



# Slovenian forests

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Slovenian forests cover more half of the country (58.07%) and represent an essential landscape element. Forests take up 1 177 244 hectares and predominate on as much as three quarters of Slovenian territory; Slovenia is a mountainous country, where more than one third of its territory lies above 600m and two thirds of this is forest.

Half of the land in Slovenia has an incline greater than 20% and a good fifth more than 35%. Three quarters of the areas with an incline greater than 20% are forested, while forests cover up to 90% of land with an incline of 35% or more. Forests have mainly been preserved in higher and steeper locations, which are less suitable for agriculture and where their protective role is reflected in the protection of settlements, infrastructure and agricultural land against natural disasters. The present situation, enabling stable agricultural production, can only be maintained in Slovenia through high forest cover. Forests are thus an essential feature and constituent part of the environment, and their protective and social importance is steadily increasing.

The macroclimates in Slovenia are influenced by the Mediterranean Sea, the Alps, and the Pannonian Plain. Most of Slovenia's forests are located within the natural environment of beech, which, together with the beech-oak and fir-beech forests, cover about 70% of the nation's forestland. Seventy-one tree species can be found in total in Slovenian forests, of which 10 are coniferous and 61 are deciduous species.

The heterogeneous ecological conditions result in diverse forest vegetation patterns. Based on studies of the phyto-geographic regions and on different geographic features such as geology, soil, relief, precipitation, temperature, potential vegetation, climate, and phenology, the country can be divided into seven eco-regions and sub-regions (Kutnar et al., 2002).

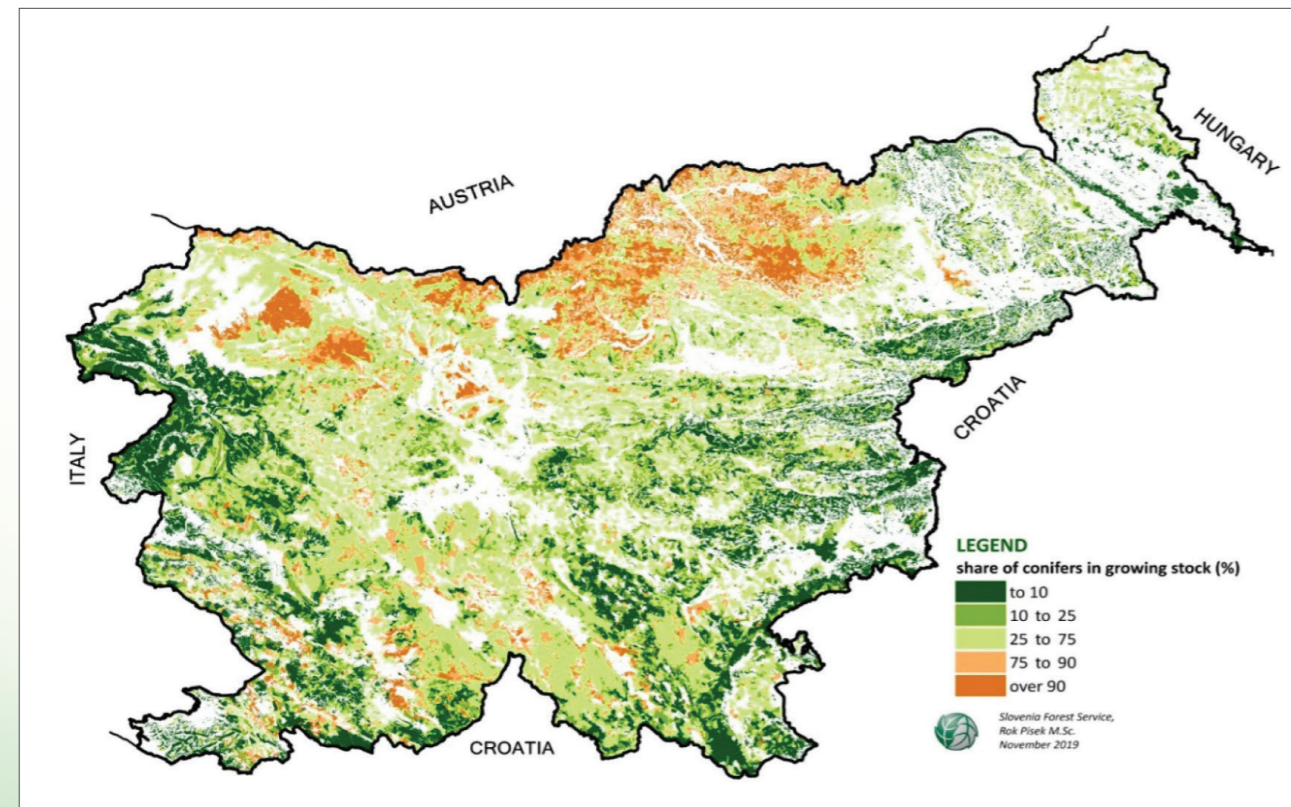


Figure 1: Slovenian forests (SFS, 2019)

**The Alpine eco-region (1)** consists of the Julian Alps, the Kamnik-Savinja Alps, and the Karavanke mountain chain. In the western part of this region, at altitudes of 900 m.a.s.l. up to the upper forest line at approximately 1 500 m.a.s.l., beech and silver fir-beech forests of different associations grow (*Anemone trifoliae-Fagetum*, *Homogyno sylvestris-Fagetum*, *Ranunculo platanifoliae-Fagetum*). Many beech and silver fir-beech forests have been converted to essentially pure monoculture of Norway spruce. Some potentially natural sites of primary Norway spruce forest can be found above

1 000 m.a.s.l. Secondary spruce forests of *Avenello flexuosae-Piceetum* extend over a large area, on non-calcareous parent material of potentially natural sites of acidophilic beech forests at Pohorje mountains. At lower altitudes, acidophilic beech forests of *Castaneo sativae-Fagetum* grow. In the Alps and Karavanke, the upper tree line reaches 1 700 m.a.s.l. The woody vegetation that can be found above timber line is dwarf-mountain-pine shrubbery (*Rhodothamno-Rhododendretum hirsuti* association), mixed with single larch (*Larix decidua* Mill.) trees.

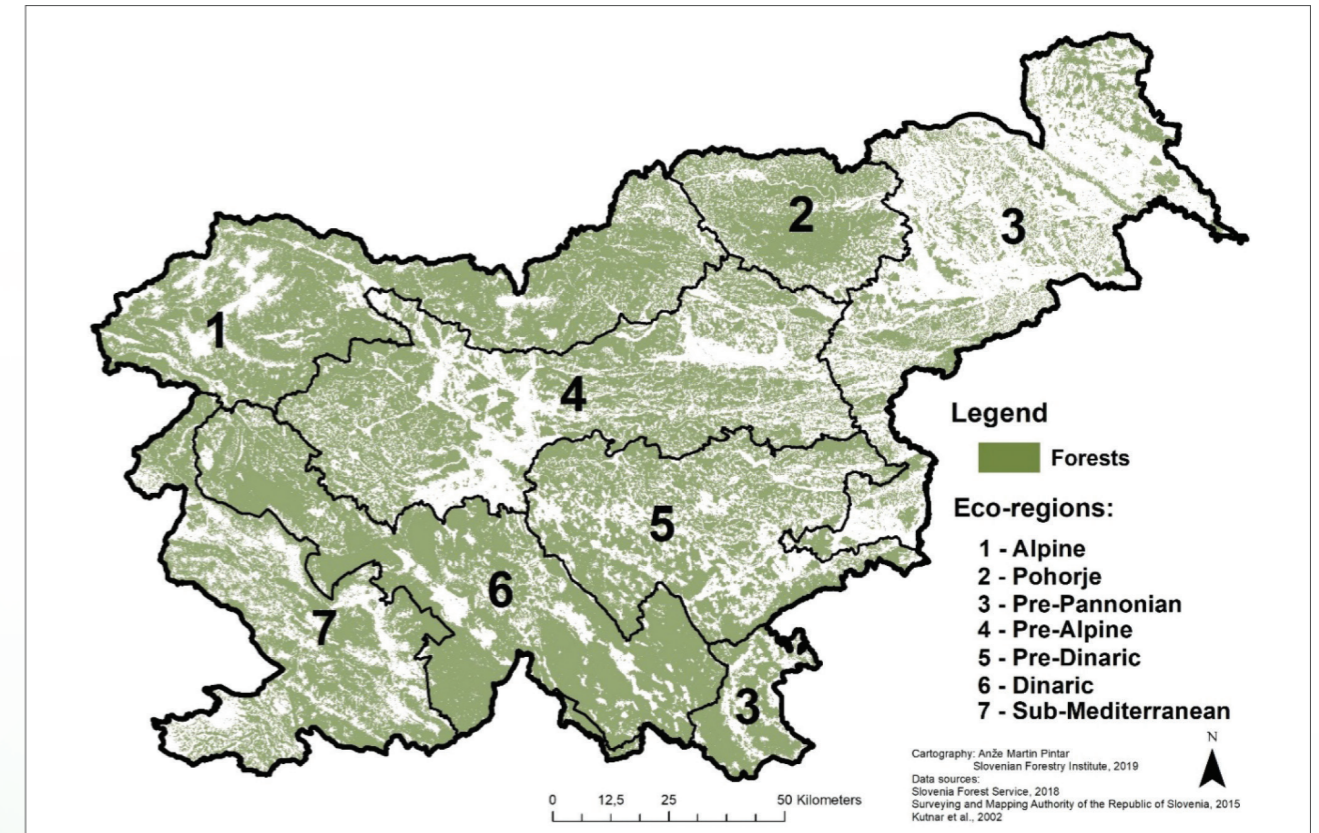


Figure 2: Slovenian eco-regions (Cartography by Anže Martin Pintar).

**The Pohorje eco-region (2)** includes the crystalline Pohorje massif and Kozjak Mountains. In the lowland and hilly areas, mixed forests of beech, sweet chestnut, and sessile oak (*Castaneo sativae-Fagetum*) grow. In the northern part of this region, on shady and very steep slopes at altitudes from 400 to 1 000 m.a.s.l., *Galio rotundifolii-Abietetum* forests predominate. The parent materials consist of non-carbonate tonalite, gneiss, mica schist, amphibolite, and others. Predominantly at altitudes between 900 to 1 300 m.a.s.l., the so-called 'acidophilic altimountain' beech of the *Luzulo albidae-Fagetum* association occurs. The geological bedrock consists of moderately acidic non-calcareous stones. These forests have always been subject to significant human impact, such as clearing for meadows and livestock grazing. Beech was locally exterminated at the Pohorje massif range in the period when glassworks were active in the area. All these activities resulted in the complete predominance of Norway spruce (*Picea abies* (L.) Karst.), which has an evident influence on the sites. The secondary spruce forests were classified as the *Luzulo sylvaticae-Piceetum* association. The *Cardamini savensi-Fagetum* is a zonal beech association of the upper parts of the Pohorje mountain range. It grows on silicate metamorphic and igneous rocks between 800 and 1 300 m.a.s.l. In these forests, European silver fir (*Abies alba* Mill.) and Norway spruce are mixed with beech.

**The Pre-Pannonian eco-region (3)** extends from the south-east to the north-east of Slovenia. Forests cover only a small part of this region. Forests of hornbeam (*Carpinus betulus* L.) and oaks (*Quercus* sp.), which would be characteristic of lowlands and the hilly parts of Slovenia, were mainly cleared and the land has primarily been used for agriculture. On small areas along watercourses, associations of white willow (*Salicetum albae*), forests of black alder (*Alnetum glutinosae*), and pedunculate oak-ash forests (*Querco roboris-Ulmetum laevis*) occur. On the plains, which are influenced by high underground water and temporary flooding, oak-hornbeam forests (*Querco roboris-Carpinetum*) can also be found. These riparian forests are threatened since in the past the marshes and wetlands were intensively drained. In many places, they have

been converted to wet meadows. In the northern part of this region, on the lower altitudes of hills, *Pruno padi-Carpinetum betuli* occur, while at higher altitudes zonal beech forests (*Vicio oroboidi-Fagetum*) grow. On slopes from 300 to 700 m.a.s.l., moderately acidophilic beech forests with admixed sweet chestnut and sessile oak (*Castaneo sativae-Fagetum*) grow. They thrive on very different non-calcareous parent material. On Luvisols and degraded soils, forests of *Galio rotundifoli-Pinetum sylvestris* prevail.

**The Pre-Alpine eco-region (4)** is located between the Alpine region (1) in the north, and the Dinaric (6) and Pre-Dinaric regions (5) in the south. On these plain areas and gentle slopes, azonal forest associations of *Vaccinio-Pinetum sylvestris* grow. This is a pioneer association occurring mostly on poor sites. Much more common in this area are acidophilic beech forests of *Blechno-Fagetum* associations and *Castaneo sativae-Fagetum* associations, which are growing on Dystric Cambisol on various non-calcareous geological formations. In many cases, forests of *Castaneo sativae-Fagetum* have been changed either to Norway spruce monoculture forests or to coppiced forests with a mix of sweet chestnut (*Castanea sativa* Mill.), Scots pine (*Pinus sylvestris* L.), and sessile oak (*Quercus petraea* (Matt.) Liebl.). In this region, thermophilous beech forests (*Ostryo carpinifoliae-Fagetum*) cover large areas of the southern exposed sites from lowlands to an altitude of around 1 000 m.a.s.l. with a relatively high amount of precipitation. In the mountain belt, on dolomite and limestone of various geological formations, beech forests of *Hacquetio epipactis-Fagetum* and *Lamio orvalae-Fagetum* are also very common.

**The Pre-Dinaric eco-region (5)** extends from the central to the south-western part of the country. Here, beech forest of *Hacquetio epipactis-Fagetum* and *Lamio orvalae-Fagetum* associations are very common, along with a variety of other forest associations. On gently configured hills and flatlands, at altitudes from 150 to 350 m.a.s.l. there are some remnants of hornbeam forests (*Abio albae-Carpinetum betuli*). However they have mostly been converted into agricultural and urban areas. *Castaneo sativae-Fagetum* forests grow on non-calcareous parent material. A major part of these moderately acidophilic beech forests have been changed either to monoculture spruce or to coppiced forest. On Dystric Cambisol, acidophilic hornbeam forests of *Vaccinio myrtilli-Carpinetum betuli* occur. Like most forests in this hilly region, they have been intensively utilized due to their location close to settlements and easy access, as well as favourable land configuration.

**In the Dinaric eco-region (6)** the Dinaric ridge separates the littoral and continental regions. It is characterized by a mixed silver fir-beech forest (*Omphalodo-Fagetum*). It covers parts of the high Karst plateaus of southern Slovenia and extends to Croatia. It grows mostly at altitudes from 700 to 1 200 m.a.s.l. The parent material is limestone with sporadic dolomite. In the lower part of the mountain belt, between 600 and 900 m.a.s.l., beech forests of *Lamio orvalae-Fagetum* occur. From lowlands up to altitudes of around 600 m.a.s.l., sub-montane beech forests of *Hacquetio epipactis-Fagetum* can be found.

**In the Sub-Mediterranean eco-region (7)** limestone and flysch are the characteristic parent materials. The most common type of forest vegetation is *Ostryo carpinifoliae-Quercetum pubescentis*. In the past, many sites of these forests were converted to pastures. In the second half of the 19<sup>th</sup> and at the beginning of the 20<sup>th</sup> centuries, many of them were planted with Austrian pine (*Pinus nigra* Arnold). After World War II, many pastures were abandoned and have now been gradually overgrown by forests of *Ostryo carpinifoliae-Quercetum pubescentis* associations. The mountainous parts of the Sub-Mediterranean region are covered by beech forests of *Seslerio autumnalis-Fagetum*. This occurs up to 1 100 m.a.s.l. in the littoral mountain region and grows on the coldest sites of the Sub-Mediterranean region. On the edge of its area, many of these forests have been changed into secondary forests of *Seslerio autumnalis-Ostryetum carpinifolia* associations. The *Castaneo sativae-Fagetum* association is very common on medium deep to deep Dystric Cambisol on acidic flysch formations in the Brkini sub-region.

In the initial period of colonization, forests were cleared in the lowlands and on hillsides, and these areas are still the basis of agricultural production. In primarily forest regions, traces of the last colonization between the 12<sup>th</sup> and 15<sup>th</sup> centuries are still clearly visible. Today, the actual tree species composition deviates greatly from the potential vegetation. The high share of Norway spruce is the result of spruce planting during 18<sup>th</sup> and 19<sup>th</sup> centuries following the model of the German forest management school. Pine was also planted in the region of the Slovenian Karst during the second half of the 19<sup>th</sup> century to alleviate the effects of the strong north-eastern “bora” wind and regenerate the barren, rocky karstic landscape.

The high diversity of habitats and biotic communities that have developed through the millennia have created a great many different ecosystems in the relatively small Slovenian area. Numerous animal species have found their niches; above all, many amphibians and mammals are linked to the forest. Preservation of the forests has certainly contributed to Slovenia being one of the few European countries where brown bears, lynxes and wolves can be found.

Forest regulation in Slovenia has a long tradition: the first known regulation, the Ortenburg Forest Regulation, was written in 1406. Empress Maria Theresa’s “Forest regulation in Carniola” in 1771 established sustainability in forest management, securing a permanent wood supply. Almost two centuries later it was prescribed by the Forestry Act in 1953, by obligatory forest management plans that had to be elaborated for all forests irrespective of ownership and size of the property. With the independence of Slovenia, a new Forestry Act was adopted in 1993.

The tradition of planned forest use is several centuries old. The recognition of the economically valuable forests emerged in the dry and warm sub-Mediterranean climate, where sustaining the existence and regeneration of forests is difficult. The first shortage of wood occurred in the Karst, from where wood was transported to Trieste and Istrian littoral cities. It was there where the first economic measures were passed by which some municipal communities were ensured a permanent supply of wood from the neighbouring forests.

The beginnings of forest management on Slovenian territory are related to forests belonging to the Idrija mine, where mercury was discovered in 1493, the Trnovo Forest and forests in the vicinity of Tolmin and Bovec. The first timber yield regulation for the Idrija forests dates to 1742, the next to 1759. The first plan for the Trnovo Forest was produced in 1771. In the second half of the 19<sup>th</sup> century, large forest estates on the Slovenian territory started to develop forest management plans on their own initiative. In the large forest estates of the high karst of Kočevsko and Notranjska, an original method was developed of forest regulation and management, different from the German school which was established in Europe at that time. It represents an autochthonous contribution to the development of forestry and forest regulation in Slovenia. With the plan elaborated in 1892 for the Kočevje forests owned by the Count Auersperg, Leopold Hufnagl developed his own system of selection forest management. He consistently opposed and fought against the established clear-felling system to prevent the spread of karst in the context of which a simultaneous, well-organized afforestation action was carried out in the Slovenian Karst, which gained worldwide recognition. Hufnagl was also a pioneer of nature conservation, as he placed under protection some virgin forest remnants in the Kočevje region. In the area of Notranjski Snežnik, on large Schönburg-Waldenburg estates, Heinrich Schollmayer-Lichtenberg adopted Hufnagl’s concept of selection forest management and introduced an original concept of a control method in forest regulation and management. The concept was immediately put into practice in the neighbouring

Windischgraetz forest estates in the forests of Javorniki, Nanos and Hrušica. The Postojna forest management region represents a unique example in Slovenia, where the concept of a control method in a forest area of more than 20 000 ha was been practiced since 1890. In the 1950’s a management system for the entire Slovenian forest area was introduced, irrespective of ownership, and by 1968 the first regulation of all forests in Slovenia had been performed with considerable revisions for number of management units. Based on this knowledge, Slovenian forestry began the elaboration of regional forest management plans in 14 regions, with four rounds of such plans being developed for all regions (1971-1980, 1981-1990, 1991-2000, 2001-2010). According to the provisions of the Forestry Act from 1993, the National Assembly of the Republic of Slovenia adopted the National Forest Development Programme in 1996.

Table 1: Changes in the forest area in Slovenia in the period 1875-2019

Year	Forest area (x 1000 ha)	Forest cover (%)
1875	737	36
1947	897	43
1961	961	48
1970	1 026	51
1980	1 045	52
1990	1 077	53
2000	1 134	56
2006	1 174	58
2019	1 177	58

The fundamental principles of forest treatment and management are:

- **sustainability** - the sustained preservation of forests, sustained use of their goods and non-material functions,
- **close-to-nature management** - the exploitation of forests to such a degree and in such a way as to ensure the preservation of all their natural constituents, and
- **multi-purpose management** – an approach respecting the balanced significance of the ecological, productional, and social roles of forests.

In accordance with the professional foundations provided by the Slovenia Forest Service, forests are managed by forest owners: private owners (natural and legal persons), local communities and the state.

A total of 71% of forests in Slovenia are private and 29% of forests are public, owned by the state or communes. Larger and undivided forest estates of state-owned forests enable good professional management. Private forest estates are small, with an average area of only 3 ha and even these are further fragmented into several separate plots. For the great majority of these estates, forests are not of economic interest. Private forest property is becoming even more fragmented as the number of forest owners is increasing. According to the latest data there are already some 314 000 (with co-owners even 489 000) forest owners in Slovenia. The major fragmentation of forest property, the number of forest owners and co-owners, present a serious obstacle to professional work in private forests, to optimal timber production and utilization of forest potential.

## Slovenian forests in numbers (2018)

Source: National Forest Inventory NFI, Slovenian Forestry Institute (SFI) 2018, Slovenian Forest Service

Table 2: Forest area (source: Land use map MKGP, SFS)

Forest area	1 177 240 ha
Forest reserves	9 508 ha
Protective forests	98 762 ha

Table 3: Living stock (source: NFI, SFI 2018) and increment (\*ingrowth period 2007-2012, NFI 2012)

	unit	conifers	broadleaves	Σ
Living stock	m <sup>3</sup>	168 346 000	217 790 000	386 136 000
	m <sup>3</sup> /ha	143	186	329
Increment*	m <sup>3</sup> /year	4 226 000	5 262 000	9 488 000
	m <sup>3</sup> /ha, year	3.42	4.44	7.86

Table 4: Diameter class-structure (source: NFI 2018, SFI)

class	≤20cm	20-40cm	40-60cm	≥60cm	Σ
%	9.7	42.0	37.0	11.3	100

Table 5: Planned (source: report on Slovenian forests 2018) and realized cut (NFI, SFI 2018)

	unit	conifers	broadleaves	Σ
planned	m <sup>3</sup>	3 070 000	3 767 000	6 837 000
realized	m <sup>3</sup>	4 661 886	2 330 943	6 992 829

Table 6: Regeneration and tending (data source: Report on Slovenian forests (SFS))

Tending measures	3 782 ha
Regeneration with planting	477 ha
Natural regeneration	95%

Table 7: Tree species in the living stock (source: NFI, SFI 2018)

Species	[m <sup>3</sup> /ha]	%
<i>Fagus sylvatica</i> L.	European beech	109.7 33.4
<i>Picea abies</i> (L.) Karst.	Norway spruce	94.3 28.7
<i>Abies alba</i> Mill.	European silver fir	25.9 7.9
<i>Quercus petraea</i> (Matt.) Liebl.	sessile oak	17.5 5.3
<i>Pinus sylvestris</i> L.	Scots pine	13.0 3.9
<i>Acer pseudoplatanus</i> L.	Sycamore maple	12.0 3.7
<i>Carpinus betulus</i> L.	common hornbeam	7.8 2.4
<i>Castanea sativa</i> Mill.	sweet chestnut	5.3 1.6
<i>Pinus nigra</i> Arnold	Austrian pine	5.2 1.6
<i>Ostrya carpinifolia</i> Scop.	hop hornbeam	4.7 1.3
other		33.3 10.2
Σ		328.7 100.0

### Literature

National Forest Inventory (NFI), Slovenian Forestry Institute (SFI) 2018

Kutnar L., Zupančič M., Robič D., Zupančič N., Žitnik S., Kralj T., Tavčar I., Dolinar M., Zrnec C., Kraigher H. 2002. The delimitation of the regions of provenance of forest tree species in Slovenia based on ecological regions. *Zbornik Gozdarstva in Lesarstva* 67:73 - 117.

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