

FORESTS IN POLAND 2011



Centrum Informacyjne
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Forests in Poland 2011

The *Forest Act* of 28 September 1991 places the State Forests National Forest Holding under an obligation to draw up annual reports on the condition of forests in Poland. This brochure is a shortened form of the *Annual Report on the Forest Condition in Poland for 2010* which is based on the materials obtained from the Ministry of 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 forests under all forms of ownership in 2010 against data from recent years and, where it was possible and justified, in the context of other countries whose natural conditions are comparable to Poland. These are: 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). They all represent different types of forestry as compared with the Central-European forest economy. The scope of the Report consists of three groups of issues: forest resources in Poland, functions served by 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 productivity with a market value. Forests are a public 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 40% of the territory within the Polish borders at that time, but this figure had fallen to just 20.8% by 1945. Deforestation and associated depletion of the stand species structure resulted in a decrease of biological diversity in forests, degradation of the landscape, soil erosion and disturbance of water balance. Reversal of this process came about in the period 1945–1970, when Poland's forest cover increased to 27% as a result of afforestation.

At present, the total area of forests in Poland is 9 121.3 thousand hectares (the Central Statistical Office (GUS) figure as of 31 December 2010). This is equivalent to 29.2% of the country's land area (Fig. 1).

Assessment using the internationally adopted standard which takes into account the land associated with forest management puts the forest area in Poland, as of 31 December

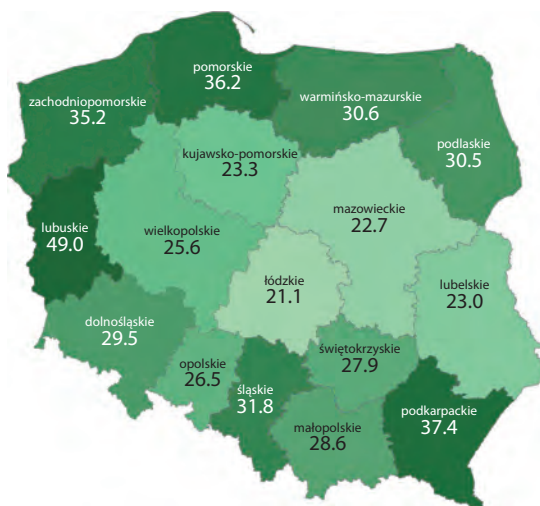


Fig. 1. Forest cover by province (Central Statistical Office)

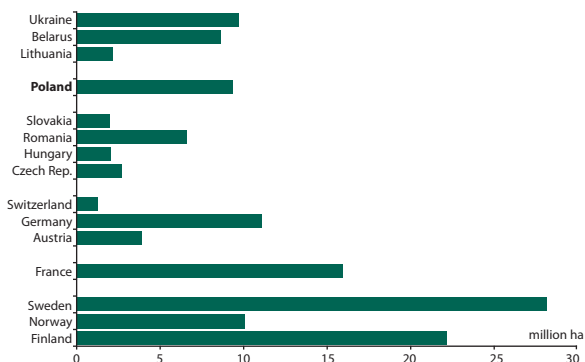


Fig. 2. Total forest area (FRA 2010)

2010, at 9.3 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).

The forest cover of the countries adopted for analysis (related to their land area excluding inland waters, as stipulated by the international standard) is much less varied than the absolute area of forest. Among the studied countries, a distinctly greater forest cover is found in those countries in which large areas of land are unsuitable for other land uses but forestry, for example marshy or mountainous areas (e.g. Scandinavian countries, Austria, Slovakia). Countries with forest cover smaller than that of Poland are Ukraine, Hungary and Romania and in Western Europe – France and Great Britain. At the end of 2010, Poland's

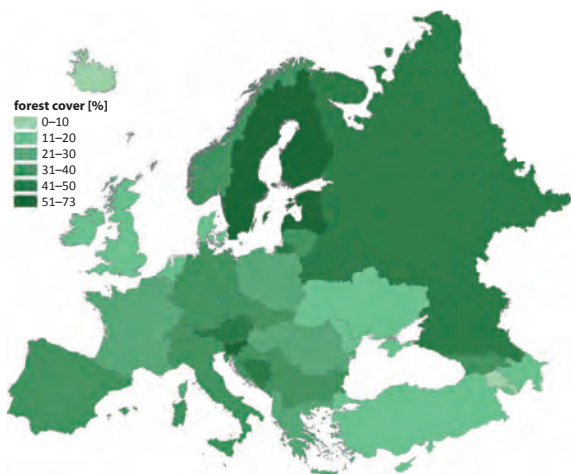


Fig. 3. Forest cover in European countries (FRA 2010)

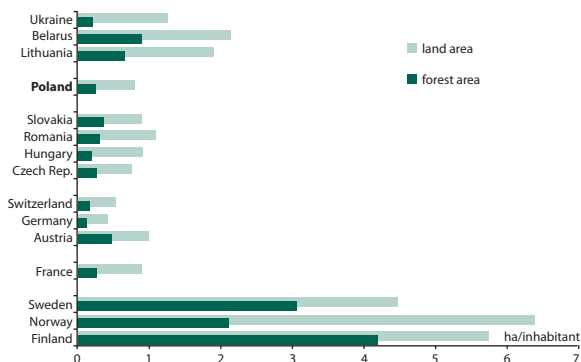


Fig. 4. Area of forests against the total land area per inhabitant (FRA 2010)

forest cover measured by the international standard amounted to 30.5% and was lower than the European average (34%, 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, 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. Ownership structure of forests

With regard to their ownership structure (Table 1), 81.5% of forests in Poland are publicly-owned, of which 77.5% are forests under the management of the State Forests (Fig. 5). The ownership structure of forests in the post-war period has remained almost unchanged.

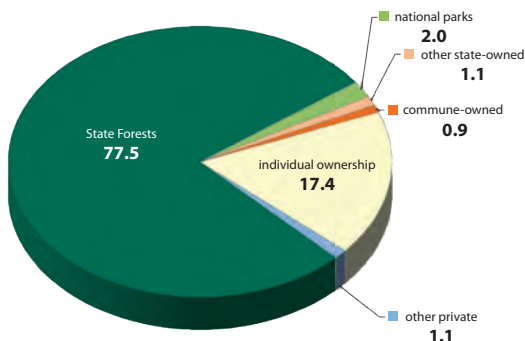


Fig. 5. Ownership structure of forests in Poland in % (Central Statistical Office)

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Table 1. Forest ownership structure in Poland

Type of ownership	31 December 1995		31 December 2000		December 2009		December 2010	
	'000s ha	%	'000s ha	tys. ha	'000s ha	%	'000s ha	%
Total	8756^{a)}	100.0	8865^{a)}	100.0	9 088^{a)}	100.0	9 121^{a)}	100.0
Publicly-owned forests	7262	82.9	7341	82.8	7 434	81.8	7 435	81.5
State Treasury-owned forests	7186	82.0	7262	81.9	7 350	80.9	7 351	80.6
including:								
administered by State Forests	6868 ^{b)}	78.4	6953 ^{b)}	78.4	7 068 ^{b)}	77.8	7 072 ^{b)}	77.5
national parks	162	1.9	181	2.0	184	2.0	184	2.0
other	156	1.7	128	1.4	98	1.1	95	1.1
Municipally-owned forests	76	0.9	79	0.9	84	0.9	84	0.9
Privately-owned forests	1494	17.1	1524	17.2	1 654	18.2	1 686	18.5
including:								
individual owners	1397	15.9	1428 ^{c)}	16.1	1 557 ^{c)}	17.1	1 587 ^{c)}	17.4
land cooperatives	68	0.8	69 ^{c)}	0.8	68 ^{c)}	0.7	67 ^{c)}	0.7
agricultural cooperatives	14	0.2	9 ^{c)}	0.1	6 ^{c)}	0.1	6 ^{c)}	0.1
other	15	0.2	18 ^{c)}	0.2	24 ^{c)}	0.3	26 ^{c)}	0.3

^{a)} plus land associated with forestry management: 1995 – 190 000 ha, 2000 – 194 000 ha, 2010 – 208 000 ha^{b)} plus land associated with forestry management: 1995 – 187 000 ha, 2000 – 189 000 ha, 2010 – 201 000 ha^{c)} including land associated with forestry management: 2000 – 200 000 ha, 2010 – 600 ha

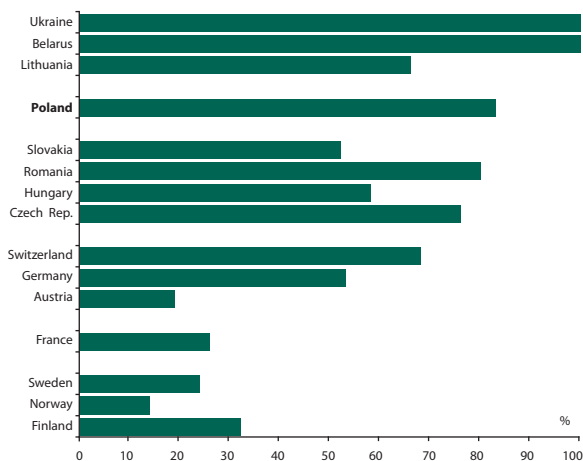


Fig. 6. Share of public forests in the total forest area (FRA 2010)

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 Russian Federation where almost 100% of forests are state-owned, 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.

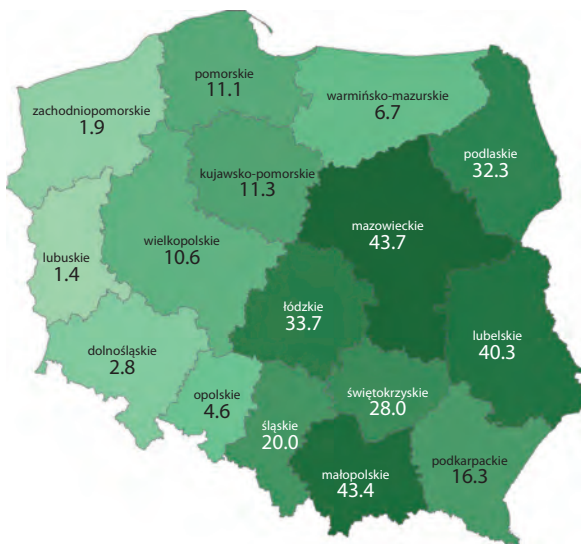


Fig. 7. Share of private forests in the total forest area by province (Central Statistical Office)

The share of privately-owned forests in Poland varies among the regions (Fig. 7) – the greatest is in the Mazowieckie Province – 43.7% of its total forest area (353,400 ha) and the lowest is in the Lubuskie Province – 1.4% (9,600 ha).

3. Habitat structure

Poland has retained forests mostly on the poorest soils, which is reflected in the structure of forest habitat types (Fig. 8). Coniferous forest habitats predominate, accounting for 52.1% of the total forest area, while broadleaved forest habitats account for 47.9%. In both groups, upland habitats occupy 5.5 % of the forest area and mountain habitats at 8.7%.

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>Oł</i> – alder forest |
| <i>BWG</i> – high-mountain coniferous forest | <i>Ołj</i> – alder-ash forest |
| <i>LG</i> – montane broadleaved forest | |

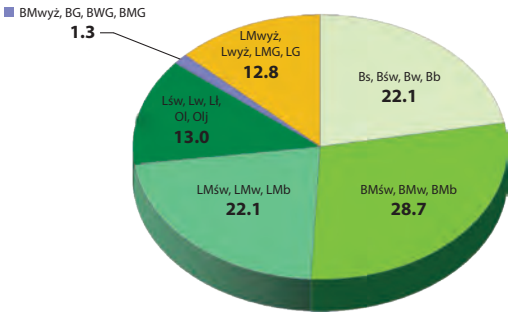


Fig. 8. Areal share (in %) of forest habitat types in the forests in all ownership categories (Large-Scale Forest Inventory)

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 stands with pine as the dominant species prevail.

Coniferous species dominate in Polish forests, accounting for 70.8% of the total forest area (Fig. 9, Table 2). 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 60.4% of the area of forests in all ownership categories, for 62.2% in the State Forests and for 57.7% in the privately-owned forests.

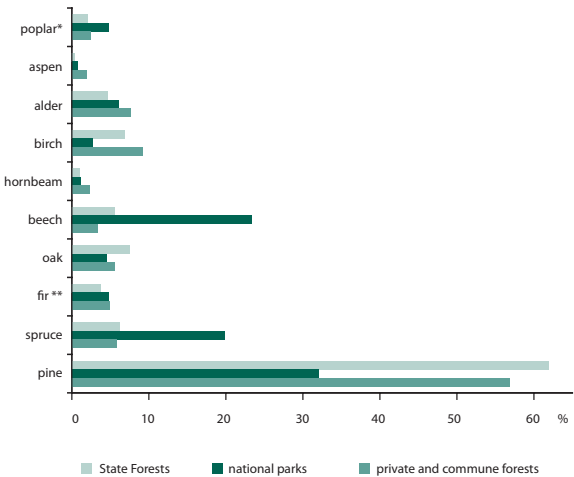


Fig. 9. Areal share of dominant species in the State Forests, national parks and private forests (Large-Scale Forest Inventory), including:

* other broadleaved

** other conifers

In the period 1945–2010, the species structure of Poland's forests underwent substantial changes resulting, among other things, 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%.

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Table 2. Forest area by tree groups

Tree groups	State Forests		National parks		Privately-owned forests	
	'000 ha	%	'000 ha	%	'000 ha	%
Total	7068.4	100.0	183.9	100.0	1 655.0	100.0
Conifers	5087.5	71.9	104.2	56.7	1 122.8	67.9
Pine	4380.6	61.9	58.7	32.0	951.4	57.6
Spruce	440.8	6.2	36.7	19.9	94.4	5.7
Fir and other conifers	266.1	3.8	8.8	4.8	77.1	4.6
Broadleaves	1980.9	28.1	79.7	43.3	532.1	32.1
Oak	527.2	7.5	8.3	4.5	88.2	5.3
Beech	395.3	5.6	42.9	23.3	49.4	3.0
Hornbeam	68.3	1.0	2.3	1.2	40.1	2.4
Birch	485.7	6.9	5.0	2.7	156.9	9.5
Alder	332.7	4.7	11.2	6.1	126.6	7.6
Aspen	28.8	0.4	1.2	0.3	33.1	2.0
Poplar and other broadleaved	142.8	2.0	8.9	4.8	37.9	2.3

Source: Forest Management and Geodesy Bureau: Large-scale Forest Inventory in all ownership categories for the years 2006–2010

5. Age structure

Stands aged 41–80 years, representing age classes III and IV, prevail in the age structure of the forests and cover 27.1% and 18.3% 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 forest 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 11.4% of the forest area managed by the State Forests, while in private forests they account for 2.1%. The share of non-afforested land in privately-owned forests accounts for nearly 6.7%, while in the State Forests, it is 2.9% (Fig. 10, Table 3).

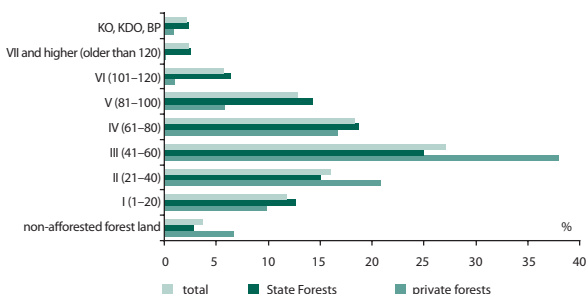


Fig. 10. Areal share of stands by age class under all forms of ownership, in the State Forests and private forests (Large-Scale Forest Inventory)

Table 3. Forest area by age class

Specification	State Forests		Privately-owned forests	
	'000 ha	%	'000 ha	%
Total	7068.4	100.0	1655.0	100.0
including afforested	6865.6	97.1	1543.4	93.3
Class I (aged 1–20 years)	889.4	12.6	164.4	9.9
Class II (21–40)	1067.8	15.1	344.5	20.8
Class III (41–60)	1764.7	25.0	627.1	38.0
Class IV (61–80)	1324.5	18.7	276.9	16.7
Class V (81–100)	1008.1	14.3	97.4	5.8
Class VI (101–120)	453.6	6.4	15.8	1.0
Class VII and higher	184.3	2.6	2.9	0.2
KO, KDO, SP	173.2	2.4	14.4	0.9

Source: Forest Management and Geodesy Bureau: Large-scale Forest Inventory in all ownership categories for the years 2006–2010

A steady increase in the share of stands older than 80 years from about 0.9 million hectares in 1945 to nearly 1.89 million hectares (excluding the KO and KDO classes) in 2006–2010 is an indicator of the changes in the age structure of forests.

6. Changes in forest area

According to the data published by the Central Statistical Office, Poland's forest area increased by 33 thousand hectares in 2010 in comparison with the previous year, and by 365 thousand hectares since 1995 (according to the land records). This increase was the result of afforestation carried out on post-agricultural land as well as of the conversion of other lands into forests.

The basis for all afforestation activities undertaken in Poland is *The National Programme for the Augmentation of Forest Cover* (KPZL), 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 of the Programme necessitated some modification which was completed in 2002. Consequently, the area foreseen 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 (Fig. 11).

The Programme's main task is to increase the forest cover to 30% by 2020 and to 33% by 2050, as well as to ensure an optimal

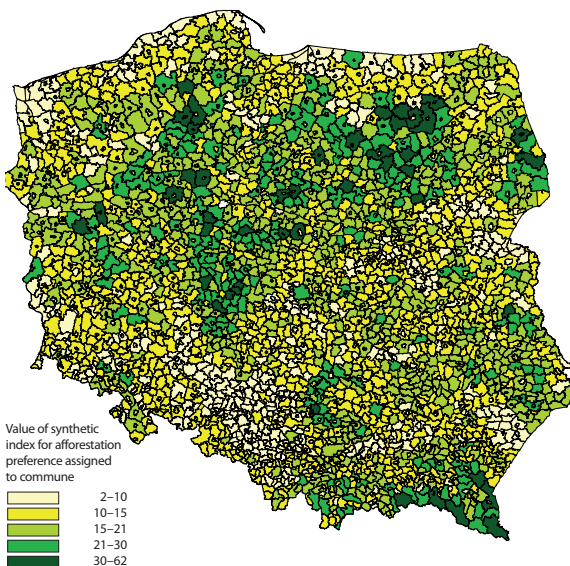


Fig. 11. Communes given preference in *The National Programme for the Augmentation of Forest Cover* revised in 2002 (variant III – environmental), (Forest Research Institute)

spatial and temporal distribution of afforestation and to set ecological and economic priorities and tools for its implementation.

The afforestation of land under all ownership categories carried out in 2010 covered 5 864.9 hectares (Fig. 12). The area of afforestation in 2010 increased by 253 hectares (4.5%), compared with 2009. The dramatic reduction of afforested areas (from 16,933 hectares in 2006 to 5864.9 hectares in 2010, or 65%) is primarily the result of the change of the 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 (PROW) 2007–2013*).

According to the Central Statistical Office data, about 209 hectares were regarded as forests established by way of natural succession in 2010 (249 hectares in 2009).

Thanks to the subsidies from the state budget and a loan from the European Investment Bank, the afforestation process within the State Forests has accelerated since 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. The area afforested between 1994 and 2004 approximated to 10.8 thousand hectares. Since 2005, a steady

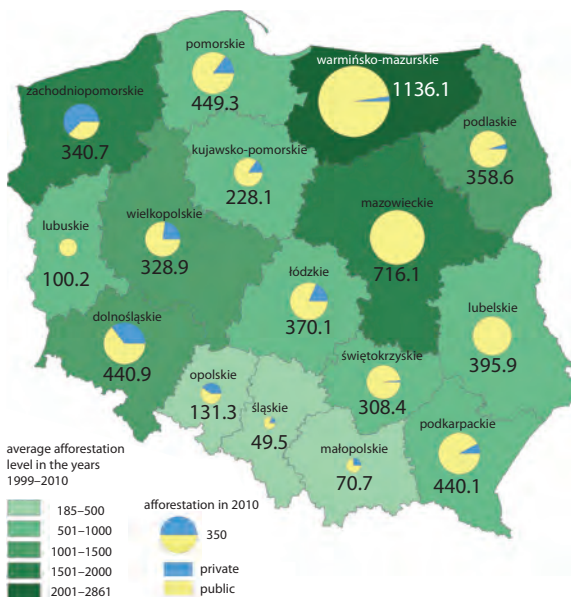


Fig. 12. The area of artificial afforestation in 2010 by province against the average level of afforestation in 1999–2010 (Central Statistical Office, Forest Research Institute)

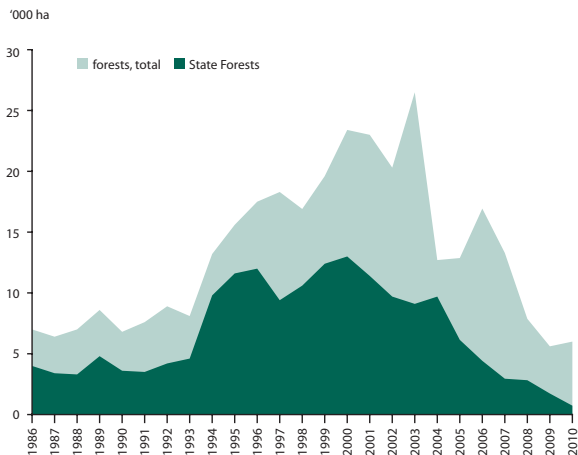


Fig. 13. The scale of afforestation in Poland in the years 1986–2010 (Central Statistical Office)

decline in the afforestation rate within the State Forests has been noted, with 6.1 thousand hectares in 2005 and only 0.7 thousand hectares in 2010 (Fig. 13).

In addition to the afforestation of farmland and wasteland, forest plantations are established in areas where timber stands have been removed. The area restocked in 2010 covered 46 080 hectares of land under all ownership categories, of which 4 631.2 hectares (10.1%) were naturally regenerated stands. The area restocked in 2010 was larger by about 1 900 hectares, as compared to 2009.

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 2006–2010 amounted to 2 336 million m³ of gross merchantable timber, including 1 865 million m³ in the State Forests and 355 million m³ in private forests. As of 1 January 2010 (the latest update), the estimated timber resources in the forests managed by the State Forests amounted to 1 748 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 1.914 million m³ of gross merchantable timber.

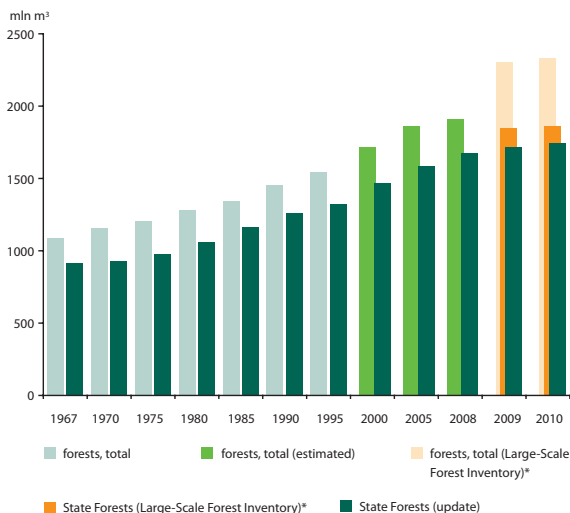


Fig. 14. Timber resources in Poland's forests in 1967–2010, in millions of m³ of gross merchantable timber (Central Statistical Office, Forest Management and Geodesy Bureau, Large-Scale Forest Inventory)

* data of the Large-Scale Forest Inventory in 2005–2009 and 2006–2010

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

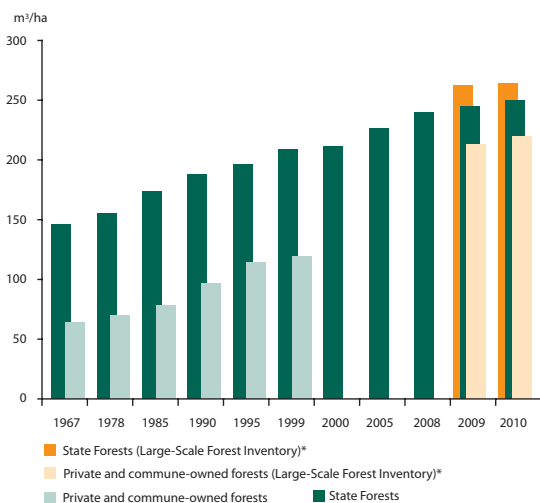


Fig. 15. Average standing volume in Poland's forests, 1967–2010, in m³/ha of gross merchantable timber (Central Statistical Office, Forest Management and Geodesy Bureau, Large-Scale Forest Inventory)

* data by Large-Scale Forest Inventory for 2005–2009 and 2006–2010

Stands in the age class III and IV account for more than 50.6% 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 17.7% of all resources within the State Forests and 3.1% in private forests.

According to the forest area and timber resource update of 1 January 2010, the average standing volume of afforested land in the forests managed by the State Forests was 250 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 264 m³/ha, while in private and commune-owned forests it was 220 m³/ha.



Fig.16. Standing volume in selected countries (FRA 2010)

Polish forests are ranked among the European leaders with regard to standing volume (Fig.16). The average for Poland, which according to FRA 2010 amounts to 219 m³/ha, is nearly twice as large as the European average (111 m³/ha, without the Russian Federation – 156 m³/ha).

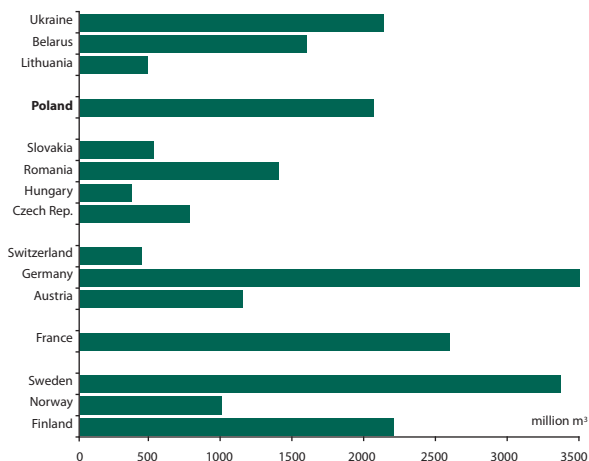


Fig.17. Timber resources in selected countries (FRA 2010)

According to FRA 2010, Poland – with a relatively large absolute area of forests and standing volume exceeding the European average – has significant timber resources amounting to more than 2.049 billion m³ (Fig. 17).

8. Changes in timber resources

Lack of reliable historical data on timber resources in private, commune and Treasury-owned forests (except the State Forests) makes it impossible to trace the changes in the volume of forest resources for the whole country. However, it is possible to determine increment in timber resources under the management of the State Forests.

From January 1990 to January 2010, the increment in the forests managed by the State Forests amounted to about 1 072 million m³ of gross merchantable timber. During that period, 586 million m³ of merchantable timber was harvested, which means that 486 million m³ of gross merchantable timber, representing 45% of total increment, remained to augment the timber resources.

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.

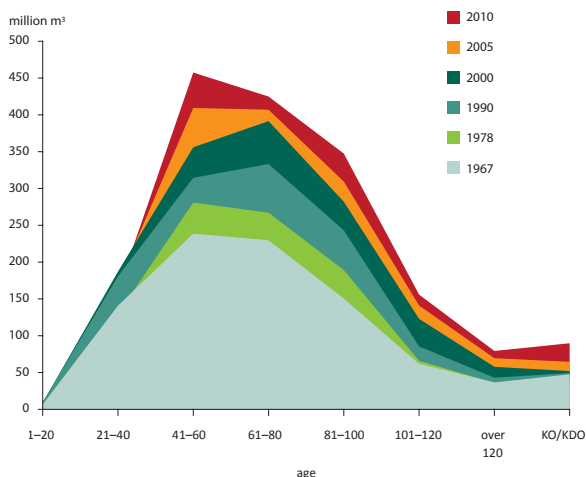


Fig. 18. Changes in timber resources in the State Forests by age class (Forest Management and Geodesy Bureau)

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 the recorded increase of the timber resources may be due to more accurate inventory methods.

Due to the marginal share of merchantable timber, the volume of stands aged 1–20 years (age class I) does not constitute a significant component in the total volume. The decrease in the volume of stands aged 1–20 and 21–40 years is the result of big changes in their areas.

The observed changes in timber resources in the analysed age classes suggest that an increase in standing volume (volume per hectare) is not only the result of expanding of the area of forests. A steady increase of this indicator is observed for all age classes of stands (excluding KO and KDO).

Forest functions

Forests serve diverse functions, either naturally or as a result of human activities. These functions are:

- **Ecological (protective) functions:** favourable impact on the shaping of the climate both locally and globally, the regulation of the water cycle in nature, the prevention of floods, avalanches and landslides, the protection of soil against erosion and landscape against steppeization;
- **Productive (economic) functions:** primarily the production of renewable biomass, including timber and non-timber products;
- **Social functions:** providing health-improving and recreational conditions for society and contributing to the labour market.

The ecological function of forests

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

The recognition in forest management of the ecological and social functions of forests, frequently referred to as non-productive functions, has resulted since 1957 in establishing protective forests. The total area of protective forests managed by the State Forests as of 31 December 2010 amounted to 3 292 thousand hectares, which represents 46.6%, and together with the nature reserves – 48.3% of the total forest area. The majority of the protective forests are located in the uplands and in the industrial areas (Fig. 19).

The area of private forests recognised as protective is estimated at 65.8 thousand hectares, or 3.9% of their total area. Protective forests owned by communes cover an area of 25.1 thousand hectares, or 29.4% of their total area.

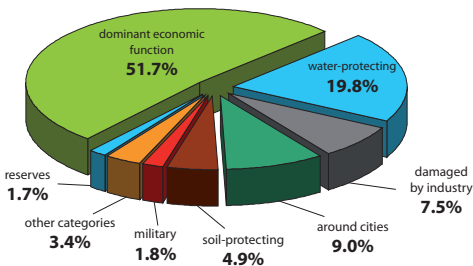


Fig. 19. Share of protective forest categories within the State Forests in 2010 (Directorate General of the State Forests)

In comparison with other countries in our region, Poland has a relatively high proportion of protective forests (about 36%). Only Ukraine has a larger area of protective forests (40.7%). Germany has a similar proportion of protective forests but in Slovakia, the Czech Republic and Hungary, these do not exceed 18%. In the Scandinavian and Mediterranean countries, the area of protective forests usually does not exceed 10%, except for Norway where it is 21.6%.

Carbon sequestration

Until recently the assessment of the amounts of carbon absorbed by ecosystems (including forests) has been of an almost exclusively scientific nature. The growing threat of climate warming caused by the increased concentrations of atmospheric CO₂ and the rising 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 increased carbon sequestration and included them in the total balance of greenhouse gas emission and absorption. The general rules governing the amounts of carbon absorbed by forest ecosystems and their inclusion in the total CO₂ emission balance are based on the decisions taken at the Conferences of the Parties to Climate Convention and the goals set out in the *Kyoto Protocol*. At the latest conference in December 2010 in Cancún, Mexico, the parties agreed to create the strategies and plans for low carbon development, including both the public sector and private investors.

According to the estimates based on the available data on timber resources in Poland, the forest biomass contains more than 968 million tonnes of carbon of which about 80% is accumulated in the aboveground biomass. The amount of CO₂ absorbed every year by forests (including soil) is estimated at 52.3 million tonnes, which roughly translates to 14.3 million tonnes of carbon.

2. The social function of forests

Forests are an attractive place for recreation and leisure, particularly for the inhabitants of large urban agglomerations. Forests are also a popular destination for excursions, mainly by schools, which give children and adolescents the opportunity for direct contact with nature.

The health-enhancing properties of forest ecosystems are conducive to the development of tourism and recreation, primarily in the areas classified as health resorts. The healing abilities of forests, such as hornbeam, mixed coniferous, pine, oak-woods and even poplar and willow riparian forests, are known to

stimulate cardio-respiratory systems. Moreover, 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 the timber, pulp-and-paper or power industries.

Forest education for the society

The Promotional Forest Complexes (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 a public good (see the map on the inner page of the cover). The PFCs were established within the State Forests as part of the national policy on forests and the provision of the Forest Act. Their main aim is to provide educational programmes to the society as a whole and particularly to children and young people, which promote pro-ecological and multifunctional forest management and give the opportunity for direct contact with foresters. In order to achieve this the PFCs have developed a sizeable educational and tourist infrastructure, which is usually available free of charge. This comprises: environmental education centres (22), nature-forest exhibition rooms (50), open-sided teaching shelters adapted for use by so-called "green classes" (69), educational trails (154), education points (318), dendrology parks and gardens (17), a "green school" and also overnight accommodation.

The 19 Promotional Forest Complexes are located in each of the 17 Regional Directorates of State Forests. At present, their total area is over 1 million hectares of which 979 thousand hectares are located in areas administered by the State Forests, which accounts for nearly 14% of their territory.

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 across the board.

The Forest Culture Centre in Gołuchów plays a special role in providing forest education to society. 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 2010 alone, nearly 140 thousand people, mainly children and young people, participated in the educational events provided by the Centre, among them 4 permanent and 11 temporary exhibitions and an international outdoor art competition "Forest Inspirations II".

The educational activity using the mass media is carried out primarily by the State Forests Information Centre (CILP) and the State Forests Centre for Development and Implementation in Bedoń. This includes the forestry educational portal www.erys.pl, forest journals and book publications, as well as radio and television programmes. The publishing activity of the Information Centre includes periodical titles *Echa Lasu*, *Głos Lasu* and *Biuletyn Informacyjny LP*, as well as a rich offer of non-periodical publications. The educational activity of the State Forests in 2010 was financed mainly from the forest districts' own resources (PLN 13.1 million). In addition, PLN 1.9 million was obtained from the national and regional funds for environmental protection and PLN 1 million from other sources.

The State Forests as a whole offer the following facilities to the visitors: 66 education centres, 301 forest exhibition rooms, 545 open-sided teaching shelters adapted for use by "green classes", 1 013 educational trails, 106 parks and dendrology gardens, 1 840 education points and 2 676 other facilities. Such large number of educational facilities demonstrates the commitment of the State Forests to promoting forest education particularly among the young and to meet the demand from schools for this form of education.

The number of visitors participating in the educational events organised by foresters in 2010 reached 1.8 million, including 560 thousand who took part in the activities provided by the Promotional Forest Complexes.

The State Forests also offer a wide range of recreational tourist facilities which are available to visitors of any age and social group. There are nearly 4 500 beds available in recreation and training centres as well as guest rooms in foresters' and hunters' lodges. They can provide a welcome rest after a day of walking or cycling. There are many established routes in the forests for both walking and cycling: 22 thousand kilometres of walking trails, 21 thousand kilometres of cycling trails and about 3 000 kilometres of horse riding routes. There are also over 300 camping sites in forests with places for a campfire, 600 forest bivouac sites, 200 campgrounds, as well as 1 100 forest car parks and parking spaces for nearly 3 thousand cars, almost 100 sports facilities and 650 other facilities.

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

2. The productive function of forests

The 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 the timber harvested in Poland in 2010 amounted to 33 568 thousand m³ of net merchantable timber, including 1 243 thousand m³ from private forests and 201 thousand m³ from the stands in national parks.

In the same year the State Forests' harvest was 33 769 thousand m³, including 31 882 thousand m³ of net merchantable timber (or 100.2% of the approximate prescribed cut) of which 15 261 thousand m³ (93.3% of prescribed cut) was obtained from final felling and 16 621 thousand m³ (107.5% of prescribed cut) from intermediate felling. The volume harvested in sanitation felling as a result of natural processes, *i.e.* deadwood obtained from wind disturbances (windbreaks and windthrows), outbreaks of pest insects, disturbances in water relations, air pollution and weather anomalies, amounted to 5 686 thousand m³, or 17.8% of the total harvest of merchantable timber and was slightly higher than in the previous year (17.2%).

In 2010, 6.1 million m³ of merchantable timber was harvested under the clear-cut system, which accounts for 19.0% of total harvest. The cutting area totalled 26.0 thousand hectares and was one of the lowest since the 1980s (43 thousand hectares in

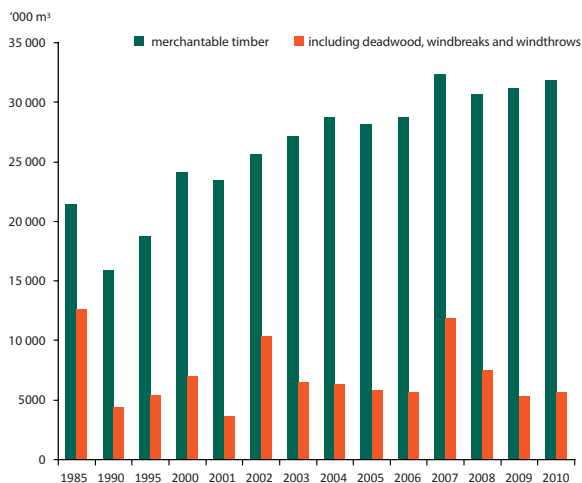


Fig. 20. Share of deadwood, windbroken and windthrown timber in total utilisation in the State Forests in 1985–2010, in '000 m³ of net merchantable timber (Directorate General of the State Forests)

1980) (Fig. 21). In the past decade, the area of clear-cuts was 26.6 thousand hectares, on average. The reduction in the size of the clear-cut area is indicative of the progress in the 'ecologisation' of forest management. The use of clear-cuts is often necessitated by large-scale damage to forests induced by wind, drought, fungal infection or insect outbreak.

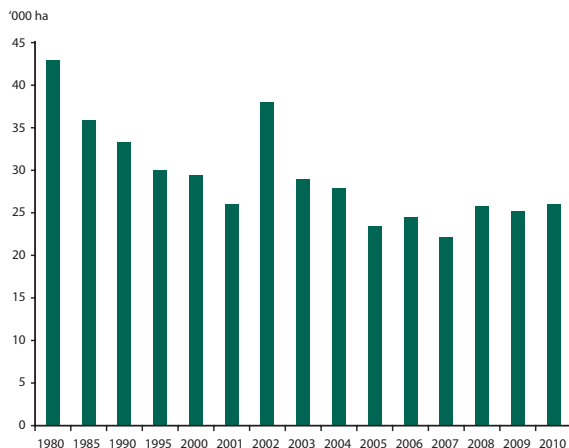


Fig. 21. Area of clear-cuts in the State Forests in the years 1980–2010, in '000 ha (Directorate General of the State Forests)

A comparison of several years' data on timber harvest points to a relative stability of the forest utilisation process (Table 4). 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 4.0–4.5 m³/ha (in 2005 – 4.00 m³/ha, in 2007 – 4.58 m³/ha, in 2010 – 4.51 m³/ha). The harvest level did not exceed the allowable amount of cut.

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 in a one-hectare area per annum in the period of 2001–2005. As in Poland, the majority of the countries in the region harvest over 50% of the increment (55% in Poland), with the exception of Italy (26%) and Germany (40%).

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).

Table 4. Harvest of net merchantable timber from forests under different forms of ownership, 1980–2010

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

^{a)} estimated data prior to 1997

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

Source: Central Statistical Office, Directorate General of the State Forests

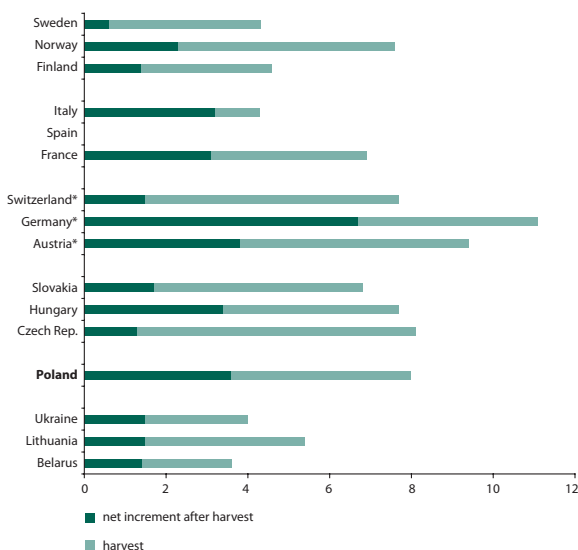


Fig. 22. Share of harvest in annual increment (SoEF 2007)

* data as of 2000



Complying with the Forest Act and the national policy on forests, the State Forests has for many years been carrying out an up to date inventory of all valuable forms of biological diversity, with individual forest districts often supplying the data. The inventory covers all elements subjected to legal protection, *i.e.* nature reserves, natural monuments, areas of ecological utility and endangered and rare species.

Table 5. 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	283.4
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	1085.5	344	5820.9	2513.8
2000	22	306.5	190.9	1307	148.7	47.4	120	2531.0	1345.9	407	7213.1	2856.5
2001	23	314.5	190.7	1345	147.7	51.6	120	2552.8	1365.5	412	7353.8	2874.4
2002	23	314.5	191.2	1354	149.0	52.2	120	2569.2	1372.4	409	7349.1	2868.6
2003	23	314.6	192.1	1368	160.6	60.9	120	2573.0	1367.7	448	7165.3	2348.4
2004	23	317.4	190.4	1385	162.4	61.7	120	2603.7	1391.7	445	7129.2	2325.5
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	166.8	102.1	120	2602.1	1325.3	411	6990.8	2279.5
2007	23	317.3	194.9	1423	168.8	103.1	120	2603.3	1331.0	413	7049.7	2252.9
2008	23	314.5	195.1	1441	173.6	104.9	120	2601.7	1308.5	419	7057.8	2285.4
2009	23	314.5	195.0	1451	163.4	104.7	121	2607.1	1309.8	384	7055.3	2278.7
2010	23	314.5	194.7	1463	164.2	99.2*	121	2607.5	1307.8	386	7075.5	2227.9

* area of forest in forest reserves – 57 100 ha; area of forest in non-forest reserves – 42 100 ha

Source: Central Statistical Office status as of 31 December 2010.

As of 31 December 2010, the inventory carried out in the State Forests included:

- 1 250 nature reserves with an area of 122 000 hectares, of which more than half are forest reserves (693) covering 62.600 hectares;
- 11 549 natural monuments, including 8 881 single trees, 1 562 groups of trees, 185 tree avenues, 463 erratic rocks, 226 rocks and caves, 232 areas embraced by 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 1 630 hectares;
- 130 nature-and-landscape complexes with a total area of 46 837 hectares.

In addition, 3 195 protective zones have been created in the State Forests to protect refuges of rare birds, mammals, reptiles, insects and lichens. They cover an overall area of 152 301 hectares, of which 31 975 hectares are under permanent protection throughout the whole year.

The State Forests has also been implementing its own programmes aimed at the preservation of biological diversity and restoration of the endangered flora and fauna species. Some of the more important initiatives are: the *Programme for the Preservation of Forest Genetic Resources*, the *Programme for the Restitution of Fir in the West Sudety Mountains*, the *Programme for the Restitution of Yew* and the *Programme for the Reintroduction of Capercaillie*. Forest Districts benefit from EU subsidies to develop and implement this type of projects.

There are five botanical gardens in the territory administered by the State Forests. These are: the Forest Arboretum of Warmia and Mazury in the Kudypy Forest District near Olsztyn; the Wirty Arboretum in the Kaliska Forest District (the oldest dendrology forest in Poland); the Dendrology Garden in Glinna in the Gryfino Forest District; the Forest Arboretum in Syców; the Park-Arboretum in the Forest Culture Centre in Gołuchów.

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 6). The number of most ungulates (elk, red deer, fallow deer) has remained at a high level and in some cases even increased, posing a threat to forests.

Natura 2000 network

The main goal 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 are obligated to establish special protection areas to be included in the Natura 2000 network. The legal basis for the implementation of this programme are two EU directives: *Birds Directive* and *Habitats Directive*. Both were

Table 6. Occurrence of more important game animals in Poland

Years	Elk	Fallow deer Individuals	Mouflon	Red deer	Roe deer	Wild boar	Fox	Hare	Pheasant	Partridge
							in '000s of individuals			
1980	5 797	4 010	455	72.7	402.2	85.1	60.5	1455.9	620.6	872.8
1985	4 406	4 094	540	74.4	476.5	57.1	49.0	1346.8	348.5	1033.8
1990	5 374	5 384	933	92.2	560.8	79.9	55.8	1153.8	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
2010/2009%	111.6	112.8	108.3	102.3	99.3	99.6	97.5	99.3	100.2	87.8
2010 : 1990%	156.1	433.1	301.3	195.4	146.6	312.8	355.4	48.4	122.8	42.2

Notes: estimates according to spring population status

Source: Ministry of the Environment, Polish Hunters Association.



Fig. 24. Natura 2000 areas in Poland (General Directorate of the State Forests)

incorporated into the Polish legislation as one of the forms of nature protection by the Act of 16 April 2004.

The network comprises two types of protection areas:

- Special Protection Areas (SPAs) designated for the conservation of wild birds;
- Sites of Community Importance (SCIs) for protection of natural habitats and rare flora and fauna species.

By the end of 2010, 144 Special Protection Areas covering 5 571 thousand hectares, and 823 Sites of Community Importance covering 3 792 thousand hectares were established (General Directorate of Nature Protection, GDOŚ). These areas cover nearly 20% of the country's land area.

The Natura 2000 areas account for 40% of the total forest area under the management of the State Forests. This means that the foresters are charged with the responsibility for the state of habitats and species populations. 122 Special Protection Areas for Birds cover 2 063 thousand hectares (29.2% of the State Forests area) and 662 Sites of Community Importance – 1 511 thousand hectares (21.4%).



Threats to the forest environment

Poland's forests are among the most threatened in Europe due to a permanent, concurrent impact of a number of factors which cause changes in their health conditions. The negative phenomena, often called stress factors, can be classified with respect to their origin as abiotic, biotic and anthropogenic.

The impact of stress factors on the forest environment is complex and frequently synergic. Moreover, the response to a stress factor from the moment of its occurrence can be delayed. This creates a difficulty in interpreting the observed phenomena, particularly the direct cause-and-effect relationships.

1. Abiotic threats

In 2010 (October 2009 – September 2010), damage caused by abiotic factors to the forests managed by the State Forests was reported on 164.4 thousand hectares of stands older than 20 years. Over 38 thousand hectares of stands were damaged by wind, nearly 68 thousand hectares by groundwater level fluctuations, 54 thousand hectares by snowfall, 2.3 thousand hectares by emissions and 644 hectares by low and high temperatures.

Fig. 25 illustrates the distribution of damage to forests caused by abiotic factors in the period 2006–2010. 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.

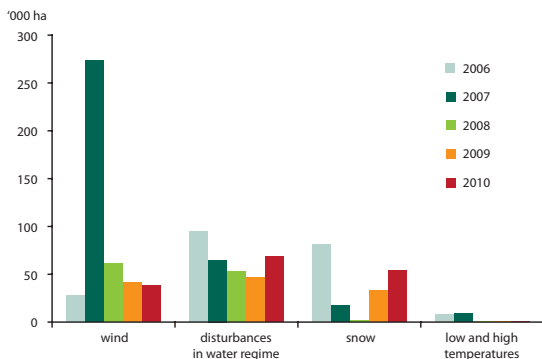


Fig. 25. Area of distribution of damage to the forests administered by the State Forests between 2006 and 2010 caused by abiotic factors

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 high diversity and 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 of the country (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 of the country it is associated with primary pests (chiefly nun moth). The zones with a low or moderate level of threat extend from the Silesian Plain in the west to the Lubelska Upland (excluding the Świętokrzyskie Mountains), and as far east as the Mazowiecka Plain and the Mazury Lakeland.

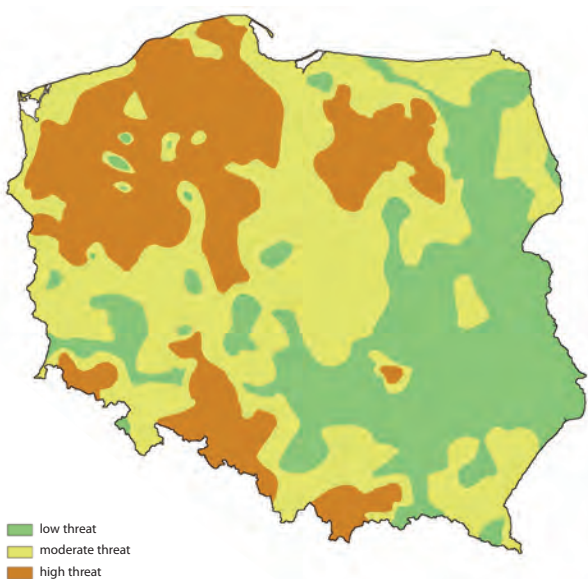


Fig. 26. Zones with threat to Poland's forests posed by primary and secondary insect pests together (Forest Research Institute)

The activity of pest insects in 2010 decreased by nearly 10% in comparison with the previous year. The control treatments aimed to reduce the populations of about 45 insect species covered an overall area of almost 12.8 thousand hectares, which is 4.3 thousand hectares less than in 2009. The reduction in the area of stands affected by insect pests was due to a decline in the population of sawflies (*Diprionidae* spp.), pine beauty moth (*Panolis flammea* Den. et Schiff.) and imagines of *Melolontha* spp.

In 2010:

- Chemical treatments against folivorous insects were carried out on 439 hectares of pine stands, a decrease by ca. 3.5 thousand hectares in comparison with 2009.
- Chemical control against folivorous insects covered nearly 2.4 thousand hectares of broadleaved stands, an increase by 300 hectares in comparison with 2009.
- The total area of pine plantations and young stands subjected to pest control treatments was 8.3 thousand hectares, a decrease of 2.4 thousand hectares in comparison with 2009.
- The total area of spruce and larch stands subjected to control treatments against pest insects was 2.3 thousand hectares and was four times larger than in 2009.
- Salvation measures taken against root pests of forest trees and shrubs were applied to plantations and nurseries in areas of 993 hectares.
- Of the major folivorous pests, cockchafer imagines were controlled in the largest area of 1 346 hectares, oak tortrix moth – on 911 hectares, pine sawflies on 295 hectares and pine webworm (*Acantholyda nemoralis* L.) on 128 hectares (Fig. 27).

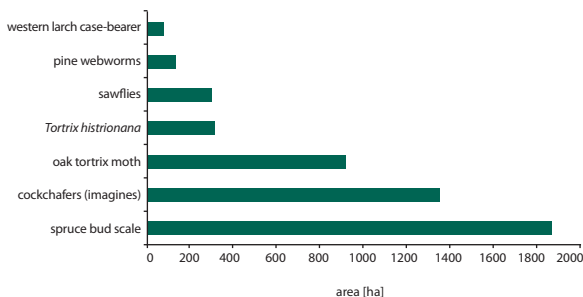


Fig. 27. Area of stands covered by protective treatments against major folivorous insect pests in 2010

Threats to forests posed by infectious fungal diseases

In 2010, infectious diseases were reported over a total area of 384 thousand hectares of stands, a decrease by nearly 27.5 thou-

sand hectares (or 7%) as compared with 2009. This was due to a three-fold decrease in the areas afflicted by *Lophodermium* needle cast of pine. In turn, an increase was noted, to a varying degree, in the areas of occurrence of other diseases of assimilatory apparatus: pine shoot disease, pine twisting rust (630 hectares and 310 hectares respectively), as well as oak mildew and needle and leaf rust (by 7% and 13% respectively). The dieback of all broadleaved tree species: oak, beech, birch and ash was less severe (decrease of 23%, 28%, 25% and 23%). The area of stands showing the symptoms of alder dieback was reported to decrease by 1800 hectares and of fungal diseases in poplars (cankers and tree dieback taken together) – by 48%.

A slight decrease was also noted in the area of forests affected by pine gall rust and stem and trunk diseases (14% and 4% respectively). The occurrence of root-rot diseases was reported in an area of 2.2 thousand hectares. The area of stands affected, to a varying degree, by the *Heterobasidion* root rot decreased by 2%, while the occurrence of the *Armillaria* root rot remained at the same level (Fig. 28).

A comparison of the health condition of stands in individual Regional Directorates of the State Forests with the 2009 data is presented in Fig. 29.

The area of occurrence of fungal diseases in forest nurseries in 2010 increased in comparison with the previous year by 20 hectares.

The occurrence of diseases in the stands of up to 20 years of age was noted in the area smaller by 23% (by 13 500 hectares) in comparison with 2009. The loss of foliage in mature stands was by one third greater due to a significant increase in the threat to stands caused by the oak mildew. The area of stands affected by the *Armillaria* root rot slightly increased (by 2%) while the area of

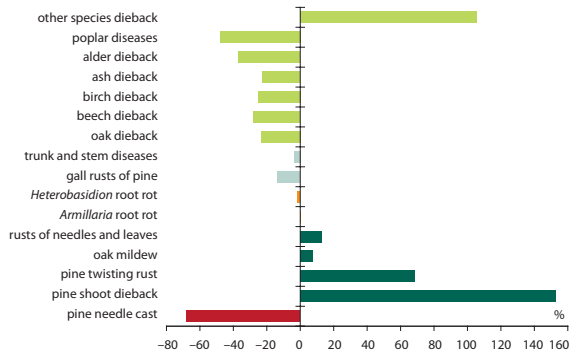


Fig. 28. Changes in the area affected by infectious diseases in 2010 in comparison with 2009 (%)

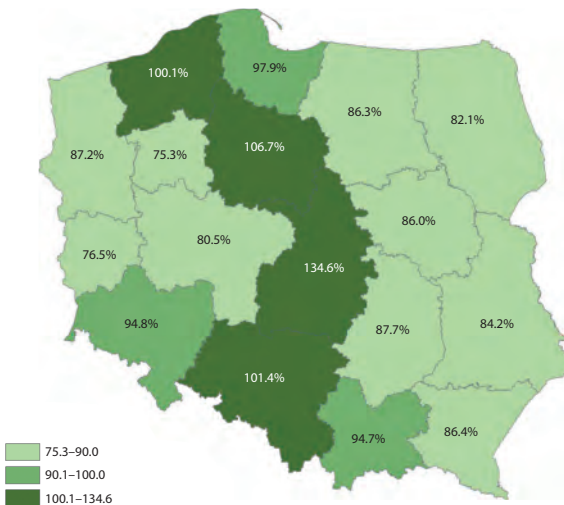


Fig. 29. Changes in the area of occurrence of infectious diseases in 2010 expressed as a percentage of the area under threat in the previous year

stands with broadleaved tree species affected by *Heterobasidion* root rot, pine gall rust, as well as stem and trunk diseases decreased (Fig. 28).

Damage caused by game

Damage to forest ecosystems caused by animals in the territory of the State Forests in the 2009/2010 season affected 170 thousand hectares, including 76 thousand hectares of plantations, 62 thousand hectares of young stands and 22 thousand hectares of stands of older age classes. The area of stands damaged by deer browsing or bark stripping increased by 14 thousand hectares in comparison with 2009.

In 2010, nearly 51 thousand hectares of land in the territory of the State Forests was restocked and afforested. During that time, 100 thousand hectares of forest plantations were protected (using different methods) against game animals.

The eight-year inventory of damage to forests caused by deer in forest plantations shows that after a slow but steady decline in the pressure of herbivore mammals, the situation in 2009 and 2010 was reversed. An increase in the area of damage to both young and older generation of forest was observed.

Data on the population dynamics of the major agents (ungulate) clearly show a steady growth in spite of a relatively higher harvest level than in 2009. In the 2009/2010 hunting season, the population of elk was estimated at 8 387, red deer at 180 thou-

sand, fallow deer at 23 thousand and roe deer at 822 thousand. At the same time, the harvest of game animals amounted to 49 thousand red deer, 4.5 thousand fallow deer and 167 thousand roe deer. No elk was harvested in the 2009/2010 hunting season as a hunting moratorium imposed on this species in 2000 is still in force.

3. Anthropogenic threats

Forest fires

There were 4 680 forest fires in 2010 (compared to 9 161 in 2009). The burnt area covered 2 126 hectares of forests which is a 52% decrease on the previous year. The largest number of fire events took place in the Mazowieckie Province (23% of the total number), the lowest – in the Opolskie and Podlaskie Provinces (Fig. 30).

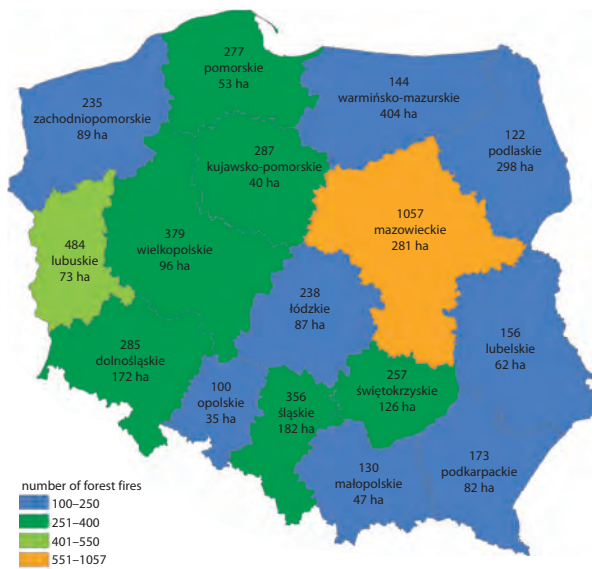


Fig. 30. Number of fires and the burnt area by province in 2010

In 2010, the number of forest fires within the State Forests was 1 740 (37% of all forest fires in Poland) and covered an area of 380 hectares (18% of the total). The largest number of forest fires occurred within the Regional Directorates of Zielona Góra (236), Szczecin (230) and Katowice (222). The largest burnt area

Tab. 7. Statistics of the forest fires in Poland, 2001-2010

Years	No. of forest fires		Area burnt [ha]		Average area of one fire [ha]			SF % share of national total	
	total	State Forests	total	State Forests	total	State Forests	other	No. Of fires	Area burnt
2001	4 480	2 044	3 333	685	0,74	0,34	1,09	46	21
2002	10 101	3 760	5 083	1 180	0,50	0,31	0,62	37	23
2003	17 088	8 209	21 500	4 182	1,26	0,51	1,95	48	19
2004	7 006	3 445	3 781	998	0,54	0,29	0,78	49	26
2005	12 169	4 501	5 826	1 197	0,48	0,27	0,60	37	21
2006	11 828	4 726	5 912	1 250	0,50	0,26	0,66	40	21
2007	8 305	2 818	2 844	550	0,34	0,20	0,42	34	19
2008	9 090	3 306	3 027	663	0,33	0,20	0,41	36	22
2009	9 161	3 429	4 400	970	0,48	0,28	0,60	37	22
2010	4 680	1 740	2 126	380	0,45	0,22	0,59	37	18

(108 hectares, or 28% of all fire areas within the State Forests) was reported in the Katowice Regional Directorate. There were no large fires (covering more than 10 hectares) in the territory of the State Forests in contrast with the rest of the country where 14 occurred.

The average area of a single fire in the forests under all ownership categories decreased by 0.03 hectare compared with 2009 and was 0.45 hectares (the smallest average fire area of 0.32 ha was recorded in 2008). These figures for the State Forests and for forests in other forms of ownership in 2010 were 0.22 hectares and 0.59 hectares respectively.

The most frequent causes of fires within the State Forests were arson (43%) and careless adults (25%). Nearly 4% of fires spread from areas other than forests (4.3% 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 17% of unknown causes.

The largest number of fires occurred in July (1807 fires, or 39% of all fires) followed by April (29%) and June (12%). The months with the smallest number of recorded fires were September (1%), May (3%) and August (4%).

Air pollution

According to the Central Statistical Office, the total emission of major air pollutants in Poland is one of the highest (in absolute values) among the EU countries. In 2008, the total emissions of sulphur oxides (Fig. 31) in Poland amounted to 999 thousand tonnes, of nitrogen oxides calculated as NO₂ – to 831 thousand tonnes and of ammonia – to 285 thousand tonnes.

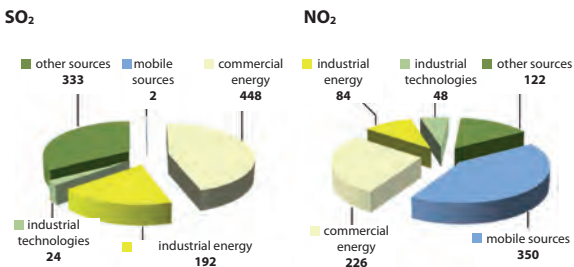


Fig. 31. Total emissions of sulphur dioxide and nitrogen dioxides by sources of pollution in 2008, in '000 tonnes (Central Statistical Office)

The forest monitoring network provides information on the concentrations of major pollutants in the forest environment in

different regions of Poland. Data collection on gaseous pollutants of sulphur and nitrogen oxides, ammonia and ozone is based on the annually averaged monthly measurements using the passive method.

The Intensive Monitoring Network consists of 12 Permanent Observation Plots (POPs), five of which are located in pine forests in the Forest Districts: Chojnów (Warszawa Regional Directorate of the State Forests), Strzałowo (Olsztyn RDSF), Białowieża (Białystok RDSF), Krucz (Piła RDSF) and Zawadzkie (Katowice RDSF). Three POPs are located in the spruce stands in the Forest Districts: Suwałki (Białystok RDSF), Bielsko (Katowice RDSF) and Szklarska Poręba (Wrocław RDSF), two – in the oak stands in the Forest Districts: Łąck (Łódź RDSF) and Krotoszyn (Poznań RDSF) and another two – in the beech stands in the Forest Districts: Gdańsk (Gdańsk RDSF) and Bircza (Krosno RDSF).

The ozone level was measured during the growing season from April to October, when high concentrations are anticipated due to the conditions conducive to its formation in the troposphere (high temperatures, strong insolation). The lowest ozone concentrations throughout the analysed period occurred in the Białowieża and Chojnów Forest Districts. Particularly high ozone concentrations were recorded in the mountain and foothill regions of the Bielsko, Szklarska Poręba and Bircza Forest Districts.

Average annual concentrations on observed forest plots oscillated between $1.1\text{--}1.6\text{ }\mu\text{g}\cdot\text{m}^{-3}$ SO_2 , $2.4\text{--}9.0\text{ }\mu\text{g}\cdot\text{m}^{-3}$ NO_2 and $2.0\text{--}3.7\text{ }\mu\text{g}\cdot\text{m}^{-3}$ NH_3 (Fig. 32). Lower gas sulphur deposition than in the other regions of the country was recorded in the plots located in northern and eastern Poland (Strzałowo, Gdańsk, Suwałki and Białowieża Forest Districts). Higher concentrations occurred in southern and central Poland, particularly in Łąck,

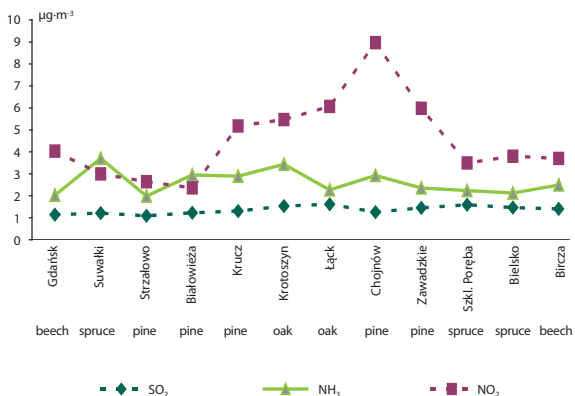


Fig. 32. Average values of concentrations of sulphur dioxides, ammonia, and nitrogen dioxide in the air measured on the Permanent Observation Plots of Intensive Monitoring in 2010

Szklarska Poręba, Krotoszyn, Bielsko and Zawadzkie Forest Districts. Seasonal changeability was significant – in heating period, especially in January, February, November and December, the highest concentrations of SO₂ and NO₂ were recorded.

The highest concentrations of nitrogen dioxide were recorded in central Poland in the Chojnów, Łąck, Zawadzkie, Krotoszyn and Krucz Forest Districts. Significantly lower concentrations occurred in northern and eastern Poland (Białowieża, Strzałowo and Suwałki Forest Districts) and in the foothill and mountain regions (Szklarska Poręba, Bircza and Bielsko Forest Districts).

Acidifying compounds reach the forest ecosystem from the atmosphere with precipitation (rainfall, drizzle, snow, mist, etc.). The sulphate and nitrate ions, as well as protons contained in the precipitation, have a direct impact on the tissues of the assimilatory apparatus and are generally less damaging to the environment than the gaseous deposition. However, the influx of these elements into the soil usually brings long-term consequences for the ecosystems.

Acid precipitation includes rain, snow or hail with a pH value less than 5.6. More than half of the monthly precipitation recorded on the Permanent Observation Plots of Intensive Monitoring in 2010 had a pH below 5.5. The precipitation acidity was the highest at the beginning of the year in January and February.

The annual ion deposition transferred with the precipitation to forest areas oscillated between 28 and 55 kg·ha⁻¹. The lowest ion deposition was recorded in the Białowieża, Krotoszyn and Chojnów Forest Districts, while the highest – in the mountain region in the Bielsko and Szklarska Poręba Forest Districts which also have the highest precipitation.

The deposition of heavy metals, *i.e.* zinc, copper, cadmium and lead (with the quantitative prevalence of zinc) ranged from 300 to 800 g·ha⁻¹·rok⁻¹. A significantly higher content of heavy metals was recorded on the two mountain POPs located in the territory of the Szklarska Poręba and Bielsko Forest Districts, which is associated with the high total deposition in these regions, as compared to rest of the country.

4. Threats to forest sustainability

The impact of stress factors on forests which already have a reduced resistance of forest ecosystems (e.g. unsuitable species composition for the habitat conditions and introduction of tree ecotypes of foreign origin) may, in extreme cases, lead to their total decline. This situation occurred in 1980–1991 in the Sudety Mountains where the dieback process affected all forests located higher than 800 metres above the sea level. In order to protect the deforested areas from soil erosion and degradation, the State Forests carried out afforestation works often in parallel with the control treatments against secondary pests. In the

period 1981–1996, 14 thousand hectares of land was 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 (LBG) 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 late 1970s and 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. One of the examples of such action is a programme of preventive measures developed by the Katowice RDSF for the Beskid Śląski and Beskid Żywiecki forests.

In 2003, the *Programme for the Beskid Mountains* was developed and implemented as part of the *Regional Operational Programme of the National Policy on Forests*. The document includes a protective and silvicultural treatment strategy for the Beskid forests and its implementation resulted in nearly 3 000 hectares of spruce stands being subject to conversion. The costs of the programme amounted to almost PLN 61 million in 2003–2006.

In spite of the intensive programme of preventive measures, an increased dieback of trees was observed in the past four years, resulting in stand decline in the Beskid forests. This is caused by a number of factors, just as it was in the Sudety Mountains. The situation is being made worse by the fact that the owners of privately-owned forests (which have a significant share in the region) can be reluctant to carry out the required level of sanitation treatments.

The favourable weather conditions in the growing season of 2009 have contributed to the improvement of the health condition of the Beskid forests and the reduction of the rate of spruce stand decline.

The occurrence of many stress factors is regarded as the cause of the increased dieback of broadleaved trees observed in recent years. The cyclic recurrences of oak dieback observed since the 1970s have been attributed to extreme climate conditions, such as the very high or low temperatures, long-lasting draughts 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 2010, the phenomenon of oak dieback was observed on 20.4 thousand hectares, 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 2 300

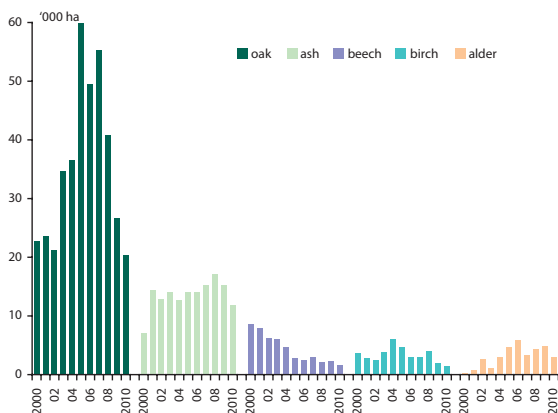


Fig. 33. Area of dieback of selected broadleaved tree species within the State Forests in the years 2000–2010

hectares, and since 2001, ash dieback has been recorded in an area of 13–14 thousand hectares each year. In 2010, the area of ash decline was the lowest since 2001 and amounted to 11.8 thousand hectares.

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 2010 – only on 1.7 thousand hectares.

The dieback of alder was for the first time reported in 1999 on an area of 31 thousand hectares. In 2010, the area of threatened alder stands amounted to 3 000 hectares.

In total, the phenomenon of tree dieback in 2010 was observed on 40.4 thousand hectares, a decrease by about 22% compared with the previous year.

4. 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 2010, an assessment of defoliation covered 39 080 trees older than 20 years, which were located on 1 954 Level I Permanent Observation Plots (20 trees on each plot).

Among the trees subjected to assessment, 21.0% showed no defoliation (defoliation class 0 – healthy trees), including 18.8% of conifers and 25.2% of broadleaves. The largest share of coniferous trees without defoliation was reported for fir (32.8%), and

the lowest – for pine (17.6%). The largest share of healthy broad-leaved trees was reported for beech (47.3%) and the lowest – for oak (12.8%) (Fig. 34).

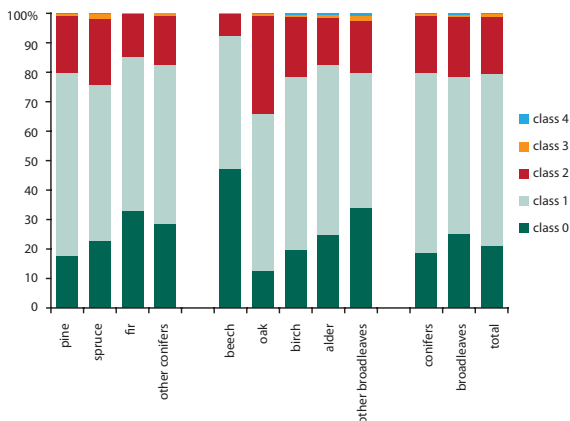


Fig. 34. Share of monitored tree species in defoliation classes on Permanent Observation Plots (Forest Monitoring) Level I in 2010, in stands older than 20 years, in all ownership categories (Forest Research Institute)

The share of all damaged trees with defoliation over 25% (defoliation classes 2–4) was 20.7%; the share among conifers was 20.2% and among broadleaves 21.5%. Spruce had the highest share of damaged coniferous trees (24.0% of trees with defoliation over 25%) and of broadleaves – oak (34.2%). The lowest share among the conifers had fir (14.6%) and among broadleaves beech (7.5%) (Fig. 34).

The order of species from the healthiest to the most damaged (determined on the basis of average defoliation and the share of healthy and damaged trees) is as follows: beech, fir, other conifers, other broadleaved, alder, pine, birch, spruce and oak.

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 – 2011. Technical Report of ICP Forests* (UNECE, Hamburg 2011).

A comparison of the levels of damage to forests in European countries in 2010, arranged in order of increasing share of trees in defoliation classes 2–4, ranks Poland among the countries with a moderate share at 20.7% (Fig. 35). A high level of damage, over 35% of trees in defoliation classes 2–4, was found in the Czech Republic (54.2%), Great Britain (48.5%) and Slovakia (38,6%). The stands in Russia, Ukraine, Belarus and Denmark had the lowest share of damaged trees (below 10% of trees in defoliation classes 2–4).

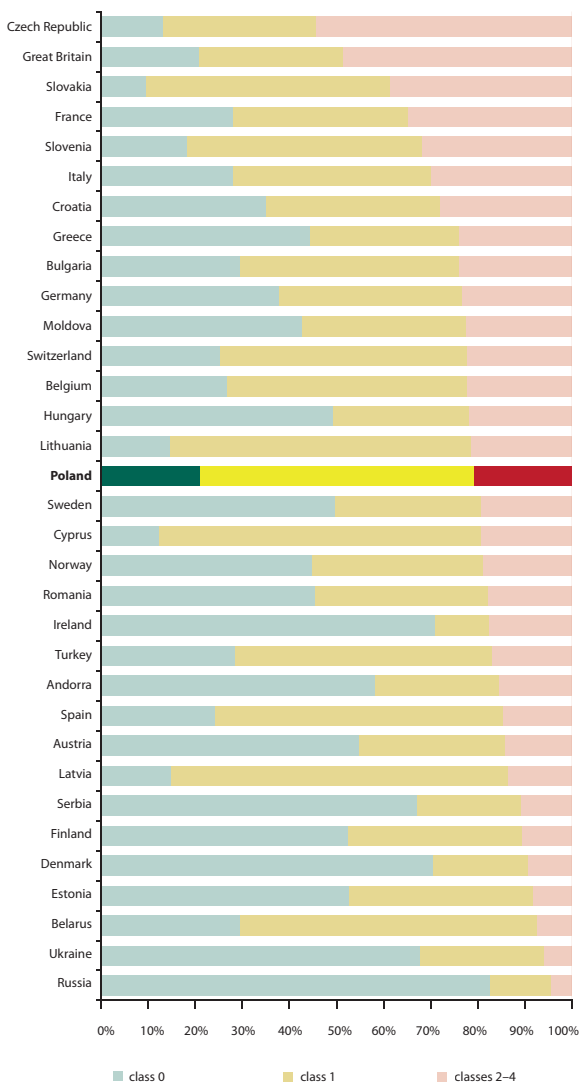


Fig. 35. Defoliation of stands in European countries in 2010, arranged in order of increasing share of trees in defoliation classes 2-4 (Forest Research Institute after UNECE, 2011)

Summary

- 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 regime and protection of the landscape. Forests, as a form of land use, assure biological production with a market value and are a public good which helps 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 country's land area under the legal protection. The share of protected forests in the total forest area is 40.9%, while the share of protective forests – mainly the water-protecting ones, those around cities and those damaged by industry – 38.4%. The areas of Natura 2000 network cover nearly 20% of the country's land area. Special Protection Areas for birds (SPAs) cover 2 063 thousand hectares (29.2% of the State Forests' area) and Sites of Community Importance (SCIs) – 1 511 thousand hectares (21.4%).
- The country's timber resources are steadily increasing. This is demonstrated by the increase of gross merchantable timber volume to 2.3 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 264 m³/ha (in private forests – 215 m³/ha), and the average stand age – 57 years (46 years in private forests).
- In 2010, the area of post-agricultural land and wasteland afforested under the *National Programme for the Augmentation of Forest Cover* increased slightly to 5.9 thousand hectares in comparison with 5.6 thousand hectares in 2009. 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 2010, 33 568.3 thousand m³ of net merchantable timber was harvested in Poland, of which 31 882 thousand m³ came from the State Forests (100.2% of approximated annual cut). Intermediate (tending) felling, as well as incidental and sanitation felling associated with the care of stands damaged by disasters, had a significant share in total stand utilisation in the State Forests (17.8%).

- Poland's forests are under constant threat from abiotic, biotic and anthropogenic factors, to a greater degree than almost anywhere else in Europe. Atmospheric pollution is a significant hazard to forest ecosystems.
- The assessment of the 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 20.7%.
- Poland is in the group of countries in which unfavourable phenomena in forests, such as mass outbreaks of insect pests, occur with high diversity and cyclic intensity. The activity of the most dangerous pest insects in 2010 decreased by about 10% in comparison with the previous year. Control treatments to reduce the populations of about 45 insect species covered an area of 12.8 thousand hectares.
- Infectious fungal diseases were reported on a total of 384 thousand hectares of stands which is a 7% decrease as compared with 2009 when 411.4 thousand hectares were affected. For many years, root rot diseases (*Heterobasidion* and *Armillaria* spp.) have posed the major threat to forests (68%), especially to those established on post-agricultural land. The area of stands showing symptoms of oak, beech, birch and ash dieback decreased by 25%, and the area of alder dieback by 37%. Significant damage to forests was also caused by large herbivore mammals, mainly red deer, roe deer, and locally by rodents (beavers and mice).
- The privately own forests cause concern with regard to their protection status, management and utilisation. They are fragmented and frequently incompetently managed or simply neglected. A large proportion of privately owned forests (38%) still does not have management plans.

Glossary

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 21–40 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.

- **annual prescribed cut in final cuts in the State Forests** – an annually averaged sum of final cuts in a given Forest District; this volume of harvest is set out in the forest management plan (usually established for a 10-year period) for a given Forest District 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 in a given Forest District.

Bark stripping (peeling) – a method of feeding by ungulate animals using their teeth to strip the bark off 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 impacts of industrial emissions, changes in water relations, etc.
- Defoliation** – premature loss of leaves or needles due to a variety of environmental causes, 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.
- Ecotype** – *ecological form, race* – 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 morphological (less frequently) characteristics.
- Epiphytosis** – epidemic (mass) appearance of plant diseases in a given area, caused by a single pathogenic agent (e.g. fungus) and 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 to the typological classification applied in Poland.
- Gene conservation stands (*in situ* conservation stands)** – stands selected for preservation of the entire 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 forest** – forest which is 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 that has attained sufficient size and volume to be suitable for harvesting, *i.e.* 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 without bark of at least 5 cm (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 favourable to the given species.
- Pathogens** – factors causing diseases; primary pathogens attack living organisms while secondary pathogens attack already damaged trees.
- pH** – 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 immature trees to improve the quality of the remaining forest stand; part of stand tending procedure.
- Promotional Forest Complex** – 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 the functions they serve or the degree of threat they face.
- Reforestation (renewal, regeneration)**: re-establishment of a forest stand by natural or artificial means, following the removal of a previous stand 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 game 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 harvest).
- Selection structure (BP)** – a type of vertical structure of stands, representing groups and clumps of uneven-aged and sized trees.
- 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.). It includes all trees with diameter (with bark) over 7 cm at breast height. The standing (growing) stock is often calculated per hectare.
- Thinning** – cuts made in immature stands that have passed through the cleaning period during which the economically undesirable trees were removed. Thinning has a positive

effect on the quality of stands as it allows the trees to increase their volume, height and crown size.

- **early thinning** – cuts covering a period of intensive natural self-thinning process;

- **late thinning** - cuts following early thinning.

Timber resources – the total volume of the 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 – is an increase in the volume of: 1) a tree, 2) a stand (including harvested timber) over a period of time.

current increment – an increase in volume over a specified period of time; depending on the length of time interval it can be:

- current annual increment,

- periodic current increment (more than one year),

- current increment over the whole period (from origin to a specified age);

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

- mean annual increment over a specified period,

- mean annual increment over the whole period (from origin to a specified age).

Windbroken and windthrown trees (windfalls) – trees snapped or brought down by the wind and/or snow.

