

POLAND  The State Forests

FORESTS IN POLAND

2016



State Forests

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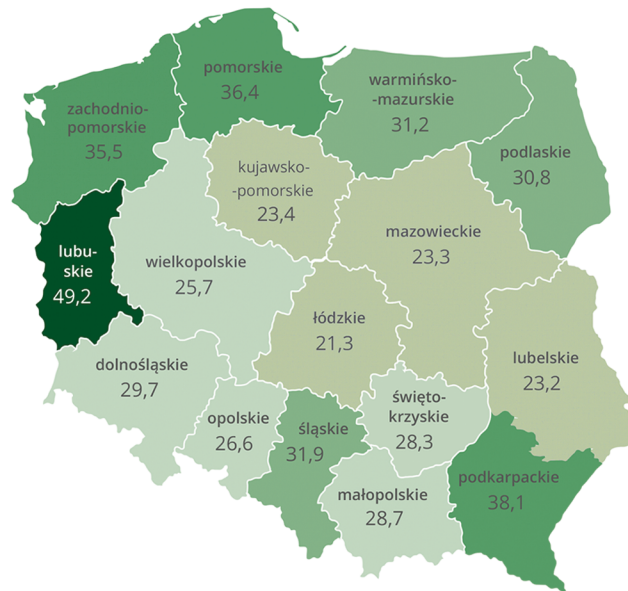
The Forest Act of 28 September 1991, (Journal of Law 2015, item 2100 as later amended) legally obliged the State Forests to publish an annual report on the condition of forests in Poland. This publication, entitled *Forests in Poland 2016*, is an abridged version of the report for the year 2015 which was compiled by the Forest Research Institute and commissioned by the Directorate-General of the State Forests on the basis of materials provided by: the Ministry of the Environment, the Directorate-General of the State Forests, the Forest Research Institute, the Bureau of Forest Management and Geodesy, the Central Statistical Office and also international reporting. The report presents the state of forests in all types of ownership in 2015, in the context of the data coming from recent years, and where possible and advisable also in the context of other countries. The scope of this publication covers three main issues: forest resources in Poland, forests functions, and threats to the forest environment.



FOREST RESOURCES IN POLAND

Forest area and forest cover

In our climatic and geographical zone forests are the least distorted natural formation. They are a necessary element of crucial ecological balance and sustainability.



The forest area in Poland is 9215 thousand ha (according to the Central Statistical Office, figure for 31 December 2015), which puts forest cover at 29.5%. The Lubuskie province has the highest forest cover (49.2%) whereas the Łódzkie has the lowest (21.3%).

FOREST COVER IN POLAND by province (Central Statistical Office)

0.24 ha

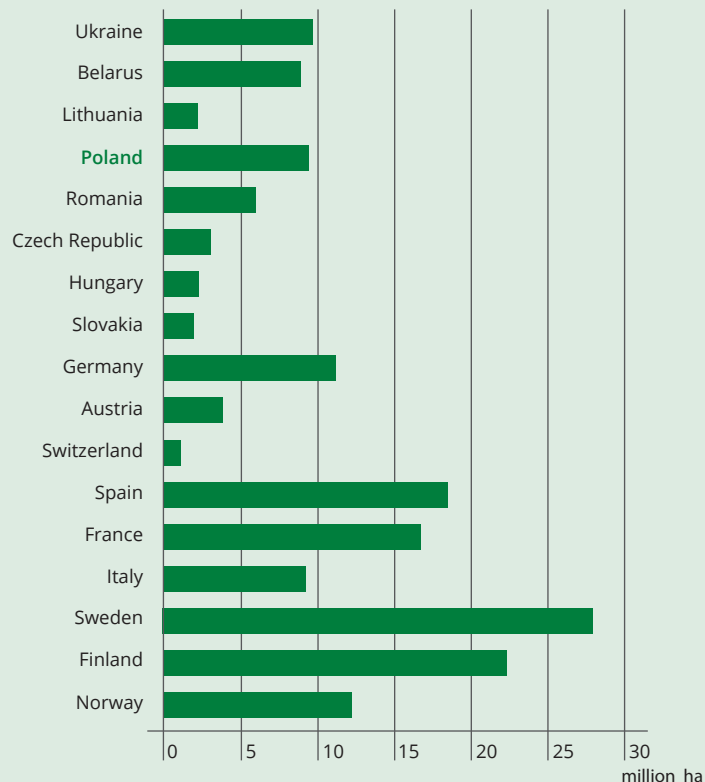
of forest area per
one inhabitant
of Poland

At the same time, forests are also a form of land use ensuring biological production with a market value. Forests are the common good which shapes the quality of human life.

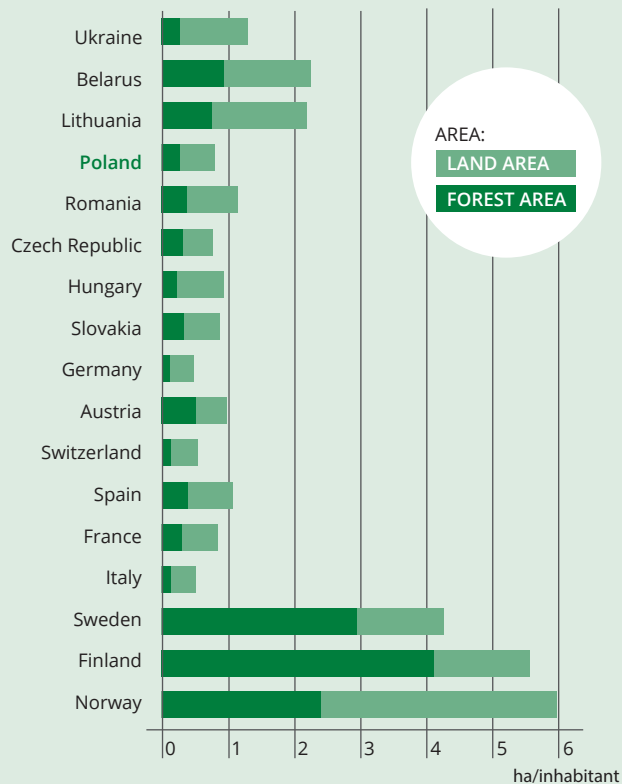
According to measurement standard adopted by the international assessment which takes into account also the lands associated with forestry, the forest area in Poland is 9420 thousand ha, as of 31 December 2015, and is close in size to the forest area of Ukraine and Italy. In six European countries (apart from Russia) this number was more than 10 million ha.

Within the analysed group of states, a comparison with Poland shows that the countries with great share of land unsuitable for use other than forestry, e.g. swamps and montane areas, have substantially higher forest cover (Scandinavian countries, Austria, Slovakia). Lower forest cover is in Ukraine, Hungary, Romania, and, out of western countries - in France and Great Britain. In 2015, the forest cover in Poland measured by the international standards, amounted to 30.8% and was lower than the European average 32.8% (44.7% - including the forests of the Russian Federation).

A comparison of forest area per capita in Europe with the total land surface clearly shows that these values are higher in less populated countries; the forest cover of such countries is higher than the average. Forest area per capita in Poland (0.24 ha) is one of the smallest in Europe.



TOTAL FOREST AREA (SoEF 2015)



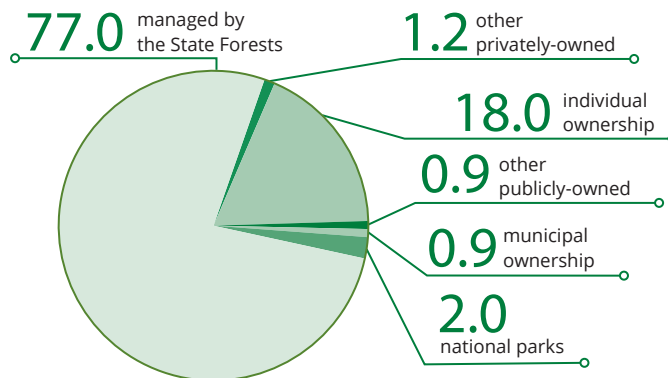
**FOREST AREA against total land area,
per inhabitant** (SoEF 2015)

Forest ownership in Poland



In the ownership structure of forests in Poland the public forests are predominant – 80.8%, of which 77.0% are under the administration of the State Forests National Forest Holding (the State Forests). In the post-war period the forest ownership structure was changing very slightly. In the years 1990-2015, the share of privately-owned forests increased by 2.2% to 19.2%. Concurrently, the share of public forests decreased from 83.0% to 80.8%.

In Poland, the share of privately-owned forests varies between regions: the largest is in the Mazowieckie province at 44.9% of its to-



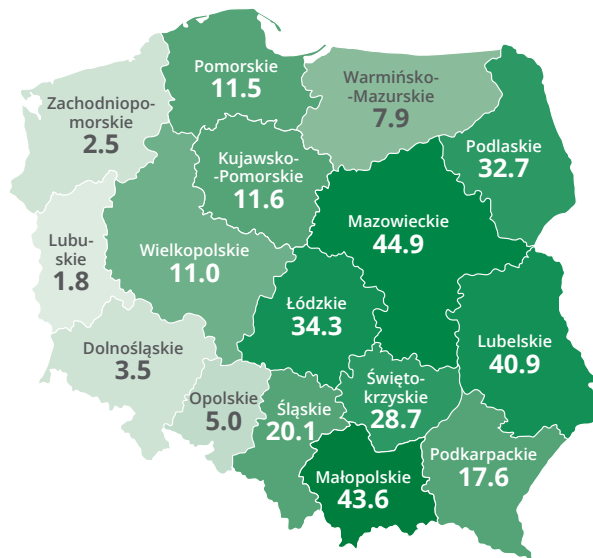
FOREST OWNERSHIP STRUCTURE in Poland, in % (Central Statistical Office)

In Poland
80.8%
of forests
are public

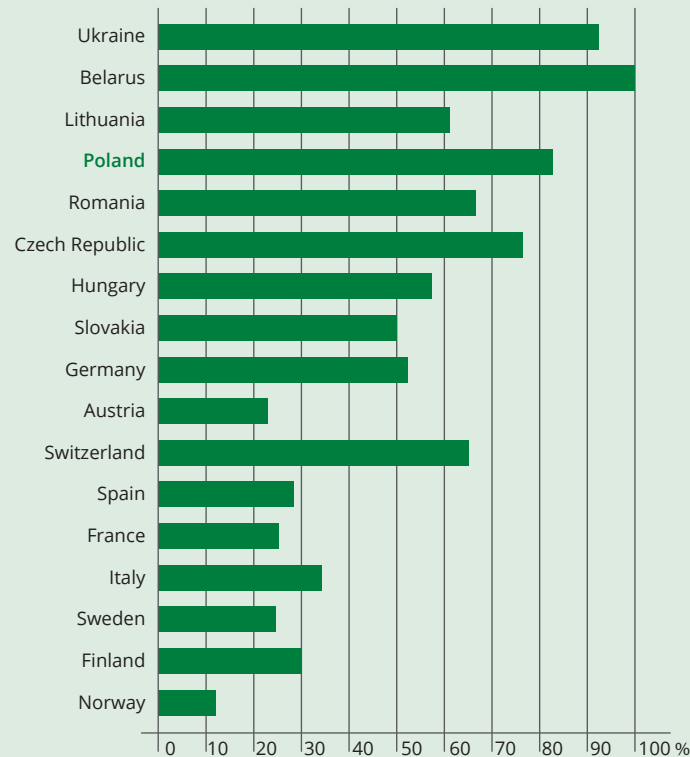
In Poland the share of private forests varies between regions: the greatest is in the Mazowieckie province at 371.2 thousand ha, the Małopolskie at 190 thousand ha, and the Lubelskie at 239.1 thousand ha, respectively. The lowest share of private forests is in the Lubuskie at 12.5 thousand ha, the Zachodniopomorskie at 20.4 thousand ha, and the Dolnośląskie at 20.5 thousand ha.

tal forest area which is 371.2 thousand ha, the Małopolskie at 43.6% (190 thousand ha), and the Lubelskie at 40.9% (239.1 thousand ha), respectively.

The lowest share of private forests is in the Lubuskie province at 1.8% (12.5 thousand ha), the Zachodniopomorskie at 2.5% (20.4 thousand ha), and the Dolnośląskie at 3.5% (20.5 thousand ha).



SHARE OF PRIVATE FORESTS in the total forest area
by province, in % (Central Statistical Office)

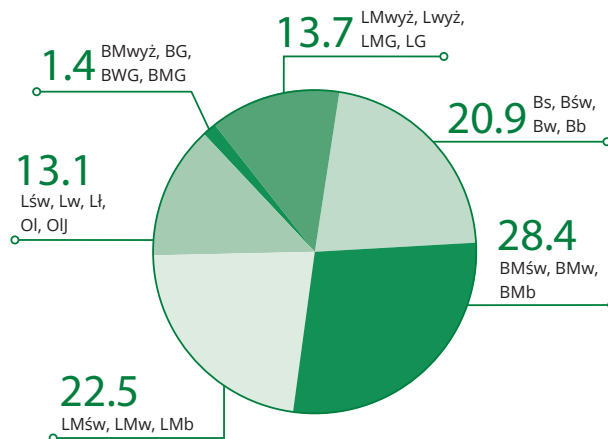


SHARE OF PUBLIC FORESTS in the total forest area
by country (SoEF 2015)



Forest habitats

Forests in Poland mainly occur in the areas with the poorest soils, which is reflected by the distribution of the forest habitat types. Coniferous forests are predominant as they account for 51% of the forest area, while the broadleaved habitats account for 49%. In both groups there are upland sites accounting for 6.3% of the total forest area and montane sites occurring in 8.6% of forests.



AREA SHARE of forest habitat types in Poland,
in % (National Forest Inventory 2011–2015)



LEGEND:

- Bb – swamp coniferous forest
- BG – montane coniferous forest
- BMb – swamp mixed coniferous forest
- BMG – montane mixed coniferous forest
- BMśw – fresh mixed coniferous forest
- BMw – moist mixed coniferous forest
- BMwyż – upland mixed coniferous forest
- Bs – dry coniferous forest
- Bśw – fresh coniferous forest
- Bw – moist coniferous forest
- BWG – high-mountain coniferous forest
- LG – montane broadleaved forest
- Lł – riparian forest
- LMb – swamp mixed broadleaved forest
- LMG – montane mixed broadleaved forest
- LMśw – fresh mixed broadleaved forest
- LMw – moist mixed broadleaved forest
- LMwyż – upland mixed broadleaved forest
- Lśw – fresh broadleaved forest
- Lw – moist broadleaved forest
- Lwyż – upland broadleaved forest
- Ol – alder forest
- Olj – alder-ash forest



Species composition

The geographical distribution of the forest sites is very well reflected by spatial distribution of dominant species. Apart from mountain regions, where the share of spruce, fir and beech in the stands species composition is larger, in most of the country pine is the dominant species in the majority of stands.

LEGEND:

PINE

SPRUCE

FIR

OTHER CONIFEROUS

BEECH

OAK

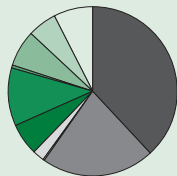
HORNBEAM

BIRCH

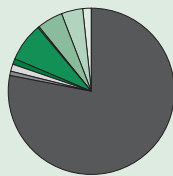
ALDER

OTHER BROADLEAVED

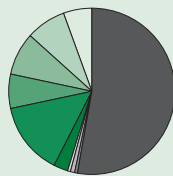
DOLNOŚLĄSKIE



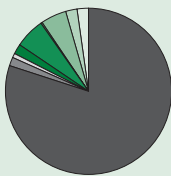
KUJAWSKO-POMORSKIE



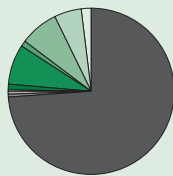
LUBELSKIE



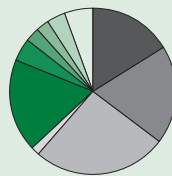
LUBUSKIE



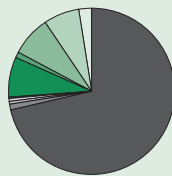
ŁÓDZKIE



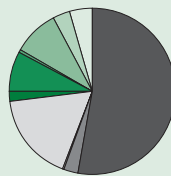
MAŁOPOLSKIE



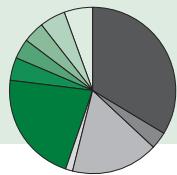
MAZOWIECKIE



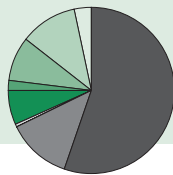
OPOLSKIE



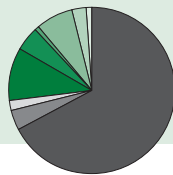
PODKARPACKIE



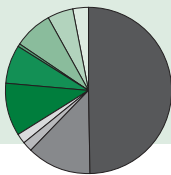
PODLASKIE



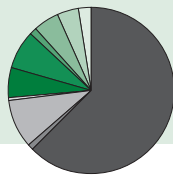
POMORSKIE



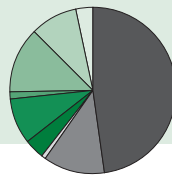
ŚLĄSKIE



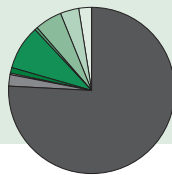
ŚWIĘTOKRZYSKIE



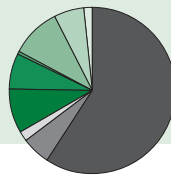
WARMIŃSKO-MAZURSKIE



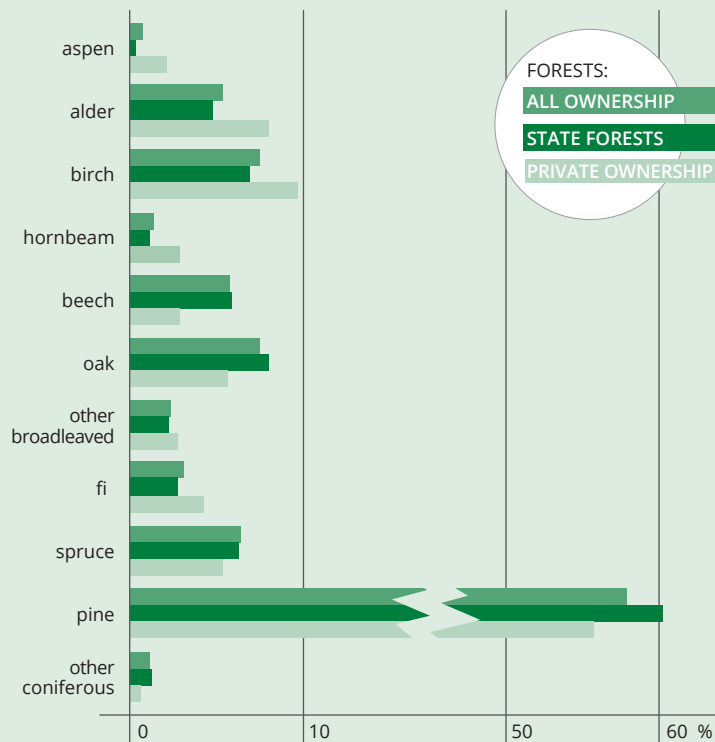
WIELKOPOLSKIE



ZACHODNIOPOMORSKIE



SPATIAL DISTRIBUTION OF TREE STANDS by dominant species and by province (National Forest Inventory 2011–2015)



AREA SHARE OF DOMINANT SPECIES in all ownership categories, in the State Forests, and in private forests (National Forest Inventory 2011–2015)

Coniferous species are dominant in 68.7% of the area of Polish forests. Pine, which according to the National Forest Inventory accounts for 58.1% of forests in all ownership categories, 60.3% of the area managed by the State Forests, and 55.4% of private forests, has found in Poland optimal climatic and site conditions within its Euro-Asian natural range. Owing to this, pine managed to produce many valuable ecotypes such as taborska and augustowska pines.

In Polish forests in the years 1945–2015, the structure of species composition changed significantly, which is evident in the increased share of stands with predominant deciduous species. In the State Forests, where these changes are monitored owing to the annual updates of the forest surface and timber resources, the area of broadleaved stands increased from 13.0 to 23.5%.

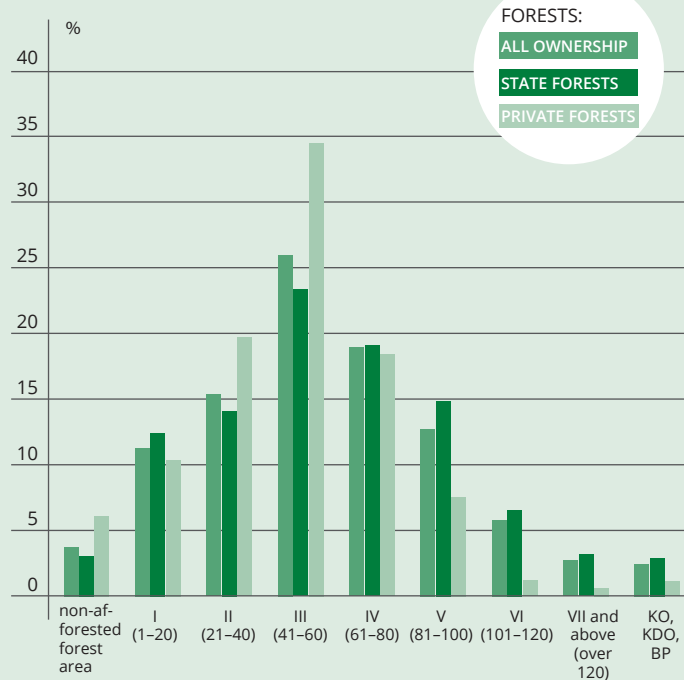
Age structure

Stands representing age classes III and IV prevail in the forest age structure and cover 25.5% and 19.1% of the forest area, respectively. In the majority of ownership categories, class III is dominating and in private forests its share is 34.7%. Stands older than 100 years including stands in restocking class (KO), class for restocking (KDO) and selection structure (BP), account for 12.6% of the area managed by the State Forests, whereas in privately-owned stands they account for 3.1%. Non-afforested surface in private forests constitutes 6.5% of their total area, and in the State Forests the corresponding value is 3.1%.

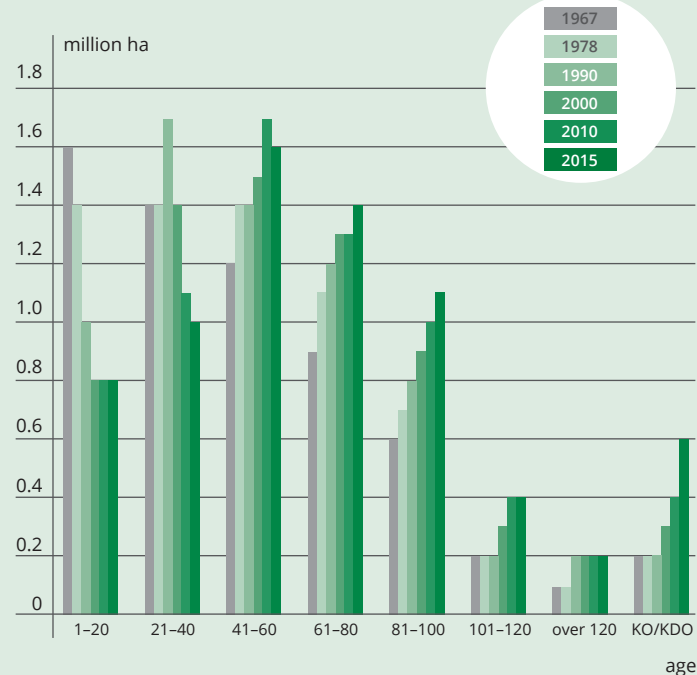
In Poland
58.1%
of forests
are pine



Stands aged
41–80 years
dominate
in Polish
forests



AREA SHARE STRUCTURE OF STANDS by class and by all ownership categories, in the State Forests and in private forests (National Forest Inventory 2011–2015)



CHANGES IN AREA OF AGE CLASSES in forests managed by the State Forests (Bureau of Forest Management and Geodesy)

More detailed direction of changes in the area structure of age classes is better exemplified by the forest resources administered by the State Forests National Forest Holding.

According to the statistics provided by the National Forest Inventory 2011–2015, the area of stands aged above 80 years (excluding restocking class KO and class for restocking KDO) has increased from about 0.9 million ha in 1945 to over 2 million ha in 2015. Additionally, in the same period the average age of stands in forests in all ownership categories increased from 44 to 57 years (58 years in the State Forests, 48 years in privately-owned forests).

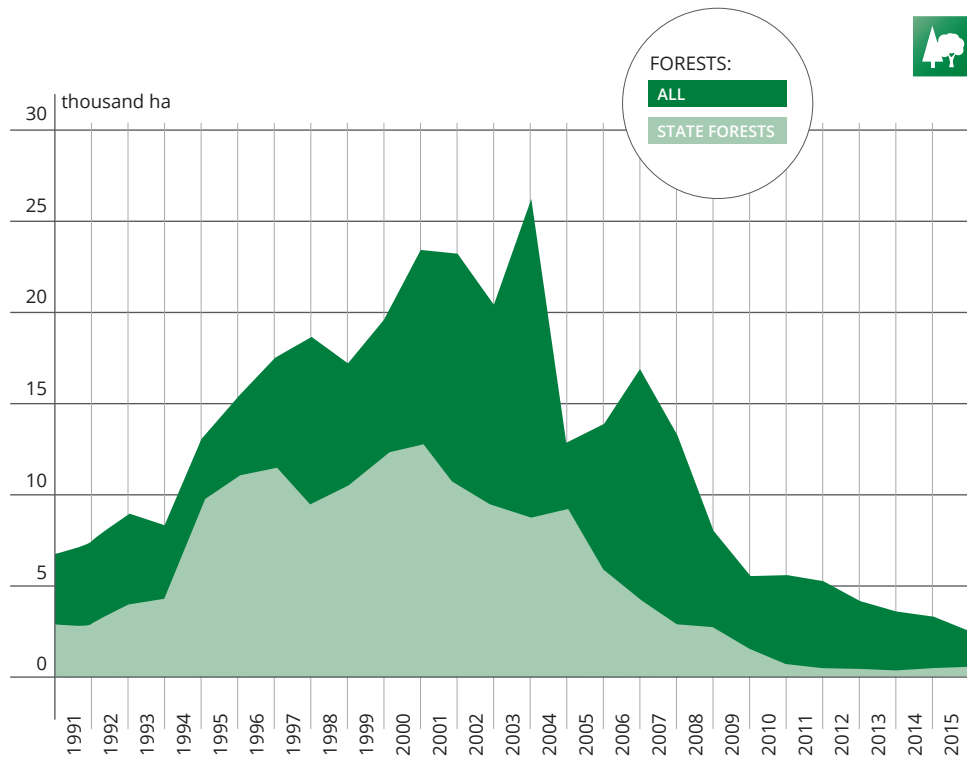
In 2015, forest renewals (excluding local afforestation and planting of second layer) were carried out in 56 394 ha of land in all ownership categories, of which 9176 ha (16.3%) was natural regeneration. Restocking area in 2015 was larger by about 3.5 thousand ha in comparison with 2014. Renewals were carried out in 0.61% of the total forest area (from 0.37% in the Podlaskie to 0.87% in the Opolskie province).

For the last 40 years of the past century, the proportion of restocking in the total area of forest renewals and, as a consequence, the share of stands in the youngest age classes, has been rapidly declining. This trend, however, has been altered since the beginning of the 21st century.

It is also worth noticing that since the mid-1970s the share of natural regeneration in the total area of forest renewals has been gradually increasing. In 1976–1980, the area of natural regeneration was 3.4% of the total renewal area, in 1981–2000 – 4.2%, in 2001–2010 – 10.4% and in the last five years – 13.7%



**In 2015
forest renewals
were carried out
on over
56 thousand ha**



SIZE OF AFFORESTATION (artificial) in Poland
in 1991–2015 (Central Statistical Office)



Changes in forest area

According to the statistics provided by the Central Statistical Office the total forest area increased by 521 thousand ha in 1991–2015, while in the latter year by 17 thousand ha.

The basis for all afforestation in Poland is the *National Programme for the Augmentation of Forest Cover* created in 1995 on the initiative of and commissioned by the then Ministry of Environment, Natural Resources and Forestry. The programme was developed by the Forest Research





Institute and recommended by the Council of Ministers on 23 June 1995. In 2002 it was modified. The main objective of the programme is to augment the forest cover of the country to 30% by the year 2020 and to 33% by 2050, to ensure an optimal spatial and temporal distribution of afforestation, to establish environmental and economic priorities and the instruments for their implementation.

In 2015, there were afforested (artificially) 2270 ha of land in all ownership categories. The largest afforested areas were in the Zachodniopomorskie – 314 ha, and in the Warmińsko-Mazurskie – 292 ha; the smallest were in the Śląskie – 8 ha and the Małopolskie – 20 ha. In 2015, the afforestation surface was by 1505 ha (i.e. by 40%) smaller as compared with the previous year. Additionally, in 2015 there were 194 ha afforested presumably as the result of natural succession (in 2014 – 259 ha).

Drastic decline in afforestation (from 16 933 ha in 2006 to 2270 ha in 2015, i.e. by 87%) is largely a result of changes made to the criteria by which private agricultural land is designated for afforestation within the framework of the Rural Development Programme, including: the raise of minimal acreage of thick afforestation area, withdrawal of permanent grasslands and areas designated as Natura 2000 sites from EU subsidies for afforestation, and attractive financial aid for agricultural production.

A similar drastic decrease in the size of afforested areas was observed in the State Forests, where in 2015 only 748 ha were artificially afforested as compared with 9.7 thousand ha in 2004. This was a result of a rapid decline in the area of post-agricultural and uncultivated land transferred to the State Forests by the Agricultural Property Agency.

2270 ha
were afforested
in 2015



Wood resources in
Poland

2491

million m³

of gross merchantable
timber

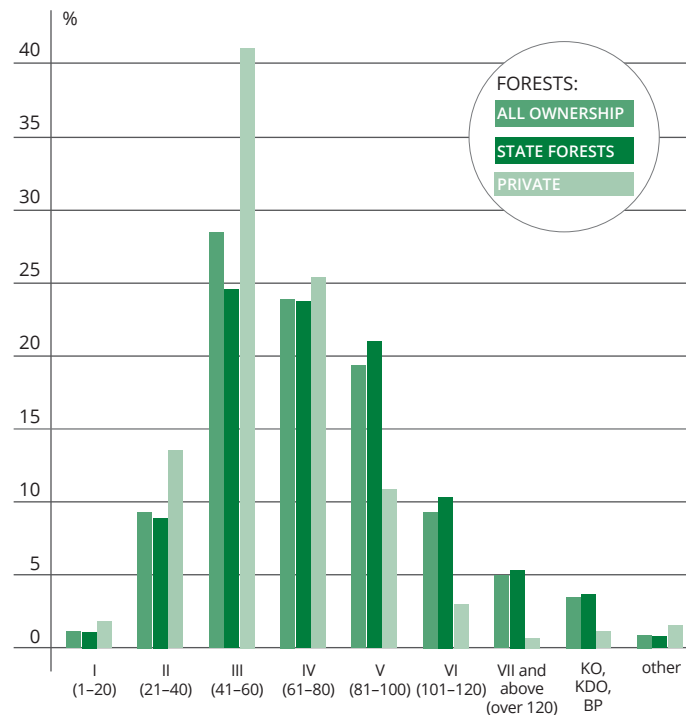
Volume structure of timber resources

According to the measurements carried out by the National Forest Inventory in 2011–2015 and related to the area of forests at the end of 2014, the timber resources amounted to 2491 million m³ of gross merchantable timber, out of which 1965 million m³ comes from the State Forests and 409 million m³ from the privately-owned.

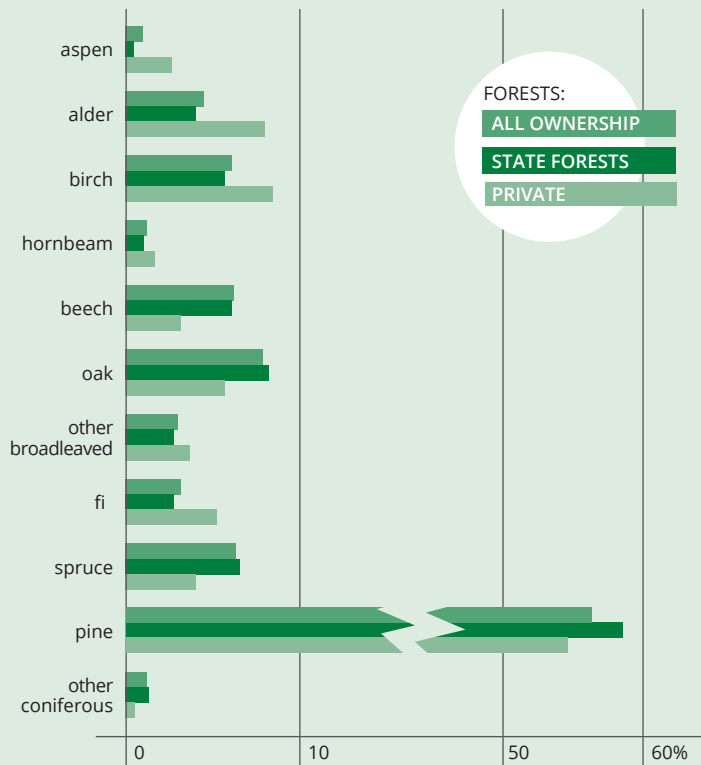
Over a half of timber resources (52.0%) are in stands in age classes III and IV: 49.0% in the State Forests and 67.3% in private forests. The volume of timber resources in stands aged over 100 years including restocking class (KO), class for restocking (KDO), and selection structure (BP) accounts for 19.3% in the State Forests and 4.9% in private forests.

According to the results of the National Forest Inventory 2011–2015, the average volume of growing stock in Polish forests is 271 m³/ha, including for the forests managed by the State Forests 277m³/ha and for the private forests 234 m³/ha. The greatest volume of growing stock is in the forests of the Podkarpackie (310 m³/ha) and the Małopolskie (308 m³/ha), while the smallest is in the forests of the Mazowieckie (244m³/ha) province.

Pine accounts for 56.7% of the volume of timber resources in forests in all ownership categories. In the State Forests this share is 58.6%, whereas in privately-owned the same figure is 54.3%. As compared with the volume structure of timber resources in the State Forests,



**VOLUME STRUCTURE OF TIMBER RESOURCES by age class,
in all ownership categories, in the State Forests and in private forests**
(National Forest Inventory 2011–2015)



ACTUAL VOLUME SHARE OF TIMBER RESOURCES by tree species, in all ownership categories, in the State Forests, and in private forests (NFI 2011–2015)

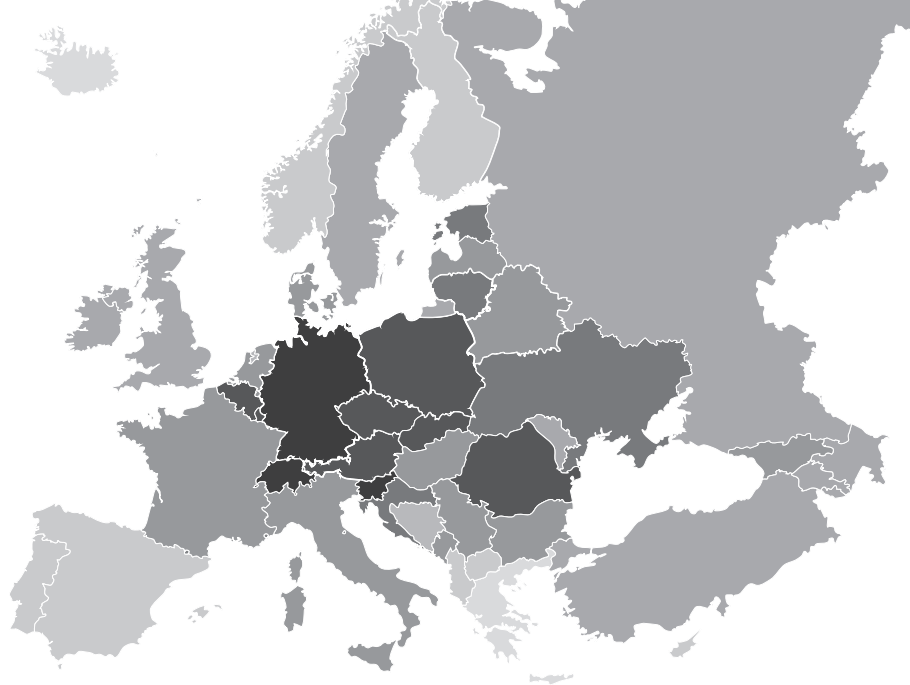
private forests are characterized by larger volume of broadleaved species as birch, alder, aspen and hornbeam in particular, but with smaller share of oak and beech.

Polish forests rank highly among the European leaders with regard to the density of growing stock. The mean value for Poland provided by the *State of Europe's Forests (SoEF)* statistics for 2015 (269 m³/ha if we take into account combined forest area and the grounds associated with forest management) is much higher than the European average, i.e. 163 m³/ha (114 m³/ha including the Russian Federation).

According to *SoEF* assessment, Poland is a country with a relatively large absolute area of forests and with growing stock density higher than the European average; also has significant in the region timber resources which amount to more than 2.5 billion m³.

Average volume
of growing stock
in Poland
271 m³
of timber per one ha
of forest





GROWING STOCK (m³/ha):

301–353

151–200

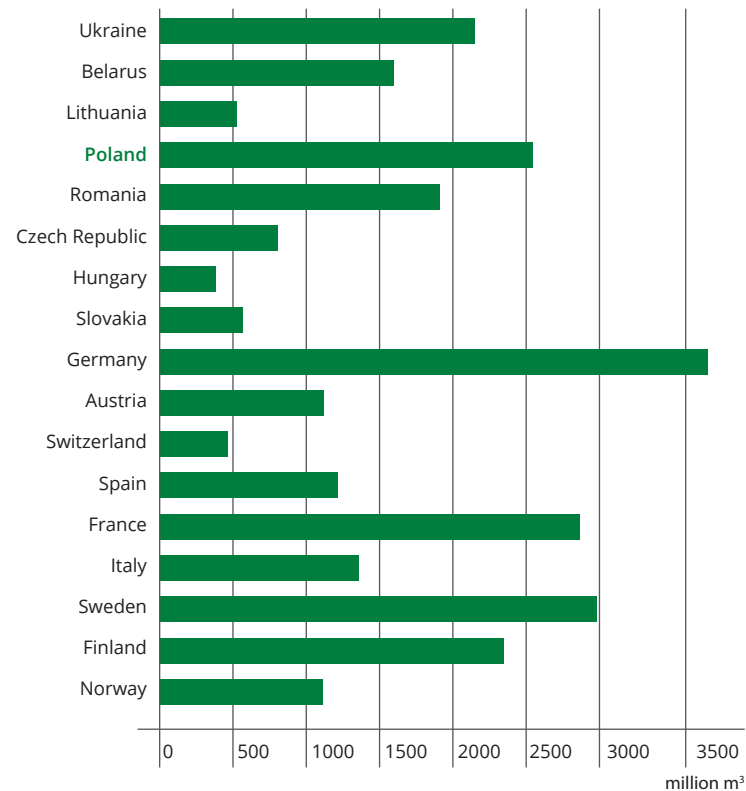
0–50

251–300

101–150

201–250

51–100



TIMBER RESOURCES in selected countries (SoEF 2015)



Changes in timber resources

There has been a steady growth of timber resources since the first update in the State Forests took place in 1967. In the last few years, a reliable source of information has become the National Forest Inventory. In relation to the State Forests, the NFI records indicate a slightly higher figure (by 6%) for forest resources, in comparison with annual updating reports. According to the NFI, for the periods 2006–2010 and 2011–2015, the combined value of timber resources in the country was increasing annually by an average of 31 million m³.

In the last 20 years, from January 1995 to January 2015, the increment of gross merchantable timber in forests managed by the State Forests was 1225 million m³. During this period, 687 million m³ of merchantable timber was harvested, which means that 538 million m³ of gross merchantable timber (representing 44% of the total increment) augmented the volume of stem resources.

General growth of timber resources is not only the result of increasing forest area, there are also changes in growing stock volume per hectare within individual age classes. In the analyzed period this indicator has been continually increasing for all age classes, except restocking class (KO) and class for restocking (KDO).

The increase in timber resources within the State Forests is a result of harvesting wood in accordance with the principle of forests sustainability, and of continuing augmentation of the forest area. To some extent it may also be due to applying more accurate inventory methods.



Timber
resources
in Polish forests
increase by

31 million m³
annually

LEGEND:

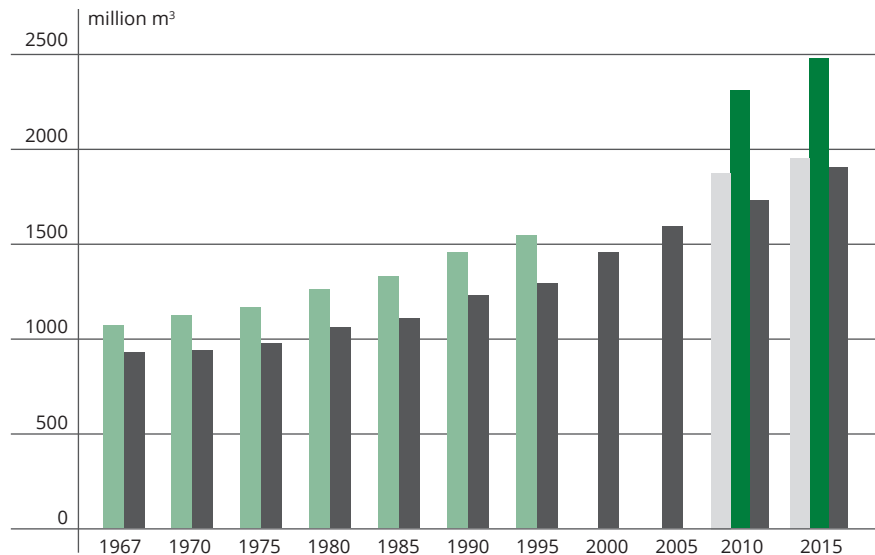
ALL FORESTS (Central Statistical Office)

STATE FORESTS BY NFI*

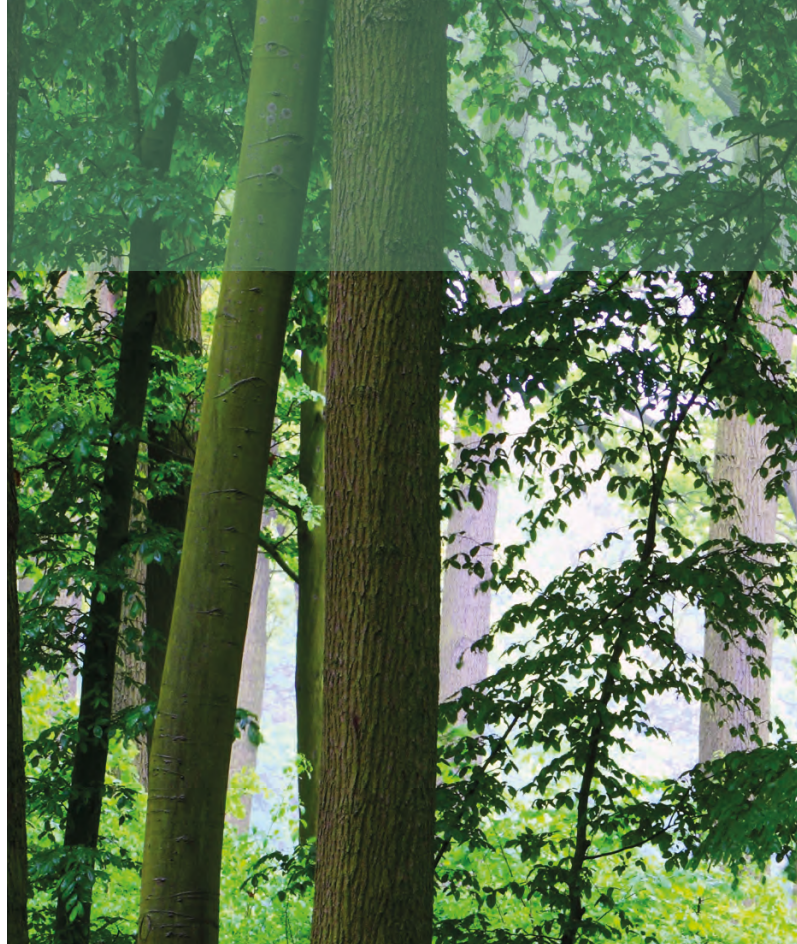
ALL FORESTS BY NFI*

STATE FORESTS (update)

* National Forest Inventory data for periods 2006–2010 and 2011–2015



AMOUNT OF TIMBER RESOURCES in Polish forests in the years 1967–2015, in million m³ of gross merchantable timber (Central Statistical Office, Bureau of Forest Management and Geodesy, National Forest Inventory); figures for 1 January



FOREST FUNCTIONS

Forests fulfil diverse functions, either naturally or resulting from human activities, the main of which are:

ENVIRONMENTAL (PROTECTIVE) FUNCTIONS

having positive impact on global and local climate, regulation of water cycle in nature, prevention of floods, avalanches and landslides, protection of soil against erosion and landscape against stepplisation;

SOCIAL FUNCTIONS

providing health-enhancing and recreational conditions for society, contributing to the labour market and ensuring development of environmental education of society;

PRODUCTIVE (ECONOMIC) FUNCTIONS

mainly the capacity of biomass reproduction including wood and non-wood forest products, as well as effective management of hunting.

The State Forests have a legal obligation to operate according to the principles of sustainable forest management which are directed at preserving the sustainability of forests and their continuous multifunctional use, as well as the augmentation of forest resources.



Forest provides jobs for nearly 50 thousand people who deal either with forest management or nature protection. It provides incentives for industrial production and help maintain jobs in other branches of economy such as wood industry, pulp and paper sector, or energetics.



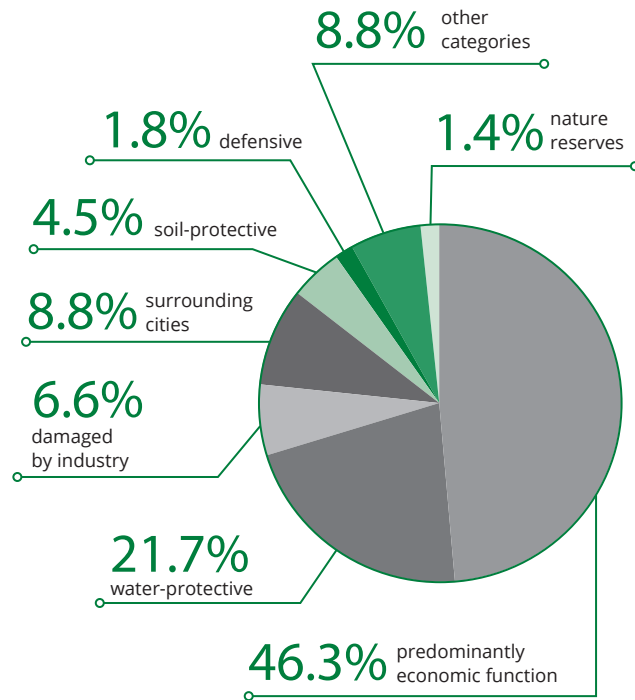
Environmental functions of forests

In Poland
53.7%
of all forests
are protective

The earliest formal regulations on social and environmental forest functions and especially on distinguishing a category of protective forests were included in the first post-war *Instruction on Forest Management*, published in 1957. By the year 1975, a total of 1485 thousand ha of forest were designated as protective, which comprised 22.5% of the forest area administered by the State Forests at that time. As of 1 January 2015, the total area of protective forests increased to 3709 thousand ha, which represents 52.3% of the total forest area, or 53.7% including 102 thousand ha of nature reserves. The majority of protective forests is located in the southern part of the country, in the mountain areas (90.2% in Kraków RDSF, 84.0% in Krosno RDSF) and in the areas affected by industry (83.5% in Katowice RDSF).

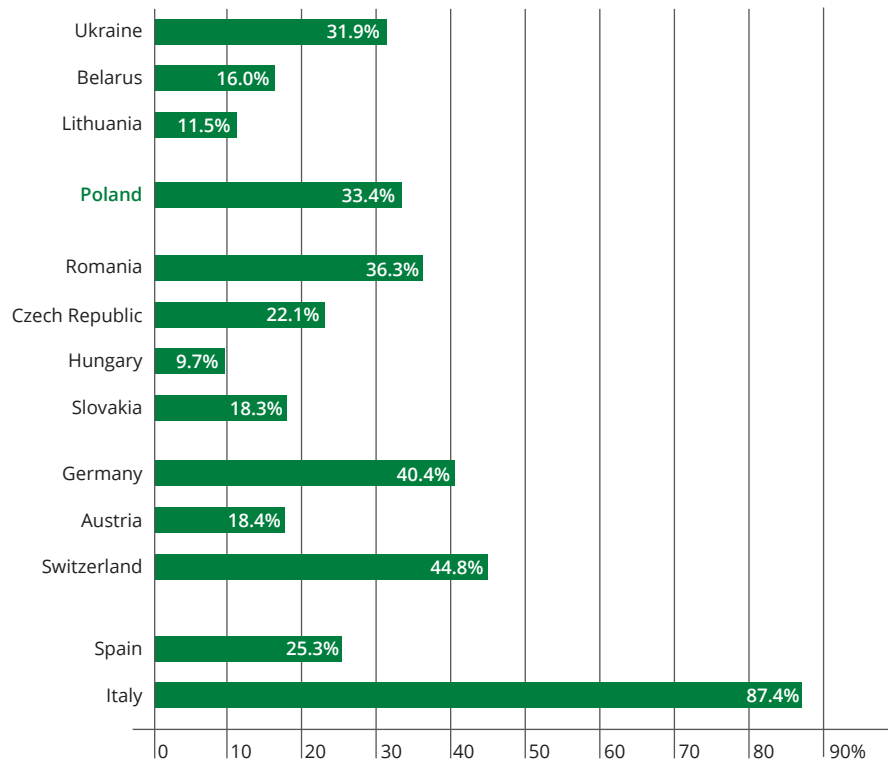
The area of private forests recognized as protective has been estimated at 65.2 thousand ha, or 3.7% of their total area; municipal protective forests cover an area of 22.1 thousand ha (25.8%). The share of protective forests in all ownership categories in the total forest area in Poland currently has reached 41.2%, and including the area of nature reserves – 42.3%.

In comparison with other countries in the region, Poland has a relatively high proportion of protective forests (33.4%, according to the SoEF 2015 criteria). Slightly ahead of Poland are Germany (40.4%) and

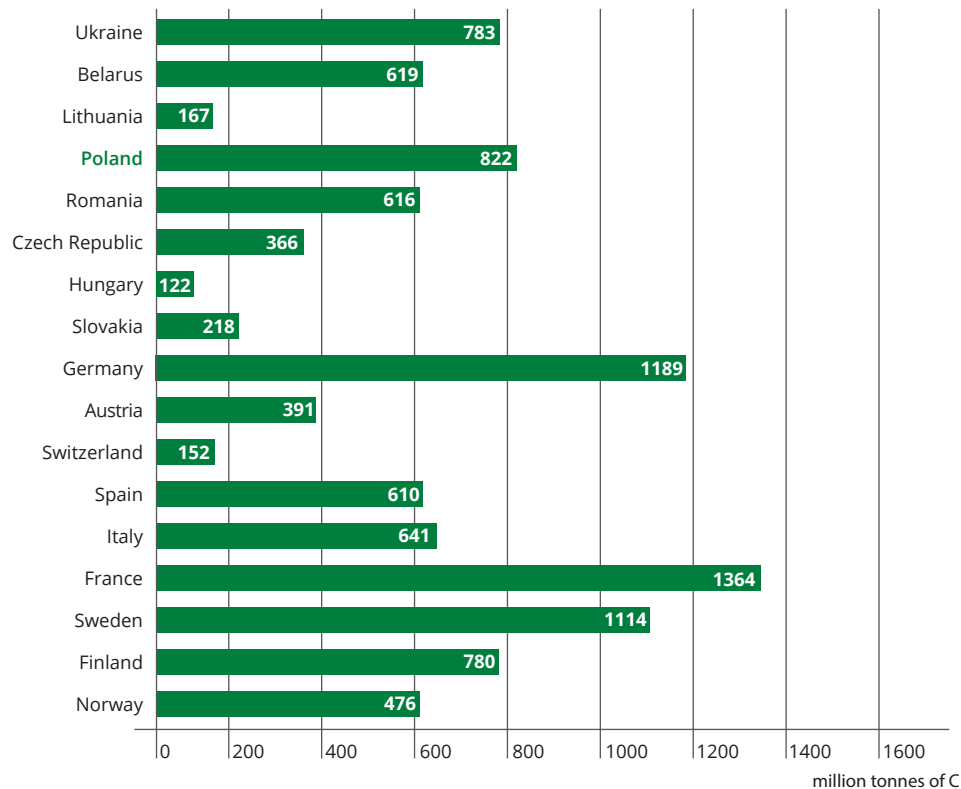


SHARE OF PROTECTIVE FORESTS in the State Forests in 2015
(Directorate-General of the State Forests)

Romania (36.3%). Out of the countries who have reported to the *SoEF* 2015, the largest share of protective forests occurs in Italy (about 87.4%) mainly due to large areas of soil- and water-protective forests. Protective forests are subject to different management practices, depending on their predominant function. These may include limited clear-cuttings, raising the felling age, adjusting species composition to their functions, creating recreational facilities, etc.



SHARE OF PROTECTIVE FORESTS in the total forest area (*SoEF* 2015)



AMOUNT OF CARBON captured and stored in standing wood biomass (SoEF 2015)

Carbon sequestration

Assessment of the amount of carbon absorbed by ecosystems (including forest) was, until recently, of almost exclusively scientific interest. Climate warming caused by the increased amount of CO₂ in the atmosphere, and raising social awareness of this threat have brought about more practical dimension expressed in the Kyoto Protocol (in force since 16 February 2005). The value of forestry activities which foster increased carbon sequestration has been financially estimated and included in the overall balance of emission and absorption of greenhouse gases.

The general rules for assessing the amount of carbon sequestered by forests and the possibility to include this amount in the total balance for CO₂ emission are based on the decisions taken during the Conference of the Parties for Climate Change and the assumptions of the Kyoto Protocol.

In December 2015, during the conference in Paris it was agreed that one of the most effective methods to hinder the increase of global temperature is the sequestration of CO₂ by forest ecosystems. Therefore the Paris Conference issued another appeal to take effective measures in order to limit deforestation of large areas and to ensure growth of timber resources, mainly through planting new stands. The concept of 'forest carbon farms' in which specifically adjusted forest management would enable additional CO₂ capture by forest ecosystems was also presented.

The data on timber resources show that the amount of carbon stored in wood biomass in Poland has been estimated at 822 million tonnes,

including 685 million tonnes in standing volume and 137 million tonnes in the underground part; the amount of carbon in deadwood has been assessed at 32 million tonnes (SoEF 2015). The annual amount of CO₂ sequestered by forests (including the absorption of the gas by soils) is estimated at 41.4 million tonnes, which equals approximately 11.3 tonnes of carbon.

Poland is one of the leaders among European countries as regards the amount of sequestered carbon in the wood biomass. This is mainly the result of both the size and the structure of forest resources in our country (species, habitat and age structure).

The reduction of the amount of greenhouse gases may be improved by appropriate activities linked to the forest management, e.g. through the above mentioned increase of the forest area resulting from afforestation of post-agricultural land, forest renewal with the participation of fast-growing species, silvicultural treatment enlarging growing stock, extending durability of wooden products and their recycling, reduction of fossil fuels emission, use of wood as energy source or increasing retention of soil organic carbon.

The State Forests, by subsidising research projects, have undertaken actions in order to strengthen knowledge on carbon dioxide balance in managed forests, and to develop methodology of obtaining necessary data to measure carbon sequestration by forest areas. Efforts are also made to test the possibility of introducing Removal Units (RMU) into domestic market, which would be 'produced' and shared by the State Forests with the external entities and within the framework of the so called additional activities in forestry.

Social functions of forests

Forest education

The aim of forest education is to disseminate in society the knowledge on forest environment and sustainable forest management, to raise social awareness on reasonable and responsible use of all forest functions and to build trust to foresters' professional activities.

In 2015, more than 3.5 million people took part in various kinds of educational activities organized by the foresters. There were typical outdoor lessons and guided tours, classes in forest education chambers, meetings with foresters at schools, meetings outside schools, educational events and actions, exhibitions, forest contests, festivities, fairies, etc. The largest group of participants in educational activities comprised primary school children. The educational events and activities were also largely attended by students and adults.

Such variety of educational activities is possible thanks to the commitment of over 9 thousand foresters who devoted part of their time to forest education. They were supported by attractive educational infrastructure which includes: forest education centers (65), educational chambers (269), educational shelters called 'green classes' (562), educational trails (1011), educational points (1882), other facilities (2734), and also overnight accommodation.



3.5
million
participants in
educational
programmes

The educational offer of the State Forests is integrated with a wide range of tourist attractions available to all ages and social groups. The visitors to the forest have at their disposal a very well-developed accommodation consisting of nearly 4.5 thousand beds available in recreation and training centres, also guest rooms and hunting lodges. There are over 20 thousand kilometres of walking routes, nearly 4 thousand kilometres of cycling routes and about 7 thousand kilometres of horse riding routes. Forest visitors can also use over 600 bivouac sites and camping places. Camp fires are permitted in 400 designated places, either in the forest or nearby. Cars may be left at 3160 forest parking lots or vehicle parking places. Visitors may use 614 other facilities, also 60 training and recreation centres, about 130 hunting lodges and over 200 guest rooms. One may look for the information about current tourist offer provided by the State Forests at www.czaswlas.pl website which was created in 2010.

Littering is one of the consequences of the more intense tourism in the forest areas. Despite educational campaigns and provision of more appropriate infrastructure, the cost of keeping forests clean is continually growing. In 2015, the State Forests spent nearly 17.5 million PLN on forest cleaning and over 122 thousand m³ of litter were removed.

Productive functions of forests

Productive functions of forest are defined as production of timber resources and other products which can be utilised by man and are the basis of many industries, professions, traditions and cultures.

In 2015, the amount of net merchantable timber harvested in Poland was 38 327 thousand m³ (by 665 thousand m³ more than in 2014), including 1406 thousand m³ from private forests (a decrease of 120 thousand m³ on 2014), and 179 thousand m³ from national parks.

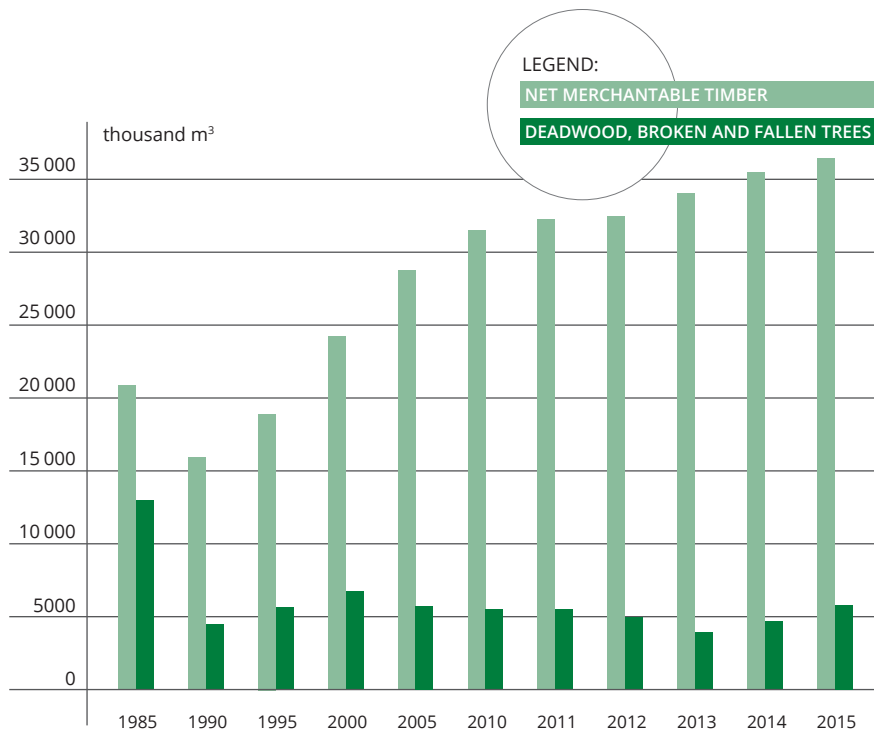
In 2015, the State Forests harvested 38 408 thousand m³ of raw timber, including 36 497 thousand m³ of net merchantable timber (102.1% of the approximate prescribed cut by volume), out of which 18 253 thousand m³ (97.0% of prescribed cut) were obtained in final felling, and 18 224 thousand m³ (107.7 % of prescribed cut) from pre-final felling.

Additionally, the volume of timber harvested for sanitation reasons by clearing deadwood, broken or fallen trees which were damaged in natural processes, wind activity, gradations of insect pests, disturbances in water relations, air pollution and other disastrous weather events amounted in 2015 to 5097 thousand m³, or 14.0% of the total harvest of merchantable timber. According to the relevant data, this was one of the lowest shares in the last 30 years, although it was a little higher than that in the previous year.



38.3
million m³

of gross merchantable
timber was harvested
in 2015

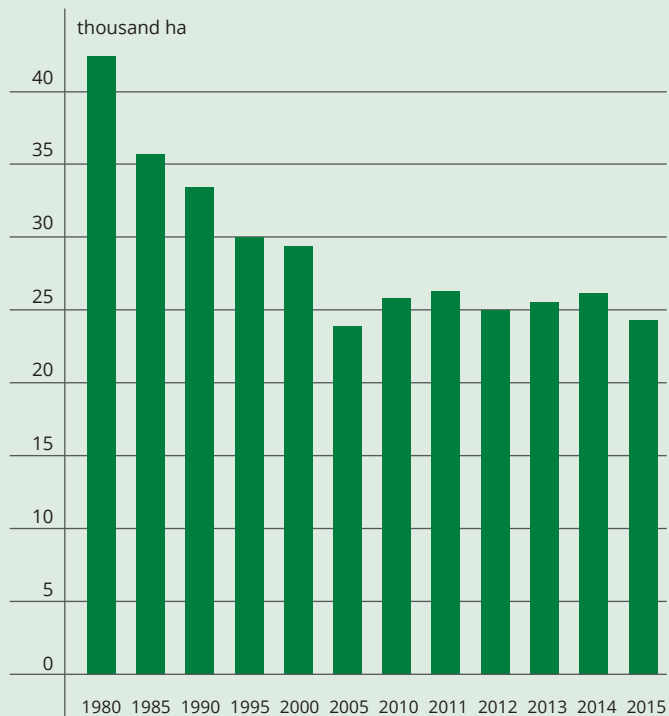


SHARE OF DEADWOOD, BROKEN AND FALLEN TREES in total harvest in the State Forests
in 1985–2015, in thousand m³ of net merchantable timber (Directorate-General of the State Forests)

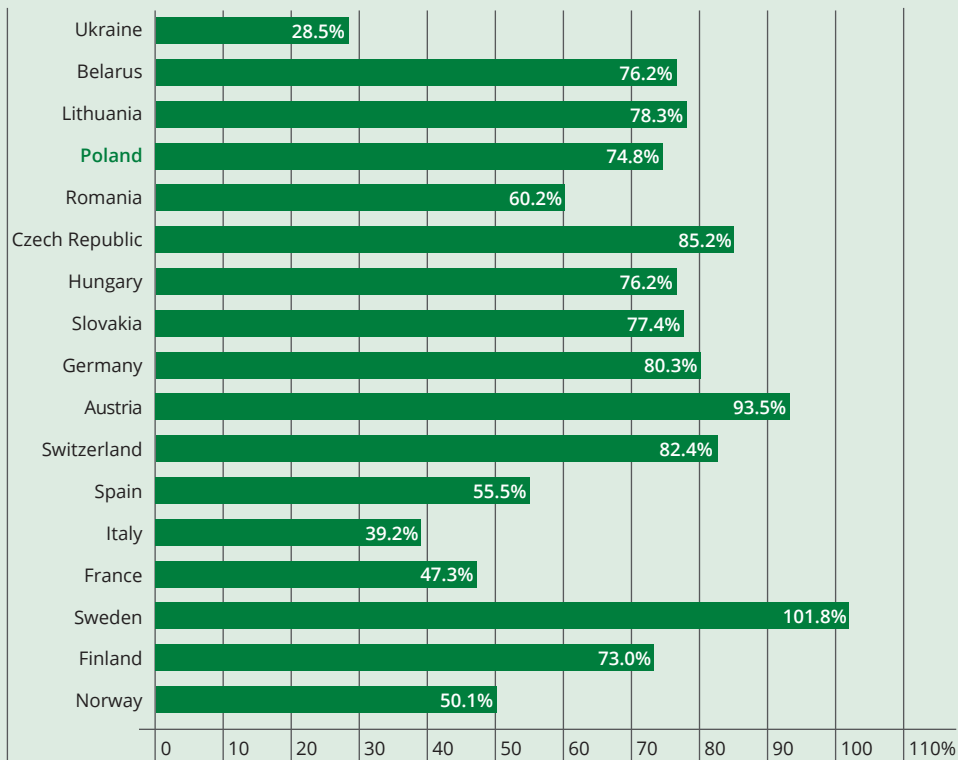
In the State Forests, during the last 20 years (1996–2015) the prescribed cut for final felling has been fulfilled in 93%, in turn the prescribed cut for pre-final felling (by volume) determined in forest management plans has been fulfilled in 112.3%.

To put it another way, in 2015 under the clear-cut system in the State Forests 6861 thousand m³ of merchantable timber was harvested, which accounts for 18.8% of the total merchantable timber harvest. The clear-cut area amounted 24.2 thousand ha and was slightly smaller than the average surface for the past decade amounting 25.2 thousand ha. The gradual reduction in size of the clear-cut areas is indicative of the progress in implementing the more ecological forest management, however it is worth remembering that the clear-cuts are often necessary due to the occurrence of large-scale damages caused by wind and other abiotic factors, or of forest dieback due to drought, fungal disease or insect gradation.

Furthermore, a comparison of the respective indicators for the group of countries with similar geographic condition is indicative of the appropriate intensity of felling in Poland. In the majority of countries in the region, over 50% of the increment is harvested, with the exception of such countries as Ukraine (28.5%), Italy (39.2%) and France (47.3%).



CLEAR-CUT AREA IN THE STATE FORESTS in 1980–2015
in thousand ha (Directorate-General of the State Forests)



RELATION OF TIMBER HARVEST to annual increment (SoEF 2015)



Forests in nature and landscape conservation

Forests in Poland are one of the most valuable elements of the environment and are protected by a variety of nature and landscape protection forms. There are national parks, nature reserves, areas of protected landscape, Natura 2000 sites, areas of ecological utility, nature and landscape complexes and documentation sites.

The highest form of nature protection are national parks which currently number 23 and cover 314.7 thousand ha. Forests comprise 195.2 thousand ha, i.e. 62% of the total area of national parks.

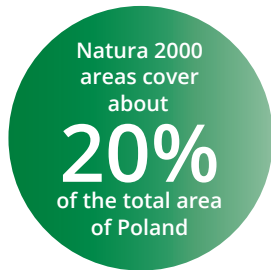
Nature reserves, 1490 in number, cover an area of 166.9 thousand ha. Majority of reserves (1279) are located within administrative boundaries of the State Forests. The combined forest area in nature reserves is 95.6 thousand ha.

There are 122 national parks, created through administrative orders of provincial governors, of a combined area 2606.1 thousand ha, out of which 1317.0 thousand ha (50.5%) are forests. The areas of protected landscape include 383 objects of nature with a total area of 7093.9 thousand ha, of which forests constitute 2296.4 thousand ha (32.4%). Both forms of nature conservation account for over 50.2% of the area of the State Forests.

Within Natura 2000 network, at the end of 2015, there were designated 145 special protection areas for birds with a total land and sea area

of 5575 thousand ha, and 849 sites of Community importance with a total area of 3851 thousand ha. Natura 2000 sites cover 6853 thousand hectares which is about 20% of the country's total area. In the areas administered by the State Forests, special protection areas for birds cover 2217 thousand ha (29.1%), whereas sites of Community importance 1659 thousand ha (21.8%).

The State Forests, in compliance with the Forest Act and the national policy on forests, have been keeping records of all statutory forms of nature protection; the data is currently updated, e.g. while creating nature conservation programmes in forest districts.

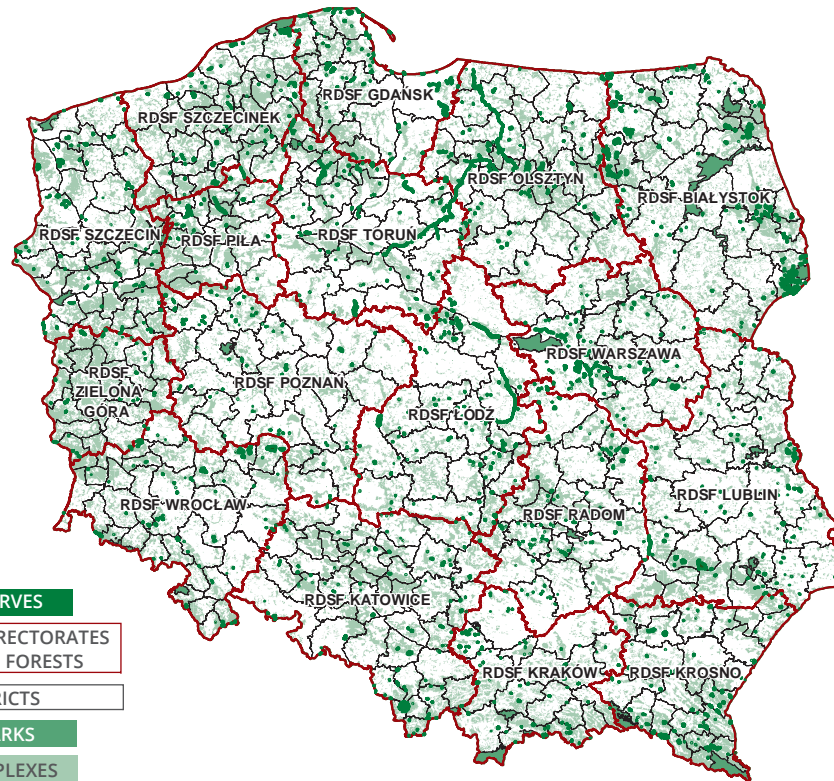


As of 31 December 2015, in the area of the State Forests have been recorded the following nature protection forms:

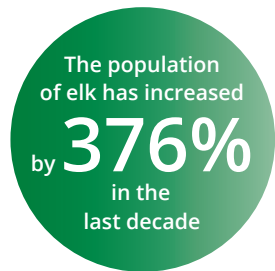
- 1279 nature reserves with an area of 123.4 thousand ha;
- Natura 2000 sites with a total area of 2891 thousand ha (38% of the State Forests territory), including: 133 special protection areas (SPA) for birds covering 2217 thousand ha (29.1%) and 706 sites of Community importance (SCI) with a combined area of 1659 thousand ha (21.8%);
- 10 328 monuments of nature, including 8523 individual trees, 1471 groups of trees, 130 avenues of trees, 473 erratic boulders, 204 rocks, grottoes and caves, and 163 area surface monuments (346 ha);
- 8924 areas of ecological utility comprising 28 682 ha;
- 127 documentation sites with an area of 1151 ha;
- 141 nature and landscape complexes with a combined area of 37 654 ha.

In the State Forests over 3394 protective zones for endangered species were approved with a total area of 147 261 ha, of which over 20% is an area of all-year protection. These zones are being created in order to protect the refuges of birds (3097), mammals (1), reptiles (39), insects (10), plants (5), lichens (251) and other (1).

In the total area of stands under special protection over 195 811 ha are designated as the seed bases, of which 15 544 ha are selected seed stands, 173 804 ha are seed producing stands, 1858 ha are seed



NATURE RESERVES in Poland in the lands administered by the State Forests (Directorate-General of the State Forests)



orchards and seed crop plantations and 4604 ha are gene conservation crops and stands, which supply material for further propagation of native ecotypes of forest-forming tree species.

In order to preserve biological diversity and restore endangered species of flora and fauna the State Forests also initiate their own programmes aimed at maintaining habitats and species at good condition. Among them are mainly the *Programme for the Preservation of Forest Genetic Resources*, and such projects as the *Programme for the Restitution of Fir in the Western Sudetes*, *Programme for the Restitution of Yew* and programmes focusing on reintroduction of capercaillie, black grouse, peregrine falcon, lynx, edible dormouse and European bison, and within own financial resources programmes of in situ and ex situ conservation of such species as wild service tree, smooth snake, hermit beetle, great capricorn beetle, stag beetle, hare, grey partridge and many others. In forest districts there are animal rehabilitation centres (8), botanical gardens (5) and arboreta (5).

Game animals, whose number in Poland is one of the highest in Europe, are indicative of the richness of species of the forest fauna. Population sizes of main species have remained at high level for several years so the great pressure on the forest environment from these animals results in damages. As compared with 2014, the populations of most game animals in 2015 did not change significantly. There was a noticeable increase only in the size of population of elk (by 19%), pheasant (by 8%) and hare (by 5%), and a decrease in population of wild boar (by about 7%).

In the last decade, however, there was an increasing trend as far as most species are concerned. The significant increase has been noted in the population of elk (by 376%), fallow deer (by 110%), mouflon (72%), wild boar (by 52%), red deer (by 52%) and roe deer (by 25%). The reverse trend was observed only in the population of grey partridge (by about 18%).

In order to protect valuable elements of the ecosystems, the organisational units of the State Forests carry out numerous projects aided with additional domestic and EU funding as the National Fund for Environmental Protection and Water Management, the European Regional Development Fund, Life+, Operational Programme 'Infrastructure and Environment'. In 2015 these projects, among other issues, concerned:

- Reclamation for environment the degraded and post-military land administered by the State Forests (58 forest districts in a total area of over 30 thousand ha);
- Increasing water retention capacity and counteracting flood and drought in the lowland forests ecosystems (175 forest districts in the whole country);
- Counteracting the adverse effects of the outflow of precipitation water in the mountainous areas. Increasing water retention and preserving streams and the related infrastructure in good condition (55 forest districts in 4 RDSFs).

The State Forests also take actions aimed at implementing integrated programmes linked to the priority objectives of the European programmes such as: Adapting forests to climate change until 2020 and Counteracting climate change in the forestry sector until 2020.

THREATS TO THE FOREST ENVIRONMENT

Types of stress factors

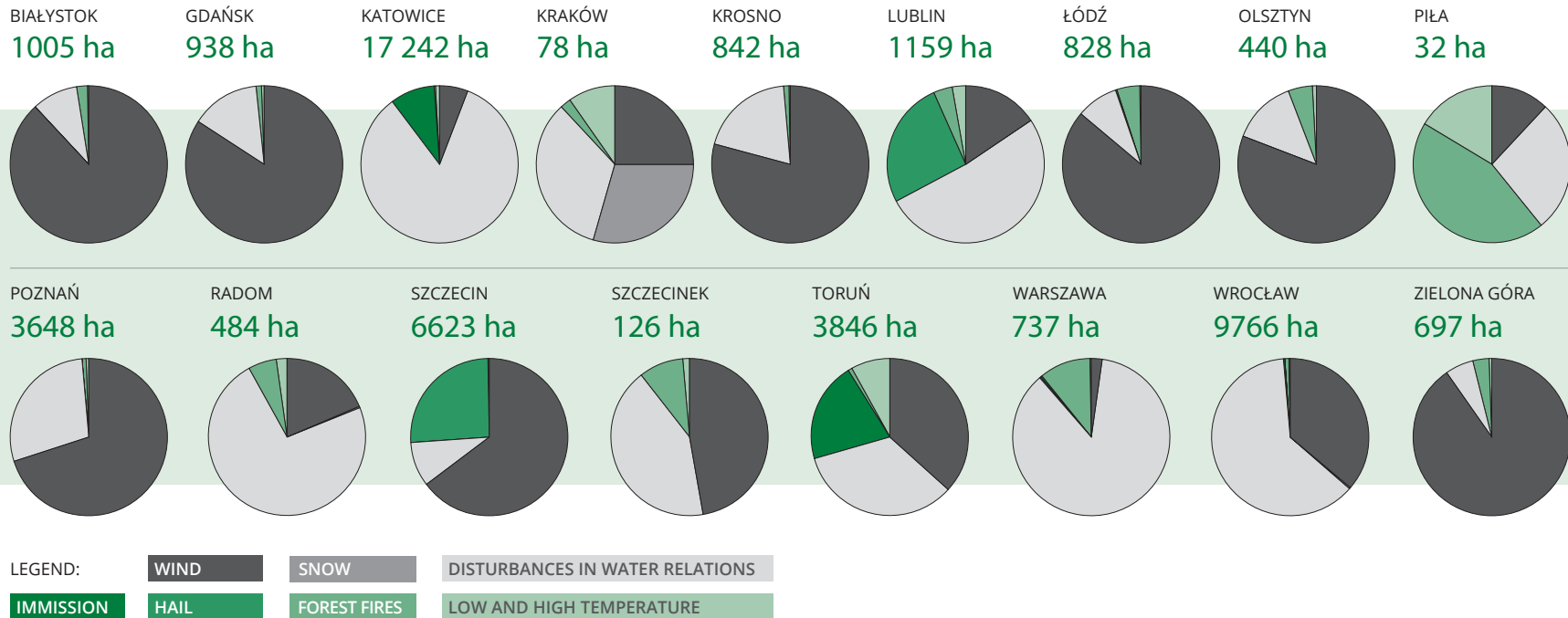
Forests in Poland are among the most threatened in Europe which is mainly because of the country's position on the border of two climates, i.e. continental and maritime, and as a consequence the simultaneous and continual influence of many factors fostering adverse effects and changes in the health condition of forests. The factors creating harmful effects, described also as stress factors, can be classified according to

- origin as abiotic, biotic and anthropogenic;
- type of impact as physiological, mechanical and chemical;
- duration of impact as chronic and periodical;
- function in the process of disease as predisposing, inciting and contributing.

The influence of stress factors on forest environment is very complex and often based on synergy. Additionally, the reaction to the occurrence of an incentive may be delayed in time. The research and observation carried out so far reveal that simultaneous occurrence of many stress factors highly and continually predisposes forests to disease and causes continuing processes of destruction in the forest environment. More intense periodical occurrence of just one stress factor (pest gradation, drought, forest fires) may cause the collapse of the ecosystem's biological resistance and disastrous threats (local or regional).



Depending on their type and intensity, the occurrence of stress factors may cause damage or even extinction of organisms, disturbance in forest ecosystems, biodiversity impoverishment, permanent limitation of the habitat productivity, total dieback of stands, and synanthropisation of an entire plant community.



AREA OF STANDS aged over 20 years damaged to various degrees by selected abiotic and anthropogenic factors in each RDSF in 2015

Abiotic threats

In 2015 the greatest natural disaster for the whole country was persistent drought which weakened both coniferous and broadleaved stands and increased their vulnerability to various pests and pathogenic fungi. One of the abiotic factors of disastrous nature which affected the level of damage to trees were mostly hurricane winds. In most cases these events were local or, at the most, regional.

Damage caused by at least one abiotic factor was reported by 91% of forest districts. The combined area of such stands in 2015 was 48 492 ha. The largest area was affected by disturbances in water relations, droughts (25 741 ha in 184 forest districts) and strong winds (17 256 ha in 186 forest districts).



Biotic threats

Threats to forest from primary insect pests

Forests in Poland are under constant pressure from a variety of biotic factors of which insects and pathogenic fungi cause most damage, especially species that tend to occur massively in a form of cyclic gradations and epiphytotics. In recent years damage caused by forest animals is also on the increase. All of these can cause various types of damage to stands which, in extreme cases, can lead to their destruction. The economic impact can be serious as both productive and non-productive functions of forests can be limited.

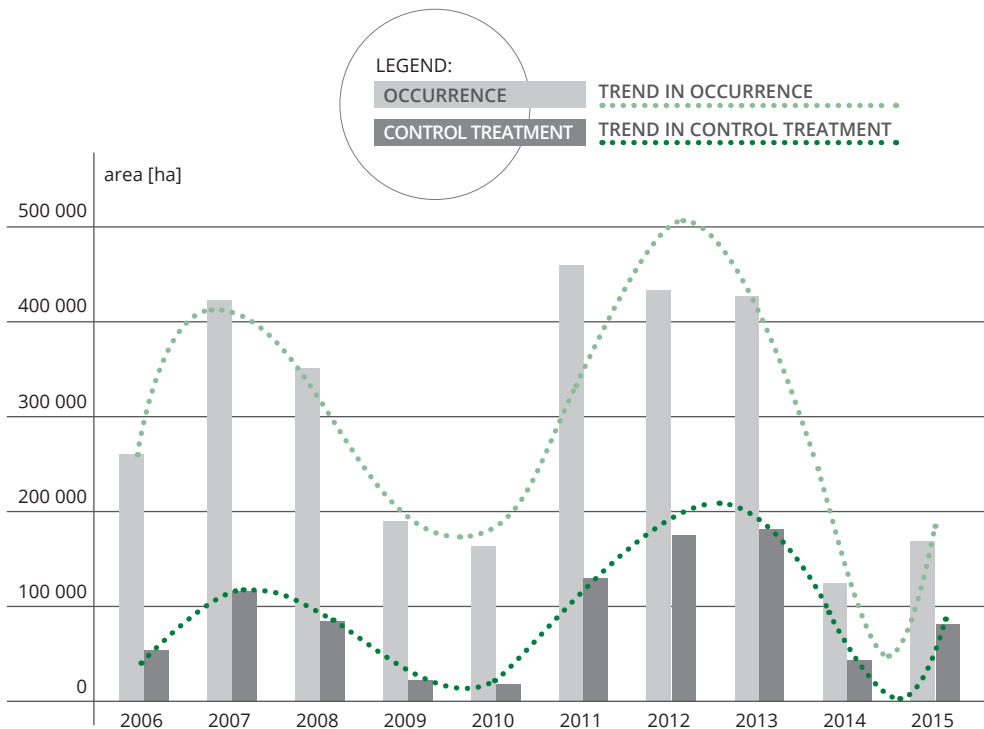
In 2015, in the forests under the State Forests administration the threat from primary insect pests was rather low. The total area of their occurrence comprised 175 thousand ha, whereas imagines of cockchafers took 126 thousand ha of that area.

As a consequence it was necessary to apply control treatment in order to reduce populations of 42 pest species or groups. In 2015, the total area of forest stands which were subject to population control treatment was approx. 86 thousand ha and was over twice larger than in the previous year. The largest area of stands in which population control treatment was applied was recorded in Lublin RDSF (over 30 thousand ha).



In the SF
protective
treatment was
applied on about

86
thousand
ha



AREA OF OCCURRENCE AND POPULATION REDUCTION of primary insect pests in 2006–2015, showing trend in changes

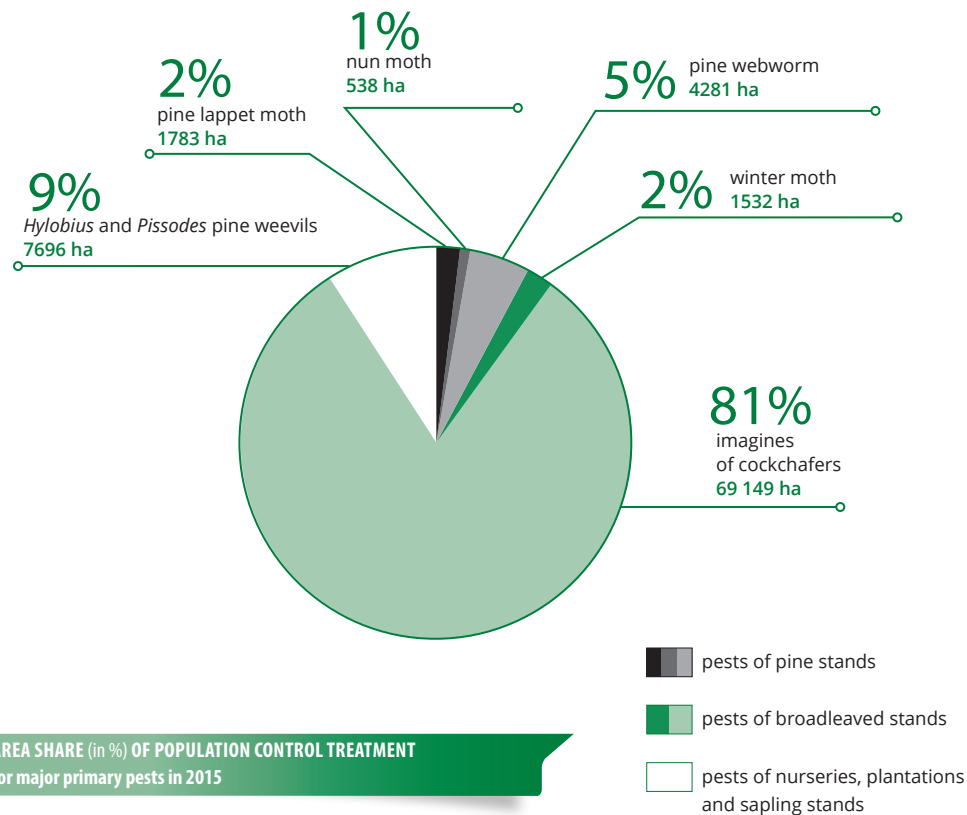
In 2015 there was a three-fold increase of the total area of broad-leaved stands (mainly oak) threatened by folivorous pests, from 46 803 ha in 2014 to 138 409 ha in 2015. There was a substantial increase, almost seven-fold, in the total area subject to chemical control treatment against folivorous pests of broadleaves. The largest increase in the area subject to agricultural aviation and on-the-ground treatment concerned imagines of cockchafers (69 149 ha – over 137-fold increase). Other folivorous pests of broadleaved stands were combated on 2262 ha. The control treatment was mainly applied to oak stands threatened by winter moth and its companion species, and by green oak moth.

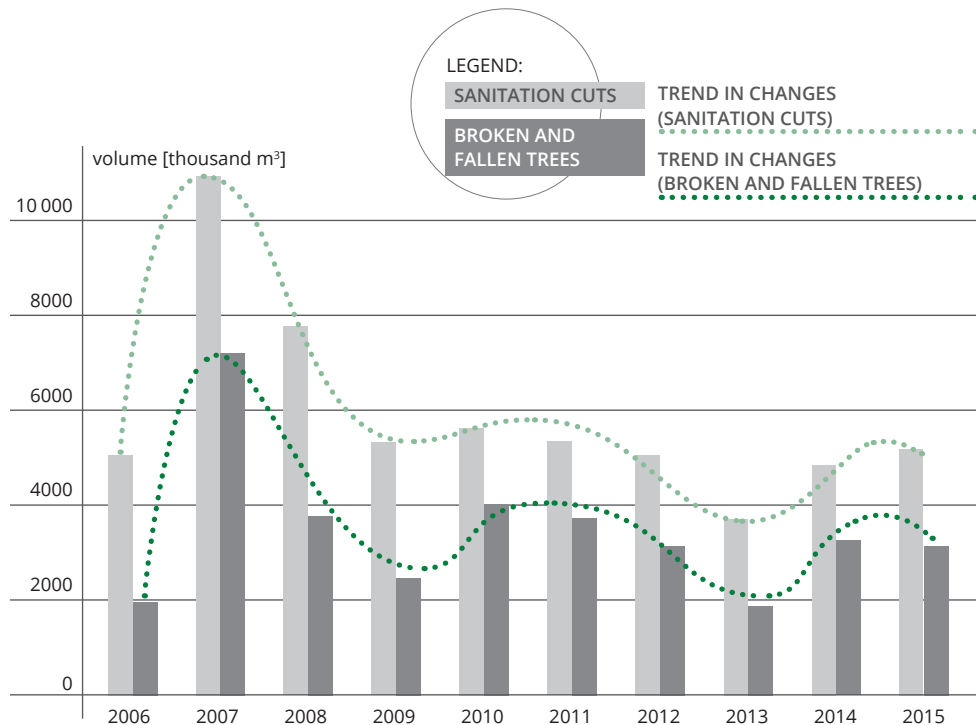
Primary pests attacking older pine stands are usually the major insect pest group mainly because they occur in the largest area. They cause large scale damage and therefore the expenditure incurred on their combat by the State Forests is very high. In 2015, a low level of threat by this group of insects was recorded. In order to control them, the agricultural aviation treatment was applied on the area of 6803 ha. In this group, the most dangerous pests were web-spinning sawflies (Pamphiliidae), and the total area of the applied control treatment comprised 4281 ha and was slightly smaller than in 2014. Pine lappet moth and nun moth had significant economic impact as the control treatment was carried out on the area of 1783 ha (decrease by 75% as compared to 2014) and 538 ha (decrease by 90%), respectively.

In 2015, the population control treatment for pests occurring in plantations, sapling stands and pole forests was applied in the area of over 7.6 thousand ha. However, the major damage was caused by pine weevils *Hylobius* and *Pissodes*.

The occurrence of many other species/groups of insect pests was also recorded, including root pests of trees and shrubs, which continually damage Polish forests, and also pests of spruce, larch, fir and Douglas fir. Their economic impact, however, was minor. The combined area of spruce, larch and fir stands in which population control treatment for insect pests was applied was 164 ha.

Control treatment for root pests of forest trees and shrubs was applied in nurseries and plantations in the area of 40 ha.





VOLUME OF TIMBER harvested in sanitation cuttings, including broken and fallen trees, in 2006-2015, showing trend in changes¹

¹ In 2012 there was a change in reporting methodology concerning the data on timber volume harvested in sanitation cutting. The data for the years 2006–2011 cover period October to September of the next year while data for the years 2012–2015 cover period January to December of a given year.

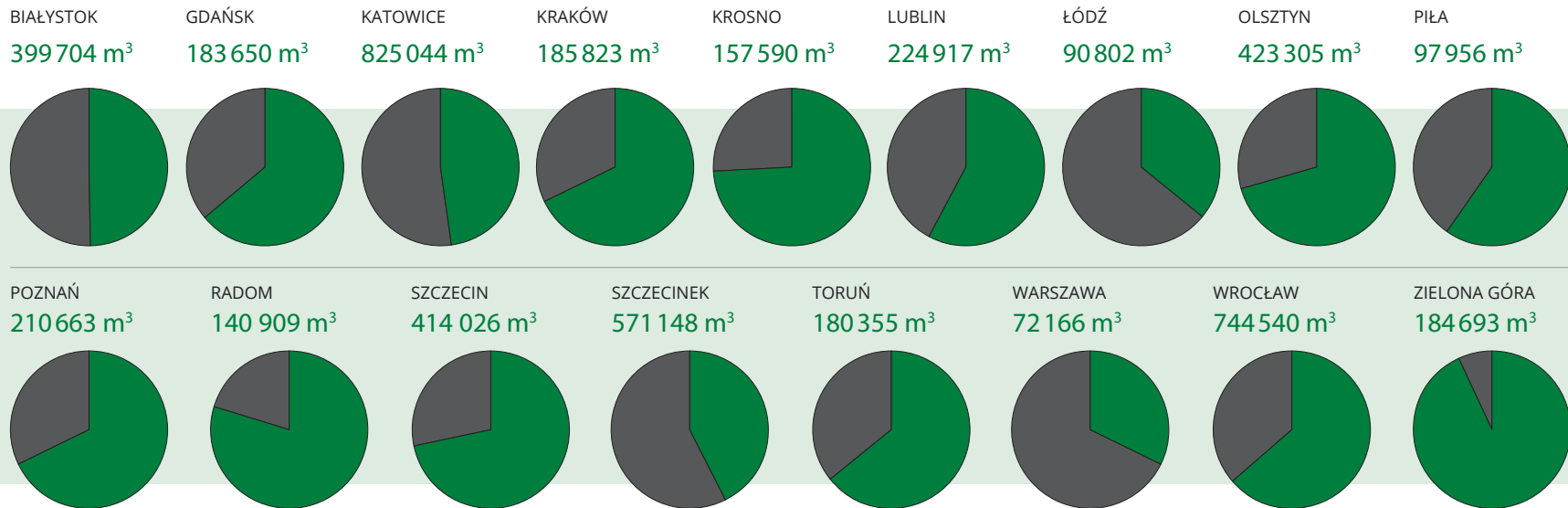
Threats to forest from secondary insect pests

In 2015, weather conditions, particularly the drought, caused fungal diseases, mainly those attacking roots, to spread and created perfect conditions for secondary pests to develop. Negative effects of abiotic and biotic factors were already visible in forests in the second half of 2015, but the greatest intensity of damage (increased sanitation cutting, especially deadwood harvesting) will occur in 2016 and probably in the years to follow.

In 2015, the timber harvest resulting from sanitation cutting was 5107 thousand m³, of which 60% were broken and fallen trees.

Coniferous stands were most threatened: 4194 thousand m³ of wood were harvested, of which 57% were broken and fallen trees. The volume of pine timber felled in 2015 in the sanitation cutting scheme was 2236 thousand m³, of which 28% was deadwood. Major secondary pests of pine stands in 2015 were steelblue jewel beetle and engraver beetle whose gradations were noted mainly in Lublin RDSF. The amount of spruce timber harvested in sanitation cutting in 2015 was 1813 thousand m³, of which deadwood was 63%. Main secondary pests of spruce stands were the European spruce bark beetle and its companion species: small spruce bark beetle, six-toothed spruce bark beetle and northern bark beetle.

The size of sanitation cutting in broadleaved stands in 2015 was at 912 thousand m³, of which over 75% were fallen and broken trees.



LEGEND:

DEAD OR DYING TREES

BROKEN AND FALLEN TREES

VOLUME OF DEADWOOD, BROKEN AND FALLEN TREES
harvested in sanitation cutting in 2015 in each RDSF

In 2015
infectious
diseases affected

172.5
thousand ha
of forests in
Poland

Threats to forest from infectious fungal diseases

In 2015 infectious diseases were reported over a combined area of 172.5 thousand ha of stands, a decrease of 35.8 thousand ha (by 17%) as compared with 2014.

The most significant changes in the area of occurrence (threat decrease by 50%) concern two diseases of assimilatory apparatus, namely pine shoot dieback and powdery mildew of oak. The acreage affected by the occurrence of pine needle cast increased by 36% and leaf and needle rust by 21 ha. The area affected by pine bark rust slightly decreased (by 14%), also the occurrence of fungi causing inner cankers and rots of logs and stems was reported in the acreage smaller by 4.3 thousand ha (21.6 thousand ha).

The improvement in health of broadleaved stands continues. Combined area affected by dieback of trees amounted to 7.5 thousand ha (in 2014 it was 10.2 thousand ha). In 2015 the dieback of such species as oak, beech, ash and alder was less intense, however in stands with the participation of birch and other species the dieback increased. According to the reports, in 2015 there were no health problems of poplar.

Areas affected by root diseases decreased by 26 thousand ha as compared with 2014, while the acreage of damage caused by *Armillaria* root rot increased by 7%, and by *Heterobasidion* root rot decreased by 28%.

In nurseries the area affected by fungal diseases amounted to 486 ha (in 2014 it was 504 ha). The occurrence of diseases in stands aged up to 20 years was recorded in the area of 16.2 thousand ha, which is smaller than that in the previous year by 2.8 thousand ha. Fungal diseases in mature stands occurred in the total area of 156.4 thousand ha, which is smaller than that in the previous year because of the significant decrease in the area affected by pine shoot dieback and oak mildew.

Protective treatment applied in forestry in order to control the spread of infectious fungal diseases is carried out in forest nurseries (mainly chemical methods) and in stands, as and when it is necessary (biological and mechanical methods). In 2015 chemical treatment was used on the combined area of 1.1 thousand ha, protective biological and mechanical treatment on 19.2 thousand ha and 3.2 thousand ha, respectively.



Damage
caused by
animals was
reported on nearly
90
thousand ha
of forests

Threats to forest from animals

In 2015, damage to stands caused by game and protected animals was reported in the combined area of 89.5 thousand ha. Damage within the range 21–40% occurred on 62.8 ha, but above 40% on 26.7 thousand ha.

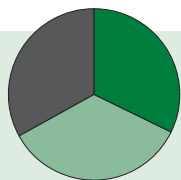
Damage caused solely by game including red deer, fallow deer, roe deer, wild boar and hare was reported in the area 68.3 thousand ha, of which 33.0 thousand ha are plantations, 25.9 thousand ha are sapling stands, and 9.5 thousand ha are stands in older age classes.

Besides damage from game, in 2015 animal species under various protection forms were also reported as being harmful to forests. The species reported as the most destructive are primarily elk, beaver and the European bison.

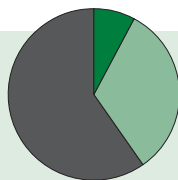
The greatest damage from elks was observed in regions recognised as the main refuges of this animal, namely in north-eastern Poland. Similarly to damage caused by elks, beavers are the most harmful in the north-eastern Poland. The damage brought about by beavers was reported in a combined area of 13.0 thousand ha. For instance, severe harm to forests made by beavers was reported mainly in the area of Białystok RDSF (3.3 thousand ha) and Olsztyn RDSF (2.9 thousand ha). Additionally, the injuries to renewals caused by the European bison were observed in the combined area of 376 ha, mainly in Białystok RDSF (269 ha) and Krosno RDSF (100 ha).



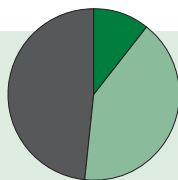
BIAŁYSTOK
10 990 ha



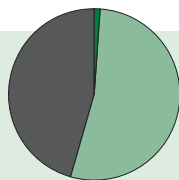
GDAŃSK
1900 ha



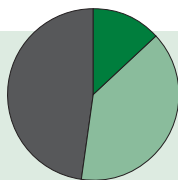
KATOWICE
7076 ha



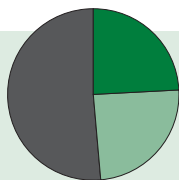
KRAKÓW
1022 ha



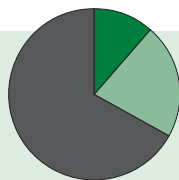
KROSNO
2330 ha



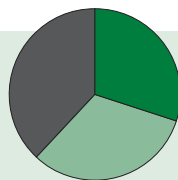
LUBLIN
6650 ha



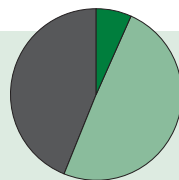
ŁÓDŹ
2516 ha



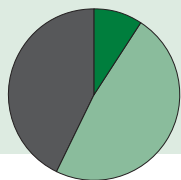
OLSZTYN
7856 ha



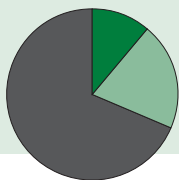
PIŁA
8851 ha



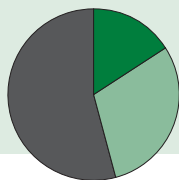
POZNAŃ
3209 ha



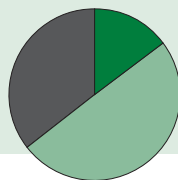
RADOM
2115 ha



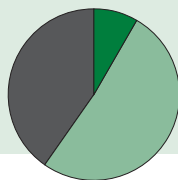
SZCZECIN
3312 ha



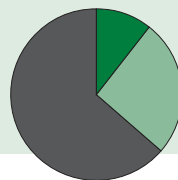
SZCZECINEK
4960 ha



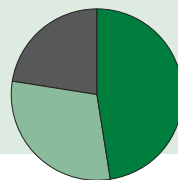
TORUŃ
4734 ha



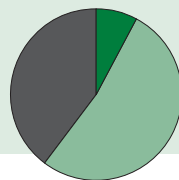
WARSZAWA
2300 ha



WROCŁAW
15 658 ha



ZIELONA GÓRA
4020 ha



LEGEND:

OLDER STANDS

PLANTATIONS

SAPLING STANDS

AREA OF STANDS in each RDSF where damage exceeding 20% was caused by game and protected animal species, in 2015



Anthropogenic threats

Forest fire

In 2015, the average area of fire in forests in all ownership categories amounted to 0.45 ha (by 0.06 ha less than in 2014). In the State Forests it was smaller by 0.07 ha and was 0.24 ha. In other ownership categories the average area of fire amounted to 0.54 ha.

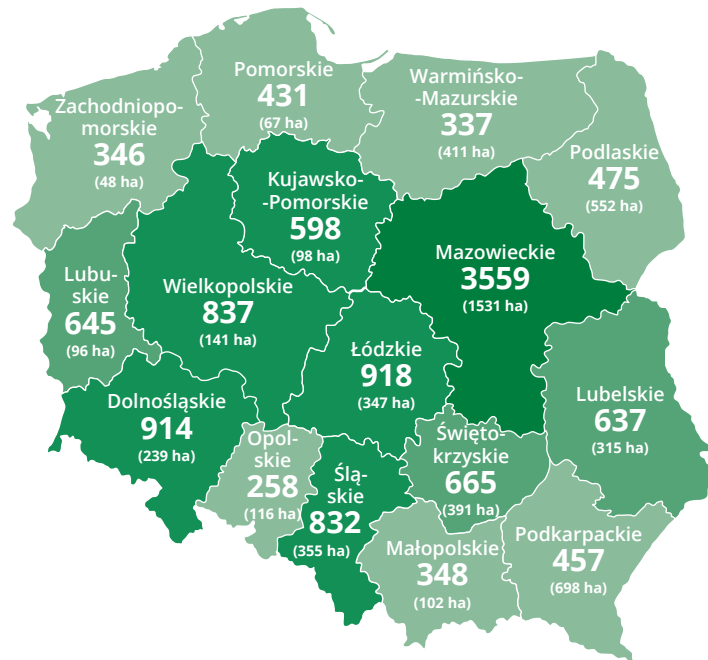
In 2015, in Poland as a whole 12 257 forest fires were recorded, which is 7012 more than in the previous year, 5510 ha of stands were burnt, which is by 2820 ha more than in 2014. The largest number of fires, as in 2014, broke out in the Mazowieckie province (3559, which is 29% of the total number), the lowest, however – in the Opolskie (258) and the Warmińsko-Mazurskie (337).

In 2015, in the State Forests there were 3732 forest fires (30.45% of all forest fires in Poland) in the area of 878 ha (15.93% of the total), excluding the territories used by the military. The largest number of fires in 2015 took place in Katowice RDSF (531); they also covered the largest area of 160 ha.

In 2015, in the territory used by the military there were 165 fires, which comprised 776.17 ha (in 2014 there were 102, and covered 607.21 ha).

Countrywide, four large-scale fires were reported in 2015 (above 100 ha), there were also 28 very big fires (in 2014, 2 large-scale and 19 very big fires, respectively)

The average area of fire in the forests in all ownership categories in 2015 amounted to 0.45 ha (by 0.06 ha less than in the previous year).



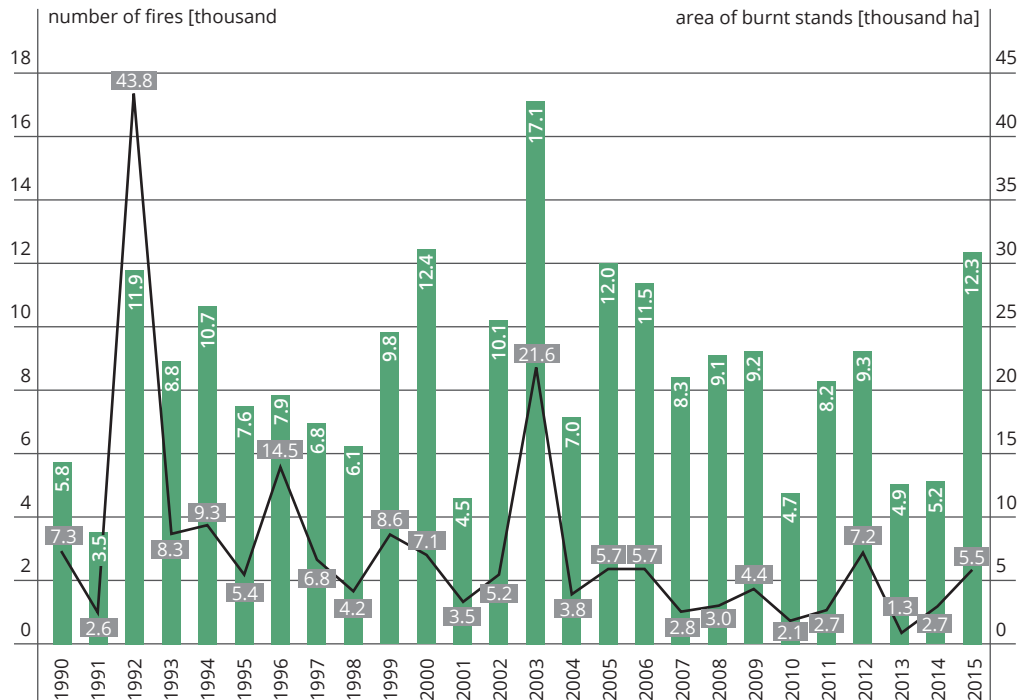
1-125	251-500	751-1000
126-250	501-750	above 1000

NUMBER OF FOREST FIRES in Poland in 2015

As compared to 2014, the average area of fire decreased by 0.07 ha, reaching 0.24 ha. In forests of other ownership it was 0.54 ha.

The most frequent causes of fires in the State Forests were arson (40%) and negligence (16%), however the share of fires from an unknown cause amounted to 37% of all fires. In forests in all ownership categories, 43% of fires were caused by arson, 29% by negligence, 8% by accidents, 1% by natural reasons, but in case of 19% the cause remained unknown.

The most combustible month in 2015 was August (33.7% of all fires, i.e. 4129), then April (12.9%), June (12.7) and July (12.0%).



LEGEND:

NUMBER OF FIRES

AREA OF BURNT STANDS

TOTAL NUMBER OF FOREST FIRES and area of burnt stands in Poland
in the years 1990–2015



Air pollution

Forest monitoring provides information about major pollutants in the forest areas. The network of intensive monitoring consists of 12 permanent observation plots. Five plots are located in pine stands (Chojnów, Strzałowo, Białowieża, Krucz and Zawadzkie forest districts), two in oak stands (Łąck and Krotoszyn forest districts), two in beech stands (Gdańsk and Bircza forest districts), and three in spruce stands (Suwałki, Szklarska Poręba and Piwniczna forest districts).

Average monthly concentration of sulphur dioxide and nitrogen dioxide measured on observation plots, was within 0.3–3.9 $\mu\text{g SO}_2/\text{m}^3$ (average value during the investigation period 0.9–2.7 $\mu\text{g SO}_2/\text{m}^3$) and 2.3–20.6 $\mu\text{g NO}_2/\text{m}^3$ (average value during the investigation period 4.2–14.8 $\mu\text{g NO}_2/\text{m}^3$).

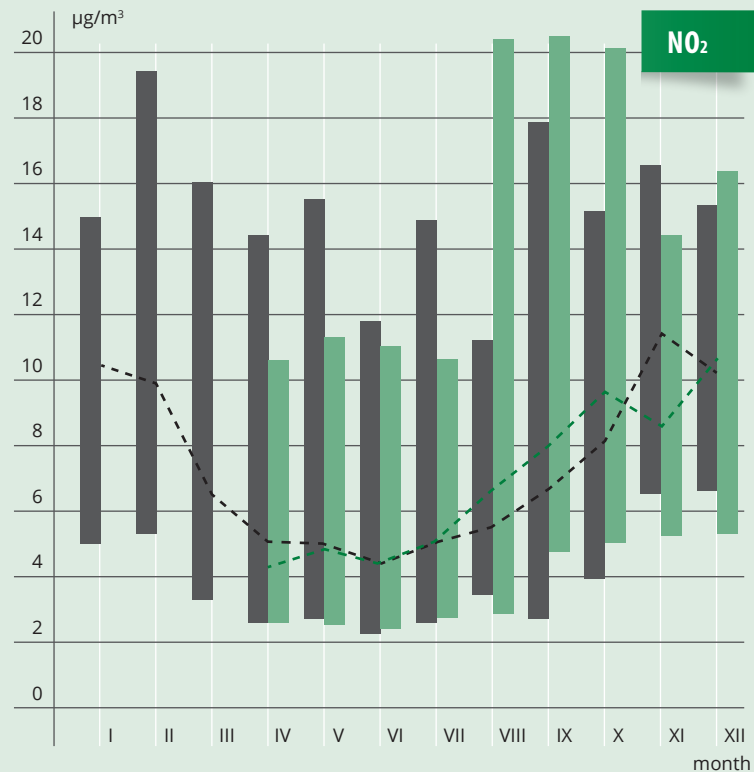
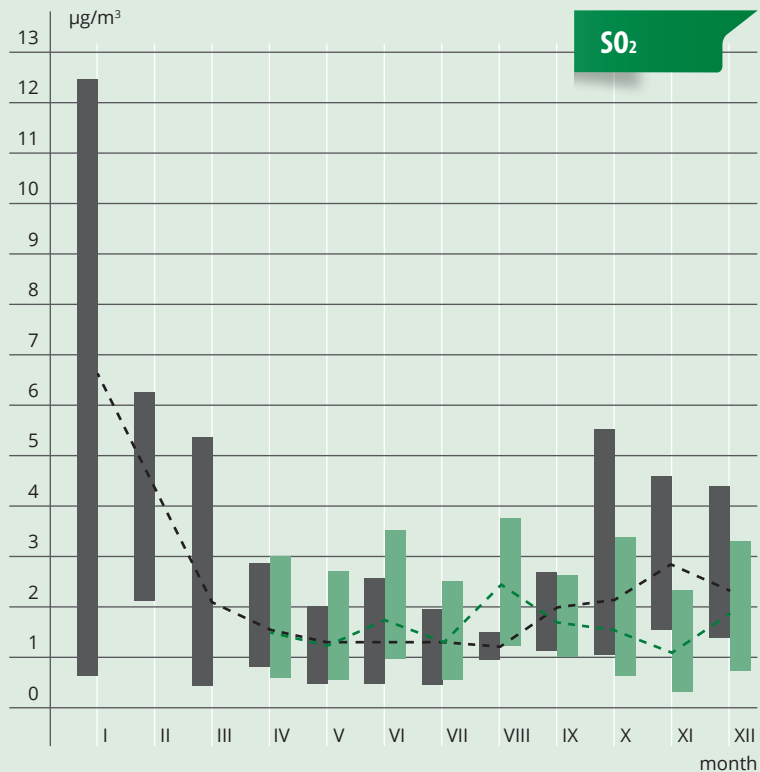
Lower average concentration of sulphur dioxide (below 1.2 $\mu\text{g}/\text{m}^3$ during the investigation period) than in other regions of the country was recorded in the north-eastern Poland. The highest concentration (2.7 $\mu\text{g SO}_2/\text{m}^3$ during the investigation period) was noted in Upper Silesia.

Average concentration of nitrogen dioxide, as in previous years, was the highest in the central area of Poland (from 11.1 to 14.8 $\mu\text{g NO}_2/\text{m}^3$ during the investigation period), in Upper Silesia and Krotoszyn Forest District (9.4 and 8.5 $\mu\text{g NO}_2/\text{m}^3$ during the investigation period, respectively).

Pollution is cleared from the atmosphere by means of precipitation and deposition such as rain, snow, drizzle, fog, etc. Usually, these precipitations contain acidifying substances such as sulphate and nitrate ions, which are less harmful to plants than direct gas deposition. Acidic precipitation is defined as having pH value below 5.6. It is worth noticing that in 2015 about one third of monthly precipitation measured on intensive monitoring permanent observation plots was precipitation with pH value below 5.5.

Furthermore, acidic precipitation (pH below 5.5) was almost two-fold frequent in the winter than in the summer. Raised precipitation acidity, with average pH values 5.1–5.6, was noted in southern regions of Poland. In central and western parts of Poland the precipitation pH values were 5.2–6.1, and in northern and north-eastern regions the acidity was 5.4–6.2.





CHANGES IN CONCENTRATION in the air (average, minimal and maximal values) of sulphur dioxide and nitrogen dioxide, measured on intensive monitoring observation plots in the 2nd, 3rd and 4th quarters of the year, in comparison with 2014

2014

2015



The Forest Gene Bank Kostrzyca carries out numerous projects of the countrywide strategic importance, such as conservation of forests genetic resources and selective silviculture, as well as testing the progeny of: selected seed stands, parent trees, seed orchards, seed crop plantations; also protection and restitution of common yew and wild service tree, and the restitution of fir in the Sudetes.

Threats to forest sustainability

Apart from insect pests, pathogenic fungi and animals, Polish forests are more and more frequently disturbed by various abiotic factors which may eventually become large-scale natural disasters threatening the sustainability of forests. On the other hand, very dynamic or even catastrophic weather events caused by climate change (droughts, floods, hurricanes etc.) have had substantial impact both on the health condition of forest stands and on the populations of forest pests. Constant and severe exposure to a variety of stress factors, combined with limited resistance of forest ecosystems (e.g. inappropriate species composition for the habitat and introduction of ecotypes of non-native trees) may lead, in extreme cases, to the dieback of whole stands. This is what happened in the Sudety in the 1980s and in the Beskidy in the first decade of this century. Foresters' efforts to reinforce the sustainability of forests, which is achieved mainly by rebuilding stands in order to match them better with site conditions, do not always prevent damage, especially when faced with unpredictable extreme weather anomalies.

Notably, the main responsibility for rebuilding forests and maintaining them in good health and appropriate structure falls on the State Forests. In 2015 the rebuilding of stands was carried out in a total area of 6.6 thousand ha, cleanings on 130.8 thousand ha, and thinning on 306.4 thousand ha. Moreover, the stability of forest stands was reinforced by introducing understoreys (0.5 thousand ha), planting second storey (4.1 thousand ha), afforesting gaps (1.0 thousand ha), and by agricultural aviation and water drainage treatment (65.5 thousand ha).

The work which is being done in order to enhance the sustainability of forests often has limited effect in the face of increasingly frequent anomalous weather events. It was therefore, necessary, to find long-term solutions to preserve threatened forest ecosystems in Poland, including securing seed material from trees, shrubs and forest floor vegetation. As a result, the Forest Gene Bank Kostrzyca, located in Miłków at the foothills of the Karkonosze mountains, was opened in the middle of the 1990s. The objectives for the Forest Gene Bank were prepared by the State Forests and the Institute of Dendrology of the Polish Academy of Sciences.

At present, the Forest Gene Bank Kostrzyca has a stock of as many as 5809 genetic resources relating to 90 forest plant species, both whole populations and individual plants. Of these, 28 species are the forest-forming trees and shrubs such as Scots pine, Norway spruce, European larch, Douglas fir, black pine, black alder, European beech, Weymouth pine, and ash. The remaining 62 species are of rare and protected plants all of which are enlisted in the *Polish Red Data Book of Plants*. Resources of the Forest Gene Bank constitute seed batches which have been harvested from the selected seed stands, conservation and other stands, as well as parent, legacy or conservation trees and other individual trees, as well as parts of plants designated for long-term storage in liquid nitrogen.



Level of damage to forests

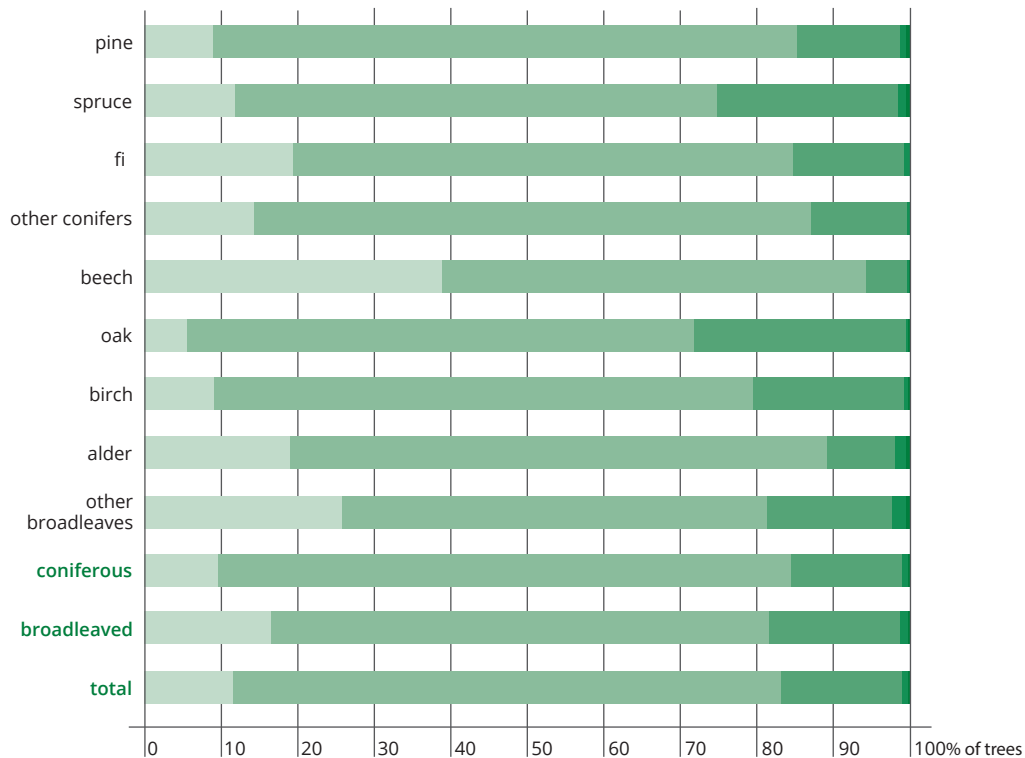


The level of damage to forests in Poland has been assessed every year since 1989 as part of the forest monitoring programme which is one of the elements of the National Environment Monitoring system. Monitored are forests in all ownership categories and being under different forms of protection. Measurements are taken in observation plots located in stands aged more than 20 years; sample trees of all tree species are selected for scrutiny.

Within the forest monitoring programme, on Level I Permanent Observation Plots the level of tree crowns defoliation is assessed every year. In 2015, the assessment of the condition of crowns was made on 40 360 trees aged over 20 years which were located on 2018 Level I Permanent Observation Plots. The average defoliation of all species amounted to 21.5%, coniferous – 21.6%, and of broadleaved – 21.4%. The share of healthy trees (up to 10% defoliation) of all species was 11.9%, and damaged trees (over 25% defoliation) – 16.7%. Broadleaved species had larger share of healthy trees (16.2%) and larger proportion of damaged trees (18.4%) than coniferous species (9.6% and 15.8% respectively).

Among coniferous species the healthiest was fir which was characterised by the highest proportion of healthy trees (19.5%), low share of damaged trees (15.3%) and the lowest average defoliation (20.0%). The most damaged was spruce with the lowest share of healthy trees (12.2%), the highest proportion of damaged trees (25.1%) and the highest average defoliation (23.0%) as well.

In Polish
forests
beech
is the healthiest
tree



SHARE OF MONITORED TREE SPECIES BY DEFOLIATION CLASSES on Level I Permanent Observation Plots (Forest Monitoring) in 2015

Among broadleaves the healthiest in this group of species was beech with the highest proportion of healthy trees (38.3%), the lowest share of damaged trees (5.2%) and the lowest average defoliation (15.7%). The most damaged was oak with the lowest share of healthy trees (5.2%), the highest proportion of damaged trees (28.1%) and the highest average defoliation (24.5%).

Countrywide, there is very little variation in the condition of forests in different categories of ownership. The highest proportion of damaged trees was recorded in national parks (24.0%), lower in the forests of 'other ownership' (21.4%) and in private forests (19.2%), and the lowest was in the State Forests (15.4%).

The results of defoliation monitoring on sample observation plots allow to distinguish areas according to the health condition of forests. Tree stands included in large and dense forest complexes occurred to be much healthier in comparison with stands comprising small and quite scattered forest areas.

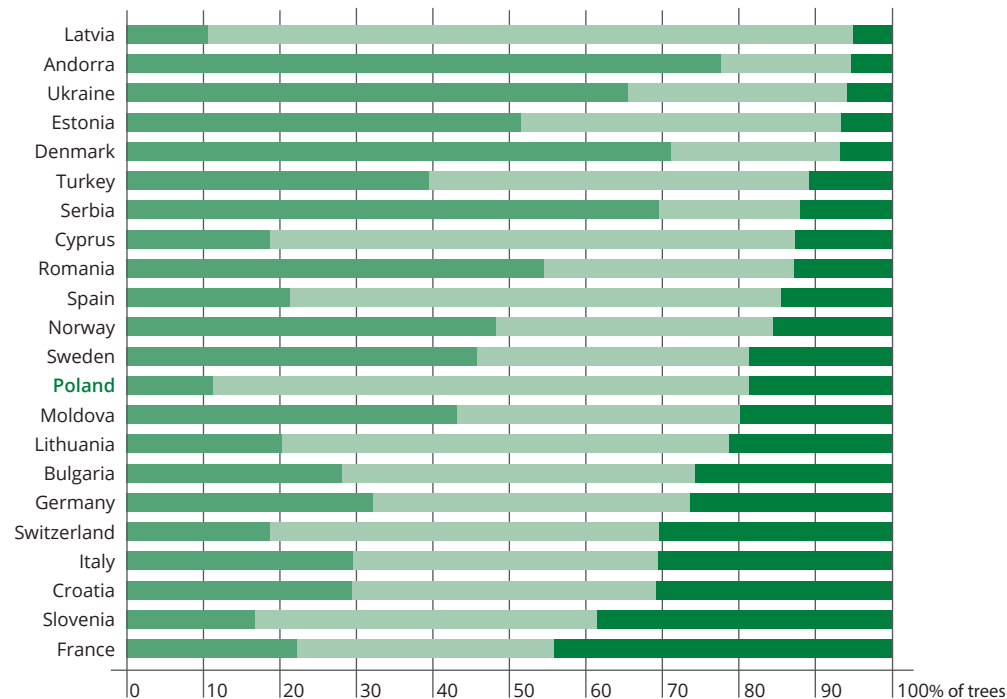
The latest report providing data on the state of European forests in 2015 (*Forest Condition in Europe...*, 2015), places Poland rather low

CLASS:

- 0 0-10% defoliation
- 1 11-25% defoliation
- 2 26-60% defoliation
- 3 above 60% defoliation
- 4 dead trees

with regard to the condition of tree crowns. The share of healthy trees (defoliation class 0) in Polish forests was much smaller (11.6%) than in the forests of most European countries. Only Latvia has lower proportion of trees in this defoliation class.

As far as the share of damaged trees (defoliation classes 2–4) is concerned the situation of Polish forests has improved (18.9%). It was slightly higher in four European countries whereas in five of them the share of damaged trees was significantly higher than in Poland (over 30%). Lower proportions of damaged trees were recorded in 11 countries. Andorra, Denmark, Ukraine and Serbia have the healthiest forests in Europe, while the most damaged stands are in France and Slovenia.



STANDS DEFOLIATION in the European countries in 2014;
countries are ranked by growing share of trees in
defoliation classes 2–4 (Forest Research Institute adapted from
UNECE, 2015)

CLASS:

- 0 0–10% defoliation
- 1 11–25% defoliation
- 2–4 above 25% defoliation including dead trees





SUMMARY

- In our climatic and geographical zone, forests are the most natural formation. They are a crucial element of ecological balance, life continuity, landscape diversity, and of neutralization of contaminants therefore counteracting degradation of the environment. The conservation of forests is the necessary condition for reducing the erosion of soils, preservation of water resources and stabilizing water relations, and for protecting landscape. Forests, as a form of land use, allow biological production with a market value and, as a public good they shape the quality of human life.
- Forest ecosystems in Poland are the most valuable and the most representative components of all nature protection forms. They account for 38.0% of the land area under legal protection. In relation to the total forest area, the share of protected forests accounts for 41.3%, while the protective forests, including water-protective, surrounding cities and damaged by industry, amount to 41.2%. The areas of Natura 2000 network cover about 20% of the country's land area. Within the State Forests, special protection areas (SPAs) for birds cover 2217 thousand ha (29.1% of the State Forests territory), and the sites of Community importance (SCIs) – 1659 thousand ha (21.8%).
- Poland's timber resources have been steadily increasing, which results in the increase of gross merchantable timber volume up to 2.5 billion m³. Timber resources in the State Forests (1.9 billion m³) are the largest in the country: the average volume of growing stock amounts to 277m³/ha and the average age of stands is 58 years. In private forests the respective data are 234 m³/ha and 48 years.

Forests in Poland are the most natural environmental formation

- In 2015 the area of post-agricultural land and wasteland afforested under the *National Programme for the Augmentation of Forest Cover* decreased again in comparison with the previous years. Afforestation (artificial) covered 2.8 thousand ha of post-agricultural land and wasteland (3.8 thousand ha in 2014, and 4.1 thousand ha in 2013).
- In 2015, 38 327 thousand m³ of net merchantable timber was harvested, of which 36 497 thousand m³ came from the State Forests, i.e. 102.1% of the annual prescribed cut by volume, of which 18 253 thousand m³ was cut in final felling (97% of prescribed cut) and 18 224 thousand m³ in pre-final felling (107.7% of prescribed cut). As a result of salvage and sanitation cuttings, 5097 thousand m³ of timber was harvested (14.0% of total merchantable timber). The size of clear-cuts was restricted to the area of 26.6 thousand ha, the timber harvested in clear-cutting to 6861 thousand m³ of merchantable timber, i.e. to 18.3% of the total harvest. According to data for the last 20 years, in the State Forests the share of merchantable timber harvest stood at 56% of the current increment.
- The health condition of forests in Poland, assessed on the basis of the tree crowns defoliation, improved significantly. The share of damaged trees (defoliation exceeding 25%) decreased from 18.9% in 2014 to 16.7% in 2015. The share of healthy trees increased slightly from 11.6% in 2014 to 11.9% in 2015. The average defoliation determined for all species accounted for 21.5% – this value has been the lowest for the last five years

- In 2015, the activity of the most destructive primary insect pests was at low level. However, cockchafer imagines of *Melolontha* species were the exception. Protective treatment was applied on the area of over 86 thousand ha, including this aimed at cockchafer on the area of over 69 thousand ha. As compared with the previous year, the size of sanitation cuttings increased slightly by 6%.
- Acreage of infectious fungal diseases decreased in 2015 by 17%, and covered 172.5 thousand ha. There was a significant change in the area (decrease of threat by 50%) affected by pine shoot dieback and oak mildew diseases. However, the total area affected by pine needle cast has increased by 36%.
- In 2015, damage caused by game and protected animals occurred in a combined area of 89.5 thousand ha (in 2014 on 90.2 thousand ha).
- According to the records of the last five years, in 2015 forest fire were the most frequent. There were 12 257 fires recorded, by 7012 more than in the previous year, and the area of burnt stands was 5510 ha, which is by 2820 more than in 2014.





GLOSSARY

Afforestation – new forest established in non-forest areas which were previously used for agriculture or were constituting uncultivated grounds.

Age class – agreed, usually 20-year period which allows grouping of stands according to their age; stands aged up to 20 years form class I, stands aged from 21 to 40 years form class II, and so on.

Amount of cut (felling) – the amount (volume) of timber scheduled for removals in management and financial plans.

Annual prescribed cut by volume in the State Forests – an annual measure of forest use, determined in forest management plans for each forest district as a sum of final and pre-final felling (approximately equaling 1/10 of the cut prescribed for a 10-year period). The quota is variable and depends on the condition of forests; the total sum of annual prescribed cuts in each district must be balancing over a 10-year period, i.e. at the end of the current forest management plan.

annual prescribed cut by volume in final cuts in the State Forests – an annually averaged sum of prescribed final cuts agreed for every forest district; the volume of final cuts in particular forest districts is determined in the forest management plans as absolute maximum in the whole (usually 10-year) planning period and therefore must not be exceeded;

annual prescribed cut by volume in pre-final cuts in the State Forests – an annually averaged sum of approximate prescribed pre-final cuts agreed for every forest district.

Bark borers – insects living under bark and feeding on cambium, i.e. inner bark of a tree.

Bark stripping – stripping the bark of standing or lying trees by hoofed animals (ungulates) in order to acquire food.



A

B

B

C

D

E

F

G

Biological diversity (or biodiversity) – the variety of life forms on Earth, usually related to three levels of nature organization:

species diversity – variety of species;

ecological diversity – a variety of community types (biocoenoses, ecosystems);

diversity of genetic resources – a variety of genes forming a gene pool of a population.

Broken and fallen trees – trees damaged by being broken or thrown down by wind or snowfall.

Class for restocking (KDO) – a type of vertical structure of stands in which there is simultaneous felling and restocking under the shelter of parent stand, and in which the level of renewal has not met the required standard yet.

Cleaning – a series of tending treatments aimed at adjusting species composition, species mixture and structure of restocking; regulates the density of stands and improves the quality of saplings;

early cleaning – cleanings in plantations prior to crown closure;

late cleaning – cleanings in plantations during the period between crown closure and the beginning of stands' natural self-thinning.

Clear-cuts – an area from which whole stand has been removed in final felling, designated for renewal within five incoming years

Deadwood – trees which are dead or dying as a result of excessive density in the stand, attacks of primary or secondary insect pests, the impact of industrial emissions, changes in water conditions, etc.

Defoliation – loss of leaves or needles which intensifies with a worsening health condition of a tree.

Diameter at breast height (DBH) – thickness (diameter) of a standing tree measured at the standard height of 1.3 m above the ground.

Ecotype – race, ecological form – the entire population of one tree species or other plant covering a particular area; it develops as a result of long-lasting ecological conditions decisive for its establishment. Ecotypes differ with regard to their physiological properties and, less frequently, morphological characteristics.

Epiphytotic – epidemic (mass) prevalence of plant diseases in a given area, caused by a single pathogenic agent (e.g. fungus) whose mass occurrence was facilitated by a set of favourable conditions.

Final felling (cutting) – wood harvesting associated with stand's renewal or deforestation of land due to change in the land use; the timber obtained in final felling is final felling harvest

Forest cover (or index thereof) – percentage of the area covered by forests in the total geographical territory of a country.

Forest ecosystem – a basic ecological functional unit represented by a relatively homogenous forest plot, and within the area of which the habitat, flora and fauna are interdependently forming a dynamic system which functions as a whole.

Forest habitat (site) type – a basic unit of the typological classification of forest sites applied in Poland comprising a forest area with similar site condition.

Folivores – leaf-eating animals.

Gene conservation stands (in situ conservation stands) – stands selected for preservation of endangered populations of the indigenous forest tree species.

Gradation – mass occurrence of insects as a result of favourable environmental factors for a given species.

Growing stock (standing volume) – the thickness (volume) of all live trees in a given area (stand, province, country, etc.) with a diameter at breast height over 7 cm (measured with bark). Growing stock may be calculated per hectare.

Increment (of volume) – an increase in the volume of (1) a tree, (2) a stand (including harvested timber) over a period of time;

current increment – an increase in volume over a specified time; depending on the length of that period we distinguish:

- current annual increment,
- periodic current increment (longer than one year),
- current increment over the whole age (from the emergence of a tree to its specified age)

mean increment – quotient of the current increment and the length of the period of time:

- mean annual increment over a period,
- mean annual increment over the whole age.

Merchantable timber (large-size wood) – (1) volume of wood with the diameter 7 cm measured with bark at the thinner end (refers to growing stock); (2) round wood with the diameter at least 5 cm measured without bark at the thinner end (refers to felled wood);

gross merchantable timber – with bark;

net merchantable timber – without bark and loss during harvest working operations.

Pathogens – factors causing disease; primary pathogens attack healthy organisms, secondary attack already damaged organisms (e.g. trees).

pH – potential hydrogen; indicator of acidity level, e.g. of soil.

Pollutant immission – gaseous and particulate air contaminants affecting the surrounding, i.e. reaching organisms or ecosystems and exerting influence on them.

Pre-final felling (cutting) – harvest of wood related to forest tending.

Production forests – forests managed on the basis of the principles of a planned sustainable forest management in order to fulfil productive and non-productive functions of forest, while complying to the rules of spatial and temporal order.

Productive seed stands – stands whose origin and good quality indicate that their seed crop is very likely to produce valuable offspring ensuring in given ecological conditions long-lasting production of timber of satisfactory quality and quantity.

Promotional forest complex (PFC) – a functional forest area of special ecological, educational and social value, established for the purpose of promoting sustainable forest management and protection of nature resources in forests.

Protective forests – forests that mitigate or prevent the impact of natural risks and hazard therefore being under special protection because of their function.

Regeneration (renewal, restocking, reforestation) – new forest established in place of the previous stand which was either removed by felling or destroyed by natural disaster;

natural renewal – established by self-seeding or offshooting;

artificial renewal – planted by man.

Repellents – plant protection products used to safeguard young trees against damage caused by animals.

R

S

T

V

X

Restocking class (KO) – a type of vertical structure of stands in which felling and restocking is practiced concurrently under the shelter of the parent stand whose level of regeneration allows to move on to the next stages of tending.

Selected seed stand – the most valuable seed stands aimed mainly at seed supply therefore they are excluded from logging for a defined period of time (excluded from final felling)

Selection structure (BP) – a type of vertical structure of stands in which there is mutual penetration of groups and clumps of trees and shrubs being of different age and height.

Small-sized timber – round wood with a diameter at the thicker end up to 5 cm (measured without bark).

Steppisation – limiting natural conditions that foster forest development, mostly by drying which, in turn, allows steppe vegetation to enter.

Thinning – tending cuts made in stands after they had undergone the period of cleanings, during which economically undesirable trees are removed. Thinning has positive effect on stands as the increment of thickness, height and crown size of trees is more intense therefore the quality of stand improves.

early thinning – covers the period of intensive natural selection of trees;

late thinning – covers later period.

Timber resources – total volume of trees in forest, usually equated with the measured (estimated) volume of merchantable timber in stands.

Volume (thickness) of wood – the amount of wood, measured in cubic metres (m³).

Xylophagous insects – insects feeding only on wood.

