

POLAND  The State Forests

FORESTS IN POLAND 2013



State Forests

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The Forest Act of 28 September 1991 requires that the State Forests publish an annual report on the condition of forests in Poland. This brochure is a shortened version of the report for 2012, which is based on the materials obtained from the Ministry of the Environment, the Directorate-General of the State Forests, the Forest Research Institute, the Forest Management and Geodesy Bureau, the Central Statistical Office and on international statistics. The report details the condition of Polish forests under all forms of ownership in 2012 in the context of the data from recent years. Where it was possible and justified, the report refers to the data from other countries whose natural conditions are comparable to those in Poland: France, the German-speaking countries (Austria, Germany, Switzerland), Central European countries (the Czech Republic, Romania, Slovakia and Hungary), the eastern neighbours of Poland (Belarus, Lithuania, Ukraine) and the Scandinavian countries (Finland, Norway, Sweden) which represent different types of forestry to that established in Central Europe). The scope of the report includes three groups of issues: forest resources in Poland, functions of forests and threats to the forest environment.

Forest resources in Poland

1. Forest area and forest cover

In our climatic and geographical zone, forests are the least distorted natural formation. They are a necessary element of ecological balance and, at the same time, a form of land use which ensures biological production with a market value. Forests are the common good which enhances the quality of human life.

Forests once covered almost the whole territory of Poland. However, the socio-economic developments such as expansion of agriculture and growing demand for timber had changed that. Even at the end of the 18th century forests covered about 40% of the territory within the Polish borders at that time, but by 1945 this figure had fallen to just 20.8%. Reversal of this process occurred in the period 1945–1970 when Poland's forest cover increased to 27% as a result of afforestation of 933.5 thousand hectares.

At present, the total area of forests in Poland is 9163.8 thousand hectares (the Central Statistical Office figure as of 31 December 2012), which puts forest cover at 29.3% (Fig. 1).

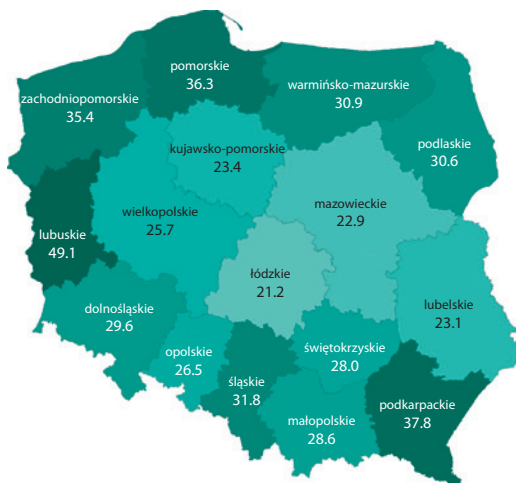


Fig. 1. Forest cover in Poland by province (Central Statistical Office)

According to the international assessment standard which takes into account the land associated with forest management, the forest area in Poland, as of 31 December 2012, was 9.37 million hectares. This figure ranks Poland in the group of countries with the largest forest area in the region, after France, Germany and Ukraine (Fig. 2).

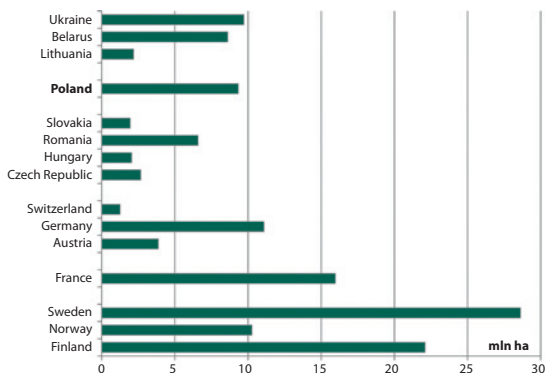


Fig. 2. Total forest area (SoEF 2011)

Countries where a large proportion of the land area is unsuitable for any other use but forestry, for example marshlands or mountain regions, have a distinctly greater forest cover (Scandinavian countries, Austria, Slovakia). Countries with forest cover lower than that in Poland are Ukraine, Hungary and Romania, and in Western Europe—France and Great Britain. At the end of 2012, Poland's forest cover measured by the international assessment standard amounted to 30.6% and was lower than the European average (32%, exclusive of the Russian Federation) (Fig. 3).

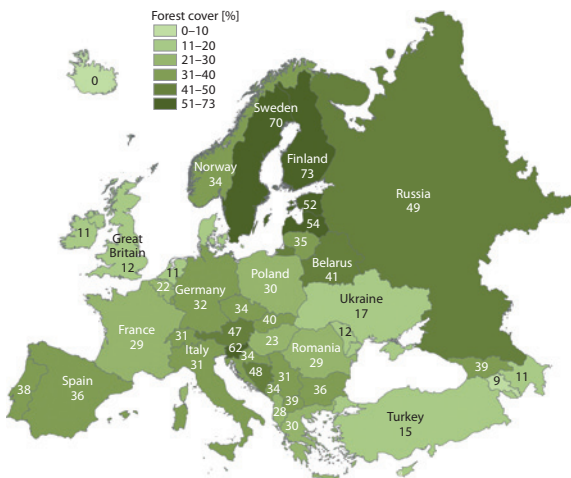


Fig. 3. Forest cover in the analysed countries (SoEF 2011)

A comparison of forest area *per capita* with an overall land area is presented in Fig. 4. In countries with low population density, these values are markedly higher; their forest cover is higher than the average. The forest area *per capita* in Poland (0.24 ha) is one of the lowest in the region.

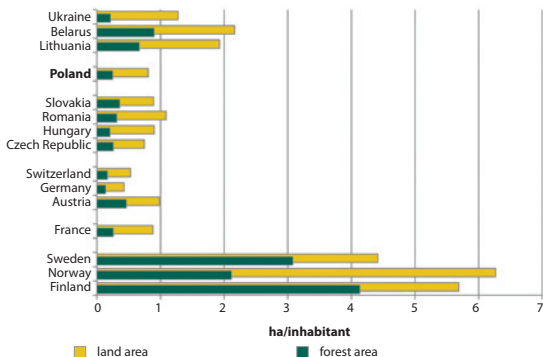


Fig. 4. Area of forests against the total land area, per inhabitant (SoEF 2011)

2. Forest ownership in Poland

In the ownership structure of forests in Poland (Table 1) the majority, 81.2%, are publicly-owned forests, of which 77.3% are under the administration of the State Forests (Fig. 5).

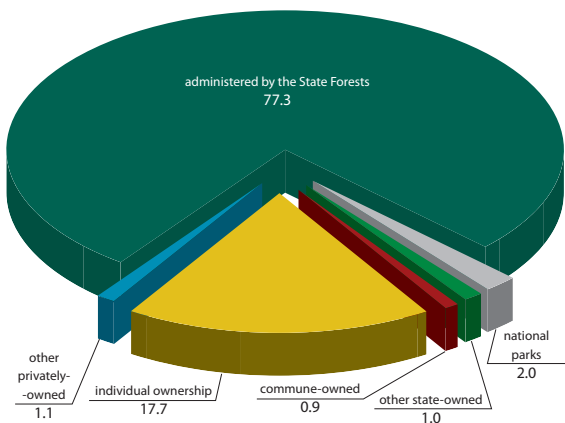


Fig. 5. Ownership structure of forests in Poland (Central Statistical Office)

The share of publicly-owned forests in the total forest area of the analysed countries is variable. Three groups of countries can be clearly distinguished: the Commonwealth of Independent States where almost 100% of forests are state-owned; the Scandinavian countries and France where a great majority of forests are privately-owned; the remaining countries which have diverse ownership structure with a predominance of publicly-owned forests.

The ownership structure has remained almost unchanged since the end of the last war. Since 1995 the share of privately-owned forests has increased from 17.1% to 18.8%. In the same period the

Table 1. Forest ownership in Poland

Type of forest ownership	31.12.1995		31.12.2000		31.12.2010		31.12.2012	
	'000 ha	%	'000 ha	%	'000 ha	%	'000 ha	%
Total	8756^{a)}	100.0	8865^{a)}	100.0	9121^{a)}	100.0	9164^{a)}	100.0
Publicly-owned								
State Treasury-owned								
including:								
– administered by the State Forests	7262	82.9	7341	82.8	7435	81.5	7439	81.2
– national parks	7186	82.0	7262	81.9	7351	80.6	7355	80.3
– other	6868 ^{b)}	78.4	6953 ^{b)}	78.4	7072 ^{b)}	77.5	7079 ^{b)}	77.3
Commune-owned	162	1.9	181	2.0	184	2.0	185	2.0
	156	1.7	128	1.4	95	1.1	91	1.0
	76	0.9	79	0.9	84	0.9	84	0.9
Privately-owned								
including:								
– individual owners	1494	17.1	1524	17.2	1686	18.5	1725	18.8
– land cooperatives	1397	15.9	1428 ^{c)}	16.1	1587 ^{c)}	17.4	1623 ^{c)}	17.7
– agricultural cooperatives	68	0.8	69 ^{c)}	0.8	67 ^{c)}	0.7	66 ^{c)}	0.7
– other	14	0.2	9 ^{c)}	0.1	6 ^{c)}	0.1	5 ^{c)}	0.1
	15	0.2	18 ^{c)}	0.2	26 ^{c)}	0.3	30 ^{c)}	0.3

^{a)} Plus land associated with forest management: 1995 – 190 000 ha, 2000 – 194 000 ha, 2010 – 208 000 ha, 2012 – 206 000 ha

^{b)} Plus land associated with forest management: 1995 – 187 000 ha, 2000 – 189 000 ha, 2010 – 201 000 ha, 2012 – 200 000 ha

^{c)} Including land associated with forest management: 2000 – 200 ha in all private ownership, 2010 – 600 ha, 2012 – 700 ha

share of publicly-owned forests decreased from 82.9% to 81.2%. The increase in the share of forests in national parks was mainly due to four new parks being established.

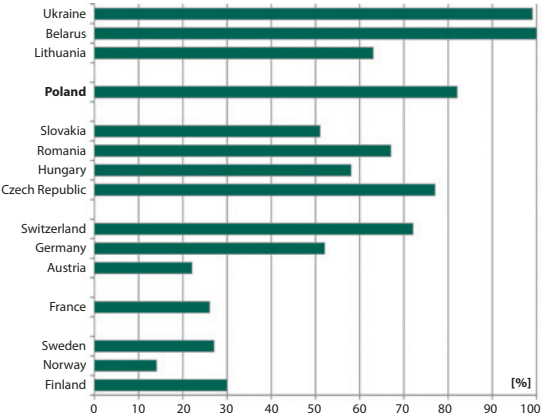


Fig. 6. Share of public forests in the total forest area (SoEF 2011)

The share of privately-owned forests in Poland varies among the regions (Fig. 7) – the greatest is in the Mazowieckie province – 44.1% of its total forest area (359.2 thousand hectares) and the lowest in the Lubuskie province – 1.7% (11.4 thousand hectares).

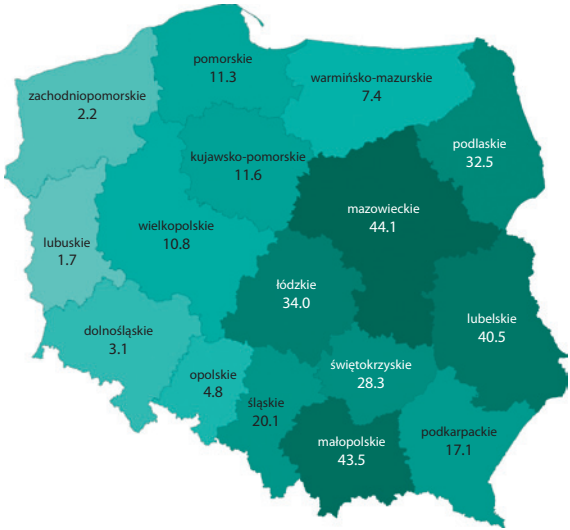
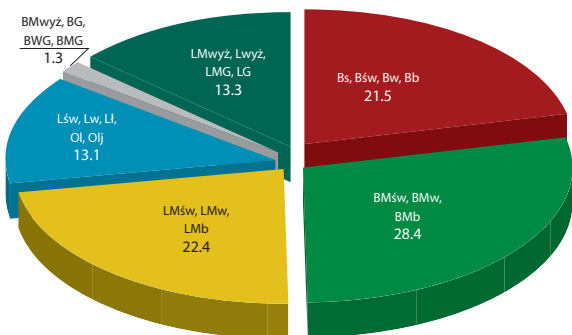


Fig. 7. Share of private forests in the total forest area by province (Central Statistical Office)

3. Habitat structure

Forests in Poland mainly occur in areas with the poorest soils, which is reflected in the structure of forest habitat types. Coniferous forest habitats predominate, accounting for 51.2% of the total forest area, while broadleaved forest habitats account for 48.8%. In both groups, upland habitats occupy 5.9 % of the forest area and mountain habitats 8.7% (Fig. 8).



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

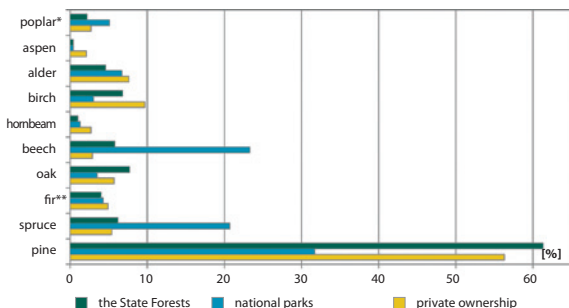
Fig. 8. Areal share (in %) of forest habitat types in the forests in all ownership categories (Large-Scale Forest Inventory)

4. Species composition

The geographical distribution of habitats is, to a great extent, reflected in the spatial structure of dominant tree species. Apart from the mountain regions where spruce (west) and spruce and beech (east) are the main species in stand composition, and a few other locations where stands have diverse species structure, in most of the country prevail stands with pine as the dominant species.

Coniferous species dominate in Polish forests, accounting for 69.9% of the total forest area (Fig. 9). Pine accounts for 59.5% of the area of forests in all ownership categories, for 61.3% in the State Forests and for 56.3% in the privately-owned forests. Poland offers optimal climatic and site conditions for pine within its Euro-Asiatic natural range, which resulted in the development of

a number of important ecotypes (e.g. the Taborska pine or the Augustowska pine). The prevalence of coniferous species is also a result of the preference of the wood industry, dating back to the beginning of the 19th century.



* including other broadleaved
 ** including other conifers

Fig. 9. Areal share of dominant species in forests in all ownership categories, in the State Forests and in private forests (Large-Scale Forest Inventory)

In the period 1945–2012, the species structure of Poland's forests substantially changed, which is evident in the increased share of stands with the prevalence of broadleaved species. In the State Forests, where these changes are monitored annually, the increase was from 13% to 23.2%. However, the share of broadleaved stands is still below the potential level which is determined by the structure of forest habitats, even though their total area has increased.

5. Age structure

Stands aged 41–80 years, representing age classes III and IV, prevail in the forest age structure and cover 26.4% and 18.7% of the forest area, respectively. Stands aged 41–60 years (class III) prevail in all ownership categories, while in private forests they occupy nearly 40% of the area. Stands older than 100 years, including stands in the restocking class (KO), stands in the class for restocking (KDO) and stands with selection structure (BP) account for 12% of the forest area managed by the State Forests, while in private forests for only 2.6% (Fig.10). The share of non-afforested land in privately-owned forests is 6.7%, while in the State Forests it is 3.9%.

A steady increase in the share of stands older than 80 years from about 0.9 million hectares in 1945 to nearly 1.96 million hectares (excluding the KO and KDO classes) in 2008–2012 is indicative of the changing age structure of forests.

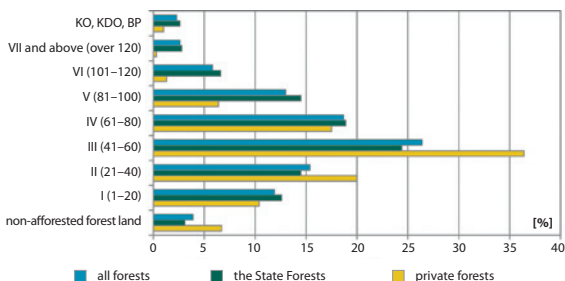


Fig. 10. Areal share of stands in all forms of ownership, in the State Forests and in private forests, by age class (Large-Scale Forest Inventory)

6. Changes in forest area

Compared with the previous year, Poland's forest area increased by 20 thousand hectares in 2012. According to the land records, the forest area has increased by 408 thousand hectares since 1995.

The basis for all afforestation in Poland is the "National programme for the augmentation of forest cover", which was commissioned by the Ministry of the Environment, Natural Resources and Forestry, and was prepared by the Forest Research Institute. The programme was adopted for implementation by the Council of Ministers on 23 June 1995.

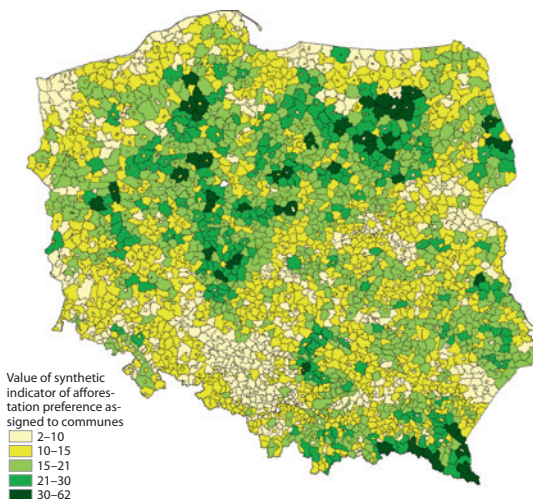


Fig. 11. Communes given preference in the 2002 revision of the "National programme for the augmentation of forest cover" (variant III – environmental) (Forest Research Institute)

The main aims of the programme are to increase forest cover to 30% by 2020 and to 33% by 2050, to ensure an optimal spatial and temporal distribution of afforestation and to set ecological and economic priorities and tools for its implementation (Fig. 11).

The afforestation (artificial) carried out in 2012 covered 4853.7 hectares of land in all ownership categories. The largest areas, 878.7 hectares in total, were afforested in the warmińsko-mazurskie province and the smallest, only 47.7 hectares, in the małopolskie province (Fig. 12). The total afforested area decreased in 2012 by 424 hectares (8%) compared with 2011.

Afforestation resulting from natural succession occurred on about 167 hectares (169 hectares in 2011), according to the data from the Central Statistical Office.

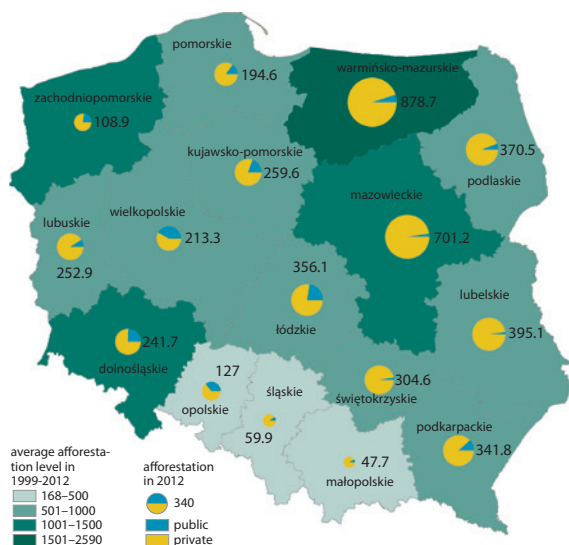


Fig. 12. Area of artificial afforestation in 2012, by province, against the average level of afforestation in 1999-2012 (Central Statistical Office, Forest Research Institute)

Thanks to the subsidies from the state budget and a loan from the European Investment Bank, the afforestation programme within the State Forests accelerated after 1994, in comparison with the period 1988-1993 when the average area of afforested post-agricultural land and wasteland was 3.9 thousand hectares per year. Between 1994 and 2004 the average afforested area stood at 10.8 thousand hectares. Since 2005, a steady decline in the rate of afforestation within the State Forests has been noted, with only 0.4 thousand hectares afforested artificially in 2012 (Fig. 13).

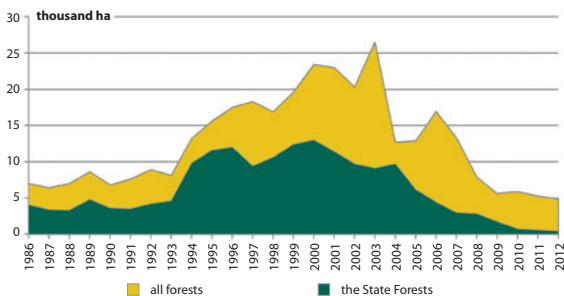


Fig. 13. Rate of (artificial) afforestation in Poland in the years 1986–2012 (Central Statistical Office)

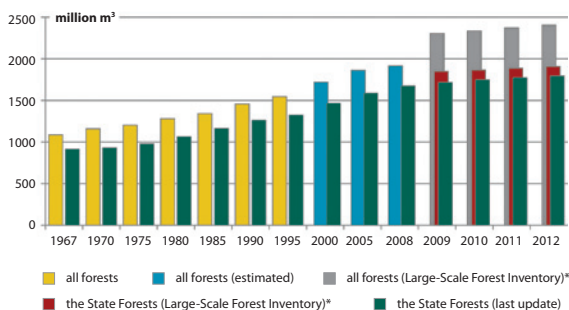
One of the main problems implementing the “National programme for the augmentation of forest cover” on the state-owned land is a significant reduction in the area of post-agricultural land and wasteland designated for afforestation by the Agricultural Property Agency. Uncertainty as to the size of the area available for afforestation makes any planning relating to the production of saplings and preparatory work quite impossible. In some areas potential afforestation is limited by the establishment of habitat protection zones under Natura 2000 network.

In addition to the afforestation of farmland and wasteland, forest plantations are being established in areas where mature timber stands have been removed. The area restocked in 2012 (without reforestation and introduction of the lower storey) covered 52 808 hectares of land in all ownership categories, of which 5899 hectares (11.2%) were stands regenerated naturally. The area restocked in 2012 was larger by about 1600 hectares than in 2011.

7. Structure of timber resources by volume

Different methods are used to assess the size of timber resources. According to the Large-Scale Forest Inventory, timber resources in forests under all forms of ownership in the years 2008–2012 amounted to 2405 million m³ of gross merchantable timber, including 1908 million m³ in the State Forests and 379 million m³ in private forests. The latest available figure produced by the Forest Management and Geodesy Bureau for 1 January 2012 puts the timber resources in the forests managed by the State Forests at 1795 million m³ of gross merchantable timber. Another figure is given by the expert estimate which assessed that, as of 1 January 2008, the total timber resources in Polish forests stand at 1914 million m³ of gross merchantable timber. The last data from the Central Statistical Office is for the year 1997.

There has been a steady growth of timber resources since the first inventory in the State Forests took place in 1967 (Fig. 14).

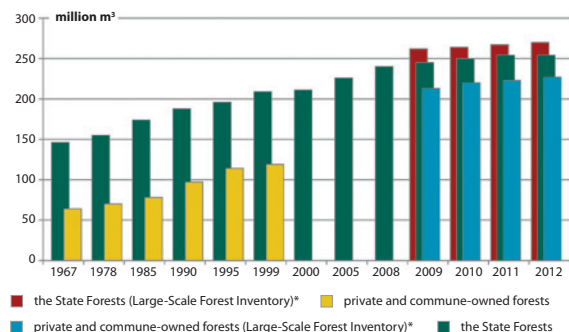


* Large-Scale Forest Inventory data for 2005–2009, 2006–2010, 2007–2011 and 2008–2012

Fig. 14. Timber resources in Poland's forests in 1967–2012, in million m³ of gross merchantable timber (Central Statistical Office, Forest Management and Geodesy Bureau, Large-Scale Forest Inventory)

Pine accounts for 61.7% of volume of timber resources in all categories of forest ownership, 63.9% in the State Forests and 57.7% in private forests.

According to the latest forest area and timber resources survey updated on 1 January 2012, the average standing volume of afforested land in the State Forests was 254 m³/ha, while in private and commune-owned forests the latest available figure (1 January 1999) puts it at 119 m³/ha (Fig. 15). The Large-Scale Forest Inventory shows that the average standing volume of forests managed by the State Forests in relation to the total forest area was 270 m³/ha, while in private and commune-owned forests it was 227 m³/ha.



* Large-Scale Forest Inventory data for 2005–2009, 2006–2010, 2007–2011 and 2008–2012

Fig. 15. Average standing volume in Poland's forests, 1967–2012, in m³/ha of gross merchantable timber (Central Statistical Office, Forest Management and Geodesy Bureau, Large-Scale Forest Inventory)

Polish forests rank high in Europe with regard to standing volume (Fig.16). The SoEF figures for 2011 demonstrate that the average for Poland, amounting to 247 m³/ha, is more than double of the European average (112 m³/ha, or 155 m³/ha excluding the Russian Federation).

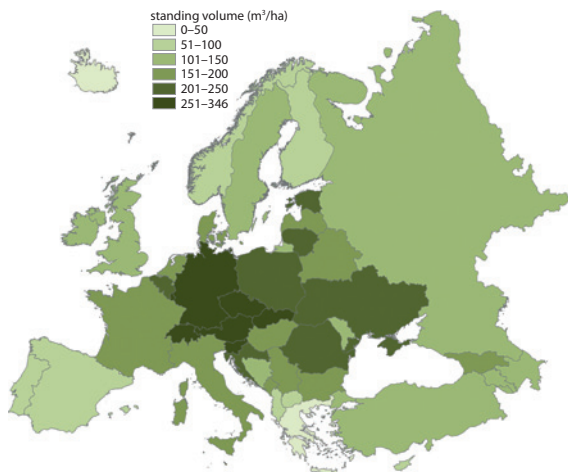
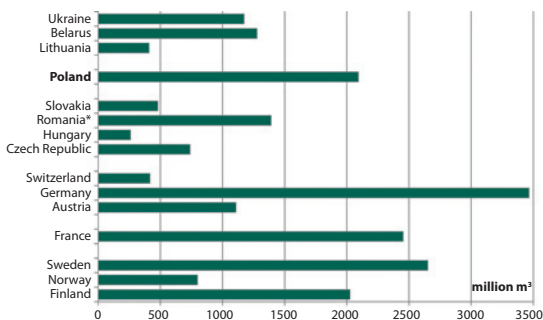


Fig.16. Standing volume in selected countries (SoEF 2011)

Poland, with a relatively large absolute area of forests and with standing volume exceeding the European average, has significant timber resources which amount to more than 2.304 billion m³, according to SoEF 2011 (Fig. 17).



* no data with regard to availability for utilisation, figures show the general level of timber resources

Fig.17. Timber resources available for utilisation in selected countries (SoEF 2011)

8. Changes in timber resources

Lack of reliable historical data on timber resources in private, commune and Treasury-owned forests (other than the State Forests) makes it impossible to track the changes in the volume of forest resources for the whole country. However, it is possible to determine the increment in timber resources from the annual data collected by the State Forests for forests under its administration.

This increment in the last 20 years, from January 1992 to January 2012, amounted to 1129 million m³ of gross merchantable timber. During that period, 628 million m³ of merchantable timber was harvested, which means that 501 million m³ of gross merchantable timber, representing 44% of the total increment, remained to augment standing timber resources in the State Forests.

The growth of timber resources over several decades is shown in the diagram depicting changes in volume increment of merchantable timber for all age classes (Fig. 18).

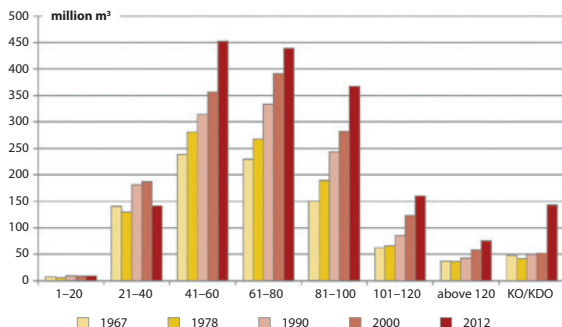


Fig. 18. Changes in timber resources in the State Forests, by age class (Forest Management and Geodesy Bureau)

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



Forest functions

Forests fulfil diverse functions, either naturally or as a result of human activities:

- environmental (protective) functions: favourable impact on shaping of the local and global climate, regulation of water cycle in nature, prevention of floods, avalanches and landslides, protection of soil against erosion and landscape against steppeisation;
- social functions: providing health-enhancing and recreational conditions for society and contributing to the labour market;
- productive (economic) functions: primarily production of renewable biomass, including timber and non-timber products.

1. Environmental functions of forests

Forests have a positive impact on the human environment and their diverse structure supports a variety of human activities.

Environmental and social functions of forests, often referred to as non-productive functions, have long been recognised in forest management which begun to distinguish a category of protective forests as early as in 1957. The total area of protective forests managed by the State Forests, as of 1 January 2012, amounted to 3481 thousand hectares, which represents 49.2% of the total forest area, or 50.6% including 101 thousand hectares of nature reserves (Fig. 19). The majority of protective forests are located in the mountain regions and in areas affected by industry.

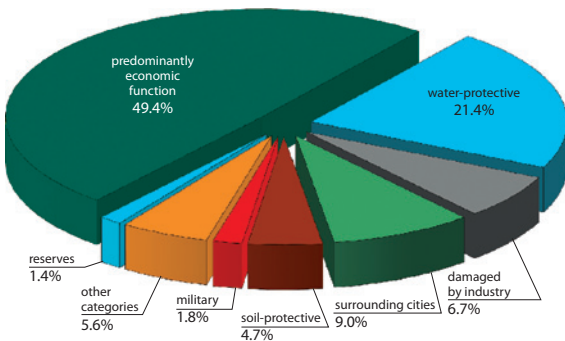


Fig. 19. Share of protective forests in the State Forests in 2012 (Directorate-General of the State Forests)

The area of private forests recognised as protective is estimated at 64.8 thousand hectares, or 3.8% of their total area. Protective forests owned by communes cover an area of 24.7 thousand hectares (28.8% of their total area). The share of protective forests in all ownership categories in the total forest area in Poland currently stands at 40.1%.

In comparison with other countries in the region, Poland has a relatively high proportion of protective forests (almost 30%, excluding social functions) (SoEF 2011). Slightly ahead of Poland are Germany (34%) and Belarus (32%) but the largest proportion of protective forests occurs in Italy (about 87%) due to large areas of soil- and water-protective forests.

Carbon sequestration

Assessment of the amount of carbon absorbed by ecosystems (including forests) was, until recently, of almost exclusively scientific interest. The growing threat of climate warming caused by the increased concentration of atmospheric CO₂ and the social awareness of this threat, have brought about a more practical approach which was expressed in the Kyoto Protocol (in force since 16 February 2005). The Protocol listed and evaluated various forestry-related actions aimed at increasing carbon sequestration and included them in the total balance of greenhouse gas emission and absorption. The general principles of working out this balance are based on the Kyoto Protocol and decisions taken at the subsequent Conferences of the Parties. At the last Conference in Doha (Qatar) in 2012 it was decided to extend the commitment period for the second term, until 2020.

According to the estimates based on the available data on timber resources in Poland, the forest biomass contains 1099 million tonnes of carbon, of which 26 million tonnes occur in dead wood (SoEF 2011). The amount of CO₂ absorbed every year by forests (including soil and taking into account utilisation) is estimated at 34 million tonnes, which roughly equals 9.3 million tonnes of carbon.

2. Social functions of forests

Forests are an attractive place for recreation and leisure, particularly for the inhabitants of large conurbations. Forests are also a popular destination for excursions, mainly organised by schools, which give the opportunity for youngsters for direct contact with nature and for foresters to provide forest education programmes.

Health-enhancing properties of forest ecosystems encourage development of tourism and recreation, primarily in the areas designated as health resorts. Forests contribute to the process of cleaning the air of heavy metals and dust and help to reduce

noise levels, therefore have a beneficial effect on the microclimate of urban areas.

Forests provide employment for nearly 50 thousand people directly involved in their protection and management. They also stimulate industrial production and support many jobs in other sectors of the economy, such as timber, pulp-and-paper or power industries.

Forest education for the society

Promotional forest complexes (PFCs) (see the map on the inner page of the cover) were established within the State Forests as part of the national policy on forests and to comply with the provision of the Forest Act. The PFCs provide an excellent ground for pursuing the principles of forest management which integrate goals such as nature protection, sustainable utilisation of forest resources and participatory management of forests as a public resource.

In order to achieve these goals the PFCs have developed a sizeable educational and tourist infrastructure, which is available to the public mostly free of charge. It comprises: environmental education centres (23), forest exhibition rooms (55), teaching shelters for use as "green classes" (93), educational trails (166), educational points (305), dendrology parks and gardens (22), cultural and heritage centres (48), a "green school" and also overnight accommodation.

There are 25 promotional forest complexes located in each of the 17 regional directorates of the State Forests. Their total area is almost 1208 thousand hectares, of which 1180 thousand hectares are administered by the State Forests (nearly 15.5% of its territory).

Nature and forest education in all organisational units of the State Forests is based on the two documents resulting from the directive issued by the Director-General of the State Forests on 9 May 2003: "Directions of development of forest education in the State Forests" and "Programme for forest education of society in forest districts". These documents ensure that all educational activities are properly planned and delivered.

A special role in providing forest education is played by the Forest Culture Centre in Gołuchów. Many educational and cultural events initiated by the Centre, such as the national storytelling competition, the national amateur art competition for foresters or the educational festival on the "Earth Day", have become permanent items in the educational calendar of Poland. Last year alone, over 160 thousand people, mainly children and youngsters, participated in educational events, such as art and photographic competitions and various exhibitions.

Forest and nature education is also delivered through the portal provided by the State Forests at www.erys.pl, which attracts several hundred thousand visitors each year.

The educational activity of the State Forests is financed mainly from the forest districts' own resources and from the national and regional funds for environmental protection. In 2012, over 25 million PLN was spent on forest education.

The State Forests, including the PFCs, at present provide the following facilities to the visitors: 50 education centres, 250 forest exhibition rooms, 517 teaching shelters and "green classes", 957 educational trails, 1756 educational points and 2235 other facilities.

The State Forests also offer a wide range of tourist attractions which are available to visitors of any age and social group. 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. Additionally, the visitors can use designated bivouac and camping places, almost 100 sports facilities and over 650 other attractions. There are nearly 4.5 thousand beds available in recreation and training centres and in hunters' lodges.

Information about the State Forests' tourist facilities can be found at www.czaswlas.pl.

3. Productive functions of forests

Productive functions of forests manifest themselves as the production, by nature and human activity, of timber and other goods which can be utilised by man and which create industries, trades and contribute to traditions and cultures.

Utilisation of forests as a renewable source of raw material is justified by silvicultural needs, principles of regulating the structure of forest resources, market demand for timber and wood products, and by the necessity to create economic conditions for forestry. Forests are utilised at a level determined by natural conditions and by the principles of sustainability of forests and the augmentation of their resources.

The volume of net merchantable timber harvested in Poland in 2012 amounted to 34 978 thousand m³ (101 thousand m³ more than in 2011), including 1348 thousand m³ from private forests and 176 thousand m³ from national parks.

The State Forests harvested 35 267 thousand m³ of raw timber, including 33 212 thousand m³ of net merchantable timber (or 99.6% of the approximate prescribed cut), of which 16 017 thousand m³ (92.4% of prescribed cut) was obtained from final felling and 17 195 thousand m³ (107.4% of prescribed cut) from intermediate felling.

The volume harvested for sanitation reasons from clearing deadwood resulting from natural processes or from wind damage, outbreaks of insect pests, disturbances in water relations, air pollution and weather anomalies, amounted in 2012 to 4967 thousand m³, or 15% of the total harvest of merchantable timber, and was the lowest in the last decade (Fig. 20).

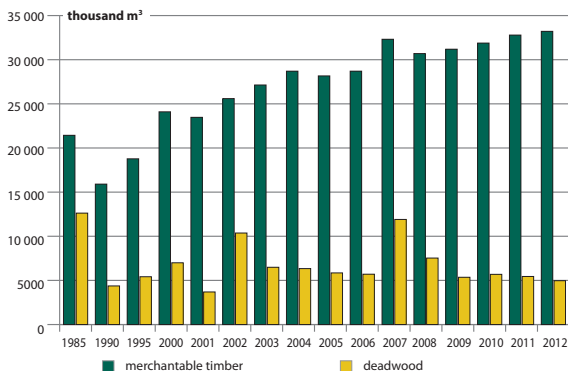


Fig. 20. Share of deadwood in the total utilisation in the State Forests in 1985–2012, in thousand m³ of net merchantable timber (Directorate-General of the State Forests)

In 2012, under the clear-cut system, almost 5 865 thousand m³ of merchantable timber was harvested in the State Forests, which accounts for 17.7% of total harvest. The clear-cut area totalled 25 thousand hectares and was one of the lowest since the early 1980s when it reached nearly 43 thousand hectares, while the average for the past decade was just over 25.6 thousand hectares (Fig. 21). The reduction in size of the clear-cut area is indicative of the progress in sustainability of forest management.

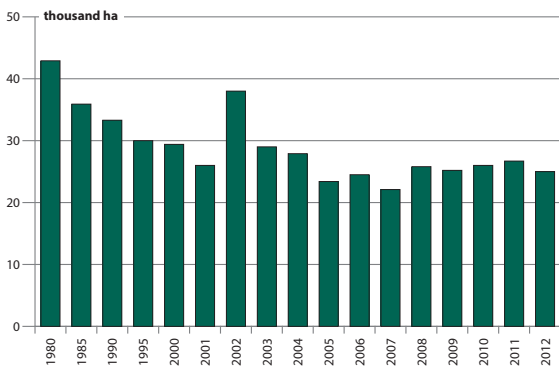


Fig. 21. Area of clear-cuts in the State Forests in the years 1980–2012, in thousand ha (Directorate-General of the State Forests)

A comparison of several years' data on the size of timber harvest points to a relative stability of forest utilisation (Table 2). Over the last five years the volume of timber harvest in the State Forests expressed in net merchantable timber per hectare of forest area levelled (4,35 m³/ha in 2008, 4,63 m³/ha in 2011 and 4,76 m³/ha in 2012) and did not exceed the allowable amount of cut.

Table 2. Harvest of net merchantable timber from forests in different forms of ownership, 1980–2012

Year	State Forests		National parks		Privately-owned forests ^{a)}	
	'000 m ³	m ³ /ha	'000 m ³	m ³ /ha ^{b)}	'000 m ³	m ³ /ha
1980	19 184	2.85	78	1.39	1 293	0.83
1985	21 435	3.16	164	2.75	1 173	0.79
1990	15 906	2.34	103	1.23	1 345	0.91
1995	18 774	2.73	200	1.71	1 470	0.98
2000	24 097	3.47	231	1.77	1 432	0.94
2001	23 471	3.37	172	1.31	1 153	0.75
2002	25 595	3.66	192	1.47	1 111	0.72
2003	27 134	3.87	209	1.61	1 157	0.74
2004	28 699	4.08	196	1.49	1 268	0.81
2005	28 164	4.00	198	1.72	1 124	0.71
2006	28 700	4.07	200	1.41	1 099	0.68
2007	32 313	4.58	234	1.60	1 349	0.84
2008	30 695	4.35	216	1.53	1 248	0.82
2009	31 188	4.40	192	1.48	1 090	0.66
2010	31 882	4.51	201	1.43	1 244	0.74
2011	32 789	4.63	180	1.30	1 633	0.97
2012	33 212	4.76	176	1.28	1 349	0.78

^{a)} estimated data prior to 1997

^{b)} in relation to forest area under partial protection

Source: CSO, GDSF

A comparison of the respective indicators for a group of countries with similar geographic conditions is indicative of the intensity of forest utilisation in Poland. Fig. 22 illustrates the comparison between the volume of increment and the volume

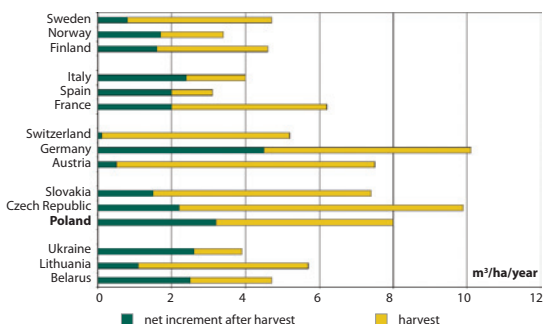


Fig. 22. Share of harvest volume in annual increment volume (SoEF 2011)

of harvest per annum in a one-hectare area for the year 2010. The majority of countries in the region harvest over 50% of the annual increment (60% in Poland), with the exception of Ukraine (33%) and Belarus (47%).

4. Forests in nature and landscape conservation

Of all forms of nature and landscape conservation, forests are the most valuable and best represented category (Fig. 23).

The highest level of protection is given to national parks, which currently (Central Statistical Office figures for 31 December 2012) number 23 and cover an area of 314.6 thousand hectares, of which 195 thousand hectares (62%) are forests (Table 3).

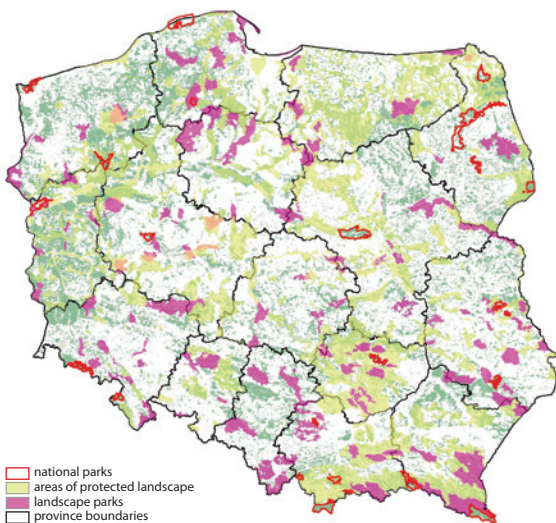


Fig. 23. National and landscape parks in Poland (General Directorate for Environmental Protection)

According to the figures provided by the Central Statistical Office, the 1481 nature reserves cover an area of 165.5 thousand hectares, of which 91.5 thousand hectares are forests (40.5 thousand hectares in non-forest reserves, but this figure is incomplete due to on-going inventory).

122 landscape parks have been created by the local authorities; they cover a total area of 2607.1 thousand hectares, including 1307.8 thousand hectares (50.2%) of forests. The areas of protected landscape include 385 nature sites with a total area of 7078.1 thousand hectares, of which 2223.8 thousand hectares (31.5%) are forests (Central Statistical Office, data as of 31 December 2012).

Table 3. Selected forms of nature and landscape protection in Poland

Year	National parks			Nature reserves			Landscape parks			Areas of protected landscape		
	number	area '000 ha		number	area '000 ha		number	area '000 ha		number	area '000 ha	
		total	forest area		total	forest area		total	forest area		total	forest area
1960	10	74.6	55.9	366	23.9							
1970	11	94.7	66.9	550	52.6							
1980	13	118.9	82.9	759	75.3	16.7	11	236.4	109.8	60	642.3	282.4
1990	17	165.9	118.8	1001	117.0	35.9	68	1215.4	687.7	214	4574.8	2113.8
1995	20	270.1	169.5	1122	121.3	39.1	102	1971.5	1083.5	344	5820.9	2513.8
2000	22	306.5	190.9	1307	148.7	50.0	120	2531.0	1345.9	407	7213.1	2856.5
2005	23	317.2	193.7	1395	165.2	61.9	120	2603.6	1403.4	449	7130.4	2327.6
2006	23	317.2	193.8	1407	166.9	63.1	120	2602.1	1325.3	411	6993.4	2279.5
2007	23	317.3	194.9	1423	168.8	63.4	120	2603.0	1331.0	412	7047.5	2252.6
2008	23	314.5	195.1	1441	173.6	64.3	120	2601.7	1308.5	418	7057.8	2285.4
2009	23	314.5	195.0	1451	163.4	64.3	121	2607.1	1309.8	384	7059.1	2278.7
2010	23	315.5	194.7	1463	164.2	64.6	121	2607.5	1307.8	386	7075.5	2227.9
2011	23	314.6	194.9	1469	164.5	66.5	121	2607.7	1308.3	386	7078.1	2223.9
2012	23	314.6	195.0	1481	165.5	66.9^{a)}	122	2607.1	1307.8	385	7078.1	2223.8

^{a)} Area of forest in forest reserves – 51 000 ha, area of forest in non-forest reserves – 40 500 ha

Source: Central Statistical Office, figures as of 31.12.2012

The combined area of national and landscape parks and areas of protected landscape increased from 3.2% of the total land area in 1980 to 32% in 2012. It now stands at almost 10 million hectares, of which 3.7 million hectares are forests (Central Statistical Office).

Within the network Natura 2000, at the end of 2012, there were 145 special protection areas for birds, with a total land and sea area of 5575 thousand hectares (of which 2675 thousand hectares were forests), and 845 sites of Community importance (awaiting to be designated as special areas of conservation of habitats), covering an area of 3795 thousand hectares (of which 2061 thousand hectares were forests). Both categories of Natura 2000 sites cover about 20% of the country's total area (Fig. 24).

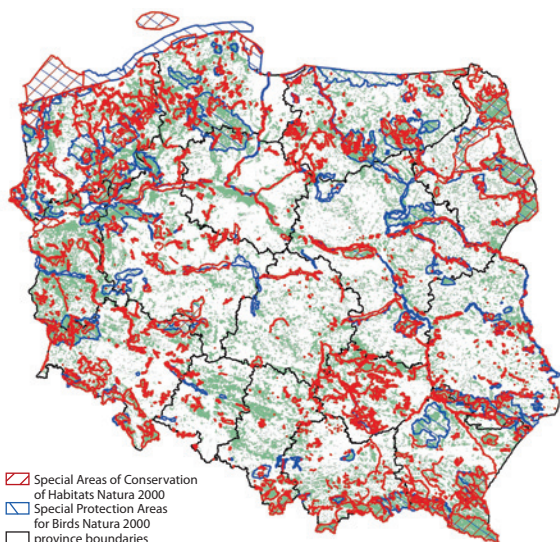


Fig. 24. Natura 2000 areas in Poland (General Directorate for Environmental Protection)

The State Forests, in compliance with the Forest Act and the national policy on forests, has for many years been carrying out an inventory of all forms of nature protection, which is kept up to date with the data provided annually by forest districts.

As of 31 December 2012, the State Forests inventory included:

- 1 267 nature reserves with an area of 121.7 thousand hectares, including 104.2 thousand hectares of forests;
- Natura 2000 sites: 134 areas for protection of birds (SPAs) with a total area of 2214 thousand hectares (31.8% of the forest area) and 722 areas for protection of habitats (SCIs) with a total area of 1641 thousand hectares (23.5%);
- 10 997 natural monuments, including 8532 single trees,





1484 groups of trees, 136 tree avenues, 469 erratic boulders, 193 rocks and caves, 191 areas under monument protection (317 hectares);

- 9027 areas of ecological utility with a total area of 29 029 hectares;
- 147 documentation sites with a total area of 1137 hectares;
- 126 nature-and-landscape complexes with a total area of 47 024 hectares.

Additionally, 3146 protective zones have been created within the State Forests in order to protect refuges of rare birds, mammals, reptiles, insects and lichens. They cover an overall area of 150 436 hectares, of which the largest area (29 891 hectares) is designated for all year protection of birds.

The State Forests maintains over 208 940 hectares of stands designated as the seed base (of which 15 496 hectares are selected seed stands and 187 194 hectares are economic seed stands), 1901 seed and seedling orchards and 4349 hectares of gene reserve stands and plantations. This base supplies material for promoting native ecotypes of forest-forming species in our forests.

The State Forests also initiates its own programmes aimed at maintaining biological diversity and protecting and restoring endangered species of flora and fauna. Among them are the "Programme for the preservation of forest genetic resources" and numerous projects such as the "Programme for the restitution of fir in Western Sudety", "Programme for the restitution of yew" and two projects focusing on preserving Capercaillie and black grouse. Other facilities include 6 botanical gardens, 4 arboreta and 9 animal rehabilitation centres ran by forest districts.

Game animals, whose number in Poland is one of the highest in Europe, are indicative of the richness of species of the forest fauna (Table 4). Populations of most species remain at high levels, which can pose a threat of damage to forests caused by animals. In the last decade the population of elk has increased by 523%, fallow deer by 267%, wild boar by 185%, mouflon by 183% and red deer by 165%. Even the population of hare has increased by 30% in that period. Only the partridge population continues to decrease (by 11%).

5. Promoting sustainable forestry

Forests in Poland are managed according to the principles of sustainable forestry. Foresters in all units of the State Forests are actively involved in promoting these principles, mainly by providing educational programmes for the society. The promotional work is co-ordinated by the State Forests Information Centre (CILP).

In 2012 the promotional work of CILP focused on the new campaign under the title "The State Forests: an invitation". The aim of the on-going campaign, which targets mainly families living in larger towns and cities, is to demonstrate that Polish

Table 4. Occurrence of the most important game animals in Poland

Year	Elk	Fallow deer individuals	Mufflon	Red deer	Roe deer	Wild boar	in '000 individuals					Partridge
1980	5 797	4 010	455	72.7	402.2	85.1	60.5	1 455.9	620.6			872.8
1985	4 406	4 094	540	74.4	476.5	57.1	49.0	1 346.8	348.5			1 033.8
1990	5 374	5 384	933	92.2	560.8	79.9	55.8	1 153.8	377.0			920.2
1995	3 099	7 478	1 742	99.8	514.9	81.0	67.4	925.7	312.3			960.7
2000	2 076	9 050	1 725	117.5	597.1	118.3	145.1	551.4	263.7			345.6
2001	2 188	9 240	1 616	120.2	614.4	123.4	160.7	471.8	258.2			313.4
2002	2 242	10 180	1 514	123.3	623.2	138.1	163.6	462.3	280.0			328.9
2003	2 813	11 365	1 529	130.2	652.6	163.3	184.8	493.9	314.9			363.0
2004	3 413	12 130	1 559	133.4	667.6	160.5	187.2	480.2	321.7			350.0
2005	3 896	13 115	1 684	140.7	691.6	173.5	201.2	475.4	333.1			346.6
2006	4 620	14 966	1 935	147.4	706.5	177.1	218.8	506.9	361.0			366.9
2007	5 414	15 423	1 811	154.2	705.8	178.6	215.4	515.8	367.6			374.0
2008	6 479	17 830	2 065	163.6	760.2	211.8	209.5	531.8	412.7			408.2
2009	7 515	20 667	2 595	176.1	827.5	251.0	203.3	562.4	462.0			442.3
2010	8 387	23 319	2 811	180.2	822.0	249.9	198.3	558.7	462.9			388.4
2011	9 862	26 517	2 772	194.7	829.9	267.8	211.9	596.7	458.5			330.3
2012	11 714	27 225	2 766	203.0	829.0	255.8	209.2	601.7	457.0			292.2
2012 : 2011 %	118.8	102.7	99.8	104.3	99.9	95.5	98.7	100.8	99.7			88.5
2012 : 2002 %	522.5	267.4	182.7	164.6	133.0	185.2	127.9	130.2	163.2			88.8

Note: estimates based on the size of spring populations

Source: Central Statistical Office

forests are well prepared to offer active and attractive forms of recreation. The State Forests foresters organised various events within this campaign, such as open days, "Summer in the forest" or "Mushroom picking", both at national and regional levels.

In 2012, the State Forests Information Centre either organised or participated in the following major events:

- Scientific picnic – organised by the Polish Radio and the Copernicus Science Centre, it is the biggest event of this type in Europe.
- Educational festival promoting nature conservation under the symbol of the Polish forget-me-not, organised at the Forest Education Centre in Jedlnia-Letnisko.
- Festival "Earth Day" in Pole Mokotowskie in Warsaw, during which the State Forests representatives gave away 10 thousand saplings to visitors who were encouraged to "plant your own tree".

In addition, the Centre promoted the State Forests through numerous competitions and exhibitions across the country. In May 2012, the State Forests participated in the events associated with a large safety campaign, which took place in 11 Polish cities. Under the title "Your friends' numbers", the campaign aimed to promote general awareness of safety and included seminars and concerts.

The State Forests Information Centre publishes educational and promotional literature and in 2012 it published 21 non-periodical titles, mainly of professional interest or promotional nature. Printing varied from a few hundred to even 11 thousand copies (e.g. instructions). It also continued to publish three periodical titles: "Głos Lasu", an internal circulation monthly magazine, another monthly "Biuletyn Informacyjny Lasów Państwowych" and a quarterly "Echa Leśne".

Promotional work is also carried out on the Internet. The State Forests website (www.lasy.gov.pl) is the main source of information about the organisation and its activities. It was visited by 1.187 million users in 2012, an increase of 750 thousand on the previous year. The Information Centre also runs two services at: www.czaswlas.pl and www.erys.pl and supervises the web pages of the Public Information Bulletin (www.bip.lasy.gov.pl).

One of the most popular pages on the State Forests website in 2012 was a live transmission from the nest of a pair of white-tailed eagles and later from the bison feeding station.

The Information Centre engaged other media in its promotional work: television, radio and the press. It also collaborated with the State Forests Centre for Development and Implementation in Bedoń on the production of films on the natural world.

Threats to the forest environment

Forests in Poland are among the most threatened in Europe due to a constant and simultaneous impact of a number of factors which have detrimental effect on the health of forests. These negative phenomena, which are often called stress factors, can be classified with respect to their origin as abiotic, biotic and anthropogenic.

1. Abiotic threats

In 2012, damage caused by abiotic factors to the forests administered by the State Forests was reported on 65.3 thousand hectares of stands over the age of 20 years. Almost 33 thousand hectares of stands were damaged by wind, nearly 27 thousand hectares by groundwater level fluctuations, 3.7 thousand hectares by snow and 1.1 thousand hectares by hail.

Fig. 25 illustrates the distribution of damage to forests caused by abiotic factors in the period 2007–2012. The data show that forests are exposed to a constant pressure associated with extremely adverse thermal conditions and fluctuations in the groundwater level, as well as to a random occurrence of other factors.

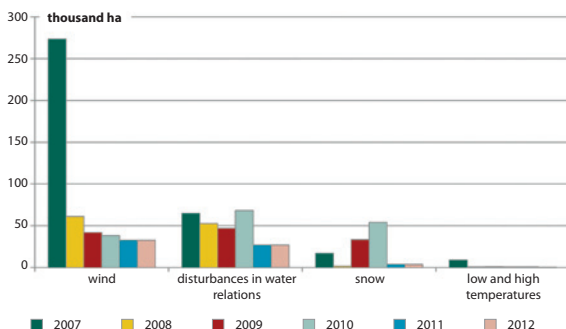


Fig. 25. Distribution of forest damage caused by abiotic factors in the State Forests in 2007–2012

2. Biotic threats

Forests in Poland are exposed to a continuous threat from a large number of biotic factors, of which the most damaging are insects and pathogenic fungi, especially species occurring cyclically in mass outbreaks or epiphytotics. They cause different types of damage to forest stands and in extreme cases their total decline.

Threats to forests from insects

Poland has been divided into three zones with regard to the level of threat from insect pests, both primary and secondary, and from fungi pathogens (Fig. 26).

Most vulnerable to attacks from primary insect pests are the stands in northern Poland (western part of Mazury Lake District) and in the north-west (Pomorze and Wielkopolska Lake Districts). Secondary pests cause most damage in three southern regions (Sudety, Śląsk Opolski and Beskid Wysoki). Low and moderate threat zones stretch across the middle part of the country, from the Silesian lowlands in the west, through the southern uplands of Małopolska and Lubelskie to the east (with the exception of Świętokrzyskie Mountains) and as far as the Mazowieckie lowlands and Mazury Lake District.

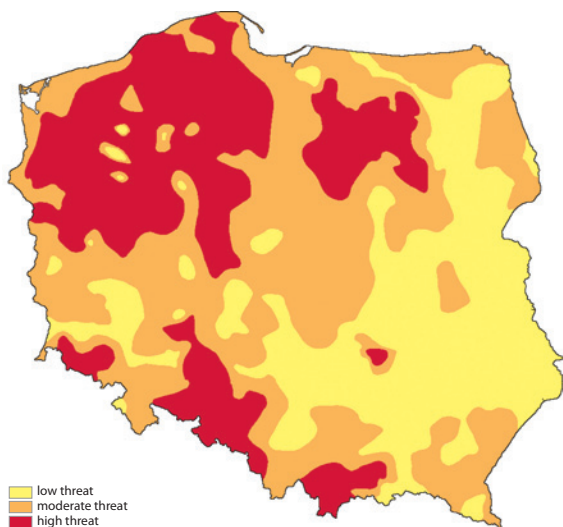


Fig. 26. Threat zones of insect pests outbreaks (both primary and secondary) in the forests of Poland (Forest Research Institute)

The activity of insect pests in 2012 increased by 23% in comparison with the previous year. The control treatment aimed to reduce the populations of about 50 insect species covered an overall area of 170.3 thousand hectares, which is almost 32 thousand hectares more than in 2011. The most dynamic were the populations of folivorous insects attacking pine stands and of pests attacking roots of forest trees and shrubs.

There was a significant increase in the activity of both nun moth *Lymantria monacha* L. and pine lappet moth *Dendrolimus pini* L. Treatment aimed at reducing the populations of folivorous pests was carried out on an area of 148.9 thousand hectares of pine stands (78.3 thousand hectares more than in the previous year).

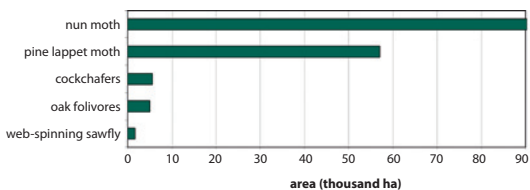


Fig. 27. Area of stands subjected to protective treatment against major folivorous insect pests in 2012

Control treatment against nun moth covered 90.3 thousand hectares and against pine lappet moth 57 thousand hectares (Fig. 27).

Threat to broadleaved stands, especially from geometrid moths *Geometridae* and tortricid moths *Tortricidae*, also increased and chemical treatment against these insects covered 5 thousand hectares, 4.8 thousand hectares more than in the previous year. However, there was a decrease in the threat from cockchafer imagines *Melolontha* spp., which resulted in a much smaller area having to be treated against them (a reduction from 44.9 thousand hectares in 2011 to 5.6 thousand hectares in 2012).

The total area of pine plantations and young stands subjected to pest control treatment was 10.2 thousand hectares, a decrease of 0.9 thousand hectares in comparison with 2011. The most destructive pest, large pine weevil (*Hylobius abietis*) was treated on an area of 5824 hectares.

The total area of spruce and larch stands subjected to control treatment against insect pests was 221 hectares, a reduction of 50% on the previous year. The largest area, 82 hectares, was treated for spruce adelgids (*Sacchiphantes* sp.).

Salvation measures taken against root pests of forest trees and shrubs were applied to plantations and nurseries in a total area of 419 hectares. The most wide-spread were larvae of two species of cockchafers: *Melolontha melolontha* L. and *M. hippocastani* F.

Of secondary pests, the largest threat in 2012 was presented by the following: blue jewel beetle (*Phaenops cyanea* F.), weevils (*Pissodes* spp.) and pine shoot beetles (*Tomicus* spp.) in pine stands; spruce bark beetle (*Ips typographus* L.) and four-eyed spruce bark beetle (*Polygraphus poligraphus* L.) in spruce stands; and oak buprestid beetle (*Agrilus biguttatus* F.) in oak stands.

Threats to forests from infectious fungal diseases

In 2012 infectious diseases were reported over a total area of 323.7 thousand hectares of stands, a decrease by nearly 77.6 thousand hectares (or 19.3%) compared with 2011. The most important change in the level of threat concerns pine shoot die-back which was reported on a total area of only 1.25 thousand hectares compared with 38.5 thousand hectares in the previous year. As in 2011, most of the affected areas (82%) were located in the Toruń RDSF.

The area affected by pine needle cast *Lophodermium* decreased by two-thirds but the incidence of needle and leaf rust increased threefold. Other diseases of assimilatory apparatus (pine twisting rust, oak mildew) were reported on smaller areas than in 2011 (respectively by 38% and 20%).

The improvement in health condition of broadleaved stands continued in 2012. Areas affected by dieback of oak, beech, alder and ash decreased by, respectively, 38%, 35%, 37% and 12%. The area affected by birch dieback was only larger by 92 hectares compared with 2011 and by poplar diseases taken together (cankers and tree dieback) by 380 hectares (Fig. 28).

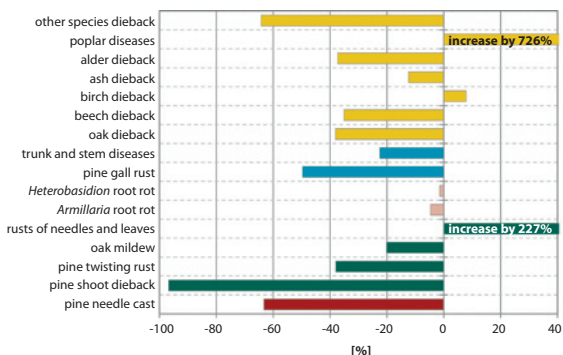


Fig. 28. Changes in areas affected by infectious diseases in 2012, in comparison with 2011 (%)

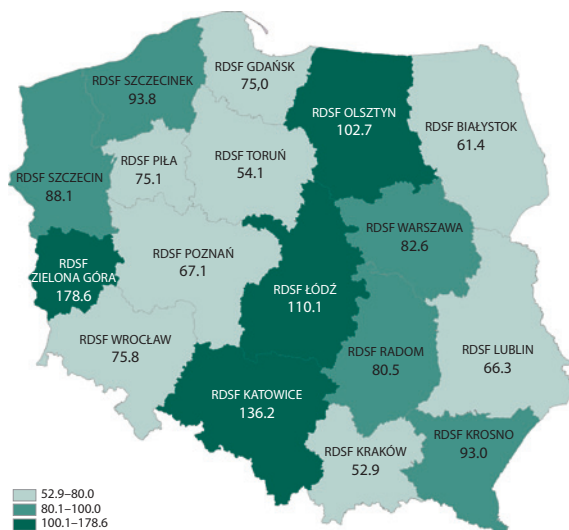


Fig. 29. Changes in the area of occurrence of infectious diseases in 2012, expressed as a percentage of area affected in the previous year

Generally, the health condition of forests in each of the regional directorates of the State Forests improved in 2012 (Fig. 29). The significant increase in the area affected by disease (by 78.6%) was observed in the Zielona Góra RDSF, which was entirely due to the spread of pine needle cast over an area of 2.8 thousand hectares compared to 130 hectares in 2011.

Damage caused by animals

In the 2011/2012 season, damage to trees in restocked forest areas occurred on 97 thousand hectares in total, including 37 thousand hectares of plantations, 39 thousand hectares of young stands and 21 thousand hectares of stands in older age classes.

Data collected during the 8-year inventory of damage to the restocked areas by deer show that after a period of diminishing pressure from these animals, the trend has reversed since 2010. Both young and older generations of renewed forests have been adversely affected.

3. Anthropogenic threats

Forest fires

There were 9265 forest fires in 2012 (compared to 8172 in 2011). The burnt area covered 7235 hectares of stands, which is almost three times more than in the previous year. The largest number

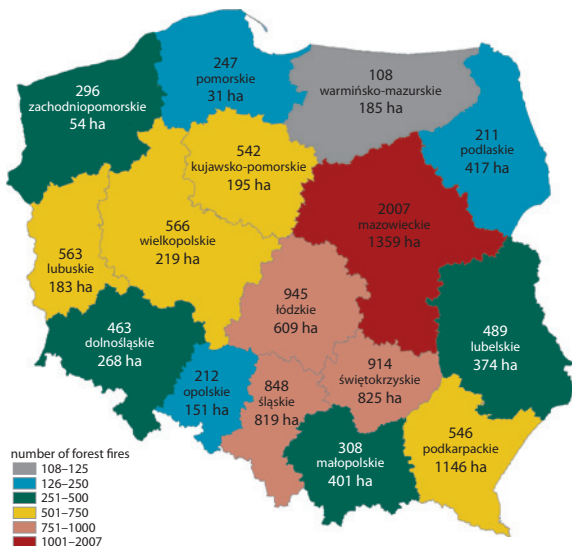


Fig. 30. Number of forest fires and the burnt area by province in 2012

of fire events, as in 2011, took place in the Mazowieckie province (22% of the total number), the lowest – in the warmińsko-mazurskie, podlaskie and opolskie provinces (Fig. 30).

In the State Forests, there were 3112 forest fires in 2012 (33.6% of all forest fires in Poland), which covered an area of 1216 hectares (16.8% of the total). The largest number of forest fires occurred within the Katowice RDSF (516), and they covered the largest area of 410 hectares.

The average area of a single fire in forests under all ownership categories increased by 0.45 hectare compared with 2011, and was 0.78 hectare. In the State Forests the average area of fire was 0.39 hectare and in other forests 0.98 hectare (Table 5).

The most frequent causes of fires in the State Forests were arson (40%) and careless adults (20%). Nearly 8.5% of fires spread from areas other than forests (11% of burnt forest area). The number of fires of unknown origin (23.5% of all fires and 23.6% of burnt forest area) is still high. The corresponding figures for forests under all ownership categories were: 42.7% fires caused by arson, 30.5% caused by careless adults and 19.8% of unknown causes.

The largest number of fires occurred in March (2433 fires, or 26.3% of all fires) and the smallest (of the risk period) in June and September.

Air pollution

The Central Statistical Office estimates that the total emission of air pollutants in Poland in 2010 amounted to over 974 thousand tonnes of sulphur dioxide and 867 thousand tonnes of nitrogen oxides, which is 64% and 103%, respectively, of emissions recorded in 2000 (Fig. 31). Among the EU countries, Poland has one of the highest levels of the total emission of main air pollutants.

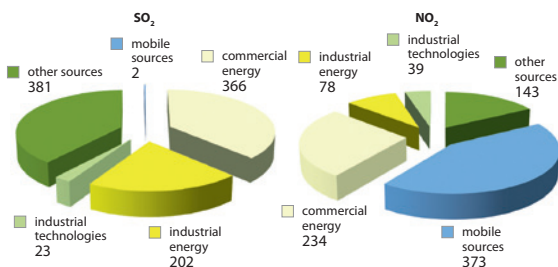


Fig. 31. Total emissions of sulphur dioxide and nitrogen oxides (calculated as NO_x) by source of pollution in 2010, in thousand tonnes (Central Statistical Office)

While downward trends in the levels of emission of some pollutants (e.g. sulphur dioxide and dust) were observed over the last decade, other gas pollutants, such as nitrogen oxides, still enter the atmosphere at levels of emission essentially unchanged (Fig. 32).

Table 5. Forest fires in Poland in 2001–2012

Year	Number of forest fires		Burnt forest area [ha]		Average area of single fire [ha]				% of fires in the State Forests in the total for Poland	
	total	State Forests	total	State Forests	total	State Forests	other forests		number of fires	burnt forest area
2001	4 480	2 044	3 466	685	0.77	0.34	1.14		45.63	19.76
2002	10 101	3 760	5 210	1 180	0.52	0.31	0.64		37.22	22.65
2003	17 087	8 209	21 551	4 182	1.26	0.51	1.96		48.04	19.41
2004	7 006	3 445	3 782	998	0.54	0.29	0.78		49.17	26.39
2005	12 049	4 501	5 713	1 197	0.47	0.27	0.60		37.36	20.95
2006	11 541	4 726	5 657	1 250	0.49	0.26	0.65		40.95	22.10
2007	8 302	2 818	2 841	550	0.34	0.20	0.42		33.94	19.36
2008	9 090	3 306	3 027	663	0.33	0.20	0.41		36.37	21.90
2009	9 162	3 429	4 400	970	0.48	0.28	0.60		37.43	22.05
2010	4 680	1 740	2 126	380	0.45	0.22	0.59		37.18	17.87
2011	8 172	3 007	2 678	580	0.33	0.19	0.41		36.80	21.66
2012	9 265	3 112	7 235	1 216	0.78	0.39	0.98		33.59	16.81

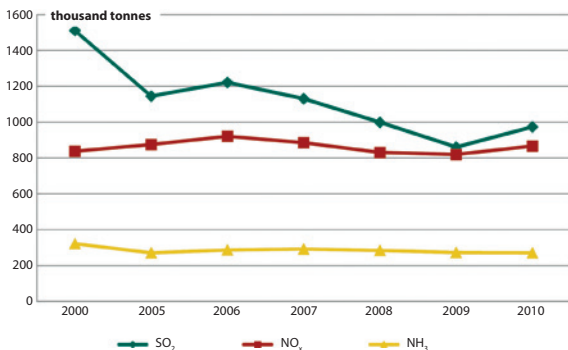


Fig. 32. Total emission of SO₂, NO_x (calculated as NO₂) and NH₃ in Poland, in thousand tonnes, in 2000-2010 (Central Statistical Office)

Information on major pollutants in forests in different regions of Poland is supplied by the intensive monitoring network. The network consists of 12 permanent observation plots, five of which are located in pine stands, three in spruce stands and two in each oak and beech stands.

Average monthly concentration of sulphur dioxide and nitrogen dioxide in the air measured on the observation plots were within 0,3–16 µgSO₂·m⁻³·m·c⁻¹ and 0,8–28 µgNO₂·m⁻³·m·c⁻¹ (Fig. 33). The lowest concentration of sulphur dioxide was observed in the north-east regions of the country while the highest occurred in the south, particularly in the foothill and mountain regions and in Upper Silesia. In central Poland these values were in the middle range.

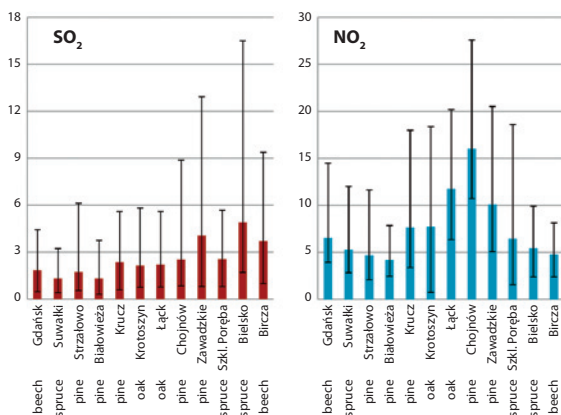


Fig. 33. Annual average and monthly minimal and maximal values of concentration (µg·m⁻³) of sulphur dioxides and nitrogen dioxide in the air, measured on intensive monitoring permanent observation plots in 2012

The level of concentration of nitrogen dioxide, as in previous years, was the highest in the central regions of Poland. Forests in the north-eastern regions and in the southern foothills and mountain areas had a significantly lower concentration of NO_2 , which points to the density of population and associated road traffic as one of the causes of the recorded distribution.

Chemical composition of the air changed with the seasons: the highest concentration of SO_2 and NO_2 was observed in the six winter months, which coincided with the heating season and therefore increased emissions.

More than half of the monthly precipitation recorded on permanent observation plots in 2012, as in the previous year, was acidic with the pH value below 5.5.

Deposition of heavy metals, i.e. zinc, copper, lead and cadmium (with the quantitative prevalence of zinc) ranged from 261 to 685 $\text{g}\cdot\text{ha}^{-1}\cdot\text{year}^{-1}$. The highest level of heavy metal deposition occurred on two spruce mountain plots in the Szklarska Poręba and Bielsko forest districts and on beech plots in Bircza and Gdańsk.

4. Threats to forest sustainability

The impact of stress factors on forests already suffering from reduced resistance of their ecosystems (due, for example, to unsuitable species composition for the habitat conditions or introduction of tree ecotypes of foreign origin) may, in extreme cases, lead to a total decline of stands. Such situation occurred in 1980–1991 in the Sudety Mountains where a combination of effects of a long lasting drought and a large-scale infestation by secondary pests had a disastrous effect on forests already weakened by industrial pollution. Through sanitation cutting, 15 thousand hectares of affected stands in the State Forests were completely removed and over 4 million m^3 of deadwood was harvested. The dieback affected all forests located more than 800 metres above sea level. In order to protect the deforested areas from soil erosion and degradation, the State Forests carried out afforestation work, often in parallel with the control treatment against secondary pests. In the period 1981–1996, over 14 thousand hectares of forest land were renewed.

The ecological disaster in the Sudety Mountains focused attention on the necessity of establishing a body which would oversee the conservation of endangered ecosystems in Poland. Its remit was developed as a result of cooperation between the State Forests and the Institute of Dendrology of the Polish Academy of Sciences. The Kostrzyca Forest Gene Bank was officially opened in December 1995. It is located in Miłków at the foothill of the Karkonosze Mountains which, alongside the Jizera Mountains, were most affected by the ecological disaster in the early 1980s.

The Kostrzyca Forest Gene Bank was established in response to the emerging threat to the sustainability of forests from various abiotic, biotic and anthropogenic factors. Regrettably, these threats still continue, and the role of foresters is to take any possible action to minimise their effects.

An example of such intervention was the programme of remedial action with regard to the forests of Beskid Śląski and Żywiecki, which was developed by the Katowice RDSF. Over the last 30 years work has been carried out to reduce the share of spruce in the local forests.

In 2003, the "Programme for Beskidy" was developed and implemented as part of the regional operational plan of the national policy on forests. It outlined the strategy for protection of the Beskidy forests and stated silvicultural targets which concentrated on the reconstruction of stands as a remedy for their decline. Implementation of this programme resulted in nearly 3 thousand hectares of spruce stands being subject to conversion.

Despite all the remedial measures, the tree dieback intensified in the period 2006–2008, resulting in further stand decline in the Beskidy forests. The rate of decline only began to decrease in the years 2009–2011, which was mainly due to a combination of favourable weather conditions and intensive efforts on the part of foresters. Unfortunately, the condition of stands deteriorated again in 2012.

Simultaneous occurrence of multiple stress factors is also regarded as the cause of increased dieback of broadleaved trees in the last few years. Recent scientific reports point to a significant role of fungi of the genus *Phytophthora* in the decline of broadleaved stands.

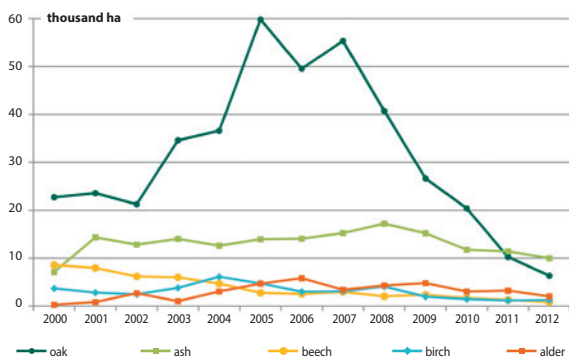


Fig. 34. Area of dieback of selected broadleaved tree species within the State Forests in the years 2000–2012

In total, the phenomenon of tree dieback in 2012 was observed on 21.5 thousand hectares, a decrease of 26% on the previous year (Fig. 34).

5. 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.

Assessment of defoliation in 2012 covered 39 300 trees over the age of 20 years, which were located on 1965 Level I permanent observation plots (20 trees on each plot).

In that sample, 11.3% of trees showed no defoliation (defoliation class 0 – healthy trees), including 8.7% of conifers and 16.1% of broadleaves. The largest share of coniferous trees without any defoliation was reported for fir (18%), and the smallest – for pine (8%). The largest share of healthy broadleaved trees was reported for beech (36%) and the smallest – for oak (5.1%) (Fig. 35).

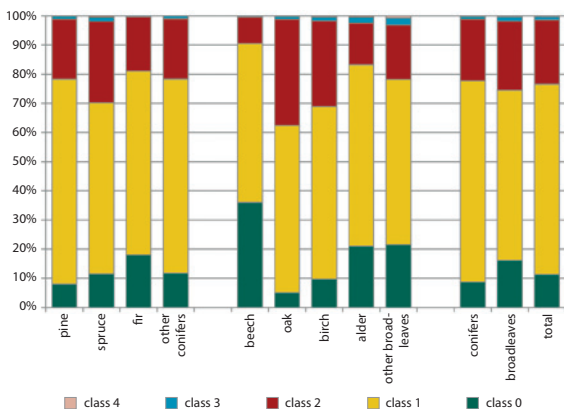


Fig. 35. Share of monitored tree species on Level I permanent observation plots (Forest Monitoring) in defoliation classes in 2012

The share of damaged trees with defoliation over 25% (defoliation classes 2–4) for all species was 23.4%; the share among conifers was 22.2% and among broadleaves 25.5%. The lowest share among the conifers had fir (18.9%) and the highest spruce (29.8%). Among the broadleaves beech had the lowest share (9.5%) and oak the highest (37.6%) (Fig. 35).

In forests under the management of the State Forests the share of healthy trees (class 0) of all species was 11.8% and of damaged trees (classes 2–4) 21.8%. Forests in private ownership had smaller share of healthy trees (9.9%) and larger share of damaged trees (27%). In national parks the share of healthy trees was 13.6% and of damaged trees 23.9%.

A comparison of the level of damage to forests in Poland and in other European countries is based on the report "Forest Condition in Europe – 2013. Technical Report of ICP Forests" (UNECE, Hamburg 2013). The figures for 2012 show that Poland is in the

group of countries in which the share of trees of all species in the defoliation classes 2–4 is in the higher range, at 23.4% (Fig. 36).

High level of damage (above 35% of trees in the defoliation classes 2–4) was observed in the Czech Republic (50.3%), France (41.1%), Slovakia (37.9%) and Italy (35.7%). The lowest level of defoliation (below 10% of trees in defoliation classes 2–4) occurred in the forests of Latvia, Estonia, Ukraine, Denmark, Andorra and Ireland.

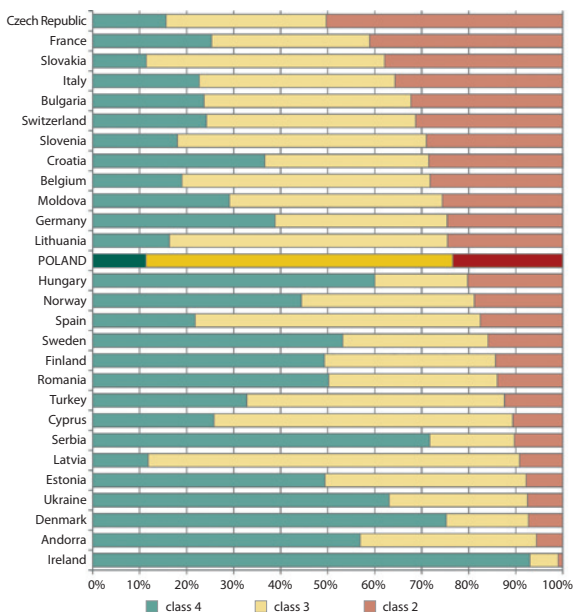


Fig. 36. Defoliation of stands in European countries in 2012, arranged in order of increasing share of trees in defoliation classes 2–4 (Forest Research Institute after UNECE, 2013)

Among the countries across Poland's eastern border the level of damage to forest stands in the period 2008–2012 was low in Belarus and Ukraine (below 10% of trees in defoliation classes 2–4). In Lithuania a relatively low level of defoliation was observed in 2011 (15.4% of trees in classes 2–4) but in the remaining years of the period 2008–2012 the level of damage was higher and was comparable to that in Poland.

- In our climatic and geographical zone, forests are the most natural formation. They are a crucial element of ecological balance, life continuity, landscape and neutralisation of contaminants, thus counteracting environmental degradation. Forests, as a form of land use, assure biological production with a market value and help to shape the quality of human life.
- Forest ecosystems are the most valuable and best represented component of all forms of nature protection in Poland and account for over 37.3% of the land area under legal protection. The share of protected forests in the total forest area is 40.7%, while the share of protective forests – mainly water-protective, those around cities and those in areas damaged by industry – 39%. The areas of Natura 2000 network cover about 20% of the country's land area. Within the State Forests, Special Protection Areas for birds (SPAs) cover 2214 thousand hectares (31.8% of the State Forests territory) and Sites of Community Importance (SCIs) – 1641 thousand hectares (23.5%).
- Poland's timber resources have been steadily increasing. Their volume stands at 2.4 billion m³ of gross merchantable timber. Timber resources in the State Forests (1.9 billion m³) are the largest in the country and their quality (according to available data) surpasses that of the forests under other forms of ownership.
- In 2012, the area of post-agricultural land and wasteland afforested under the "National programme for the augmentation of forest cover", which assumes the increase in forest cover to 30% by 2020 and to 33% by 2050, decreased slightly in comparison with the previous year. The total area of (artificial) afforestation was 4.9 thousand hectares (5.3 thousand hectares in 2011).
- 34 978 thousand m³ of net merchantable timber was harvested in Poland in 2012, of which 33 212 thousand m³ came from the State Forests (99.6% of the volume of approximated annual prescribed cut). Significant share (15% or 4967 thousand m³) in general utilisation of stands had incidental and sanitation felling associated with the care of stands damaged by disasters. Area size of clear-cuts was limited to 25 thousand hectares and timber harvested from clear-cutting to 5865 thousand m³ of merchantable timber (17.7% of total harvest). Utilisation of timber resources in the State Forests in 2012 was at a lower level than the volume of increment, as it was in the past 20 years when harvest volume was about 56% of the volume of increment.
- Poland's forests are under constant threat from abiotic, bio-

tic and anthropogenic factors, to a greater degree than almost anywhere else in Europe.

- The assessment of defoliation of tree crowns shows deterioration in the health condition of forests managed by the State Forests. Although the share of damaged trees (defoliation in excess of 25%, defoliation classes 2–4) decreased slightly and stood at 23.4%, the share of healthy trees also decreased from 14% in 2011 to 11.3% in 2012.
- Activity of the most dangerous insect pests in 2012 increased by about 23% in comparison with the previous year. There was a continuing increase in the incidence of nun moth and pine lappet moth. Control treatment to reduce the populations of about 50 insect species covered an area of 170.3 thousand hectares.
- Infectious fungal diseases were reported on a total area of 324 thousand hectares (401 thousand hectares in 2011), which is almost a 20% decrease. For many years, root rot diseases (*Heterobasidion* and *Armillaria* spp.) have posed the major threat (76%) to forests, especially to those established on post-agricultural land. The area of stands affected by oak, beech and alder dieback decreased by more than 30% and ash dieback by 12%. There was a significant reduction in occurrence of pine shoot dieback.
- Damage to forests was also caused by large herbivore mammals, mainly red deer, roe deer, and locally by rodents (beavers and mice).

Afforestation – the establishment of new forests on the land previously used for agriculture or on wasteland.

Age class – an agreed period, usually 20 years, which allows the grouping of stands by age (stands aged up to 20 years form class I, stands ranging from 21 to 40 years form class II, and so on).

Amount of cut, yield – the amount (volume) of timber that may be harvested in accordance with management objectives and financial plans.

Annual prescribed cut by volume in the State Forests – a measure of utilisation of forests in a given year, as set out in forest management plans. It is calculated as a sum of final and pre-final (intermediate) cuts for any given forest district (approximately equalling 1/10 of the cut prescribed for a 10-year period). The annual quotas may vary depending on forest condition, but the overall harvest in any given district must balance over a 10-year period during which the current forest management plan is in force.

- **annual prescribed cut in final cuts in the State Forests** – an annually averaged sum of final cuts agreed for every forest district; the volume of harvest is set out in the forest management plan (usually established for a 10-year period) and should not be exceeded.

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

Bark stripping (peeling) – a method of feeding by ungulate animals using their teeth to strip off the bark from standing or cut trees.

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

- **species diversity** – a variety of species,
- **ecological diversity** – a variety of community types (biocoenoses, ecosystems),
- **diversity of genetic resources** – a variety of genes forming a gene pool of a population.

Class for restocking (KDO) – a type of vertical structure of stands in which there is simultaneous utilisation and regeneration under the canopy of the parent stand, and in which the level of regeneration does not yet meet the adopted requirements.

Clear-cuts – an area from which all trees have been removed in one operation (final cut) and which is designated for reforestation within the period of two years.

Deadwood – trees dead or dying as a result of excessive crowding in the stand, attacks by primary or secondary insect

pests, the impact of industrial emissions, changes in water relations, etc.

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

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

Economic seed stands – stands whose origin and quality indicate that seeds harvested from them will produce valuable progeny thus ensuring long-lasting production of timber of satisfactory quality and quantity.

Ecotype – *race, ecological form* – the entire population of one plant species found in a specific location; it develops as a result of long-term conditioning by the specific (local) properties of the environment; ecotypes vary with regard to their physiological and, less frequently, morphological characteristics.

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

Final cutting (felling) – the harvest of wood associated with the restocking of a stand or deforestation as a result of a change in land-use; the wood obtained from final felling is known as the final cut timber.

Folivores (folivorous species) – leaf-eating animals.

Forest cover (or index thereof) – percentage of the area covered by forests in the country's total land area.

Forest habitat (site) type – a generalised concept of the group of stands on sites of similar suitability for forest production; the basic unit of the typological classification applied in Poland.

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

Industrial emissions – gaseous chemical compounds and particles released into the atmosphere by industrial, municipal and other plants.

Managed forests – forests which are managed according to a plan and whose function is to produce wood and other forest products, while applying the principles of spatial and temporal order.

Merchantable timber (large timber) – (1) the volume of a tree above stump with a diameter at the thinner end of at least 7 cm with bark (refers to standing timber), (2) round wood with a diameter at the thinner end of at least 5 cm without bark (refers to harvested timber).

- **gross merchantable** – timber with bark,

- **net merchantable** – timber without bark and without losses during harvest.

- Outbreak (gradation, infestation)** – a mass occurrence of insect pests as a consequence of environmental factors which are favourable to the given species.
- Pathogens** – factors causing diseases; primary pathogens attack vigorous healthy organisms while secondary pathogens attack already damaged trees.
- pH** – indicator of acidity level, e.g. of soil.
- Pollutant emission** – gaseous substances and particles in the air which impact upon their surroundings, *i.e.* by reaching organisms and ecosystems and exerting an influence on them.
- Pre-final (pre-commercial, intermediate) cutting (felling)** – harvesting of wood associated with stand tending procedure.
- Promotional forest complex (PFC)** – a forest area of special ecological, educational and social value, established for the purpose of promoting sustainable forest management and protection of natural resources.
- Protective forests** – forests under special protection because of their functions or vulnerability to threats.
- Regeneration (renewal, restocking, reforestation):** new forest stands established after the removal of previous stands by felling or as a result of damage by natural causes;
- natural regeneration** – stands established as a result of self-seeding or suckering;
- artificial regeneration** – stands established by man by planting or seeding.
- Restocking class (KO)** – a type of vertical structure of stands in which there is simultaneous utilisation and regeneration under the canopy of the parent stand, and in which the level of regeneration permits the subsequent stages of tending.
- Selected seed stand** – a stand of high quality trees whose main purpose is seed production; they are excluded from felling for a defined period of time (excluded from final felling).
- Selection structure (BP)** – a type of vertical structure of stands, representing groups and clumps of trees of uneven age and size.
- Small-sized timber** – round wood with a diameter at the thicker end (under bark) of up to 5 cm.
- Standing volume** – the volume of all live trees in a given area (stand, province, country, etc.), with a diameter (with bark) over 7 cm at breast height. Standing volume is often calculated per hectare.
- Thinning** – cuts made in immature stands after they have passed through the cleaning period, during which economically undesirable trees are removed. Thinning has a positive effect on the quality of stands as it allows the trees to increase their volume, height and crown size.
- Tree volume** – the amount of wood expressed in cubic metres (m³).
- Volume increment** – an increase in the volume of 1) a tree, 2) a stand (including harvested timber) over a period of time;
- Windthrows** – trees broken or brought down by wind.

