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INSTITUT NATIONAL DE L'INFORMATION GÉOGRAPHIQUE ET FORESTIÈRE

CHANGER D'ÉCHELLE

NATIONAL FOREST INVENTORY

A handbook

2024 EDITION

STATISTICAL SURVEY, FRENCH NATIONAL FOREST INVENTORY

The national forest inventory was created in 1958 as a means of describing and monitoring forests in an objective and representative way. As such, it is the only system that provides details of forest ecosystems and wood resources for all forests under public and private ownership in France and Corsica.

The national forest inventory is based on a 'continuous' method, introduced in 2005 to take better account of the more rapid changes that our forests have undergone since the storms of December 1999 and the drought and heatwave of 2003. The results of the inventory are published each year and are based on data collected in the field over the previous five years. Nearly 70,000 field plots, surveyed from 2019 to 2023, will therefore be used for the results published in 2024 (including 12,000 plots observed in 2023).

This handbook provides an overview of the forests in mainland France and Corsica, highlighting some of the data collected, such as surface area, volume of wood, species, production, removals and mortality.

The data is collected and processed by around a hundred officers, field technicians, photo-interpreters and experts in various fields. They develop the protocols needed to respond to changes in the environmental context. They are supported by several partners, including the National Forests Office (ONF), the National Centre for Forest Ownership (CNPF), the National Research Institute for Agriculture, Food and the Environment (INRAE) and local authorities.

STATISTIQUE PUBLIQUE

Since 2017, the National Forest Inventory Survey has been one of the mandatory surveys recognised as being of general interest and of statistical quality (in the same way as INSEE's surveys).

This certification from the French National Council for Statistical Information guarantees quality, objectivity and the protection of privacy.

INTRODUCTION

At a time when more and more is expected from our forests every year, this 2024 edition of the National Forest Inventory Memento sheds new light on these essential yet fragile ecosystems. Carbon sinks, biodiversity reservoirs, renewable resources, etc. - these are just some of the functions of forests that IGN is helping to support and follow-up decision-makers in the design, implementation and monitoring of national and local public policies.

Among the results shown in this handbook, it is worth noting that the surface area of forest in mainland France and Corsica is still growing. However, a sharp rise in tree mortality is taking place, and the total growing stock volume is plateauing, after rising for several decades. Repeated climatic events (hydric stress, extreme heat) and the diseases that develop in their wake are all aspects identified by the forest thermometer that is the national forest inventory.

What is more, this handbook is an opportunity to look at newly produced forestry information. To mention just one, there is a series of items relating to the renewal of forest stands and the pressure of large ungulates on this regeneration. Based on a protocol drawn up with all those involved in the balance between woodland and wildlife (i.e., 'sylvo-cygenetic' balance), and at the request of the government, the results are preliminary (only one year's data is available) but nonetheless significant. The future of forests begins with their regeneration, and this new scheme will significantly improve the monitoring of young trees, which will make up the forests of tomorrow.

This is a crucial time, and IGN is aware of its responsibility within the forestry community. An initial forest information blueprint is now underway for the 2025-2030 period. It will serve as a guideline for making the most of the national inventory scheme, leveraging investments in high-density Lidar, artificial intelligence, multi-sourcing techniques, etc., to meet the challenges of the future in terms of knowledge. This plan, which has been prioritised by and for data producers and users, is intended to serve the forestry community.

We hope you enjoy reading it!

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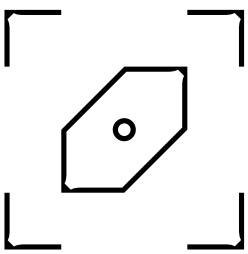

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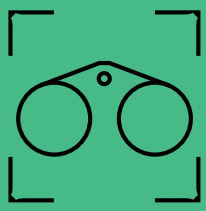
SIGNS OF THE PRESENCE OF LARGE UNGULATES

The presence of trees* in their juvenile stages is very common, with 16.5 of the 16.7 million hectares of forest featuring such trees. 25% of the time, these developing trees cover more than half of the inventory plot. The forest thus contains 11 billion recordable trees and 194 billion young trees at least 50 cm tall.

Young trees and other understory vegetation are a source of food for animals, particularly large ungulates. Traces of browsing (consumption of buds or leaves - most frequently), rubbing (rubbing of male antlers on the stem) and/or barking (consumption of bark) are visible on 29% of young trees. This rate varies greatly from one area to another and from one species to another (see opposite).

* Trees are defined here as all woody species for which at least one individual of the species has already been measured by the inventory, i.e. it reached a diameter of at least 7.5 cm at 1.30 m.



At the request of the Ministry of Forestry and thanks to successful collaboration and sharing with its many partners (Inrae, OFB, CNPF, ONF, FNC, UCFF, Fransylva, etc.), IGN is rolling out a new data collection protocol.

Signs of presence left by large ungulates (deer, roe deer, etc.) on young trees* (non-recordable trees, have a diameter at 1.30 m of less than 7.5 cm and are at least 50 cm high) are counted on two sub-plots of 2 m radius (25 m^2) on each inventory plot.

For each species, IGN workers noted the height class, the traces of browsing (in the upper third of the stem) and the marks of rubbing or barking.

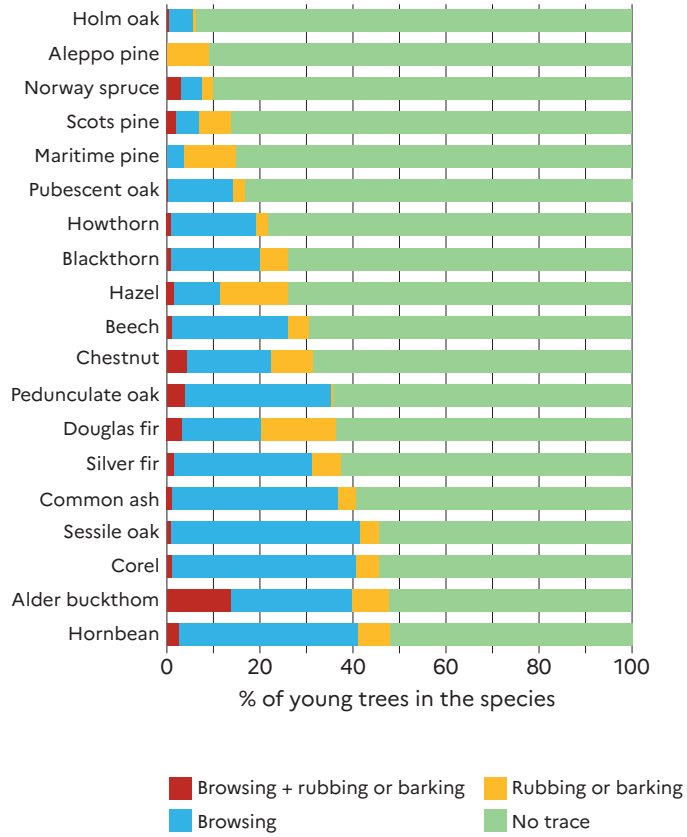
The results presented here are based on the only measurement survey currently available (2023). The acquisition of data over more annual inventory surveys will make it possible to refine the results, for example by species or geographically, and to monitor changes. Various indicators linked to the qualification of young stands and the sylvo-cynegetic balance are currently being developed.

Nearly half of young sessile oaks show marks, compared with 30% of young beeches. Overall, conifers have fewer marks than broadleaved (19% vs. 29%) and show more signs of rubbing or barking and less browsing. However, more than a third of young silver fir trees show marks, very often in the form of browsing.

Other species of lower economic interest to the forester are also frequently affected: blackthorn, hazel, hawthorn, holly, field maple and buckthorn. They provide an alternative resource for animals, which can draw their attention away from their primary target species.

Thanks to this new protocol, other information can be verified on a national scale. For example, the shortest stems are the most browsed (40% of stems under 1.30 m compared with 6% of stems over 2 m). Conversely, the tallest stems were the most rubbed (13% of stems over 2 m compared with 2% of stems under 1.30 m).

PERCENTAGE OF YOUNG STEMS BY TYPE OF PRESSURE FOR SELECTED SPECIES



FOREST AREAS

Continuously expanding for over a century, forests now cover almost a third of mainland France and Corsica – varying greatly from region to region in terms of history and characteristics. Forests also account for a large proportion of the land in the French Overseas Territories.

FORESTS IN OVERSEAS FRANCE

Forests in the five French overseas departments and regions (DROM) account for almost half of the total forest area in France, i.e. 8.24 million hectares. The afforestation rate in these territories ranges from 38% (Mayotte) to 97% (French Guiana), which is higher than in mainland France and Corsica (32%).

Overseas forests feature a wealth of biodiversity, both within each territory and from one territory to another. Mangroves are present in all French overseas departments and territories – high-stake areas – except for the Reunion Island. They remain rare (less than 5%) compared with other types of forest (xerophilous, seasonal evergreen, high-altitude cloud forests, etc.) and are home to a limited number of tree species: on average, 10 in a hectare of mangrove and 210 in a hectare of Guianese forest.

This extremely rich forest heritage, both in terms of biodiversity and biomass stock, is not as fully documented as the forests of mainland France and Corsica, mainly because they do not yet have a permanent forest inventory. However, in 2024, IGN is still producing maps and initiating forest inventories in these territories, the results of which are expected in a few years' time.

However, preliminary sets of indicators are available. In 2015, the GIP Ecofor* produced monographs on the forests of French Guiana, Guadeloupe and Martinique. In addition, every five years, the Food and Agriculture Organization of the United Nations (FAO) produces a global forest overview that includes these five departments. IGN, through its national forest inventory, provides the information for mainland France and Corsica, and works with the ONF to report on the DROMs.

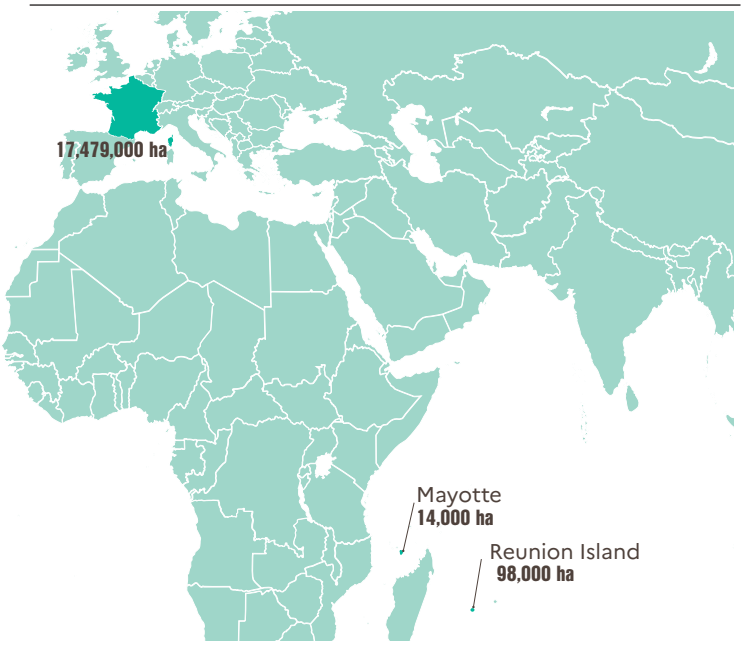
TO FIND OUT MORE:

observatoire.foret.gouv.fr/themes/les-forets-en-outre-mer

	Forest area	Afforestation rate	Change in area	Protected area
	ha	%	%/year	%
Guadeloupe	72,000	44	≈ 0	32
Martinique	52,000	49	+ 0,4	26
French Guiana	8,003,000	97	≈ 0	31
Mayotte	14,000	38	- 0,4	7
Reunion Island	98,000	39	+ 0,5	63

Source: FAO, 2020, Forest Resources Assessment

* GIP Ecofor: Public Interest Group on Forest Ecosystems. It brings together twelve public bodies, including IGN, which pool resources to advance forestry research and management.



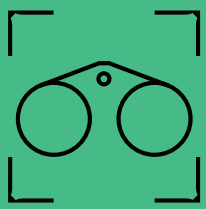
FORESTS IN MAINLAND FRANCE AND CORSICA

Forests in mainland France and Corsica cover 17.5 million hectares, or 32% of the country, with a statistical uncertainty of around 100,000 ha.

After agriculture, which covers more than half of France, it is the most important type of land cover.

The results in this first chapter – 'Forest area' – refer to the entire forest, whether it is available for wood supply or not.

The other chapters deal only with those areas of forest available for wood supply, for which more data is being collected by the forest inventory. This type of forest covers 16.6 million hectares, or 95% of the total forest area. These are forests where neither land use nor access conditions are an obstacle to the potential harvesting of timber.

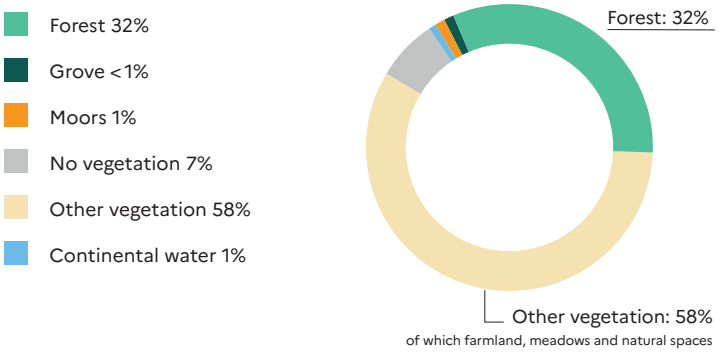


A grove is an area greater than or equal to 5 ares (500 m²) and less than 50 ares, with tree cover of more than 40%.

A forest is defined as an area of at least 50 ares (5,000 m²) with trees that can reach a height of more than 5 metres at maturity in situ, a canopy cover of more than 10% and an average width of at least 20 metres.

Forest does not include wooded land that is predominantly used for agricultural or urban purposes according to the FAO's international definition. IGN also uses the same definition.

REPRESENTATION OF THE 55,000 POINTS OF THE 2023 SURVEY, INTERPRETED FROM AERIAL PHOTOGRAPHS



In the following pages, if the territory concerned is not mentioned, the default is *mainland France and Corsica*.

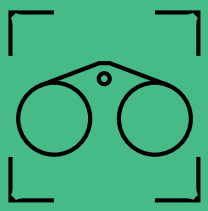
WHO OWNS THE FOREST?

Three quarters of the forest (13.1 million hectares) is privately owned. 3.1 million hectares are covered by a simple management plan, i.e. 18% of the forest.

Public forest therefore accounts for a quarter of all forests. It is divided between state-owned forests (1.55 million hectares) and other public forests (2.8 million hectares), essentially communal forests.

In the west of France, the proportion of private forest is significantly higher than the national average, with over 90% in the Pays de la Loire, Nouvelle-Aquitaine and Bretagne regions.

Only in the Grand Est region is the proportion of private forest in the minority (45%).

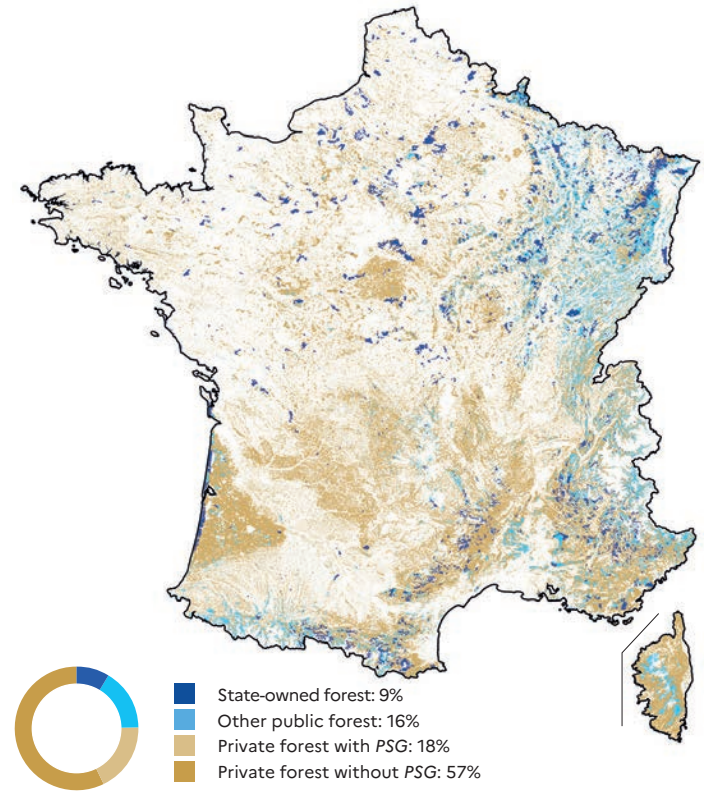


The legal status of the site is determined by the category of ownership. A plot of land is considered public when it comes under the forestry regime. Among public land, state-owned land (state forests) belongs to the State. Other public land generally belongs to municipalities (communal forests) but also to other local authorities or public institutions.

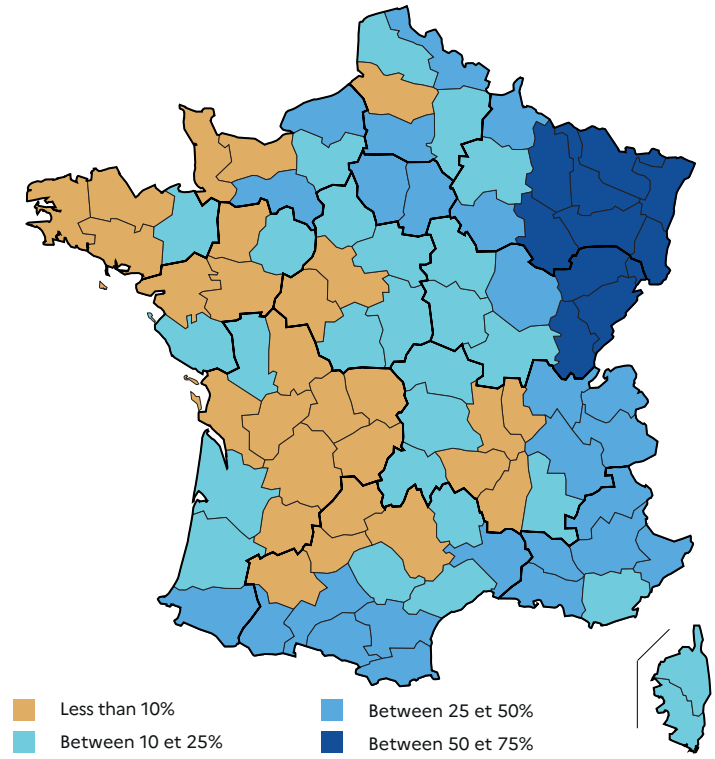
All land not covered by the forestry regime is classified as private for the purposes of the national forest inventory. The ONF provides the IGN with information on properties covered by the forestry regime.

The French national centre for forest ownership (CNPF) provides the IGN with information on areas privately owned and covered by a simple management plan (*PSG* in French).

DISTRIBUTION OF FOREST OWNERSHIP



PROPORTION OF PUBLIC FOREST AREA BY DEPARTMENT



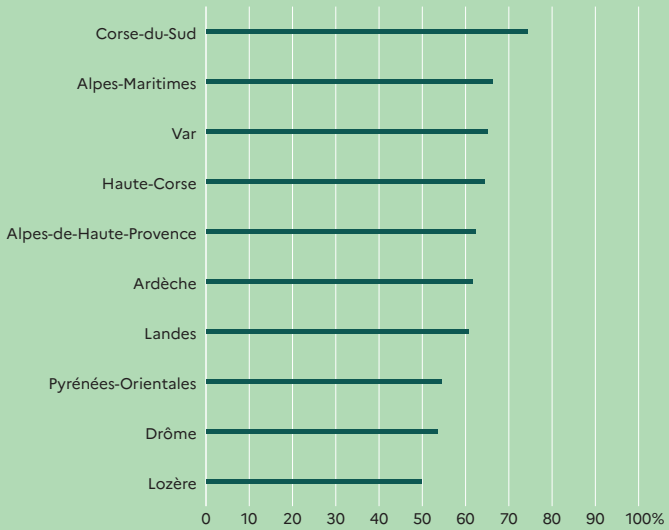
AFFORESTATION RATE

32% of France is covered by forest. A century ago, in 1908, the afforestation rate was 19%. However, these averages do not reflect the significant differences from one department to another.

Today, the afforestation rate is below 10% in four departments (compared with eighteen in 1908): Manche, Vendée, Mayenne and Deux-Sèvres.

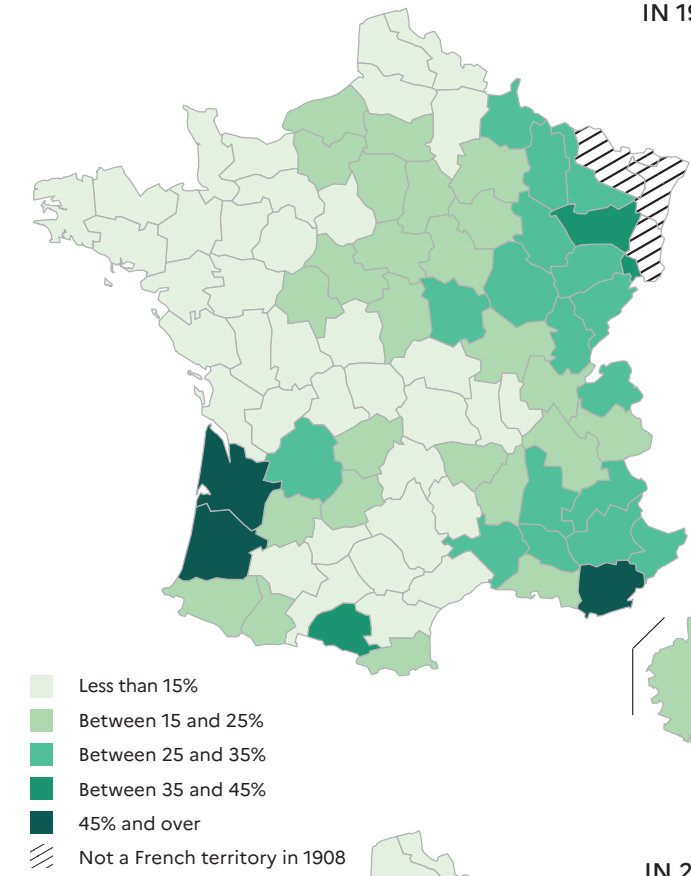
Seven departments (none in 1908) have an afforestation rate of 60% or more (see barchart below).

THE TOP TEN DEPARTMENTS WITH THE HIGHEST AFFORESTATION RATES

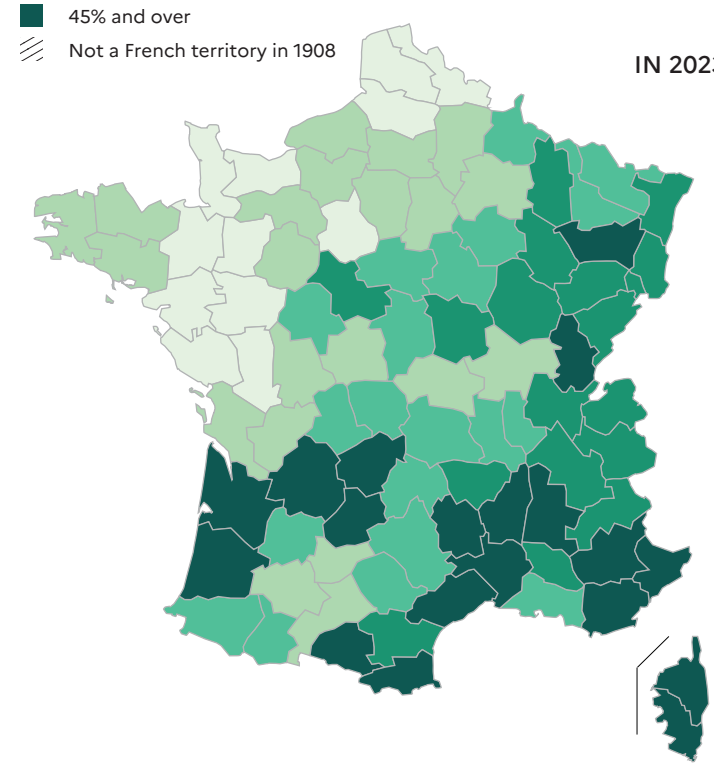


AFFORESTATION RATE BY DEPARTMENT

IN 1908



IN 2023



INCREASE IN FOREST AREA

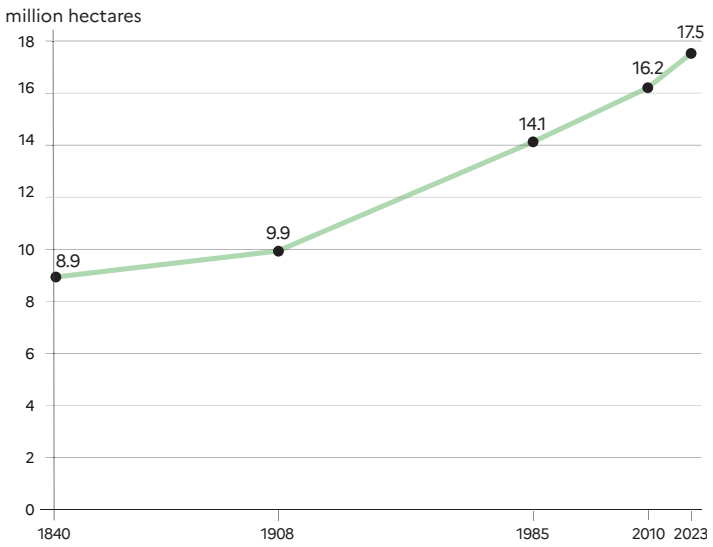
The forest area has been increasing for almost two centuries. A century ago (1908), forest covered almost 10 million hectares. It now covers 17.5 million hectares.

The post-war rural exodus and agricultural revolution, the afforestation of land supported by the National Forestry Fund - from 1947 to 1999, 2 million hectares were afforested or reforested - and the ongoing reforestation of mountain areas all played a major role in this expansion.

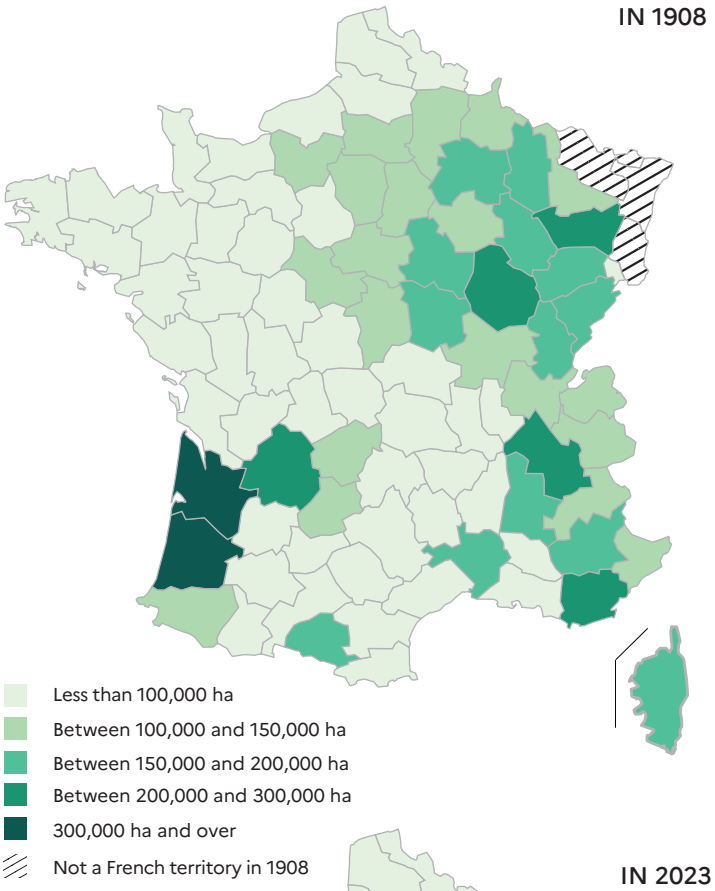
Between 1908 and 1985, the forest expanded by 4.2 million hectares, at an average rate of more than 50,000 hectares per year, particularly in the Massif central and on the tip of Bretagne.

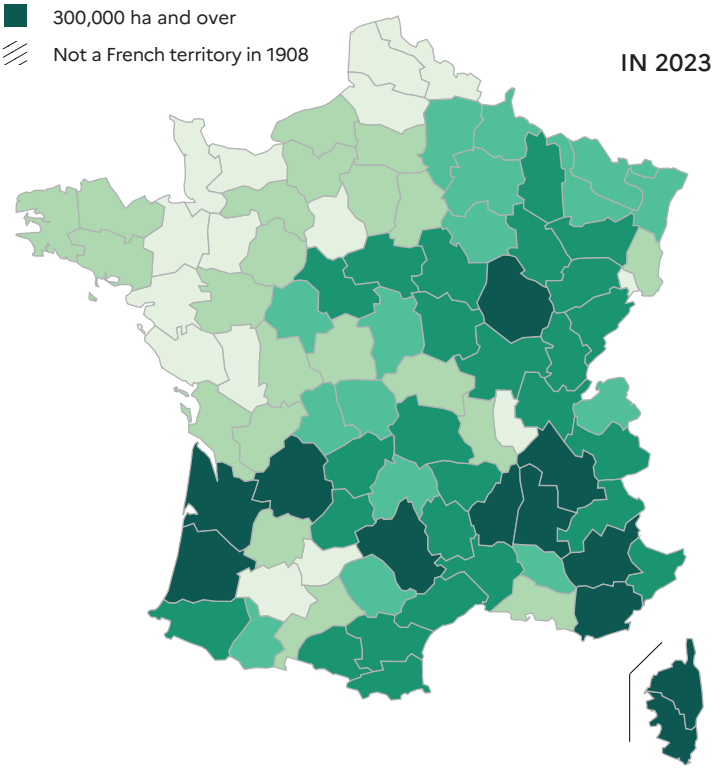
In 1985, forest covered 14.1 million hectares. Since then, forest area has increased by 3.3 million hectares, which is more than the surface area of the Pays de la Loire region. Forest area is still growing steadily at 90,000 hectares per year. Forest expansion is particularly marked in Bretagne and the Mediterranean region.

CHANGE IN FOREST AREA SINCE THE MID-19TH CENTURY



FOREST AREA OF DEPARTMENTS



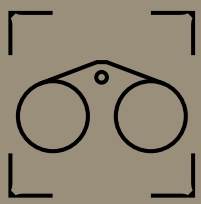


WOOD RESOURCES

The growing stock volume (2.8 billion cubic metres) varies according to tree growth, removals and mortality – which is rising sharply. The balance of these three fluxes tends to decrease but remains positive over the period 2014-2022.

CHANGES IN WOOD RESOURCES

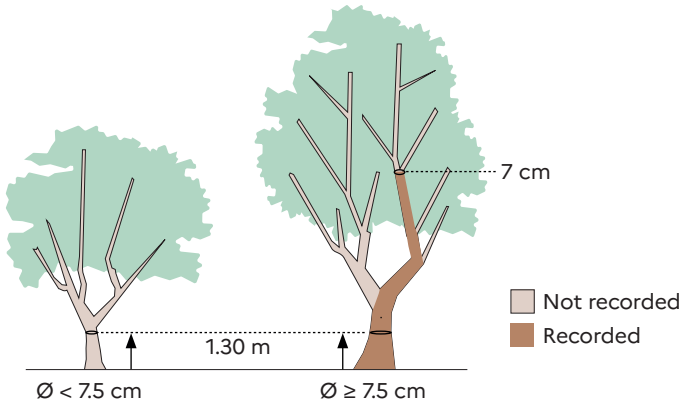
The increase in forest area also means a sharp – though lagged – rise in the stock of wood. Since 1985, the growing stock has increased from 1.8 to 2.8 billion cubic metres. In about just forty years, that's an increase of more than 50%!



The volume of trees is calculated from field measurements.

As a rule, only trees with a circumference greater than or equal to 23.5 cm (7.5 cm diameter) at a height of 1.30 m are recorded in the inventory. The estimated volume includes the main stem from ground level up to a section of 7 cm in diameter (known as the 'stem wood' volume).

Note: the volume does not take the volume of branches into account, which is generally greater for deciduous trees than for conifers.

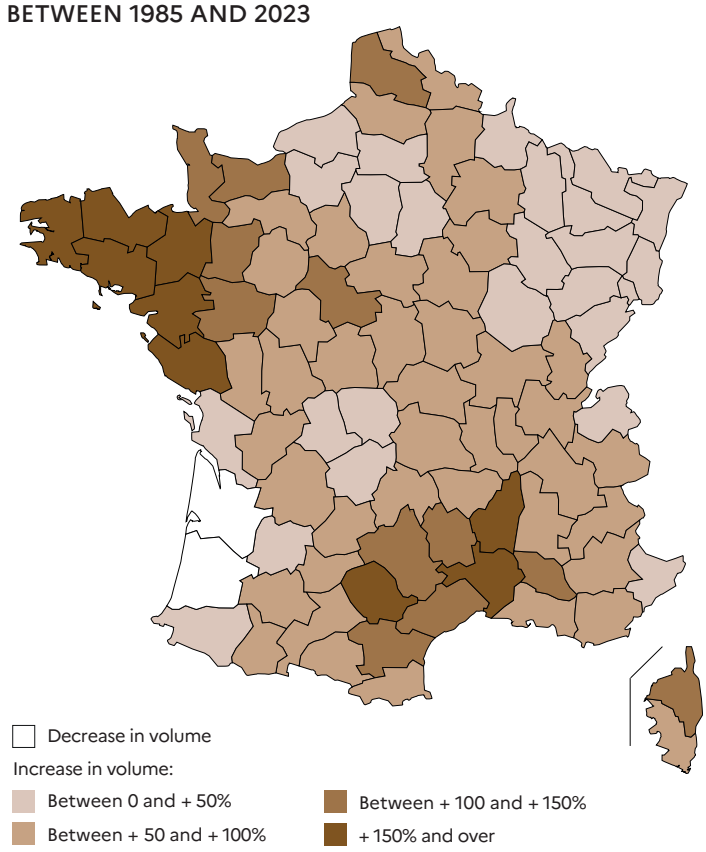


Between 1985 and 2023, trends across the French departments are mixed. Over this period, the volume of growing stock decreased in two departments: Gironde (-6%) and Landes (-33%); which were hit hard by the 1999 and 2009 storms. Since then, the volume of wood has increased again.

Growth in the north-eastern departments is lower than the national average, mainly because the forest is already mature and because of the 1999 storm and recent deaths due to drought, spruce bark beetles and *chalorosis fraxinea* (causing ash dieback).

The strongest growth drive is recorded in the departments south to the Massif central and in the Bretagne region. The stock of wood in these forests has at least doubled in four decades.

CHANGE IN GROWING STOCK VOLUME BETWEEN 1985 AND 2023



This increase in the growing stock, of around one billion cubic metres between 1985 and 2023, is steady over time. It has risen by 260 million cubic metres of wood in forests over the last ten years (see chart below).

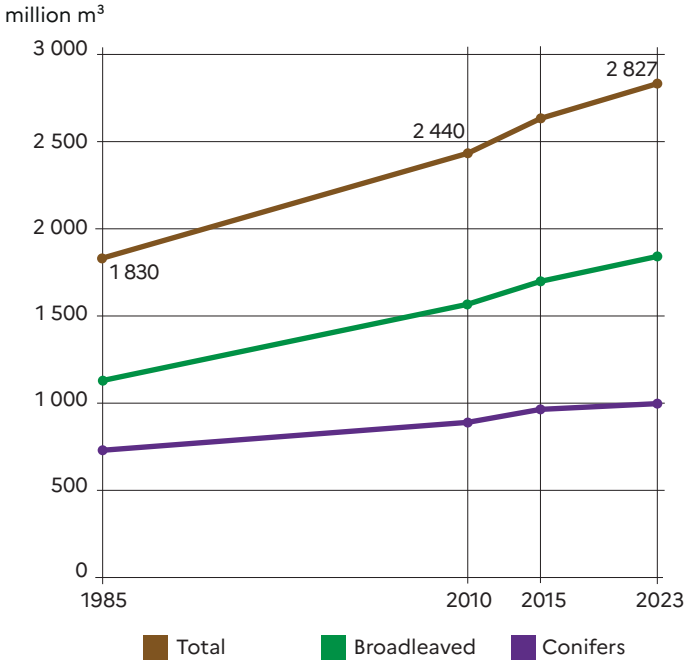
However, it has been slowing down in recent years, particularly for conifers, due to lower biological production and increased mortality and removals (see page 34 onwards).

The increase in the stock is greater for broadleaved (+65% in around forty years, or almost 720 million m^3) than for conifers (+38%, or almost 270 million m^3).

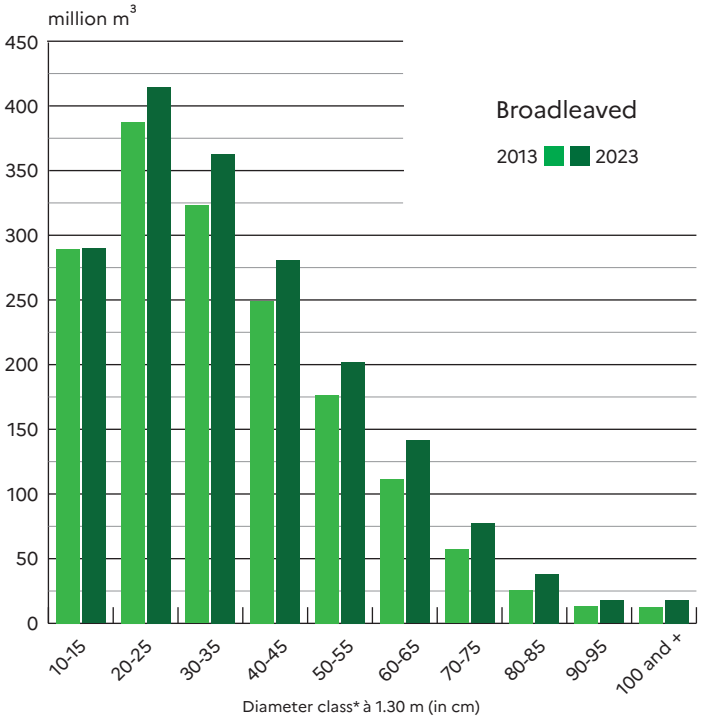
Over the last ten years, the stock has increased for all broadleaved diameter classes, except for the smallest (less than 20 cm), the stock of which has remained unchanged. For conifers, only the volumes of trees in diameter classes of 40 cm or more have increased, while the values for the smallest classes have remained statistically steady.

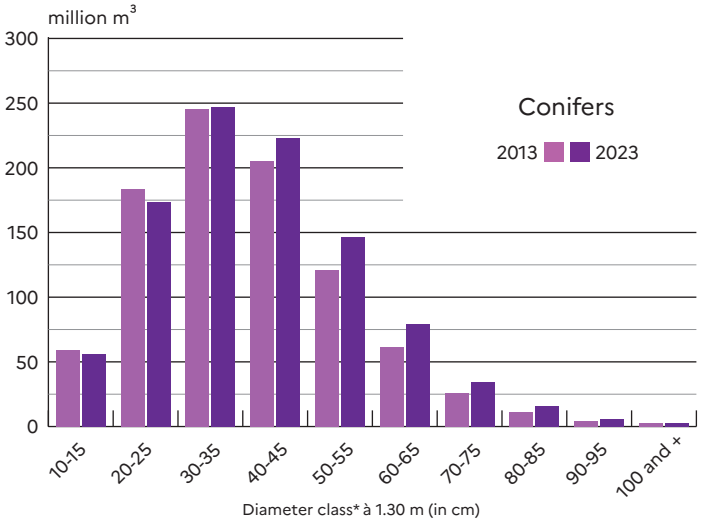
The upward trend in these diameter classes will be better described as information becomes available on stand regeneration.

CHANGES IN TOTAL BROADLEAVED AND CONIFERS VOLUME OVER THE LAST FORTY YEARS



CHANGE IN VOLUME OF LIVING WOOD OVER THE PAST TEN YEARS, BY DIAMETER CLASS AND SPECIES GROUP





* The diameter classes are centred values.
For example, class 10-15 covered [7.5 - 17.5 cm] diameters, class 20-25 covered [17.5 - 27.5 cm] diameters, etc.
Trees with a diameter of less than 7.5 cm are not counted.

VOLUME OF GROWING STOCK

As stated previously, the volume of growing stock totals 2.8 billion cubic metres. Broadleaved trees account for 65% and conifers for 35%.

Oaks (sessile, pedunculate, pubescent and holm) are the most common broadleaved species across the territory (44% of the volume of broadleaved species; this ratio has remained steady over time).

Norway spruce and silver fir together account for 40% of the volume of conifers (down from 43% ten years ago).

The average volume of growing stock per hectare is 172 m^3. It is higher in public forests (198 m^3/ha) than in private forests (163 m^3/ha).

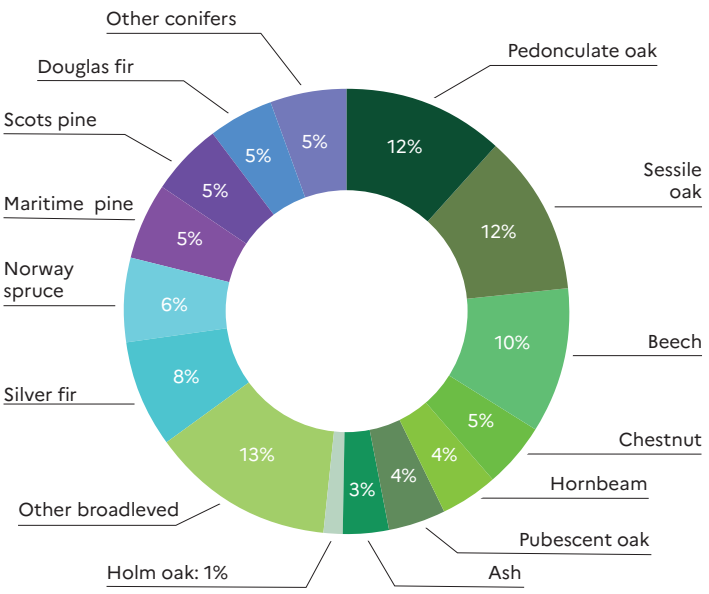
It is over 200 m^3/ha in many mountainous sylvoecoregions*. On the other hand, the lowest values are found in the south, particularly around the Mediterranean region. This is mainly due to less favourable environmental conditions, the way forest stands are managed in the Landes massif, and the storms of 1999 and 2009 that affected the South-West.

In France, the growing stock rose on average from 137 m^3 to 172 m^3 per hectare between 1985 and 2023. During this period, the number of stems per hectare decreased only slightly, so trees are larger and/or taller (the average unit volume of a tree rose from 0.19 m^3 to 0.25 m^3). This suggests that the forest is maturing in some way.

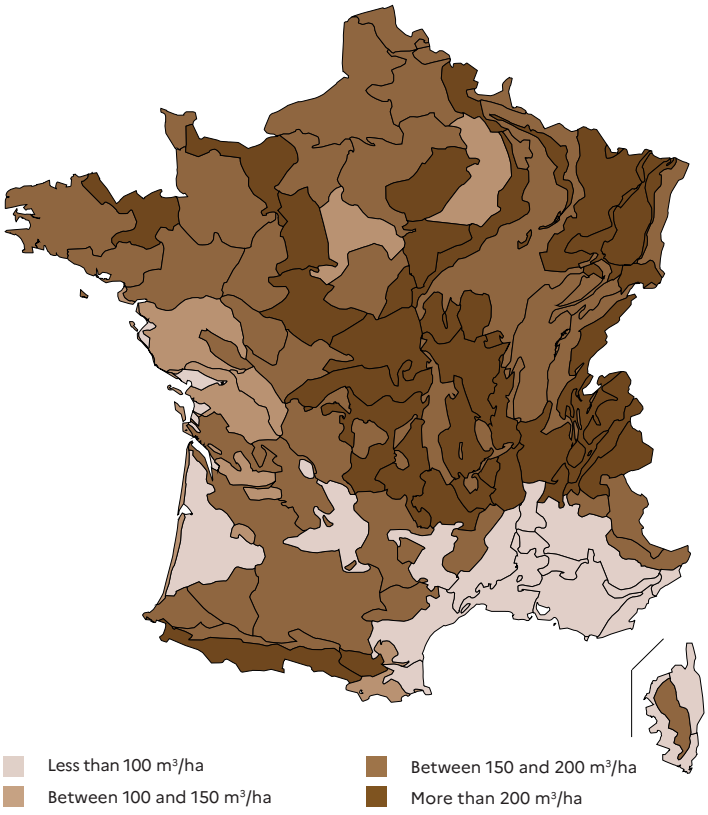
* A 'sylvoecoregion' refers to a sufficiently large geographical area, within which either the combination of values taken by the factors that determine forest production or the distribution of forest habitats is distinctive.

VOLUME OF GROWING STOCK DISTRIBUTION BY SPECIES

Conifers: 985 million m^3 Braodleaved: 1,842 million m^3



VOLUME OF GROWING STOCK PER HECTARE BY SYLVOECOREGION



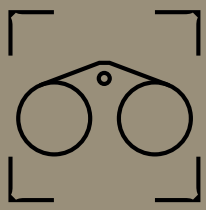
STANDING DEADWOOD

Standing deadwood and windfall were reported on more than a third of the production forest area.

Standing deadwood and windfall account for 148 million cubic metres, or 5% of total tree volume (living, dead and windfall) on average in 2023. This compares with 119 million cubic metres in 2013.

While the volume of standing deadwood over five years old remains stable (around 60 million m^3), the same is not true of the volume of trees that have been dead for less than five years. In fact, the volume of deadwood less than five years old has doubled over the last decade (see diagram), and now exceeds the volume of deadwood more than five years old. This is due to the recent sharp rise in mortality (see page 34) and partly explains the lower increase in living volume in recent years (see page 24).

The proportion of dead and windfall trees in total volume varies widely from one species to another. For example, 17% of the volume of chestnut is dead or windfall, 9% of ash, 8% of spruce, but less than 2% of sessile oak (see table on page 61).

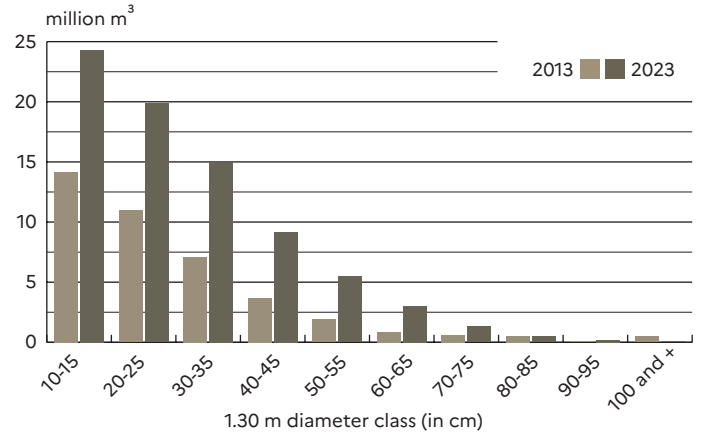


Standing deadwood: tree showing no sign of life above 1.30 m and still standing – whether broken at stem, or crown level – or not.

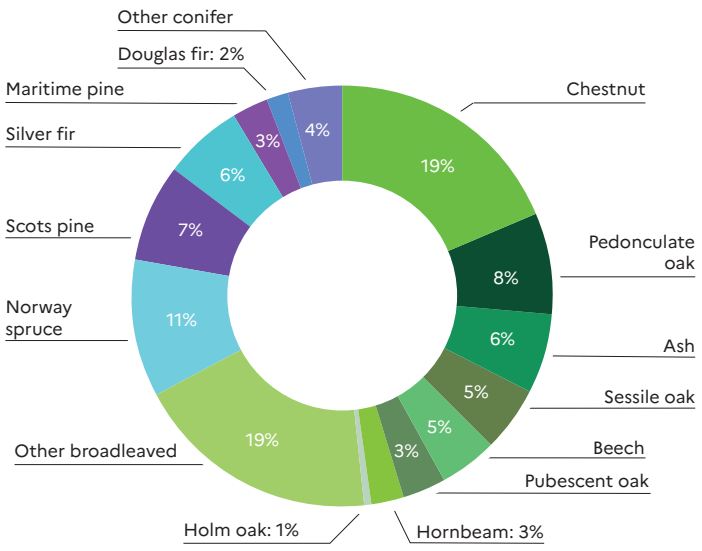
Windfall: tree uprooted by an accident, the trunk of which forms an angle of less than 30 grades with the ground, with a sign of life above 1.30 m in relation to the root collar.

On average, there is 9.0 m^3 of deadwood and windfall per hectare (compared with 6.6 m^3/ha ten years ago). As with the volume of living wood, two-thirds of the volume of standing deadwood and windfall comes from broadleaved species. However, the individual share of each species varies considerably. Chestnut, affected by various diseases, accounts for 19% of standing deadwood and windfall (28 million m^3).

CHANGE IN UNDER-FIVE-YEAR-OLD STANDING DEADWOOD BY DIAMETER CLASS



DISTRIBUTION OF STANDING DEADWOOD AND WINDFALL BY SPECIES



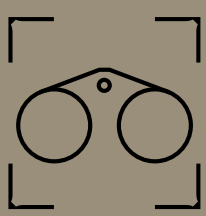
LYING DEADWOOD

Lying deadwood accounts for an average of 289 million cubic metres in 2023 and is also on the rise (262 million cubic metres in 2013).

On average, there is 18 m^3 of lying deadwood per hectare of forest. Mountainous sylvoecoregions have more lying deadwood than nearby lowland regions. This is partly due to a higher volume of living wood per hectare, a greater difficulty in exploiting the wood and tree mortality.

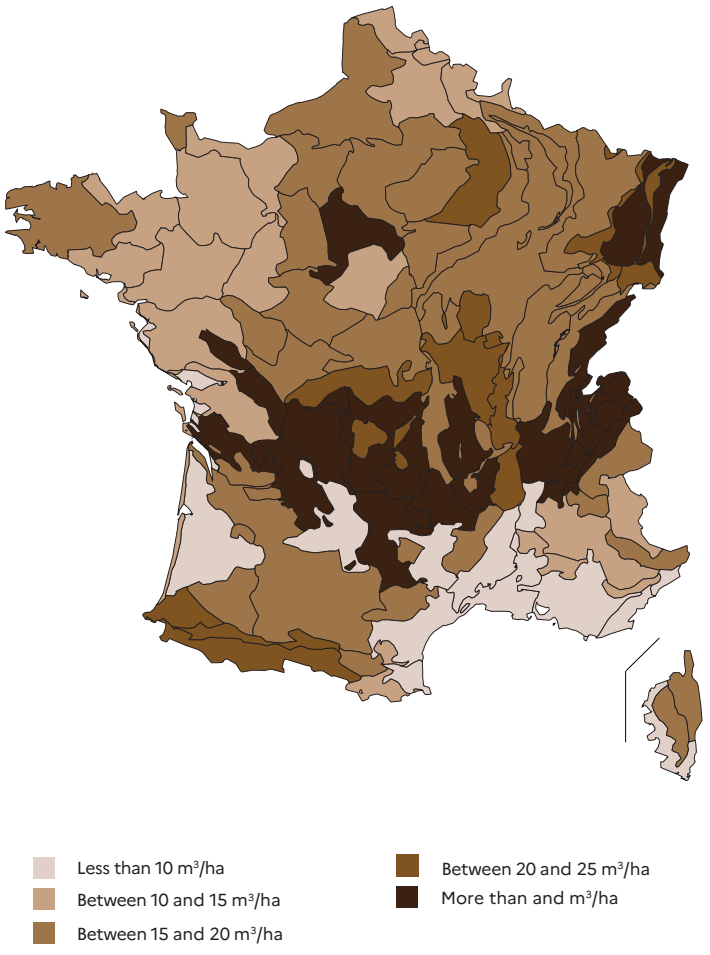
In addition, as with standing deadwood, this distribution also depends on tree species: lying deadwood is most common in chestnut (11%), silver fir, beech, sessile and pedunculate oak (each accounting for around 8% of lying deadwood) and Scots pine (7%).

Small-diameter specimens (less than 20 cm) account for around 70% of lying deadwood. More than two-thirds of the volume of lying deadwood is in advanced state of decomposition (moderate to complete decomposition, or even in an altered state).



Lying deadwood: a piece of wood (branch or trunk) detached from its stump naturally – or artificially, if the cut dates back over a year.

VOLUME PER HECTARE OF LYING DEADWOOD BY SYLVOECOREGION



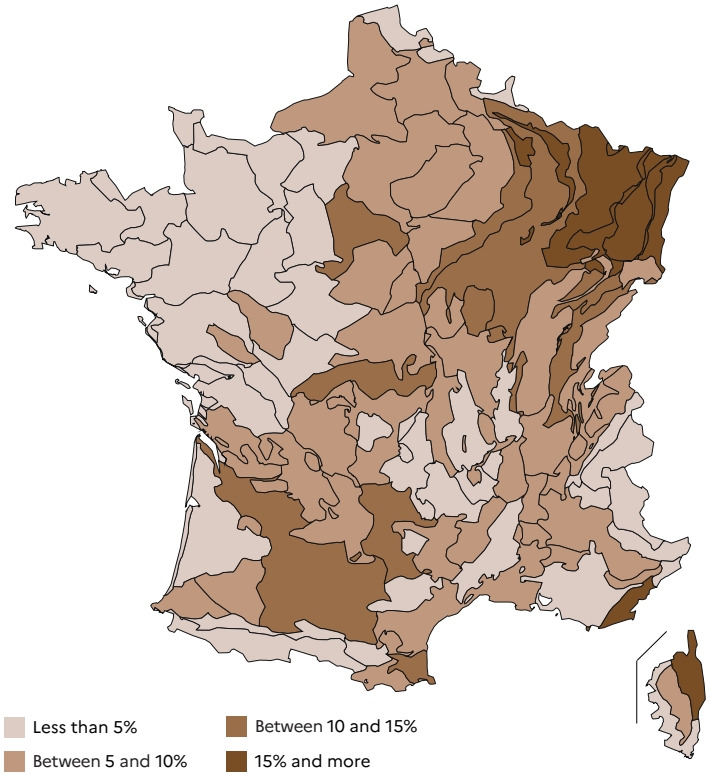
FOREST HEALTH

The increasingly unfavourable soil and climate conditions affecting trees as a result of climate change can lead to a direct deterioration in their physiological state. These conditions also make them less resistant to bio-aggressors (fungi, insects, bacteria, etc.).

To assess a tree's health, a simplified scoring system using two perennial symptomatological criteria (which do not consider foliage, which is sensitive to more occasional events) is used to provide a quick and robust appraisal of a tree's condition. They include the presence of dead branches in the upper part of the crown and the lack of needles (for conifers) or branches (for broadleaved), which is a proxy for health of living branches.

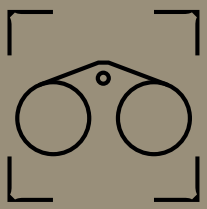
Over the period 2021-2023, France counts 186 million affected trees (living or dead standing for less than five years), out of a total of 2,270 million qualified trees. The average rate of affected forest trees is therefore 8%. The proportion is identical in terms of volume (174 million cubic metres affected).

PROPORTION OF AFFECTED FOREST TREES

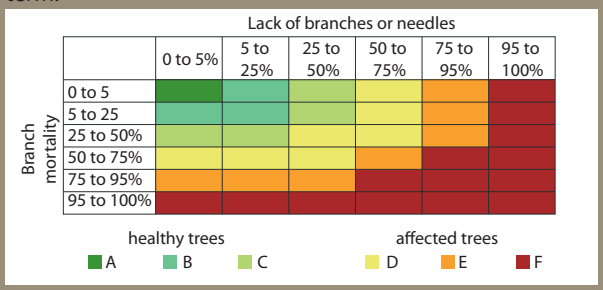


This is a minimum or seemingly minimum figure: young trees are not subject to this type of survey, trees that have deteriorated and been felled quickly are generally seen 'harvested' by IGN teams, and trees that have been dead for more than five years are not considered.

Affected trees can be found almost everywhere in France, but there are significant geographical contrasts. The highest rates are found in north-eastern France. The species most affected are ash (27% of trees of this species are damaged), chestnut (20%), pedunculate oak and Norway spruce (10%).



The state of health of the forest can be considered from several angles: habitat, soil, trees, etc. In this report, only the health of some of the trees is considered.
Collaborating with the Forest Health Department (DSF) of the Ministry responsible for forestry has enabled IGN to collect new information on trees with a diameter of at least 22.5 cm, which are not affected and have full access to light. The new information quantifies the lack of branching in deciduous trees and the lack of needles in coniferous trees. Since the 2021 survey, the combination of this information and the rate of dead branches has made it possible to give a better account of the condition of the trees, by means of a synthetic grade (from A to F). At a grade of D or above, the tree is considered to have affected. However, this does not mean that the tree will be affected in the short or longer term.



The rate of affected trees shown opposite is the ratio of the number of affected trees (D to F) to the total number of qualified trees (A to F) in each sylvoecoregion.

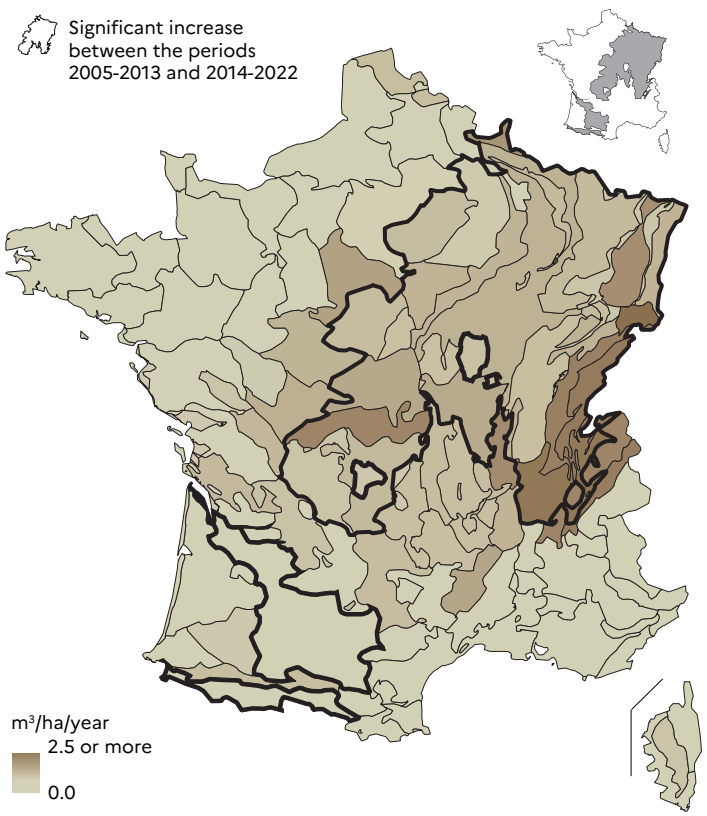
In the 2023 edition of the Memento, the condition of stands was assessed solely based on the number of dead branches on the dominant trees. With this one criterion, the rate of affected trees is 4% (it is 8% with the two perennial symptom criteria).

TREE MORTALITY

In France, annual mortality averages 15.2 million cubic metres (Mm^3/year) over the period 2014-2022, with a statistical uncertainty of around 0.6 Mm^3/year. This represents an average of 1.0 m^3/ha/year.

Mortality has continued to rise in recent years: it was 7.4 Mm^3/year over the period 2005-2013. This two-fold increase in mortality is mainly caused by health crises related to climatic conditions that are both ever more stressful for trees (drought and high temperatures) and conducive to xylophagous insects, particularly bark beetles.

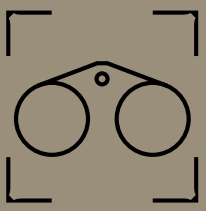
DISTRIBUTION OF MORTALITY OVER THE 2014-2022 PERIOD



Annual mortality averages 0.5% of the total volume of living standing wood. The extent of mortality varies greatly from one species and region to another.

Chestnut used to be the species with the highest mortality (1.6 Mm^3/year). Since the bark beetle crisis of 2018-2019, Norway spruce has ranked first (2.2 Mm^3/year). Ash comes third (1.4 Mm^3/year): its mortality is also rising sharply, mainly due to a fungus (chalarosis).

Mortality is increasing regardless of the type of stand (pure or mixed).



Mortality is calculated as the volume (see page 22) of recordable trees initially seen alive and found dead during the second observation of the inventory plots (five years later). The result is calculated on an annual basis. Some trees may die during the five years between the two surveys. If they are seen again cut down, they are counted in the removals (next page) and not in the mortality.

It is also possible to describe another flux: that of living trees that are cut down again five years later. It concerns 4.2 Mm^3/year over the period 2014-2022, or an average of 0.3 m^3/ha/year. This flux is also on the rise.

WOOD REMOVALS

In France, the annual volume of wood removals averages 53.1 million cubic metres (Mm^3/year) over the period 2014-2022, with a statistical uncertainty of around 2.9 Mm^3/year.

Over this period, an average of 23.8 Mm^3 of broadleaved trees and 29.4 Mm^3 of coniferous trees were felled each year. Conifers therefore account for 55% of the felled volume, although they represent only 35% of the resource.

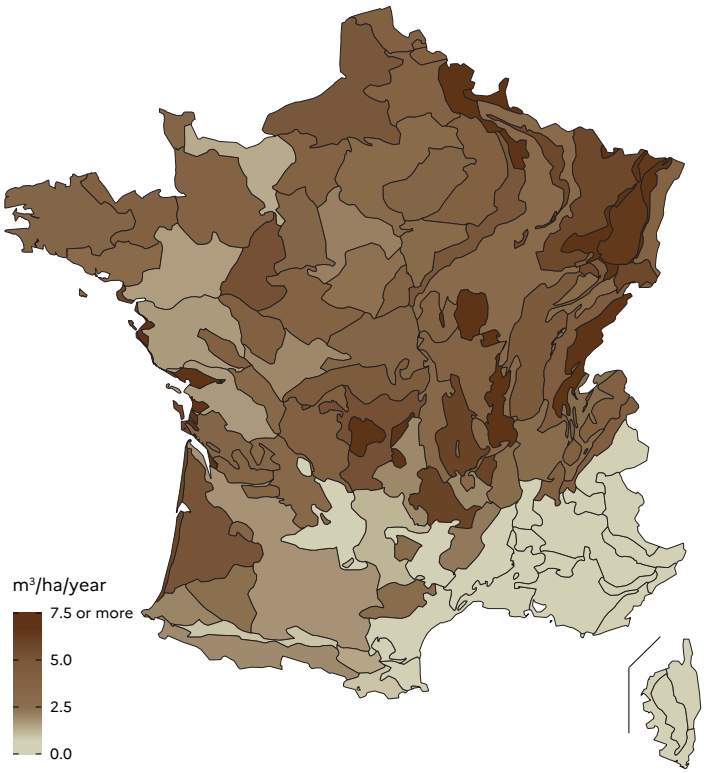
Overall removals have risen slightly over time (over the period 2005-2013, they represented an average of 47.2 Mm^3/year, including trees damaged by storm Klaus in 2009). In recent years, harvesting of coniferous trees has increased.

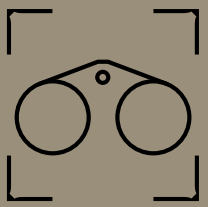
This rise is mainly due to sanitation cuttings of spruce trees that have died from drought or bark beetles. Fellings of this species has risen from 5.1 to 9.0 Mm^3/year in less than ten years. It is now the most widely removed species, ahead of maritime pine (6.7 Mm^3/year), and accounts for 17% of the volume of wood cut in forests.

The large volume of wood removals in the Vosges, Jura and Ardennes sylvoecoregions is mainly due to spruce felling. In the Massif central, Douglas fir and spruce are the main species to be cut.

Oaks (sessile, pedunculate and pubescent) account for 13% of all removals in France, or 6.9 Mm^3/year.

DISTRIBUTION OF WOOD REMOVALS OVER THE PERIOD 2014-2022





The volume of removals corresponds to the volume (see page 22) of recordable living trees in the forest and removed between two surveys (five years apart).

Some of these live trees removed during the first observation correspond to sanitation cuttings: the trees died between the two surveys. Although this volume is significant in certain species and regions, it cannot be quantified.

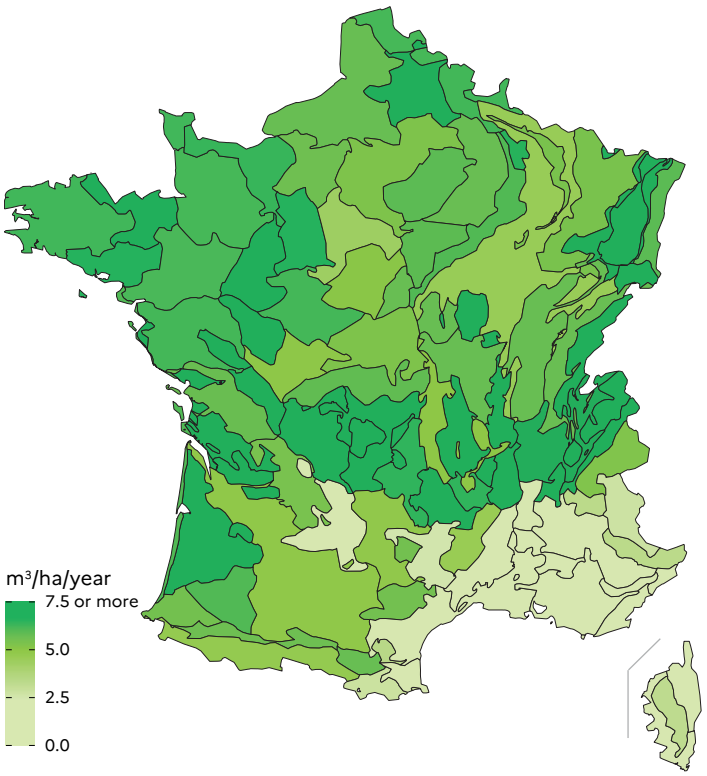
The volume of trees initially seen as dead or windfall (see page 28) and subsequently removed can also be estimated. It amounts to 2.2 Mm^3/year over the period 2014-2022, with a statistical uncertainty of around 0.3 Mm^3/year. Nearly 90% of these removed trees were whole dead trees or broken trees (around 10% windfall).

BIOLOGICAL PRODUCTION OF TREES

In France, gross annual biological production averages 87.9 million cubic metres (Mm^3/year) over the period 2014-2022, with a statistical uncertainty of around 1.3 Mm^3/year. It breaks down into 51.8 Mm^3/year for broadleaved species and 36.0 Mm^3/year for conifers.

Average annual wood production is 5.4 m^3/ha/year. The sylvoecoregions with an average annual production per hectare below the national average are around the Mediterranean area and the Causses in the south-west.

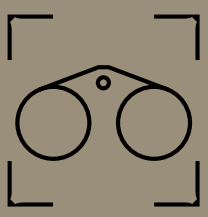
DISTRIBUTION OF BIOLOGICAL PRODUCTION OVER THE PERIOD 2014-2022



The current average annual wood production remains slightly lower than in previous years: it was 91.5 Mm^3/year (5.8 m^3/ha/year) over the period 2005-2013. This is mainly due to harsh weather conditions which affected the trees and were conducive to various pests.

This so-called 'gross' production shows the 'productivity' of growing stock. The net average annual production figure is obtained by subtracting mortality over the same period (see page 34: in France and excluding windfall, this amounts to 15.2 Mm^3/year, or 1.0 m^3/ha/year).

So-called 'net' production, which ultimately contributes to changes in the growing stock, is therefore 72.7 Mm^3/year (or 4.4 m^3/ha/year) on average over the period 2014-2022. This compares with 84.1 Mm^3/year (or 5.3 m^3/ha/year) over the period 2005-2013. Depending on the sylvoecoregion, net production varies from less than 1 to more than 7 m^3/ha/year.



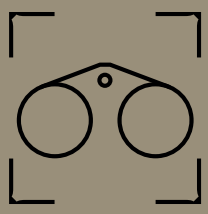
Biological production in a forest refers to the increase in wood material produced by the growth of trees over a given period. It is expressed here in terms of volume of large-diameter stem wood.

WOOD FLUX BALANCE

In France, the wood flux balance is on average + 19.5 million cubic metres (Mm³/year) over the period 2014-2022, with a statistical uncertainty of around 3.1 Mm³/year.

This breaks down into +18.6 Mm³/year for broadleaved and +1.5 Mm³/year for conifers. The flux balance for conifers is therefore close to neutral. Some species show a zero or negative balance. This is the case for ash and Norway spruce (balance of - 5.6 ± 1.8 Mm³/year; compared with + 2.1 ± 1.2 Mm³/year over the period 2005-2013).

Between 2014 and 2022, the wood flux balance (+ 19.5 Mm³/year), smoothed over the last nine years, is therefore clearly in decline (- 53%) compared with the period 2005-2013 (it was+ 41.7 Mm³/year). This drop is due to a rise in mortality, an increase in removals (partly driven by the decline in trees' health) and a fall in biological production. All these trends are statistically significant.



The wood flux balance in the forest corresponds to biological production from which removals and mortality are subtracted. The result of this balance provides information about changes in the volume of living wood in the forests: a positive balance shows an annual increase in the stock of wood, while a negative balance illustrates a decrease in the volume of wood in the forests.

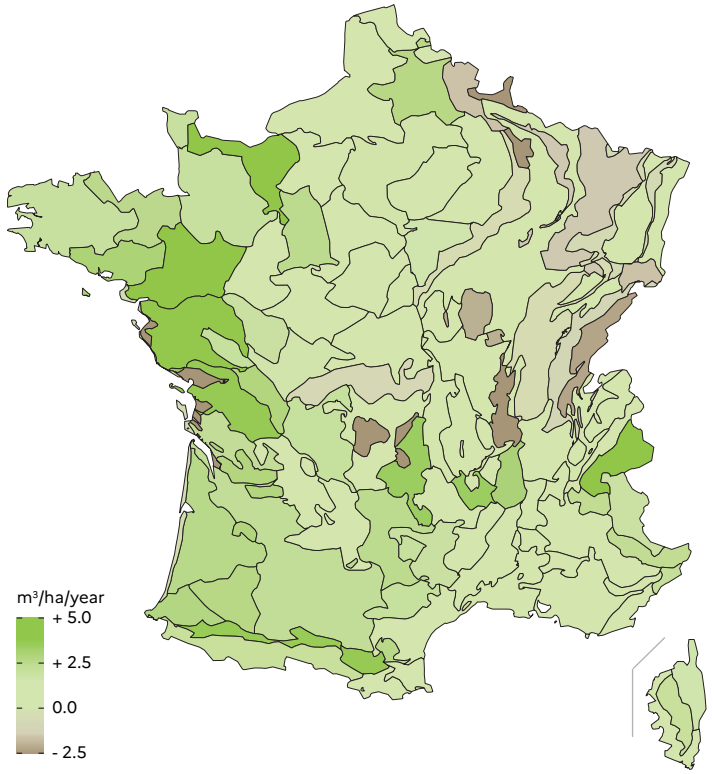
TO FIND OUT MORE:

- Read the results by administrative region on the next page, and by species in the table on pages 60-61.
- Read the booklet on wood fluxes: https://inventaire-forestier.ign.fr/?rubrique250

The average flux balance is + 1.1 m³/ha/year for France as a whole. Several sylvoecoregions in northeastern France have flux balances well below the national average, and even below zero. This is mainly due to the negative effects of successive droughts on trees, as well as to the development of pathogens or insects on tree species that are very common in these areas (spruce attacked by bark beetles and ash infected by chalarosis).

NB: The areas where the growing stock volume is decreasing – i.e., where the flux balance is negative – are not the same on the figures on pages 23 and below, due to the spatial and temporal differences between the two maps.

DISTRIBUTION OF THE WOOD FLUX BALANCE OVER THE PERIOD 2014-2022



SELECTED REGIONAL DATA

REGIONS	FOREST AREA[1]		LIVING WOOD VOLUME[1]		NUMBER OF STEM[1]	
	TOTAL FOREST (in thousand hectare)	PRODUCTION FOREST (in thousand hectare)	TOTAL (million m³)	PER HECTARE (m³/ha)	TOTAL (million stems)	PER HECTARE (stems/ha)
Île-de-France	288 ± 11	272 ± 12	53 ± 5	196 ± 16	154 ± 14	566 ± 44
Centre-Val de Loire	1,043 ± 23	1,025 ± 23	189 ± 10	185 ± 9	658 ± 34	644 ± 29
Bourgogne-Franche-Comté	1,775 ± 26	1,753 ± 27	373 ± 14	214 ± 7	1,185 ± 40	679 ± 20
Normandie	441 ± 19	433 ± 19	85 ± 8	197 ± 16	240 ± 24	556 ± 48
Hauts-de-France	496 ± 21	483 ± 21	90 ± 7	189 ± 13	252 ± 20	527 ± 35
Grand Est	1,977 ± 28	1,960 ± 28	411 ± 15	210 ± 7	1,273 ± 42	652 ± 19
Pays de la Loire	411 ± 17	398 ± 17	73 ± 7	185 ± 15	246 ± 21	624 ± 47
Bretagne	453 ± 18	439 ± 18	80 ± 7	184 ± 14	273 ± 22	626 ± 45
Nouvelle-Aquitaine	2,921 ± 40	2,828 ± 41	410 ± 17	146 ± 6	1,783 ± 62	634 ± 20
Occitanie	2,785 ± 49	2,602 ± 52	359 ± 20	139 ± 7	2,007 ± 86	778 ± 30
Auvergne-Rhône-Alpes	2,623 ± 40	2,430 ± 43	527 ± 22	219 ± 9	1,874 ± 67	778 ± 24
Provence-Alpes-Côte d'Azur	1,660 ± 34	1,461 ± 40	130 ± 11	89 ± 7	1,022 ± 68	702 ± 43
Corse	606 ± 24	469 ± 30	45 ± 9	97 ± 18	377 ± 61	810 ± 121
France	**17,479 ± 104**	**16,553 ± 111**	**2,827 ± 46**	**172 ± 3**	**11,343 ± 172**	**689 ± 9**

REGIONS	PRODUCTION[2]	REMOVALS[2]	MORTALITY[2]	FLUX BALANCE[2]	PRODUCTION[2]	REMOVALS[2]	MORTALITY[2]	FLUX BALANCE[2]
	(million m³/year)				(m³/ha/year)			
Île-de-France	1.4 ± 0.1	0.6 ± 0.2	0.2 ± 0.1	0.5 ± 0.2	5.0 ± 0.3	2.3 ± 0.7	0.9 ± 0.3	1.8 ± 0.8
Centre-Val de Loire	5.6 ± 0.2	2.8 ± 0.5	1.2 ± 0.1	1.7 ± 0.5	5.5 ± 0.2	2.9 ± 0.5	1.2 ± 0.1	1.4 ± 0.5
Bourgogne-Franche-Comté	10.3 ± 0.3	8.5 ± 1.0	2.7 ± 0.3	-1.0 ± 1.1	5.9 ± 0.2	5.0 ± 0.6	1.6 ± 0.2	-0.7 ± 0.6
Normandie	2.6 ± 0.2	1.6 ± 0.4	0.2 ± < 0.05	0.8 ± 0.4	6.1 ± 0.4	3.8 ± 0.8	0.4 ± 0.1	1.8 ± 0.9
Hauts-de-France	2.8 ± 0.2	1.9 ± 0.4	0.4 ± 0.1	0.5 ± 0.4	6.0 ± 0.3	4.3 ± 0.8	0.8 ± 0.2	0.8 ± 0.9
Grand Est	12.2 ± 0.4	10.0 ± 1.0	2.5 ± 0.3	-0.3 ± 1.1	6.3 ± 0.2	5.3 ± 0.5	1.3 ± 0.2	-0.3 ± 0.5
Pays de la Loire	2.6 ± 0.2	1.6 ± 0.5	0.2 ± 0.1	0.8 ± 0.5	6.7 ± 0.4	4.1 ± 1.2	0.6 ± 0.2	2.0 ± 1.2
Bretagne	2.9 ± 0.2	1.4 ± 0.5	0.3 ± 0.1	1.2 ± 0.5	6.6 ± 0.4	3.4 ± 1.1	0.7 ± 0.2	2.5 ± 1.2
Nouvelle-Aquitaine	18.8 ± 0.7	12.0 ± 1.4	1.9 ± 0.2	4.9 ± 1.6	6.7 ± 0.2	4.3 ± 0.5	0.7 ± 0.1	1.7 ± 0.6
Occitanie	9.9 ± 0.5	3.4 ± 1.0	1.6 ± 0.2	4.9 ± 1.1	3.9 ± 0.2	1.5 ± 0.4	0.7 ± 0.1	1.7 ± 0.5
Auvergne-Rhône-Alpes	14.7 ± 0.6	8.7 ± 1.6	3.2 ± 0.3	2.7 ± 1.7	6.1 ± 0.2	3.6 ± 0.7	1.4 ± 0.1	1.1 ± 0.7
Provence-Alpes-Côte d'Azur	3.0 ± 0.2	0.6 ± 0.3	0.6 ± 0.1	1.9 ± 0.4	2.1 ± 0.1	0.4 ± 0.2	0.4 ± 0.1	1.3 ± 0.3
Corse	1.0 ± 0.2	< 0.05 ± < 0.05	0.2 ± 0.1	0.8 ± 0.2	2.1 ± 0.3	0.1 ± 0.1	0.4 ± 0.3	1.6 ± 0.4
France	**87.9 ± 1.3**	**53.1 ± 2.9**	**15.2 ± 0.6**	**19.5 ± 3.1**	**5.4 ± 0.1**	**3.3 ± 0.2**	**1.0 ± < 0.05**	**1.1 ± 0.2**

(1) 2019-2023 average

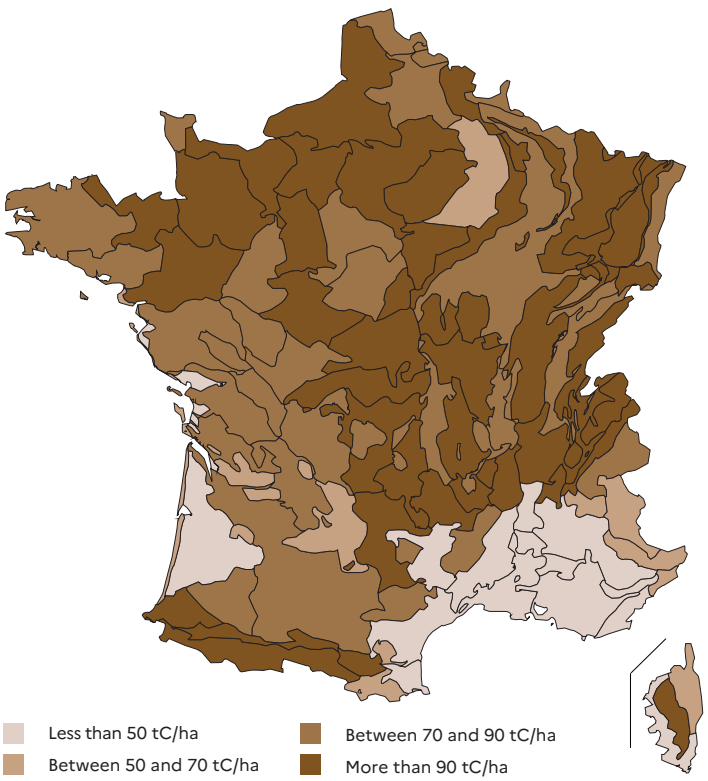
(2) Reference period 2014-2022

CONTRIBUTION TO GREENHOUSE GAS MITIGATION

As they grow, trees absorb carbon from the atmosphere and store it in wood, a sustainable and renewable material. IGN counts 11.3 billion trees in 2023, representing a stock of 1,300 million tonnes of carbon*. Forests have the capacity to mitigate the greenhouse effect. This stock changes continuously depending on the intensity of incoming (production) and outgoing (mortality, harvesting) wood fluxes. Thus, when the flux balance is positive, the carbon stock in the forest increases, reducing the amount of CO_2 in the atmosphere. Conversely, if the balance is negative, the stock decreases and forests add to it.

* The total carbon pool of the forest ecosystem is estimated at 2.8 billion tonnes of carbon, distributed between living recordable trees (45% of the carbon pool; see definition p. 22), dead trees (4%), the plant litter that covers the ground (5%) and the organic matter contained in the top 30 centimetres of soil (46%).

CARBON STOCK PER HECTARE BY SYLVOECOREGION



Mainland France's forests have absorbed an average of 39 million tonnes of CO_2 per year over the period 2014-2022 (net balance). As a result, the carbon stock grew by 17% between 2009 and 2023. Each hectare of forest now contains an average of 81 tonnes of carbon in its growing stock, compared with an average of 73 tonnes in 2009. This dynamic of wood and carbon capitalization in forests goes back much further (see page 27), with an average stock of 58 tonnes of carbon per hectare in 1981.

Although this stock is still increasing, in recent years there has been a noticeable slowdown in this dynamic due to the multiplication of health crises (spruce bark beetles, ash chalarosis, chestnut dieback, etc.) combined with episodes of severe drought and heatwave. By way of comparison, the net balance was 63 million tonnes of CO_2 per year over the period 2005-2013.

Given the scale of crises such as the bark beetle crisis in the north-east of France, some forests are experiencing mortality and harvesting levels (particularly sanitation cuttings) that are higher than biological production. Forest stocks, which have taken years to build up, are suddenly falling. This effect is mitigated by a temporary increase in the amount of dead wood.

However, the dynamics of forest areas should be analysed over the long term, as numerous factors, both cyclical (natural disasters, health crises, drought, etc.) and structural (age of stands, state of renewal, etc.), are constantly modifying the fluxes and therefore the evolution of the stock.

While forests are assets in the fight against the amplification of the greenhouse effect, it appears that they are equally subject to it. Renewing affected forests in favour of more resilient stands is a key condition for maintaining the supply of goods and services we expect from forest ecosystems.

© IGN - M. Dalmasso / Orchid of the genus *Epipactis*

FOREST ECOSYSTEMS

The diversity of forest ecosystems leads to a varied spatial distribution of tree species and plant species across the territory. It also influences species richness and stand categories.

THE MAIN FOREST TREE SPECIES

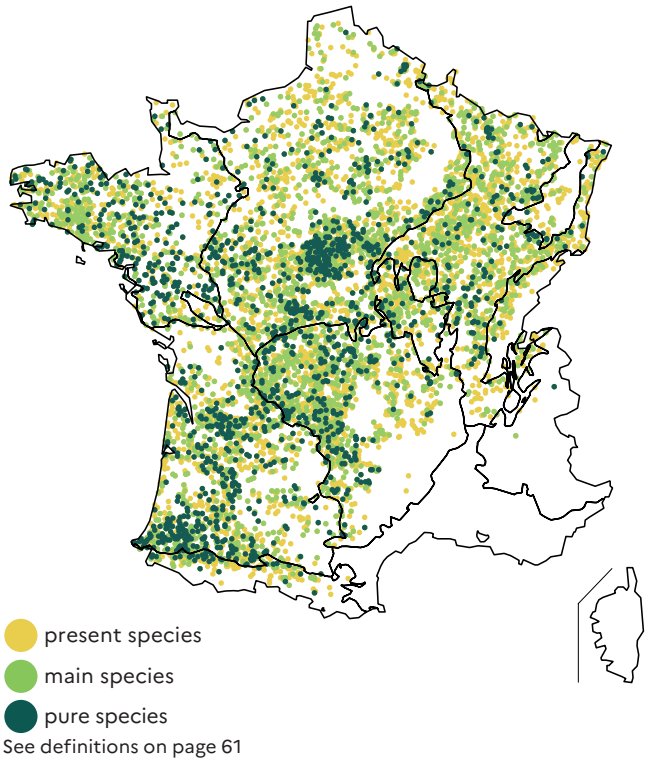
PEDUNCULATE OAK

The pedunculate oak is found over most of the country, except for the south-east. It is the most represented species as a main species in a stand (2.2 million hectares). It is often surrounded by other species, notably hornbeam, beech, ash, chestnut or Scots pine.

Large and very large trees are well represented (9% of stems of this species, compared with 2% for all broadleaved trees combined).

Nearly 5% of trees in this species have at least 25% dead branches in their crowns, and the larger the tree, the more dead branches.

The majority (63%) of this species' wood volume is found in private forests without a simple management plan.



See definitions on page 61

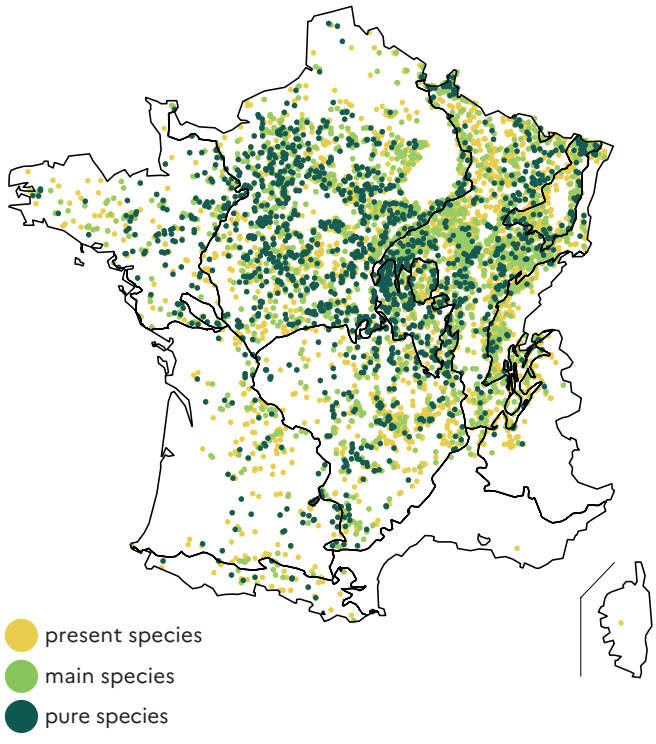
SESSILE OAK

Sessile oak occurs over a large part of the country and is more often found in pure stands than pedunculate oak. When it is in a mixed stand, it is often surrounded by other species such as beech, hornbeam, pedunculate oak, ash or Scots pine.

Large and very large trees are well represented (7% of stems of this species, compared with 2% for all broadleaved trees combined).

Nearly 3% of trees in this species have at least 25% dead branches in their crowns, regardless of diameter class.

This oak species appears to be more frequently managed than other species, since 37% of the wood volume is in public forest, 30% in private forest with a simple management plan and only 33% in private forest without one.



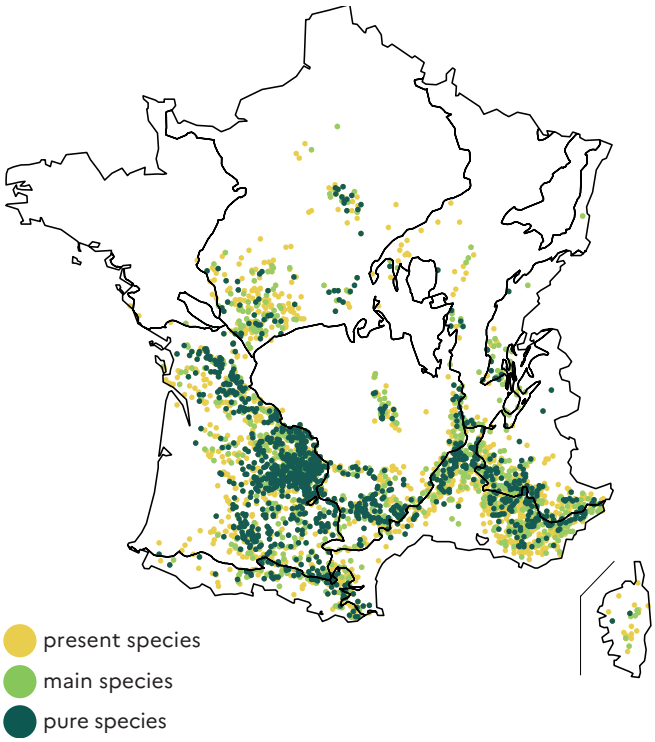
PUBESCENT OAK

Pubescent oak is found mainly in the south of the country, in warm or dry areas. It is often found in pure stands, especially in the southwest. When it is in a mixed stand, it is notably surrounded by Scots pine or other pines, holm oak or pedunculate oak.

Trees are typically of small size (87% of stems are small-wooded).

Nearly 5% of trees in this species have at least 25% dead branches in their crowns, and the larger the tree, the more dead branches.

Nearly all the wood volume of this species occurs in private forests, notably those without a simple management plan (87% of volume).



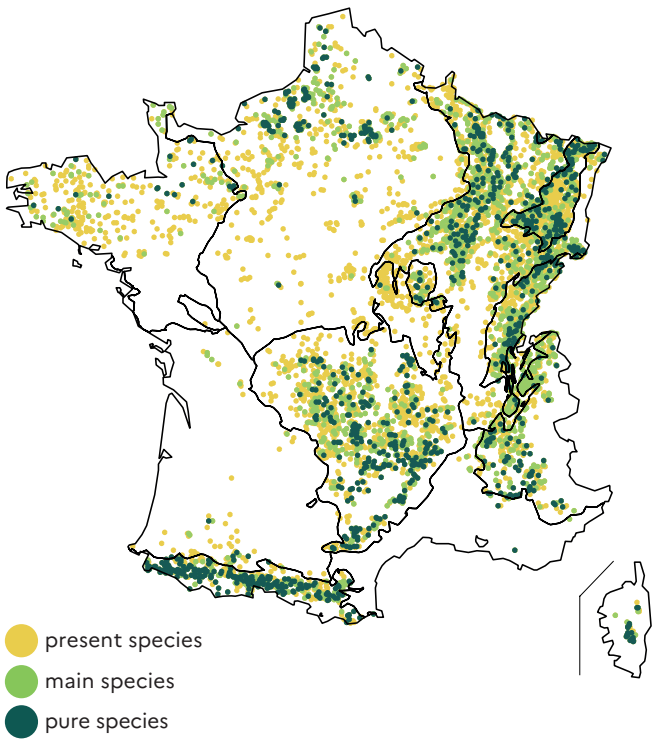
BEECH

Beech occurs in the northern half of the country and in the mountains. It is the most common tree species (6 million hectares), often found alongside other species: oaks on the plains, silver fir or spruce in the mountains, or ash, hornbeam or Scots pine.

The distribution of diameter classes follows the average for the broadleaved considered here (75% of trees are small wood, 22% medium wood and 4% large or very large wood).

Nearly 2% of trees of this species have at least 25% dead branches in their crowns - twice as many as a decade ago.

The volume is distributed almost equally between public and private forests. Private forests without a simple management plan account for 40% of this species' volume (which represents 57% of forest area).



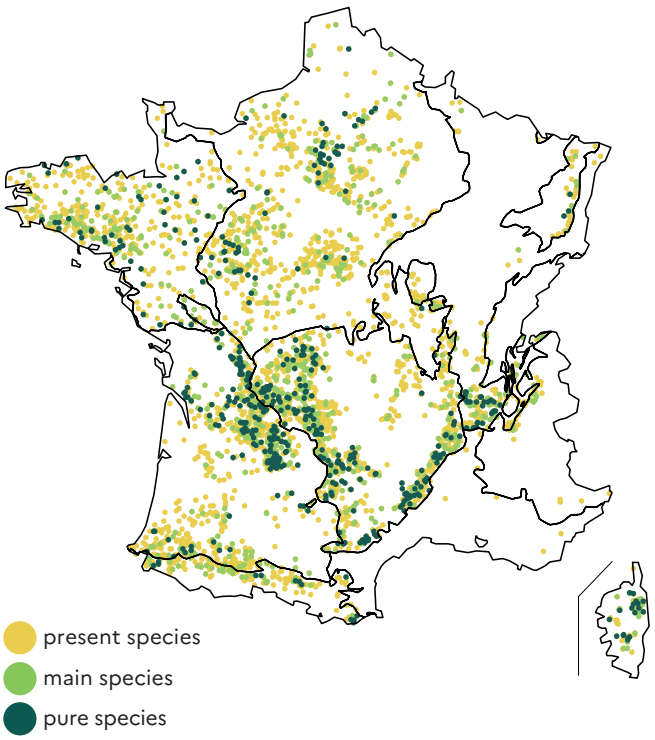
CHESTNUT

Chestnut is more common in western France, on non-calcareous soils. It is often mixed with other species, mainly pedunculate or holm oak, Scots pine or other pines.

Trees are often smaller (80% of stems are of small size).

The species has a high proportion of trees with at least 25% dead branches in the crown (15% of trees), and the larger the tree, the greater the proportion (nearly 35% of very large trees).

Almost all the wood volume of this species is found in private forests, notably those without a simple management plan (three quarters of the volume).



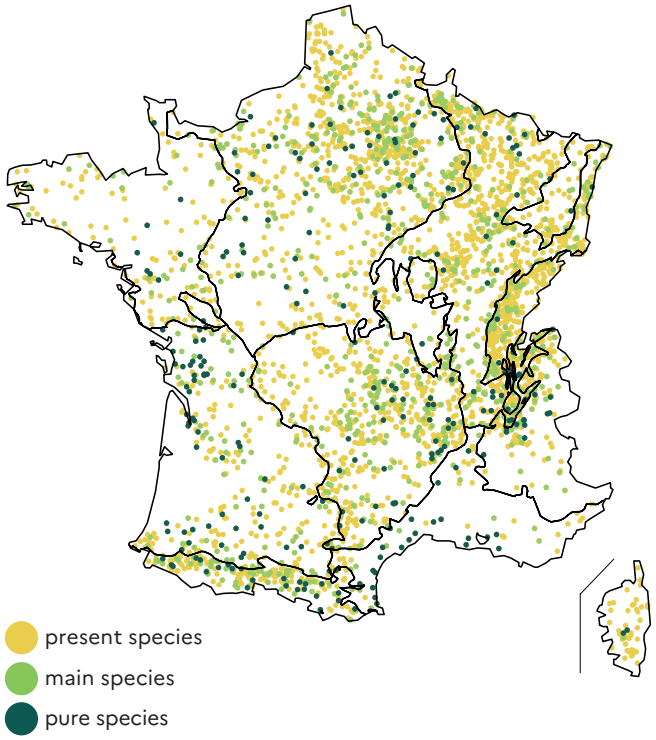
ASH

Ash is a frequent accompanying species (5.5 million hectares), often mixed with other broadleaved species. It is found across a large part of the country, mainly on cool areas.

Large ash trees are a rare occurrence (less than 2% of stems are large or very large).

It is the species presenting the most trees with at least 25% dead branches in their crowns (18% of trees). Affected by ash dieback, the health of this species has deteriorated (2% of ash trees were in this condition ten years ago). Over the period 2014-2022, the ash flux balance is close to zero (see page 61).

A large proportion of this species' wood volume is in private forests, notably those without a simple management plan (77% of volume).



MARITIME PINE

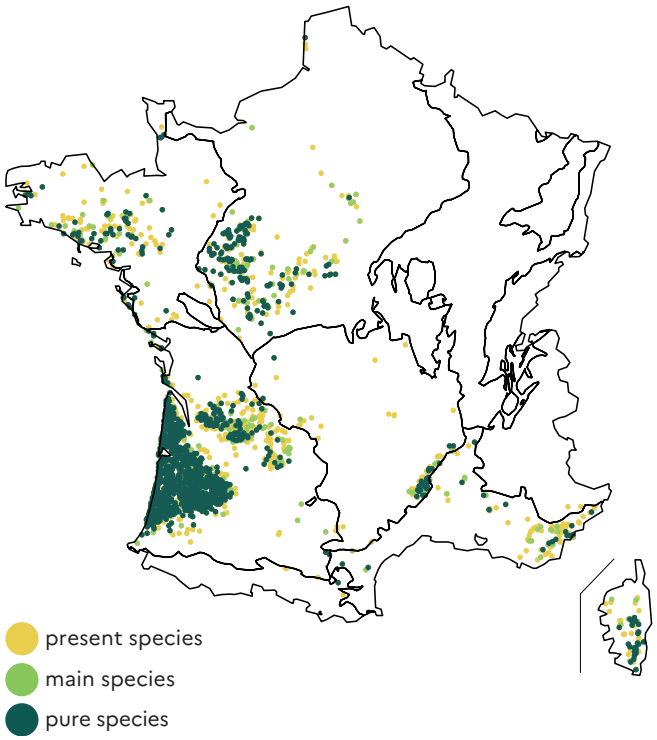
Maritime pine is the most common coniferous species in main species and pure stands (786,000 ha), particularly in the Landes de Gascogne.

Smaller trees are more common than for other conifers (70% of stems), notably due to the storms that hit the Landes Forest hard in 1999 and 2009, resulting in significant renewal and rejuvenation of the forest and its resources.

This species* is the most represented in private forest with a simple management plan (41%).

It used to be the most widely harvested species until the spruce beetle crisis (see page 37).

* Among those presented in this handbook



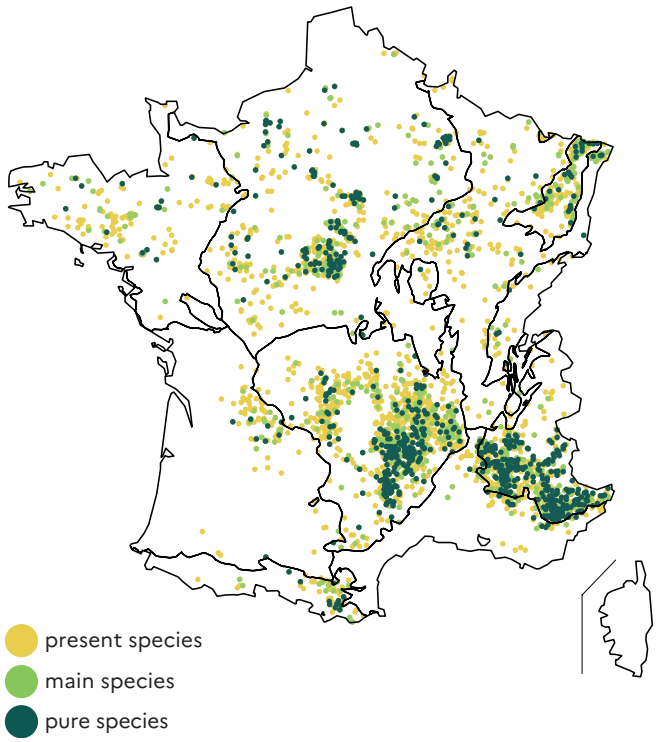
SCOTS PINE

Scots pine is the most common coniferous species found in stands (2.4 million hectares) in both northern and southern France. When it is found in mixtures, it is with other conifers as well as other broadleaved.

The diameter class distribution is close to the average for conifers presented here, but with fewer large and very large trees (62% of trees are small, 36% medium and 2% large or very large).

This species is in relatively poor health compared with conifers, with more dead branches, particularly in very large trees, and dead trees account for 7% of the volume (see page 61).

Ownership of this species is similar to the average in all species: almost three-quarters of volume is in private forest, and 58% of volume is in private forest without a simple management plan.

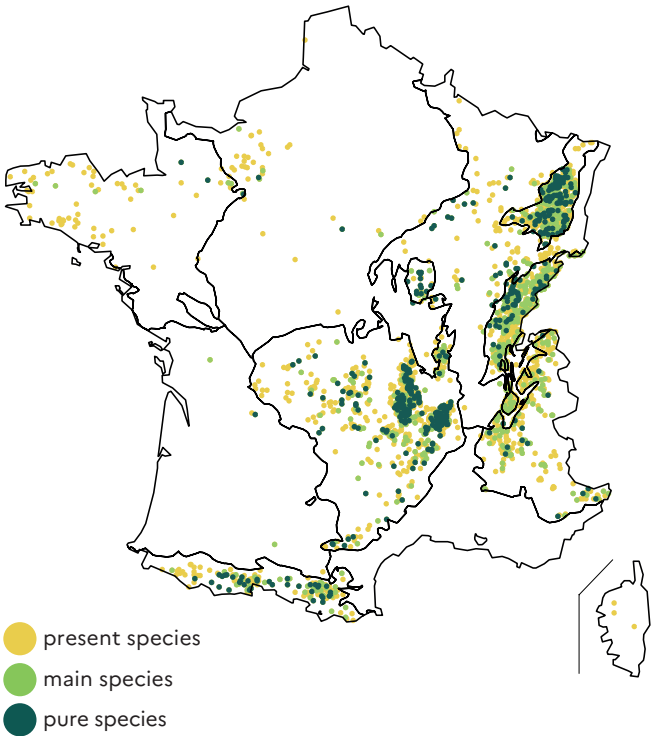


SILVER FIR

Silver fir is very common in mountain stands, where it can be pure or mixed, notably with beech or Norway spruce.

The diameter class distribution is close to the average for conifers presented in this handbook, but with a strong representation of large wood (62% of trees are small wood, 31% medium wood and 7% large or very large wood).

The volume splits into two almost equal parts between public and private forests. Private forests without a simple management plan account for 35% of this species' volume.



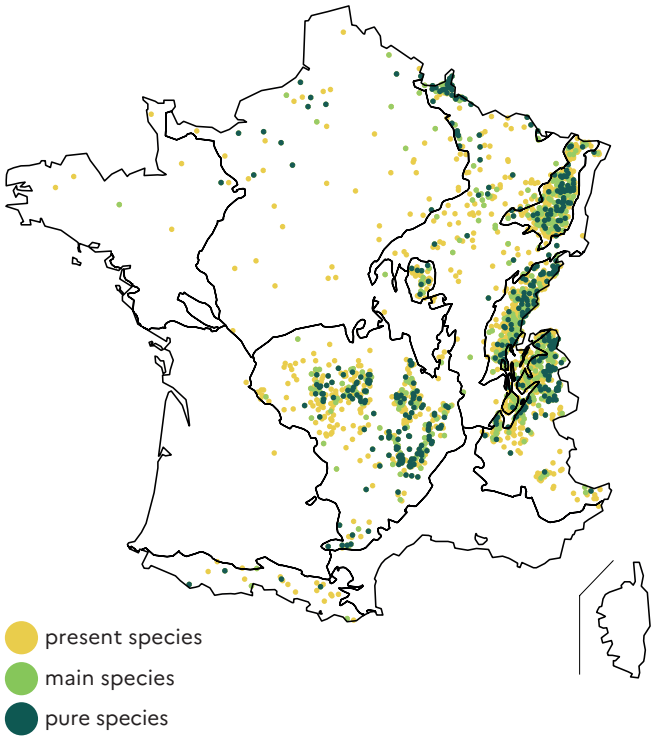
NORWAY SPRUCE

Norway Spruce is native to the mountain ranges of eastern France (often mixed with beech and silver fir), introduced (often in pure stands) to the Massif central, the Ardennes and the plains of the northeast, where it thrives in non-calcareous soil and cool climate.

Nowadays, due to droughts, bark beetle attacks and the ensuing sanitary cuttings, it is the most removed coniferous species, and the one with the highest mortality. As a result, it is one of the only species with a negative flux balance.

Medium-sized trees are well represented (41% of stems).

Public forests account for a large proportion (42%) of this species' wood volume. 42% of this species' volume is found in private forests without a simple management plan.

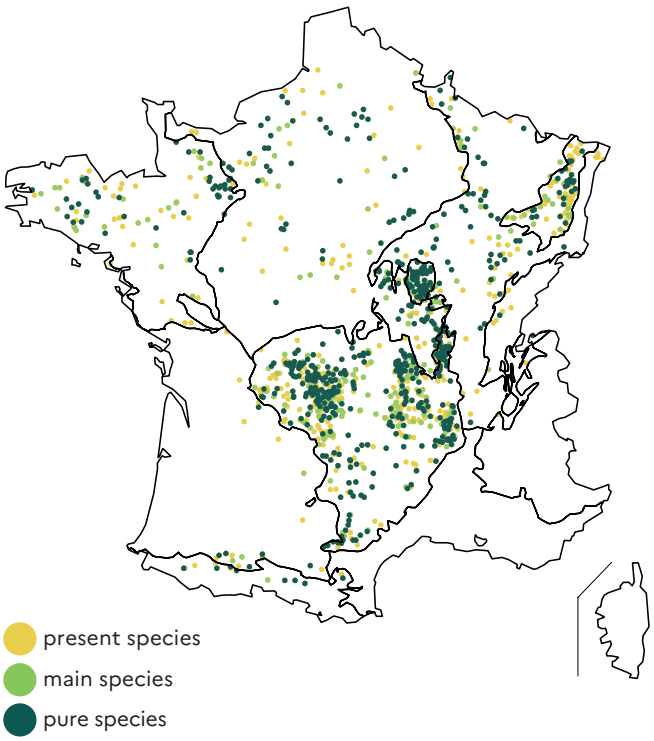


DOUGLAS FIR

Douglas fir - an introduced species - is found mainly in mid-mountain regions (Limousin plateau and northeastern Massif central, Morvan, Vosges). It covers more than a million hectares, of which 300,000 ha are pure Douglas-fir stands (see page 60).

It is the species with the highest average tree volume (0.7 m^3). Trees with a diameter of at least 47.5 cm at 1.30 m (medium, large and very large wood) are highly represented (48% of stems; a sign that the resource is massively reaching harvesting diameter. This often means clear-cutting in pure stands.

Over 83% of this species' timber volume is found in private forests, almost half of which is covered by a simple management plan.



ADDITIONAL INFORMATION ON TREE SPECIES

IGN collects information on almost 190 tree species, gathered into 70 species groups. The tree species presented on the preceding pages and on the following double page spread account for around 70% of the surface area of the main tree species and of the volume of living standing wood.

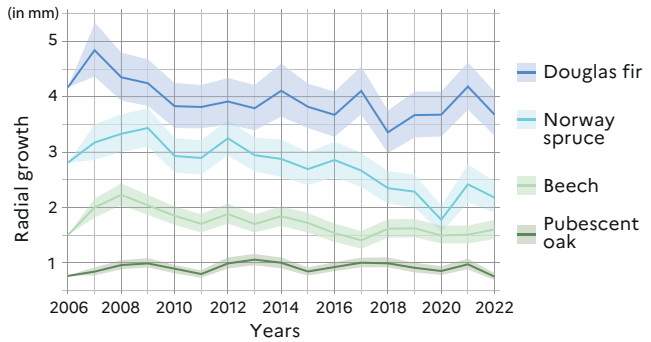
In addition, information on many fewer common species is also provided – although with less statistical precision.

CLICK BELOW TO ACCESS
INFORMATION ON SECONDARY SPECIES:

inventaire-forestier.ign.fr/?rubrique250

Moreover, the growth chronologies of twelve forest species are updated annually and available at the scale of large ecological regions (GRECO). They enable us to visualize temporal and spatial variations in growth anomalies resulting from climate conditions.

GROWTH ANOMALIES IN FOUR TREE SPECIES



CLICK BELOW TO VISUALIZE GROWTH ANOMALIES:

inventif.ign.fr/croissance/

KEY FIGURES ON TREE SPECIES

SPECIES	SURFACE AREA[1] (in thousands hectares)			STANDING WOOD VOLUME[1]				
	where species is present[2]	where species is main species[3]	where species is pure[4]	living wood (million m³)	% medium wood	% large wood	deadwood and windfall (million m³)	% dead trees and windfall [5]
Pedunculate oak	5,652 ± 94	2,210 ± 67	734 ± 41	333 ± 12	45	30	12 ± 1	3
Sessile oak	4,151 ± 81	1,843 ± 58	777 ± 39	333 ± 13	46	29	7 ± 1	2
Pubescent oak	3,254 ± 85	1,413 ± 62	841 ± 49	117 ± 7	43	6	5 ± 1	4
Beech	6,050 ± 92	1,500 ± 59	592 ± 39	294 ± 15	47	24	7 ± 1	2
Chestnut	3,440 ± 84	686 ± 42	266 ± 27	133 ± 9	51	8	28 ± 3	17
Ash	5,560 ± 104	622 ± 41	137 ± 19	96 ± 6	54	15	9 ± 1	9
Hornbeam	4,666 ± 78	622 ± 36	71 ± 13	122 ± 5	41	3	4 ± < 0.5	3
Holm oak	1,884 ± 66	801 ± 51	456 ± 41	34 ± 4	22	3	1 ± < 0.5	3
Maritime pine	1,540 ± 54	1,027 ± 44	786 ± 40	153 ± 12	56	21	4 ± 1	3
Scots pine	2,438 ± 76	893 ± 49	481 ± 38	148 ± 9	68	14	11 ± 1	7
Silver fir	2,501 ± 69	563 ± 36	237 ± 24	218 ± 18	49	30	9 ± 2	4
Norway spruce	1,846 ± 60	494 ± 34	241 ± 24	178 ± 16	60	24	16 ± 3	8
Douglas fir	1,157 ± 49	443 ± 32	296 ± 26	135 ± 17	57	29	3 ± 1	2

SPECIES	NUMBER OF STEMS [1]		PRODUCTION [6]	REMOVALS [6]	MORTALITY [6]	FLUX BALANCE [6]
	Living tree (million stems)	Average volume per stem m³	(million m³/year)			
Pedunculate oak	620 ± 24	0.5	7.0 ± 0.2	2.9 ± 0.5	1.1 ± 0.2	2.9 ± 0.5
Sessile oak	642 ± 31	0.5	6.9 ± 0.3	3.4 ± 0.4	0.7 ± 0.1	2.7 ± 0.5
Pubescent oak	961 ± 60	0.1	2.5 ± 0.2	0.5 ± 0.3	0.4 ± 0.1	1.6 ± 0.3
Beech	912 ± 53	0.3	6.8 ± 0.3	3.9 ± 0.6	0.7 ± 0.2	2.1 ± 0.6
Chestnut	710 ± 49	0.2	4.2 ± 0.3	1.8 ± 0.4	1.6 ± 0.2	0.8 ± 0.5
Ash	383 ± 25	0.3	3.0 ± 0.2	2.1 ± 0.5	1.4 ± 0.2	-0.5 ± 0.5
Hornbeam	1,035 ± 41	0.1	4.2 ± 0.2	1.9 ± 0.3	0.5 ± 0.1	1.7 ± 0.3
Holm oak	798 ± 74	< 0.05	0.8 ± 0.1	0.1 ± 0.1	0.1 ± < 0.05	0.6 ± 0.1
Maritime pine	484 ± 38	0.3	9.5 ± 0.6	6.7 ± 1.0	0.3 ± 0.1	2.6 ± 1.2
Scots pine	495 ± 38	0.3	3.7 ± 0.2	1.9 ± 0.5	1.0 ± 0.2	0.8 ± 0.6
Silver fir	380 ± 28	0.6	6.5 ± 0.5	4.2 ± 0.8	0.9 ± 0.3	1.4 ± 1.0
Norway spruce	302 ± 25	0.6	5.6 ± 0.4	9.0 ± 1.7	2.2 ± 0.6	-5.6 ± 1.7
Douglas fir	194 ± 19	0.7	6.2 ± 0.6	4.9 ± 1.6	0.2 ± 0.1	1.1 ± 1.7

(1) Average for period 2019-2023
(2) Presence of at least one recordable tree of the species on the plot.
(3)Recordable trees of the species account for the highest relative canopy cover on the plot.
(4) Recordable trees of the species account for more than 75% of the plot's relative canopy cover.
(5) The percentage of dead trees and windfall is the ratio between the stock of standing deadwood and living windfall and the total stock (living and standing deadwood and living windfall).
(6) Reference period: 2014-2022

TREES SPECIES RICHNESS

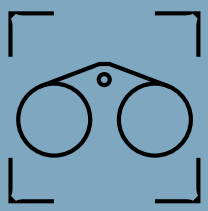
On average, a forest inventory plot comprises 5.0 tree species. This richness is increasing in France. Ten years ago, a forest inventory plot contained an average of 4.9 tree species.

The *Landes de Gascogne* and the *Marais littoraux* are the sylvoecoregions with the lowest average species richness, with less than two species per plot. Meanwhile, the Plateaux calcaires du Northeast and the Premier plateau du Jura sylvoecoregions have an average of seven different tree species. Overall, this average species richness is lower in the Mediterranean region and higher in the north-east (see map).

CLICK BELOW TO SEE BIODIVERSITY INDICATORS:

inventif.ign.fr/biodiversite/

(Including the *Arbres/Indicateurs de diversité/Richesse spécifique des arbres/Richesse spécifique par territoire* tabs)



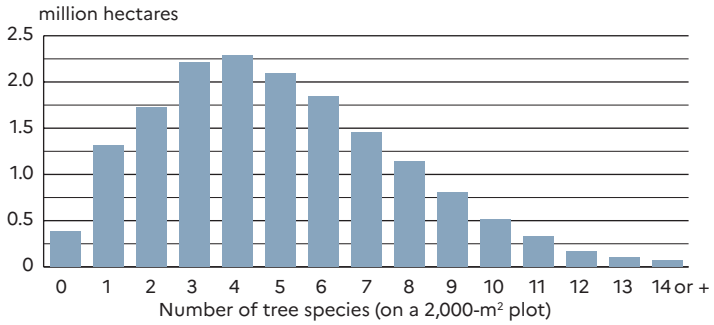
The specific tree richness is used to measure the diversity in forest stands by counting the number of different tree species in recordable trees observed – i.e. trees with a diameter of at least 7.5 cm at a height of 1.30 m.

It applies to a given surface area. For the inventory, total species richness is calculated for a plot of 2,000 m² (25 m radius) and corresponds to the total number of species for which at least one tree can be counted. The average species richness can then be calculated at the scale of an area, in this case a sylvoecoregion. It corresponds to the average number of species recorded on the plots in the area.

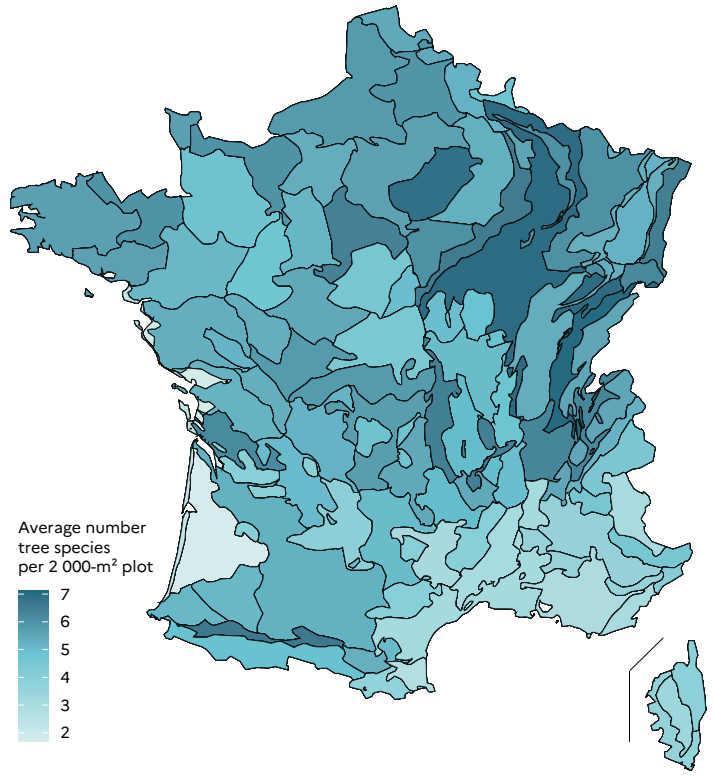
In France, 1.7 million hectares of forest are composed of less than two species, whereas 1.2 million hectares of forest have at least ten different species (see graph below).

On a regional scale, species richness is an average. Local and intra-plot trends may differ. In almost all the sylvoecoregions, some plots were recorded with at least ten tree species or with no countable trees (very young stands or temporarily deforested plots).

FOREST AREA BY TREE SPECIES RICHNESS



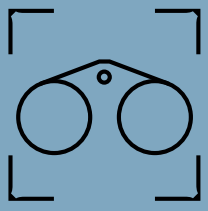
AVERAGE SPECIES RICHNESS BY SYLVOECOREGION



FOREST STAND CATEGORIES

Just under half of the forest* comprises pure stands: in 4.5 million hectares, a single broadleaved species prevails (most often beech or pubescent, sessile, pedunculate or holm oak) and in 2.6 million hectares, a single conifer species stands out (most often maritime or Scots pine).

On the remaining 8.2 million hectares of forest, the tree species are more mixed - generally a mixture of broadleaved trees, or conifers and broadleaved trees, and more rarely conifers.



Cross-referencing data* on stand diversity and composition provides information on the main categories of stands, according to the following table:

How many species count for at least 75% of the canopy?	Which species group accounts for at least 75% of the stand cover?		
	Broadleaved	Conifers	Neither of them
1 specie	Pure broadleaved	Pure conifers	
2 species	Mix of 2 broadleaved species	Mix of conifers	Mix of conifers and broadleaved
3 species or more	Mix of various broadleaved		

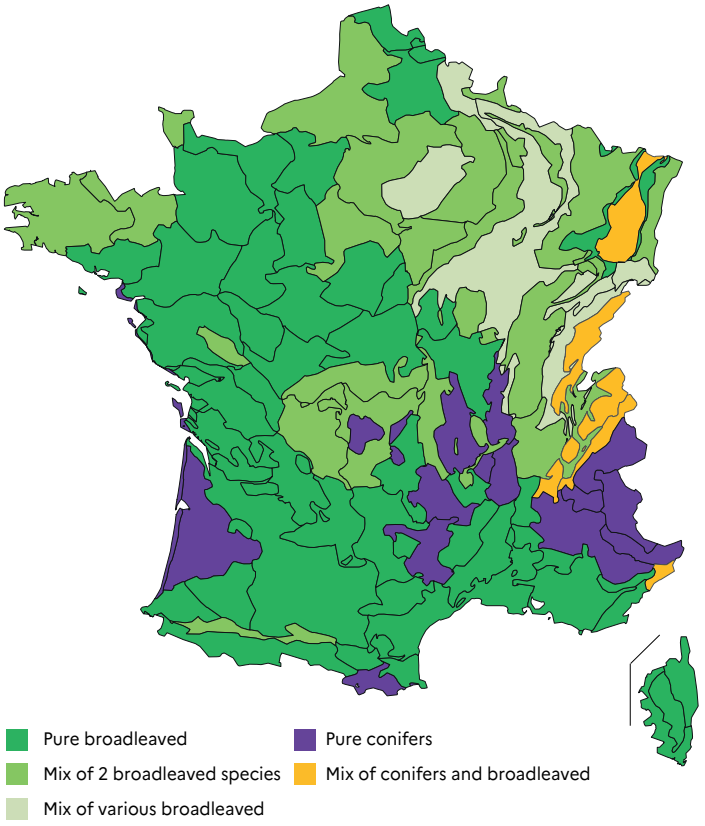
* For the 2,000-m² plot, this data is calculated only for stands with more than 15% canopy cover in trees over 7.5 cm in diameter, which cover an area of 15.3 million hectares.

The stand category most represented in each sylvoecoregion is very often broadleaved.

North-eastern France is more diversified (a mixture of several broadleaved trees: oak, beech, hornbeam and ash in particular) than the rest of the lowlands (predominantly pure broadleaved trees).

The "pure conifers" and "mix of conifers and broadleaved" categories are the most common in the mountainous sylvoecoregions and the Landes massif.

DOMINANT STAND CATEGORY BY SYLVOECOREGION



FLORISTIC SURVEYS

Since the 1990s, IGN has been carrying out floristic surveys in each inventory plot. Nearly 220,000 surveys have been conducted across the whole of France, including almost 120,000 since the systematic annual inventory was introduced throughout the country in 2004. See an example cartogram below.

Customised cartograms can be created, in particular by selecting one or more taxa, on the forest inventory website using DataIFN - the application for viewing and downloading raw forest inventory data.

Around twenty orchid species can be found in the forests, of which about ten are fairly common, at least locally. Three of them are shown here: the *Epipactis* genus and the *Orchis* genus, present in most regions, and the *Goodyera* genus, which is more limited.

Species of the *Epipactis genus*

Epipactis atrorubens
Epipactis helleborine
Epipactis microphylla
Epipactis palustris
Epipactis purpurata

Species of the *Goodyera genus*

Goodyera repens

Species of the Orchis genus

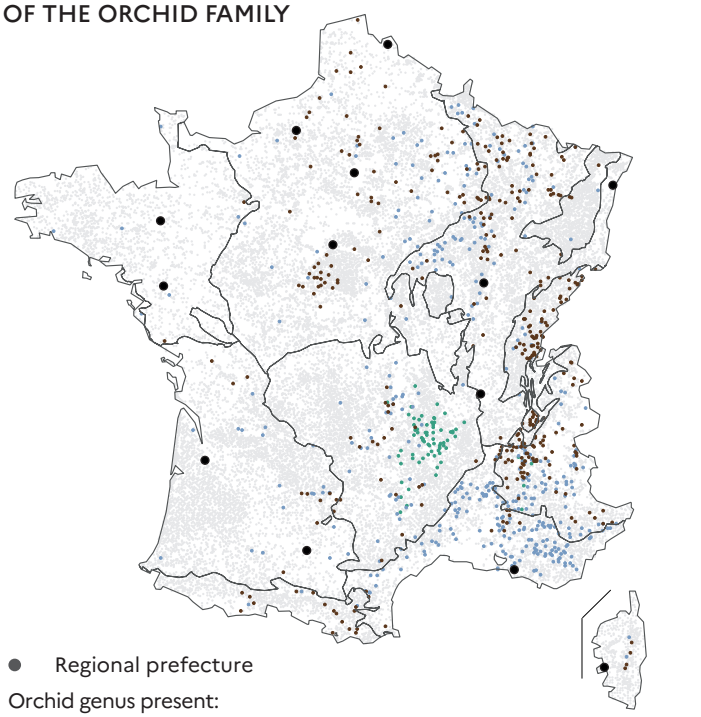
Orchis anthropophora
Orchis mascula
Orchis militaris
Orchis pallens
Orchis provincialis
Orchis purpurea
Orchis simia

Orchids are perennial plants with rhizomes that usually bloom in summer. Orchid flowers have a distinctive flower shape, made up of three sepals and three petals, with the lower petal clearly distinguishable. Depending on the species, the shape and colour of the inflorescences vary greatly, as do the plant's location requirements (rich or stony soils, shady or more open locations, calcareous or more acidic soils, etc.)

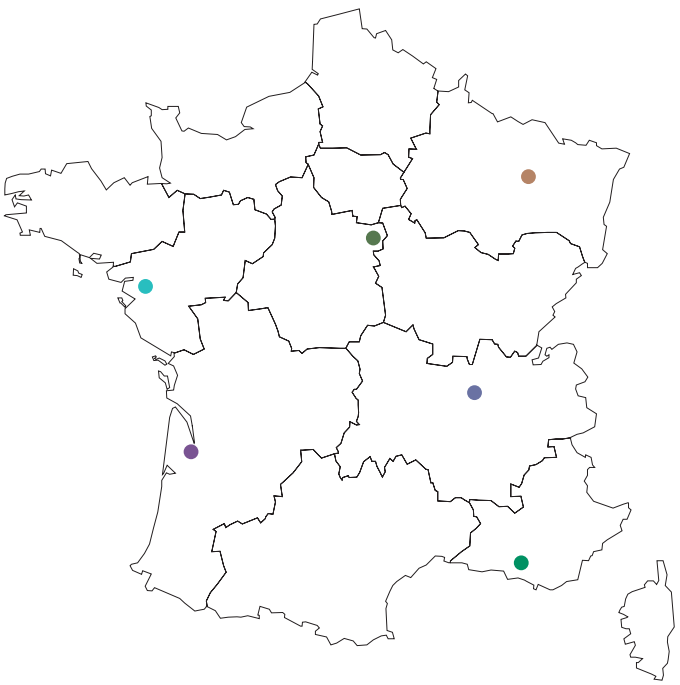
Basically, orchids are rare on the most acidic sites, which is why they are virtually absent from the forests of the crystalline and oceanic Great West and in the Landes de Gascogne sector. The *Goodyera* genus is the only one to occur frequently on acid soils: it prefers cool undergrowth of conifers, mainly in the mountains, although it is rare in the Vosges.

CLICK HERE TO ACCESS THE DATAIFN APPLICATION:
inventaire-forestier.ign.fr/dataifn/?lang=en

DISTRIBUTION OF THREE GENERA OF THE ORCHID FAMILY



USEFUL REGIONAL CONTACTS



- **Service de l'information statistique forestière et environnementale**
(*Forestry and environmental statistical information service*)
Chemin du Château des Barres
45290 NOGENT-SUR-VERNISSON
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- **Direction territoriale Grand-Ouest**
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- **Direction territoriale Şud-Ouest**
(*Territorial department of Southwest regions*)
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- **Direction territoriale Centre-Est**
(*Territorial department of East-central regions*)
239, rue Garibaldi
69422 LYON CEDEX 03
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- **Direction territoriale Sud-Est**
(*Territorial department of Southeast regions*)
Bâtiment B6 EUROPARC PICHAURY
1330, avenue J.R. G. Gauthier de la Lauzière
LES MILLES
13290 AIX-EN-PROVENCE
Phone: +33 (0)4 42 16 31 00

IGN RESOURCES AND TOOLS

- Click here to find out more about IGN's forest inventory: inventaire-forestier.ign.fr/?lang=en

- If you want to produce your own analyses based on national forest inventory data on a variety of themes and geographical levels, use the OCREGP tool: inventaire-forestier.ign.fr/?rubrique226

- View and download unit data collected in the field by the national forest inventory with the DataIFN tool: inventaire-forestier.ign.fr/dataifn/?lang=en

- Consult the BD Forêt forest map of France (Version 1 and Version 2): geoportail.gouv.fr (view) and geoservices.ign.fr/bdforet (download)

- Access an interactive visualisation of the forest inventory results on the following themes: growth anomalies, biodiversity and forest health: inventif.ign.fr

- Find reference and theme-based information on today's major forestry issues, as well as maps and services useful for understanding and managing forests at regional level with the Observatoire des forêts françaises (Observatory of French Forests): observatoire.foret.gouv.fr

- email address: contact.geoservices@ign.fr

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