Part II: European Forests: Status, Trends and Policy Responses

Criterion 4: Maintenance, Conservation and Appropriate Enhancement of Biological Diversity in Forest Ecosystems

Key findings

Indicator 4.1 Tree species composition

Around 70% of the forests in Europe are dominated by 2 or more tree species. The remaining 30% are dominated by 1 tree species alone, mainly conifers. The area of forest covered by a single tree species decreased over the last 15 years at a rate of around 0.6% annually. This may be related to changes in forest management practices or non-management aimed at the establishment of more mixed forest stands.

Indicator 4.2 Regeneration

Annual natural expansion and regeneration is increasing slightly in the Central-West, South-East and South-West European regions, while in other European regions planting and afforestation are the most widely used annual regeneration types. Nearly 68% of the total forest area in Europe is regenerated naturally or through natural expansion. In some European countries coppicing with rotation poplar and willow coppices is becoming more common as a renewable energy source.

Indicator 4.3 Naturalness

The area of semi-natural forest and plantations increased in Europe over the 20-year period 1995-2015. Around 87% of European forests are classified as semi-natural. Undisturbed forests cover 4% and plantations 9% of forest area in Europe. The highest share of undisturbed forests within the forest area can be found in countries of Central-East and South-East Europe, while the share of plantations is the highest in the Central-West, South-West and South-East European regions.

Indicator 4.4 Introduced tree species

Introduced tree species currently dominate 4.4% of the European forest area, which is roughly equivalent to the land surface of the Republic of Ireland. Tree species that are considered to be invasive currently occupy 0.5% of Europe’s forests. Although Central-West Europe presented the highest share of introduced tree species, this area declined over the last decade and no substantial changes were noted for the remainder of Europe. Importantly, concerns have been raised regarding inconsistencies in the reporting of data on introduced (and invasive) tree species in individual countries.

Indicator 4.5 Deadwood

The average volume of deadwood, both standing and lying, ranges between 8 m$^3$/ha in North Europe and 20m$^3$/ha in Central-West Europe. The amount of deadwood, particularly standing deadwood, increased slightly in most of Europe’s regions over the last 20 years. The amount of deadwood varies considerably depending on forest types, the standing volume of the stands, the rate of decay and vegetation zones, and is influenced by forest management regimes.

Indicator 4.6 Genetic resources

The areas managed for in situ and ex situ conservation and for seed production increased during the 1990-2015 period. In 2015, around 500,000 ha and slightly more than 10,000 ha were managed for in situ and ex situ genetic conservation respectively, and 1,000,000 ha were managed for seed production. Overall, the areas were managed for a total of 145 tree species, including subspecies and hybrids. There are significant gaps in the geographical representativeness of the areas managed for in situ genetic conservation within the distribution range of European tree species.
**Indicator 4.7 Forest landscape pattern**

Two thirds of European forests are in a core natural landscape pattern. Over the 2000-2012 period, forests in this pattern tended to increase due to natural expansion of forests and newly planted forests. The remaining one third of European forests are in a mixed pattern of natural, agricultural and artificial lands and more than half of them appear as ‘only some forest’ embedded in predominantly agricultural and artificial landscape. For what concerns the connectivity of forest areas, the number of landscapes with highly connected forests was either stable or decreased in most countries over the 2000-2012 period. This would suggest that the distance and landscape permeability between forest areas were not sufficiently accounted for in management and planning. Landscapes with poorly connected woodlands represent over 60% of the EU territory.

**Indicator 4.8 Threatened forest species**

The availability of information on threatened forest species continues to develop positively in Europe. This relates to forest tree species that are reported under the IUCN Red List categories in particular: 79% of threatened forest-occurring tree species were classified as vulnerable and endangered by reporting countries, and 18% were seen as critically endangered. This includes trees growing at the limits of their potential range. The information available on other threatened species groups remains more heterogeneous and sometimes fragmentary. Thus any changes should be interpreted with care as the number of threatened species may be related to an improvement in the knowledge about species and monitoring surveys.

**Indicator 4.9 Protected forests**

Over the last 15 years, the area of forest in Europe designated for biodiversity and landscape protection increased by half a million hectares annually. Around 12.2% (or 29.9 million ha) of European forests are protected with the main objective of conserving biodiversity. Around 7% have the protection of landscapes representing an area of 19 million ha as a main objective. The strictness of protection for biodiversity varies considerably within Europe: while restrictive protection with minimal or no intervention dominates in North Europe and some East European countries, active management in protected areas is more common in Central and South European countries.

**Qualitative Indicator**

**Indicator B6 Biodiversity**

Biodiversity remains an important topic for forest policy and management in Europe. Biodiversity-related forest policy objectives have been maintained since the previous reporting period. Regulatory instruments continue to play an essential role in conserving biodiversity in forests and have been fostered using new financial, informational measures. The EU’s biodiversity policy is a major trigger for changes related to informational, financial and legislative instruments at national level.
**Indicator 4.1 Tree species composition**

*Area of forest and other wooded land, classified by number of tree species occurring and by forest type*

**Introduction**

*Area of forest, classified by number of tree species occurring*

Species diversity and the dynamics of forest ecosystems differ considerably throughout Europe. This is reflected by the broad range of forest types found there, from boreal forest in North Europe to broadleaved evergreen forests in the Mediterranean region. These forest types are differentiated by unique key factors related to structural, compositional (including tree species composition) and functional forest ecosystem components, such as biotic and abiotic disturbance factors and forest management. Mixed forests and other wooded land, composed of several tree species, are often richer in biodiversity than those comprising 1 tree species. However, some natural forest ecosystems are dominated by only 1 or 2 species, e.g. natural boreal pine forests on dry sites, natural sub-alpine spruce stands and beech forests growing in favourable conditions on lowlands.

The countries were requested to provide updates for the tree species occurrence data for 2010 and additional trend information for the years 1990, 2000, 2005 and 2010.

**Status**

33 countries reported data for the year 2010. These countries account for 89% of the total forest area in Europe. The data show that around one third of European forests are dominated by a single tree species (Figure 56). Around half of the forests contain 2 to 3 tree species. 14% of the forest have 4 to 5 tree species and only 4% of the forest is composed of 6 or more tree species.

![Figure 56. Forest area by species abundance category in Europe for the year 2010](image)

Single tree species forests accounting for an over 40% share of the national forest area are found in Turkey, Cyprus, Portugal, Albania, Iceland, United Kingdom, Norway, Bulgaria, Montenegro, Poland and Austria (in order of decreasing relative importance; Figure 57).

![Figure 57. Forest area by species abundance category for 2010](image)
These forests are typically homogenous single-age coniferous forests. Broadleaved forests are more likely to present a greater mixture of tree species.

**Trends**

Regional trend data (Figure 58) suggests a steady decrease in forests dominated by a single tree species. Between 1990 and 2010, North Europe’s forests, in particular, gained a more diverse tree species composition. In general, quite a steady evolution towards mixed forest composition could be observed in all regions between 1990 and 2010.

Figure 58. Trend analysis 1990-2010: Average annual rate of change by tree species abundance class: (a) change relative to 2010 (percentage) and (b) absolute change (1,000 ha)
Indicator 4.2 Regeneration

Regeneration: Area of regeneration within even-aged stands and uneven-aged stands, classified by regeneration type

Introduction

Regeneration by natural seeding, vegetative regeneration, or artificial planting and seeding is the prerequisite for maintaining the forested land as forest permanently or in the long-term.

Forested area can also be increased through afforestation or natural expansion on land that was previously subject to other uses, e.g. agriculture.

Natural regeneration contributes to conserving the diversity of the genotypes and to maintaining the natural tree species composition, structure and ecological dynamics. However, natural regeneration may not always be suitable for achieving biodiversity conservation goals. For example, to convert forests from introduced tree species to native tree species, planting is necessary in most cases, and restoration activities may require the elimination of naturally regenerating trees growing outside their natural range. Furthermore, the occasional replanting programmes made necessary by heavy storms or insect calamities may influence the proportion of regeneration methods used, and, consequently, the statistics.

Status

Nearly 40 European countries reported on the share of forest area expressed by regeneration types for 2010. The values reported here concern regeneration in forests. Regeneration in other wooded land is not discussed as the data did not allow for a comprehensive assessment. Few of data differentiate between regeneration methods in even-aged and uneven-aged forests, thus combined results are presented for these two forest structures. Forests regenerated naturally and through natural expansion clearly dominate throughout Europe. Based on the available data from the countries in 2010 (see Table 43), 133 million ha, or around 68% of even-aged and uneven-aged forests in Europe, were regenerated through natural regeneration and natural expansion. The forests regenerated by afforestation and planting and seeding represent around one quarter of the total forest area in Europe. Coppicing is only common in a few South European countries.

The type of regeneration used varies considerably between the individual countries and regions. In Central-East Europe natural regeneration and natural expansion as well as afforestation and regeneration by planting and seeding were practised to an almost similar extent. Natural regeneration and natural expansion are dominant in North, Central-West, South-East and South-West Europe.

Table 43. Share (percentage and million ha) of forest area (uneven-aged and even-aged) by regeneration types in the European regions, 2010 (based on the available data)

<table>
<thead>
<tr>
<th>SOEF Region</th>
<th>Natural regeneration and natural expansion</th>
<th>Afforestation and regeneration by planting and seeding</th>
<th>Coppicing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>million ha</td>
<td>% of forest area</td>
<td>million ha</td>
</tr>
<tr>
<td>North Europe</td>
<td>48.4</td>
<td>68</td>
<td>22.4</td>
</tr>
<tr>
<td>Central-West Europe</td>
<td>22.3</td>
<td>64</td>
<td>10.6</td>
</tr>
<tr>
<td>Central-East Europe</td>
<td>16.1</td>
<td>52</td>
<td>13.0</td>
</tr>
<tr>
<td>South-West Europe</td>
<td>26.1</td>
<td>86</td>
<td>3.3</td>
</tr>
<tr>
<td>South-East Europe</td>
<td>19.9</td>
<td>72</td>
<td>4.0</td>
</tr>
<tr>
<td>Europe</td>
<td>132.8</td>
<td>68</td>
<td>53.2</td>
</tr>
<tr>
<td>EU 28</td>
<td>98.5</td>
<td>68</td>
<td>38.8</td>
</tr>
</tbody>
</table>
In 2010, over half of the forests were regenerated by planting and seeding, i.e. forests in Ukraine, Belgium, Hungary, Iceland, Denmark, Netherlands, Ireland and Czech Republic (Figure 59). In Latvia, Switzerland, Cyprus, Spain, Norway, Albania, Estonia, Italy, Liechtenstein, Croatia and Greece over 80% of the forests were regenerated by natural means.

In some European countries, specifically Montenegro, Hungary, Portugal, Turkey, Ukraine, France and Bulgaria, the forest area regenerated through coppicing represented around 10% of the forest area and accounted for 8.2 million ha in 2010. Short rotation poplar and willow coppices are becoming more common in Europe as a renewable energy source.

Figure 59. Share (percentage) of forest area (even-aged and uneven-aged) by regeneration types for selected countries in Europe, 2010 (based on the available data)
Almost 30 countries provided data on the annual regeneration types for 2010. This information did not differ considerably from the previous figures on the share of forest area divided by regeneration types. Regeneration by planting dominates in Central-East and North Europe (see Figure 60). Annual afforestation accounts for the highest share in South-East and South-West Europe. The share of annual natural expansion is also the highest in these regions. Based on these figures it may be stated that the increase in new forest area is most intensive in South-East and South-West Europe and is the result of both natural and artificial regeneration. As an annual regeneration type, natural regeneration is most common, in Central-West (Switzerland, Liechtenstein) and North Europe (Estonia, Latvia, Lithuania and Norway).

Figure 60. Share (percentage) of the total regenerated area in European regions represented by annual afforestation, natural expansion, natural regeneration, planting and coppice sprouting in 2010 (based on the available data)
Around 30 European countries submitted the complete data set on regeneration for 1990, 2000, 2005 and 2010. A comparison between 1990 and 2010 in Europe indicates that the forest area regenerated by afforestation and by planting and/or seeding increased by 10 million ha while that regenerated by coppicing rose by 2 million ha. A detailed analysis by European region and county reveals that natural regeneration and natural expansion as regeneration types increased in all regions except North Europe. In Sweden and Finland the shares accounted for by natural regeneration and planting/seeding indicate a slight increase in planting and seeding over the last 20 years. Based on the data for the annual regeneration methods, it may be assumed that natural regeneration is quite stable in Central-East and Central-West Europe, whereas in South-East and South-West Europe there was an increasing trend in natural regeneration and expansion over the last 20 years (see Figure 61).

Figure 61. Natural regeneration and natural expansion of forest area (1,000 ha) in European regions for 1990, 2000 and 2010 (based on the available data)
Indicator 4.3 Naturalness

Naturalness: Area of forest and other wooded land classified as "undisturbed by man", "semi-natural" or "plantations", each by forest type

Introduction

The degree of naturalness of forests reflects the intensity and history of human intervention. Variations in utilization intensity are indicated not only by the remaining forest area in the country, but also by changing structures and the presence of different species communities within the forested areas.

Degrees of naturalness are described in this report using three categories: forest area undisturbed by man, semi-natural forests and plantations. Forests undisturbed by man are those in which the natural forest development cycle has remained or been restored, and displays the characteristics of natural tree species composition, natural age structure, deadwood components and natural regeneration, and no visible sign of human activity.

Forests undisturbed by man have a high conservation value, especially when they form large-scale continuous forest areas allowing natural disturbance processes to arise. Undisturbed forests also serve as reference areas for understanding ecological principles and contribute to the development of forest management methods.

Plantations usually represent ecosystems on their own, which are established artificially by planting or seeding, often with introduced tree species, and are intensively managed. Semi-natural forests are neither undisturbed by man nor plantations, but display some characteristics of natural ecosystems. However, stands are also considered semi-natural forests if they were established as plantations but did not undergo intensive management for a significant period of time.

Status in 2015

The analyses of classes of naturalness are based on data from nearly 40 European countries. The values reported here concern the naturalness in forests. Naturalness in other wooded land is not discussed as the data did not allow for a comprehensive assessment. Most forests in the Europe (87%, 174 million ha of the forest area) were classified in 2015 as semi-natural (see Figures 62 and 63, Table 44). Due to the definition, semi-natural forests include a broad range of forests with different levels of naturalness and biodiversity.

The share of forests undisturbed by man in Europe as a whole represents around three percent (73 million ha) of the total forest area.
In terms of classes of naturalness considerable differences exist between the European regions (see Table 44, Figure 63). The highest proportion of undisturbed forests within the forest area can be found in countries in Central-East and South-East Europe, while the share of plantations is the highest in Central-West, South-East and South-West Europe. Large areas of forests undisturbed by man, i.e. over 100,000 ha, can be found in Montenegro, Belarus, Norway, Finland, Romania, Bulgaria, Turkey, Sweden and Georgia (see Figure 63 and 64). In most European countries, the share of forests undisturbed by man is low, ranging from 0% to 1% of the forest area. Forests undisturbed by man are mostly located in remote or inaccessible areas where extreme climate or topographical conditions prevail.

Plantations cover around 20 million ha, or 9% of the total forest area in Europe. Plantations are important for wood production in many countries and dominate forest areas in Iceland, Ireland, United Kingdom, Denmark and Belgium (Figure 65). All forests in Malta are plantations. The definition of plantation includes the reservation that stands of native tree species that were established as plantations but have been subject to intensive management for a significant period of time could be considered semi-natural forests. This could influence the interpretation of the data, especially regarding old plantations that have been transferred in part to semi-natural forests.
Trends

The area accounted for by semi-natural forest and plantations in Europe increased over the 20-year period under consideration (Figure 66). The area of semi-natural forests expanded considerably by 11.8 million ha while the area of plantations increased by 3.8 million ha. These changes can be partly explained by the increase in the total forest area, afforestation and different interpretations of the definitions. The small increase of the area of undisturbed forests may reflect forest protection measures. However, in several countries, former semi-natural forests that were initially designated as protected areas have subsequently been considered as undisturbed forests.

Figure 65. European countries with a share of plantations greater than 5% of the total forest area, 2015 (based on the available data)

Figure 66. Forest (million ha) by classes of naturalness in Europe for 1990, 2000, 2005, 2010 and 2015 (based on the available data)
**Indicator 4.4 Introduced tree species**

*Area of forest and other wooded land dominated by introduced tree species*

**Introduction**

Introduced tree species may be defined as tree species occurring outside their natural vegetation range; they are sometimes also referred to as *non-indigenous*, *exotic* or *alien species*. There are various reasons for introducing tree species outside of their natural range, such as the need to satisfy the growing demand for wood, increase forest cover quickly, introduce species for horticultural purposes, restore disturbed forests or reduce erosion.

Although some introduced tree species make a significant contribution to wood production in many countries, certain species have become problematic due to their ecological characteristics, which put substantial pressure on native ecosystems. Such introduced tree species are referred to as *invasive tree species*, i.e. species whose introduction and consequent spread cause socio-cultural, economic and/or environmental harm. In particular, such species may change the function, structure and dynamics of forest ecosystems.

![Figure 67. Share of forest area dominated by introduced tree species as of the total forest area (percentage) in 2015 (the following countries are not presented due to a lack of forest cover or available data: Liechtenstein, United Kingdom, Belarus, Moldova, Andorra, Holy See, Malta, Monaco, Albania, Bosnia and Herzegovina, Greece, Serbia, the Former Yugoslav Republic of Macedonia and Slovenia)](image-url)
**Status**

Introduced tree species cover just over 9.5 million ha, which equates to 4.4% of the total European forest area. The largest areas dominated by introduced tree species are currently found in South-West and Central-West Europe where they occupy 8.5% (i.e. 2.6 million ha) and 6.5% (i.e. 2.5 million ha) of these regions’ forests respectively. In contrast, the lowest proportion of introduced tree species was reported in North Europe, i.e. 1.4% (about 1 million ha).

The largest share of introduced tree species is found in Ireland, Iceland, Denmark, Belgium, Hungary and Portugal (Figure 67). The status clearly reflects the fact that plantation forests, where introduced species are used, are common in some of the above-mentioned countries. In Ireland, for example, introduced tree species (mainly *Picea sitchensis* and *Pinus contorta*) were used predominantly for afforestation with a view to increasing the country’s forest area, which only represented 1% of the land cover at the beginning of 20th century. Today, thanks to afforestation schemes using introduced species, the forest area covers 11% of the country’s land area. In the case of Iceland, which has only 1 native tree species, *Betula pubescens*, introduced tree species have also played an important role in the efforts to increase the country’s forest cover.

Although 20 countries did not state the precise year in which the data were recorded, the remainder of the countries reported that the data were collected between the years 2005 and 2015. Extrapolation (of the most recent available data) was the most frequently cited method of generating values if 2015 data were not available. The data for other wooded land were not used as only 7 countries supplied data for this category.

It is important to note that many introduced tree species play a key role in timber production; in particular, various introduced *Pinus* species, i.e. *P. contorta*, *P. nigra*, *P. radiata* etc. Species from this genus cover approximately 1.7 million ha in Europe (Table 43). Commercially important introduced tree species also include *Picea spp.*, especially *P. sitchensis* and *P. abies*, which account for a substantial proportion of the forestry estate in Central-West and North Europe (Table 45).

*Pseudotsuga menziesii* is an introduced tree species that has been widely planted in most parts of Europe due to its characteristics, i.e. high production and quality timber properties. It accounts for almost 0.8 million ha in Europe (see details in Table 43). Furthermore, in the context of climate change *P. menziesii* is considered as offering competitive advantages as it is less susceptible to heat and drought damage compared to *Picea abies*, for example.

The significance of *Eucalyptus* spp. is particularly pronounced in South-West Europe where it covers almost 0.8 million ha (majority of this area is reported in Spain). In addition, the presence of *Larix* spp. (e.g. *L. decidua*, *L. kaempferide*, *L. europea*, *L. leptolepis*) and *Populus* spp. (other species excluding *P. tremula*) have been reported in all parts of the European continent (Table 45).

With regard to introduced tree species referred to as invasive: these currently occupy just over 1 million ha (i.e. 0.5%). *Robinia pseudoacacia* and *Ailanthus altissima* were the most frequently reported invasive species and are most common in the Central-East and South-East Europe country groups. It should be noted, however, that their occurrence in other European regions may be under-reported as many countries did not supply the relevant data. The largest share of invasive tree species is found in Hungary where invasive tree species, mainly *R. pseudoacacia*, occupy 24% (approximately 0.5 million ha) of the entire country’s forest area. Denmark and Italy follow with 5.5% and 2.7% respectively. *R. pseudoacacia* is widely used for various purposes, such as ornament, timber, firewood, re-vegetation of dry land and provision of nectar for honey production. *A. altissima* is mainly used for its ornamental properties; it is also used in roadside planting. *Pinus mugo*, *Acer negundo* and *Prunus otina* were also reported as invasive.

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**Table 45. The area (1,000 ha) occupied by individual introduced tree species. The numbers in the brackets following each area value indicate the number of countries within an individual country group that provided data**

<table>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>North Europe (n=8)</td>
<td></td>
<td>565 (6)</td>
<td>179 (4)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>2 (3)</td>
<td>54 (7)</td>
<td>0 (0)</td>
<td>33 (3)</td>
</tr>
<tr>
<td>Central-West Europe (n=10)</td>
<td></td>
<td>647 (9)</td>
<td>1362 (8)</td>
<td>731 (9)</td>
<td>0 (0)</td>
<td>280 (5)</td>
<td>276 (7)</td>
<td>120 (4)</td>
<td>18 (2)</td>
</tr>
<tr>
<td>Central-East Europe (n=9)</td>
<td></td>
<td>96 (6)</td>
<td>11 (1)</td>
<td>15 (5)</td>
<td>11 (1)</td>
<td>172 (5)</td>
<td>9 (1)</td>
<td>92 (6)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>South-West Europe (n=5)</td>
<td></td>
<td>312 (2)</td>
<td>0 (0)</td>
<td>40 (2)</td>
<td>770 (3)</td>
<td>97 (1)</td>
<td>9 (1)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>South-East Europe (n=11)</td>
<td></td>
<td>71 (5)</td>
<td>0 (0)</td>
<td>8 (6)</td>
<td>2 (2)</td>
<td>59 (3)</td>
<td>2 (2)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Total area (n=43)</td>
<td></td>
<td>1,690 (28)</td>
<td>1,551 (13)</td>
<td>793 (22)</td>
<td>783 (6)</td>
<td>609 (17)</td>
<td>350 (18)</td>
<td>212 (11)</td>
<td>51 (5)</td>
</tr>
</tbody>
</table>
**Trends**

In the 38 countries that provided time series data, the total area of introduced tree species in Europe remained relatively stable over the last 25 years (Figure 68). However, a slight decrease in the area occupied by introduced tree species could be observed in Central-West Europe over the past decade. This may be attributed to the changes in forest management paradigms, the ways introduced species are perceived and the emphasis being placed on native species. In most of the countries, only marginal changes occurred in the extent of the area dominated by invasive tree species. In particular, there has been a visible decline in the area of introduced tree species in France over the last ten years. The trend for EU 28 and for all of Europe can be observed in Figure 69.

![Area of introduced tree species in individual European regions](image1)

**Figure 68. Area of introduced tree species in individual European regions**

![The sum of forest areas dominated by introduced tree species for EU 28 and all European countries](image2)

**Figure 69. The sum of forest areas dominated by introduced tree species for EU 28 and all European countries**
Indicator 4.5 Deadwood
Volume of standing deadwood and of lying deadwood on forest and other wooded land classified by forest type

Introduction

Deadwood is an important substrate for a large number of forest species, including vertebrates, invertebrates, algae, bryophytes, vascular plants, fungi, slime moulds and lichens. Deadwood contributes to the structural stability of soils, e.g. on slopes, and it helps in the retention of organic matter, carbon, nitrogen and water. Deadwood can be considered as an array of microhabitats that evolves continuously over time through increasing decay with each phase being distinguished on the basis of the associated species. The amount of deadwood in natural forests depends on many factors, such as tree species composition and structure, the stage of succession, the type and frequency of natural disturbance in the region, the type of management, and the soil and climate characteristics. The amount of deadwood in undisturbed and managed forests varies considerably. The late development stages of natural forests are characterized by the large volumes and diversity of deadwood.

The type of deadwood is important and is related to properties, such as whether the deadwood is standing or lying, its dimensions, and the tree species of the deadwood. In general, lying deadwood is richer in species than standing deadwood, however some species or species clusters are confined to standing or lying deadwood only, indicating that both types have their own intrinsic importance. Felling residues form yet another type of deadwood that is important for many species. The dimension (diameter) of deadwood is also an important deadwood property as different saproxylic species, for example, are limited to different sizes.

As European forests have been managed for long periods of time, the late development phases are missing or scarce. Because of the lack of deadwood in many forests, several of the deadwood-dependent species are endangered. Indeed, increasing the amount of deadwood in forests is considered one of the potential management options for enhancing biodiversity in most of Europe’s forest types. On the other hand, in some circumstances, the accumulated fresh dying deadwood can create a risk of insect outbreaks.

The countries were asked to provide updates for deadwood for 2010 and additional trend information for the years 1990, 2000 and 2005.

Status
Total deadwood, standing and lying

A total of 28 countries, which account for 72% of the forest area in Europe, provided information on the status of deadwood in 2010. The values reported here concern deadwood in forests. Deadwood in other wooded land is not discussed as the data did not allow for a comprehensive assessment. The weighted average volume of total deadwood as the sum of both standing and lying deadwood is around 11.5 m$^3$/ha for the reporting countries. In terms of the individual regions, deadwood amounts range from between 8 m$^3$/ha in North Europe to 20 m$^3$/ha in Central-West Europe. At country level, the estimates for standing and lying deadwood range between 5 and 15 m$^3$/ha for most countries. The outliers are countries like Albania, Cyprus and Serbia, which reported values below 2 m$^3$/ha. Latvia and France report figures just under 25 m$^3$/ha (Figure 70) while Slovak Republic reported the very high average amount of standing and lying dead wood of 40.6 m$^3$/ha.
**Trends**

A sufficient amount of data allowed for the analysis of trends for the regions Central-West Europe, South-East Europe and North Europe (Figure 71). The data for these regions suggest a continuing increase in deadwood in forests. For other regions, the relative importance of the trend information that was actually available was counteracted by the missing data. Nevertheless, a similar trend can also be assumed with caution for these regions.

The increase in the amounts of deadwood can be explained through the effect of policy in favour of nature-oriented forest management, for example, or through the setting of requirements by forest certification schemes. However, major disturbances, such as storms, fires or insect outbreaks, can also result in considerable regional and even national variations.

**Figure 71.** Weighted average volume of standing and lying deadwood by region for the years 1990, 2000, 2005, 2010. Based on data for the countries, for which data were available for at least one reference year. Missing data were replaced by duplicates from the nearest available reference year.
Indicator 4.6 Genetic Resources

Area managed for the conservation and utilization of forest tree genetic resources (in situ and ex situ genetic conservation) and area managed for seed production

Introduction

The conservation and use of forest genetic resources is a vital component of sustainable forest management. Genetic diversity ensures that forest trees can survive, adapt and evolve under changing environmental conditions. Genetic diversity is also needed to maintain the vitality of forests and cope with pests and diseases. Forest management in Europe is largely based on the management of wild or semi-wild tree populations; the establishment of new forests through artificial or natural regeneration always involves the deployment of genetic material.

Following the establishment of the European Information System on Forest Genetic Resources (EUFGIS) in 2010, 34 European countries started to implement the “pan-European minimum requirements for dynamic genetic conservation units of forest trees” for the data reported as “area managed for in situ conservation”. The minimum requirements are based on the concept of the dynamic conservation of genetic diversity, which emphasizes the maintenance of evolutionary processes within tree populations to safeguard their potential for continuous adaptation.

Ex situ genetic conservation units consist of stands and clone collections established with collected or multiplied genetic material. Seeds from forest trees are produced in specific areas established (seed orchards) or selected (seed stands) for this purpose. Data on areas managed for ex situ genetic conservation and seed production have been collected consistently since 1990.

Status

A total of 38 countries reported their 2015 data on this indicator (or part of it) to the EUFORGEN Secretariat at Bioversity International (see Table 32 Output Tables, data per country). Of these countries, 36 had also provided the data in 2010, while only 25 provided the data in 1990 and 2000. Most countries (34) used the EUFGIS Portal (http://portal.eufgis.org) to report areas managed for genetic conservation. The EUFGIS database is populated by national data providers and contained data on 3,213 units in January 2015. The units harbour a total of 4,057 tree populations and most of them (92%) are managed for in situ genetic conservation. The data reported on the area managed for ex situ genetic conservation include both dynamic and static ex situ genetic conservation units. Areas managed for seed production include seed orchards and seed stands. Seed sources identified for seed collection in the national registers of basic material are excluded as they are not actively managed for seed production.

The total areas managed for genetic conservation per country do not provide adequate information to enable the assessment of the status of the genetic conservation of various tree species at pan-European level as their distribution ranges and biological characteristics vary considerably. Hence the countries were also requested to report the areas per tree species. In Annex 8: Output Tables 32, 33, 34 and 35 show species-specific data for the trees listed under the Council Directive (1999/105/EC) on the marketing of forest reproductive material. As the EUFGIS database provides geo-referenced data on the conservation units, the geographical distribution of the units was compared with the distribution maps of selected tree species with a view to drawing some conclusions on the geographical representativeness of the genetic conservation efforts at pan-European level.

Area managed for genetic resources

A total of 501,567 ha were managed for the in situ genetic conservation of forest trees in 38 countries in 2015. The total area managed for ex situ conservation is 11,553 ha in 37 countries; for seed production it is 1,027,434 ha in 38 countries. A total of 145 tree species (including subspecies and hybrids) were reported for this indicator. However, these species are not managed equally for genetic conservation (in situ and ex situ) and seed production. A large proportion of the trees targeted for in situ genetic conservation are widely occurring stand-forming tree species, which are important for forestry. A group of five economically relevant tree species (Abies alba, Fagus sylvatica, Picea abies, Pinus sylvestris and Pinus pinaster) alone account for 55% of the total area managed for in situ genetic conservation, while in the case of many other economically important tree species, only small areas are managed for the same purpose.

Furthermore, very few genetic conservation areas are managed for scattered tree species (e.g. Populus nigra, Sorbus domestica, Tilia platyphyllos and Ulmus laevis), which are often considered of low importance. However, while these species may not be economically important, they have a high value in terms of maintaining forest biodiversity and ensuring ecosystem stability.
The assessment of the geographical representativeness of the in situ genetic conservation areas in Europe showed a clear need for the intensification of genetic conservation efforts. Significant gaps in genetic conservation exist, even in the case of common forestry species, for which large areas are managed for genetic conservation (see Figure 72 and 73). The geographical representativeness of the genetic conservation areas is considerably lower for most other tree species in Europe. These gaps mean that a large amount of valuable genetic resources are not managed for long-term genetic conservation.

Regarding ex situ genetic conservation, the collected data also reveal an imbalance in the efforts made for three species alone (Pinus sylvestris, Picea abies and Quercus robur), which account for 60% of the total ex situ genetic conservation areas in Europe. One exotic species, Pseudotsuga menziesii, is the fifth most important in terms of number of hectares, but accounts for just 3% of the area managed for ex situ genetic conservation in Europe.

Six stand-forming species (Pinus sylvestris, Fagus sylvatica, Picea abies, Quercus petraea, Quercus robur, and Abies alba) account for 60% of the total area managed for seed production. This indicates a strong emphasis on a very small number of economically important species in seed production.

**Trends**

Following the adoption of the Pan-European minimum requirements, which have been implemented by most European countries since 2010, it is possible to consistently analyse the trend for in situ genetic conservation areas for all European countries since 2010. Trends in ex situ genetic conservation and seed production can be examined between 1990 and 2015.

For the 34 countries that provided data in both 2010 and 2015, in situ genetic conservation between 2010 and 2015 displays some progress towards the conservation of the genetic resources of more tree species. In 2010, 74% of the area managed for genetic conservation was composed of five economically important tree

![Figure 72. Pinus sylvestris: distribution range (shaded) and units managed for genetic conservation (dark dots). Data sources: EUFGIS Portal (http://portal.eufgis.org) and EUFORGEN (www.euforgen.org)](image_url)
species, while in 2015 the same percentage included 12 species. In the case of many species, the in situ area declined in terms of hectares as a result of the harmonized definition. However, between 2010 and 2015, there was a considerable increase in the number of countries that have initiated conservation activities for new species and in the total number of genetic conservation units.

The areas managed for in situ conservation increased for 27 species (55%) and decreased for 19 species (39%). For 23 species, units were established in countries that did not conserve those species in 2010, representing a 50% increase in terms of the species.

The trend in areas managed for ex situ genetic conservation shows a continuous increase since 1990. The increase is more evident in Central-East Europe than the rest of Europe. While the total area managed for ex situ conservation tripled in the 28 countries that have reported data since 1990 (from 2,901 ha to 9,003 ha), it is possible to observe a general increase in the number of species conserved in each country. In the case of ex situ conservation, 67% of the countries reported an increase in the number of species conserved.

Based on the 26 countries that consistently provided data on the areas managed for seed production, it is possible to observe an increase from 672,160 ha in 1990 to 983,759 in 2015. It is also possible to note a greater focus on this activity in Central-East Europe (in terms of number of hectares managed for seed production), which alone accounts for around half of the European conservation effort.

In terms of the area managed for seed production for different species between 2010 and 2015, despite a noticeable reduction in terms of total number of hectares, there was an increase in the number of countries that established new areas for species not considered previously. 85% percent of the countries reported an increase in the number of species managed for seed production and a reduction can only be observed for three exotic species.
Indicator 4.7 Forest landscape pattern

Introduction

The forest spatial pattern can be described by: (1) the spatial distribution of the forest cover; (2) the landscape mosaic composition in the forest surroundings, in terms how, by what and how much the forest cover is fragmented; and (3) the connectivity of forest cover, which also specifies how far apart forest areas are and which types of land separate them from the perspective of functional groups of forest species.

Fragmentation is mainly due to the expansion of agricultural areas, transport infrastructure and settlements. It may also be temporary and recoverable within forested land use areas following forestry operations such as cutting. Landscape patterns and their changes are important because they influence forest conservation and the provision of ecosystem services, such as habitat provision and disturbance regulation. They affect ecological processes, e.g. gene flow, pollination, wildlife dispersal and pest propagation, in different ways.

The area of forest in Europe increased in recent decades, mainly due to the planting of new forests and the natural expansion of forests onto former agricultural land. This increase is not homogeneously distributed and nationally aggregated area estimates do not provide an insight into the change in the forest spatial pattern following the cumulative impact of forest losses and gains. For example, new forest areas in a region can contribute significantly to habitat connectivity (e.g. woodland islets in the landscape acting as new stepping stones between isolated patches). Conversely, new forest areas may have minor impact on connectivity when they are planted too far from other woodlands or merely enlarge an existing patch.

Due to the poor availability and lack of harmonization based on a jointly agreed definition and assessment methodology, it has not been possible to evaluate the current situation and trends in forest patterns in Europe from national pattern data. For the purposes of this status report, a European-wide case study is presented. An integrated modelling framework based on four family indices is now available at the European Commission’s Joint Research Centre (JRC). It was implemented to assess forest landscape patterns in a harmonized manner, and to measure progress in mitigating fragmentation and enhancing connectivity over the period 2000-2012. The proposed definition and methods represent an assessment scheme that is suitable for implementation at any scale in regions and in more complex implementation contexts, e.g. the entire European territory.

Figure 74. Country-based and Europe-wide forest cover shares of three fragmentation patterns in 2012 and trends in the period 2000-2012

How to read the graph: The graph shows how much forest per country displays a ‘core natural’ pattern, i.e. not fragmented and/or always adjacent to other natural/semi-natural lands, how much displays a ‘mixed natural’ pattern and is thus fragmented by agricultural and/or artificial land uses, but still in a predominantly natural context, and how much displays in a ‘some natural’ pattern whereby woodlands are strongly fragmented and embedded in a predominantly agricultural or artificial context. The countries and European Union are ranked per decreasing share of ‘core natural’ forest pattern in 2012. Below the chart, changes in shares over the period 2000-2012 are also shown for the three forest fragmentation patterns according to the following intervals: below -1% (-), between -1% and -0.1% (-), between -0.1% and 0.1% (=), between 0.1 % and 1 % (+) and above 1 % (++). Regardless of forest area changes, they highlight trends in the dynamics of fragmented patterns (‘mixed natural’ and ‘some natural’) versus the unfragmented pattern (‘core natural’). The input data are from the Europe-wide Corine Land Cover maps for 2012 (preliminary version), 2006 and 2000.

The name of the countries in horizontal axix is abbreviated using ISO code (ISO 3166 alpha-2), except for Greece and the United Kingdom for which the abbreviations “EL” and “UK” are recommended. ISO 3166 MA also reserves “EU” for identifying the European Union.
The available data and method

The assessment for year 2012 is based solely on the Corine Land Cover forest map (available for the years 2000, 2006 and, in its preliminary version, 2012). The assessed forests (with canopy cover of 30 %) include broadleaved, coniferous and mixed forests. This layer enables the observation of broad patterns of forest with a minimum mapping unit of 25 ha, however it tends to underestimate connectivity when compared with higher-resolution data. The high resolution European forest map for 2012 was not yet available for this report, by showing spatial details at a resolution of approximately one ha, this layer is able to capture fine-grained vegetation patterns like hedgerows and woodland islets, which are important for landscape permeability and forest connectivity.

Two measures were used: (1) The forest landscape fragmentation pattern measure which aims to identify where and how each hectare of forest land is surrounded by forest, natural/semi-natural lands, and fragmented by agricultural and/or artificial lands. It was calculated for a forest neighbourhood of 1 km² and three fragmentation patterns types were deduced (core natural, mixed natural, some natural). (2) The forest connectivity index which places greater emphasis on the forest patch size, distances and the permeability/suitability of the landscape between forest patches. It was calculated locally using landscape units of 25 km x 25 km for ecoprofiles of forest generalist species with median dispersal capability of 1 km. Three connectivity ranges for the forest in the landscape were deduced (poorly connected, intermediate, highly connected).

Status and trends 2000-2012: Forest connectivity

In 2012, 65% of the European forest lands were in a ‘core natural’ landscape pattern, meaning that they were not fragmented or were always adjacent to other natural/semi-natural lands. 35% were in a mixed pattern of natural, agricultural and artificial lands; more than half of them (22%) appeared as ‘only some forest’ embedded in predominantly agricultural and artificial landscape and the remaining 30% were located in a mixed but still predominantly natural context. On average in Europe, and for half of the countries between 2000 and 2012, the forest shares in a ‘core natural’ pattern tended to...
increase due to natural expansion of forests and newly planted forests. Less forest fragmentation by (mainly) roads and agriculture probably explained the slowdown of the development towards a mixed landscape mosaic pattern.

**Status and trends 2000-2012: Forest connectivity**

In 2012, over 60% of the European Union comprised landscapes with poorly connected woodlands for forest generalist species with a median dispersal distance of 1 km. In most countries, the number of landscape units with highly connected forest was either stable or decreased in the period 2000-2012.

Between 2000 and 2012 in Europe, only one third of the landscapes with a forest area increase, acknowledged also a significant increase in forest connectivity. This was due to the cumulative facts of enlarged forest patches, reduced distance and enhanced landscape permeability between forest patches. This finding supports the need to account for forest connectivity to provide better guidance for conservation and restoration efforts. This would be valuable for forest planning and monitoring, also in the context of the European Green Infrastructure strategy.

**Figure 76. Country-based forest area changes and impact on connectivity for generalist forest species with a dispersal of one km in the period 2000-2012; insight into landscapes with a net forest area gain**

*How to read the graph: Countries are ranked per decreasing proportion of landscape units (25 km x 25 km) with a forest area gain. The input data are from the Europe-wide Corine Land Cover maps available for 2012 (preliminary version), 2006 and 2000. Example, in the Czech Republic, forest area increased in nearly 90% of the landscapes; this area gain enhanced significantly the connectivity of forests for less than half of them, otherwise it had only a minor impact (and probably only increased forest patch sizes).

The name of the countries in horizontal axis is abbreviated using ISO code (ISO 3166 alpha-2) except for Greece and the United Kingdom for which the abbreviations “EL” and “UK” are recommended. ISO 3166 MA also reserves “EU” for identifying the European Union.*
**Indicator 4.8 Threatened forest species**

*Number of threatened forest species, classified according to the World Conservation Union (IUCN) Red List categories, in relation to total number of forest species*

**Introduction**

The most noticeable form of biodiversity depletion is the loss of plant and animal species. Slowing down the rate of species extinction due to anthropogenic factors is a key objective of biodiversity conservation. This is very much reflected in the corresponding international, European and national initiatives and actions. Examples of these include the Convention on Biological Diversity, the European 2020 targets, which were agreed on at the FOREST EUROPE Ministerial Conference in Oslo 2011, the EU Biodiversity Strategy 2020, and national and regional biodiversity strategies which express their ambitions through set targets (link to Indicator B6). It is further highlighted by the fact that threatened forest species are seen also as indicators of change in forest ecosystems.

According to the IUCN Red List categories, a species is listed as threatened if it falls within one of the following categories: ‘critically endangered’, ‘endangered’ or ‘vulnerable’. A forest species is regarded as one that is dependent on a forest as its habitat, for either part or all of its requirements for day-to-day living or reproduction. Hence, an animal species may be considered a forest species even if it does not actually spend most of its life in a forest.

The relationships between threatened species, forest composition and habitat structures are complex but often of crucial importance. However, threats to a certain species can often be the result of multiple factors, making it difficult to determine clear causalities. In particular, the required amount and quality of deadwood is a topic that requires continuing research support. Many species are dependent on small key biotopes, habitats or habitat structures available in both protected forest areas and managed forests. To provide science-based input for raising awareness of the need to integrate biodiversity considerations into forest management, further attention needs to be focused on these elements by research and monitoring.

**Data availability**

The compilation and presentation of data for different species groups is a highly demanding and time-consuming task. The data obtained from the questionnaire survey form the basis for the analysis. The requested information includes numbers of threatened forest species and their relation to the total number of forest species for trees, birds, mammals, other vertebrates, invertebrates, vascular plants, and cryptogams and fungi. In terms of the reporting countries, the data coverage is most extensive for threatened forest-occurring tree species, followed by mammals, birds and vascular plants. It is less extensive in relation to the number of other vertebrates, invertebrates and fungi.

In total, 30 countries reported data for threatened forest-occurring species in at least one of the organism groups for the 2015 assessment (including ‘0’ values). This indicates a slight increase compared with previous assessments (27 countries reported in 2011) and covers around 80% of the forest area in Europe. However, information is still lacking in countries of the South-East, South-West and Central-East Europe regions. Thus, only a partial picture is provided of threatened forest-occurring species in those regions. The best covered category is in all regions that of threatened forest-occurring tree species.

On closer examination, the country data appears to be rather heterogeneous. For several countries, the data reported for the 2015 assessment are identical to those provided for 2011 and even earlier reporting years. While some countries presented detailed inventories for forest and threatened species (Red Lists), others were only able to provide either incomplete or fragmentary information, or have designated all or certain IUCN categories as “data not available”. In many cases the information is derived from national classification systems rather than the IUCN Red List. Furthermore, secondary sources are used and the data are often estimated due to the lack of quantitative measurements. The reliability and accuracy of the information can vary, depending on both the quality and coverage of the available data. This also applies to the assessment of the risk of a species becoming threatened.

In general, species diversity is higher in South Europe than in North Europe. However, forest-occurring species are proportionally more abundant in the North and in countries with extensive forest cover. Therefore, comparisons of absolute numbers between countries are not always meaningful. Also, if the total number of forest-occurring species is related to the unit area, i.e. divided by the area of forest land in a country, small countries may emerge as more species-rich. If Europe as a whole is considered, the situation of threatened forest species may differ and probably appears more positive than when individual countries are considered. For example, species that have a limited distribution in one country may be classified as threatened while they may be more widespread at European level.
28 of 45 countries reported data for threatened forest-occurring tree species (Table 46). Those countries represent around three quarters of the total European forest area. The number of threatened forest-occurring tree species generally ranges between 1 and 9. 4 countries reported more than 10 species as threatened (Figure 77). The largest number was reported for Albania (32). Notable figures were also indicated for the Czech Republic, United Kingdom, Austria and Sweden. 5 countries indicated that they have no threatened forest-occurring tree species. The percentages of threatened forest tree species as compared to the total number of forest tree species in individual countries is highlighted in Table 47.

Sweden reported that 2 widespread tree species, *Fraxinus excelsior* and *Ulmus glabra*, are categorized as threatened. Their decline is caused by ash dieback and

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<th>Other invertebrates</th>
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<td>79</td>
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</table>

2 Threatened forest-occurring species include the IUCN Red List categories “vulnerable”, “endangered” and “critically endangered.”
Dutch elm disease respectively. In the United Kingdom, all of the country’s 13 *Sorbus* species are listed as threatened. Hungary differentiated its 9 threatened tree species by endangerment category with *Alnus viridis* being specified as vulnerable, *Taxus baccata* as endangered and *Pyrus magyrica* critically endangered. *Abies nebrodensis* and *Zelkova vasiculata* are critically endangered in Italy. 4 tree species in total were designated as extinct in the wild: 2 in Belgium and 1 in Albania and Hungary.

An overview of the distribution of forest-occurring tree species, which were classified under the IUCN Red List categories, shows that around 30% are classified as vulnerable, 49% are considered endangered and 18% as critically endangered (Figure 78). This also includes trees that are growing at the limits of their potential range. The threatened tree species do not include economically important and abundant tree species for wood production but may have a considerable value in terms of biodiversity.

<table>
<thead>
<tr>
<th>Country</th>
<th>Threatened forest tree species in % of total number of forest trees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulgaria</td>
<td>0.0%</td>
</tr>
<tr>
<td>Liechtenstein</td>
<td>0.0%</td>
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<td>Lithuania</td>
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<td>Sweden</td>
<td>23.3%</td>
</tr>
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</table>

Table 47. Threatened forest tree species in % of total forest tree species in individual countries (number of reporting countries: 19)

An overview of the distribution of forest-occurring tree species, which were classified under the IUCN Red List categories, shows that around 30% are classified as vulnerable, 49% are considered endangered and 18% as critically endangered (Figure 78). This also include trees that are growing at the limits of their potential range. The threatened tree species do not include economically important and abundant tree species for wood production but may have a considerable value in terms of biodiversity.

Figure 77. Number of threatened forest-occurring tree species, classified according to IUCN Red List categories (including ‘extinct in the wild’). Note: The figure in brackets after the country name indicates the total number of forest-occurring tree species in a country where provided (number of reporting countries: 28)

Figure 78. Share of vulnerable, endangered, critically endangered and extinct forest tree species of the total number of threatened forest-occurring tree species.
The total number of extinct forest-occurring species reported for 2015 is lowest for tree species while higher numbers were reported for other organism groups with greater species diversity. Fungi, other invertebrates and vascular plants are the organism groups with the highest total number of extinct forest-occurring species (Table 48). On the other hand, some countries that have been making efforts to preserve species from extinction or re-colonize extinct species were able to report positive results. Austria, for example, noted the return of the wild cat which was previously extinct in its forests.

Next to the threatened forest-occurring tree species, mammals and birds are the species for which most data are available. Around half of the 45 reporting countries provided information for the remaining categories. Due to the high number of threatened forest birds reported for the Czech Republic (248), the most noticeable number is found in Central-East Europe (422). Other regions range between 59 and 80 threatened forest-occurring birds. For example, Italy listed 2 species, one of which is critically endangered (Columba oneas) and a second that has become extinct (Aegypius monachus).

The highest number of threatened mammals is reported for the Central-East Europe region (129, of which 17 are critically endangered); however, country coverage for that region is rather limited. Information is particularly lacking in countries of South-East and South-West Europe, thus providing only a partial picture in relation to threatened forest-occurring mammals. The best covered region is North Europe (100% of the forested area) where the number of threatened mammals ranges from 1 in Estonia and 9 in Denmark, Latvia and Norway.

The highest absolute numbers of threatened vascular plants are recorded for the Czech Republic, (711), France (512) and Ukraine (500). With respect to individual regions, Central-East Europe (1,902, with 5 of 9 countries reporting) and Central West Europe (1,152, with 8 of 10 countries reporting) report the highest numbers of threatened vascular plant species occurring in the forest.

23 out of 45 countries reported figures for other threatened vertebrates and 20 countries reported on other invertebrates and fungi. This represents an increase in coverage compared to earlier assessments. Very few countries in South-West Europe continue to provide information. North Europe has the most complete data coverage for these groups with noticeable number of ‘other invertebrates’ (1,853) and ‘fungi’ (2,184) designated as threatened. In Central-West Europe, in particular, Germany reported 1,475 fungi species as threatened, which represents an increase of more than 10% compared to the number reported for the previous assessment. For other invertebrates, Slovak Republic designated 644 species as threatened; no information was available was available on this category in previous assessments.

Trends

The reporting situation has developed positively with more countries providing information than for earlier assessments. However, the data on threatened forest-occurring species by country are still heterogeneous and sometimes fragmentary. Thus many of the reporting countries stated that trend analyses should be avoided.
An increase in the number of threatened species may not necessarily indicate a loss of biodiversity. For example, an increased number of vulnerable or endangered species can reflect either a real deterioration in the situation or an improvement in the scientific knowledge on species, the implementation of more comprehensive surveys and the availability of better mapping tools for species distribution. Furthermore, while the number of threatened species may have risen in one organism group within a particular country, successful measures may have been implemented in another to prevent it from becoming threatened or even extinct. In addition to the designation of protected forest areas, forest management practices are developing towards the greater integration of biodiversity issues. Such integrated forest management approaches may give rise to improved habitat conditions for threatened species e.g. through increasing the amount of standing and lying dead wood, designating stepping stones and habitat trees, and preserving habitat structures and allowing for their development. However, the effects of biodiversity-oriented forest management practices will become evident only with time. Therefore, in addition to such long-term commitments, the continuation of efforts in relation to the monitoring of the development of threatened forest-occurring species will be crucial.

Table 48. Numbers of extinct forest-occurring tree species, birds, mammals, other vertebrates, other invertebrates, vascular plants and fungi by regions, EU 28 and Europe (number of reporting countries: 45)
**Indicator 4.9 Protected forests**

Protected forests: Area of forest and other wooded land protected with the aim of conserving biodiversity, landscapes and specific natural elements in accordance with the MCPFE Assessment Guidelines

**Introduction**

Protected areas are one of the oldest instruments for conserving nature and natural resources, and constitute a main pillar of nature conservation laws across Europe. Explicitly designated protected areas focus mainly on conserving biological diversity, landscapes, natural monuments and the protective functions of forests.

**Status**

Information was provided by over 22 countries in accordance with the Assessment Guidelines. In some cases, countries could provide data for forest only and not for other wooded land. The area of forests and other wooded land was used as a basis for the European scale calculations. In cases where countries did not provide data on forest and other wooded land, the data for forest area was taken into account. The area protected for biodiversity in Europe totals around 29.9 million ha. This is equivalent to 12.2% of the European forest area (Table 49 and Figure 79 and 80).

Within the area of forest protected for biodiversity in Europe, the share (76% of forest area) for the category “active conservation management” (MCPFE class 1.3) is highest. The share (15% of the forest area) for the strictest category “no active intervention” (class MCPFE 1.1) is very low (Table 49).

The size of forest area protected for biodiversity varies considerably between the European countries. In addition, very clear differences can be observed between the countries in relation to the shares applicable for the subclasses (MCPFE 11-13), i.e. the strictness of management for biodiversity (Figures 80 and 81). The forest area protected for biodiversity (all MCPFE classes 11-13) is highest in Spain, Italy, Finland and Sweden.

Of the total area protected for biodiversity in Europe, at over half (two million ha), the largest forest area with no active intervention is located in Finland. Sizeable areas of over 100,000 ha with no active intervention can also be found in Italy, Estonia, Sweden and Belarus.

The largest forest areas with minimum intervention (MCPFE Class 1.2) that are protected for biodiversity are located in Italy, Sweden, Spain and Norway.

Large forest areas of active conservation management for biodiversity (MCPFE Class 1.3) can be found in Italy, Belarus, Finland and Portugal. Germany (31 million ha, for 2010) and Spain (4.8 million ha) also reported large forest areas with active conservation management for biodiversity, however, according to the explanatory country information, both countries included all forest areas where Natura 2000 sites are located in MCPFE class 13. In Germany, these areas are partly located outside the legally protected forest areas. Spain reported some Natura 2000 areas in Class 13 and also included all of the large forest areas containing Natura 2000 sites in the MCPFE Class 2 “landscape protection”.

The differences in management reported for the protection for biodiversity reflect the various approaches adopted to forest protection: whereas Central, North-West and South European countries stress active management for biodiversity depending on forestry conditions, the Nordic/Baltic and East European countries focus strictly on protection.

The forest protection for “landscape and specific natural elements” (MCPFE class 2) supports the conservation goal of biodiversity, in particular by protecting special natural elements. However, this objective is principally aimed at achieving the goals of landscape diversity, cultural, aesthetic, spiritual and historical values, and recreation. In some cases this class also includes Natura 2000 areas. In general, commercial forestry is possible in these areas as long as it complies with the primary objective of landscape protection. Therefore, the results are described separately from the protected areas for biodiversity (MCPFE classes 11-1.3), whose principal conservation goal is strictly biodiversity.

Up to 2015, around 17.3 million ha or 7% of forest and other wooded land in Europe, was protected for landscape and specific natural elements (Table 49).
Landscape protection prevails mainly in Central and West European countries. The countries with the highest proportion of landscape protection areas (over 15% share of the total forest area) are Germany, Portugal, Slovak Republic, Czech Republic, Switzerland, France and Hungary. The size of the landscape protection area in countries with a high proportion of boreal forests in the landscape and low population density, e.g. Finland, Sweden and Norway is very small.

Table 49. Area of forest and other wooded land protected (million ha) and percentage of protection (percent) for biodiversity (MCPFE Classes 1.1-1.3) and landscape (MCPFE Class 2) in Europe, 2015 (based on the available data; where on forest and other protected wooded land were not available, data for protected forest were used in the calculations)

<table>
<thead>
<tr>
<th>Management objective</th>
<th>Europe</th>
<th>% of total forest area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biodiversity, MCPFE categories 1.1-1.3</td>
<td>29.9</td>
<td>12.2</td>
</tr>
<tr>
<td>1.1 No active intervention</td>
<td>3.6</td>
<td>1.5</td>
</tr>
<tr>
<td>1.2 Minimum intervention</td>
<td>7.3</td>
<td>3.1</td>
</tr>
<tr>
<td>1.3 Conservation through active management</td>
<td>19.0</td>
<td>7.6</td>
</tr>
<tr>
<td>Landscape, MCPFE Category 2</td>
<td>17.3</td>
<td>7.2</td>
</tr>
<tr>
<td>Total - Biodiversity and Landscape combined</td>
<td>47.2</td>
<td>19.4</td>
</tr>
</tbody>
</table>

Figure 80. Total protected forest area and share of the protected area by MCPFE classes for biodiversity by country in Europe, 2015 (based on available data; where data were not available on forest and other protected wooded land, data for protected forest were used in the calculations)
Trends

It was possible to analyse the changes in the area of protected forests using data from 2000, 2005, 2010 and 2015, however, it was not possible to reconcile the situation in 1990 in the countries with the MCPFE classes. A clear trend involving an increase in the area of forests protected for biodiversity and landscape in Europe can be observed over the last 15 years (Figure 82). The figures indicate, in particular, that the protected forest area with active management for biodiversity (MCPFE classes 1.2 and 1.3) has increased. The area of strictly protected forest areas (MCPFE 1.1) did not increase significantly between 2015 and 2010. This may be explained by countries being aware of the most important, rare and vulnerable forest areas and having already segregated the protected areas without human impact.

The area of protected forests for biodiversity and landscape in Europe increased by around 500,000 ha annually over the last 15 years.

![Figure 81. Total forest area protected (1,000 ha) by MCPFE Classes 1.1-1.3, for 2015 (based on available data). Data for Germany and Switzerland based on data for 2010](image)

![Figure 82. Area of protected forest (1,000 ha) in Europe by MCPFE class (1.1-1.3 and 2) in 2000, 2010 and 2015 (based on available data)](image)
Qualitative Indicator
Indicator B6 Biodiversity

Biodiversity remains an important area of engagement for sustainable forest management and forest policy with significantly different strategies reported by the states in Europe

Status, trends and main changes in policy objectives since SoEF 2011

90% of reporting signatories have specific objectives in relation to biodiversity that have remained stable since the last reporting period.

Biodiversity remains an important dimension of forest management in Europe. The majority of reporting signatories (31 of 34) reported specifically formulated policies (objectives) in relation to biodiversity. The key objectives and instruments of these policies are:

- To increase protected forest areas (Albania, Belgium, Latvia, Luxemburg, Montenegro, Norway), inter alia in conjunction with the implementation of Natura 2000 network of protected areas under the European Union’s Habitats and Birds Directives (Bulgaria, Croatia, Hungary, Italy, Slovak Republic, Slovenia, Serbia).
- To practise multifunctional or close-to-nature forest management (many countries).
- To protect rare and endangered species and deal with issues relating to invasive alien species (Austria, Cyprus, Czech Republic, Finland, Italy, Latvia, Romania, Switzerland, United Kingdom).
- To protect forest genetic resources (Bulgaria, Italy, United Kingdom).
- To preserve natural environments of cultural or aesthetic value (Estonia, Sweden).
- To improve knowledge about forest biodiversity and management through research and communication (Germany, Iceland, Latvia) and also (new) monitoring (Austria, Turkey).

Overall, biodiversity-related forest policy objectives remained stable compared to the previous reporting period; the reported changes (11 of 34 countries) refer to one of the above-listed objectives and instruments. Regarding protected forest areas, several countries have adopted quantified objectives which differ significantly with regard to the quantity and qualification of the protection status (e.g. Albania plans for 25% of its forests designated as protected areas by 2020, in Luxemburg 5% of public forests shall be ‘total reserves’ in the future).

Only 6 out of 34 reporting signatories submitted responses on key lessons learnt with most of them referring to better performance regarding biodiversity conservation and/or the better integration of biodiversity conservation into forest management. Some of the most prominent examples include: the integration of Natura 2000 and other forest biodiversity requirements into forest management practice (Slovenia) and the enhancement of cooperation between foresters and conservationists as current disputes are counter productive (Slovak Republic).

Institutional framework

Continuity in institutional frameworks for most reporting countries

Regarding institutional frameworks, around 25% of the signatory countries reported changes. Changes were mostly related to general administrative reforms in the forest and environmental sector. Turkey reported the establishment of a Biodiversity Division in the Non-Wood Forest Products and Services Department.

Legal/regulatory framework and international commitments

Half of the signatories reported changes, most of which were driven by the implementation of the Natura 2000 networking programme

Regarding the policy mix applied for the governance of biodiversity-related management in forests, regulatory instruments play an essential role. In total, 15 of 34 reporting signatories reported changes regarding the legislative framework, relating specifically to:

- the adoption and amendment of national legislation in relation to Natura 2000 (Belgium, Montenegro, Croatia, Hungary);
- the development of national programmes/strategies on the protection and reproduction of forest tree species and/or biodiversity in general (Czech Republic, France, Romania, Spain);
- compensation mechanisms for biodiversity conservation, primarily relating to Natura 2000 (Belgium, Hungary, Slovak Republic, Sweden).

In general, the EU’s biodiversity policy and, specifically, Natura 2000 appear to provide an important trigger for legal changes in the European countries, in particular in the ‘new’ EU Member States in Central and Eastern Europe and also in EU accession countries.
Financial instruments and economic policy, and informational means

**Few changes reported regarding financial and informational means**

Few changes are reported regarding financial (25 of 34 countries report no change) and informational (26 of 34 countries report “no change”) instruments relating to biodiversity conservation and management in forests. With regard to financial instruments, a few countries report changes relating to compensation mechanisms, e.g. for Natura 2000 forest sites. For example, Hungary introduced Natura 2000 payments for 120,000 hectares to improve the management of privately owned forests protected under the EU network of protected areas.

Regarding informational instruments, only 4 countries reported new developments that are specifically relevant to biodiversity and forests. These involve, for example, annual forest communication plans (Finland), the use of social media (Austria) and new publications (e.g. on the protection of animal species, Luxembourg).

### Selected objectives of the EU Biodiversity Strategy to 2020 of relevance to forests:

1. Halting the loss of biodiversity and the degradation of ecosystem services in the EU by 2020, and restoring them in so far as feasible.

2. Putting forest management plans or equivalent instruments in place for all forests that are publicly owned and for forest holdings above a certain size so as to bring about a measurable improvement in the conservation status of species and habitats that depend on or are affected by forestry and in the provision of related ecosystem services as compared to the EU 2010 baseline.

3. Fully implementing the Birds and Habitats Directives with a view to improving conservation status through the implementation of 100 percent more habitat assessments and 50 percent more species assessments under the Habitats Directive and establishing secure or improved status through the implementation of 50 percent more species assessments under the Birds Directive.