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Climate Change and the Cultural Environment

Recognized Impacts and Challenges in Finland

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MINISTRY OF THE ENVIRONMENT

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PREFACE

Climate change became a subject of broad discussion in the 2000s. The debate on future changes in climate, measures for mitigating climate change, and opportunities for adaptation continues in various sectors. The connections between climate change and the cultural environment have also led to interest at the national, Nordic and international levels.

In late 2007, the joint Nordic project *Effekter av klimaendringer på kulturminner og kulturmiljö (The Effects of Climate Change on Heritage Sites and the Cultural Environment)* was launched for the purpose of gathering and disseminating information on how climate change is expected to affect the Nordic countries, in particular, the specific impacts of climate change on the cultural environment and its care and administration. This report is part of the project and was prepared with funding for international activities from the Ministry of the Environment of Finland.

The report has been prepared by Jonna Berghäll, Planning Officer, Natural Heritage Services of Metsähallitus (formerly National Board of Forestry), and Minna Pesu, Researcher, Department of Monuments and Sites of the National Board of Antiquities. The work was steered by a project group consisting of Senior Planning Officer Anu Vauramo of Metsähallitus, Curator Margaretha Ehrström of the National Board of Antiquities, and Senior Architect Minna Perähuhta of the Ministry of the Environment. While under preparation, the work received comments from, among others, environmental administration bodies and museums (see Appendix 1: Experts interviewed in the spring of 2008 for the Climate Change and the Cultural Environment report, and Appendix 2: Expert bodies from which comments were requested for the Climate Change and the Cultural Environment Report in September 2008).

This report charts the most important currently recognized threats from climate change to the cultural environment and opportunities provided by it in Finland and more broadly in the Boreal Zone of Northern Europe. The report also discusses what information is still needed and presents themes for further study.

Director General,
Department for the Built Environment Helena Säteri

CONTENT

Concepts

Climate change

Climate change means any chronological change in the climate that can be the consequence of natural factors and human activity alike (Karttunen et al. 2008). This term often refers to global warming of the climate exceeding natural variation and resulting directly or indirectly from human activity (United Nations 1992).

Mitigating climate change

Climate change mitigation means human activities that reduce greenhouse gas emissions or that increase the number of sinks of greenhouse gases (Ministry of Agriculture and Forestry 2005).

Adaptation to Climate Change

Adaptation to climate change is understood as the adaptation of man and nature to changes in climate that are either anticipated or that have already occurred by making use of their benefits or minimizing adverse effects. Adaptation can be anticipatory, voluntary, planned or reactive (Ministry of Agriculture and Forestry 2005).

The cultural environment

'Cultural environment' is a general term for an environment with traits manifesting the various stages of culture and the interaction between man and nature. The cultural environment also encompasses man's relationship with his environment in the past and present, involving its varied meanings, interpretations and naming. The cultural environment comprises cultural landscapes, the built cultural environment, traditional rural biotopes and the archaeological heritage (Ministry of the Environment & the National Board of Antiquities 2006).

The built cultural environment

The built cultural environment – that is, the architectural heritage – is an entity consisting of the urban structure, buildings with their exteriors and interiors, yard areas and parks, infrastructure (e.g. streets, roads, bridges, canals), and other man-made works in the environment (Ministry of the Environment & the National Board of Antiquities 2006). The concept refers to the environment built in concrete terms, the history of land use and building, and how it has come about.

The cultural landscape

Cultural landscapes are created through the joint impact of man and nature. Distinct types of cultural landscapes are the rural cultural landscape shaped through the long-term interaction between man and nature and, as an extreme case, the urban landscape created almost uniquely by human effort (Ministry of the Environment & the National Board of Antiquities 2006).

Traditional rural biotopes

Traditional rural biotopes are created through the effects of traditional cattle raising, cutting hay and grasses, and grazing. They are classed as open and wooded traditional rural biotopes. Most of the open traditional rural biotopes are various kinds of meadows, classified according to vegetation, the humidity of growth sites, contour, nutrient content and the limestone content of the soil. Wooded traditional rural biotopes include forest meadows, pastures and meadows with deciduous trees (Ministry of the Environment & the National Board of Antiquities 2006).

Archaeological heritage

The archaeological heritage consists of structures and layers preserved in the landscape or the soil deriving from the activities of people who have lived at the site. They include burial cairns, offering stones, ancient hillforts, stone labyrinths and fortifications (Ministry of the Environment & the National Board of Antiquities 2006). In addition, immovable archaeological heritage under the surface of the ground, such as inhumation graves, and the underwater archaeological heritage are antiquities as defined in the Antiquities Act (295/63). The underwater archaeological heritage consists of the wrecks, or parts thereof, of ships or other vessels that can be assumed to have sunk over a hundred years ago, and man-made underwater structures related to past settlement and history.

1 Introduction

Climate change, or the warming of the climate, is indicated by observations of changes in the temperature of the air and the sea, the melting of snow and ice and the rise of sea levels (IPCC 2007). The greenhouse gas content of the atmosphere is higher than ever before and is continuing to rise. Carbon dioxide is one of the most important greenhouse gases and calculations of carbon balance can be used in determining stores, sinks and emissions of carbon. Even if the rise in carbon dioxide emissions could be halted, carbon content in the atmosphere would continue to grow. Eleven of the preceding twelve years (1995–2006) are among the twelve warmest years on earth since 1850, when measurements of temperature first became available. Depending on the scenario, mean global temperature is expected to rise by 1.1°C to 6.4°C by the end of the century.

On the global scale, climate change has different impacts in different regions on the production of foodstuffs and the availability of water, among other aspects. The temperature of the northern land regions will rise considerably and precipitation will also increase in the northern latitudes. Although the total amount of rainfall will increase, long dry periods may occur more often between rainy weather. Tropical and subtropical regions, in turn, will be threatened by drought and reduced crop production as a result. Climate change will have major effects on the polar regions, especially the melting of glaciers (IPCC 2007, Barr 2008).

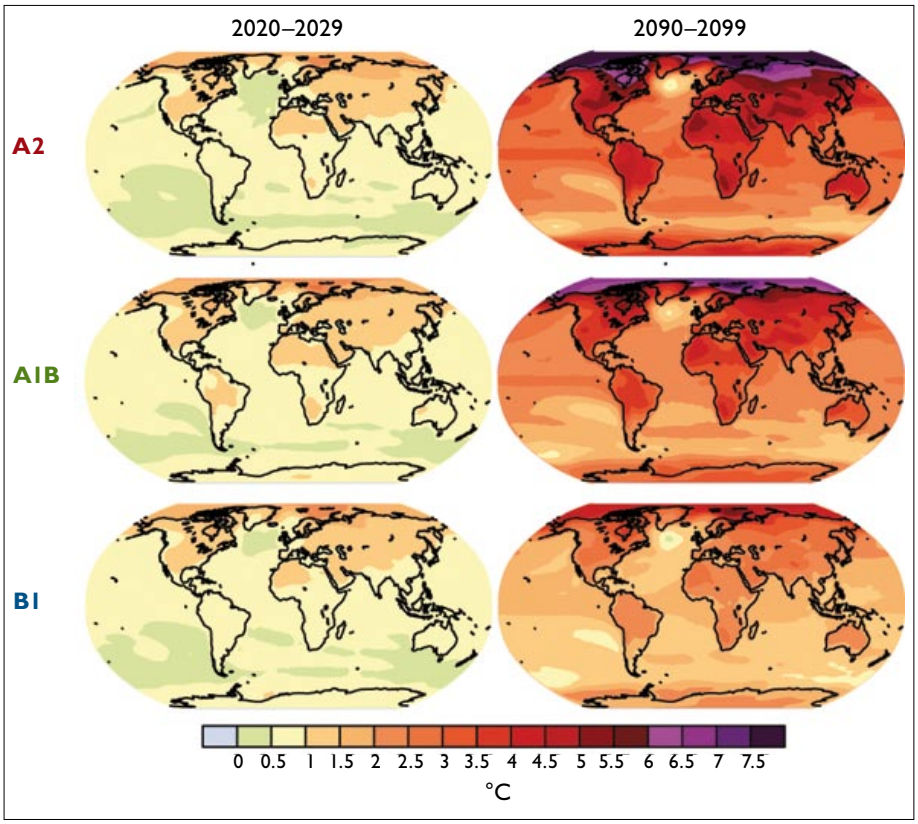

Figure 1. Predicted global changes in temperature in the 21st century compared with the period 1980–1999 using different SRES scenarios. Scenario A2 presents a highly heterogeneous globe with high population growth, poor economic growth and poor development of technology. Scenario A1B depicts a situation of rapid economic growth, population growth declining in the mid-21st century and technological evolution. Scenario B1 is similar to A1B but with economic structures developing rapidly towards a service-oriented and information society (source: IPCC 2007).

In addition to researchers, citizens have also become increasingly convinced that human activity is causing the climate to change. In a Finnish survey concerning meteorological information, 90 % of the respondents believed that human activity is causing climate change and 60 % believed that the climate had already changed (Kankaanpää, Carter & Liski 2005). Climate change in Finland is expected to result in a rise in the mean temperature, increased precipitation (especially in winter) and effects on the strength and/or rate of occurrence of extreme climatic phenomena (Ministry of Agriculture and Forestry 2005). The effects of climate change, both positive and negative, will apply in different ways to various sectors.

Climate change mitigation and related adaptation

Objectives, agendas and action related to climate change are broadly divided into measures mitigating change and promoting adaptation to it. International agreements and commitments largely guide Finland's climate and energy policies and strategies for mitigating climate change, the most of important of which is the national strategy to implement the Kyoto Protocol (Ministry of Trade and Industry 2005). This strategy has brought about adaptation strategies specific to sectors of administration. The term *national adaptation strategy* is used hereinafter for the strategy for adaptation to climate change at the national level.

The cultural environment and climate change

The cultural environment is an environment reflecting the interaction between man and nature. It is an integral part of human culture and the identity of people. The preservation and maintenance of the specific characteristics of the cultural environment are steered through legislation on building and land use. Finland has agreed to protect and maintain its cultural heritage by ratifying international conventions. The cultural environment is also an important factor in tourism, for example, attracting tourists at the local, national and international levels.

International organizations such as UNESCO (United Nations Educational, Scientific and Cultural Organization) have noted the possible impacts of climate change on the cultural and natural heritage. By ratifying the UNESCO convention concerning the protection of the world's cultural and natural heritage, Finland has agreed to attend to the preservation of its nationally significant cultural and natural heritage for future generations. In addition, agreements approved by the Council of Europe, and ratified by Finland, place Finland under the obligation to maintain and care for its cultural heritage (see Appendix 3). The Council of Europe has three central conventions on the cultural heritage, specifically concerning the protection of the architectural heritage (Granada Convention of 1985), the protection of the archaeological heritage (Malta Convention of 1992) and the protection of the landscape (Florence Convention of 2000).

UNESCO has noted that while climate change may pose a threat to the preservation of the cultural and natural heritage, there is not yet sufficient information on the impacts of climate change on the cultural environment (UNESCO 2008). An interdisciplinary expert body has been established upon the initiative of the director-general of UNESCO to monitor issues related to climate change in all sectors of UNESCO's work. In a survey concerning UNESCO's World Heritage sites, 72 % of the consulted persons in charge of these sites noted that climate change has an impact on the natural and cultural heritage. Although the majority of the World Heritage sites for which climate change is believed to cause immediate problems are natural or natural and cultural sites, climate change is also regarded as a challenge for the preservation of many ancient monuments, churches, fortresses and castles (UNESCO 2007a).

The cultural environment has strong connections with the climate – livelihoods shaping the landscape are based on species thriving in the prevailing climate, and towns and communities have been planned and built according to the predominant local climate. The connection between climate and the cultural environment may encounter problems not only because of purely climatic factors and meteorological phenomena, but also because of mitigation measures of a climate and energy-political nature and the adaptation measures that are needed especially in settled areas to preserve living conditions (UNESCO 2007b).

Content of the report

This report discusses in the light of presently available information and existing agendas and reports the threats and opportunities caused by climate change that concern the cultural environment of Finland. It considers both the immediate effects of climate and meteorological phenomena and the impact of mitigation and adaptation policies. It is to be noted that not all effects can be evaluated comprehensively with the existing information.

The chronological scope of the report varies. Extreme weather phenomena such as floods and storms are already possibly (either because of climate change or regardless of it), as are also mild winters without snow with temperature variations just around freezing. On the other hand, changes in biodiversity and pest species may take place over a longer period. The effects of climate change on temperature and precipitation have mostly been forecast up to the end of the century, and the period considered in this report is delimited accordingly. Over the short term, the cultural environment may be affected less by climate change as such than by mitigation and adaptation measures, such as the construction of wind-power facilities, various solutions for energy efficiency and preparations for extreme weather phenomena.

The national climate and adaptation strategies are the main points of departure of the present report. These strategies, however, do not consider the cultural environment directly; thus, it is taken under consideration partly in an indirect manner via other sectors. This report draws on international literature discussing threats to the cultural heritage (e.g. UNESCO 2007a & 2007b; English Heritage 2006). In addition, the report relies on international projects that have produced information on the subject (e.g. the European Commission project *Noah's Ark – Global Climate Change Impact on Built Heritage and Cultural Landscapes*[1]). The present report is mainly based on the views of interviewed experts. See Appendix 1: List of experts interviewed in the spring of 2008.

[1] On the Noah's Ark project, <see http://noahsark.isac.cnr.it>.

2 Climate change – mitigation and adaptation in Finland

This section first discusses climatic predictions and estimates of the occurrence of extreme weather phenomena in Finland. The forecasts of the warming of the climate, precipitation and snow cover are not considered in close detail. Instead, the guidelines for expected changes over different time periods as presented in the national adaptation strategy are described without further discussion of the scenarios and their underlying assumptions. The forecasts are mainly based on the SILMU research programme on changes in the atmosphere (1990–1995)[2] and the more recent FINSKEN project (1999–2002)[3]. The current ACCLIM project of the Finnish Meteorological Institute[4] is updating earlier scenarios of climate change. Extreme weather phenomena are considered with reference to the EXTREMES I and II projects.[5] The national climate strategy and the national adaptation strategy are discussed at the end of the section.

2.1 Predicted effects of climate change in Finland

Annual mean temperature in Finland has risen by approximately one degree Celsius since the middle of the 19th century – the spring seasons in particular have grown warmer. Change has been particularly rapid since the 1970s and the rise in temperature is expected to continue. Predictions of climate change, however, entail many factors of uncertainty, such as natural variation, predicted changes in the composition of the atmosphere, chronological variation, and the simplification of the climatic system.

In the following, an estimate of changes until 2040 and until 2100 is presented. Natural variation until 2030 may significantly reinforce or lessen impact, and the scenarios for various levels of emissions are largely unanimous regarding impact. It is only towards the end of the century that differing forecasts are obtained, but even then the uncertainty of the forecasts increases.

Air temperature will rise between 2010 and 2039 by 1.3–3.1°C, by 1.8–5.2°C between 2040 and 2069, and by 2.4–7.4°C between 2070 and 2099 (in relation to the period 1961–1990).[6] Winter and spring will see the most changes. This is also shown by the forecasts of the ACCLIM project (Fig. 2). It has been estimated that summer temperatures will rise at an even pace in Northern Europe, while in the winter the so-called cold extreme will see the most warming.[7] Air temperature will also influence the temperatures of water bodies during the open-water season. In particular, the highest temperatures of surface waters will increase.[8] Winters with ice will become less severe towards the end of the century: depending on the model and scenario applied the extent of ice cover will decrease by 54 % to 80 % of its present extent,[9] the time of freezing will be

[2] See Carter et al. 1996: FINSKEN: a framework for developing consistent global change scenarios for Finland in the 21st century. – Boreal Env. Res., 9, 91–107.

[3] For the FINSKEN project, see <http://www.finessi.info/finsken/index_fi.html>.

[4] For the ACCLIM project, see <http://www.ilmatieteenlaitos.fi/organisaatio/yhteys_92.html>.

[5] The EXTREMES project analyses and simulates extreme weather phenomena (see, e.g. Ruokolainen, L., Räisänen, J., & Makkonen, L. 2005 and Ruokolainen, L., 2005).

[6] See Jylhä et al. 2004: Climate change projections for Finland during the 21st century. – Boreal Env. Res., 9, 125–152.

[7] See Kjellström 2004: Recent and Future Signatures of Climate Change in Europe. Ambio, 33, 193–198.

[8] See Carter et al. 1996: FINSKEN: a framework for developing consistent global change scenarios for Finland in the 21st century. – Boreal Env. Res., 9, 91–107.

[9] See Räisänen et al. 2003: GCM driven simulations of recent and future climate with the Rossby Centre coupled atmosphere – Baltic Sea regional climate model RCAO. SMHI Reports Meteorology and Climatology No. 101. http://www.blackwell-synergy.com/links/doi/10.1034/j.1600-0870.2003.00013.x/abs/, Barr 2008.

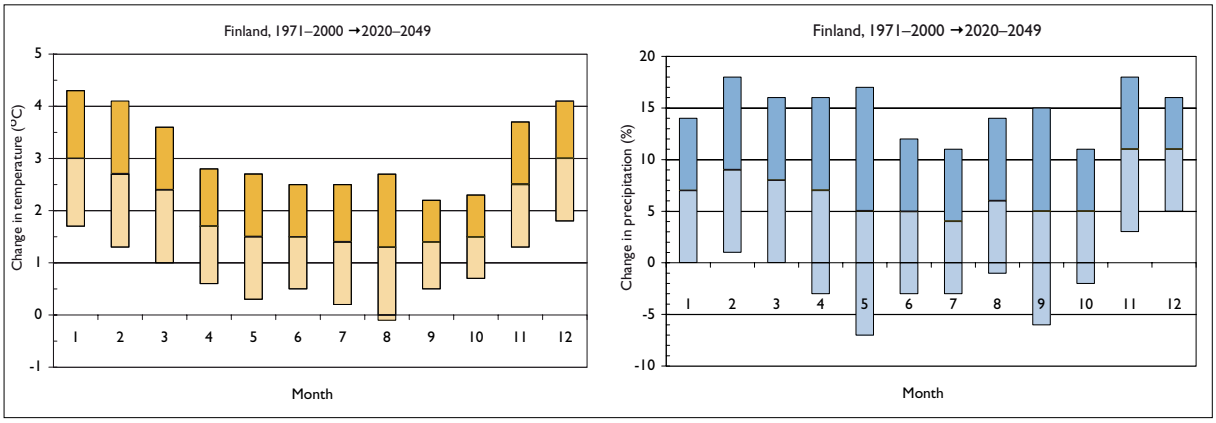

Figure 2. The ACCLIM project of the Finnish Meteorological Institute predicts monthly changes in temperature and precipitation in Finland with reference to various scenarios. Between 1971 and 2000 and between 2020 and 2049 winters and springs, in particular, are expected to become warmer and rainier. The forecasts are based on the results of 19 worldwide climatic models. The line in the middle of the bars presents the average of the models, while the upper and lower boundaries give the range of uncertainty (source: Jylhä et al. 2008: ACCLIM, Sään ääri-ilmiöt nykyilmastossa ja uusimpiin mallikokeisiin perustuvat arviot ilmastonmuutoksesta sopeutumistutkimuksia varten. Paper delivered at the ISTO interim seminar, 4–5.3.2008).

delayed,[10] and the duration of winter with ice cover will be halved on the south coast of Finland and by 70–80 % in the Gulf of Bothnia. Variations in thaw and freezing are generally expected to lessen in Europe, while in the Nordic countries the cycles of thaw and freezing may become greater.[11]

Rainfall is expected to increase in Finland between 2040 and 2069 by 1–28 % and by as much as 6–30 % between 2070 and 2099.[12] Rainfall will increase the most in the winter, while some models predict even reduced rainfall in the summer seasons (see Fig. 2). As the atmosphere will be warmer in the future, it can hold larger amounts of moisture and, accordingly, heavy rainfall will probably occur more often. The number of rainy days per year is expected to increase at least in the winter, and periods of no rain will decrease.[13] The forecasts for spring and summer are conflicting.

According to the forecasts, the number of days of snow cover per year in Finland will decrease by 20 % to 40 % of their present number.[14] The changes will be most prominent in southern Finland, where the period of snow cover is expected to shorten by two months and snow depth to be reduced to approximately one third of present figures. Predictions for ground frost vary in different parts of Finland and are tied to snow cover. It is expected that ground frost will decrease the most in northern Finland as the result of rising air temperature and the effects of snow cover. In southern Finland, the ground frost layer may even become deeper, if the period of freezing weather comes at a time when there is no insulating snow cover.[15]

Most of the models predict greater occurrence of low atmospheric pressure.[16] Although this mainly concerns windiness, the results, however, have varied both in magnitude and direction.

Extreme weather phenomena, such as storms and floods, can be studied by looking at, among other things, maximum and minimum temperatures, maximum wind speed and short-term rainfall maximums (these refer to extreme readings that are exceeded on average once every 50 years). According to an analysis of extreme values, thaw and freezing cycles, among others, will decrease by up to 40 % in the Uusimaa region, while they will increase in northern Finland, for example, at Sodankylä, by 15 % during the period 2071–2100 (comparison period 1961–1990). Maximum wind speed is predicted to grow especially in the coastal

[10] See Tuomenvirta et al. 2000: The impact of climate change on the Baltic Sea ice and soil frost beneath snow-free surfaces in Finland. Ministry of Transport and Communications Finland, Publications 13/2000.

[11] See Ministry of Agriculture and Forestry 2005, Noah's Ark 2006a.

[12] For the FINSKEN project, see <http://www.finessi.info/finsken/index_fi.html>.

[13] For the Prudence project see <http://prudence.dmi.dk>.

[14] See Tuomenvirta et al. 2000: The impact of climate change on the Baltic Sea ice and soil frost beneath snow-free surfaces in Finland. Ministry of Transport and Communications, Finland, Publications 13/2000.

[15] See Venäläinen et al. 2001: The impact of climate change on soil frost under snow cover in a forested landscape. Climate Research 17: 63–72. See Venäläinen et al. 2001: The influence of climate warming on soil frost on snow-free surfaces in Finland. Clim. Change 50: 111–128.

[16] See Cubash et al. 2001 Projections of future climate change. In: Houghton J.T. et al. (eds.): Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, 525–582.

regions by up to 15%. The five-day maximum rainfall will increase in all parts of Finland, but the heaviest downpours are to be expected in northern Finland. At Kokkola, Kuopio and Sodankylä, among other locations, maximum rainfall is expected to increase by clearly over 50 % (Wahlgren et al. 2008).

The main reasons for flooding are heavy downpours with runoff flowing into rivers, increased precipitation in areas of water systems, and heavy rainfall occurring simultaneously with the melting of snow. Spring floods of rivers will decrease in all areas except Lapland in conjunction with smaller amounts of snow. In southernmost Finland, spring flooding will decrease and the largest floods will be caused by downpours in the summer or autumn. The risk of flooding will grow especially in the region of Finland's large central lake systems (Saimaa, Päijänne, Näsijärvi). In northern Finland, the largest floods will continue to be caused by the melting of snow, occurring, on average, at the same or to a greater extent as presently. Storm winds and low atmospheric pressure will cause a rise in sea water with flooding along the coast. According to estimates, the increase in sea flooding caused by rising sea levels will be partly cancelled out in Finland by land uplift.[17] Flood damage in Finland, however, is believed to remain at lower levels than in Central Europe, because swamps and lacustrine areas will level off peak runoff and there are no mountains to exacerbate the problem of flooding.

2.2

National energy and climate policies

Finland's energy and climate policies of the early 2000s have been based on the national climate strategy approved by the Government in 2001 and issued as a report to the Finnish Parliament. The renewed strategy (Ministry of Trade and Industry 2005) was prepared in 2005 under the supervision of a ministerial working group on climate and energy policy. The national climate strategy of 2005 is a strategy for measures to mitigate climate change and is specifically based on the European Climate Change Programme and the Emissions Trade Directive. The national adaptation strategy is also included in it (see 2.3).

The national climate strategy maintains the importance of, among other aspects, secure energy supply, diversity in energy provision, improved energy production and use, and greater utilization of renewable sources of energy. The use of energy in buildings and the urban structure are also considered.

2.3

National adaptation policy

The national adaptation strategy (Ministry of Agriculture and Forestry 2005) was prepared in 2005 in connection with the revision of the national climate strategy. In addition to future scenarios of change, it contains an overview of the impact of climate change on various sectors and an adaptation strategy according to sectors. The cultural environment is noted in the adaptation strategy mainly in indirect terms when considering biodiversity, agriculture and building. Different areas of public administration have specified their own adaptation measures in separate programmes for specific measures.

The national adaptation policy has been supported by, among others, the projects of the environmental cluster research programme. Examples of these include the

FINADAPT project on adaptation (Carter 2007) of the Finnish Environment Institute, the TOLERATE project which builds on the results of the FINADAPT project,[18] the ACCLIM project of the Finnish Meteorological Institute, the EXTREMES I and II projects on extreme weather phenomena, a project on taking climate change into account in town and regional planning (Wahlgren et al. 2008), and a project on biodiversity and climate change on the functioning of protected areas and grazed pastures in conserving populations of species.

[17] On variations in sea level in the Baltic Sea region, see e.g. BALTEX 2006, Miljödepartementet 2007, Näslund, J-O. 2008.

[18] For the TOLERATE project, see <http://www.vatt.fi/en/research/projects/tolerate/>.

3 The impact of climate change on the cultural environment

Climate change can have a variety of impacts on the cultural environment. Some of them are the direct results of human-induced warming of the climate, while others will result, for example, from changes in the water cycle and atmospheric composition. Some of the effects will be caused indirectly through climate and energy policy measures. Section 3 discusses the currently recognized impacts of climate change on the cultural landscape, the built cultural environment and the archaeological heritage, and also adaptation to climate change and its mitigation.

3.1

Cultural landscapes

The cultural landscape in Finland encompasses both built areas and the natural environment. A decision-in-principle issued by the Government in 1995 lists 156 landscape areas (730,000 hectares) of national significance, most of which are in the cultivated regions of south and west Finland, but also including, for example, reindeer husbandry areas in Lapland. In addition, the Ministry of the Environment has listed 171 landscape areas of regional significance. For the time being, three landscape conservation areas have been established under Finland's Nature Conservation Act.

Traditional rural biotopes are part of the Finnish cultural landscape. Heritage landscapes are Finland's most endangered biotope (Raunio et al. 2008). A national inventory identified approximately 19,000 hectares (3,694 sites) of traditional rural biotopes classified as valuable, of which 10,000 hectares covers areas under care (Vainio et al. 2001). In terms of both numbers and area, Finland Proper (Southwest Finland) has the most traditional rural biotopes. A review of endangered species carried out in 2000 notes that 28 % of them are primarily found in traditional rural biotopes, mainly in dry meadows and fields (Rassi et al. 2001). The main reason for species becoming endangered and extinct is eutrophication and growth of bushes and thickets after management and use have ended.

In addition to biological values, traditional rural biotopes are integrally associated with cultural-historical and landscape-related values. Slightly less than 3,000 hectares of the traditional rural biotopes included in the national inventory were in landscape areas listed as nationally valuable (Vainio et al. 2001). Traditional rural biotopes have also been noted as being clearly connected with the early history of settlement and land use. In the Uusimaa region, for example, research has established that one third of all traditional rural biotopes are in environments from which archaeological sites are also known and they have distinct connections with old village plots (Seppälä 2006).

3.1.1

Changes in temperature and humidity

Changes in the distribution of species are to be expected along with the warming of the climate. In Finland, biodiversity is expected to increase as the climate becomes warmer, with species spreading further north and new species migrating into Finland from the south. Many species and habitats, however, may become rarer (Carter 2007; Ministry of Agriculture and Forestry 2005). The greatest threats are to northern and mountainous habitats and species with poor resistance to change and poor migratory ability, such as the Lake Saimaa ringed seal, a relict species.

Also at risk are species of small populations. The rise in temperature, carbon dioxide levels and rainfall especially in the hemiboreal and south boreal zones will presumably lead to the spread of luxuriant flora. Climate change will also most likely lead to increases in populations of southern butterfly species and boreal species, as well as pests

and invasive species (Ministry of Agriculture and Forestry 2005).

The warming of the climate has also been observed to increase the leaching and deposition of nutrients. Runoff and rainfall will carry nutrients into water bodies, leading to eutrophication and macrophyte growth. Eutrophication of soil because of excess nutrients is also an emerging concern. Dry and barren traditional rural biotopes will be negatively affected if rainfall increases and large amounts of nutrients are deposited in these areas. This will have an impact on species that have adapted to soils with limited nutrients and open environments (Ministry of Agriculture and Forestry 2005).

A central concern in adapting to climate change is to maintain and improve linkages between ecological networks to permit species to migrate from one area to another in a fragmented environment. Sufficiently large conservation areas that are representative in terms of conservation biology with ecological corridors connecting them are the most certain way to preserve biodiversity. Ecological corridors are also important for the southern species spreading north as a result of climate change having altered their former habitats.

Changes in species also have more comprehensive effects on the cultural landscape. As the forest line moves to higher altitudes, the fell landscape will become overgrown, while the landscape of southern Finland will become more dominated by deciduous trees. As a result of changes in weather conditions, more intensive grazing than previously may be needed to maintain traditional rural biotopes and the open landscapes in the south. The prolonged growth period will in turn permit a longer grazing period than previously.

Finland is one of Europe's most forested countries. Commercial forests are part of the Finnish landscape. In view of the European Union's climate and energy policy objectives, increasing the provision of renewable energy sources is important. Forests are an important carbon sink. The challenges of maintaining the controlled balance of energy and climate benefits produced by the forests is also recognized in Finland's national forestry programme.

How does the conservation area network function in conditions of climate change?

The possible shifting of habitats beneficial to different species creates new challenges for the conservation area network. Among other bodies, UNESCO (2007a) has considered the issue of how optimal the locations of conservation areas will be in later years. Climate change will underscore the importance of ecological corridors facilitating the migration of species. In addition to traditional conservation areas, parks, planted hardwood forests and urban green zones in southern Finland may gain importance as corridors for species' migration. The need for studies on linkages between climate change, biodiversity and conservation areas has been recognized in, among others, the National Strategy and Action Plan for Conservation and Sustainable Use of Biodiversity in Finland 2006–2016 (YM 2007a) and in work on developing monitoring indicators for biodiversity (SYKE 2006).

An important issue for the preservation of cultural landscapes and traditional rural biotopes is the viability of agriculture. If diversified agriculture and animal husbandry are profitable, landscapes will remain open and species dependent on traditional rural biotopes will survive. On the other hand, the growth in unit and farm sizes in agriculture can result in the landscape becoming too one-sided, especially concerning traditional features and range of species. Changes in climatic conditions will affect the regional locations of agricultural production and, among other features, the use of fields (Ministry of Agriculture and Forestry 2005). This may lead to significant regional changes in the rural landscape.

MTT Agrifood Research Finland (2008) and the Swedish Board of Agriculture (2007) have observed that climate change will have both positive and negative effects on agriculture and its viability. The warming of the climate and the prolonged growth period may improve the profitability of agriculture as crop yields increase and new cultivated plants gain ground. The adaptation of new species, however, to day length and weather conditions

in Finland will require special breeding of plants. Problems faced by new species concern the need for drying and irrigation, the leaching of nutrients and erosion caused by the packing of soils, increased precipitation, and new pest species and diseases.

The viability of agriculture will also be affected by many other factors than the changes predicted above. The main concern here is trends in world markets, influenced, among other aspects, by the impact of climate change on agricultural production in other parts of the world, and thereby on the supply and prices of produce. On the other hand, changes, for example, in EU agricultural policies will have significant effects on the profitability of agriculture in Finland in the future.

In regard to reindeer herding, climate change will have an effect on more than just its profitability, as climate change will also have an effect on Sámi culture and identity, as well as on those areas important to reindeer herding. The connection between climate and weather conditions and reindeer husbandry have been studied and the effects clearly proven, for example, on the availability of nourishment, migration and calving of reindeer. The warming of the climate and increased rainy weather are expected to cause problems for reindeer herding (e.g. difficult snow conditions, sufficient availability of nutrition in the winter, insect stress). On the other hand, climate change may have positive effects, such as earlier spring and good availability of nourishment during the spring and summer (Ministry of Agriculture and Forestry 2005). The cultural landscape of Lapland is already affected indirectly by less snow cover in southern Finland, as a result of which tourism and related building and development in Lapland have increased. On the other hand, rises in the price of oil and, accordingly, higher travel costs may reduce pressure for building in this sector.

3.1.2

Increased occurrences of extreme weather phenomena and adaptation to them

Extreme weather phenomena – downpours, floods and storms – will impact cultural landscapes because of the need to prepare for them and adapt to them, among other actions. The minimization of flood risks will restrict building in shore zones and may support the preservation of biodiversity and open landscapes in areas with water bodies. In the Finnish landscape, bogs and swamps, lacustrine areas and forests play a significant role in regulating floods and green zones are important in coastal defence. Better coastal defence will have significant impacts on the landscape (Carter 2007), as many of Finland's nationally or regionally significant landscape areas are on the coasts. This is discussed in further detail in connection with the built environment in Section 3.2.2.

3.1.3

Measures for mitigating climate change

Climate and energy policies, such as the increasing use of renewable sources of energy, may have significant effects on the cultural landscape. The generation of hydroelectric power is not expected to increase, as this would require major changes to legislation. On the other hand, there is great potential for the utilization of wind power in coastal and fell regions and maritime regions (Ministry of Trade and Industry 2005). Wind-power parks have extensive impacts on the landscape and their siting and planning are of central importance for the preservation of the cultural landscape. There are particularly great risks in the open landscapes of fells and coastal areas. If wind power is built to conform to the landscape and is combined, for example, with other industrial or transport-related environments, wind power will also provide opportunities to create a new type of cultural landscape.

Climate and energy policies may have indirect impacts on cultural landscapes and their typical vegetative species. Increased cultivation of energy crops may increase biodiversity and landscape-related values, if the crops are cultivated in abandoned farmland. On the other hand, the traditional agricultural landscape may change as the result of extensive cultivation of energy crops. The goal of steering development and building to fit into the existing structure and infrastructure of settled communities will support the preservation of open agricultural landscapes, although special attention should be given to the open spaces that have a long historical continuity.

3.2

The built cultural environment

Finland's built cultural environment has been shaped by interactions between man and nature over centuries. The diverse built environment tells of the country's settlement and means of livelihood and of the non-material and cultural heritage that has formed through the course of history. The chronologically multidimensional nature of the environment and its balanced development provides conditions for an environment of good quality, both locally and regionally.

A Government decision-in-principle in 2000 listed a total of 1,772 nationally significant sites and locations of the built environment.[19] The conservation of these areas is primarily implemented in regional, general and local plans in accordance with the Land Use and Building Act (132/1999).

This section discusses the threats and opportunities related to climate change that apply to urban structure, buildings and infrastructure. Not considered here are the green zones and public outdoor space included in the built cultural environment.[20] The building stock of Finland is very young, with only 6 % of the existing building stock predating the 1920s. A large proportion of the building stock, approximately 50 %, was constructed from the 1970s to the 2000s (Fig. 3). Figure 4 shows that buildings are typically of wooden construction in both their exteriors (71.5 %) and load-bearing structures (87.0 %).

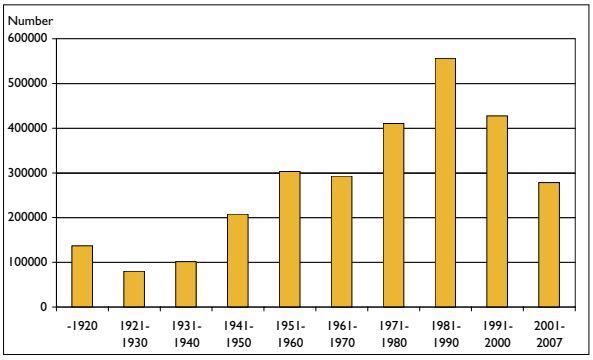

Figure 3. Distribution by age of the building stock of Finland (source: Building Data of the Finnish Population Information System, 27 December 2007).

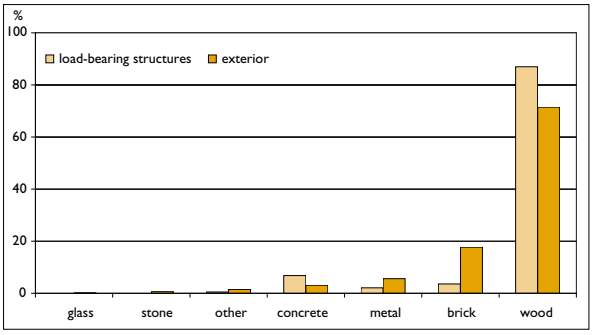

Figure 4. The most widely used building materials in Finland (source: Building Data of the Finnish Population Information System, 27 December 2007).

3.2.1

Changes in temperature and humidity conditions

The warming of the climate and increasing humidity will cause various biotic and abiotic problems for the built cultural environment. Winters in particular are estimated to become warmer and to experience more rain. Continuous temperature variations around the freezing point will be a problem of the winter season especially in northern Finland.

Higher amounts of rainfall and the possible rise in groundwater levels will increase the moisture content of soils, which will weaken the stability of the soil as a foundation for buildings and structures. There is also the risk of erosion and landslides, the latter, however, only on shore banks and bluffs of fine-grained soil. Long, dry summer seasons will lower groundwater levels, which may cause damage to the foundations of buildings and structures (Carter 2007; Ministry of Agriculture and Forestry 2005). Traditional timber structures with ventilated base floors are quite resistant to movements of the foundation, but damage to fireplaces will increase the risk of fire. In masonry buildings, damage to the foundation is reflected throughout the structure and the exterior, and will cause a significant need for repairs. Owing to changing conditions, the repair cycle of damage to foundations, other structural parts or the exterior will become more frequent, posing a risk to cultural-historical traits and authenticity. Many of the materials and working methods used in structures and building exteriors have become rare or the related skills are disappearing. In most cases repairs will lead to the disappearance of original materials and building components.

[19] See, Ympäristöministeriö & Museovirasto 1993: Rakennettu kulttuuriympäristö – valtakunnallisesti merkittävät kulttuurihistorialliset ympäristöt.

[20] It should be noted, however, that public outdoor space and green zones are part of the built environment. Urban green zones serve as ecological corridors for species and parks are also of significance as flood routes.

The exteriors of buildings will be affected negatively by oblique rain, humidity and variations in temperature. Alternating cycles of freezing and melting will cause weathering of building façades, will increase stress on surface structures and will cause fissures of various kinds. Porous materials, such as brick and rendering, are particularly susceptible if humidity builds up and cannot evaporate before freezing. This will result in breakage, cracks, peeling and crumbling (UNESCO 2007a & 2007b; Ministry of Agriculture and Forestry 2005; Noah's Ark 2007). This is a normal and well-known phenomenon as such, which may become more prominent through climate change. The timber of old wooden façades differs from present-day timber in both dimensions and the way it was worked and crafted. Climate change will increase stress on the exteriors of buildings, possibly resulting in a need to replace wooden parts, which can alter the dimensions of façades and reduce authenticity. As a result of long periods of humidity, painted surfaces have been observed to contain high numbers of micro-organisms. At the same time, mould is affecting paints to an increasing degree because of restrictions on solvent content.

The corrosion of metals will worsen with increasing humidity – especially when combined with growing levels of air pollution (UNESCO 2007a; Noah's Ark 2006a & 2007). The joint effect of pollutants and climate change will destroy both metals and masonry. Air quality has improved continuously in Finland, or at the least has remained stable (there has been an increase only in ozone levels), and compared with the results of air quality monitoring in other parts of Europe, air quality in Finland is good (Anttila et al. 2003). Concerning the building stock of Finland, corrosion threatens prefabricated buildings of the 1970s–1980s the most in numerical terms, but there is also a significant threat to buildings representing the modernism of the 1930s–1950s. Increasing humidity combined with periodic drying of structures will cause crystallization of salts to increase on surfaces and wall paintings (UNESCO 2007a).

As a hygroscopic material, wood is sensitive to changes in humidity (Noah's Ark 2006b). Humidity damage to buildings may grow as rainfall increases, and wooden buildings and structures in particular may face the problem of decay and mould. Both wooden and other structures are susceptible to humidity problems if the structural features that dry them are disturbed by flooding or rising groundwater levels (Ministry of Agriculture and Forestry 2005). In traditional timber buildings, which include most of the wooden buildings constructed before the 1920s, a type of construction ventilated from below is very common. This method withstands ground humidity quite well and functions properly after floods. Old buildings have other features that make them adaptable to climate change. They are usually in elevated locations with steep roofs and wide eaves. A problem is posed by buildings renovated in the 1970s–1980s, in which the natural ventilation of structures was prevented. Increasing climatic humidity will raise the risk of mould and sapotrophs. With reference to rising temperatures and changes in humidity, Noah's Ark (2006b) predicts that measures will be required in Scandinavia to control decay and fungi growth even without any particular flooding problems.

3.2.2 Increased occurrence of extreme weather phenomena and related adaptation

Downpours, storms and flooding, as well as extreme aridity, are to be expected as a result of climate change. Flooding will be caused most commonly by downpours, storms and melting snow (particularly in northern Finland). Owing to land uplift, rising sea levels are not expected to cause flooding in Finland (Ministry of Agriculture and Forestry 2005). Rising sea levels, however, may worsen the effects of floods, and the forecasts for rising sea levels in the IPCC report are regarded as unduly low in some studies.

Floods cause problems for the built cultural heritage, first during the flooding stage, as major movements of water will cause wear on building exteriors and may cause structures to collapse. Additionally, flooding is an important concern in the safety of dam structures. As the intensity of flows and currents rises, old hydroelectric plants and, in part, even older dams may be under stress, especially at the oldest sites, which are classed as antiquities (such as the Teijo dams from the 17th century). Further problems arise as structures begin to dry out. This stage is laborious and expensive,

The Verla Mill Museum is at risk from floods

The Verla Mill Museum, a UNESCO World Heritage site, has encountered flooding problems in recent years as water rising from the adjacent canal has damaged its wooden and brick structures. According to present climate forecasts, precipitation is increasing and the stability of the site is deteriorating. Peak flooding at the Verlankoski rapids occurs more often and the mill, situated on a slope, is at risk. The flooding risks at Verla are to be charted during 2008 and related precautionary plans will be prepared.

and, if handled poorly, the growth of hazardous micro-organisms, such as fungi and moulds, will occur (UNESCO 2007a & 2007b). In the control of flood risks, the planning of the use of areas and community planning play an important role, which has also been noted in the Floods Directive of the European Parliament and Council (2007/60/EC) (see also Ministry of Agriculture and Forestry 1999, Ministry of the Environment 1999 and Ministry of Agriculture and Forestry 2003).

Heavy rainfall may also cause problems for the built cultural environment. In Old Rauma, among other locations, discussion has begun on channelling surface water, and the solutions may call for technologies and use of space that are poorly suited to the historic milieu of Old Rauma. In Old Rauma as in many other historic wooden towns, the surfaces and stone pavings of streets have been renewed by recoating the old layers. As a result, the street level may rise above the foundations of houses. During downpours, surface water will flow into the structures and basements of houses, from which there is no natural exit for the water. In Old Rauma, where the municipal water mains and storm drain network have been renewed, the original street levels have also been restored and stone pavings have been laid so as to allow water to pass through them.

Along with increasing precipitation, growing windiness may lead to the need for change for cultural heritage buildings and sites. In renovation work, the structures of some buildings have been reinforced to the level of existing norms, for example, with regard to predictable wind load. In the rebuilding of Porvoo Cathedral in 2007–08, the roof structures of the church were designed to withstand extremely high winds of up to 38 m/s. The load values for load-bearing structures are thus set to take into account the effects of extreme weather phenomena, but changes in stresses are difficult to evaluate in the light of present-day knowledge (Ministry of the Environment 2008).

The risk of coastal erosion will grow as extreme weather phenomena occur more often – especially since the period of ice cover on the sea is predicted to become shorter and the risk of coastal winter storms is expected to grow (Barr 2008). In Canada, for example, the conservation of the cultural heritage has required the moving of buildings from coastal locations in order to keep them dry (UNESCO 2007b). A major storm in Finland in January 2005 showed that the risk of flooding also genuinely exists on the coasts of Finland. The above-normal high sea levels caused major economic losses and the risk of a catastrophe in Helsinki's Market Square was very close (Uusimaa Regional Council 2007). This storm also had an impact on the Suomenlinna Fortress. It is possible that coastal defence has to be improved in Finland in response to windiness and storms (Carter 2007). Protection measures may change the characteristics of the built cultural environment and the cultural landscape of the coastal areas.

As a whole, preparations for extreme weather phenomena will increase the need for safety repairs at restoration and conservation sites and the costs of risk management. The monitoring of sites should also include the potential risks caused by climate change and preparations for higher repair costs alongside the standard repair work, and landscape and maintenance care.

The Suomenlinna Fortress and climate change

Experts do not believe the sea level in the Baltic will rise to any marked extent, because land uplift is expected to balance it out (Ministry of Agriculture and Forestry 2005). If sea levels do rise, however, this will have dramatic consequences for the Suomenlinna Fortress, a World Heritage site. This was demonstrated by the storm of January 2005 with its rise of sea level by approximately 1.55 metres.

Even a temporary rise of sea level of 1.50–1.60 metres damages the shoreline structures of Suomenlinna, such as its piers, bridges, supporting walls and sand-built earthworks. The amount of damage will increase if this coincides with high seas. Flooding will also threaten the historic dry dock of Suomenlinna as water rising over the level of the gates can enter its basins. Even a rise of sea level of 1.30 metres already poses problems for service transport and at 1.40 metres, public ferry transport to and from Suomenlinna will require special measures, as the water level will inundate the pier at Market Square. The increasing occurrence and strengthening of extreme weather phenomena (especially storms) will also cause damage to roofs and trees at Suomenlinna.

The growing occurrence of damp and warm winters may cause sapotrophic and mould damage to the structures of buildings of different age of the Suomenlinna Fortress. Further, the masonry buildings of Suomenlinna generally have base floors, floor structures and ceilings of wood. The variation in temperature around the freezing point is already causing damage to rendered and brickwork façades of Suomenlinna and to the walls made of natural stone. It has been estimated that freezing and thawing currently take place around 100 times a year (between October and April). Warmer winters may increase these cycles in mid-winter and there will be fewer cycles in the autumn and spring. Dry summers may increase erosion caused by tourists on the earthworks of Suomenlinna, as vegetation preventing wear dries out and disappears.

Figures 6 and 7. Damage at the Suomenlinna Fortress caused by sea level rise in January 2005. Left: Gun battery on Länsi-Mustasaari Island with collapse of its supporting wall and sand earthworks caused by high sea level and waves (Photo: Heikki Lahdenmäki, Suomenlinna Governing Body). Right: Shoreline wall on Pikku-Mustasaari Island with erosion caused by high sea level and waves (Photo: Heikki Lahdenmäki, Suomenlinna Governing Body).

3.2.3

Measures for mitigating climate change

Along with factors of a natural scientific nature, climate and energy policies will also have direct and indirect effects on the built cultural environment. Finland's national climate strategy underscores, among other aspects, increased use of renewable sources of energy and improved energy efficiency. The heating of buildings accounts for 23 % of energy use in Finland.[21] Because of milder winters and periods of hot summer weather the need to cool buildings has grown, contributing to higher consumption of energy. Other factors have also contributed to the growing need to cool buildings, such as improved insulation and the heat produced by the large amount of electrical equipment and appliances in use. Reducing the overall energy consumption of buildings will require both energy-efficient solutions and a reduction in energy consumption by electrical equipment. It is important to take into account all factors affecting energy efficiency, including the carbon balance of building materials.[22]

Requirements for energy efficiency have so far concerned only new buildings and development and repair and renovation projects of a significant extent, but at the European Union and national levels means are also being sought to reduce the energy consumption of the existing building stock. It is difficult to apply the changes required by regulations on energy efficiency and renewable energy infrastructure to buildings of cultural-historical value (English Heritage 2006). Regulations on improving energy efficiency are included in, among others, the directive of the European Parliament and Council (2002/91/EC) on the energy performance of buildings. Neither this directive nor Finland's national act on the energy certification of buildings (487/2007), implementing the directive, applies to the officially protected architectural heritage.[23] In Finland, however, only a small part of the building stock is protected in accordance with the provisions of the directive and the act.

According to Finland's Land Use and Building Act (132/1999), buildings or streetscapes of historical or architectural value may not be damaged and renovation must take into account the properties and special features of buildings. The definition of cultural-historical or townscape-related factors and considerations of the characteristics of buildings in renovation projects are core issues of conserving the built heritage that have received highly varying responses up to now. Stricter requirements for energy efficiency and the desire of property owners to reduce energy consumption will presumably increase the desire to carry out renovation, which is a positive development. Owing to energy-saving goals, renovation projects can be expected to increase and repair cycles to become shorter, which may endanger cultural-historical characteristics and the authenticity of structures and building components and materials.

Densification of the urban structure has been recognized as one of the important measures for mitigating and adapting to climate change. This provides an added challenge to protecting the built cultural environment. Buildings and developed areas of the reconstruction period of the 1940s and of the 1950s and 1960s are noted for their

[21] Statistics Finland 2007.

[22] For the carbon balance, see, e.g. Pingoud, K. & Perälä, A.-L., 2000.

Stricter requirements to be expected for the energy efficiency of buildings

Minister of Housing Jan Vapaavuori opened the 2008 expert meeting on the care and renovation of the architectural heritage on 31 March 2008 with a speech underlining how international requirements of climate and energy policies will pose a major need for change in the energy efficiency of buildings in Finland. Regulations on new buildings are getting stricter and will come into force in 2010. In the future, the existing building stock must also be adapted to the requirements of energy efficiency in connection with other repairs and renovation. In order to preserve the characteristics of buildings undergoing renovation, different and even highly individual solutions are needed.

[23] "-- 5) a building protected through a plan in accordance with the Land Use and Building Act (132/1999), a ruling in accordance with the Act on the Protection of Buildings (60/1985) or the Statute on the Protection of State Owned Buildings (480/1985), or defined as being of cultural historical significance in an inventory carried out by the National Board of Antiquities. –" (Act on the Energy Certification of Buildings (487/2007).

spaciousness and the interspersing of green spaces with the built areas. Together with the restrained nature of the architecture of the period, this is a feature typical of the era in cultural-historical terms. Preserving this feature is a challenge to the densification of the urban structure, and to the need for additional building and development and for repair and renovation of buildings. The national climate strategy notes that safeguarding the cultural heritage, recreational areas, green zones and their diversity may pose further conditions for the process of integrating the urban structure. We can expect new opportunities with regard to the cultural environment, for example, through establishing more car-free town and city centres or centres with restricted use of automobiles.

3.3

Archaeological heritage

The archaeological heritage depicts life, habitation, communications, means of livelihood, religious practices, and the burial of the dead in the past. The archaeological monuments and sites register of the National Board of Antiquities currently lists some 20,000 sites and ancient monuments, and inventories are continuously revealing hitherto unknown sites. Systematic survey and inventory work concerning archaeological sites and remains from historically documented times has only begun.

The largest category of the archaeological heritage consists of dwellings and burial sites of different age, of which usually only layers in the soil remain. The easiest to observe are burial cairns of the Bronze and Iron Ages, especially in open locations. Ancient hillforts dominate their surroundings, as do rock paintings of a prominent nature. The best-known archaeological sites of historically documented times are castles, fortresses and the ruins of churches, and the numerous sites related to the history of livelihoods, such as tar-burning pits. A special group of remains of this period consists of the cultural layers preserved under the buildings of towns and cities. These include cellars, building foundations and the stone pavings of squares and streets preserved after extensive town fires.

At present some 700 underwater archaeological sites are known in Finland, of which 94 % are shipwrecks. Besides shipwrecks, the underwater archaeological heritage includes the remains of bridges, piers, jetties and defensive structures. Most of them are primarily made of wood.

3.3.1

Changes in temperature and humidity conditions

The archaeological heritage located and preserved underground is usually in balance with the hydrological, chemical and biological processes of the soil. Acidification has been observed to weaken the preservation of underground archaeological sites (Riksantikvarieämbetet 2007). Warmer temperatures and increasing humidity resulting from climate change, changes in the water table and the deposition of emissions (changes in pH) may disturb that balance and lead to the destruction of the archaeological heritage (UNESCO 2007a, Barr 2008). A study is currently under way in Sweden, and it is hoped that the results will provide further information for conserving rune stones. The study concerns 32 parts of rune stones from a range of locations, extending from Scania to Jämtland, and the work is intended to establish the impacts of climate and pollution on them (Riksantikvarieämbetet 2007).

The archaeological heritage located underground in forest areas has survived relatively well up to now, because heavy machinery is used in these areas only when the ground is frozen. Over the long term, unfrozen soil conditions will damage the archaeological heritage under the surface of the ground in southern Finland. When the surface layer is moist and soft, even light wear and tear from activities such as mechanized forest harvesting or from large numbers of visitors can erode it. At some sites it has become necessary to provide visitors with special routes and bridges, which alter the surroundings while aiding in the preservation of the site.

The organic materials of cultural-historical sites buried in the cultural layers of towns and cities may be destroyed by sudden variations in humidity and aridity. Also the corrosion of metals will gain pace with increased humidity, especially in connection with air pollution. This has already been observed, for example, in investigations of Iron Age cemeteries. As with buildings, the archaeological heritage above ground is susceptible to weathering, crumbling and fissures. The preservation of prehistoric rock paintings may be

endangered by the weathering of the surface of rock faces.

With the underwater archaeological heritage, organic and inorganic materials come into chemical balance with their surroundings over time, but before achieving this balance changes and deterioration occur in the remains. If environmental conditions change, deterioration may gain pace as the materials again seek a state of equilibrium. Environmental factors having an impact on the underwater archaeological heritage are the movements of water, the concentration of oxygen and other dissolved gases, pH, redox or reduction-oxidation reaction potential, temperature, salinity, water pressure and the amount of light (Salminen 2006). At present only estimates can be given regarding the effects of climate change on the preservation of the underwater archaeological heritage.

The national adaptation strategy has considered whether the overall rise of sea level and strong winds will increase the exchange of water through the Danish straits into the Baltic and increase the salinity of the Baltic Sea. Increased salinity may introduce the shipworm (Teredo navalis), which destroys marine-archaeological shipwrecks and other wooden materials and which would be a threat to the underwater archaeological heritage of the Baltic that have hitherto survived well. Most reports, however, maintain (albeit with reservation) that the salinity of the Baltic will become lower as the result of increased rain and runoff (BALTEX 2006; HELCOM 2007). This would mean that even in the future the shipworm would not be a threat to wrecks at the bottom of the Baltic Sea. Unfortunately, lower salinity will have considerable ecological impact on the Baltic and the species living in it. Runoff from large amounts of rainfall is estimated to increase the eutrophication of the Baltic (BALTEX 2006). This may have an impact on the appeal of marine historical sites for tourists and the number of visitors.

3.3.2

Increased occurrence of extreme weather phenomena and related adaptation

The threats posed by flooding and storms to archaeological sites are seen, for example, in the aftermath of the storm Gudrun that raged over Sweden in 2005, damaging over 3,200 out of 11,000 archaeological sites in Kronoberg County. Repairs to the damage caused by storms may lead to further damage, for example, from wider roads constructed in forests (Riksantikvarieämbetet 2007).

The flooding of water bodies may also cause problems for archaeological sites. Many sites are situated on the banks of regulated inland water bodies and have now partly collapsed into the water. In addition, floods carry loose soil that can cover the archaeological heritage.

The possible increase in windiness and storms may lead to problems, not only in shore locations and above the surface of the water, but also under the surface. Wrecks and other underwater structures that were previously in relatively unchanging conditions will come under increasing mechanical strain. The expected decrease in the severity of winters with ice and their shorter duration may lessen the strain caused by pack ice, which may benefit the underwater archaeological heritage at least in areas of shallow water.

Rapid variations in temperature in winter will endanger road traffic, resulting in more salting of roads. Salt will spread outside the road area and to surrounding archaeological sites. The metal burial finds of Iron Age cemeteries especially along national highways will become corroded quickly and be completely destroyed. Archaeological sites in this risk zone should be investigated before irretrievable destruction takes place.

3.3.3

Measures for mitigating climate change

The national climate strategy underlines the increased use of renewable sources of energy. Changes in forestry practices, such as removing stumps for use in energy production can damage, among other things, Stone Age dwelling sites or other cultural-historical layers in large areas. The regeneration of forest land is also becoming more effective, with the use of different practices of treating forest land such as revealing mineral soil in patches or harrowing. Actors in forestry have been trained to take archaeological sites into account in their work. Geographical information of archaeological sites should be specified in order to avoid damage.

4 Challenges to administration and proposals for measures

This report and the forecasts of threats posed by climate change on the cultural heritage that are presented in it are mainly based on the views of interviewed experts (see Appendix 1: Interviewed experts). The challenge is to recognize the real impacts on the cultural environment caused by climate change and to specify and deepen the information on climate change and the cultural environment. The objective is to anticipate and mitigate changes in the operating environment and find joint courses of action and prioritize measures together with other actors. Preparations for climate change must take into account the chronological diversity of the environment and its balanced development.

Information on the cultural environment in support of political and administrative decisions

There is a great deal of research in progress on the effects of climate change in natural-scientific terms. The challenge is to apply research and results in hydrology, chemical and biological processes associated with climate change to the fixed nature of the cultural environment. Cross-disciplinary research should also take into account pollution, which exposes sites to the effects of climate change.

Applying the results of multidisciplinary research projects to risk analyses of specific sites and types of sites to support administration and political decision-making and for the purposes of training and preparing guidelines is a major challenge for actors in the cultural environment sector. In the future, situational analyses could apply scenario-type simulations of chains of effects. Cooperation with universities and research institutes will be of importance in this regard.

The information needed now includes recognition of the attendant conditions of integrating the urban structure, which should be studied in terms of ecology, networks of green zones, values of cultural history and the milieu. The impacts of climate change on urban landscapes and urban space is poorly identified at present. Special issues requiring attention are, for example, the control of rain water and melting snow and the care of parks and other public spaces in towns and cities. More information is required on milieus of cultural-historical value in flood-prone areas and issues concerning their conservation. To get this information, further studies should be carried out and a plan for measures to protect these cultural-historical milieus should be prepared. Central issues for further research with regard to the preservation of the building stock are the long-term durability of structures and the exterior material of buildings and their susceptibility to predicted variations in temperature and humidity. Research taking into account cultural heritage values should be arranged together with the building materials industry and research institutes in the field. The cultivation of energy crops and the impacts on rural cultural landscapes and their typical species should also be investigated.

Research should consider the cultural acceptability of measures undertaken in renovation and the care of the environment with preparation for and adaptation to climate change. A central challenge will be the recognition of the socio-psychological impacts of climate change and influence on the values of people.

The distribution of tasks within administration

Public administration concerning the cultural environment in Finland involves three different sectors, which calls for a well-functioning distribution of tasks and designation of responsibility. Information on climate change

and the cultural heritage should be distributed to different areas of administration and included in the national climate strategy.

Decisions on energy and climate policies for the near future are steered by a national strategy to implement the Kyoto Protocol (Ministry of Trade and Industry 2005). Mitigation measures and focused climate and energy policies, such as increased use of renewable energy sources, including effective utilization of forest resources, require the cultural environment sector to be in active contact with other actors. The challenge here is the sensitivity of actors in different sectors to take into account the conditions for the preservation of the cultural environment. The existing broad perspective of cultural environment actors can be regarded as an asset.

A further challenge to experts and authorities dealing with cultural environment issues is to integrate the evaluation of impacts on the cultural environment into the planning systems of different sectors of public administration. Recognizing the impacts of climate change and taking them into account are important aspects of planning and evaluating, for example, safety measures for clients and products. The dissemination of information and the division of tasks within fire and rescue services, among others, need to be developed to prepare for the anticipated changes and for mitigation of the effects, as floods or exceptional weather phenomena are expected to increase in the future.

In order to outline the effects of climate change and to recognize regional characteristics and their changes it is necessary to organize the monitoring of the state of the cultural environment – of landscapes, the built heritage and archaeological sites. The monitoring of the cultural environment requires access by all sectors to the information resources of different authorities. Information on changes will be acquired by adding further data on features such as the condition and state of preservation of sites to existing indexes and registers. Furthermore, the availability of up-to-date geographical information on sites needs to be ensured. Follow-up studies should evaluate climate change in terms of direct impacts and additions to information should be done systematically.

The impacts of climate change should be taken into account not only at the national level, but also in preparedness plans at the local and regional levels and in related working groups. The assessment of environmental impacts in accordance with the Land Use and Building Act and similar assessment procedures in connection with significant plans and programmes should take into account the fact that climate change may either reinforce recognized impacts or make them less visible. The Hague Convention on the protection of cultural property in the event of armed conflict, which Finland ratified in 1994, calls for preparedness for crisis situations in peacetime. A proposal by a working group appointed by the Ministry of Education (Ministry of Education 2007) suggests that regional working groups be established to implement the Convention and promote the protection of the cultural environment. Crisis situations and the aftermath of natural catastrophes necessitate preparedness, protection and information exchange, and the charting of man-made and natural risks. In the future, this work on preparedness could be combined with addressing the extreme situations brought on by climate change.

Supervision of land use and building

Energy and climate policies influence the cultural environment through the supervision of land use and building. The planning of the use of areas and community planning gain central significance, for example, in the control of flood risks. Information on climate risks should be included in land-use planning procedures and at different levels of plans.

In the process of increasing the use of renewable sources of energy, the impacts of wind-power plants and wind-power parks on the cultural environment need to be comprehensively investigated. The Ministry of the Environment should prepare guidelines for the siting of wind-power plants and other structures and infrastructure needed for producing renewable forms of energy.

Flood risks are currently taken into account in detailed plans, but rarely in other plans. The EXTREFLOOD project already noted the need for a comprehensive study of building and development in flood-prone areas. Research should also be carried out on supervisory and legal practices related to the control of risk areas in environmental

administration and the administrative courts (Peltonen et al. 2006). The EXTREMES project concerning extreme weather phenomena also notes that preparations for highly rare meteorological and geophysical extreme phenomena when planning communities are not ecologically practical. Plans should take into account natural phenomena that occur relatively often.

It is important to provide information for actors in the property and building sectors. In addition to charting flood risks it is also necessary to consider systems and means for the drainage and drying of plots and buildings. Assessments of site conditions and buildings can be developed and the charting of risks, such as property-specific plans for combating floods, can be attached to the use and service manuals of buildings (Ministry of the Environment 2008).

The energy consumption of buildings can be reduced through structural improvements, by improving the energy efficiency of equipment and systems and by changing customs of use. The challenge here is to recognize the characteristics of the building stock of cultural historical significance and to take these into account when applying norms of energy efficiency and building regulations in order to avoid excess repairs. Research on the real effects of climate change is needed to support the renovation of the building stock of cultural historical value to avoid excess repairs.

The potential intensification of the repair cycles of buildings should be taken into account by promoting traditional and tested working methods and by training skilled workers in the use of traditional materials and repair methods. The life-span analyses that have become more common in recent years should aim increasingly at considering emissions in a comprehensive manner and monitoring the carbon balance. In addition to limiting the energy consumption of buildings, it is also necessary to monitor the use of natural resources in the building process and related emissions. Along with authorities, land-use planners and the owners and users of buildings play an important role in the care of the building stock and in applying changes required by regulations on energy efficiency in buildings of cultural and historical significance that pose demanding requirements. The everyday choices of the users of buildings are important.

International cooperation and commitments

A challenge to administration and decision making at the national level is to anticipate and take into account the impacts of climate change on the environment, the opportunities of livelihoods, and the economy and the cultural environment at the European level. The need for cooperation has been noted among the Nordic countries. International cooperation and commitment to, among others, the UNESCO World Heritage Convention calls for the exchange of information, monitoring of developments, the sharing of experiences, preparation for reporting as required by international agreements, the monitoring of sites and locations in Finland, the charting of risks, and follow-up work. See Appendix 3: International agreements in the field of the cultural heritage to which Finland is committed. The worldwide and regionally varying consequences of climate change may affect Finland indirectly by attracting environmental refugees to the country.

Cooperation between the cultural environment administration and the private sector

Climate change will impact the conditions under which the business sector and other sectors, including agriculture and tourism, operate. This change in the operating environment of different sectors is linked to, among other factors, changes in different biotopes and in the built environment. At present no internal migration in response to climate change is taking place in Finland, but it is possible that climate change will have an impact on daily life and livelihoods in communities.

In addition to applying scientific data, there is a need for socio-economic studies and cost-benefit analyses to evaluate the potential economic losses from climate change in the tourist sector, among others (UNESCO 2008). The consequences of climate change vary regionally and global changes in the operating environment of the business sector and other sectors may also have indirect impacts on Finland.

5 Monitoring of the Climate Change and Cultural Environment Project

The Climate Change and Cultural Environment project is part of the joint Nordic project The Effects of Climate Change on Heritage Sites and the Cultural Environment (Effekter av klimaendringer på kulturminner og kulturmiljö) headed by the Norwegian Directorate for the Cultural Heritage. The project began in late 2007 and will end in 2010. Based on background studies at the national level, this project addresses threats posed by climate change to the cultural environment, evaluates related impacts on the care and administration of the cultural environment, and proposes separate research projects.

This report presents the currently recognized impacts and challenges as well as guidelines for the information needed and necessary actions. The proposals that will be specified during the project and their implementation will be monitored in 2010 as part of the activities of the working group on nature, outdoor recreation and the cultural environment of the Nordic Council of Ministers.

The special features of the cultural environment and building stock and the need for studies concerning them have been recognized in, for example, the National Strategy for Adaptation to Climate Change of the Ministry of Agriculture and Forestry. The implementation of this strategy and the monitoring of the implementation of the project on the Climate Change and Cultural Environment together will provide information on how to take the special issues of the cultural environment into account.

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Appendix 1

Experts interviewed in the spring of 2008 for the Climate Change and the Cultural Environment report

National Board of Antiquities
- Olli Cavén
- Selja Flink
- Tommi Lindh
- Seija Linnanmäki
- Maija Matikka
- Helena Taskinen
- Marianne Schauman-Lindqvist
- Leena Söyrinki-Harmo

Provincial Museums
- Museums of Central Finland: Päivi Andersson
- Museum of North Ostrobothnia: Juhani Turpeinen

Governing Bodies of World Heritage Sites in Finland
- Verla: Heikki Pyykkö
- Suomenlinna: Heikki Lahdenmäki
- Old Rauma: Juhani Korpinen

Metsähallitus
- Katja Raatikainen

Appendix 2

Expert bodies from which comments were requested in September 2008 for the Climate Change and the Cultural Environment Report

Ministry of Education
Ministry of Agriculture and Forestry
Ministry of the Environment

Finnish Environment Institute
South Savo Regional Environmental Centre
Häme Regional Environmental Centre
Southeast Finland Regional Environmental Centre
Kainuu Regional Environmental Centre
Central Finland Regional Environmental Centre
Lapland Regional Environmental Centre
Southwest Finland Regional Environmental Centre
West Finland Regional Environmental Centre
Pirkanmaa Regional Environmental Centre
North Karelia Regional Environmental Centre
North Ostrobothnia Regional Environmental Centre
North Savo Regional Environmental Centre
Uusimaa Regional Environmental Centre

The Finnish Forest Research Institute
The Forestry Development Centre Tapio
MTT Agrifood Research Finland

National Board of Antiquities
Museum of South Karelia
Provincial Museum of South Ostrobothnia
Helsinki City Museum
Historical Museum of the City of Hämeenlinna
Museum of North Karelia
Kainuu Museum
Museum of Central Finland
K.H. Renlund Museum
Cultural-Historical Museum of Kuopio
Kymenlaakso Museum
Lahti City Museum
Provincial Museum of Lapland
Museum of Ostrobothnia
Museum of North Ostrobothnia
Porvoo Museum
Museum of Satakunta
Savonlinna Provincial Museum
Tammisaari Museum
Museums of Tampere
Tornionlaakso Provincial Museum
Turku Provincial Museum
Sámi Museum and the North Lapland Natural Heritage Centre
Sarka, the Finnish Museum of Agriculture
Lusto, the Finnish Forest Museum

The Finnish Federation of Municipalities

Regional Council of South Karelia
Regional Council of South Ostrobothnia
Regional Council of South Savo
Regional Council of Häme
East Uusimaa Regional Council
Kainuu Region – Municipal Federation
Regional Council of Central Ostrobothnia
Regional Council of Central Finland
Kymenlaakso Regional Council
Lapland Regional Council
Council of the Tampere Region
Regional Council of Ostrobothnia
Regional Council of North Karelia
Regional Council of North Ostrobothnia
Regional Council of North Savo
Regional Council of Päijät-Häme
Regional Council of Satakunta
Uusimaa Regional Council
Regional Council of Southwest Finland

Helsinki City Planning Office
Helsinki City Building Supervision Office

School of Cultural Production and Landscape Studies, University of Turku
Centre for Urban and Regional Studies, Helsinki University of Technology

ICOMOS Finland
Suomen Kulttuuriperinnön säätiö ja Tuki r.y. (The Finnish Cultural Heritage Foundation)
Natur och Miljö r.f. (The Finnish Society for Nature and Environment)
PROAGRIA / Maa- ja kotitalousnaisten keskus r.y. (Rural Women's Advisory Organisation)
Rakennusperinteen Ystävät r.y.
SAFA – Finnish Association of Architects
Finnish Association for Local Culture and Heritage
Finnish Association for Nature Conservation

Appendix 3

International agreements in the field of the cultural heritage to which Finland is a signatory

- World Heritage Convention (UNESCO)
  Convention concerning the Protection of the World Cultural and Natural Heritage
- The Hague Convention (UNESCO)
  Convention for the Protection of Cultural Property in the Event of Armed Conflict
- Malta Convention (Council of Europe)
  European Convention on the Protection of the Archaeological Heritage
- Granada Convention (Council of Europe)
  Convention for the Protection of the Architectural Heritage of Europe
- Florence Convention (Council of Europe)
  European Landscape Convention
- Biodiversity Convention
  Convention on Biological Diversity (CBD)
- Ramsar Convention
  Convention on Wetlands of International Importance especially as Waterfowl Habitat

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November 2008</td></tr>
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<tr><td>Abstract</td><td colspan="4">Climate change has become the subject of wide-ranging discussion in the 2000s. Various sectors are addressing the forecasted changes in climate, and mitigation and adaptation measures. The impacts of climate change that Finland will encounter and the challenges posed by them for the care of the cultural environment also apply to the Boreal Zone of Northern Europe in more general terms.

Climate Change and the Cultural Environment – Recognized Impacts and Challenges in Finland is a joint report issued by Metsähallitus (the state forestry enterprise), the National Board of Antiquities and Finland's Ministry of the Environment. The report charts the challenges of climate change to the cultural environment of Finland. Its focus is on the effects of climate change on the care and maintenance of cultural landscapes, the built cultural environment and archaeological heritage, and on the related adaptation and mitigation measures. The special features of the cultural environment and building stock and the specific needs for related studies have previously been identified in, among others, the National Strategy for Adaptation to Climate Change issued by Finland's Ministry of Agriculture and Forestry in 2005.

Finland's energy and climate policies for the near future are steered by the national strategy to implement the Kyoto Protocol (Ministry of Trade and Industry 2005). Energy and climate policies impact the cultural environment by guiding land use and building. The challenges are to recognize real impacts on the cultural environment and to provide more specific and detailed information on climate change and the cultural environment. The objective is to anticipate and mitigate changes in the operating environment and establish joint courses of action and prioritize measures together with other actors in the field.

Administration concerning the cultural environment in Finland is divided among three sectors, which requires a well-functioning distribution of tasks and responsibilities. Information on climate change and the cultural heritage needs to be disseminated among different sectors of administration and included in the national climate strategy. Administration and decision-making at the national level faces the challenge of anticipating and taking into account the impacts of climate change on the living environment, the opportunities for livelihoods, the economy, and the cultural environment. The need for cooperation at the Nordic level has also been recognized. International cooperation and commitment to the conventions of UNESCO and the European Council, among other bodies, entails the exchange of information, preparation for the reporting required by international conventions and agreements, the monitoring of sites and locations in Finland, the charting of risks and follow-up work.

This report is part of the Nordic project Effekter av klimaendringer på kulturminner og kulturmiljö (2007–2010) on the impacts of climate change on the cultural heritage. The Finnish bodies participating in the project are the National Board of Antiquities and Metsähallitus.</td></tr>
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<tr><td>Julkaisun osat/ muut saman projektin tuottamat julkaisut</td><td colspan="4"></td></tr>
<tr><td>Tiivistelmä</td><td colspan="4">Ilmastonmuutos on noussut laaja-alaisen keskustelun kohteeksi 2000-luvulla. Keskustelua käydään eri sektoreilla niin edessä olevista ilmastollisista muutoksista, hillitsemistoimista kuin sopeutumismahdollisuuksistakin. Suomen kohtaamat ilmastonmuutoksen seuraukset sekä niiden aiheuttamat haasteet kulttuuriympäristön hoidolle ovat koskevat laajemminkin Pohjois-Euroopan boreaalista vyöhykettä.

Metsähallituksen, Museoviraston ja ympäristöministeriön raportti Ilmastonmuutos ja kulttuuriympäristö – tunnistetut vaikutukset ja haasteet Suomessa kartoittaa ilmastomuutoksen Suomen kulttuuriympäristölle tuomia haasteita. Raportissa on lähestytty ilmastonmuutoksen seurauksia sekä ilmastonmuutoksen sopeutumis- ja hillitsemistoimien vaikutuksia kulttuurimaisemien, rakennetun kulttuuriympäristön ja muinaisjäännösten hoidon ja vaalimisen kautta. Kulttuuriympäristön ja rakennuskannan erityispiirteitä ja niihin kohdistuvia selvitystarpeita on tunnistettu aiemmin mm. maa- ja metsätalousministeriön Ilmastonmuutoksen kansallisessa sopeutumisstrategiassa (MMM 2005).

Lähiajan energia- ja ilmastopolitiikan linjauksia ohjaa kansallinen strategia Kioton pöytäkirjan toimeenpanemiseksi (KTM 2005). Energia- ja ilmastopolitiikka vaikuttaa kulttuuriympäristöön maankäytön ja rakentamisen ohjauksen kautta. Haasteena on ilmastonmuutoksesta johtuvien todellisten kulttuuriympäristöön kohdistuvien vaikutusten tunnistaminen ja ilmastonmuutos ja kulttuuriympäristö -tiedon tarkentaminen ja syventäminen. Tavoitteena on ennakoida ja hallita toimintaympäristön muutoksia sekä yhdessä muun toimijakentän kanssa löytää yhteisiä linjoja ja asettaa toimia tärkeysjärjestykseen.

Kulttuuriympäristöä koskeva hallinto jakautuu Suomessa kolmelle eri hallinnonalalle, mikä edellyttää toimivaa tehtävien jakoa ja vastuiden määrittelyä. Ilmastonmuutos ja kulttuuriperintö -tietoa tulee levittää eri hallinnonaloille sekä sisällyttää kansalliseen ilmastostrategiaan. Kansallisessa hallinnossa ja päätöksenteossa on haasteena ennakoida ja huomioida koko Euroopan laajuiset ilmastonmuutoksen vaikutukset elinympäristöön ja elinkeinojen toimintamahdollisuuksiin sekä kulttuuriympäristöön. Pohjoismaisella tasolla yhteistyön tarve on huomioitu. Kansainvälinen yhteistyö ja sitoutuminen kansainvälisiin, mm. UNESCOn ja Euroopan neuvoston, sopimuksiin merkitsee tiedonvaihtoa, varautumista sopimusten edellyttämään raportointiin ja Suomen kohteiden seuraamista, riskien kartoittamista ja seurantaa.

Raportti liittyy pohjoismaiseen hankkeeseen ilmastomuutoksen vaikutuksista kulttuuriperintöön, Effekter av klimaendringer på kulturminner og kulturmiljö (2007–2010). Suomesta hankkeessa ovat mukana Museovirasto ja Metsähallitus.</td></tr>
<tr><td>Asiasanat</td><td colspan="4">Ilmastonmuutos, kulttuuriympäristö, rakennettu kulttuuriympäristö, kulttuurimaisema, perinnebiotooppi, muinaisjäännös</td></tr>
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<tr><td>Painopaikka ja -aika</td><td colspan="4">Edita Prima Oy, Helsinki 2008</td></tr>
</table>

PRESENTATIONSBLAD

<table>
<tr><td>Utgivare</td><td colspan="2">Miljöministeriet
Avdelningen för den byggda miljön</td><td>Datum
November 2008</td></tr>
<tr><td>Författare</td><td colspan="3">Jonna Berghäll, Minna Pesu</td></tr>
<tr><td>Publikationens titel</td><td colspan="3">Climate Change and the Cultural Environment • Recognized Impacts and Challenges in Finland
(Klimatförändringen och kulturmiljön • Identifierade verkningar och utmaningar i Finland)</td></tr>
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<tr><td>Publikationens tema</td><td colspan="3">Byggd miljö</td></tr>
<tr><td>Publikationens delar/ andra publikationer inom samma projekt</td><td colspan="3"></td></tr>
<tr><td>Sammandrag</td><td colspan="3">Klimatförändringen har blivit föremål för en bred debatt på 2000-talet. Debatten förs inom olika sektorer såväl om de förestående klimatförändringarna, om åtgärder för att dämpa dem som även om möjligheterna att anpassa sig till dem. Följderna av klimatförändringarna i Finland samt de utmaningar som de orsakar för vården av kulturmiljön gäller i större utsträckning den boreala zonen i Nordeuropa.

Forststyrelsens, Museiverkets och miljöministeriets rapport Ilmastonmuutos ja kulttuuriympäristö – tunnistetut vaikutukset ja haasteet Suomessa (Klimatförändringen och kulturmiljön – identifierade verkningar och utmaningar i Finland) kartlägger de utmaningar som klimatförändringen medför vad gäller kulturmiljön i Finland. I rapporten har man närmare granskat hur följderna av klimatförändringen samt verkningarna av åtgärderna i syfte att anpassa och dämpa klimatförändringen påverkar kulturlandskap, den byggda kulturmiljön och fornlämningarna. Särdragen i kulturmiljön och byggnadsbeståndet samt behovet av utredningar har tidigare behandlats i jord- och skogsbruksministeriets publikation: Nationell anpassningsstrategi för klimatförändringen (JSM 2005).

Linjedragningarna för energi- och klimatpolitiken inom den närmaste framtiden styrs av den nationella strategin för verkställandet av Kyoto protokollet (HIM 2005). Energi- och klimatpolitiken påverkar kulturmiljön via styrningen av markanvändning och byggande. Det är en utmaning att identifiera de verkliga följderna av klimatförändringen på kulturmiljön samt att precisera och fördjupa informationen om klimatförändringen och kulturmiljön. Målet är att förutse och behärska förändringarna samt att tillsammans med övriga aktörer finna gemensamma linjer och prioritera åtgärder.

Förvaltningen inom kulturmiljön är i Finland fördelad på tre olika områden, vilket förutsätter en fungerande fördelning av uppgifterna och en definition av ansvarsområdena. Informationen om klimatförändringen och kulturarvet bör delges de olika förvaltningsområdena samt inkluderas i den nationella klimatstrategin. För den nationella förvaltningen och beslutsfattandet är det en utmaning att förutse och observera de omfattande verkningarna av klimatförändringen på livsmiljön och på förutsättningarna för näringarna samt på kulturmiljön i ett europeiskt perspektiv. På nordisk nivå har behovet av samarbete uppmärksammats. Internationellt samarbete och internationella avtal, bl.a. UNESCO:s och Europarådets konventioner innebär utbyte av information, beredskap för rapportering samt en uppföljning av våra kulturminnen, med kartläggning av risker och uppföljning av dem.

Rapporten hänför sig till ett nordiskt projekt om klimatförändringens verkningar på kulturmiljön, Effekter av klimatendringer på kulturminner og kulturmiljö (2007–2010). Från Finland deltar Museiverket och Forststyrelsen i projektet.</td></tr>
<tr><td>Nyckelord</td><td colspan="3">Klimatförändringen, behärskning av klimatförändringen, anpassning till klimatförändringen, kulturmiljö, byggd kulturmiljö, kulturlandskap, vårdbiotop, fornlämningar</td></tr>
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Climate change impacts the cultural heritage of Finland. Adaptation and mitigation measures are posing challenges along with the consequences of climate change. Cultural landscapes, the built cultural environment and the archaeological heritage all will be affected. The impacts of climate change that Finland will face and the challenges posed by them for the care of the cultural environment also apply to the Boreal Zone of Northern Europe in more general terms.

This report charts the challenges posed by climate change on the cultural environment, estimates its effects on related conservation and management measures and administration, and proposes separate research projects. The near future will require the cultural environment sector to have closer contacts with other actors. The challenges are to identify real effects on the cultural environment and to provide more specific and in-depth information on climate change and the cultural environment. The objective will be to anticipate and manage changes in the operating environment and to prioritize measures along with other actors in the field.

Climate change poses a shared threat, and Finland's commitment to international agreements and conventions, such as those of UNESCO and the European Council, entails the exchange of information, preparation for the reporting required by international agreements, the monitoring of Finnish sites and locations, the charting of risks, and follow-up work.

This report is part of the Nordic project *Effekter av klimaendringer på kulturminner og kulturmiljö* (2007–2010) on the impacts of climate change on the cultural environment. The Finnish bodies participating in the project are the National Board of Antiquities and Metsähallitus.

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