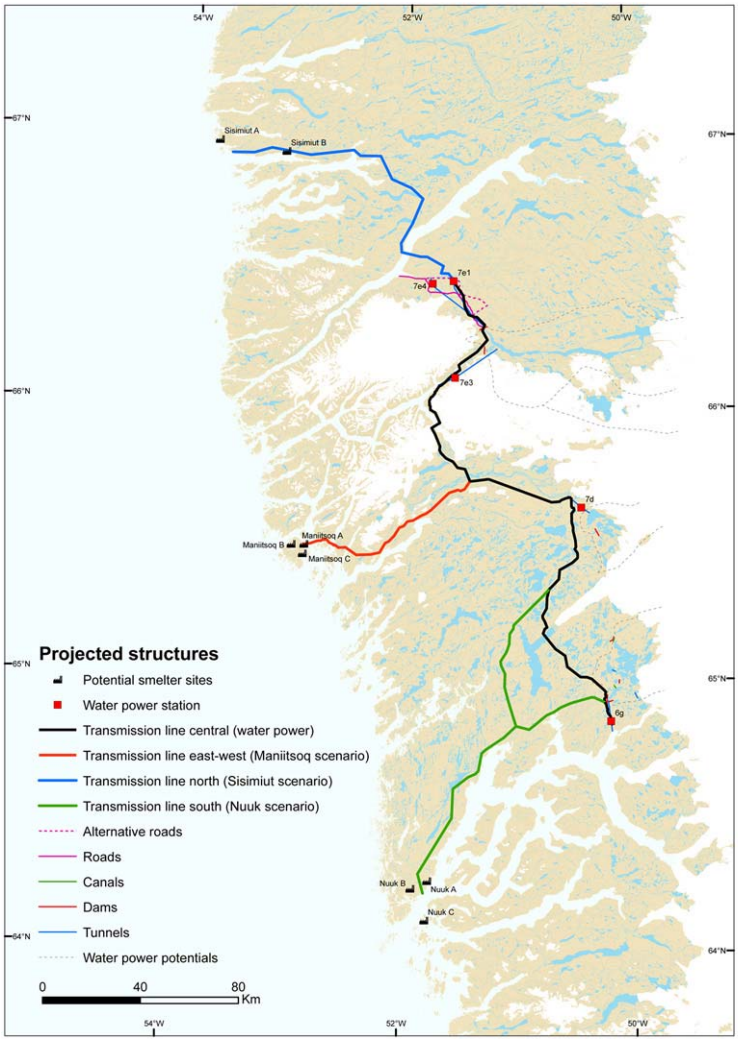


Table 1 The quality/validity of data for each species has been assessed on the basis of the scale and criteria stated below.

Score	Description	Criteria
3	Good data	Good geographical coverage, several surveys, new data
2	Deficient data	Inadequate geographical coverage, 1+ surveys
1	Few data	Inadequate geographical coverage, 0-1 survey, old data
0	No data	No surveys

Table 2 Where a certain activity is considered likely to affect a species, the nature of the impact is stated by means of the symbols and criteria set out below.

Category	Description	Criteria
I	Irreversible impact	Area where the impact is irreversible
R	Major impact, reversible	Area where the impact is assumed to have a major impact on the entire population or a sub-population
r	Minor impact, reversible	Area where the impact is assumed to affect individual members of the species
0	No impact	Area where there is no likely impact
?	Possible impact	Area where it is considered likely that there is a risk of impact
	No data	Area where it is not known whether there will an impact or not

Table 3 The seriousness of the impacts is indicated for each kind of impact on a specific species, using the scale and criteria set out below.

Category	Description	Criteria
3	Very serious	Rare/endangered species or species of cultural or economic significance of which a large proportion of the total population will be affected
2	Slightly serious	Species that are not rare, but impact on population level
1	Not serious	Very common species; very little impact on the total population
0	No impact	

Table 4 Red List categories

Category	Description
CR	Critically endangered
EN	Endangered
VU	Vulnerable
NT	Near threatened
LC	Least concern
#	Not evaluated

4.0 Review of material

4.1 Vegetation

The vegetation in the region is sub-Arctic with clear differences between coastal area close to oceans and continental areas close to the ice cap. The vegetation including its accessibility is an important landscape aspect that governs the distribution of animal life, first and foremost by providing food for herbivore animals and birds, but also because the vegetation provides cover and nesting space for birds. Knowledge of the composition of the vegetation (quality and diversity) and its distribution is thus a precondition for understanding wildlife's seasonal use of an area and for understanding migration routes.

Vegetation types

Data

Vegetation maps of part of the region were prepared in connection with a project focusing on the interplay between vegetation, caribou and human activity in West Greenland: the RenVej Project that took place in 1997-2000. The project report is available at http://www.natur.gl/Default.asp?lang=dk&num=486 and the maps can be found at http://www2.dmu.dk/1_Viden/2_Miljoe-tilstand/3_natur/renveg/HTML/vegetationskort.htm.

Impacts in the construction and operation phases

Generally, construction work should be carried out so that areas covered with vegetation are affected at little as possible. Arctic vegetation is very vulnerable and the use of heavy vehicles may leave tracks that will be clearly visible in the landscape for more than twenty years. Such tracks will be formed if vehicles are driving in very wet or very dry areas in the summertime, and may also be caused by frost damage and the compression of snow in the wintertime. In areas with permafrost the so-called active layers, ie the top soil layers that thaw in the summer, will be permanently damaged and there is a risk that such damage will start an erosion process.

In connection with the establishment of the hydropower stations some small or large areas will probably be flooded, the result of which will be that the vegetation in the flooded areas either change or disappear completely.

The operation of the hydropower stations and the smelter is not expected to have any other effect on vegetation.

Remedial measures and additional studies and surveys

Heavy vehicle traffic in areas with vegetation should insofar as possible be avoided or should only take place along specially made tracks/roads.

In particularly important areas and in areas where there is a risk of erosion, it should be specifically assessed whether revegetation is necessary. It should be ensured that the top soil layer including roots and plants is preserved, so that it can be replaced after completion of the construction activities. The occurrence of vulnerable, rare and important species in the areas concerned should therefore be mapped.

Rare plants

The region has a number of plants that must be considered rare and which may be affected and, in a worst case scenario, may be eliminated in connection with the construction and operation of the hydropower stations and aluminium smelter.

Data

Available data about all species, common as well as rare, in an area of West Greenland including the SEA region are collated in a publication from 1996. The underlying study concerned vascular plants only and no similar studies are available for mosses, lichens and fungi. The study was based on collections at the Botanical Museum in Copenhagen. In term of geography, the collection covers a reasonably extensive area, but there are areas that will be affected by the project about which there are no data on plants.

There are no data on the exact locations where the plants were found. Figure 2 is based on scanned dot maps, which means that there is great uncertainty about the places where the plants were actually found, as each dot covers an area of about 65 km^2.

A total of 37 species that are considered to be rare have been found in the region. Nine of these species are endemic (which means that they are only found in Greenland). As far as 24 of the 37 species are concerned, their occurrence in the SEA region is important for their occurrence in Greenland as a whole. Nine of these species have their only habitats in Greenland in this region.

Impacts in the construction and operation phases

The transmission line will pass several habitats of rare plant species. The largest habitat that seems to be affected by the establishment of transmission lines is an area at the bottom of Akugdleq, where the Sisimiut-Tasersiaq transmission line (7e) is planned to pass (Figure 2). Establishment of transmission lines in this area may cause irreversible damage to the habitats of a number of plant species for which the region is important in terms of their occurrence in Greenland.

The operation of the hydropower stations and the smelter is not expected to have any other impact on rare species.

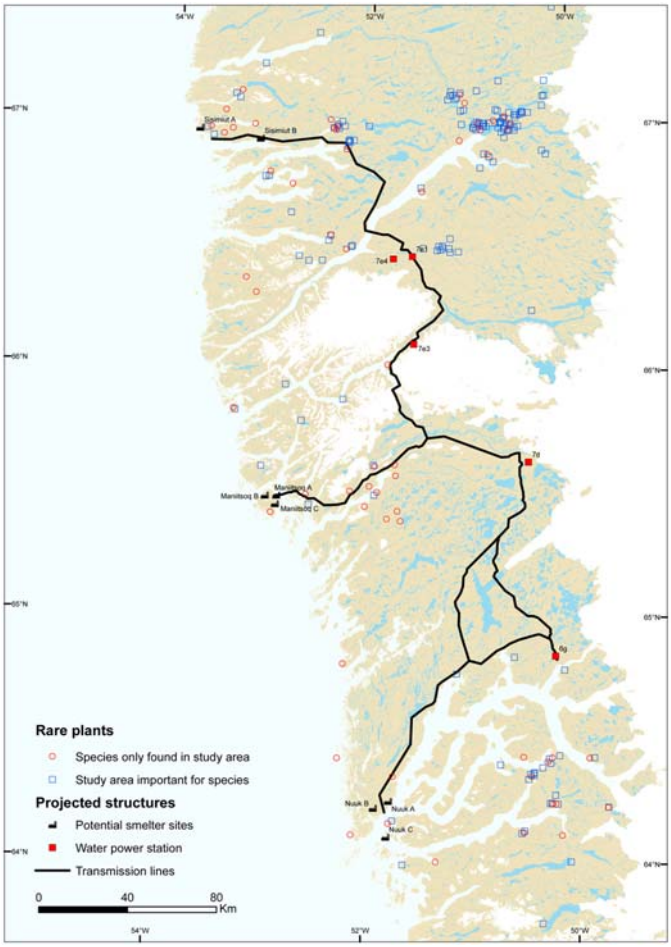
Remedial measures and further studies and surveys

As mentioned above, the data concerning rare plants are not sufficiently comprehensive, and supplementary surveys and studies should therefore be made in the areas for which no data are available.

The transmission lines should be located where they will insofar as possible have no impact on the habitats of rare plants.

Figure 2

The occurrence of rare species of vascular plants that in Greenland are only found in the SEA region (red circles) and/or for which the region is important in terms of their occurrence in Greenland (blue squares).



4.2 Land mammals

Four of the eight species of land mammals in Greenland are found in West Greenland and the SEA region. Arctic fox and Arctic hare are very common and the populations of those two species will probably not be materially affected by the projects. Caribou are common throughout the region, while musk oxen are primarily found in the area to the south and east of Kangerlussuaq. These two species seem likely to be affected by the project and are discussed in greater detail in the following sections.

Caribou

Caribou are very common in West Greenland. In the SEA region there are three separate herds, between which there is very little interchange. None of the three herds are considered to be endangered but the species has great cultural significance in terms of hunting activities and therefore attracts great public attention.

The sizes of the three herds have been estimated on the basis of counts in 2005 and 2006. Additional analyses of the existing data material should be carried out to assess the size of herds in the individual areas in the region.

Activities associated with the establishment of a smelter, hydropower stations and transmission lines may have a disturbing effect on the caribou in the calving season. Man-made structures in the landscape and flooding may form obstacles to or cause changes in migration routes and may also disturb or destroy important feeding areas.

Caribou: calving areas

Before the calving period, the cows gather in calving areas, which are typically located in a zone along the edge of the ice cap. Immediately after calving, the cows gather in herds of varying sizes, with our without calves, and migrate between good feeding areas. In this period, cows with calves are very sensitive to disturbances and will, if such disturbances are sustained, leave the area.

Data

Only a few studies of calving areas in calving periods have been made, and there has been only one aerial count (in 1995). However, interviews with hunters and previous non-systematic studies indicate that many areas other than those registered are used in the calving season.

Impacts in the construction and operation phases

A great deal of traffic and disturbance must be expected in the period when the hydropower stations are constructed and the transmission lines laid close to the edge of the ice cap (7d, 6g and middle transmission). Disturbances in the calving areas may force cows with calves to go to less good feeding areas.

The operation of the hydropower stations are not expected to entail any disturbances in the calving areas, although this will depend on the activities that remain in the area in connection with the operation of the stations and on whether roads or other types of structures will be established in connection with the stations, thus causing increased traffic in the areas.

Remedial measures and additional surveys and studies

The extent of calving areas in the study area should be mapped, so that construction activities can be avoided in the period from 20 May to 20 June. In this period, fly-overs at low altitudes (below 500 metres) should also be avoided in the calving areas both in the construction and the operation phase.

Caribou: migration routes

Data

The seasonal distribution of caribou in the area is known from aerial counts, most of which were made in March-April (1995 and 2000/2001), and from a satellite marking project involving groups of seven and eight animals respectively that were followed over a long period of time (1997-1999). In addition, a single calving-season survey has been made (1995).

In the late winter period from March to April, the animals are primarily seen close to the coast in the southern part of the region, while they are mainly seen to the east, closer to the ice cap, in the northern part.

There is only little information available about the distribution of caribou in the region in the rest of the year. The 1997-1999 satellite marking project showed that caribou generally migrate between inland areas and coastal areas. The

animals are mainly in inland areas in the early summer period, while they tend to stay in areas closer to the coast for the rest of the year.

In the southern part of the region, migration patterns proved to be more complex, as half of the marked animals remained in the coastal area throughout the year. The other half of the marked animals migrated between coastal areas, where they spent the winter, and inland areas, where they spent the calving and summer seasons.

Impacts in the construction and operation phases

Disturbances caused by construction work in connection with the establishment of hydropower stations or transmission lines must be expected to affect the distribution of animals locally in the area. Once the construction work is completed, and the disturbances consequently stop, the animals are likely to return to some extent, provided that no human activity takes place in the area. This has been the case after the construction work carried out in connection with the establishment of the hydropower station at Buksefjord and the transmission line to Nuuk, but no scientific studies have been made in this respect.

Remedial measures and additional studies and surveys

No data is available to show whether caribou in Greenland follow specific migration routes throughout the year. The conclusion of a study made in 1967 was that the caribou tended to migrate in particular when the herds were large, while they tended to be more stationary when herds were small. This should be investigated further in new studies.

Furthermore, no systematic, direct studies of caribou reactions to transmission lines across an area have been made. If transmission lines are to be established through a core caribou area, such studies ought to be made.

Impacts on migration routes may be minimised by preventing blockage of narrow passages and by confining activities to periods in which only a few caribou are expected to be in the activity areas.

Caribou: feeding areas

The distribution of caribou in an area is determined by the availability of good feeding areas. The quality of a feeding area is mainly determined by a number of environmental factors such as vegetation type, height above sea level, the shape of the terrain, soil type, humidity, luxuriance, the concentration of

nutrients in plants, etc. Flooding and construction activities may cause disturbances and destruction of important feeding areas.

Data

A study based on vegetation maps, terrain models and positions of satellite marked caribou (1997-1999) have identified the most important summer feeding areas for caribou (Figures 3 and 4). As the study is based on the identified positions of two groups of seven and eight caribou respectively, marked in delimited areas, it is uncertain how representative the study is for the entire SEA region. Furthermore, a large part of the region is not covered either in terms of vegetation maps or in terms of satellite marked animals.

Impacts in the construction and operation phases

Sisimiut

The construction of a smelter at Sisimiut would probably not affect any major feeding areas, but a number of smaller areas would be affected by the installation of transmission lines and the establishment of a smelter to the east (Sisimiut B).

Maniitsoq

No data are available for the Maniitsoq area, but on the basis of a count made in the area in 1995 and hunting data reported in 2004-2005 this area is not considered to have any major significance for the caribou population.

Nuuk

It appears from the maps of important feeding areas that there are important caribou areas particularly in Nordland (Akia) and at Narssarssuaq to the north of the Godthåb Fjord. The establishment of a transmission line to Nuuk would affect important feeding areas along most of the line.

If a smelter is established in Nordland, it must be expected that a large area will be used not only for the establishment of the smelter itself, but also for various structures related to the smelter. Furthermore it must be expected that a large neighbouring area will be disturbed because of the increased activity in the area both in the construction and the operation phase.

Hydropower

With regard to the hydropower stations, data are only available from the area close to 6g. Based on the available date, construction activities in this area are not expected to affect important feeding areas. No data are available

concerning the areas around the two other hydropower stations and the transmission line that connects the three stations.

Depending on the intensity of activities at the hydropower stations in the operation phase, there is a risk of increased disturbance in surrounding feeding areas.

Figure 3 (Kang_RSF_simple)
Map of the preferred habitats of caribou in the Kangerlussuaq area in August. The red and orange areas are the most attractive for caribou, followed by the yellow and green areas. The white areas are the least attractive.

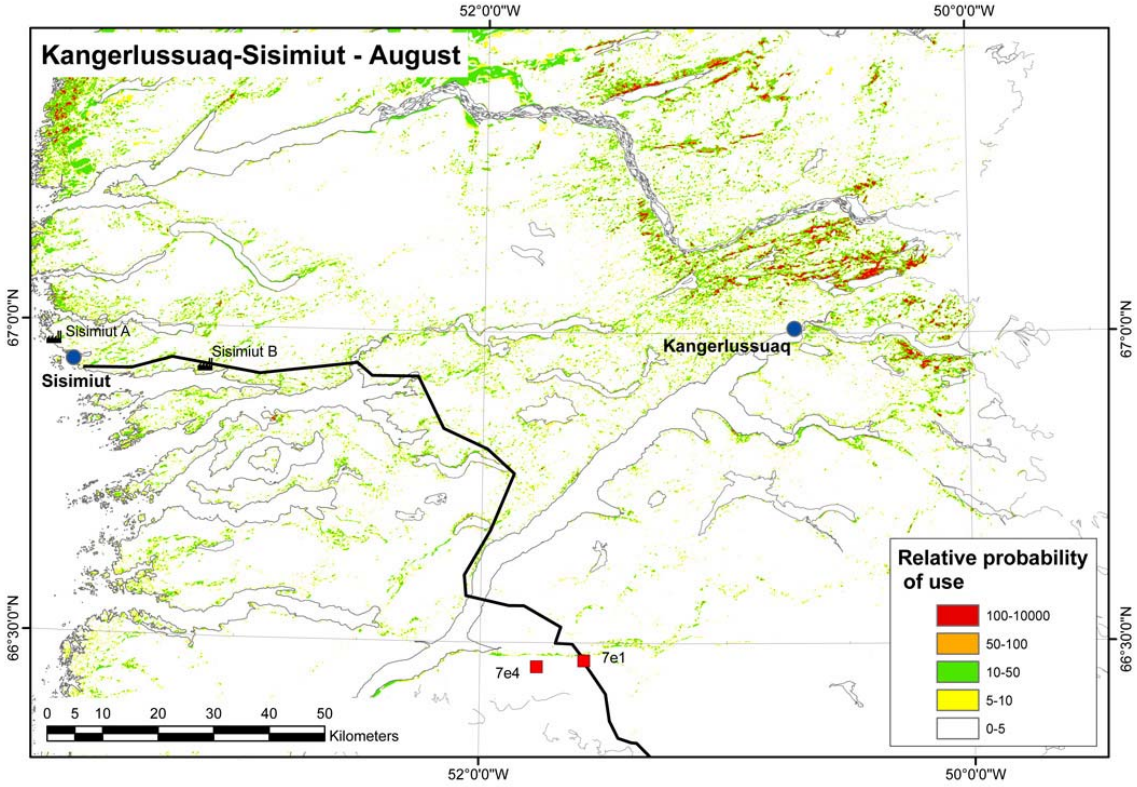
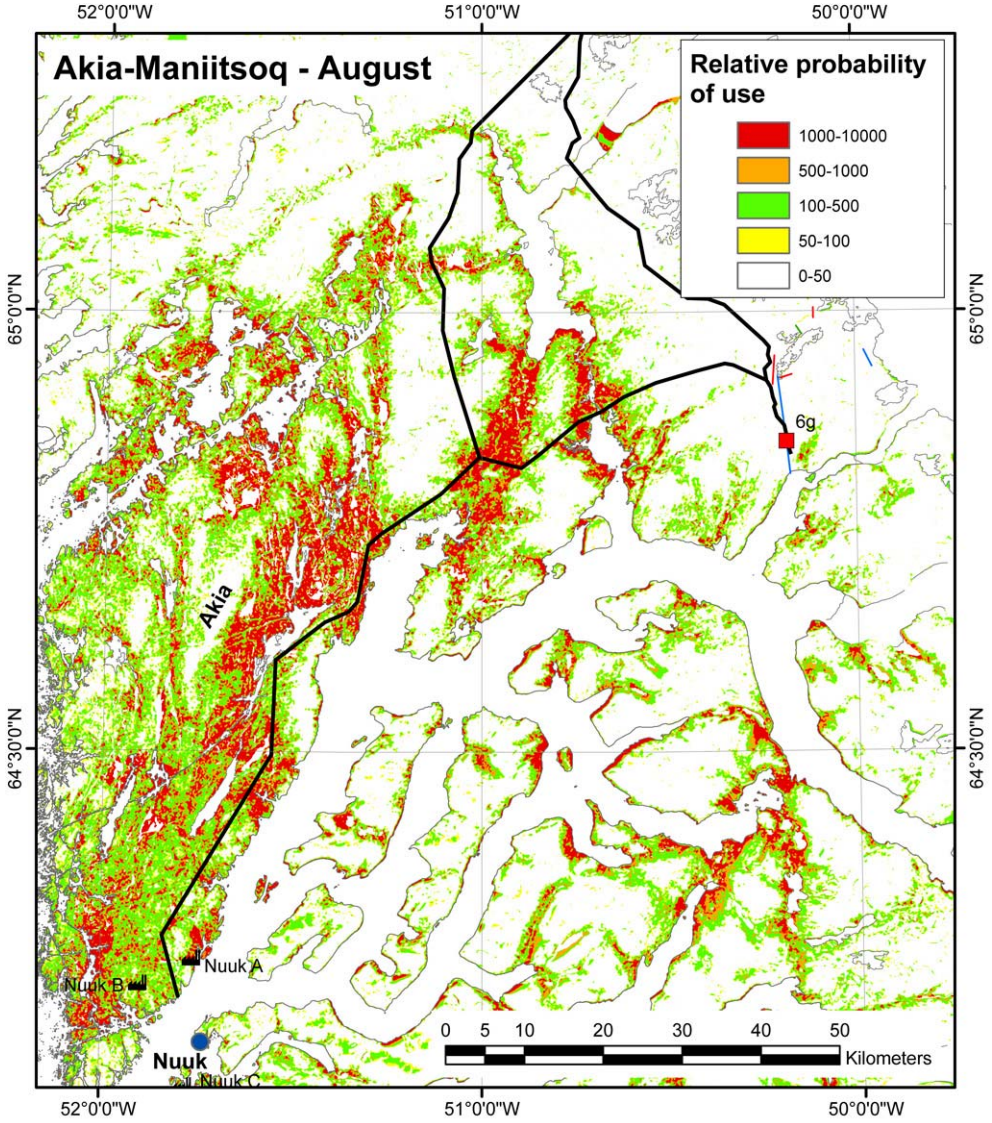


Figure 4 (Nuuk_RSF_simple)
Map of the preferred habitats of caribou in the Nuuk area in August. The red and orange areas are the most attractive areas for caribou, followed by the yellow and the green areas. The white areas are the least attractive.



Caribou: disturbances caused by hunting and recreational activities
The establishment of roads and lines in an area that has until now been undisturbed will lead to increased activity in the area. Because of easier access to the area, there will also be an increase in the use of the area for hunting and recreational activities. This is an effect seen everywhere in Greenland where hitherto undisturbed areas are ‘opened up’, and this effect must be expected to

manifest itself even in the construction phase and to continue in the operation phase.

The population of caribou is considered to be close to the area's level of sustainability, which means that there is a risk of a population collapse. Increased hunting is not believed to have any negative impact as long as the population is large. In fact, it may have a positive effect as the pressure on grassing areas will be reduced. However, if the population collapses, it will become small and vulnerable and thus sensitive to the hunting pressure.

Impacts in the construction and operation phase

Sisimiut

Increased access as a result of the location of a smelter at Sisimiut may have a great impact if a road is established from Sisimiut to the smelter. This is particularly true of smelter site B.

Maniitsoq

No effect is expected in this area. See the section on Maniitsoq under feeding areas.

Nuuk

As the possible smelter sites in Nordland at Nuuk are very close to the town and also characterised as important feeding areas, it must be assumed that a smelter in Nordland will cause increased hunting pressure and have a disrupting impact as a result of increased recreational activities in the area. In particular, a location at Ikaarissat (Nuuk B) would probably have a greet impact, as the site is located away from the coast.

Hydropower

The effect of increased access to the areas close to the sites of the two southern hydropower stations (7d and 6g) will depend on whether roads are established in the area and how long such roads will be.

A road going to the Tasersiaq lake (7e) would provide access deep into the area by boat. However, it is uncertain how dense the caribou population is in this area.

Remedial measures and additional studies and surveys

Caribou hunting is currently regulated by quotas. If the population collapse, it may become necessary to introduce additional measures to control traffic and hunting.

Musk ox

NERI had no conclusive data at the time of the deadline for this SEA.

Musk ox is common in the Angujaartorfiup Nunaat area between Søndre Strømfjord and Sukkertoppen Iskappe. They are mainly found in the northeastern part of the area and in the Qinngua Valley (Paradisdalen). This means that it would mainly be the construction and operation of the hydropower station at Tasersiaq (7e) that might affect the musk ox population (see the cumulative study).

4.3 Sea mammals

Of the sea mammals, only the common seal is considered important in this context.

Common seal

The common seal is the only seal species that gives birth and moult on land. Consequently it is more exposed and vulnerable than other seal species to activities in coastal areas.

Data

It is known that ten haul-out sites have been used by common seal in the SEA region in historical time. However, studies carried out between 1992 and 1997 indicate that six of these sites had been left at the time of the studies. Hunting in the pupping and moulting seasons has made the common seals leave many haul-out sites. However, not all of the potential haul-out sites have been studied in the past ten to fifteen years, so it is unclear which sites are currently being used.

Impacts in the construction and operation phases

The seals will probably become used to disturbances, provided they are not hunted. The estuary at Kangerlussuaq was once an important haul-out site where several hundred seals could be seen lying on the banks close to the

airstrip fifty years ago. Today there are only few seals in the area, the reason being a decline in the population rather than disturbances.

There is a risk that the common seal might be affected by the project, particularly in the construction phase (harbour and road structures and associated helicopter and ship traffic), but it is unlikely that any of the currently known haul-out sites would be affected. The estuary at Sarfartoq was once a known haul-out site for common seals and might become one again. Before any construction work in the area, it should be investigated whether any seals are present and, if so, such presence should be taken into account in the planning.

4.4 Land and freshwater birds

Several of the bird species in the region use the land or freshwater areas in their breeding season. Most of these species are very common and represented in large numbers, and the populations would not be materially affected by the project.

Several duck species breed close to freshwaters, just as Artic terns may also occur in inland areas. Local occurrences of these species might be affected by the project. This should be investigated and assessed in connection with the project.

The other species that seem likely to be affected are considered below. They are the species that potentially would be most exposed to impacts caused by the project: harlequin duck, red-throated diver, great northern diver, Greenland white-fronted geese, Canada geese, gyr falcon, perigrine falcon and white-tailed eagle.

Harlequin duck

The harlequin duck is a small diving duck, which in the breeding season lives close to rivers and lakes with clear water. The population is very scattered, and the number of breeding birds is unknown but assumed to be very small, as very few breeding sites have been registered. The species is protected in Greenland, and there are no immediate threats against the population. However, since the population is small it is redlisted as ‘near threatened’ (NT).

Data

A few breeding occurrences have been registered in the region but, since knowledge about this species is very limited, these findings cannot be used as a basis for assessing the status of the species in the region. This is why NERI

conducted a count of the species in the period from 28 June to 2 July 2007. The count was made from a helicopter in areas where it was considered likely that there would be harlequin ducks. Very few birds were observed (a total of eleven birds in three different places), which is probably not a representative result but nevertheless shows that the species lives in the area.

The count also showed that the three large lake areas that are to function as catchment areas for the hydropower stations are not habitats for harlequin ducks. The water is not clear (melting water from the ice cap), and at the time of the count the lakes were still covered with ice (with the exception of a narrow band along the shore). It must therefore be concluded that the harlequin duck population in the study area is unlikely to be affected by the construction and operation of the three hydropower stations

Red-throated diver and great northern diver

In the breeding season, these two diver species live close to lakes and ponds and may therefore be affected by the establishment of hydropower stations.

Data

Both diver species are found in the study area, but there are no specific data about numbers, prevalence and distribution in the area.

The red-throated diver is generally common in Greenland. It is protected and there are no immediate threats against the population. It is not redlisted in Greenland.

The population of great northern divers is not considered to be exposed to any immediate threats. However, since reproduction is very slow, the population is sensitive to increased mortality among adult birds and, because the population in Greenland is assumed to be very small, the great northern diver has been redlisted as ‘near threatened’ (NT).

During the counts of harlequin ducks and geese in the early summer of 2007 and in August 2007, both diver species were counted as well. During the first count, only a few red-throated divers and no great northern divers were seen. In the second count, a few more birds of each species were seen. Both species must be assumed to be represented in very low numbers in the area but, since they live at lakes and ponds with clear water, the populations are unlikely to be affected by the establishment of the hydropower stations (see also the section on harlequin ducks).

Geese

The Greenland white-fronted goose and the Canada goose are the two most common goose species in West Greenland. They arrive from their winter habitats in early May and need to build up their energy reserves upon arrival. They breed in the area in May and June. In July the moult their flight feathers, which means that they are flightless and consequently very sensitive to disturbances in this period. Around mid-September both species leave Greenland to fly south to their winter habitats. The two species will be described in detail in the following sections.

Until the 1970s and 1980s, the Greenland white-fronted goose was predominant in West Greenland, which is the species' only breeding area globally. The Greenland white-fronted goose population increased throughout the 1980s and 1990s as a result of hunting regulations, but has declined dramatically since then. The Canada goose came to Greenland in the 1990s. At first it was a moulting, non-breeding bird living in the northern part of West Greenland, but later it began to breed and gradually moved farther south. The number of Canada geese seems to be continuously increasing in Greenland.

There have thus been major changes in the two goose populations in the past two or three decades, which means that the data collated in this period do not really reflect the current presence of the populations in West Greenland.

Greenland white-fronted goose

The Greenland white-fronted goose (*Anser albifrons flavirostris*) is a sub-species of the white-fronted goose (*Anser albifrons*). As mentioned above, Greenland is the only place in the world where this species breeds, which is why Greenland has a special responsibility for it. The Greenland white-fronted goose population has declined dramatically in recent years and it now redlisted as 'endangered' (EN).

Greenland white-fronted goose: spring staging areas

Data

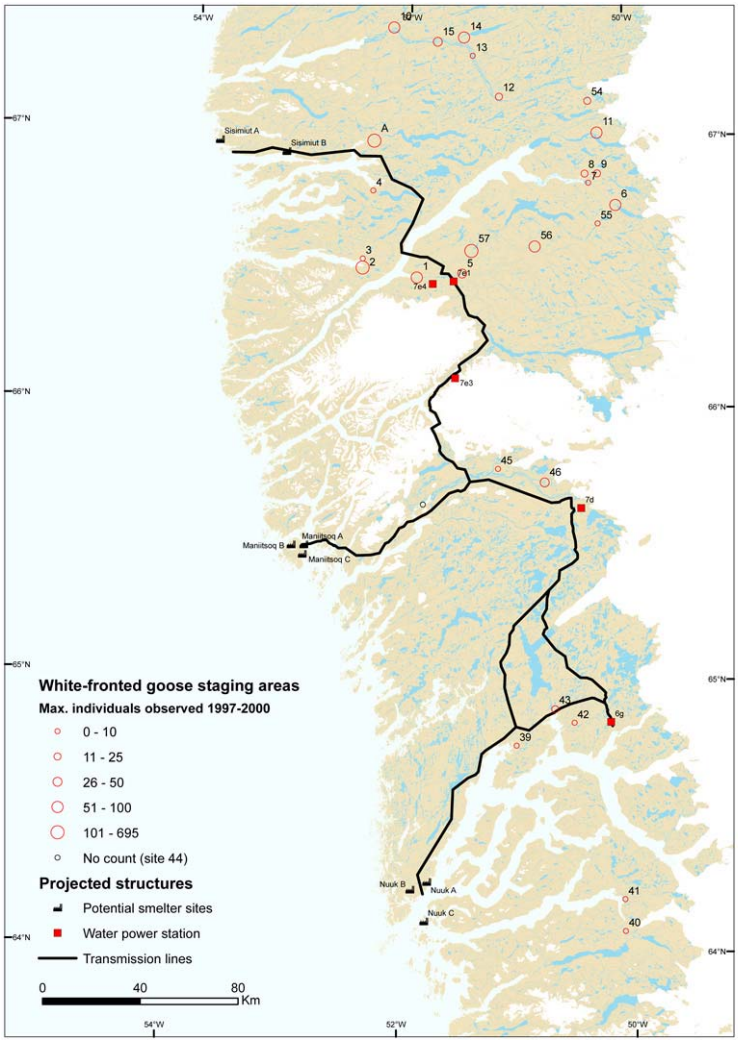
The most important spring staging areas are located between Sukkertoppen Iskappe and Ndr Strømfjord. NERI studied the spring staging areas of the Greenland white-fronted goose in 1995, 1997 and 2000.

The area to the north of Sukkertoppen Iskappe is by far the most important area for staging white-fronted geese. Two of the sites where counts were made were

particularly important, namely A and 57, both of which accommodated a very large proportion of the geese counted (Figure 5).

In the area to the south of Sukkertoppen Iskappe only three sites (39, 43 and 46) has any numbers of significance (Figure 5).

Figure 5 Spring staging areas of Greenland white-fronted geese



Impacts in the construction and operation phase

The geese in the staging areas are very sensitive to disturbances and if they are forced away it may, in a worst case scenario, affect their breeding season, as they will not be able to build up sufficient energy reserves after their migration to Greenland.

It is uncertain whether the transmission lines will have an impact in the operation phase because of geese flying into the high-voltage lines.

Sisimiut
As mentioned above, the most important staging areas are located to the north of Sukkertoppen Iskappe. If transmission lines to Sisimiut are established, the two most important sites in this area will be affected. The establishment of a smelter at Sisimiut is not likely to have any disturbing impact on known staging areas.

Maniitsoq
There are no known staging areas between Maniitsoq and the north-south transmission line.

Nuuk
Transmission lines to Nuuk will pass known, albeit less important staging areas. There are no known staging areas close to the potential smelter sites at Nuuk.

Hydropower
One of the most important staging areas to the north of Sukkertoppen Iskappe is located close to Tasersiaq (7e). Consequently, there is a risk that the geese will be disturbed both in connection with the construction and the operation of the hydropower station.

At the two southernmost hydropower stations (7d and 6g) there are no known staging areas in the immediate surroundings, but helicopter and aeroplane traffic to and from the areas may disturb a few sites.

Remedial measures and additional studies and surveys
The staging areas should be mapped, so that construction activities close to staging areas can take place outside the staging period (1-20 May). In addition, helicopter and aeroplane traffic should be regulated, so that aircraft flying over the most important staging areas can be avoided.

Greenland white-fronted goose: breeding areas
Data
The breeding area is located between 65ºN and 72º30'N, but the exact boundaries of the area are not known. Greenland white-fronted geese do not

breed in colonies but in individual pairs, and the distance between individual nests is generally one or two square kilometres.

Surveys of breeding white-fronted geese and Canada geese were made in 1999 and 2005. The Nordland area was surveyed in 1999, but no breeding white-fronted geese were observed there. No flights were made over the entire ice cap area to the south of the Iskappe in the two years in question.

The most important breeding area for Greenland white-fronted geese is the area to the north of Kangerlussuaq. The density of nests in this area was the highest found within the counting area, which went up to Svartenhuk at about 72ºN.

It is likely that the density of white-fronted goose nests in the area north of Sarfartoq and up to Kangerlussuaq is the same as the density at and north of Kangerlussuaq, while the density is probably much lower to the south of Sarfartoq and down to Sukkertoppen Iskappe because this area is located relatively high above sea level. Generally, the density of white-fronted goose nests is low, and it is assumed that relatively few nest biotopes would be affected by the planned construction activities.

Impacts in the construction and operation phases

As the most important breeding area is located to the north of Sukkertoppen Iskappe, it would be the establishment of transmission lines to Sisimiut that might affect breeding white-fronted geese. It has not been determined whether the establishment of a smelter at Sisimiut would affect breeding areas.

No breeding white-fronted geese have been observed in the Nordland area, and no surveys of breeding white-fronted geese have been made at Maniitsoq.

It is not likely that there are any important breeding areas at the two southernmost hydropower stations (7d and 6g), but the area north of Sarfartoq may be important (7e).

Greenland white-fronted goose: moulting areas

The geese go to suitable moulting areas in late June. The areas must have lakes or rivers where the geese can be safe from attacking foxes, just as there must be a feeding area that is sufficiently large to provide the geese with food in the three or four weeks that the moulting of flight feathers take. This area must be relatively close to the freshwater areas. The geese moult in flocks of up to

several hundred birds. This means that there are relatively large concentrations of geese in the moulting periods, in which the geese are vulnerable as they are unable to fly. If disturbances force them to leave their moulting areas, the geese will be vulnerable because they have to leave both the lakes that protect them and the feeding areas that are probably optimal for them in the moulting period.

Data

Extensive transect flights were undertaken in 1992 and 1995, but only in the northernmost part of the region.

No flights were made in the moulting period in the area between Kangerlussuaq and Nuuk. Based on assessments of luxuriance of vegetation in various areas in West Greenland, it is estimated that the inland areas between Sukkertoppen Iskappe and Nuuk may accommodate 2500-5000 moulting white-fronted geese. Within the area going from Kangerlussuaq to Sukkertoppen Iskappe the number of moulting birds is probably highest in the area between Kangerlussuaq and Sarfartoq.

Previously no data were available about the areas to which Greenland white-fronted geese went between the end of the moulting period in August until the beginning of the autumn migration in mid-September. However, NERI carried out a number of transect flights in the region in late August 2007, during which several flocks were observed in the northern area close to the ice cap. Other flocks have been seen further into the country. No flocks have been observed in the area to the south of Sukkertoppen Iskappe. It is believed that only a few post-moulting feeding grounds would be affected by the planned hydropower stations.

Impacts in the construction and operation phases

It will be necessary to map the moulting areas in the SEA region in order to determine the area's significance with regard to moulting white-fronted geese, partly because the geese gather in flocks in the moulting period and are very dependent on the moulting area chosen for a relatively long period of time, and partly because they are very sensitive to disturbances. A survey showed that more than half of the flocks leave the moulting area for five days, while a little less than half of the birds in a flock never returned after the flock had been disturbed by a single person walking in the area

Remedial measures and additional studies and surveys

Mapping of the way in which the geese use the area in the moulting period, so that disturbances can be avoided in the relevant areas and so that aeroplane and helicopter traffic can be regulated in the moulting period from 15 June to 10 August.

Canada goose

Canada geese migrated to Greenland in the 1980s and 1990s on their own accord, and their number seems to increase continuously in Greenland.

Canada goose: spring staging areas

No studies have been made concerning any spring staging areas for Canada geese. The only observations available are that the Canada geese seem to arrive in West Greenland about one or two weeks after the Greenland white-fronted geese. No Canada geese were observed in connection with the surveys of the spring staging areas of Greenland white-fronted geese in mid-May 1995, 1997 and 2000. As the Canada geese's migration route from North America to West Greenland is shorter than the migration route of Greenland white-fronted geese, there is a theoretical possibility that the Canada geese do not to the same extent need to build up their energy reserves in spring staging areas before the breeding season.

Canada goose: breeding grounds

Canada geese breed more or less within the same area as Greenland white-fronted geese, ie between 65ºN and 72º30'N. Just like the Greenland white-fronted goose, the Canada goose does not breed in colonies but in single couples. It is, however, possible to find several separate couples at the same lake.

Data

In connection with the surveys of breeding white-fronted geese in 1999 and 2005, surveys of breeding Canada geese were conducted as well.

Only few breeding Canada geese were observed in the area to the south of Sukkertoppen Iskappe. Only the Nordland area was surveyed to the south of the Iskappe, and this area was not surveyed in connection with a similar count in 2005.

The most important breeding area was the area around Kangerlussuaq to the north of Sukkertoppen Iskappe. The density of nests in this area was the highest found in the area covered by the count, which went up to Svartenhuk at around 72ºN.

It is likely that the density of Canada goose nests in the area between Sarfartoq and Kangerlussuaq is the same as the density at and to the north of Kangerlussuaq, while the density is probably much lower between Sarfartoq and Sukkertoppen Iskappe because of the latter area's height above sea level. In general, the density of Canada goose nests is low, and relatively few nesting biotopes are likely to be affected by the planned hydropower stations.

Impacts in the construction and operation phases

As in the case of the Greenland white-fronted goose, the most important breeding ground of the Canada goose it to the north of Sukkertoppen Iskappe. Transmission lines to Sisimiut could therefore affect breeding geese. It has not been determined whether a smelter established at Sisimiut would occupy any breeding grounds.

Only few breeding Canada geese have been observed in the Nordland area, and no surveys of breeding Canada geese at Maniitsoq have been made.

No important breeding grounds are assumed to be located close to the two southernmost hydropower stations (7d and 6g), but the area to the north of Sarfartoq (7e) may be important.

Canada goose: moulting areas

Just like the white-fronted geese, the non-breeding Canada geese start moulting in early July. The majority of these young birds probably come to West Greenland from North America exclusively to find suitable moulting areas. Over the 1990s, the moulting areas of Canada geese by and large became identical with the moulting areas used by Greenland white-fronted geese. In areas where both Canada geese and Greenland white-fronted geese moult, observations suggest that the white-fronted geese are forced away to areas where the quality of the food is not as good. Like white-fronted geese, Canada geese need to have moulting areas with lakes and rivers where the geese can be safe and find food enough for three or four weeks

In the moulting period, there are relatively high concentrations of birds in the areas, and they are vulnerable as they are unable to fly in this particular part of the year.

Data

Surveys of moulting white-fronted geese and Canada geese cover only the northernmost part of the SEA region. In this area, no moulting Canada geese were seen in the surveys carried out in 1992 and 1995. However, there are probably many moulting Canada geese in the area going from north of Kangerlussuaq to Sarfartoq, and possibly also several moulting birds in the inland area between Sukkertoppen Iskappe and Nuuk.

Until the transect flights were carried out in the region in late August 2007, there were no data indicating where the geese would stay between the end of the moulting period in early August and the autumn migration in mid-September. Fly-overs showed that the Canada geese would primarily stay in the area to the north of Kangerlussuaq, while only relatively few geese would stay in the area between Kangerlussuaq and Sukkertoppen Iskappe and the area to the south of the Iskappe. It is believed that only a few post-moulting feeding areas would be affected by the planned hydropower stations.

Remedial measures and additional studies and surveys

The moulting areas in the SEA region should be mapped, as the geese are very sensitive to disturbances in this period, as explained above.

Gyr falcon and perigrine falcon

Both falcon species are found in the study area. The perigrine falcon is quite common, while there are extremely few gyr falcons.

Data

The populations of both species are counted and monitored in the area close to Kangerlussuaq airport, but no relevant data have been published.

The perigrine falcon is relatively common throughout West Greenland and in large parts of East Greenland. It is protected in Greenland, and there are no immediate threats against it. There are relatively dense populations in several inland areas in low-Arctic Greenland. The perigrine falcon is not redlisted in Greenland.

On the other hand, there are extremely few gyr falcons. Gyr falcons are found throughout Greenland. They are basically resident birds and will be in the region throughout the year. The density of gyr falcons in the area is a couple of falcons per 570 km^2. The species is protected in Greenland, and there are no immediate threats against it, but as it is estimated that there are less than five hundred couples in Greenland as a whole, the gyr falcon is redlisted as 'near threatened' (NT).

Impacts in the construction and operations phases

Both species are sensitive to disturbances in nesting areas, but only a few couples are likely to be affected during the construction of the hydropower stations, just as an impact on the population as a whole is unlikely.

White-tailed eagle

The white-tailed eagle lives in coastal areas where food is abundant. It is a resident bird, which means that there will be eagles in the SEA area throughout the year.

Data

The white-tailed eagle is found in low-Arctic Greenland. The population is very small. At the latest count in 1990 it was estimated at no more than two hundred couples. The available data on the occurrence of white-tailed eagles in the study area are mainly related to Godthaab Fjord, where 37 territories of white-tailed eagles have been registered over the past thirty years. It is assumed that there is a similar density of territories in the area to the north of the registered area.

The Greenland white-tailed eagle differs morphologically from white-tailed eagles in other populations and is therefore considered to be an endemic (isolated) sub-species. The species is protected in Greenland, and there are no immediate threats against the population. However, because of the size of the population, the species is redlisted as 'vulnerable' (VU).

Impacts in the construction and operation phases

The white-tailed eagle is most vulnerable in the breeding period and when the chicks are very young (April to June), and disturbance close to the nest may easily cause the birds to leave the nest and give up breeding in that season.

Hydropower
It is unlikely that there are any breeding white-tailed eagles in the inland areas where the three hydropower stations are planned, as there is no suitable food in those areas. Consequently the establishment of the hydropower stations will not affect the white-tailed eagle population in the study area. However, it should be borne in mind that there may be eagle's nests in areas where transport corridors to the construction sites are established

Smelter
As the white-tailed eagles live close to the coast, there is a risk of conflict between one or two eagle territories and the location of an aluminium smelter. Eagle couples living very close to the smelter site must be expected to leave the area.

Remedial measures should first and foremost be a more 'considerate' use of areas in which eagles are known to breed.

4.5 Sea birds
Along the coasts of the study area there are numerous breeding colonies of sea birds. A varying number of sea birds breed in very limited areas in the summer months. The breeding couples often sit very close to each other, so close that the distance between nests in colonies of thick-billed murre and black-legged kittiwakes may be less than one metre. Some colonies may be very sensitive to disturbances, as large proportions of the populations may be affected.

The most numerous sea bird species that breed in colonies are great auks, glaucous gull and Iceland gull. These species are very common and numerous in Greenland and have many colonies in the region. None of these are particularly big, and the total populations of these species are therefore unlikely to be affected even in the case of major disturbance of individual colonies.

Thick-billed murre and black-legged kittiwake
The vulnerable colony-breeding species in the region are the species that are in decline in Greenland and that live in large, but relatively few colonies, which means that impacts on a single colony could potentially have an effect on the population as a whole. These species are primarily thick-billed murre and black-legged kittiwake.

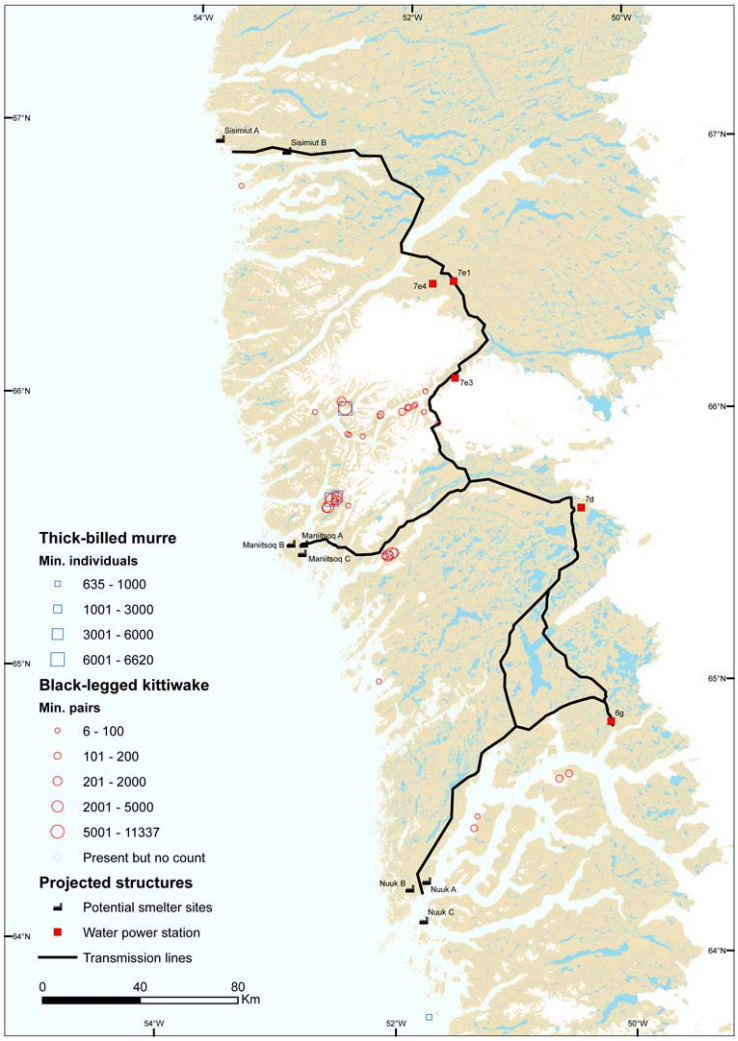
Data

The available data on the breeding colonies of sea birds in the region are good. The data are available in a database of bird colonies that contains all available historical data on sea bird colonies comprising more than five breeding couples. NERI updates this database each year.

In the region, there are several breeding colonies of thick-billed murre in the fjords in Maniitsoq municipality. These colonies account for about 3% of the total breeding population in Greenland (Figure 6). The protection status of the species is negative, and the species is redlisted as 'vulnerable' (VU). In the same colonies there are some breeding couples of the common murre species, which is listed as 'endangered' (EN). The thick-billed murre is found in 21 colonies along the entire coastline of West Greenland and in a few colonies in East Greenland. The total breeding population in Greenland is declining because of non-sustainable exploitation.

The fjords at Maniitsoq are very important for the black-legged kittiwake population in Greenland. In 2003, the population was counted to comprise about 32,000 birds, which is no less than one third of the total population in Greenland. In addition to these colonies in Maniitsoq, the region has some minor colonies in Godthaab Fjord (Figure 6). The black-legged kittiwake is very common in numerous breeding colonies along the ice-free coastlines in Greenland. The breeding population of this species is in decline in Greenland, but the causes are less evident than the causes of the decline in the thick-billed murre population. The black-legged kittiwake is therefore redlisted as 'vulnerable' (VU).

Figure 6
The distribution of breeding colonies of thick-billed murre (blue squares) and black-legged kittiwake (red circles) in the SEA area.



<u>Impacts in the construction and operation phases</u>
Transport corridors for ships and helicopters may have a disturbing effect. Fly-overs at low altitudes in particular will have a very disturbing effect on breeding colonies of thick-billed murre.

Smelter
There are neither thick-billed murre nor black-legged kittiwake colonies close to the proposed smelter sites, but where the transmission lines to Maniitsoq are established along the coast, they will pass breeding colonies including both thick-billed murre and black-legged kittiwake. It will in particular be in connection

with the installation of the transmission lines that there will be a risk of causing disturbance in the colonies.

Hydropower
The two southern hydropower stations are located in inland areas and their construction will not affect any sea bird colonies. If the hydropower station at Tasersiaq (7e) is established with an outlet into the Evighed Fjord (7e3), it might lead to increased ship traffic in the fjord, where both thick-billed murre and black-legged kittiwake colonies have been registered.

Remedial measures and additional studies and surveys
Ship traffic close to the colonies should take the presence of the colonies into consideration and helicopter and aeroplane traffic should be regulated so that low-flying aircraft and landing close to the colonies are avoided in the breeding period from 1 June to 15 September.

4.6 Fish

There are only four types of freshwater fish in Greenland: Arctic char, Atlantic salmon, three-spined stickleback and American eel. Of these four species, only the Arctic char is likely to be affected by the project.

In addition, lumpfish and capelin (ammassat) are described, because they have a certain economic value and could be affected by the project, as they spawn in the coastal zone.

Arctic char

The Arctic char is common in most rivers in the area and is also seen in lakes. There are two types: a type that spends its entire life in freshwater and a migrating type that spends the summer in the sea and the winter in freshwater where it spawns. The establishment of hydropower stations may obstruct the chars' migration and affect spawning and living areas. In addition, the flooding of areas may cause leaching of mercury, thus ensuing higher mercury concentrations in the fish in the lake. However, this effect will only be temporary.

Data
Only a few major Arctic char surveys have been conducted in the region: one at Buksefjord, another at Tasersuaq northeast of Sisimiut, and a third at Sarfartoq. In these three areas, only the char population in Sarfartoq will be affected by the project (see cumulative survey).

In addition, an interview-based study has been made on fishing resources in the shallow waters of West Greenland. This study was made in 1999 and covered the coast of Greenland from Paamiut to Aasiaat. Because of the relatively low number of respondents in the study as compared with the size of the area, it must be assumed that the study is not fully representative of the area.

Impacts in the construction and operation phases

Physical obstacles such as waterfalls and dams determine how far upstream the char can go in a river. Silt in the water does not reduce its occurrence, but the Arctic char needs clear water to spawn. In order for the Arctic char to survive in a river, there must be a certain amount of water in the river throughout the year, so that it will not freeze solid. The operation of a hydropower station will generally remove some of the water in a river, which may become critical for the char's survival in that river.

The establishment of a reservoir for the hydropower station will change the water levels in the lake used for water storage considerably, as water will constantly be tapped from the lake all around the year. As compared with the original situation, the water level after the spring thaw will rise more in the summer, while it will fall more in the winter. Part of the lake's shores will therefore alternately be dry or covered in water. The biological consequences may be that the Arctic char's spawning and living areas in the shallow water along the shore may be affected. Another implication may be that mercury concentrations in the lake increase temporarily, as mercury may be leached from flooded areas. This may result in temporarily increased mercury concentrations in the fish in the lake.

The river in Sarfartoq has a large char population. One of its tributary rivers drains the Tasersiaq lake. This outlet will be blocked if hydropower station 7e is established (see cumulative survey).

Remedial measures and additional studies and surveys

The destruction of a single population does not pose any threat to the total char population. However, a population that is important for local fisheries may be affected. It has not been investigated whether there are any char populations in the rivers affected by the two southernmost hydropower stations (7d and 6g). This should be clarified, just as the possible significance of any occurrence of Arctic char in relation to the total local char population should be determined.

It is possible to remedy the impacts of a hydropower station to a certain extent by ensuring that water will be led to the river even in critical periods. The inflow of water to the river from catchment areas other than the one used for hydropower generation would also contribute to increasing the level of water left in the river.

Lumpfish and capelin

Capelin (ammassat) is a small salmon that is very common in the fjords of Greenland. It is extremely important in the marine ecosystem because it constitutes a large proportion of the food of seals, toothed whales, sea birds and large fish such as cod and halibut. Within the region, the capelin swims to the coast to spawn in May-June and is then found in large shoals. The capelin is not fished on any commercial basis but is an important species for local 'household fishing'.

The lumpfish is common in southwest Greenland and in the study region. In the spring (May-June) it swims to the coast to spawn. It prefers specific locations where the fish gather to spawn. It is fished here because of its roe, which is sold, and the fishing of it is important for small-boat fishermen in several settlements. Most of the lumpfish fishing in Greenland takes place in this region, in particular in the Maniitsoq area.

Data

The interview study from 1999 described in the section about Arctic char also concerned capelin and lumpfish.

As far as capelin is concerned, more spawning areas were mapped in the municipality of Maniitsoq than in the municipalities of Nuuk and Sisimiut. This difference is probably not reflecting the real situation but is merely due to reporting differences. There are probably many other spawning areas in the municipalities of Nuuk and Sisimiut within the areas designated as important fishing areas.

With regard to lumpfish, both spawning areas and important fishing areas were mapped. It was not possible to distinguish between the two types of areas, and the authors of the report do not consider the mapping to be exhaustive. Most spawning and fishing areas in the region are located close to the open sea. The fjords are less important, with the exception of Godthaab Fjord and Fiske Fjord

Impacts in the construction and operation phases
Some filling or excavation of shallow coastal areas must be expected in connection with the construction of harbour facilities for the smelter. This may cause irreversible destruction of spawning places and habitats of both capelin and lumpfish. In the table, an 'I' indicates that a smelter location overlaps spawning/fishing areas identified in the interview survey, while 'I?' is used where no spawning/fishing areas were identified in the survey.

Both species are very common in Greenland, and impacts caused by this project are not expected to have any consequences for the population as a whole.

5.0 Conclusion

The establishment of a smelter will have major impacts in all three municipalities. However, most of these impacts can be reduced by means of remedial measures. Some of these measures will require prior studies or surveys, particularly where activity must be avoided in certain periods of the year, eg caribou calving areas and moulting areas for white-fronted geese. Both the studies and the remedial measures recommended are stated in the matrices in Annexes 1 and 2. The following sections set out for each of the three municipalities the aspects that are believed to be most important in terms of protecting the natural environment and wildlife when determining the location of the smelter. These aspects are marked in grey in the matrix.

Sisimiut

Greenland white-fronted goose and Canada goose. West Greenland is the only area where the Greenland white-fronted goose breeds, which is why Greenland has a special responsibility in relation to this species. The area to the north of Kangerlussuaq is generally important both for the Greenland white-fronted goose and the Canada goose. Consequently the specific importance of the area and the way it is used by these two species should be determined, so that activity can be avoided in staging and moulting areas in the relevant periods.

Caribou. The area between Itilleq and Sisimiut is of great importance to caribou. The establishment of a transmission line to Sisimiut through this area could affect migration between this area and inland areas. The construction of roads in the area would also increase the level of disturbance and increase hunting activity as a result of easier access to the area.

Rare plants. The establishment of transmission lines through an area at the bottom of Akugdleq, where it has been proposed to locate the transmission line from Sisimiut to Tasersiaq (7e) may cause irreversible damage of the habitats of a number of plant species, for which the SEA region is important in terms of their occurrence. It would be relatively easy to remedy this problem by mapping the occurrence of the rare plants in the area and then determine the exact location of the transmission line so that it will not affect those areas.

Maniitsoq

Thick-billed murre and black-legged kittiwake. If the transmission lines to Maniitsoq are installed along the coast, they will pass breeding colonies for both thick-billed murre and black-legged kittiwake, both of which are in decline in Greenland. It will in particular be in connection with the actual installation of the lines that the colonies may be disturbed. Disturbing activities such as the use of helicopters and large vessels close to the breeding colonies should therefore be avoided in the breeding season.

Nuuk

Caribou. Nordland (Akia) and Narssarssuaq to the north of Godthaab Fjord are core areas for caribou. The establishment of a transmission line to Nuuk would affect important feeding areas along most of the line. Furthermore, the establishment of a smelter in Nordland would mean a location relatively close to a town, which would increase the level of disturbance as a result of smelter-related activities and because of increased hunting resulting from increased recreational activities in the area.

No data are available as to whether caribou in Greenland follow certain migration routes throughout the year. If a smelter is located at Nuuk or Sisimiut, such data should be obtained. Furthermore, there are no systematic, direct studies of the reaction of caribou to, for example, transmission lines going through an area. If transmission lines are to be established through a core caribou area, such studies should be made. The impact on migration routes may be reduced by avoiding the blockage of narrow passages and by limiting activities to periods in which only few caribou are expected to be in the activity areas.