

POLAND  The State Forests

FORESTS IN POLAND 2012

Published by
The State Forests
Information Centre
Warszawa 2012

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ISBN 978-83-61633-89-1

Prepared for printing by:
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Printed by:
ORWLP in Bedoń



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ISBN 978-83-61633-89-1



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PROMOTIONAL FOREST COMPLEXES

BIĄŁOWIEŻA PRIMEVAL FOREST
Area – 52 637 ha
Forest Districts: Białowieża, Browsk, Hajnówka

TUCHOLSKIE FORESTS
Area – 84 140 ha
Forest Districts: Tuchola, Osle, Dąbrowa, Woźniowa, Trzebciny

GOSTYNIŃSKO-WŁOCŁAWSKIE FORESTS
Area – 53 093 ha
Forest Districts: Gostynin, Łąck, Włocławek

KOZIENICKA PRIMEVAL FOREST
Area – 30 435 ha
Forest Districts: Kozienice, Zwolęń, Radom

ŚWIĘTOKRZYSKA PRIMEVAL FOREST
Area – 76 885 ha
Forest Districts: Kielce, Łagów, Suchedniów, Zagnańsk, Skarżysko, Daleszyce

JANOWSKIE FORESTS
Area – 31 620 ha
Forest District: Janów Lubelski

LUBUSKIE PRIMEVAL FORESTS
Area – 32 135 ha
Forest District: Lubsko

BESKID ŚLĄSKI FORESTS
Area – 39 883 ha
Forest Districts: Bielsko, Ustroń, Wisła, Węgierska Górka

OLIWSKO-DARŻLUBSKIE FORESTS
Area – 40 907 ha
Forest Districts: Gdańsk, Wejherowo

RYCHTAŁSKIE FORESTS
Area – 47 992 ha
Forest Districts: Antonin, Syców, Forest Experimental Station in Siemianice (University of Life Sciences in Poznań)

BIRCZAŃSKIE FORESTS
Area – 29 578 ha
Forest District: Bircza

MAZURSKIE FORESTS
Area – 118 216 ha
Forest Districts: Strzałowo, Spychow, Mragowo, Pisz, Maskulińskie, Research Station for Ecological Agriculture and Preservation of Native Breeds of the Polish Academy of Sciences at Popielno

SPALSKO-ROGOWSKIE FORESTS
Area – 34 950 ha
Forest Districts: Brzeziny, Spała, Forest Experimental Station in Rogów (University of Life Sciences in Warsaw)

BESKID SĄDECKI FORESTS
Area – 32 051 ha
Forest Districts: Piwniczna, Nawojowa
Forest Experimental Station in Krynica (University of Agriculture in Cracow)

SUDETY ZACHODNIE
Area – 22 866 ha
Forest Districts: Szklarska Poręba, Świeradów

NOTECKA PRIMEVAL FOREST
Area – 137 273 ha
Forest Districts: Potrzebówice, Wronki, Krucz, Sieraków, Oborniki, Karwin, Międzychód

SZCZECIŃSKIE PRIMEVAL FORESTS
Area – 61 070 ha
Forest Districts: Kliniska, Gryfino, Trzebież, Municipal Forests of the City of Szczecin, Educational Centre "Świdwie"

WARSZAWSKIE FORESTS
Area – 52 099 ha
Forest Districts: Drewnica, Jabłonna, Celestynów, Chojnów, Municipal Forests of the City of Warsaw

DOLINA BARYCZY FORESTS
Area – 42 379 ha
Forest Districts: Milicz, Żmigród

ŚRODKOWOPOMORSKIE FORESTS
Area – 55 655 ha
Forest Districts: Warcino, Polanów, Karnieszewice

KNYSZYŃSKA PRIMEVAL FOREST
Area – 47 486 ha
Forest Districts: Supraśl, Dojlidy, Czarna Białostocka

NIEPOŁOMICKA PRIMEVAL FOREST
Area – 10 926 ha
Forest District: Niepołomice

BIESZCZADZKIE FORESTS
Area – 24 234 ha
Forest Districts: Stuposiany, Lutowiska, Cisna

ELBLĄSKO-ZUŁAWSKIE FORESTS
Area – 18 827 ha
Forest District: Elbląg

OLSZTYŃSKIE FORESTS
Area – 33 894 ha
Forest Districts: Olsztyn, Kudypy

The total area of PFCs – 1 211 231 ha



Eurasian jay

European blue tit

FORESTS IN POLAND 2012



Centrum Informacyjne
Lasów Państwowych

Forests in Poland 2012

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 2011 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 2011 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 but who represent different types of forestry to that established in Central Europe: 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). 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. 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 9143.6 thousand hectares (the Central Statistical Office figure as of 31 December 2011), which puts forest cover at 29.2% (Fig. 1).

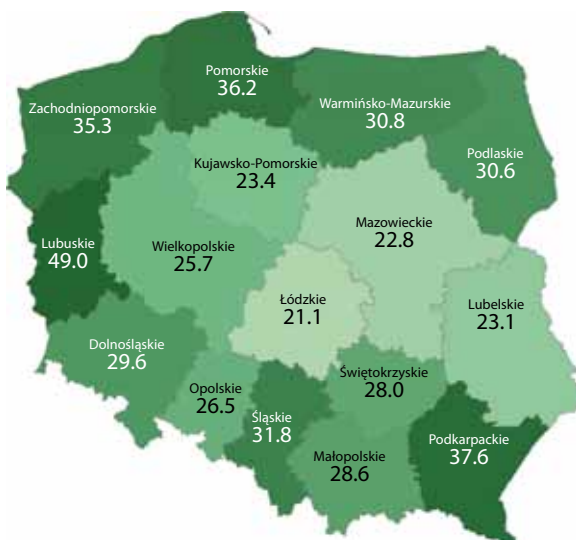


Fig. 1. Forest cover by province (Central Statistical Office)

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 2011, was 9.35 million hectares. This figure places Poland in the group of countries with the largest forest area in the region, after France, Germany and Ukraine (Fig. 2).

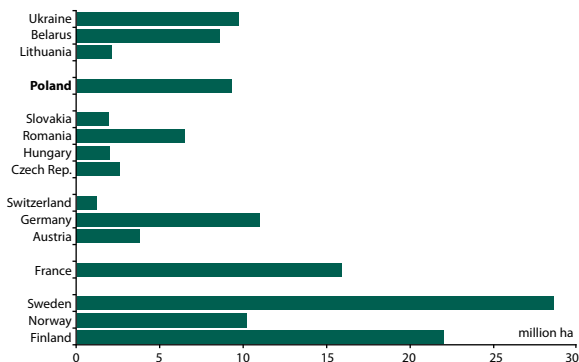


Fig. 2. Total forest area (SoEF 2011)

The forest cover of the analysed countries is much less varied than their absolute forest areas. A distinctly greater forest cover is found in those countries in which large areas of land are unsuitable for any other use but forestry, for example marshlands or mountain regions (Scandinavian countries, Austria, Slovakia). Among the 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 2011, Poland's forest cover measured by the international standard amounted to 30.5% and was lower than the European average (32%, exclusive of the Russian Federation) (Fig. 3).

A comparison of forest area *per capita* with an overall land area is presented in Fig. 4. In countries with low population density,

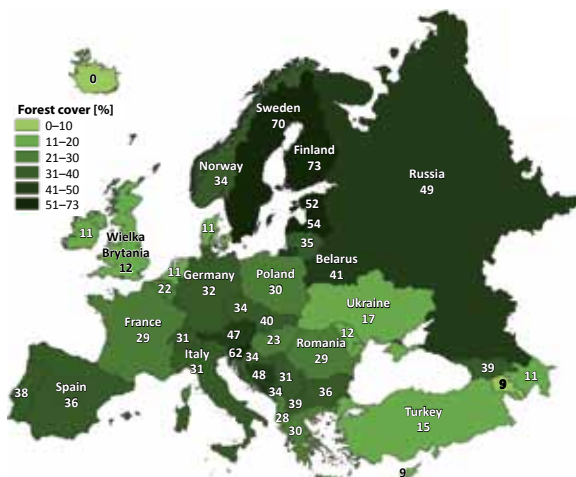


Fig. 3. Forest cover in European countries (SoEF 2011)

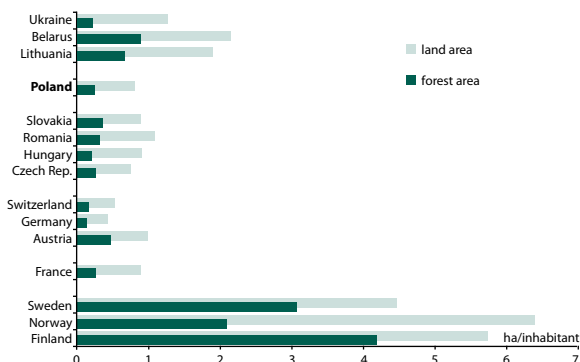


Fig. 4. Area of forests against the total land area per inhabitant (SoEF 2011)

these values are markedly higher than the average. The forest area *per capita* in Poland (0.24 ha) is one of the lowest in the region.

2. Forest ownership structure

In the ownership structure of forests in Poland (Table 1) the majority, 81.3%, are publicly-owned forests, of which 77.4% are under the management of the State Forests (Fig. 5). The ownership structure of forests in the whole post-war period has remained almost unchanged.

The share of publicly-owned forests in the total forest area in 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 Nordic states and France where a great majority of forests are privately-owned, and the remaining countries which have diversified ownership structure with a predominance of publicly-owned forests.

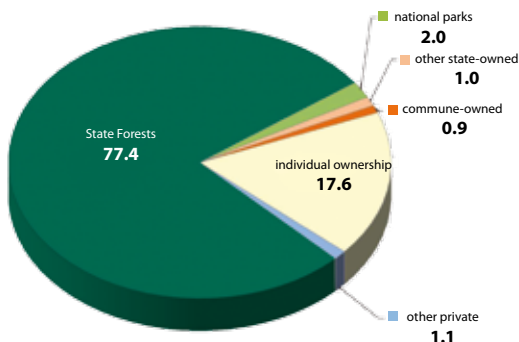


Fig. 5. Ownership structure of forests in Poland (Central Statistical Office)

FORESTS IN POLAND 2012

Table 1. Forest ownership structure in Poland

Type of ownership	31.12.1995		31.12.2000		31.12.2010		31.12.2010	
	'000 ha	%	'000 ha	%	'000 ha	%	'000 ha	%
Total	8756^{a)}	100.0	8865^{a)}	100.0	9121^{a)}	100.0	9144^{a)}	100.0
Publicly-owned forests	7262	82.9	7341	82.8	7435	81.5	7438	81.3
State Treasury-owned forests	7186	82.0	7262	81.9	7351	80.6	7354	80.4
including:								
administered by State Forests	6868 ^{b)}	78.4	6953 ^{b)}	78.4	7072 ^{b)}	77.5	7077 ^{b)}	77.4
national parks	162	1.9	181	2.0	184	2.0	184	2.0
other	156	1.7	128	1.4	95	1.1	93	1.0
Commune-owned	76	0.9	79	0.9	84	0.9	84	0.9
Privately-owned forests	1494	17.1	1524	17.2	1686	18.5	1706	18.7
including:								
individual owners	1397	15.9	1428 ^{d)}	16.1	1587 ^{d)}	17.4	1605 ^{d)}	17.6
land cooperatives	68	0.8	69 ^{d)}	0.8	67 ^{d)}	0.7	67 ^{d)}	0.7
agricultural cooperatives	14	0.2	9 ^{d)}	0.1	6 ^{d)}	0.1	5 ^{d)}	0.1
other	15	0.2	18 ^{d)}	0.2	26 ^{d)}	0.3	29 ^{d)}	0.3

^{a)} Plus land associated with forestry management: 1995 – 190 000 ha, 2000 – 194 000 ha, 2010 – 208 000 ha, 2011 – 207 000 ha

^{b)} Plus land associated with forestry management: 1995 – 187 000 ha, 2000 – 189 000 ha, 2010 – 201 000 ha, 2011 – 200 000 ha

^{c)} Including land associated with forestry management: 2000 – 200 ha in all private ownership, 2010 – 600 ha, 2011 – 700 ha

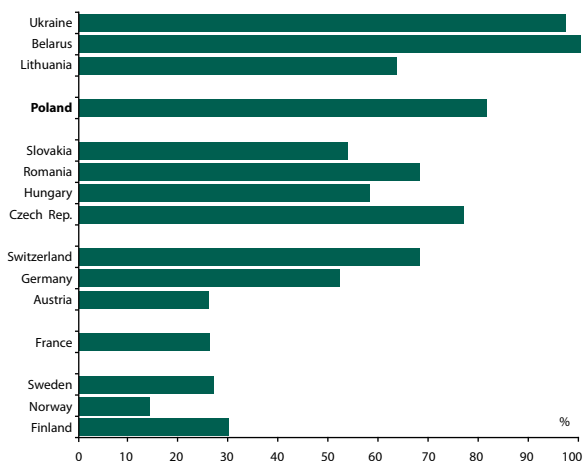


Fig. 6. Share of public forests in the total forest area (SoEF 2011)

The share of privately-owned forests in Poland varies among the regions (Fig. 7) – the greatest is in the Mazowieckie Province – 43.8% of its total forest area (354.7 thousand hectares) and the lowest in the Lubuskie Province – 1.5% (10.3 thousand hectares).

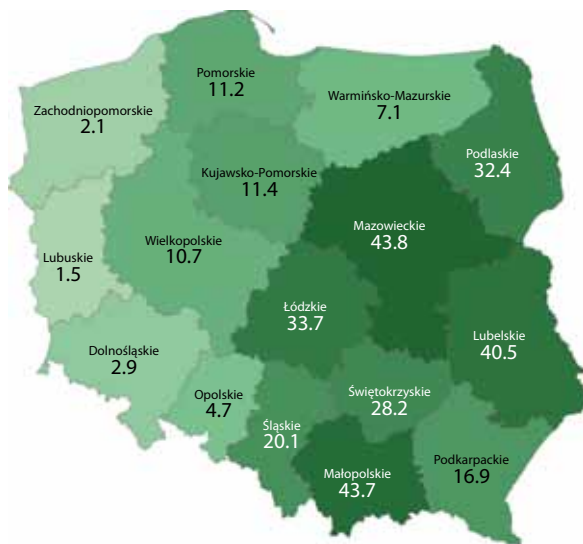


Fig. 7. Share of private forests in the total forest area by province (Central Statistical Office)

3. Habitat structure

Forests in Poland mainly occur on the poorest soils, which is reflected in the structure of forest habitat types (Fig. 8). Coniferous forest habitats predominate, accounting for 51.7% of the total forest area, while broadleaved forest habitats account for 48.3%. In both groups, upland habitats occupy 5.7 % of the forest area and mountain habitats 8.6%.

Legend:

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

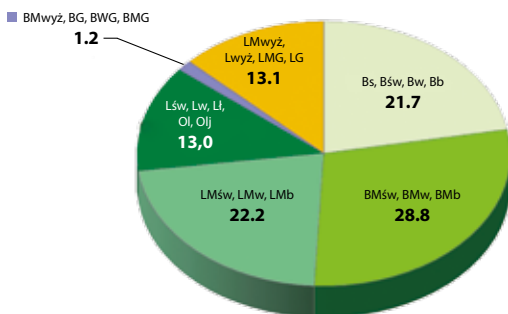


Fig. 8. Areal share (in %) of forest habitat types in the forests in all ownership categories (Large-Scale Forest Inventory)

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 diversified species structure, in most of the country prevail stands with pine as the dominant species.

Coniferous species dominate in Polish forests, accounting for 70.3% of the total forest area (Fig. 9). Poland offers optimal climatic

and site conditions for pine within its Euro-Asiatic natural range, which resulted in development of a number of important ecotypes (e.g. the Taborska pine or the Augustowska pine). Pine accounts for 59.9% of the area of forests in all ownership categories, for 61.7% in the State Forests and for 56.6% in the privately-owned forests.

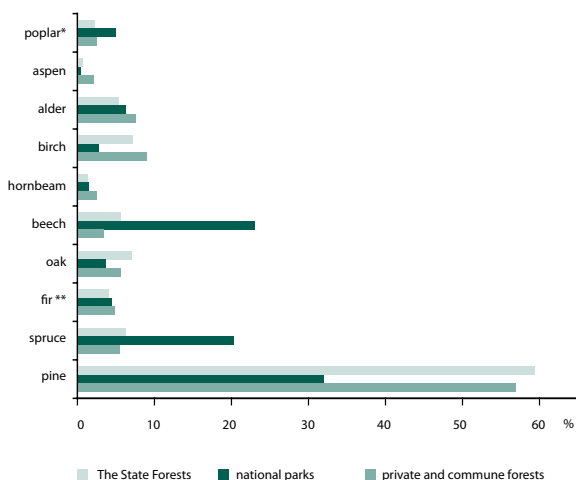


Fig. 9. Areal share of dominant species in the State Forests, national parks and in private and commune forests (Large-Scale Forest Inventory)

* including other broadleaved

** including other conifers

In the period 1945–2011, the species structure of Poland's forests substantially changed, resulting in an increase in the 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%.

5. Age structure

Stands aged 41–80 years, representing age classes III and IV, prevail in the forest age structure and cover 26.7% and 18.5% 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 11.7% of the

forest area managed by the State Forests, while in private forests only for 2.3%. (Fig. 10, Table 2).

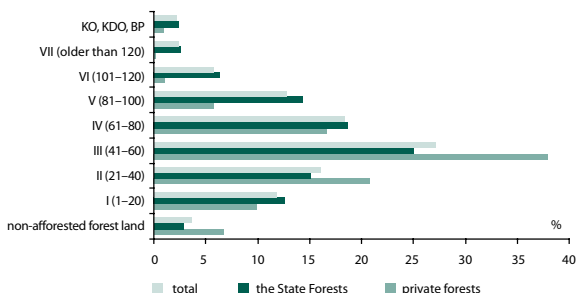


Fig. 10. Areal share of stands by age class under all forms of ownership, in the State Forests and in private forests (Large-Scale Forest Inventory)

Table 2. Forest area by age class

Specification	State Forests		Privately-owned forests	
	'000 ha	%	'000 ha	%
TOTAL AREA	7072.4	100.0	1685.7	100.0
including afforested	6865.6	97.1	1576.0	93.5
Class I (aged 1–20 years)	895.6	12.7	174.7	10.3
Class II (21–40)	1041.4	14.7	349.5	20.8
Class III (41–60)	1746.7	24.8	618.3	36.7
Class IV (61–80)	1330.2	18.8	290.6	17.2
Class V (81–100)	1022.8	14.4	104.6	6.2
Class VI (101–120)	457.1	6.5	17.8	1.1
Class VII (older than 120)	194.2	2.7	3.5	0.2
KO, KDO, SP	177.7	2.5	17.0	1.0

Source: Large-Scale Forest Inventory, data for 2007–2011

A steady increase in the share of stands older than 80 years from about 0.9 million hectares in 1945 to nearly 1.93 million hectares (excluding the KO and KDO classes) in 2007–2011 is an indicator of the changes in the age structure of forests.

6. Changes in forest area

In 2011, as compared with the previous year, Poland's forest area increased by 22 thousand hectares. Since 1995, the forest area has increased by 388 thousand hectares (according to the land records).

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 and prepared by the Forest Research Institute. The Programme was adopted for implementation by the Council of Ministers on 23 June 1995. The experience gained during the implementation necessitated some modification of the programme, which was completed in 2002. The area designated for afforestation in 2001–2020 was increased by 100 thousand hectares to 680 thousand hectares and afforestation preferences for each commune in Poland were revised.

The programme's main aims are to increase the 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).

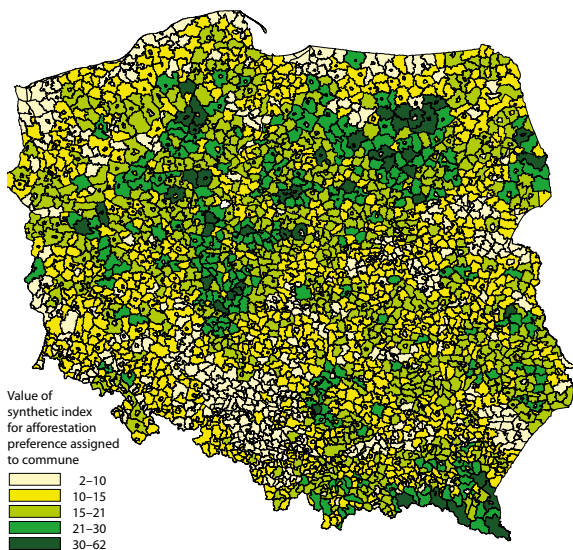


Fig. 11. Communes given preference in the National Programme for the Augmentation of Forest Cover revised in 2002, variant III – environment (Forest Research Institute)

The afforestation of land in all ownership categories carried out in 2011 covered 5277.1 hectares (Fig. 12). Afforestation resulting from natural succession occurred on about 169 hectares (209 hectares in 2010), which is 18% of average annual afforestation planned by the programme for 2011–2020.

The area of afforestation in 2011 decreased by 588 hectares (10%), compared with 2010. The dramatic reduction of afforested areas (from 16 933 hectares in 2006 to 5277.1 hectares in 2011, or by 69%) is primarily the result of the change in criteria for

designating privately-owned agricultural land for afforestation (mainly the increase in the size of a minimal area from 0.30 hectares to 0.50 hectares under the *Programme for the Development of Rural Areas 2007–2013*).

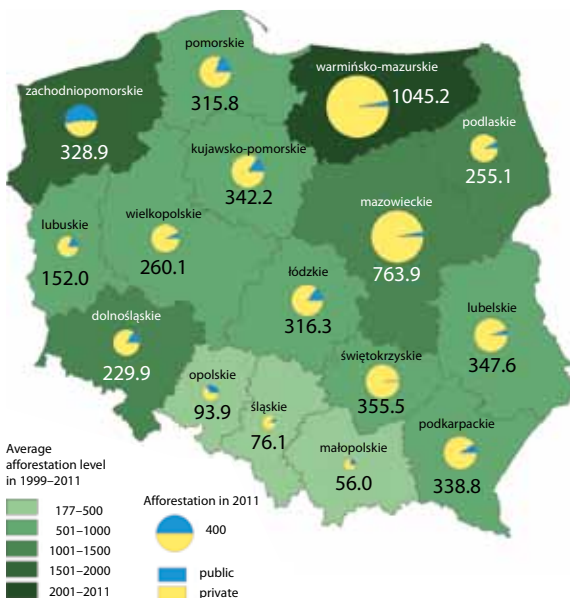


Fig. 12. The area of artificial afforestation in 2011 by province against the average level of afforestation in 1999–2011 (Central Statistical Office, Forest Research Institute)

Thanks to the subsidies from the state budget and a loan from the European Investment Bank, the afforestation process 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 afforestation rate within the State Forests has been noted, with 6.1 thousand hectares in 2005 and only 0.6 thousand hectares in 2011 (Fig. 13).

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 2011 covered 51 182 hectares of land under all ownership categories, of which 6215.2 hectares (12.1%) were naturally regenerated stands. The area restocked in 2011 was larger by about 5100 hectares, as compared to 2010.

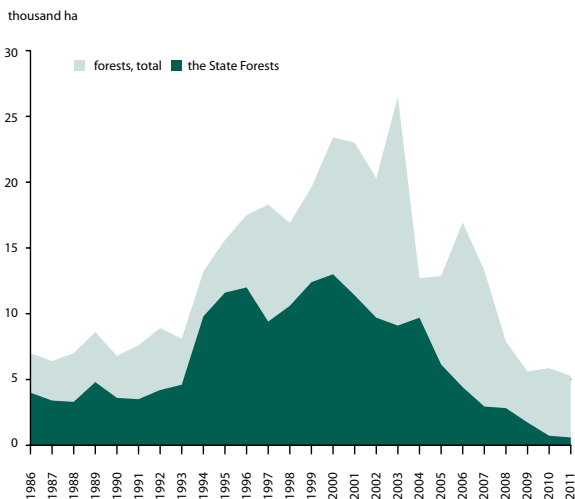


Fig. 13. The scale of afforestation in Poland in the years 1986–2011 (Central Statistical Office)

7. Structure of timber resources by volume

According to the Large-Scale Forest Inventory, timber resources in the forests under all forms of ownership in the years 2007–2011 amounted to 2372 million m³ of gross merchantable timber, including 1886 million m³ in the State Forests and 368 million m³ in private forests. The latest available figure (1 January 2011) puts the timber resources in the forests managed by the State Forests at 1772 million m³ of gross merchantable timber. According to the Forest Management and Geodesy Bureau, the timber resources (as of 1 January 1999) in private and commune-owned forests stood at 188.6 million m³ of gross merchantable timber. The estimate of the timber resources under the management of the State Forests and under other forms of ownership, as of 1 January 2008, stands at 1914 million m³ of gross merchantable timber.

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

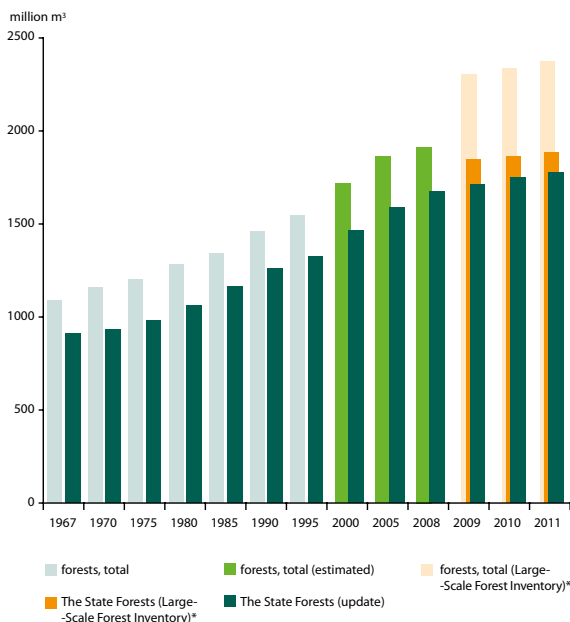


Fig. 14. Timber resources in Poland's forests in 1967–2011, in millions m³ of gross merchantable timber (Central Statistical Office, Forest Management and Geodesy Bureau, Large-Scale Forest Inventory)

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

Stands in the age class 41–80 years account for more than 50.4% of timber resources within the State Forests and nearly 70% in forests in private ownership. The volume of stands older than 100 years (including classes KO, KDO and BP) accounts for 18% of all resources within the State Forests and 3.6% in private forests.

Pine accounts for 61.9% of volume of timber resources in all categories of forest ownership, 64.3% in the State Forests and 57.7% in private forests.

According to the forest area and timber resources update of 1 January 2011, 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 the forests managed by the State Forests in relation to the total forest area was 267 m³/ha, while in private and commune-owned forests it was 223 m³/ha.

Polish forests are ranked among the European leaders 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, without the Russian Federation – 155 m³/ha).

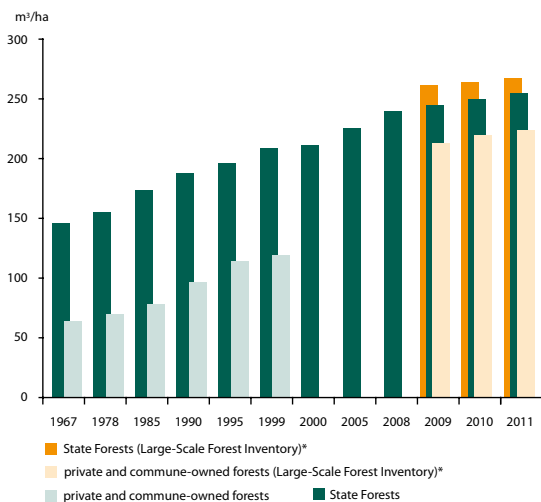


Fig. 15. Average standing volume in Poland's forests, 1967–2011, in m³/ha of gross merchantable timber (Central Statistical Office, Forest Management and Geodesy Bureau, Large-Scale Forest Inventory)

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

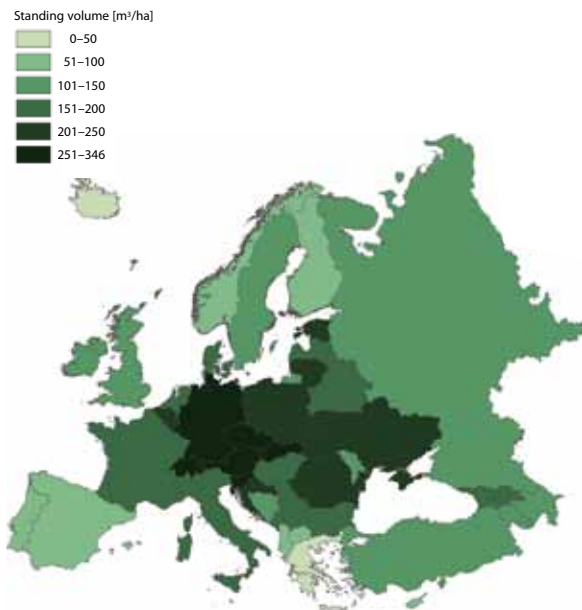


Fig.16. Standing volume in selected countries (SoEF 2011)

Poland, with a relatively large absolute area of forests and 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).

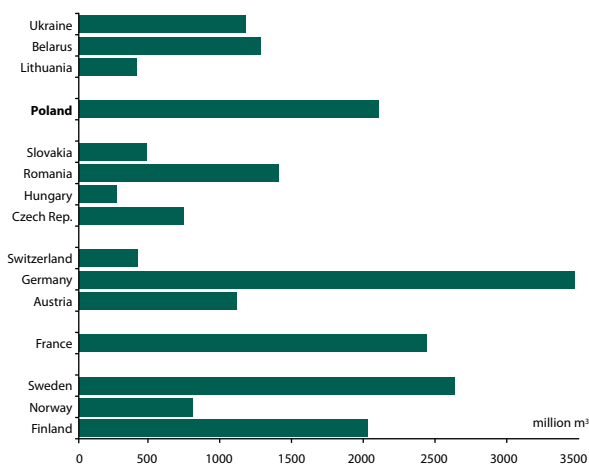


Fig. 17. Timber resources available for utilization in selected countries (SoEF 2011)
 * no data with regard to availability for utilization, figures show the general level of timber resources

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 data collected by the State Forests for forests under their management.

The increment in the last 20 years, from January 1991 to January 2011, amounted to about 1088 million m³ of gross merchantable timber. During that period, 606 million m³ of merchantable timber was harvested, which means that 482 million m³ of gross merchantable timber, representing 44% of total increment, remained to augment the standing timber resources in the State Forests.

The recorded changes in the growth of timber resources over several decades are shown in the diagram depicting changes in volume increment of merchantable timber for all age classes (Fig. 18). The volume of stands aged 41–60 years (age class III) and

older has significantly increased. The volume of stands aged 1–20 is negligible and the decrease of volume in the age classes 1–40 is caused by significant changes in the area of these two classes.

The steady increase in standing volume (volume per hectare) is evident in all age classes (except KO/KDO).

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

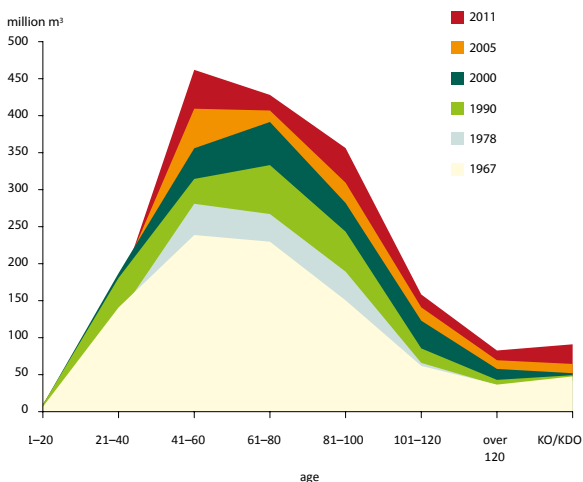


Fig. 18. Changes in timber resources in the State Forests by age class (Forest Management and Geodesy Bureau)

Forest functions

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

- **Ecological (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 steppization;
- **Social functions:** providing health-improving 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. Ecological functions of forests

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

Ecological 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 31 December 2011, amounted to 3372 thousand hectares, which represents 47.7% of the total forest area, or 49.0% including nature reserves (Fig. 19). The majority of protective forests are located in the mountain regions and in the areas affected by industry.

The area of private forests recognised as protective is estimated at 64.3 thousand hectares, or 4.3% of their total area. Protective forests owned by communes cover an area of 24.6 thousand hectares (28.7%). The share of protective forests in all ownership categories in the total forest area in Poland currently stands at 38.7%.

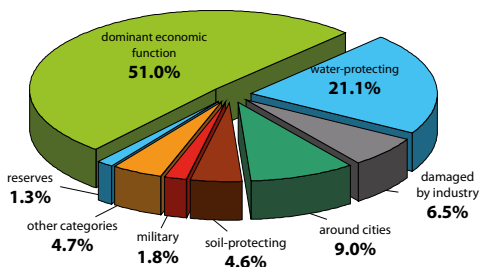


Fig. 19. Share of protective forests in the State Forests in 2011 (Directorate-General of the State Forests)

In comparison with other countries in the region, Poland has a relatively high proportion of protective forests (almost 30%, excluding social functions). 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* (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.

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 the land utilization) is estimated at 51.9 million tonnes, which roughly equals 14.2 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 organized by schools, which give youngsters the opportunity for direct contact with nature.

Health-enhancing properties of forest ecosystems encourage development of tourism and recreation, primarily in the areas designated as health resorts. Healing properties of certain tree communities, such as hornbeam, mixed coniferous, pine, oak woods and even poplar and willow riparian forests, are known to stimulate the cardio-respiratory system. Forests also 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.

The 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 are an excellent ground for implementing and pursuing the principles of management planning which integrate goals such as general nature protection, support for the environment-shaping function of forests, sustainable utilisation of forest resources, economic stabilisation of forest management and participatory management of forests as public resource. Their main aim, however, is to provide educational programmes promoting ecological and multifunctional forest management and give the opportunity for direct contact with foresters to society as a whole and particularly to children and young people.

In order to achieve this aim the PFCs have developed a sizeable educational and tourist infrastructure, which is usually available to the public free of charge. It comprises: environmental education centres (24), nature exhibition rooms (56), teaching shelters for use as "green classes" (73), educational trails (150), education points (316), dendrology parks and gardens (18), 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 1211 thousand hectares of which 1190 thousand hectares are located in areas administered by the State Forests, which accounts for nearly 16.7% of their territory. Six new PFCs were created in the late 2011 and two existing ones were enlarged.

Nature and forest education in all organizational units of the State Forests is based on *The Programme for Forest Education of Society in Forest Districts*, in force since 1 January 2004, which helps in planning and targeting educational activities.

The Forest Culture Centre in Gołuchów plays a special role in providing forest education. Many educational and cultural events initiated by the Centre, such as the national story-telling competition "Tales from the Forest Clearing", the national amateur art competition for foresters, the educational festival "Meeting with Forest" and the "Earth Day" festival have become permanent items in the educational calendar of Poland. In 2011 alone, nearly 170 thousand people, mainly children and youngsters, participated in educational events, such as art and photographic competitions and various exhibitions.

A popular form of forest and nature education is the educational 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. The money is used to create new educational centres, for training, purchase of

educational materials and for publishing information and literature.

The State Forests, including the PFCs, at present offers the following facilities to the visitors: 50 education centres, 246 forest exhibition rooms, 509 teaching shelters and "green classes", 935 educational trails, 1681 educational points and 3142 other facilities.

The State Forests also offers a wide range of tourist facilities which are available to visitors of any age and social group. There are nearly 4.5 thousand beds available in recreation and training centres and in foresters' and hunters' lodges. They provide a welcome rest after a day of walking, cycling or horse riding. 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 almost 100 sports facilities and 650 other facilities.

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 raw timber and other goods which can be utilized by man and which create industries, trades and contribute to traditions and cultures.

The volume of net merchantable timber harvested in Poland in 2011 amounted to 34 877 thousand m³, including 1633 thousand m³ from private forests and 180 thousand m³ from national parks.

The State Forests harvested 35 075 thousand m³ of raw timber, including 32 789 thousand m³ of net merchantable timber (or 101.2% of the approximate prescribed cut) of which 15 703 thousand m³ (93.9% of prescribed cut) was obtained from final felling and 17 086 thousand m³ (109.1% of prescribed cut) from intermediate felling.

The volume harvested in sanitation felling, eg. deadwood resulting from natural processes or wind disturbances (windbreaks and windthrows), outbreaks of insect pests, disturbances in water relations, air pollution and weather anomalies, amounted in 2011 to 5445 thousand m³, or 16.6% of the total harvest of merchantable timber, and was the lowest in the last decade.

In 2011, under the clear-cut system, almost 5.9 million m³ of merchantable timber was harvested, which accounts for 18.0% of total harvest. The clear-felling area totalled 26.7 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 26.9 thousand hectares (Fig. 21). The reduction in the size of the clear-felling area is indicative of the progress in the 'ecologization' of forest management. The use of

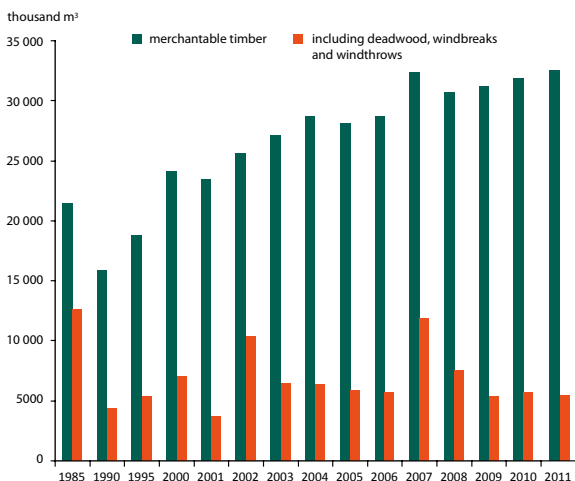


Fig. 20. Share of deadwood, windbreaks and windthrows in the total utilisation in the State Forests in 1985–2011, in thousand m³ of net merchantable timber (Directorate-General of the State Forests)

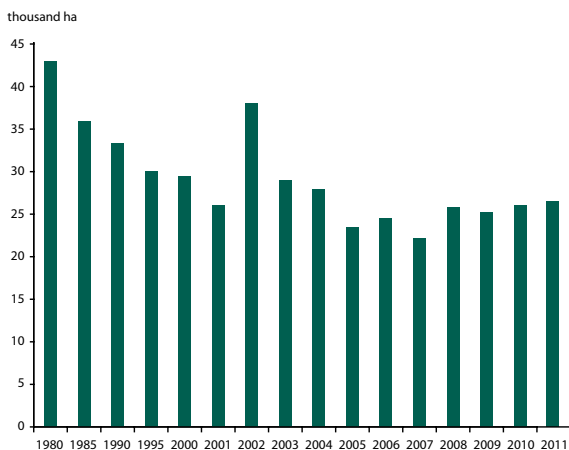


Fig. 21. Area of clear-cuts in the State Forests in the years 1980–2011, in thousand ha (Directorate-General of the State Forests)

clear-cuts is often necessitated by large-scale damage to forests caused by wind, drought, fungal infection or insect outbreak.

A comparison of several years' data on timber harvest points to a relative stability of the forest utilisation process (Table 3). Over the last five years the volume of timber harvest in the State Forests expressed in net merchantable timber per hectare of forest

area was around 4.5 m³/ha (in 2007 – 4.58 m³/ha, in 2010 – 4.51 m³/ha, in 2011 – 4.63 m³/ha) and did not exceed the allowable amount of cut.

Table 3. Harvest of net merchantable timber from forests in different forms of ownership, 1980–2011

Years	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	1293	0.83
1985	21 435	3.16	164	2.75	1173	0.79
1990	15 906	2.34	103	1.23	1345	0.91
1995	18 774	2.73	200	1.71	1470	0.98
2000	24 097	3.47	231	1.77	1432	0.94
2001	23 471	3.37	172	1.31	1153	0.75
2002	25 595	3.66	192	1.47	1111	0.72
2003	27 134	3.87	209	1.61	1157	0.74
2004	28 699	4.08	196	1.49	1268	0.81
2005	28 164	4.00	198	1.72	1124	0.71
2006	28 700	4.07	200	1.41	1099	0.68
2007	32 313	4.58	234	1.60	1349	0.84
2008	30 695	4.35	216	1.53	1248	0.82
2009	31 188	4.40	192	1.48	1090	0.66
2010	31 882	4.51	201	1.43	1244	0.74
2011	32 789	4.63	180	1.30	1633	0.97

^{a)} estimated data prior to 1997

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

Source: Central Statistical Office, DGSF

A comparison of 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 timber increment volume and the harvested volume *per annum* in a one-hectare area in 2010. As in Poland, the majority of the countries in the region harvest over 50% of the increment (60% in Poland), with the exception of Ukraine (33%) and Belarus (47%).

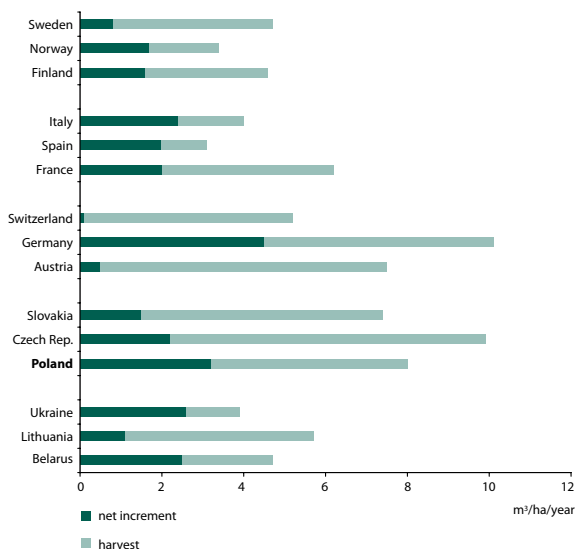


Fig. 22. Share of harvest in annual increment (SoEF 2011)

4. Forests in nature and landscape conservation

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

The highest level of protection is given to national parks, which currently number 23 and cover an area of 314.6 thousand hectares, of which 194.9 thousand hectares (62.0%) are forests (Central Statistical Office – status as of 31 December 2011) (Table 4).

According to the Central Statistical Office data, the 1469 nature reserves cover the area of 164.5 thousand hectares, of which 91.1 thousand hectares is forest land (including 40.4 thousand hectares in non-forest reserves).

121 landscape parks have been created by order of provincial governors; they cover a total area of 2607.7 thousand hectares, including 1308.3 thousand hectares (50.2%) of forests. The areas of protected landscape include 386 nature sites with a total area of 7078.1 thousand hectares, of which 2223.9 thousand hectares (31.5%) are forests (Central Statistical Office, data as of 31 December 2011).

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 and includes the data from Forest Districts.

Table 4. Forms of nature and landscape conservation in Poland

Year	National parks			Nature reserves			Landscape parks			Areas of protected landscape		
	number	total	forest area	number	total	forest area	number	total	forest area	number	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	2603.3	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	314.5	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^{a)}	121	2607.7	1308.3	386	7078.1	2223.9

^{a)} Area of forest in forest reserves – 50 700 ha, area of forest in non-forest reserves – 40 300 ha

Source: Central Statistical Office, status as of 31.12.2011

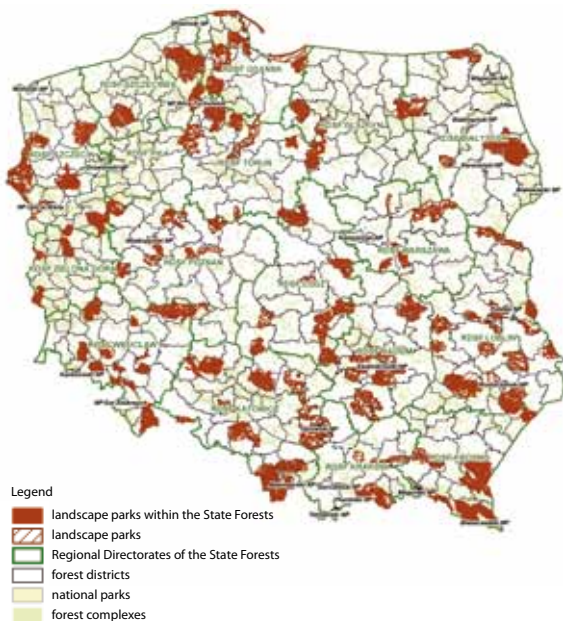


Fig. 23. National and landscape parks in Poland (Directorate General of the State Forests)

As of 31 December 2011, the State Forests inventory included:

- 1 255 nature reserves with an area of 124 thousand hectares, of which more than half are forest reserves (696) covering 61.7 thousand hectares;
- 11 498 natural monuments, including 8 831 single trees, 1551 groups of trees, 182 tree avenues, 476 erratic boulders, 226 rocks and caves, 232 areas under monument protection (356 hectares);
- 9 262 areas of ecological utility with a total area of 29 485 hectares;
- 370 documentation sites with a total area of 1630 hectares;
- 130 nature-and-landscape complexes with a total area of 46 837 hectares.

Additionally, 3091 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 149 042 hectares, of which the largest area (31 145 hectares) is designated for all year protection of birds.

The State Forests also maintains over 212 474 hectares of stands designated as the seed base (of which 15 740 hectares are selected seed stands and 192 496 hectares are economic seed stands) and 4238 hectares of gene reserve stands and plantations. This allows propagation of the native ecotypes of forest-forming species in our forests. Six of the 33 botanical gardens in Poland are also managed by the State Forests.

Table 5. Occurrence of most important game animals in Poland

Year	Elk	Fallow deer Individuals	Mouflon	Red deer	Roe deer	Wild boar	Fox	Hare	Pheasant	Partridge
							In '000 individuals			
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
2011/2010%	117.6	113.7	98.6	108.0	101.0	107.2	106.9	106.8	99.0	85.0
2011 : 1990%	170.1	661.3	609.2	267.8	206.3	314.7	350.2	41.0	73.9	37.8

Note: estimates based on the status of spring populations
Source: Central Statistical Office

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 5). The number of most ungulates (elk, red deer, fallow deer) remains at a high level and in some cases has even increased, posing a threat to forests. Only populations of hare, pheasant and partridge have decreased and are now, respectively, at 41%, 74% and 38% of their sizes recorded in 1980.

Natura 2000 network

The aim of the European network of protected areas Natura 2000 is to prevent the extinction of endangered plant and animal species and to protect the biological diversity in Europe. All member states of the European Union are obliged to implement the network. The legal basis for the implementation are two EU directives: *Birds Directive* and *Habitats Directive*. Both were incorporated into the Polish legislation as one of the forms of nature protection by the *Nature Protection Act* of 16 April 2004.

The Natura 2000 network comprises two types of protection areas:

- Special Protection Areas (SPAs) designated for the conservation of wild birds populations;

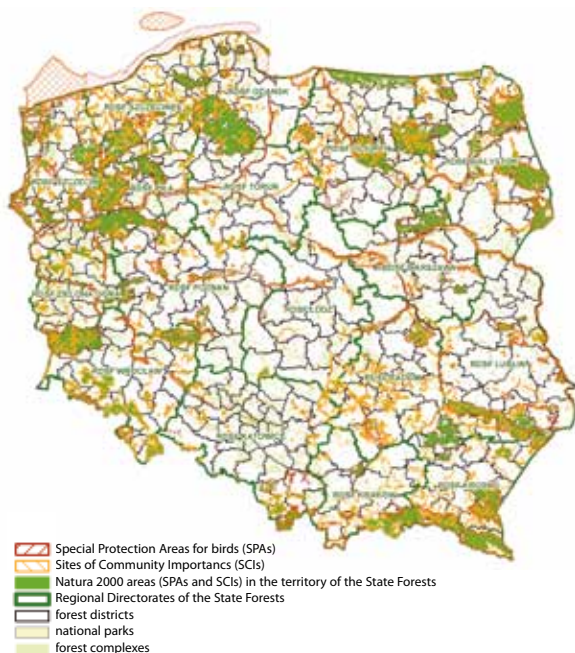


Fig. 24. Natura 2000 areas under the management of the State Forests (Directorate-General of the State Forests)

- Sites of Community Importance (SCIs) for protection of natural habitats and rare flora and fauna species.

In Poland, by the end of 2011, 144 Special Protection Areas covering 5571 thousand hectares, and 823 Sites of Community Importance covering 3792 thousand hectares were established (General Directorate for Environmental Protection). Together, these areas cover nearly 20% of the country's land area.

Natura 2000 areas account for 40% of the total area under the management of the State Forests. This means that the foresters are charged with the responsibility for the condition of habitats and species populations. At present, within the State Forests, there are 124 Special Protection Areas for Birds covering 2207 thousand hectares (31.2% of the forest area) and 662 Sites of Community Importance covering 1623 thousand hectares (22.9%).

5. Promoting sustainable forestry

The United Nations declared 2011 as the International Year of Forests (resolution 61/193/2006). Its motto was "Forests for the people" and it was intended to increase social awareness of how important forests are for our lives and how necessary they are for the survival and wellbeing of people in the whole world.

The State Forests in Poland were actively involved in promoting forests and sustainable forestry. Five themes based on the UN motif were used to promote the important role forests play in human life: "More forests in Poland", "Forests in Poland are for everyone", "Forests protect lives", "Forests as employer and business partner", "Wood as sustainable resource".

The promotional campaign during the International Year of Forests was co-ordinated by the State Forests Information Centre with the active participation of all units within the State Forests and other organizations. Many special events took place across the country throughout the year.

A large part of the State Forest Information Centre's activity is publishing professional and promotional literature, amounting to several dozen book publications annually and several periodicals. In 2011 the publishing plan included the leading ideas of the International Year of Forests and most educational and promotional publications carried its logo.

The Information Centre also engages the media in its promotional work. In 2011 there were numerous TV broadcasts promoting forests, natural world and forestry on the main TV channels and several programmes on the Polish Radio. The Centre also ensured that foresters appeared on regular radio and TV programmes to raise the State Forests' profile.

The Information Centre maintains or sponsors several internet sites, which are the most used source of information about the State Forests. In 2011 they were visited by almost 3.7 million users.

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 damaging influence on the health of forests. The negative phenomena, often called stress factors, can be classified with respect to their origin as abiotic, biotic and anthropogenic.

1. Abiotic threats

In 2011 (October 2010 – September 2011), damage caused by abiotic factors to the forests managed by the State Forests was reported on 104.6 thousand hectares of stands over the age of 20 years. Almost 52 thousand hectares of stands were damaged by wind, nearly 40 thousand hectares by groundwater level fluctuations, 5.5 thousand hectares by snowfall, 1.9 thousand hectares by pollutants and 5.2 thousand hectares by low or high temperatures.

Fig. 25 illustrates the distribution of damage to forests caused by abiotic factors in the period 2007–2011. 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 the random occurrence of other factors.

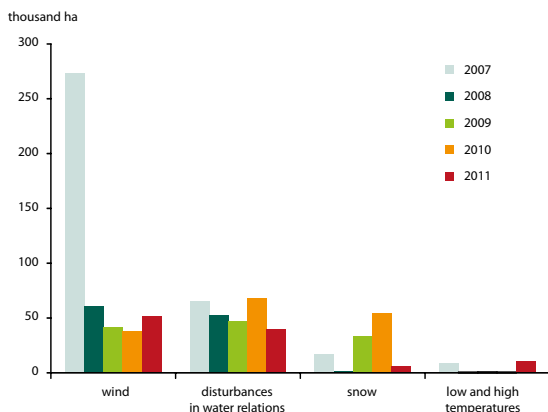


Fig. 25. Area of distribution of forest damage in the State Forests in 2007–2011 caused by abiotic factors

2. Biotic threats

Poland is in the group of countries in which unfavourable phenomena in forests, such as mass outbreaks of insect pests or infectious fungal diseases, occur with large variety and high intensity.

Threats to forests posed by insects

The geographical distribution of damage to forest stands by insect pests (Fig. 26) shows that most threatened are the stands in northern Poland (western part of the Mazury Lakeland), in the north-west (Pomorze and Wielkopolska Lakelands) and in three southern regions (the Sudety Mountains, Śląsk Opolski and the Beskid Wysoki Mountains). The severe threat to forests in southern Poland is almost solely attributed to secondary pests, while in other regions it is associated with activity of primary pests (mainly nun moth).

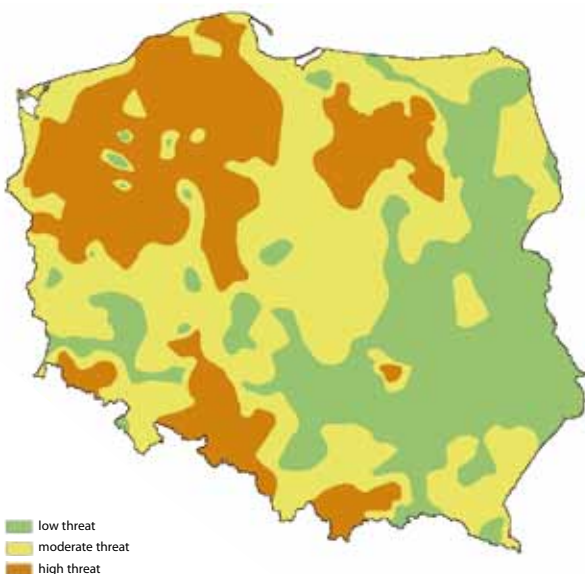


Fig. 26. Danger zones of threatened activity of both primary and secondary insect pests in Poland (Forest Research Institute)

The activity of insect pests in 2011 increased by nearly 180%, in comparison with the previous year. The control treatment aimed to reduce the populations of about 50 insect species covered an

overall area of almost 128.2 thousand hectares, which is almost 114 thousand hectares more than in 2010.

- Chemical treatment against folivorous insects was carried out on 70.6 thousand hectares of pine stands, an increase by 70.2 thousand hectares in comparison with 2010.
- Chemical treatment against folivorous insects covered nearly 45.3 thousand hectares of broadleaved stands, an increase by 42.9 thousand hectares in comparison with 2010.
- The total area of pine plantations and young stands subjected to pest control treatment was 11.5 thousand hectares, an increase of 3.2 thousand hectares in comparison with 2010.
- The total area of spruce and larch stands subjected to control treatment against insect pests was 486 hectares and was almost five times smaller than in 2010.
- Salvation measures taken against root pests of forest trees and shrubs were applied to plantations and nurseries in areas of 240 hectares.
- Of the major folivorous pests, pine sawflies were controlled on the largest area of 55 378 hectares, cockchafers imagines on 44 894 hectares, nun moth on 8640 hectares, pine lappet moth on 4915 hectares and pine webworm (*Acantholyda nemoralis* L.) on 1703 hectares (Fig. 27).

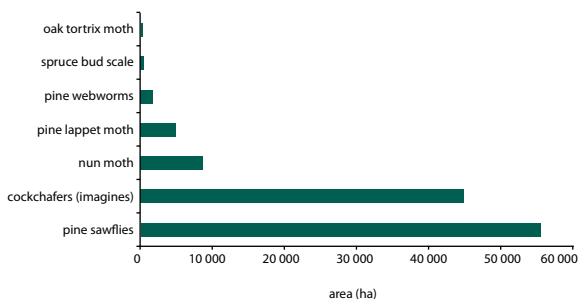


Fig. 27. Area of stands subjected to protective treatment against major folivorous insect pests in 2011

Threats to forests posed by infectious fungal diseases

In 2011 infectious diseases were reported over a total area of 401.28 thousand hectares of stands, an increase by nearly 17.2 thousand hectares (or 4.5%) as compared with 2010. The most important change in the level of threat concerns the outbreak of pine shoot dieback which was reported on the total area of 38.5 thousand hectares. Compared with 2010, the affected area was 37 times larger and 96% of damage was located in the Toruń RDSF.

There was a threefold increase in the area affected by pine needle cast but other diseases of assimilatory apparatus (pine

twisting rust, oak mildew, rust) were reported on smaller areas than in 2010 (respectively by 50%, 21% and 54%).

The improvement in health condition of broadleaved stands continued. Areas affected by dieback of oak, beech, birch and ash decreased by, respectively, 50%, 22%, 20% and 3%. Poplar diseases taken together (cankers and tree dieback) decreased by 42%. Only alder dieback increased slightly, affecting an area larger by 190 hectares than in the previous year.

A decrease was also noted in the area of forests affected by pine gall rust and stem and trunk diseases (by 20% and 6% respectively). Generally, the occurrence of root rot diseases was reported in an area smaller by 9.5 thousand hectares. The area of stands affected by the *Armillaria* root rot decreased by nearly 3% and by *Heterobasidion* root rot by over 4% (Fig. 28).

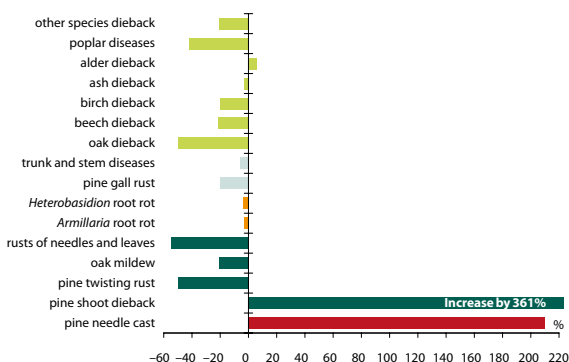


Fig. 28. Changes in areas affected by infectious diseases in 2011 in comparison with 2010 (%)

Damage caused by animals

In the 2010/2011 season damage to trees in restocked forest areas occurred on 183 thousand hectares in total, including 78 thousand hectares of plantations, 75 thousand hectares of young stands and 30 thousand hectares of stands in older age classes. The area of stands damaged by deer browsing or bark stripping increased by 13 thousand hectares in comparison with 2010.

Data on the population dynamics of the main perpetrators (ungulates) clearly show a steady growth in spite of a relatively higher harvest level than in 2010. In the 2010/2011 hunting season, as in the previous season, no elk was harvested as a hunting moratorium imposed on this species in 2000 is still in force.

3. Anthropogenic threats

Forest fires

There were 9220 forest fires in 2011 (compared to 4680 in 2010). The burnt area covered 2850 hectares of stands, which is a 34% increase on the previous year. The largest number of fire events took place in the Mazowieckie Province (17% of the total number), the lowest – in the Warmińsko-Mazurskie and Podlaskie Provinces (Fig. 29).

In 2011, there were 3007 forest fires within the State Forests (33% of all forest fires in Poland), which covered an area of 580 hectares (20% of the total). The largest number of forest fires occurred within the Regional Directorates of Zielona Góra (429), Katowice (397) and Szczecin (367). The largest burnt area (132 hectares, or 23% of all fire areas within the State Forests) was reported in the Katowice Regional Directorate. As in 2010, there were no large fires (covering more than 10 hectares) in the territory of the State Forests although 10 occurred elsewhere in the country.

The average area of a single fire in forests under all ownership categories decreased by 0.14 hectare, as compared with 2010, and was 0.31 hectare. In the State Forests the average area of fire was 0.19 hectare and in other forests 0.37 hectare.



Fig. 29. Number of forest fires and the burnt area by province in 2011 (Forest Research Institute)

Table 6. Forest fires in Poland in 2001–2011

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	21 501	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	9 220	3 007	2 850	580	0.31	0.19	0.37	32.61	20.35

The most frequent causes of fires in the State Forests were arson (43%) and careless adults (24%). Nearly 3% of fires spread from areas other than forests (5.2% of burnt forest area). The number of fires of unknown origin (22% of all fires and 22% of burnt forest area) is still high. The corresponding figures for forests under all ownership categories were: 43% fires caused by arson, 33% caused by careless adults and 16% of unknown causes.

The largest number of fires occurred in April (2348 fires, or 25.5% of all fires) followed by May (22%) and June (21%). The months with the smallest number of recorded fires were July and August (2% each).

Air pollution

The Central Statistical Office estimates that the total emission of major air pollutants in Poland in 2009 amounted to over 860 thousand tonnes of sulphur dioxide and 820 thousand tonnes of nitrogen dioxide, which is 57% and 98%, respectively, of emissions recorded in 2000 (Fig. 30). Among the EU countries, Poland has one of the higher levels (in absolute values) of the total emission of main air pollutants.

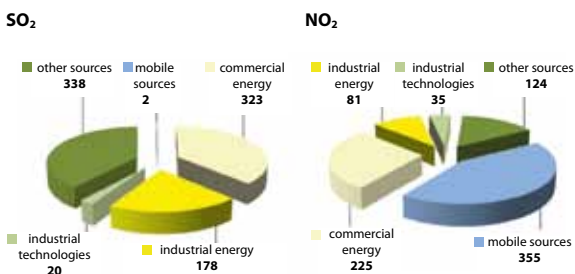


Fig. 30. Total emissions of sulphur dioxide and nitrogen oxides (calculated as NO₂) by sources of pollution in 2009, in thousand tonnes (Central Statistical Office)

While the downward trends in the levels of emission of some pollutants (sulphur dioxide, ammonia and dust) are observed over a period of several years, other gas pollutants, such as nitrogen oxides, still enter the atmosphere at levels of emission essentially unchanged in the last decade (Fig. 31).

The forest monitoring network provides information on major pollutants in forests in different regions of Poland. Data collection on main air pollutants, sulphur and nitrogen oxides, is based on monthly measurements using the passive method. In 2011, measuring of concentrations of ammonia and ozone in the air was abandoned and the methodology of passive measurements of SO₂ and NO₂ was altered.

The intensive monitoring network consists of 12 permanent observation plots (POPs), five of which are located in pine forests

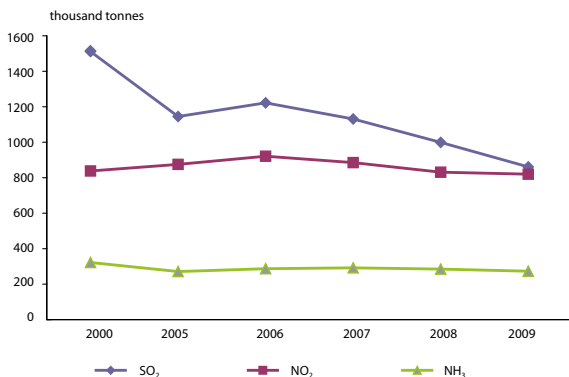


Fig. 31. Total emission of SO₂, NO_x (calculated as NO₂) and NH₃ in Poland, in thousand tonnes, in 2000–2009 (Central Statistical Office)

in the following Forest Districts: Chojnów (Warszawa RDSF), Strzałowo (Olsztyn RDSF), Białowieża (Białystok RDSF), Krucz (Piła RDSF) and Zawadzkie (Katowice RDSF). Three POPs are located in the spruce stands in the Suwałki (Białystok RDSF), Bielsko (Katowice RDSF) and Szklarska Poręba (Wrocław RDSF) Forest Districts, two – in the oak stands in the Łąck (Łódź RDSF) and Krotoszyn (Poznań RDSF) Forest Districts and another two – in the beech stands in the Gdańsk (Gdańsk RDSF) and Bircza (Krosno RDSF) Forest Districts.

Average monthly concentration of sulphur dioxide and nitrogen dioxide in the air measured on the observation plots were within 0.1–10 µg·m⁻³ SO₂ and 2.0–23 µg·m⁻³ NO₂ (Fig. 32).

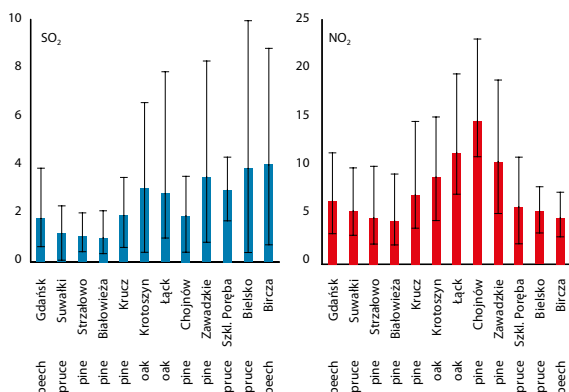


Fig. 32. Annual average and monthly minimal and maximal values of concentration (µg·m⁻³) of sulphur dioxides and nitrogen dioxide in the air, measured on intensive monitoring permanent observation plots in 2011.

The chemical composition of the air changed with the seasons: the highest concentration of SO₂ and NO₂ was observed in winter months, particularly in January, February, November and December, which coincides with the heating season and therefore increased emissions.

The atmosphere is cleared of pollutants through precipitation (rain, snow, drizzle, mist, etc.). Acid precipitation is defined by pH value of less than 5.6. More than half of the monthly precipitation recorded on the permanent observation plots in 2011, as in 2010, had a pH below 5.5.

The average monthly pH values of precipitation reaching tree crowns oscillated between 4.2 and 7.0 and between 3.9 and 7.1 for under-crown precipitation.

The highest annual level of acid precipitation occurred in the southern regions in Szklarska Poręba, Bircza, Bielsko and Zawadzkie Forest Districts. The lowest average annual level was recorded in the north and east of Poland in Suwałki, Strzałowo, Białowieża i Gdańsk Forest Districts.

Deposition of heavy metals, *i.e.* zinc, copper, lead and cadmium (with the quantitative prevalence of zinc) ranged from 223 to 770 g·ha⁻¹·year⁻¹, which is at a slightly lower level than in 2010. The highest level of heavy metal deposition occurred on two spruce mountain plots in the Szklarska Poręba and Bielsko Forest Districts.

4. Threats to forest sustainability

Dieback of stands in the Sudety and Beskidy mountains

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 were completely removed from the State Forests land and over 4 million m³ of deadwood was harvested. The dieback process 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 restocked.

The ecological disaster in the Sudety Mountains prompted the establishment of an institution which would oversee the conservation of endangered ecosystems in Poland. Its remit was developed as a result of cooperation between the representatives

of the State Forests and of 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, like the Izerskie Mountains, were severely 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 is the *Programme for the Beskid Mountains* which was developed and implemented as part of the regional operational plan in 2003. The document outlines a protective and silvicultural treatment strategy for the Beskid forests and recommends reconstruction of stands to improve their condition. Implementation of this programme resulted in nearly 3000 hectares of spruce stands being subject to conversion.

Despite all the preventive measures, the tree dieback continued in the period 2006–2008, resulting in stand decline in the Beskid forests. As in the Sudety Mountains, a combination of harmful factors was to blame. The situation was being made worse by the fact that a high proportion of forests in that region are privately-owned and the owners can be reluctant to carry out the required level of sanitation treatment.

Favourable weather conditions in the growing season of 2009 have contributed to the improvement in the health condition of the Beskid forests and the reduction of the rate of spruce stand decline. The harvest of wood affected by secondary pests in the five Forest Districts of Beskid decreased from 805 thousand m³ in 2008 to 153 thousand m³ in 2011.

Dieback of broadleaves

Simultaneous occurrence of several stress factors is also regarded as the cause of high level of dieback of broadleaved trees in recent years. The cyclic recurrence of oak dieback, observed since the 1970s, has been attributed to extreme climate conditions, such as the very high or low temperatures, long-lasting droughts and changes in groundwater level. Recent scientific reports point to a significant role of fungi of the genus *Phytophthora* in the decline of broadleaved stands. In 2011, the phenomenon of oak dieback was observed on 10.2 thousand hectares, half of the area affected in 2010 and the smallest area since 2000 (Fig. 33).

Ash dieback has been observed in Poland for more than a decade. In 1999, the affected area amounted to about 2.3 thousand hectares. In 2008 the area of ash dieback exceeded 17 thousand hectares but from the following year a steady decrease was noted and in 2011 the affected area was the smallest since 2000 at 11.4 thousand hectares.

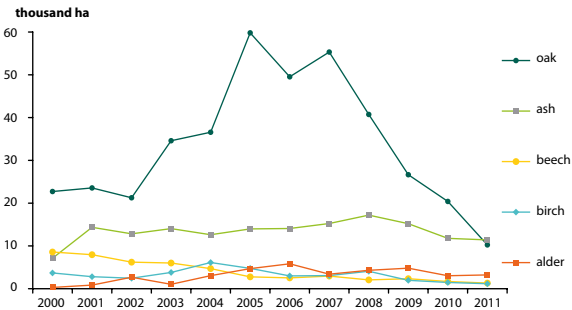


Fig. 33. Area of dieback of selected broadleaved tree species within the State Forests in the years 2000–2011

Recent years have seen a steady improvement in the situation of beech stands. In 2000, beech dieback was recorded in an area of 8.6 thousand hectares, while in 2011 – only on 1.3 thousand hectares.

The dieback of alder was for the first time reported in 1999 in an area of 31 thousand hectares. Currently, the area of threatened alder stands amounts to 3.2 thousand hectares.

In total, the phenomenon of tree dieback in 2011 was observed on 29 thousand hectares, a decrease of 28% on the previous year.

5. The 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.

In 2011, an assessment of defoliation covered 38 940 trees over the age of 20 years, which were located on 1947 Level I Permanent Observation Plots (20 trees on each plot).

Among the assessed trees, 14.0% showed no defoliation (defoliation class 0 – healthy trees), including 11.3% of conifers and 19.1% of broadleaves. The largest share of coniferous trees without any defoliation was reported for fir (23.2%), and the smallest – for pine (10.3%). The largest share of healthy broadleaved trees was reported for beech (35.5%) and the smallest – for oak (9.8%) (Fig. 34).

The share of damaged trees with defoliation over 25% (defoliation classes 2–4) was 24.0%; the share among conifers was 24.2% and among broadleaves 23.5%. The lowest share among the conifers had fir (16.3%) and the highest spruce (26.2%). Among the broadleaves beech had the lowest share (11.2%) and oak the highest (30.6%).

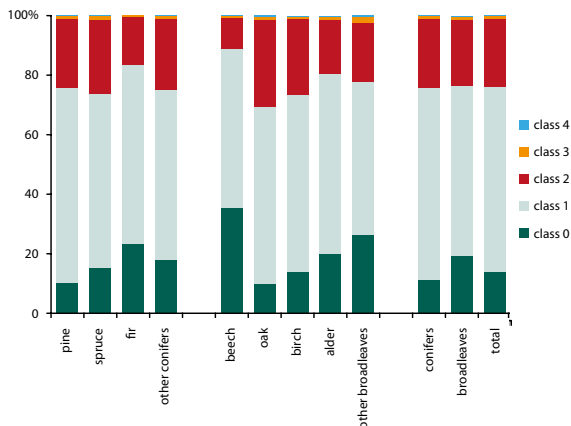


Fig. 34. Share of monitored tree species in defoliation classes on Permanent Observation Plots (Forest Monitoring) Level I in 2011, in stands aged over 20 years, in all ownership categories (Forest Research Institute)

In forests under the management of the State Forests the share of healthy trees (class 0), of all species was 14.5% and of damaged trees (classes 2–4) 22.3%. Forests in private ownership had smaller share of healthy trees (12.2%) and larger share of damaged trees (28.8%). In national parks the share of healthy trees was 15.7% and of damaged trees 28.9%.

A comparison of the level of damage to forests in Poland and in other European countries (Fig. 35) is based on the report *Forest Condition in Europe – 2012. Technical Report of ICP Forests* (UNECE, Hamburg 2012).

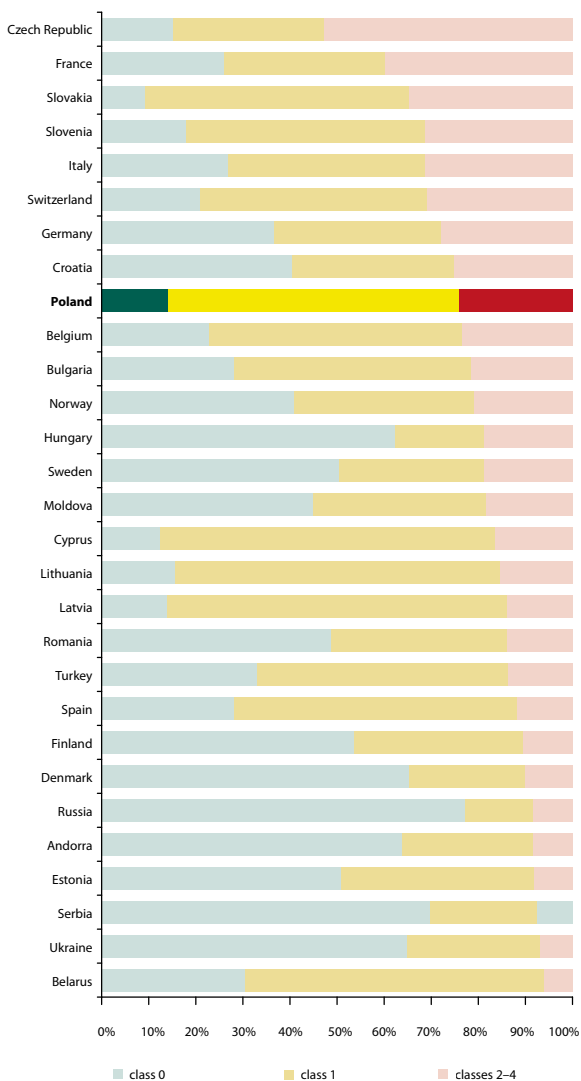


Fig. 35. Defoliation of stands in European countries in 2011, arranged in order of increasing share of trees in defoliation classes 2-4 (Forest Research Institute after UNECE, 2012)

- In our climatic and geographical zone, forests are the most natural formation. They are a crucial element of environmental balance, life continuity, environmental diversity and neutralisation of the contaminants which contribute to environmental degradation. Preservation of forests is the necessary condition for reducing soil erosion, preservation of water resources, regulation of water relations and protection of the landscape. 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 various 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 40.8%, while the share of protective forests – mainly the water-protecting ones, those around cities and those in areas damaged by industry – 38.7%. The areas of Natura 2000 network cover nearly 20% of the country's land area. Within the State Forests, Special Protection Areas for birds (SPAs) cover 2207 thousand hectares (31.2% of the State Forests territory) and Sites of Community Importance (SCIs) – 1623 thousand hectares (22.9%).
- Poland's timber resources have been steadily increasing. This is demonstrated by the increase of gross merchantable timber volume to 2.4 billion m³. 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. This is reflected in the volume of the growing stock which within the State Forests is 267 m³/ha (in private forests – 218 m³/ha), and the average stand age – 57 years (46 years in private forests).
- Utilisation of timber resources in the State Forests in 2011 was at a lower level than the volume increment, as it was in the past 20 years when harvest volume was about 56% of the increment.
- In 2011, the area of post-agricultural land and wasteland afforested under the *National Programme for the Augmentation of Forest Cover* decreased slightly in comparison with the previous year (5.3 thousand hectares in 2011 and 6.0 thousand hectares in 2010). The afforestation plans assume the increase in forest cover to 30% by 2020 and to 33% by 2050.
- Forests are a renewable source of timber. Utilisation of timber resources in recent years has been on a level below their natural potential, as defined by the forest sustainability and timber resource augmentation principles. In 2011, 34 877.3 thousand m³ of net merchantable timber was harvested in Poland, of which 32 789 thousand m³ came from the State Forests (101.1% of approximated annual cut). Significant share (16.6% and

5445 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-felling was limited to 26.7 thousand hectares and timber harvested from clear-felling to 5.9 million m³ of merchantable timber (18.0% of total harvest).

- Poland's forests are under constant threat from abiotic, biotic 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. The share of damaged trees (defoliation in excess of 25%, defoliation classes 2–4) increased by 3.0% to 24.0%.
- Poland is in the group of countries in which unfavourable phenomena in forests, such as mass outbreaks of insect pests, occur with large variety and high intensity. The activity of the most dangerous insect pests in 2011 increased by about 180% in comparison with the previous year. The increase of threat to stands was mainly due to an outbreak of cockchafer and the increase in populations of sawflies, nun moth and pine lappet moth. Control treatment to reduce the populations of about 50 insect species covered an area of 128.2 thousand hectares. Constant and persistent preventive action is necessary.
- Infectious fungal diseases were reported on a total area of 401 thousand hectares (384 thousand hectares in 2010), which is a 4.5% increase. For many years, root rot diseases (*Heterobasidion* and *Armillaria* spp.) have posed the major threat to forests, especially to those established on post-agricultural land. The area of stands affected by oak dieback decreased by half; beech and birch dieback occurred in areas smaller by 20% and there was no change in the health condition of stands containing ash and alder. There was a decrease in diseases of poplars and in trunk and stem diseases but a significant increase was noted in occurrence of pine shoot dieback (area affected was 37 times larger than in 2010) and of pine needle cast (area increase of 200%).
- Significant 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; for example, 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 volume to be harvested in the forest in a given year, as set out in a forest management plan. It is calculated as a sum of final and pre-final (intermediate) cuts for a 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 a given District must balance over a 10-year period during which the current forest management plan is in force.

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,
- ecosystem 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 stand structure in which there is simultaneous utilisation of the stand 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 were removed in one operation (final cut) and which is designated for reforestation within the period of two years.

Deadwood – trees dying or dead 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 allow to anticipate that seeds harvested from them will produce valuable progeny thus ensuring long-lasting production of timber of good 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.

Epiphytosis – epidemic (mass) appearance 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 felling (cutting) – 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.

Foliophages (folivorous species) – leaf-eating insects.

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) – a mass occurrence of insect pests as a consequence of ecological factors which are favourable to the given species.

Pathogens – factors causing diseases; primary pathogens attack living organisms while secondary pathogens attack already damaged trees.

pH – indicator of acidity level, e.g. of soil.

Pollutant emission – the gaseous pollutants and particles in the air which impact upon their surroundings, *i.e.* by reaching organisms and ecosystems and exerting an influence upon them.

Pre-final (pre-commercial, intermediate) felling (cutting)

– 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 promotion of sustainable forest management and protection of natural resources.

Protective forests – forests under special protection because of their functions or the degree of threat they face.

Reforestation (renewal, regeneration): 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.

Repellents – repelling substances used to protect young trees against damage from animals, insects, etc.

Restocking class (KO) – a type of vertical stand structure in which there is simultaneous utilisation of the stand and regeneration under the canopy of the parent stand, and in which the level of regeneration allows subsequent stages of tending to proceed.

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.

Soil absorbing capacity – the quantity of cations which can be absorbed by 100g of soil

Standing volume – the volume of all live trees in a given area (stand, province, country, etc.) with diameter (with bark) over 7 cm at breast height. The standing (growing) stock is often calculated per hectare.

Steppization – limiting of the conditions favourable to the development of forest, mainly through drying out, which allows the spread of steppe flora.

Thinning – cuts made in immature stands after they have passed through the cleaning period, during which economically undesirable trees are removed.

Timber resources – the total volume of trees in a forest, most often equated with an estimated volume of merchantable timber in stands.

Tree volume – the amount of wood expressed in cubic metres (m^3).

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

Windbreaks and windthrows (windfalls) – trees broken or brought down by wind or snow.

