LRTAP
Long-range Transboundary Air Pollution

International Co-operative Programme
on Assessment and Monitoring of Air
Pollution Effects on Forests (ICP Forests)

European Commission

# European Forests in a Changing Environment

## Forest Monitoring by ICP Forests and the European Commission

## Introduction

Throughout Europe, the goods and services that forests provide are valuable economically, but also play a significant role in the development of rural areas, and for recreational purposes. In addition, forests have a major role in nature conservation and environmental protection and are significant carbon sinks, and thus extremely relevant in the context of climate change mitigation. Forests also represent a controlling factor within the water cycle. Sustainable forest management, as well as environmental policies, rely upon the sound scientific resource provided by long-term, large-scale and intensive monitoring of forest ecosystems.

In 1985, the International Co-operative Programme on the Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) was established under the UNECE Convention on Long-range Transboundary Air Pollution. In 1986, the European Union (EU) adopted the Scheme on the Protection of Forests against Atmospheric Pollution, based on the ICP Forests monitoring platform. For over twenty years, ICP Forests and the EU have been closely co-operating in monitoring the effects of air pollution and other stress factors on forests. With the expiration of the Forest Focus Regulation (EC No. 2152/2003) in 2006, there is no more legal basis for forest monitoring in the EU. Today 41 countries participate in the ICP Forests monitoring programme which contributes to the implementation of clean air policies at European and national level. The programme is one of the largest and longest running biomonitoring networks in the world, covering over two hundred million hectares of forest.

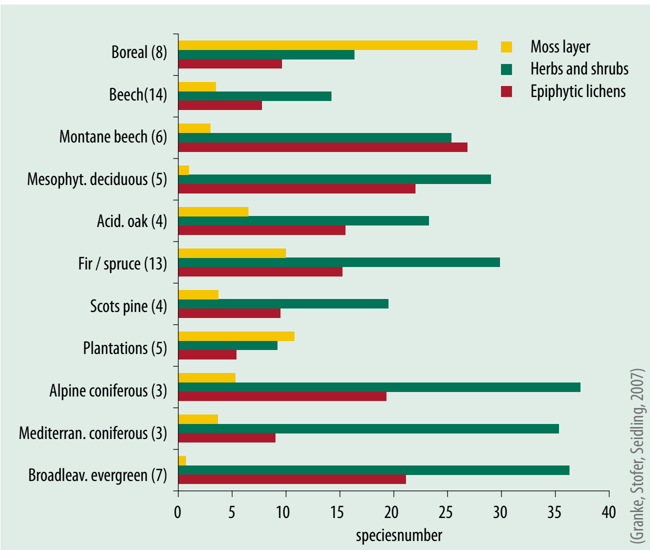
EU/ICP Forests monitoring activities have made significant differences to both environmental and forestry policy and practice, at international, European and national scales. At the international level, the establishment of direct effects of atmospheric pollution on forest growth and ecosystem functioning has helped in the development of UN pollution abatement protocols, and in Europe the passing of several air quality Regulations. The joint ICP Forests and EU monitoring scheme is also one of the main data providers for the Ministerial Conference on the Protection of Forests in Europe (MCPFE) Criteria and Indicators.

The programme includes large scale monitoring based on around 6 000 so called Level I plots and an intensive monitoring level including surveys of crown condition, foliar chemistry, soil chemistry, tree growth, ground vegetation on around 700 – 800 plots, atmospheric deposition on 544 plots, meteorology on 221 plots as well as surveys of stand structure, epiphytic lichens, soil solution chemistry, ambient air quality, phenology and litterfall on a smaller number of plots.

## Forest biodiversity monitoring

### EU-funded pilot projects lead the way.

In 2002 the environment ministers of Europe declared a halt to the loss of biodiversity by 2010. Within the European forest monitoring programme, some indicators related to biological diversity have been assessed from its inception. With co-financing from the European Commission, a specific biodiversity test phase was completed on 96 Level II plots in 2006 (ForestBIOTA project). A related demonstration project (BioSoil) on Level I plots was started in 2006. Key 'indicators' are assessed (a) to develop methods and indicators that are scientifically sound, relevant and cost effective, and (b) to carry out a baseline monitoring against which future monitoring results can be compared. Biodiversity sampling in the BioSoil project includes plot design and description, forest classification and verification, structural forest diversity (tree diameter, species composition of woody plants, canopy closure, tree layering and deadwood) and compositional forest diversity as a vascular plant species list. Twenty one EU countries are carrying out the survey on more than 4 000 Level I plots.

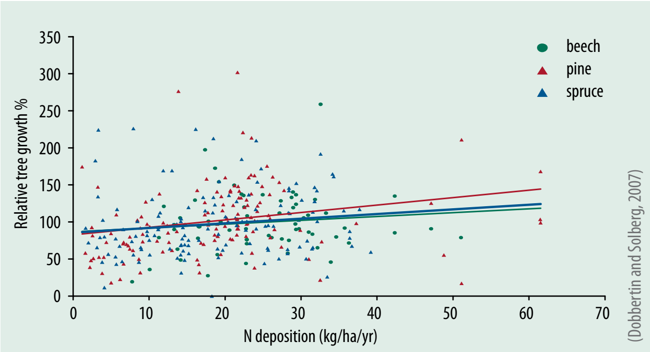




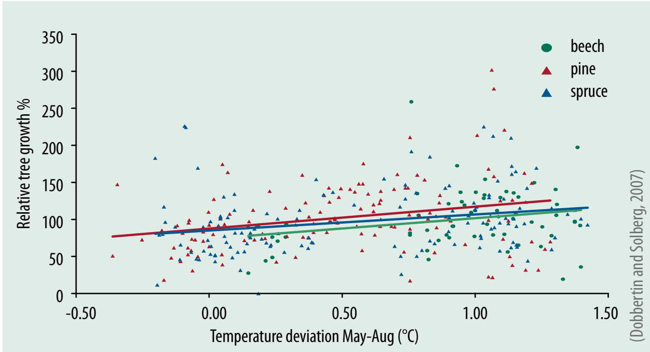
Within pilot studies, epiphytic lichen species on the forest plots and the impacts of environmental conditions have been monitored (Photo: *Lobaria pulmonaria*).

Left: Number of plant and lichen species on plots in different forest types (in brackets: number of plots). Different numbers of moss, herb and lichen species are typical for different forest types.

# Forest growth and climate change mitigation




Relative tree growth in relation to nitrogen deposition. Overall, an increase of 1 kg nitrogen deposition per hectare and year accounted for an increase of 1 % in stem growth.

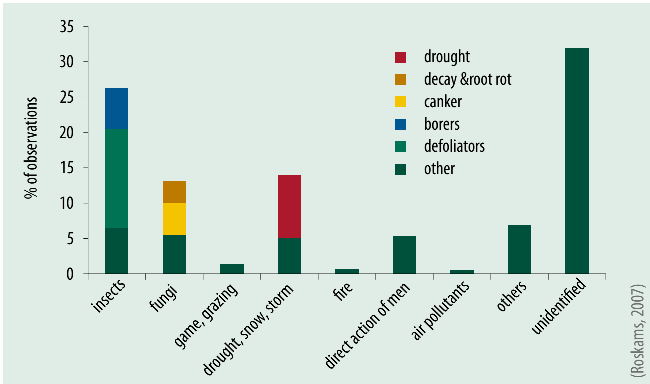



Relative tree growth in relation to temperature deviation from the long term mean. A temperature deviation of 0.1°C accounted for an increase of between 2 to 4 % in growth.

**Nitrogen deposition and high temperatures accelerate forest tree growth.**
The monitoring data show the effects of temperature and deposition on forest growth. The growth of spruce and pine trees was significantly higher on plots with high nitrogen deposition, especially on infertile soil types. In contrast, results suggest that the increase in relative growth may not be sustained on nitrogen saturated sites in the future. Above average temperatures during the growing season also correlated with higher relative growth for spruce, pine and beech. However, low rainfall may offset the effects of increased temperature for pine and spruce at droughty sites. Uptake of carbon in forests (sequestration) delays the rise of $CO_2$ concentrations in the atmosphere and thus slows down the rate of climate change. EU/ICP Forests monitoring data have been valuable in helping to quantify forest ecosystem carbon amounts and fluxes. For example, they have contributed to the EU CarboEurope project cluster which informs on the role of the European continent in the global carbon cycle.

# Forest health and vitality

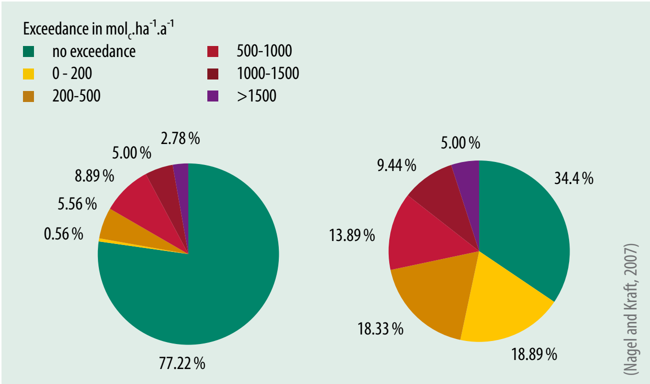

Crowns of undamaged, slightly and moderately damaged Scots pine trees.




Percentage of observed damage causes. Insects, fungi and weather influences were most frequent.

**Stabilization in 2006 after some years of worsening.**
The health condition of forest trees is monitored throughout Europe by an annual survey of tree crown defoliation. The MCPFE uses defoliation as one of four indicators for forest health and vitality. In 2006, crown condition data were submitted from almost 130 000 trees in six thousand plots across 32 countries. Nearly 25 % of all trees assessed had a needle or leaf loss of more than 25 % and were thus classified as either damaged or dead. European and sessile oak were the worst affected, with over one third in this category. These results point to the need for continuing vigilance in the state of European forests, and in seeking mechanisms for their protection.

**Regional relevance of stress factors and extreme events.**
Forest condition is determined by a multiplicity of factors. Monitoring of damage causes is important for sustainable forest management and for estimating the response of forest ecosystems to changing climate. EU/ICP Forests has focused recently on effective monitoring of insect damage, which is the most important cause of tree defoliation, though locally of very differing importance. ICP Forests and EU monitoring platforms have also provided the means of quantifying the effects of extreme events such as the intense drought in central Europe in 2003, and tracking the recovery of forest ecosystems afterwards. A combination of research and monitoring enables stress factors to be better understood.




Shares of plots with exceedance of CL for acidity (left) and nutrient nitrogen (right). The term 'critical load' refers to the amount of atmospheric pollutants below which no significant harmful effects on the forest ecosystem are expected in the long run.

# Air Pollution

**Critical loads for nitrogen deposition and acidity are still exceeded on many plots.**

As a result of clean air policies, European forests suffering from critical load exceedances for acidity are now much more restricted in area than they were– over three quarters of plots studied had no critical load exceedance in the 1999 to 2004 monitoring period. In contrast, over 65 % of nearly 200 ICP Forests and EU plots showed critical load exceedance for nitrogen, notably in central Europe. In these forests, nutrient enrichment remains a threat to vegetation diversity, and to the pollution of surface and ground waters. Continuous monitoring suggests that nitrogen inputs to forest ecosystems are not decreasing on over 80 % of the plots.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41 countries are participating in the monitoring programme.

Your local contact is:

**Publications and Websites**
www.icp-forests.org
The ICP Forests website contains details of the monitoring programme, all participating and supporting bodies and access to the annual reports and other publications, plus a calendar of events and useful links.
http://ec.europa.eu/environment/forests/ffocus.htm
http://forest.jrc.it/ForestFocus/
The European Commission maintains specific websites related to the Forest Focus Regulation and to forest monitoring in the EU.

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