# Climate Change in European Forests:

## How to Adapt

EFI Policy Brief 9

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# Foreword

Recent research indicates that it is most likely climate change will exceed a 2 °C rise in mean global temperature by 2100 – without drastic policy change mean temperature may rise between 3 and 6 °C in Europe.

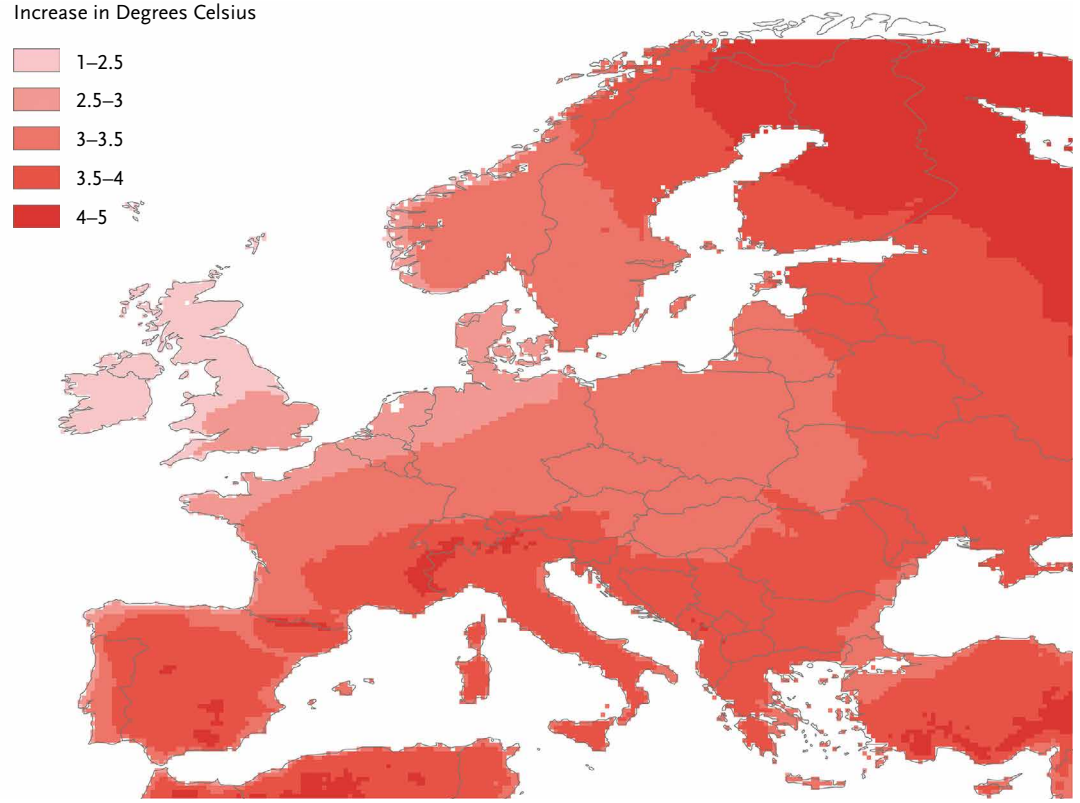
A comprehensive EU climate change adaptation strategy will be launched in April, 2013. Forests are an important resource in Europe, covering almost 38% of total land area of EU-27 countries in 2010. It is essential that decision makers are aware of the potential impacts of climate change on forests and are prepared to adapt policy to minimise negative effects.

This policy brief is based on research carried out as part of the Models for Adaptive Forest Management (MOTIVE) project, a large scale integrated project in the 7th Framework Programme of the EU. The examples used come from case studies examined in MOTIVE. Further information can be found on www.motive-project.net

# Forests, climate change and long term planning

The management of forest ecosystems requires planning for the long term. A forest management cycle (planting, harvesting, replanting) can range from less than 10 years up to over 100 years in length. Climate change has already caused many changes in European forests and this is expected to continue and accelerate. The question of how to adapt forests to a new climate is an important one for these times.

In this policy brief, we discuss different types of adaptive management for climate change with examples from forests around Europe.




The projected increase in annual mean temperature by 2070–2099 as compared with 1961–1990 (average of four climate models for the A1B scenario described in detail in the Intergovernmental Panel on Climate Change – IPCC – Special Report on Emissions Scenarios).

# Forest management needs to adapt to climate change

Forest management by its very nature involves planning for the long term. This includes dealing with uncertainties related to future timber prices, forest productivity and growth, and other variables. Another source of uncertainty to be considered in forest management planning is the question of how to adapt to climate change. Climate change may have an effect on tree growth, species choice, and risk from disturbances such as wind, fire and pests.

Climate change is projected to have significant long term impact on the growth and performance of many forest tree species and forest ecosystems in Europe. However, while performance and productivity of forests change, forest management decisions themselves may or may not be dramatically changed.

## Catalonia, Spain

Many trees are under water stress due to recent increases in aridity. Increased mortality has been recorded in some species such as Scots pine.

Joanne Fitzgerald

Rui Ferreira / shutterstock.com

## Portugal

In the forests of Chamusca, fires are already the main threat, and they are expected to increase as the future climate will be characterized by dryer summers and longer fire seasons.

Manfred Lexer

## Austria

In the forests of the Montafon, where Norway spruce is dominant, protection against gravitational hazards is likely to be adversely affected by bark beetles.

Thomas Nissen

Since 1990, several storms have caused widespread damage in European forests. After Storm Lothar in 1999, the Norway spruce dominated forest in Baden-Württemberg, Germany was extensively damaged and was further destroyed by bark beetle attack. Forest managers responded by replanting with 20 different species and aiming for 50% natural regeneration in the future.

# Reactive Management: Passive waiting and responding after impacts occurred

With a reactive management approach, a decision maker awaits and observes the actual outcomes and impacts of climate change as it develops.

This decision making approach does not include forecasting or forming expectations about the likelihood of different climate change developments, nor their potential future impacts on forest ecosystems. A person using this approach does not adjust current decisions to the possible implications indicated by such forecasts or expectations.

Decision making approaches like this may be quite widespread among forest managers. If uncertainty about direction and/or impact of climate change is very large, the decision maker has little basis for firm expectations and it may be a relevant approach, even if not the most favourable one. It may also be a relevant approach to follow if the expected changes are small or gradual in form.

Michael den Herder

# Reactive decision making could be the best approach in Northern Boreal Forests

In North Karelia, Finland, a modeling analysis of mixed stands of Norway spruce, Scots pine and birch was carried out using projected climate data to 2100. It was found that, with respect to handling the uncertain growth development under climate change, reactive approaches were not found to be inferior to a more anticipatory approach. In this case the models found that a reactive approach leads to forest management similar to that when including expectations for the future in the assessment.

In this part of Europe, climate change is not likely to drastically impact the health or stability of the forest ecosystem but rather is expected to gradually change the absolute and relative performances of the most common species. Forest management may respond adequately to this type of change in a reactive manner. It is always advisable, however, to be proactive about monitoring climate developments and potential impacts on forests.

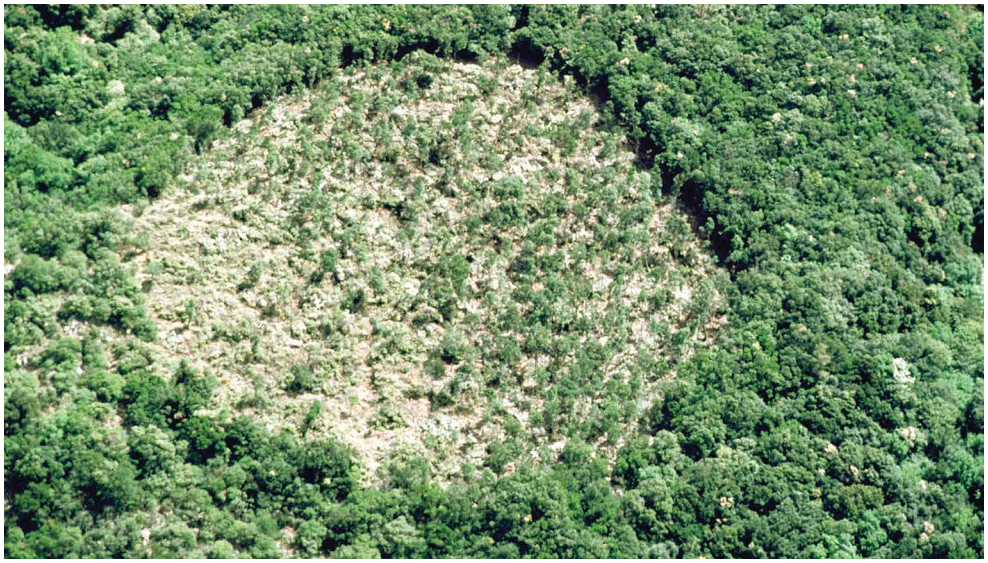

# Proactive management: Active anticipation and management actions

Proactive management could also be described as a fully adaptive management approach. The decision maker applying this approach not only observes developments in current climate and the state of forest ecosystems; but also assesses likely projected developments and impacts of climate change. This may be done using numerous sources of information as well as observations. This decision maker bases current decisions both on observed status of the forest and on expectations of future climate change impacts.

If the proactive manager succeeds in anticipating future changes, (s)he should perform at least as well as the reactive manager.

In proactive decision making, the quality of the information on which decisions are based are paramount.

Carlos Gracia



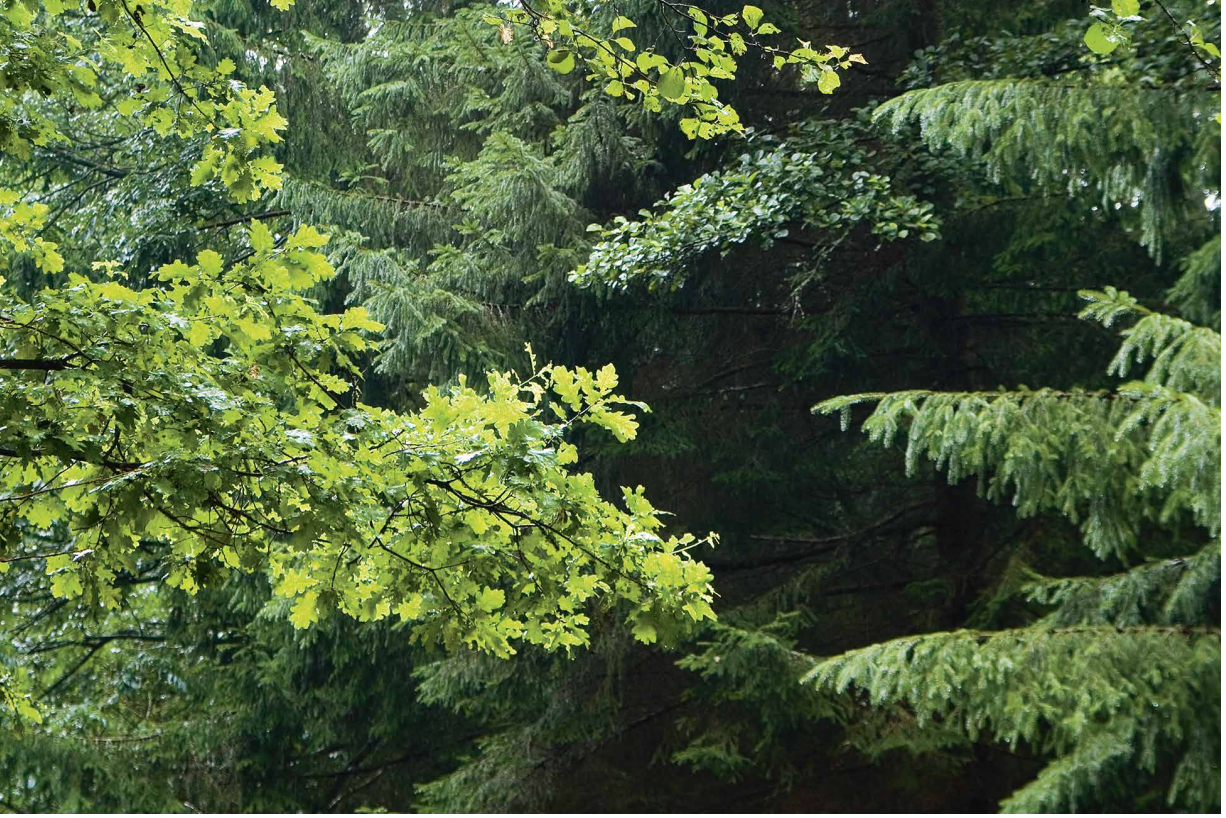
The circular area shows a thinned plot in a forest. The plot was better able to withstand drought conditions two years later.

# Mediterranean Forest, Catalonia, Spain: What proactive management can do

Most trees in the Mediterranean zone are very to extremely drought resistant which means they have a low risk of mortality due to drought. The most serious threat of climate change to forests in the area is the increased occurrence of long dry spells. Climate models project that these will increase in frequency, and their average duration will also increase. The longest annual dry spell is predicted to increase in length by over 15 days in Catalonia by the end of the century. Species like Scots pine, which find their southernmost distribution areas in Catalonian mountains are directly threatened by climate change. Scots pine has no possibility to migrate to higher elevations as they already occupy the highest zone, and mortality is already evident in the area.

In Poblet forest in Catalonia, business-as-usual (BAU) practice is clearcut harvest or destruction by fire at variable age without any previous tending or thinning. Models show that BAU management under climate change leads to a decrease in biomass production and affects other ecosystem services. In this case, management is a very effective tool to adapt to climate change. More thinning and longer rotation lengths are found to be optimal.

The reduction of tree density increases the amount of water available per tree, which is critical in a drought situation. The remaining trees are then able to continue transpiring which means less mortality and better overall growth performance.



Aleksander Bolbot / shutterstock.com

| | Climate change outcome | | |
|---|---|---|---|
| *Species* | *Worst* | *No change* | *Best* |
| Norway spruce | -17882 | 807 | 7540 |
| Oak | 632 | 632 | 632 |

Simulated land expectation values (LEV) [€/ha] for 3 different climate change outcomes for a new forest stand consisting of either Norway spruce or oak.

| | Expected LEV | |
|---|---|---|
| *Species* | *Before* | *After* |
| Norway spruce | -3178 | 2993 |
| Oak | 632 | |

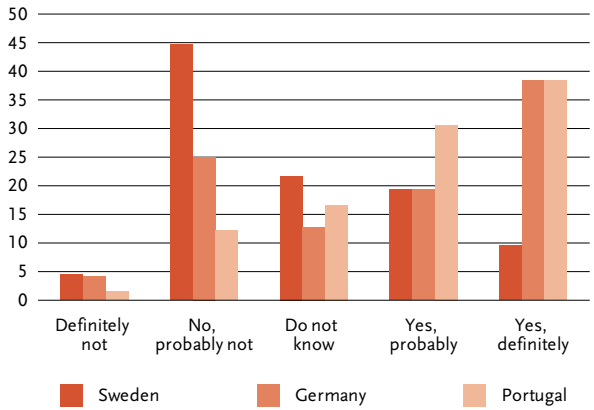
Expected land expectation values (LEV) [€/ha] when decision is taken before or after the true climate change scenario has been revealed. If the decision is taken before, oak will be chosen even if it is inferior in two out of three scenarios. If we can wait taking the decision until more information is available, we will only choose it in one out of three scenarios, thus increasing the expected value. This is the value of waiting for more knowledge.

# Million euro question: Which tree species to plant and when?

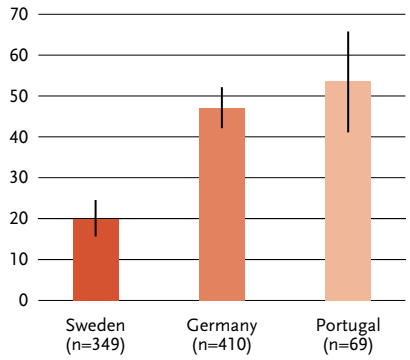
The issue of tree species choice is one of the most far-reaching decisions in forestry and therefore one where proactive assessment of the potential long term impacts may play the largest role. Recent research studied the impacts in Denmark of when to switch from Norway spruce to oak. Oak is expected to perform better under climate change than Norway spruce. However currently, Norway spruce is the more profitable species.

With climate change, increased risks of wind damage, drought-related bark beetle pests and similar may reduce the profitability of Norway spruce. Yet, economic sensitivity analyses reveal that quite a bit of negative impact is needed to reduce the expected economic performance below that of oak.

It is likely we will know more about climate impacts on forests as time passes. This causes a dilemma: Should we wait for this information, and make better informed management decisions? Or, should we act already on the basis of more incomplete information, in order to adapt earlier and minimize the potential adverse impacts?




Percentage of those surveyed who alleged strength of belief in having experienced climate change, per country.




Percentage of those surveyed who have already adapted their management in response to climate change. Bars denote 95% confidence intervals.

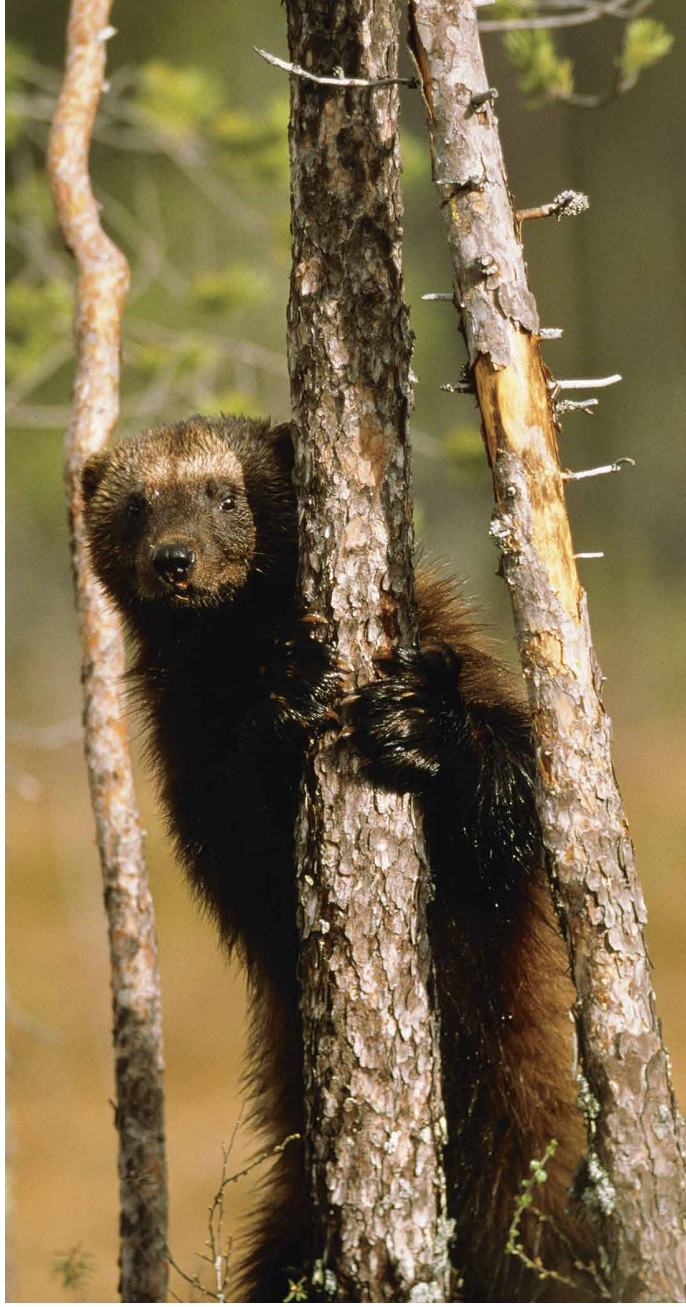
A recent study surveyed 845 private forest owners in Sweden, Germany and Portugal representing a north-south gradient across Europe.

# Climate change: Learning and beliefs lead to adapting

When forest owners believe in and see the effects of climate change, they are more likely to have taken adaptive measures. These two personal factors almost completely explain and predict forest owners' adaptation to climate change.

A lower proportion of forest owners in Sweden (Kronoberg county) stated that they had adapted their management practices in response to climate change compared to those surveyed in Germany (Black Forest) and Portugal (Chamusca).

Source: Blennow et al. 2012. PLOS ONE 7/11 e50182



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Yannis Raftoyannis

Small wooded dams protect against soil erosion after a forest fire in Greece.

# Forest adaptation: Management for society and for profit may differ

In parts of Europe, there may be a perception that the consequences of climate change for forestry are not too severe for the coming decades. However, long term provision of many ecosystem services and benefits like biodiversity conservation, recreational use, and erosion protection may be more sensitive to climate change than forest growth and productivity.

One such example is the increased risk of forest fires in Southern Europe which calls for adaptive management to protect ecosystem services and benefits. **But** there may be no positive economic incentive for the forest owner to carry out adaptive management.

This potential discrepancy between adaptive forest management for society, and the economic costs and benefits of adaptation needs to be addressed. Policy instruments and regulation measures that create incentives for forest managers to align decisions and management with societal objectives may be helpful.

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# Recommendations

- Communicating evidence of climate change and its effects is crucial to facilitate adaptation.
- Sharing experiences of successful adaptation measures across regions helps managers to prepare for changing conditions.
- In some areas, currently favoured forest species and systems might perform better than alternatives in the near future, even if their performance is expected to decline as the climate changes. In the longer run, when expected changes have grown larger, adaptive measures may be required.
- Adaptive forest management might be warranted from the perspective of a collective but not from the perspective of the individual forest owner, or vice versa. A recommendation for adaptive action or inaction should always be accompanied with information on the perspective applied since adaptation might be warranted from one perspective but not the other.
- The capacity of forests to resist change or recover following disturbance is strongly dependent on biodiversity. Maintaining and restoring biodiversity in forests promotes their resilience to expected climate change impacts.
- Uncertainty around future climate change impacts is one of the largest challenges of planning adaptive measures. There is no reason to believe that this uncertainty will disappear any time soon. Management thus needs to account for uncertainty. One way of doing that is to apply alternative decision making strategies in different locations. Diversity supports resilience at different scales.
- The quality of information on which decisions are based is paramount – continuous monitoring of forest health, pests and diseases is critical under climate change.

# Make the right decision at the right time

Timely adaptation is about making the right decision at the right time. This may not necessarily result in immediate management change if it is better to wait and learn more about the changes first. The decision of when and how to adapt depends on how large the effects are expected to be, but also on the costs of adaptation.

Communication of climate change scenarios and assessments of climate change impacts will provide opportunity for informed proactive and timely adaptation.

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