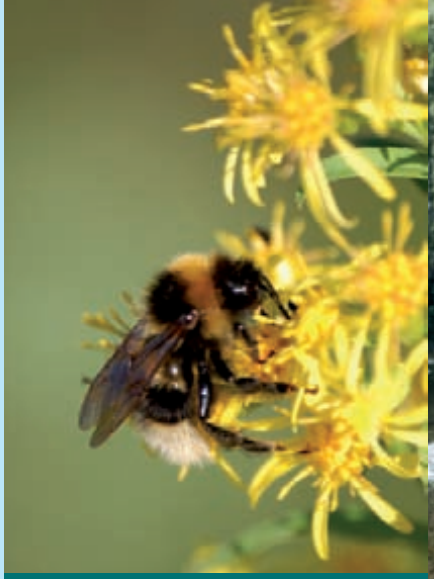
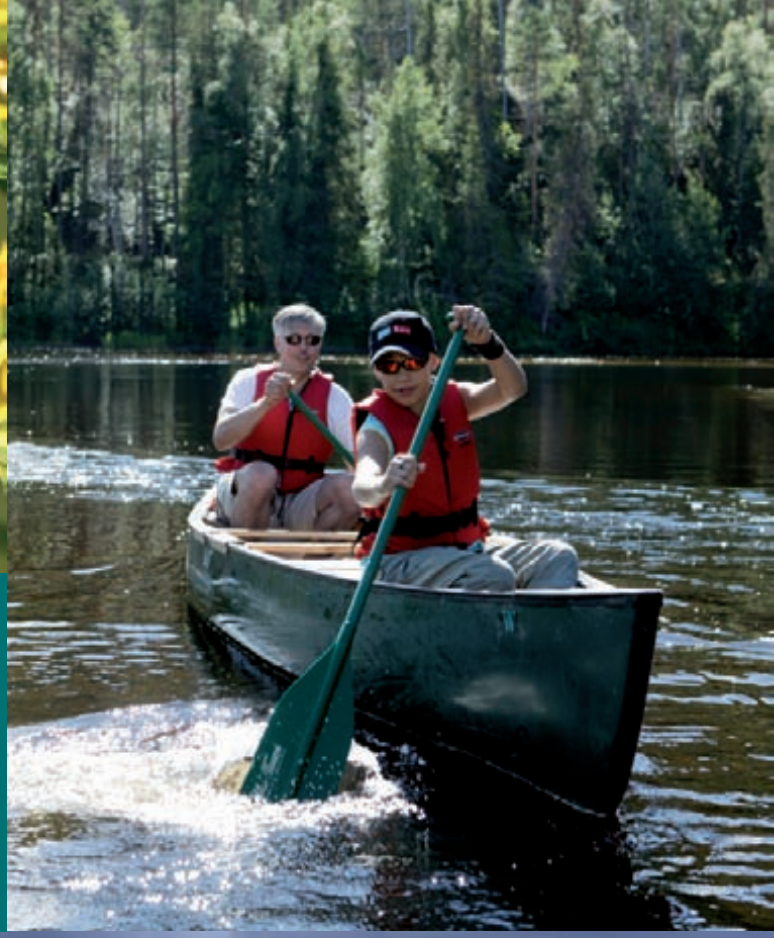
VACCIA





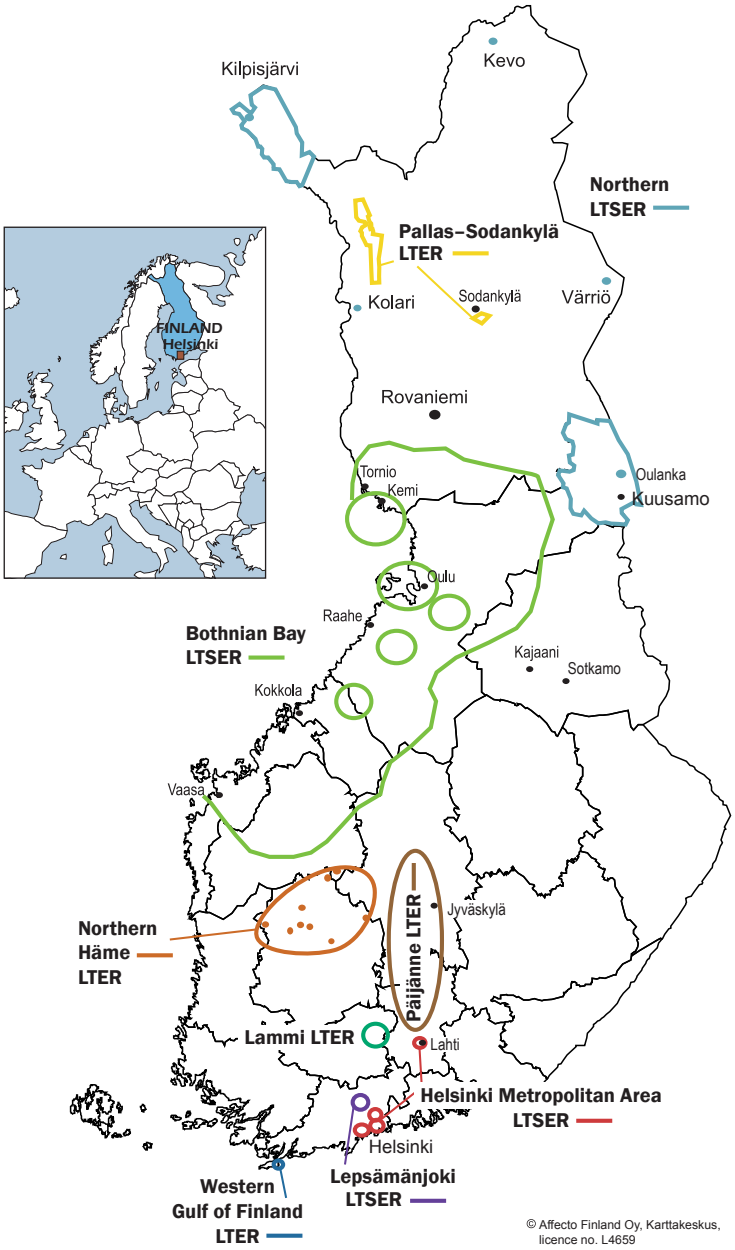
Climate change is here already. Will ecosystem services be disrupted, will we adapt to change?

VACCIA

Vulnerability Assessment of Ecosystem Services for Climate Change Impacts and Adaptation – VACCIA

Layman's Report

Contents



The key components of the VACCIA project are nine geographical areas forming a Finnish Long-Term Socio-Ecological Research Network as part of the Finnish National-level Research Infrastructure. Ecological and environmental research is the main focus in the LTER areas, whereas socioeconomic research is strongly represented in the LTSER areas.

VACCIA project

The VACCIA project (Vulnerability Assessment of Ecosystem Services to Climate Change Impacts and Adaptation — VACCIA) investigated the vulnerability of ecosystem services to climate change, and assessed the possibilities of adaptation to such changes. The project, implemented in 2009—2011 and funded by the EU LIFE+ Programme, provided work to almost a hundred researchers around Finland. In addition to the Finnish Environment Institute SYKE, which coordinated the project, the following were involved as partners: the Finnish Meteorological Institute and the universities of Helsinki, Jyväskylä and Oulu.

During the project, comprehensive investigations and assessments were conducted on how climate change affects ecosystem services, and how their vulnerability affects the livelihoods dependent on them. In addition, assessments were made of the possibilities of adaptation by ecosystem services and livelihoods. Assessment of the latter focused on agriculture, forestry and fisheries. Ecosystem services and land use of urban environments was also studied.

Methods employed in monitoring and predicting climate change included climate and air quality scenarios, and remote sensing and geographic information system (GIS) data. Research work was conducted in nine geographical areas, forming a Finnish Long-Term Socio-Ecological Research network (map image).


Aarno Torvinen

The term ‘ecosystem services’ refers to the intangible and tangible benefits nature provides to people, such as clean air and water, food production, recreation, aesthetic values, and science and education. A changing climate is already affecting ecosystem services. Changing and deteriorating ecosystem services impact on the everyday lives of each and every one of us.

The objectives of the project:

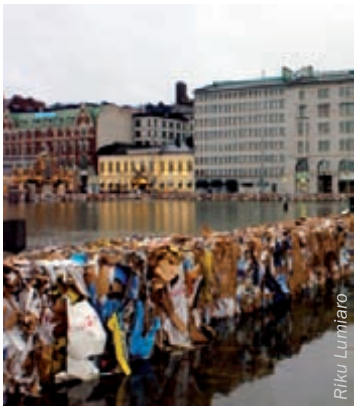
- ***To assess the impacts of climate change on ecosystem services***
- ***To produce environmental change scenarios***
- ***To develop modelling, GIS and database solutions in order to assess ecosystem changes***
- ***To outline the means by which society can adapt to changing conditions***
- ***To convey the information obtained to decision-makers and the general public***
- ***To support regional and local scale planning and decision making***
- ***To generate information for adaptation strategies at national and EU level***

Mika Heittola/Plugi


Raili Malmen


Ilkka Heikkinen


Sirpa Pellinen


Riku Lumiaro

Changing climate

Global warming will also cause changes in the Finnish climate. Since forecasting always involves uncertainty, no precise predictions on the future climate are possible. Such uncertainties are due both to the methods employed and natural variability. The more specific the area of study or the closer to the present day the time targeted, the greater the uncertainty involved.

Climate change assessments are based on results yielded by a variety of climate models and scenarios. Several key changes can be expected also in the Finnish climate.

Changes in Finland

- *The rate of warming will be higher in winter than in summer*
- *Winters will become yet cloudier*
- *Snow cover will diminish, especially in the south; on the other hand, in Lapland, the snowfall may increase*
- *The soil frost layer will thin*
- *Relative humidity may increase during winter*
- *In summer, hot days will become more common and heat waves will last longer*
- *Average wind speeds will intensify in September–April*
- *Days with heavy rainfall will become more common and heavy rains will intensify*


Pedacom Oy/Plug!


Mikko Kuusinen


Antti Below


Petri Koivisto

Vulnerable ecosystem services

Climate change will harm ecosystem services. 'Vulnerability' is the term used to describe the susceptibility of ecosystem services or various fields of activity to the harmful effects of climate change.

The level of vulnerability may differ between geographical areas and ecosystem services. Such variation is based on varying capacity to adapt to change. To a certain extent, spontaneous adaptation by society and ecosystems to the impacts of climate change is possible.

Provision of ecosystem services is dependent on biodiversity, for example. For this reason, fostering biodiversity is of vital importance. Efforts can be made to maintain biodiversity by means, for instance, of *ex situ* conservation. *Ex situ* conservation refers to the protection of species outside their actual habitats. As part of the VACCIA project, a national *ex situ* action plan was drawn up for the conservation of Finnish flora. The general objective of the programme is to achieve a 40% conservation status in the protection of endangered Finnish vascular plants by 2016.

The impacts of climate change affect all fields of human activity. Changes can no longer be completely prevented, and mitigation measures are still necessary in order to slow down the rate of change. Adaptation is necessary in order to diminish the harmful effects of change and take advantage of the opportunities it presents. Such adaptation is already required in our changed and constantly changing conditions. Mitigation of climate change and adaptation to it must be considered complementary measures.

Jorma Leskelä/Plugi

Delicate water bodies

The terrestrial and water ecosystems of the boreal coniferous forest belt are susceptible to changes in climate conditions. Changes in catchments and waterways also affect the ecosystem services provided by water bodies.

Ecosystem services provided by water bodies include clean water, production of fish, and recreational opportunities. Groundwater recharge, hydrological regulation and the capacity to retain nutrients are among the services provided by catchments.

The effects of climate change may weaken the water quality of water bodies, recreational opportunities, and the aesthetic values of the water environment. Changes, particularly in precipitation, evaporation, runoff and land use affect the ecosystem services of water bodies. Climate change causes both temporal and quantitative changes in the circulation and leaching of nutrients; eutrophication is one of the biggest threats to water bodies. The more common occurrence of extreme weather events, such as floods and drought periods, and reduced duration of ice cover, pose additional challenges. For water bodies, the most important adaptation challenges are linked to greater runoff, erosion and nutrient loads, as well as temporal changes in these.

Effects on biota

Environmental changes manifest themselves in the flora and fauna of the water environment. In coastal marine ecosystems, climate change is having diverse impacts. Both biotic and abiotic environmental constituents are undergoing such changes.

Water turbidity and eutrophication have increased in the western Gulf of Finland. Increasing floods and rainfall may further intensify the nutrient load and the abundance of agents causing turbidity. This change reveals itself, for instance, in the distribution, breeding and dominance of species. Global warming can be seen in water birdlife, for example in the form of advanced spring migration and protracted autumn migration.

In the Bothnian Bay region, the rise in sea level will slow the rate of new shore emerging through land uplift. Shores are a prime habitat for many endangered species in Finland. In the Bothnian Bay, sea shore meadows, currently threatened by overgrowth, form a natural habitat for the endangered creeping alkali grass (*Puccinellia phryganodes*) and arctic pendant grass (*Arctophila fulva* var. *pendulina*). Further threats to shore biota, both vegetation and coastal birds, include floods and the increase in their occurrence, as well as grazing by cattle on shore meadows.

Kuvastaja/Plugi

Urban green areas

Green areas of urban centres are termed 'urban green spaces'. In an urban environment, green areas are the primary providers of ecosystem services in cities. Such services include the cleaning of air and water, filtering of water, neutralisation of contaminants, biosequestration of carbon dioxide, and reduction of the risk of flooding and adverse effects associated with storm waters. In addition, urban green areas offer important aesthetic values and cultural ecosystem services, such as recreational opportunities.

In cities, the area covered by impervious surfaces is increasing. Rainwater and melt water flow over solidly laid paving or asphalted surfaces into sewers. In densely populated areas, this flowing water is called storm water. Higher precipitation will increase the amount of storm water. In cities, storm water gathers high quantities of contaminants and foreign matter along the way, ultimately placing a strain on water treatment plant and receiving water bodies.

Urban green areas are important with a view to storm water management. In green areas, rainwater filters into the ground and becomes available for vegetation. However, the accelerating rate of urbanisation and denser urban structure constitute a treat to the number of city green spaces. A dense urban structure weakens the ecosystem services provided by soil. As far as city green spaces are concerned, the denser urban structure represents the key adaptation challenge.

Adaptation requires both new innovative design solutions and a comprehensive approach, in which one method of adaptation is not emphasised over others. Not all ecosystem services provided by urban green spaces can be replaced by construction or environmental technology solutions.

Unto Tapio


Sini Yrjänä/Plugi


Pentti Sormunen/Plugi


Jorma Sikeä/Plugi

Adaptation in assistance of livelihoods

Adaptation is required in facing current climate fluctuations and changing conditions in the future. In order to assess the possibilities for adaptation, information is required on the probability of changes, the vulnerability of ecosystem services and possibilities for adaptation in different geographical regions.

Ecosystems react differently in different parts of the country and in varying environments. The effects of climate change on ecosystem services were investigated in diverse environments ranging from large cities (Helsinki, Lahti) and recreational centres (Kuusamo, Sotkamo) to different types of forest, agricultural and watercourse environments from north to south and from inland regions to the coastal zone. Assessment and outlining of various means of adaptation is helpful when developing environmental policies at local and regional level, as well as at national level. The project sought various means of adaptation for fisheries, agriculture, forestry and tourism. Results emerging from the VACCIA project may be used, for instance in the forthcoming reform of the National Strategy for Adaptation to Climate Change.

Antti Ekola/Plugi


Jouko Lehmuskallio


Aarno Torvinen


Reili Malinen

Food security from northern fields

During the last hundred years, the crop growing season has become longer. Farmers have taken cautious steps to adapt to this change by sowing their spring crops earlier. Global warming may advance the arrival of spring yet further, which will lengthen the growing season. In autumn, diminishing light amounts limit the lengthening of the growing season.

A warming and lengthening growing season facilitates higher yields than before and the introduction of a broader range of crops. However, these changes require the breeding of crops and development of farming methods. By means of plant breeding, efforts can be made to improve, for instance, plants' intake of water and nutrients.

Climate change will not only bring positive developments to Finnish agriculture. The occurrence of extreme weather events threatening crops, such as heavy rains, long rainy periods, floods, storms, and periods of drought, is expected to increase. Rainy winters with little snow and heavy rains may weaken land capability and increase erosion. In addition, pests adapted to a warm climate may become a problem for Finnish agriculture. Global climate change may reduce yields in agricultural production areas outside Finland, which could enhance the importance of agriculture practiced in the north as a guarantor of food supply.

In the future, agriculture must increasingly manage its own climate and environmental impacts. Water protection must be intensified by aiming for a closed nutrient cycle, which would reduce the load on water bodies. Increasing precipitation, on the other hand, requires good maintenance of ditch networks. Land capability can be managed by rotating a larger variety of crops; simultaneously, this would improve tolerance of plant diseases. Climate change necessitates effective water protection, plant conservation and water management methods suited to local conditions. In agriculture, breeding of crops and increased variety of production are excellent means of adaptation.


Plugi


Pekka Lyukkola


Marja-Leena Nenonen


Tuomas Heinonen/Plugi


Ilkka Kallio/Plugi

Diversity in silviculture

The Finnish forests have grown remarkably well over the last few decades. However, it is difficult to separate which part of this growth can be attributed to climate change, and which to other change factors. In the future, climate change will affect both forest renewal and silviculture, and the lengths of rotation periods. Efforts must be made in forestry to adapt to these changes.

As in other sectors, here too the changes brought by climate change are diverse and partly inconsistent. Variations in the timing of precipitation periods can cause longer drought periods in summer, while winter snowfalls may, in the future, turn to water. Since the increasing carbon dioxide content in the atmosphere may enhance water intake by trees, drought is unlikely to become a problem for forests. As in the fields, earlier onset of spring will also manifest itself as the earlier appearance of leaves in forests. A longer spring growing period will enhance the production of forest resources, i.e. the development of forest biomass.

The key adaptation challenges for forestry may be the choice of wood species, timing of forest renewal and improvement cutting, and preparation for different kinds of damage and diseases. Further challenges may be posed by various fungal diseases, insects, drought and storm damage. As regards adaptation, account must also be taken of biota other than trees, since they also need means of adaptation as conditions change.

Forest use is often confronted with several conflicting requirements. Measures for ensuring the provision of ecosystem services and climate change may even increase the number of such conflicts. Biodiversity, both in the variety of wood species and the objectives of silviculture, will offer more alternatives for reconciling these conflicts and adaptation to changing conditions.

Pentti Sormunen/Plugi


Pekka Luukkola


Toni Pihkanen/Plugi


Riku Lumiaro

Adaptable fisheries

The predicted changes in, for example, the temperatures of water bodies and ice cover will affect the behaviour of fish, and the fishing industry. The adaptation of fisheries was studied in a VACCIA sub-project implemented on Lake Päijänne. Changes in temperature affect, for example, the duration of the ice-cover period, spawning times, hatching, dominance of species and migration of fish. A rise in temperature and an increase in precipitation may directly or indirectly affect the quality of water and eutrophication of water bodies.

Warmer waters constitute both a threat and an opportunity for fish fry. On the one hand, fish fry may have more food in warmer waters; on the other, species preying on fry may be more active. Water temperature affects the growth and mortality of fish fry. Warming may increase the cyprinid populations and reduce the number of salmonoids. Thus climate change may also lead to changes in target fish species.

As a well-adapting livelihood, the fisheries has already made the necessary adjustments, for example, to annual fluctuations. In the future, professional fishing must continue to adapt to changes in both conditions and fish stocks. Possible means of adaptation include changing the species caught, or the fishing area. Export of fish considered to be of low commercial value in Finland could also make adaptation easier. The predicted changes may take time to occur, in which case the fisheries industry will be capable of adapting to them over time.

Pedacom Oy/Plugi


Jaakko Suvala/Plugi


Topi Yli-Mononen/Plugi


Tapio Heikkilä

Northern tourism as a year-round activity

Tourism, nature tourism in particular, is dependent on the prevailing weather at any given time. Climate change, such as shorter, warmer winters with variable snow cover, can change the preconditions for tourism activity in Northern Finland, for instance.

Intensifying weather fluctuations and uncertain circumstances constitute risks, in particular to winter tourism, transport arrangements and the profitability of the tourist trade. Climate change may have conflicting effects on tourism. For example, warming of surface waters may lengthen the water activity season, but simultaneously lower water quality in the form of increases in algal blooms. This may lead to swimming prohibitions and bans on using water for drinking.

Through interviews and workshops, the prerequisites for tourism to adapt to the challenges posed by climate change were investigated by one of the VACCIA sub-projects. The purpose of the study was to outline factors considered critical from the perspective of the local ecosystem and local community, and which might have an impact on nature tourism. Adaptation measures were contemplated alongside tourist trade actors and stakeholders in Kuusamo and Sotkamo.

Both regions are dependent on wintry natural conditions and winter nature tourism. Tourism can prepare for the risks presented by climate change, by developing all-year-round tourism in particular. Both short-and long term means of adaptation should be formulated. In short-term adaptation, the focus should be on building safe crossings over water bodies and increased the sanding and salting of roads. In the long term, tourist routes should be moved entirely onto dry land and set up for year-round use. Construction should be avoided in risky areas and year-round tourism developed. The tourist trade's own efforts to reduce its climate impact would support the implementation of long-term goals. By means of adaptation, it is possible to ensure that nature retains its position as a tourist attraction.

VACCIA in figures

- *Participants in the project: 5 institutes and universities (Finnish Environment Institute SYKE, Finnish Meteorological Institute, and universities of Helsinki, Jyväskylä and Oulu)*
- *Actors involved in the project: 100 researchers throughout Finland*
- *Duration of the project: 3 years (2009—2011)*
- *Project funding: 3.1 million euros*

Reports and publications:

- *Synthesis Report*
- *20th anniversary report on Valkea-Kotinen region*
- *Layman's Report*
- *Sub-project reports, studies and research papers 61*
- *Brochures at the beginning and end of the project*

Seminars and workshops:

- *National Final Seminar for stakeholders*
- *Sub-projects seminars and workshops 13*
- *Lectures and presentations in national and international seminars and conferences 10*

Presentation of results in media:

- *Articles in national and regional papers 27*
- *Articles in local papers 17*
- *Radio presentations 4*
- *Television presentation 1*
- *Fairs and other public events 6*
- *Press and news releases in the Internet 7*

Websites and portals:

- *www.ymparisto.fi/syke/vaccia*
  Homepage of the project (in Finnish)
- *www.miljo.fi/syke/vaccia*
  Homepage of the project (in Swedish)
- *www.environment.fi/syke/vaccia*
  Homepage of the project (in English)
- *http://maps.tvarminne.helsinki.fi*
  VACCIA GIS portal for recognition of changes in coastal ecosystems
- *http://vaccia7.maat.helsinki.fi/*
  Lepsämänjoki Long-Term Socio-Ecological Research (LTSER) network
- *http://thule.oulu.fi/vaccia/*
  VACCIA website of the University of Oulu
- *http://litdb.fmi.fi/vaccia/database/*
  VACCIA air quality portal, Finnish Meteorological Institute, Pallas-Sodankylä GAW station

VACCIA

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