855 NINA Assignment notice

Impact assessment for Andmyran wind farm in Andøy municipality, Nordland - bedrock, vegetation, birds and other wildlife

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presentation

Andmyran Vindpark AS plans to develop a wind power plant on the north-eastern part of And island, in the marshy areas west of Ramsa and Breivik. A planning area of approximately 11.8 km is for investigation.[2] Consequences of any development on the natural environment were assessed by NINA's department for arctic ecology in Tromsø. Assessments have been made in relation to vegetation, bedrock, birds and other wildlife.

Factors assessed in connection with valuation are the degree of production and continuity, biological function, occurrences of threatened (red-listed) species, as well as rarity and threat to nature and vegetation types in the area.

For the topic of Quaternary and bedrock geology, few discoveries of a conservation nature were made. Some smaller areas of marine loose masses raise the value to small.

The landscape is totally dominated by wet nature types, where various bog types are the most common. An area in the southern part of the planning area is considered to have great natural value, as the area is covered by an intact, eccentric high bog. The nature type is assessed as valuable by the Directorate for Nature Management, and as a vegetation type, this type of high bog is assessed as highly threatened in the report on threatened vegetation types in Norway. A smaller, pristine high bog in the northern part of the planning area, east of Stor vatnet, is assessed to have medium nature value. The same value is given to a small area of medium-rich solid matter bog just east of Breivik. The intact rain marshes in the areas, as well as the aquatic vegetation in Storvatnet, are considered to have little natural value.

The planning area's overall value with regard to the bird fauna is assessed as medium. However, there is one area (close to Storvatnet) that is considered to be of great value. The reason for this is that an area with this type of nesting fauna is valued by the Directorate for Nature Management as valuable at national level. It is particularly the presence of nesting red-listed species that raises this value. Furthermore, one of two corridors for red-listed birds of prey, as well as a corridor for a pair of whooper swans and for small birds at Storvatnet will also be of great value. This is because they are completely dependent on moving between the nesting areas and the important hunting areas down by the coast and this happens at a height that is usually between 50 and 200 meters above ground level.
The last raptor corridor that runs between Sverigedalsvatnet and Breivika has a medium value.

The overall assessment shows that the greatest values are centered in the southern and northern parts of the planning area, and that the consequences of any development will be less serious for the central parts.

Abstract

Andmyran Vindpark AS plans to construct a wind park at the north-eastern part of Andøya, Nordland, at the bog-dominated flatlands west of Ramsa and Breivik. An investigation area of c. 11.8 km ^{2} is evaluated. Consequences of a construction are estimated by NINA's Depart ment of Arctic Ecology in Tromsø. Estimations are based on values of vegetation, geology, bird fauna and other fauna.

Aspects that were evaluated in relation to valuation is degree of production and continuity, biological function, occurrences of threatened (red-listed) species, in addition to rarity of nature types and vegetation types within the investigation area.

Few registrations of valuable geological characters were made. A few minor areas with marine sediments increase the value to minor.

The landscape is totally dominated by wetlands, of which various bog and fen types are the most common. A site in the southern part of the investigation area is estimated to have high biological value, because it is covered by an intact, ombrotrophic, asymmetric concentric bog. This nature type is considered as valuable by the Norwegian Directorate for Nature Manage ment, and in the report on threatened vegetation types in Norway, it is considered as endan gered. A less developed concentric bog in the northern part of the investigation area, east of Storvatnet, is considered to be of intermediate value. The same value is given to a small site consisting of moderately rich lawn fen slightly east of Breivik. The intact ombrotrophic bogs within the investigation area, as well as the limnic vegetation in Storvatnet is considered be of minor value.

The investigation area's total value with regard to bird fauna is considered to be intermediate. Nevertheless, there is a site close to Storvatnet which is considered to be of high biological value. The reason for this is that its type of breeding bird fauna is valuated by the Norwegian Directorate for Nature Management as valuable on a national scale. In particular, the occur rences of breeding red-listed species contribute to increase the value. Moreover, one of two flight corridors for red-listed raptors, as well as one corridor for a pair of breeding whooper swans and for red-breasted divers near Storvatnet, are also of high value. This is because these birds are totally dependent upon having the opportunity to move from their respective breeding areas to their important hunting areas by the coastline, and these movements gener ally take place at altitudes between 50 m and 200 m above ground. The last corridor for rap tors, which runs between Sverigedalsvatnet and Breivika, is of intermediate value.

The overall evaluation shows that the highest values are centred in the southern and the northern parts of the investigation area, and that the consequences of the planned construc tions will be less serious for the central parts.

Preface

NINA's department for arctic ecology in Tromsø has been commissioned to investigate the consequences for the natural environment in connection with the possible development of a wind farm at Andmyran in Andøy municipality, Nordland.
The owner of the initiative is Andmyran Vindpark AS.

We thank Professor Jakob Møller at Tromsø Museum for information on geological conditions, and Professor Karl-Dag Vorren at the Department of Biology, University of Tromsø for information on botanical conditions, as well as for the loan of aerial photographs and advice on useful literature. We also thank our colleagues at NINA in Oslo, Svein-Erik Sloreid and Lars Erikstad, for the GIS work.

The fieldwork for vegetation has been carried out by Jarle W. Bjerke, while Karl-Birger Strann, Vigdis Frivoll and Espen Bergersen have investigated the area's bird fauna and other wildlife.

Tromsø, 16 December 2004

Jarle W. Bjerke

Contents

1 Introduction

Like other man-made constructions in nature, such as power lines, roads and bridges, will
wind power plants could also affect the surrounding natural environment. Besides banding ground areas, can
The actual constructions and alignments from the wind power plants destroy and divide natural
plant and animal habitats both during the development itself and later during the operation of the facilities (see
for example Iversen et al. 2002).

The biggest advantage of modern wind power technology is the absence of polluting emissions. Accordingly
does the utilization of wind power have any negative consequences for the natural environment on a global scale and in general
the technology is considered a welcome contribution to the development of usable energy (see, for example, Bellona
1995). However, the actual development and operation of such facilities can have other consequences than for polluting
emissions and on a local scale such facilities can contribute to negative environmental impacts. Accordingly
it is pointed out in most impact assessments that deal with wind power development that local holdings can have a major
impact on the extent of any negative impacts. Local conditions such as
may be important are topography, occurrence and distribution of local plants and animals, human use
of the area, as well as local variations in weather, wind and light conditions (summarized by Clausager & Nøhr
1995).

Overall, existing studies (mainly from countries other than Norway) have demonstrated limited
negative consequences for the natural environment. This may in itself be a consequence of it being taken
consideration of local conditions during development; the "precautionary principle" has been used. However, you must
also note that such studies cover or have covered almost all aspects. Many surveys are only carried out for certain species or
groups of animals, or carried out for limited periods of time which consequently will not reflect consequences in all seasons or
cover all relevant weather,
wind and light conditions, the latter being particularly central when it comes to impacts on bird life.

The client Andmyran Vindpark AS (AVAS) is planning a wind power plant on Andøya, specifically Andmyran, and the Norwegian
Directorate of Water Resources and Energy (NVE) has ordered AVAS to carry out an impact assessment program where the
consequences for the themes of landscape, cultural heritage,
cultural environment, outdoor life and traffic, birds, other fauna, flora, noise and shadow casting, other land use,
infrastructure and societal impacts are assessed. NINA's contribution in this context is
analyzes of the natural environment, i.e. of geology, flora, birds and other wildlife. The analyzes are based on
data from inspections in the summer of 2004, satellite images, geological maps, geological and botanical databases, as well
as information from professional personnel and local acquaintances.

The consequences have been assessed for A) the wind farm with supply roads, B) the planned power line
transformer station at Tordalshågen and north to Storvatnet, as well as C) transformer station at
Tordalshågen by the road to Tordalsvatnet.

2 Method and data base

The following criteria, based on the Directorate for Nature Management's (1999a) handbook for mapping
nature types, has been followed for the valuation of localities and nature types within the survey area:

Degree of production. Nature types with high production lead to high densities and often high species richness.

Degree of continuity. Areas with high continuity have had stable ecological conditions for longer
time, and therefore provides conditions for specialized species and communities to develop.
Biological function. Areas with an important biological function are areas that fulfill key functions for populations in the area.

Occurrences of red list species. Red list species are species classified as particularly vulnerable. Most of the species on the
red list are classified in a threatened category, based on a destruction or reduction of
important habitats (Table 1).
Rarity / endangered nature. Nature types that have been exposed to significant reduction in recent years
time, as a result of man-made interventions and influences, falls under this criterion.

The data collection is designed so that we can characterize as many of the above as possible
the criteria. Furthermore, valuation of vegetation types has been assessed, among other things. based on the report on
threatened vegetation types in Norway (Fremstad & Moen 2001), as well as knowledge of regionally rare vegetation types.

Experienced field personnel examined the various nature types based on DN handbooks no. 13
(nature types, Directorate for Nature Management 1999a), 15 (fresh water, Directorate for Nature Management
2000), 11 (wildlife areas, Directorate for Nature Management 1996) and National Red List (responsible species and
red-listed species, Directorate for Nature Management 1999b). Nature types are classified based on NINA Te mahefte 12
(Fremstad 1998).

The national red list for threatened species (Directorate of Nature Management 1999b) deals with threatened species
species of varying degrees, see table 1. In addition, it deals with species for which Norway has a special responsibility
for because a large proportion of the species is in the country all or part of the year (Norwegian response species).

Table 1. Threat categories for red-listed species (according to the Directorate for Nature Management 1999b). The division is used in the text and in the tables below.

Code	Description
Ex (Extinct)	Species that are extinct as reproducing species in the country within the last 50 years. Ex? indicates species that have disappeared for less than 50 years ago.
E (Endangered)	Species that are directly threatened and that are in danger of extinction in the immediate vicinity future if the negative factors continue to operate.
V (Vulnerable)	Vulnerable species with a strong decline, which may transfer to the group directly threatened if the negative factors continue to operate.
R (Rare)	Rare species that are not directly threatened or vulnerable, but which are still in a vulnerable situation due to small populations or scattered ones and sparse distribution.
DC (Declining, care demanding)	Care-demanding species that do not belong to category E, V or R, but which, due to decline, require special considerations and measures.
DM (Declining, monitor species)	The category that should be monitored includes species that have declined, but which are not considered endangered. For these species there is a reason monitoring the situation.

The wind farms, supply roads, power lines and adjacent areas were investigated.

The area of influence will vary with which topics are affected. For vegetation and botany correspond
the area of influence the physically affected areas. For bird life, the area of influence is considerably larger, then
the wind farm can affect nesting birds several 100 meters from the nearest installation. Besides, will
migration through the area, both in the form of foraging, local movements and seasonal migration could be
affected by the plant. We have chosen not to define a limited area of influence, but discuss the consequences in chapter
6.

In this context, the zero alternative will correspond to the current situation, see chapter 5. In consequence assessments,
the zero alternative must describe the current situation, as well as any other measures in the area,
if the planned measure is not carried out.

Based on the area's natural value with regard to geological, botanical and zoological values, the consequence of the
measure is assessed using the following scale:

+4	Very large positive consequence
+3	Great positive consequence
+2	Medium positive consequence
+1	Small positive consequence
0	Negligible/No consequence
–1	Small negative consequence
–2	Medium negative consequence
–3	Big negative consequence
–4	Very large negative consequence

The scale is taken from the National Roads Administration's (1995) manuals on impact assessments, and the terminology from that is also used in this report.

2.1 Quaternary and bedrock geology

Geological assessments have been based on studies of geological maps of bedrock, Quaternary geology, geomorphology and loose masses, as well as searches in NGU's databases of geological resources (NGU 2004). These include overviews of ores, industrial minerals, deposits of natural stone and deposits of sand, gravel and crushed stone for construction purposes, as well as groundwater.

The purpose of the assessment has been to map any conflicts between the measures and protect worthy geological sites, or the development of deposits that may be of interest for extraction and the like, as well as geological formations that may provide distinctive vegetation. The areas are not traveled by a geologist in connection with this study, and the geological part is therefore not as extensive as the biological part. The conclusions must therefore be assessed based on this.

2.2 Vegetation and flora

The field work was carried out by Jarle W. Bjerke in the period 5-9 July 2004. Lists of registrants vascular plants and lichens were made. Vegetation and flora were also recorded with an emphasis on dominant species, character species, indicator species as well as rare and red-listed species. A species list for vascular plants is given in the appendix 1. The vegetation types are classified according to Fremstad (1998). The plants are checked against Norwegian flora (Lid and Lid 1994) and volumes published so far by the Nordic flora project (Jonsell et al. 2000, 2001). Rarity of vascular plants is assessed in relation to various literature sources where distribution is indicated (for example Hultén 1971, Gjærevoll 1990, Lid & Lid 1994, Engelskjøn & Skifte 1995). Lichens were checked against the Norwegian lichen flora (Krog et al. 1994), as well as specialist literature. Information about botanical records in the immediate area was obtained in advance of the field surveys from literature (for example Vor ren 1979, Buys 1992), through conversations with botanists with a lot of knowledge about Andøya, especially Karl-Dag Vorren (pers. comm.), as well as through a database of collected vascular plant material registered at the herbarium at Tromsø Museum (TROM). Access to these registrations is provided by Geir Mathiassen and Geir Arnesen at the museum. Parties directly affected by the measure were thoroughly re-examined. This includes marshes and water to the extent that they can be affected by changes in the water supply to the seal as a result of interventions.

Localization and findings of red-listed species follow as a separate attachment to the client. This information is exempt from public disclosure following reference to the Act on public disclosure in the administration, of 19 June 1970 no. 69 §5 and §6, point 2c.

2.3 Bird

The field work was carried out by Karl-Birger Strann and Vigdis Frivoll 18-20. June 2004. Furthermore Espen Bergersen did fieldwork in the period June 20-30. July 2004. Lists of registered birds was made.

The occurrences of birds as well as traces such as swallowtails etc. were recorded systematically. For each species, it is indicated what function the affected areas have and whether they are important for the species, or less important if the area did not have a particular function. Based on knowledge of the species

biotope requirements, areas suitable for vulnerable species were registered and the species composition mapped.

DN's method for game mapping was used to value the areas (DN handbook 11) on a scale from local to international value. Where several species overlapped, the area was given the corresponding value highest game value for the area plus one.

2.4 Animal life other than birds

The field work was carried out by Karl-Birger Strann and Vigdis Frivoll 18-20. June 2004. Furthermore did Espen Bergersen fieldwork in the period 20-30 June 2004. Occurrences of mammals were recorded at to look for trace signs such as excrement and marking sites, as well as den areas. Furthermore, all recorded activity of animals in the area was noted.

3 Area description — current situation

AVAS is investigating an area on Andmyran for possible locations for the establishment of a wind farm **(figure** 1). NINA has been asked to monitor a planning area of approximately 11.8 km ^{2} which covers the aforementioned investigation ning area (= plan area), as well as parts of the surrounding areas, especially to the west. Most of the plan area is covered by moisture-demanding nature types, and then mainly bogs, but also some ponds and rivers. In addition, the planning area borders two larger bodies of water, Torddalsvatnet and Stor vatnet. A smaller area is also arable land. In the vegetation atlas for Norway, the area is included in the middle boreal zone (Moen 1998). Typical of this zone is that bogs cover large areas, and especially so typical hill bogs. Division into vegetation sections is used to show the geographical variation between coast and inland, which is linked to differences in oceanicity, where the difference between summer and winter temperature, as well as humidity, are important climate factors. The planning area is located in its whole within the so-called clearly oceanic section, which is characterized by western vegetation types and species, but with weak eastern features, and climatically by many days of precipitation (Moen 1998).

The plan area is little used for outdoor activities due to the damp and difficult terrain to move in, few landscape-wise interesting formations, little production of berries, and otherwise a lot of mosquitoes the summer. Although mullein is a common plant on the moors, it does not seem to produce any returns importance. Very few fertile plants (plants with flowers or fruit) were observed during the inspections. Some thoroughfares are used to get to cabins, water and hiking terrain west of the planning area. Parts of the planning area are within Statskog's property.

3.1 Quaternary and bedrock geology

The plan area is mainly covered by organic material, i.e. peat, and rocks and loose masses is only present in places during the day, and then mainly as marine beach material, but with some patches moraine material (Flakstad et al. 1985, NGU 2004). Fluvial material is also present today in a small area along eastern parts of the Nordelva. Beneath the peat and Quaternary geological loose masses, the bedrock is i southern parts light gray gneiss with light feldspar, biotite and hornblende, while in northern parts it consists of gabbro and gabbronorite (NGU 2004). In the south-eastern part, as far as within the planning area, there are different ones types of siltstone and sandstone. The bedrock probably has little impact on the vegetation within the planning area, as the leachate that comes up during the day has probably not been particularly in contact with the bedrock. However, the loose masses can have a greater impact on the vegetation compositions. A disused mass roof (cf. NGU 2004) is found west of Breivika in the area with marine loose masses. There is also a mass roof in the far south-east, by Gårdselva.

Figure 1. Map of the planning area at Andmyran, Andøy municipality. Red line indicates outer branch see for plan area.

3.1.1 Valuation, Quaternary and bedrock geology

The value of the geological deposits is moderate. It is then especially the marine loose masses that are of most interest, but the areas with such material are small. Professor of Quaternary geology Jakob Møller at Tromsø Museum (personal communication, 30 November 2004) agrees with this assessment.

3.2 Vegetation and flora

3.2.1 General information about vegetation

The planning area forms part of the Andmyran bog complex. This is Norway's largest contiguous bog complex (Buys 1992). Parts of the bog complex are protected in two nature reserves located to the south-west and north of the planning area. The bog complexes on Andmyran have been well investigated in the past (Osvald 1923, 1925, Hornburg 1975, Vorren 1979, Buys 1992, Vorren et al. 1999), albeit without investigation fields within the plan area itself.

Bogs can be characterized on the basis of several criteria. Morphology, nutrient supply and vegetation composition are the main criteria, and these are often closely linked (Fremstad 1998, Norwegian Directorate of Nature Management 1999a). Morphologically, the bog complex on Andøya consists of so-called flat raised bogs, hill bogs and flark bogs. That is why the term mire complex is used, because the area consists of several different types of mire. High bogs are convex (vaulted), that is, they have their highest point in the center of the bog (concentric) or near one of the sides (eccentric). Hill bogs are sloping and are, so to speak, absent within the plan area, while flark bogs (= string bogs) are approximately flat with a large proportion of hedgerows. Intact high bogs are mentioned as a priority nature type by the Directorate for Nature Management (1999a). Vorren (1979) mentions that the best developed high bog element on Andøya is the Sellevollmyra at Myre. However, this marsh is not included in any of the protected areas on the island. In the largest conservation area, however, there are two smaller, more stylish elements that partly meet the need for the protection of oceanic marshes (Vorren 1979). Within the planning area we also find raised bogs. Some of these are then also shown on the Quaternary geological and geomorphological map for northern Andøya with the help of sketches of surface structures in bogs (Flakstad et al. 1985).

3.2.2 Detailed information on vegetation and flora within the planning area

The best developed raised bog within the planning area is the eccentric raised bog east of Leira between Gårdselva and Nordelva. The highest point is approximately at coordinate point UTMWGS84 WS 407 754. Parts of this high bog are also clearly visible on an aerial photograph of the area lent to us by K.-D. Voren. Otherwise, there are other, less clean high bog elements scattered northwards in the planning area, for example one directly east of Storvatnet and north of Kroktjørna, with the center at point WS 426 803.

High bogs are ombrotrophic bogs, or rainfall bogs, because the only added nutrients come from rainfall. They are characterized by a microrelief consisting of high tufts and relatively deep peat mud holes. These casings often form series in the direction of the slope, which function as drainage paths, troughs (Buys 1992). Ground bogs also have a nutrient supply from groundwater seepage.

When there is a large supply of nutrients, the moors become eutrophic, and are then often called rich moors, because a rich flora and plenty of nourishment. No bogs in the planning area are eutrophic, but mesotrophic bogs (with an intermediate supply of nutrients) are found. Precipitation bogs are called impoverished bogs in this respect, primarily because the nutrient supply is small, but the term can also indicate that species diversity is low.

In terms of vegetation, the plan area is relatively monotonous. The same vascular plants more or less dominate the entire area. Dwarf birch, mountain cricket and heather are dominant species on the highest tufts.
The contribution of lichens is large, mainly from the widely distributed species mountain reindeer lichen, gray reindeer lichen, spiny lichen, brown coral lichen, Iceland lichen, narrow Iceland lichen and large lichen. Here, heather moss is also a dominant species. In many cases, these tufts do not have access to the water in the peat below. The vegetation type is called ombrotrophic marshland (J2, Fremstad 1998), and with both the sedge-rust peat moss formation (J2a) and the dwarf birch-rust peat moss formation (J2b) present. Just a few centimeters lower, the tufts immediately become more moist and the content of peat moss increases. Here the lichen species disappear, while mullet, heather peat wool, and sedge are common vascular plants (ombrotrophic solid mat bog with sedge-stiff peat moss design, J3c).

Where the transition between tussocks and hedgerows is not very abrupt, you get some flatter moist soft mats, characterized by dysdry, dusty coal and narrow sun fog (ombrotrophic soft mat/loose bottom mire, J4). The ditches are often devoid of vegetation and deep. This particularly applies to the area between Gårdselva and Nordelva. The slightly shallower casings have elements or are completely covered by buckthorn leaves, dust coal, river coils and bottle-

large (river-reel swamp with river-reel design, O3a, or with bottle-reel design, O3b).
A few enclosures also have mountain thorn buds, while various mosses may cover the bottom.

In other words, large parts of the area are characterized by abrupt transitions from relatively dry tufts to vegetation-poor enclosures. However, four other vegetation types within the planning area should also are mentioned.

Bog types that receive a certain supply of nutrients through leachate have been observed in the upper part of the bog complex and in an area in the center of the planning area just south of the road to Sverigedalsvatnet. In the upper, western part of the planning area, there is a weak supply of nutrients through leachate from moraine material. This leads to elements of a number of other species than in the poor Hølje-Tue communities. Here you can find large ones quantities of rome, bluetop, carpet root and sweltstorr (northern version of poor solid mat marsh with bell heather-rome design, K3a), as well as more modest quantities of thread stork, spotted marigold, forest marigold and small tube channel. One individual of the orchid night violet was also observed. Night violet is a bit unusual, but is known from two other localities in the northern part of Andøya (Engelskjøn & Skifte 1995). The richer mire element in the center of the area (center at point UTM WS 218 784) has elements of character species (indicator species) such as mountain sedge, common sedge, thistle, mountain thistle, marsh leek, small sivaks, dwarf sedge, sheath size, special bus size and pasture size. The two latter greats often appear in so-called extreme kingdoms fixed mat ants (M3, Fremstad 1998), while the first six species often occur in medium-rich solid mat mires (M2), so it is most correct to characterize this mire area as medium-rich solid food mire, whose peat is rich in nutrients, probably with a pH of around 6-7. There is also some rum here, blue top, lifiol and thread stork. This area is nourished by leachate from the marine loose masses. Here, stones also stick up through the relatively thin peat cover as an indication of the influence of the loose masses below.

The registered bog communities within the planning area correspond well with those communities which has already been described from Andøya by Vorren (1979), Buys (1992) and Vorren et al. (1999). Vor ren (1979) listed nine different societies, Buys (1992) a total of 26 different societies, while Vorren et al. (1999) beat together part of the communities in regional classes to create a regional division of the marshes. Of them of the nine main units they arrived at, four were present on Andøya. Some are ombrotrophic, while others are mesotrophic (medium-rich), and the bog communities within the planning area largely fit into this the division. Some of the species that these authors mention as special to Andøya also became found within the planning area. This applies, for example, to pasture sorghum, lifiol, dys-dry, thread sorghum and small sivaks. However, other specially mentioned species, such as blue button **(Succisa pratensis),** sedge **(Carex pani cea),** lead sedge **(C. livida)** and cock's comb **(Lychnis flos-cuculi)** were not recorded within the flat area.

Along the visible waterways there is also another type of vegetation. Higher herbs and graminids grows here, for example wood stork's bill, meadow wort, swamp hawk's beard, norland's stork, goat rams, bitter gourd, silver pile, forest reed sedge, sheep's sedge, as well as a number of shorter-growing vascular plants such as gray sedge, forest marigold, blacktop, meadow sedum, kidney sedum and jablom. Birch also grows along the riverbeds depressions, and the vegetation type fits best under Fremstad's high-growth dove birch forest with tall perennial birch design (C2a), but with transitions towards other vegetation types, for example against river rapids-large swamps with nordlandstorr design (O3c) and against poor swamp forest with normal design (E1a).

In the slow-flowing, deep rivers, as well as in some adjacent waters and some coves, there are various vascular plants. Houseplants have already been mentioned above. In the rivers, especially Storeelva and Gårdselva, mountain thornbush, flot grass and horse's butt grow. In Storvatnet, several plants were found, among them yarrow, common sedge, grass sedge, wire sedge and stiff bream grass. Stiff bream grass is scarce collected north of the coast, but is known from three other waters on Andøya (Engelskjøn & Skifte 1995).

In the disturbed areas along the roads, near the fields and in the gravel roofs, a number of culturally dispersed species were found, i.e. plants that have directly or indirectly been helped by humans to spread and establishment. None of these are of particular importance.

A total of 144 vascular plant species were registered within the planning area. None of these are red-listed, and very few of them can be said to be locally or regionally rare (cf. mention of stiff bream grass and night violet above).

A number of stone-dwelling lichens grow on protruding mounds of loose masses. All the lichens examined are widely distributed species, for example, soll lichen **(Umbilicaria torrefacta),** gray colored lichen **(Parmelia saxati lis),** grain rag **(Ramalina polymorpha)** and grain brass lichen **(Xanthoria candelaria),** the latter two character species for the type of vegetation called epilithic lichen vegetation with a gritty texture (R7e), a type of vegetation dependent on manure from birds. The most interesting recorded lichen is the Nor mørslav **(Cornicularia normoerica) ,** which is not found much further north on the coast (cf. Timdal 2004). A few individuals were observed within the planning area, but much larger populations remained observed on the mountains above the plan area.

3.2.3 Valuation of vegetation and flora

The plan area's value with regard to vegetation and flora is assessed as medium to large **(figure** 2). The basis for this is the presence of nature and vegetation types that are considered valuable at the national level. As mentioned above, intact high bogs are assessed as valuable by the Directorate for naturforvaltning (1999a), this because it is a rare nature type. Furthermore, the arguments apply to the ecological function of the marshes with many specialized species, and the landscape ecology of the marshes function. In an international context, Norway has a special responsibility for the nature type, which is very important rare in Europe (Directorate of Nature Management 1999a). The directorate particularly emphasizes the importance of intact high bogs of over 50 acres. The eccentric high bog east of Leira is about 1.25 km long and 0.5 km wide, and is thus far larger than 50 acres. The value of this marsh is assessed as large, while the less clean high bog at Storvatnet is assessed as medium. The value of raised bogs and rain bogs are further highlighted in the report on threatened vegetation types in Norway (Moen et al. 2001). High bogs without edge forest, such as those on Andøya, come under the term "Terrein-covering". mire and other oceanic precipitation mire" (Moen et al. 2001). This type of vegetation is considered as highly endangered (EN). The scale used for the threat of vegetation types is somewhat different to that presented for red list species (see Table 1). Threatened vegetation types are divided into the acutely threatened categories (CR), highly threatened (EN), somewhat threatened (VU) and demanding attention (LR), see Fremstad & Moen (2001), and this division is based on global red list criteria.

The vegetation type "Terrain covering bog and other oceanic precipitation bog" includes high bogs (see above) and ground-covering mires in a narrow sense. The latter are characterized by the fact that they cover the landscape, both flats and ridges, like a carpet (Directorate of Nature Management 1999a). We have assessed whether the large marsh areas within the planning area should be considered as so-called ground-covering marshes. For example, the intact marsh areas on Stadshavet between Breivik and Sto river, as well as the areas between Tordalshågen and Stiksåa, tend to cover the terrain.
But as loose masses stick up from the bogs, these bogs do not satisfy the criteria to stay characterized as ground-covering. Over time, at least in the event of increased rainfall, these marsh areas may have the potential to develop into real ground-covering marshes as described by the Directorate for Nature Management (1999a). The values of these moors are assessed as small **(figure** 2).

Medium-rich solid food marshes have also been assessed by Moen et al. (2001). They consider the type of vegetation to somewhat threatened, but only includes the bogs north to the southern boreal zone, as these are somewhat more threatened and area-wise more limited than corresponding bog types further north. The bog type is nevertheless regionally rare. The value of the small field with such vegetation just north of Stiksåa is therefore assessed as medium **(figure** 2), and its value is somewhat reduced by the interventions that have been made to the north (road), east (cultivated land) and west (mass extraction) for the marsh area.

Storvatnet has a relatively species-rich flora and the value of the water, as well as adjacent marsh and swamp areas is considered small **(figure 2).** Only a very small part of this area lies within the planning area. However, it must be noted that encroachment on the marshes immediately east of Storvatnet may be due to run-off affect the water itself.

In other words, it is mainly the eccentric high marsh elements within the plan area that contributes to the area's high natural value. It is especially the marsh east of Leira, but also to a certain extent the marsh area east of Storvatnet, which is included in the high marsh category.

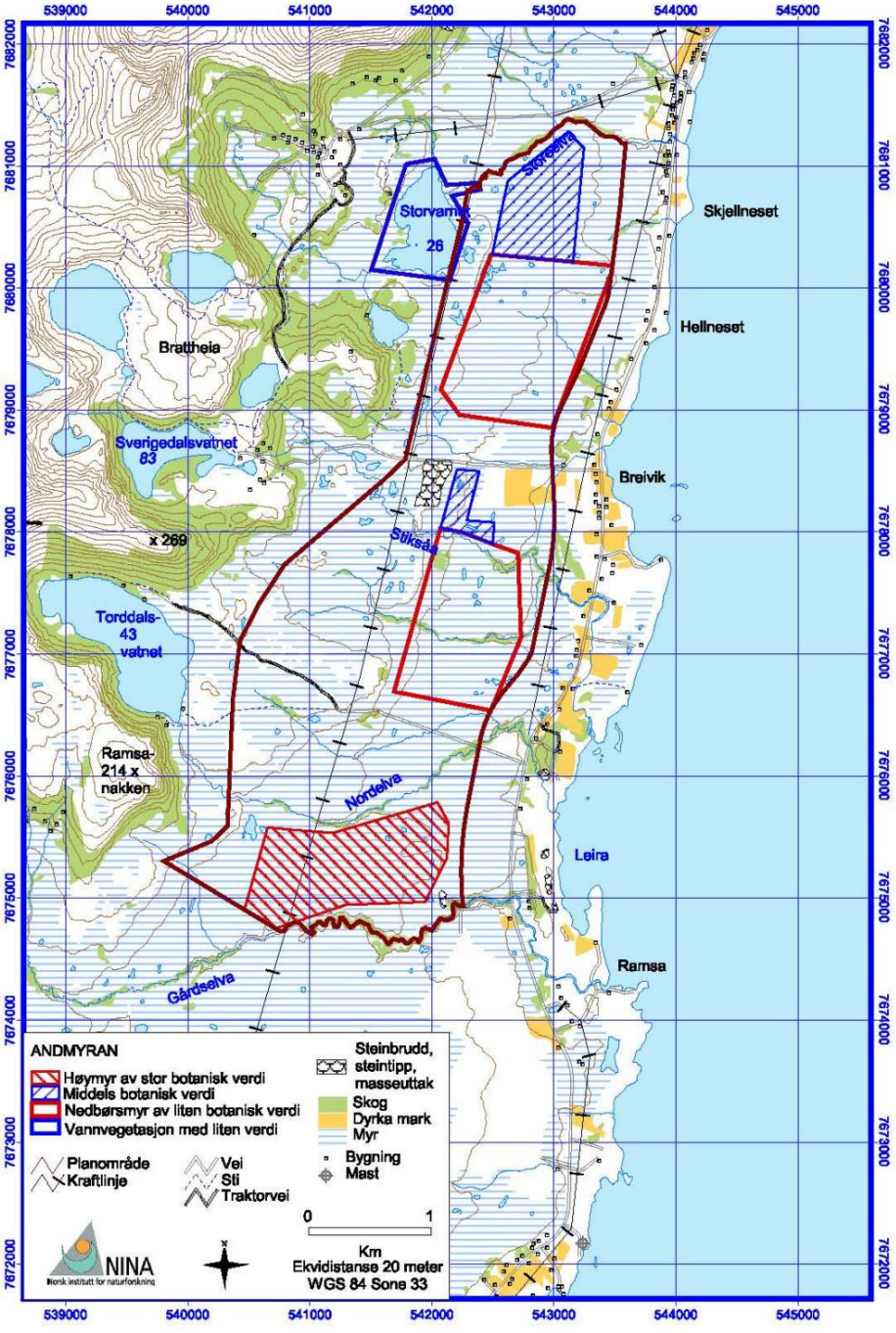

Figure 2. Areas with high, medium and low natural value with regard to botany within the plan area and adjacent areas.

3.3 Bird

The large marsh areas found on Andøya have a rich fauna of wetland birds in some places.
In particular, birds associated with freshwater such as ducks, loons and waders make up the most important groups. In addition, the edge zones between the marsh areas, cultivated land and the shore have significant

arrivals of birds. This then provides good living conditions for birds of prey, which largely nest in connection with the larger mountain massifs located in the center of the island. Three nesting pairs of red-listed birds of prey have been detected, all nesting just outside the study area. All three pairs largely use parts of the study area for hunting or as important flight corridors on their way to and from the breeding areas **(figure** 3, K1-K3). The investigation area is also the main corridor when they fly to and from other hunting areas that are further away. Especially during the fledging period in May and until the beginning of June, these corridors are used many times a day by both parents.

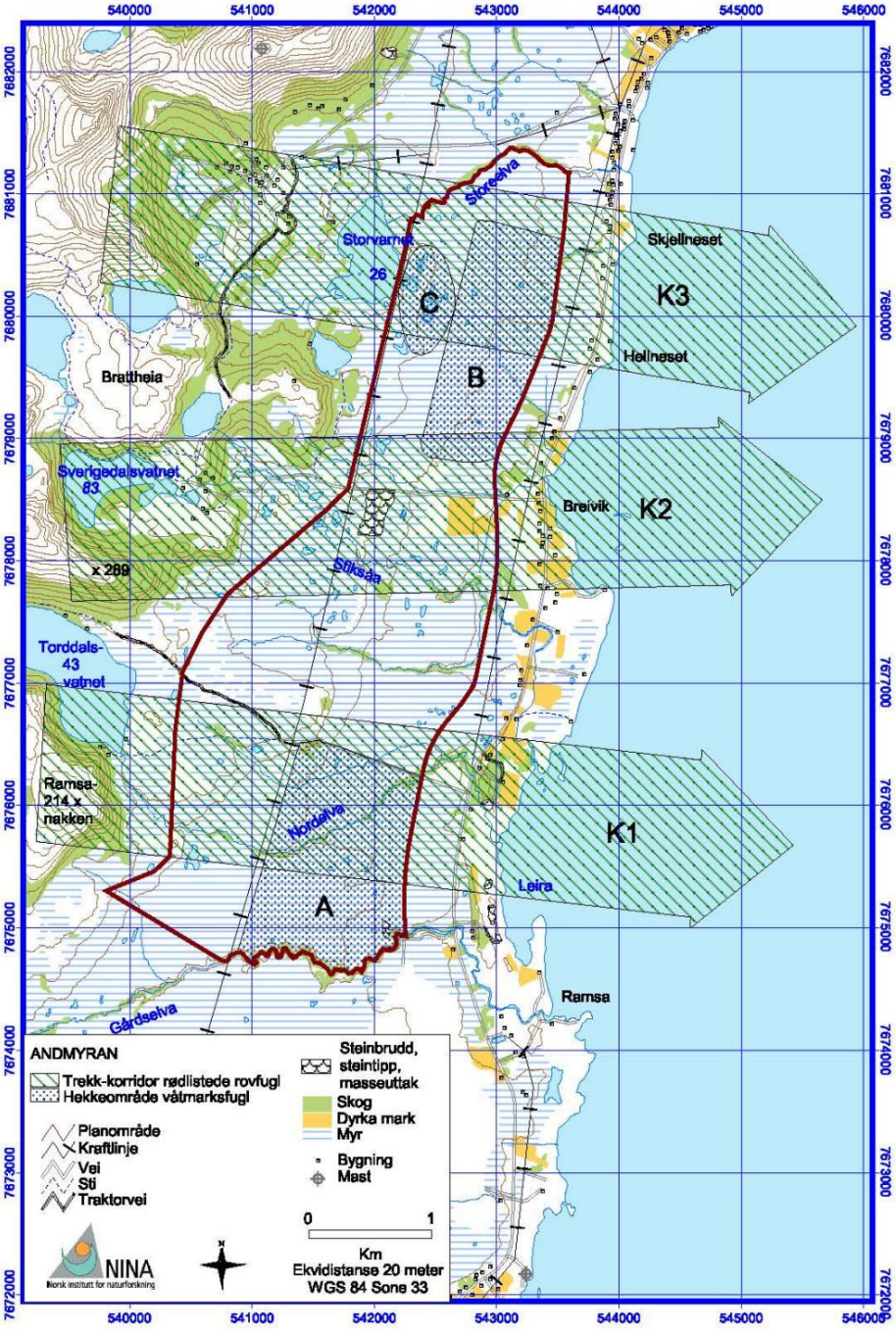

Figure 3. Areas of high and medium nature value with regard to birds within the planning area and adjacent areas.

During the spring and autumn migration, many birds roost both in the riparian areas (waders) and on marshland and farmland (geese). However, this only occurs to a lesser extent within the study area. The is, however, one area that stands out here. The whooper swans that breed on Lake Storvatnet (outside the study area itself) move in the spring many times a day between the lake areas around Breivika and Storvatnet. This primarily applies to the period it is still in ice covering the important grazing areas in the water. This trait diminishes strongly as soon as the swans begin to incubate and while they have young.

The birdlife in the study area is consistently relatively poor, but with three smaller areas that stand out as important nesting areas. One area is in the south-east part of the study area, around Nordelva **(figure** 3, area A). A number of species breed here waders and small birds (red-listed as sensitive). The second area is located in the far north east, directly west of Hellneset **(figure** 3, area B). This area also has a rich nesting fauna dominated by waders. The last area is directly west of this second area and adjoins it towards Storvatnet, which lies just outside the boundary of the study area **(figure** 3, area C). This last area has a number of nesting pairs of grebes, ducks and waders and is the richest of all three identified areas. Thieves breed scattered throughout the study area, but mostly as single couples.

3.3.1 Valuation of bird life

The planning area's overall value with regard to the bird fauna is assessed as medium. However, it is one area (the area close to Storvatnet) which is considered to be of great value **(figure** 3, area **C).** The reason for this is that an area with this type of nesting fauna is valued by the Directorate for Nature Management (DN 1996) as valuable at national level. It is particularly the occurrence of nesting red-listed species that raises this value.

Furthermore, one of the two corridors for the birds of prey **(figure** 3, K1) as well as the corridor for the pair of whooper swans and the little loons at Storvatnet **(figure** 3, K3) will also gain great value. This is because they are completely dependent on moving between the nesting areas and the important hunting areas below the coast and this happens at a height that is usually between 50 and 200 meters above ground level. The last raptor corridor that runs between Sverigedalsvatnet and Breivika **(figure** 3, K2) has medium value.

3.4 Other wildlife

With the exception of a few elk cows with calves, no important occurrences of game other than venison have been detected bird within the study area. Admittedly, the occasional otter (red-listed that should be monitored) occasionally migrates along the Nordelva and several of the smaller rivers and streams in the area. However so little trace of this species was detected that we do not consider the area of investigation to be that important for the species. Nor have large densities of small rodents or gray cats been detected, although all of them are acts regularly within the area of investigation.

3.4.1 Valuation of other wildlife

The planning area's overall value for mammals is considered to be small.

4 Impact assessments

4.1 Consequences on Quaternary and bedrock geology

The assessment applies to the sub-theme collectively for all types of interventions, both in the operational and construction phases. The con sequences are small, and Jakob Møller (personal communication) does not consider the geological conditions as an obstacle to the implementation of the measures.

4.2 Consequences on vegetation and flora

Important factors when assessing the consequences of the interventions are the direct reduction of vegetation types and habitats, erosion over time where vegetation is damaged or removed, as well as drainage or changes in water supply, particularly from bogs and vegetation affected by moisture.

Degradation of habitats involves a negative consequence that is linked to both the construction and operational phases. In general, the construction phase will have a larger scope than the operational phase. The construction phase for the various measures will result in a larger area being exposed to wear and tear through the use of machines, digging and landfills. This activity can also form the basis for increased erosion damage over time. During the operational phase, traffic will be concentrated on the then developed units. Terrain with abrasion damage from the construction phase will be able to be re-established during the operation phase.

The operational phase of the wind farm will nevertheless also involve an increased use of the areas that are close to roads and installations compared to current use (the zero alternative), for example in the case of increased traffic from the roads, maintenance work, etc.

During the construction phase, new habitat will also be created for plants that are adapted to disturbances.
Road cuttings are a typical such "culturally conditioned" habitat. Such newly created habitats will over time undergo a change in species composition towards a more stable community, if no new disturbances occur. The local ecological conditions determine, among other things, the time perspective in this process.

The negative effect that a change in water supply to moisture-dependent vegetation entails is particularly linked to the operating phase. It is the established facility, for example a permanent road, that leads to the changed environmental conditions. This gives visible results often only after a longer period of time.
Drainage of bogs can, however, be linked to activities during the construction phase, for example in the form of tracks where water erosion over time can dig the track even deeper and the tracks "moat" the bog.

Changes in local climatic conditions due to wind towers can also have an effect, for example by changes in snow distribution and the subsequent effect on the snow bed, riparian vegetation etc. However, the concrete implications of this and potential consequences have not been studied previously and are not assessed here.

As the scope of the measure will entail extensive construction of roads, the risk of draining marshes, as well as the construction of wind towers, the scope of the measure will be considered large. Due to the medium to high nature value of the planning area, the measure is considered to have a major negative impact on vegetation and flora within the planning area if no mitigating measures are implemented. Trenching and other interventions mentioned will lead to direct, visible damage and changes at and close to the damage sites. Moreover, the lowering of the groundwater causes less visible changes that can be felt far from the damage sites, and in the worst case destroy the rain bogs as functioning hydrological systems (cf. Moen et al. 2001). Visible changes in vegetation can occur over time, and drainage will lead to the establishment of less moisture-demanding vegetation types. Furthermore, pollution from motorized traffic and the release of nutrients from loose masses during overturning and extraction can lead to an increased supply of nutrients, which is a particular threat to the nutrient-poor environments that the rain bogs represent.

Drainage in the vicinity of Storvatnet can reduce the natural value of the water. The water is dammed up by the loose masses which lie as a line approximately 200 meters east of the water. Leachate from the bogs in the middle lom flows down to the water, and not to the sea or the rivers.

4.3 Consequences bird

When assessing the possible consequences of the wind power plants on birdlife, it will be natural to distinguish between birds that pass the area during the spring and autumn migration, and birds that live in the area (possibly passing the area in the morning and evening to and from grazing areas and resting places). Such "permanent" birds can either be individuals that nest in the area or use it as a resting and/or grazing area. Some species also stay within the same habitat all year round, while others have more separate winter and summer areas. The reason why consequences are assessed after such a division is that studies have shown that local species have to a certain extent the opportunity to adapt to the newly established constructions, in contrast to migratory species that only

pass the wind power plants once or twice a year (Meek et al. 1993; Dirksen et al. 1998).
It has also been shown that birds that stay sporadically near wind turbines will easily be able to
are frightened by the installations (Clausager & Nøhr 1995).

A wind power plant can directly affect birdlife through an increased risk of collision between flying birds and the wind turbines themselves, destruction and fragmentation of the habitat, as well as negative
affect the local breeding population through reduced breeding success near the facility. One
Wind power plants, on the other hand, can also have indirect effects through disturbances during development
and/or during normal operation of the facilities displaces the birds from their habitats. An increased but dangerous activity
at the facilities can also destroy habitats through wear and tear on the vegetation (Crockford 1992).

Within the study area, a full-coverage wind farm could have a negative impact on
the nesting, red-listed birds of prey in the Ramsanakke area and the pair of whooper swans on Storvat net. We believe that the greatest negative effect will occur in the southernmost part of the study area
between Ramsanakken and Leira. Here is a moderately important nesting area for wetland birds
at the same time as an important flight corridor for two pairs of red-listed day birds of prey crosses the area. We consider the least conflicts to be in connection with the corridor between Sverigedalsvatnet
and Breivika.

However, professional reservations must be taken as to how serious any consequences will be as a result
one has only a small amount of knowledge about how several of our northern Norwegian nesting bird species
responds to wind turbines. We know particularly little about possible conflicts between birds and wind turbines in
dark time. It is possible that a species such as the white-tailed eagle that lives in the same area all year round will be able to to adapt to the windmills, while a species such as small lom that only stays in for a couple of months
breeding season, will have bigger problems.

4.4 Consequences other wildlife

The development of a wind farm will probably not have major negative consequences for anything else
wildlife. The incidence of mammals is low and no important functional areas for mammals have been identified within the study area.

5 Mitigation measures and follow-up investigations

5.1 Vegetation and flora

Considering the vegetation, and thus also the bird life in most contexts, it is general
important to avoid obstruction of natural drainage and to limit erosion damage from roads.

Use of already existing access roads will help to reduce some of the negative consequences. There is the greatest negative consequence associated with interventions that directly or indirectly affect the two aforementioned eccentric raised bogs, the one west of Leira and the one east of Storvatnet. By letting the areas of high and medium value, shaded in **Figure 2** remain intact, the negative consequences of the measure will be reduced considerably. If these areas are spared, the intervention is considered to be minor negative consequence.

Local climatic changes and their significance for the vegetation due to the wind towers are rather
not investigated as knowledge about this is very deficient. It is desirable that these aspects are discussed on a general basis.

5.2 Birds and other wildlife

For nesting birds of prey, the most vulnerable area is in the far south in the area between Ramsanakken
and Clay. Here one should avoid placing mills south of Torddalsvatnet. For nesting waterfowl i
Storvatnet and the adjacent wetland area just to the east will see a deployment of wind turbines in

immediate proximity could also have a negative effect. However, very little is known about the effects of windmills on many of our bird species. Knowledge about effects on birds is particularly lacking of wind turbines from areas with dark hours. It is not known how poor light conditions can affect the possibility of detecting the moth wings in time.

Studies that will reveal how the various vulnerable species use and do not use the study area at least how and at what height the raptors and whooper swans move through the flight corridors will be able to provide knowledge about how the individual wind turbines should be placed.

6 Conclusion

In the tables below, the consequences are distributed among the sub-themes, in relation to construction and operation as well as the following measures: A) the wind farm with supply roads, B) power line between the substation and the existing network and C) substation with service building. The consequences are assessed both without and with proposed mitigation measures.

6.1 General description of situation and characteristics

The value of the area is assessed as medium to large for vegetation/flora and medium to large for birdlife. For vegetation, there is an endangered nature type, as well as vegetation types of regional value, while there are instances of red-listed bird species: three pairs divided into two species of diurnal birds of prey, small loons and singing swan. The area has no special values related to geology or wildlife other than birds.

6.2 Summary table Quaternary and bedrock geology

None of the geological deposits have values that entail particularly negative consequences degree. The substation and the power line are planned to be filled with loose material during the day, which can be imagined utilized in the future, but probably of little value.

	Construction	Drift
A) Park and road		**–1**
B) Line of force	**phase –1 –1**	**–1**
C) Transformer station	**–1**	**–1**

6.3 Summary table of vegetation and flora

There are great botanical values in the area in the form of a large, intact, eccentric high bog, a natural type which is considered endangered. Furthermore, a smaller, more pristine high bog in the northern part is assessed to have medium value. A smaller area of mesotrophic bog vegetation is also considered to have medium value. Large, intact areas with gently sloping and in some places slightly domed rain marshes are considered to have little value. It the aquatic flora in Storvatnet is considered to have the same value; this area is mainly outside planning area. The proposed power line between Tordalshågen and Storvatnet partly affects the latter area. As a mitigating measure, it is proposed to avoid interventions in the areas of high and medium nature value (cf. Figure 3).

	Without mitigation measures		**With mitigating measures**	
	Construction phase		**Construction phase**	**Operation**
A) Park and road	**Operation –3**	**–3**	**–1**	**–1**
B) Line of force	**–1**	**–1**	**–1**	**–1**
C) Transformer station	**0**	**0**	**0**	**0**

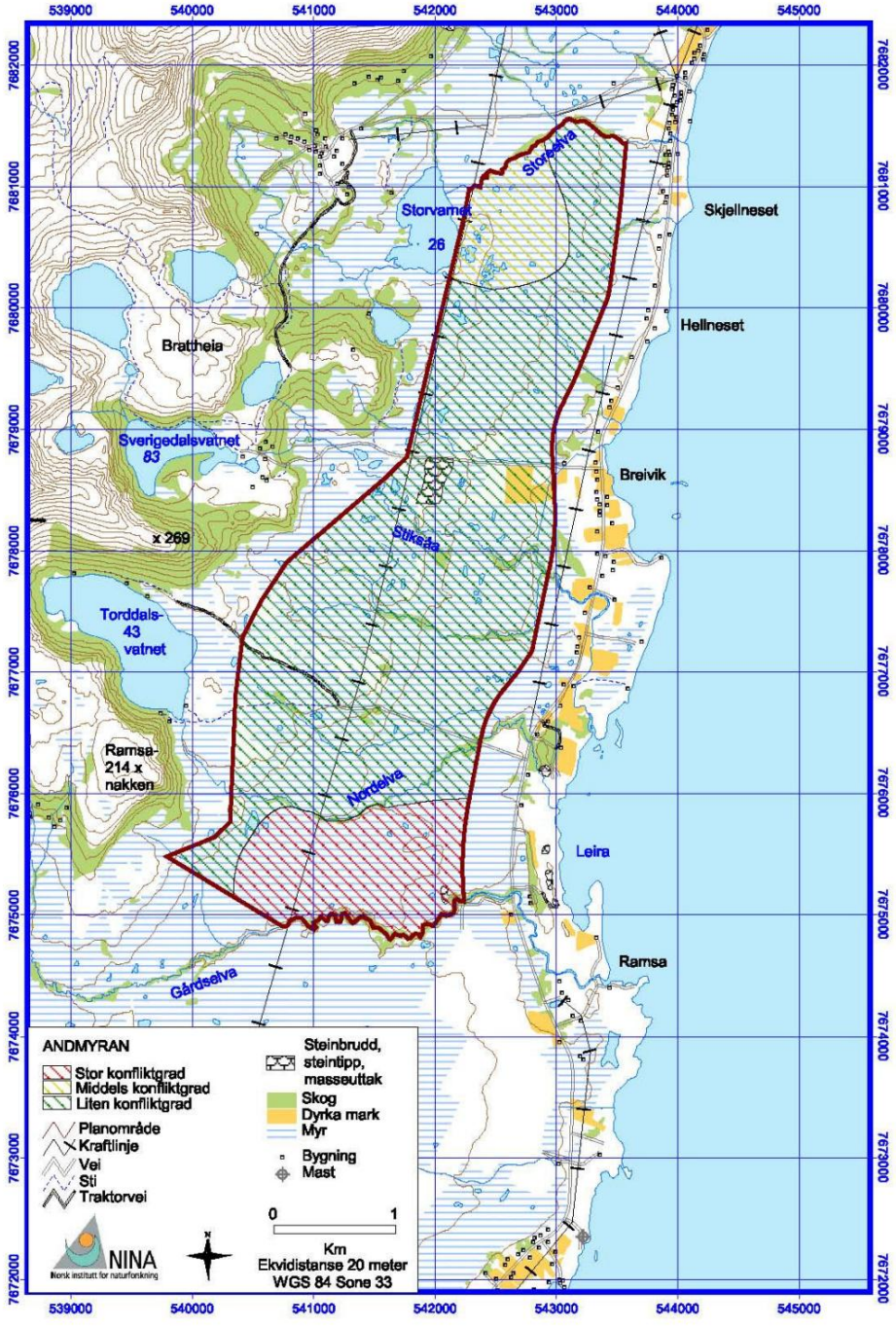

Figure 4. Overall assessment of areas of high nature value within the planning area based on all types of registration.

6.4 Summary table bird

There are great values for birds in the study area's southern part around Nordelva and in the far north in the area around Storvatnet. In the area between Sverigedalsvatn and Breivika there is a medium value for birds. However, there is uncertainty related to the individual species' use patterns of

ning area. Only time studies can provide such information. The indicated figures in the table below must therefore be taken with reservations.

	Without mitigation measures		With mitigating measures	
	Construction phase	Operation	Construction phase	Operation
A) Park and road	–2	–3	–1	–1
B) Line of force	–2	–2	–1	–1
C) Transformer station	0	0	0	0

6.5 Summary table other wildlife

No greater values in terms of wildlife other than birds have been detected in the area.

	Without mitigation measures		With mitigating measures	
	Construction phase	Operation	Construction phase	Operation
A) Park and road	0	0	0	0
B) Line of force	0	0	0	0
C) Transformer station	0	0	0	0

6.6 Overall assessment

Based on our records of botanical, zoological and geological values, we have generated a map showing the biggest areas of conflict between planned development and the natural environment **(figure** 4). we see that it is especially in the northernmost and southernmost parts of the planning area that we find the largest the conflicts. Centrally, the conflicts are smaller.

7 References

Bellona 1995. **Wind power.** Fact sheet no. 7, Bellona, Oslo.

Buys, E. 1992. Mire morphology, vegetation and hydrochemistry of the Andmyran mire reserve. **Tromura Natural Science** 70: 1-164.

Clausager, I. & Nøhr, H. 1995. **The impact of wind turbines on birds. Status of knowledge and perspectives.** Academic report from DMU, no. 147. Denmark's Environmental Studies, Copenhagen.

Crockford, N.J. 1992. **A review of the possible impacts of wind farms on birds and other wildlife.** Joint Nature Conservation Committee Report No. 27, Peterborough, Storbritannia.

Directorate for Nature Management 1996. **Wildlife mapping.** DN handbook 11. Directorate for Nature Management, Trondheim.

Directorate for Nature Management 1999a. **Mapping of habitat types - valuing biological diversity.** DN handbook 13. Directorate for Nature Management, Trondheim.

Directorate for Nature Management, 1999b. **National red list for threatened species in Norway 1998.** DN report 1999-3. Directorate for Nature Management, Trondheim.

Directorate for Nature Management, 2000. **Mapping of freshwater locations.** DN handbook 15. Directorate for Nature Management, Trondheim.

Dirksen, S., van der Winden, J. & Spaanes, A.L. 1998. Nocturnal collision risks of birds with wind turbines in tidal and semi-offshore areas. I: Ratto, C.F. & Solari, G. (red.): **Wind energy and landscape.** AA Balkema, Rotterdam.

Engelskjøn, T. & Skifte, O. 1995. The vascular plants of Troms, Northern Norway. Revised distribution maps and altitude limits after Benum: The flora of Troms Fylke. **Tromura, Natural Sciences** 80: 1-227.

Fremstad, E. 1998. **Vegetation types in Norway.** 2nd edition. NINA Theme booklet 12. Norwegian Institute for natural research, Trondheim.

Fremstad, E. & Moen, A. (ed.) 2001. **Endangered vegetation types in Norway.** NTNU Science Museum Report Botanical Series 2001-4. Norwegian University of Science and Technology, Science Museum, Trondheim.

Gjærevoll, O. (red.) 1990. **Maps of distribution of Norwegian vascular plants, volume II. Alpine plants.** The Royal Norwegian Society of Sciences, Trondheim.

Hornburg, P. 1975. **Record of conservation fens and wetlands. 45. The bogs in the area Skogvollvatnet – Arnipa – Sauravatnet in Andøy municipality.** Unpublished report, Department of Environmental Protection, Oslo.

Hultén, E. 1971. **Atlas of the distribution of plants in the Nordic region.** 2nd edition. The General Staff's lithographic institution publishing house, Stockholm.

Iversen, M., Strann, K.-B., Systad, GH, Tombre, I. & Tømmervik, H. 2002. **Consequence rescues for four wind farms in Finnmark: Skallhalsen wind farm, Vadsø municipality.** Norwegian Institute for Natural Research, Department of Arctic Ecology, Tromsø.

Jonsell, B., Karlsson, T., Agestam, M., Bygren, N., Hultgård, U.-M. & Persson, E. (ed.) 2000. **Flora Nordica vol. 1,** Lycopodiaceae **to** Polygonaceae. The Bergius Foundation, The Royal Swedish Academy of Sciences, Stockholm.

Jonsell, B., Karlsson, T., Agestam, M., Bygren, N., Hultgård, U.-M. & Persson, E. (ed.) 2001. **Flora Nordica vol. 2,** Chenopodiaceae **to** Fumariaceae. The Bergius Foundation, The Royal Swedish Academy of Sciences, Stockholm.

Krog, H., Østhagen, H. & Tønsberg, T. 1994. **Low flora. Norwegian shrub and leaf lichens.** University forla go, Oslo.

Lid, J. & Lid, DT 1994. **Norwegian flora.** 6th edition at Reidar Elven. The Norwegian Association, Oslo.

Meek, E.R., Ribbands, J.B., Christer, W.G., Davy, P.R. & Higginson, I. 1993. The effect of aero generators on moorland bird populations in the Orkney Islands, Scotland. **Bird Study** 40: 140-143.

Moen, A. 1998. **National atlas for Norway: Vegetation.** The National Map Agency, Hønefoss.

Moen, A., Skogen, A., Vorren, K.-D. & Økland, RH 2001. Bog vegetation. In: Fremstad, E. & Moen, A. (ed.): **Endangered vegetation types in Norway,** pp. 105-124. NTNU Science Museum Report Botanical Series 2001-4. The Norwegian University of Science and Technology, Science Museum, Trondheim.

NGU 2004. **The bedrock geology database.** Available at www.ngu.no/kart/bg250.

Osvald, H. 1923. Die Vegetation des Hochmoores Komosse. Uppsala. **Swedish Plant Sociology Proceedings of the Society** 1: 1-436.

Osvald, H. 1925. Zur Vegetation der ozeanischen Hochmoore in Norwegen. **Proceedings of the Swedish Plant Sociology Society** 7:1-106.

Norwegian Public Roads Administration 1995. **Consequence analyses.** Norwegian Road Administration Handbook-140, part I-III. State's Norwegian Road Administration, Directorate of Roads, Oslo.

Timdal, E. 2004. Norwegian lichen database. Available at http://www.nhm.uio.no/lichens (Last updated 19 November 2004).

Vorren, K.-D. 1979. Bog inventories in Nordland, Troms and Finnmark, summer 1976, in connection with the Norwegian bog reserve plan. **Tromura Natural Sciences** 3: 1-118.

Vorren, K.-D., Eurola, S. & Tveraabak, U. 1999. The lowland terrestrial mire vegetation about 69°N lazy. in northern Norway. **Tromura Natural Science** 84: 1-90 + 13 tables.

8 Appendix

Appendix 1. Vascular plants registered during inspection of the planning area for Andmyran Vindpark AS at Andøya, Andøy municipality, Nordland. Scientific and Norwegian names mainly follow Norwegian flora (Lid & Lid 1994). Registrations are divided into three areas within the planning area, called South, Central and North. Area Sør extends from the southern border along Gårdselva north to Tordalshågen (roughly equal to UTM line 770 north). Area Central extends from UTM line 770 to point 51 m above sea level due south for Nakkevatnet (UTM 795 north). Area North covers the remaining part of the planning area, i.e. north to northern border that crosses the Storeelva (UTM 812 north).

Scientific name	Norwegian name	Territory South	Territory Central	Territory North
Huperzia selago coll.	Louse grass	X	X	X
Lycopodium annotinum coll.	Stiff crow's foot	X	X	X
Diphasiastrum alpinum	Fjelljamne	X	X	X
Selaginella selaginoides Isoëtes	Dwarfjamne Stiff		X	
lacustris	bream grass **Equisetum**			X
arvense ssp. **arvense** Field sedge **Equisetum pratense** Meadow		X	X	
sedge **Equisetum sylvaticum Equisetum palustre** Marsh **sedge**		X	X	
fluviatile River sedge	**Equisetum**	X	X	X
Gymnocarpium **dryopteris** Bird's sedge Worm **sedge Dryopteris filix-**		X	X	X
mas Dryopteris expansa Sheep **sedge Phegopteris connectilis**		X	X	X
Hedge **heather Blechnum spicant** Bean comb **Juniperus communis**		X	X	X
Vanleg einer **munis**	ssp. **com**	X	X	
		X	X	X
		X	X	X
		X		
		X	X	
Salix glauca ssp. **glauca** Sølvvier **Salix lapponum** Lappvier **Salix**		X	X	X
myrsinifolia coll.		X	X	X
	Svartvier	X		
Salix phylicifolia Grønvier **Salix caprea** ssp. **sericea** Silkeselje			X	X
Populus tremula Osp **Betula pubescens** coll.		X		X
			X	
	Bjørk	X	X	X
Betula nana Dvergbjørk **Betula nana × pubescens** coll.		X	X	X
	Hybrid birch	X	X	
Rumex longifolius Venleg haymole **Rumex acetosa** coll.			X	
	Engsyre	X	X	X
Rumex acetosella ssp. **acetosella** Vanleg småsyre **Bistorta vivipara** Harerug		X		
Stellaria media Vassarve **Cerastium fontanum** coll.		X	X	X
			X	
	Woodwort	X	X	X
Silene dioica Red John's wort **Caltha palustris** ssp. **palustris** Brook flower			X	
Trollius europaeus Ball flower **Ranunculus auricomus** agg.		X	X	X
		X		
	Nyresoleie		X	
Ranunculus acris coll.	Meadow	X	X	X
buttercup **Ranunculus reptans** Common buttercup **Thalictrum**				X
alpinum Mountain seed star **Capsella bursa-pastoris** Shepherd's purse			X	
Drosera anglica Narrow sun dog **Drosera rotundifolia** Round sun dog			X	
John's wort **Parnassia palustris Filipendula ulmaria** Meadowsweet		X	X	X
		X	X	X
		X	X	X
		X	X	X

Scientific name	Norwegian name	Territory South	Territory Central	Territory North
Potentilla palustris Myrhatt **Potentilla erecta** Tepperot **Blackberry**		X	X	X
chamaemorus Molte Tågebær **Rockberry Alchemilla** aff.		X	X	X
glomerulans Kjeldemarikåpe **Sorbus aucuparia** ssp. **aucuparia**		X	X	X
Creeping clover	Vanleg rogn	X	X	
Kvitkløver **Lotus corniculatus** Tiriltunge **Vicia cracca** Fuglevikke **Geranium**		X	X	X
sylvaticum Skogstorkenebb **Viola canina** ssp. **montana** Lifiol **Epilobium**		X	X	X
angustifolium Geitrams Epilobium **palustre** Myrmjølke **Myriophyllum**			X	
alterniflorum Tusenblad **Hippuris vulgaris** Hesterumpe **Cornus**		X		
suecica Skrubbær **Anthriscus sylvestris** Hundekjeks **Angelica**		X	X	
sylvestris Sløkje **Loiseleuria procumbens** Greplyng **Andromeda polifolia**		X	X	X
Kvitlyng **Arctostaphylos alpina** Rypebær **Calluna vulgaris**			X	
Røsslyng **Vaccinium vitis-idaea** Tytebær **Vaccinium uliginosum**		X	X	X
Blokkebær **Vaccinium myrt** that Blåbær **Vaccinium oxycoccus** ssp.		X	X	
micro Småtranebær **carpus**				X
		X		X
		X	X	X
			X	
		X	X	
		X	X	
		X	X	X
		X	X	X
		X	X	X
		X	X	X
		X	X	X
		X	X	X
		X	X	X
Empetrum nigrum ssp. **hermaphroditum**	Mountain cricket	X	X	X
Trientalis europaea	Forest star	X	X	X
Menyanthes trifoliata Galium	Bay leaf	X	X	X
palustre coll.	Myrmaure	X		X
Galeopsis tetrahit	Kvass then		X	
Melampyrum pratense Euphrasia	Stormarimjelle	X	X	X
frigida (aff. var. **pa lustris)**	Mountain eye comfort		X	X
Rhinanthus minor coll.	Smaengkall	X	X	X
Pedicularis palustris coll.	Myrklegg	X	X	X
Bartsia alpina	Black top	X	X	X
Pinguicula vulgaris	Tettegras	X	X	X
Valeriana sambucifolia ssp. **sam bucifolia**	Vendelrot	X	X	X
Achillea millefolium	Yarrow		X	
Matricaria maritima coll.	Strandbalderbrå		X	
Solidago virgaurea	Golden rice	X	X	X
Saussurea alpine Cirsium	Mountain thistle	X	X	
helenioides Leontodon	Kvitbladtistel	X	X	
autmunalis Crepis paludosa	Følblom			X
	Sumphauke beard	X	X	
Cicerbita alpina	Lucky	X		
Taraxacum spp.	Dandelions	X	X	X
Hieracium spp.	Floating		X	X
Triglochin marsh	Myrsaulauk		X	
Potamogeton swimming	Normal earnings			X

Scientific name	Norwegian name	Territory South	Territory Central	Territory North
Potamogeton grass Potamogeton	Grastjønnaks			X
filiformis Sparganium	Thread thread			X
hyperboreum Sparganium	Mountain spike bud	X	X	X
angustifolium Narthecium ossifragum	Flotgras	X		X
Tofielda pusilla Dactylorhiza	Rome	X	X	X
spotted Dactylorhiza	Bjønnbrodd	X	X	
fuchsii Platanthera bifolia Listera	Flekkmarihand	X	X	X
cordata Juncus	Forest Marihand	X	X	
alpinoarticulatus coll.	Nattfiol		X	
	Small double leaf	X		
	Forest reeds	X	X	
Juncus arcticus ssp. **balticus Juncus**	Sand seep	X		
trifidus Juncus	Rabesive		X	
filiformis Luzula pilosa	Wire reed	X	X	X
Luzula multiflora	Hair Fritter	X		
coll.	Eng- / setterfrytle	X	X	
Luzula sudetica	Myrfrytle	X		X
Eleocharis quinqueflora	Small sivaks		X	
Eriophorum sheathum Eriophorum	Whirlwind	X	X	X
angustifolium Trichophorum	Duskull	X	X	X
cespitosum ssp. **grassy**	Small bean beard	X	X	X
Carex pauciflora Carex	Sveltstorr	X	X	X
dioica Carex	Specially dry		X	
maritima Carex	Bogestorr	X		
canescens Carex	Greystorr	X	X	X
brunnescens coll.	Seat size	X	X	X
Carex echinata Carex	Star size	X	X	
bigelowii Carex nigra	Rigid	X	X	
ssp. **juncella Carex aquatilis** ssp.	Post size	X	X	X
aquatic Carex serotina ssp. **serotina Carex**	Nordlandstorr	X		
sheathed Carex paupercula Carex limosa	Pasture size		X	
Carex rariflora Carex	Slirestorr	X	X	
lasiocarpa Carex rostrata	Fringe size	X	X	
Molinia caerulea	Dystorr	X	X	X
Anthoxanthum	Snipestorr	X	X	
odoratum ssp.	Thread size		X	
	Bottle size	X	X	X
	Blue top	X	X	X
alpine	Mountain goulash	X	X	X
Phleum pratensis	Timothy		X	
Agrostis canina	Dog barking	X	X	
Calamagrostis purpurea	Skogryrkvein	X	X	X
Calamagrostis stricta	Smårøyrkvein	X	X	X
Deschampsia cespitosa	Silver pile	X	X	X
Deschampsia flexuosa Dactylis	Smile	X	X	X
glomerata ssp. **such groups**	doggrass		X	
Poa pratensis ssp. **alpigena Festuca**	Seterrapp	X	X	X
rubra Festuca	Raudsvingel	X		
vivipara Nardus stricta	Goat finger	X	X	X
Elymus repens 144	Finnish beard	X	X	X
arter/underarter/	Strandrug	X		

artsgrupper

Appendix 2. Wild animals registered during inspection of the planning area for Andmyran Vindpark AS on And øya, Andøy municipality, Nordland. Waypoints are mainly indicated by a number. Exa

locations of the waypoints as GPS coordinates are available from the second author and can can be supplied on request.

Date	Waypoint	Observation
30.jun	x4	Overgfalk have
	x5	Tyvjo
	x7	Mallard with chicks
	x6	Single snipe
	x8	Hello, 2
	x9	Egret, 2
	Storvatnet	Sandpiper with 3 chicks
	Storvatnet	Brunnakke, 2
	Storvatnet	Rødstilk
	Storvatnet	Gray Heron, 1
	Storvatnet	Stokkand, 1
	Kroktjønna	Småmom, 3 ad (1 warning with neck lowered into the water)
	1 route 17	Hello, 1 pair
	2 route 17	2 Red stalk, 1 pair
		Hello, 1 pair breeding
	3	Herring gull, 2 pairs (NB see point 4!)
	3	lirype relieved
	3	2 songbirds came flying low up (chased by thief) Landed in one earnings on the marsh a little below Nakkevatnet (out of sight).
	4	Draw a semicircle around this point, 500 meters east, north, south.
	4	Gull, 6 pairs (including the 2 pairs mentioned in point 3)
	4	Tyvjo, 3 by
	4	Antsnipe, so 2 in
	4	Little plover, 1 pair nesting
	5	1 eider female released from the nest
	6	Tyvjo, 1 by
	7	Tyvjo, 1 by
	7	Lyrype, 2 in
	8	Tyvjo, 1 by
	8	Småspove, 1 per
	8	Hilo, 1 pair (the 3 mentioned species within a 100 m radius)
	8	Woodcock flew by and made the "whizzing noise"
	9	Storsteinen på myra (seat for sea eagles). Southern limit of productive area including approx. 200 meter buffer. Width of the area (see map) is approx 350 meters west and 250-300 meters east.
	9	A whooper swan flew low from Breivikbukta and up towards Storvatnet.
03.jul	10 11	Storspove, 1 pair nesting
		Thief, 2 ind probably nesting. They chased away a young blackbuck.
	11	Pairs of gray gulls fly over and warn
	11	Blackbuck fly up the marsh in the direction of Storvatnet.
	12	Woodcock, 1 warning, nesting behavior
	13	2 heilos took off and flew away
	13	Nesting woodcock, not the same as before. Ring marked a cub
	14	Tyvjo, 1 pair 100m due east
	15	Little plover, 1 pair nesting
	15	Foreboding Gray Gull
	15	Warning blackback

Date	Waypoint	Observation
03 Jul	16	Egret, 5 females perched 100m due east. Flew up.
	18	Thief, 1 breeding pair. Ringmarked 1 young.
	17	
	18	Thief, 1 breeding pair.
	19	Northern limit of productive area below the water main. Draw a line to the northernmost observation further up + buffer. Saw not a single bird north of this point on the trip to Storelva/the main road.
	541138, 767823	Fjellvåk flew up in Sverigedalen (nesting there) (point not saved on GPS).
	20	Thief, 1 ind chased away the sea eagle that sat on the marsh. The thief nests faithfully. The sea eagle flew and landed 500 meters further down.
	20	Heard hello
	21	Large round pond 75 meters above the power line.
	21	Gray herons passed at a height of 150 metres.
	21	Hello alerts.
	21	
05.jul	22	Hello, 2 alerts
	22	Moose cow with newborn moose calf
	23	Woodcock, 1 warning
	24	Redstalk, alerts/hedges
	25	Gull, warning about 200 m southeast
	26	Thief, 3 assembled 75 m west. Probably 1 breeding pair.
	26	Småspove, warning 150 m east
	27	Hello, 1 whistleblower
	28	Redstalk, 1 pair of notices
	28	Storspove, 2 pairs of alerts (arable field)
	28	Barn owl, 1 hunting
09.jul	29	Location of my gorgeous BMW
	30	Hello, nesting
	30	Little plover, nesting 50 m west
	30	Thief, 1 flew over
	30	Black back, 1 wing above
	31 route 18	Redstalk, nesting
	32 route 18	Small sparrow, nesting
	33 route 18	Gull, warnings
	32	Particularly productive area:
	32	Herring gull, about 25 pairs
	32	Tyvjo, I fought 10+
	32	Blackback, 2+
	32	Steinvender, hears 1 or more
	33	Redstalk, 1 breeding pair
	34	Blackback, 1 breeding pair
	35	Smålom, 1 ind flew around in large circles around Ramsamy ra (in the middle of the study area)
	36	Red stem, 2 pairs
	36	Steinvender, 1 in
	36	Tyvjo, 3 ind 100 m west
	37	Steinvender, 1 warning
	37	Steinvender, 1 pair 100 m west, warning
	37	Heilo, 1 ind 100 m west, warning
	37	Herring gull, about 5 pairs
	37	Smålom, 2 ind flew over the marsh at about 150 meters height

Date	Waypoint	Observation
09.jul	37 38 39	Steinvender, 1 pair of hedgerows 50 meters north
		Tyvjom 1 nesting pair (player dead)
		Thief, couple, possible breeders. 150 meters apart
	39	Småspove, 1 pair of hedges
	40	Hello, 1 couple of alerts
	40	Småspove, 1 pair of hedges (a different pair than in 39)
	41	Hello, 2 pairs of alerts
	42	Hello, 1 pair of hedges
	42	Hears 1-2 warblers flying high over the area.
	43	Hello, 1 pair of hedges
	44	Småspove, 1 pair of hedges
	44	Tyvjo, 1 possible breeding pair
	44	Woodcock, playing/warning 100 m southwest
	45	Smålom, 2 ind relieved from this earnings. Fly low and check the area.
	45	Steinvender, 1 breeding pair.
	45	Smålom, 1 ind is located on the tjønna 50 m north-northeast. Could be one of the individuals from the previous observation.
	46	Gull, about 4 pairs 100-200 meters east
	46	Småspove, 1 warning
	46	Thief, more birds in the air, 7-10...
	46	Redstalk, 1 nesting 100 m southeast
	47	Herring gull, 7 pairs
	47	Barn sparrows, 1 pair, warning
	47	Krikkand, 1 hunn passerte
	47	Constantly sees small birds flying in the air and playing (2 ind).
	48	Moose cow with yearling calf
	48	Thief, 1 ind 100 m east + 3 individuals chasing each other.
	49	Hear hello about 200 m west
	49	Tyvjo, 1 ind 50 m west (probably nesting). 1 ind 40 m north
	49	Rødstilk, warning 200 mnorthwest
	50	Hello, 1 couple of alerts
	51	Common snipe, 1 ind heard 50 m south.
	x1	1 bottom pair
	x2	1 Hello
	x3	1 bottom pair

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