



YPEF
European contest
about forests and
forestry

Educational material
Ninth edition,
2019

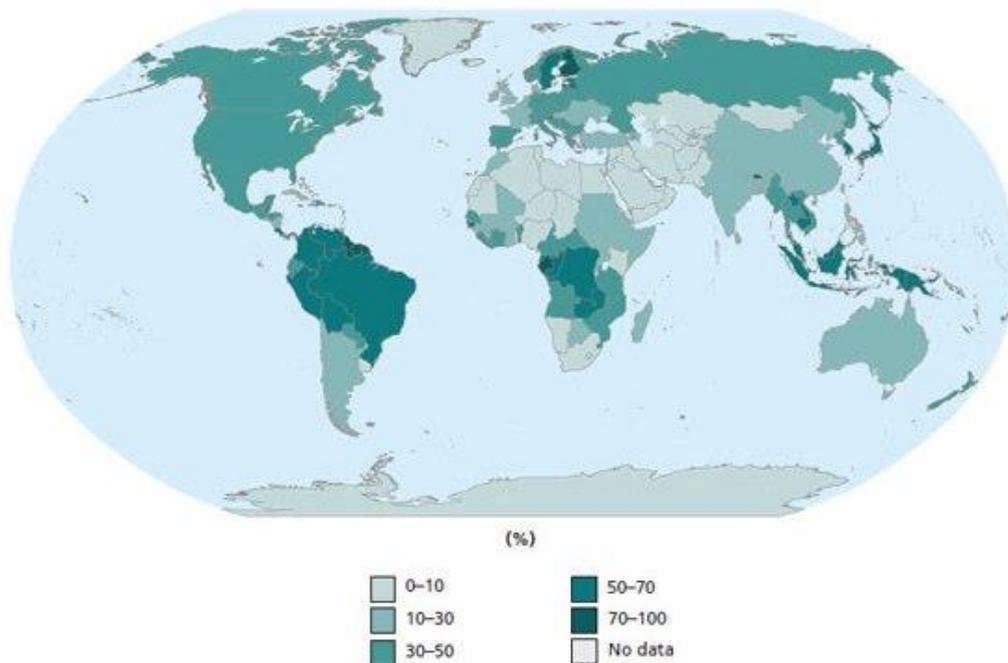
Contents

European Forests.....	3
Forests and forestry of	
Austria	25
Czech Republic	27
Estonia	30
Germany	37
Greece	43
Hungary	48
Latvia	56
Lithuania	59
Poland.....	64
Portugal	71
Romania.....	79
Ukraine	86
List of authors	95
Sources and references.....	96

European Forests

If we look at Europe from Space, through the digital eye of a satellite, we will notice a seemingly solid structure formed of vast, dark green woodland. When we compare Europe to all the other continents we realize that Europe is actually a green oasis in the world. It is an area where forests do not decrease (as in the rest of the planet) but on the contrary have increased since the XVIII century. In Europe the relationship between forests and society continues to evolve, turning its back on the demands for mass raw material and focusing more on the ecological aspects such as the protection and conservation of ecosystems and landscapes. There is the tendency to move away from the typical aspect of using the forest solely for timber production. This is a privilege that only a quite wealthy society such as the European can afford. In the poorer parts of the World, there is pressure for more agricultural land at the expense of forests because of the millions of starving people who use wood to survive on a daily basis.

Forest area as a percentage of total land area by country, 2010



Forest area as a percentage of total land area by country, 2010. Source: FAO, 2013

At first glance, the forests of Europe seem to be similar, however, with a closer look the local and regional differences of the most complex ecosystems appear. The boundaries between forests can be distinguished. One can see the northern and mountain spruce forests, the endless terrain of pine forests, the multi species forests on highlands and mountains, the long stretches of riparian forests, the Mediterranean evergreen bushes of macchia, and even some remains of ancient forests. All types of forests are unique depending on the different tree species, the flora and fauna diversity, the fertility of the habitat, land management and forest policy in the area which in certain areas was **sometimes formed** by several countries.



Wonderful Forest. Source:
Robert Pache

We will start our journey from the Mediterranean and we will continue towards the north according to the chronological order of settlement in Europe. We will see how the history of our economy is related to forest resources. The first traces of settlement are 8000 years old and come from southeastern Europe, whereas similar findings in the northern part of the continent appear 6000 years later. Oak and cedar forests died out in the medieval times (in those days people struggled for their survival). Systematic forest management by people in Western Europe dates back in the middle of the last millennium. In northern Europe, management of some forests started 200-300 years ago. Many forests escaped the exploitation phase during the era of industrial development. Sustainable forest management started later providing also a steady income. The journey northwards will also have a different dimension. As we will follow the footsteps of the withdrawing glacier, we will pass through forest areas of different climate conditions and soil surface of different geological age.

We will therefore follow the history of civilization and at the same time we will learn about forests which are similar to old forests and grew during the postglacial period. Let's start our journey...

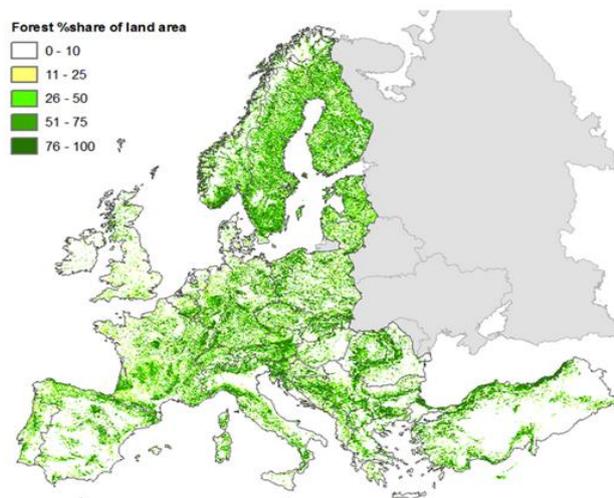
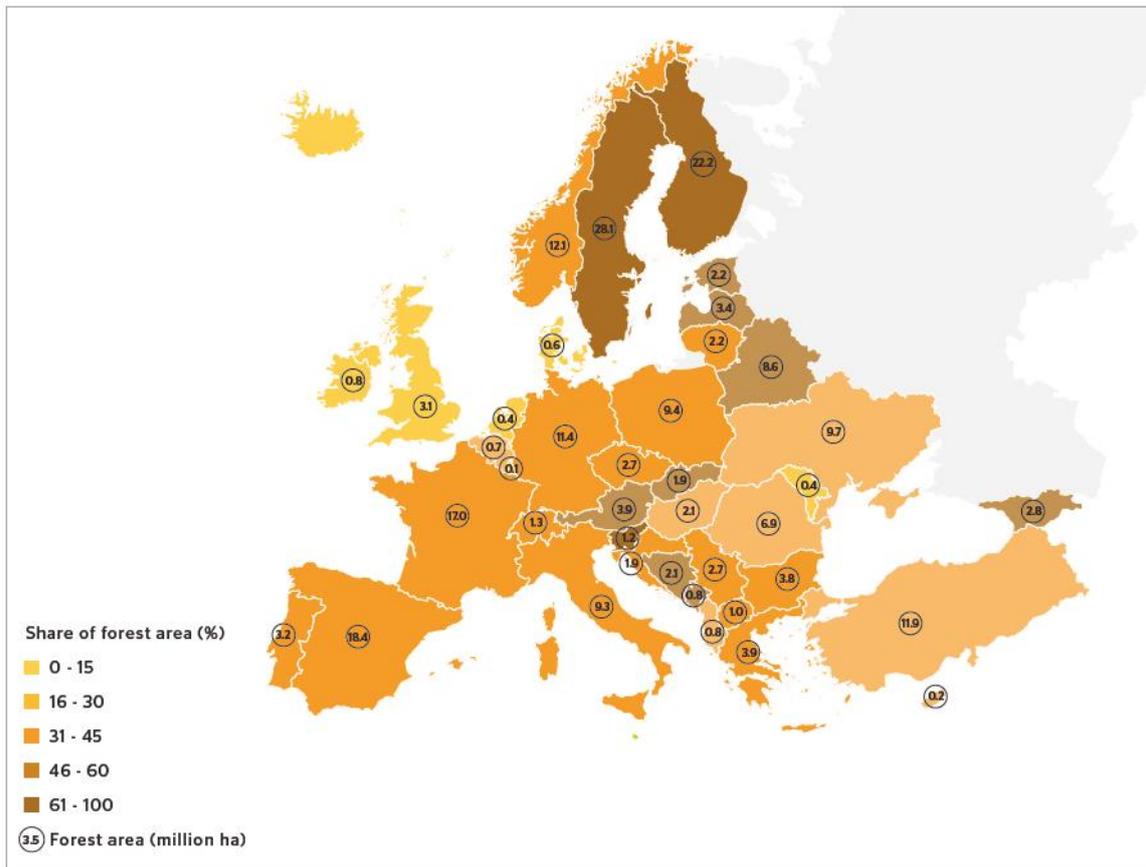


Figure 1: IRS- and SPOT-based forest cover map of the EC Joint Research Centre (Kempeneers et al. 2011), aggregated to 1km x 1km.

IRS- and SPOT-based forest cover map of the EC Joint Research Centre. Source: Kempeneers et al., 2011

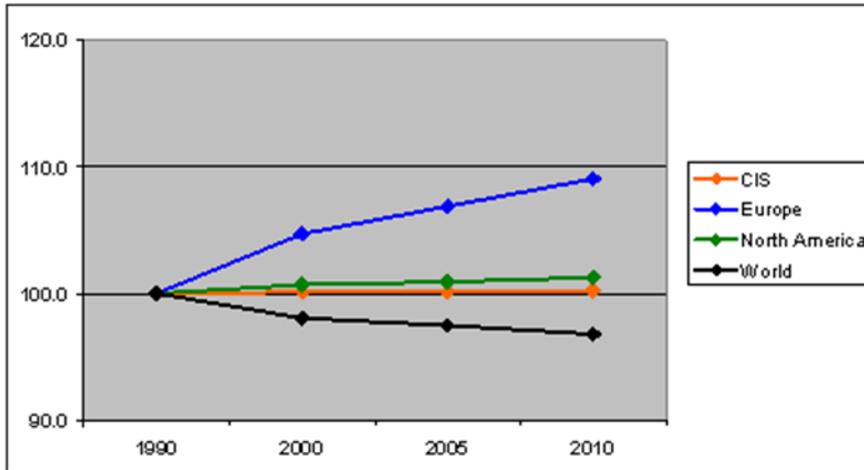


Forest cover in Europe, as percentage of land area and forest area (million ha). Source: FOREST EUROPE, 2015: State of Europe's Forests 2015 Ministerial Conference on the Protection of Forests in Europe, 2015

Where do forests grow? Forest area as a result of historical changes - Europe

For most of Europe, forest vegetation is the result of natural succession. If we abandoned the way we use our land today, the forest area would take up about 90 % of the continent, excluding only mountain areas above tree border line, sand dunes on the sea coast, big rivers and their surrounding areas where people have settled down. Within Europe only the endless steppes, stretching from across the Asian plains to the north of the Caspian and Black Sea, where the insufficient amount of rain water prevents the growth of forests, can compete (with) our forests. The percentage obtained by comparing the area occupied by forests to the total land area (excluding the area covered by water) is drastically different in different European countries. The more mountainous and less inhabited a country is, the higher the above percentage is. Forests in today's landscape is the result of limited human settlement throughout history due to unsuitable terrain (e.g. mountain and swamp forests), inappropriate climate conditions, infertile soil (poor coniferous forests) or deliberate decisions made by the rulers (hunting grounds). The Mediterranean landscape of southern Europe indicates that cattle breeding is mainly responsible for limiting the reproduction and development of forests, which were cut down for timber and fuel. Forests were destroyed and burned down for forming farmlands. The unveiled soil on the slopes of mountains was prone to erosion, and rainfall gradually washed away the most fertile layer (formed by the forest), until it became totally barren. The degraded land, which was later covered in bush, could only be used for

sheep and goat herding. Animals ate the new trees preventing forests from returning to their natural habitat. In this way, 90 % of all primary forests of Europe disappeared.



Change of forest area in the UNECE region (in relation to the area of 1990). Source: FAO FRA, 2010.

During later settlements in the north, people preferred fertile soils in valleys and plains as farmland leaving less accessible slopes and wetlands as meadows and pastures. Changes in Europe's forested land took place during the XVIII and XIX centuries, when mining and railway connection were undergoing intensive development. New forms of industry appeared based on huge amounts of timber. Trains became a new and convenient form of transporting wood, independently of the waterways used for floating down timber. Mass deforestation was also caused by the development of paper and textile industries, which used wood in chemical processing.

Forest cover in certain European countries ranges from 86 % in Finland to 7 % in Ireland. That gives an average of 35 % in Western Europe and 47 % for the whole of the continent. But do these percentages reflect forests' role in the landscape of each country? There are high forests in areas where land is inaccessible for cultivation and human population is low. Forests for example cover the wild inland of Norway whilst people live on the coast (3/4 of them in cities). Moreover, the percentage of a country's forested area does not include only forests. In Italy, where the forest cover is 29 %, only ¼ are forests with high trees. The rest is plantations (producing timber, cork and chestnut), forest trees for firewood, macchia and bush areas with a low percentage of tree species. The situation is similar in other Mediterranean countries, where climate, soil and most importantly history (including settlement), have pushed forests into inaccessible areas, unsuitable for growing crops or vineyards. The upland and mountain countries (Slovenia, Alpine countries) have a higher level of forest cover because there are mountain slopes, where forests have a soil protective function, preventing mud slides and avalanches. Forests can also be helpful in case of increased rainfall. The crown of a single large tree can hold up to 500 litres of water. If a slope is covered by a multilayered forest then a limited amount of water reaches the mineral soil which is then steadily distributed to the soil. Understorey also slows down the speed of the water flow, preventing floods in river valleys. Depending on the intensity of the rainfall, forests can hold up to 85% of all water. This is the main reason of the high forest cover percentage in mountain countries.

On the other hand, there are countries with a very low percentage of forest cover (e.g. United Kingdom and Ireland – around 10 %), whereas in the past they were covered by dense deciduous forests (and coniferous in Scotland). Nowadays, only a few fragments of these natural forests have remained, such as oak and beech forests (south England and highland Wales), or pine (Scotland), all of which are treated as natural monuments. Other forest areas are covered by coniferous forest trees, used mainly for timber production.



Oak Forest.

Source: Robert Pache

Countries in Western and Central Europe are very similar in terms of forest cover, forest composition and structure. The percentage of forest cover reaches 30%. Native species are the most dominant, but there is a large group of highly productive, fast growing trees (especially various species of pine and spruce), created by the XIX century need for fast timber growth and harvesting. Despite long settlement and turbulent times, some of the forests have kept their grandeur, resembling the ancient forests of Europe. That was because rulers used isolated forest areas for hunting, which was not just for entertainment but it also provided food. That allows us today to enjoy the beauty of these fertile lowland forests, such as Białowieża Forest in Poland and Belarus and also New Forest in Hampshire, Great Britain, one of the oldest forests to be protected for hunting (since the XI century).

Who owns forests? Forests ownership influences their quality, their distribution and their exploitation – Europe

Among European countries we can distinguish three groups of countries with different percentages of public forests. The highest percentage of private forests is found in the Scandinavian countries (Norway, Sweden and Finland), and also in France and Austria. In these countries the percentage of public forests does not exceed 30%. Nevertheless, there are not any strict restrictions on public access to private forests, apart from some exceptions. On the other hand, in Ukraine and Belarus the State owns all forests. Access to forests is usually restricted in countries with less forest cover and with food traditions related to collecting forest fruits. Such restrictions are applied in countries like Italy, where people who pick mushrooms, chestnuts and “gifts of the forest” believed that forest was their own yard or agricultural crop.

Forest ownership plays an important role in forming forest policy which promotes the conservation of the environment. The State as a dominant owner can follow non profitable policies in relation to forestry in order to keep the society happy. It is much harder to fund private owners, in order to convince them to give up their personal profit and follow policies aiming at nature conservation and recreational activities in the forests. It is much easier to protect large areas belonging to one forest owner from the harmful

effects of strong winds, by creating appropriate spatial structures between neighboring tree stands.

Moreover, creating a network of observation points can also protect these areas from fire. Another important aspect is the possibility of planning and implementing actions for changing the composition and structure of tree stands in greater forest areas. Reconstructing tree stands is an action beyond the prospect of financial profit within one or two decades. The durability and importance of these reconstructed tree stands is not counted in terms of money.

What are forests? Forest diversity in Europe

Plant formations in Europe have a parallel but quite different layout. Their structure is influenced by the oceanic climate in the western part of the continent and the continental climate in the east. There are conditions favorable for European forest vegetation south of the arid tundra of the Arctic. European forest vegetation begins with a stretch of shrubs and rare birch forests on the Scandinavian Peninsula and in Russia. Further south we will find the taiga, consisting of conifers, such as spruce and pine, and to some extent fir and birch. Moving closer towards the equator, we are likely to spot more and more deciduous species: aspen, fewer elm, alder, maple and lime. Further to the south the taiga zone passes into deciduous and mixed forests of oak, beech and other species. In Western Europe, which does not stretch that far to the north, we will not find a taiga zone. We will find unique forest vegetation along the Atlantic coast (the coasts of west Norway, Great Britain, Ireland, western Spain and Portugal), such as moors with beeches and oaks. Further, in areas with a milder climate, we will find the typical forests of the region. On the shores of the Mediterranean and in the southern and central parts of the Iberian Peninsula we can find typical Mediterranean vegetation, dominated by sclerophyllous, eternal green thicket, formed after the destruction of forests. The meridional position of an area, as well as its height, influences the composition of the forest. In southern Europe we can find forests at a higher altitude (in Bulgaria at 2300 meters above sea level) than in northern Europe (in Scotland at 500 meters above sea level).



Fruits of a Coniferous tree and fragile seedling. Source: Robert Pache

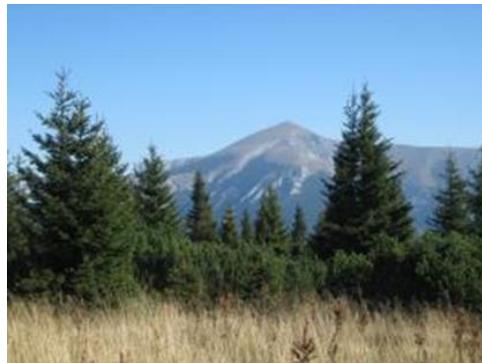
The original European vegetation has changed as a result of the economic activity, especially in the central and southern part of the continent. That occurred at a smaller scale in the north and north eastern part.

In the British Isles natural vegetation covers only 10 % of the land (not only forests, but also heath land and bog), whilst in northern Scandinavia and Russia this percentage comes up to 90%. However, these are areas unsuitable for agriculture because of their climate.

The diversity of species in the forests depends on the geographical position, but also on the forest management policy implemented over the years. For the past 200 years, European forestry has preferred monospecific coniferous tree stands (mainly spruce and pine), resulting in the reduction of mixed and deciduous forests. Currently, due to the reconstruction of tree stands, there are more forest areas adapted to their natural habitat. Across Europe, mixed forests cover about 14 % of forest area. The largest shares of these tree stands are found in Malta (60 %), Czech Republic (56 %), Latvia and Estonia (above 40 %). Monospecific coniferous forests dominate because of natural conditions (climate and soil), mainly in northern countries (Scandinavia) and in mountain areas (Austria, Germany, Switzerland).



Beech forest in Germany.
Source: A. Schilling



Mountain forest in Austria. Source:
YPEF Austria

Coniferous species sometimes dominate because of economic decisions related to forest management. In Great Britain and Ireland, the large share of coniferous species is the result of a long-term forest policy, which supported the cultivation of sitka spruce - an alien species to the flora of Europe. Deciduous species play a greater role in countries situated in the south of the continent: Serbia, Bosnia and Herzegovina, Croatia (80 %), Hungary and Italy (70 %).

One way to measure resources in a forest is to calculate the growing stock which is the volume of the total standing timber at a particular time. Only wood suitable for processing is usually calculated, excluding thinner branches. The growing stock in the forests of Europe varies. In a single species stand, it depends on the age, the composition, the structure and the density of the forest. The average growing stock in the whole continent is about 140m³/ha, while growing stock in Ireland, Greece and Spain are below 100 m³/ha. In the alpine countries these numbers are much greater due to high rainfall and large tree stands of fir and spruce. In Austria it amounts to 309 m³/ha, in Slovenia and Germany - around 280 m³/ha. Forests in Slovakia and the Czech Republic have an average of 260 m³/ha because of the domination of hill and mountain forests.

In order to have sustainable forest management we need to know the annual increase of wood volume (annual increment). The volume of the timber logged every year, is not permitted to exceed the annual increment. More specifically, is permitted to be logged only a 60-70% of the annual increment every year. Tree stands with the highest growth

rate are situated in western and central Europe ($5 \text{ m}^3/\text{ha}$ per year). Limited growth is due to the following factors: short growing season in Europe and drought in southern Europe. Factors speeding up growth are: longer growing season in the south and higher amount of rainfall associated with milder maritime climate in the west.



Maritime pine stand.
Source: YPEF Portugal

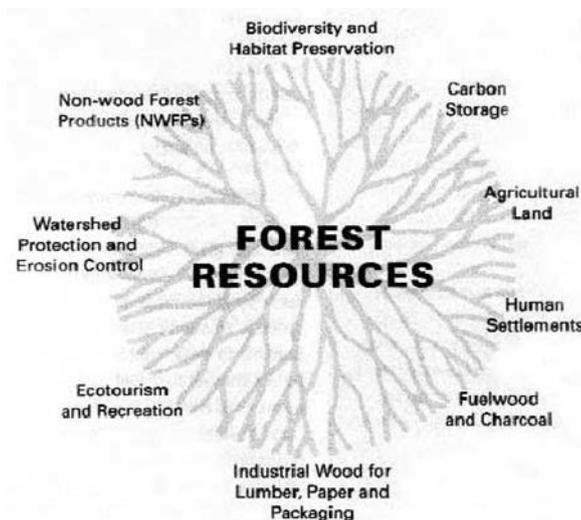
Among European forests one can find areas which provide firewood. Tree stands providing firewood consist of tall and thin trees and species sprouting from a cut tree. These stands rarely exceed 30 years old and they are treated as forests of lower category. They are located mainly in southern Europe - in France, Italy and Greece. Forests with high trees coming from seeds and seedlings are the most valuable category. The age of these forests is distinguished by different age classes (20 years). The largest areas are occupied by trees between 20-80 years old (II-IV class). That resulted from afforestation after World War II, which took place in the central part of the continent, due to changes of borders and land ownership. In Europe there are 13 million hectares of forests, more than 100 years, which will continue to exist because of the restrictions enforced for environmental protection and because of social pressure. Age classes of forests are evenly distributed in Switzerland, Luxembourg, Czech Republic, Finland and Norway. Ireland is among the countries with an irregular age structure of tree stands. That resulted from afforestation funded by the European Union. Countries in a similar situation are Portugal, Austria and Denmark. On the other hand in Germany, the percentage of the tree stands of a younger age group is extremely low as a result of forest cultivation and forest regeneration. For example, the age for pine felling in the Nordic countries ranges from 110 to 180 years, in Central Europe from 80 to 120 years, in Hungary from 60-70 years and in the countries bordering the Atlantic Ocean up to 50 years (which is also an index of the species growth rate).



Old growth forests. Source: Robert Pache

The geographical location of a country affects the richness of fauna and flora in forests. There is certainly a greater diversity in species in the south of the continent. European forests consist of around 150 species of trees, all at different distribution. The largest area is covered by pine, spruce, beech, fir and oak. Depending on the location of the country, between 200 and 6,000 vascular plants can be found. The majority of them are found in countries in the south and east of Europe and less in the north of Europe. The problem for some of the forests is the large number of alien species. In Northwest countries, introduced species take up an average of 15 % of forest areas, but in some countries this percentage is much higher (Ireland, Denmark, Iceland, Great Britain, Hungary, the Benelux countries). In the group of alien species, we can also include species that grow well away from their natural habitat. Among coniferous species one should first mention spruce, Sitka spruce, Douglas fir, and several species of pine. Among deciduous trees, non-native species include red oak, robinia and different poplar species. When moisture and temperature conditions are favourable, eucalyptus tree covers large forest areas (Spain, Portugal). Some of the alien species which are invasive, have adapted to the European forest ecosystems and are now occupying new areas. Some of them are: robinia – black locust (*Robinia pseudoacacia*) and black cherry (*Prunus serotina*), and *Ailanthus altissima* (Slovenia, Albania) in the south-east.

Forests are home to half of the mammals of Europe. Their number depends on the location and history of the countries' economy. The largest group of mammals lives in the forests of south-eastern Europe, the Czech Republic, Slovakia and Lithuania. Moreover, in the Czech Republic, Slovakia, Austria, Poland, Scandinavia and Lithuania we can spot a large number of nesting bird species in forests. Significantly fewer nesting birds are found in the forests of Germany, Italy and the Benelux countries.



Forest resources. Source: Adapted from Sten Nilsson, Do We Have Enough Forests? 1996

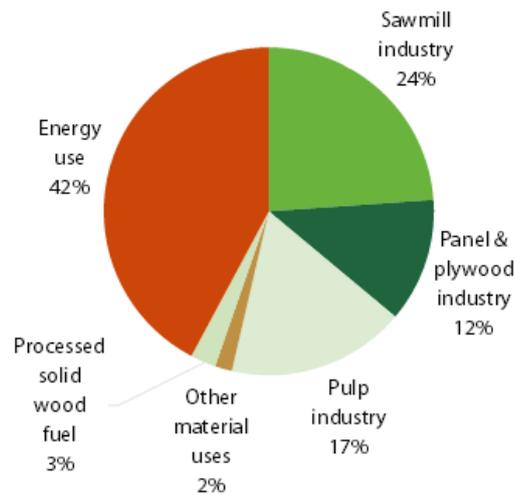
What's the relationship between man and forests? Forest management and nature conservation – Europe

Forests in Europe are usually preserved in areas unsuitable for agriculture. There is also a small percentage of forests untouched by human intervention. Virgin forests (ancient / pristine / old-growth / primary) which are not affected by man account for about 4% of all forests of Europe, although defining what a virgin forest is varies among different countries.

Most of them grow in places difficult to public access as in northern Scandinavia, northern areas of the European part of Russia, the Alps and the Balkans. Most of these forests are located in Sweden (16 %). On the other hand, few European forests derive entirely from artificial plantations. There are some exceptions. Countries with many plantation crops are those with a well-developed alien species cultivation (Spain, Turkey, United Kingdom and Ireland, France and Portugal). There are no plantations in Finland, Germany and Austria. In defining plantation crops, the purpose of their establishment is taken into account, for example fast timber production. In plantations, soil protection is taken into account, including fertilization, keeping regular spacing between trees, pruning. Forests, consisting of shade-intolerant species, may resemble plantation crops in the early stages of their life. However, even in plantations with few tree species and regular spacing between trees, the tending treatments may lead to loss of this spacing. These stands will become semi-natural forests due to random factors and foresters' decisions. In Central Europe the composition of Scots pine forests (*Pinus sylvestris*) can change due to their enrichment with oak (because of birds) and birch (wind).

As a result of afforestation during the period after World War II and of a tendency to propagate pine and spruce, large forest areas over-covered by spruce and pine. These forest areas need restoration in order to have more deciduous trees and firs. This change occurs in at least two ways. In younger tree stands of II-III age class, shadow-tolerant species are introduced under the pine. In a few decades they will dominate by replacing the previous dominant species. Old tree stands either not well adapted in the natural habitat or stands with a closed canopy that does not let light reach the forest floor, are restored by cutting. The type and size of felling depends on the demands of the introduced younger generations.

Revaluation of the role of European forests forced managers to use management methods, which do not lead to total removal of all old trees. Cutting trees in groups on small areas of irregular shape are partly a response to social expectations for forest protection. Due to the above reason and not for economical ones, clearcuttings have been abandoned for the stands' regeneration. However, in tree stands requiring light, which grow in poor habitats, abandoning clearcuttings is not entirely possible. In the case of natural regeneration of shade-intolerant species by seeds, clearcutting is necessary.



Source: EUwood, 2010

Wood resources use in the EU-27, 2010. Source: EUwood, 2010

Despite various restrictions in timber production, demand for wood is increasing in all European countries. The European Community faces a dilemma. How to support ecological forestry in their area and at the same time cover the growing demand for wood? Is importing raw materials from outside Europe the proper solution? Imported timber, in order to be cheap and profitable, should either derive from plantations or from non-sustainable logging. In this way we protect forests in our home country but we cause forests degradation in other, poorer regions of the world. One solution is to follow a more rational approach to multifunctional forest management at local level such as adopting a system for certifying the origin of wood raw material. Certified products guarantee that all proper procedures during the entire cycle of production, transportation and processing were followed.



Forest works. Source: YPEF

What will forests be like? Future and threats – Europe

During the history of forestry there has been evidence for the disruption of the forest production cycle due to the appearance of insect pests, natural disasters and extreme climate changes- drought, strong winds, floods and frost. Fungal diseases are signs of modern times. Seedlings deprived of mycorrhizal fungi are vulnerable to parasitic pathogenic fungi. The number of harmful insects has increased partly because of humans who created even-aged monospecies stands in large areas. Because of the disturbed balance and the absence of self defense mechanisms of the forest ecosystem, the population of these harmful insects could rapidly increase, leading to disaster. The largest pest gradation in European forest history caused by the Nun Moth (*Lymantria monacha*) from 1978 till 1984 in Poland, destroyed about 1/3 of the country's total forest area.

These disasters can only be faced with chemicals which are expensive and have a negative impact on the environment. Since prevention is better than cure it is better to keep the balance of the forest ecosystem than try to face the negative impacts. Climate change is increasing the risk of another insect gradation caused by a species with unknown economical impact.



Gall and Pests. Source: Robert Pache

Among abiotic factors, wind has the most intense effects. Strong winds, braking and knocking down trees in large areas, hit European forests regularly with increasing frequency. Particularly heavy losses are caused by wind in mountain areas, dominated by man-made spruce forests. Mixed forests are much more resistant to these threats, especially if they consist of species adapted to local conditions, such as beech and fir forests.

Fire is another important factor. There are three conditions that need to be present in order for a wildfire to burn, which firefighters refer to as the fire triangle: fuel, oxygen, and a heat source. Forest fires have a devastating impact not only in the warm and dry southern countries but also in other European regions. That happens because of several factors: lower forest humidity (dehydration), rising average air temperatures, declining health of forest stands and greater human intervention. Unhealthy forests with open canopy let more light reach the understory, thus helping ground vegetation, especially grass, to grow. Grass vegetation then becomes dry and can easily catch fire.

Different wildfires burn differently in forests. Fires that burn organic material in the soil are called ground fires. This is a slower burning fire, usually under litter or under vegetation. They burn by glowing combustion.

Some fires burn on the surface of the ground. They burn dry leaves, broken twigs and branches and other materials on the ground. These fires spread quickly and are known as surface fires.

Crown fires burn with huge flames and has intense heat and power. They burn from tree top to tree top and spread very quickly with the wind and heat. It is even worse if they are exposed to steep slopes.

In 2003, over half a million hectares of woodland were destroyed by fires in southern Europe, causing several billion euros worth of damage.

Forest fires are a tragedy for the living part of the forest ecosystem. There are also a threat to people's lives. Also increases carbon dioxide emissions. You should know that four out of every five wildfires are started by people.



Forest after fires.
Source: YPEF Portugal

Despite numerous threats the future of European forests is bright. Their total area is increasing. Forests continue to offer a lot to the people. Society continues to exert pressure on the State to abandon the productive functions of forest resources, or at least reduce them. There are many European programs for forest protection. European forests are certainly changing for the better.



Listen to the silence of a forest and Picnic at the forest. Source: A. Schilling

Nature conservation and Policy framework

European policy regarding protected areas is mostly the product of initiatives from two main sources: the United Nations Convention on Biological Diversity, and the European Union itself.



Children around a tree, which is protected.
Source: Astrid Schilling

The UN Convention on Biological Diversity is an international treaty which almost 200 countries signed. The Convention states that, as far as possible and appropriate, parties shall “establish a system of protected areas or areas where special measures need to be taken to conserve biological diversity”. The following international and pan-European conventions have been promoting the establishment of protected areas (EEA Report, 5/2012).

Conventions at the global level		
The Convention on Wetlands of International Importance (Ramsar Convention)	1971	The Convention on Wetlands is an intergovernmental treaty signed in Ramsar, Iran, and came into force in 1975. It is the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.
The World Heritage Convention	1972	The World Heritage Convention was adopted by the General Conference of UNESCO, and links nature conservation and the preservation of cultural properties.
The Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)	1979	The Convention on the Conservation of Migratory Species of Wild Animals was signed in Bonn, Germany and came into force in 1983.
United Nations Convention on the Law of the Sea	1982	The Convention has been ratified or acceded to by more than 150 states and the European Union. It governs all aspects of ocean space from delimitations to environmental control, scientific research, economic and commercial activities, technology and the settlement of disputes relating to ocean matters.
Convention on Biological Diversity (CBD)	1992	The objectives of the Convention are: conservation and sustainable use of biological diversity; and the fair and equitable sharing of the benefits arising out of the use of genetic resources. The CBD came into force in 1993.

Conventions at the pan-European level		
The Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention)	1979	The Bern Convention is a binding international legal instrument in the field of nature conservation, which covers most of the natural heritage of the European continent and extends to some states of Africa. It was opened for signing in Bern, Switzerland, and came into force in 1982.
Alpine Convention	1994	The Alpine Convention sets out the basic principles and general measures for sustainable development in the Alpine region and includes the Protocol for the Implementation of the Convention in the field of Nature Protection and Landscape Conservation. The Convention entered into force in March 1995.
European Landscape Convention (Florence Convention)	2000	The European Landscape Convention promotes the protection, management and planning of European landscapes, and organises European cooperation on landscape issues. The Convention was adopted in Florence, Italy, and came into force in March 2004.
Carpathian Convention	2003	The Carpathian Convention, signed in Kiev, Ukraine, provides the framework for cooperation and multi-sectoral policy coordination, a platform for joint strategies for sustainable development, and a forum for dialogue between all stakeholders in the Carpathian region.

Conventions on global and pan-european level. Source: IUCN

At EU level, two directives of the European Council have been particularly important for the creation of protected areas.

Directives of the European Union		
Directive 79/409/EEC on the conservation of wild birds (Birds Directive)	1979	The Birds Directive is the EU's oldest piece of nature legislation and one of the most important, creating a comprehensive scheme of protection for all wild bird species naturally occurring in the Union. Following numerous updates over the years, the codified version was published in 2009 (Directive 2009/147/EC).
Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (Habitats Directive)	1992	The Habitats Directive forms the cornerstone of Europe's nature conservation policy. It is built around two elements: the Natura 2000 network of protected sites and the strict system of species protection.

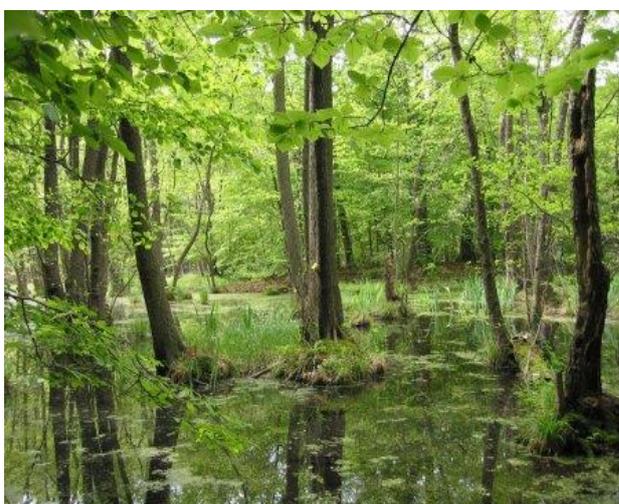
Directives of the European Union. Source: IUCN

Europe has established other policy instruments which are important for the protection of the environment:

- as The London Convention Relative to the Preservation of Fauna and Flora in their Natural State,
- European Diploma of Protected Areas,
- Man and the Biosphere Programme (MAB),
- European Network of Biogenetic Reserves and
- Global Geoparks Network.

- **IUCN management categories**

According to the International Union for Conservation of Nature (IUCN) a protected area can include any area of sea, lakes, rivers or land that has been identified as important for conservation of nature, and managed for this purpose. Some protected areas allow industry, extensive agriculture or fishing to occur within their boundaries, while others prohibit all of these activities.



Alder forest.
Source: Administration of Biosphere reserve Schorfheide-Chorin, Germany

- **IUCN protected areas management categories system**

While a designation type often provides information about the purpose of a protected area, it does not provide information on the type of management applied in the individual site. In an attempt to describe and categorize the different management approaches in individual sites, the IUCN has identified seven different protected area categories, based on management objectives.

IUCN category		Description
Ia	Strict Nature Reserve	Strictly protected areas set aside to protect biodiversity and also possibly geological/geomorphologic features, where human visitation, use and impacts are strictly controlled and limited to ensure protection of the conservation values. Such protected areas can serve as indispensable reference areas for scientific research and monitoring.
Ib	Wilderness Area	Usually large unmodified or slightly modified areas, retaining their natural character and influence without permanent or significant human habitation, which are protected and managed so as to preserve their natural condition.
II	National Park	Large natural or near natural areas set aside to protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible, spiritual, scientific, educational, recreational, and visitor opportunities.
III	Natural Monument or Feature	Protected areas set aside to protect a specific natural monument, which can be a landform, sea mount, submarine cavern, geological feature such as a cave, or even a living feature such as an ancient grove. They are generally quite small protected areas and often have high visitor value.
IV	Habitat/Species Management Area	Protected areas aiming to protect particular species or habitats, their management reflects this priority. Many Category IV protected areas will need regular, active interventions to address the requirements of particular species or to maintain habitats, but this is not a requirement of the category.
V	Protected Landscape/Seascape	A protected area where the interaction of people and nature over time has produced an area of distinct character with significant, ecological, biological, cultural and scenic value: and where safeguarding the integrity of this interaction is vital to protecting and sustaining the area and its associated nature conservation and other values.
VI	Protected area with sustainable use of natural resources	Protected areas that conserve ecosystems and habitats together with associated cultural values and traditional natural resource management systems. They are generally large, with most of the area in a natural condition, where a proportion is under sustainable natural resource management and where low-level non-industrial use of natural resources compatible with nature conservation is seen as one of the main aims of the area.

IUCN categories. Source: IUCN

Protected areas in Europe

About 25% of the EU 27 terrestrial land is protected under Natura 2000 or national designations or some combination of the two.

The size of Europe's designated areas varies greatly, ranging from an individual tree, to some million hectares (ha) for a site. Ninety per cent of sites are less than 1.000 ha, however. Protected areas provide a wide range of services in a context of increasing pressures and a rapidly changing environment.

For the vast majority of nationally protected areas (90%) the area is less than 1.000 ha and 65% range between 1 and 100 ha. The average size of the Natura 2000 sites is larger: two thirds (68%) are less than 1.000 ha and almost a third of the sites are bigger than 1.000 ha (EEA Report, 5/2012).

Area size	Nationally protected areas (CDDA)	Natura 2000 sites
<1	12%	2%
1 - 100 ha	65%	33%
100 - 1 000 ha	16%	33%
1 000 - 10 000 ha	5%	23%
>10 000 ha	2%	9%

Protected areas in Europe. Source: CDDA version 2011 and Natura 2000 data base, 2011

Natura 2000 network

Natura 2000 is an EU-wide network of nature protection areas established under the 1992 Habitats Directive. The aim of the network is to assure the long-term survival of Europe's most valuable and threatened species and habitats. It is comprised of Special Areas of Conservation (SAC) designated by Member States under the Habitats Directive, and also incorporates Special Protection Areas (SPA) which they designate under the 1979 Birds Directive. It also applies to the marine environment. The total area of the Natura 2000 network represents approximately 18% of the total EU terrestrial area.



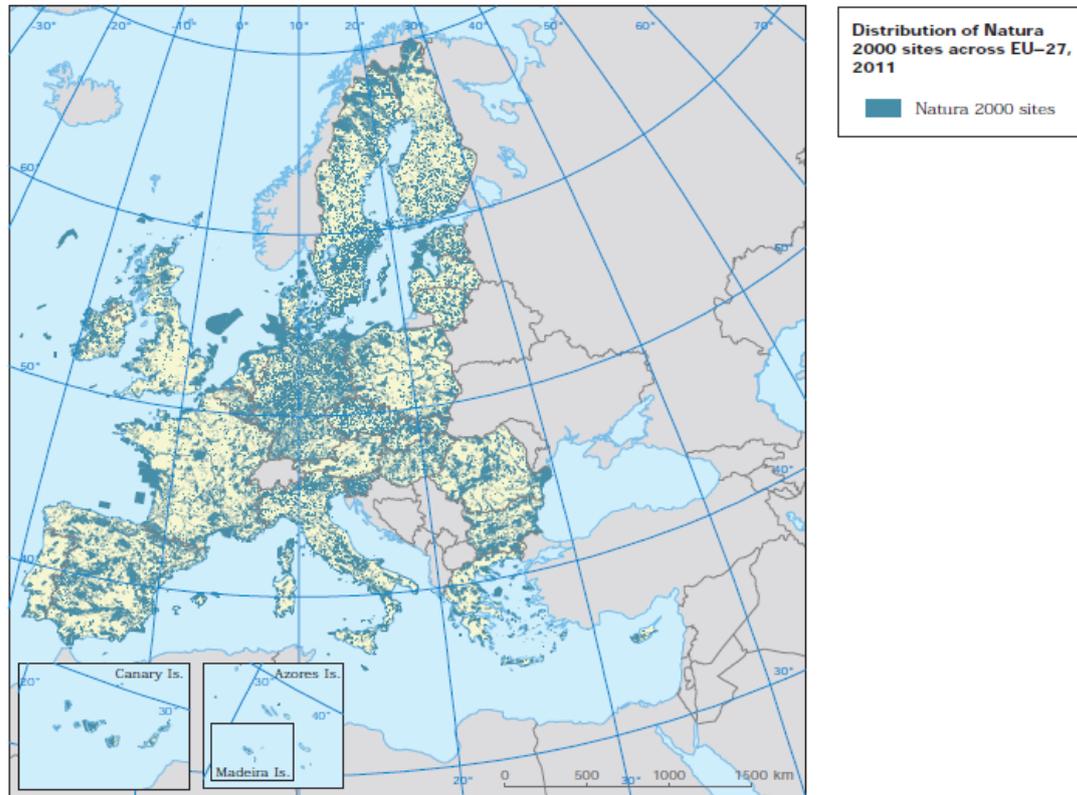
Logo of Natura 2000. Source: ec.europa.eu

The establishment of the Natura 2000 network has been an important milestone and a turning point in the history of European protected areas. It is the most extensive protected area system worldwide, at the moment comprising more than 26.000 sites.

The approach to designating sites under the Habitats Directive, building the Natura 2000 network and managing it is innovative, and includes several aspects that are unique for a piece of multi-national legislation on protected areas.

As a matter of fact, the concept of Natura 2000 builds on, but goes beyond the 'traditional' definition of "protected area": on the one hand it is based on strict provisions of an EU directive (hard law), on the other hand, it promotes the sustainable use of

resources and the consideration of economic, social and cultural requirements for achieving the nature conservation goals (EEA Report, 5/2012).



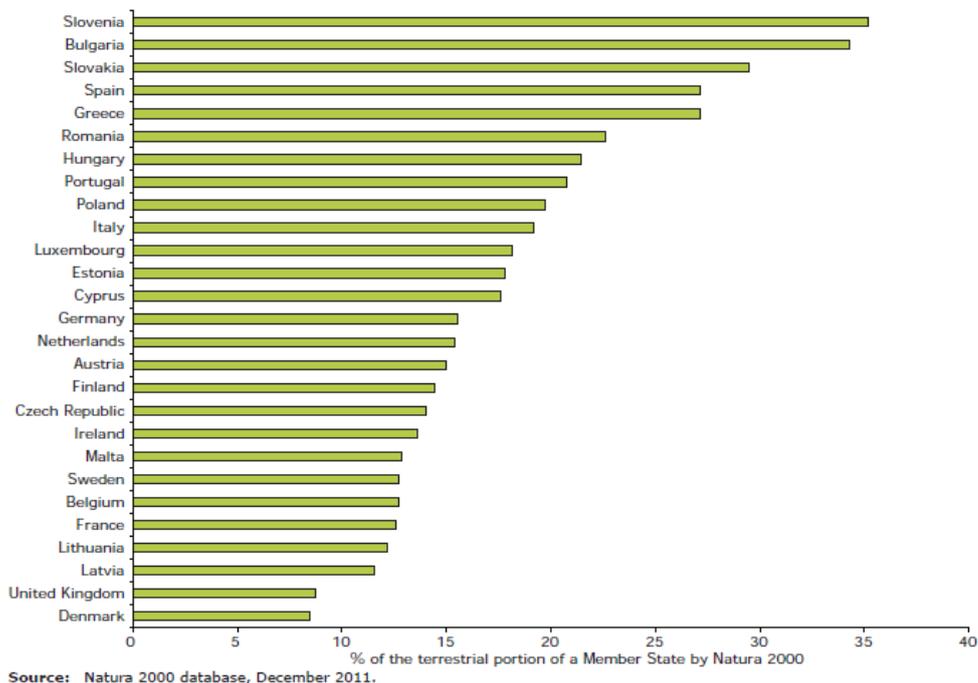
Distribution of Natura 2000 sites across EU-27, 2011. Source: Natura 2000 database, 2011

The main goal of Natura 2000 is to contribute to the maintenance or restoration of a favorable conservation status for the target habitats (231 different types) and species (over 900 taxa). The notion and definition of “favorable conservation status” is one of the most distinctive and key aspects introduced by the Habitats Directive in European nature conservation policy, and clearly contribute to an outcome-oriented policy.

Another original aspect of Natura 2000 is its use of bio geographical regions. These bio geographical regions are used to both build the network and to identify target species and habitat types. This has been accomplished while recognizing the ecological differences within and between EU Member States; a fact that was particularly important after the EU enlargement, which greatly increased the geographical area covered by the directives and the network (to the North and the East).

Building a network of sites across Europe on the basis of a common methodology, criteria and set of ecological features favors better ecological coherence than if the networks were only organized within each Member State. A European network helps migratory species, and allows for taking into account genetic diversity and ecological variability. It also facilitates the identification and designation of sites across borders that better take into account the natural distribution of species and habitat types.

Figure 5.3 Proportion of terrestrial land covered by Natura 2000



Proportion of terrestrial land covered by Natura 2000. Source: Natura 2000 database, 2011.

Another unique aspect of the Natura 2000 network is the comprehensive set of provisions introduced by the Habitats Directive concerning conservation measures and assessments of impacts for projects likely to have a significant effect on the sites. The provisions are set in Article 6 of the directive, for which the European Commission has been issuing extensive guidance, from legal interpretation to practical guidance on specific sectors like wind energy.

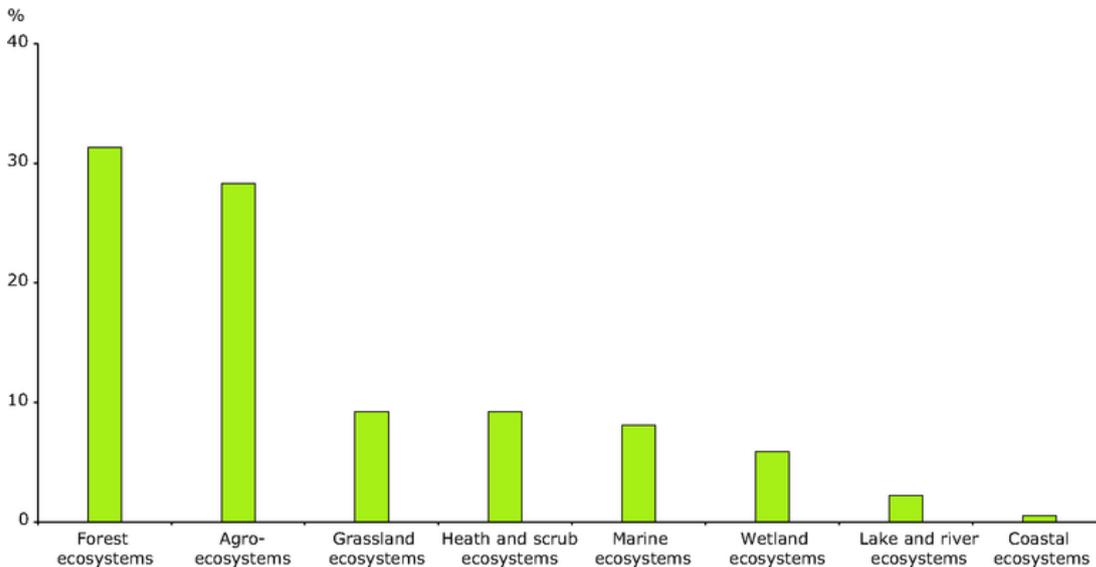
Another distinct aspect of Natura 2000 compared to other regional networks of protected areas is the way it is financed through different EU mechanisms. Finally, Natura 2000 has been responsible for much research activity over the past twenty years. This research has comprised both applied research to help implement the directives, as well as research that studies the process of implementation itself.

- **Share of protected areas in selected ecosystems in Europe**

It is possible to estimate the extent of broad ecosystem-types within the total area of nationally protected sites in Europe. Forest ecosystems take up the largest share of nationally designated areas in EEA countries. Agro-ecosystems are the next largest, which are followed by grasslands and marine ecosystems.

Mountain areas generally offer greater opportunities for designing protected areas because competition for land use is much lower than in plains or in coastal areas. In addition, because they are generally more remotely located, mountain areas are important reservoirs of biodiversity. The factors leading to the protection of coastal areas are different.

They are usually the result of political will to protect areas against urbanization and infrastructure development (ports, roads, industrial plots), or due to natural limits on land use like strong natural dynamics such as erosion (EEA Report, 5/2012).



Share of protected areas in selected ecosystems. Source: EEA Europa.eu

- **The type of forests included in Natura 2000**

Listed in Annex I of the Habitats Directive are over 70 different forest habitat types, of which many are classed as priority. Altogether, they correspond to a third of all the habitats covered by the Directive. The large number of habitat types in Annex I does not however imply an abundant resource. On the contrary, it goes to confirm their generally rare and residual nature.

Over 50% are restricted to just one or two countries (and in some cases to just one or two locations). Typical examples include: Fennoscandian wooded pastures found only in Finland and Sweden, Canarian endemic pine forests, Nebrodi fir forests of Sicily.... Only a handful of the more “common” and well known forest types such as alluvial forests, oakwoods and a variety of beech forests are present in the majority of Member States.

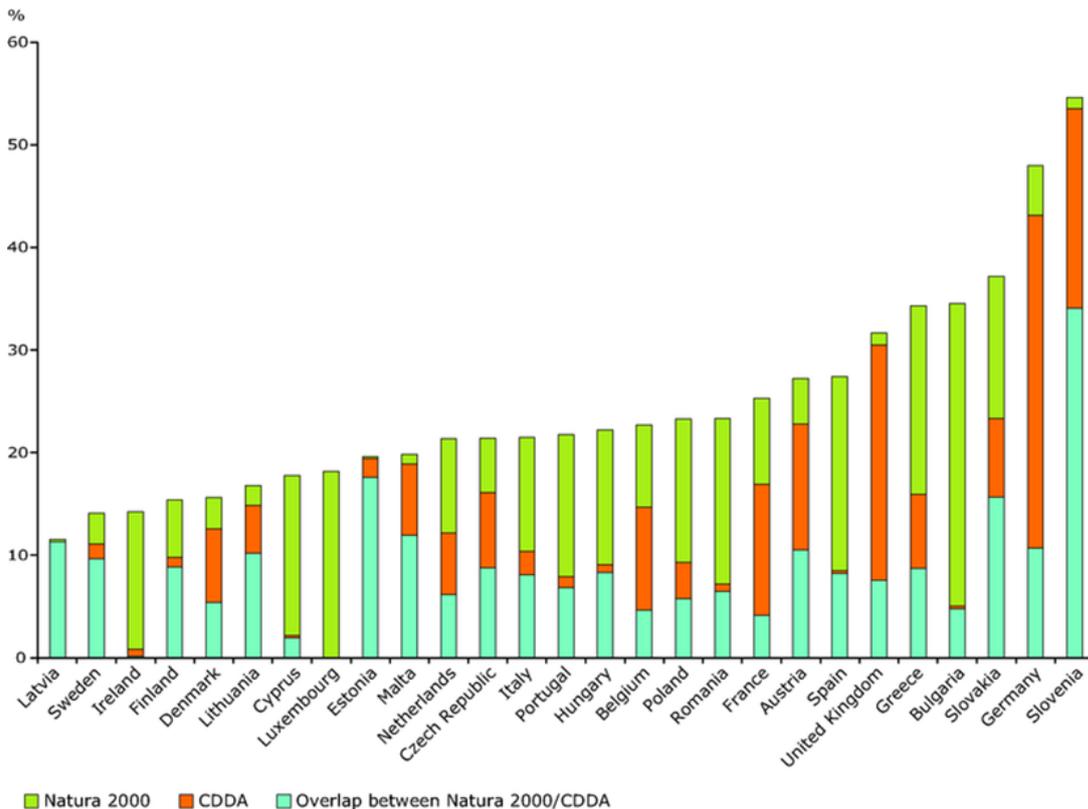
To help select sites for Natura 2000, Member States and the Commission agreed that they should focus specifically on the following:

- forests of native species, forests with a high degree of naturalness,
- forests of tall trees,
- presence of old and dead trees,
- forests with a substantial area and
- forests having benefited from continuous sustainable management over significant period.

These principles indicate that preference should be given to the forests with little human interference and/or to those already subject to sustainable management practices favoring biodiversity. It is estimated that two thirds of the sites included in the Natura

2000 network have at least one forest habitat type, which suggests they tend to form part of a complex matrix of habitats within a larger area.

The range of actions undertaken for forests is almost as diverse as the habitat types themselves. Many involve initial one-off restoration actions in order to bring the forest back up to its original high conservation state. Most also develop management plans in close collaboration with local stakeholders and forest authorities. Some go on to try out innovative ways of bringing together conservation with economic activities. Yet others focus instead on wildlife management issues, for instance, creating suitable habitats and corridors for woodland species such as bears and grouse (EEA Report, 5/2012).



Share of terrestrial area designated in EU Member States under Natura 2000 and national designations. Source: EEA Europa.eu

Complementarity between national designations and international networks

The system of protected areas in Europe is complex, and in many cases, there is a complementarity and overlap between different designation-types at various levels.

- protected areas under Natura 2000 and national designation represents 25% of the EU-27 terrestrial land
- Natura 2000 overlaps with nationally designated areas on 7.7% of the EU land territory
- Natura 2000 covers 9.7% of the EU land territory beyond existing nationally designated areas
- 7.7% of the EU land territory is only covered by nationally designated areas
- Natura 2000 contributes to 70% of the total surface area of protected areas within the EU-27.

There are some countries (such as Austria, Denmark, Estonia, Germany, Latvia, Lithuania, Malta, Slovenia, and the United Kingdom) where Natura 2000 nearly always overlaps with national designations (CDDA). But the situation is quite different in Bulgaria, France, Greece, Hungary, Italy, and Portugal, where many Natura 2000 sites do not overlap with existing nationally designated sites.

It is also remarkable to notice how in some countries (Austria, Belgium, Estonia, France, Germany, Slovenia and the United Kingdom), national designations significantly complement the Natura 2000 network in terms of area covered. Although a large part of these national designations are targeted at landscape protection or sustainable territorial development (IUCN management categories V and VI) and not specifically focused on biodiversity conservation, the main goal of Natura 2000 sites (EEA Report, 5/2012).



Young people in the forest. Source: Astrid Schilling

Austria

Forest characteristics and forest types

Austria's forests cover about half of the country's federal territory. The growing stock is more than one billion m³, which offers the potential for sustainable forest management.



Forests in Austria. Source: YPEF Austria

Austria's forests are today a cultivated landscape, the result of centuries of human care and attention. The benefits of forests and their functions are defined in the Forest Act which focuses on the protective function of forests, wood and timber production, the possibility of using forests for recreational purposes, and the social benefits of forests.

The key functions of Austrian forests (according to the Forest Development Plan) are: Economic function 65%, Protective function 31%, Beneficial function 3% and Recreational function 1%.

In the mountain country of Austria (50% are mountain forests), Alpine natural hazards are a serious threat to people in some areas. Natural hazards such as floods, debris flow, avalanches, landslides and rock fall threaten people, their settlements, economic activities and traffic routes. Forests protect people against these natural hazards!

- **Tree species composition**

Austria's productive forests are characterised by a high share of conifers. The total growing stock in Austrian forests is 1095 billion m³ in Austrian forests and 1/3 of the annual increment is felled every year.



Forests in Austria. Source:
YPEF Austria

Typical and exceptional fauna and flora species in forests

The distribution of tree species in percentages is the following: 54% Spruce, 2% Fir, 5% Larch, Pine 6%, other conifers 1%; 10% Red beech, 2% Oak, 10% other deciduous.

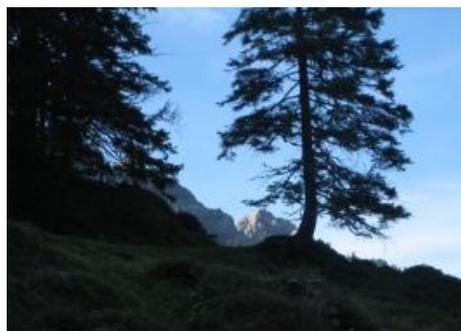
Austrian's forests are habitats for much typical middle European wildlife. Hunting has a long tradition. The main species are: red deer, fallow deer, roe deer, chamois, moufflon, wild boar, fox, badger, martens, hairs and feather animals mainly pheasant, with roe deer ranking at the first place.

Forms of nature protection such as national parks and Natura 2000 sites

Forests cover about 47% of Austria's federal territory and are thus of great importance for the maintenance and enhancement of biodiversity. About 43% of the Natura 2000 areas reported by Austria are forest areas. About 2/3 of the forest area can be classified as natural, near-natural or semi-natural.



Separate National Park Administration Offices have been established to protect these valuable ecosystems. The Names of the six National Parks are: Hohe Tauern, Kalk Alps, Gesaeuse, Thaya Valley, Danube Floodplain and Lake – Neusiedl – Seewinkel (www.nationalparke.at).



Impressions of Austria. Source: YPEF Austria

Nature parks, unlike national parks, are areas managed by man and smaller in size. (www.naturparke.at). Biosphere reserves (parks) are natural landscapes which are of particular importance to humans.

Organization of Forestry

In Austria, sustainable forest management is implemented within an established legal framework. Forest enterprises, wood industry, sawmill and paper industries provide in total some 50.000 jobs. Furthermore, many of the 145.000 forest owners earn more or less an additional income from the forest.



Impressions of Austria. Source: YPEF Austria

- **Ownership status**

We have 80% Private forests, 15% Federal Austrian Forests (Österreichische Bundesforste AG) and 5% other public forests.

- **Forest Authorities**

All actions and activities of the forest authorities are based on the 1975 Forestry Act as amended.

Czech Republic

Forest characteristics and forest types

Forests in the Czech Republic cover an area of about 1/3 of the country and the amount of woodlands has been increasing as a result of excess of newly cultivated areas over those taken away. The vast majority of forest is situated in areas which are not suitable for intense agriculture activity.

The Czech Republic belongs to the group of smaller countries in Europe, although it has a large amount of natural resources including a diverse and rich forest bioceonosis. The variedness of habitats and the geographic position of the country, which is situated at the cross of several phytogeographic areas, have caused the creation of wide range of floral communities.

The forests are mainly gymnosperms /needle-bearing (3/4) with the predominant spruce (*Picea abies*) representing 51% of the population. Another coniferous trees are pine (*Pinus sylvestris*, 17%), larch (*Larix decidua*) and fir (*Abies alba*). The main group of broad – leaf trees (1/4) are beech (*Fagus sylvatica*), oak (*Quercus*) and birch (*Betula*).

The ratio/number of broad-leaf trees has risen since 1950 from 12.5% to 25%. The ratio/share of regenerated amount of broad-leaf trees is about 40% at the moment. It is caused by the financial support of EU programmes which contribute to the increase of stability and biodiversity. It is apparent that the change in species composition in favour of more resistant trees is going to continue even in future.



Spruce bark beetle. Source: VULHM archive.



Forest damage caused by Spruce bark beetle. Source: Stanislav Janský.

In the Czech Republic three main categories of forests with different approaches are determined:

1. Agro forests, Productive forests (3/4): the main purpose of the forests is the production of wood.
2. Protective forests (2.5%): forest at extremely unfavourable stands, on its existential borders and also forests occurred close to the upper border of a tree line. Their main task is to protect soil from erosion and ground movement and the lower agro forests.
3. Special purpose forests (1/4): forests in national parks or national reservations, forests around natural spring resources of mineral waters or along protected water ways. In this category there are also forests with sub-productive - soil protective function, e.g. smaller areas of woodland in cities, urban forests, school forests dedicated to education and research and forests in protective areas.

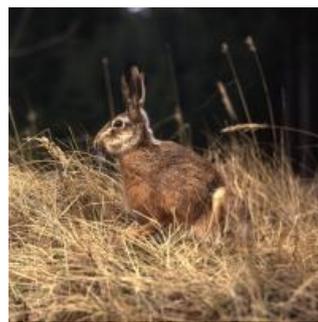
Typical and exceptional fauna and flora species in forests

Species composition and distribution of Czech forests altered in the past in an effort to increase the great demand for some tree species. Forests are natural communities with a great species diversity. Even the poorest forest is home to thousands of animal species. This means that forests are home to an enormous number of animals which are adapted to live both on the surface and inside the tree trunks, in tree blossoms, fruits or on treetops.



Red deer
and Roe deer. Source:
www.mezistromy.cz

The most common animals in Czech forests are red deer, roe deer, wild boar, sitka deer, fallow deer, mouflons, wild boar, fox, brown hare, and pheasant.



Sitka deer, Wild boar and Hare. Source: www.mezistromy.cz

We can mention capercaillie (*Tetrao urogallus L.*) and black grouse (*Lyrurus tetrix L.*), which can be found in Šumava National Park.



Capercaillie = Wood grouse (*Tetrao urogallus L.*) and Heathcock = Black grouse (*Lyrurus tetrix L.*) Source:
www.mezistromy.cz



Pine stand with blueberry (*Vaccinium myrtillus L.*). Source: UHUL Plzeň archive. Woodruff (*Galium odoratum*) . Source: www.mezistromy.cz

Organization of Forestry

- **Forest Management Legislation**

The main valid rule is the Forest Act. It defines law and obligations of forest owners and forest visitors, prohibits certain inconvenient behaviour such as making fire, camping, using motor vehicles, making noise, disturbance of soil or bike rides off the marked routes. It obligates the forest owners maintaining 50 ha of land to have the forest management plan made – i.e. estimated economic activities in 10 years plan. The preservation of the Czech forest for future generations, the increase of competitiveness in the Czech countryside, the increase of biodiversity of forest ecosystems and support the importance of education, research and innovations in forest economy belong to the main long-term aims of the Czech forest policy.

- **Ownership Structure**

The largest percentage of forest (60%) belongs to the state., i.e. the state company Forests of the Czech Republic, Military Forests and Farms and National Parks Authorities. Private forests are present about 23% and 17% belong to municipalities. The law that guarantees the restitution of forest lands to the Church has passed recently. The estimated ratio part of returned forests is about 5%.

- **Social Situation in Forestry**

The number of employees and entrepreneurs in forestry has been declining for a long time. The creation of new labour in the country and areas with high unemployment has become an important social aspect recently. The average salary in forestry is about 5% lower than in other branches of the economy. In general the wood processing industry is employing about 200 thousand people at the moment.

- **Game Management**

Game management has been a part of forest management. Game management has a rich history and complex structure. The smallest hunting ground is defined by law. Statutory rules define the determined number of game as well as the number of hunting dogs used in particular hunting grounds.

In spite of the existence of this sophisticated system, the overpopulation of deer and wild boar still occurs exists. According to the hunt the widespread species are: wild boar, roe deer, red deer, fallow deer, moufflon and game birds like pheasant and wild duck.

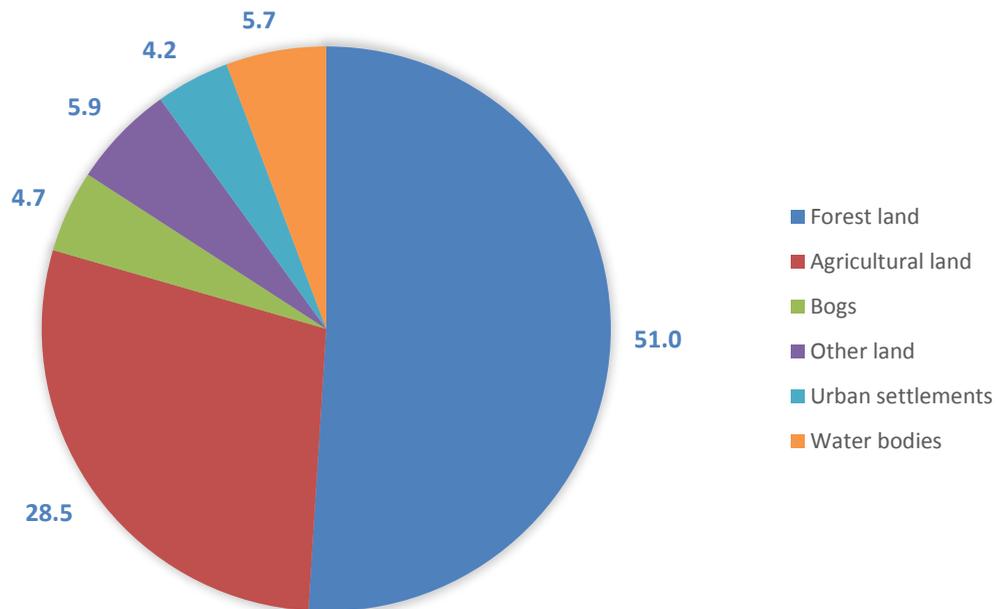
Estonia

Overview of Estonian forests

Estonia is located in northern Europe on the eastern coast of the Baltic Sea in the hemiboreal vegetation zone, within a transition zone from the maritime to continental climate. The country's relief is mostly flat or slightly hilly, with an average height of 50 meters above sea level. Estonia's highest point is 318 meters. The climate varies from maritime to continental. Average annual precipitation increases from west to east within

a range of 600–700 mm. Average temperatures in July and February are 17 °C and 5 °C, respectively. Inland ice melted 10.000 years ago forming the present landscape. The ice left behind sediment or moraines of different thickness and consistency. Because of that, growth conditions vary enormously.

Forests cover around 50% of the total area of Estonia contributing around 2.2 million hectares with the growing stock approximately 470 million m³. According to the UN FAO Global Forest Resources Assessment (FRA), based on forest coverage (share of forest area in land area), Estonia ranks sixth in Europe after Finland, Sweden, Slovenia, Montenegro and Latvia.



Total area of Estonia by land categories

The proportion of dominant deciduous and coniferous forests is more or less equal, covering 51% and 49% of the total forest area respectively. Roughly 80% of forest land consists of 3 main species – Scots pine (*Pinus sylvestris*, 32%), Norway spruce (*Picea abies*, 19%) and Silver and downy birch (*Betula pendula* and *Betula pubescens*, 30%). The world’s tallest Scots pine (*Pinus sylvestris*), (46.6 m), grows in southern Estonia in the Ootsipalu valley.

Despite of the country’s small size, 45.000 km², more than 20 forest site types can be distinguished. The most common forest types in Estonia are:

1. **Mesotrophic forest** – beautiful well-lighted Scots pine (*Pinus sylvestris*) and Norway spruce (*Picea abies*) stands, growing on sandy soils. These are the forest where the highest quality pine and spruce timber is growing. In regards of growth speed and productivity these forest belong above the medium level. Stem volume

in 100-year-old pine stand may be around 300-350 m³/ha. Ground vegetation contains mainly shrubs and mosses. These are well-lighted and beautiful forests, which makes them also very important in regards of recreational aspect – hiking, nature photography. So far, gathering is very popular in Estonia, mesotrophic forests are perfect for picking bilberries, cowberries and chanterelle.



Mesotrophic forest - Mature Scots pine stand in Myrtillus site type

2. **Mesoeutrophic forest** – mainly Norway spruce, silver birch (*Betula pendula*) and mixed-species forests with high soil fertility and high timber productivity. At the maturity, the stands growing volume may reach up to 600 m³/ha. From ground vegetation, mainly herbs may be found. Besides the best quality timber, these forests provide us perfect also suitable possibilities for recreational activities.



Mesoeutrophic forest - Middle aged Norway spruce stand in Oxalis site type

3. **Nemoral forest** – the most productive forests in Estonia due to very fertile soils with favourable moisture conditions and the humus layer up to 30 cm. Mainly deciduous species are growing here – Silver birch, European aspen (*Populus tremula*), grey alder (*Alnus incana*). The growing stock of the mature stands may be as high as 700(1000) m³/ha. Ground vegetation contains of lush broad-leaved herbs. For hikers these forests are not the first choice, still, loads of mushrooms can be gathered here.
4. **Swamp forests** – the forests growing in organic soils (peat) where the thickness of peat layer is minimum 30 cm and may even reach as deep as 10(17) meters. These ecosystems are in the constant developing phase from swamp to raised bogs. Due to the constant excess moisture, the stands of Scots pine and downy birch (*Betula pubescent*) are of very low productivity and timber quality. Thus, the real value of swamps forests lies in nature conservation and their stunning beauty: they are extremely important as fresh water and carbon reservoirs. Further, these ecosystems are very famous and popular among nature photographers around the world. For gatherers, loads of cranberries and mushrooms are available there. Depending on the age of the peatland, different kind of ground vegetation is present – hydrophilic herbs and mosses at the young stage (swamp) and shrubs and sphagnum species at the mature stage (raised bog). At the intermediate development stage (mesotrophic mire) species from both swamp and bog are present.



Raised bog with the wooden path for hiking

5. **Drained peatland forests** – formed as a result of an artificial drainage of different swamp forests. Long lasting drainage of peatlands causes gradual changes in site properties; the productivity and composition of understory species change similarly to a forest growing on mineral soils, making drained areas more favourable for tree growth as well as for forest management. Timber quality and productivity of these forests vary in big scale, depending on the duration of the drainage. In some cases, the stands of downy birch or Scots pine may reach the top on the productivity scale.



Drained peatland forest - mixed-conifer stand

For the past thousand years, forests have strongly been influenced by human. Forest covered up to 80% of the country's territory but by the end of the 19th century it dropped to 30%. Forest loss was mainly due to the use of land for agricultural purposes. The situation changed again after World War II. Until the mid-20th century Estonia was mostly an agricultural country, but agricultural reforms during the Soviet occupation left huge proportions of agricultural land out of use. These areas were then covered again with forests.

Today Estonian forest area accounts for approximately half of the country's territory. Compared to year 1939, the total forest area has increased by more than 50%. Today, the growing stock volume is 476 million m³.

Forest habitats in Estonia

The diversity of forests in Estonia provides habitats for a large number of species. This is also due to the location – close to the sea and to the vast forests of Russia. An important part of forestry is game management, which aims to preserve wild game resources. A total of 55 species are listed as game species: 18 mammal species and 37 bird species. Moose (*Alces alces*), wild boar (*Sus scrofa*) and roe deer (*Capreolus capreolus*) are the most important game species. Furthermore, the populations of big game species – brown bear (*Ursus arctos*), wolf (*Canis lupus*) and lynx (*Lynx lynx*) – are in good conditions and are hunted, though, under strict control. Example of endangered species: European mink (*Mustela lutreola*) is listed by the IUCN as Critically Endangered species due to continuous reduction, which is more than 50% over the past three generations and it is expected to decline at a rate exceeding 80% over the next three generations. In Estonia its reduction seems to coincide with the spread of the American mink. European mink now exists only on the isolated island of Hiiumaa where it has been reintroduced since 2000 and from where the American mink was removed.

Hunting bag and status of Game populations in Estonia

	Hunting bag (2016)	Estimated populations size (2017)
Moose (<i>Alces alces</i>)	7390	11410
Wild boar (<i>Sus scrofa</i>)	17610	5620
Red deer (<i>Cervus elaphus</i>)	1664	3436
Roe deer (<i>Capreolus capreolus</i>)	11000	n.e.
Brown bear (<i>Ursus arctos</i>)	55	700
Wolf (<i>Canis lupus</i>)	114	200

Organization of forestry

Forests provide 35,000 jobs in the forestry sector and many jobs also indirectly in transport, tourism, sports and other sectors. Regarding ownership Estonian forests are divided into two categories: 1. State forests, which are mainly managed by The State Forest Management Centre (RMK). State forests are divided into 18 forest districts and are used for commercial and nature protection purposes. RMK also creates and supports recreational facilities. State forests account for approximately 50% of Estonian forests. 2. Private forests, which are managed by physical and juridical (companies) owners. They account for about 50% of the forests. There are about 110.000 private forest owners and the average size of forest property is 10 ha.

About 75% of Estonian forests are managed. Forest act on forest management is very strict. For example a forest must be restored within 5 years after clear-cuts and there is a minimum cutting age for tree species (for Scots pine it's 90 years). This ensures sustainability in forestry. Forests are important for timber production, nature conservation and recreation. For every Estonian there is 1.7 ha of forest. One out of 15 Estonian people work in forestry.

The Baltic region, including Estonia, can be considered as a transitional zone between intensively managed Western Europe and old-growth forest rich North-Eastern Russia. Estonian forests play an essential role in economy, as well as maintaining the ecological balance and carrying out social functions. Forestry is one of the most important branches of Estonia's economy. Wood and wood products are almost the only import-export articles in Estonia's which have positive balance.

Mostly timber is used for construction and furniture production, also plywood and veneer. Production of granulated timber or pellets is enhancing due to growing importance of using bioenergy.

Forms of nature protection in Estonia

Conservation of forest communities in Estonia dates back to the first millennium A.D. Ancient Estonian believed in the spirits of nature and considered old forests to be sacred. Big oak and lime trees were considered to be sacred trees and people turned to them for help. It was strictly forbidden to harm those trees in any way. The first dated act of forest protection was in 1327, when Danish King forbade felling on three small islands in Tallinn Bay in order to maintain them as maritime navigation landmarks.

Forests have mainly been used for the protection of marshlands, nature sites or landscapes. In 1910, the Riga Association of Naturalists rented Vaika bird islands, in order to ensure safe nesting opportunities for local birds and prevent the collection of eggs. Thus, the first nature conservation area in the Baltics was established.

Today is 18 % of Estonian mainland and 27 % of Estonian water area covered with different protection areas. Estonia started to establish Natura 2000 network in year 2000 and chose the areas to be included by 2004, when Estonia also became a member of European Union. Natura 2000 consists of 66 areas for birds and 542 nature areas with total area of 14 863 km². Less than half of the areas are located in the sea. On mainland the Natura 2000 areas cover 17 % of Estonia territory.



Figure 5 Natura 2000 areas. YPEF Estonia

Main problems in Estonian forestry in the light of climate changes

Climate changes have a considerable impact on Estonian forest and forestry both on ecological and economical level.

Predicted increasing annual temperatures and precipitation influence forest ecosystems functioning through more frequent storms and heavy rains. Due to milder winters ground remains unfrozen which makes forest cuttings and timber extraction from moist forest site types aggravated.

Milder climate favours the spread of the indigenous root rot (*Heterobasidion* spp) in coniferous stands. Further, invasive pathogens, such as red belt needle blight (*Dothistroma septosporum*) on pines or ash dieback (*Chalara fraxinea*) on deciduous trees are becoming more common in Estonian forests.

Germany

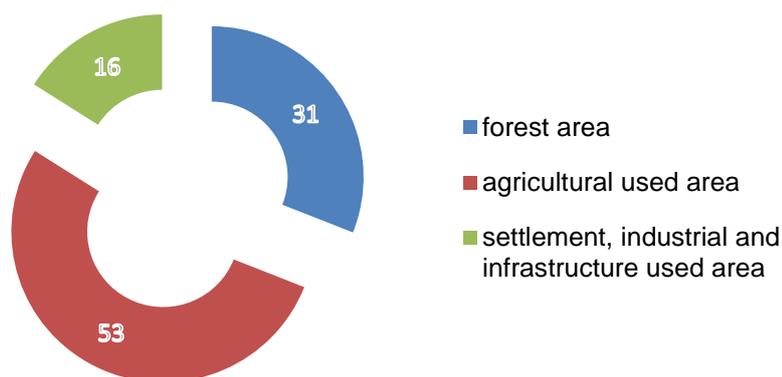
Forest characteristics and forest types

Germany is dominated by the temperate zone. Geographically Germany is divided into northern German lowlands, low mountain range and foothills of the Alps with the Alps. These conditions cause a natural diverse forest structure in Germany. The originally forest vegetation is the deciduous forest and mixed forest with coniferous forests in mountain regions. Forests increased by approx. 1 million hectares (10%) in Germany over the past four decades.



Aerial view 10 km north east from Berlin.
Source: Stephanie Gotza

The amount of forest area is about 11 Million ha (approximately 1/3 of the total area of Germany). The forest in Germany consists of just over half of coniferous trees (55%) (forstwirtschaft-in-deutschland.de, 2019). The proportion of coniferous trees has been decreasing for some years; the percentage of mixed forest is increasing (Waldwissen.de, 2019).



Amount of Forest area in Germany in %. Source: Holzabsatzfonds, 2006

Today's distribution of forests, farmed agricultural areas, traffic spaces and settlement areas in Germany is the result of human interventions over many centuries. The remaining forests are no longer primeval forests, but production forests shaped by humans. As a potentially natural vegetation form, beech forest communities would prevail in German forests and cover 2/3 of the forest area (BMELV.de, 2011).



Typical picture of a coniferous forest. Source: Stephanie Gotza



Beech forest in autumn. Source: Astrid Schilling

Generally, the today forest area in Germany can be divided into:

1. the rich pine north of Germany
2. the rich hardwood low mountain range of Germany
3. the rich spruce south of Germany
4. the coast area in Germany.

The forests in Germany have been managed according to the principle of sustainability for 300 years. Today this principle is anchored in the Federal Law on Forests. The founder of the principle of sustainability is the German Hans Carl von Carlowitz. In 1713 he presented in his book “*Sylvicultura oeconomica*” the assumption that only so much wood should be felled as can grow back through regular reforestation.



Germany ranks among the densely wooded countries in Europe. This is largely a result of the efforts to rebuild high-yielding and ecologically valuable forests after the destruction of large forest tracts over the past centuries (BMELV.de, 2011).

Today you can find about 70 types of trees in Germany. The main types of trees are pine (*Pinus sylvestris*), spruce (*Picea abies*), beech (*Fagus sylvatica*) and oak (*Quercus ssp.*).

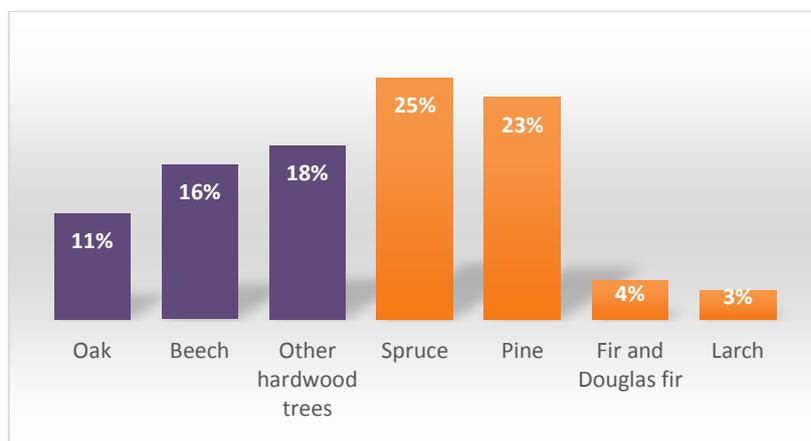


Fig. 32: Distribution of the tree species in Germany in % (Schilling). Source of data: Waldwissen.de, 2019
 Since 30 years the forestry in Germany works after the principle “close to nature forest management”. Therefore, the structure of the German forests changes. Step by step rich coniferous sites were and will be transformed into mixed deciduous sites.

Exceptional Fauna and flora species in forests

Mammals, who are living today in the German deciduous forest, are Martens, Fallow Dears, Red Dears, Boars, Lynxes, Foxes, Beavers and Otters. At the moment there are diverse discussions about an apex predator in the German forest. There were no more wolves in Germany for more than hundred years. But since the beginning of the new millennium, the wolf (*Canis lupus*) came back home to Germany. Almost 1000 Wolves live in Germany now (BfN, 2018). Most of the wolf packs live in the eastern part of Germany, especially in the States of Brandenburg and Sachsen.



Wolf in the Schorfheide, Germany. Source: Bernd Petrikat (Pixabay)



Otter in the Schorfheide, Germany. Source: Astrid Schilling

The rare plant species in Germany include, for example, the Pheasant’s eye (see photo 91). This plant is found on dry grasslands and in pine forests in Europe.

Old native tree species are planted again, especially at forest edges. This includes, for example, the Wild pear (*Pyrus pyraster*) as seen in photo 9. Strictly protected plants, like the Monkshood (*Aconitum* ssp.) should not be collected or damaged in the wild (see photo 93). From strictly protected plants no flowers, leaves or roots may be picked (www.kostbarenatur.net/pflanzen-unter-naturschutz/).



Pheasant’s eye (*Adonis vernalis*). Source: Pixabay



Wild pear (*Pyrus pyraster*). Source: Pixabay



Monkshood (*Aconitum* ssp.). Source: Annette Meyer, Pixabay

Future and challenges of forests

But what is the future of the German forests? The Global Warming, especially the annual average rise of the temperatures, will influence the forest ecosystems. In 100 years there will grow more deciduous than coniferous trees.

The incidence of rare flora and fauna is also fostered by targeted measures or omissions such as:

- the establishment, tending and conservation of close to-nature forest edges,
- leaving deadwood in forests (see photo 94),
- the conservation and upkeep of special biotopes in forests, e.g. wetlands, heathland and xeric grassland,
- the protection of certain species such as red ants, bats, birds or orchids.



Leaving deadwood in the forest. Source: Astrid Schilling

So the Climate change is the main problem for the German forests. The frequency and intensity of extreme weather conditions such as heat, drought and storms, pose a significant threat. As a result, the trees are getting weaker and give way to pest infestations, like insects and fungi. Risk assessments predict an increasing forest fire risk for Germany in the coming decades. This is mainly due to increased temperatures and declining rainfall during spring, summer and fall months. That's why a future task for foresters in Germany is the stabilization and vitalization of forest stands by conversion of forests to climate-adapted mixed forests with predominantly native broadleaf and needle tree species.

Organization of Forestry

The Federal Law on Forests and the Law of Forests of the states guarantee the sustainable ecological, economic and social performance of the forests. The German forest area is divided into state forest (34%), community forest (20%) and private forest (46%).

In most of the Federal states the state forest is divided in regional forest offices. The forest offices consist of individual forest districts with a size of 1.500 to 3.000 hectares. The forest districts are managed by foresters.



Young foresters in Eberswalde, Germany. Source: Astrid Schilling



Old Forest academy in Eberswalde, today HNE Eberswalde. Source: Astrid Schilling

The main tasks of the forest offices are the management of the property as well as the management of the forests under economic aspects. These tasks include the production of wood as well as harvesting and marketing of wood and non-wood products. On the same area they have to guarantee the protection and recreational function of the forest.

In Germany there are four Universities, where you can study Forest Sciences. At five Universities of Applied Sciences you can study Forestry, like at the HNE Eberswalde. There the education is more practice-oriented.

In the last years the annual logging in Germany has been greater than 50 million m³ (without bark). The per capita consumption of wood amounts 1.3 m³. The forest- and timber industry, including processing and paper as well as printing and publishing, comprise nearly 1.3 million jobs. Most of the people are organised in various professional and interest groups, like BDF (Union of German foresters) or SDW (German Association for the Protection of Forests). The SDW was founded in 1947 and is the oldest citizens' initiative in Germany.

People and Forests



Photo 97: Planting a tree with a forester. Source: Astrid Schilling

In Germany, anybody can enter forests for recreational purposes at anytime and anywhere. It is a right to which citizens are entitled, but also commits them to act responsibly towards the forest owner, nature and other people who take a rest in forests. Forest and nature conservation legislation contains restrictions and requirements for forest visitors, e.g. ban on access to certain areas, ban on smoking and open fire and straying from roads, keeping dogs on a lead and the protection of trees, timber and forestry or hunting facilities (BMELV.de, 2011).

Forest education is forest-related environmental education and is one of the central tasks of a German forester. Forest education conveys values such as respect

for nature and the environment and responsible use of our natural resources. Forest education at its best is learning by experience and acting.

To lift out the value of the tree in the society, a Tree of the Year (BAUM DES JAHRES) is presented in Germany. Every year numerous activities take place all around the Tree of the Year, e.g. special educational programs for children or tree planting actions.

Nature protection (Biosphere reserves - National Parks - Nature reserves – Natura 2000)

Protected areas, like national parks or surfaces of Natura 2000 protected area network, are considered classical means to conservation of biodiversity (WWF, 2008).

Protected areas designated under National law include Biosphere reserves, National parks and Nature reserves. In Germany 16 Biosphere reserves are recognized by UNESCO (see figure left). One of the most beautiful Biosphere reserves is the Spreewald in the State of Brandenburg (see picture right).



Biosphere reserves in Germany (green areas).

Source: Lencer, 2009

<https://commons.wikimedia.org/w/index.php?curid=3719798>



Biosphere reserve Spreewald.

Source: Astrid Schilling



The National park “Bayerischer Wald” was founded in 1970 as the first national park in Germany. Today we have 16 national parks in exciting landscapes in Germany.

Additionally nearly 9.000 nature reserves exist in Germany. They take about 4% of the surface of Germany (BfN, 2016). The sign for a nature reserve (Naturschutzgebiet) is a black owl on a yellow background.

Natura 2000 and the Flora-Fauna-Habitat (FFH) areas are protected areas under European law. In Germany Natura 2000 became legally binding in 1998. Germany has reported more than 4.500 FFH areas, which cover three bio geographical regions (Alpine, Atlantic and Continental).

Even though not the entire spectrum of biodiversity in protected areas is represented and can be protected, they contribute significantly to the preservation of the most endangered habitats and species (WWF, 2008).

Greece

Forest characteristics and forest types

Greece is located at the southern edge of the Balkan Peninsula. The country's topography is mostly mountainous. The tallest mountain is Olympus (2.918 m).

The climate is typically Mediterranean over most of the country, with warm-to-hot summers and mild winters. Usually there is little or no rain in the summer, but quite often the dry season may start as early as April and finish in fall.

In Greece, forests and woodland account for 49% of the country's territory, 57% of which are deciduous and 43% conifers. The main tree species are: *Quercus sp.*, *Pinus halepensis*, *Abies sp.* and *Fagus sp.*



Forests in Greece. Source: YPEF Greece

The forest cover in Greece is low. Nevertheless, Greece has a significant diversity of forest ecosystems. This diversity is due to the rich flora, the diversity of climate types, the diversity of geological formations and rocks, the existence of peninsulas and islands, the geographical position of the country among 3 continents and the historical, economic and social changes.

The following vegetation zones can be distinguished:

Mediterranean evergreen forest. At low altitudes, there exist evergreen broadleaved species like *Olea europaea*, *Arbutus sp.*, *Quercus coccifera*, *Quercus ilex* and *Erica sp.*.

Forests of *Pinus halepensis*, *Pinus brutia*, are found in patches in the coastal lowlands. The forests are rather open, and have a shrub layer of evergreen species.



Forests in Greece. Source: YPEF Greece

Macchie or maquis. The term “macchie” or “maquis” is used to describe a dense, sometimes impenetrable, scrub vegetation, generally 1.5-3.5 m tall which is mainly composed of hard-leaved evergreen species such as *Quercus ilex* and *Arbutus unedo*. Macchie also is composed of some deciduous shrubs.

Phrygana. The term "phrygana" is used for an open dwarf shrub dominated by low, often cushion-shaped, aromatic, spiny or grey-leaved shrub. In islands and degraded evergreen broadleaved forests, (as a result of long and frequent fires) there are areas covered by “phrygana”.

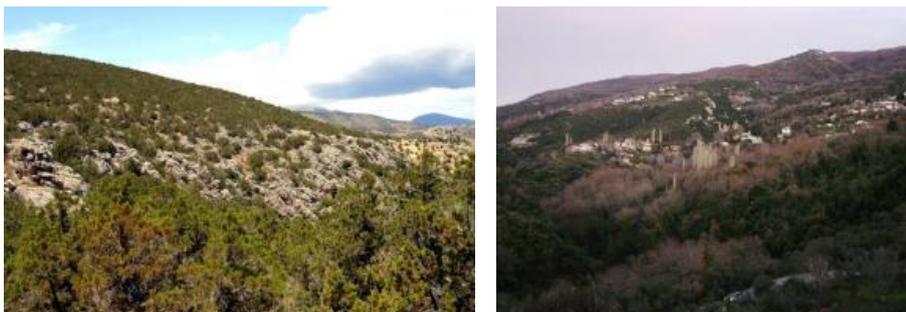


Impressions of Greece. Source: YPEF Greece

Deciduous forest. *Quercus pubescens* and *Q. frainetto* are the most widespread species of deciduous oaks generally occurring in the hills and lower mountain slopes in the more continental parts of the country. Well-developed natural forests of *Castanea sativa* occur locally in central and northern Greece.

Montane coniferous forest. Large coniferous forests, dominated by either *Pinus nigra*, or by *Abies* occur on the mainland at altitudes between 600 and 1.800m. *Pinus sylvestris* forms forest locally on non-calcareous mountains in the north. In the same zone, broadleaved deciduous *Fagus sylvatica* and *Fagus orientalis* form pure stands on the richer and deeper soils.

Montane Mediterranean. In higher altitudes, over 1.800m., there are forests such as *Juniperus foetidissima* and *Pinus heldreichii*. In northern Greek borders and at medium altitudes, we can also find forest sections of *Betula pendula*, *Larix decidua*, *Pinus peuce* and *Picea abies* species.



Impressions of Greece. Source: YPEF Greece

Subalpine and alpine communities. The timberline is generally formed by *Pinus* or *Abies*, in northern Greece and by *Cupressus* on Crete. Over 2.000-2.200 m high the areas are covered with species of low-growing shrubs.

Lowland cliff vegetation. Limestone cliffs and to some extent also cliffs of siliceous rocks, especially in the Aegean region, are of great botanical interest, with a characteristic flora called “chasmophytes”. The chasmophytes are generally long-lived, woody-based perennials.



Riparian vegetation. Streambeds at low altitudes are generally lined by trees of *Platanus orientalis* and *Nerium oleander* and at higher altitudes by *Salix sp.*, *Alnus glutinosa*, *Fraxinus angustifolia* and *Populus sp.*.



Impressions of Greece. Source: YPEF Greece

Typical and exceptional fauna and flora species in forests

- **Flora**

In Greece there are about 6.900 species and sub-species of vascular plants. Endemic species and sub-species in Greece are over 1.300.

Flora diversity is the result of a number of factors, the most important being:

- Old flora containing many Tertiary species which have survived the Quaternary Ice Ages.
- The existence of islands, mountain ranges, isolated land masses, as a result of geological change in the Mediterranean Sea.
- The fact that flora in Greece is influenced by central European, Anatolian and Pontic flora.
- Human intervention and domestic animals which destroy and change natural vegetation.



Impressions of Greece. Source: YPEF Greece

- **Fauna**

Fauna in Greece has a great diversity because of the many forest types ranging from mountain habitats of dwarf pines to coastal gallery forests. It is actually a mixture of European, Asian and African species. It includes bears, wild cats, brown squirrels, jackals, foxes, deer, wolves, as well as the rare species of wild-goat, which inhabit the mountain regions of Crete. In Greece there are about 116 mammal species, many bird species most of which are migratory birds and a rich entomofauna.



Animals of Greece. Source: YPEF Greece

Forms of nature protection such as national parks and Natura 2000 sites

In Greece there are four forms of nature protection:

1. Ancient semi-natural forest types
They include regions that were integrated into the European network of biogenetic reserves.
2. Strictly protected forest reserves
This category includes National Parks, Aesthetic Forests and Wetlands.
3. Forest and woodland under a special management regime



This category includes Protected Natural Monuments, Controlled Shooting Areas, Game Breeding Stations and Wild Life Refuges.

4. Natura 2000 sites

Nowadays in Greece NATURA 2000 sites cover 22% of the total territory and they are divided into three main categories:

1. Mountainous and inland NATURA 2000 sites which are far from coasts and wetlands.
2. NATURA 2000 wetlands such as lakes, lagoons, rivers, swamps.
3. Island and coastal NATURA 2000 sites.





Impressions of Greece. Source: YPEF Greece

Organization of Forestry

The contribution of the forest sector to the country's GDP is low. In Greece state forests account for 74%, whereas 26% are non-state forests.

Forestry in Greece is based on sustainable forest management. Greece established the principle of sustainable forest management in the Forest Law in 1928. Since then sustainable forest management has been implemented in forestry. Management of all forests is based on forest management plans which are valid for a period of 10 years.

The main body for protecting and managing the country's state forests as well as for supervising the private forests, is the Forest Service.

Hungary

Forest characteristics and forest types

Hungary is situated in the middle of Europe, at the central and Western part of the Carpathian Basin. Hungary is mainly flat. Only 1/3 of the country has an altitude of over 200m above sea level. The highest peak is Kékes-tető (1014m) whereas the lowest altitude is the floodplain of river Tisza (75.8m), in the south of the country.

The most characteristic regions in Hungary are the Northern and Transdanubian Mountains of medium height and the two basins: the Great Plain and the Small Plain. The slopes of the two mountains are mostly covered with forests.

The backbone of the country's water resources are two big rivers, the Danube and the Tisza. Part of the natural watercourses originates from the Alps and Carpathians and flows into the two big rivers in the territory of the country. The largest lakes are Lake Balaton, Lake Velencei and Lake Fertő at the Austrian border.

The majority of Hungary belongs to the European deciduous forest zone and parts of the Great Plain to the forest-steppe zone. However, the preserved original plant cover of Hungary is only a small fraction.

The large lower parts are characterised by small amounts of precipitation and extreme temperature changes. The natural forest areas are found in the Western Transdanubian region and mountains. There the annual precipitation generally exceeds 600 mm, which is necessary for the maintenance of forests. In the lower regions, forests can only develop on floodplains or where the water level is not too high but close to tree root. In areas with no water resources only brush lands develop which can hardly be called forests. As forests are needed at such areas for protecting and improving soil and agricultural areas

or for providing recreational areas, drought tolerant species are planted (usually trees that are not native to the area). Thus, it is clear that climate conditions – mostly the annual precipitation and the related air humidity – and the presence or absence of supplementary water resources determine the areas where Hungarian forests grow.



Vitality. Source: Pál Kovácsévics

Years of human intervention and natural conditions have changed forests and the natural environment significantly. There is no forest in Hungary which is unaffected by human intervention.

Typical and exceptional fauna and flora species in forests

- **Flora**

Beech (*Fagus sylvatica*) forests are mainly located in mountains and in the lowest but colder and more precipitated Trans-Danubian regions. Today in Hungary, beech forests provide the largest wood volume per hectare and are also very important for the environment and nature protection.



Beech forests. Source: Pál Kovácsévics

Oaks (*Quercus sp.*) are the most typical species in the country. They form mixed forest stands with a number of other species. Hornbeam-oak forests are found on hills of average height with a characteristically closed canopy. In their typical two-storey stands, hornbeams form the second canopy underneath sessile and pedunculate oaks.



Acorn. Source: Pál Kovácsévics



Hornbeam forest. Source: Géza Gelemen

Hornbeam-Oak forest. Source: Szabolcs Szabó.

Turkey (*Quercus cerris*) and **sessile oak** (*Quercus petraea*) forests are the most widespread associations, common in the mountains and hills. The shrub and herbaceous layer of turkey and sessile oak forests, is usually very rich due to the light-demanding construction of the canopy of both species which lets light pass through.



Turkey oak forests.
Source: Pál Kovácsévics

Loess-oak forests (*Quercus robur*) are special relict forests under priority conservation of which only a few acres maintain the original marginal lowland vegetation before human intervention.

Beside climate-zonal forests, **gallery riparian forests** play an important conservation, ecological and economic role.

Hardwood forests, consisting of oak, ash and elm, are found in flooded areas and were developed due to the presence of water. The main species are pedunculate oaks (*Quercus robur*), Hungarian ashes (*Fraxinus angustifolia* ssp. *pannonica*) and the fluttering elm (*Ulmus laevis*) which unfortunately declines due to the elm tree disease.

Willow and poplar floodplain groves are associations found in the lowest flooded areas of the Plain rivers. They are commonly characterised by rivers, flooded for long periods throughout the year.

The major species of these associations are white willows (*Salix alba*), black and white poplars (*Populus nigra* and *Populus alba*) and the bush-willows (*Salix sp.*).

Today, on this area due to intensive forest management Euramerican poplars have also been planted.

The widely cultivated forest species is the **black locust “acacia”** (*Robinia pseudoacacia*) with short rotation periods which make acacia the most common species in the country's forests. This species, native to America, was introduced to Europe hundreds of years ago. Acacias are especially important in poor soil sites, where it is often the only species that can grow. Its wood, apart from other uses, is very useful as firewood even when it is moist. Moreover, acacia's nectar is good for feeding bees.



Flowering acacia. Source: Péter Bross.



Acacia wood. Source: László Géza Greguss.

Climate conditions in Hungary are not the most appropriate for **pine forests**. Pine forests usually form single species forests. Mixed forests are only formed with Austrian pine (*Pinus nigra*) and Scots pines (*Pinus sylvestris*) which are of great importance in Hungary. We can also find spruces and larches (*Picea abies* and *Larix decidua*). Single planted pine species are ecologically unstable, since they are threatened by pest diseases.

The rapid growth of **Euramerican poplars** (*Populus x. euramericana*) – typically planted on plain or floodplain areas – facilitates intensive economic activities. Euramerican poplars are established for economic reasons (paper production) and not for protective reasons.



Euramerican poplars with willows along the Danube. Source: László Géza Greguss.

- **Fauna**

Game stock is a vital part of forest biocenosis.

Large forests are the perfect habitat for red deer (*Cervus elaphus*), fallow deer (*Dama dama*), moufflon (*Ovis musimon*), roe deer (*Capreolus capreolus*) and wild boar (*Sus scrofa*). Small game species such as hares (*Lepus europeus*) and pheasants (*Phasianus colchicus*) are also found in Hungarian forests, mainly in smaller plain forests.

All experts agree that big game stock has exceedingly multiplied, and in some cases animals cause serious damages to forests, mainly because of browsing. Over the past decades, due to conservation policy, predatory mammals such as wolf, lynx, wild cat and golden jackal (*Canis lupus*, *Lynx lynx*, *Felis sylvestris*, *Canis aureus aureus*) have re-appeared in the highland forests from where they were previously excluded.



Fallow deer and Moufflon. Source: László Géza Greguss.

Forms of nature protection such as national parks and Natura 2000 sites

- **Nature protection**

Protection of forest resources (plant and animal species, geological elements) is ensured by declaring them as protected and strictly protected areas. These areas include: national parks, landscape protection areas, protected natural areas, and natural monuments. Nearly 10% of the national territory is under legal protection. Nature conservation is in many cases related to forestry. This is proved by the fact that the proportion of forests in the total protected area is more than 50%. Forest reserves are a unique nature protection category.



Pusztá National Park Hortobágy and Water regulation in National Park Fertó-Hanság.

Source: Pál Kovácsévics

The most significant part of NATURA 2000 area in Hungary includes forests. The benefits of forests on people's health and life are increasingly appreciated by society. Forest management includes recreational activities as forests are overwhelmed by visitors especially in areas close to big cities. Access to forests is free of charge in Hungary.



White poplar-juniper forest in National Park Kis-Kunság. Source: Pál Kovácsévics

- **Forest Health**

There is a big discussion about the harmful effects of human activity on forests and their deterioration. The crucial threats for moderate climate forests are air pollution, since the 1970's, and climate change, since the 1990's. Although air pollution affected forests in many European regions, this was not the case for Hungary's forests.

Organization of Forestry

For the past 80 years the forest area of Hungary has been gradually increasing. This is due to large-scale afforestation and tree planting carried out under the supervision of professional foresters. As a result, forest area which after the Second World War was hardly larger than 1 million hectares today exceeds 1.9 million ha.

In Hungary the share of state forests is 56%, of community forests is 1% and of private forests is 42%. A long-term goal is the increase of private and community owned forest areas through afforestation. State forests are managed by state forest management corporations. However, other national institutions – like water resource directorates, national parks – are also managing state forests. The share of community forests is relatively small. These forests mostly managed by municipalities of villages and cities.



Forest Fun Park and High Seat. Source: Pál Kovácsévics

The majority of private forests are undivided joint properties which are managed by natural persons – having contracts- or corporations.

To ensure sustainable forest management forests are managed only according to district forest management plans issued by the forestry authority for both public and private forests.

Forest Fires in Hungary

Forest fires multiplied in the last few decades in Hungary. The reasons can be found in climate extremities, less precipitation, the increase of mean annual temperature and a series of winters without snowfall.

Not only the frequency but the intensity and the speed of forest fires heightened heavily in extremely hot summers in the latest years. High fire intensity has adverse effects on the whole vegetation, its structure and the forest site as well. Contrary to low intensity fires, the vegetation is not always capable to short term regeneration after intensive fires, and the secondary effects (erosion, deflation) may result in the degradation of the site.

Surface fires, when surface litter and other dead vegetal parts and smaller shrub burn have been common in Hungarian forests. As a result of changing natural and weather conditions surface fires develop to canopy fires more and more frequently. Canopy fires mostly develop in coniferous forests, mainly in the Great Hungarian Plain. Ground fire is not significant in Hungary, though – due to partial, relatively thick peat – it is not unknown either.

“Traditional” grassland use includes burning methods in early spring, which can accidentally spread to nearby forest. These fires usually burn between February and April, after snow-break.

Forest litter, needles, dead twigs and branches get totally dry in arid summer periods (June- August) without rainfall and start easily burning as a consequence of negligently lighted fire. Coniferous forests are highly endangered, as a small litter layer fire can even result in canopy fire in this period. Summer fires usually burn in the Great Hungarian Plain.

Forest fire hazard strongly depends on weather. In extreme weather conditions the forest authority prohibits fire or visitation at specified forest plots. When a fire ban is in place, the lighting of any open is forbidden, including camp fires within 200 metres of any forest land.

The role of the selected target audiences in human caused forest fires

The farmers and farmstead owners usually induce fires in the frames of their agricultural activities by controlled burnings and wasteland burnings which are lighted negligently, irregularly or without the needed permission. Most rarely wildfires are caused by improperly used agricultural equipment.

The hikers usually cause fires by campfires which are not properly extinguished or which were lightened at an improper place. Another common cause of fires is burning cigarette thrown away by hikers, but it is also possible to induce fire by a car parking on high grass. A case study has revealed that the extremely high number of fires arose near highways and railways had been caused mostly by burning cigarettes, and secondly by the brakes of freight trains.

Children (age of 5 or 6 years) might cause fires negligently by throwing burning matches or unattended and not extinguished small camp fires.

The relevant information on fire prevention might be easily transmitted to adult audience through the children. (Hey, Daddy, do not throw away your burning cigarette!)

Main problems concerning forests

Based on long-term observations the condition of Hungarian forests is normal compared to the European standards. This may be due to the site features, the dominance of mixed broad-leaved forests, and also traditional, carefully controlled forest management based on management planning.

However, the area of forest damage showed an increasing trend in the last 60 years. It is because the climate has been changing: and the health status of the Hungarian forests – beside the forest management – strongly depends on the weather conditions.

The climate change scenarios (more frequent and more severe droughts, more frequent extreme meteorological events) therefore predict even further negative trends in forest health.

Therefore the practice of the recent forest management must be reconsidered from different points of view:

- natural regeneration is better than artificial;
- tree species choice must be fine-tuned, and climate matching/assisted migrations should be fostered: introducing propagation material from more southern populations of the most climate sensitive tree species like beech, sessile oak, etc.;
- increasing biodiversity: mixed stands instead of monocultures and supporting earlier neglected native tree and shrub species, even „weed trees“;
- increasing the structural diversity, such as small scale cutting areas, increasing size and age diversity, certain amount of dead wood left in the forest as microsite;
- alternative forest management systems: continuous cover forestry instead of clear-cut systems should be considered where possible;
- proactive consideration of potential future health risks: arising native and alien pests and pathogens, extreme weather events, forest fires;

Source: Recent trends of forest health in Hungary: Gy. Csóka and A. Hirka (Sopron, 2017)

Latvia

Forest characteristics and forest types

The total area of the forest lands constitute more than a half of the territory of the state. Latvia is the fourth country in Europe (after the Finland, Sweden and Slovenia) with the largest proportion of land area covered by forests and other wooded lands.

In Latvia, forests are comparatively natural systems. Most of them are naturally regenerated forests however with clearly visible indications of human activities. In the context of forest growing conditions approximately half of the forests of Latvia are located on dry mineral soils. However a comparatively large proportion of forests lay also on drained soils. The forests on wet mineral soils take only small part the total forest area, as well as forests on wet peat soils.

The forests of Latvia are dominated by three tree species – Scots pine, Norway spruce and birch species (silver and downy birch). The remaining forest areas are occupied by stands of black alder, grey alder, aspen, ash and oak, and other tree species. The coniferous stands in general occupy almost half of the total forest area, but stands of deciduous trees – other half.



Forests in Latvia. Sources: Aigars Jansons and Raimond Putninš, LSFRI „Silava“.

Typical and exceptional fauna and flora species in forests

Latvia is located in the contact zone of boreal coniferous forests and nemoral summer green deciduous forests, therefore the species, which are typical for these both forest biomes, can be also found in the forests of Latvia.

The rare and especially protected species in the forests of Latvia are brown bear, dormouse, northern birch mouse and several species of flitter-mouse. A protected species is also otter. From reptiles, the very rare and especially protected species are smooth snake and swamp turtle. The diversity of bird species in the forests of Latvia is very large. The very rare and endangered species are spotted eagle, red and black kite, eagle-owl, roller and green woodpecker. The rare and protected tree species in Latvia is common yew, which occurs mostly along the coastline. A protected species is also common hornbeam.



Forests in Latvia. Source: Raimond Putninš, LSFRI „Silava“.

Forms of nature protection such as national parks and Nature 2000 sites

In order to protect and maintain biodiversity of nature, in Latvia there are 684 specially protected natural areas approved by law or regulations of the Cabinet of Ministers. The protected areas are classified as:

Strict nature reserves. Territories untouched by human activities or nearly natural, in which unhindered development of natural processes shall be ensured in order to protect and study rare or typical ecosystems and parts thereof. There are 4 strict nature reserves established in Latvia – Moricsala, Grīņi, Krustkalni and Teiči.

National parks. Broad areas which are characterised by outstanding nature formations of national significance, landscapes and cultural heritage landscapes untouched by human activities or nearly natural, a diversity of biotopes, abundance of cultural and historical monuments. Along with nature protection, scientific research, education and organization of leisure have an important role. There are 4 national parks in Latvia: Gauja National Park, Ķemeri National Park, Slītere National Park and Rāzna National Park.



Gauja NP and Ķemeri NP Latvia.

Biosphere reserves. Broad territories in which landscapes and ecosystems of international importance are located. The aim of these reserves is to ensure the preservation of natural diversity and to promote sustainable social and economic development of the territory. In 1997 North Vidzeme Biosphere Reserve was established in Latvia. It is included in the international network of biosphere reserves.

Nature parks. Territories that represent the natural, cultural and historical values in particular region, and are suitable for recreation, education and the instruction of society. There are 42 nature parks in Latvia, from which the most popular are Tērvetes Nature Park and Nature Park “Daugava’s Circles”.

Protected landscape areas. Territories remarkable for original and diverse landscapes and special beauty. The aim of these areas is to protect and preserve cultural environment and landscapes characteristic of Latvia in all their diversity, as well as to ensure the preservation of environment appropriate for recreation of society and tourism. There are 9 protected landscape areas in Latvia.

Nature reserves. Nature territories unaffected or slightly affected by human activity, which include habitats of specially protected wild plant and animal species, and protected biotopes. There are 259 nature reserves in Latvia.

Nature monuments. Separate, isolated natural formations: protected trees (secular trees, potential secular trees, rare trees of foreign species, specifically trees), dendrological plantings, avenues, geological and geomorphological nature monuments (detritions of rocks, secular stones, caves, springs, waterfalls), which have scientific, cultural and historical, aesthetic or ecological value. 206 geological and geomorphological nature monuments, 89 dendrological plantings and 60 avenues are protected in Latvia.



Forests in Latvia. Source: Raimond Putniņš, LSFRI „Silava“.

Organization of forestry

In Latvia, approximately half of the forests are owned by the state, but the others are owned by the private owners and enterprises, and local governments. The territories of the state forest property, where the main aim of management is nature protection – forests in the National parks and strict nature reserves, are managed by the institutions of the Ministry of Environmental protection and regional development. For its part, the state forest property, the main aim of management of which is to ensure the implementation of commercial interests, is managed by the Joint Stock Company “Latvijas valsts meži” (“Latvian State Forests” or LVM). LVM performs forest management over the whole rotation cycle, including the sales of timber.

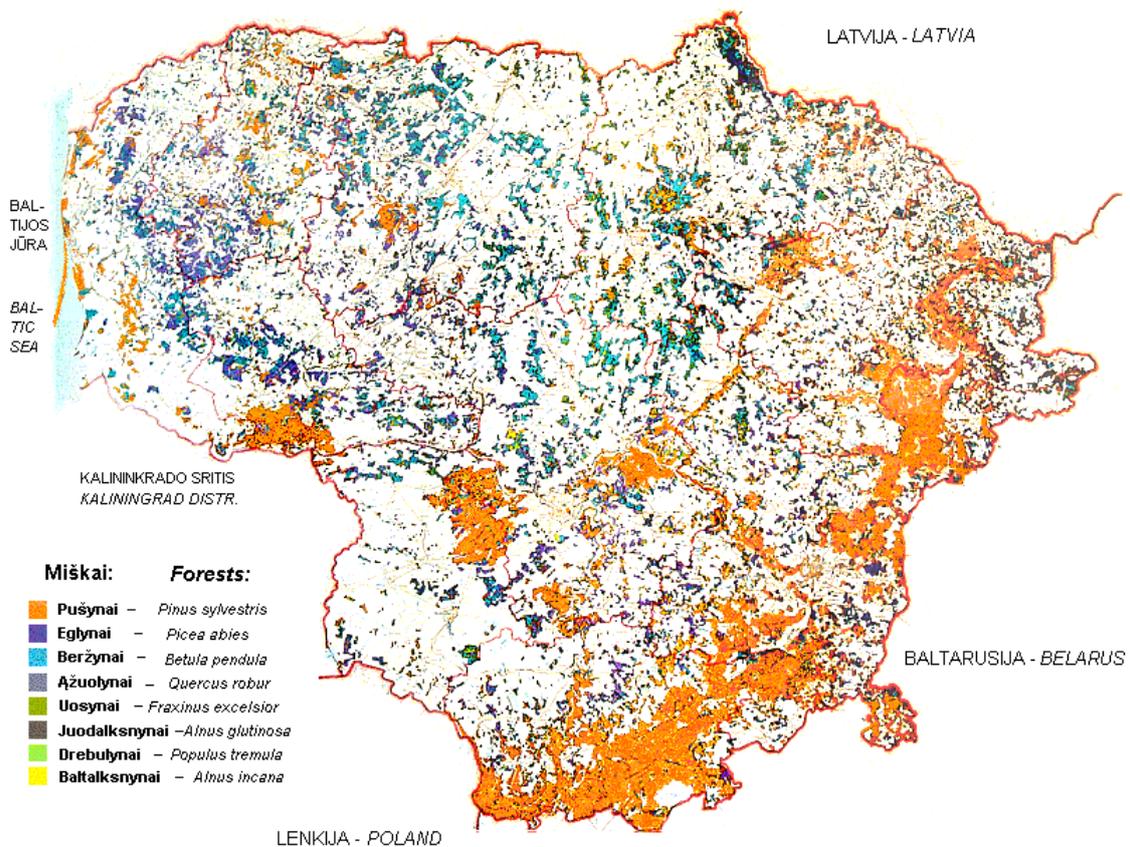
Sustainable development in the forest sector is guaranteed by the Forest Law, which define norms related to the duties of forest owners when they manage their properties. The Forest Law also determine that natural persons have the right of access and free movement in a state or a local government forest, if normative acts do not limit it. Access and free movement of natural persons in other forests may be restricted by the owner or the lawful possessor of the forest.

Lithuania

Forest characteristics and forest types

Lithuania is a country in Northern Europe. It is a lowland country. Total land area of Lithuania is ~6.5 million hectares and population of 2,9 million.

The climate of the Lithuania can be described as typical European continental influenced climate with warm, dry summers and fairly severe winters. Lithuania is situated within the so-called mixed forest belt with a high percentage of broadleaves and mixed conifer-broadleaved stands.



Lithuanian forests by dominating tree species.

Forests cover almost 2,2 million hectares, or about 33,5% of the total area of Lithuania and gives ~0.7 ha per capita (comparing with the nearest neighbors, this number is less than in Latvia, but higher than in Poland).

Pine forest is the most common forest type, it covers more than 1/3 of the forest area. It is followed by Spruce and Birch account for about 21 and 22 percent respectively. There are some forest areas with Alder, which is fairly high, and indicates the moisture quantity of the sites. Oak and ash can each be found on about 2 percent of the forest area. The area occupied by aspen stands is close to 3 percent.

During World War II Lithuania's forests were overexploited. Estimations shows that in 1948 forest coverage was less than 20% of total area. To fix this situation actions, such as a large-scale afforestation, started to be taken.

Coniferous tree species are prevailing in Lithuania. Pine and spruce stands amount to more than a half of forests, whereas among deciduous species birch stands are prevailing. The highest volume of timber is recorded in pine, spruce and birch stands, and the highest annual increment is noted in aspen and black alder stands.

Forest and society

Role of forest is very important in Lithuania from social, economic and ecological point of view. Numerous people, either individually or with families spending time in forest for hiking, harvesting fruits or berries, collecting herbs, watching birds, hunting, educating kids etc. As there are no oil or coal nor gold or diamonds, forest remains one of the basic sources for the state economy. About 80 thousand people in Lithuania both directly and indirectly are involved in forest industry. Despite it, in general 2/3 of Lithuanians think negatively about forest cuttings.

Typical and exceptional fauna and flora species in forests

Natural and semi natural flora occupy one third of Lithuanian territory. There are 1795 flora species inventoried in Lithuania. Most flora species grow (713 species) in forests. More than 4000 species of fungus are found in forests. There are 321 bird species, 213 of them bred or used to breed in Lithuania. The White Stork (*Ciconia ciconia*) was declared the national bird of Lithuania in 1973.

Lithuanians believe that storks bring harmony to the families on whose property they nest; they have also kept up the tradition of telling their children that storks bring babies. Stork Day is celebrated on March 25. Notably, Lithuania is a beneficial and important habitat for these birds: it has the highest known nesting density in the world.

Among trees, there are exceptional trees in forests. Oak stands occupy 2% of forest areas in Lithuania. Oak is a symbol of strength. Down the ages Oaks were respectfully protected. Since 1420, the felling of old oaks was forbidden. Stelmuze Oak is the thickest and the oldest tree in Lithuania and one of the most aged oaks in whole Europe. Stelmuze Oak age is about 1.500 years, diameter is 3.5m, perimeter close to ground is 13m, and height is 23m. Just 8-9 men can to clasp in arms the stem of Stelmuze Oak.

The tallest tree in Lithuania is 46 m height 150 years of age larch in Degsne botanical reserve.

The largest animal in Lithuanian forests is European Bison (*Bison bonasus*). The reintroduction of European Bison started in 1969. In 2017, there are about 210 free ranging European Bisons.

Among game animals, Roe Deer (*Capreolus capreolus*) predominate in Lithuanian forests and open countryside. One of the most popular game animals to hunt is Wild Boar (*Sus scrofa*), not just because of the taste of their meat, but also because they can cause a variety of damage. The most common complaint is rooting resulting in the destruction of crops and pastures.

Fallow deer (*Dama dama*) were brought to Lithuania in the 16-17th centuries. They were raised in enclosures and served as decoration for parks. Later on fallow deer disappeared. The present population was came from fallow deer, which were brought from former Czechoslovakia and Soviet Union in 1976-77.

Beaver (*Castor fiber*) are a keystone species helping support the ecosystem of which they are a part. They create wetlands, which increase biodiversity and provide habitat for many rare species such as water voles (*Arvicola terrestris*), otters (*Lutra lutra*) and water shrews (*Neomys fodiens*). They were almost extincted at the beginning of 20th century, then the reacclimatization of beavers started, and as a result of which these animals became common on the whole territory of the country, bringing more and more damage to the forests, flooding farming land. A beaver family can fell as many as 300 trees in a single winter. According to official statistics on game animals in 2015, there were ~44 thousand beavers.



Stelmuze Oak.
Source: Mindaugas Maksvytis

Among trees there are exceptional trees in forests. Oak stands occupy 2% of forests areas in Lithuania. Oak is treated as a symbol of strength. Down the ages Oak was respectfully protected. The felling of old oaks was forbidden since 1420. Stelmuze Oak is the thickest and the oldest tree in Lithuania and one of the most aged oaks in whole Europe. Stelmuze Oak age is about 1.500 years, diameter is 3.5m, perimeter close to ground is 13m, and height is 23m. Just 8-9 men can to clasp in arms the stem of Stelmuze Oak.

The tallest tree in Lithuania is 46 m height 150 years of age larch in Degsne botanical reserve.

The largest animal in Lithuanian forests is European Bison (*Bison bonasus*). The reintroduction of European Bison started in 1969. There are more than 50 free ranging European Bisons nowadays.

Among game animals Roe Deer (*Capreolus capreolus*) predominate in Lithuanian forests and open countryside. One of the most popular game animals to hunt is Wild Boar (*Sus scrofa*), not just because of the taste of their meat, but also because they can cause a

variety of damage. The most common complaint is rooting resulting in the destruction of crops and pastures.



Sus scrofa. Source: Mindaugas Maksvytis

Fallow deer (*Dama dama*) were brought to Lithuania in the 16-17th centuries. They were raised in enclosures and served as decoration for parks. Later on fallow deer disappeared. The present population was raised from fallow deer which were brought from former Czechoslovakia and Soviet Union in 1976-77.

Beaver (*Castor fiber*) are a keystone species helping support the ecosystem of which they are a part. They create wetlands which increase biodiversity and provide habitat for many rare species such as water voles (*Arvicola terrestris*), otters (*Lutra lutra*) and water shrews (*Neomys fodiens*). They were almost extinct at the beginning of 20th century, then the reacclimatization of beavers started, and as a result of which these animals became common on the whole territory of the country, bringing more and more damage to the forests, flooding farming land. A beaver family can fell as many as 300 trees in a single winter. According to official statistics on game animals in 2015 there were ~44 thousand beavers.

Organization of Forestry

From 2018 Lithuania State Forests Enterprise performs functions of the institution implementing the rights and duties of the owner of its 26 regional branch offices. It coordinates and organizes regeneration, maintenance, protection of state forests and the exploitation of forest resources, forest regeneration, protection and management, organizes a uniform state fire prevention and sanitary forest protection system.

Nature Protection and Forest Department at the Ministry of Environment directly participates in the formation, organization and coordination of forest policy and strategy.

Types of forests ownership

In 1990, after the restoration of Lithuanian independence, the land reform started. Today there are three types of forest ownership in Lithuania. Today there are three types of forest ownership in Lithuania. Almost half of forests (49,8%) are the forest of State importance and managed by State Forest Enterprises. The area of private forests was gradually increasing. In 2015, it reached ~839 thousands of hectares, or almost 40% of the total forestland area. Rests of the forests are those reserved for restitution and other forests. In 2016, there were ~250 thousand of private forest owners, the average forest area per owner being 3.4 ha.

Forms of nature protection such as national parks and Nature 2000 sites

By 1st January 2016, the national network of protected areas covered ~1,15 million ha or 17,6 % of the total Lithuania's territory. There are four categories of protected areas:

conservational, ecological, recuperational and integrated. Under these categories 14 types of protected areas, such as national and regional parks, reserves, objects of heritage and other can be marked. Usually protected territories are overlapping with the Natura 2000 network. State Service for Protected Areas supervises all of them. There are also other types of protected areas: municipality reserves and woodland key habitats. Woodland



The Treetop Walking Path in Anykščiai Regional Park.
Source: Mindaugas Maksvytis

key habitats. Woodland key habitats are the sites in the forest, which provide for the existence of rare and endangered species having highly specific demands for the habitat.

The Red Data Book of Lithuania serves as a legal document on which the protection of rare and endangered plant, fungi and animal species is based. The Red Data Book contains descriptions of 767 species of animals, plants, lichens and fungi. Capercaillie (*Tetrao urogallus*), European pond turtle (*Emys orbicularis*), Smooth Snake (*Coronella austriaca*), Green Woodpecker (*Picus viridis*), Tengmalm's Owl (*Aegolius funereus*) are just few examples of rare and endangered species which inhabits forest.

Main problems concerning forests

There are few main concerns in Lithuanian forests. Ash dieback, caused by *Hymenoscyphus fraxineus* fungus, conditioned felling down ~1000 ha of ash stands in 2015.

With climate changes unpredictable storms and strong winds fells and brakes trees. Sometimes in one night in one forest rangery (in average size of forest rangery in Lithuania is ~3,5 thousand ha) wind can "harvest" same amount of timber as it would be harvesting for 10-15 years.

As forest is not just trees and mushrooms, but also and animals, such as Wild Boar, which population in some areas is affected by African swine fever virus (ASFV), hunters instead of increasing the population, as they were doing it before, are forced to reduce it.

Forest fires are not a big problem in Lithuania because of uniform fire protection and prevention system and public awareness in the country, but



ASFV trouble-spot. Source: DELFI / Domantas Pipas

sometimes mainly in recreational areas (for example in Curonian spit in 2014) it strikes.

Illegal felling and stealing of logged roundwood brings economical losses to the forest owners. Rate of illegal felling in private forests is almost 3 times higher comparing to the state forests.



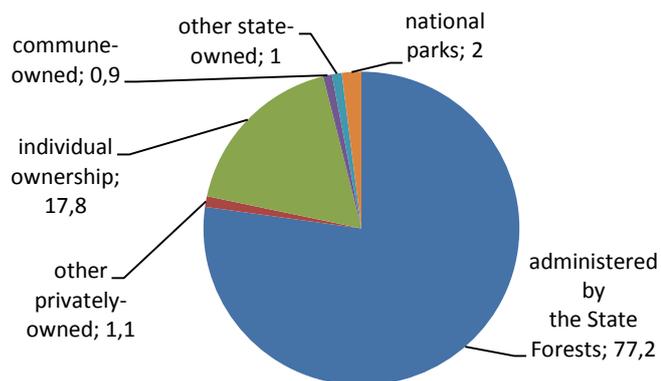
Cormorant collony. Source: vstt.lt

Great Cormorant (*Phalacrocorax carbo*) damages huge areas of valuable old forests in Curonian Spit National Park and other areas in the country. Cormorants makes damage on or even can kill the trees they nest in, as well as smaller trees, shrubs and other plants underneath nests. They do this by evacuating on the branches.

Poland

Forest characteristics and forest types

Nowadays forest area in Poland covers ca. 9 million hectares. (according to 2014 data from Central Statistical Office) which is 29.4% of the country's territory. There is a constant increase of the forest area. Regarding forests ownership, most of the forests are state-owned. State forests manage 77.2% of forests territory. Ownership status is presented below.



Ownership status of forests in Poland (GDSF 2014)



Typical pine forest in Stare Masiewo surroundings. Coniferous forests cover 52.6% of the forested area in Poland.

Oak-hornbeam forest in Bialowieza National Park. Broadleaved forests cover 47.4% of the forested area in Poland. Source: YPEF

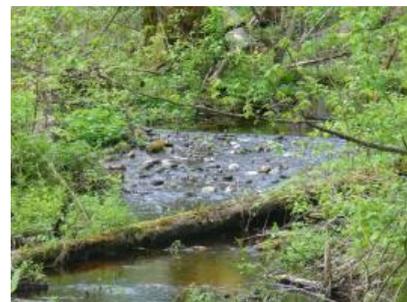
Pine dominates in lowlands, whereas spruce dominates in highlands and mountains. This domination of coniferous species even on very rich habitats, often as monoculture stands, is the result of clear-cutting forest management, which was very popular in the past. Clear-cutting involves removing mature stands in one cut (often in big areas) and establishing new stands artificially (by planting and rarely by sowing).

The most interesting flora communities are: oak-hornbeam forests, riparian forests and alder forests.

Oak-hornbeam forests are broadleaved forests on fertile loam soil. They are often adjacent to riparian or alder forests from one side, and mixed pine forests from the other. In the tree level we can mostly find: oak, hornbeam, small-leaved lime. Hornbeam is an important forest component, nursing the upper level.

Riparian forests are typical of river and stream valleys. Shallow groundwater is the characteristic element of these forests. In these forests we can find: black alder, ash, singly- maple, hard beam, bird cherry and spruce.

Alder forests - In the tree level we can find alder as well as downy birch, spruce, English oak, ash, and sometimes other species. For alder forests periodic flows caused by the raise of shallow groundwater are common.



Oak-hornbeam forests, riparian forests and alder forests are most interesting in respect of flora. Source: YPEF Poland

Typical and exceptional fauna and flora species in forests

Because of its moderate climate (in-between oceanic and continental) Poland is famous for the most diverse and the richest forest biocenose in Central Europe. There are 2.300 vascular plants, 600 mosses, 250 *Hepaticopsida*, and 1.600 lichens. Among vascular plants we can find species from various geographical regions such as: Eurasia, North-American, Arctic, Middle-Europe, West-Europe, Black-Sea; even Mediterranean Sea.

Pine trees (*Pinus sylvestris*) and sporadically larch cover 70% of the forest area.

Spruce (*Picea abies*) covers 5.5%, and is mainly found in north-east Poland and in highlands and mountains. Silver fir (*Abies alba*) is a significant species (2%). Its share in highlands and mountain forests is constantly increasing.

Among broadleaved species, oak (*Quercus sp.*) dominates - 7.3%. Mostly we can find pedunculate oak (*Quercus robur*), and rarely sessile oak (*Quercus petraea*), which grows on less fertile soils. Birch (*Betula sp.*) covers almost 7% of forests. Birch, as a pioneer species, is the species usually regenerated first on waste grounds.

European beech (*Fagus sylvatica*) - covers 5% of forests. Beech is found in the south and west of Poland.

Alder (*Alnus sp.*) covers 4.4% of the forest and is mostly found in wet habitats - alder and riparian forests. Other broadleaved species, e.g. maple, sycamore maple, aspen, poplars, hornbeam and mountain ash in total cover less than 1% of area.

Among the endemic species in Poland the following can be mentioned: *Larix polonica*, *Delphinium oxysepalum*, *Dendranthema zawadskii*.



Betula nana



Delphinium oxysepalum



Dendranthema zawadskii

Plants of Poland. Source: YPEF Poland

Among relict species (disappearing species or from other periods) the following can be mentioned: *Dianthus sylvestris*, *Salix lapponum*, *Betula nana*, *Dryas octopetala*, *Saxifraga wahlenbergii*.



Salix lapponum and *Saxifraga wahlenbergii*. Source: YPEF Poland

Fauna in Poland is characterized by species which came to Poland during various periods, especially after the last glacier. In Poland about 33.000 of fauna species can be found (including invertebrates). Among terrestrial vertebrates there are 85 mammal species, 220 bird species nesting in Poland, 8 reptile species, 17 amphibians and 55 fishes. Most of them can spread easily and fast and can be found in the whole European moderate zone. The number of endemic species is estimated at 36 and relict species at 38. Chamois (*Rupicapra rupicapra*) and alpine marmot (*Marmota marmota*) are examples of relict species.



Rupicapra rupicapra and *Marmota marmot*. Source: YPEF Poland

- **Description of some fauna species**

Exceptional species: Bison (*Bison bosanus*). Nowadays in Poland there are more than 1000 individuals. Adult males weigh about 440-920kg, females are smaller, 320-640 kg whereas young bisons weigh 16-35kg. The duration of pregnancy is about 260 days and young bisons are born during spring. Bisons eat mostly plants from forest ground, and spend 80% of their life for grazing.

Typical species: Deer (*Cervus elaphus*). In Poland there are more than 178 000 individuals. Adult males weigh about 220kg. Antlers are shed every winter and grow again in spring; at the age of 10 deer have got the biggest antlers.

Exceptional species: Wolf (*Canis lupus*). In Poland there are about 600-700 individuals. These populations are found in the north-east, middle-east and Carpathian part of the country.



Bison and wolf – exceptional species of fauna in Polish forests
Source: YPEF Poland

Forms of nature protection such as national parks and Natura 2000 sites

Nature Protection in Poland includes:

- Flora and fauna species protection
- Nature monuments protection
- Establishment of nature reserves
- Establishment of National parks
- Establishment of Landscape parks
- Designation of protected landscape areas
- Designation of NATURA 2000 sites

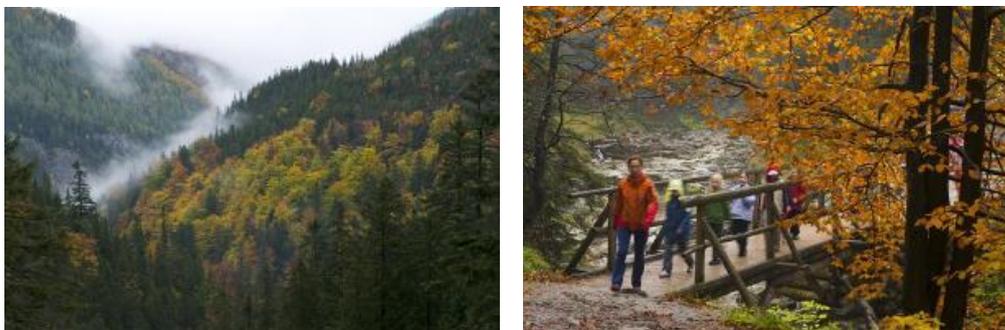
The most known Polish national parks are:

Bialowieża National Park is the oldest national park in Poland. Its emblem is the bison. It includes very valuable natural lowland forests. 500 years ago hunting and settlement were prohibited with a king's decree which, although it was issued for other purposes, was beneficial for nature and society. Animals were set free to nature from zoos and animal gardens during interwar times.



Strictly protected area in Bialowieza National Park and polish primitive horse. Source: YPEF Poland

Tatra National Park is the only mountain range with alpine characteristics. Its emblem is the chamois. It is connected with the Slovak Tatra National Park. In both parks brown bear and alpine marmot can be found.



Forests in Tatra National Park and touristic path in mountains. Source: YPEF Poland

Góry Stołowe National Park represents the only example in Poland and a very rare in Europe where mountains are in horizontal rock layers. There we can also see a stone city, a mushroom-shaped rock and other formations, as a result of erosion.



Characteristic mountains with rock layers and the flat tip – “table mountains”.
Source: YPEF Poland

Biebrza National Park is the biggest one. It includes the valuable Biebrza wetlands (the biggest European wetlands) which are almost untouched. Biebrza River is the last one of this size in Europe maintaining its natural character.



Wetlands of Biebrza valley with a big moose population. Source: YPEF Poland

Kampinoski National Park is found next to the capital of Poland, Warsaw. Every year it is visited by one million tourists, who can hike on 360 km trails. The park is famous for the sand dunes, close to swamps, and for moose, beaver and lynx reintroduction.



Sand dunes next to swamps near Warsaw (Kampinoski NP). Source: YPEF Poland

There are 23 National Parks in Poland. They cover a total of 300.000 ha, that is 1% of the country. 60% of the Parks are forests. 7 parks have been declared as world biosphere reserves. Białowieża NP is the only one on the UNESCO list. By the end of 2008 in State Forests

there were over 1200 reserves. In the forests there are also almost 11.000 nature monuments (trees or trees groups, alleys, rocks, caves).

Poland is a participant of NATURA 2000 – European Commission action. By the end of 2008 2.2 million ha Special Area of Conservation (SAC) were declared, what is 29% of State Forests area, and 1.1 million of Special Protection Areas for birds (SPA) was declared, what is 15.1% of forests.



Photo 138: On forest trails. Source: YPEF Poland

Organization of Forestry

In Poland public forests dominates (81,8%), therein State Forests are 94%. Private forests, mainly persons, share 16.4 % of forests (1.6 million ha). Legal rules of forest management are based on “Forest Act” from 1991. Act is used for all forests irrespective of ownership form. Environmental Minister supervises State Forests while mayors of counties are responsible for the non – state forests.

State Forest National Holding (PGL LP) manages state forests. The PGL LP General Director supervises management, with help of employees of State Forest General Directorate and 17 Regional Directorates of State Forests.

Basic units in forest management system are forest inspectorates, managed by forest inspectors. Inspector, on the basis of forest management plan, makes the management decisions independently. In Poland there are 428 forest inspectorates.



When there is high fire risk, there is no entrance to the forest. Source: YPEF Poland

In Poland forests are commonly available; although limitations can involve sensitive areas, like forest nursery, research areas, animal territories, river springs. Limitation can be also periodic (e.g. due to fire, stand destruction).

Main problems concerning polish forests

The basic problems related to forest management in Poland are related to climate change in this part of Europe. Global warming and changes in the structure of precipitation during the growing season cause an increase in the share of tree diseases - especially sub-boreal species such as Norway spruce. There is observed with concern also problems of Scots pine - responds to periods of drought.

Climate changes also increase the frequency of strong winds and hurricanes that cause forest disasters on many thousands of hectares of forest. The dying and dry forests are very susceptible to the emergence of forest fires. This anthropogenic factor still increases the risk of forest management

New diseases of forest animals are becoming more and more important in Poland. For example, the population of wild boars is limited due to the presence of ASF viruses.

Portugal

Forest characteristics and forest types

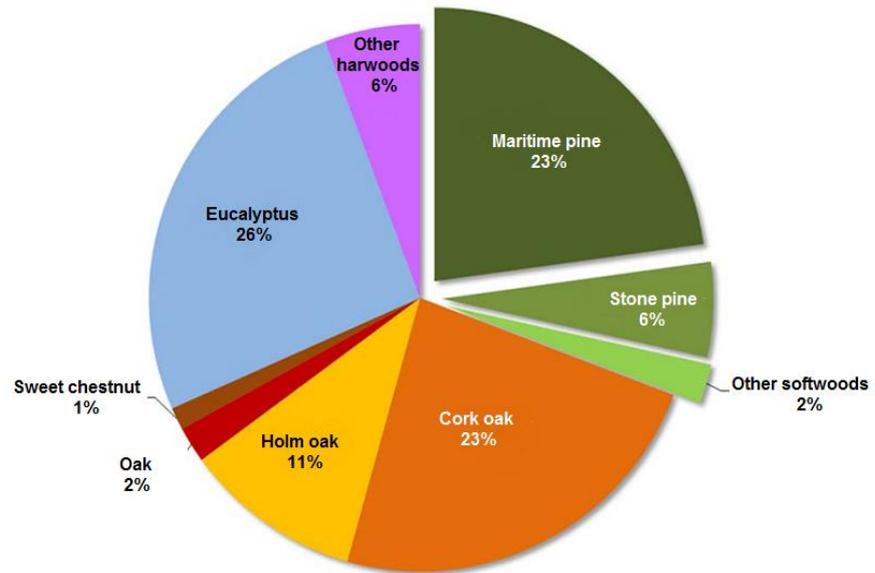
As they look like today, Portuguese forests are recent. In 1870 the total forest area was around 4 to 7%, and now represents 35,4%^[1] of the continental territory. This increment was due to a lot of reasons, some linked to the migration of rural populations to the cities and others to the higher demand of materials by the industry. These lead to an increment of reforestation and fire vulnerability, since the forests were no longer cleaned to feed cattle and used as fuel resource^[2].

Portuguese forests are very diverse. The composition and their geographical distribution are determined by the gradient of water abundance/drought. As one goes from the rainier North, to the drier south, or from coastline to inland, trees are more resistant to drought successively^[2].



Diversity of Portuguese forests. Source: YPEF Portugal

The main tree species are: Eucalyptus (*Eucalyptus globulus*) - 26%, Maritime pine (*Pinus pinaster*) – 23%, Cork oak (*Quercus suber*) – 23%, Holm oak (*Quercus rotundifolia*) – 11%, Stone pine (*Pinus pinea*) – 6%, other Oak (*Quercus spp.*) – 2%, Sweet chestnut (*Castanea sativa*) – 1%, other hardwoods and other softwoods – 6%^[1].



Distribution of total areas by species/species group. Source: IFN6, ICNF.

• **Maritime pine forests**

Pinus pinaster is coniferous evergreen tree of up to 40m and rounded, arched or irregular crown, thick reddish-brown bark, needle-shaped leaves grouped in pairs, the cones are conic 8–22 cm long and 5–8 cm broad and its seed, “penisco”, is wind-dispersed^[3]. This tree is able to colonize poor or degraded soils. So it is called a pioneer species.

Actually it is present from the coastline to the inland of the North and Central regions of Portugal (90,8%)^[4]. The expansion throughout the country was the result of the large afforestation programs promoted by the State and the reforestation of abandoned agricultural land^[2]. From 1995 to 2010, the maritime pine forest area has decreased in 263.000 ha, mostly transformed into "scrub and pastures" (165.000 ha), eucalyptus (70.000ha), forest areas with other tree species (13.000ha) and urban areas (13.000ha)^[1]. In the early XX century, in the great period of its expansion, the timber and resin were used for pitch and mineral tar production for shipbuilding and chemical industry^[2].

• **Eucalyptus forests**

Eucalyptus globulus is a fast growing evergreen tree, exploited in plantations with production cycles of about 12 years^[2]. The name “globules” was given because its fruits seemed ancient clothing buttons.

In Portugal, it’s distributed throughout the country with preference for coastal areas. More than half of the areas of settlements, whose dominant species is the eucalyptus, are located in the Central region (48%) and Alentejo (29%)^[4]. The area of eucalyptus increased from 100 thousand hectares (4%), in the 60s^[2,4] to the actual 812 thousand hectares (26%)^[1]. Its flowers are sought by bees for honey production and its leaves have a oil called cineol or eucalyptol,



Eucalyptus stand. Source: YPEF Portugal

which has balsamic and antiseptic properties that can be inhaled or used in sweets to combat the cold and bronchitis^[6]. Even though eucalyptus is not an endemic tree species, i.e. unique to a defined geographic location, under the Portuguese law it is not an invasive plant.

- **Cork oak forests**

The cork oak is an evergreen tree with rounded crown up to 20m. Its bark is the cork that is used for the wine stoppers. The leaves are toothed and oval and the fruit is the acorn^[3]. *Quercus suber* forests, called ‘Montados de Sobro’, are agro-forestry semi-artificial ecosystems created by man, very important in terms of biodiversity and multifunctionality. Till 1950, cork oak forests increased in an effort to restore an ancient system of land use and to respond to the growing demand for cork by the industry. In the recent past, afforestation of marginal agricultural land has led to an increase in the total area of cork oak in some regions, while in others there has been a loss of forest area to scrubs and pastures, despite the great Portuguese law constrain of its logging^[2,4]. In Portugal these forests are mostly present in Alentejo (84,1%), Central region (6,3%) and Algarve (4,6%)^[4]. In 2001 *Quercus suber* was declared as a protected species under the Portuguese law and, in 2012, was officially declared as the national tree.



Cork bark stripping.
Source: YPEF Portugal

- **Holm oak forests**

The Holm oak is an evergreen tree of 15 to 20m, with stiff and split gray bark, slightly oval shape and thorny leaves, whose fruit is the acorn^[3]. *Quercus rotundifolia* forests, called ‘Montados de Azinho’, are open structures with agro-forestry-pastoral use, which provide a wide variety of products such as acorn, firewood, charcoal and forage, honey, mushrooms and game. They are present from Trás-os-Montes to the Algarve, but mainly in East Alentejo^[9]. The main product, acorn, is a very important food resource for



Holm oak forest.
Source: YPEF Portugal

domestic species such as ‘Alentejan pig’ and game species such as *Alectoris spp*, *Sus scrofa* and *Cervus elaphus*^[8].

Oak forest.
Source: YPEF Portugal

- **Other oaks forests**

In Portugal there are also other oak forests. Forests of native **Portuguese Oak** (*Quercus faginea*), known by ‘Cercais”, have amazing landscape and are extremely rich in biodiversity^[10]. They can grow to 25m and habit Algarve, cork oaks of Trás-os-Montes and Beira Alta^[3]. Its wood is very good for construction, in the form of beam, and suitable for firewood and charcoal^[11].



Forests of native **European oak** (*Quercus robur*) are mainly found in the North and Centre region, where there is a highest percentage of natural distribution with high ecological, economic and social value^[2,12]. Its trees can reach 45m and their high-quality wood is used for carpentry^[3].

Forests of native **Pyrenean oak** (*Quercus pyrenaica*) provide a multiple use of the forest, soil and water conservation, biodiversity, natural landscape and improvement of the climate and are an important source of wood and non-wood resources^[13]. Its trees can reach 25 m and is spontaneous, especially on the northern and centre inland. The wood of the pyrenean oak is very hard, heavy and very resistant to rot. It is recommended for uses involving water. Historically, these trees were used as structural element of buildings, furniture and construction of fishing and war fleets. Its most common use is perhaps the construction of barrels for wine aging^[14].

- **Stone pine forests**

The stone-pine is a resinous evergreen tree of up to 30m, arched canopy, thick and cracked bark, needle-shaped and pair leafs. The cones produce seed called pine nut or pinion or pinhões. *Pinus pinea* forests are natural or artificial stands that were traditionally used for wood and seed (pinion) production. Common along the Southern coast where we can find the highest percentage of contiguous stands (62% of the total area). In this area is produced 50% of the total pinecone^[15].



Stone Pine forest.

Source: YPEF Portugal

The vegetation under forest cover is an important source of biodiversity. For this reasons, coast stone pine forest is considered a priority habitat in the Natura 2000 Network^[16].

- **Sweet chestnut forests**



Sweet chestnut stand.

Source: YPEF Portugal.

The sweet chestnut is a deciduous tree of up to 30m, light gray bark split in vertical plates and oblong-lanceolate boldly toothed leaves. The fruit is the chestnut^[3]. Mainly, this tree is present in Trás-os-Montes and Beiras^[17]. *Castanea sativa* forests used for timber are called 'Castingais', while forests used for chestnut production are called 'Soutos'. These forests provide high quality wood (for carpentry, joinery and furniture) and also a large quantity of chestnut (for human consumption or animal breeding) contributing to the increased diversity in the composition and structure of forest stands. Chestnut is the main dry fruit produced in Portugal and, in 2011, held the 3rd place in chestnut production in Europe with an average production of 30.000 tons^[3,17].

- **Riparian forests**

The forests along the river banks are called riparian. They protect water streams and ensure water quality. In the riparian forest you can find species like poplar (*Populus spp.*), willow (*Salix spp.*), ash (*Fraxinus spp.*), elm (*Ulmus spp.*), alder (*Alnus glutinosa*), securinega (*Securinega tinctoria*), saltcedar (*Tamarix spp.*) and, more rarely, the pyrenean oak (*Quercus pyrenaica*) or common hazel (*Corylus avellana*).



Riparian forest. Source: YPEF Portugal

- **Laurissilva forests**

Laurissilva forests are classified as UNESCO World Heritage Sites. Since humid temperate conditions are rare on Earth today, Laurissilva forests are relict formations found in few habitats, always on the edge of the temperate regions, with major oceanic influences. These forests are found in Portuguese islands of Madeira (nearly 60% of the land) and Azores^[18].

Typical and exceptional fauna and flora species in forests - Portugal

Below, we can see some indicative examples of endemic and native fauna and flora species of the Portuguese territory, including Azores and Madeira archipelagos, and Iberian Peninsula.

- **Fauna**

Class	Species	Classification
Migratory and freshwater fishes	Portuguese pardelha (<i>Chondrostoma lusitanicum</i>)	Endemic species in Portugal
	Torgal chub (<i>Squalius torgalensis</i>)	
Amphibians	Gold-striped salamander (<i>Chioglossa lusitanica</i>)	Endemic species in Portugal
	Iberian painted frog (<i>Discoglossus galganoi</i>)	
Reptiles	Iberian rock lizard (<i>Lacerta monticola</i>)	Endemic species in Portugal
	Bedriaga's skink (<i>Chalcides bedriagai</i>)	
Birds	Trocaz Pigeon (<i>Columba trocaz</i>)	Endemic species in Madeira
	Plain swift (<i>Apus unicolor</i>)	
	Azores' Bullfinch (<i>Pyrrhula murina</i>)	Endemic species in Azores
	Goldcrest (<i>Regulus regulus sanctae-mariae</i>)	
Mammals	Iberian lynx (<i>Lynx pardinus</i>)	Endemic species in Iberian Peninsula
	Cabrera's vole (<i>Microtus cabrerae</i>)	

Fig. 26: Fauna of Portugal: Endemic species. Source: ICNF.

- **Flora**

Indigenous tree species	Indigenous shrub species
Carob tree (<i>Ceratonia siliqua</i>)	Flax-leaved daphne (<i>Daphne gnidium</i>)
Common Holly (<i>Ilex aquifolium</i>)	Lavender (<i>Lavandula sp.</i>)
Narrow-leafed ash (<i>Fraxinus angustifolia</i>)	Prickled broom (<i>Pterospartum tridentatum</i>)
Portugal laurel(<i>Prunus lusitanica</i>)	Portuguese heath (<i>Erica lusitanica</i>)
Prickly cedar (<i>Juniperus oxycedrus</i>)	Montpelier Rock Rose (<i>Cistus monspeliensis</i>)
White cedar (<i>Cupressus lusitanica</i>)	Weaver's broom (<i>Spartium junceum</i>)

Fig. 27: Indigenous tree and shrubs species of Portugal. Source: ICNF.

Forms of nature protection such as national parks and Natura 2000 sites

In Portugal, the National Classified Areas System includes the National Network of Protected Areas, Natura 2000 Network and other international commitments. In December 2014, the total area under these two first Networks accounted for 22% of the continental Portuguese territory^[19].



Portuguese nature. Source: YPEF Portugal

Natura 2000 sites

In Portugal within Natura 2000 network there are 97 Sites of Community Importance and 59 Special Protection Areas^[19,20]. In comparison with the other countries of the European Union, Portugal is above the average (about 15%). According to information from the European Commission, in 2011, only Spain, Bulgaria and Slovenia had a higher percentage of Sites of Community Interest than Portugal^[21].

National Network of Protected Areas

These areas account for about 7.8% of Portuguese territory, plus a marine surface^[19]. Managed by the Public Forest Services, there are currently the following types: National Park (Peneda-Gerês National Park); Natural Parks; Natural Reserves; Protected Landscapes; Natural Monuments and Protected Areas. Azores has Protected Areas and Natural Parks and Madeira's Natural Park covers about 2/3 of the island. The Laurissilva is classified as a Biogenetic Reserve by the European Council and as a World Natural Heritage by UNESCO^[22].

Organization of forestry

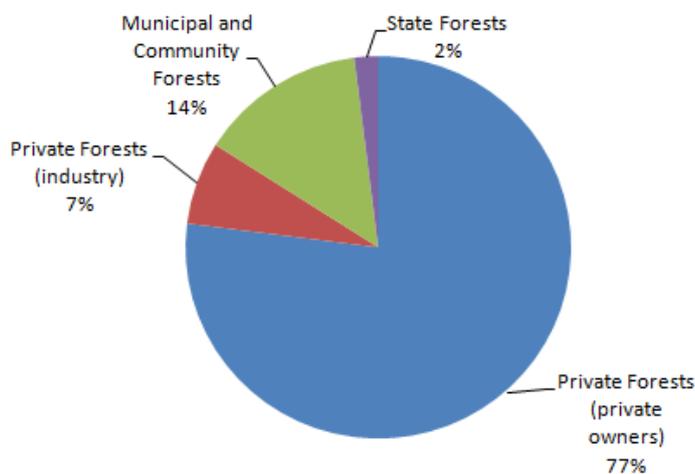
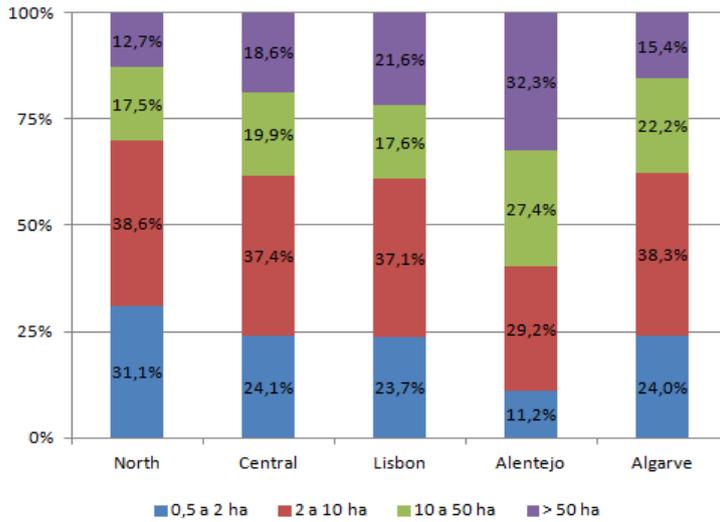


Fig. 28: Portuguese forest owners. Source: ICNF

Portugal is one of the European countries with the highest percentage of private forests (84%). Only 2% is owned or managed by the State and 14% are community forests (common land management by local people, public and private entities)^[23]. The private property forest has many differences large areas in the South and small and fragmented forest areas in North and Central regions, where 54% of the forest stands are less than 10 ha^[4].

The very fragmented land, in small size plots, as well as the rural exodus and abandonment of the land, is a



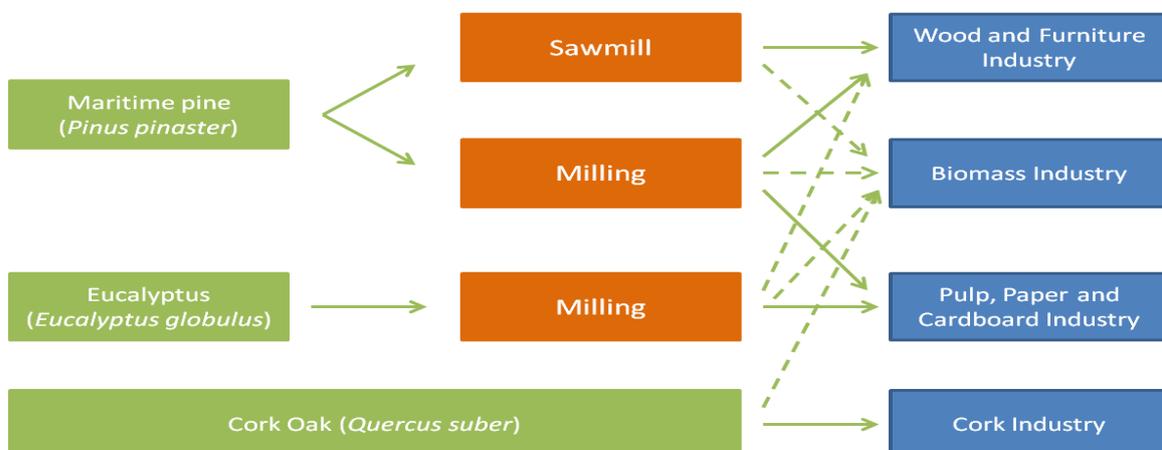
Stands size classes by region.
Source: AIFF, 2013.

strong obstacle to the sustained progress and socio-economic development of the forests and forestry sector. These also leads to financial and technical constrains for forest owners to implement sustainable forest management, which can be translated into more land abandonment, lower productivity and quality of wood and increase forest fire risk^[2]. Due to these, private owners associations (POA) are a solution to help forest owners. They are a central element in the representation of the

interests of forest owners, by providing forest management activities and services such as counselling, technical support, forest management, group forest management and forest certification. They also guarantee the implementation of state programs for forest promotion and protection, particularly, those of defence of forest against fires and biotic agents (mostly pests and diseases). In 2016, were registered 129 associations in continental Portugal, 83% in the North and Central region, where the forest area is more fragmented^[23]. In Portugal, the 2% of public forests are managed by the Institute for Nature Conservation and Forests (ICNF, I.P.).

• **Forest sector**

The forest sector is the third economic sector in Portugal. It is one of the pillars of the country's economic development. In 2011, the Gross Value Added of the forestry sector represented 2,5% of the National Gross Value Added demonstrating the economic importance for the country.



Another aspect is that the forestry sector correspond to 1,2% of the Gross National Product (GNP), value that, in context of the European Union countries, is only surpassed by Finland and Sweden^[4]. In the same year, the sector represented 2,4% of the national employment, with the main advantage of being sustained by national recourses that can't be transferred to other countries. It is divided in three main forest sub-sectors that are specialized in the export of products and whose value represents, on average, 10% of the national exports^[24].

○ **Sub-sector of Pine**

Maritime pine (*Pinus pinaster*) forest is the backbone of the sawmill industry and conglomerates. Its main objective is the production of wood to be used in unwinding or sheet, furniture and interior decoration, carpentry and joinery, sawing, grinding and firewood^[5]. One of the by-products is bark which is used as organic matter to nurseries or fuel.

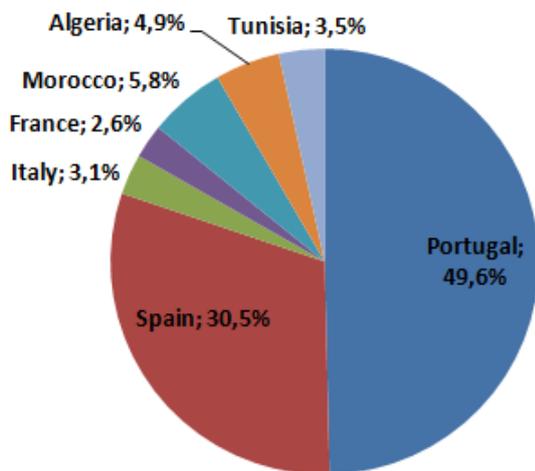
It is important for rural areas economy, either for commercial purposes or for activities such as apiculture, pastoralism, game, mushroom production or resin tapping^[5].

○ **Sub-sector of Eucalyptus**

Eucalyptus is mainly used by the pulp, paper and cardboard industry. In 2011, this industry was composed of 327 companies (4,8% of the forestry sector) that employed 10.610 persons (16,1% of the forestry sector). In 2012, Portugal was the 4th European producer of paper pulp and in the paper and cardboard it was the 11th European and the 6th worldwide producer. The paper is the main product line in exports. Paper and pulp represent more than half of the total exports. In this industry 34% of the electricity produced internally from biomass cogeneration is sold. ^[25].

○ **Sub-sector of Cork Oak**

Portugal is the country with the largest area of *Quercus suber* in the world (34%)^[6], followed by Spain, Morocco, France and Italy. It is, therefore, the world leader in cork production and processing accounting for 53% of world production^[10]. Almost the entire production (90%) is exported, making cork industry extremely important for the economy. Cork stoppers are the main products exported, followed by construction materials^[7].



Cork production. Source: APCOR, 2011.

○ **Portuguese forests value**

The economic value of Portuguese forests (wood, cork, fruits and seeds, pastures, resin, honey, mushrooms and herbs, hunting, fishing, coastline, water protection regime, desertification, biodiversity, carbon storage, biomass for energy), taking also into account losses (related to forest fires, pests and diseases), is estimated at 994 million Euros^[26].

Main problems concerning Portuguese forests - Forest Fires

Forest fires are one of the biggest problems in the Portuguese forest. During the dry season, Portugal is affected by forest fires which cause profound changes in the forest's capacity to guarantee the various environmental and socio-economic benefits and services that it provides, in particular in biodiversity, soil, water protection, landscape quality, the contribution to local and regional economy and the populations quality of life. Since fires reduce forest area, they endanger lives and equipment. They also cause economic damage because of forest destruction and high amounts of money spent on prevention and combat.

In the last decade (2007-2017), occurred an average of 18.371 forest fires and 117.706 hectares of forest burned, of which 46% were forest stands and 54% were scrubs. However comparing the values of the year 2017 with the history of the previous 10 years, it is noted that there were less 3.6% occurrences, but more 428% of area burned in relation to the annual average of the period according to the last fire report (INCF,IP).

In Portugal, large fires are considered when the total area affected is equal to, or greater than, 100 hectares. At October 31st, 2017, there were 214 fires in this category that burned about 93% of the total area burned of that year.

The National Network of Protected Areas (RNAP) is estimated to have burned about 5.5%. The Serra da Estrela Natural Park stands out for the largest burned area, about 22% of the total area of the Park. In the lands subject to State management, Mata Nacional de Leiria stands out, where 9,476 hectares have burned, 86% of the entire forest.

Four key factors are increasing the risk of forest fires, creating the perfect conditions for their occurrence: the expansion of forests due to the depopulation of rural areas and abandonment of the land; increased fuel load and continuity due to lack of forest management; the high number of ignitions with human origin caused by negligence, accidents and conflicts over land use, as well as natural causes; the increase of the temperature and the decrease of the precipitation, due to climatic changes.

Among the solutions is the need for the forest to have a long-term strategy, with a focus on forest management and prevention, making forests more resilient to climate change; managing resources to reduce fuel load and continuity; creating policies that allow the resolution of socio-economic conflicts and of land use that may be behind the ignitions.

Romania

Forest characteristics and forest types

Forests provide ecosystem services that support human survival and prosperity. They produce the necessary wood for human society, but the wealth it brings does not reduce only to this. Forest is a renewable source of other products (game, fish, raw materials needed by the pharmaceutical industry, forest fruits, forest seeds, medicinal and aromatic plants, edible mushrooms, trees and ornamental shrubs) but also other considerable and non-quantifiable benefits to the human society.

According to Millennium Ecosystem Assessment, the ecosystem services are classified in:

- Provisioning services that relate to the tangible products, such as timber, non timber forest products, fish and pharmaceuticals products;

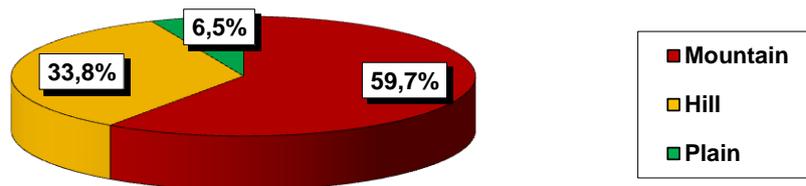
- Regulating services that refer to ecosystems natural processes such as carbon sequestration and water regulation which contribute to social wellbeing;
- Cultural services which relate to the non-material benefits obtained from ecosystems, for example, through tourism and educational use;
- Supporting services that are necessary for the production of all other ecosystem services (e.g. soil formation or nutrient cycling).

Raising awareness on the importance of the services provided by the forests to society should be a constant activity. Taking into account the wealth provided by forests, sustainable development plans must include this domain, by carefully analyzing and planning their responsible use of forest resource.

Romania is covered by rich and diverse vegetation, where forests account for about 27% of the national territory. From the top of the mountains to the seashore, one can find shrub and rocky vegetation, impressive coniferous forests, mixed spruce, primary fir and beech forests, meadows and ancient forests on hills and plain regions, oak or mixed broadleaved forests on plains, fringing forests along flooded meadows, halophytic or costal plants alongside the large rivers or the seashore, wetland vegetation or boundless reed beds within swamps and the Danube Delta vegetation. This rich diversity is due to the country's geographical location, wherein different climates coexist: continental, sub-Mediterranean and central European. Therefore, in Romania 5 geographic bioregions can be found (alpine, continental, pontic, panonian, stepic).

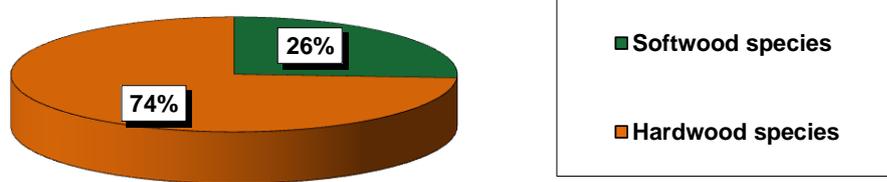
The wide variety of terrestrial shapes influences the climate to a large extent and support numerous local species or species common both for Europe and Asia.

The distribution of forests on various relief types is illustrated in the diagram bellow. According to the forest national inventory, the distribution of forests on various relief types is the one illustrated in the diagram bellow



Forest on relief types.

In the state forest area in Romania can be distinguished two main groups of species: softwood species and hardwood species, with the following distribution:



Share of tree species.

The most common softwood species in Romania is the Norway spruce. Within the hardwood species group, beech and oak are the most common species



Beech and Norway spruce, the most common tree species in Romania.

Source: YPEF Romania

Forest structure indicates the orientation of the Romanian forestry in applying seed-based regeneration of older stands in order to obtain diversified and uneven aged stands with high ecological stability and valuable industrial timber.

During the last century, forests have been affected by natural and human factors. The main factors are long dry periods (climate change), industrial pollution (transboundary in some cases), intensive grazing and forest logging using improper technologies. The most affected species are oak and fir. Due to climate changes, some forest vegetation zones are taking the place of others in some mountain ecosystems. For example, beech forests are advancing in altitude replacing former fir forests.

Typical and exceptional fauna and flora species in Romanian forests

Our forests have a rich diversity in terms of woody and herbaceous species providing a considerable stability of forest ecosystem and environment protection. The dominant part of the vegetation formations, identified at national level, are forest formations including species of zonal areas such as Norway spruce, fir, beech, durmast, Hungarian oak, Turkish oak as well as some species of intrazonal areas such as larch, black pine, ash, elm, native poplars and willows.

Among the natural forests of the Romanian Carpathians, some relict species which have survived the glacial ages are worth mentioning: *Syringa josikaea*, *Hepatica transsilvanica*, *Betula nana*, *Betula humilis*, *Vaccinium oxycoccus*.

Many endemic species have also been identified such as: *Dianthus tenuifolius*, *Dianthus spiculifolius*, *Ranunculus carpaticus*, *Silene dubia* etc, and the well-known *Dianthus callizonus* (Symbol of the Piatra Craiului Massif).



Dianthus callizonus. Source: YPEF Romania

The typical animals that can be found in the Romanian forests are: roebuck (*Capreolus capreolus*), red deer (*Cervus elaphus*), wild boar (*Sus scrofa*), fox (*Vulpes vulpes*), hare (*Lepus europaeus*). The fauna species of European interest that are found in Romania and which require a strict protection are: bear (*Ursus arctos*), wolf (*Canis lupus*), lynx (*Lynx lynx*), wild cat (*Felis silvestris*), otter (*Lutra lutra*) etc.

In Romania there is a rich tradition of game species management, tradition developed and perfected by foresters. Carpathians, by their geographical position, the variety of landscape and the rich hydrographic network, are an ideal habitat for maintaining viable populations of animals from different species and vigorous specimens. The presence of large carnivores (brown bear, wolf and lynx) is an element that favours the development process of natural selection and the emergence of exceptional trophies.



Wolf and bear, ones of the most important fauna species in Romanian forests.

Source: YPEF Romania

Forms of nature protection such as national parks and Natura 2000 sites

Virgin and quasi-virgin forests are of great importance for the conservation of the forest biodiversity, as they host many flora and fauna species which are typical of the temperate zone, as well as an important number of relict and rare species. Romania is one of the countries with the highest areas of virgin forests in Europe.

In order to preserve the biodiversity, Romania has created a network of protected areas designating natural protected areas of different types such as: National and Nature Parks (some of them having world recognition: Biosphere Reserves or Ramsar sites) Scientific Reserves, Nature Reserves, Natura 2000 sites. The most important National and Nature Parks in Romania:

Maramures Mountains Nature Park is the largest nature park in Romania, which includes a zone of contiguous habitats in the northern side of the country. Restricted access due to the country border line and steep relief helped typical flora and fauna species of the Carpathians to survive. The area is considered to be a protected area created by nature. Houses, wooden churches and gates come to complete a landscape still untouched in the middle of the Carpathians.

The most important National and Nature Parks in Romania:

Maramures Mountains Nature Park is the largest nature park in Romania, which includes a zone of contiguous habitats in the northern side of the country. Restricted access due to the country border line and steep relief helped typical flora and fauna species of the Carpathians to survive. The area is considered to be a protected area created by nature. Houses, wooden churches and gates come to complete a landscape still untouched in the middle of the Carpathians.



Steam train on a narrow gauge railway (Mocănița). Source: YPEF Romania

Piatra Craiului National Park with the longest limestone ridge of Romania hosts the largest number of valleys and residual shapes such as: walls, belts, notches and hollows. *Dianthus callizonus* is an endemic species of the area, also referred as the emblem of the mountain. Some of the big carnivores typical of this park are: brown bear, wolf and lynx. Chamois is also to be found at the upper belt of the mountain.



Piatra Craiului National Park. Source: YPEF Romania

Vanatori Neamt Nature Park is lying on the north-eastern side of the Romanian Carpathians, in the historic province of Modavia, the Vanatori Neamt Nature Park is the only one in Romania which developed a programme for the bison reintroduction. That's the reason the Park is well known as the "Bison Land". It is known as a Sacred Natural Site, because of the presence of the famous Romanian Orthodox monasteries and hermitages. The living monastic communities represent the second largest Christian monastic community in Europe.



AgapiaVeche Convent and European Bison. Source: YPEF Romania

Retezat National Park is the oldest Romanian National Park, established in 1935. The Retezat famous treasures are found in the alpine zone, where there are numerous lakes. As for unique landscapes, the glacial cirques and valleys are breath taking for the visitors. Bucura Lake is the widest glacial lake in Romania; Zanoaga Lake is the deepest glacial lake. There are also impressive primary beech and Norway spruce forests.



"Slavei" glacial Lake and Chamois on Retezat's screes. Source: YPEF Romania

Apuseni Nature Park characteristics are the karstic landscape which exhibits a wide variety of shapes: cliffs, steep valleys, lapis, caves, underground waters.



Piatra Altarului Cave and Landscape in Apuseni Nature Park. Source: Apuseni Nature Park Administration

Organization of Forestry

There have been many linkages between forestry and nature conservation in the last century. While intensive logging had negative impacts on nature conservation in the first half of the twentieth century, the close to nature approach that has been practiced extensively since the 1950s in Romanian forestry has reduced such impacts. Many forest ecosystems and wildlife species have been preserved due to the efforts of the foresters. Nowadays, the forest ratio in the country is 27%, that is the 1/3 of the forest coverage in the far past. According to the forest legislation, forest coverage cannot decrease any further. Forests are managed on the basis of forest management plans and they are valid for 10 years. For poplar, willow and other fast growing species, forest management plans can be valid for a shorter period (5 years).

After the forest restitution process to former owners, state forests decreased at 49% of the total forest area in Romania. State Forests are managed by the National Forest Administration – Romsilva, which is supervised by the Minister of Environment Waters and Forests. Romsilva is divided into regional forest directorates, coordinated by a central office in Bucharest. Further, the forest directorates are divided into forest administrative units that are the basic forest divisions for the sustainable forest management. The main activities of Romsilva are: forest regeneration and ecological rehabilitation, young stands tending, pest control, timber harvesting, production of timber and other wood products, exploitation of other forest products, wildlife management and hunting, management of natural protected areas (the largest protected areas administrator in Romania), preserve the genetic variability within horse breeding farms (17) etc..

The main challenges concerning forests in Romania:

Forest restitution to former owners - since 1991, in a transition society, the reestablishment of ownership of forests was undoubtedly a major aggression factor for the forestry system.

Illegal logging the magnitude of this phenomenon has surpassed the field of interest of forestry specialists, becoming a constant concern for the attention of the whole society. Attention to this phenomenon has been attracted by floods and landslides, often with devastating effects on local communities and infrastructure, calamities that have been linked to causation with massive loggings in affected areas. At the same time, tendencies of aridization and desertification have been reported in the southern areas of the country

as a result of the destruction of forest protection shelterbelts and illegal logging of entire forest bodies.

Forest protection programs, grounded and adopted every year, aimed to ensure the integrity of the forest fund and to adopt measures to reduce the population's pressure on the forest, lead to a reduced rate of illegal logging.

Among the **biotic factors**, the largest and most constant influences on forest ecosystems have been generated by the defoliators (leaf-eating insects) in the case of deciduous trees and bark beetle insects (attacking between bark and wood) in the case of resinous trees.

The resinous stands, especially Norway spruce, have often faced windthrows (trees uprooted or broken by wind) and windbreaks or snowbreaks on large surfaces. As a result of these calamities, favorable conditions for mass multiplication of bark beetles have been created.

The most effective methods of controlling bark beetle populations are prevention, timely evacuation of broken, debilitated, infested trees etc., thus preventing the mass multiplication of these insects. Other prevention methods are: creating mixed forests – resistant to windthrows/windbreaks/snowbreaks, and afforestation with tree species within their natural area.

Among the most used combating methods are the placement of trap trees (ecological method) and the use of pheromone traps.

By promoting biologic means or selective substances in the prevention and control of the action of forest diseases and pests, the contribution to the reconstruction of forest ecosystems, much previously affected, is evident. FSC forest management certification has resulted in a further reduction in the number of chemicals with negative potential for forest ecosystems.

Forest fires - represent an important challenge in forest management, with periodic action and showing fluctuations depending on climatic conditions. Thus, in the years characterized by excessive drought in Romania (2000, 2002, 2007, 2012, 2017), the number of forest fires was very high, exceeding 500 cases at national level. Although most fires, which ranged in large areas, were recorded in the plain area, yet the most dangerous and difficult to control proved to be those in mountain areas.

The main cause of the forest vegetation fires is the propagation of the fire from the agricultural land through: the burning of the pastures, predominantly in the vegetation season, which are mostly unsupervised or out of control and occur in periods with intensified winds burning stubble after harvesting agricultural products during July - August .

Ukraine

General characteristics of Ukrainian forests

Ukraine is the largest country in Eastern Europe with a coastline at the Black Sea and the Sea of Azov, it is bordered by Belarus, Poland, Slovakia, Hungary, Romania, Moldova and Russia.

Ukraine covers an area of 603,500 km². Almost 95% of its surface consists of plains with an average height of 175 m above sea level. Exceptions are the mountain range of the Ukrainian Carpathians along the western border and the Crimean Mountains in the extreme south. The highest mountain in the country is Mount Hoverla reaches 2,061 m.

The climate is temperate continental, excluding a narrow strip of subtropical climate on the Crimean South Coast.

Based on a combination of natural vegetation and climate, the country is divided in the five zones - Mixed forests, Forest-Steppe, Steppe, Carpathians and Crimea.

The total area of forest lands in Ukraine is 10.4 million hectares. Forests of Ukraine according to their purpose perform mainly ecological (water protection, protective, sanitary and hygienic and other) functions and have limited commercial significance. Forest cover in Ukraine is 15.9%.



Ukrainian forests

The forests of Ukraine are distributed very irregularly over the country, as a result of climatic conditions and anthropogenic influences over a long period of time. The largest forest territories are concentrated in the Mixed forests and in the Ukrainian Carpathians. Concerning the age structure the middle aged forests have the largest share, mature and over mature stands is only 17%. The average age of forests is around 60 years. The aging of forests has taken place gradually, leading to deterioration of sanitary conditions.

Typical and exceptional fauna and flora species in forests

Flora

Ukrainian forests are composed of over 30 tree species. The prevailing species are: pine (*Pinus silvestris*), oak (*Quercus robur*), beech (*Fagus silvatica*), spruce (*Picea abies*), birch (*Betula pendula*), alder (*Alnus glutinosa*), ash (*Fraxinus excelsior*), hornbeam (*Carpinus betulus*), fir (*Abies alba*).

The forests of Ukraine are rich in berries, mushrooms, fruits of wild growing plants and medicinal plants.

Fauna

The wildlife of Ukraine is distinguished by a large variety of species with almost 45 thousand kinds of animals. There are many unique natural localities in Ukraine where one can encounter rare surviving animals.

Elk, wisent, moose, sika deer, fallow deer, roe deer, wild boar, red deer, squirrel are inhabitants of forest zone; foxes and wolves are numerous, one may meet brown bears and lynx there. Of the avifauna, there is a large number of black cock, hazel grouse, wood grouse, starling, blue titmouse, cranes. The steppe zone is inhabited with ground squirrel, hamster, jerboa, field mouse, and marmot; of birds, there are skylark, quail, pink starling, steppe eagle, and others.

Some fur animals (nutria, mink, silvery-black fox, muskrat) were brought in from afar, and they acclimatized themselves well to the environment.



Animals of Ukraine

Wildlife of the coast region of the Black Sea and the Sea of Azov is highly varied; birds are especially numerous: martins, pochards, wild ducks, herons, bittern, pelicans, sea gulls, cormorants, etc.

The South Coast of Crimea and the mountainous region of peninsula with climatic conditions similar to the Mediterranean, harbor such creatures as Crimean and rock lizards, leopard snake, southern nightingale, black vulture, red deer, and mouflon.



Animals of Ukraine

Hoofed, fir and bird-game are also widespread on the territory of Ukraine. In the game-preserves that may be found in practically all the regions of Ukraine, hunting is arranged for elk, wild boar, European hare, fox, wild duck and goose, etc.

Ownership of forests

According to the Land and Forest Codes of Ukraine forests may be in state, communal and private property. The majority of forests are state-owned. 73% of forest fund are managed by the State Forest Resources Agency enterprises. During the division of land between state and communal ownership to communal property there can be transferred about 1.3 mln. ha (12.5%) of land of forestry purposes which are in constant use of companies subordinated to local governments. The share of private forest ownership is less than 0.1% of the total area of forest land.

Forest regeneration and enlargement forest area

In Ukraine there are a lot of land under the influence of erosion and annual growth eroded land is more and more. In order to reduce the impact of erosion on agricultural lands and improve soil fertility state forest enterprises are carried out afforestation measures.



Forest nursery in Lviv region

For optimal forest ratio in Ukraine (20%) there should be created a new forests. It is potentially possible using land withdrawn from agricultural turnover. The question of increasing forest cover is included in priority areas of forestry development. In Ukraine every second hectare is created artificially. Within the last half- century period there was soil protection stands along the banks of small rivers, there was established shelter forest belts aiming to protect arable land. For providing large-scale afforestation it is created sufficient facilities.

Conservation of forest biodiversity

Protected forests under subordination of State Forest Resources Agency composes one third of total protected areas of the country.

A significant percentage of protected forests in Ukraine show that forestry was created strict criteria on the management principles and they fully meet all European strategy for the conservation of biological and landscape diversity.

In subordination of the State Forest Resources Agency there are 13 environmental institutions, including: 6 nature reserves, 6 national parks and 1 household park.

The most important Nature Reserves and National Parks in Ukraine

Shatsky National Natural Park is the largest Natural Park. It was created to preserve one of the most valuable natural landscapes in Ukraine. Within the park there are 23 lakes

(one of the largest lake groups in Europe). Major lake is Svitiaz, the deepest lake in Ukraine, depth of 58 metres.



Shatsky National Natural Park

Half of Park is covered with forest with several villages located on the shores of lakes. Botanists estimate that in the park there are over 800 species of vascular plants, including many rare and are protection.

Rivne Nature Reserve is the second largest in Ukraine. Within the reserve are the largest and best preserved swamp in the whole Ukraine. It helps to maintain and develop the nature of Polissya. Reserve has a great diversity of plants and animals. Among them, many are in the Red Book of Ukraine and different lists of endangered plants and animals of international organizations.



Rivne Nature Reserve

Reserve conventionally divided into forests and swamps. Among the major role forests have made a pine and pine-birch forests.

National Park “Skolivski Beskydy” was created for the purpose of conservation, restoration and sustainable use of landscapes of the western part of the Ukrainian Carpathians with typical and unique natural complexes, which have important environmental, ecological, aesthetic, educational and recreational value.



National Park "Skolivski Beskydy"

In the village near the park were opened rich reserves of mineral waters, such as "Naftusya". The park also has more than 30 mineral springs spa.

The Yalta Mountain Forest Natural Preserve laying along the Black Sea coast, to the mountainous region called Ayu-Dag. It was first formed in an attempt to provide protection specifically to forest ecosystems that occur naturally in the mountains. These forests are usually made up of trees like the beech, oak, juniper, hornbeam and the Crimean pine.



The Yalta Mountain Forest Natural Preserve

Promoting tourism and recreation in forests

Recreation and health-improving forests serve mostly for recreational, health, hygiene and health-improving functions and are located on an area of more than 2 mio ha (almost 15% of the forest fund).

In forest there are located unique natural systems that have high landscape value with rare species of flora and fauna. There are also waterfalls, caves, forest lakes, space settlements of rare birds and animals and objects of historical and cultural significance. Foresters are assigned for preserving these objects in their natural state and restoration and protection of natural systems. In this regard it is important to improve public awareness and promote honorable attitude to natural resources, as well as creating suitable conditions for people visiting these areas.

In addition proper use of forest and its all useful properties can contribute to economic and social development forest enterprises as well as regions. A significant number of forest areas traditionally used by the population for recreation.

Forest protection against pests and deceases

Forests are influenced by abiotic, biotic and anthropogenic factors that cause the defoliation, decrease of increment and tree dieback.

The major factor to have a negative impact is damage by foliage-browsing insects and pathogens.

Forest protection against fires

The main reason of forest fires in Ukraine is as a rule violation with the requirements of the fire safety in forests during the high and extreme level of fire danger period and burning on agricultural lands.

In State Forest Resources Agency forests there is a network composed of towers aimed to observation of forest area, half of them with television surveillance system. State forest enterprises systematically conduct awareness rising activities aimed to explain safety regulations within fire danger period in forests, define persons who violate such regulations and fined them.

Electronic wood accounting system

Since 2013 unified state electronic wood accounting system was introduced at all state forest enterprises under subordination of State Forest Resources Agency of Ukraine situated in the most forested regions of Ukraine. This system is functioning now and provides online an accurate accounting of forest resources by means of marking wood with special labels with barcode and using mobile electronic devices in carrying out accounting operations in forest.



Marked wood with special label with barcode

The system is an effective method of combating illegal logging and is also an effective factor in increasing the efficiency of forestry production.

Relationship between society and the forest

Realizing the need for promotion respect for nature, understanding of general public importance of creating new forest stands as a major component of environmental balance of the planet State Forest Resources Agency under support of Association of Ukrainian Foresters since 2006 holds an annual campaign "Future forests in your hands". The campaign starts March 21 at the International Forest Day and lasts until Day of Environment. The main event of the action is creating new forest stands with broad participation of school pupils and students, public officials and the media. In each vegetation zone of Ukraine there are defined special day for this event according to the weather conditions. Each year around 20 thousand peoples are participated into campaign.

Forestry schools

Foresters also organize a large-scale vocational work with school youth. In cooperation with local state forest enterprises there are operating 540 forest schools where more

than 17 thousand children receiving all necessary primary information about forests and forestry. More than 200 active members of such schools annually decide to continue forest education aiming to become forester.

From other point of view students of forestry school significantly help foresters in solving everyday practical problems. They are planting and tending thousands of hectares of forest stands annually and help in greening cities and villages.

Pupils also help with feeding forest inhabitants, posting on trees artificial nesting places, growing medical herbs etc.

Foresters have organized for them student workshops, trips, conferences, lectures and competitions.

Young foresters of Ukraine take part annually in the national competition for the best forestry school and best forestry research work.

Main problem concerning forests in Ukraine. - “Biological fires”

Bark beetles are the most destructive insects of pines in Ukraine. The bark beetle is capable of killing trees in large numbers, and this makes it an important species both on economic and ecological terms.



*Bark beetle (*Ips acuminatus*) kills pine*

Recurring outbreaks over the last few years have had catastrophic effects on forest economy and ecology in Carpathian region and in Polissya. In Carpathian region, a large outbreak of bark beetle these year killed forests equivalent to 14 million cubic meters of dead wood.



Dying pine in Polissya and other species in Carpathian region

The bark beetle is also important in ecological terms. When the beetle kills all swathes of trees, it changes the forest environment radically by changing the light conditions and replacing species that live off living trees with species that live off dead trees.

The deterioration of forest plantations is noted in all European countries. But there is one difference between Ukraine and other countries, foresters have the opportunity to react and cut damaged trees in time, when the tree is still "alive" and its timber is valuable. In Ukraine, according to sanitary rules it is a long procedure (about 2 month) to get an agreement to cut damaged trees.

Climate change may increase the risk of bark beetle outbreaks, especially in the old forests, which has so far been discouraged from major outbreaks. Higher temperatures will favor the beetles and induce a transition from one to two generations per year. Furthermore, simulations indicate that we may witness more frequent bark beetle outbreaks if extreme winds become more frequent.

List of authors

(In alphabetical order)

- Ávila**, Andreia (Forestis – Associação Florestal de Portugal): Portugal
- Baschny**, Thomas (Federal Ministry of Agriculture, Forestry, Environment and Water Management, Department of Forestry, Austria): Austria
- Bateira**, Joana (Forestis – Associação Florestal de Portugal): Portugal
- Derveni**, Anna (Management Body of National Forest Park of Parnitha, Greece): Europe and Greece
- Dudek**, Albert (Warsaw University of Life Sciences – SGGW, Poland): Poland
- George**, Karetzos (Forest ecology and Hydrology, Institute of Mediterranean Forest Ecosystems and Forest Technology Products, Athens): Europe and Greece
- Gotza**, Stephanie (Hochschule Ruhr West, Mülheim an der Ruhr, Germany): Germany
- Janský**, Stanislav (Association of Municipal and Private Forest Owners SVOL, Czech Republic): Czech Republic
- Jansons**, Aigars (Latvian State Forest Research Institute “Silava”): Latvia
- Kosmas**, Albanis (Forest Management and Economics, Institute of Mediterranean Forest Ecosystems and Forest Technology Products, Athens, Greece): Europe and Greece
- Kováčevics**, Pál - (Hungarian Forestry Association): Hungary
- Kritikos**, Theodoros (Forest Ecology and Hydrology, Institute of Mediterranean Forest Ecosystems and Forest Technology Products, Athens, Greece): Europe and Greece
- Lipmeister**, Juta (Estonian Society of Foresters): Estonia
- Orzechowski**, Michał (Warsaw University of Life Sciences - SGGW, Departement of Forest Management Planning, Poland): Europe and Poland
- Pache**, Robert (ROMSILVA, Romania): Romania
- Panayiotopoulou**, Danae (Institute of Mediterranean Forest Ecosystems and Forest Technology Products, Athens, Greece): Europe and Greece
- Parro**, Kristi (Estonian Forest Society): Estonia
- Petrakis**, Panos V. (Forest Ecosystems Protection and Forest Fires - Forest Entomology, Institute of Mediterranean Forest Ecosystems and Forest Technology Products, Athens, Greece): Greece
- Poliakova**, Liubov International Cooperation Department State Forest Resources Agency of Ukraine: Ukraine
- Schilling**, Astrid (HNE Eberswalde, Faculty of Forest and Environment, Germany): Germany
- Soulioti**, Nikoletta (Forest Pathology, Institute of Mediterranean Forest Ecosystems and Forest Technology Products, Athens, Greece): Greece
- Tomusiak**, Robert (Warsaw University of Life Sciences – SGGW, Poland): Poland
- Zabolotnyy**, Serhiy (Warsaw University of Life Sciences – SGGW, Poland): Ukraine
- Zute-Abizāre**, Līga (Latvia’s State Forests JSC): Latvia

Sources and references

Europe

EEA (2012): Protected areas in Europe- an overview. Report/No 5.
<http://www.eurosfairer.prd.fr/7pc/bibliotheque/consulter.php?id=643>
<http://www.euractiv.com/sustainability/brussels-chops-eu-forest-rules-news-530610>
http://ec.europa.eu/environment/nature/natura2000/management/gp/forest_intro.html
http://ec.europa.eu/environment/nature/natura2000/management/gp/forest_intro.html
FOREST EUROPE, 2015: State of Europe's Forests 2015 Ministerial Conference on the Protection of Forests in Europe, 2015

Germany

BMELV (2011): German forests. Nature and economic factor. Berlin
Waldbericht der Bundesregierung, 2017 (<https://www.forstwirtschaft-in-deutschland.de/index.php?id=371&L=1>)
<https://www.umweltbundesamt.de/daten/land-forstwirtschaft/waldbraende#textpart-1>

Lithuania

<http://www.am.lt>
<http://www.gmu.lt>
<http://www.vstt.lt>
<http://www.forest.lt>
ftp://195.182.70.69/incoming/www/Valstybiniai_miskai/Leidiniai/2012_2013_Lithuanian_state_forests.pdf

Portugal

- [1] INCF – Instituto da Conservação da Natureza e das Florestas, 2013. IFN6 – Áreas dos usos do solo e das espécies florestais de Portugal continental. Resultados preliminares.” [pdf], ICNF - Instituto da Conservação da Natureza e das Florestas. Lisboa.
- [2] Pereira H., Domingos T., Vicente L., Proença V., “Ecosistemas e Bem-Estar Humano: Avaliação para Portugal do Millennium Ecosystem Assessment”, Editado pela Fundação da Faculdade de Ciências da U. L. e Escolar Editora, 2009.
- [3] Bingre P., Aguiar C., Espírito-Santo D., Arsénio P. & Monteiro-Henriques T [Coord.s Cient.] (2007): Guia de Campo – As árvores e os arbustos de Portugal continental. 462pp. In vol. IX de Sande Silva J. [Coord. Ed.] (2007): Coleção Árvores e Florestas de Portugal. Jornal Público/Fundação Luso-Americana para o Desenvolvimento/Liga para a Protecção da Natureza. Lisboa. 9 vols.
- [4] Caldeira, B.; Praxedes, J.; Santos, P.; Brígido, S. (2013). “Estudo prospetivo para o setor florestal”, Edited by AIFF – Associação para a Competitividade da Indústria da Fileira Florestal.
- [5] Oliveira A., Moura P., Pinto M. (1999). “Manual de boas práticas florestais para o Pinheiro bravo”. Centro Pinus – Associação para a valorização da floresta de pinho.
- [6] António N., Ficha técnica sobre o Eucalipto. Naturlink. Available in: <http://naturlink.sapo.pt/Natureza-e-Ambiente/Fichas-de-Especies/content/Ficha-do-Eucalipto?viewall=true&print=true>, Acedido em: 20/11/2015
- [7] Evangelista, M. (2011). “Cortiça. Cultura, natureza, futuro. - Estudo de Caracterização Sectorial 2011”. APCOR – Associação Portuguesa da cortiça.
- [8] Capelo J., Catry F. (2007). “Biologia, ecologia e distribuição da azinheira”. In: Silva, J.S. (Coord. Ed.) Os Montados - Muito para além das árvores. Vol. 3: 119-129. Coleção Árvores e Florestas de Portugal. Jornal Público/Fundação Luso-Americana para o Desenvolvimento/Liga para a Protecção da Natureza. Lisboa. 9 vols.
- [9] AFN. Bilhetes de Identidade da Floresta. Available in: www.icnf.pt/portal/agir/resource/doc/sab-ma/florest/bi-floresta. Accessed at: 15/11/2015
- [10] Silva J.S. (2007). “O carvalho-português e as antigas florestas do Litoral Centro – Introdução”. In: Silva, J.S. (Coord. Ed.) Os carvalhais - Um património a conservar. Vol. 2: 11-44. Coleção Árvores e Florestas de Portugal. Jornal Público/Fundação Luso-Americana para o Desenvolvimento/Liga para a Protecção da Natureza. Lisboa. 9 vols.
- [11] António N., Ficha do Carvalho-português. Naturlink. Available in: http://naturlink.sapo.pt/Natureza-e-Ambiente/Fichas-de-Especies/content/Ficha-do-Carvalho-portugues?bl=1&viewall=true#Go_1, Accessed at: 20/11/2015

- [12] Carvalho J., Alves P. C., Grosso-Silva J. M., Santos T. M. (2007). "Biologia e ecologia do carvalho-roble". In: Silva, J.S. (Coord. Ed.) Os carvalhais - Um património a conservar, Vol. 2: 185-200. Coleção Árvores e Florestas de Portugal. Jornal Público/Fundação Luso-Americana para o Desenvolvimento/Liga para a Protecção da Natureza. Lisboa. 9 vols.
- [13] Carvalho J. P. F., Santos J. A., Reimão D. (s/d). O Carvalho-Negral em Portugal e Transformação Tecnológica da Madeira". Universidade de Trás-os-Montes e Alto Douro (UTAD), INETI - Instituto Nacional de Engenharia, Estação Florestal Nacional.
- [14] António N., Ficha do Carvalho-português. Naturlink. Available in: http://naturlink.sapo.pt/Natureza-e-Ambiente/Fichas-de-Especies/content/Ficha-do-Carvalho-roble?bl=1&viewall=true#Go_1, Accessed at: 20/11/2015
- [15] Costa R., Evaristo, I. (2008). "Condução de Povoamentos de Pinheiro Manso e Características Nutricionais do Pinhão". Projecto AGRO 45. Instituto Nacional dos Recursos Biológicos, I.P. INRB, I.P..
- [16] Costa J. C. (2007). "Biologia e ecologia do Pinheiro-manso". In: Silva, J.S. (Coord. Ed.) Pinhais e Eucaliptais. A floresta cultivada. Vol. 4: 109-120. Coleção Árvores e Florestas de Portugal. Jornal Público/Fundação Luso-Americana para o Desenvolvimento/Liga para a Protecção da Natureza. Lisboa. 9 vols.
- [17] Monteiro A., Oliveira A., Laranjo J. G., Delgado F., Carvalho J., Rodrigues L., Caetano F. (2011). I Simpósio Nacional do Castanheiro "Espécie a defender". Sociedade de Ciências Agrárias de Portugal (SCAP), Instituto Superior de Agronomia (ISA), Universidade de Trás-os-Montes e Alto Douro (UTAD) e Câmara Municipal de Trancoso (CMT).
- [18] Dias E., Elias R. B., Melo C., Mendes C. (2007). "O elemento insular na estruturação das florestas da Macaronésia". In: Silva, J.S. (Coord. Ed.) Açores e Madeira – A floresta das ilhas. Vol. 6: 15-48. Coleção Árvores e Florestas de Portugal. Jornal Público/Fundação Luso-Americana para o Desenvolvimento/Liga para a Protecção da Natureza. Lisboa. 9 vols.
- [19] Fernandes A., Teixeira A., Guerra M., Ribeiro R., Rodrigues S., Alvarenga A. (2014). "Relatório do Estado do Ambiente 2014". Agência Portuguesa do Ambiente - Ministério do Ambiente, Ordenamento do Território e Energia. Available in: <http://sniamb.apambiente.pt/infos/geoportaldocs/REA/rea2014.pdf>
- [20] ICNF, I.P. RN2000 - Portugal – Resumo. Available in: <http://www.icnf.pt/portal/naturaclas/rn2000/rn-pt/rn-PT>. Accessed at 20/11/2015
- [21] Vilão R., Venâncio C., Teixeira A., Gervásio I., Liberal P., Ribeiro R., Panão S. (2011). Relatório do Estado do Ambiente 2011. Agência Portuguesa do Ambiente, I.P. – Ministério da Agricultura, do Mar, do Ambiente e do Ordenamento do Território. Available in: <http://sniamb.apambiente.pt/infos/geoportaldocs/REA/rea2011.pdf>. Accessed at 20/11/2015
- [22] MAOTDR - Ministério do Ambiente, do Ordenamento do Território e do Desenvolvimento Regional (2007). "Programa Nacional da Política de Ordenamento do Território (PNPOT) – Relatório". Available in: http://www.dgterritorio.pt/filedownload.aspx?schema=f7664ca7-3a1a-4b25-9f46-2056eef44c33&channel=35C2E555-C85C-4720-84D1-E2D2F910E83C&content_id=6E0740EA-E664-4110-AA83-75DEB7B251F8&field=storage_image&lang=pt&ver=1&filetype=pdf&dtestate=2013-06-03170058. Accessed at 20/11/2015.
- [23] ICNF, I.P. "Associativismo Florestal". Available in: <http://www.icnf.pt/portal/florestas/gf/opf/assoc-flor>. Accessed at 30/11/2016
- [24] ICNF, I.P. "Importância Económica". Available in: <http://www.icnf.pt/portal/florestas/fileiras/econ>. Accessed at 20/11/2015
- [25] AICEP Portugal (2013). "Pulp & Paper Industry". Available in: www.portugalglobal.pt/en/biblioteca/documents/pulppaper.pdf. Accessed at: 20/11/2015
- [26] DGRF – Direção-Geral dos Recursos Florestais (2007). "Estratégia Nacional para as Florestas". Imprensa Nacional-Casa da Moeda.

Ukraine

Forest Resources of the State Agency of Ukraine: <http://dklg.kmu.gov.ua>

Board of the scientific and information security Deržlisagentstva (Forest Resources of the State Agency of Ukraine) of Ukraine.