



Directorate for **Nature Management**

Report 2007-2b

Climate Change

– Nature Management Measures



Environmental
collaboration



Nature areas
and their use



Flora and fauna



Outdoor
recreation

Climate Change

– Nature Management Measures

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Publisher:

The Directorate for Nature Management

Date:

September 2007
(English version)

Number of pages:

25

Keywords:

Climate, climate change, adaptations, measures, biodiversity, outdoor life

Ordering:

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Telephone: +47 73580500
Telefax: +47 73580501
www.dirnat.no/publikasjoner

TE 1232

Referred to as:

The Directorate for Nature Management 2007
Climate Change – Nature Management Measures.
DN Report 2007-2b

Cover photo:

Bjørn Pedersen

Abstract:

There is widespread scientific agreement today that human-caused climate change is already upon us and will remain with us far into the future, regardless of our efforts to reduce emission of climate gasses. It is therefore necessary that management authorities at all levels take this into consideration and implement measures to counteract the effects of climate change.

In this report, the Directorate of Nature Management presents possible remedial actions within nature management to counteract the effects of climate change. Various measures are discussed and considered within the areas *sustainable use and protection of biological diversity and outdoor life*. These include planning, management decisions, physical measures, changes in acts and regulations, information campaigns, advisory services, cooperation, monitoring activities, and research and development.

One backdrop for the report is a workshop held on 3-4 October 2006, where measures and adaptations were discussed within the various areas.

Ekstrakt:

Menneskeskapte klimaendringer skjer, og vil komme til å skje lenge framover, uavhengig av tiltak som settes inn for å begrense utslipp av klimagasser. Dette er det i dag stor grad av vitenskapelig enighet om. Det er derfor nødvendig at forvaltningsmyndigheter på alle nivå tar høyde for dette, og setter i gang tilpasninger eller tiltak som tar hensyn til effekter av klimaendringer.

I denne rapporten presenterer Direktoratet for Naturforvaltning mulige tiltak mot og tilpasninger til effekter av klimaendringer innen naturforvaltningen. Ulike typer av tilpasninger eller tiltak er diskutert og vurdert som mulig innenfor resultatområdene *Bærekraftig bruk og vern av biologisk mangfold og Friluftsliv*. Dette omfatter planarbeid, forvaltningsvedtak, fysiske tiltak, endring i lover og regler, informasjon og rådgiving, sektor-samarbeid, overvåking og FoU.

Som bakgrunn for foreliggende rapport ble det arrangert en workshop 3.-4. okt. 2006, der tiltak og tilpasninger til klimaendringer i naturforvaltningen ble diskutert. Referatene fra workshopen er med som vedlegg i den norske versjonen av rapporten.

Preface

Climate change has and will continue to have increasing consequences for society and the environment, and dealing with the effects of climate change is today one of the major challenges nature management and others must address.

In the summer of 2005 the administration of the Norwegian Directorate for Nature Management (DN) initiated a two-pronged climate project. Part I of the project consisted of a review and compilation of the ecological effects of climate change. The results from Part I have been presented in Report 2006-2: "*Effekter av klimaendringer på økosystemer og biologisk mangfold*" [Effects of climate change on ecosystems and biological diversity]. A database has also been established to provide easy access to projects and results concerning climate change (<http://klima.dirnat.no/>). Based on the results from Part I, Part II of the climate project was to focus on the remedial actions and adaptations that can be implemented by nature management to counteract the negative effects or exploit the positive effects of climate change. Another aim of the project was to highlight what is currently being done in nature management to address climate change.

This report presents the results of Part II of the climate project, and has been prepared by an in-house working group consisting of Anne Britt Storeng, Anne Lise Sørensen, Akse Østebrøt, Bård Ø. Solberg, Erik Lund, Heidi Hansen, Steinar Sandøy, Linda Dalen and Else Løbersli (project manager). The report is based on the above-mentioned DN Report 2006-2, as well as conclusions from a workshop entitled "*Tilpasninger til og tiltak mot effekter av klimaendringer i naturforvaltningen*" [Adaptations and remedial actions to counteract climate change in nature management], which was arranged by DN in October 2006. Representatives from the Ministry of the Environment, the county governors' environment departments, local authorities, research environments, NGOs and DN employees participated. The minutes from the group work are appended to the Norwegian version of the report.

The report presents DN's assessments of possible adaptations and measures in nature management based on today's knowledge on the effects of climate change and expected change in the future. The report primarily deals with adaptations and measures in DN's area of responsibility and must be considered as a point of departure for further work to develop strategies for adapting to climate change and to integrate measures in nature management.

The report may also help the public authorities in their efforts to develop a national adaptation strategy. DN also wants to contribute to ensuring that the content and form of measures in the areas of responsibility of other sectors have the necessary focus on ecosystems and biological diversity.

Trondheim, January 2007

Janne Sollie
Director

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Summary

There is now widespread agreement that human-caused climate change is upon us and will remain with us for many years to come, regardless of the measures we initiate to reduce the emission of climate gases. Scenarios for climate change in Norway suggest a temperature increase of 2.5 to 4 degrees over the next 110 years. We can expect a 10-15 per cent increase in precipitation, the number of episodes with heavy precipitation will increase, and it is assumed that the growth season may be extended by three to six weeks. Effects from such climate change will impact ecosystems on land and in water. To counteract the expected effects of climate change DN now wishes to incorporate climate concerns into its fields of interest and assess adaptations and measures that can be introduced.

This report points to a number of possible climate adaptations and measures within the areas of *sustainable use and preservation of biological diversity* and *outdoor life*. The adaptations are generally based on methods and measures already being used by nature management authorities today, but which need additional focus to address the future challenges that climate change will give us.

Measures to combat effects of climate change can be grouped into such categories as planning, management decisions, physical measures, amendments of acts and regulations, information and advisory services, sector cooperation, monitoring and R&D. In nature management, as in other sectors, we need to raise awareness of climate issues so that the climate is always taken into consideration in any relevant nature management context. Providing information and advisory services on the effects of climate change and possible adaptations will therefore be an important measure for both nature management and other agencies and individuals. An important general measure in planning and management decisions will be to ensure that climate considerations are included in comprehensive administrative plans for ecosystems on land and in water. For example, protection planning must ensure that there are adequately large areas

with large climate gradients and opportunities for movement and migration, and sustainable populations with adequate genetic variation to adapt to climate change. Physical measures include such activities as care and maintenance of selected cultural landscapes to counteract further overgrowing, adaptation of outdoor activities in the event of changes in weather and snow conditions, measures to stop erosion of river banks or paths at risk if precipitation increases, and combating introduced species that might have better survival conditions if the climate warms up. Other relevant measures and adaptations involve amending acts and regulations. Examples include adapting hunting seasons and hunting quotas for species that change their migration periods, migration routes or population sizes, revising licence terms in regulated watercourses to cope with changed precipitation patterns, regulating fishing quotas in the sea to deal with the impact on fish stock from changing temperatures and currents and controlling the importing and dispersal of alien species.

The effects of climate change interact with a number of other impact factors in nature. It is the sum of this impact, together with remedial actions, that is decisive for the effects and future development of nature. The particularly involves the use of areas, changes in and cessation of use, with fragmentation and overgrowing the result, and effects of alien species. Other sectors also have major impact, such as petroleum activities and sea fisheries, pollution and environmentally toxic substances from agricultural drainage, watercourse regulation and much more. Nature management must look at the big picture when it takes such impact and considerations under review. Measures that minimize other stress factors that pull in the same direction as effects of climate change will help alleviate the situation. Therefore nature management must cooperate with other sectors and act as a consultant in those cases where climate adaptations in other sectors have an impact on nature and biological diversity.

In many cases it is necessary to introduce further measures of the same type as implemented by nature management today to remain adaptable to effects of climate change. This

means better management of species giving strong stocks with broad genetic variation, having good monitoring and cataloguing systems and stronger planning and area administration. This applies to all the administration levels, centrally as well as locally. In addition to the central administration authorities, the local authorities also have separate responsibilities in general area planning.

Common to all these areas is that we should continue to expand our knowledge base on the effects of climate change. This particularly applies to the modelling of effects based on downscaled climate scenarios of the ecosystem level considered together with other impact and changes in the landscape. Furthermore, good monitoring systems must be established to establish what the effects of climate change are so that measures may be adjusted through adaptive management. In this connection it is also important that relevant long time series are continued.

When it comes to DN's own areas of responsibility, this report will serve as the foundation for setting further priorities and specifying efforts such as in activity planning and budgeting activities. DN emphasizes that climate considerations shall now be embedded as an integral element in all areas of responsibility.



Climate change will have effects on different ecosystems and communities.
Photo: Morten Ekker

Introduction

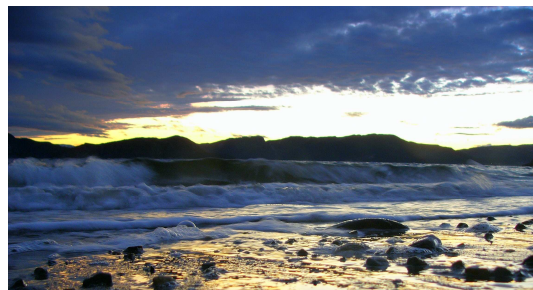
It is well documented that climate change is now upon us and will remain with us (see for example ACIA 2005). Recently prepared scenarios for climate change in Norway suggest temperature increases of 2.5 to 4 degrees over the next 110 years, a 10-15% increase in precipitation and an increase of three to six weeks in the growing season as we move towards 2050 (RegClim 2005; Hanssen-Bauer et al. 2005; Skaugen & Tveito 2004). In addition to the predicted climate change, substantial ecological and social consequences are also expected. Climate change comes in addition to other types of impact on ecosystems, such as destruction of habitats, introduced species, pollution and overtaxing (Millennium Ecosystem Assessment 2005), and may in some cases amplify the negative consequences of the other types of impact. When adapting to climate change, we must not consider it in isolation from other factors but always have the holistic effect of all types of impact in mind.

The Ministry of the Environment is working together with other Ministries to prepare a strategy for adaptations to climate change in Norway (St.prp. (Proposal to Parliament) no. 1 2006-2007 Ministry of the Environment). Adaptations are necessary now, as even if all human-caused emissions of greenhouse gases were to be stopped immediately, global heating would continue for some decades because the gases will remain in the atmosphere. Hence, the work to adapt to climate change must be undertaken at the same time that we are striving to reduce emissions nationally and internationally. Climate change concerns most societal sectors, and through their legislation, the various sector authorities are responsible for adapting their activities to the challenges that climate change has thrust upon us (St.prp. nr. 1 2006-2007 Ministry of the Environment).

Through the UN's Framework Convention on Climate Change, Norway has undertaken an international responsibility to prepare strategies and implement measures for adapting to climate change. This is also a vital aspect of the work under the Convention on Biological Diversity (see for example AHTEG 2003) and in other international forums such as the EU, the Arctic Council and the Nordic Council of

Ministers (see for example the Nordic Council of Ministers 2005). Climate will be a major area of responsibility through the Norwegian chairmanship of the Arctic Council (2006-2008).

The UN's Intergovernmental Panel on Climate Change (IPCC) has defined "adaptation" as "adjustment in natural and human systems to a new and changing environment" (IPCC 2001). This can mean adjusting practices, processes or structures in response to real or expected climate change to reduce vulnerability or detrimental effects. Such adaptation activities may include scientific, technological, institutional, political, financial, regulatory and behavioural changes.



Climate change has effects in the sea and on land which nature management must be prepared to adapt to.

Photo: Morten Ekker.

For nature management, adaptations to climate change means:

- Adapting to reduce negative impact on biological diversity and outdoor life
- Adapting to optimize the utility effects on biological diversity and outdoor life
- Assessing the consequences of the sectors' adaptation measures for biological diversity
- Cooperating with other sectors on development of adaptations and measures that promote the necessary consideration of biological diversity

Adaptations to climate change will be necessary in all sectors with responsibility for nature and resource management, such as management of water resources, agriculture, forestry, fisheries, infrastructure, travel, outdoor life and wildlife and fishing management. It is vital that adaptations and measures in these as well as

other social sectors are designed with the necessary consideration of ecosystems and biological diversity in mind.

The Directorate for Nature Management made its initial analysis of possible consequences for nature and nature management in Norway already in 1990 (DN report 1990-1). After 1990 the challenges that global warming presents and the effects of climate change have been documented in much detail and concerns have multiplied (see for example the IPCC's main reports 1990, 1995, 2001, the Nordic Council of Ministers 2005). The comprehensive Arctic Council project "Arctic Climate Impact Assessment" (ACIA) has recently documented substantial climate change in the Arctic which is having ecological and social consequences (ACIA 2005). National efforts in research and monitoring in recent years have helped to document the consequences for ecosystems and biological diversity in Norway (Framstad et al. 2006).

Observed effects in connection with changes in temperature on land and in the sea include changes in the arrival and departure time of migrating species, earlier sexual maturity in animals, higher production and reproduction, earlier budding, earlier anadromous fish migration and changes in spawning areas for fish in the sea. Changes in precipitation impact runoff water, particles and nutrients that in turn may have great impact on the environment, particularly in coastal and freshwater systems.



Changes in migration patterns of migratory birds may negatively impact their food supply because it is not always in step with the birds. Here: the Knot, a red-listed species nesting in the Arctic, migrating through Norway, seeking food along Norwegian coastal beaches. Photo: Morten Ekker.

Changes in precipitation and temperature will also impact the thickness and duration of snow covers and formation of ice. Deep snow has been shown to have a negative effect on the growth of some animal stocks, the duration of snow affect the growth season, and stronger ice formation has, for example, a negative effect on grazing conditions for reindeer. In contrast, ice cover on rivers has a protecting effect on smolt in the winter. (For more detailed overviews of effects see Framstad et al. 2006).

Based on regional climate scenarios for Norway prepared by the RegClim project (<http://regclim.met.no>), in the future, changes to all nature types are expected due to climate change. Complex interactions determine the effects of climate change, and climate works together with other factors, such as overgrowing, physical changes and pollution. Species on land and in water will migrate north with a warmer climate, and new species will arrive in Norway. With a warmer climate it is probable that some alien species (i.e. species introduced by people) which previously have been unable to survive in the cold Norwegian climate may also establish themselves in the sea, freshwater and on land. It may also become difficult for some species that are adapted to the current climate to survive. Hence, changed species diversity is expected in Norway due to climate change. Due to increased immigration from the south, the number of species is expected to rise rather than fall, which may be negative for ecosystems with a poor selection of species (such as freshwater ecosystems poor in nourishment) which are typical for Norway.

Climate change is expected to hasten the ongoing overgrowing, which today is very visible on the heather moors along the coast and in the grazing areas in the mountains. A reduced variation of the types of nature and landscape, which, in a European perspective, Norway is very rich in, will reduce opportunities for different nature experiences and other ecosystem services. This has great importance for the Norwegian tourist industry, which features nature and landscape as its most important "product". When overgrowing gets the upper hand, accessibility and views are reduced. Historical traces, identity and special characteristics associated with some types of landscape and types of nature will disappear.

When it comes to the responsibility of nature management for outdoor life, the most important effects of the climate scenarios are expected to be higher summer temperatures in *Sørlandet*, the southern part of Norway, shorter skiing seasons in low-lying regions, large amounts of snow in the mountains in the short term (50 years) and heavier precipitation with danger of flooding and erosion. Such changes will have consequences for efforts to safeguard areas, and for access rights, recreational activities and opportunities of stimulating environmentally friendly outdoor recreation.

A Nordic report on Nordic nature management in a changed climate (the Nordic Council of Minister 2005) points to several areas where a proactive attitude and early adaptation may integrate and cope with the development of climate change and thus minimize the negative impact on nature. Among these areas are improving knowledge, specific measures, legislation and support schemes and regional cooperation. Specific measures we can mention are to minimize other stress factors, ensure protection of large nature areas, ensure migration corridors for species and adapt practices in relevant industries. Bearing these recommendations in mind, and considering updated knowledge on consequences in Norway, DN now wants to focus on what nature management should do to counter effects of climate change in DN's work and areas of responsibility.

The report primarily deals with the result areas *sustainable use and protection of biological diversity*, and *outdoor life*, which comprises DN's main areas of responsibility and work, and is further divided into five main themes: 1) protected areas and cultural landscapes, 2) freshwater, 3) marine areas, 4) wildlife and 5) outdoor life and the tourist industry. Areas where other sectors have major administrative responsibility are not dealt with in depth by this report.

This report deals with all of Norway, and has no particular focus on northern areas, which are those that may be hardest hit by climate change. For the Norwegian section of the Arctic we refer to a painstaking review now being carried out under the aegis of the Ministry of the Environment through the NorACIA programme (2005-2009)

(<http://acia.npolar.no>). This programme aims to collate and present knowledge on climate change, effects and adaptations in the Norwegian section of the Arctic, and is a national follow-up of the ACIA study.



There will be major effects of climate change in the Arctic, where, for example, polar bears will have problems when much of the ice melts away. Photo: Morten Ekker

Measures and adaptations in nature management

The current situation

We have only recently had enough awareness that climate change will take place regardless of measures to reduce emissions and only now are we beginning to think about adaptations and remedial actions to counteract the effects of this change. The Ministry of the Environment (ME) has, as mentioned above, taken the initiative to catalogue the degree to which all sectors are now embedding the expected effects of climate change in their planning and how they intend to deal with this. The ME is also attaching great importance to stimulating sectors to shoulder their sector responsibilities and cooperate on this vital issue.

In nature management consideration of effects of climate change has been dealt with in some areas, in part as a deliberate strategy, and in part as an indirect consequence of other processes. Of specific measures that have been initiated where climate change has had major focus, we can mention:

- Modification of monitoring projects to include effects of climate change (in terrestrial nature monitoring TOV)
- A project has been initiated to monitor palsas (peat-covered mounds with perma-

- frost), which are particularly vulnerable to a warmer climate
- A scenario project has been launched for red deer which includes the effects of climate change
- A climate database has been established to gain an overview of important impact of climate change
- Norwegian follow-up of the Arctic ACIA project, NorACIA (cf. the preceding chapter)
- The ongoing research programme NORKLIMA under the Research Council of Norway with the Ministry of the Environment as the principal source of funding, which contributes new knowledge on consequences of climate change and provides the basis for planning adaptations to climate change
- Climate research in connection with IPY (the International Polar Year) 2007-2008.

Indirectly, a number of measures have also been initiated by nature management that will counteract negative effects of climate change, including:

- Large areas protected against destruction and fragmentation through the national park plan
- Some protected areas have protected whole hillsides, thus ensuring climate gradients and migration corridors
- Care of cultural landscapes and disused cultivated fields (semi-natural nature types) in some protected areas and particularly valuable cultural landscapes is being practised, which checks the further impact of climate change on disused fields that are now overgrown
- Processes of priority and selection of types of area for care in protected areas
- Selection of particularly valuable cultural landscapes in agriculture for special preservation in cooperation with agricultural organizations and the Director for Cultural Heritage in Norway
- National stock monitoring programmes for red deer and predator animals, stock monitoring of geese, monitoring of some threatened species, health monitoring programme for red deer (HOP) and programme for terrestrial nature monitoring (TOV) all contribute important information about climate-related effects

- Work is being done in counties and municipalities to chart habitats and nature types and protect these in area management, which will provide information on species that are vulnerable to climate change
- Regional planning processes for proposed national wild reindeer areas are being launched, and will help conserve areas for wild reindeer, which are also particularly vulnerable to climate change
- There is north European and Baltic collaboration (NOBANIS) on gaining an overview of alien species in the areas, including species that previously were not deemed to be at risk because they could not have survived the cold climate in the north

An important prerequisite for drawing up adaptations and measures in nature management is awareness of the theme and the issues involved. The climate workshop that was arranged on 3 and 4 October and which is the basis for this report, included representatives from DN, the county governor and local authority levels as well as NGOs and researchers, and contributed to raising the awareness of the theme on a broader level.

Relevant adaptations and measures

This chapter discusses a number of possible adaptations or measures nature management can introduce to counteract the effects of climate change. The chapter is organized according to five themes (corresponding to the division into groups at the workshop), and under each theme an overview is presented in a table of adaptations and measures we have identified as important for nature management. The measures are classified in the following principal types: planning, management decisions, physical measures, changes to acts and regulations, information and advisory services, sector cooperation, monitoring and R&D (research and development activities), and the most relevant actors for each measure have also been stipulated. A list of the abbreviations used is supplied at the end of the report.

Protected areas and cultural landscapes

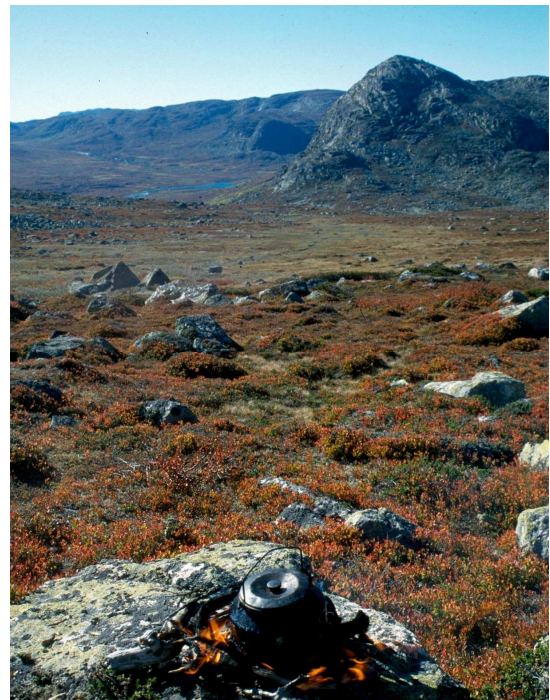
Assessments of adaptations to climate change in protected areas and in cultural landscapes (in this context with focus on outfields) must focus on the interplay between several factors. Landscape changes due to human intervention, fragmentation, overgrowing due to abandonment of land or changed use, and effects from the spreading of alien species are particularly important factors. The expected climate change will intensify this impact, and remedial actions against climate change must thus be considered with all of these and other measures in mind. If measures are not implemented, many species, vegetation types and landscapes may be at risk of extinction.

Climate change will most likely substantially reduce the areas of mountain ecosystems in Norway, and species only found in mountain habitats will come under pressure. Biological diversity in the high pastures of the mountains, already threatened because of abandonment or changes in use, will become even more overgrown. The timberline will in the long term ascend substantially, and forests close to the timberline will grow significantly denser. Effects from climate change, such as from the extended growth season and changed or abandoned use of land, will work in the same direction, and all in all, the high-lying ecosystems in Norway will undergo significant change. Together with other factors, climate change is expected to put our mountain ecosystems under extra pressure.

As a consequence of reduced mountain areas, the nature management of these areas should aim to stop further fragmentation of higher-lying areas. If the mountain ecosystems are to be able to deal with the changes of the future, further fragmentation must be prevented and new measures in area management must be assessed. This applies in general to area management on all levels when it comes to new infrastructure measures, recreation cottages and construction of new facilities for the tourist industry.

The work on the national park plan which will protect around 15% of the mountain areas may prove to be extremely valuable in relation to

climate change, as established national parks will prevent fragmentation and also protect mountain ecosystems against manmade intrusions. At the same time, extra consideration should be given to restricting protected areas due to the climate threat. It will be important that established protected areas and also new protected areas include large climate gradients within the framework of the provided protection. Beyond national parks this will be a key element of the protection of forest areas. Large habitats with significant climate gradients do not only give migration opportunities for species that need to migrate to new areas to find suitable habitats, but also enable sustainable populations with adequate genetic variation to adapt to climate change.



Large national parks maintain areas where species may migrate if they need to due to changing climate conditions. Here from Norway's largest national park, Hardangervidda. Photo: Knut Nylend

In general, the overgrowing processes proceed more rapidly in low-lying regions, and climate change is expected to speed up these more quickly than in high-lying regions and in the north of Norway. Many species, vegetation types and landscapes are already in danger of disappearing. Reduced variation of nature and landscape also gives reduced opportunities to

have nature experiences, which is vital for Norway's tourist industry.



Climate change will hasten the process of overgrowing for several threatened types of nature. Extra efforts are required to preserve the type of nature and the diversity of species. Here overgrown old hayfield. Åfjord, Sør-Trøndelag. Photo: Akse Østebrøt

To counteract landscape overgrowth and preserve biological diversity it is necessary to focus on remedial measures in prioritized areas with special cultural landscape values, and on more general measures that keep open the landscape surrounding and close to these special areas. The expected changes in the climate must be dealt with by having clearer priorities for measures inside and outside protected areas. This means that many and large tracts must be allowed to become overgrown. In the case of more rapid landscape changes it may be necessary to adapt the traditional maintenance methods and develop new ones that are suitable for a new climate situation (for example other grazing regimes than what is currently in use, alternatives to burning heather). Cooperation with agricultural administration authorities is vital in this work.

Several values needing protection in the beach zone may also be particularly vulnerable to climate change. Many protection areas in beach zones are very narrow in their border to land, and even very small increases in the sea level may change the general conditions drastically. Many of the beach areas also abut on either infrastructure or farming areas so that any rise in the sea level will be critical.

Climate change is expected to increase the dispersal of introduced species. Abandoned old grazing fields or hayfields, or reduced use of them, provide good conditions for alien species to spread, and those areas where conditions are poor will be more conducive to this dispersal. The sycamore or sycamore maple (*Acer pseudoplatanus*), the Japanese rose (*Rosa rugosa*) and lupine (*Lupinus* spp.) are examples of expanding introduced species. To counteract the spreading of these species, monitoring and control are recommended, in addition to increased maintenance in selected areas in and outside protected zones.



Spreading of the Japanese rose, an imported species, is a problem in many beach meadows and old farmed fields with reduced grazing. Expected climate change will reinforce spreading and overgrowing. Here from a landscape protected area at Jæren, Rogaland. Photo: Bård Bredesen

Improving the knowledge we have on how climate change works together with other factors will be vital. Monitoring programmes should also be established in protected areas and selected areas that are important for biological diversity in agricultural cultural landscapes that are not protected. This will be decisive if we are to initiate successful measures against the expected changes in Norwegian nature due to climate change.

The challenges we face in the management of protected areas and cultural landscapes undergoing change due to climate change in interaction with other factors is wide and comprehensive, and demand cooperation between nature management and landowners, local authorities and other sectors, particularly the agricultural sector. The local authorities have particular responsibility for area planning in their regions.

PROTECTED AREAS AND CULTURAL LANDSCAPES		
Adaptations/measures	Type	Relevant actor/sector/level
Greater focus on avoiding major technical or physical interventions or changes that fragment the landscape, particularly in the mountain areas.	Planning Administrative decisions	ME/DN/CG SMTC Local authorities
Raise awareness of the fact that areas in the mountain dairy farm region and the mountains will diminish and ensure channelling/facilitation so that human activities do not exert increased pressure on these areas.	Planning Information/advisory service	ME/DN/CG SMTC Local authorities
Assess expanding existing protected areas in relation to effects of climate change, with special focus on protecting forest zones and beach zones.	Planning Administrative decisions	DN/CG
Preserve some large protected areas with large climate gradients.	Planning Administrative decisions	DN/CG
Increased focus on maintenance needs in relation to overgrown outlying fields (includes natural areas and agricultural fields).	Planning Physical measures	ME/DN/MAF/NAA CG Local authorities Landowners
Selection, and clear and strict priorities of types of areas (or reference areas) in protected areas and particularly valuable cultural landscape (outside protected areas) for maintenance.	Planning Administrative decisions	DN, CG, ME, DCH, MAF/NAA
Include cataloguing of introduced species in future surveys to track development of these species when the climate changes.	Planning	DN
Develop SNO as an actor in maintenance and registration activities in protected areas.	Competence development Information/ advisory service	DN
Field/registration activities under the auspices of SNO (species, status etc.)	Monitoring	DN
Assess the degree to which threatened types of nature (including semi-natural ones) are impacted by climate change and implement necessary surveying and monitoring.	R&D and monitoring	ME
New monitoring programme for protected areas. Utilize monitoring in protected areas to uncover effects of climate change.	R&D and monitoring	DN

New monitoring programme for biological diversity in agricultural cultural landscape.	R&D and monitoring	Interdepartmentally
Continue long measurement series to uncover effects of climate change.	Monitoring	DN
Develop knowledge on overgrowing due to changing operations because of climate change, including developing alternative methods for maintenance.	R&D	ME/MAF
Acquire knowledge on habitat changes due to climate change, and develop models that distinguish effects of climate change from other factors, such as overgrowing and physical interventions.	R&D	ME

Freshwater

Watercourses and lakes are important and characteristic elements of Norwegian nature and help give Norway its special character. They are also the basis for important natural resources, we use them to produce energy and they are important for outdoor life. Rivers have had an important function in forming the Norwegian landscape, and during episodes of heavy precipitation these same processes may cause damage to life and property. One of the consequences of a changed climate is that such episodes might become more frequent and perhaps more violent. According to climate scenarios, precipitation will increase in the autumn and winter, and episodes of extreme precipitation may become more frequent. This will lead to more frequent flooding and subsequent damage, increased erosion and increased danger of landfalls. It is important to bear this in mind when building in and close to watercourses, when roads and bridges are built, and when planning residential areas or other activities close to rivers. It is vital that no construction/intervention should be allowed in waterways that might increase the danger of heavy flooding.

Changed regimes in water flows and higher temperatures will also have ecological consequences in lakes and rivers. Climate change will also change the geo-chemical processes in the soil, which will cause changes to the chemical composition of the water. Climate scenarios indicate that parts of Norway may have less precipitation in the summer. Combined with higher temperatures this will result

in more primary production and eutrophication of lakes. These are areas that also currently have problems with eutrophication. With more intensive farming in the future, remedial actions to counteract drainage from agriculture will thus be an important adaptation to future climate change. Re-establishing and protecting vegetation along riverbanks will be more and more necessary in the future.

Higher temperatures in rivers and lakes will make it easier for species from southern regions to establish themselves here. With growing tourism and travel in Norway and abroad, this may become a serious threat to the freshwater fauna characteristic to Norway.



All types of freshwater systems will be influenced by changes in precipitation and temperature. This may lead to increased drainage, erosion and new imported species surviving in a warmer climate. Here from a mountain lake in the Jotunheimen mountains. Photo: Heidi Hansen.

Norwegian freshwater ecosystems typically have few species. West of the divide two to four fish species are generally typical of rivers and lakes. These are unique ecosystems, also

on a global scale, and it is an important duty for Norway to protect these. Therefore it is important to initiate preventive measures against further spreading of imported freshwater species and to introduce extermination actions where alien species already have established themselves. It will be particularly important to remove or prevent spreading of introduced species such as the Japanese knotweed (*Fallopia japonica*), Indian balsam (*Impatiens glandulifera*), Tromsø palm (*Heracleum persicum*), giant hogweed (*Heracleum mantegazzianum*) and butterbur (*Petasites hybridus*) along our watercourses. These are introduced species that replace the species growing naturally along Norwegian rivers. In contrast to the species occurring naturally, these wither completely in the autumn, leaving the earth fallow. This leads to greater erosion and sediments that cover spawning grounds and food animals during episodes of heavy precipitation.



Indian balsam is an imported species that is spreading rapidly along Norwegian rivers replacing indigenous species. Here near Lierelva, Buskerud. Photo: Heidi Hansen.

With the exception of some of the regulated watercourses, some effects of a changed climate are difficult or impossible to counteract through remedial actions. We simply must accept higher temperatures and changed river flows in many watercourses if the climate scenarios are realised. If the natural populations are to adapt to these changes, we must ensure that we have strong populations with large genetic variation.

Salmon is a species that is very important for Norway and which we have international responsibility for. Any temperature change will probably force the southern boundary for salmon northward so that it might encounter

problems in some of the rivers in southern Norway. The impact of fish escaping from fish-farming cages will reduce the genetic variation in wild salmon stocks, render the stocks less robust and increase the negative consequences of future climate change.

In regulated rivers it will in some cases be possible to counteract the effect of climate change by adjusting the amount of water released through power stations and from reservoirs. This applies to regulation of water temperatures according to the layer of water released, and also the amount of water released. To do this, however, we must amend the terms of the licences.

If we are to undertake the correct adaptations, it is vital that we have a clear and resolute nature management that must be stronger and better at implementing and following up measures. However, there are still many holes in our knowledge that must be filled.

It is very important that the long measurement series we have on biological parameters are continued to document the changes actually occurring. It will also be very important to prepare ecological scenarios for freshwater systems based on the most relevant climate scenarios. Studies of key species and key systems in freshwater and the development of ecosystem models will be an important activity for adapting to climate change. The long measurement series will be very useful in calibrating such models.



With heavier precipitation the danger of flooding increases, which in turn has effects such as erosion or damage to life and property. Adjusting the amount of water released through power stations may help regulate flooding. Here from Vamma power station in the river Glomma during the large flooding in 1995. Photo: Heidi Hansen.

FRESHWATER		
Adaptations/measures	Type	Relevant actor/sector/ level
Revision of licence terms in regulated rivers (change the manoeuvring rules, flexible intakes in regulation reservoirs).	Administrative decisions Physical measures	MPE/NWE
Assess setting out fish against habitat measures (large placements of fish may reduce natural selection and thus the speed and possibility of developing adaptations to the new climate).	Administrative decisions	DN, CG
Restore rivers and streams that have been channelled and given reinforced banks (to reduce erosion and sediments of material with fine particles and nutrient salts).	Physical measures	NWE, CG
Re-establishment of natural bank vegetation (and other measures against erosion).	Administrative decisions Physical measures	DN, CG, Local authorities
Remedial actions against drainage from agriculture (we might have more intensive agriculture in the future).	Physical measures	NPCA, MAF
Removal/restriction/control of introduced species, particularly where they have established bridge-heads far from their natural habitat and in or close to our areas where the number of species is low.	Physical measures	MAF, MFC, MPE, MTC, NSFA, DN, CG, local authorities, NGOs
Work to have naturally strong fish populations with large genetic variation that are more robust and can resist climate change. For salmon: reduce the number of fish escaping from fish-farming facilities	Physical measures Sector cooperation	ME/DN MPE/NWE MFC/DF
Measures against spreading of species (including information).	Changed Acts/regulations Information/ advisory service	MFC, MAF, MTC. ME, NSFA, DN, CG, Local authorities, NGOs
Increased cooperation between environmental authorities and river authorities to enable better implementation of measures and changes in regulated watercourses.	Sector cooperation	ME/DN, MPE/NWE
Develop administration plans for watercourses in keeping with the Framework Directive for Water.	Sector cooperation Planning	Regional water authority, DN, NPCA, NWE, Local authorities, Users/NGOs
Continue long measurement series to uncover effects of climate change.	Monitoring	DN, NPCA, NWE, NRC

Ecological scenarios based on the most relevant climate scenarios.	R&D	ME, NRC
Studies of key species and key systems (must we prioritize and focus activities on selected species/systems?).	R&D	ME, NRC
Ecosystem modelling.	R&D	ME, NRC
Research oriented towards measures (to develop the best possible measures to alleviate negative climate impact).	R&D	ME, NRC
Effects of extreme situations (floods and drafts).	R&D	ME, NWE
More knowledge (thermal preference and tolerance, competitive power) on potential spreading species (eastern and southern species).	R&D	ME, NRC

Marine

To give good advice on adaptations and measures to counteract effects of climate change it is important to understand both the human-caused and the natural effects of the ecosystems. For example, if we consider the North Sea, which is a partly closed ocean area with a separate oceanographic circulation system, this ecosystem is influenced by not only the climate but also by several large rivers running into it, and substantial inflow of freshwater from the Baltic. In addition to these sources of natural impact, we also have strong impact from human activities that include emissions from agriculture, industry and large densely populated areas, as well as ship traffic, digging of sand and sediments, kelp trawling, large fisheries and intensive petroleum activities. A large degree of human impact on such a complex system might make it even more sensitive to climate change, and contribute to making the real climate effect more difficult to distinguish from the other factors.

If we are to have any possibility at all of studying the effects of climate change, one measure would be to shelter the marine protected areas from human impact factors other than climate, so that parallel studies inside and outside the protected areas might help uncover the climate effects.



Effects of climate change work together with effects from a number of sectors, such as petroleum activities. Photo: iStochPhoto

Good indicators, i.e. early, sensitive and cost-effective measures of the status of habitats, should be established to pinpoint status changes as early as possible. This is particularly important because the changes rarely are linear and the systems may change from one state to another (co-called regime changes) relatively quickly. We have little knowledge of effects of changes in climate variability, but there are indications that these may be even more important than the long-term changes. Large changes within short periods of time may have a great effect and are a risk for ecosystems as they make it more difficult for the species to adapt to the prevailing conditions.



Sea anemone. Photo: iStochPhoto

In the event of large human-caused climate effects it is important to ensure that the other impact factors such as petroleum activities, fisheries and emission of environmentally toxic substances are operated or kept within sustainable frames in relation to effects on the ecosystem level. It is vital to understand any interacting effects. Comprehensive, ecosystem-based plans that include expected effects of climate change should therefore be made for the different ocean areas. It is also necessary that these management plans are flexible so that they can help nature management adapt to the necessary changes that are required for successful management. Good rules are also important to avoid detrimental effects. Planning of nature management should aim help counteract too large shifts in the populations that are most important for the viability of the most vulnerable ecosystem components (populations, communities and habitats). Large

changes (for example due to over-fishing) in the ecosystems of harvested resources may reduce the stability of the ecosystems. This is not least a challenge for fisheries management. It is therefore important to coordinate processes based on a comprehensive and interdisciplinary approach and to use good monitoring indicators that can quickly spot changes.

Climate change must be considered in an international perspective. It is therefore important to intensify Norway's efforts in the established international environment protection collaboration in the marine sector, such as under the aegis of Norwegian-Russian cooperation, the Arctic Council programmes, ICES, OSPAR and others.



Changes in fish stocks may impact sea birds feeding on food found in the sea. Here the puffin (Fratercula arctica). Photo: Arild R. Espelien

MARINE		
Adaptations/measures	Type	Relevant actor/sector/ level
Prepare comprehensive ecosystem-based management plans that include climate effects for all sea areas.	Planning	ME
Establish a more restrictive regime for determining fish quotas to counteract too large fluctuations in the stocks that are of greatest importance for the viability of the most vulnerable ecosystem components.	Planning Administrative decisions Changes to Acts/regulations	MFC
Prevent human impact on marine protected areas so that they can be used as reference areas to uncover	Changes to Acts/regulations	ME

changed states due to climate change.		
Ensure that other impact factors, such as petroleum activities, fisheries and emission of toxic substances are kept within sustainable frames in relation to effects on ecosystem levels.	Planning Administrative decisions Sector cooperation	Inter-sector cooperation (ME, MFC, MPE and others)
Intensify Norway's efforts in international climate cooperation on marine environments.	Cooperation	ME
Establish a monitoring system for the Norwegian coast and sea areas (monitoring plans exist).	Monitoring	ME
Downscale the most probable predicted climate models to more local levels.	R&D	Meteorological Institute, MRI
Establish good indicators that can capture status changes at an early stage.	R&D	DN
Establish a national climate fund for monitoring and counteracting climate impact caused by burning petroleum produced by Norway.	Other	Norwegian Parliament

Wildlife

The dispersion and presence of wildlife is subjected to a dynamic regime with a number of contributing factors, including the climate. This is illustrated by the migration into Norway of various species after the ice age, and also the increasing stocks of such species as red deer (*Cervus elaphus*) and roe (*Capreolus capreolus*). Higher temperatures encourage some animals to live in areas previously unsuitable for them, for example pheasants. Similarly, a warmer climate regime will give species that have adapted to and depend on today's regime poorer conditions. Wild reindeer (*Rangifer tarandus*) and mountain fox (*Alopex lagopus*) are examples of this.



Wild reindeer require large mountain areas, and may encounter problems if climate conditions change. Photo: Knut Nylend

A warmer climate may expand the outdoor season substantially for livestock that graze outdoors for parts of the year. This will increase the odds that they will come into contact with wild animals, which could easily cause mutual transfer of parasites and diseases. Typical livestock diseases may infect wild animals more easily, and wild animals may then serve as a medium of infection. We have already seen how the sheep tick (*Ixodes ricinus*) has spread north and east in Norway, both due to a milder climate and the higher number of deer. Grazing livestock also serve as hosts for ticks.

Natural migration of new species when climates change is a given fact. New species of bats must be expected, and there is some danger that some of these may carry the rabies infection.

Many of our naturally occurring wild animals have strict habitat requirements, and are not very robust when it comes to changes. Human-caused changes in their habitats may be fatal to a species, regardless of whether this is a direct consequence of climate change or caused indirectly through other conditions (change of trees, new cultivated plants) in areas due to climate change. Nature management will have

to work harder on maintaining wildlife habitats in the future due to climate change. Preserving and establishing border zones and migration corridors is a vital step to take to ensure the interchanging of individual animals between different areas. Maintaining migration routes is particularly important for species that are negatively impacted by climate change, for example wild reindeer. In the effort to maintain wildlife habitats, climate change also actualises measures to combat overgrowing and keep landscapes open. One example is maintaining bird habitats by increasing livestock grazing on islands and formerly cultivated fields.

A number of exotic animal species are kept as pets. Some of these, including mammals, birds, reptiles and amphibians, have been imported illegally into Norway. Today's Norwegian climate is not suitable for the survival of exotic species, with the possible exception of the south-western regions. A mild increase in the average temperature might enable additional species to survive and reproduce in Norwegian nature. The North American turtle, the red-eared slider (*Trachemys scripta*), is kept as a pet in Great Britain and on the European continent, and escapees and others released into nature have allowed it to establish itself in the wild. This could just as easily occur in Norway with this species and a number of others. Red-eared sliders have also been observed in the wild in Norway. Reptiles have salmonella as part of their natural intestine flora. After the keeping of reptiles as pets was banned in the USA, the number of salmonella cases dropped dramatically. Norway has had cases of children being hospitalised after being infected by salmonella from turtles. Stricter controls on importing and selling imported species are thus required, and the rules relating to which species may be imported for various purposes need to be reviewed and made more restrictive.

Changes in the point in time when migrating birds come to Norway have already been registered, and many species will also be leaving Norway at a later point in time than has been normal. This introduces new challenges in the administration of hunted species, and particularly for several goose species, not least when it comes to damage caused by

feeding. Climate effects must be more in focus when revising hunting seasons, species that can be hunted, facilitation for hunting and adjustment of kill levels. Once every five years adaptations are made to the hunting seasons and species that may be hunted (protecting species from being hunted or allowing new species to be hunted). It will be important to stimulate more hunting of species (such as goose) that are positively influenced by climate change as they are responsible for grazing damage and resource exploitation. Flexible hunting seasons must be maintained and hunting of species introduced by man must be stimulated, while natural migrant species must be administered in the ordinary manner. It will also be necessary to adapt kill levels and hunting quotas to compensate for changes in the growth rate of stocks (particularly deer) due to climate change.

Based on current knowledge, developing good prediction models for given climate scenarios for some species or groups of species will be an important tool for nature management. In combination with good monitoring this will make it possible to keep ahead of expected developments.



The pink-footed goose (Anser brachyrhynchus) is one of the species that has changed its migration season due to climate change. This has caused challenges concerning grazing damage where this goose feeds.
Photo: Morten Ekker

WILDLIFE MANAGEMENT		
Adaptations/measures	Type	Relevant actor/sector/ level
Establish, maintain and restore migration corridors.	Planning Administrative decisions Change Acts/regulations	All administration levels of nature management
Facilitate grazing to prevent overgrowing in previously attractive bird habitats on the coast.	Physical measures	Stakeholders, agricultural and environment authorities
Strengthen control on the importing and spreading of introduced species, including pets.	Physical measures Change Acts/regulations	ME, MAF and customs authorities
Dynamic hunting season management.	Change Acts/regulations Administrative decisions	DN
Increased consideration of wild reindeer when regulating hydroelectric reservoirs.	Change Acts/regulations Administrative decisions	NWE, local regulation authorities
Adaptation of kill levels and hunting quotas.	Changed Acts/regulations Administrative decisions	Local authorities, stakeholders
Intensified monitoring of wildlife stocks and habitats.	Monitoring	ME, DN
Develop prediction models for species and groups of species for given climate scenarios.	R&D	ME, DN, NRC

Outdoor life/tourism

Most Norwegians, 90% according to Report to Parliament no.39 (2000-2001) – *On Outdoor Life*, are involved in one form or another of outdoor activity; mainly walking, swimming and sunbathing, hiking, skiing, picking berries and mushrooms, boating trips, fishing, bicycling, running or jogging, downhill skiing, hunting and extreme sports. The tourist industry is generally based on these same activities, and the trend is that the tourism industry is increasing its focus on using nature in its campaigns.

Expected climate change means higher average summer temperatures and shorter snow seasons, which will change the framework of



Which outdoor activities will we pursue when the snow is gone in lower-lying regions?

Photo: Anne Lise Sørensen

various outdoor recreational activities. With less snow in low-lying regions, people who want to take part in winter sports will have to go to the mountains or other locations where there is enough snow. One consequence of this is that the areas with ample snow will not have the capacity to satisfy demand, which in turn can lead to pressure to build new tourist facilities in locations currently untouched by technical intervention.



Building walking paths to prevent erosion will become more important as climate change will lead to heavier precipitation in large regions of Norway. Here from Estenstadmarka, Trondheim. Photo: Mari Lise Sjong

Many of the large protected areas are located in the high mountains, and it can be expected that there will be more pressure to use these for tourism and outdoor recreation. This pressure might even reach the Arctic and Antarctica. Such a development would increase transportation needs, which is a problem in itself due to pollution and the emission of climate gases it causes. Another could be greater class divisions in the population, where those who have the resources are able to transport themselves and their families to the most attractive areas for outdoor recreation. If neighbourhood outdoor areas are adapted for year-round use, this may stimulate people to use their local neighbourhood also in winter and thus reduce transportation needs. Examples of this could include constructing walking paths and lighted paths for the dark season. In the future there

should be greater focus on protecting local neighbourhood areas for outdoor recreation. It may also be helpful to amend the Outdoor Recreation Act. For example, today, foot travel on cultivated ground is only permitted during the period of the year when the ground is frozen or covered by snow.

We are expecting wetter autumns and winters, which will increase the danger of landslides and erosion, and it may become more difficult to travel. Wetter autumns and winters would mean greater needs for channelling, and perhaps greater needs to regulate vulnerable areas.

Drier and warmer weather in eastern and southern Norway will expand the swimming and boating season. With the expected extreme temperatures along the Mediterranean and on the Canary Islands, the traditional Norwegian holiday resorts, caused by climate change, larger numbers of Norwegians and foreign nationals will choose to holiday in Norway, which will put additional pressure on the coastal zone. It may therefore be necessary to comprehensively adapt recreational activities along the coast to include something more than sunbathing and swimming.

A warmer climate will accelerate the process of overgrowing, which is already occurring in many cultural landscapes. This chokes out variety and blocks views, thus making landscapes less exciting. In addition to the importance for the visual attraction of a landscape, this may also hamper accessibility. To curtail this, maintenance programmes are required in this landscape in addition to clearing paths (see also the Chapter "Protected areas and cultural landscapes" in this report).

Climate change may cause changes in Norwegian nature, and we might have new species to hunt and fish but also challenges when it comes to the spreading of new parasites and the introduction of new species. This development means we will need to change the hunting and fishing season and which species may be hunted. A warmer climate will also increase the chances of new species spreading through tourism. Stricter regulation and more information to foreign tourists, hunters and fishermen are important to reduce the danger of spreading of parasites and introduced species in connection with human activities. Adapting to climate change in tourism and outdoor life requires

studies to determine what is needed to encourage people to undertake outdoor activities, including adaptations, motivation and information. The local authorities that have launched measures to meet climate change must be encouraged to share their experiences with other local authorities. Public agencies should assume responsibility for providing information and advising others on effects and possible adaptations to climate change, and NGOs might be a resource to be used in information campaigns.



A more arid and warmer climate in southern and eastern Norway will expand the swimming and sunbathing season. Norway might become the "tropical paradise" of the future. Photo: Anne Lise Sørensen

OUTDOOR LIFE/TOURISM		
Adaptations/measures	Type	Relevant actor/sector/ Level
Channelling water due to longer seasons without snow, more flooding and erosion.	Physical measures Information	DN, CG
Clear overgrown paths and landscapes in selected and prioritized outdoor recreation areas.	Physical measures	DN, CG, local authorities, landowners, NGOs, the agricultural sector
Adapt for additional outdoor recreational activities in the local neighbourhood (reduce transportation needs).	Physical measures	Local authorities
Adapt for varied use of outdoor recreation areas.	Physical measures	Local authorities
Adapt coastal areas for use by the general public in other activities than sunbathing to increase health gains.	Physical measures	Local authorities
Stricter regulation to protect vulnerable areas.	Change Acts/regulations Administrative decisions Planning	DN
Adapt hunting seasons to new species.	Administrative decisions	DN
Over time: assess changing the Outdoor Recreation Act to protect the public right of access if cultivated fields do not freeze.	Change Acts/regulations	ME/DN
Give advice on effects and possible adaptations and measures.	Information/advice	DN, CG
Challenge NGOs to get involved.	Information/advice	NGOs

Measures that reduce the danger of spreading species in a tourist context.	Information Physical measures	The tourism industry in cooperation with DN
Surveying what happens locally, present experiences to other local authorities.	R&D	Local authorities NRC
Study what is required to get people outdoors and to start outdoor recreation activities, such as adaptation, motivation and information.	R&D	ME NRC
Enhance public transport service for access from urban areas to daytrip areas.	Planning Advising Administrative decisions	Public authorities, transport companies

Conclusion

Within each of the fields of nature management's responsibility there are any number of adaptations or remedial actions that can be introduced to counteract the effects of climate change, and many activities have also been implemented without them always being explained as adaptations to climate change. Relevant adaptations are generally based on methods and measures already being practised by nature management, and in many cases it is just a matter of following up with additional measures of the same type. But nature management will have to be clearer and have more muscle to ensure that the measures are being carried out.

Several types of measure are common to many of the fields of responsibility. This means, not least, including climate considerations in holistic ecosystem-based nature management, viewing climate change together with other factors that impact biological diversity and outdoor-life activities, and using this knowledge in planning.

Factors that could have more effect on many ecosystems impacted by climate change include introduced species that are more likely to survive in a warmer climate, fragmentation of habitats that will have greater detrimental effects if species have to migrate to survive, overgrowing which will increase with a warmer climate and a longer growing season, and pollution and drainage that might increase

with heavier precipitation. Erosion due to heavier precipitation is a problem that will impact rivers and which might have a huge effect on outdoor life. Moreover, interactions between all the factors are important. To counteract these effects it will be especially important in all ecosystems to protect large habitats with significant climate gradients and viable populations with sufficient genetic variation to adapt to climate change. Maintenance in prioritized areas will be essential to counteract overgrowing, initiatives to prevent spreading of introduced species will be important in all ecosystems and measures to control drainage and prevent erosion will be vitally important physical measures.

Common to most of these areas is that our knowledge of effects should be expanded through R&D, particularly when it comes to modelling of effects in downscaled climate scenarios, and research should be initiated to develop the best possible measures to reduce the detrimental effects of climate change. Good monitoring systems must also be built so we can establish what the effects of climate change are so we can adjust measures through adaptive management. In this connection it is also important to continue relevant long time-series measurements.

To put climate adaptations and measures higher on the agenda in various sectors it will also be necessary to provide the general public with clear information. The general populace

must be well informed so they can form opinions on climate change.

Within DN's own areas of responsibility we generally have the necessary measures and methods to address climate considerations. Based on the adaptations and measures presented in this report, DN will continue to implement priority measures through its annual planning and budget. It will be important to focus on embedding consideration of the climate in all areas of nature management. It will continue to be important for DN to give priority to cooperation and advisory work with other sectors that undertake adaptations and measures within their fields of responsibility to ensure that nature and biological diversity are protected.

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Abbreviations

- CG – County Governor
- DCH – The Directorate for Cultural Heritage
- DF– Directorate of Fisheries
- DN – Directorate for Nature management
- IMR – Institute of Marine Research
- MAF – Ministry of Agriculture and Food
- ME – Ministry of Environment
- MFC – Ministry of Fisheries and Coastal affairs
- MPE – Ministry of Petroleum and Energy
- MTC – Ministry of Transport and Communication
- NAA – Norwegian Agricultural Authority
- NGO – Non-governmental Organization
- NPCA – Norwegian Pollution Control Authority
- NRC– Norwegian Research Council
- NVE – Norwegian Water Resources and Energy Directorate

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The Directorate for Nature Management edits four publication serials:

Utredning for DN (Research Report for the DN) is a statement report worked out on the instructions of the DN. The conclusions here are to be considered as advice to DN, and they constitute a basis for DN's future statements or decisions.

DN-rapport (DN Report) presents the Directorate's official proposals or views, based on statement reports worked out by DN.

DN-notat (DN Note) is a less comprehensive survey, summary, report, etc.

DN-håndbok (DN Handbook) is a set of guidelines, advice, or directives, concerning nature management. The handbooks are usually made as a help for local management.

More information:
www.dirnat.no/publikasjoner

Directorate for Nature Management

The Directorate for Nature Management (DN) is the central professional organ for nature management in Norway. DN was established in 1985, as a department under the Norwegian Ministry of Environment.

Authority to manage natural resources is given through a variety of laws and regulations. Apart from its legally specified tasks, the Directorate also has a responsibility to identify, prevent and solve environmental problems through collaboration with, and the provision of advice and information to other authorities and population groups.



Directorate for
Nature Management