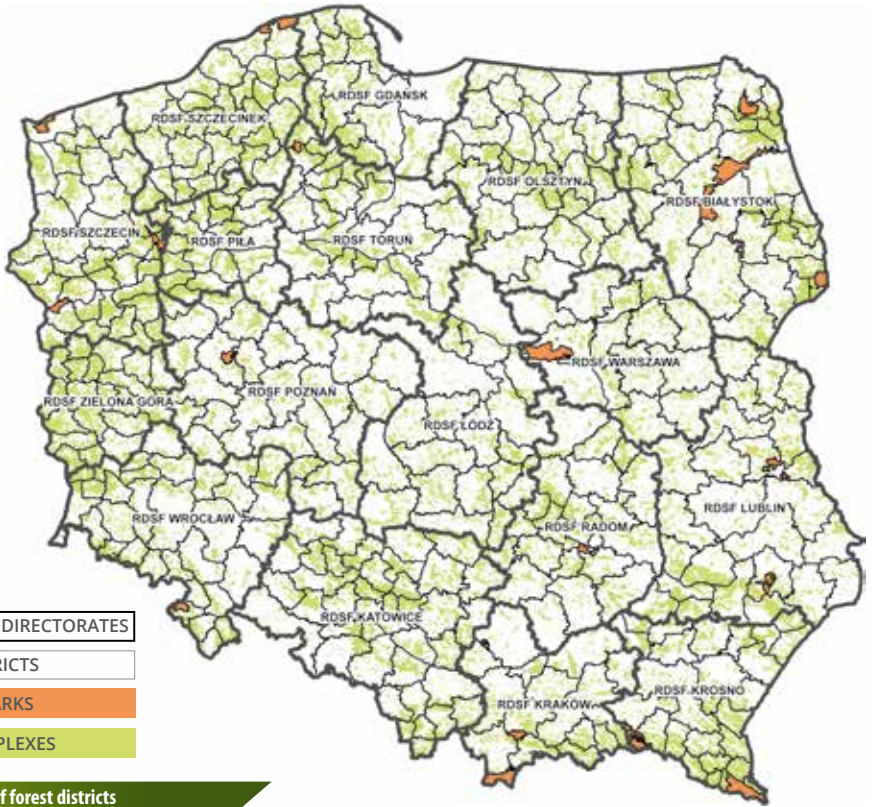
POLAND The State Forests

FORESTS IN POLAND 2017

State Forests



LEGEND:

SF REGIONAL DIRECTORATES

FOREST DISTRICTS

NATIONAL PARKS

FOREST COMPLEXES

TERRITORIES of forest districts and regional directorates of the State Forests

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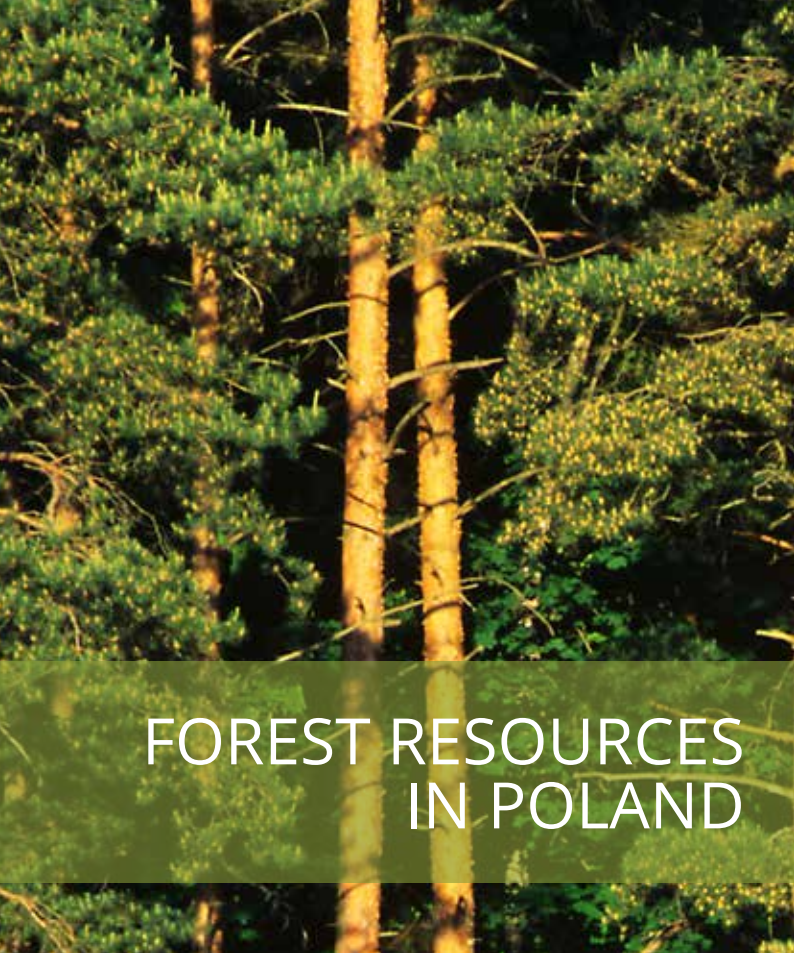
FORESTS IN POLAND 2017

State Forests

The Forest Act of 28 September 1991, (Journal of Law 2017, item 788) legally obliged the State Forests to publish an annual report on the condition of forests in Poland. This publication, entitled *Forests in Poland 2017*, is an abridged version of the report for the year 2016 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 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 2016, 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, the least distorted natural formation are forests which are the necessary factor for ecological sustainability. At the same time, the 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.

At present, the forest area in Poland is 9230 thousand ha (according to the Central Statistical Office, figure for 31 December 2016), which corresponds to forest cover of 29.5%. The forest cover is the highest in the Lubuskie province at 49.2%.

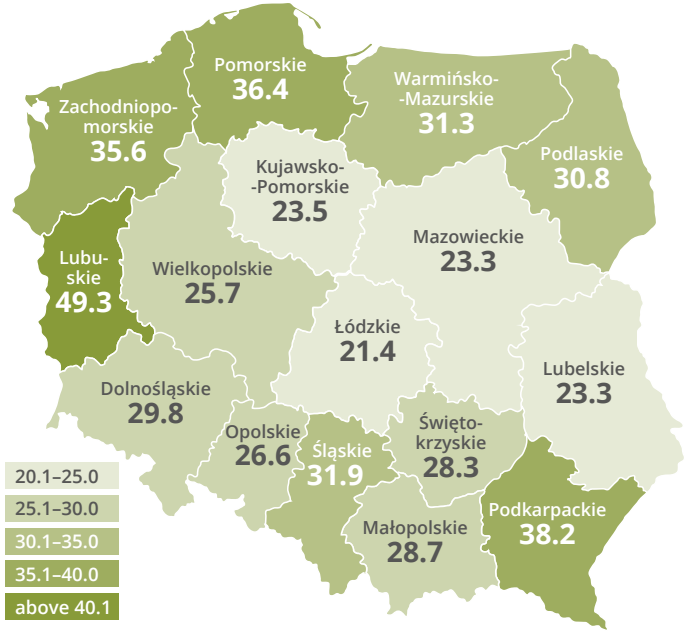
According to the measurement standard adopted by the international assessment which also includes the lands associated with forest management, the forest area in Poland is 9435 thousand ha, as of 31 December 2016, and is close in size to the forest area of Ukraine and Italy. In six European countries (apart from Russia) this number was more than 10 million ha.

In comparison with Poland, within the analysed group of states, the countries with great share of land which is unsuitable for other use 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 2016, 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).

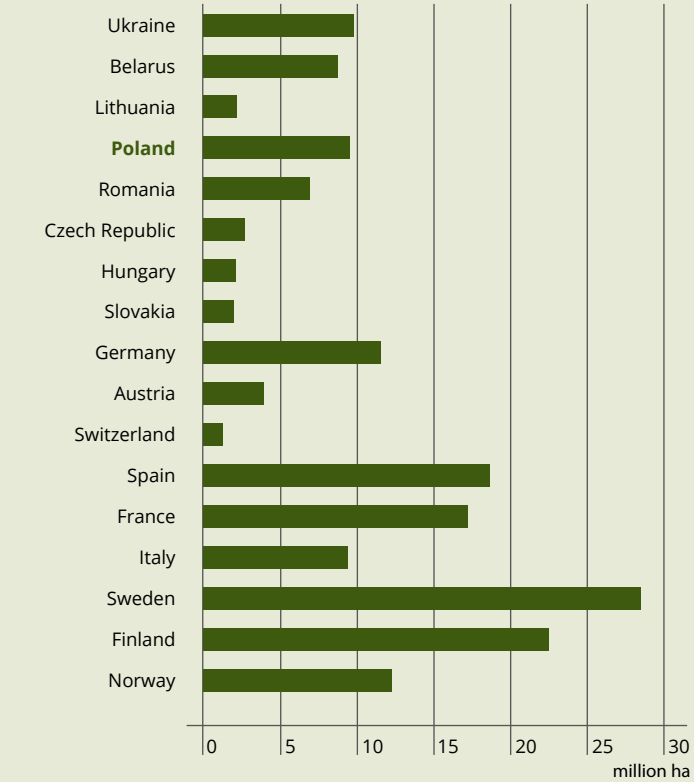
In the past, forests covered almost the entire territory of our country. As a result of historic social and economic processes, dominated by economic objectives, primarily due to the expansion of agriculture and strong demand for wood, they had undergone significant transformation.

In Poland, the forest cover, which at the end of the 18th century was about 40% (within borders of that time), decreased in 1945 to 20.8%. The reversal of this process occurred in the years 1945-1970, when the forest cover in Poland rose to 27.0% as a result of afforestation of 933.5 thousand ha.

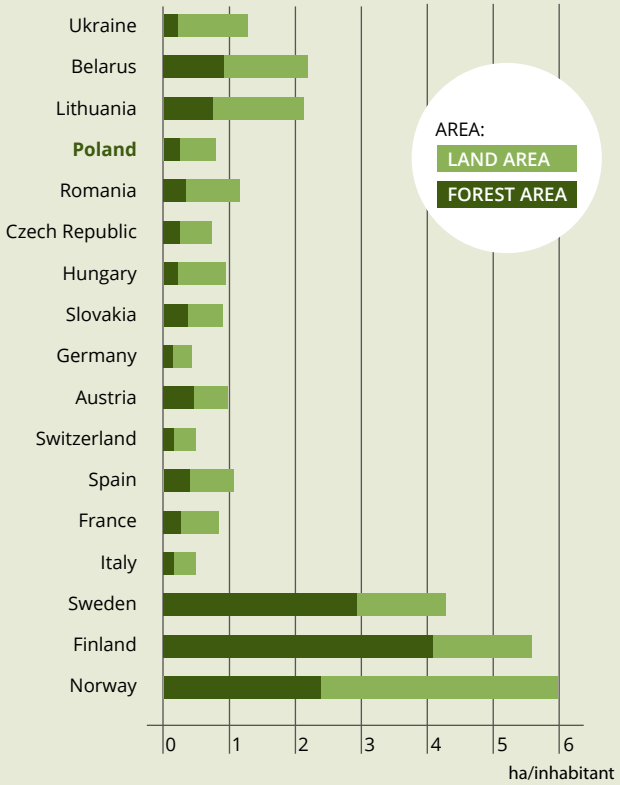
A comparison of forest area per capita in Europe with the total land surface clearly shows that these values are higher in less populated countries; the forest cover of such countries is higher than the average. Forest area per capita in Poland (0.24 ha) is one of the smallest in Europe.



FOREST COVER IN POLAND (in %) **by province** (Central Statistical Office)



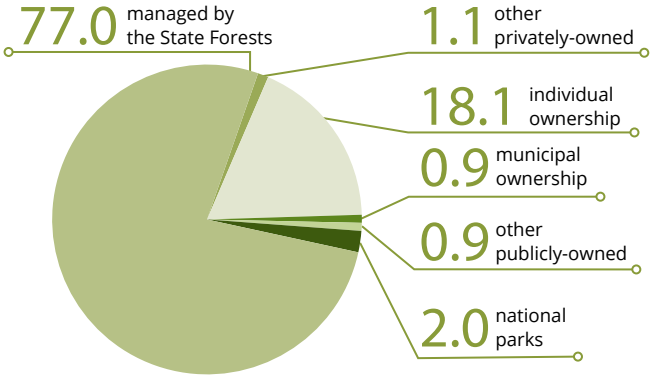
TOTAL FOREST AREA (*SoEF* 2015)



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 1990–2016, the share of privately-owned forests increased by 2.2 percentage points to the current 19.2%. Concurrently, the share of publicly-owned forests decreased from 83.0% to 80.8%.

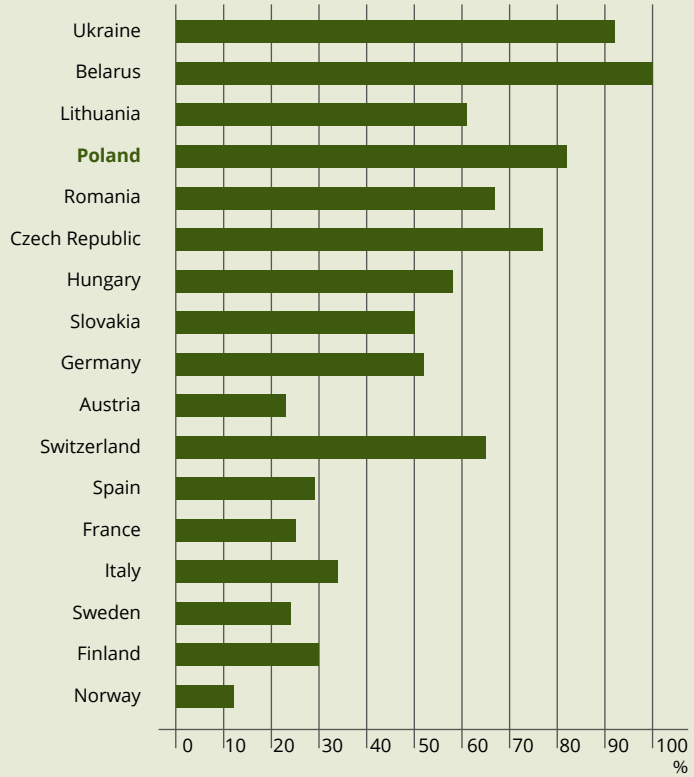


FOREST OWNERSHIP STRUCTURE in Poland, in % (Central Statistical Office)*

* The values do not add up to 100% due to rounding.

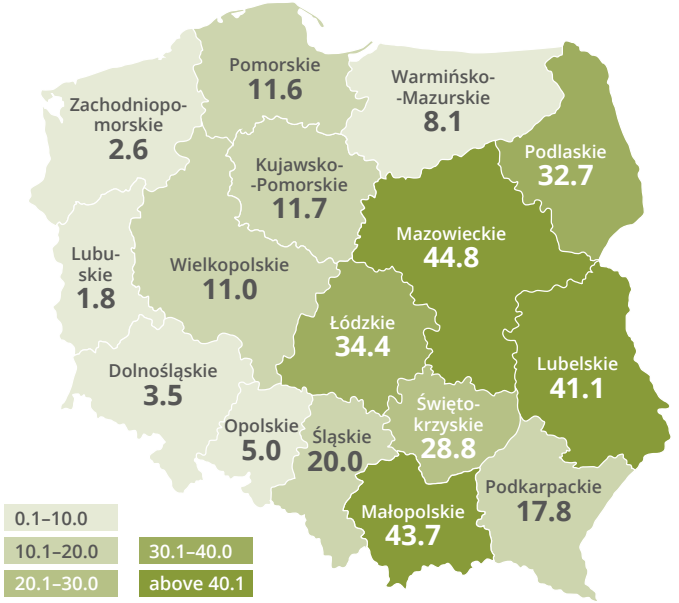
In Poland **80.8%** of forests are publicly-owned

The following comparison shows that the share of public forests in the total forest area significantly varies within the group of states selected for the analysis.



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

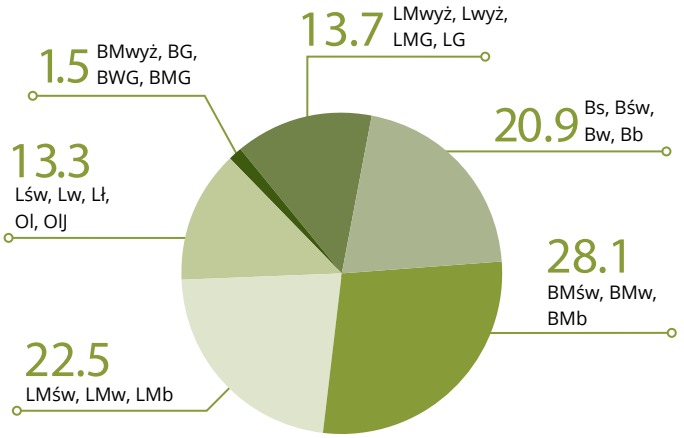
In the Commonwealth of Independent States nearly 100% of forests are owned by the state, in the Scandinavian and Mediterranean countries the vast majority of forests are privately owned, while in other countries the ownership structure varies with predominant share of public forests.



SHARE (in %) **OF PRIVATE FORESTS in total forest area of each province** (Central Statistical Office)

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. In the structure of forest sites, coniferous forests are predominant as they account for 50.5% of the forest area, while the broadleaved habitats account for 49.5%. In both groups there are upland sites accounting for 6.5% of the total forest area and montane sites occurring in 8.7% of forests.



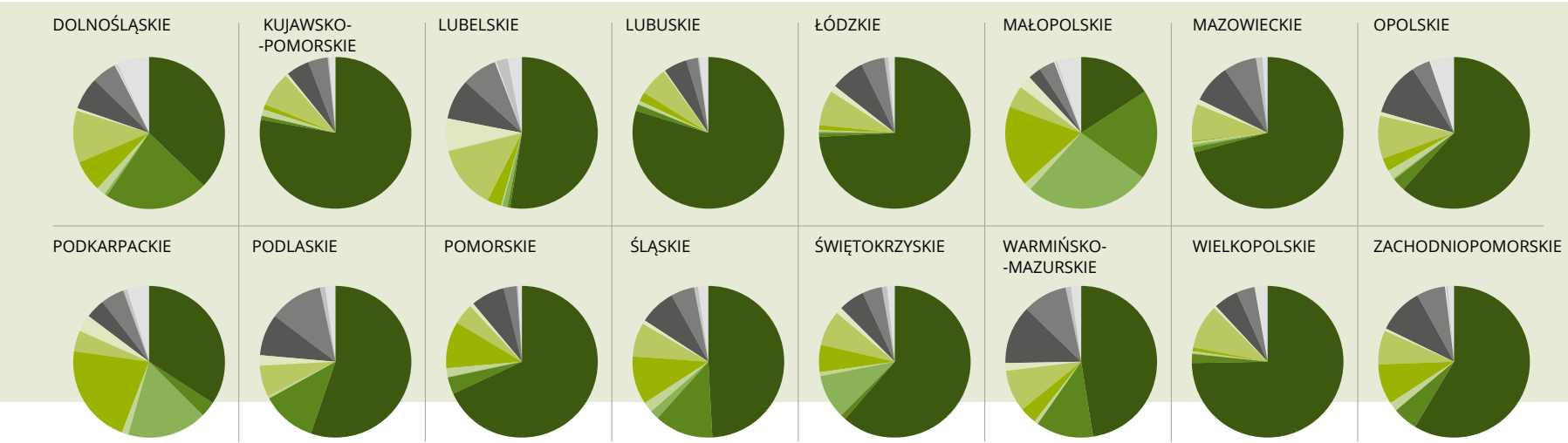
AREA SHARE (in %) **of forest habitat types in Poland**
(National Forest Inventory 2012–2016)

LEGEND:

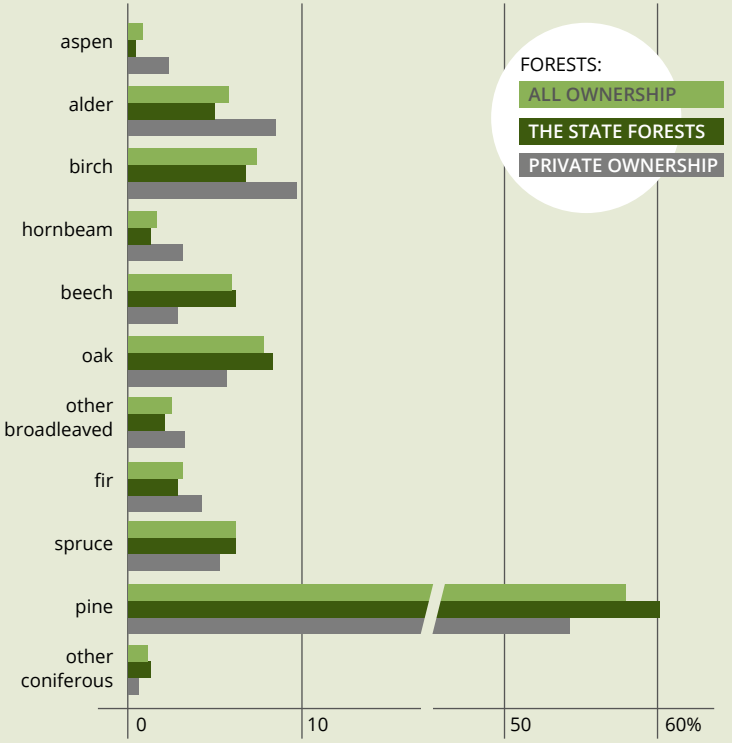
Bb – swamp coniferous forest
BG – montane coniferous forest
BMb – swamp mixed coniferous forest
BMG – montane mixed coniferous forest
BMśw – fresh mixed coniferous forest
BMw – moist mixed coniferous forest
BMwyż – upland mixed coniferous forest
Bs – dry coniferous forest
Bśw – fresh coniferous forest
Bw – moist coniferous forest
BWG – high-mountain coniferous forest
LG – montane broadleaved forest
Ł – 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

Spatial distribution of the forest sites is very well reflected by spatial distribution of dominant species. Apart from mountain areas, where the share of spruce, fir and beech in stands' species composition is larger, in most of the country the tree stands with pine as a dominant species are predominant.



SPATIAL DISTRIBUTION OF TREE STANDS by dominant species in each province (National Forest Inventory 2012–2016)



AREA SHARE OF DOMINANT SPECIES in all forest ownership types, in the State Forests, and in private forests (National Forest Inventory 2012–2016)

Coniferous species are dominant in 68.5% of the area of Polish forests. Pine, which according to the National Forest Inventory accounts for 58.2% of the area of forests in all ownership categories, 60.1% of the area managed by the State Forests, and 55.0% in 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 or Augustowska pine.

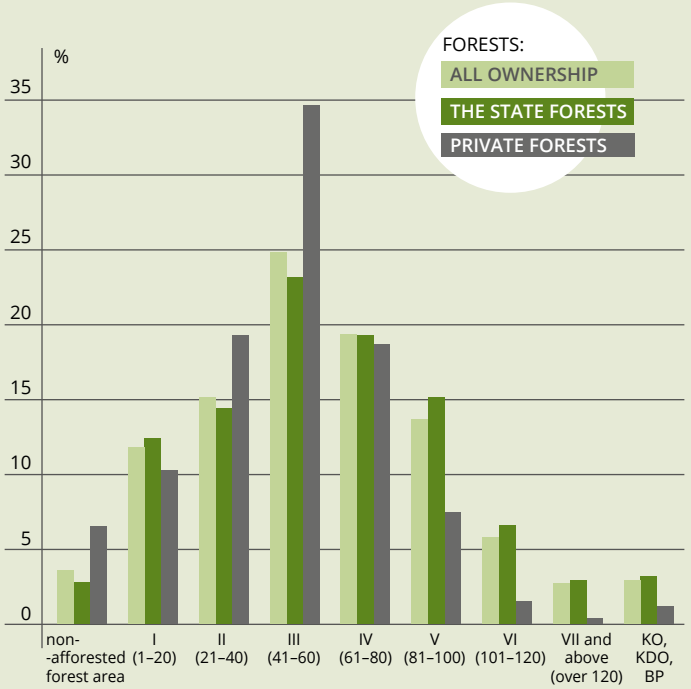
In the years 1945–2016, the structure of species composition in Polish forests changed significantly, which is evident also in the increased share of stands with predominant deciduous species. In the State Forests, where it is possible to track these changes owing to the annual updates of the forest area and timber resources, the area of broadleaved stands increased from 13.0 to 23.8%.

Pine occurs in **58.2%** of forest area in Poland

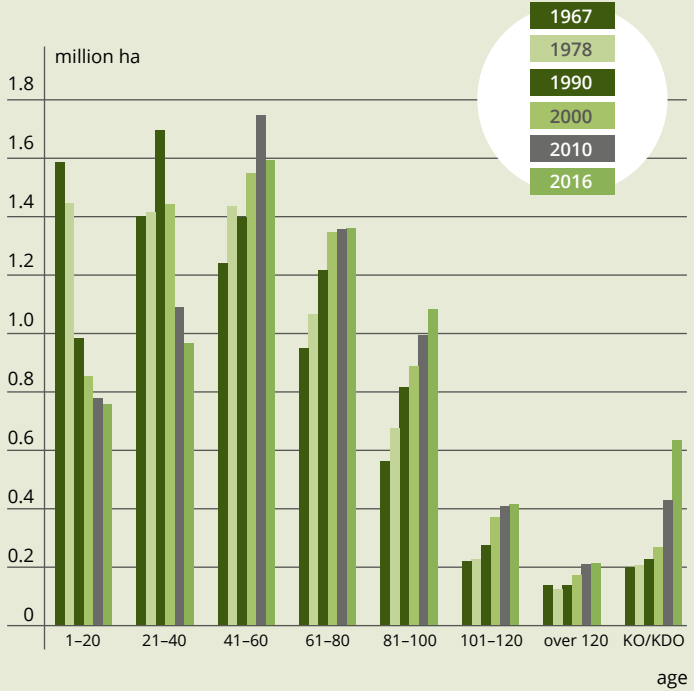
Age structure

Stands representing age classes III and IV prevail in the forest age structure and cover 24.9% and 19.4% of the forest area, respectively. In the majority of ownership categories, class III is dominating and in private forests its share is 33.2%. Stands older than 100 years including stands in restocking class (KO), class for restocking (KDO) and selection structure (BP), account for 12.7% of the area managed by the State Forests, whereas in privately-owned stands they account for 3.2%. Non-afforested surface in private forests constitutes 6.1% of their total area, and in the State Forests the corresponding value is 2.8%.

Stands aged
41–80
years
dominate in Polish forests



AREA SHARE STRUCTURE OF STANDS by age class, in all ownership categories, in the State Forests and in private forests (National Forest Inventory 2012–2016)

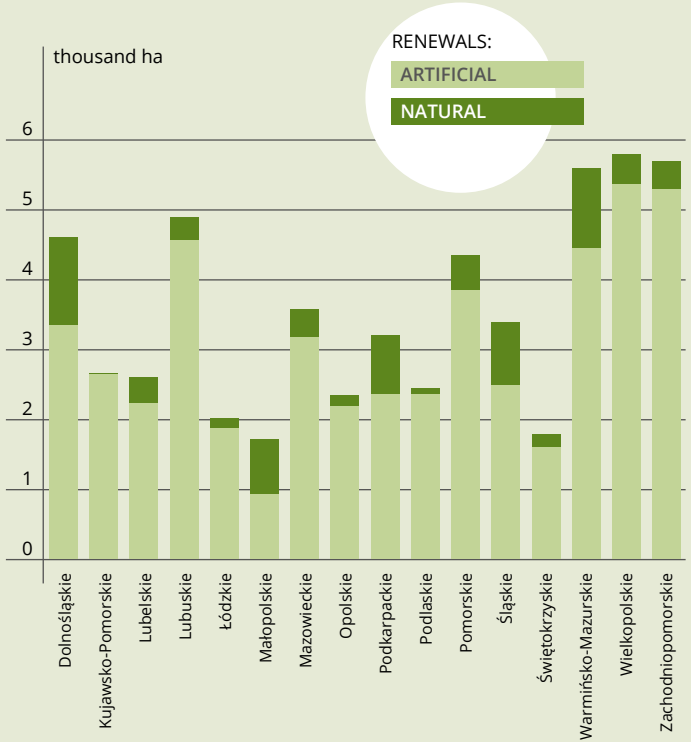


CHANGES IN AREA OF AGE CLASSES in forests managed by the State Forests (Bureau of Forest Management and Geodesy)

More detailed direction of changes occurring in the area structure of age classes is better exemplified by the forest resources managed by the State Forests National Forest Holding. The diagram compares the distribution of age classes in years 1967, 1978, 1990, 2000 and 2010 with the current distribution. The constant decrease of the area of youngest stands (I and II age classes) is a matter of concern; this phenomenon can pose a threat to the sustainability of forest in the future, which is a desirable age class structure. Its causes include, among other things, a significant decrease of afforestation and reduction of principal felling (depletion of the renewal areas). According to the data provided by the National Forest Inventory 2012–2016, 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 2016. In the same period the average age of stands in forests in all ownership categories increased from 44 to 57 years (59 years in the State Forests, 48 years in privately-owned forests).

In 2016, forest renewals (excluding local afforestation and second layer planting) were carried out in 56 096 ha of land in all ownership categories, of which 7912 ha (14.1%) was natural regeneration. Restocking area in 2016 was smaller by about 0.3 thousand ha in comparison with 2015. Renewals were carried out in 0.61% of the total forest area (from 0.39% in the Podlaskie and the Małopolskie to 0.93% 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



SIZE OF FOREST RENEWAL AREA in 2016 in each province (Central Statistical Office)

Almost **56** thousand hectares of forest were renewed in 2016

trend, however, has been slightly altered since the beginning of the 21st century.

It is also worth noticing that since the beginning of 1980s the share of natural regeneration in the total area of forest renewals has been gradually increasing. In 1976–1980, this share was 3.4%, in years 1991–1995 – 6.5%, in 1996–2010 – 10.5% and in the last five years it amounted 13.8%.

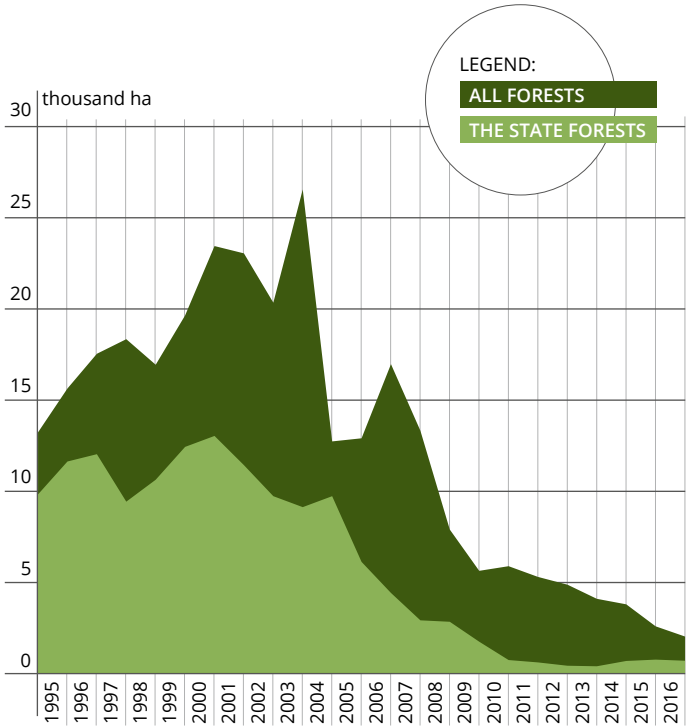
Seedlings for renewals and afforestation are produced in forest nurseries. The production area of forest nurseries in 2016 was 1966 ha, including 1943 ha in the State Forests, 15 ha in the national parks, and 8 ha in other public forests.

Changes in forest area

According to the data provided by the Central Statistical Office, the total forest area increased by 536 thousand ha in 1991–2016, while in the latter year by 15 thousand ha.

The basis for all afforestation in Poland is the National Programme for the Augmentation of Forest Cover (KPZL) 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 for implementation by the Council of Ministers on 23 June 1995. In 2002, however, the programme was modified. The main objective of the programme is

In 2016 afforestation amounted **2011** hectares



SIZE OF AFFORESTATION (artificial) in Poland in 1995–2016
(Central Statistical Office)

to augment the forest cover of the country up to 30% by the year 2020 and up 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 2016, there were afforested (artificially) 2011 ha of land in all ownership categories. The largest areas were afforested in the Zachodniopomorskie – 331 ha, and in the Warmińsko-Mazurskie – 221 ha; the smallest afforested areas were in the Śląskie – 11 ha and the Małopolskie – 19 ha. In 2016, the afforestation surface was by 259 ha (i.e. by 10%) smaller as compared with the previous year. Additionally, in 2016 there were 177 ha afforested, presumably as a result of natural succession (in 2015 – 194 ha).

Substantial decline in afforestation areas (from 16 933 ha in 2006 to 2011 ha in 2016, i.e. by 88%) 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, which includes: the raise of minimal acreage of dense afforestation area, withdrawal of permanent grasslands and areas designated as Natura 2000 sites from EU subsidies for afforestation, and also attractive financial aid for agricultural production.

A similar enormous decrease in the size of afforested areas was observed in the State Forests, as in 2016 there were artificially afforested only 687 ha, compared with 9.7 thousand ha in 2004. This was a result of a rapid decline in the area of post-agricultural land and the wasteland transferred to the State Forests by the Agricultural Property Agency.

Volume structure of timber resources

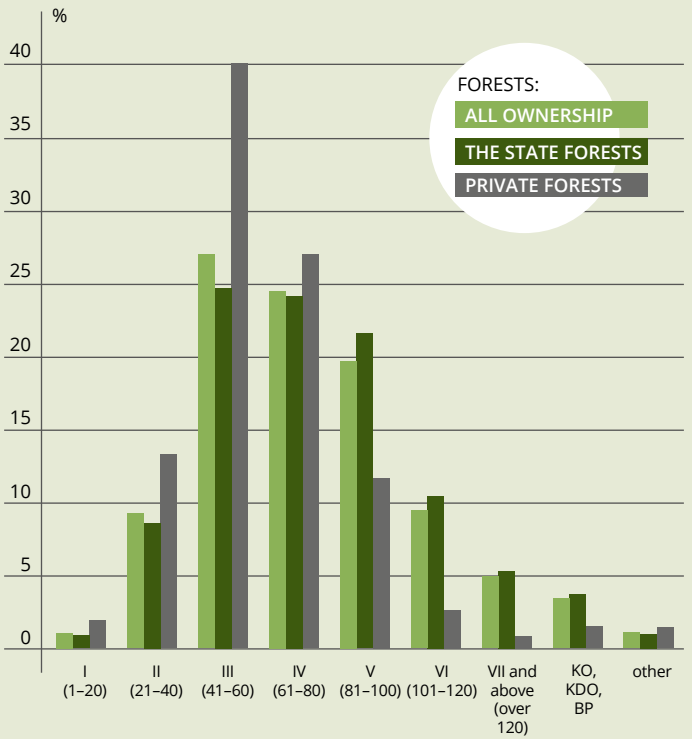
Timber resources in Poland
2550 million m³
of gross merchantable timber

According to the measurements carried out by the National Forest Inventory in 2012–2016 and related to the area of forests at the end of 2015, the timber resources amounted to 2550 million m³ of gross merchantable timber, out of which 2005 million m³ comes from the State Forests and 424 million m³ from the privately-owned.

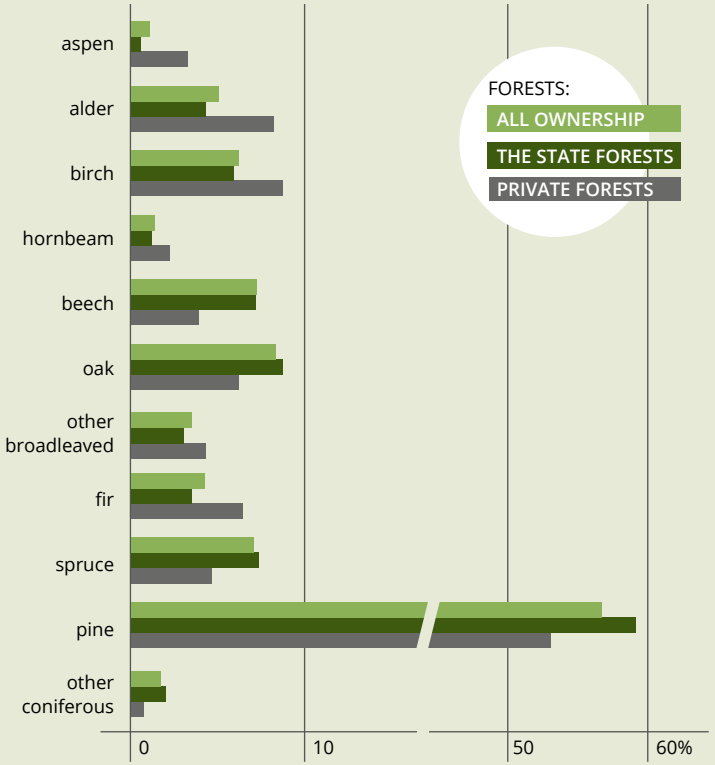
More than a half of timber resources (51.4%) are the stands in age classes III and IV: 48.7% in the State Forests and 66.9% in private forests. The volume of timber resources in stands aged over 100 years including restocking class (KO), class for restocking (KDO), and selection structure (BP) accounts for 19.3% in the State Forests and 4.9% in private forests.

According to the results of the National Forest Inventory 2012–2016, the average volume of growing stock in Poland's forests is 277 m³/ha, including for the forests managed by the State Forests 285 m³/ha and for the private forests 240 m³/ha. The greatest volume of growing stock is in the forests of the Małopolskie (318 m³/ha) and the Podkarpackie (317 m³/ha), while the smallest is in the forests of the Mazowieckie province (249 m³/ha).

Pine accounts for 56.6% of the volume of timber resources in forests in all ownership categories. In the State Forests this share is 58.5%, whereas in privately-owned forests the same figure is 53.8%. In com-



VOLUME STRUCTURE OF TIMBER RESOURCES by age class in forests in all ownership categories, in the State Forests and in private forests
(National Forest Inventory 2012–2016)



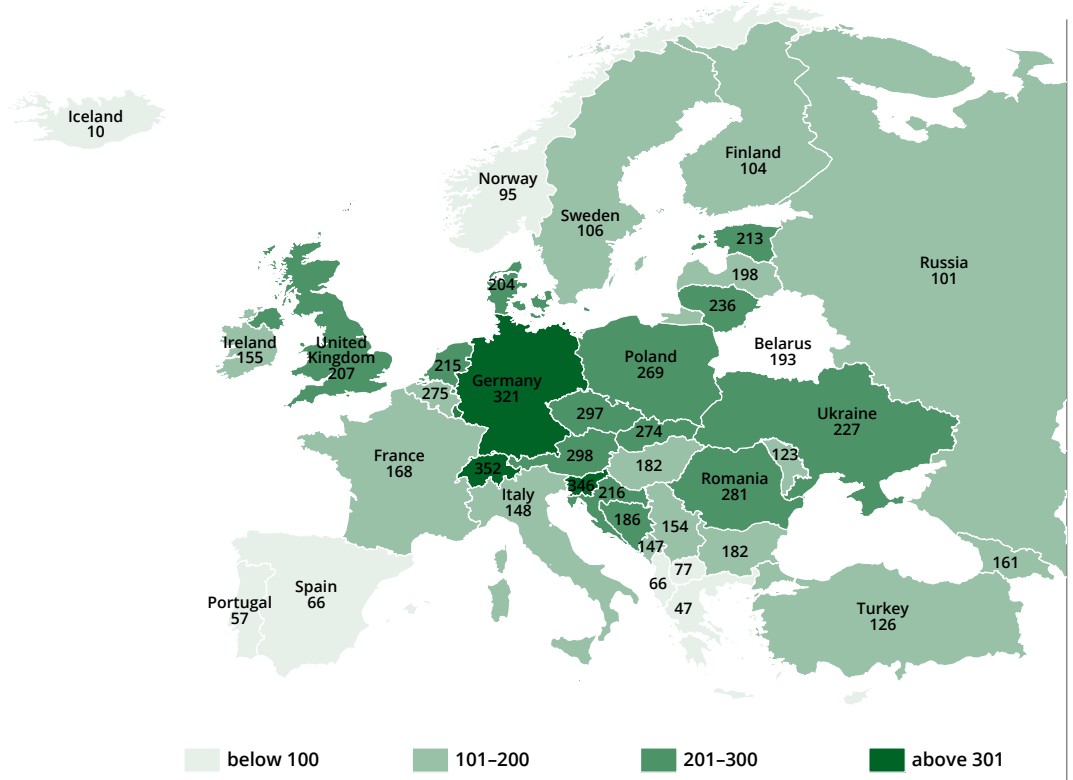
VOLUME SHARE of timber resources by tree species in all ownership categories, in the State Forests, and in private forests (NFI 2012–2016)

parison with the volume structure of timber resources in the State Forests, private forests are characterized in particular by larger volume of broadleaved species as birch, alder, aspen and hornbeam, but with smaller share of oak and beech.

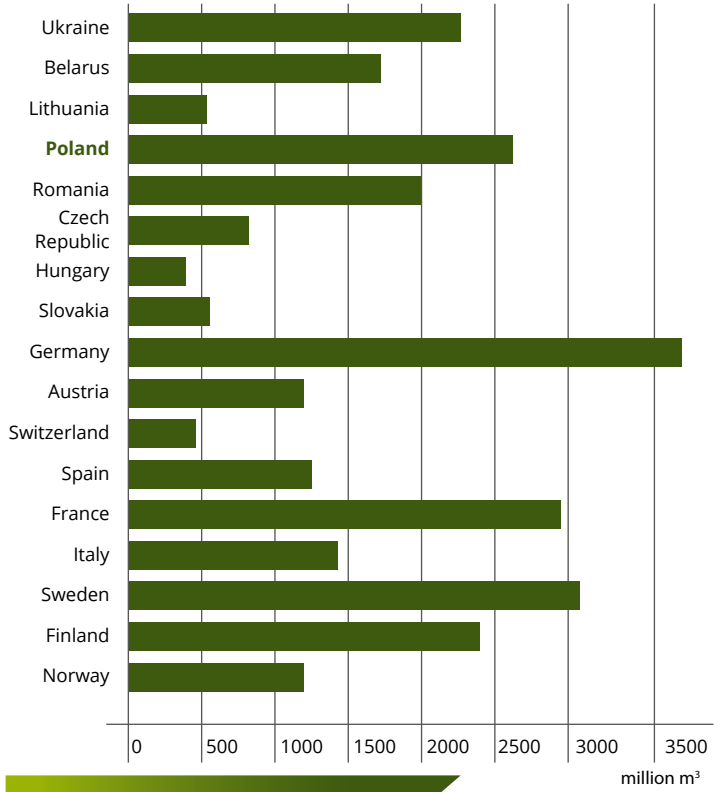
Polish forests rank highly among the European leaders with regard to the growing stock. The mean value for Poland provided by the report *State of Europe's Forests* (*SoEF*) statistics for 2015 (269 m^3/ha if we take into account combined forest area and the grounds associated with forest management) is much higher than the European average i.e. 163 m^3/ha (114 m^3/ha including the Russian Federation).

According to *SoEF* assessment, Poland as a country with a relatively large absolute area of forests and with growing stock density higher than the European average, has also significant in the region timber resources which amount to more than 2.5 billion m^3.

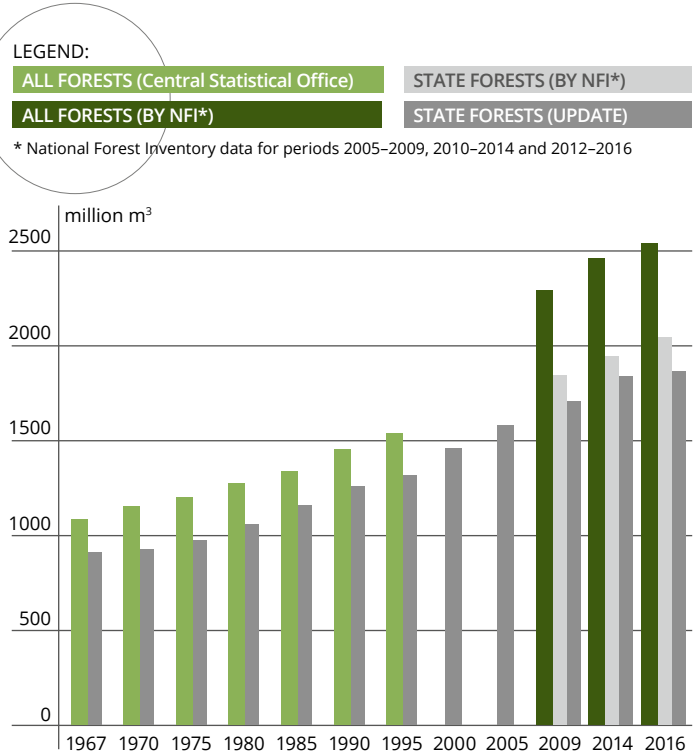
Growing stock of Polish forests is **269** m^3/ha



GROWING STOCK in analysed countries in m³/ha (*SoEF* 2015)



TIMBER RESOURCES in selected countries (*SoEF* 2015)



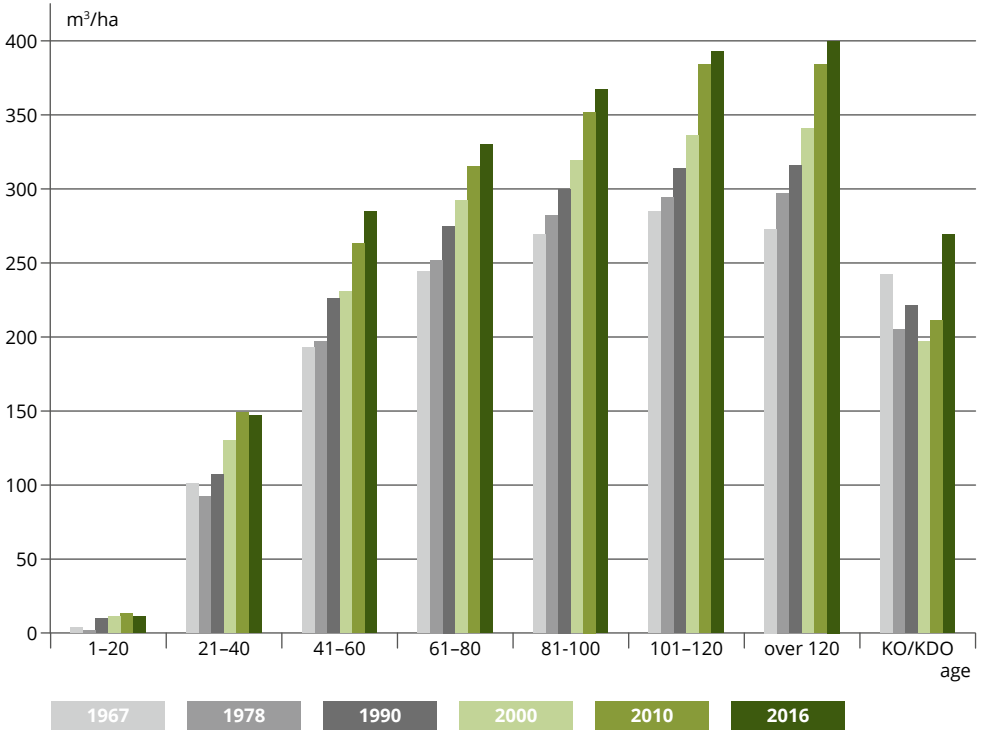
AMOUNT OF TIMBER RESOURCES in Poland's forests in the years 1967–2016, in million m³ of gross merchantable timber (Central Statistical Office, Bureau of Forest Management and Geodesy, National Forest Inventory); **figures for 1 January**

Changes in timber resources

Since 1967, when the first update of timber resources in the State Forests was made, there has been a steady growth in the volume of timber. In the last few years, a reliable source of data for the country, which has also released the statistics on the resources of private forests, has been the National Forest Inventory. In relation to the State Forests, the NFI records indicate a slightly higher figure (by 10%) for forest resources, in comparison with the data coming from the updating reports on the condition of forest area and timber resources. According to the NFI for the periods 2005–2009 and 2012–2016, the total value of timber resources in the country was increasing annually by an average of 35 million m³.

In the last 20 years, i.e. from January 1996 to January 2016, the increment of gross merchantable timber in forests administered by the State Forests amounted to 1239 million m³. During this period, 710 million m³ of merchantable timber was harvested, which means that 530 million m³ of gross merchantable timber, representing 43% of the total increment, augmented the resources of standing volume. General increase in timber resources is not only the result of increasing forest area, since there are also changes in growing stock (volume per hectare) within individual age classes. This indicator has been continually increasing in the analysed period 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, however, it may also be due to applying more accurate inventory methods.

Timber resources in Polish forests increase by 35 million m³ annually



CHANGES IN TIMBER RESOURCES by age class in the State Forests
(Bureau of Forest Management and Geodesy)

FOREST FUNCTIONS

Forests fulfil diverse functions, either naturally or as a result of 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 steppisation;

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

these are 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 is directed at conservation of the durability of forests, continuity of their multilateral use and augmentation of forests resources.

Forests provide employment for nearly 50 thousand people directly involved in their utilisation and protection. Forests stimulate industries and support jobs in other sectors of the economy, such as timber, pulp-and--paper and energy industries.

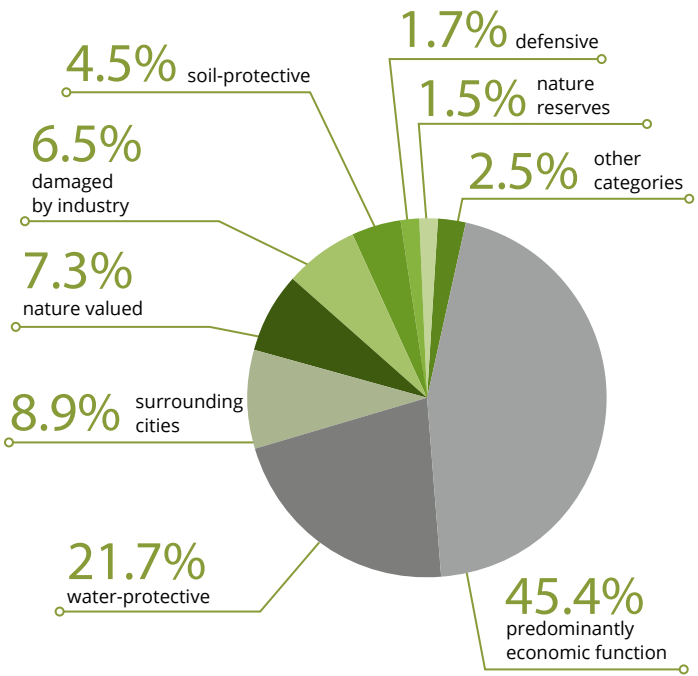
Environmental functions of forests

Protective forests account for 53% of all forests in Poland

The oldest 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 2016, the total area of protective forests increased to 3776 thousand ha, which represents 53.2% of the total forest area, or 54.6% including 103 thousand ha of nature reserves.

Among distinguished categories, water-protective forests take the largest area: 1542 thousand ha, suburban – 633 thousand ha, nature valued – 517 thousand ha, damaged by industry – 463 thousand ha and soil-protective – 323 thousand ha. The majority of protective forests is located in the southern part of the country, in the mountain areas (90.0% in Kraków RDSF, 83.9% in Krosno RDSF) and also in the areas being affected by industry (83.4% in Katowice RDSF).

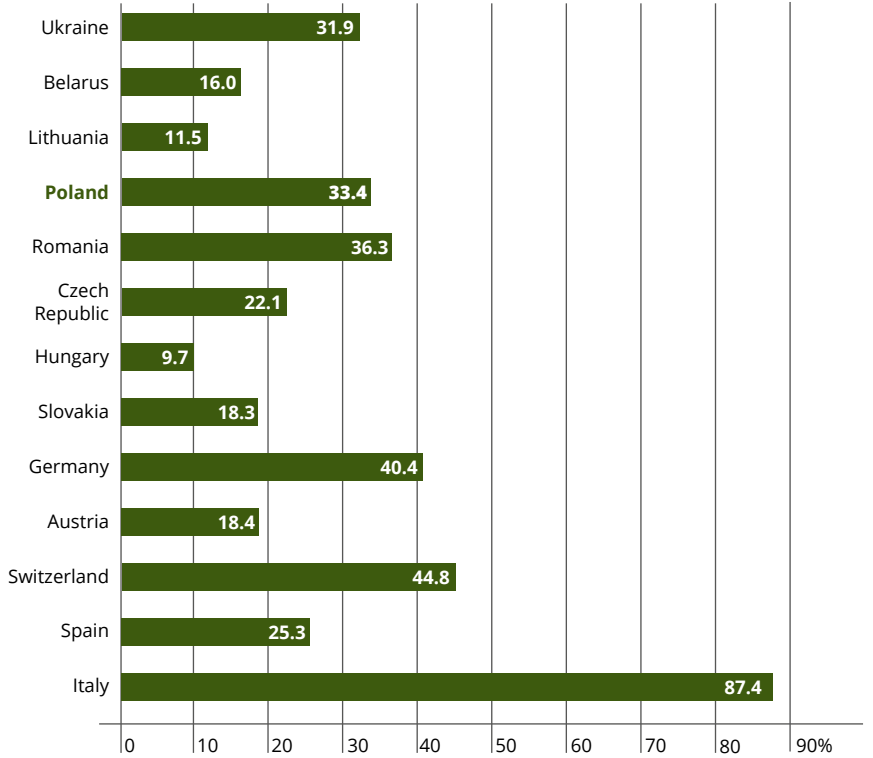
The area of private forests recognized as protective has been estimated at 65.3 thousand ha, which comprise 3.7% of their total area; municipal protective forests cover an area of 22.7 thousand ha (26.6%). The share of protective forests in all ownership categories in the total forest area in Poland has already reached 41.9%, and including the area of nature reserves – 43.0%.



SHARE OF PROTECTIVE FORESTS in the State Forests in 2016
(Directorate-General of the State Forests)

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 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*)

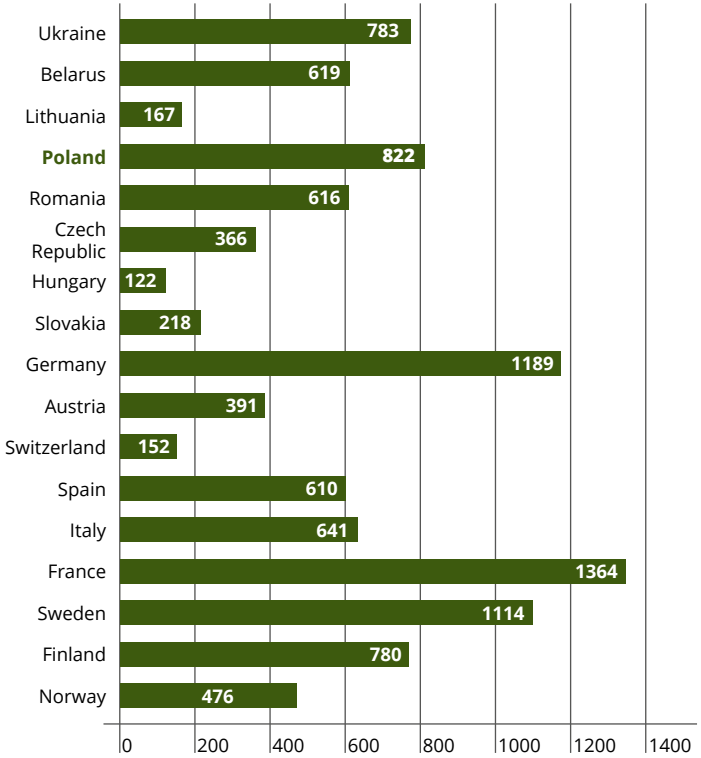
Carbon sequestration

Assessment of the amount of carbon absorbed by ecosystems (including forest) was, until recently, of almost exclusively scientific interest. The growing threat of climate warming caused by the increased amount of CO_2 in the atmosphere, and especially the raised 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.

Forest Carbon Farms is the State Forests' idea to increase CO_2 absorption

The general rules for assessing the amount of carbon sequestered by forests and the possibility to include this amount in the total balance for CO_2 emissions are based on the decisions taken during the Conference of the Parties for Climate Change and the assumptions of the Kyoto Protocol. The last such conference took place in Marrakech (Morocco) in November 2016, and its main purpose was to develop a roadmap for the implementation of the new climatic agreement concluded earlier in Paris by all states participating in the Convention.

It was agreed among other things that individual countries would make every effort to reduce global warming (the maximum growth cap was set at 2°C), which would result in further reductions of greenhouse gases and pollutants, mainly CO_2. Binding this gas by forest ecosystems has been listed as one of the most effective methods to slow global warming.



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

Poland's position on methods of reducing emissions is based also on the use of renewable energy sources, including geothermal energy, and the use of forest areas for the absorption of CO_2. In practice, this means taking up activities related to increasing the forest area of the country (the afforestation potential is expressed by the amount of nearly 2 million hectares of poor soils that do not guarantee the profitability of agricultural production), as well as the introduction of the second storey, fast growing species, sub-planting, the promotion of natural regeneration and the limitation of clear-cuts. As a result, this will lead to the increase in the amount of plant biomass accumulated in forest ecosystems.

Beginning in 2016, the State Forests have launched the pilot project of Forest Carbon Farms, which aims to increase the absorption of CO_2 and other greenhouse gases by forests as a result of additional activities in forestry. Other activities undertaken by the State Forests, related to the promotion of building houses from the wood raw material, which is a kind of coal storage, will serve the above-mentioned aims.

The data concerning timber resources show that the amount of carbon stored in the wood biomass in Poland has been estimated at 822 million tonnes, including 685 million tonnes of the standing volume and 137 million tonnes in the underground part; the amount of carbon in dead wood has been assessed at 32 million tonnes (*SoEF 2015*).

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

The reduction of the amount of greenhouse gases may be improved also by appropriate activities linked to the forest management practice, 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 the fossil fuel emission, use of wood as energy source or increasing retention of soil organic carbon.

The tasks of the State Forests as stated in the Forest Act are in line with the objectives of the Kyoto Protocol and the Paris Agreement, which may be reflected in the increase in the last ten years of forest land and resources under the State Forests management by 57 thousand ha and 241 million m^3, respectively.

Biomass of Polish forests contains **822** million tonnes of carbon

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 as professionals.

In 2016, more than 3.7 million people took part in various kinds of educational activities organized by the foresters. They were as usual:

PROMOTIONAL FOREST COMPLEXES in Poland in 2016

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, fairs, 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 aided with attractive and various educational infrastructure which includes: forest education centers (66), educational chambers (278), educational shelters called 'green classes' (595), educational trails (1039), educational points (1998), other facilities (2946), and also overnight accommodation.

Educational activity of the State Forests is financed mainly from the forest districts' own resources, also from the relevant Provincial Fund for Environmental Protection and Water Management and the National Fund for Environmental Protection and Water Management. In 2016, approximately 30.3 million PLN were spent on forest education, including 27 926.1 thousand PLN coming from forest districts' own resources (92%).

The unquestionable leaders of forest education are promotional forest complexes (PFCs) which attract about 30% of the participants in the educational training prepared by foresters. Experienced and qualified professionals, known as the leaders of forest education, work within the areas of promotional forest complexes. They have at their disposal there a best-developed infrastructure including for-

est education centers (33), educational chambers (56), educational shelters (129), educational trails (230), educational points (533) and other facilities (564).

Promotional forest complexes are particularly important for science especially because the interdisciplinary research carried out within their areas is based on fully recognized forest environment. The study results allow for the improvement of forest management methods and for setting acceptable limits on economic (commercial) interventions in forest ecosystems. They are also an alternative to overburdened national parks where tourism is limited by very strict rules. PFCs not only give the opportunity to learn about the principles of ecological forest management, but also ensure free access and unrestricted contact with nature.

The State Forests' policy on promoting sustainable forest management allowed to create 25 PFCs, located in all 17 regional directorates of the State Forests. The total area of PFCs amounts 1274 thousand ha, including over 1200 thousand ha within the State Forests.

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 in 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. 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.

Educational and tourist activities are also carried out in national parks and in forests of other forms of ownership, mainly in urban forests. Foresters in cooperation with these institutions, develop good practices for forest access, which is evident by incorporation of urban forests of Szczecin, Warsaw and Olsztyn and forest experimental institutes in Rogów, Siemianice, Krynica and Popielno into forest promotional complexes.

Foresters prepared about **3160** parking lots and vehicle parking places

Productive functions of forest

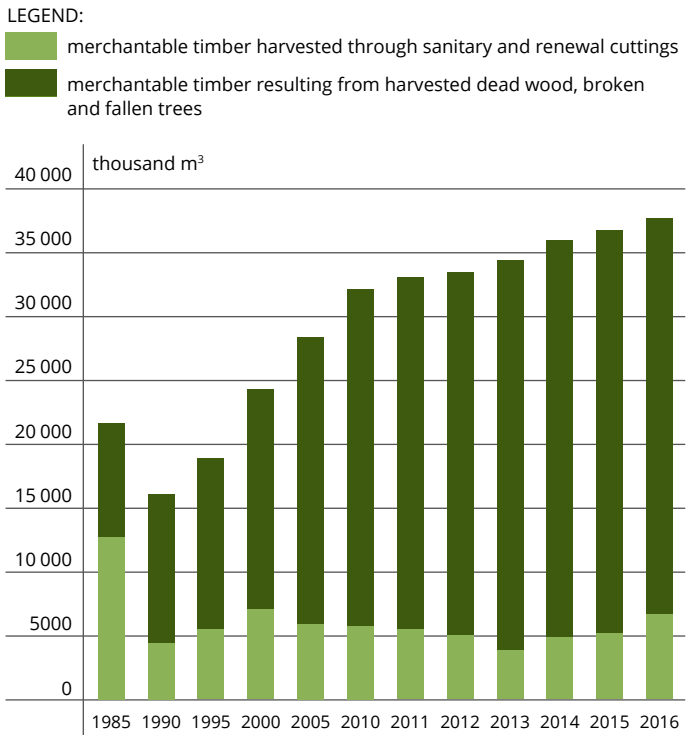
Productive functions of forest are defined as production by nature and human work of timber resources and other products which can be utilised by man and are the basis of many industries, professions, traditions and cultures.

In 2016 in Poland **39.1 million m³** of net merchantable timber were harvested

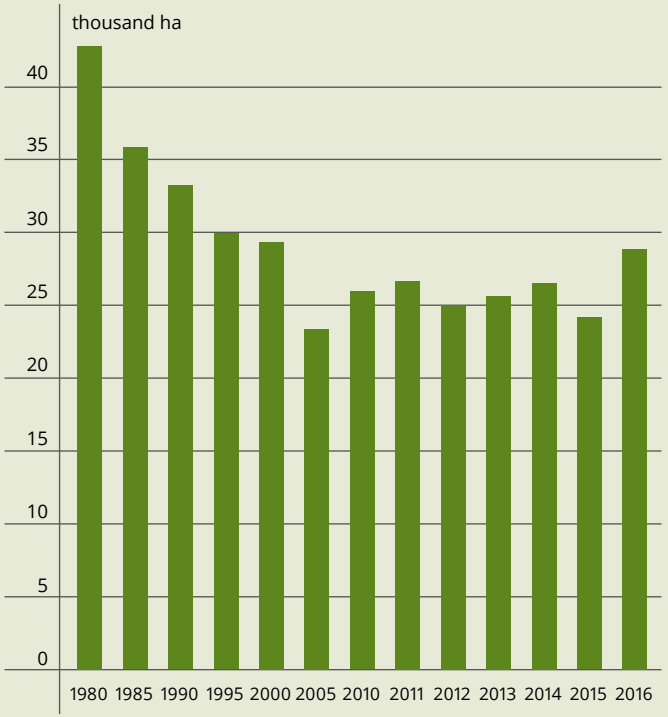
In 2016, the amount of net merchantable timber harvested in Poland was 39 129 thousand m³ (by 802 thousand m³ more than in 2015), including 1290 thousand m³ from private forests (a decrease of 236 thousand m³ on 2015), and 192 thousand m³ from national parks.

In 2016, the State Forests harvested 39 165 thousand m³ of raw timber, including 37 405 thousand m³ of net merchantable timber (102.1% of the approximate prescribed cut by volume), of which 18 818 thousand m³ (97.4% of prescribed cut) were obtained in final felling, and 18 586 thousand m³ (107.3 % of prescribed cut) from pre-final felling.

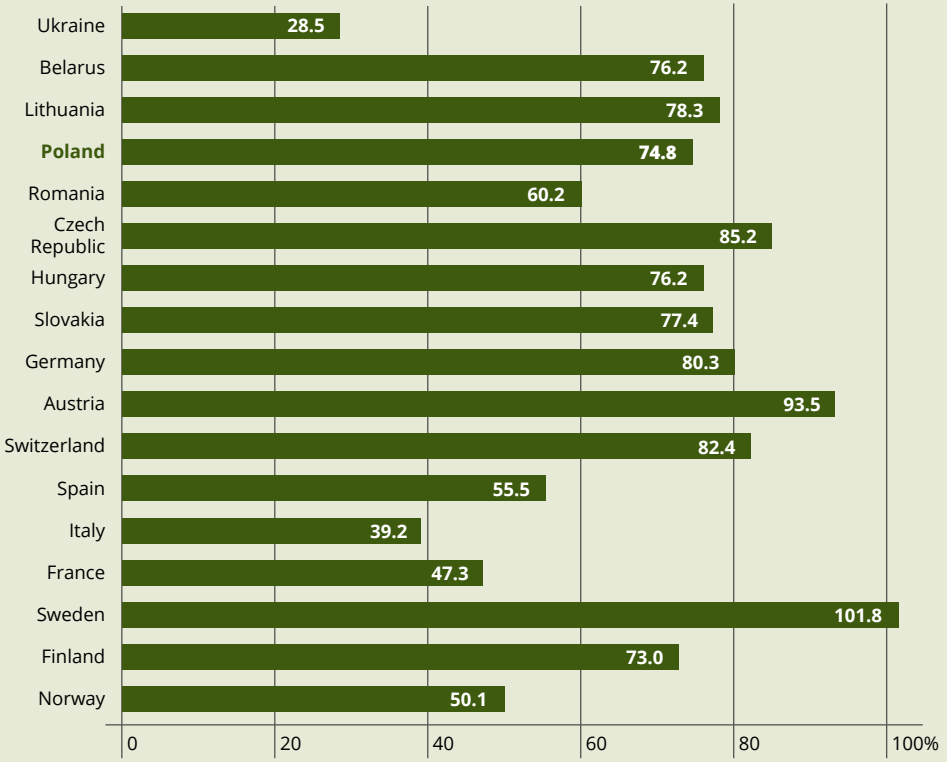
The volume of timber harvested for sanitation reasons by clearing dead wood, broken and fallen trees being the result of natural processes, wind activity, gradations of insect pests, disturbances in water relations, air pollution and the anomalies of the weather, amounted in 2016 to 6611 thousand m³, or 17.7% of the total harvest of merchantable timber. This figure is slightly lower than the average of the past 10 years, which is 18.2%. The size of salvation cuts in 2016 was primarily affected by the damage caused by weakened stands due to severe regional droughts, hurricane winds of similar nature and secondary pests.



SHARE OF DEAD WOOD, BROKEN AND FALLEN TREES in total felling in the State Forests in 1985–2016, in thousand m³ of net merchantable timber
(Directorate-General of the State Forests)



AREA OF CLEAR-CUTS in the State Forests in 1980–2016
(Directorate-General of the State Forests)



RELATION OF TIMBER HARVEST to annual increment (*SoEF 2015*)

In 2016 timber harvest from clear-cuts in SF was **19.2%** of total harvest

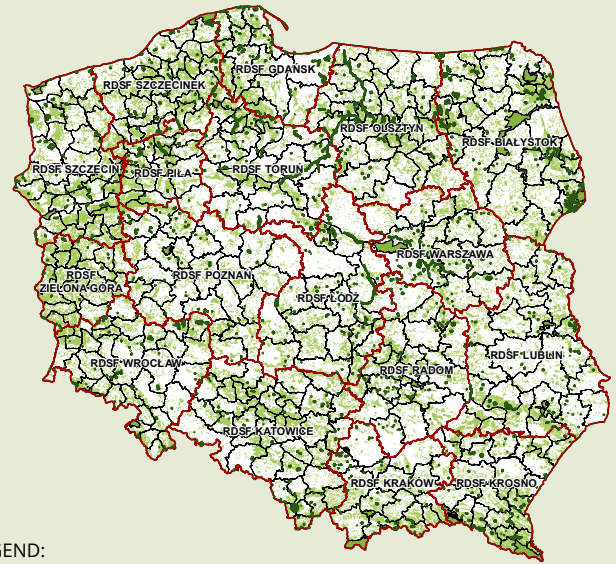
In the State Forests, during the last 20 years (1997–2016) the prescribed cut for final felling has been fulfilled in 94%, in turn the prescribed cut for pre-final felling (by volume) determined in forest management plans has been 112.0%.

In the State Forests, in 2016, under the clear-cut system 7164 thousand m^3 of merchantable timber was harvested, which accounts for 19.2% of the total harvest. The clear-cut area amounted 28.9 thousand ha and was slightly higher than the average for the past two decades amounting 26.9 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 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 diseases or insect gradations.

In the last five years in the State Forests there has been observed a stabilization of the volume of timber harvest, expressed in the volume of net merchantable timber per one hectare of forest area, at 5.26 m^3/ha. In 2015, this indicator – calculated for a five-year period – amounted 5.14 m^3/ha. However, the size of felling does not exceed the permissible forest use and according to data from the last 20 years it is at 57.3% of current increment.

A comparison of the respective indicators for the group of countries with similar geographic conditions is indicative of the appropriate intensity of felling in Poland.

Just like in Poland (74.8%), in the majority of countries in the region, over 50% of the increment is harvested, with the exception of Ukraine (28.5%), Italy (39.2%) and France (47.3%).



LEGEND:

NATURE RESERVES

REGIONAL DIRECTORATES OF THE STATE FORESTS

FOREST DISTRICTS

NATIONAL PARKS

FOREST COMPLEXES

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

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 an area 315.1 thousand ha. Forests comprise 194.8 thousand ha, i.e. 61.8% of the total area of national parks.

Nature reserves, 1493 in number, cover an area of 168.3 thousand ha. Majority of reserves (1281) are located within administrative boundaries of the State Forests. The combined forest area in nature reserves is 96.1thousand ha.

There are 122 landscape parks, created through administrative orders of provincial governors, of a combined area 2604.7 thousand ha, out of which 1319.1 thousand ha (50.6%) are forests. The areas of protected landscape include 385 objects of nature with a total area of 7085.9 thousand ha, of which forests constitute 2305.9 thousand ha (32.5%). 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 2016 there were designated 145 special protection areas (SPAs) for birds with a total land

Out of 1493 nature reserves in Poland

1281

are located within the State Forests

Natura 2000 areas cover about **20%** of the total area of Poland

The State Forests have been keeping records of all statutory forms of nature protection in the lands under their management; the data is currently updated, e.g. when creating nature conservation programmes in forest districts. As of 31 December 2015, in the area of the State Forests there have been recorded the following:

- 1281 nature reserves with an area of 123.3 thousand ha;
- Natura 2000 sites with a total area of 2891 thousand ha (38.0% of the State Forests' territory), including: 133 special protection areas (SPA) for birds covering 2217 thousand ha (29.1%) and 707 sites of Community importance (SCI) with a combined area of 1678 thousand ha (21.8%);
- 10 988 monuments of nature, including 8611 individual trees, 1511 groups of trees, 133 avenues of trees, 506 erratic boulders, 237 rocks, grottoes and caves, and 157 areas under monument protection (314 ha);
- 8965 areas of ecological utility with an area of 29 517 ha;
- 125 documentation sites with an area of 1155 ha;
- 136 nature and landscape complexes with a combined area of 37 235 ha.

In the State Forests over 3539 protective zones for endangered species were created with a total area of 150 470 ha, of which over 21% is an area of all-year protection. These zones are being created in order to protect the refuges of birds (3147), mammals (4), reptiles (36), insects (12), plants (5), lichens (334) and other (1).

and sea area of 5575 thousand ha, and 849 sites of Community importance (awaiting to be designated by the Minister of the Environment as special areas of habitat conservation) with a total area of 3851 thousand ha. Currently, Natura 2000 sites cover 6853 thousand ha 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%), and sites of Community importance 1678 thousand ha (21.8%).

All forms of forest management and conservation, aimed at ensuring their sustainability and biological resilience, also serve to maintain genetic resources and biodiversity.

In the total area of forest stands under special protection with regard to preservation of genetic resources over 188 915 ha are designated as the seed base, of which 15 612 ha are selected seed stands, 167 710 ha are seed producing stands, 1820 ha are seed orchards and seed crop plantations, and 3773 ha are gene conservation stands and plantations, 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, also within own financial resources there are 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 (7) in Kudypy, Kaliska, Gryfino, Syców, Gdańsk, Karnieszewice and Marcule forest districts and arboreta (4) in Tułowice and Supraśl forest districts, in the Forest Gene Bank Kostrzyca in Miłków, and in the Centre of Forest Culture in Gołuchów.

In order to increase the efficiency of management in forest areas characterized by a high diversity of species, with particular reference to Natura 2000 sites, the State Forests have launched a system of periodic universal inventories of plant and animal species and other organisms. In 2016, a large-scale nature inventory project was launched in the area of the Białowieża Forest and in Krosno RDSF.

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 major 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 the previous year, the populations of most game animals in 2016 increased slightly. The largest increase was noticed in the size of a population of elk (by 8.1%), hare (by 6.1%) and mouflon (by 3.4%), and a decrease in population of wild boar (by 5.5%) and grey partridge (by 2.4%). In the last decade, however, there was an increasing trend as far as most species are concerned. The significant increase was noted in the population of elk (by 334%), fallow deer (by 89%), mouflon (by 55%), hare

(by 48%), deer (by 48%) and wild boar (by 41%). The reverse trend was observed only in the population of grey partridge (by about 25%) and fox (by nearly 8%).

The Białowieża Forest

Nature reserves and reference areas in the Białowieża Forest take **33%** of forest districts' territory

The Białowieża Forest, covering the areas of the Białowieża National Park (10.5 thousand ha) and three forest districts: Białowieża, Browsk, and Hajnowka (52.6 thousand ha) is a very valuable forest ecosystem, recognized at national and international levels. This is the Biosphere Reserve which was also inscribed on the UNESCO World Heritage List, and the entire land constitutes the Protected Landscape Area "Białowieża Forest" and Natura 2000 Site PLC200004 "Białowieża Forest".

By the year 2016, in the part of the Białowieża Forest managed by the State Forests there were created 21 nature reserves, including reserves of forest (14), fauna (4), flora (2) and peatland (1), with a total area of 12 028 ha. There were also established 1131 monuments of nature – mainly single trees, 110 sites of ecological use with a total area of 695 ha, 193 protection zones around lung lichen (*Lobaria pulmonaria*) and nesting sites of birds with an area of 2727 ha. Under the provisions of the Forest Act, the area managed by the State Forests is at the same time the Promotional Forest Complex "Białowieża Forest".

In addition to nature reserves, where human intervention is subject to nature protection, other areas have been created where human activity is reduced to various degrees. On 31 March 2016, the Director-General of the State Forests issued the Decision No. 52 on establishing detailed principles of forest management within the territorial scope of Białowieża and Browsk forest districts which introduced a reference area (5611 ha) with severe restrictions on forest management.

The areas of limited forest use were identified according to the plan of protective task (regarding stands in moist habitats or aged over 100 years with an area of 34.5 thousand ha). In total, the reference areas and nature reserves cover 17.6 thousand ha, i.e. slightly over 33% of the combined area of Białowieża, Browsk and Hajnowka forest districts; which is 65.5% of their area if the lands of limited use are taken into account. Therefore, commercial cuts are allowed only in 1/3 of the forest stands of the Białowieża Forest area being under the management of the State Forests.

Through the decision of the Director-General of the State Forests, an inventory of the most important natural and cultural resources, including selected species of birds, insects, amphibians and one species of bat – western barbastelle, also rare and protected plants, as well as natural habitats and heritage objects, was carried out in the area of the Białowieża Forest in 2016.

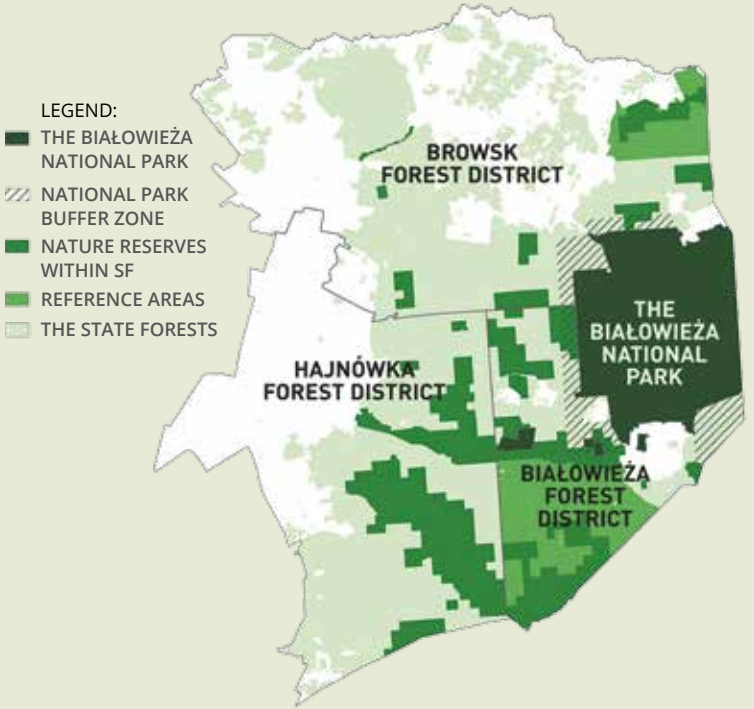
Cultural heritage objects were identified using airborne laser scanning technology. In addition, 665 surfaces were examined for the content of organic carbon in forest soils. This was the first inventory of selected components in the area of the Białowieża Forest that covered its entire territory and was done by systematic research.

Ornithological inventory covered 11 species of birds, including three--fingered woodpecker, which pecks out hollows in the trunks of dead or dying trees. It was found that the number of pairs of this species in commercial forests does not differ significantly from their amount in the area of Białowieża National Park (4.7–5.4 pairs in BNP and 4.5–4.8 in the forests of Białowieża Forest District).

Within the framework of entomological inventory, 94 415 insects of the ground beetle family (Carabidae) and 27 335 of the rove beetle family (Staphylinidae) were identified on 634 surfaces. There was no trace of great capricorn beetle (*Cerambyx cerdo*) – the species is most likely to be considered extinct in the Białowieża Forest. Out of 6 species of butterflies being under protection in Natura 2000 site (PLC200004 Białowieża Forest), 4 species are no longer present there, i.e. scarce large blue (*Phengaris teleius*), marsh fritillary (*Euphydryas aurinia*), the Eros blue (*Polyommatus eroides*), and Danube clouded yellow (*Colias myrmidone*). The inventory, however, has confirmed the occurrence of the hermit beetle – the relic species associated with the old den trees, and saprophyte beetles (*Cucujus cinnaberinus* and *C. haematodes* and also *Boros schneideri*) living under the bark of dead trees and even in greater number than in the area of BPN.

Within the herpetological inventory, the occurrence of northern crested newt in forests managed by the State Forests was noted in 7 sites, and of European fire-bellied toad in 3 sites. Among bats, the highest share among caught individuals was western barbastelle (over 80%).

Rare and protected plant species were found in 2167 sites. There were also evaluated five natural habitats.



BIAŁOWIEŻA FOREST – administrative division and forms of nature conservation

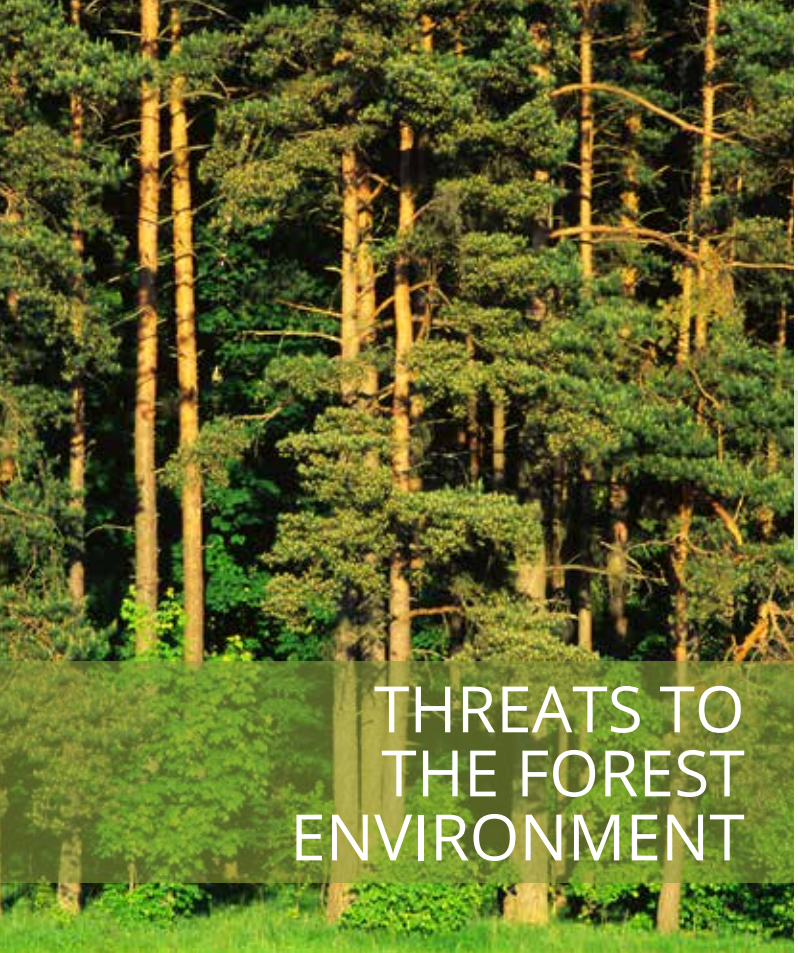
Within the inventory of cultural heritage, in the area of the Białowieża Forest, there were noted two large settlement centres, 266 positively verified archaeological objects (including mounds, graves, tar kilns, charcoal piles or potasheries), and 290 km of linear objects, probably the remnants of ancient baulks. The objects were found both in the territory under SF management and in the area of BNP.

The inventory also allowed to determine the amount of dead wood in the Białowieża Forest, with particular emphasis on dead spruce, which mainly comes from trees infested by the bark beetle. In the national park the average stock of dead wood amounts 109.4 m^3/ha, including 54.7 m^3/ha of spruce; in the area of the State Forests, the relevant values are 54.5 m^3/ ha and 26.7 m^3/ha, respectively. The total stock of dead wood remaining in the forest, both standing and lying, amounted to 3.8 million m^3, including spruce – 1.9 million m^3.

Began in 2012, the bark beetle gradation was still in progress in 2016. It resulted in 379 thousand infested spruce trees, most of which grow in Białowieża Forest District – 199 thousand trees.

The only known effective way to fight the bark beetle gradation is to remove infested trees. However, their number, and therefore their volume, has already exceeded the allowable limits on logging specified in the forest management plan for Białowieża Forest District. In order to save the remaining spruce stands and to avoid degradation of nature valued Natura 2000 areas, in March 2016, the Minister of the Environment approved an annex to the forest management plan prepared for Białowieża Forest District for the years 2012–2021. In the annex, the limit on harvesting wood coming mainly from infested trees increased from 63 471 m^3 to 188 000 m^3. This action is supposed to stop the process of spruce dieback in the Białowieża Forest.

The economic activities undertaken by the State Forests in the administrative area of the Białowieża Forest under SF management are in line with the plan of protective tasks determined by the order of Regional Director for Environmental Protection in Białystok of November 2015 for the area Natura 2000 “Białowieża Forest”.



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 resilience and disastrous threats (local or regional).

Abiotic threats

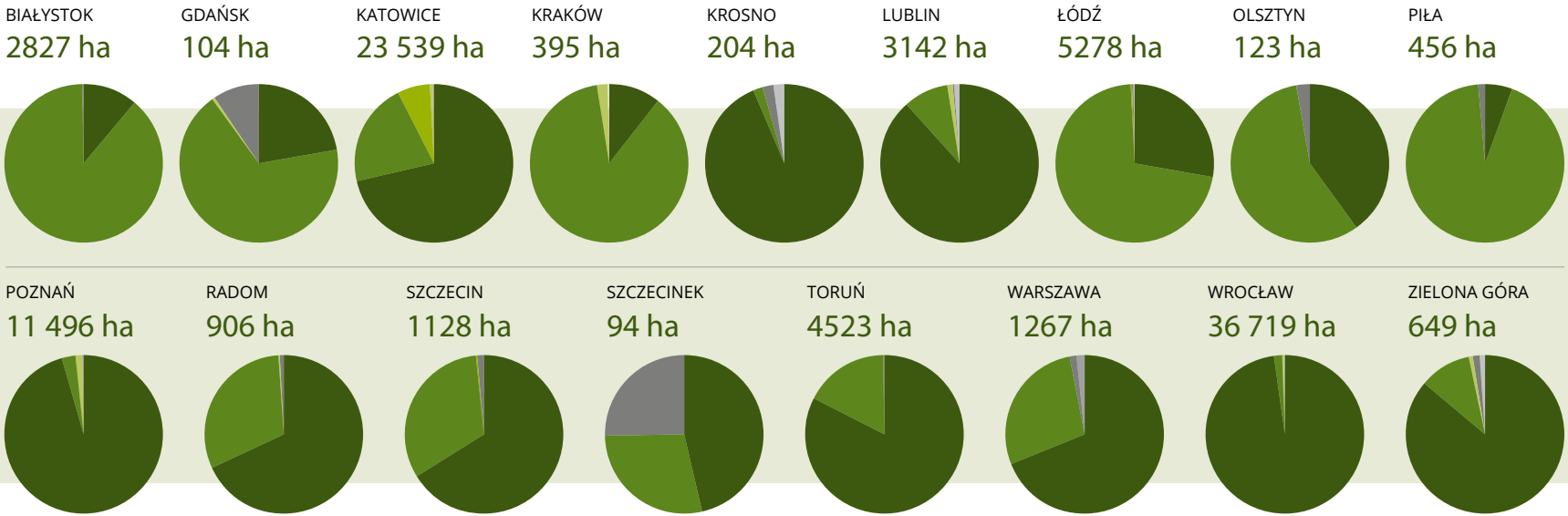
In 2016 abiotic factors damaged **92.8 thousand ha** of forests

Recent climate changes of a very dynamic character has affected either the condition of stands or the population of forest pests. Abiotic factors are one out of three main groups (apart from biotic and anthropogenic factors) that shape the health condition of forests.

In 2016 the greatest natural disaster for the whole country was a strong drought which weakened both coniferous and broadleaved stands and their increased vulnerability to pests and pathogenic fungi. One of the abiotic factors of disastrous nature which affect the level of damages to trees mostly were in 2016 hurricane winds.

Nearly twofold increase in the area of stands damaged by abiotic factors was noted. While in 2015 it amounted 48.5 thousand ha, then in the next year it was 92.8 ha.

Damage to forest caused by at least one abiotic factor was reported by majority (81%) of forest districts (44% reported one factor as a cause of damage, 31% reported two factors, 5% three factors and 1% four factors. Damage caused by disturbances in water relations, mostly droughts (75 thousand ha in the area of 235 forest districts) and strong winds (15.3 thousand ha in the area of 173 forest districts), was reported on more acreage than the average. In 2016, the timber volume of broken and fallen trees of forest-forming species has slightly exceeded 3 million m^3.



AREA OF STANDS aged over 20 years damaged to varying degrees by selected abiotic factors in each RDSF in 2016

LEGEND: DISTURBANCES IN WATER RELATIONS | WIND | IMMISSION | LOW AND HIGH TEMPERATURE | FOREST FIRES | SNOW | HAIL

Biotic threats

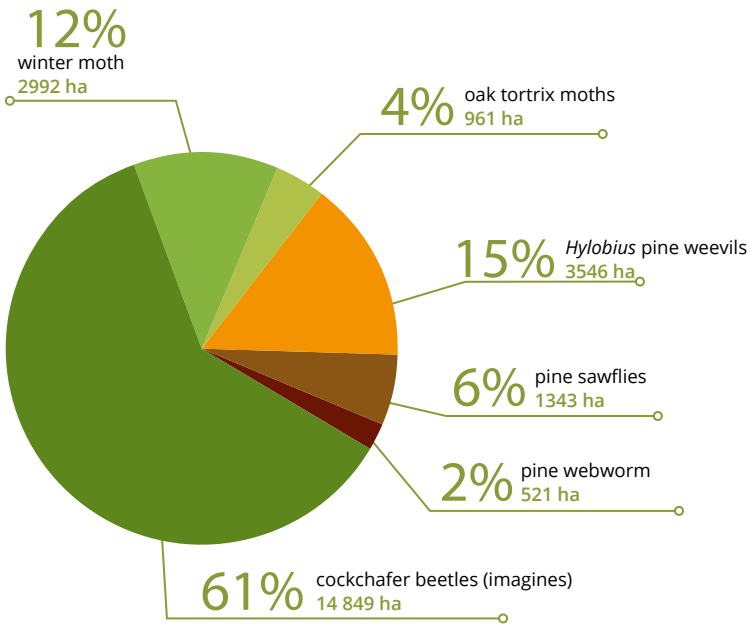
Threats to forests from primary insect pests

Protective treatment in SF was applied to about **92.8** thousand ha of forests

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.

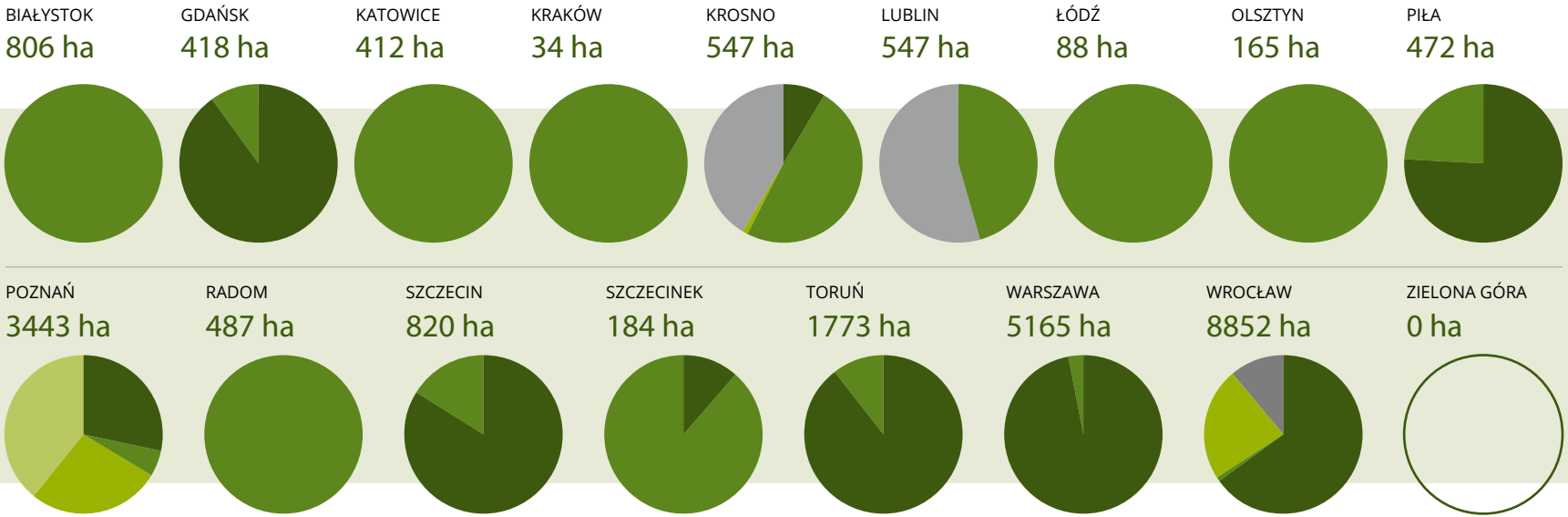
In 2016, in the forests administered by the State Forests, threat from insect pests was record low – the total area where they occurred was 94 thousand ha. It was necessary to apply control treatment aimed to reduce populations of 45 pest species or groups. In 2016, the total area of forest stands subject to such treatment was nearly 28 thousand ha and was over three times smaller than in the previous year.

Major pests damaging stands in 15 regional directorates of the State Forests were imagines of cockchafer beetles. Control treatment was applied to nearly 15 thousand ha of stands in the area of 19 forest districts, including over 5 thousand ha only in the area of Wyszków Forest District (RDSF Warszawa).



(pests of pine stands are marked in brown, pests of broadleaved stands – in green, pests of nurseries, plantations and sapling stands – in orange)

AREA SHARE OF POPULATION CONTROL TREATMENT for major primary insect pests in 2016



AREA OF POPULATION CONTROL TREATMENT for major primary insect pests in each RDSF in 2016

LEGEND:

- COCKCHAFER BEETLES (IMAGINES)
- *HYLOBIUS* PINE WEEVILS
- WINTER MOTH
- PINE SAWFLIES
- OAK TORTRIX MOTHS
- PINE WEBWORM

Pine sawflies were combated on about 1.3 thousand ha of forests

Apart from this group of insect pests, there were also other folivorous species that were subject to control treatment on the area slightly exceeding 4 thousand ha. In 2016, the second group of insects causing most damage were pests occurring in nurseries, plantations and pine sapling stands. The total area subject to control treatment for this group amounted nearly 6.5 thousand ha, including slightly over 3.5 thousand ha for *Hylobius* pine weevils.

In 2016, in pine stands the control treatment was mainly applied against folivorous pests on an area of nearly 2 thousand ha, by 70% smaller than that in the previous year. Major pests were pine sawflies which were combated on 1.3 thousand ha of surface. In 2016, apart from three major groups of primary pests the occurrence of many other species/groups of insect pests was also recorded, including pests of spruce, larch, fir, and Douglas fir as well as root pests of trees and shrubs, which continually damage Polish forests. The combined area of spruce, larch and fir stands to which control treatment for insect pests was applied was 252 ha.

Control treatment for root pests of forest trees and shrubs was applied in nurseries and plantations in the area of 97 ha.

Threats to forests from secondary insect pests

Forests in Poland were significantly weakened by the drought that began in 2015. Weather conditions caused fungal diseases, especially those attacking roots, to spread more actively and created perfect conditions for secondary pests to develop. In 2016, the increased activity of secondary pests was noted due to persistent drought since 2015. The timber harvest resulting from sanitation cutting was 6.6 million m^3. About one third of harvested dead wood (2 million m^3) was populated by cambi- and xylophagous insects.

In 2016, coniferous stands were most threatened: 5.6 million m^3 of wood were harvested, of which over 41% (2.3 million m^3) were broken and fallen trees.

The volume of pine timber harvested in 2016 within the framework of sanitation cutting scheme was 3.0 million m^3, of which 53% were broken and fallen trees. Major secondary pests of pine stands in 2016 were the following species: steelblue jewel beetle (*Phaenops cyanea*), engraver beetle (*Ips acuminatus*), also *Pissodes* pine weevils and *Tomicus* pine shoot beetles.

The amount of spruce timber harvested in sanitation cutting in 2016 was 2.4 million m^3, of which broken and fallen trees were 25%. Major secondary pests of spruce stands in 2016 were the European spruce bark beetle (*Ips typographus*) and its companion species: small spruce bark beetle (*Polygraphus polygraphus*) and six-toothed spruce bark beetle (*Pityogenes chalcographus*).

The size of sanitation cutting in broadleaved stands in 2016 was significantly smaller at 1.0 million m^3, of which over 72% were fallen and broken trees.

BIAŁYSTOK
979 185 m^3

GDAŃSK
120 762 m^3

KATOWICE
1 076 178 m^3

KRAKÓW
146 510 m^3

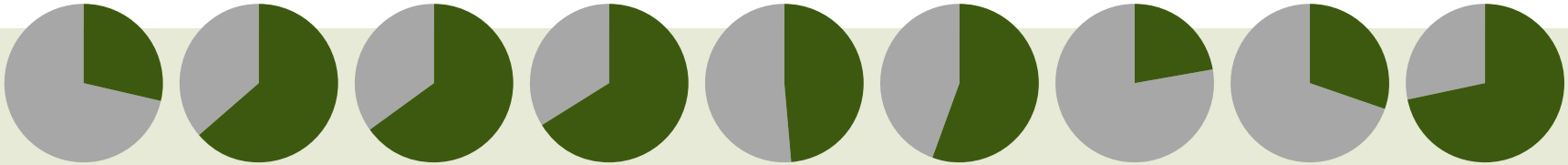
KROSNO
76 845 m^3

LUBLIN
289 477 m^3

ŁÓDŹ
224 744 m^3

OLSZTYN
441 360 m^3

PIŁA
135 126 m^3



POZNAŃ
294 468 m^3

RADOM
174 314 m^3

SZCZECIN
257 805 m^3

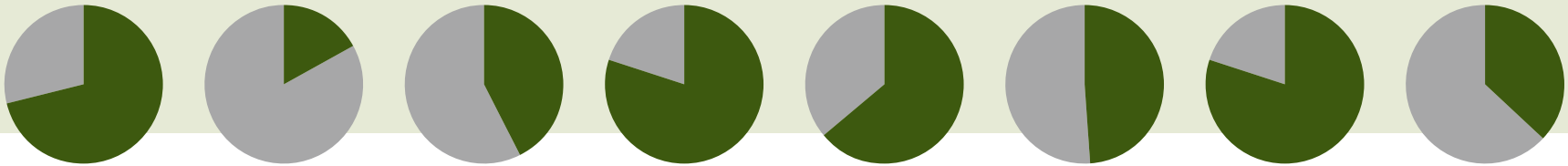
SZCZECINEK
451 872 m^3

TORUŃ
196 608 m^3

WARSZAWA
119 178 m^3

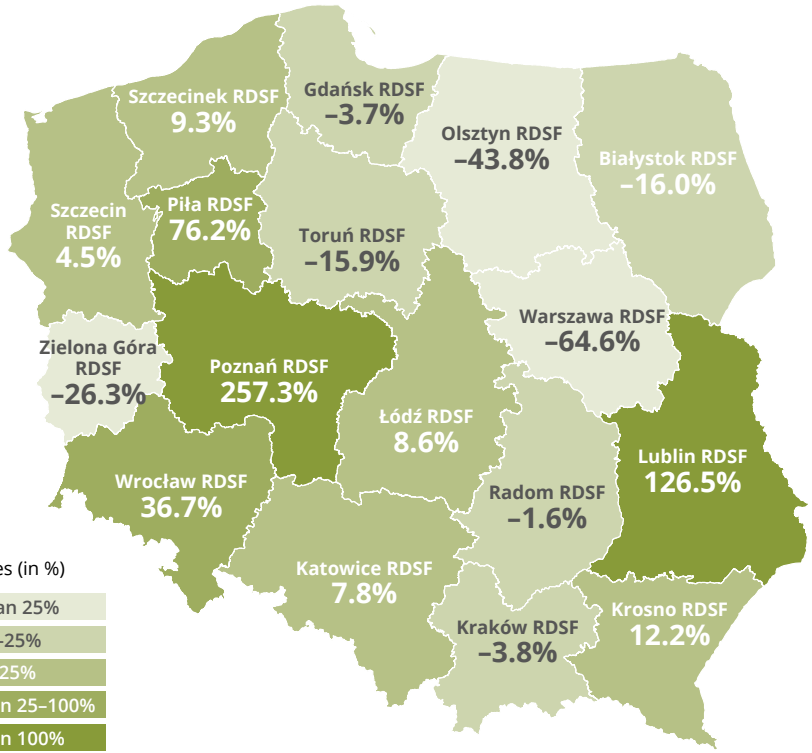
WROCŁAW
1 151 809 m^3

ZIELONA GÓRA
71 622 m^3



VOLUME OF DEAD WOOD, BROKEN AND FALLEN TREES
harvested in sanitation cutting in each RDSF, in 2016

LEGEND: DEAD OR DYING WOOD | BROKEN AND FALLEN TREES



CHANGES IN AREAS AFFECTED BY INFECTIOUS DISEASES in 2016, expressed as percentage of the area threatened in previous year

Threats to forests from infectious fungal diseases

In 2016 infectious diseases were reported over a combined area of 0.2 million ha of stands, an increase of 23 thousand ha (by 13%) as compared with 2015. This is the consequence of the increased risk from *Heterobasidion* root rot and drastic intensification of pine shoots dieback which covered 30 times larger area than that in 2015.

The area of oak stands with the symptoms of powdery mildew of oak increased by 30% in 2016. In case of other diseases occurring on needles or leaves, the size of the area under this threat was insignificant or remained at the level of the previous year. The area of occurrence of pine gall rust decreased significantly (by 45%), also the occurrence of fungi causing inner cankers and rots of logs and whole stems was reported in the acreage smaller by 4.5 thousand ha (on 17 thousand ha).

The total occurrence of root diseases was noted in the area larger by 12 thousand ha, however the area of damage caused by *Armillaria* root rot decreased by 3%, whereas by *Heterobasidion* root rot increased by 18%.

Comparison in individual regional directorates of the State Forests of forest health condition in 2016 and 2015 shows that there was significant improvement in the area of Olsztyn and Warszawa RDSFs, the largest increase of the area of threat however, which is as much as 3.5-fold, was noted in Poznań RDSF.

In nurseries the area affected by diseases amounted to 428 ha and was by 58 ha smaller than in 2015. The occurrence of diseases in stands aged up to 20 years was noted in the area of 16 thousand ha, which is smaller than that in the previous year by 90 ha.

Fungal diseases in mature stands (aged over 20 years) occurred in the area of 179.5 thousand ha, which is larger by 23 thousand ha than in the previous year.

Protective treatment applied in forestry in order to control the spread of infectious fungal diseases is conducted in forest nurseries and in stands, as and when it is necessary. In 2016 protective treatment was applied on a combined area of 23.4 thousand ha, chemical treatment on 950 ha and biological on 15.4 thousand ha.

Threats to forests from animals

In 2016, damage to stands caused by game and protected animals was reported in the combined area of 88.7 thousand ha. Damage within the range 21–40% occurred on 61.5 thousand ha, but above 40% on 27.2 thousand ha. Damage to stands in older age classes were reported to a greater or lesser extent in all 17 regional directorates of the State Forests.

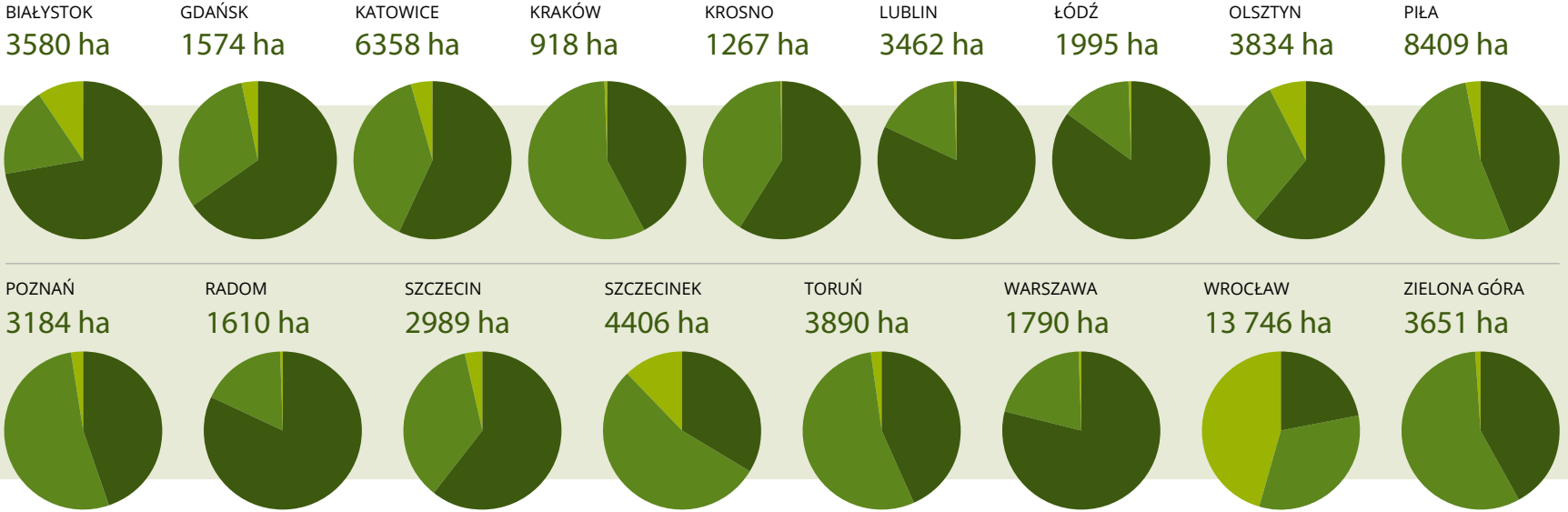
Damage caused solely by game, including red deer, fallow deer, roe deer, wild boar and hare was reported in 66.7 thousand ha, of which 32.7 thousand ha are plantations, 25.7 thousand ha are sapling stands, and 8.3 thousand ha are stands in older age classes.

Besides damage from game, in 2016 animal species under various forms of protection were also reported as being harmful to forests, above all beavers, elks, and European bison.

Damage to stands caused by beavers is observed in a total area of 12.8 thousand ha. The greatest damage from beavers is observed in north-eastern and eastern Poland, in the area of Białystok (3.4 thousand ha), Olsztyn (2.9 thousand ha) and Lublin (1.4 thousand ha) RDSFs. The largest area damaged by elks in 2016 was noted in Białystok RDSF (3.7 thousand ha), Lublin RDSF (1.4 thousand ha) and Olsztyn RDSF (1.1 thousand ha).

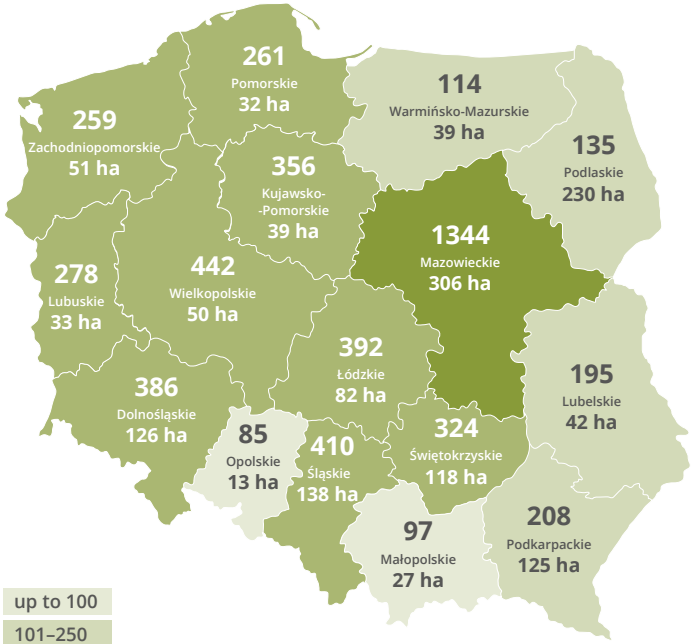
The European bison as a population of free-living animals in the forest environment lives in the areas under the management of Białystok, Krosno, Piła and Szczecinek RDSFs, where the pressure on stands from these animals is observed. Injuries to stands caused by herbivorous mammals were reported in a total area of 539 ha.

In 2016 damage caused by animals was reported in **88.7 thousand ha** of forests



AREA OF PLANTATIONS, SAPLING AND OLDER STANDS in each RDSF where damage exceeding 20% was caused by game and protected animal species, in 2016

LEGEND: PLANTATIONS | SAPLING STANDS | OLDER STANDS



NUMBER OF FOREST FIRES and burnt area in each province, in 2016

Anthropogenic threats

Forest fires

In 2016, 5286 forest fires were recorded, which is by 6971 less than in the previous year. 1451 ha of stands were burnt, by 4059 ha less than in 2015. The largest number of fires, as in 2015, broke out in the Mazowieckie province (1344, which is 25.4% of the total number), the lowest, however – in the Opolskie (85), the Małopolskie (97) and the Warmińsko-Mazurskie (114).

In 2016, in the State Forests there were 1725 forest fires (32.63% of all forest fires in Poland) in the area of 299 ha (20.61% of the total), excluding the territories used by the military. The largest number of fires in 2016 took place in Katowice RDSF (237), where they also covered the largest area (54 ha).

In 2016, in the territory used by the military there were 121 fires, which comprised 144.92 ha (in 2015 there were 165, and covered 776.17 ha).

Countrywide, 6 large fires were reported in 2016, and one very large fire (>100 ha); in 2015 there were 28 large fires and 4 very large fires. (in 2014, 2 great and 19 large fires, respectively).

The average area of fire in the forests in all ownership categories, in 2016 amounted to 0.27 ha (by 0.18 ha less than in 2015). As com-

In 2016
5286
forest fires were recorded

pared to 2015, the average area of fire in the State Forests decreased by 0.07 ha, reaching 0.17 ha. In forests of other ownership it was 0.32 ha.

The most frequent causes of fires in the State Forests were arson (40%) and negligence (14%), however the share of fires from an unknown cause amounted to 39% 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 causes. In case of 19% the cause remained unknown.

In 2016, the largest number of fires occurred in May (24.7% of all fires, i.e. 1304), then June (21%), April (14.8%) and September (14.6%).

Air pollution

Forest monitoring network consists of **12** observation plots

Forest monitoring provides information on major pollutants in the forest areas. The network of intensive monitoring consists of 12 permanent observation plots distributed in the area of Poland. 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 active plots in spruce stands (Suwałki, Szklarska Poręba and Piwniczna forest districts), like the fourth, currently not functional plot in Bielsk.

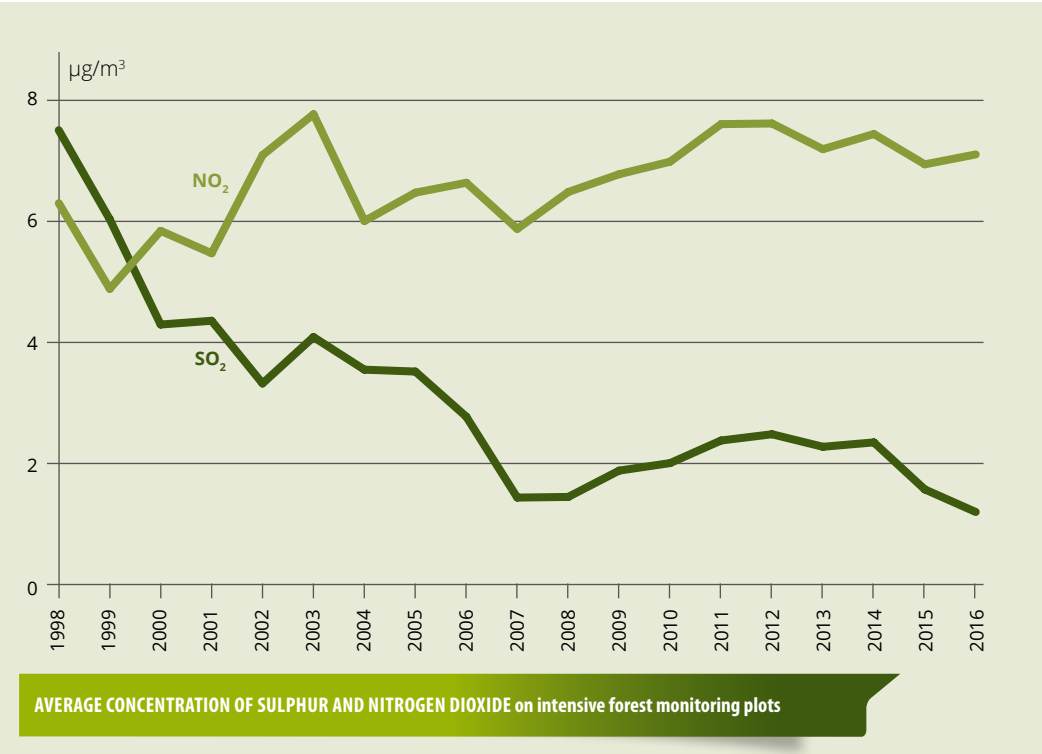
According to Central Statistical Office, emissions of sulphur dioxide and nitrogen dioxide have decreased considerably in recent decades

in Poland. Decreasing emissions were accompanied by a decrease in concentrations of gaseous pollutants recorded in forest areas subject to monitoring of air quality. This concerned primarily sulphur dioxide. Concentrations of SO_2 were decreasing expressly until 2007, followed by a period of relative stabilization.

NO_2 concentration over the years 1998–2016 was relatively stable, however a slight increase in concentrations in recent years has been recorded.

In 2016, monthly air concentrations in the studied forest areas ranged between 0.2–4.8 µg SO_2/m^3 (average 0.9–2.1 µg SO_2/m^3 year) and 2.3–20.2 µg NO_2/m^3 (average 4.0–15.0 µg NO_2/m^3 year). The concentration of SO_2 higher than in other regions of the country was recorded in Upper Silesia (Zawadzkie), at the foothills in southern Poland (Bircza) and in central Poland (Łąck and Krotoszyn). The concentration of NO_2 was the highest in central Poland (Chojnów, Łąck, Krotoszyn) and in Upper Silesia (Zawadzkie).

In a range of stresses affecting forests, air pollution is only one of the elements influencing the sustainability of ecosystems. In contrast to the majority of biological and abiotic stress factors, the impact of dry and wet deposition is long-lasting, weakening the forest's resistance to damage, if threshold values of other environmental and anthropogenic stress factors are exceeded.



AVERAGE CONCENTRATION OF SULPHUR AND NITROGEN DIOXIDE on intensive forest monitoring plots

Threats to forest sustainability

Apart from insect pests, pathogenic fungi and animals, Polish forests are more and more frequently disturbed by various sorts of abiotic factors which may seldom become large-scale natural disasters threatening forests sustainability.

The ongoing climate changes of very dynamic or even catastrophic character (droughts, floods, hurricanes etc.) have had substantial impact both on the health condition of forests stands and on 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, mainly through rebuilding stands to match them with the site conditions do not always prevent damage, especially when faced with unpredictable weather anomalies.

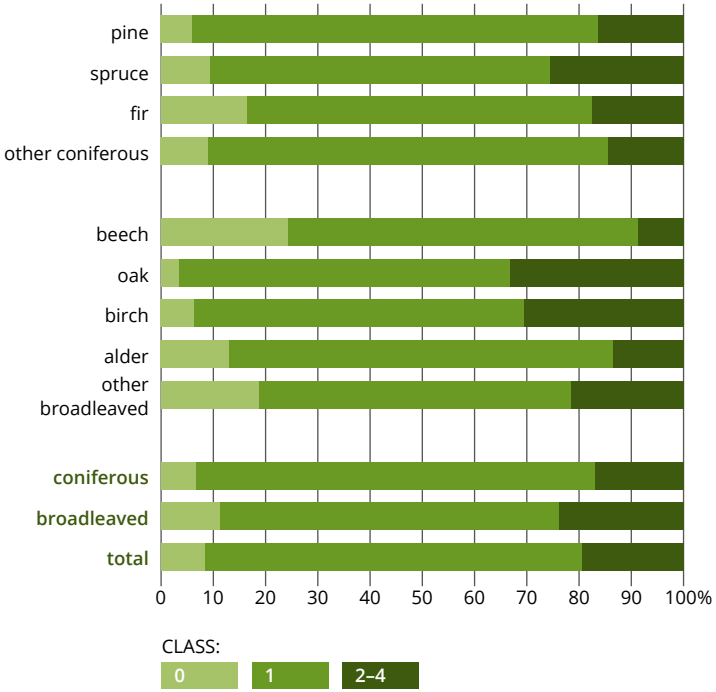
The main responsibility for rebuilding forests and maintaining them in good health condition and proper structure falls on the State Forests. In 2016 rebuilding of forest stands was carried out in an area of 1.5 thousand ha, cleanings on 131.0 thousand ha, and thinnings on 423.3 thousand ha. Moreover, the stability of stands was being reinforced by introducing understoreys (0.3 thousand ha), planting second storey (2.9 thousand ha), afforesting gaps (0.9 thousand ha), and by agritechnical and water drainage treatment (64.2 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 necessary, therefore, to find longer-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 representatives of the State Forests and the Institute of Dendrology of the Polish Academy of Sciences.

The Forest Gene Bank Kostrzyca has a stock of 8000 genetic resources relating to 114 forest plant species, both whole populations and individual plants. Of these, 28 species are trees and shrubs such as Scots pine, Norway spruce, European larch, Douglas fir, black pine, black alder, European beech, and ash. The remaining species are of rare and protected plants which are enlisted in the *Polish Red Data Book of Plants*.

Forest Gene Bank constitute seed batches which have been harvested from the selected seed stands, conservation stands, other stands, as well as parent trees, legacy trees or conservation trees and other individual trees or parts of plants designated for long-term storage in refrigerator (–10 and –20°C) and cryogenic (–150 and –196°C) conditions.

Forest Gene Bank Kostrzyca has a stock of over **8000** genetic resources



SHARE OF MONITORED TREE SPECIES by defoliation classes on Level I Permanent Observation Plots (Forest Monitoring) in 2016

Level of damage to forests

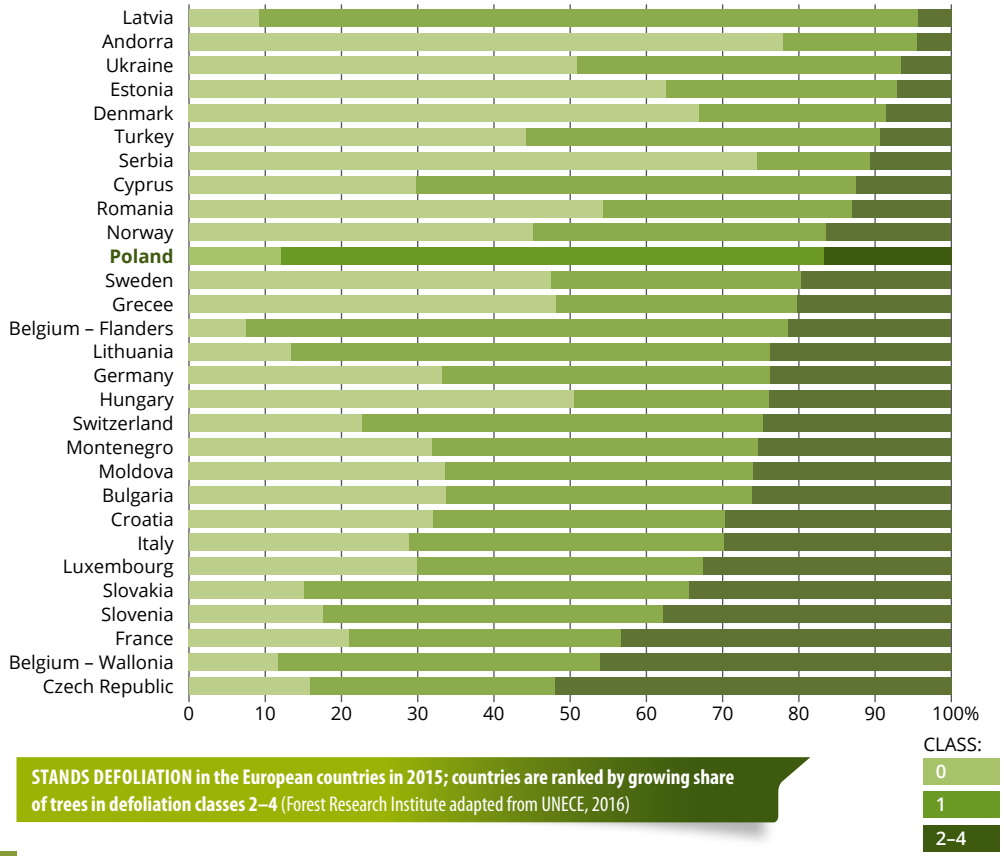
The level of damage to forests in Poland has been assessed every year since 1989 as part of the forest monitoring programme which is one of the elements of the National Environment Monitoring system. The network of Level I Permanent Observation Plots has been in operation since 2007. It is common to both the forest monitoring programme and the National Forest Inventory since 2009.

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 2016, the assessment of the condition of crowns was made on 40 020 trees aged over 20 years which were located on 2001 Level I Permanent Observation Plots. The average defoliation of all species amounted to 22.7%, all coniferous – 22.4%, broadleaved – 23.2%. The share of healthy trees (up to 10% defoliation) of all species was 8.3%, and damaged tress (over 25% defoliation) – 19.5%. Broadleaved species had larger share of healthy trees (11.2%) and larger proportion of damaged trees (24.0%) than coniferous species (6.7% and 17.1%, respectively).

Among coniferous species the healthiest was fir which was characterised by the highest proportion of healthy trees (16.3%), low share of damaged trees (17.5%) and the lowest average defoliation (21.1%).

Beech
is the healthiest tree in Polish forests



STANDS DEFOLIATION in the European countries in 2015; countries are ranked by growing share of trees in defoliation classes 2–4 (Forest Research Institute adapted from UNECE, 2016)

The most damaged was spruce with lowest share of healthy trees (9.2%), the highest proportion of damaged trees (25.7%) and the highest average defoliation (24.2%) as well.

Among broadleaved species the healthiest was beech with the highest proportion of healthy trees (24.3%), the lowest share of damaged trees (8.8%) and the lowest average defoliation (17.8%) in this group of species. The most damaged was oak with the lowest share of healthy trees (3.4%), the highest proportion of damaged trees (33.2%) and the highest average defoliation (25.7%).

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 (28.5%), lower in forest of 'other ownership' (25.3%) and in private forests (22.5%), and the lowest share was in the State Forests (18.0%).

According to the latest report on the state of European forests in 2015 (*Forest Condition in Europe..., 2015*), Poland is in a group of countries where the share of both healthy trees (up to 10% defoliation, defoliation class 0) and damaged trees (over 25% defoliation, defoliation classes 2–4) were not high.

In 2015, the forests of Andorra, Estonia, Ukraine, Denmark, Serbia, Turkey and Romania were the healthiest in Europe (more than 40% of healthy trees and up to 15% of damaged trees); The most damaged forests were found in the Czech Republic, Slovakia, Slovenia, Belgium (Wallonia), and in France (up to 20% of healthy trees and more than 30% of damaged 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, 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 38.2% of the land area under legal protection. In relation to the total forest area, the share of protected forests accounts for 41.9%, but taking into account the area of forest reserves it amounts to 43.0%. The areas of Natura 2000 network cover about 20% of the country's territory. 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) – 1678 thousand ha (21.8%).
- The area of forests and the timber resources of the country are increasing steadily. At present, their area is 9230 million ha, including 7105 million ha in the State Forests, volume of gross merchantable timber – 2550 million m^3, of which in the State Forests 2005 million^3 m and in private forests 424 million m^3. At present, the average growing stock amounts 277 m^3/ha; in the State Forests, however, this indicator is higher than in private forests – 282 m^3/ha and 240 m^3/ha, respectively. The average age of stands is 59 years in the State Forests and 48 years in private forests.

Forest in Poland are the most natural formation

Forests are a crucial element of ecological balance

- In 2016, the area of post-agricultural land and wasteland afforested under the National Programme for the Augmentation of Forest Cover barely reached 2011 ha, which is the lowest value since the programme was implemented. The afforestation area is still decreasing (in 2013 4.1 thousand ha were afforested, in 2014 – 3.8 thousand ha, in 2015 – 2.8 thousand ha) which is the result of changes made by which private agricultural land is designated for afforestation within the framework of the Rural Development Programme as well as attractive direct subsidies for agricultural production.
- In Poland, 39 129 thousand m^3 of net merchantable timber were harvested in 2016, of which of which 37 405 thousand m^3 was from the State Forests, i.e 102.1% of the indicative annual prescribed cut by volume, of which 18 818 thousand m^3 came from final felling (97.4% of prescribed cut) and 18 586 thousand m^3 from pre-final felling (107.3% of prescribed cut). As a result of salvage and sanitation cuttings, 6611 thousand m^3 of timber was harvested (17.7% of total merchantable timber). The size of clear-cuts was restricted to the area of 28.9 thousand ha, and the timber harvested in clear-cutting to 7164 thousand m^3 of merchantable timber, i.e. to 19.2% of the total harvest of merchantable timber. According to data for the last 20 years, in the State Forests the share of merchantable timber harvest stood at 57.3% of the current increment.
- The health condition of forests in Poland, assessed on the basis of the tree crowns defoliation, worsened slightly. The share of damaged trees (defoliation exceeding 25%) increased from 16.7% in 2015 to 19.5% in 2016. The share of healthy trees also decreased slightly from 11.9% in 2015 to 8.3% in 2016. The average defoliation determined for all species accounted for 22.7% – this value has been higher by 1.2 percentage points than that in 2015.
- In 2016, the activity of the most destructive primary insect pests was at exceptionally low level. The total area of occurrence of this group of insects was 94 thousand ha, including that of cockchafer imagines – 23 thousand ha. Protective treatment was applied on the area of 28 thousand ha. The threat to forest from secondary insect pests as compared to the previous year increased by 29%.
- In comparison to the previous year the acreage of infectious fungal diseases increased in 2016 by 23 thousand ha and covered 200 thousand ha. This is the consequence of the increased risk from *Heterobasidion* root rot and drastic intensification of pine shoots dieback, which covered 30 times larger area than that in 2015. Among the diseases of assimilatory apparatus the threat from pine twisting rust was lower (by 53%) and rust on needles and leaves (by 96%).
- Damage of commercial significance is also caused by herbivorous mammals, mostly deer, roe deer, elk, and locally rodents (beavers and murids). In 2016, damage caused by game and protected animals occurred in a combined area of 88.7 thousand ha, including injuries between 21–40% on an area of 61.5 thousand ha, however, strong damage exceeding 40% – in an area of 27.2 thousand ha.
- According to the records of the last fifteen years, in 2016 forest fires were less frequent There were 5286 fires recorded, by 6971 less than in the previous year, and the area of burnt stands was 1451 ha, by 4059 less than in 2015. The main causes of fires were arson and negligence (fires caused unintentionally by people).

GLOSSARY

A

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

Age class – an agreed, usually 20-year period which allows grouping of stands according to their age, e.g. 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 (intermediate) 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.

B

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

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

species diversity – variety of species;

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

genetic diversity – 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.

C

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 standard requirement yet.

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

early cleanings – cleanings in plantations prior to crown closure;

late cleanings – 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.

D

Dead wood – 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.

E

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.

F

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.

Folivores – leaf-eating animals.

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

Forest ecosystem – a basic functional ecological unit represented by a relatively homogenous forest plot, and within the area of which the habitat, flora and fauna are interdependent 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.

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 specifies 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 a 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 working harvest 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 immissions – gaseous and particulate air contaminants affecting the surrounding, i.e. reaching organisms or ecosystems and exerting influence on them.

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

Production forests – forests managed according to 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.

Production seed stands – stands whose origin and good quality indicate that their seed crop is very likely to produce valuable off-

spring 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; forests under special protection because of their function.

R

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.

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.

S

Selected seed stands – 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 clamps 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).

Steppization – limiting natural conditions fostering forest development, mostly by drying which, in turn, allows steppe vegetation to enter.

T

Thinning – tending cuts made in stands after they have 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 – combined volume of trees in forest, usually equated with the measured (estimated) volume of merchantable timber in stands.

V

Volume (thickness) of wood – the amount of wood, measured in cubic metres (m^3).

X

Xylophagous insects – insects feeding only on wood.

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