Forests

Forest dynamics in Europe and their ecological consequences

Forests used to constitute the dominant natural vegetation in most of Europe, covering up to 80 % of the land surface. However, the current extent and condition of forest ecosystems are the result of the process of human appropriation (domestication), which started more than 5000 years ago. By the end of the 17th century, more than half of Europe's original forest had disappeared and covered just a few percent of the total land area in countries such as Denmark or Ireland. In response to forest depletion, stricter forest management practices emerged to replant, protect and maintain forest cover and the multi-functionality of forests in terms of wood production and protection against, for example, soil and wind erosion.

- Driven by market forces and by EU and national policies on energy and climate mitigation, the demand for forest products and ecosystem services is projected to increase in the future.
- Forest ecosystems are increasingly prone to disturbances, such as storms, fires, droughts, invasive species and outbreaks of insect infestation and disease, all amplifying vulnerability to climate change.
- The way forest management faces these increasing demands and disturbances will have profound effects on the health, diversity, productivity and resilience of forest ecosystems.
- Ecosystem-based management is one approach to rethinking sustainable forest management in ways that are compatible with multi-functionality.
- Information on multi-causal changes in forest cover is currently limited; dedicated use of very high-resolution satellite imagery would overcome this lack of data.

One of the main land use changes in Europe over the last 200 years has been the expansion of the forest area, mainly driven by large-scale afforestation programmes in many European countries. At the same time, the rural exodus accelerated and changes in technology allowed the intensification of agricultural systems on smaller areas (Mather, 2001; Pile et al., 2012). Forests expanded through spontaneous regeneration on abandoned agricultural land.

In the 50 years after the Second World War, the forest area in western Europe increased by almost 30 %. The growth was substantially lower in central and eastern as well as in southern Europe,

with about 20 % and 16 % respectively (Gold, 2003). In northern Europe, forest was already the dominant land cover. The increase in forest cover continues up to the present, although it stabilised after the beginning of the 1990s, with the exception of western Europe (Forest Europe, 2015). Afforestation and deforestation are now locally concentrated in a few European countries and involve less than 0.4 % and 0.3 % of land conversions respectively. However, a stable forest area does not necessarily mean that Europe's forests are not subject to change: forest ecosystems respond to human activities and maturing, and other natural dynamics.

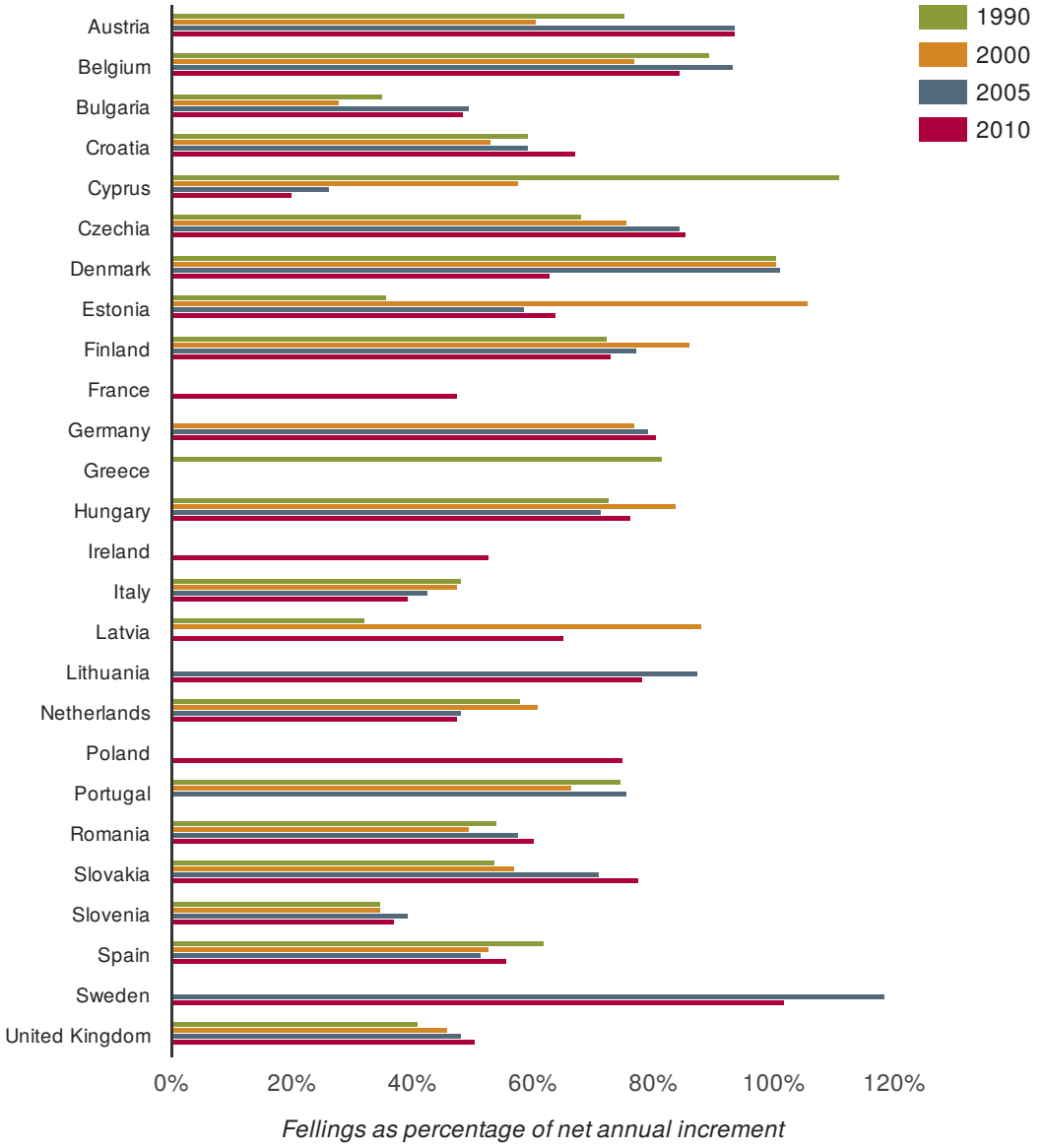
In recent years, the multiple functions and potential uses of forests have attracted interest. Afforestation has been found to be a means of increasing the terrestrial carbon sink and protecting unstable soils. In addition to a supply of wood, forests also provide multiple ecosystem functions and services that are vital to society and human well-being. These include providing freshwater and clean air, regulating climate and nutrient cycling, and contributing to human health and recreation (Thompson et al., 2014).

Forests host a dominant part of Europe's terrestrial biodiversity and contribute significantly to climate change mitigation. Forests remove around 430 million tonnes of atmospheric carbon dioxide and store 13 % of Europe's greenhouse gas emissions (Nabuurs et al., 2015). Without forests, or in the event of inadequate forest management, these resources and services could be damaged or destroyed.

The Food and Agriculture Organization of the United Nations (FAO, 2016) reports that less than 10 % of the forest area is intensively managed plantations. Nevertheless, their role may grow with the incentives offered under new EU policies to manage forests for, for example, regulation of land-based carbon accounting (land use, land use change and forestry) and energy. This means maximising the provision of biomass either from Europe's forests or, as has already happened, by importing more biomass (e.g. wood pellets from North America).

Forest management needs to maintain the resilience of forest ecosystems while avoiding abrupt and destructive changes. However, currently, the information available on forest management practices across Europe is too sparse and unrepresentative to give a reliable overview of the condition of forest-ecosystems and their biodiversity. Furthermore, some national statistics may not include all logging activities, some of which are for domestic heating purposes.

Figure 1. Forest utilisation rates for the EU-28 countries, 1990-2012 (excluding Malta and Luxembourg)



Data sources: a. Forest Europe. Forest Europe 2015 b. EEA – Indicator SEBI017

Explore chart interactively

In this regard, country statistics provide information on the intensive use of Europe's forests. Europe is one of the largest producers of roundwood in the world (Eurostat, 2017). Roundwood production has increased steadily in the most recent decades, temporarily declining in 2007/2008 because of the financial crisis. It recovered from 2010 onwards, returning to more stable production by 2013 at the pre-crisis level of around 458 million cubic metres (Eurostat, 2017).

At the same time, the average forest utilisation rate (the ratio between the average annual volume felled and the volume of annual growth in the stock of living trees) stayed well below 100 %. This indicates that, although it varied by country, the production of timber remained sustainable (see Figure 1; Forest Europe, 2015; EEA, 2016). Wood production and forest management in a considerable share of European forests take place under forest certification schemes that aim to promote long-term environmental sustainability and the supply of the wide range of ecosystem services that society requires.

However, the currently stable forest area and sustainable use of forests do not necessarily mean that Europe's forests are not subject to pressures and changes that may threaten their multi-functionality. Aspects of the condition of forests give rise to concern for their long-term stability and health across Europe (EEA, 2015). Climate change impacts, such as storms, pests and pollution, and encroaching human development (infrastructure and tourism), as well as natural disturbances, are all threats to our forests.

There are signs of an increasing limitation of phosphorous for the growth of trees and forest stands (e.g. Sardans et al., 2016). Several studies show nitrogen saturation in central European forests, which leads to nutrient imbalances between nitrogen and other mineral elements (e.g. Meesenburg et al., 2016) as well as phosphorous. Furthermore, sulphate — a driver of soil acidification — is still high in central and southern Europe (e.g. Waldner et al., 2014).

Extreme weather severely affects forests: natural disturbances have recently caused a loss of 0.15 % of the growing stock in Europe (in some countries up to 10 % of annual fellings). Storms account for 53 % of abiotic damage and forest fires for 16 % of abiotic damage: the total burnt area in 2016 was higher than in each of the previous 3 years.

Only 26 % of forest species and 15 % of the forest habitats were found to be in favourable conservation status (EEA, 2015). The EU-28 Member States report forest practices as one of the main causes of unfavourable and bad conservation status of forest habitats and species under the Habitats Directive. However, the reporting under the directives does not quantify the extent of damage caused by forest activities or the extent of the ecological consequences.

Forest practices vary substantially across Europe — ranging from no management due to abandonment, through management for nature protection, to intensive short-rotation monoculture forestry managed for producing energy-related biomass. The ecological functions of forests are resilient to certain rates and degrees of disturbance, as forests evolve under the influence of natural disturbances. The current composition and structure of Europe's forests reflects a variety

of novel anthropogenic disturbances (Novàkovà et al., 2015; Thorn et al., 2017; Vacchiano et al., 2017).

Intensive management operations involve overlogging, skidding damage to remaining trees and the soil, and a lack of replanting at critical sites. Unsustainable forest practices in the form of, for example, planting non-native tree species and monocultures and, in some cases, illegal logging increase the vulnerability of forests at a time when the need for biomass and many other services is growing. Examples include the tendency for non-native species to become invasive, establishing over large areas and becoming difficult to control and eliminate, e.g. after plantingPiceaorEucalyptus(Liebhold et al., 2017; Dieler et al., 2017).

Other pressures on forests, e.g. the effects of nitrogen deposition, climate change, loss of top predators that control herbivore populations, may cause damage to forests. Illegal logging is increasingly reported (e.g. in the Carpathian region). Such degradation of forest ecosystems may increase the risks of eroding the biodiversity and ecological condition of forests and of forest soils due to compaction, loss of nutrients and loss of forest soils (Bengtsson et al., 2000; Frelich et al., 2018).

Considering the above, it is very clear that better information and knowledge about European forest ecosystems is required if we are to meet the needs of environmental protection, and the climate and energy policies, all in the context of the Sustainable Development Goals adopted by all countries as part of the United Nations Agenda 2030. This includes accurate quantification of forest land use and land cover changes, and information on forest management practices and their impacts on forest resources.

Future methodologies will provide improved information on changes in forest area and in forest managements at the European level. This will include the regular updates to the Copernicus land monitoring services, which will deliver very high-resolution forest information such as density of tree cover, forest type, and riparian and small woody tree features. Closer collaboration between the EEA member countries via the Eionet network will contribute to harmonising country information and increasing the quality of the assessments.

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